DeepEarth Technologies, Inc.
8201 W. 183rd St., Suite C
Tinley Park, IL 60487
(708) 396-0100
tech@deepearthtech.com

September 7, 2017 **DTI Proposal # 2170 Pilot Demonstration**

Redevelopment Authority of the City of Racine
c/o Amy Connolly, Executive Director
730 Washington Avenue, Room 102
Racine, Wisconsin 53403

RE: Racine Steel Castings, Racine, WI – PCB & TCB Release Site – Proposed Cool-Ox® Pilot Demonstration Project

Dear Ms. Connolly,

We are pleased to learn that the Redevelopment Authority of the City of Racine (Client), has decided to move forward with the *Cool-Ox*® Pilot Demonstration proposed for the PCB & TCB release at the Racine Steel Castings Site located at 1425 North Memorial Drive in Racine, Wisconsin. Upon receiving word of this decision, we have revisited our files to review the information you supplied regarding this project and convened discussions with our field crew that will be conducting this work. The purpose of this review was to ferret out the details of the proposed on-site work and compare them to applications DTI has previously conducted under similar circumstances. The following design work scope embodies the information and data we received from you, coupled with the input from our field operations group to make sure our conclusions are valid based upon what we know at this time.

Project Background:
The Racine Steel Castings site, now a Brownfield redevelopment property, has been subdivided into two lots. These are currently designated as the North and South Lots. It is the North Lot that is the location and focus of this proposed pilot demonstration. Including approximately 2.2 acres, it is the location of the most heavily concentrated contaminants of concern (COCs). These include polychlorinated biphenyls (PCBs) as well as 1, 2, 4-trichlorobenzene (TCB). The site has been the scene of foundry operations that dates back to the late 1800s. Like many industrial sites, contaminant sources can be traced to general site operation, both above and below ground storage tanks, electrical transformers, chemical drum storage and numerous unintended spills and releases of production chemicals. Under an intended official reuse program, the City has conducted extensive environmental impact investigations over the last decade with the intention of cleaning up the site for redevelopment.

Review of the Current Information:
Although much of the surface of the North Lot is covered with foundry sand (a byproduct of the casting operations), and contains low levels of metals and polyaromatic hydrocarbons (PAHs), the major COCs are PCBs and TCB.

PCBs - Investigations (conducted by others) have revealed that the majority of the PCB impacts above the United States Environmental Protection Agency (USEPA), Toxic Substances Control Act (TSCA) (concentrations greater than 50 mg per kilogram (50 mg/Kg)) and deeper than six (6) feet below ground surface (ft-bgs), are located in a contiguous area adjacent to the northeast corner of the existing site building (see Area A (Orange Polygon) – Figure 1A - Total PCBs in Soil North Lot). Area A is centered on a line between soil boring G-2E and the manhole and measures approximately fifty (50) by fifty-five (55) for (2,750 ft.^{2}) with a suggested vertical treatment interval (VTI) of ground surface (0) to twelve (12) (ft-bgs) (1,222 yd.^{3}). (Area A is configured from approximately 11 o'clock North to 5 o'clock South). Cross-referencing the location of PCB sampling points (see Figure 1A) with the contaminant depth information found in (Table 4 - Soil PCB Analytical Results), it is apparent that with the exception of Area A (where PCBs extent to a depth of approximately twelve (12) ft-bgs), the majority of the PCB contaminants present elsewhere on site are located at a depth of approximately six (6) ft-bgs or less.

TCB - Examination of (Figure 4 - 1, 2, 4-Chlorobenzene in Soil - North Lot), (Figure 5 - Proposed Probe Locations - North Lot), (Figure 10 - Extent of VOCs in Soil - North Lot, (Orange Polygon), compared with (Table 7 - Soil VOC Analytical Results - North Lot), indicate that the VOCs (including all isomers of chlorobenzenes and other chloro-carbons), occupy roughly the same general aerial configuration (2,750 ft^2) as that of the PCBs. However, there is a variation in the depth of the vertical extent of the two COCs. For example, VOCs in soil borings SB-38, BNL-03, BNL-15, and BNL-02, apparently extend to a depth of fourteen (14) ft-bgs, with borings BNL-12, and BNL-18, showing VOC impacts to twenty (20) ft-bgs; or roughly eight (8) feet deeper than the depths of PCBs. The good news (from a remediation point of view), is that the vertical extent of both groups of contaminants (PCBs and VOCs) is confined to largely the same aerial and vertical extent. Thus, they can be treated at the same time and under the same application scenario.

