State of Wisconsin
Department of Natural Resources
PO Box 7921, Madison WI 53707-7921
dnr.wi.gov

Technical Assistance, Environmental Liability Clarification or Post-Closure Modification Request

Form 4400-237 (R 12/18)

Notice: Use this form to request **a written response (on agency letterhead)** from the Department of Natural Resources (DNR) regarding technical assistance, a post-closure change to a site, a specialized agreement or liability clarification for Property with known or suspected environmental contamination. A fee will be required as is authorized by s. 292.55, Wis. Stats., and NR 749, Wis. Adm. Code., unless noted in the instructions below. Personal information collected will be used for administrative purposes and may be provided to requesters to the extent required by Wisconsin's Open Records law [ss. 19.31 - 19.39, Wis. Stats.].

Definitions

"Property" refers to the subject Property that is perceived to have been or has been impacted by the discharge of hazardous substances.

"Liability Clarification" refers to a written determination by the Department provided in response to a request made on this form. The response clarifies whether a person is or may become liable for the environmental contamination of a Property, as provided in s. 292.55, Wis. Stats.

"Technical Assistance" refers to the Department's assistance or comments on the planning and implementation of an environmental investigation or environmental cleanup on a Property in response to a request made on this form as provided in s. 292.55, Wis. Stats.

"Post-closure modification" refers to changes to Property boundaries and/or continuing obligations for Properties or sites that received closure letters for which continuing obligations have been applied or where contamination remains. Many, but not all, of these sites are included on the GIS Registry layer of RR Sites Map to provide public notice of residual contamination and continuing obligations.

Select the Correct Form

This from should be used to request the following from the DNR:

- Technical Assistance
- Liability Clarification
- Post-Closure Modifications
- Specialized Agreements (tax cancellation, negotiated agreements, etc.)

Do not use this form if one of the following applies:

- Request for an **off-site liability exemption or clarification** for Property that has been or is perceived to be contaminated by one or more hazardous substances that originated on another Property containing the source of the contamination. Use DNR's Off-Site Liability Exemption and Liability Clarification Application Form 4400-201.
- Submittal of an Environmental Assessment for the **Lender Liability Exemption**, s 292.21, Wis. Stats., **if no response or review by DNR is requested**. Use the Lender Liability Exemption Environmental Assessment Tracking Form 4400-196.
- Request for an **exemption to develop on a historic fill site** or licensed landfill. Use DNR's Form 4400-226 or 4400-226A.
- **Request for closure** for Property where the investigation and cleanup actions are completed. Use DNR's Case Closure - GIS Registry Form 4400-202.

All forms, publications and additional information are available on the internet at: dnr.wi.gov/topic/Brownfields/Pubs.html.

Instructions

1. Complete sections 1, 2, 6 and 7 for all requests. Be sure to provide adequate and complete information.
2. Select the type of assistance requested: Section 3 for technical assistance or post-closure modifications, Section 4 for a written determination or clarification of environmental liabilities; or Section 5 for a specialized agreement.
3. Include the fee payment that is listed in Section 3, 4, or 5, unless you are a "Voluntary Party" enrolled in the Voluntary Party Liability Exemption Program **and** the questions in Section 2 direct otherwise. Information on to whom and where to send the fee is found in Section 8 of this form.
4. Send the completed request, supporting materials and the fee to the appropriate DNR regional office where the Property is located. See the map on the last page of this form. A paper copy of the signed form and all reports and supporting materials shall be sent with an electronic copy of the form and supporting materials on a compact disk. For electronic document submittal requirements see: http://dnr.wi.gov/files/PDF/pubs/rr/RR690.pdf"

The time required for DNR's determination varies depending on the complexity of the site, and the clarity and completeness of the request and supporting documentation.

Section 1. Contact and Recipient Information

Requester Information

This is the person requesting technical assistance or a post-closure modification review, that his or her liability be clarified or a specialized agreement and is identified as the requester in Section 7. DNR will address its response letter to this person.

Last Name Alito	First Ferdinand	MI	Organization/ Business Name Navistar, Inc.	
Mailing Address 2701 Navistar Drive		City Lisle	State IL	ZIP Code 60532
Phone # (include area code) (331) 332-6364	Fax # (include area code)	Email Ferdinand.Alido@navistar.com		

The requester listed above: (select all that apply)

- ☒ Is currently the owner
- ☐ Is renting or leasing the Property
- ☐ Is a lender with a mortgagee interest in the Property
- ☐ Other. Explain the status of the Property with respect to the applicant:
- ☐ Is considering selling the Property
- ☐ Is considering acquiring the Property

Contact Information (to be contacted with questions about this request) ☐ Select if same as requester

Contact Last Name Davenport	First Josh	MI	Organization/ Business Name KPRG and Associates, Inc.	
Mailing Address 14665 W. Lisbon Road, Suite 1A		City Brookfield	State WI	ZIP Code 53005
Phone # (include area code) (262) 781-0475	Fax # (include area code) (262) 781-0478	Email JoshuaD@KPRGinc.com		

Environmental Consultant (if applicable)

Contact Last Name Davenport	First Josh	MI	Organization/ Business Name KPRG and Associates, Inc.	
Mailing Address 14665 W. Lisbon Road, Suite 1A		City Brookfield	State WI	ZIP Code 53005
Phone # (include area code) (262) 781-0475	Fax # (include area code) (262) 781-0478	Email JoshuaD@KPRGinc.com		

Section 2. Property Information

Property Name Former Navistar/RMG Foundry			FID No. (if known) 268005430	
BRRTS No. (if known) 02-68-098404		Parcel Identification Number		
Street Address 1404 Perkins Ave		City Waukesha	State WI	ZIP Code 53186
County Waukesha	Municipality where the Property is located ● City ○ Town ○ Village of Waukesha	Property is composed of: ● Single tax parcel ○ Multiple tax parcels	Property Size Acres 12	

1. Is a response needed by a specific date? (e.g., Property closing date) Note: Most requests are completed within 60 days. Please plan accordingly.

● No ○ Yes
Date requested by: ______________
Reason:

____

2. Is the "Requester" enrolled as a Voluntary Party in the Voluntary Party Liability Exemption (VPLE) program?

● No. **Include the fee that is required for your request in Section 3, 4 or 5.**
○ Yes. **Do not include a separate fee.** This request will be billed separately through the VPLE Program.

Fill out the information in Section 3, 4 or 5 which corresponds with the type of request:
Section 3. Technical Assistance or Post-Closure Modifications;
Section 4. Liability Clarification; or Section 5. Specialized Agreement.

Section 3. Request for Technical Assistance or Post-Closure Modification

Select the type of technical assistance requested: **[Numbers in brackets are for WI DNR Use]**

☐ No Further Action Letter (NFA) (Immediate Actions) - NR 708.09, [183] - **Include a fee of $350.** Use for a written response to an immediate action after a discharge of a hazardous substance occurs. Generally, these are for a one-time spill event.
☐ Review of Site Investigation Work Plan - NR 716.09, [135] - **Include a fee of $700.**
☐ Review of Site Investigation Report - NR 716.15, [137] - **Include a fee of $1050.**
☐ Approval of a Site-Specific Soil Cleanup Standard - NR 720.10 or 12, [67] - **Include a fee of $1050.**
☒ Review of a Remedial Action Options Report - NR 722.13, [143] - **Include a fee of $1050.**
☐ Review of a Remedial Action Design Report - NR 724.09, [148] - **Include a fee of $1050.**
☐ Review of a Remedial Action Documentation Report - NR 724.15, [152] - **Include a fee of $350**
☐ Review of a Long-term Monitoring Plan - NR 724.17, [25] - **Include a fee of $425.**
☐ Review of an Operation and Maintenance Plan - NR 724.13, [192] - **Include a fee of $425.**

Other Technical Assistance - s. 292.55, Wis. Stats. [97] (For request to build on an abandoned landfill use Form 4400-226)

☐ Schedule a Technical Assistance Meeting - **Include a fee of $700.**
☐ Hazardous Waste Determination - **Include a fee of $700.**
☐ Other Technical Assistance - **Include a fee of $700.** Explain your request in an attachment.

Post-Closure Modifications - NR 727, [181]

☐ Post-Closure Modifications: Modification to Property boundaries and/or continuing obligations of a closed site or Property; sites may be on the GIS Registry. This also includes removal of a site or Property from the GIS Registry. **Include a fee of $1050, and:**

  ☐ Include a fee of $300 for sites with residual soil contamination; and
  ☐ Include a fee of $350 for sites with residual groundwater contamination, monitoring wells or for vapor intrusion continuing obligations.

Attach a description of the changes you are proposing, and documentation as to why the changes are needed (if the change to a Property, site or continuing obligation will result in revised maps, maintenance plans or photographs, those documents may be submitted later in the approval process, on a case-by-case basis).

Skip Sections 4 and 5 if the technical assistance you are requesting is listed above and complete Sections 6 and 7 of this form.

Section 5. Request for a Specialized Agreement

Select the type of agreement needed. Include the appropriate draft agreements and supporting materials. Complete Sections 6 and 7 of this form. More information and model draft agreements are available at: dnr.wi.gov/topic/Brownfields/lgu.html#tabx4.

☐ Tax cancellation agreement - s. 75.105(2)(d), Wis. Stats. [654]

- **Include a fee of $700, and the information listed below:**

(1) Phase I and II Environmental Site Assessment Reports,
(2) a copy of the Property deed with the correct legal description.

☐ Agreement for assignment of tax foreclosure judgement - s.75.106, Wis. Stats. [666]

- **Include a fee of $700, and the information listed below:**

(1) Phase I and II Environmental Site Assessment Reports,
(2) a copy of the Property deed with the correct legal description.

☐ Negotiated agreement - Enforceable contract for non-emergency remediation - s. 292.11(7)(d) and (e), Wis. Stats. [630]

- **Include a fee of $1400, and the information listed below:**

(1) a draft schedule for remediation; and,
(2) the name, mailing address, phone and email for each party to the agreement.

Section 6. Other Information Submitted

Identify all materials that are included with this request.

Send both a paper copy of the signed form and all reports and supporting materials, and an electronic copy of the form and all reports, including Environmental Site Assessment Reports, and supporting materials on a compact disk.

Include one copy of any document from any state agency files that you want the Department to review as part of this request. The person submitting this request is responsible for contacting other state agencies to obtain appropriate reports or information.

☐ Phase I Environmental Site Assessment Report - Date: ________
☐ Phase II Environmental Site Assessment Report - Date: ________
☐ Legal Description of Property (required for all liability requests and specialized agreements)
☐ Map of the Property (required for all liability requests and specialized agreements)
Analytical results of the following sampled media: Select all that apply and include date of collection.
☐ Groundwater ☐ Soil ☐ Sediment ☐ Other medium - Describe: ________
Date of Collection: ________
☐ A copy of the closure letter and submittal materials
☐ Draft tax cancellation agreement
☐ Draft agreement for assignment of tax foreclosure judgment
☒ Other report(s) or information - Describe: Groundwater Remedial Action Options memo

For Property with newly identified discharges of hazardous substances only: Has a notification of a discharge of a hazardous substance been sent to the DNR as required by s. NR 706.05(1)(b), Wis. Adm. Code?

○ Yes - Date (if known): ________
○ No

Note: The Notification for Hazardous Substance Discharge (non-emergency) form is available at: dnr.wi.gov/files/PDF/forms/4400/4400-225.pdf.

Section 7. Certification by the Person who completed this form

☒ I am the person submitting this request (requester)

☒ I prepared this request for: Navistar, Inc
Requester Name

I certify that I am familiar with the information submitted on this request, and that the information on and included with this request is true, accurate and complete to the best of my knowledge. I also certify I have the legal authority and the applicant's permission to make this request.

Signature	3/3/21 Date Signed
Senior Project Engineer Title	(262) 781-0475 Telephone Number (include area code)

Section 8. DNR Contacts and Addresses for Request Submittals

Send or deliver one paper copy and one electronic copy on a compact disk of the completed request, supporting materials, and fee to the region where the property is located to the address below. Contact a DNR regional brownfields specialist with any questions about this form or a specific situation involving a contaminated property. For electronic document submittal requirements see: http://dnr.wi.gov/files/PDF/pubs/rr/RR690.pdf.

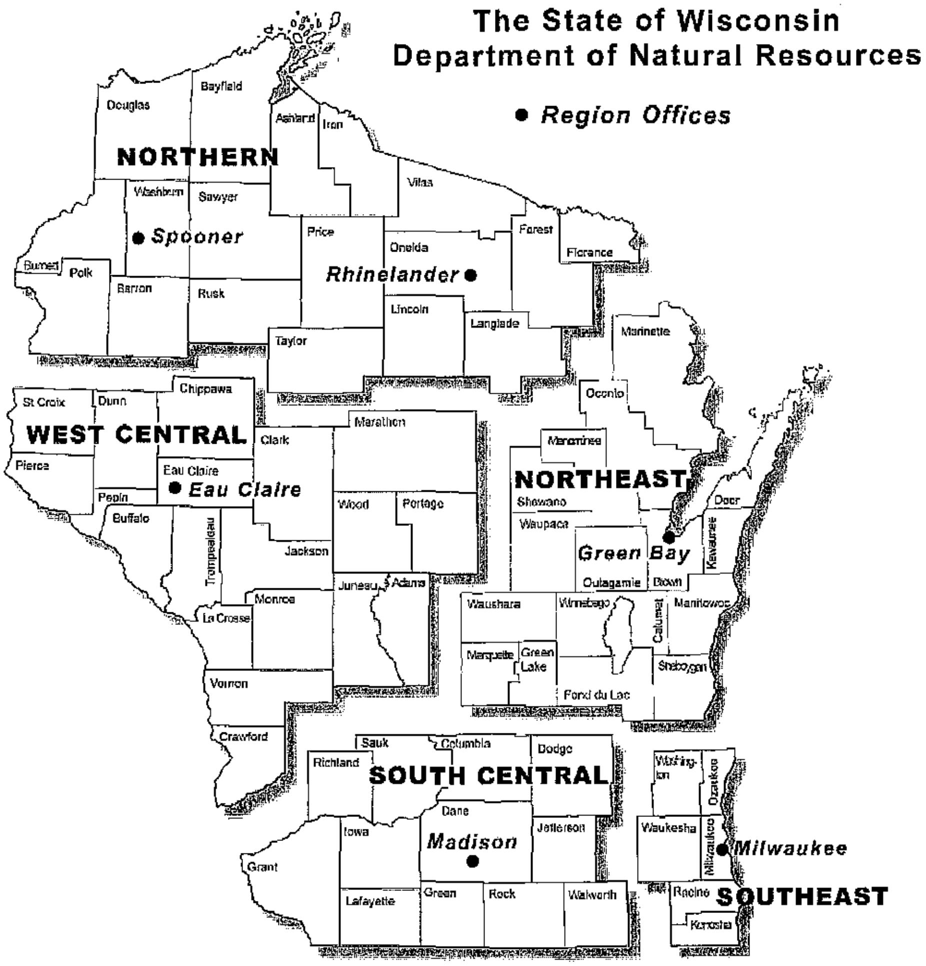
DNR NORTHERN REGION
Attn: RR Program Assistant
Department of Natural Resources
223 E Steinfest Rd Antigo, WI 54409

DNR NORTHEAST REGION
Attn: RR Program Assistant
Department of Natural Resources
2984 Shawano Avenue
Green Bay WI 54313

DNR SOUTH CENTRAL REGION
Attn: RR Program Assistant
Department of Natural Resources
3911 Fish Hatchery Road
Fitchburg WI 53711

DNR SOUTHEAST REGION
Attn: RR Program Assistant
Department of Natural Resources
2300 North Martin Luther King Drive
Milwaukee WI 53212

DNR WEST CENTRAL REGION
Attn: RR Program Assistant
Department of Natural Resources
1300 Clairemont Ave.
Eau Claire WI 54702



Note: These are the Remediation and Redevelopment Program's designated regions. Other DNR program regional boundaries may be different.

