Ford Motor Company

Response Activity Plan for Interim Response Activities – In-situ Injections to Promote De-chlorination of VOCs in Groundwater

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Livonia Transmission Plant Response Activity Plan for Interim Response Activities – In-situ Injections to Promote De-chlorination of VOCs in Groundwater

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1 Introduction

On behalf of Ford Motor Company (Ford), Arcadis of Michigan, LLC (Arcadis) has prepared this Response Activity Plan (RespAP) for injection-based groundwater remediation. This RespAP presents results from the execution of the Work Plan for Design Validation Injection Testing (Design Validation Work Plan) submitted on June 22, 2022 and approved by the Department of Environment, Great Lakes and Energy (EGLE) on September 1, 2022. The RespAP builds on those results to design a remediation approach to begin to address volatile organic compounds (VOCs) in groundwater by injecting an organic carbon substrate to promote enhanced reductive dechlorination (ERD). ERD is a method of in-situ remediation that modifies the biogeochemical environment of the subsurface to create conditions suitable for the biological degradation of VOCs, such as trichloroethene (TCE) and vinyl chloride (VC), to non-toxic degradation products ethane and ethene.

1.1 Historical Site Activities

The Livonia Transmission Plant (LTP; the site) is located at 36200 Plymouth Road, Livonia, Michigan (Figure 1) and occupies 178 acres of land. The LTP has been active in manufacturing in some capacity since the 1950s. The LTP building occupies approximately 3 million square feet. The area surrounding the site includes light industrial, commercial, and residential properties.

The plant was initially constructed for manufacturing tanks and was converted to automotive transmission after a few years. Currently, the LTP operates as an assembly plant for aluminum automotive transmissions. Chlorinated solvent usage at LTP ceased in the early 1980s, and associated equipment or tanks that stored or used solvents have been removed or demolished.

1.2 Contaminants of Concern

TCE is the primary contaminant of concern (COC) and has been detected in the uppermost groundwater above the lacustrine clay at concentrations exceeding the non-residential volatilization to indoor air criteria (NR VIAC). Other chlorinated ethenes, including cis-1,2-dichloroethene (cis-1,2-DCE), trans-1,2-dichloroethene (trans-1,2-DCE), and VC, have also been detected in groundwater samples collected from on-site monitoring wells. Cis-1,2-DCE, trans-1,2-DCE, and VC are degradation byproducts of TCE. These constituents are likely present due to naturally occurring reductive dechlorination and are therefore considered secondary COCs. The activities discussed below are designed to target the accessible TCE and VC impacts exceeding the NR VIAC with the understanding that the remaining chlorinated ethene impacts are collocated and can be addressed via the same degradation mechanisms.

1.3 Response Activity Objectives

The objectives of the ERD approach are as follow:

1. Initiate active source area treatment.
2. Accelerate site-wide remediation in groundwater containing COCs at concentrations exceeding NR VIAC.

The proposed interim response activity will target mass removal from accessible source areas exhibiting the highest concentrations and at transects within the groundwater plume. The proposed activities will focus on areas with chlorinated ethene concentrations exceeding NR VIAC criteria. Reduction in the generation and migration of the VOC plume on site will reduce contaminant mass migrating to the hydraulic capture system (HCS) over time.

2 Site Conditions

2.1 Geology and Hydrogeology

The site is located at approximately 670 feet above mean sea level (amsl), has a relatively flat topography with a gentle slope to the east and southeast. The uppermost geology at the site consists of outwash made up of a heterogenous mix of coarse to fine sand, silty sand, and silt extending to approximately 18 to 20 feet below ground surface (ft bgs). Below the outwash is a lacustrine clay with relatively low hydraulic conductivity. Depth to groundwater at the site ranges from approximately 7 to 9 ft bgs.

2.2 Contaminant Distribution

Groundwater impacts at the site are generally limited to the saturated portion of the outwash sediments, which extends from the water table down to the lacustrine clay. The lacustrine clay is a lower boundary for the contamination due to the relatively low hydraulic conductivity. Most groundwater transport occurs within the sandier portions of the outwash, but elevated concentrations of site impacts are often observed in both the coarser intervals and the relatively finer-grained silty sand and silt intervals of the outwash.

3 Design Validation Injection Testing

Design validation injection testing was completed between November 2, 2022 and December 28, 2022 with the objective of collecting site-specific information for evaluation and design of an injection-based interim response activity for the impacts identified in the shallow groundwater. This work, which included both an active injection phase and a passive drift phase, was completed in accordance with the Design Validation Work Plan (Arcadis 2022) approved by EGLE on September 1, 2022.

3.1 Objectives

As described in the Design Validation Work Plan, the objectives of the injection phase of the testing were to collect the following site-specific parameters:

- Mobile porosity;
- Maximum sustainable injection rate;
- Optimal injection radius of influence (ROI); and
- Injection duration (time required for each injection event; will be discussed in Section 4.3).

The drift phase portion of the test was used to estimate the following site-specific parameters:

- Direction of groundwater flow;
- Average groundwater velocity; and
- Injection frequency.

3.2 Well Network Installation

The injection test area was located within the test track near monitoring well MW-23. To complete the injection testing, the existing monitoring well network was supplemented with one new injection well and seven additional monitoring wells, shown on Figure 2. Details regarding the well location and construction are below and summarized in Table 1. Boring logs and well constructions logs are presented in Appendix A.

3.2.1 Injection Wells

The injection well (IW-1) was installed using a hollow-stem auger (HSA) drilling method. The geology logged during injection well installation identified a relatively coarse portion of the outwash from the ground surface to a depth of 13 ft bgs that consisted primarily of medium to coarse sand and pebbles. Underlaying that relatively coarse portion of the outwash was an interval of interbedded sand, silt, and clay that extended from approximately 13 ft bgs down to 18.5 ft bgs. The low-permeability lacustrine clay was identified at approximately 18.5 ft bgs.

IW-1 was constructed using 2-inch-diameter polyvinyl chloride (PVC) casing with a 2-inch-diameter 10-foot-long stainless steel vee-wire wrapped screen. The well screen was set at the top of lacustrine clay, which was located at a depth of 18.5 ft bgs. A coarse sand pack was installed to 1 foot above the top of the screen. Two feet of fine choker sand was placed on top of the coarse sand pack to separate the sand pack from the well seal. The remainder of the well annulus was sealed using neat cement.

The 10-foot well screen and filter pack installed from 7.5 to 18.5 ft bgs spanned both the relatively coarse outwash that extended down to 13 ft bgs and the underlying interbedded sand, silt, and clay that extended to the top of the lacustrine clay. The boring and construction log for IW-1 is provided in Appendix A.

3.2.2 Dose-Response Wells

Four nested dose-response wells (DR-1S, DR-1D, DR-2S, and DR-2D) were used during the injection phase of the injection design validation study to monitor the breakthrough of the tracer as it migrated away from the injection well. The shallow dose-response wells (DR-1S and DR-2S) were screened discretely in the coarsest portions of the upper portion of the saturated outwash at depths of 10 to 13 ft bgs. The deeper dose-response wells (DR-1D and DR-2D) were screened just above the lacustrine clay in the deeper portion of the outwash that consisted of interbedded sand, silt, and clay at depths of 15.5 to 18.5 ft bgs and 14.5 and 17.5 ft bgs, respectively. The nested wells were installed at two locations approximately 6 and 12 feet from the injection well (Figure 2). The dose-response wells were installed in different directions relative to the injection well to evaluate both the heterogeneity of the aquifer in relation to the target ROI and the washout of the tracer after completion of the injection. The exact screen depth of each dose-response well was determined based on geologic logs developed during drilling at each location.

