

Memo

**SUBJECT**

RACER Pontiac North Campus – RW-08-14 Shutdown Request

TO

Peter Ramanauskas
US Environmental Protection Agency, Region 5
77 West Jackson Blvd LU-9J
Chicago, Illinois 60604-3590

DATE

July 21, 2022

DEPARTMENT

Environment

PROJECT NUMBER

30112891.00005

COPIES TO

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Project File

FROM

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INTRODUCTION

Arcadis of Michigan, LLC (Arcadis) prepared this memorandum on behalf of Revitalizing Auto Communities Environmental Response (RACER) Trust for the Pontiac North Campus Site (Site) located in Pontiac, Michigan (**Figure 1**). The purpose of this memorandum is to request shutdown of RW-08-14 light non-aqueous phase liquid (LNAPL) recovery system operation activities based on the results of additional LNAPL transmissivity testing activities.

LNAPL transmissivity testing activities were conducted at recovery well RW-08-14 in November/December 2021. The scope of 2021 LNAPL testing activities was developed based on the following:

- The results of LNAPL transmissivity and cumulative recovery at the RW-08-14 LNAPL Recovery System which was summarized and reported in the *RACER Pontiac North Campus – LNAPL Recovery Well RW/SB-08-14 Interim Measures Implementation, System Installation and Operation Update* (Arcadis 2020), *RACER Pontiac North Campus – 2020 Additional LNAPL Transmissivity Testing* (Arcadis 2021a), and subsequent LNAPL gauging activities
- Previous investigation activities, internal LNAPL Conceptual Site Model and Decision Tree analyses and previous reports and references including the *Draft RACER Pontiac North Campus – Corrective Measures Proposal* (Arcadis 2013), the *Michigan Department of Environmental Quality (MDEQ) Non-Aqueous Phase Liquid (NAPL) Characterization, Remediation, and Management for Petroleum Releases* (MDEQ 2014), the *RACER Pontiac North Campus – 2013/2014 LNAPL Investigation Technical Memorandum* (Arcadis 2015), the *2018 LNAPL IM Feasibility Confirmation and Pre-Design Specification Testing Memorandum* (Arcadis 2018a), the *RACER Pontiac North Campus Additional LNAPL Pre-Design / Transmissivity Testing and Interim Measure Removal Work Plan* (2018b)

The Michigan Department of Environment, Great Lakes, and Energy (EGLE) *Non-Aqueous Phase Liquid (NAPL) Characterization, Remediation, and Management for Petroleum Releases*, dated June 2014, states, “The metric of transmissivity for NAPL recovery is a secondary metric and would be utilized after the risks are adequately abated, removed, and/or managed since the primary metric for remediation, exposure elimination, and recovery will be determined by the risks at the Site”. To address the potential for risks associated with the LNAPL at the Site the following summary was provided to USEPA for review:

- *Appendix A “LNAPL Assessment Summary” to the RACER Pontiac North Campus – Draft Corrective Actions Summary of Activities Report (Arcadis 2021b)*

This document provides a summary of the evaluation of potential risks associated with the LNAPL and how these potential risks were abated, removed, and/or managed at the Site. The document also provides reference to other reports detailing additional activities conducted to investigate and address the LNAPL at the Site. Additionally, an LNAPL Assessment Overview presentation was given to USEPA on June 9, 2021, which also outlined the LNAPL investigation activities completed, potential risks, and the abatement, removal, and management of LNAPL at the Site. LNAPL recovery activities occurred various times throughout 2004-2020. LNAPL composition, mobility and Natural Source Zone Depletion (NSZD) evaluations were conducted in 2007 (ENCORE 2007) and 2013/2014 (Arcadis 2015). Remaining potential risks associated with LNAPL at the Site are or will be addressed by NSZD, monitoring, and Declaration of Restrictive Covenants (DRCs) for each of the applicable parcels within the Site.

Following up on the results of previous investigation and recovery activities, the scope of 2021 transmissivity testing activities included evaluating the feasibility of continued LNAPL system operation at RW-08-14. Refer to **Figure 2** for the location of this well.

RW-08-14 RECOVERY WELL CONSTRUCTION INFORMATION

The well screen construction of RW-08-14, which extends from 5 to 25 feet below ground surface (bgs), was slightly longer than the initial well screen at SB-08-14 which extended from 10-20 ft bgs. The longer screen length in the recovery well was used to ensure fluid levels remained within the screened interval and to accommodate the length of the skimmer pump installed within the well. The analytical solutions used for transmissivity analysis focus on the relationship between LNAPL discharge and LNAPL drawdown and a different screen length would not affect results or resulted in transmissivity results exceeding the EGLE lower limit LNAPL transmissivity value of 0.5 ft² /day.

In the 2020 Additional LNAPL Transmissivity Testing Memorandum, dated March 4, 2021, it was stated that “RW-08-14 is a six-inch diameter PVC well screened from 5 to 25 feet bgs, with a saturated zone under confined conditions.” The transmissivity testing completed in November 2020 used the Theim Equation solution for confined conditions to calculate transmissivity based on the LNAPL recharge over the testing period. In the 2018 ITRC LNAPL Site Management: LCSM Evolution, Decision Process, and Remedial Technologies document, it is noted that for LNAPL under confined or perched conditions, the LNAPL thickness in the adjacent well will likely be exaggerated. Confined LNAPL is trapped in a saturated unit beneath a layer that limits the upward movement of the LNAPL. The term ‘confined LNAPL’ is used because the mobile LNAPL is under pressure against the underside of a capillary confining layer (often fine-grained, lower permeability lithology). The LNAPL is under pressure within this zone, and a monitoring or recovery well screened across a mobile confined LNAPL interval acts as a “pressure release valve.” After installation, the LNAPL enters the well screen and rises in the well to equalize with atmospheric pressure and accumulates as an exaggerated in-well LNAPL thickness. Refer to

Attachment 1 for hydrographs for original well SB-08-14 and recovery well RW-08-14 to show the relationship between fluid levels over time.

Diagnostic properties of confined conditions are observed in wells where both the apparent LNAPL thickness in the wells increases as the air-LNAPL interface and the corrected groundwater potentiometric surface increase. This trend is best observed in RW-08-14 in 2021 after the skimming system had been shut down and the LNAPL interfaces were stabilizing following the transmissivity testing in 2020. The fluid level pattern over time appears to be consistent with a mobile LNAPL interval near 943 to 945 feet above mean sea level filling upward into the well. This interval was identified based on the observation that the LNAPL-water interface (blue line; **Figure 2 in Attachment 1**) remains relatively constant between this elevation range during mid to late 2021 when fluid levels were equilibrating. With fluctuating fluid levels over time and exaggerated LNAPL thickness, we are seeing a large smear zone vertically with thin, mobile LNAPL intervals within. This interpretation is further supported by intermittent laser-induced fluorescence (LIF) response with depth in adjacent borings (Cross-section B-B'; Appendix A to the Draft Corrective Actions Summary of Activities Report [Arcadis 2021b]).