Pilot Demonstration Objectives:

It is important to remember that DTI does not conduct pilot demonstrations to prove the efficacy of the technology to destroy certain contaminants. If necessary, this step will have been performed prior to mobilization to the site. Instead, DTI performs pilot demonstrations to use a small representative area of the site to determine the most efficient application methods and formulas to ascertain the most effective method for overall site remediation. What have we learned thus far?

- Upon contact, the *Cool-Ox®* technology will destroy chlorinated organics by a mechanism of abiotic reductive dechlorination. The COCs impacting this site succumb to that process.
- The majority of the deep (to twenty (20) ft-bgs) COCs are located in a small (with respect to the entire site) contiguous area of approximately 2,750 ft^2.
- The vertical interval most impacted by the COCs extends from surface to approximately twenty (20) ft-bgs.

- The volume of the soil matrix of this vertical and aerial extent is approximately 2,037 yd^3.
- The majority of COCs and other organics impacting the overall site are generally present within the upper six (6) feet if soil.

The objectives of this Pilot Demonstration are:

- To demonstrate *Cool-Ox®* is effective in remediating the halogenated organics under the circumstances found at the site.
- To design and implement a remedial pilot program that shall produce data that will reveal the most efficient, economical, and appropriate application methods for remediation of the contaminants impacting this site.
- To conduct the pilot demonstration in an area that will make the greatest contribution to not only collecting data toward the efficient overall remediation of the site but, will also be making a contribution toward the final remediation of the site itself.

Path Forward - Selection of Pilot Area & Remedy:

Selecting the Pilot Area - The configuration (depth) and common location (area) of the two major contaminant groups (PCBs and VOCs) at this site tend to indicate that the most opportune area for siting a pilot demonstration is the approximately 2,750 square foot (ft^2) area depicted as Area A (see Orange Polygon in Figure 1-A and Figure 10). This area includes the majority of both COCs co-contaminating the site, and although the vertical extent is different (approximately to twelve (12) ft-bgs for PCBs and circa to twenty (20) ft-bgs for VOCs), a remedial design employing a combination of two application techniques can treat both COCs with a singular application. *Thus, a pilot demonstration properly conducted in this area can produce data on the effect of the remedies on both contaminants as well as contribution to the overall remediation of the site.*

***Selecting the Pilot Remedy* –** Based upon DTI's experience at remediating similar sites under similar circumstances, DTI believes that there are two scenarios offering two combined remedial solutions that would present a very successful remedy for this site. While DTI believes that DPT injections are tailor made for application in the deeper area, it has been our experience that the employment of in-situ soil blending of soils where contaminant concentrations are present at a depth of six (6) ft-bgs or less would deliver the best results.

Given our current knowledge of the site conditions, remedial chemistry and soils, DTI believe that a combination of deep zone (six (6) to twenty (20) ft-bgs), DPT injections followed by soil blending the shallower (surface to six (6) ft-bgs – to the approximate groundwater table) contaminated areas as a remedial strategy in the pilot area would be the most expedient and economical remedy. This would deliver a second important data set upon which to design the most practical remedy for the shallower zone. Thus, DTI suggests a combination of two remedial applications, DPT injections of the deeper zone (six (6) to twenty (20) ft-bgs) and soil blending of the shallow zone (surface to six (6) ft-bgs), constitute the work scope of this pilot demonstration. This scenario would also assure complete remediation of the shallow zone that is the most difficult to treat with DPT equipment.

References made to soil blending other locations (shallow areas) of the site are included as references to additional work task(s) that may be required for complete remediation of the entire site.