DNR Use Only			
Date Received	Date Assigned	BRRTS Activity Code	BRRTS No. (if used)
DNR Reviewer	Comments		
Fee Enclosed? ○ Yes ○ No	Fee Amount $	Date Additional Information Requested	Date Requested for DNR Response Letter
Date Approved	Final Determination		

KPRG

ENVIRONMENTAL CONSULTATION & REMEDIATION

KPRG and Associates, Inc.

GROUNDWATER REMEDIAL ACTION OPTIONS MEMORANDUM

March 3, 2021

To: Mr. Mark Drews, P.G., Wisconsin Department of Natural Resources
141 NW Barstow Street, Room 180
Waukesha, WI 53188

From: Josh Davenport, Tim Stohner, Rich Gnat, KPRG and Associates, Inc. (KPRG)

VIA E-MAIL and FEDEX KPRG Project No. 11717

Re: Technical Memorandum – Groundwater Remedial Action Options / Interim Remedial Action Plan
Former Navistar/RMG Foundry - 1401 Perkins Avenue, Waukesha, WI
BRRTS # 02-68-098404

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KPRG and Associates, Inc. (KPRG), in support of our client Navistar Inc. (Navistar), is pleased to present this Technical Memorandum to summarize Remedial Action Options for the treatment of the groundwater impacts on the foundry property and to outline the Interim Remedial Action Plan to implement the selected remedial action option.

The purpose of this memorandum is as follows: to inform WDNR of the remedial action options that Navistar and KPRG have developed and evaluated to address the groundwater impacts associated with the historical chlorinated volatile organic compound (CVOC) impacts, specifically trichloroethene (TCE), beneath the core room area of the former on-site foundry and the northwest portion of the property. This memorandum then provides the preferred remedial action option for this area and requests WDNR's concurrence with the selected approach prior to Navistar initiating bidding and scheduling the work in 2021.

It should be noted that KPRG presented a similar technical memorandum dated May 29, 2020 for the parking lot area shallow soil TCE impacts near the southwest corner of the RMG foundry property, which was approved by WDNR in an October 5, 2020 letter. Similarly, KPRG is concurrently preparing another technical memorandum for a former employee parking lot located across the street from the foundry property on the south side of Perkins Avenue and west of Raymond Street. KPRG intends to use those documents and approaches as models for presenting and addressing our methodology for remediating the noted on-site groundwater TCE impacts.

1.0 BACKGROUND

1.1 Summary of Groundwater Data

As discussed in the Comprehensive Site Investigation (SI) Report dated June 1, 2020, in this area of Waukesha there are two separate but commingled plumes of TCE: one plume is north of Perkins Avenue (the North Plume) and the other plume is south of Perkins Avenue (the South Plume). Figure 1 depicts the isoconcentration map from the groundwater analytical results for the fourth quarter of 2020 illustrating the two plume areas. It is noted that as the two plumes extend to the west beneath Frame Park, towards the Fox River discharge boundary, the plumes become further commingled.

As stated in the SI Report, TCE and its associated breakdown products (i.e., cis-1,2-dichloroethene (cis-1,2-DCE), 1,1-dichloroethene (1,1-DCE), vinyl chloride (VC) and 1,1,1-trichloroethane (TCA) are the primary constituents of concern (COCs). For the purposes of evaluating the areal and vertical extent of impacts in this memo, TCE will be used as the tracer compound since any of the other CVOC compound enforcement standard (ES) exceedances are generally within the extent of the TCE impacts with concentrations above the TCE ES of 5 micrograms per liter (µg/L)].

The South Plume is much larger and more diffuse than the North Plume. It covers an area from just east of Main Street to beneath Frame Park to the west, and from Perkins Avenue south to near Main Street. Minor contributory impacts to the South Plume may be associated with some TCE impacted fill defined beneath the south and southwest parking lots. However, based on an understanding of the local hydrogeology, standard contaminant transport physics, the past/present industrial land uses south of Perkins Avenue and their environmental regulatory history, a focused forensic chemistry study, and recent groundwater data provided to the WDNR by Alloy Products, there is overwhelming evidence that there are separate sources of CVOC groundwater impacts resulting in the South Plume that are unrelated to any historical operations on the former Navistar property. (It should be noted that Navistar ceased operations on the site in May 2015 and RMG ceased operations on site in the fall of 2020. The facility is now no longer operating, some of the equipment has been removed from the site, but the buildings still remain.)

The focus of this technical evaluation of remedial alternatives and the proposed Interim Remedial Action (IRA) is the North Plume. The main groundwater impacts within the North Plume are beneath and downgradient of the Building 29 core room area. There is no evidence of existing or ongoing sources beneath the core room or further upgradient of this area on the foundry property. If historical operations within the core room were the source of the noted impacts, the source is no longer present. North Plume monitoring wells for which there is historical data (e.g., NMW-1, NMW-3, NMW-4, NMW-7, NMW-8, NMW-9, MW-11, MW-13, MW-15 and MW-23) generally show steady to decreasing TCE concentrations over time. This observation further indicates that there is no existing ongoing source of TCE impacts at this time.

The highest TCE and TCA concentrations were detected at well location MW-30, which is located within Building 29, on the east side of the core room and on the west end of the foundry facility. The highest concentrations of TCE and TCA were detected in the November 2017 sampling event at 5,600 µg/L and 462 µg/L, respectively. TCE and TCA concentrations at MW-30 have since fluctuated, with the March 2020 analytical results at 4,280 µg/L and 291 µg/L, respectively. That was the most recent sampling event prior to the groundwater treatment pilot test performed in May 2020. The most recent sampling event in December 2020 had TCE and TCA concentrations in MW-30 at 1,340 µg/L and 80.8 µg/L, respectively, the decrease being a direct result of the successful pilot test injection.

Well MW-23 is downgradient of well MW-30 and is downgradient of, and influenced by groundwater quality emanating from the IPT property. It is noted, however, that the three most recent analytical results for MW-23 (June 2020, September 2020, and December 2020) indicate significant decreases in TCE concentrations, with the latest data showing two orders of magnitude lower than the peak reported TCE concentrations since 2015. This decline may be associated with focused drawdown recovery tests performed in August 2019 during the installation of multiport well MPW-23 just west of MW-23. The multiport well installation and associated drawdown recovery testing was performed in preparation for the May 2020 injection pilot test conducted as part of potential remedial option evaluations.

Monitoring wells directly downgradient of the core room area display CVOC impacts at concentrations decreasing with distance away from MW-30 and MW-23. This is observed in wells MW-37 and MW-55 that are located within Frame Park. MW-37 is located approximately 570 feet downgradient and had a TCE concentration of 205 µg/L, which occurred in November 2017, which is the same sampling event that the peak TCE concentrations were observed in MW-30. The TCE concentrations in MW-37 declined to its lowest concentration (130 µg/L) in June 2020, while the most recent TCE detections at this location (160 µg/L in September 2020 and 177 µg/L in December 2020) may indicate some temporal variation. The TCE concentrations in MW-37 have consistently been lower than the TCE concentrations in MW-30. MW-55 was installed in June 2019 immediately adjacent (within 20 feet) to the Fox River and has consistently shown TCE concentrations below their respective ESs. MW-55 is approximately 1,300 feet downgradient from MW-30.

This relationship is further observed between wells MW-36 and MW-38. MW-38 is approximately 290 feet downgradient of MW-36 with TCE concentrations that have been consistently lower than the TCE concentrations in MW-36. MW-36 had a TCE concentration of 510 µg/L, which occurred in November 2017, which is the same sampling event that the peak TCE concentrations were observed in MW-30. The TCE concentrations in MW-36 declined to its lowest concentration (5.8 µg/L) in June 2019, while the most recent TCE detections at this location (228 µg/L in September 2020 and 454 µg/L in December 2020) may indicate some temporal variation. The TCE concentrations in MW-38 have generally been lower than the TCE concentrations in MW-36. The TCE concentrations in MW-38 ranged from a peak of 143 µg/L in December 2018 to a low of 1.4 µg/L in June 2020.

The extent of the North Plume is limited to the western portion of the property and the observed downgradient, offsite impacts shown on Figure 1. Monitoring well and temporary well groundwater data from locations to the east and upgradient of well MW-43 do not indicate any TCE or TCA detections above the ES. One exception to this is the detection of TCE slightly above the ES at locations TW-39 (6 µg/L, September 2017). TW-39 was located within the Salvage Yard and hazardous material storage area and MW-33, located in the former core wash area and former parts cleaner operation. Wells MW-28, MW-32 and MW-33 are monitoring wells in closest proximity to TW-39. At well locations MW-28 and MW-32, TCE concentrations have consistently remained below the ES since groundwater sampling began in December 2017. At well location MW-33, TCE was detected above the ES during the first three sampling events and then dropped below the ES from October 2018 through December 2019. TCE concentrations increased to slightly above the ES (7.4 µg/L in March 2020 and 6.2 µg/L in June 2020) and then concentrations dropped below the ES in September 2020 (0.33 J µg/L) and December 2020 (2.9 µg/L). This data set suggests there are no existing significant residual sources of TCE impacts on the eastern portion of the foundry property.

Overall, the groundwater monitoring data indicates that, at the present time, the main groundwater impacts within the North Plume are beneath and downgradient of the Building 29 core room area. There is no evidence of existing sources further upgradient of this area on the foundry property. If historical operations within the core room were the source of the noted impacts, the source of those impacts is no longer present as demonstrated by soil data within that area that was presented in the SI Report. In addition, based on the existing data, potential residual TCE impacts associated with former operations on the current IPT property cannot be definitively ruled out, which is consistent with previous historical data interpretations.

To evaluate the vertical extent of impacts, there are three well clusters, NMW-9/MW-9D/MW-9D2, MW-24/24D, and MW-29/29D). Comparing the data between the shallow and deep wells within each cluster indicate decreasing concentrations with depth at sampling locations MW-24/24D and MW-29/29D. The March 2020 groundwater sampling event yielded TCE concentrations for shallower wells MW-24 and MW-29 at 3,490 µg/L and 160 µg/L, respectively. At deep well locations MW-24D and MW-29D, TCE has remained below the ES or not detected. The analytical results after the groundwater injection pilot test continue this trend.

Up until October 2018, monitoring well MW-9D displayed a decreasing TCE concentration trend towards the ES for TCE. In October 2018, however, there was an apparent spike in the TCE groundwater concentration (1,340 µg/L), which has subsequently been generally decreasing since that time. The cause of this sudden increase in TCE concentration is uncertain; however, it may be associated with some downward, dissolved phase plume mixing from locations further upgradient. Due to this TCE increase in well MW-9D, KPRG installed an additional, deeper well (MW-9D2) to further define the extent of vertical impacts at this monitoring well cluster location. Sampling began at MW-9D2 in July 2019. The three most recent rounds of groundwater sampling at the deeper well were below the ES, indicating that the vertical extent of TCE impacts has been defined at this location.

1.2 Horizontal and vertical distribution of impacts to define treatment zone

The TCE extent of impacts map created using the analytical results from the March 2020 sampling event and shown on Figure 2 was used to determine the approximate horizontal extent of the treatment zone. This sampling event was chosen because it was prior to the pilot test injection and provides the most recent view of the groundwater contamination present without outside influences. Based on the horizontal extent of impacts, the source area of the groundwater impacts is centered on monitoring wells MW-23, multi-port well 23 (MPW-23), MW-24, MW-24D, and MW-30 and the extent of the contamination extends, west, north, and south towards the property lines, with the entire extent of the impacts extending beyond the property line.

The estimated mass of TCE impacts within the groundwater plume identified on Figure 2 were determined to assist in defining the extent of the horizontal treatment zone. The evaluation was done for the 4,000 µg/L, 3,000 µg/L, 300 µg/L, 200 µg/L, and the 100 µg/L isoconcentration contours. The horizontal extent of each contour within the limits of the RMG foundry property as well as a depth of 20 feet were used to determine an estimated TCE mass concentration present in the groundwater. The depth of 20 feet was chosen based on the results of the groundwater pilot test, which is discussed in Section 2. The results of this calculation are only an estimate because of the fact that the groundwater continually moves and the concentrations will fluctuate, but this method provides a quantitative method to determine the most effective area of treatment. The results of the estimated calculations are shown in Table 1. Based on the analysis, treating the groundwater within the 300 µg/L plume area of approximately 37,500 square feet would treat an estimated 69% of the cumulative groundwater TCE impacts. Expanding the horizontal treatment area to the 200 µg/L contour would double the volume of treatment area but would treat only an additional 14% of the contaminant mass. Therefore, the 300 µg/L contour will be used as the horizontal limits of the treatment area.

The vertical extent of the treatment zone is based on the comparison of the analytical results between the water table monitoring wells and the deep monitoring wells through March 2020. Well MW-23 is screened over the approximate interval of 16 to 26 feet below ground surface (bgs), MW-24 is screened over the approximate interval of 10 to 25 feet bgs, and MW-30 is screened over the approximate interval of 20 to 25 feet bgs. Multi-port well MPW-23 is divided into four screened intervals, identified as MPW-23-1 (screened from 20-30 feet bgs), MPW-23-2 (screened from 30-40 feet bgs), MPW-23-3 (screened from 40-50 feet bgs), and MPW-23-C (screened from 50-60 feet bgs). Well MW-24D is screened over the approximate interval of 55 to 60 feet bgs. Wells MW-23, MW-24, and MW-30 have TCE analytical results consistently above the ES since 2015. Sampling of MPW-23 identified analytical results for TCE above the ES in intervals MPW-23-1, MPW-23-2, and MPW-23-3, while the analytical results for interval MPW-23-C were above the PAL (0.5 µg/L) but below the ES. Well MW-24D has TCE analytical results below the ES from its installation in November 2017 to March 2020. Based on the above, the vertical treatment would extend from the screened interval of well MW-30 (20 to 25 feet bgs) to MPW-23-3 (40-50 feet bgs).

1.3 Remedial Options Evaluation

1.3.1 Remedial Action Objective(s)

The objective of the remedial action is to treat the source of the groundwater impacts that were identified in Section 1.1. Treatment would occur over the extent of area identified in Section 1.2. The treatment will reduce the TCE impacts in the source area and reduce the available TCE that would travel downgradient and ultimately reduce the downgradient TCE concentrations.

1.3.2 Remedial Action Options

Given the above background information on environmental conditions, the identified remedial action options are summarized below and evaluated in accordance with the following criteria established in NR 722.07(4) and appropriate site-specific conditions:

- Technical Feasibility
    - Implementability
    - Long-Term Effectiveness
    - Short-Term Effectiveness
    - Relative Timeframe

- Economic Feasibility

A narrative discussion of the identified remedial action options follows below, while the technical and economic feasibility and timeframes of each option are further explored in the attached Table 2.

The title options discussed below are the main technologies that would be used to treat the source of the groundwater contamination. In discussions with the experts associated with each technology, it was determined that they would be best used to treat the source of the groundwater contamination and additional technologies would be needed to treat the extent of the treatment zone in Section 1.2. A scaled-down version of the proposed chemical oxidation discussed in Section 1.3.2.1 was combined with the proposed source treatment technology. It is possible to use only the source zone treatment and not the additional technology, but for comparison purposes, the additional technology was included with each source technology.

The chemical oxidation included with the other source zone treatments discussed in Sections 1.3.2.2 through 1.3.2.3 would be implemented in the same manner as the chemical oxidation in Section 1.3.2.1 except the number of points would be reduced from 35 injection points to 18 injection points.