RW-08-14 RECOVERY WELL OPERATING HISTORY AND PRE-TEST GAUGING ACTIVITIES

As outlined in the *LNAPL Recovery Well RW/SB-08-14 Interim Measures Implementation, System Installation and Operation Update* (Arcadis 2020), RW-08-14 was installed in 2018 (over-drilled and replaced SB-08-14) as part of the USEPA-approved LNAPL Interim Measures completed at the Site. The LNAPL Recovery System includes an automated skimmer which operated from May 2019 through August 2020. The recovery system fluid measurements and LNAPL volumes recovered were used to calculate monthly transmissivity estimates which fell below the EGLE lower limit LNAPL transmissivity value of 0.5 ft²/day. As this threshold was identified as a milestone for system shut down, the recovery system was shut down on August 3, 2020 to allow LNAPL to accumulate for a short-term transmissivity test which was conducted on November 2-4, 2020 as documented in *2020 Additional LNAPL Transmissivity Testing* Technical Memorandum (Arcadis 2021a). The transmissivity from this test was estimated at 0.11 ft²/day which is below the EGLE lower limit LNAPL transmissivity value of 0.5 ft²/day.

The recovery system remained off for a year following this test while LNAPL accumulation was monitored so that a confirmation transmissivity test could be conducted in 2021 in accordance with the USEPA-approved *Additional LNAPL Pre-Design / Transmissivity Testing and Interim Measure Removal Work Plan* (Arcadis 2018b). During the latest shutdown period, Arcadis gauged recovery well RW-08-14 on an approximately weekly basis from November 2020 through November 2021 to monitor LNAPL accumulation and confirm that the location would be conducive to LNAPL transmissivity testing based on LNAPL thickness.

A summary of gauging data at SB-08-14 (2014 through 2018) and at RW-08-14 beginning at system start-up is included as **Table 1**, while the well construction log for RW-08-14 is included in **Attachment 2**.

RW-08-14 LNAPL TRANSMISSIVITY TESTING

LNAPL transmissivity represents the volumetric rate of LNAPL flow through a unit width of porous media per unit time under a unit hydraulic gradient. LNAPL transmissivity is an ideal parameter for assessing LNAPL recoverability, inherently accounting for the combined effects of aquifer matrix permeability, LNAPL physical properties, and the relative proportion of pore space occupied by LNAPL within a specified vertical interval of aquifer material.

Based on the previous information discussed in this memo, transmissivity testing was conducted at recovery well RW-08-14 on November 29-December 2, 2021 based on LNAPL thickness and fluid levels. LNAPL transmissivity testing and analysis was completed following ASTM International (ASTM), Interstate Technology and Regulatory Council (ITRC) and American Petroleum Institute (API) methods.

The well had an initial depth to LNAPL of 7.95 feet and a depth to water of 20.76 feet, for a total LNAPL thickness of 12.81 feet. Consistent with historical observations, exaggerated LNAPL thickness in RW-08-14 has been measured after extended periods of time. LNAPL at this location is under pressure against the underside of the confining unit as it accumulates and equalizes with atmospheric pressure; therefore, the measured LNAPL thickness in the well is not representative of the amount of product in the subsurface (ITRC 2018). Additional details regarding the construction of RW-08-14 are included in preceding sections of this report.

Using a bailer, field staff evacuated LNAPL from the well, a total of approximately 23 gallons, and monitored LNAPL and water depths periodically over the next three days. LNAPL thickness recovered to 3.67 feet by the end of the monitoring period. The total LNAPL recovery was approximately 29% over almost 3 days. Transmissivity was estimated in the range of 0.09-0.1 ft²/day depending on the analytical drawdown solution with an average of 0.1 ft²/day; refer to the Transmissivity Test Output Charts included in **Attachment 3**. This transmissivity falls below the EGLE lower limit LNAPL transmissivity value of 0.5 ft²/day and verifies previous results indicating that removal activities continue to remain not feasible at this location. A summary of the November 2021 data is presented in **Table 2**.

RW-08-14 will continue to be gauged on an annual basis during the Site-wide Annual Groundwater Sampling event. Sentinel and monitoring wells down-gradient of the LNAPL are also gauged on an annual basis to verify that LNAPL at the Site is not migrating (LNAPL Assessment Overview Presentation dated June 9, 2021). A DRC has been recorded for this area which mitigates potential risks associated with LNAPL to potential on-Site receptors.

It is noted that as referenced in Appendix A to the Draft Corrective Actions Summary of Activities Report [Arcadis 2021b]), requested LNAPL removal at RW-08-14 by periodic bailing/removal is not recommended. LNAPL removal will not decrease the overall three dimensional extent of LNAPL at the Site, nor add to mitigation of potential LNAPL-associated risks at the Site. The NSZD study completed in 2012 showed that NSZD rates are 1-2 orders of magnitude higher than active LNAPL recovery at the Site. LNAPL is degrading on its own and based on the low transmissivity of LNAPL at RW-08-14, active recovery will not meaningfully change the rate of overall mass removal.

Peter Ramanauskas
US Environmental Protection Agency
July 21, 2022

CONCLUSIONS AND RECOMMENDATIONS

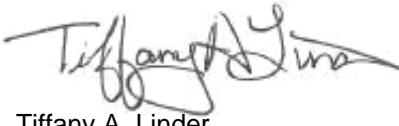
The following conclusions and recommendations are made based on the results of RW-08-14 transmissivity testing and LNAPL evaluation activities:

- Based on the results of the November 2021 transmissivity verification testing, it is recommended that the LNAPL recovery system at RW-08-14 be dismantled and removed from service. The recovery well RW-08-14 and associated storage shed will remain and just system components will be removed from the shed.

Please contact us if you have any questions regarding this memo or its attachments.

Sincerely,

Arcadis of Michigan, LLC



Tiffany A. Linder
Certified Project Manager

Enclosures:

Tables

- Table 1 SB-08-14/RW-08-14 Gauging Data
Table 2 LNAPL Baildown Testing and Analysis Results

Figures

- Figure 1 Site Layout Map
Figure 2 LNAPL Transmissivity Testing

Attachments

- Attachment 1 Hydrographs for SB-08-14 and RW-08-14
Attachment 2 RW-08-14 Well Construction/Boring Log
Attachment 2 RW-08-14 Transmissivity Test Output Charts