Rationale - Technology:

On several occasions over the years prior to this Pilot Demonstration, *Cool-Ox*® has been bench tested to verify its efficacy toward the destruction of numerous halogenated compounds as well as PCBs and isomers of chlorobenzene. In May 2017, DTI conducted a bench scale test on samples collected from the Racine site. The results indicated a reduction in concentration of PCBs of nearly 78%. Bench scale studies have also been performed to assess the efficacy of the technology to destroy pentachlorophenol and dioxins. These studies resulted in highly successful field applications at two difficult sites in California (both of which received closure and are attached as examples). These sites and the only Agent Orange site ever remediated and closed by in-situ chemical reduction (ISCR) and other sites are described on the DTI web site www.cool-ox.com. The foundation chemistry underpinning all of this work was discovered and published by the brilliant English chemist, Sir Christopher Ingold, in the 1930s and was until recently was used to produce synthetic alcohols.

But, even though the chemistry might be sterling, in the hands of inexperienced purveyors it could fail. That is why DTI considers our field operations personnel essential. In over nearly two decades of actual remediation projects, the DTI field crews have developed the know-how to make the technology work. In fact, a review of numerous site applications (conducted to update our website), have revealed that on almost every job, modifications conducted extemporaneously by the experienced field crews to meet unexpected challenges, were responsible for the success of the project. Below is a response from a member of our field crews to a question posed by a customer, regarding why we can penetrate seemingly impossibly hard clay.

> *Actually, reagent volume and pressure play a part in fracture penetration wherever the Cool-Ox® process is applied. The mechanism of surfactant production is the key. May we explain! The generation of foam at the surface gives us an indication of what is happening below. A study of surfactant chemistry reveals that three (3) components are necessary to produce foam. These are water, a surfactant and a gas. In partially oxidizing hydrocarbons an amphoteric (hydroxylated hydrocarbon – i.e., surfactant) molecule is formed. Gas (carbon dioxide) is generated by the mineralization of a portion of the contaminants. This gas, forced through the surfactant/water mixture creates foam.*
>
> *In the subsurface, carbon dioxide is continuously produced and in an effort to dissipate the reaction pressure the gas seeks out any pathway it can find to escape the reaction*

zone. In this manner, it will travel through fractures (where available), regardless of the orientation (horizontal or vertical) of the fracture to the formation. Because the carbon dioxide is formed in the reaction media, it will attempt to escape in any direction to any area of lower pressure. As the gas migrates it pushes reagent with it, thereby distributing reagent into any fissures or fractures that may be harboring contaminants which in turn, will react to produce more gas and as this gas migrates…. etc. This dynamic mixing process underpins the success of the Cool-Ox® technology in any media where it may be applied.

Proposal:

The successful execution of this proposed scope of work calls for the melding of two proven *Cool-Ox®* application techniques (in Area A) into one Pilot Demonstration designed to provide the basic data for the overall remediation of site. These two application techniques include DPT injections and in-situ soil blending. Phase 1 (DPT injections) will be initiated first. At or near the end of Phase 1, the initiation of Phase 2 (Soil Blending) will be implemented. DPT injections must be completed first to assure a stable soil condition for the DPT probe.

The successful execution also requires a detailed work plan, permitting and documentation of the work. As provided in this Proposal, DTI will provide those services, as well as verification sampling to demonstrate the efficacy of the process, and a final report. A description of these services is provided after a summary of the treatment implementation.

***Phase 1 DPT Injections* -** will include the sequential driving of one-hundred ten (110) Injection Points (IPs), laid out on a five (5) foot matrix, to a depth of twenty (20) ft-bgs. Each IP will receive an average of one-hundred thirty (130) gallons *Cool-Ox®*, injected from bottom-up over a Vertical Injection Interval (VII) of twenty (20) to six (6) ft-bgs (VII of fourteen (14) feet). Each IP will be sealed with Bentonite® Granules after sufficient time for observation by the applicators. After all IPs have been completed, Phase 2, Soil Blending of upper six (6) feet of Area A, will commence. An AMS 9500 PowerProbe® will be employed to drive the probe steel. *Cool-Ox®* mixing, pumping and metering will be supplied by the DTI *Deep-Shot® Rig*.