Dose-response wells were installed using the HSA drilling method. Each dose-response well was completed as a 2-inch-diameter well with 3-foot-long, 0.010-inch slotted, schedule 40 PVC screens and a solid schedule 40 PVC riser. A coarse sand pack was installed to 6 inches above the top of the screen and 6 inches of fine sand placed on top of the coarse sand pack. A bentonite seal was installed above the fine sand in the remainder of the well annulus. Boring and construction logs for the dose-response wells are provided in Appendix A.

3.2.3 Performance Monitoring Wells

One existing well (MW-23) and three new performance monitoring wells (PMW-1, PMW-2, and PMW-3) were used to track the movement of the tracer as it migrated out of the ROI during the drift phase portion of the design validation injection test. These performance monitoring wells were installed outside of the ROI approximately 30 feet (MW-23), 45 feet (PMW-1) and 60 feet (PMW-2 and PMW-3) from the injection well, respectively. PMW-2 and PMW-3 were added as performance monitoring wells based on requests from EGLE. The exact screen depth was determined based on geologic logs developed during drilling at each location and were installed on top of the lacustrine clay. PMW-1, PMW-2, and PMW-3 were installed at 8.5 to 18.5 ft bgs, 7.8 to 17.8 ft bgs, and 8.9 to 18.9 ft bgs, respectively.

Performance monitoring wells were installed using the HSA drilling method. The performance wells were completed as 2-inch-diameter wells with 10-foot-long, 0.010-inch slotted, schedule 40 PVC screens and a solid schedule 40 PVC riser. A coarse sand pack was installed to 6 inches above the top of the screen and 6 inches of fine sand placed on top of the coarse sand pack. A bentonite seal was installed above the fine sand in the remainder of the well annulus. Boring and construction logs for the performance monitoring wells are provided in Appendix A.

3.3 Design Validation Injection Test Activities

The following sections describe the activities completed for the injection phase and drift phase of the design validation injection test.

3.3.1 Injection Phase

The injection phase of the design validation injection test includes the portion of the test when active injection to the injection well was occurring.

3.3.1.1 Injection Setup

Injections were completed using a frac tank to store water and mix batches of tracer solution to the desired concentration before injection. A flowmeter was placed before the wellhead manifold to monitor the volume of tracer delivery during the injection event. The tracer solution was injected to the wellhead using a transfer pump capable of adjusting flowrates and equipped with a recirculation line to aid in controlling the flowrate.

3.3.1.2 Injection Volume and Solution

The target injection volume was 5,290 gallons for the single injection well, which was developed using a targeted ROI (r) of 15 feet, an assumed mobile porosity ($\theta\mathrm{m}$) of 10 percent, and an injection screen length (h) of 10 feet in the equation below.

$$V = \pi * r^2 * h * \theta m * 7.48$$

A 30 milligram per liter (mg/L) solution of fluorescein dye, which is a visual tracer with a bright yellow color, was used for the injection test. The final volume added to the injection well, based on the totalizer flow readings at the wellhead, was 4,949 gallons. Fluorescein (1.32 pounds) was added to the injected water, which resulted in a calculated tracer concentration of approximately 32 mg/L of fluorescein dye.

3.3.1.3 Injection Monitoring

The performance of the injection system was monitored continuously during injections. Data collected during the injection are presented in Appendix B**.** The following readings were collected during each day:

- Start time;
- Total injection flowrate (approximately every half hour);
- Wellhead pressure reading (approximately every half hour); and
- Stop time.

During the injection phase of the test, groundwater samples were collected from dose-response wells after every 250 gallons injected and from nearby performance monitoring wells after every 1,000 gallons injected. Sample notes are included in Appendix B. Samples were collected to monitor tracer concentration during injection at each well location. Data collected from sample analysis provided concentration of tracer breakthrough, which was used to determine site-specific parameters to aid in the full-scale design. When the injection test was completed, 29 samples were submitted for quantitative laboratory analysis. Injection phase analytical results are shown in Table 2. Analytical lab reports are presented in Appendix C.

3.3.2 Drift Phase

After the injection phase was completed, the post-injection drift phase monitoring program began. Samples were collected from the injection well, dose-response wells, and performance monitoring wells to track washout from the injection and dose-response wells and breakthrough at the downgradient performance monitoring wells. The drift phase performance monitoring sampling program was expected to occur weekly and last for an estimated 12 weeks. Sampling duration was based on the anticipated groundwater flow and washout rates at performance monitoring wells. During the sampling program, it was determined that washout was occurring faster than expected because tracer was detected in downgradient wells earlier than anticipated. Consequently, sampling frequency was increased to bi-weekly events, and the duration was shortened to 8 weeks. When drift phase monitoring was complete, 33 samples were submitted for laboratory analysis to quantitatively analyze the washout at each monitoring well. Drift phase analytical results are shown in Table 3**.** Analytical lab reports are presented in Appendix C.

3.4 Design Validation Injection Test Results

Data collected during the design validation injection test were evaluated to determine the site-specific parameters needed for design of a full-scale injection-based remediation system.

3.4.1 Mobile Porosity

Mobile porosity is a measure of pore space where most groundwater flow and solute transport occurs during injection. Mobile porosity is an important parameter for determining the required injection volume to achieve a given ROI. Mobile porosity can be calculated using observed breakthrough of tracer at dose-response wells during the injection phase of a tracer test. Tracer was observed at dose-response wells DR-01S, DR-01D, DR-02S, and DR-02D during the injection phase; however, the maximum detected concentrations at DR-1D and DR-2D were approximately 10 percent or less of the injected concentration, which suggests breakthrough had not stabilized at those locations. In comparison, the shallow dose-response wells (DR-1S and DR-2S) detected 88 percent and 65 percent of the injected tracer concentration. The relatively low detected concentrations of tracer in the two deeper dose-response wells suggests that only a small portion of the tracer was injected into the deeper portion of the outwash that consisted of interbedded sand, silt, and clay. Most of the tracer was added to the relatively coarser shallow outwash that was monitored by the shallower dose-response wells. Therefore, mobile porosity calculations were only completed for the two shallow dose-response wells.

Using the tracer data collected from those wells, mobile porosity can be calculated using the following equation;

$$\theta m = V/(\pi * r^2 * h * 7.48)$$

Where;

θm = calculated mobile porosity for that well,

V = volume injected when 50% of the tracer breakthrough is observed,

r = distance between the dose response well and the injection well, and

h = injection interval.

As shown in Appendix D, breakthrough of 50 percent of the maximum detected concentration at the shallow dose-response wells (DR-1S and DR-2S) occurred at approximately 1,050 and 1,900 gallons for DR-1S and DR-2S respectively. Therefore, those values were used for volume in the mobile porosity calculation. The distances from the injection well and DR-1S and DR-2S were 6 and 12 feet, respectively. Based on the visual observations of tracer migration at the dose-response wells, which suggested the tracer primarily migrated through the shallower and coarser portions of the outwash, only the 4.5-foot thickness of that coarser portion of the outwash, which was logged during well installation, was used for the mobile porosity calculations.

Based on those values, the mobile porosity for DR-1S and DR-2S was calculated to be 28 and 12 percent, respectively. The relatively large range of calculated mobile porosity values is representative of the heterogeneity of the outwash in general. The calculated mobile porosity for DR-2S, which is 12 feet from the injection well, is representative of a larger overall area and should generally be weighted heavier when selecting a “representative” mobile porosity for use in the full-scale calculations. For that reason, a site-specific mobile porosity of 15 percent will be used for injection volume calculations, but injections will be evaluated with the understanding that there is potentially a large amount of local variability. No mobile porosity estimate was developed for the deeper portion of the outwash that was monitored by dose-response wells DR-01 and DR-02 because adequate tracer breakthrough was not observed.