REFERENCES

- American Petroleum Institute (API). 2016. API LNAPL Transmissivity Workbook: A Tool for Baildown Test Analysis User Guide. API PUBLICATION 4762. April 2016.
- Arcadis. 2013. DRAFT RCRA Corrective Action Corrective Measures Proposal, Pontiac North Campus, Pontiac, Michigan. March 15.
- Arcadis. 2015. RACER Pontiac North Campus – 2013/2014 LNAPL Investigation Technical Memorandum. January 29, 2015.
- Arcadis. 2018a. RACER Pontiac North Campus – 2018 LNAPL IM Feasibility Confirmation and Pre-Design Specification Testing Memorandum. April 27, 2018.
- Arcadis. 2018b. RACER Pontiac North Campus - 2018 Additional LNAPL Pre-Design / Transmissivity Testing and Interim Measure Removal Work Plan. August 27, 2018.
- Arcadis. 2020. RACER Pontiac North Campus LNAPL Recovery Well RW/SB-08-14 Interim Measures Implementation, System Installation and Operation Update. April 28, 2020.
- Arcadis. 2021a. RACER Pontiac North Campus – 2020 Additional LNAPL Transmissivity Testing. March 4, 2021.
- Arcadis. 2021b. RACER Pontiac North Campus - Draft Corrective Actions Summary of Activities Report, Appendix A “LNAPL Assessment Summary”. June 29, 2021.
- ASTM International (ASTM). 2013. Standard Guide for Estimation of LNAPL Transmissivity. ASTM Standard E2856 -13. ASTM International, West Conshohocken, Pennsylvania.
- ENCORE. 2007. Pontiac North Campus. LNAPL Mobility Evaluation. February 7, 2007.
- Interstate Technology & Regulatory Council (ITRC). 2009. Evaluating LNAPL Remedial Technologies for Achieving Project Goals. LNAPL-2. Washington, D.C.: Interstate Technology & Regulatory Council, LNAPLs Team. www.itrcweb.org
- ITRC. 2018. LNAPL-3: LNAPL Site Management: LNAPL Conceptual Site Mode (LCSM) Evolution, Decision Process, and Remedial Technologies. March. <https://lnapl-3.itrcweb.org/>
- Michigan Department of Environmental Quality (MDEQ). 2014. Non-Aqueous Phase Liquid (NAPL) Characterization, Remediation, and Management for Petroleum Releases. RRD Resource Materials-25-2014-01. June 2014.

TABLES

Table 1
SB-08-14/RW-08-14 Gauging Data



RACER Trust Pontiac North Campus
Pontiac, Michigan

Date	Well Screen (ft bgs)	Well Screen (ft bTOC)	TOC (ft AMSL)	Depth to LNAPL (ft bTOC)	Depth to Water (ft bTOC)	Air/LNAPL Interface (ft AMSL)	LNAPL/Water Interface (ft AMSL)	Potentiometric Surface (ft AMSL)	LNAPL thickness (ft)	Notes	
SB-08-14											
6/17/2014	10-20'	12.23-22.23'	965.97	11.06	22.30	954.91	943.67	953.22	11.24	LNAPL sample collected	
6/30/2014			965.97	13.41	24.02	952.56	941.95	950.96	10.61		
7/28/2014			965.97	12.30	21.51	953.67	944.46	952.28	9.21		
9/11/2014			965.97	11.75	20.82	954.22	945.15	952.85	9.07		
9/17/2014			965.97	11.45	21.41	954.52	944.56	953.02	9.96	Transmissivity testing completed on 9/17 through 9/19	
10/24/2014			965.97	11.94	21.50	954.03	944.47	952.59	9.56		
3/31/2015			965.97	12.55	21.30	953.42	944.67	952.10	8.75		
6/24/2015			965.97	11.42	21.37	954.55	944.60	953.05	9.95		
9/21/2015			965.97	13.30	21.10	952.67	944.87	951.50	7.80		
10/23/2015			965.97	11.94	21.50	954.03	944.47	952.59	9.56		
1/18/2016			965.97	13.09	21.43	952.88	944.54	951.62	8.34		
8/15/2016			965.97	13.66	21.77	952.31	944.20	951.09	8.11	Stick-up protective casing installed 7/20/2017. Top of casing not resurveyed	
1/17/2018			NA	NS	13.95	22.97	NA	NA	NA	9.02	LNAPL sample collected
1/29/2018				NS	13.51	23.25	NA	NA	NA	9.74	
2/19/2018				NS	13.91	23.32	NA	NA	NA	9.41	LNAPL sample collected; Transmissivity test completed
7/16/2018	NS	13.15		23.47	NA	NA	NA	10.32	LNAPL sample collected; LNAPL Removal pre-design recovery testing completed on 7/16 through 7/19		
10/1/2018	NS	13.76		21.87	NA	NA	NA	8.11			

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SB-08-14/RW-08-14 Gauging Data

RACER Trust Pontiac North Campus
Pontiac, Michigan

Date	Well Screen (ft bgs)	Well Screen (ft bTOC)	TOC (ft AMSL)	Depth to LNAPL (ft bTOC)	Depth to Water (ft bTOC)	Air/LNAPL Interface (ft AMSL)	LNAPL/Water Interface (ft AMSL)	Potentiometric Surface (ft AMSL)	LNAPL thickness (ft)	Notes
RW-08-14										
4/26/2019	5-25'	NA	NS	9.38	11.10	NA	NA	NA	1.72	
5/2/2019			NS	8.88	10.15	NA	NA	NA	1.27	Fluent LNAPL Recovery System operation start
5/6/2019			NS	8.74	9.01	NA	NA	NA	0.27	
5/9/2019			NS	8.10	8.70	NA	NA	NA	0.60	
5/13/2019			NS	8.61	8.65	NA	NA	NA	0.04	
5/21/2019			NS	8.81	8.88	NA	NA	NA	0.07	
5/23/2019			NS	8.66	8.71	NA	NA	NA	0.05	
5/28/2019			NS	8.45	9.10	NA	NA	NA	0.65	
5/30/2019			NS	8.53	9.58	NA	NA	NA	1.05	
6/4/2019			NS	8.56	8.65	NA	NA	NA	0.09	
6/7/2019			NS	8.57	8.60	NA	NA	NA	0.03	
6/10/2019			NS	8.55	8.64	NA	NA	NA	0.09	
6/14/2019			NS	8.14	8.21	NA	NA	NA	0.07	
6/18/2019			NS	7.79	7.81	NA	NA	NA	0.02	
6/21/2019			NS	8.00	8.10	NA	NA	NA	0.10	
6/24/2019			NS	8.00	8.09	NA	NA	NA	0.09	
6/28/2019			NS	8.45	8.50	NA	NA	NA	0.05	
7/1/2019			NS	8.64	8.70	NA	NA	NA	0.06	
7/2/2019			NS	8.71	8.79	NA	NA	NA	0.08	
7/5/2019			NS	8.95	9.05	NA	NA	NA	0.10	
7/8/2019			NS	9.14	9.28	NA	NA	NA	0.14	
7/11/2019			NS	9.28	9.39	NA	NA	NA	0.11	
7/15/2019			NS	9.64	9.73	NA	NA	NA	0.09	
7/17/2019			NS	9.43	9.50	NA	NA	NA	0.07	
7/19/2019			NS	9.45	9.53	NA	NA	NA	0.08	
7/22/2019			NS	9.52	9.76	NA	NA	NA	0.24	
7/25/2019			NS	9.73	9.83	NA	NA	NA	0.10	
7/29/2019			NS	9.81	9.95	NA	NA	NA	0.14	
7/31/2019			NS	9.92	10.03	NA	NA	NA	0.11	
8/5/2019			NS	10.30	10.41	NA	NA	NA	0.11	
8/6/2019	NS	10.03	10.15	NA	NA	NA	0.12			
8/9/2019	NS	10.29	10.44	NA	NA	NA	0.15			
8/14/2019	NS	10.38	10.64	NA	NA	NA	0.26			
8/16/2019	NS	10.40	11.00	NA	NA	NA	0.60			
8/20/2019	NS	10.01	10.15	NA	NA	NA	0.14			
8/23/2019	NS	9.99	10.02	NA	NA	NA	0.03			
8/26/2019	NS	9.90	10.02	NA	NA	NA	0.12			
8/30/2019	NS	10.18	10.32	NA	NA	NA	0.14			