1.3.2.1 Chemical Oxidation

In-situ chemical oxidation (ISCO) includes the introduction of a chemical oxidizing agent into the groundwater via direct mixing or pressure injection points. The oxidant reacts with the contaminant to trigger destructive abiotic degradation reactions and reduce the contaminant concentration. Various wells are installed at different depths to reach as much contaminant as possible. The recirculation technique may be used to treat a larger area of contaminant faster. During recirculation, oxidants are pumped down a first well then groundwater mixed with the oxidants are pumped out a second well. Additional oxidant is introduced to the oxidant-treated groundwater, and then this groundwater is pumped back down the first well. Subsurface geology is considered for the injection delivery method as well. Due to low permeability, impacted clay soils may respond better to chemical oxidation treatment when oxidants are mixed into the subsurface using mechanical augers or excavation equipment.

Permanganate, persulfate, hydrogen peroxide and ozone are the four main oxidants used for ISCO. Permanganate, persulfate, and hydrogen peroxide are generally injected in liquid form. Depending on which oxidizing agent is used for treatment, the chemical reaction with the organics within the groundwater (including the contaminants) may result in non-hazardous by-products such as chlorine, carbon dioxide, water, oxygen, and manganese oxide. Catalysts (e.g., iron) may be used to increase the speed and effectiveness of the chemical reaction. A treatability study is typically conducted to determine the proper chemical and dosage to use for the most effective site-specific ISCO remediation, as was completed for groundwater at the RMG Foundry (detailed in Section 2.0). Based on the results of the treatability study, persulfate was determined to be the most effective and economical ISCO remedial option. Permanganate was considered as well, but was ruled out due to concern that the purple color characteristic of permanganate would dye the subsurface tributary under RMG foundry and potentially result in purple groundwater daylighting in Frame Park and the Fox River.

ISCO has shown to be effective in a wide range of geologic conditions, with increased success in homogenous subsurface conditions. The targeted vertical treatment interval for the North Plume is 17 ft bgs to 40 ft bgs, in relatively homogenous dolomite bedrock. A portion of the treatment will be performed from 17 ft bgs to 60 ft bgs.

Chemical oxidation treatment is effective and implementable on both the short and long-term basis relative to meeting cleanup objectives and risk reduction. The initial round of injections should be completed in approximately two weeks. In general, cleanup objectives are not always met with only one treatment and based on verification groundwater sampling; a "polishing" second injection over a portion of the treatment area may be needed to meet final goals.

The economic feasibility of this option is driven by the mass of contaminant that needs to be treated (and thus the quantity of oxidant required), the natural oxidant demand, the size of the treatment area, and the permeability of the surrounding soils/bedrock and the cleanup objectives the treatment needs to achieve. A second smaller round of injection is assumed for approximately one third of the treatment area (12 to 13 injection points), which is factored into the cost estimate as well.

The projected installation and operating cost for the system over a 3-year timeframe, including a 15% engineering contingency, is $598,000. The 3-year total includes approximately 6 months for design and permitting, 8 weeks to drill injection wells and inject the injectate, and 2 years of quarterly post-treatment groundwater monitoring. The timeframe also includes a second injection after 1 year of groundwater monitoring.

1.3.2.2 In-Situ Thermal Remediation

In-situ thermal remediation is technically feasible as a remediation option for the contaminated groundwater at the RMG Foundry property. In-situ thermal remediation generally consists of using electricity to heat the subsurface formation and groundwater to volatilize the organic compounds present. The volatilized organic compounds are removed through vapor extraction, treated, and released to the atmosphere. The popular methods for thermal remediation are thermal conductive heating, steam enhanced extraction, and electric resistance heating. The thermal heating technology that would be the most appropriate for the groundwater contamination and subsurface is thermal conductive heating (TCH). This is because of the bedrock present in the subsurface. Electric resistance heating is not effective in bedrock because of the resistance of the bedrock, which does not allow for the transmission of the electrical current. Steam enhanced extraction works best at sites with high groundwater flow and highly permeable aquifer matrices, which is not the case at this site because of the nature of the bedrock material (i.e., crystalline dolomite).

TCH is accomplished by installing heaters in an array of subsurface wells that pass heat into the surrounding formation. The heat would pass from each well into the formation by soil particles in contact with each other or by conducting heat through the solid bedrock formation. The groundwater in contact with the soil and/or bedrock would heat up along with the formation material. The heat distribution through each heater is uniform and the heat passes through the surrounding formation radially. Each heater is electrically powered, which allows the heat emanating from each heater to be greater than the boiling point of water.

As the formation heats up, the CVOCs present will be volatilized and captured by the vapor extraction system. The extracted vapors are passed through a vapor treatment system and then vented to the atmosphere. Any condensate captured is separated from the vapors and either containerized for later disposal or immediately discharged into the sanitary sewer after treatment.

TCH would require the installation of heating elements in vertical wells spaced in a grid across the proposed treatment area. Based on the site conditions, the heating elements would be spaced approximately 15 to 16 feet apart across a treatment area of approximately 20,000 square feet, which would result in the installation of approximately 115 heating elements. The heating elements would be installed from 10 feet bgs to 40 feet bgs. The top of the heated treatment zone needs to be above the water table elevation, which is why the top of the TCH treatment zone is higher than the impacted groundwater treatment zone of 20 feet bgs. Eight (8) temperature probes would be installed through the treatment area to monitor the subsurface temperatures. A power distribution system would be connected to each subsurface heating element, which would require connecting to the existing electrical system at the property. A vapor extraction well would be co-located in the borehole with the heating element. The extraction wells are connected to an aboveground vapor collection and treatment system. The treatment system would consist of granular activated carbon (GAC). Condensate that is separated from the vapors would also be treated using GAC and discharged directly into the sanitary sewer. Discharging to the sewer would require approval from the local publicly owned treatment works system and likely a DNR pre-treatment permit. During the operation of the system, the temperature and pressure are monitored to track the subsurface heating, and hydraulic control and the vapor and liquid treatment are monitored to track mass removal and discharge compliance. Monitoring of the system is done by a technician who is present seven days a week during system operation.

Thermal remediation is effective in the short-term because of the nature of the treatment. Advantages of thermal treatment are its ability to reach contaminants that are sorbed in the subsurface formation; it treats many chemicals simultaneously, and is effective in heterogeneous formations. In addition, thermal treatments have been used at a wide variety of sites, can be used over a wide range of hydraulic conductivities, and can be used adjacent to or under occupied buildings. Thermal treatment is most effective when treating the source area associated with a contaminant plume. In this case, the groundwater source area is the 3,000 µg/L contour, which is approximately 20,000 ft^2 in size. Thermal treatment is also effective in the long-term because of its ability to treat the sorbed contaminant within the subsurface. This prevents the rebound in groundwater contamination that can occur because the absorbed contaminants not treated by other treatment methods can back diffuse into the groundwater. The uniform heating and ability to monitor the treatments effectiveness in real-time allows the operator to know when to continue or discontinue treatment. The system is estimated to operate for 152 days with a total project duration of 70 weeks from initial permitting and work plan preparation to final report completion.

Implementing thermal remediation has the potential to be economically feasible, but the size of the treatment area would require adjustment. The factors that affect the cost of thermal remediation include but are not limited to the following:

- The presence of aboveground and below ground metallic structures and utilities;
- Whether or not PVC monitoring wells installed in the treatment area require being replaced with stainless steel wells;
- The requirement for temperature monitoring probes and their depths;
- The availability of electrical capacity to power the system;
- The areal extent of the treatment area and the number of required heating elements;
- The geology in which it is installed; and
- The remediation goals.

The implementation of thermal conductive heating over the treatment area of 37,500 ft^2 as discussed in Section 1.2 would not be as cost effective and a less efficient use of the technology. Therefore, it would be more economically efficient to treat the extent of the area occupied by the 3,000 µg/L contour on Figure 1, which is approximately 20,000 square feet using TCH. The remediation goal for this area would be to treat down to the NR 140 ES of 5 µg/L. To address the remainder of the treatment area, in-situ chemical oxidation is recommended. The in-situ chemical oxidation would consist of injecting a chemical oxidant through approximately 18 injection wells. The injections would be performed from 20 to 40 feet bgs in 15 of the injection wells and three of the wells would be performed from 20 to 60 feet bgs. The injection would be performed beginning at the west property boundary and working towards the TCH treatment area and would occur during or immediately before the operation of the TCH. If any contaminant is mobilized by the injection, then it will be mobilized towards the TCH treatment zone and will be remediated by the TCH.

The projected installation and operating cost for the system over a 4-year timeframe, including a 15% engineering contingency, is $4,500,000. The 4-year total includes approximately 70 weeks to permit, construct, and operating the TCH and 2 years of post-treatment groundwater monitoring. Also included in this cost is the work plan preparation/permitting, in-situ chemical oxidation, bi-weekly reporting, borehole waste disposal, 8 quarters of post-treatment groundwater monitoring, and post-treatment report preparation. This cost has assumed normal system maintenance and includes establishing an on-site electrical service and estimated monthly utility bills for electricity and sanitary sewer discharges.

1.3.2.3 Pump and Treat

A pump and treat system involves the removal of groundwater from a contaminated aquifer using one or more extraction wells and treating the groundwater using an aboveground treatment system prior to its discharge. The proposed aboveground treatment system would be either an air stripper or granular activated carbon (GAC) filters, which are effective at treating CVOC contaminated groundwater.

A pump and treat system for the RMG foundry property is technically feasible and would be used to remove the contaminant flux from the groundwater source area to reduce the concentration and prevent the further migration of contamination down gradient. The characteristics of the aquifer will determine the number of extraction wells for the system. The envisioned system would use four (4) to five (5) extraction wells spaced throughout the 3,000 µg/L contour with each well removing approximately 20 gallons per minute (gpm) of groundwater, which is pumped through the water treatment system.

As stated previously, the contaminated groundwater would be treated using an air stripper or GAC filters. Once removed from the ground by the extraction wells, the groundwater would be containerized in an equalization tank so the groundwater can be pumped through the treatment system at a constant flow rate, passed through an oil/water separator, and then into the air stripper or GAC filters. After the air stripper or GAC filters, the water would be containerized again, sampled, and ultimately discharged into the sanitary sewer. This plan includes the use of two bag filters in parallel to filter the water to remove sediment prior to it being passed through the air stripper or GAC filters. In some cases, treated water is re-injected into the subsurface and used to constrain the plume boundary and push contaminants towards the recovery wells. The potential exists to obtain approval from the local publicly owned treatment works (POTW) to discharge the treated water directly into the sanitary sewer, which would remove the post-treatment containment.

Pump and treat systems are more effective at containing the extent of the contaminant plume than contaminant mass removal. Pump and treat systems were more commonly used for contaminant mass removal in the 1980's and 1990's; however, review of system performance data over time has identified several drawbacks to this technology. The pump and treat systems were limited by the tendency of the contamination to sorb into the heterogeneous soil types typically present and the mass recovery was limited because of the slow pace of the back diffusion from the sorbed contaminant into the groundwater. Pump and treat systems are effective at reducing the footprint of the dissolved-phase plume of impacted groundwater. NAPL has not been observed in the groundwater plume.

Pump and treat systems are unlikely to be effective in the short-term but have been shown to be effective in the long-term. Systems that are installed for contaminant mass removal may need to operate for decades to achieve the cleanup objectives and systems installed to target plume containment may need to operate for the life of the plume or until other technologies, such as natural attenuation, reduce the contaminant concentrations to below cleanup levels. Sites with heterogeneous subsurfaces or fracture flow typically have the longest operational times. Depending on the cleanup objectives, shorter operating times for the pump and treat systems may be possible.

The implementation of a pump and treat system over the area discussed in Section 1.2 would be less economical than if it was focused on the source area within the 3,000 µg/L contour. Therefore, it would be more economically feasible to treat the extent of the area occupied by the 3,000 µg/L contour on Figure 2, which is approximately 6,800 square feet using pump and treat. The remediation goal for this area would be to treat down to the NR 140 ES of five (5) µg/L. If this goal would prove to be difficult during field operations, then the cleanup goal would be revised. To address the remainder of the treatment area, in-situ chemical oxidation is recommended. The in-situ chemical oxidation would consist of injecting a chemical oxidant through approximately 18 injection wells. The injections would be performed from 20 to 40 feet bgs in 15 of the injection wells and three of the wells would be performed from 20 to 60 feet bgs. The injection would be performed beginning at the west property boundary and working towards the pump and treat treatment area and would occur during or immediately before the operation of the pump and treat system. If any contaminant is mobilized by the injection, then it will be mobilized towards the pump and treat system treatment zone and will be remediated by the pump and treat system.

The projected installation and operating cost for the system over an estimated 10-year timeframe, including a 15% engineering contingency, is $5,190,000. The 10-year total includes time to permit, construct, and operating the pump and treat system and 2 years of post-treatment groundwater monitoring. Also included in this cost is the work plan preparation/permitting, the additional in-situ chemical oxidation, bi-weekly reporting, borehole waste disposal, 10 years of system operation, annual O&M, 8 quarters of post-treatment groundwater monitoring, and post-treatment report preparation. This cost has assumed normal system maintenance and includes establishing an on-site electrical service and estimated monthly utility bills.

1.3.2.4 Permeable Reactive Barrier

A permeable reactive barrier (PRB) is an in-situ treatment zone that intercepts and treats a groundwater contaminant plume. PRBs are most effective for chlorinated solvents with concentrations less than 10,000 µg/L and the peak concentration at well MW-30 was 4,280 µg/L as of March 2020. PRBs work best when installed within cohesive silts and sands and their effectiveness is not as well documented in well-consolidated or hard bedrock and loose, flowing sands. The preferred treatment materials used in the PRB would be zero valent iron (ZVI) or a ZVI-carbon combination. These materials have been shown to treat chlorinated ethenes such as TCE. When the TCE contacts the ZVI, it degrades into its non-toxic end products, such as ethene and ethane. The reaction process corrodes the ZVI and reduces the

TCE by replacing the chloride atom with a hydrogen atom in the CVOC molecule. Biological treatments can be used in PRBs, but the biological treatment requires sustained anaerobic conditions for the treatment of TCE. The subsurface conditions in the treatment zone have not shown the reduction of TCE and the presence of its breakdown products, therefore a biological treatment within the PRB would not be effective and the use of ZVI would be necessary. If this were the chosen alternative, bench scale testing would be performed to determine the most effective treatment media.

The optimum hydraulic conductivity of the site for a PRB is < 1.0 ft/day and the hydraulic conductivity for the RMG foundry property was determined to range from 0.726 ft/day in bedrock to 3.07 ft/day in the unconsolidated material. The optimum groundwater velocity for a PRB is < 1.0 ft/day and the determined groundwater velocity at the RMG foundry site is 0.12 ft/day in the bedrock to 0.34 ft/day in the unconsolidated material.

The dimensions of the PRB would be determined from the plume size and will be installed perpendicular to groundwater flow. The depth should intersect with an impermeable layer to reduce the chance of groundwater flowing beneath it. Based on current site conditions, this would be at 60 ft bgs. The width/thickness is determined from the residence time needed to degrade the contaminant. Other factors to incorporate to determine the residence time include constituent degradation rate, maximum contaminant concentration, and groundwater flow velocity. The length must be long enough to treat the entire width of the plume. The installation of the PRB is not feasible underneath or close to permanent structures such as buildings or utilities. The construction will include excavation and injection of reactive media.

The different possible excavation methods include:

- Unsupported Excavation – Soils have sufficient cohesion to remain open until backfilling is complete. For depths up to 25 ft bgs.