If necessary, due to over saturation of the site matrix, IPs will be skipped and will be rescheduled between two injection events to allow subsurface conditions to equilibrate. Based upon previous experience, DTI believes that this injection strategy will allow dissipation of the anticipated reaction pressures that may be built up during the injection work to accommodate a second round of injections. Rig injection pressure will not exceed two-hundred (200) psi.

Phase 2 – Soil Blending will first include the dividing of Area A (2,750 ft^2) into 27.5 (100 ft^2) treatment cells (totaling approximately 611 yd^3). Each cell will measure six (6) feet deep and include approximately 22.2 yd^3 of soil. At a design dosage of twelve (12) gal/yd^3, a total of approximately 7,332 gal will be applied or approximately 266.4 gal/cell. Each cell will be blended with *Cool-Ox®* to the satisfaction of DTI's site manager (Field Chemist). When one cell has been completed, blending of an adjoining cell will commence. A Cat 314 excavator equipped with a bucket and gripper thumb will be employed as the soil blending vehicle. *Cool-Ox*® mixing, pumping and metering will be supplied by the DTI *Deep-Shot*® *Rig*. DTI had considered using a rotary soil blender; however, site information concerning the incidence of rubble and other subsurface interferences caused DTI to select a safer option.

Health & Safety: DTI will mobilize to the site pursuant to the mobilization plan outlined in the Job Safety Analysis (JSA) developed for the Site-Specific Health & Safety Plan (SSH&SP) pertaining to this site. Once on site, a preconstruction meeting will be conducted that shall include personnel from both DTI and Client as well as members from any other company or organization authorized by Client to have site access privileges. During the meeting, the JSAs will be discussed and understood such that, each member of the remedial team shall know and understand their jobs or functions during the site work. Each working day shall begin with a tool box safety meeting.

Remedial Set Up: Upon completion of the SSH&SP orientation, DTI will locate the Injection Points (IPs) designated for DPT injections and assess the site to determine the optimum placement of equipment to facilitate the most efficient application. Third party shipment of materials will be received and stored in the secure chemical storage truck (pursuant to OSHA regulations). This unit supports the operation of the DTI *Deep-Shot*® *Rig* that will be providing the reagent blending and injection energy. The IPs will be located pursuant to the site plan and will be marked with traffic paint or utility flags at the discretion of the DTI Site Manager. When all setup work has been completed, a final inspection of all equipment and connections shall be conducted to assure that both the desired application and safe operation can be accomplished. At this point, a pre-injection site meeting would be commenced to assure that all site personnel are familiarized with the proposed procedures and all safety factors are refreshed.

Work Plan and Permitting: DTI will prepare a detailed work plan for all aspects of the project, from initiation of the pilot test to the submittal of the final report. WDNR staff knowledgeable in injection technology permitting requirements have approved this technology in the past. However, the WDNR project manager is requiring a permit application will need to be a component of the work plan submittal.

Injection Documentation: DTI will fully document all aspects of the injection process. This will include the initial plot of injection points, the development of the final injection point spacing, and the completion of the injection process. The volume of reagent applied will be documented, in terms of amount per injection point and the amount per cubic yard of treated soil.

Mixing Preparation: Mixing preparation includes the testing, removal and landfill disposal of concrete to expose the soil in the mixing area. DTI will oversee the removal of the concrete, and will document the number of truckloads leaving the site for the landfill. DTI will also obtain and review landfill tickets to verify the number of loads and weight of each load. If cleaning of the concrete surfaces is necessary, this will be done by DTI, as well.

Mixing Documentation: As with injection, DTI will fully document all aspects of the mixing process. This will include the depth of mixing the mixing process, how the reagent is applied and the amount of reagent applied. Upon the completion of the mixing, clean gravel will be incorporated to stabilize the mixed area.