Table 1
SB-08-14/RW-08-14 Gauging Data

RACER Trust Pontiac North Campus
Pontiac, Michigan

Date	Well Screen (ft bgs)	Well Screen (ft bTOC)	TOC (ft AMSL)	Depth to LNAPL (ft bTOC)	Depth to Water (ft bTOC)	Air/LNAPL Interface (ft AMSL)	LNAPL/Water Interface (ft AMSL)	Potentiometric Surface (ft AMSL)	LNAPL thickness (ft)	Notes
RW-08-14 (Cont.)										
9/3/2019	5-25'	NA	NS	10.22	10.36	NA	NA	NA	0.14	
9/6/2019			NS	10.32	10.60	NA	NA	NA	0.28	
9/10/2019			NS	10.45	11.12	NA	NA	NA	0.67	
9/13/2019			NS	10.10	10.22	NA	NA	NA	0.12	
9/17/2019			NS	9.53	9.65	NA	NA	NA	0.12	
9/20/2019			NS	9.52	9.64	NA	NA	NA	0.12	
9/24/2019			NS	9.73	9.85	NA	NA	NA	0.12	
9/27/2019			NS	9.94	10.02	NA	NA	NA	0.08	
9/30/2019			NS	9.83	9.98	NA	NA	NA	0.15	
10/4/2019			NS	9.58	9.70	NA	NA	NA	0.12	
10/8/2019			NS	9.40	9.53	NA	NA	NA	0.13	
10/10/2019			NS	9.42	9.55	NA	NA	NA	0.13	
10/14/2019			NS	9.64	9.78	NA	NA	NA	0.14	
10/21/2019			NS	9.97	10.14	NA	NA	NA	0.17	
10/24/2019			NS	10.30	10.48	NA	NA	NA	0.18	
10/28/2019			NS	10.10	10.25	NA	NA	NA	0.15	
11/4/2019			NS	9.18	9.27	NA	NA	NA	0.09	
11/11/2019			NS	9.37	9.50	NA	NA	NA	0.13	
11/14/2019			NS	9.57	9.62	NA	NA	NA	0.05	
11/18/2019			NS	9.62	9.78	NA	NA	NA	0.16	
11/25/2019			NS	9.82	9.97	NA	NA	NA	0.15	
12/4/2019			NS	9.30	9.40	NA	NA	NA	0.10	
12/9/2019			NS	9.29	9.38	NA	NA	NA	0.09	
12/16/2019			NS	9.75	9.83	NA	NA	NA	0.08	
12/24/2019			NS	10.13	10.30	NA	NA	NA	0.17	
12/30/2019			NS	10.28	10.42	NA	NA	NA	0.14	
1/6/2020			NS	9.95	10.08	NA	NA	NA	0.13	
1/16/2020			NS	8.01	8.10	NA	NA	NA	0.09	
1/20/2020			NS	8.75	8.83	NA	NA	NA	0.08	
1/30/2020			NS	7.22	7.32	NA	NA	NA	0.10	
2/6/2020	NS	7.55	7.70	NA	NA	NA	0.15			
2/13/2020	NS	8.11	8.26	NA	NA	NA	0.15			
2/25/2020	NS	8.55	8.65	NA	NA	NA	0.10			
3/4/2020	NS	8.40	8.52	NA	NA	NA	0.12			
3/9/2020	NS	8.61	8.72	NA	NA	NA	0.11			
3/17/2020	NS	8.96	9.07	NA	NA	NA	0.11			
3/26/2020	NS	9.19	9.32	NA	NA	NA	0.13			
3/30/2020	NS	8.61	8.69	NA	NA	NA	0.08			

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SB-08-14/RW-08-14 Gauging Data

RACER Trust Pontiac North Campus
Pontiac, Michigan

Date	Well Screen (ft bgs)	Well Screen (ft bTOC)	TOC (ft AMSL)	Depth to LNAPL (ft bTOC)	Depth to Water (ft bTOC)	Air/LNAPL Interface (ft AMSL)	LNAPL/Water Interface (ft AMSL)	Potentiometric Surface (ft AMSL)	LNAPL thickness (ft)	Notes
RW-08-14 (Cont.)										
4/8/2020	5-25'	NA	NS	8.50	8.52	NA	NA	NA	0.02	
4/13/2020			NS	8.59	8.71	NA	NA	NA	0.12	
4/20/2020			NS	9.10	9.19	NA	NA	NA	0.09	
4/27/2020			NS	9.49	9.59	NA	NA	NA	0.10	
5/4/2020			NS	9.60	9.77	NA	NA	NA	0.17	
5/11/2020			NS	9.74	9.98	NA	NA	NA	0.24	
5/18/2020			NS	9.05	9.18	NA	NA	NA	0.13	
5/27/2020			NS	8.05	8.13	NA	NA	NA	0.08	
6/4/2020			NS	8.52	8.59	NA	NA	NA	0.07	
6/11/2020			NS	8.82	8.91	NA	NA	NA	0.09	
6/17/2020			NS	8.77	8.90	NA	NA	NA	0.13	
6/23/2020			NS	9.07	9.18	NA	NA	NA	0.11	
6/29/2020			NS	9.41	9.52	NA	NA	NA	0.11	
7/6/2020			NS	9.80	10.41	NA	NA	NA	0.61	
7/14/2020			NS	9.96	11.58	NA	NA	NA	1.62	
7/20/2020			NS	10.20	10.30	NA	NA	NA	0.10	
7/27/2020			NS	10.40	10.53	NA	NA	NA	0.13	
8/3/2020			NS	10.52	10.60	NA	NA	NA	0.08	LNAPL Recovery System shut down
8/13/2020			NS	10.40	11.58	NA	NA	NA	1.18	
8/20/2020			NS	10.52	12.58	NA	NA	NA	2.06	
8/24/2020			NS	10.62	13.00	NA	NA	NA	2.38	
8/31/2020			NS	9.82	12.72	NA	NA	NA	2.90	
9/8/2020			NS	9.89	13.68	NA	NA	NA	3.79	
9/14/2020			NS	9.81	14.20	NA	NA	NA	4.39	
9/22/2020			NS	10.00	15.40	NA	NA	NA	5.40	
10/5/2020			NS	10.52	16.50	NA	NA	NA	5.98	
10/14/2020			NS	10.72	17.20	NA	NA	NA	6.48	
10/21/2020			NS	10.82	17.80	NA	NA	NA	6.98	
10/27/2020			NS	10.78	17.50	NA	NA	NA	6.72	
11/12/2020			NS	11.40	14.40	NA	NA	NA	3.00	Transmissivity testing completed on 11/2 through 11/4
11/19/2020	NS	11.26	15.35	NA	NA	NA	4.09			
11/23/2020	NS	11.38	15.78	NA	NA	NA	4.40			
11/30/2020	NS	11.13	16.02	NA	NA	NA	4.89			
12/9/2020	NS	11.20	16.23	NA	NA	NA	5.03			
12/14/2020	NS	11.10	16.70	NA	NA	NA	5.60			
12/21/2020	NS	10.90	17.00	NA	NA	NA	6.10			
12/30/2020	NS	10.98	17.33	NA	NA	NA	6.35			