- Supported Excavation – Utilizes trench support when soils will not remain open. For depths up to 25 ft bgs.

- Continuous Trenching – Simultaneous excavation and backfilling without the use of an open trench. For depths up to 35 ft bgs and 1.5-3 ft wide.

- Biopolymer Trenching/Hydraulic Shoring – Simultaneous excavation and filling with biopolymer to provide stability to walls. The reactive material is injected from the bottom up using a long tremie with recirculation wells spaced along length of trench. For depths up to 70 ft bgs and a width of 2 ft or greater.

- Cofferdam/Sheet Piling – Sheet piles are driven into the ground to form the excavation perimeter and the soil within is excavated. For depths in the order of 30 ft bgs.

- Augured Boreholes or Caissons – Uses an array of up to 30-in diameter boreholes installed by a hollow-stem auger. The reactive media is injected through the auger as the auger is pulled out. Caisson installation includes driving a large circular steel caisson into the ground and auguring out native material. For depths greater than 60 ft bgs.

Based on the previous site investigation work, the overburden removed during the excavating could be returned into the excavation. The previously performed soil samples have determined that TCE contamination is not present.

The different possible injection methods include:

- Direct Injection – Utilizes injection wells or borings to place reactive media through.

- Pneumatic Fracturing and Injection – Injection of a high-pressure gas to create fractures/fissures in soil or rock formations. For depths of up to 160 ft bgs.

- Hydraulic Fracturing and Injection – Injection of a slurry solution at a pressure that exceeds combined lithostatic pressure and cohesive strength of the formation.

The longevity of the system is proportional to the rejuvenation of the granular iron. Rejuvenation would need to occur to restore the reactivity and hydraulic capture capabilities. A theoretical estimate of the operation time before rejuvenation can be calculated using flow and transport models.

The effectiveness of the system would be determined through groundwater monitoring after the PRB is constructed. The groundwater monitoring would typically be conducted on a quarterly to annual basis. The PRB is designed as a passive system and only treats groundwater as it flows downgradient, which leaves the source area untreated until the contamination present there moves. Because of this, results could take as little as months to show while the remediation goal could take years. Treating the source area would require the use of another technology.

To address the remainder of the treatment area, in-situ chemical oxidation is recommended. The in-situ chemical oxidation would consist of injecting a chemical oxidant through approximately 18 injection wells. The injections would be performed from 20 to 40 feet bgs in 15 of the injection wells and three of the wells would be performed from 20 to 60 feet bgs. If any contaminant is mobilized by the injection, then it will be mobilized towards the PRB where it would be remediated.

This system would be installed downgradient of the main contamination plume. The remediation goal for this area would be to treat down to the NR 140 ES of five (5) µg/L. This option is less economically feasible because the PRB only addresses the down-gradient contamination and requires additional technology to treat the source area.

The projected installation and operating cost for the system over a 4-year timeframe, including a 15% engineering contingency, is $4,100,000. The 4-year total includes approximately 1 year for design and permitting, 45 weeks to drill injection wells and install injectate, and 2 years of quarterly post-treatment groundwater monitoring. Also included in the cost is one round of rejuvenating the ZVI injectate in the PRB.

1.3.3 Preliminary Identification of Preferred Alternative

Navistar/KPRG has evaluated all presented remedial options in general accord with NR 722.13(2)(e) as outlined below. Although all of the presented remedial options are generally technically feasible, the most technically effective and economical is the in-situ chemical oxidation injection.

Navistar/KPRG propose to begin planning the implementation of the selected remedial options upon written approval of this document by WDNR. This process will include preparation of bid documents, contractor site walk, bid opening and review, preparation of waste profiles, scheduling, and planning with the facility. It is expected that this pre-construction planning phase may take up to 10 weeks. The construction phase of the selected remedial options should be completed within 8 weeks. The timing of this construction phase, which is anticipated to be in the spring of 2021, will depend in part on the timing of the approval of this document. Based on the site-specific conditions such as the relatively small source area and moderate groundwater flow and the proposed injection program, this estimate has assumed that cleanup objectives will likely be met within two years.

It is noted that the selected remedial option is believed to be the most sustainable of all of the options evaluated. Conducting an in-situ chemical injection reduces the need to excavate or pump groundwater above the surface and use additional onsite equipment to treat the groundwater. In addition, this approach does not result in any noteworthy wasted water usage or additional impacts on water resources or excess electrical utility usage, which often requires electricity from coal-fired or nuclear power plants.

2.0 BENCH SCALE TESTING AND PILOT TEST

2.1 Bench Scale Test Results

The bench-scale treatability study was completed as the first step prior to the implementation of the pilot test. The bench scale test determined the proper oxidant and dosing to be used for the pilot test injection. KPRG provided one-gallon of site groundwater from well MW-30 to ORIN Technologies, LLC (ORIN). The groundwater was tested with different treatment chemistries to determine the most effective at reducing the TCE concentrations. The groundwater was divided into seven different samples with one consisting of the control sample and the other six treated with different chemical doses. The groundwater samples were analyzed for CVOCs using EPA Method 8260 to determine the initial and final concentrations in groundwater.

The control sample measured concentrations of TCE, 1,1,1-TCE, and 1,1-DCA at 1,200 µg/L, 191 µg/L, and 77.9 µg/L, respectively. Other contaminants, 1,1-DCE and 1,2-DCE, were measured between the Minimum Detection Limit (MDL) and Limit of Quantitation (LOQ) at 23.2 µg/L and 28.4 µg/L, respectively.

The treatment chemicals consisted of sodium persulfate ($Na_2S_2O_8$), sodium hydroxide (NaOH) and hydrogen peroxide (H_2O_2). The six samples were given either high and low doses of persulfate/caustic, high and low doses of persulfate/caustic/hydrogen peroxide, and high and low doses of persulfate/hydrogen peroxide. Each of the treatment chemicals and dosage quantities displayed the ability to reduce the COCs when compared to the control sample, to concentrations below the laboratory detection limits. Each treated sample displayed elevated levels of Acetone, with results ranging from 51 µg/L to 75.1 µg/L. It should be noted that the NR 140 ES for acetone is 9,000 µg/L and the PAL is 1,800 µg/L. ORIN believes the acetone is "due to ketone generation from the incomplete mineralization of the treatment chemistries' reaction with the groundwater", and the amount of time between dosing the samples to collection and sending them to the laboratory. ORIN expects that if the samples had sat longer between the application of the treatment chemistry and when the lab analyzed the samples, the chemical reaction would have been able to fully react and reduce the likely detection of byproducts. ORIN recommends using a lower dosage of sodium persulfate and sodium hydroxide because it will achieve the desired reduction in TCE, the persulfate is readily available, clear in color, and commonly used for groundwater treatment, and the cost of sodium hydroxide is more stable compared to hydrogen peroxide. The ORIN Treatability Study Report is located in Attachment 1.

2.2 Pilot Test Results

2.2.1 Pilot Test Description and Documentation

An injection pilot test for impacted groundwater within dolomite bedrock was conducted on May 14, 2020 near the suspect source area of the core room. ORIN injected 900 gallons of 18% sodium persulfate into borehole IW-1, shown in Figure 3. The injection occurred over a depth of 20-60 ft below ground surface (bgs) at five-foot intervals.

During the injection, high injection pressures of 100 pounds per square inch (psi) and zero to negligible flow rates were observed in the 40 to 60 feet bgs injection interval. Of the 900 gallons injected, only an estimated 25 gallons could be injected in the 40 to 60 feet bgs interval. Above 40 ft bgs, the injection pressures decreased from 100 psi to as little as 35 psi on the 20 to 25 feet injection interval and the flow rates increased to as high as 17.0 gpm, with an average flow rate of 12.5 gpm. Injectate was observed in MPW-23-1 (20-30 feet bgs) during the injection in the 25 to 30 feet bgs interval indicating a bedrock fracture that connects these two wells.

To assist in data evaluation, baseline groundwater samples were collected prior to the injection on May 4, 2020 from monitoring wells MW-23, MPW-23, MW-24, MW-24D, and MW-30. MPW-23 is the multi-port well with four discrete sampling intervals. MPW-23-1 is screened at depth 20-30 feet bgs, MPW-23-2 is screened at depth 30-40 feet bgs, MPW-23-3 is screened at depth 40-50 feet bgs, and MPW-23-C is screened at depth 50-60 feet bgs.

2.2.2 Post-Injection Groundwater Sampling Data

Post-injection samples were taken one day, one week, two weeks, and four weeks after the injection from the same wells as the pre-injection samples. Each sample was analyzed for CVOCs, total/dissolved iron, and sulfate. Field parameters of water level, pH, specific conductance, dissolved oxygen (DO), and oxidation-reduction potential (ORP) were taken at each sampling event, during the pilot test injection, and on a daily basis one week following the injection. The multi-port well was not measured for the daily field parameters following the injection due to the observation of injectate overflowing during the injection because the results were not expected to be accurate.

The pilot test analytical results are shown in Table 3. A summary of some of the analytical results are shown on the following table.

	Pre Pilot Test (5/4/2020)			Post Pilot Test (6/12/2020)		
Well	TCE	Cis-1,2-DCE	VC	TCE	Cis-1,2-DCE	VC
MW-23	59.7	9.8	<0.17	41.5	5.7	<0.17
MW-24	4,830	50.6	7.3 J	334	8.4	<0.35
MW-30	4,000	29.7 J	<8.7	677	28.1	<1.7
MPW-23-1	19.1	1310	1.3 J	1.1	0.74 J	<0.17
MPW-23-2	112	237	0.61 J	103	17.5	<0.17
MPW-23-3	15.2	47.4	0.61 J	43.3	40.8	0.18 J
MPW-23-C	1.3	4.8	0.64 J	3.1	1.0	<0.17

Some highlights of the post-injection analytical results are listed below:

- Results from MW-23, MW-24, MW-30, MPW-23-1, and MPW-23-2 showed that concentrations of TCE and cis-1,2-Dichloroethene (cis-1,2-DCE) decreased from the pre-injection sampling (May 4, 2020) to the one-month post-injection sampling (June 12, 2020).

- The vinyl chloride (VC) results remained below its detection limit for the sampling results from both before and after the injection for wells MW-23, and MW-30. The vinyl chloride results for MW-30 have remained below the detection limit, but the detection limit dropped from the pre-injection to the post-injection sampling events.

- The vinyl chloride results for MW-24 dropped from 7.3 µg/L pre-injection to below detection limits, <0.35 µg/L, post-injection.

- The VC results for MPW-23-1, MPW-23-2, and MPW-23-C dropped from above the ES to below the detection limits. The VC results for MPW-23-3 dropped from above the ES (0.61 µg/L) to below the detection limits (<0.17 µg/L) during the two weeks and three weeks post-injection sampling events, with a minor rebound to 0.18 µg/L, which is still below the ES.

The TCE results for MW-24D and MPW-23-C showed an increase from the pre-injection sampling event to the post-injection sampling event. The TCE results for MPW-23-C were at 1.3 µg/L pre-injection and slightly increased to 3.1 µg/L post-injection; even though the concentration increased, it was still below the ES. The TCE result for MW-24D increased from 0.38 µg/L to 6.7 µg/L from the pre-injection sampling event to the one-month post-injection sampling event.

The use of sodium persulfate during the pilot test would cause an increase in total sulfate post-injection in the wells the injectate reached. An increase of total sulfate was observed in wells MW-23, MPW-23, MW-24, and MW-30 from the pre-injection to the post-injection sampling events. The peak sulfate results were observed for MW-23, MW-24, MPW-23-3, and MPW-23-C seven days after the pilot test injection, with decreases observed in the following weeks sampling events, but the one month post-injection result is at or above the pre-injection results. The peak sulfate results for MW-30 and MPW-23-2 were observed two weeks after the injection with the sulfate results still greater than the pre-injection results one month after the injection occurred. The highest sulfate results were observed in MPW-23-1 along with the greatest increase in sulfate one month after the pilot test. The sulfate results from MW-24D increased in every sampling event following the pilot test, with the highest result observed one month post-injection. The sulfate results in MW-24D increased from 3.2 mg/L pre-injection to 8.3 mg/L two weeks post-injection and increased even more one month post-injection to 45.5 mg/L.

The three quarters of groundwater sampling following the pilot test showed that the TCE concentrations in wells MW-24 and MW-30 remained below the TCE concentration before the pilot test, with MW-23 showing a rebound. The TCE concentration in MW-24 before the pilot test was 3,490 µg/L in March 2020 and the concentrations in the following three quarters were 175 µg/L, 56.2 µg/L, and 73.2 µg/L. The TCE concentration in MW-30 before the pilot test was 4,280 µg/L and the concentrations in the following three quarters were 465 µg/L, 490 µg/L, and 1.340 µg/L. The MW-23 concentration before the pilot test was 60.7 µg/L in April 2020 and the concentration rebounded to 97.4 µg/L in December 2020.

The groundwater plumes for the sampling events of the second and third quarters showed that some of the contamination was pushed towards wells MW-13 and MW-15. The TCE concentrations increased from 370 µg/L prior to the pilot test to 1,090 and 1,740 µg/L for the second and third quarters, respectively, for MW-13. The TCE concentrations increased from 500 µg/L prior to the pilot test to 1,570 and 1,080 µg/L for the second and third quarters, respectively, for MW-15.

2.2.3 Estimate of Radius of Injection Influence

The results of the pilot test showed that a hydraulic connection was identified between monitoring wells MPW-23 and IW-1. Reviewing the post-injection groundwater data of the surrounding wells showed a drop in TCE levels in MW-24 from 4,830 µg/L on May 4, 2020 to 334 µg/L on June 12, 2020, which would indicate that the injected oxidant had reached this well. In addition, an increase of total sulfate was observed in wells MW-23, MPW-23, MW-

24, and MW-30 from the pre-injection to the post-injection sampling events, which also indicates the presence of injectate, as discussed in Section 2.2.2. The distance between MPW-23 and IW-1 is approximately 35 feet. The distance from IW-1 to MW-24 is approximately 75 feet. The effectiveness of the oxidant was more noticeable in MPW-23 compared to MW-24; therefore, an effective radius could be ascertained to be the average between the 75 feet distance and the 35 feet distance, which is approximately 55 feet.

2.2.4 Conclusions/recommendations

The results of the pilot test show that the chemical oxidation was effective at reducing the TCE concentrations in wells MW-23, MW-30, and as far as MW-24. The distance from the injection well and MW-24 is approximately 75 feet, which shows that the injectate had an influence as far away as 75 feet. In addition, the pilot test injection did move some of the contamination to the northwest portion of the site.

These results do show that the chemical oxidation will be effective at reducing the groundwater contamination at the site. In addition, a fracture is suspected to be present between well clusters MW-9, MW-13, MW-15 and wells MW-24, MW-23, MW-30. To prevent the migration of contamination offsite, the chemical injection should be performed starting in the northwest corner and moving towards the southeast.

3.0 INTERIM REMEDIAL ACTION IMPLEMENTATION PLAN

3.1 Permitting Requirements

Prior to the execution of the chemical oxidation injection, the pilot test Remedial Action Injection Exemption request and Wisconsin Pollution Discharge Elimination System (WPDES) application will be updated and submitted to the WDNR. The exemption request will provide the details of the proposed injection including the number and location of injection points and the proposed quantity and type of chemicals that will be used. The WPDES application authorizes the discharge of contaminated groundwater associated with remedial actions to waters of the state, if necessary.

There will be 35 points of injection total. Twenty-nine (29) injection points will be installed as 3”-4” diameter open boreholes with a target injection range of 20 ft to 40 ft bgs. Six (6) injection points will be installed as 6” diameter open boreholes with a target injection range of 20 ft to 60 ft bgs, utilizing a packer system to isolate 5-ft injection intervals.