3.4.2 Radius of Influence

As detailed in the mobile porosity discussion, a strong tracer response was noted at both shallow dose-response wells (DR-1S and DR-2S), located 6 and 12 feet from the injection well. Additionally, as shown in Table 2, tracer was detected at approximately 10 percent of the injected concentration at MW-23, which is 30 feet from the injection well in the downgradient injection. Detection of the tracer at monitoring well MW-23 could be influenced by both active distribution from injection and advective groundwater migration. However, the strong responses observed at each of the dose-response wells, as well as the detection at MW-23, suggest that an ROI larger than

12 feet should be achievable during full-scale operation. Based on that observation and Arcadis' experience with injections in similar geologic environments, a design ROI of 15 feet will be used for the targeted injection design, which would result in a 30-foot spacing between injection wells.

The relative lack of tracer response observed in the deeper dose-response wells that were also installed 6 and 12 feet from the injection well confirms that injected fluid is distributed heterogeneously throughout the target aquifer. The ROI estimates, well spacing, and screen length determinations should be targeted for the relatively coarse portions of the outwash unit.

3.4.3 Sustainable Injection Rate

The injection began at an injection rate of approximately 5 gallons per minute (gpm) with well head pressures of less than one pound per square inch (psi). During injection, the flowrate was increased up to 10 gpm, which was the highest flowrate the transfer pump could achieve. Readings on the pressure gauge during injections at 10 gpm bounced between approximately 0 and 5 psi, which is likely due to the turbulent flow within the injection header rather than actual observed pressure at the wellhead. Injection field notes are presented in Appendix B. Based on results of the design validation testing, a flowrate of 10 gpm or more is sustainable.

3.4.4 Direction and Velocity of Groundwater

Direction of groundwater flow was confirmed to be in the east direction. Impacted groundwater is flowing through the interbedded sands and gravels that overlie the lacustrine clay.

Groundwater velocity is calculated using the tracer breakthrough curve measured during the drift phase at the downgradient monitoring well. The optimal distance among injection well transects, the frequency of injections, and the overall time for remediation depends on the groundwater flow velocity. Data collected during the drift phase monitoring determined the groundwater velocity to be approximately 4.6 and 5.2 feet/day at performance monitoring wells PMW-1 and PMW-2, respectively. Groundwater velocity calculations are shown in Appendix E. Based on those values, an average groundwater velocity of approximately 4.9 feet/day will be used for targeted design. Monitoring well MW-23 was not used for groundwater velocity calculations due to the tracer that had already been detected at that location at the end of the injection phase. Performance monitoring well PMW-3 was not used for velocity calculations because no significant tracer was detected at that location during the drift phase.

4 Targeted ERD Design

As noted in the sections above, the geology at the site is varies widely. Additionally, existing infrastructure and operations may limit well installation locations and injection. Therefore, the design details discussed below are preliminary and subject to modification as needed based on results of utility locating, accessibility discussions and field observations during well installation. Any modifications that may significantly impact the effectiveness or operation of the remedy will be discussed with EGLE before implementation.

4.1 Injection Well Locations and Construction

Figure 3 was developed showing the composite lateral extent of the groundwater plume in the saturated outwash unit for impacts that exceed NR VIAC criteria for TCE and/or VC. As discussed in Section 1.2, other COCs present in groundwater are collocated with those compounds. Injection wells will be placed near to and upgradient of each VOC source area and in transects within the plume where impacts exceed the NR VIAC criteria and are accessible for well installation and injection. Based on the design validation testing discussed in Section 3, the injection ROI is designed to be 15 feet (well spacing of approximately 30 feet). The network includes up to 52 new 2-inch-diameter injection wells. The approximate injection well locations are presented on Figure 3. Locations may vary depending on subsurface utilities and accessibility for installation and field observations of impacts.

Injection wells will be installed using the HSA drilling method and will be continuously logged during drilling. Preliminary design for each well includes a 2-inch-diameter PVC casing with up to a 10-foot-long stainless steel vee-wire wrapped screen. The injection well screen will be set to intersect the coarsest portions of the saturated outwash so the actual installed screen length may be reduced based on soil logging results and field screening data. A coarse sand pack will be installed to 1 foot above the top of the screen. Two feet of fine choker sand will be placed on top of the coarse sand pack to separate the sand pack from the well seal. The remainder of the well annulus will be sealed with neat cement.

4.2 Well Development

The injection wells will be developed using intermittent surging and pumping to maximize the hydraulic connection between the well and the aquifer matrix. All injection wells will be initially pumped to remove sediments from the bottom of the well before surging. The injection wells will then be surged for approximately 30 minutes and pumped until clear and free of sediments. A maximum of 200 gallons of development water is estimated to be generated per well.

4.3 Injection Volume and Duration

The target injection volume for each well can be estimated using the site-specific mobile porosity value from Section 3.4.1 and the target ROI from Section 3.4.2 and putting them into the same equation shown in Section 3.3.1.2. Using an assumed injection well screen length of 10 feet, the target injection volume for each injection well would be 7,930 gallons. As noted above in Sections 3.4.1 and 3.4.2, the injected tracer solution appeared to migrate preferentially through the coarser portions of the outwash. If the geology observed at each location suggests that a portion of the screened interval is installed across a lower-permeability section of the outwash, the effective screen length and target injection volume will be adjusted accordingly.

Injections will be completed at multiple injection wells concurrently. The exact number of wells that will receive injections at a single time will depend on the flowrate of the available water source, the injection rate at each well, and injection logistics based on accessibility. It is expected that injections will occur at up to ten locations concurrently. As each injection well reaches the target volume, the flow to that well will be discontinued, and the injection line will be moved to a new injection well. Real-time evaluation of the results during injection will determine when the injection is complete. If any injection well cannot accept the target volume, a decision will be made in the field regarding increasing the dose of organic carbon at that location or redistributing the target volume to adjacent well locations.

4.4 Injection Solution

A dilute, 2.0 percent molasses solution will be used during the initial injection event to provide the electron donor (carbon source) for ERD treatment. A safety data sheet for molasses is included in Appendix F. Dosing at each location will be maintained as close as possible to 2.0 percent but may vary between 1.0 and 3.0 percent depending on the total achievable injection volume added to each well, the target injection volume, and visual observations of injection solution arrival at nearby performance monitoring wells. Alternative electron donors, such as lactate, emulsified vegetable oil, or pH adjustments, may be considered during future injection events depending on observations during the first injection event and post-injection performance monitoring. Significant changes to injection amendment will be proposed as part of the performance monitoring reporting before implementation.

4.5 Injection Flow Rate, Pressure and Duration

Based on results of the injection validation testing, a flowrate of 10 gpm or more is expected for each injection well location. A maximum injection pressure of 5 psi will be targeted to avoid creation of unintentional preferential flow paths or fractures. Based on a flowrate of 10 gpm and the injection volume listed in Section 4.3, injections would take approximately 13 to 14 hours at each wellhead. Each injection event is anticipated to take up to 4 weeks to complete. The actual duration of the injections will depend on the injection rates achieved, the length of injections per day, and any potential facility restrictions to injections or access.

4.6 Injection Frequency

Repeated injections will likely be required to maintain excess organic carbon within the reactive zone to sustain reductive dechlorination of VOCs at the site. Injections of soluble carbon donors are typically completed at a frequency of one injection every 3 to 4 months. Due to the higher than anticipated groundwater velocity, the injection solution will wash out faster than originally anticipated. For the targeted design, injection frequency will initially be once every 8 weeks. Ongoing performance monitoring will be used to adjust the injection frequency over time as needed. Injection frequency is expected to decrease over time as organic carbon injections build up the microbial community in situ because natural die-off of the microbes will allow for cycling of that biomass back into the groundwater for reuse as organic carbon.