Table 1
SB-08-14/RW-08-14 Gauging Data

RACER Trust Pontiac North Campus
Pontiac, Michigan

Date	Well Screen (ft bgs)	Well Screen (ft bTOC)	TOC (ft AMSL)	Depth to LNAPL (ft bTOC)	Depth to Water (ft bTOC)	Air/LNAPL Interface (ft AMSL)	LNAPL/Water Interface (ft AMSL)	Potentiometric Surface (ft AMSL)	LNAPL thickness (ft)	Notes
RW-08-14 (Cont.)										
1/20/2021	5-25'	NA	NS	11.19	17.80	NA	NA	NA	6.61	
1/29/2021			NS	11.24	18.04	NA	NA	NA	6.80	
2/5/2021			NS	11.30	18.20	NA	NA	NA	6.90	
2/12/2021			NS	11.40	18.35	NA	NA	NA	6.95	
2/19/2021			NS	11.50	18.96	NA	NA	NA	7.46	
2/26/2021			NS	11.55	18.96	NA	NA	NA	7.41	
3/4/2021			NS	11.08	18.98	NA	NA	NA	7.90	
3/11/2021			NS	10.95	18.26	NA	NA	NA	7.31	
3/18/2021			NS	10.86	18.15	NA	NA	NA	7.29	
3/23/2021			NS	10.65	18.18	NA	NA	NA	7.53	
4/2/2021			NS	10.65	18.20	NA	NA	NA	7.55	
4/8/2021			NS	10.32	18.42	NA	NA	NA	8.10	
4/15/2021			NS	10.25	18.47	NA	NA	NA	8.22	
4/23/2021			NS	10.35	18.50	NA	NA	NA	8.15	
4/29/2021			NS	10.46	18.95	NA	NA	NA	8.49	
5/13/2021			NS	10.75	19.15	NA	NA	NA	8.40	
5/20/2021			NS	10.90	19.20	NA	NA	NA	8.30	
5/28/2021			NS	11.00	19.26	NA	NA	NA	8.26	
6/3/2021			NS	10.81	19.00	NA	NA	NA	8.19	
6/10/2021			NS	10.86	18.60	NA	NA	NA	7.74	
6/17/2021			NS	9.85	18.95	NA	NA	NA	9.10	
6/22/2021			NS	9.60	19.00	NA	NA	NA	9.40	
7/2/2021			NS	8.00	18.35	NA	NA	NA	10.35	
7/9/2021			NS	7.95	18.40	NA	NA	NA	10.45	
7/14/2021			NS	8.08	19.16	NA	NA	NA	11.08	
7/23/2021			NS	7.75	19.63	NA	NA	NA	11.88	
7/27/2021			NS	7.95	19.70	NA	NA	NA	11.75	
8/6/2021			NS	7.55	19.81	NA	NA	NA	12.26	
8/13/2021			NS	7.45	19.50	NA	NA	NA	12.05	
8/20/2021			NS	7.25	19.35	NA	NA	NA	12.10	
8/24/2021	NS	7.17	19.40	NA	NA	NA	12.23			
8/31/2021	NS	7.48	19.68	NA	NA	NA	12.20			
9/10/2021	NS	7.31	20.25	NA	NA	NA	12.94			
9/14/2021	NS	7.33	20.30	NA	NA	NA	12.97			
9/24/2021	NS	6.50	20.96	NA	NA	NA	14.46			
10/15/2021	NS	6.80	20.86	NA	NA	NA	14.06			
10/25/2021	NS	6.81	21.60	NA	NA	NA	14.79			

Table 1
SB-08-14/RW-08-14 Gauging Data

RACER Trust Pontiac North Campus
Pontiac, Michigan

Date	Well Screen (ft bgs)	Well Screen (ft bTOC)	TOC (ft AMSL)	Depth to LNAPL (ft bTOC)	Depth to Water (ft bTOC)	Air/LNAPL Interface (ft AMSL)	LNAPL/Water Interface (ft AMSL)	Potentiometric Surface (ft AMSL)	LNAPL thickness (ft)	Notes
RW-08-14 (Cont.)										
11/3/2021	5-25'	NA	NS	5.94	20.10	NA	NA	NA	14.16	
11/11/2021			NS	6.35	20.71	NA	NA	NA	14.36	
11/18/2021			NS	7.25	20.80	NA	NA	NA	13.55	
11/30/2021			NS	7.95	20.76	NA	NA	NA	12.81	Transmissivity testing completed on 11/30 through 12/2

Notes:

SB-08-14 was overdrilled and replaced with RW-08-14 on October 22, 2018.

ft = feet

AMSL = above mean sea level

TOC = top of casing

bTOC = below top of casing

bgs = below ground surface

NA = not available

LNAPL = light non-aqueous phase liquid

NS = not surveyed

Table 2
LNAPL Baildown Testing and Analysis Results



RACER Trust Pontiac North Campus
Pontiac, Michigan

Well ID	Date	Test	Initial LNAPL Thickness (ft)	Test Duration (min)	Final LNAPL Thickness (ft)	LNAPL Recovery (%)	LNAPL Transmissivity, T_n (ft ² /day)			
							B&R	C&J	CB&P	Mean
AOI W-10										
RW-08-14	11/29/2021	Test 1	12.81	4,200	3.67	29%	0.09	0.1	0.1	0.1

General Notes:

All analyses completed using American Petroleum Institute (API) LNAPL Transmissivity Workbook (API 2016).

Results do not exceed 0.1 to 0.8 ft²/day lower criterion range to produce sufficient LNAPL recoverability (ITRC 2009).

Results do not exceed 0.5 ft²/day lower limit LNAPL transmissivity value defining recovery to the maximum extent practicable (MDEQ 2014).

Acronyms and Abbreviations:

AOI = Area of interest

ft = feet

LNAPL = light non-aqueous phase liquid

min = minute

B&R = Method based on Bouwer & Rice (1976) method for analysis of groundwater slug tests in unconfined aquifers.