An average of 900 gallons of 18% catalyzed sodium persulfate will be injected into the 6” diameter injection points and 450 gallons of 18% catalyzed sodium persulfate will be injected into the 3-4” diameter injection points. The exact concentrations, volume, and number of locations may vary depending on field conditions and contaminant load at each injection point such as the ability of the formation to absorb the injectate at each point. This information will be recorded during the injection event.

Once the injection exemption request and WPDES application are approved, the injection work can be scheduled.

3.2 Injection implementation

The injection will be executed over 35 injection points spaced approximately 55 feet apart as shown on Figure 4. The injection points will consist of 29 3-4” diameter points and six (6) 6” diameter points.

The 3-4” diameter injection points will be executed using the following sequence:

1. Each injection point boring will be drilled to the top of bedrock and a 6" diameter temporary sonic casing will be seated on top of the bedrock;
2. A 3-4" diameter open rock socket will be drilled to 40 feet bgs;
3. Once the total depth is reached, a 4” diameter PVC casing will be dropped inside the 6” diameter sonic casing and left as a temporary casing through the overburden;
4. The injectate will be pumped into each injection point starting from the bottom of the borehole and working towards the surface in approximate 5-foot intervals.

The 6” diameter injection points will be executed using the following sequence:

1. Each injection point boring will be drilled to the top of bedrock and an 8-9" diameter temporary sonic casing will be seated on top of the bedrock;
2. A 6" diameter open rock socket will be drilled to 60 feet bgs;
3. Once the total depth is reached, a 6” diameter PVC casing will be dropped inside the 8-9” diameter sonic casing and left as a temporary casing through the overburden.
4. The injectate will be pumped into each injection point starting from the bottom of the borehole and working towards the surface in approximate 5-foot intervals.

The waste material generated as part of installing the injection points will be drummed, sampled, and disposed of accordingly.

The injection sequencing will start from the farthest down gradient perimeter of the injectate grid (Fig. 4), with subsequent injections gradually moving towards the east end of the injection area. By ordering the injections from the outer perimeter of the treatment area and then inwards, the potential for mobilizing contaminant offsite is minimized. The location of the injection points in the northwest will also address any contaminant that may have been pushed as part of the pilot test, which was discussed in Section 2.2.2. In addition, locating the injection points on the edge of the 300 µg/L contour and in some cases beyond will also address some of the contaminants within the 200 µg/L contour because the pressure of the injection will move the injectate into this area and any groundwater flow will carry the injectate.

KPRG will contract ORIN Technologies, LLC to conduct the injection. The remedial injection treatment chemistry will be prepared using ORIN’s specialized injection equipment. The treatment chemistry will be mixed and temporarily staged prior to injection in 200-gallon tanks located inside ORIN’s enclosed injection trailer. The tank will first be filled with the proper amount of water sourced from on-site taps to achieve the appropriate treatment chemistry solution concentration. Multiple tanks will be mixed and used during the injection, which enables work to proceed steadily and efficiently. The treatment chemistry will be pumped into the formation using ORIN’s air-driven, chemically resistant pumps. The rate, pressure, and volume will be monitored using a chemically resistant inline electronic flow meter. Shut-off valves are present at numerous locations throughout the delivery system for health and safety purposes. To mitigate accidental spills and/or leaks, ORIN uses a variety of spill containment basins and sorbent pads/socks.

Once the injections are complete, the injection points will be capped to prevent infiltration until it is determined if a second round of injection is necessary. Once all the necessary injections are complete, the injection points will be properly abandoned in accordance with NR 141.

3.3 Groundwater Monitoring Post-Treatment

To monitor groundwater quality conditions after the proposed chemical oxidant injection, quarterly groundwater monitoring will be performed. Prior to sampling, a complete round of groundwater levels will be obtained from all site wells. Groundwater samples will then be collected from 24 existing monitoring wells within the North Plume. Specifically, these wells are NMW-1, NMW-3R, NMW-7, NMW-8R, NMW-9, MW-9D, MW-9D2, MW-11, MW-13, MW-15, MW-23, MW-24, MW-24D, MW-25, MW-26, MW-30, MW-31, MW-36, MW-37, MW-38, MW-39, MW-43, MW-44, and MW-55. The following sampling procedures will be used, which are the same procedures KPRG has been using for quarterly groundwater monitoring on-site since 2017:

- The water elevation will be measured using an electronic water level probe;

- To minimize the volume of purge water extracted, standard low-flow sampling will be conducted using a stainless steel, submersible, pneumatic bladder pump;

- Groundwater measurements of DO, ORP, temperature, pH and specific conductance will be obtained via a flow-through cell in the field; and

- Samples will be collected directly into laboratory prepared containers from the pump using disposable bladders and tubing. All samples will be analyzed for CVOCs.

One duplicate will be collected per round of sampling for quality assurance/quality control purposes. All samples will be properly preserved and placed on ice for subsequent transport to the laboratory under a completed chain-of-custody for analysis.

3.4 Schedule

At this time, the foundry activities at the site have ceased and the future use of the property is unknown. Therefore, it is in everyone's best interests to complete the main active portions of the proposed remedial program in the near future. With this understanding, a tentative project schedule for implementation of this RAP is as follows:

Work Item	**Tentative Schedule**
Execution of Injection Exemption & WPDES Application	March 2021 to April 2021
Installation of Injection Points	April 5, 2021 to April 30, 2021
Chemical Oxidation Injection	May 3, 2021 to May 14, 2021
Quarterly Groundwater Monitoring	April 19, 2021 to February 2023

Timeframes are tentative and subject to change depending on various plan/permit approvals for the work, weather conditions and/or the need for adjustment as appropriate to meet redevelopment scheduling needs.

4.0 CERTIFICATION

I, Joshua Davenport, P.E., hereby certify that I am a registered professional engineer in the State of Wisconsin, registered in accordance with the requirements of ch. A−E 4, Wis. Adm. Code; that this document has been prepared in accordance with the Rules of Professional Conduct in ch. A−E 8, Wis. Adm. Code; and that, to the best of my knowledge, all 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.

Joshua Davenport, Senior Engineer, 40131-006

P.E. stamp

JOSHUA D. DAVENPORT
PE #40131-006

I, Richard R. Gnat, P.G., 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. GHSS2, Wis. Adm. Code, or licensed in accordance with requirements of ch. GHSS3, Wis. Adm. Code, and that, to the best of my knowledge, all 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.

Richard R Gnat

Richard R. Gnat, Principal, G-491

Figures

NOTES:

ALL VALUES IN MICROGRAMS PER LITER (ug/L)

J NOTES ESTIMATED CONCENTRATION BETWEEN THE LIMITS OF DETECTION AND QUANTIFICATION

ES : WDNR ENFORCEMENT STANDARD OF 5.0 ug/L

NA : NOT ANALYZED

ENVIRONMENTAL CONSULTATION & REMEDIATION

KPRG

KPRG and Associates, inc.

14665 West Lisbon Road, Suite 1A Brookfield, Wisconsin 53005 Telephone 262-781-0475 Facsimile 262-781-0478

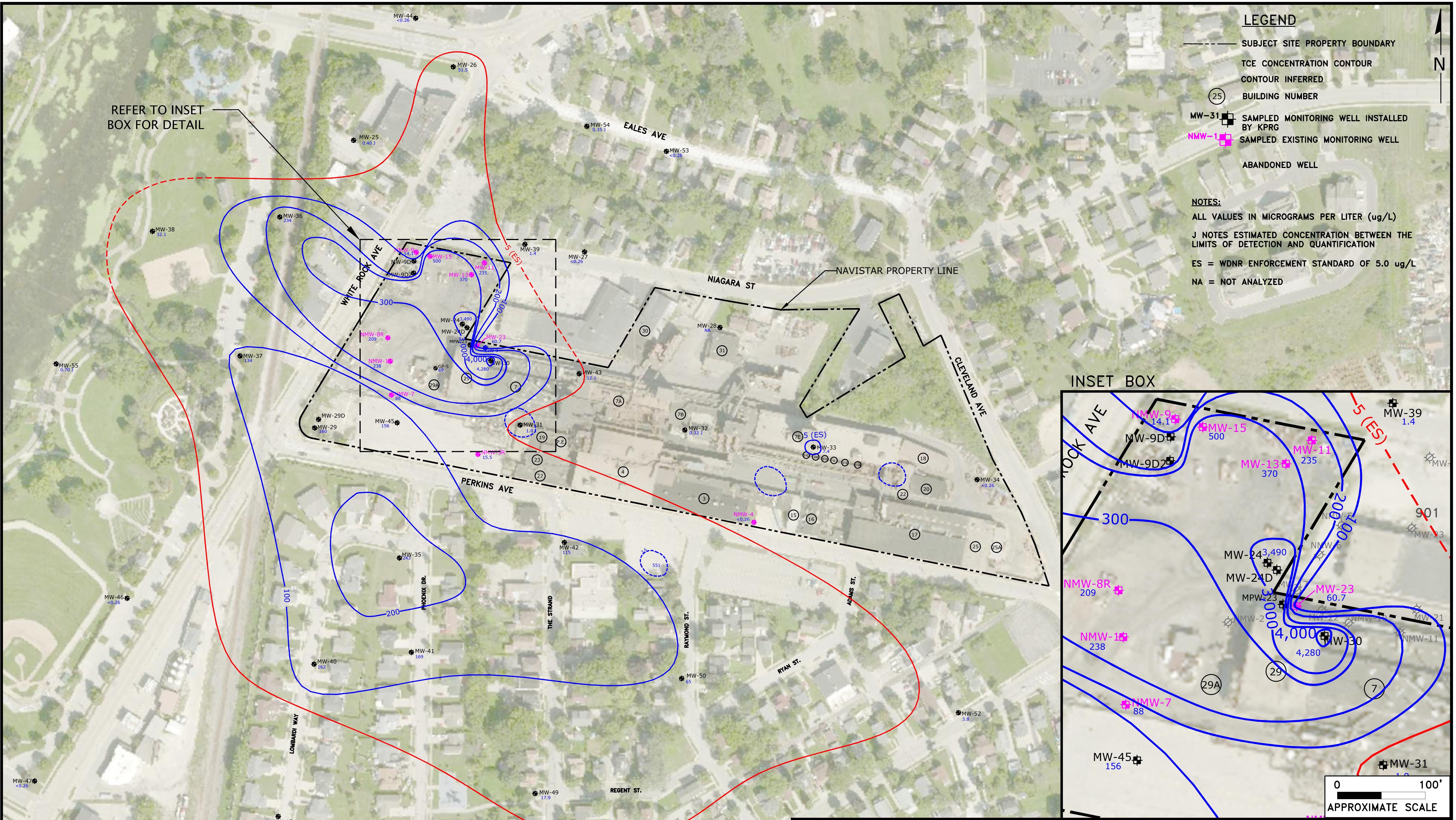
414 Plaza Drive, Suite 106 Westmont, Illinois 60559 Telephone 630-325-1300 Facsimile 630-325-1593

FOURTH QUARTER 2020 GROUNDWATER TCE ISOCONCENTRATION MAP

RMG WAUKESHA FOUNDRY
1401 PERKINS AVE, WAUKESHA, WI

Scale: 1" = 200'
Date: January 12, 2021
KPRG Project No. 11717
FIGURE 1

W:\projects\navistar\gis\report\11717 si maps.dwg



NOTES:

ALL VALUES IN MICROGRAMS PER LITER (ug/L)

J NOTES ESTIMATED CONCENTRATION BETWEEN THE LIMITS OF DETECTION AND QUANTIFICATION

ES = WDNR ENFORCEMENT STANDARD OF 5.0 ug/L

NA = NOT ANALYZED

ENVIRONMENTAL CONSULTATION & REMEDIATION

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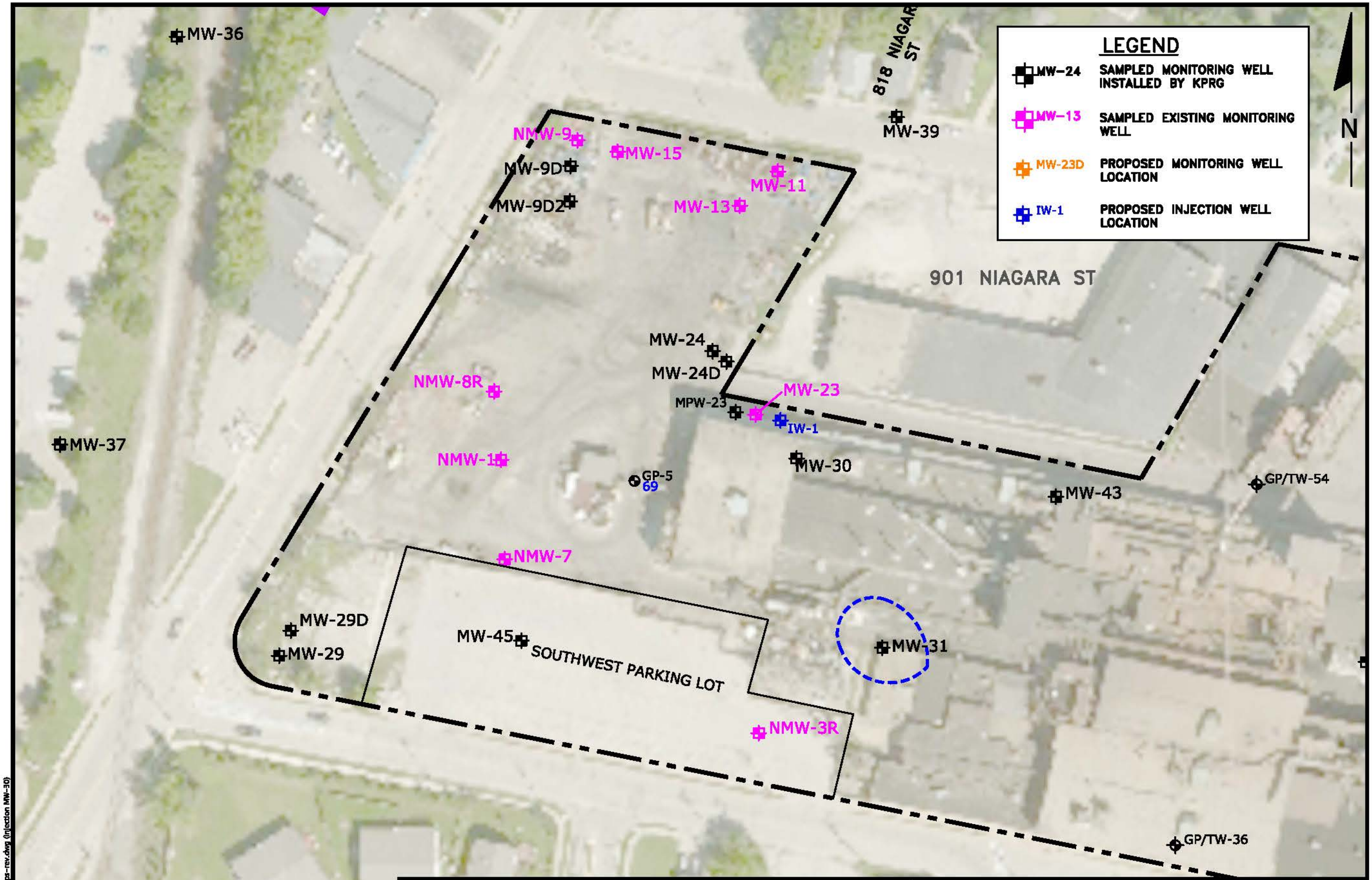
414 Plaza Drive, Suite 106 Westmont, Illinois 60559 Telephone 630-325-1300 Facsimile 630-325-1593

MARCH 2020 GROUNDWATER TCE ISOCONCENTRATION MAP

RMG WAUKESHA FOUNDRY
1401 PERKINS AVE, WAUKESHA, WI

Scale: 1" = 200'	Date: January 21, 2020
KPRG Project No. 11717	FIGURE 2

T:\projects\navistar\navistar drawings\11717 si maps_rev july 2020.dwg



E N V I R O N M E N T A L   C O N S U L T A T I O N & R E M E D I A T I O N

KPRG

KPRG and Associates, Inc.