4.7 Injection Monitoring

Injection monitoring will include periodic collection of injection wellhead pressures, injection well flowrates, cumulative injection volumes, and average organic carbon dosing data. Data collected during injections will be used to optimize flowrates and pressures and make field determinations regarding the final volume added to each injection well location.

4.8 Performance Monitoring

Groundwater will be sampled in accordance with established site-specific quality procedures outlined in the January 2021 Quality Assurance Project Plan (QAPP).

4.8.1 Performance Monitoring Well Installation

Preliminary locations for performance monitoring are shown on Figure 3. Up to seven performance monitoring wells will be installed in addition to five existing wells to compose the monitoring well network. Performance monitoring well locations were selected to provide data both near to and farther from each injection well transect, which will be used to optimized injections. New monitoring wells will be installed using the HSA drilling method and will be completed as 2-inch-diameter wells with 3-foot-long, 0.010-inch slotted, schedule 40 PVC screen. Screened intervals will be set to intersect the coarsest portions of the outwash, where the injected solution is likely to migrate based on results of the design validation injection testing. The well will be completed with a solid schedule 40 PVC riser. A coarse sand pack will be installed to 6 inches above the top of the screen and 6 inches of fine sand placed on top of the coarse sand pack. A bentonite seal will be installed above the fine sand in the remainder of the well annulus.

4.8.2 Performance Monitoring Sampling

The baseline monitoring event will begin before the first injection of the organic carbon at the site. The post-injection monitoring program will begin following the first injection of the organic carbon at the site. The post-injection monitoring will begin quarterly after the first injection event and will be completed with the previously existing on-site performance monitoring events. A summary of the performance monitoring sampling schedule is presented in Table 4. The analytes included in the post-injection sampling are:

- Site-specific VOCs;
- Total organic carbon (TOC);
- Methane, ethene, and ethane;
- Water levels; and
- Field parameters (oxidation reduction potential, dissolved oxygen, pH, temperature, conductivity, and color).

Following the first injection, a period of bi-weekly sampling for TOC only will be completed at select injection wells and at the performance monitoring wells that are closest to injection wells. The purpose of this bi-weekly sampling is to collect data on TOC degradation and migration within the immediate vicinity of the injection wells, which will be the primary indicator of when the next round of injections should be completed. As noted in Section 4.6, the anticipated injection frequency based on the results of the design validation injection testing is every 6 to 8 weeks initially. The results of this bi-weekly TOC testing will be used to confirm or adjust that injection frequency.

5 Investigation Derived Waste

Soil cuttings will be containerized in drums and disposed of at a permitted landfill. Wastewater generated from well development will be containerized and treated through the on-site HCS or disposed of through the total waste manager.

6 Reporting

Following the completion of well installation discussed above, reports will be prepared quarterly detailing injection and performance monitoring completed during that period and required as part of this workplan. The first report will include well construction details for newly installed injection and performance monitoring wells. Any significant changes to the injection or performance monitoring program will be proposed in the quarterly reports.

Tables

Table 1
Well Network for Injection Testing
Ford Motor Company
Livonia Transmission Plant

Monitoring Well	Approximate Well Depth (ft bgs)	Screen Length (ft)	Well Diameter (inches)	Approximate Distance from Injection Well (ft)	Well Function	Estimated Distance from Injection Well ROI (ft)
IW-01	18.5	10	2	0	Injection Well	0
DR-1S	13	3	2	6	Dose Response	Within
DR-1D	18.5	3	2	6	Dose Response	Within
DR-2S	13	3	2	12	Dose Response	Within
DR-2D	17.5	3	2	12	Dose Response	Within
MW-23	20	5	2	30	Downgradient Perfomance Monitoring	15
PMW-1	18.5	10	2	45	Downgradient Perfomance Monitoring	30
PMW-2	17.8	10	2	62	Downgradient Perfomance Monitoring	47
PMW-3	18.9	10	2	62	Downgradient Perfomance Monitoring	47

Footnotes:

ft bgs - feet below ground surface

ROI - Radius of Influence

Table 2
Injection Phase Analytical Results
Ford Motor Company
Livonia Transmission Plant

Well ID	Sample ID	Date Collected	Fluorescein Concentration (ppb)
IW-01	IW-01_0_110122	11/1/2022	ND
DR-1S	DR-1S_0_110122	11/1/2022	ND
	DR-1S_250_110122	11/1/2022	5,040
	DR-1S_1246_110222	11/2/2022	19,400
	DR-1S_1695_110222	11/2/2022	25,500
	DR-1S_2836_110222	11/2/2022	32,700
	DR-1S_4949_110322	11/3/2022	28,300
DR-1D	DR-1D_0_110122	11/1/2022	ND
	DR-1D_2750_110222	11/2/2022	382
	DR-1D_3500_110322	11/3/2022	785
	DR-1D_4250_110322	11/3/2022	2,010
	DR-1D_4949_110322	11/3/2022	3,400
DR-2S	DR-2S_0_110122	11/1/2022	ND
	DR-2S_500_110222	11/2/2022	2,480
	DR-2S_1000_110222	11/2/2022	4,550
	DR-2S_1750_110222	11/2/2022	9,840
	DR-2S_3250_110322	11/3/2022	14,200
	DR-2S_4949_110322	11/3/2022	20,700
DR-2D	DR-2D_0_110122	11/1/2022	ND
	DR-2D_4250_110322	11/3/2022	568
	DR-2D_4949_110322	11/3/2022	558
MW-23	MW-23_0_110122	11/1/2022	ND
	MW-23_4000_110322	11/3/2022	285
	MW-23_4949_110322	11/3/2022	3,100
PMW-1	PMW-01_0_110122	11/1/2022	ND
	PMW-01_4949_110322	11/3/2022	415
PMW-2	PMW-02_0_110222	11/2/2022	ND
	PMW-2_3000_110222	11/2/2022	1.59
PMW-3	PMW-03_0_110222	11/2/2022	ND

Footnotes:

ppb - parts per billion

IW - Injection well

DR - Dose reponse well

ND - non-detect

PMW - Performance Monitoirng Well

Table 3
Drift Phase Analytical Results
Ford Motor Company
Livonia Transmission Plant

Well ID	Sample ID	Date Collected	Fluorescein Concentration (ppb)
DR-2D	DR-2D_111722	11/17/2022	547
	DR-2D_120222	12/2/2022	481
	DR-2D_120722	12/7/2022	3,380
	DR-2D_122822	12/28/2022	4,370
DR-2S	DR-2S_110822	11/8/2022	16,600
	DR-2S_111522	11/15/2022	13,700
	DR-2S_112122	11/21/2022	5,480
	DR-2S_112822	11/28/2022	446
	DR-2S_120222	12/2/2022	1,830
	DR-2S_121322	12/13/2022	2,360
	DR-2S_122122	12/21/2022	1,310
MW-23	MW-23_110822	11/8/2022	2,780
	MW-23_111022	11/10/2022	5,380
	MW-23_111522	11/15/2022	3,900
	MW-23_111722	11/17/2022	2,770
	MW-23_112122	11/21/2022	2,070
	MW-23_112322	11/23/2022	1,330
	MW-23_112822	11/28/2022	1.77
PMW-1	PMW-1_110822	11/8/2022	5,690
	PMW-1_111022	11/10/2022	6,310
	PMW-1_111522	11/15/2022	2,970
	PMW-1_111722	11/17/2022	1,950
	PMW-1_112122	11/21/2022	1,240
	PMW-1_112322	11/23/2022	921
	PMW-1_112822	11/28/2022	416
PMW-2	PMW-2_110822	11/8/2022	5,100
	PMW-2_111522	11/15/2022	3,790
	PMW-2_111722	11/17/2022	4,120
	PMW-2_112122	11/21/2022	2,400
	PMW-2_112322	11/23/2022	1,750
	PMW-2_112822	11/28/2022	1,050
PMW-3	PMW-3_112122	11/21/2022	45.3
	PMW-3_112822	11/28/2022	24