C&J = Method based on Cooper & Jacob (1946)/Jacob & Lohman (1952) methods for groundwater flow to a well under constant drawdown or constant discharge conditions

CB&P = Method based on Cooper, Bredehoeft and Papadopoulos (1967) method for analysis of groundwater slug tests in confined aquifers.

References:

American Petroleum Institute (API). 2016. API LNAPL Transmissivity Workbook: A Tool for Baildown Test Analysis User Guide. API PUBLICATION 4762. April 2016.

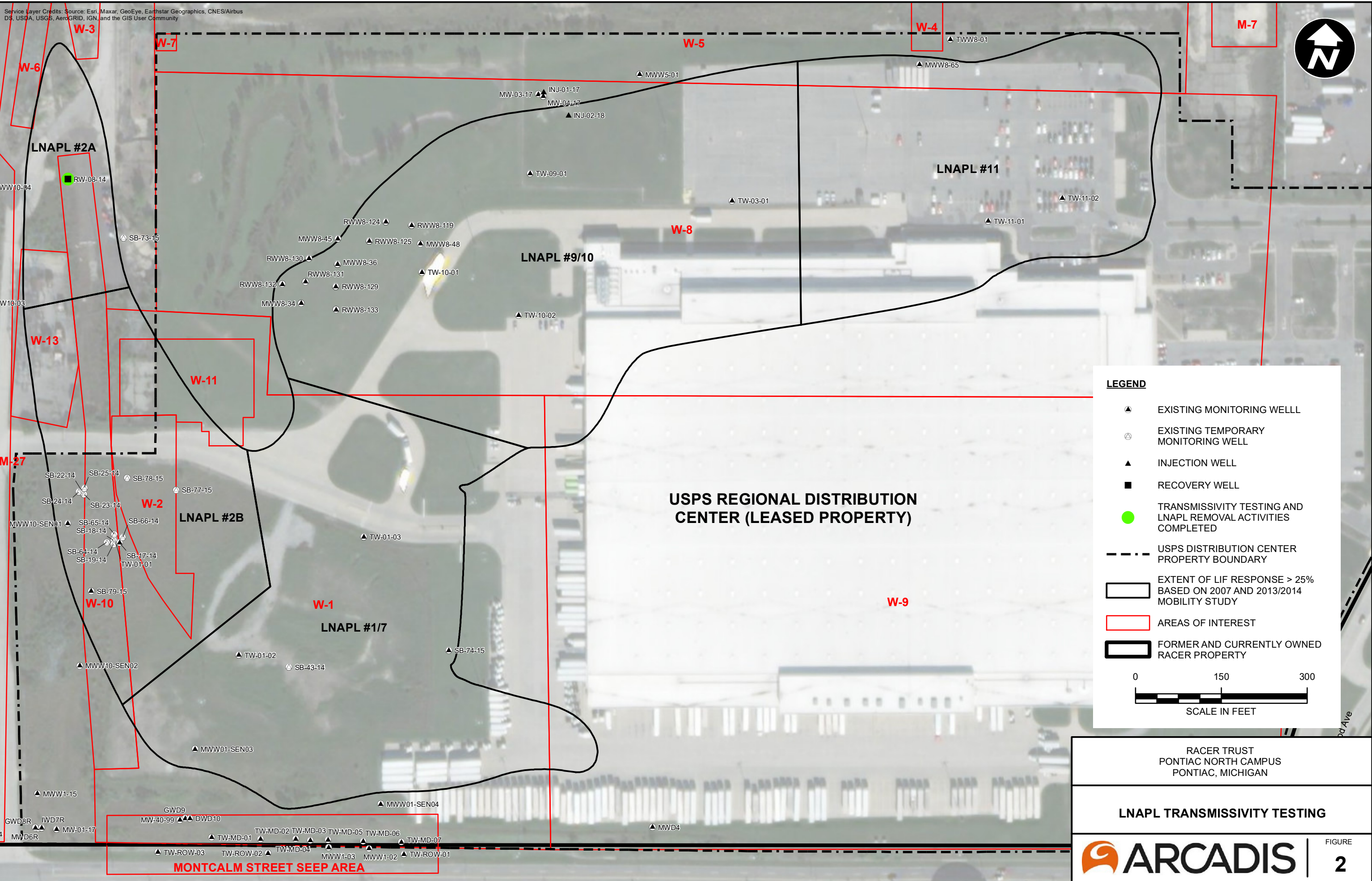
Interstate Technology & Regulatory Council (ITRC). 2009. Evaluating LNAPL Remedial Technologies for Achieving Project Goals. LNAPL-2. Washington, D.C.: Interstate Technology & Regulatory Council, LNAPLs Team. www.itrcweb.org

Michigan Department of Environmental Quality (MDEQ). 2014. Non-Aqueous Phase Liquid (NAPL) Characterization, Remediation, and Management for Petroleum Releases. RRD Resource Materials-25-2014-01. June 2014.

FIGURES

Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

CITY: NOVI, MI DIV: ENV DB: TRY PIC: PM: TM: TR: PROJECT NUMBER: COORDINATE SYSTEM: NAD 1983 StatePlane Michigan South FIPS 2113 Feet D:\GIS\Project Files\MotorsLiquidation\Company\PontiacNorthCampus\Documents\LNAPL_TransmissivityTesting_202207.mxd PLOTTED: 7/15/2022 1:03:21 PM BY: TYarborough



LEGEND

- ▲ EXISTING MONITORING WELL
- ⊙ EXISTING TEMPORARY MONITORING WELL
- ▲ INJECTION WELL
- RECOVERY WELL
- TRANSMISSIVITY TESTING AND LNAPL REMOVAL ACTIVITIES COMPLETED
- - - USPS DISTRIBUTION CENTER PROPERTY BOUNDARY
- ▭ EXTENT OF LIF RESPONSE > 25% BASED ON 2007 AND 2013/2014 MOBILITY STUDY
- ▭ AREAS OF INTEREST
- ▭ FORMER AND CURRENTLY OWNED RACER PROPERTY