Performance Verification: Approximately 2 to 3 months after the completion of the mixing, DTI will collect and analyze soil samples to verify the reduction in contaminants in both the mixing zone and the deeper injection zone. Prior to the start of any site activities, DTI will mobilize to the site to map the previous sample locations (assumes sample locations are visible in the concrete). Based on the results of the sampling performed in the various phases of previous site investigation, DTI will pre-determine locations and depths for verification sampling. The logic for determining these confirmation sample locations and depths will be detailed in the work plan, so it will be approved by the WDNR prior to the initiation of site activities.

Data Analysis and Report: Upon receipt of the laboratory results of the performance verification sampling, DTI will prepare a report summarizing the documentation discussed above, and the results of the performance of the Cool-Ox treatment.

Project Schedule: Within 5 days of receiving a signed contract including this Proposal, DTI will mobilize its Environmental Scientist to the site, begin a detailed work plan and permit application and undertake other necessary preparations to begin work at the site. Provided DTI receives a facsimile of a signed contract no later than September 26, 2017, DTI will schedule the demolition, injection and soil mixing work to commence no later than October 15, 2017, and will schedule followup performance verification testing to occur 90 days following completion of soil blending. The Data Analysis and Report will be provided within 45 days of performance verification testing.

Cool-Ox® Design Specifics and Pricing: **(DTI Job # 2170R1P Pilot Demonstration)**

The costs below cover the work scope for the application of the *Cool-Ox*® process for the remediation of PCBs and TCB found within the Pilot Treatment Area (see Figure 1A Orange polygon) at the Racine Steel Castings Site located at 1425 North Memorial Drive in Racine, Wisconsin. All mob/demob costs, *Cool-Ox*® chemical costs, equipment and personnel expenses and per diem costs are included in this lump sum pricing proposal. The pricing includes all expenses for a single *Cool-Ox*® application of the design specifications as listed below and as otherwise described in this proposal.

	DPT IJ	**Soil Blending**	**Totals**
Contaminants	PCBs/TCB	PCBs/TCB	
Media Treated	Soil & GW	Soil & GW	
Depth to GW (ft–bgs)	5 – 7	5 - 7	
Area (ft^2)	2,750	2,750	2,750
IP Spacing (ft)	5	NA	
#IPs*	110	NA	
Yd^3	1,426	611	2,037
VTI (ft-bgs)	6 to 20	0 to 6	0 to 20
Total Gal.	14,260	7,333	21,593
Gal/IP	~129	12 per yd^3	
Est. O/S days to complete:	7	3	10
Job Price (Lump Sum):	$97,114	$68,589	$165,703

*The number of injection wells may vary depending upon the options that become apparent during the injection process.

Equipment & Personnel

DPT Injections

On site Personnel (6*:

Site personnel shall consist of:
Manager/Operator (Site Safety Officer)
Senior Field Chemist
Cool-Ox® Formulator
Deep-Shot™ Operator/Formulator #1
Deep-Shot™ Operator/Formulator #2
*All DTI personnel are trained in all facets of field applications

Equipment:

1 *Deep-Shot*™ Formulation & Injection Trailer
1 Track mounted AMS 9500 DPT Probe
1 32 Foot H/D Flat Bed Transport Trailer
1 x 28 foot Secure Chemical Storage Truck
2 One ton Field Service Trucks

Soil Blending

On site Personnel (6):

Site personnel shall consist of:
Manager/Operator (Site Safety Officer)
Equipment Operator
Deep-Shot® Rig Operator/Formulator
Field Chemist, *Cool-Ox*® Formulator
Field Chemist, *Cool-Ox*® Formulator

Equipment:

1 Cat 314 Excavator & Tool Carrier
1 *Deep-Shot*™ Formulation & Injection
1 x 28 foot Secure Chemical Storage Truck
2 One ton Field Service Trucks

Oversight and Documentation

Labor and expenses:	
Work plan and permitting	$2,550
Injection	$5,700
Mixing preparation	$1,800
Mixing Implementation	$4,050
Performance verification	$2,100
Data analysis and report	$2,720
Total labor and expenses	**$18,920**
Subcontracted Services[1]:	
Site restoration	$9,500
Lab – soil	$2,680
Lab – groundwater	$ 85
Geoprobe	$2,220
Total subcontracted service	**$14,485**

Footnote 1: Competitive bids for subcontracted services will be obtained from qualified contractors, from which DTI will select its subcontractors. Along with technical qualifications, DTI will obtain documentation of the appropriate insurance and licensing requirements. However, our costs are based on the assumption that the subcontractors will contract directly with the City of Racine, thereby saving substantial financing charges. All bids will be in compliance with Davis-Bacon requirements.