14665 West Lisbon Road, Suite 1A Brookfield, Wisconsin 53005 Telephone 262-781-0475 Facsimile 262-781-0478

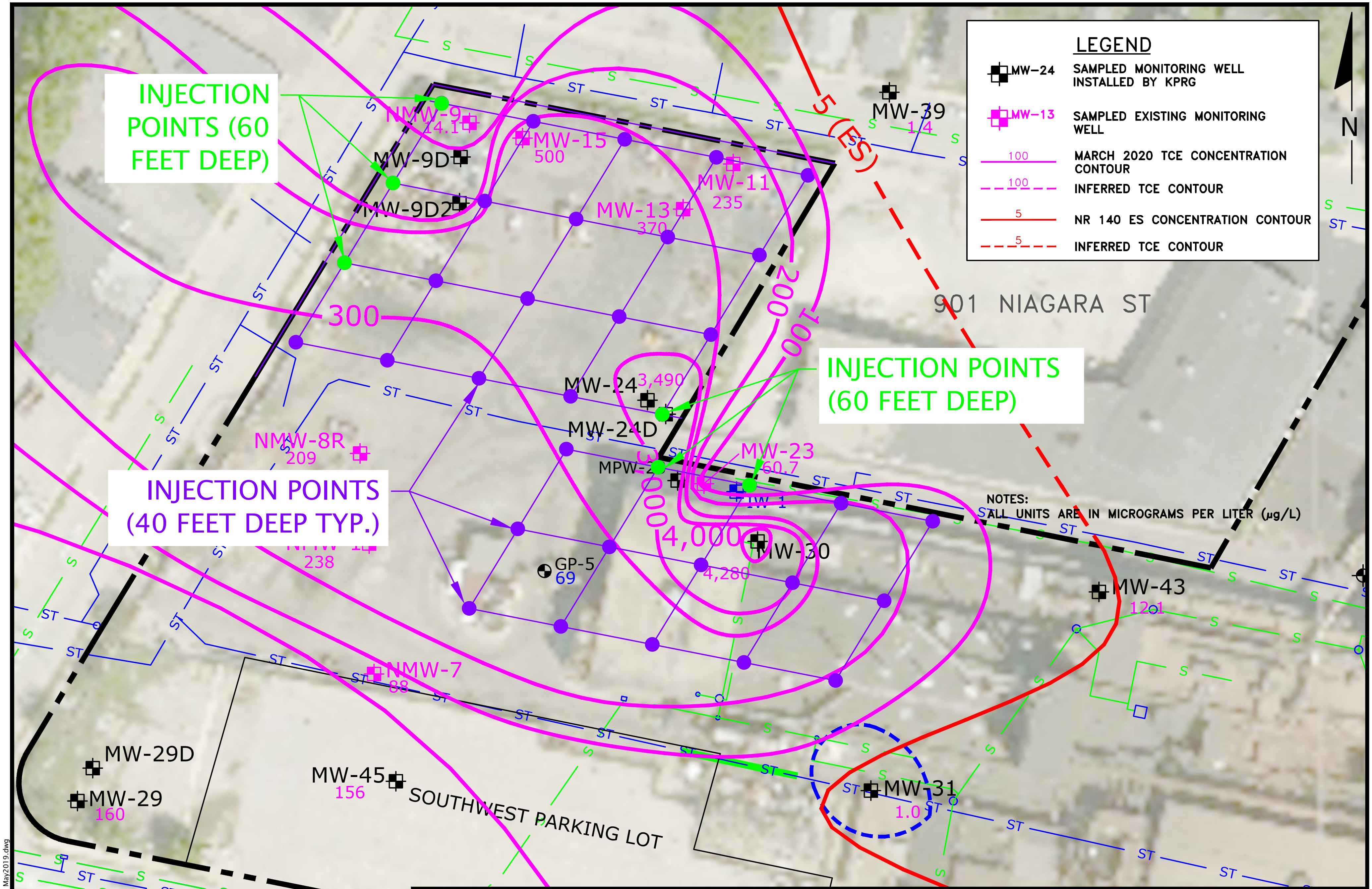
414 Plaza Drive, Suite 106 Westmont, Illinois 60559 Telephone 630-325-1300 Facsimile 630-325-1593

GROUNDWATER PILOT TEST LOCATION

RMG WAUKESHA FOUNDRY
1401 PERKINS AVE, WAUKESHA, WI

Scale: 1" = 100'	Date: January 21, 2021
KPRG Project No. 11717	FIGURE 3

W:\c\projects\Navistar Drawings\11717 SI Maps-rev.dwg (Injection MW-30)



LEGEND

MW-24	SAMPLED MONITORING WELL INSTALLED BY KPRG
MW-13	SAMPLED EXISTING MONITORING WELL
100	MARCH 2020 TCE CONCENTRATION CONTOUR
100	INFERRED TCE CONTOUR
5	NR 140 ES CONCENTRATION CONTOUR
5	INFERRED TCE CONTOUR

NOTES:
ALL UNITS ARE IN MICROGRAMS PER LITER (µg/L)

0 150'
APPROXIMATE SCALE

ENVIRONMENTAL CONSULTATION & REMEDIATION

KPRG

KPRG and Associates, inc.

14665 West Lisbon Road, Suite 1A Brookfield, Wisconsin 53005 Telephone 262-781-0475 Facsimile 262-781-0478

414 Plaza Drive, Suite 106 Westmont, Illinois 60559 Telephone 630-325-1300 Facsimile 630-325-1593

PROPOSED GROUNDWATER INJECTION GRID
AND INJECTION POINTS

RMG WAUKESHA FOUNDRY
1401 PERKINS AVE, WAUKESHA, WI

Scale: 1" = 150'
Date: January 21, 2021

KPRG Project No. 11717
FIGURE 4

W:\c\projects\Navistar\Drawings(TCE Map Soil May2019.dwg

Tables

Table 1 - TCE Contaminant Calculation in Groundwater - Navistar

Isoconcentration Line	Contour Volume (ft^3)^	Contour Volume (gal)^	Cumulative Contour Volume (gal)	Estimated Mass of TCE (ug TCE)	Estimated Percent of Total Mass (%)	Cumulative Percent of Total Mass (%)
4,000 ug/L	5,020	37,550	37,550	182,247,735	1.0%	1.0%
3,000 ug/L	129,400	967,912	1,005,462	3,841,642,728	21.0%	22.0%
300 ug/L	614,640	4,597,507	5,602,969	8,602,395,722	47.0%	69.1%
200 ug/L	1,224,940	9,162,551	14,765,520	2,597,583,265	14.2%	83.3%
100 ug/L	2,405,480	89,092	14,854,612	3,060,607,667	16.7%	100.0%

Note:

^Contour volumes are based on extent of impacts on RMG property

Table 2. Preliminary Evaluation of Groundwater Remediation Options for RMG Waukesha Foundry

Soil Remedy Options	Technology Description	Technical Feasibility	Economic Feasibility	Relative Timeframe	Remedy Cost including 15% Engineering Contingency
No action	This option assumes there is a no action alternative for the groundwater relying strictly on natural biodegradation and volatilization processes to reduce contaminant mass over time.	There is documentation of on-site groundwater impacts above the PAL and ES levels for TCE. This alternative would only be feasible in conjunction with engineered barriers and/or institutional controls. However, there are also regional groundwater impact concerns which may be at least partially impacted by this on-site source. Therefore, this option alone is unlikely to be acceptable to regulators.	No substantive additional cost.	The use of engineered barriers/institutional controls represents an ongoing obligation. This obligation would be ongoing unless the property owner elected to later reopen the site and pursue a different remedial option.	**$0.00***
Thermal Conductive Heating (TCH)	TCH uses a series of electrical heaters to uniformly transfer heat to surrounding soils, rock, and groundwater. The subsurface is heated to the boiling point of water and beyond as needed. TCH increases volatilization of the TCE, which is removed from the subsurface via groundwater and soil vapor extraction wells. Extracted groundwater and vapors are then treated as necessary and discharged.	Existing foundry electrical infrastructure would likely be sufficient for the three-phase power demands of TCH. TCH tends to achieve relatively quick results depending on plume size (operation less than one year is common) and the presence of bedrock requires drilled wells to install the extraction wells and heaters. TCH is most effective in treating source areas, which will require using additional technology to treat majority of impacts.	The cost of this treatment has assumed 152 days operating timeframe and that follow-up groundwater sampling will meet applicable TCE groundwater standards. Also included is the cost for in-situ chemical oxidation to treat impacts beyond source area. If the groundwater sampling reveals the need for additional treatment, that additioinal operating time would be in addition to the estimated remedy cost.	The project assumes initial project set up and mobilization, 152 days of TCH operation, follow up groundwater sampling, and completion reporting. Overall time frame for execution is approximately 70 weeks, which includes time for final design and permitting.	**$4,521,500**
Pump and Treat w/Air Stripping	This option includes the installation of five pumping wells within the source of the treatment area. Recovered groundwater will be conveyed via horizontal header pipe to a treatment shed where it will receive initial treatment via air stripper. An air stripper is a tower with a series of baffled trays. The contaminated groundwater is pumped up and then sprayed into the packed tower, where it will trickle down through baffling/packing material. Air is blown in through the bottom of the packed tower and passes through the contaminated water. This action strips the VOCs from the water into the air. It is assumed that this system will also require sediment removal prior to entering the air stripper.	These types of systems have a long history of usage in groundwater treatment and are effective at treating the collected groundwater. However, these systems also often require years of operation in order to treat the impacted groundwater and are limited by the porosity of the subsurface formation where the contaminant is present. Also, regular maintenance of the many components comprising the system is required and periodic replacement of filters/equipment is also necessary.	This option is economically not feasible because of the expected long-term operating expenses associated with the bedrock subsurface formation. The cost estimate is based on operating for 10 years. This system would most effectively treat the source area, so additional costs are required to perform in-situ chemical oxidation in the non-source area of groundwater contamination.	This project assumes time to design and permit system, 10 years of operation, and 2 years of post-treatment groundwater monitoring	**$5,190,000**
Permeable Reactive Barrier	This option includes the installation of a subsurface membrane consisting of reactive media such as zero-valent iron and/or Bioavailable Absorbent Media (BAM). It is typically placed in a location on site and immediately down-gradient of the probable plume source so the contaminated plume passes through. The reactive materials will either trap (i.e., sorb) the contaminant or chemically react and produce a harmless byproduct.	This remedy is technically feasible and would require the cosntruction of a long and deep barrier along portions of the western propery boundary and reaching into the underlying bedrock at likely depths of up to 60 feet below ground. This process would generate significant excess bedrock spoils. It is possible that low level CVOCs may be present in some of the bedrock and thus would require landfill disposal.	This option is not as economically feasible as other technologies because of the dpeth of the barrier required, the installtion of the barrier in bedrock and the time it would take to install the barrier. Also, if during installation, a highly permeable fracture is encountered, the quantity of injectate required would increase substantially. Additional technology is required to treat groundwater that does not flow through the barrier.	The initial final design, permitting, and construction is estimated to take 2 years. 2 years of post-construction groundwater monitoring will be conducted.	**$3,545,000**
In Situ Chemical Oxidation Treatment	This option includes the introduction of a chemical oxidizing agent, sodium persulfate, into the groundwater via pressure injection points. The oxidant would react chemically with the organics within the groundwater (including the contaminants) resulting in non-hazardous by-products such as chlorine, carbon dioxide, water, oxygen and *manganese oxide* depending upon the oxidant used in treatment. No groundwater would need to be exctracted with this option. Due to the size of the source area potentially encompassing groundwater with elevated TCE, KPRG would propose 35 injection points. The installation of the injection points would require drilling into bedrock.	Oxidant selection is important. This option generally requires a treatability study to determine the proper chemical and dosage to use. Since the oxidant chemically reacts with the contaminant to physically breakdown the chemical to non-hazardous by-products and the reaction occurs quickly, this treatment option is effective on both the short and long term basis relative to meeting cleanup objectives and risk reduction. In general, cleanup objectives are not always met with only one treatment and based on verification groundwater sampling, a "polishing" second injection over a portion of the treatment area may be needed to meet final goals.	The economic feasibility of this option is driven by: The mass of contaminant that needs to be treated (and thus the quantity of oxidant required), the natural oxidant demand, the size of the treatment area, the permeability of the surrounding soils/rock and the levels of treatment that need to be achieved. For budgetary purposes, a second smaller round of inection is assumed for approximately *one third* of the treatment area.	The timeframe for injection is relatively short and the site work would be completed within eight weeks, which includes time to install injection points and conduct the injection. Additional time is also included to conduct final design, permitting, and post-treatment groundwater monitoring. The total time for execution is 3 years.	**$571,000**

*This does not include ongoing maintenance costs associated with the engineered barrier or regulatory reporting labor costs.