Footnotes:

ppb - parts per billion

IW - Injection well

DR - Dose reponse well

PMW - Performance Monitoirng Well

Table 4
Performance Monitoring Program
Ford Motor Company
Livonia Transmission Plan

	Well ID	Baseline Sampling	Bi-weekly Samplng[A,B]	Quarterly Sampling
Select Injection Wells	IW-3, IW-10, IW-18, IW-26, IW-33, IW-45	1,2,3,4,5	1	None
Performance Monitoring Wells	PMW-4	1,2,3,4,5	1	1,2,3,4,5
	PMW-5	1,2,3,4,5		1,2,3,4,5
	PMW-6	1,2,3,4,5	1	1,2,3,4,5
	PMW-7	1,2,3,4,5	1	1,2,3,4,5
	PMW-8	1,2,3,4,5	1	1,2,3,4,5
	PMW-9	1,2,3,4,5		1,2,3,4,5
	PMW-10	1,2,3,4,5		1,2,3,4,5
	MW-4	1,2,3,4,5		1,2,3,4,5
	MW-10	1,2,3,4,5		1,2,3,4,5
	MW-21	1,2,3,4,5	1	1,2,3,4,5
	MW-23	1,2,3,4,5		1,2,3,4,5
	MW-49	1,2,3,4,5	1	1,2,3,4,5

Footnotes:

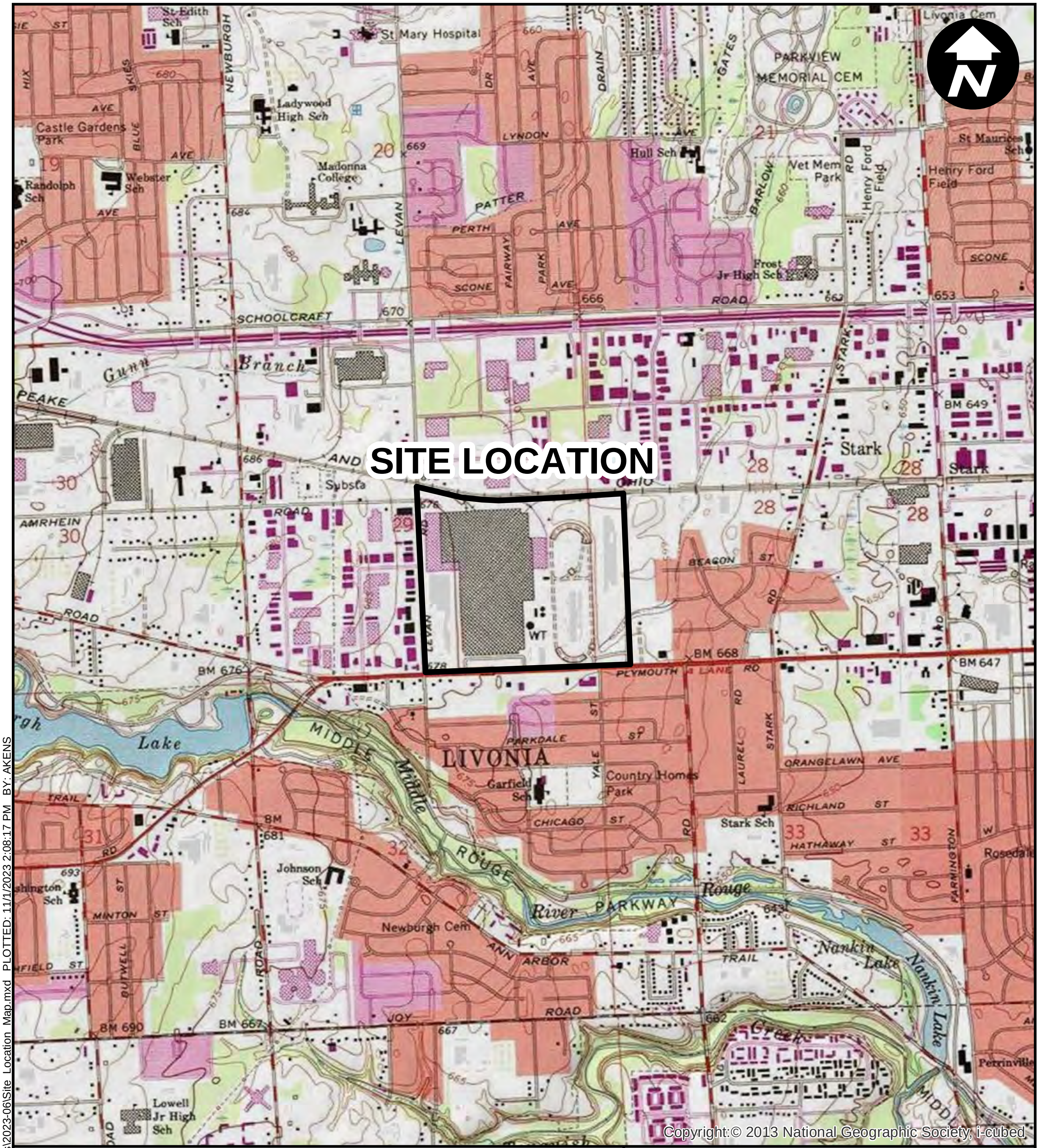
1 - Total organic carbon (TOC)
2 - Volatile organic compounds (8260D)
3 - Dissolved gases (methane, ethane, ethene)
4 - Water level
5 - Field parameters (oxidation reduction potential, dissolved oxygen, pH, temperature conductivity and color)

A - Timing for bi-weekly sampling will begin immediately after completion of injection at the nearest injection well

B - Bi-weekly sampling will only be completed between the first and second injection events. Results of TOC sampling will be used to finalize frequency of injections

Proposed sampling plan is preliminary only and will be adapted as necessary based on field observations.

Figures



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0 2,000 4,000

SCALE IN FEET

SOURCE:

USGS 7.5 MINUTE TOPOGRAPHIC MAP
NORTHVILLE AND WAYNE QUADRANGLES

FORD MOTOR COMPANY
LIVONIA TRANSMISSION PLANT
LIVONIA, MICHIGAN

SITE LOCATION MAP

ARCADIS

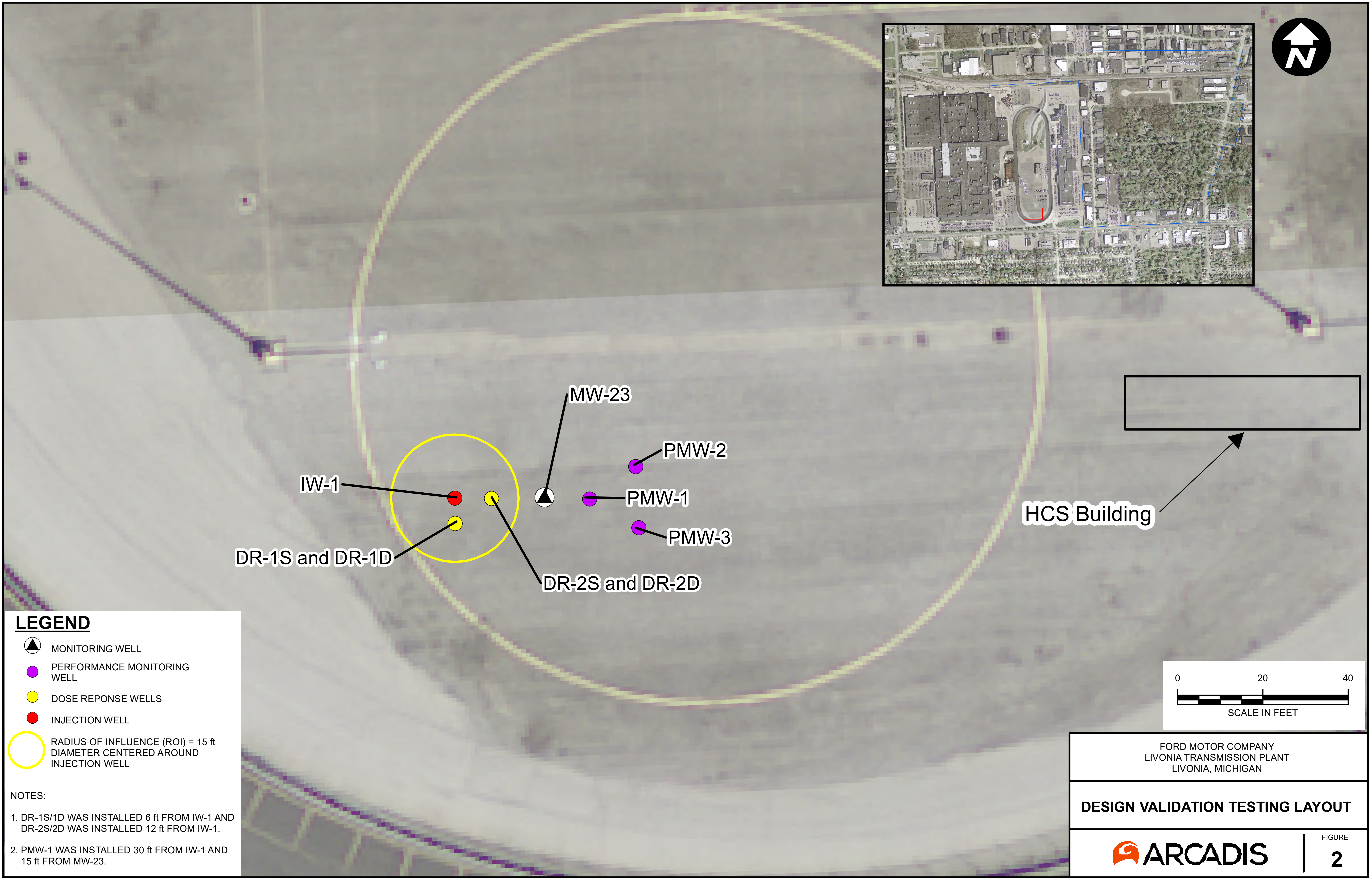
FIGURE

1

CITY: Novi DIV: ENV DB: MG PROJECT NUMBER: MI001322.0001 COORDINATE SYSTEM: NAD 1983 StatePlane Michigan South FIPS 2113 Feet

T:_ENV\NoviBrighton_MI\Ford\Livonia\GIS\docs\2023-06\Site_Location_Map.mxd PLOTTED: 11/1/2023 2:08:17 PM BY: AKENS

CITY: Novi DIV: ENV DB: MG PIC: R. ELLIS PM: K. HINSKEY PROJECT NUMBER: 30080642 COORDINATE SYSTEM: NAD 1983 StatePlane Michigan South FIPS 2113 Feet
T:_ENV\NoviBrighton_MI\Ford\Livonia\GIS\docs\2023-06\Figure 2 - PILOT STUDY LAYOUT_v3zoom.mxd PLOTTED: 11/9/2023 12:10:21 PM BY: AKENS



LEGEND

- ▲ MONITORING WELL
- ● PERFORMANCE MONITORING WELL
- ● DOSE REPONSE WELLS
- ● INJECTION WELL
- ○ RADIUS OF INFLUENCE (ROI) = 15 ft DIAMETER CENTERED AROUND INJECTION WELL

NOTES:

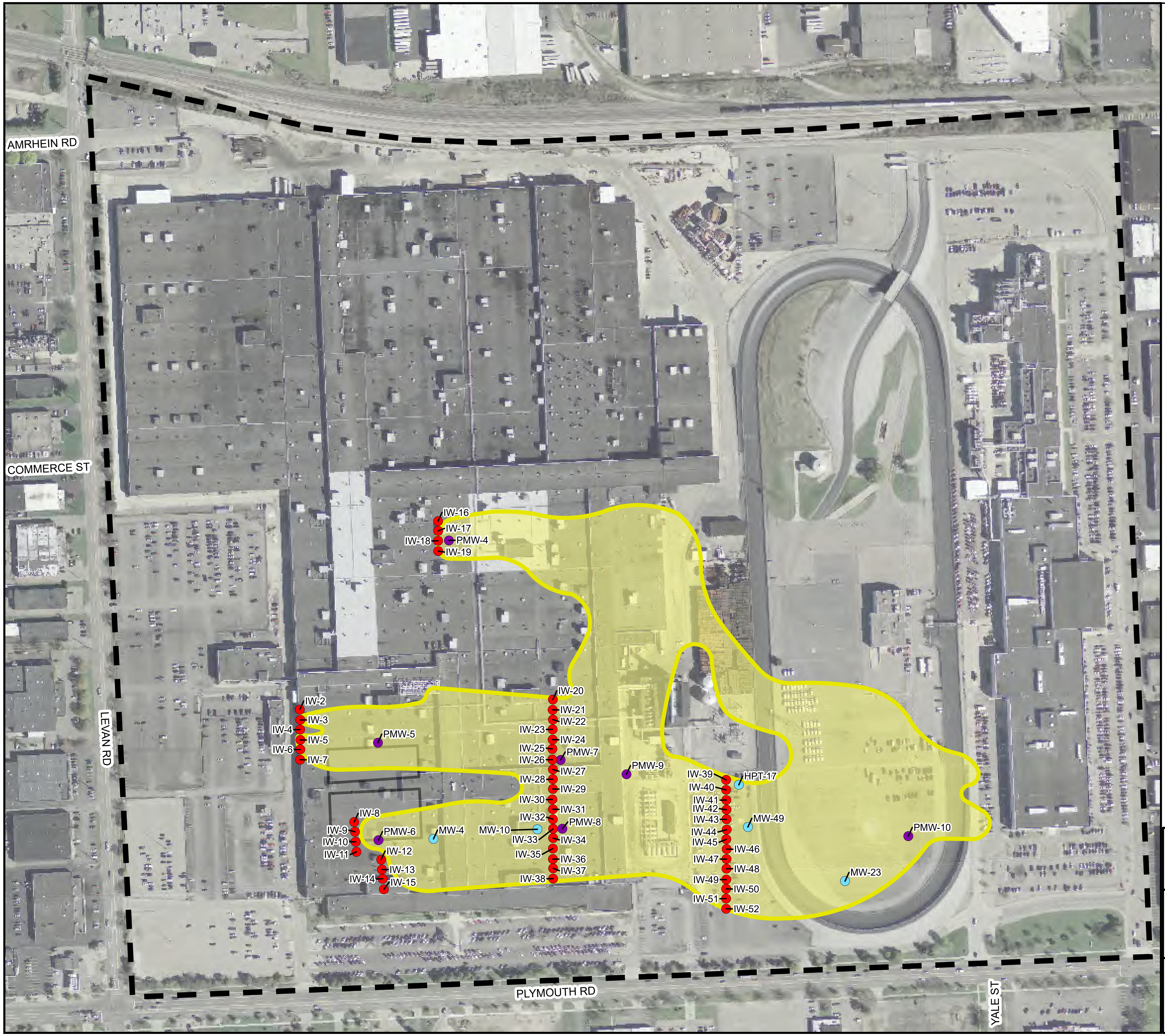
1. DR-1S/1D WAS INSTALLED 6 ft FROM IW-1 AND DR-2S/2D WAS INSTALLED 12 ft FROM IW-1.
2. PMW-1 WAS INSTALLED 30 ft FROM IW-1 AND 15 ft FROM MW-23.