Total Cost: The Total Cost and Contract Price for all work and services presented in this Proposal is $199,108.00.

Expectations:

Although DTI does not have a window to the specific subsurface conditions at the site, we can however, based upon information and observations made at other similar sites, offer suggestions on what to expect at the Racine site. We have volunteered some expectations in the text above, where we have discussed the rationale of the application.

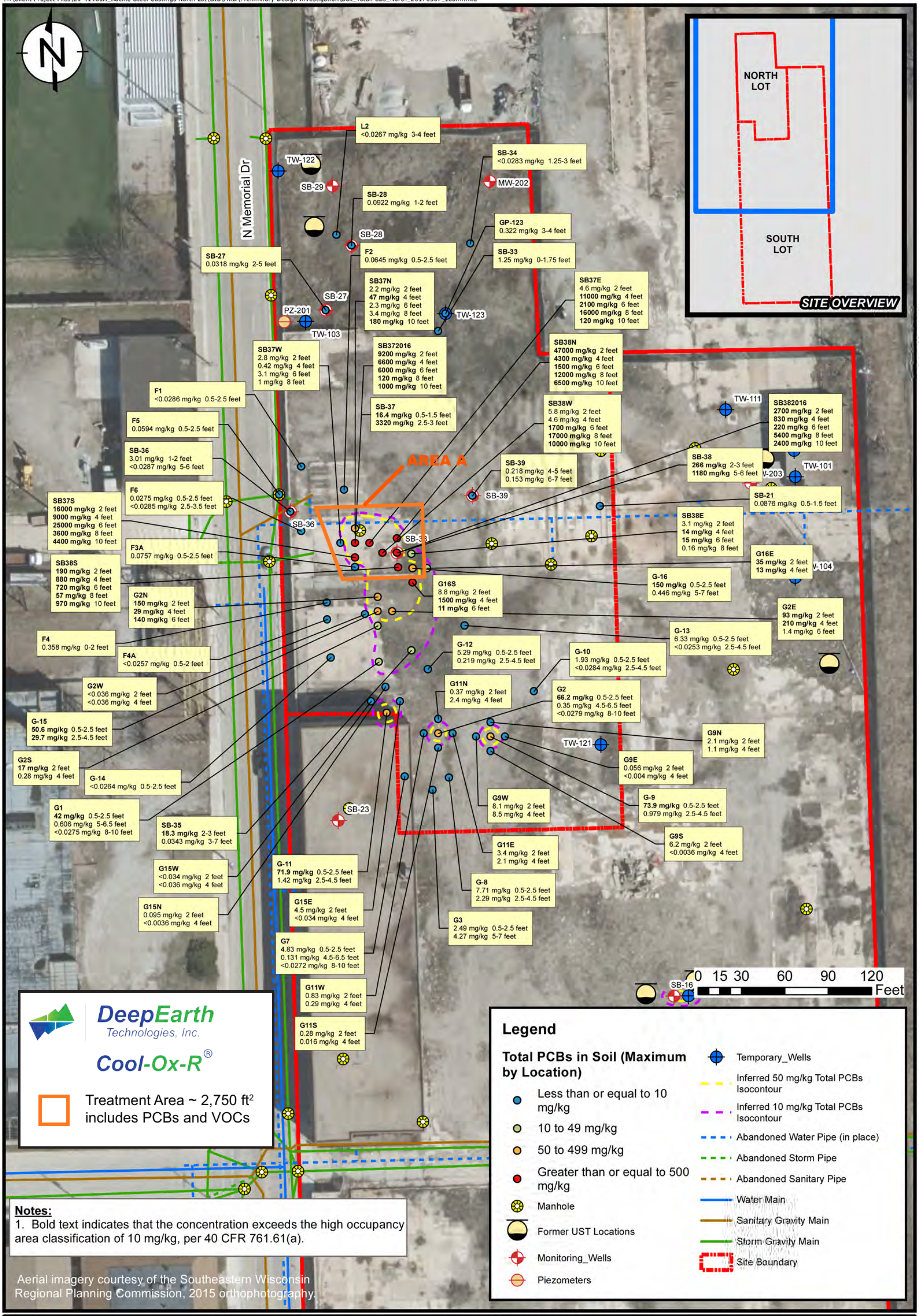
Based upon the information we currently have available for the Racine site, we expect to see contaminant concentrations in the treated area(s) decrease significantly depending upon the ability of the site to accept reagent. While we do not expect contaminant destruction to drop to closure levels with one application, we will get a very good idea of what it will take to achieve closure.