Table 3. Groundwater Pilot Test Results - former Navistar/RMG Foundry, Waukesha, WI

Well ID	WDNR NR 140 Standards		MW-23										
Parameter Date	PAL	ES	5/4/2020	5/14/2020	5/15/2020	5/16/2020	5/18/2020	5/19/2020	5/20/2020	5/21/2020	5/22/2020	5/29/2020	6/12/2020
1,1-Dichloroethane	85	850	1.9	NA	1.5	NA	NA	NA	NA	NA	1.4	1.1	1.1
1,2-Dichloroethane	0.5	5	<0.28	NA	<0.28	NA	NA	NA	NA	NA	<0.28	<0.28	<0.28
1,1-Dichloroethene	0.7	7	1.3	NA	<0.24	NA	NA	NA	NA	NA	<0.24	0.60 J	0.68J
cis-1,2-Dichloroethene	7	70	9.8	NA	8.0	NA	NA	NA	NA	NA	4.6	6.0	5.7
trans-1,2-Dichloroethene	20	100	0.70 J	NA	1.0 J	NA	NA	NA	NA	NA	1.1 J	<0.46	0.47J
Tetrachloroethene	0.5	5	<0.33	NA	<0.33	NA	NA	NA	NA	NA	<0.33	<0.33	<0.33
1,1,1-Trichloroethane	40	200	3.0	NA	3.1	NA	NA	NA	NA	NA	2.9	2.3	2.3
1,1,2-Trichloroethane	0.5	5	<0.55	NA	<0.55	NA	NA	NA	NA	NA	<0.55	<0.55	<0.55
Trichloroethene	0.5	5	**59.7**	NA	**50.7**	NA	NA	NA	NA	NA	**36.8**	**42.4**	**41.5**
Vinyl chloride	0.02	0.2	<0.17	NA	<0.17	NA	NA	NA	NA	NA	<0.17	<0.17	<0.17
Iron, Total	150	300	162	NA	**7,060**	NA	NA	NA	NA	NA	**2,360,000 P4**	77.8 J	58.3J
Iron, Dissolved	NS	NS	<29.6 P4	NA	525	NA	NA	NA	NA	NA	687	<29.6	<29.6
Sulfate, Total (mg/l)	125	250	127	NA	124 M0	NA	NA	NA	NA	NA	**351**	123	116
Dissolved Oxygen (mg/l)	NS	NS	5.41	3.34	4.95	4.81	4.69	5.01	4.61	4.73	4.98	4.71	4.63
ORP (mV)	NS	NS	-34.0	154.5	149.0	167.7	146.8	122.3	40.2	35.2	173.8	219.7	63.5
pH (SU)	NS	NS	7.09	13.15	7.44	7.53	7.50	7.43	7.48	7.38	7.61	7.08	7.43
Spec Cond (mS/cm)	NS	NS	2.23	17.23	1.78	1.74	1.74	1.77	1.90	1.78	0.32	2.09	2.09

Notes: Results are in ug/L unless otherwise noted.
PAL - Preventative Action Limit
ES - Enforcement Standard
NA - Not Analyzed/Applicable
NS - No Standard
ORP - Oxygen Reduction Potential
Spec Cond - Specific Conductivity

J - Estimated concentration between the Limits of Detection and Quantification
D3 - Sample was diluted due to the presence of high levels of non-target analytes or other matrix interference.
M0 - Matrix spike recovery and/or matrix spike duplicate recovery was outside laboratory control limits.
M1 - Matrix spike recovery exceeded QC limits
P4 - Sample field preservation does not meet recommendations
Underlined - Result exceeds PAL
Bold - Result exceeds ES

Table 3. Groundwater Pilot Test Results - former Navistar/RMG Foundry, Waukesha, WI

Well ID	WDNR NR 140 Standards		MPW-23-1										
Parameter Date	PAL	ES	5/4/2020	5/14/2020	5/15/2020	5/16/2020	5/18/2020	5/19/2020	5/20/2020	5/21/2020	5/22/2020	5/29/2020	6/12/2020
1,1-Dichloroethane	85	850	43.7	NA	NA	NA	NA	NA	NA	NA	<0.27	<0.27	<0.27
1,2-Dichloroethane	0.5	5	<1.4	NA	NA	NA	NA	NA	NA	NA	<0.28	<0.28	<0.28
1,1-Dichloroethene	0.7	7	**34.7**	NA	NA	NA	NA	NA	NA	NA	<0.24	<0.24	<0.24
cis-1,2-Dichloroethene	7	70	**1,310**	NA	NA	NA	NA	NA	NA	NA	1.7	1.4	0.74J
trans-1,2-Dichloroethene	20	100	14	NA	NA	NA	NA	NA	NA	NA	<0.46	<0.46	<0.46
Tetrachloroethene	0.5	5	<1.6	NA	NA	NA	NA	NA	NA	NA	<0.33	<0.33	<0.33
1,1,1-Trichloroethane	40	200	23.2	NA	NA	NA	NA	NA	NA	NA	0.97 J	0.85 J	<0.24
1,1,2-Trichloroethane	0.5	5	<2.8	NA	NA	NA	NA	NA	NA	NA	<0.55	<0.55	<0.55
Trichloroethene	0.5	5	**19.1**	NA	NA	NA	NA	NA	NA	NA	0.91 J	1.2	1.1
Vinyl chloride	0.02	0.2	**1.3 J**	NA	NA	NA	NA	NA	NA	NA	<0.17	<0.17	<0.17
Iron, Total	150	300	**2,360**	NA	NA	NA	NA	NA	NA	NA	**4,860 P4**	**25,100 P4**	**529J**
Iron, Dissolved	NS	NS	<29.6 P4	NA	NA	NA	NA	NA	NA	NA	<592 D3	<296 D3	6460
Sulfate, Total (mg/l)	125	250	156	NA	NA	NA	NA	NA	NA	NA	**7,980**	**9,800**	**11,400**
Dissolved Oxygen (mg/l)	NS	NS	0.3	1.72	NA	NA	NA	NA	NA	NA	3.64	6.26	5.40
ORP (mV)	NS	NS	-169.1	-55.2	NA	NA	NA	NA	NA	NA	258.2	284.3	253.4
pH (SU)	NS	NS	7.01	12.85	NA	NA	NA	NA	NA	NA	13.17	13.16	13.73
Spec Cond (mS/cm)	NS	NS	1.83	26.69	NA	NA	NA	NA	NA	NA	0.84	105	76.3

Notes: Results are in ug/L unless otherwise noted.
PAL - Preventative Action Limit
ES - Enforcement Standard
NA - Not Analyzed/Applicable
NS - No Standard
ORP - Oxygen Reduction Potential
Spec Cond - Specific Conductivity

J - Estimated concentration between the Limits of Detection and Quantification
D3 - Sample was diluted due to the presence of high levels of non-target analytes or other matrix interference.
M0 - Matrix spike recovery and/or matrix spike duplicate recovery was outside laboratory control limits.
M1 - Matrix spike recovery exceeded QC limits
P4 - Sample field preservation does not meet recommendations
Underlined - Result exceeds PAL
Bold - Result exceeds ES

Table 3. Groundwater Pilot Test Results - former Navistar/RMG Foundry, Waukesha, WI

Well ID	WDNR NR 140 Standards		MPW-23-2										
Parameter Date	PAL	ES	5/4/2020	5/14/2020	5/15/2020	5/16/2020	5/18/2020	5/19/2020	5/20/2020	5/21/2020	5/22/2020	5/29/2020	6/12/2020
1,1-Dichloroethane	85	850	6.8	NA	NA	NA	NA	NA	NA	NA	1.9	3.1	8.0
1,2-Dichloroethane	0.5	5	<0.56	NA	NA	NA	NA	NA	NA	NA	<0.28	<0.28	<0.28
1,1-Dichloroethene	0.7	7	**8.6**	NA	NA	NA	NA	NA	NA	NA	<0.24	<0.24	0.36J
cis-1,2-Dichloroethene	7	70	**237**	NA	NA	NA	NA	NA	NA	NA	16.4	18.0	17.5
trans-1,2-Dichloroethene	20	100	3.6	NA	NA	NA	NA	NA	NA	NA	1.4 J	1.5 J	0.77J
Tetrachloroethene	0.5	5	<0.65	NA	NA	NA	NA	NA	NA	NA	<0.33	<0.33	<0.33
1,1,1-Trichloroethane	40	200	0.94 J	NA	NA	NA	NA	NA	NA	NA	4.6	3.7	8.0
1,1,2-Trichloroethane	0.5	5	<1.1	NA	NA	NA	NA	NA	NA	NA	<0.55	<0.55	<0.55
Trichloroethene	0.5	5	**112**	NA	NA	NA	NA	NA	NA	NA	**26.1**	**21.4**	**103**
Vinyl chloride	0.02	0.2	**0.61 J**	NA	NA	NA	NA	NA	NA	NA	<0.17	<0.17	<0.17
Iron, Total	150	300	**1,510**	NA	NA	NA	NA	NA	NA	NA	**1,790**	**1,550**	174
Iron, Dissolved	NS	NS	<29.6 P4	NA	NA	NA	NA	NA	NA	NA	176	33.4 J	<29.6
Sulfate, Total (mg/l)	125	250	**384**	NA	NA	NA	NA	NA	NA	NA	**3,250**	**3,710**	**2,390**
Dissolved Oxygen (mg/l)	NS	NS	3.62	NA	NA	NA	NA	NA	NA	NA	0.73	12.91	7.85
ORP (mV)	NS	NS	-74.1	NA	NA	NA	NA	NA	NA	NA	230.8	273.6	159.5
pH (SU)	NS	NS	6.96	NA	NA	NA	NA	NA	NA	NA	12.52	11.78	11.72
Spec Cond (mS/cm)	NS	NS	0.82	NA	NA	NA	NA	NA	NA	NA	21.64	13.44	8.76

Notes: Results are in ug/L unless otherwise noted.
PAL - Preventative Action Limit
ES - Enforcement Standard
NA - Not Analyzed/Applicable
NS - No Standard
ORP - Oxygen Reduction Potential
Spec Cond - Specific Conductivity

J - Estimated concentration between the Limits of Detection and Quantification
D3 - Sample was diluted due to the presence of high levels of non-target analytes or other matrix interference.
M0 - Matrix spike recovery and/or matrix spike duplicate recovery was outside laboratory control limits.
M1 - Matrix spike recovery exceeded QC limits
P4 - Sample field preservation does not meet recommendations
Underlined - Result exceeds PAL
Bold - Result exceeds ES

Table 3. Groundwater Pilot Test Results - former Navistar/RMG Foundry, Waukesha, WI

Well ID	WDNR NR 140 Standards		MPW-23-3										
Parameter Date	PAL	ES	5/4/2020	5/14/2020	5/15/2020	5/16/2020	5/18/2020	5/19/2020	5/20/2020	5/21/2020	5/22/2020	5/29/2020	6/12/2020
1,1-Dichloroethane	85	850	0.91 J	NA	NA	NA	NA	NA	NA	NA	3.5	1.2	0.87J
1,2-Dichloroethane	0.5	5	<0.28	NA	NA	NA	NA	NA	NA	NA	<0.28	<0.28	<0.28
1,1-Dichloroethene	0.7	7	1.3	NA	NA	NA	NA	NA	NA	NA	<0.24	<0.24	<0.24
cis-1,2-Dichloroethene	7	70	47.4	NA	NA	NA	NA	NA	NA	NA	22.8	40.1	40.8
trans-1,2-Dichloroethene	20	100	1.4 J	NA	NA	NA	NA	NA	NA	NA	1.9	2.3	2.1
Tetrachloroethene	0.5	5	<0.33	NA	NA	NA	NA	NA	NA	NA	<0.33	<0.33	<0.33
1,1,1-Trichloroethane	40	200	<0.24	NA	NA	NA	NA	NA	NA	NA	11.6	4.2	2.5
1,1,2-Trichloroethane	0.5	5	<0.55	NA	NA	NA	NA	NA	NA	NA	<0.55	<0.55	<0.55
Trichloroethene	0.5	5	**15.2**	NA	NA	NA	NA	NA	NA	NA	**96.5**	**64.4**	**43.3**
Vinyl chloride	0.02	0.2	**0.61 J**	NA	NA	NA	NA	NA	NA	NA	<0.17	<0.17	0.18J
Iron, Total	150	300	**1,380**	NA	NA	NA	NA	NA	NA	NA	**5,370**	**5,000**	**1,310**
Iron, Dissolved	NS	NS	<29.6 P4	NA	NA	NA	NA	NA	NA	NA	<29.6	106	<29.6
Sulfate, Total (mg/l)	125	250	118	NA	NA	NA	NA	NA	NA	NA	**2,220**	**1,250**	**907**
Dissolved Oxygen (mg/l)	NS	NS	1.30	2.44	NA	NA	NA	NA	NA	NA	0.54	74.17	1.22
ORP (mV)	NS	NS	-151.4	-157.7	NA	NA	NA	NA	NA	NA	193.1	191.9	76.3
pH (SU)	NS	NS	6.94	7.21	NA	NA	NA	NA	NA	NA	12.26	11.34	10.44
Spec Cond (mS/cm)	NS	NS	0.613	0.612	NA	NA	NA	NA	NA	NA	13.05	5.44	4.04

Notes: Results are in ug/L unless otherwise noted.
PAL - Preventative Action Limit
ES - Enforcement Standard
NA - Not Analyzed/Applicable
NS - No Standard
ORP - Oxygen Reduction Potential
Spec Cond - Specific Conductivity

J - Estimated concentration between the Limits of Detection and Quantification
D3 - Sample was diluted due to the presence of high levels of non-target analytes or other matrix interference.
M0 - Matrix spike recovery and/or matrix spike duplicate recovery was outside laboratory control limits.
M1 - Matrix spike recovery exceeded QC limits
P4 - Sample field preservation does not meet recommendations
Underlined - Result exceeds PAL
Bold - Result exceeds ES

Table 3. Groundwater Pilot Test Results - former Navistar/RMG Foundry, Waukesha, WI

Well ID	WDNR NR 140 Standards		MPW-23-C										
Parameter Date	PAL	ES	5/4/2020	5/14/2020	5/15/2020	5/16/2020	5/18/2020	5/19/2020	5/20/2020	5/21/2020	5/22/2020	5/29/2020	6/12/2020
1,1-Dichloroethane	85	850	<0.27	NA	NA	NA	NA	NA	NA	NA	<0.27	<0.27	<0.27
1,2-Dichloroethane	0.5	5	<0.28	NA	NA	NA	NA	NA	NA	NA	<0.28	<0.28	<0.28
1,1-Dichloroethene	0.7	7	<0.24	NA	NA	NA	NA	NA	NA	NA	<0.24	<0.24	<0.24
cis-1,2-Dichloroethene	7	70	4.8	NA	NA	NA	NA	NA	NA	NA	<0.27	0.34 J	1.0
trans-1,2-Dichloroethene	20	100	0.62 J	NA	NA	NA	NA	NA	NA	NA	<0.46	<0.46	<0.46
Tetrachloroethene	0.5	5	<0.33	NA	NA	NA	NA	NA	NA	NA	<0.33	<0.33	<0.33
1,1,1-Trichloroethane	40	200	<0.24	NA	NA	NA	NA	NA	NA	NA	2.3	0.46 J	0.34J
1,1,2-Trichloroethane	0.5	5	<0.55	NA	NA	NA	NA	NA	NA	NA	<0.55	<0.55	<0.55
Trichloroethene	0.5	5	1.3	NA	NA	NA	NA	NA	NA	NA	1.8	2.3	3.1
Vinyl chloride	0.02	0.2	**0.64 J**	NA	NA	NA	NA	NA	NA	NA	<0.17	<0.17	<0.17
Iron, Total	150	300	161	NA	NA	NA	NA	NA	NA	NA	**13,400**	**18,000**	**9,420**
Iron, Dissolved	NS	NS	<29.6 P4	NA	NA	NA	NA	NA	NA	NA	<29.6	2,570	491
Sulfate, Total (mg/l)	125	250	58.5	NA	NA	NA	NA	NA	NA	NA	**381**	149	74.5
Dissolved Oxygen (mg/l)	NS	NS	0.28	4.97	NA	NA	NA	NA	NA	NA	1.07	153.9	2.27
ORP (mV)	NS	NS	-172.3	-114.6	NA	NA	NA	NA	NA	NA	221.5	245.2	99.7
pH (SU)	NS	NS	7.00	7.13	NA	NA	NA	NA	NA	NA	12.69	11.30	9.22
Spec Cond (mS/cm)	NS	NS	0.613	0.614	NA	NA	NA	NA	NA	NA	0.523	0.73	1.19

Notes: Results are in ug/L unless otherwise noted.
PAL - Preventative Action Limit
ES - Enforcement Standard
NA - Not Analyzed/Applicable
NS - No Standard
ORP - Oxygen Reduction Potential
Spec Cond - Specific Conductivity

J - Estimated concentration between the Limits of Detection and Quantification
D3 - Sample was diluted due to the presence of high levels of non-target analytes or other matrix interference.
M0 - Matrix spike recovery and/or matrix spike duplicate recovery was outside laboratory control limits.
M1 - Matrix spike recovery exceeded QC limits
P4 - Sample field preservation does not meet recommendations
Underlined - Result exceeds PAL
Bold - Result exceeds ES

Table 3. Groundwater Pilot Test Results - former Navistar/RMG Foundry, Waukesha, WI