0 150 300
SCALE IN FEET

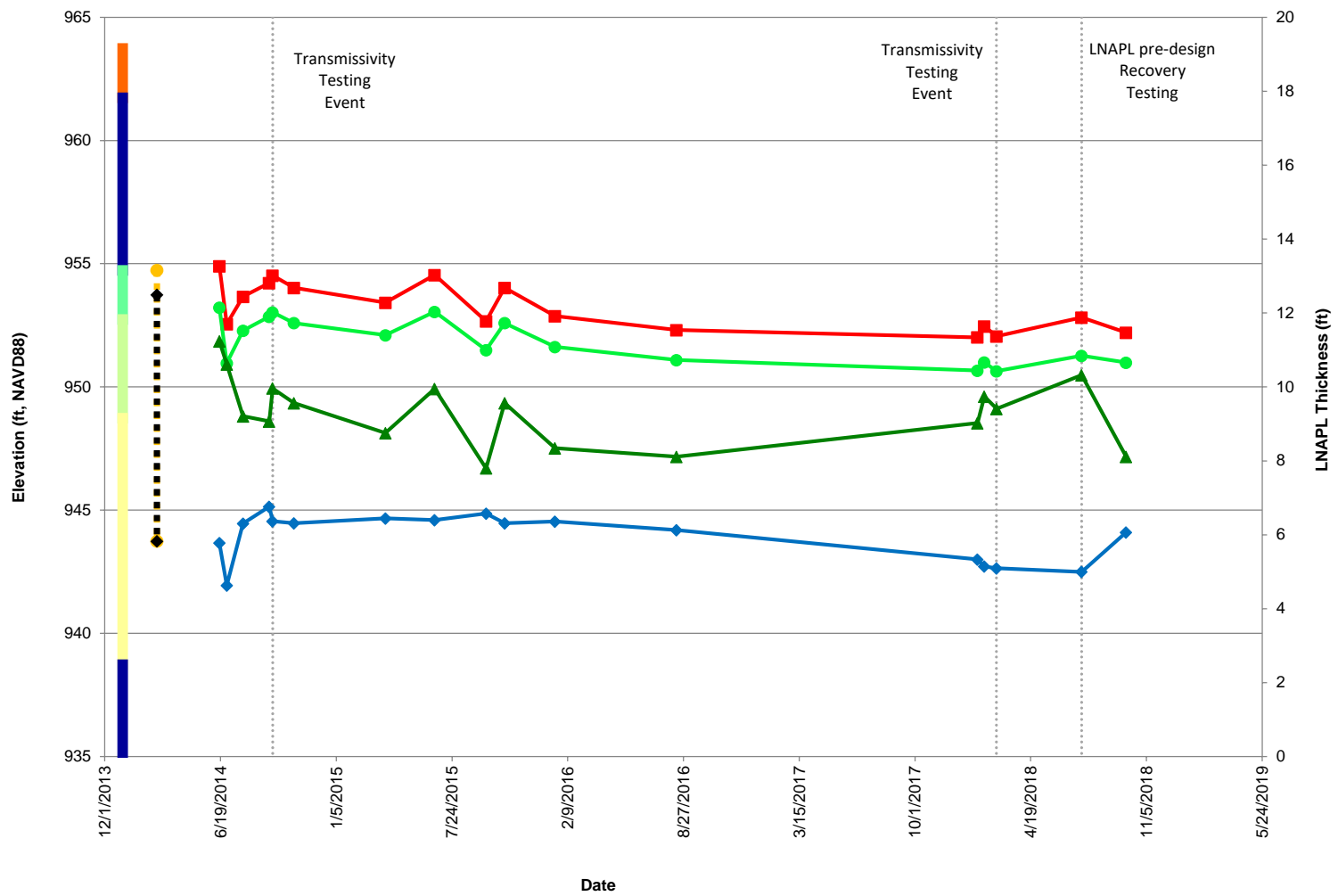
RACER TRUST
PONTIAC NORTH CAMPUS
PONTIAC, MICHIGAN

LNAPL TRANSMISSIVITY TESTING

ARCADIS | FIGURE 2

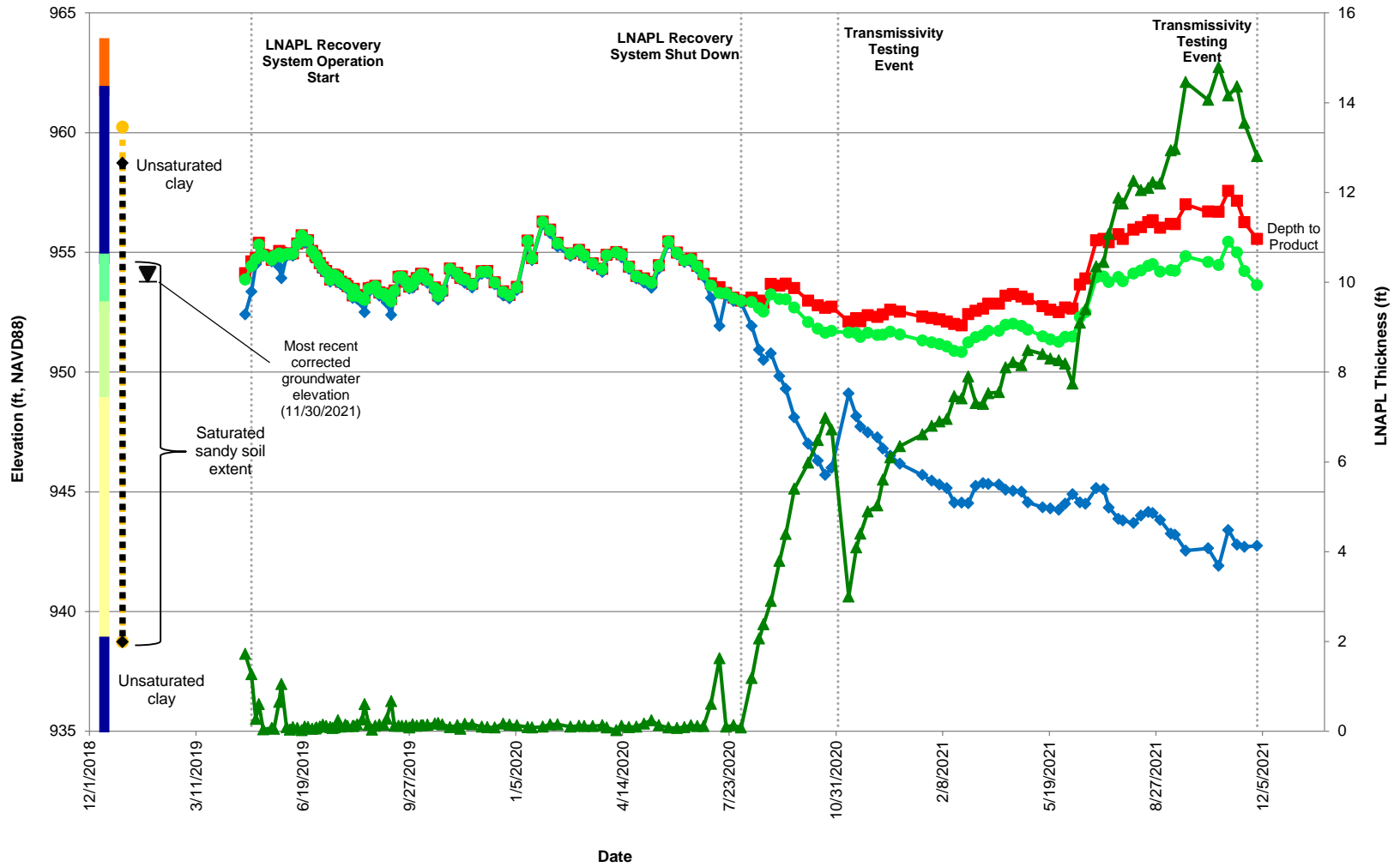
Attachment 1

Hydrographs for SB-08-14 and RW-08-14



- Air-NAPL Interface
- Potentiometric Surface (Corrected Groundwater Surface)
- ◆ NAPL-Water Interface
- Sand and Gravel
- Silty Sand
- Clay
- Fine Sand
- Medium Sand
- Filter Pack
- ◆ Screened Interval
- NAPL Thickness

RACER - Pontiac North Campus Pontiac, Michigan	
SB-08-14 LNAPL HYDROGRAPH	
	FIGURE 1



- Air-NAPL Interface
- Potentiometric Surface (Corrected Groundwater Surface)
- ◆ NAPL-Water Interface
- Sand and Gravel
- Clay
- Fine Sand
- Silty Sand
- Medium Sand
- Filter Pack
- ◆ Screened Interval
- ▲ NAPL Thickness

Note: Fluid level elevations based on estimated top of casing elevation for original well SB-08-14.