DTI appreciates the opportunity to review this site and provide a remedial design for this pilot demonstration. Should you have any questions after reviewing this document, please contact us promptly so that we might support you to meet your schedule on this project. Please be aware that in addition to your contact with me, you may reach our Customer Services Group at our corporate number. Our customer support personnel are experts in providing assistance to you and are skilled in locating us if we are out of the office when you call. In closing, may I again thank you for this opportunity.

If you are in agreement with this Proposal and wish to proceed with the project by reserving a work schedule date, please sign below and return this form to us by email or fax.

Sincerely,
William L. Lundy
Sr. V. P.
DeepEarth Technologies, Inc.
wlundy@cool-ox.com

Accepted:
Name and Title: ___________________________
Order number: ______________________________
Date: ____________________________________



RAMBOLL ENVIRON	**TOTAL PCBS IN SOIL** **NORTH LOT** RACINE STEEL CASTINGS RACINE, WISCONSIN	DRAFT	FIGURE 1
DRAFTED BY: AMW / DATE: 3/20/2017			PROJECT: 21-41460A

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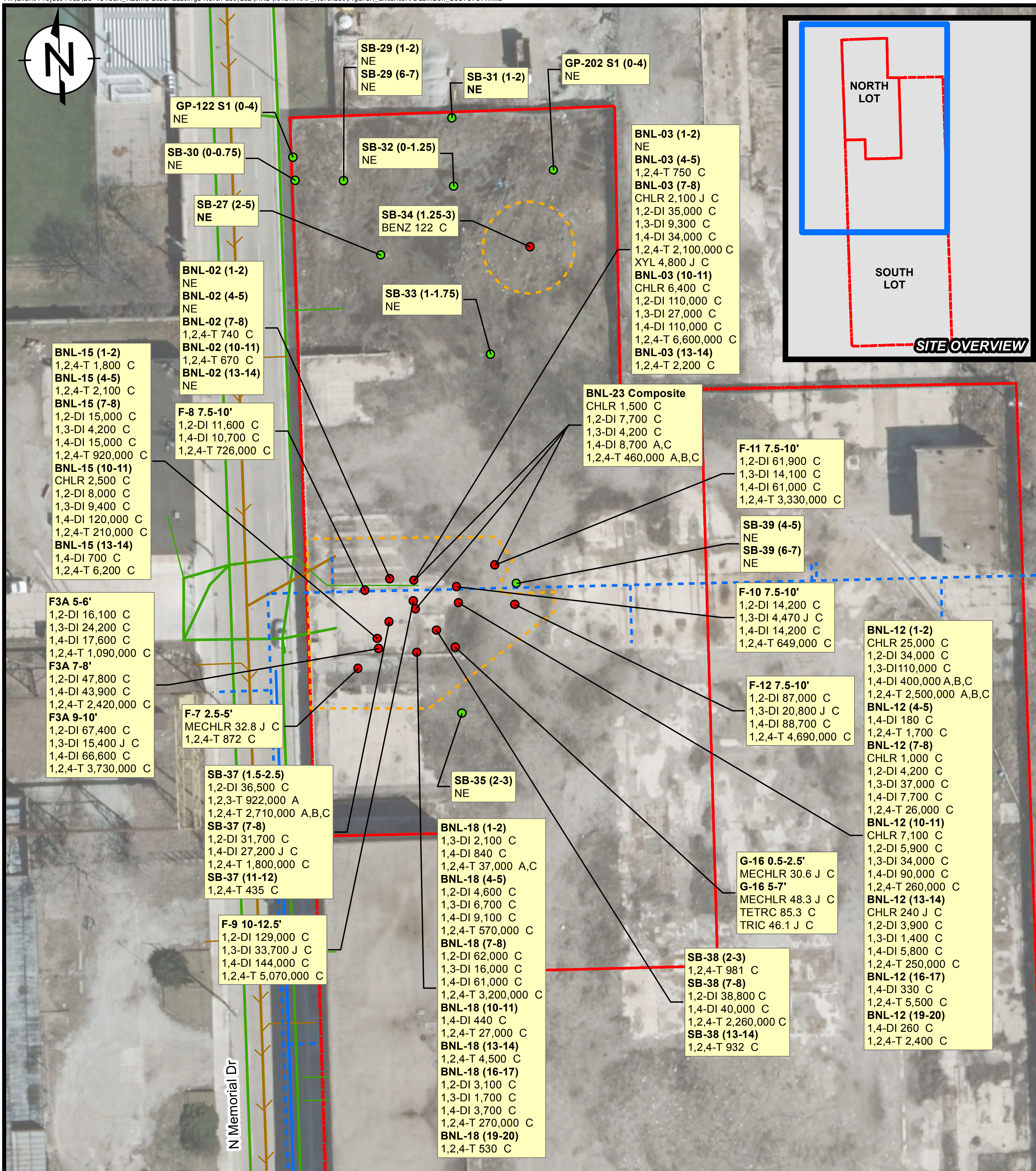