Well ID	WDNR NR 140 Standards		MW-24										
Parameter Date	PAL	ES	5/4/2020	5/14/2020	5/15/2020	5/16/2020	5/18/2020	5/19/2020	5/20/2020	5/21/2020	5/22/2020	5/29/2020	6/12/2020
1,1-Dichloroethane	85	850	87.2	NA	53.4	NA	NA	NA	NA	NA	25.5	13.0	6.3
1,2-Dichloroethane	0.5	5	<11.2	NA	<7.0	NA	NA	NA	NA	NA	<2.8	<2.8	<0.56
1,1-Dichloroethene	0.7	7	**31.0 J**	NA	<6.1	NA	NA	NA	NA	NA	<2.4	<2.4	3.1
cis-1,2-Dichloroethene	7	70	50.6	NA	53.2	NA	NA	NA	NA	NA	33.3	12.4	8.4
trans-1,2-Dichloroethene	20	100	26.1 J	NA	<11.6	NA	NA	NA	NA	NA	<4.6	<4.6	<0.93
Tetrachloroethene	0.5	5	<13.1	NA	<8.2	NA	NA	NA	NA	NA	<3.3	<3.3	<0.65
1,1,1-Trichloroethane	40	200	**221**	NA	130	NA	NA	NA	NA	NA	59.8	39.8	16.6
1,1,2-Trichloroethane	0.5	5	<22.1	NA	<13.8	NA	NA	NA	NA	NA	<5.5	<5.5	<1.1
Trichloroethene	0.5	5	**4,830 M1**	NA	**1,780**	NA	NA	NA	NA	NA	**1,390**	**731**	**334**
Vinyl chloride	0.02	0.2	**7.3 J**	NA	<4.4	NA	NA	NA	NA	NA	<1.7	<1.7	<0.35
Iron, Total	150	300	**3,190**	NA	**17,500**	NA	NA	NA	NA	NA	**5,570**	**4,550**	<35.2
Iron, Dissolved	NS	NS	<29.6 P4	NA	409	NA	NA	NA	NA	NA	961	166	<29.6
Sulfate, Total (mg/l)	125	250	88.2	NA	94.8	NA	NA	NA	NA	NA	129	115	104
Dissolved Oxygen (mg/l)	NS	NS	0.34	2.15	0.90	2.75	1.49	1.64	1.30	1.54	1.70	2.76	4.64
ORP (mV)	NS	NS	-38.1	198.8	242.9	221.9	189.5	158.9	72.0	25.6	148.7	221.4	55.2
pH (SU)	NS	NS	6.92	7.00	7.24	7.25	7.28	7.27	7.29	7.33	7.08	6.99	7.40
Spec Cond (mS/cm)	NS	NS	0.345	1.37	1.64	1.59	1.69	1.65	1.58	1.68	2.26	2.22	2.31

Notes: Results are in ug/L unless otherwise noted.
PAL - Preventative Action Limit
ES - Enforcement Standard
NA - Not Analyzed/Applicable
NS - No Standard
ORP - Oxygen Reduction Potential
Spec Cond - Specific Conductivity

J - Estimated concentration between the Limits of Detection and Quantification
D3 - Sample was diluted due to the presence of high levels of non-target analytes or other matrix interference.
M0 - Matrix spike recovery and/or matrix spike duplicate recovery was outside laboratory control limits.
M1 - Matrix spike recovery exceeded QC limits
P4 - Sample field preservation does not meet recommendations
Underlined - Result exceeds PAL
Bold - Result exceeds ES

Table 3. Groundwater Pilot Test Results - former Navistar/RMG Foundry, Waukesha, WI

Well ID	WDNR NR 140 Standards		MW-24D										
Parameter Date	PAL	ES	5/4/2020	5/14/2020	5/15/2020	5/16/2020	5/18/2020	5/19/2020	5/20/2020	5/21/2020	5/22/2020	5/29/2020	6/12/2020
1,1-Dichloroethane	85	850	<0.27	NA	<0.27	NA	NA	NA	NA	NA	<0.27	<0.27	1.0
1,2-Dichloroethane	0.5	5	<0.28	NA	<0.28	NA	NA	NA	NA	NA	<0.28	<0.28	<0.28
1,1-Dichloroethene	0.7	7	<0.24	NA	<0.24	NA	NA	NA	NA	NA	<0.24	<0.24	0.40J
cis-1,2-Dichloroethene	7	70	<0.27	NA	0.31 J	NA	NA	NA	NA	NA	0.31 J	0.29 J	5.3
trans-1,2-Dichloroethene	20	100	<0.46	NA	<0.46	NA	NA	NA	NA	NA	<0.46	<0.46	<0.46
Tetrachloroethene	0.5	5	<0.33	NA	<0.33	NA	NA	NA	NA	NA	<0.33	<0.33	<0.33
1,1,1-Trichloroethane	40	200	<0.24	NA	<0.24	NA	NA	NA	NA	NA	<0.24	<0.24	0.46J
1,1,2-Trichloroethane	0.5	5	<0.55	NA	<0.55	NA	NA	NA	NA	NA	<0.55	<0.55	<0.55
Trichloroethene	0.5	5	0.38 J	NA	1.8	NA	NA	NA	NA	NA	3.4	2.7	**6.7**
Vinyl chloride	0.02	0.2	<0.17	NA	<0.17	NA	NA	NA	NA	NA	<0.17	<0.17	<0.17
Iron, Total	150	300	**1,190**	NA	**1,190**	NA	NA	NA	NA	NA	**700**	**355**	<35.2
Iron, Dissolved	NS	NS	<29.6 P4	NA	260	NA	NA	NA	NA	NA	279	104	<29.6
Sulfate, Total (mg/l)	125	250	3.2	NA	7.1 J,D3	NA	NA	NA	NA	NA	7.8 J,D3	8.3 J,D3	45.5
Dissolved Oxygen (mg/l)	NS	NS	4.86	11.1	4.79	5.01	5.74	5.23	4.80	4.85	5.13	5.40	3.28
ORP (mV)	NS	NS	-40.6	190.1	174.9	191.0	93.1	75.7	6.7	-4.1	84.9	202.6	-6.7
pH (SU)	NS	NS	7.92	7.36	9.16	8.83	8.73	8.88	8.77	8.81	8.70	8.63	7.82
Spec Cond (mS/cm)	NS	NS	0.180	0.269	0.328	0.315	0.327	0.326	0.327	0.329	0.192	0.446	1.56

Notes: Results are in ug/L unless otherwise noted.
PAL - Preventative Action Limit
ES - Enforcement Standard
NA - Not Analyzed/Applicable
NS - No Standard
ORP - Oxygen Reduction Potential
Spec Cond - Specific Conductivity

J - Estimated concentration between the Limits of Detection and Quantification
D3 - Sample was diluted due to the presence of high levels of non-target analytes or other matrix interference.
M0 - Matrix spike recovery and/or matrix spike duplicate recovery was outside laboratory control limits.
M1 - Matrix spike recovery exceeded QC limits
P4 - Sample field preservation does not meet recommendations
Underlined - Result exceeds PAL
Bold - Result exceeds ES

Table 3. Groundwater Pilot Test Results - former Navistar/RMG Foundry, Waukesha, WI

Well ID	WDNR NR 140 Standards		MW-30										
Parameter Date	PAL	ES	5/4/2020	5/14/2020	5/15/2020	5/16/2020	5/18/2020	5/19/2020	5/20/2020	5/21/2020	5/22/2020	5/29/2020	6/12/2020
1,1-Dichloroethane	85	850	103	NA	26.9	NA	NA	NA	NA	NA	22.6	17.5	12.6
1,2-Dichloroethane	0.5	5	<14.0	NA	<1.4	NA	NA	NA	NA	NA	<2.8	<1.1	<2.8
1,1-Dichloroethene	0.7	7	**53.9**	NA	<1.2	NA	NA	NA	NA	NA	<2.4	<0.98	**8.0J**
cis-1,2-Dichloroethene	7	70	29.7 J	NA	35.6	NA	NA	NA	NA	NA	26.7	4.1	28.1
trans-1,2-Dichloroethene	20	100	<23.2	NA	5.6 J	NA	NA	NA	NA	NA	<4.6	<1.9	<4.6
Tetrachloroethene	0.5	5	<16.3	NA	<1.6	NA	NA	NA	NA	NA	<3.3	<1.3	<3.3
1,1,1-Trichloroethane	40	200	**251**	NA	66.4	NA	NA	NA	NA	NA	65.2	49.5	33.2
1,1,2-Trichloroethane	0.5	5	<27.6	NA	<2.8	NA	NA	NA	NA	NA	<5.5	<2.2	<5.5
Trichloroethene	0.5	5	**4,000**	NA	957	NA	NA	NA	NA	NA	**850**	**236**	**677**
Vinyl chloride	0.02	0.2	<8.7	NA	<0.87	NA	NA	NA	NA	NA	<1.7	<0.70	<1.7
Iron, Total	150	300	52.4 J	NA	10700	NA	NA	NA	NA	NA	**434**	**57,900**	**321**
Iron, Dissolved	NS	NS	<29.6 P4	NA	331	NA	NA	NA	NA	NA	55.5 J	394	86.3J
Sulfate, Total (mg/l)	125	250	82.4	NA	134	NA	NA	NA	NA	NA	150	**558**	137
Dissolved Oxygen (mg/l)	NS	NS	0.23	0.92	0.63	2.11	0.84	0.58	0.74	0.53	0.48	124.63	0.54
ORP (mV)	NS	NS	33.6	193.2	195.9	155.0	133.1	112.3	14.6	40.8	203.2	279.6	117.7
pH (SU)	NS	NS	6.79	7.79	7.36	7.48	7.47	7.37	7.42	7.72	7.77	7.93	7.48
Spec Cond (mS/cm)	NS	NS	0.341	1.64	1.70	1.96	2.08	2.00	1.93	1.75	2.04	2.2	2.12

Notes:	Results are in ug/L unless otherwise noted.	J -	Estimated concentration between the Limits of Detection and Quantification
PAL -	Preventative Action Limit	D3 -	Sample was diluted due to the presence of high levels of non-target analytes or other matrix interference.
ES -	Enforcement Standard	M0 -	Matrix spike recovery and/or matrix spike duplicate recovery was outside laboratory control limits.
NA -	Not Analyzed/Applicable	M1 -	Matrix spike recovery exceeded QC limits
NS -	No Standard	P4 -	Sample field preservation does not meet recommendations
ORP -	Oxygen Reduction Potential	Underlined -	Result exceeds PAL
Spec Cond -	Specific Conductivity	**Bold** -	Result exceeds ES

Attachment 1

ORIN Technologies

July 17, 2019

Rich Gnat
KPRG
14665 W. Lisbon Rd., Suite 2B
Brookfield, WI 53005

Subject: Report for Treatability Study at the RMG Waukesha Foundry Site Located in Waukesha, Wisconsin

Dear Rich,

ORIN Technologies, LLC. (ORIN) is pleased to present this treatability study report to KPRG for Treatability Testing at the RMG Waukesha Foundry site located in Waukesha, Wisconsin (site).

ORIN understands that the primary contaminant of concern (COC) is TCE. Subsurface geology is primarily gravely sand with silts. The potential injection event will take place through wells screened in bedrock. The treatability test was used to determine the most cost effective dosage rate for treatment of the COC. Site groundwater was taken from MW-30.

Treatability Testing

The objective of the treatability study was to determine the most effective treatment chemistry for the destruction of the COC. The effectiveness is determined by testing several treatment chemistries on site groundwater and measuring the performance in reducing the COCs when compared to an untreated control sample.

Materials

Sodium Persulfate – $Na_2S_2O_8$. PeroxyChem
Sodium Hydroxide – NaOH. Hydrite Chemical
Hydrogen Peroxide – H_2O_2. Hydrite Chemical

Treatability Study Methodology

Site groundwater was used to perform treatability testing as outlined in this report. Groundwater samples were analyzed for Volatile Organic Compounds (VOCs) using EPA Method 8260.

ORIN compiled site groundwater samples to create one homogenized sample. Once the samples were combined, two hundred milliliters of site groundwater were distributed into seven jars. One jar was set aside as the untreated control sample while the other six jars were scheduled to receive a specific dosage of treatment chemistry. Three samples were given a high dosage of treatment chemistry and three samples were given a low dosage of treatment chemistry. Groundwater samples were dosed on July 2nd. Following the treatment chemistry application, samples were allowed to react six days at ambient temperature and were periodically monitored for COC vapors. PID and pH notes are shown in Table 1. Samples were collected on July 8th and sent to Gulf Coast Analytical Laboratory (GCAL) for analysis. Sample results are shown in Table 2.

Results

Results were received from GCAL on July 12th. The control sample measured TCE at 2,000 ug/L. Other notable daughter products such as 1,1,1-TCE and 1,1-DCA were measured at 191 and 77.9 ug/L, respectively. 1,1-DCE and 1,2-DCE measured at 23.2 and 28.4 ug/L respectively, however they were given a "J" designation which means the result is between the Minimum Detection Limit (MDL) and Limit of Quantitation (LOQ).

Each of the tested treatment chemistries were able to reduce, all of the COCs when compared to the control sample, to below the laboratory detection limits. However, each treated sample displayed elevated levels of Acetone. In the high dose sodium persulfate and sodium hydroxide test sample (Sample 2), 2-Butanone was measured at 3.19 ug/L but was given a "J" designation. In the low dose sodium persulfate, sodium hydroxide, and hydrogen peroxide test sample (Sample 5), Chloroform was found at 0.939 ug/L and was also given a "J" designation.

Conclusions

Each of the treated samples displayed the ability to reduce the COCs within the site groundwater provided to below the treatment goals. ORIN believes that using a lower dosage of sodium persulfate and sodium hydroxide would be sufficient to reduce the COCs at the site. The elevated levels of Acetone are due to ketone generation from the incomplete mineralization of the treatment chemistries reaction with the groundwater. Another factor contributing to high Acetone levels is the amount of time between dosing the samples to collection and sending samples to the laboratory. Had the samples sat for a longer period of time following the treatment chemistry application, the chemical reaction would have been able to fully react reducing the detection of byproduct generation.

ORIN appreciates the opportunity to provide you these services. If you have any questions or comments, please contact ORIN at 608-838-6699.

Sincerely,

Jacob Mirfield
Project Manager
ORIN Technologies, LLC.

ORIN Technologies

Treatability Tables

Table 1. PID readings in ppm

Sample Name	Pre-Dose PID	Post-Dose PID	7/3/19 PID	7/8/19 PID
Control	95	-	-	-
Persulfate, Caustic (high)	88	0.2	0	0
Persulfate, Caustic (low)	77	0.2	0	0
Persulfate, Caustic, Peroxide (high)	67	0.1	0	0
Persulfate, Caustic, Peroxide (low)	65	0	0	0
Persulfate, Peroxide (high)	62	0	0	0
Persulfate, Peroxide (low)	69	0	0	0

Table 2. Treatability Results in ug/L

	1	2		3		4		5		6		7	
Analyte (ug/L)	Control	Persulfate, Caustic (high)	Percent Reduction	Persulfate, Caustic (low)	Percent Reduction	Persulfate, Caustic, Hydrogen Peroxide (high)	Percent Reduction	Persulfate, Caustic, Hydrogen Peroxide (low)	Percent Reduction	Persulfate, Hydrogen Peroxide (high)	Percent Reduction	Persulfate, Hydrogen Peroxide (low)	Percent Reduction
1,1,1-Trichloroethane	191	0	100%	0	100%	0	100%	0	100%	0	100%	0	100%
1,1-Dichloroethane	77.9	0	100%	0	100%	0	100%	0	100%	0	100%	0	100%
1,1-Dichloroethene	23.2	0	100%	0	100%	0	100%	0	100%	0	100%	0	100%
1,2-Dichloroethene	28.4	0	100%	0	100%	0	100%	0	100%	0	100%	0	100%
Trichloroethene	2000	0	100%	0	100%	0	100%	0	100%	0	100%	0	100%
2-Butanone	0	3.19		0		0		0		0		0	
Acetone	0	75.1		60.7		51		51.2		50		65.9	
Chloroform	0	0		0		0		0.939		0		0	