FORD MOTOR COMPANY
LIVONIA TRANSMISSION PLANT
LIVONIA, MICHIGAN

DESIGN VALIDATION TESTING LAYOUT

ARCADIS

FIGURE
2



LEGEND

●	PROPOSED INJECTION WELL LOCATION
●	PROPOSED PERFORMANCE MONITORING WELL LOCATIONS
●	EXISTING WELLS USED FOR PERFORMANCE MONITORING
▭	FORD PROPERTY BOUNDARY
🟨	COMPOSITE PLUME SHOWING VOC GROUNDWATER CONCENTRATIONS > NR VIAC CRITERIA

NOTES:
1. PLUME EXTENTS BASED ON DATA COLLECTED FROM VAP AND MW LOCATIONS BETWEEN FEBRUARY 2015 AND SEPTEMBER 2019.
2. Abbreviations:
   VOC = VOLATILE ORGANIC COMPOUND
   NR VIAC = NON RESIDENTIAL VOLATILIZATION TO INDOOR AIR CRITERIA

0 300 600
Feet

FORD MOTOR COMPANY
LIVONIA TRANSMISSION PLANT
LIVONIA, MICHIGAN

FULL-SCALE DESIGN LAYOUT

ARCADIS

FIGURE
3

PATH: T:_ENV\NoviBrighton_MI\Ford\Livonia_Pro\2023\Ford_LivoniaMI_Report_Figure3_ERD\Ford_LivoniaMI_Report_Figure3.aprx\ Figure 3 - Full Scale Design Layout Last Saved by : AKENS 11/1/2023

Appendix A

Boring Logs and Well Construction Logs

ARCADIS Design & Consultancy for natural and built assets

Soil Boring Log

Boring No.: IW-1

Sheet: 1 of 1

Project Name: Ford Livonia Automatic Transmissions Plant
Date Started: 04/20/2022
Logger: C. Weaver
Project Number: 30080642
Date Completed: 04/20/2022
Editor: C. Weaver
Project Location: Livonia, MI
Weather Conditions: 48° F, Sunny

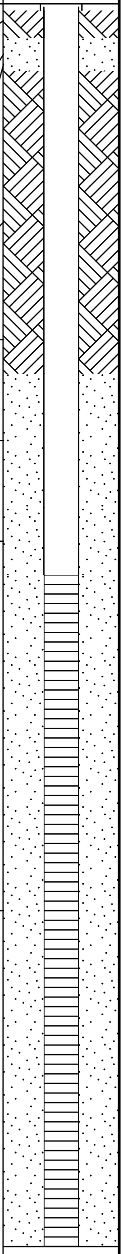
Depth (feet)	Sample Interval	Blow Counts	Recovery (in.)	Sample ID	PID (ppm)
0–5			60		NM 0.0 0.0 0.0 0.0
5–10			48		0.0 0.0 0.0 0.0 0.3
10–15			48		0.5 0.8 1.2 1.8 3.3
15–20			60		4.8 3.2 3.9 2.3 0.0

Description:

- (0.0-0.2') ASPHALT.
- (0.2-2.0') SAND, medium to coarse, subrounded to subangular; some pebbles, small to medium, subrounded to subangular; poorly sorted; dry; black (10YR 2/1). Note: Fill.
- (2.0-4.0') SAND, fine to medium, subrounded to subangular; well sorted; dry; brown (10YR 5/3).
- (4.0-9.0') SAND, medium, subrounded to subangular; trace sand, coarse, subrounded to subangular; well sorted; moist to wet; light brownish gray (10YR 6/2).
  Note: Boring appears wet at 5.0' bgs.
- (9.0-9.2') GRANULES, subrounded to subangular; and PEBBLES, small, subrounded to subangular; well sorted; wet; light brownish gray (10YR 6/2).
- (9.2-9.5') CLAY, high plasticity, slow dilatancy; some silt; wet; soft; gray (10YR 5/1).
- (9.5-10.0') SAND, fine to medium, subrounded to subangular; little silt; well sorted; wet; gray (10YR 6/1).
- (10.0-12.8') SAND, very coarse, subrounded to subangular; and GRANULES, subrounded to subangular; some pebbles, small, subrounded to subangular; poorly sorted; wet; gray (10YR 6/1).
- (12.8-16.2') SILT, rapid dilatancy, nonplastic; some sand, very fine to fine; wet; soft; gray (10YR 6/1).
  Note: Small seam of clay, high plasticity, greater than 1.0" thick present at 13.0' bgs and 13.2' bgs.
- (16.2-17.0') SAND, fine to medium, subrounded to subangular; little silt; well sorted; wet; gray (10YR 6/1).
- (17.0-18.0') SILT, nonplastic, rapid dilatancy, nonplastic; little sand, very fine to fine; wet; soft; gray (10YR 6/1).
- (18.0-18.2') CLAY, high plasticity, slow dilatancy; little silt; soft; moist; gray (10YR 6/1).
- (18.2-18.5') SILT, nonplastic, rapid dilatancy; wet; soft; gray (10YR 6/1).
- (18.5-20.0') CLAY, high plasticity, slow dilatancy; trace silt; medium stiff; dry; gray (10YR 6/1). End of boring 20.0' bgs.

Construction Details:

- 8.0" dia. Flush Mount
- (0.5-1.0') Sand
- 2.0" dia. SCH-40 PVC Casing
- (1.0-5.5') Portland Cement
- 8.0" dia. drilled hole
- (5.5-7.5') Fine Sand Pack
- (7.5-18.5') Filter Pack Sand
- (8.5-18.5') 2.0" dia. Stainless Steel 0.010 Slot Well Screen



Drilling Co.: Fibertec
Driller: Nick Wiseman
Drilling Method: Hand Auger / Direct Push
Drilling Fluid: None
Remarks: ' / ft = feet; " / in = inch; bgs = below ground surface.
Hand Auger to 5.0' bgs.

Sampling Method: 5' Macrocore
Sampling Interval: Continuous
Water Level Start (ft. bgs.): 5.0
Water Level Finish (ft. btoc.): NA
Converted to Well: ☒ Yes ☐ No
Surface Elev.:
North Coor:
East Coor:

ARCADIS Design & Consultancy for natural and built assets

Soil Boring Log

Boring No.: DR-1S

Sheet: 1 of 1

Project Name: Ford Livonia Automatic Transmissions Plant
Date Started: 04/20/2022
Logger: C. Weaver
Project Number: 30080642
Date Completed: 04/20/2022
Editor: C. Weaver
Project Location: Livonia, MI
Weather Conditions: 48° F, Sunny

Depth (feet)	Sample Interval	Blow Counts	Recovery (in.)	Sample ID	PID (ppm)
0-1	0-5		60		NM
1-2					0.0
2-3					0.0
3-4					0.0
4-5					0.0
5-6	5-10		42		0.0
6-7					0.0
7-8					0.0
8-9					0.0
9-10					0.0
10-11	10-15		45		0.8
11-12					3.5
12-13					4.3
13-14					3.3
14-15					3.8
15-16	15-20		55		2.3
16-17					1.5
17-18					2.8
18-19					3.2
19-20					0.0

Description

(0.0-0.2') ASPHALT.

(0.2-2.0') SAND, medium to coarse, subrounded to subangular; some pebbles, small to medium, subrounded to subangular; poorly sorted; dry; black (10YR 2/1).
Note: Fill.

(2.0-4.0') SAND, fine to medium, subrounded to subangular; well sorted; dry; brown (10YR 5/3).

(4.0-9.0') SAND, medium, subrounded to subangular; trace sand, coarse, subrounded to subangular; well sorted; dry to wet; light brownish gray (10YR 6/2).
Note: Boring appears wet at 5.0' bgs.