Note: Concentrations of volatile organic compounds (VOCs) are compared to the Wisconsin Department of Natural Resources Residual Contaminant Levels (RCLs). Exceedances of the RCLs are displayed on this figure. The table below displays the RCLs for these parameters in units of micrograms per kilogram (ug/kg).

Parameter	Non-Industrial Direct Contact (RCL) A	Industrial Direct Contact RCL (B)	Groundwater Pathway RCL (C)
Benzene (BENZ)	1,600	7,070	5.12
Chlorobenzene (CHLR)	370,000	761,000	135.8
1,2-Dichlorobenzene (1,2-DI)	376,000	376,000	1,168
1,3-Dichlorobenzene (1,3-DI)	297,000	297,000	1,153
1,4-Dichlorobenzene (1,4-DI)	3,740	16,400	144
Methylene chloride (MCHLR)	61,800	1,150,000	2.56
Tetrachloroethene (TETRC)	33,000	145,000	4.54
1,2,3-Trichlorobenzene (1,2,3-T)	62,600	934,000	--
1,2,4-Trichlorobenzene (1,2,4-T)	24,000	113,000	408.0
Trichloroethene (TRIC)	1,300	8,410	3.58
Xylenes (total) (XYL)	260,000	260,000	3,960

Legend

VOC Exceedances in Soil

(Based on all NR 720 RCLs)

- No NR 720 RCL Exceedance
- NR 720 RCL Exceedance
- NR 720 Groundwater Pathway Exceedance Contour
- Abandoned Water Pipe (in place)
- Water Main
- Sanitary Gravity Main
- Sanitary Lateral
- Storm Gravity Main
- Storm Lateral
- Site Boundary

Aerial imagery courtesy of the Southeastern Wisconsin Regional Planning Commission, 2015 orthophotography.

RAMBOLL ENVIRON

DRAFTED BY: MJL | DATE: 7/18/2017

EXTENT OF VOCS IN SOIL
NORTH LOT

RACINE STEEL CASTINGS

RACINE, WISCONSIN

DRAFT

FIGURE **10**

PROJECT: 21-41460A