RACER - Pontiac North Campus Pontiac, Michigan	
RW-08-14 LNAPL HYDROGRAPH	
ARCADIS	FIGURE 2

Attachment 2

RW-08-14 Well Construction/Boring Log

Soil Boring Log

Project Name: RACER PNC Date Started: 10/22/2018 Logger: K. Briggs
 Project Number: 30042811 Date Completed: 10/22/2018 Editor: C. Barton
 Project Location: Pontiac, MI Weather Conditions: Sunny, 60F

Depth (feet)	Sample Interval	Blow Counts	Recovery (in.)	Sample ID	PID (ppm)	USCS Class	Description	Construction Details	Well
1							***Lithology taken from SB-08-14. Location was overdrilled for RW-08-14 installation (0.0-2.0') PEBBLES, medium to large, subangular to angular; and SAND, fine to medium; poorly sorted; dry; dark brown (10YR 4/3). NOTE: Slag at 1.0' bgs.	(0.0-0.5') Cement (0.5-1.0') Fill Sand	
2							(2.0-9.0') CLAY, low plasticity; some very fine to fine sand; trace small to medium pebbles, subrounded to subangular; moist; soft; dark olive gray (5Y 3/2). NOTE: Moderate odor from 2.0'-4.0' bgs.	(1.0-3.5') Bentonite Pellets	
3								(0.5-5.0' bgs) 2" Sch 40 PVC Well Casing	
4									
5									
6									
7									
8									
9							NOTE: Moist at 8.5' bgs.		
10							(9.0-11.0') SAND, very fine; some silt; well sorted; wet; gray (5Y 5/1). NOTE: Moderate odor.		
11									
12							(11.0-15.0') SAND, very fine to fine; little silt; poorly sorted; wet; olive gray (5Y 4/2). NOTE: Moderate odor.	(3.5-25.5') Filter Pack Sand	
13		306			NA				
14									
15									
16							(15.0-25.0') SAND, fine to medium; trace silt; poorly sorted; wet; olive (5YR 4/3). NOTE: Strong odor; oily residue.		
17									
18							NOTE: Little coarse to very coarse sand at 18.0' bgs. Some silt at 18.5'-19.0' bgs.		
19									
20									

Drilling Co.: Cascade Sampling Method: Core Barrel
 Driller: NA Sampling Interval: Continuous
 Drilling Method: Sonic Drilling Water Level Start (ft. bgs.): NA
 Drilling Fluid: Water Water Level Finish (ft. btoc.): NA
 Remarks: Lithology taken from SB-08-14. Location was overdrilled for RW-08-14 installation. Converted to Well: Yes No
 Surface Elev.: _____
 North Coor.: _____
 East Coor.: _____

Soil Boring Log

Project Name: RACER PNC

Date Started: 10/22/2018

Logger: K. Briggs

Project Number: 30042811

Date Completed: 10/22/2018

Editor: C. Barton

Project Location: Pontiac, MI

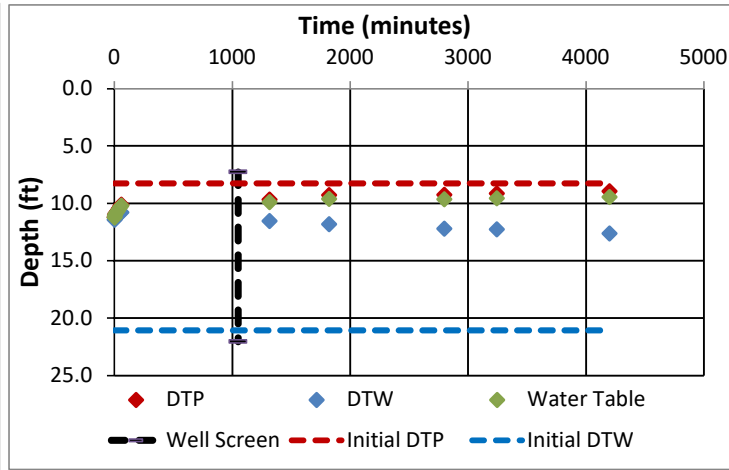
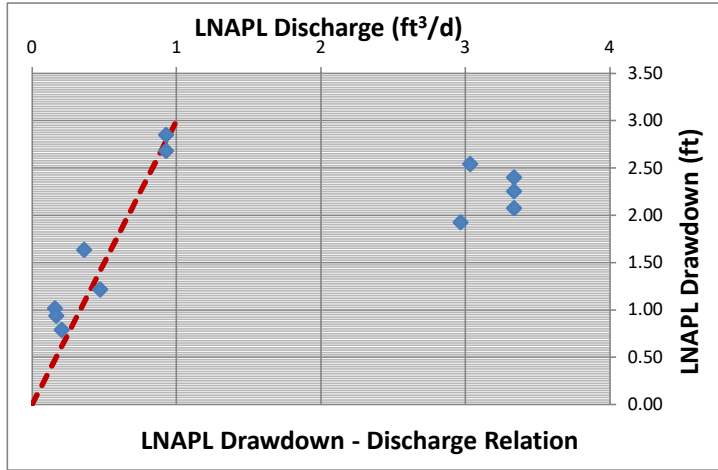
Weather Conditions: Sunny, 60F

Depth (feet)	Sample Interval	Blow Counts	Recovery (in.)	Sample ID	PID (ppm)	USCS Class	Description	Construction Details	Well
21							(15.0-25.0') SAND, fine to medium; trace silt; poorly sorted; wet; olive (5YR 4/3). NOTE: Strong odor; oily residue.	(3.5-25.5') Filter Pack Sand (5.0-25.0') 6" PVC 10-Slot Well Screen (5.0-25.0') 6" PVC 10-Slot Well Screen	
22									
23									
24									
25									
26							(25.0-25.5') CLAY, high plasticity; little silt, moist; soft; gray (10YR 5/1).		
27							End of boring at 25.5' bgs.		
28									
29									
30									
31									
32									
33									
34									
35									
36									
37									
38									
39									
40									
41									

Remarks:

Attachment 3

RW-08-14 Transmissivity Test Output Charts



Abbreviations:
 d = day
 DTP = depth to product
 DTW = depth to water
 ft = feet
 LNAPL = light non-aqueous phase liquid
 s = drawdown
 T = LNAPL transmissivity