(9.0-9.2') GRANULES, subrounded to subangular; and PEBBLES, small, subrounded to subangular; well sorted; wet; light brownish gray (10YR 6/2).

(9.2-9.7') CLAY, high plasticity, slow dilatancy; some silt; wet; soft; gray (10YR 6/1).

(9.7-12.8') SAND, very coarse, subrounded to subangular; and GRANULES, subrounded to subangular; some pebbles, small, subrounded to subangular; poorly sorted; wet; gray (10YR 6/1).

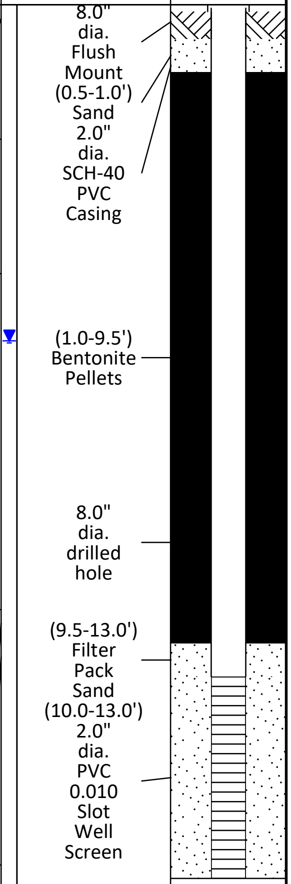
(12.8-16.5') SILT, nonplastic, rapid dilatancy; some sand, fine; wet; soft; gray (10YR 6/1).

(16.5-17.3') SAND, fine to medium, subrounded to subangular; little silt; well sorted; wet; gray (10YR 6/1).

(17.3-19.0') SILT, nonplastic, rapid dilatancy; little sand, very fine to fine; wet; soft; gray (10YR 6/1).

(19.0-20.0') CLAY, high plasticity, slow dilatancy; trace silt; medium stiff; gray (10YR 6/1).
End of boring at 20.0' bgs.

Construction Details / **Well**



Drilling Co.: Fibertec
Driller: Nick Wiseman
Drilling Method: Hand Auger / Direct Push
Drilling Fluid: None
Remarks: ' / ft = feet; " / in = inch; bgs = below ground surface.
Hand Auger to 5.0' bgs.

Sampling Method: 5' Macrocore
Sampling Interval: Continuous
Water Level Start (ft. bgs.): 5.0
Water Level Finish (ft. btoc.): NA
Converted to Well: ☒ Yes ☐ No
Surface Elev.:
North Coor:
East Coor:

ARCADIS Design & Consultancy for natural and built assets

Soil Boring Log

Boring No.: DR-1D

Sheet: 1 of 1

Project Name: Ford Livonia Automatic Transmissions Plant
Date Started: 04/20/2022
Logger: C. Weaver
Project Number: 30080642
Date Completed: 04/20/2022
Editor: C. Weaver
Project Location: Livonia, MI
Weather Conditions: 48° F, Sunny

Depth (feet)	Sample Interval	Blow Counts	Recovery (in.)	Sample ID	PID (ppm)
0-1	Hand Auger 0-5		60		NM
1-2					0.0
2-3					0.0
3-4					0.0
4-5					0.0
5-6	5-10		42		0.0
6-7					0.0
7-8					0.0
8-9					0.0
9-10					0.0
10-11	10-15		45		0.8
11-12					3.5
12-13					4.3
13-14					3.3
14-15					3.8
15-16	15-20		55		2.3
16-17					1.5
17-18					2.8
18-19					3.2
19-20					0.0

Description

(0.0-0.2') ASPHALT.

(0.2-2.0') SAND, medium to coarse, subrounded to subangular; some pebbles, small to medium, subrounded to subangular; poorly sorted; dry; black (10YR 2/1). Note: Fill.

(2.0-4.0') SAND, fine to medium, subrounded to subangular; well sorted; dry; brown (10YR 5/3).

(4.0-9.0') SAND, medium, subrounded to subangular; trace sand, coarse, subrounded to subangular; well sorted; dry to wet; light brownish gray (10YR 6/2).
Note: Boring appears wet at 5.0' bgs. ▼

(9.0-9.2') GRANULES, subrounded to subangular; and PEBBLES, small, subrounded to subangular; well sorted; wet; light brownish gray (10YR 6/2).

(9.2-9.7') CLAY, high plasticity, slow dilatancy; some silt; wet; soft; gray (10YR 6/1).

(9.7-12.8') SAND, very coarse, subrounded to subangular; and GRANULES, subrounded to subangular; some pebbles, small, subrounded to subangular; poorly sorted; wet; gray (10YR 6/1).

(12.8-16.5') SILT, nonplastic, rapid dilatancy; some sand, fine; wet; soft; gray (10YR 6/1).

(16.5-17.3') SAND, fine to medium, subrounded to subangular; little silt; well sorted; wet; gray (10YR 6/1).

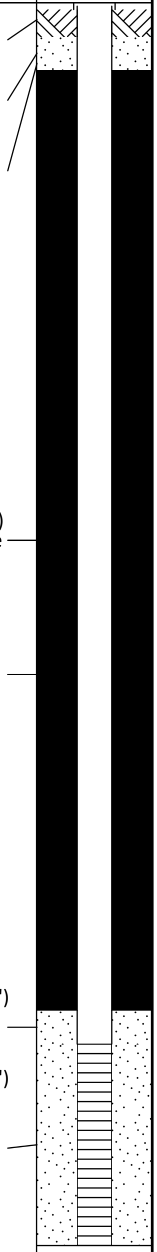
(17.3-19.0') SILT, nonplastic, rapid dilatancy; little sand, very fine to fine; wet; soft; gray (10YR 6/1).

(19.0-20.0') CLAY, high plasticity, slow dilatancy; trace silt; medium stiff; gray (10YR 6/1).
End of boring at 20.0' bgs.

Construction Details

8.0" dia. Flush Mount
(0.5-1.0') Sand
2.0" dia. SCH-40 PVC Casing
(1.0-15.0') Bentonite Pellets
8.0" dia. drilled hole
(15.0-18.5') Filter Pack Sand
(15.5-18.5') 2.0" dia. PVC 0.010 Slot Well Screen

Well



Drilling Co.: Fibertec
Driller: Nick Wiseman
Drilling Method: Hand Auger / Direct Push
Drilling Fluid: None
Remarks: ' / ft = feet; " / in = inch; bgs = below ground surface.
Hand Auger to 5.0' bgs.

Sampling Method: 5' Macrocore
Sampling Interval: Continuous
Water Level Start (ft. bgs.): 5.0
Water Level Finish (ft. btoc.): NA
Converted to Well: ☒ Yes ☐ No
Surface Elev.:
North Coor:
East Coor:

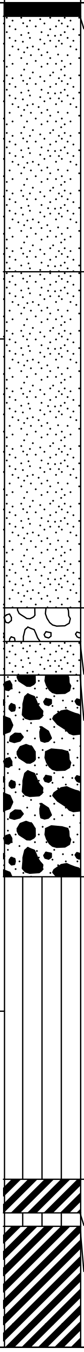
ARCADIS Design & Consultancy for natural and built assets

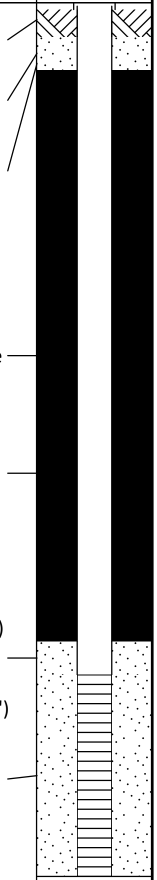
Soil Boring Log

Boring No.: DR-2S

Sheet: 1 of 1

Project Name: Ford Livonia Automatic Transmissions Plant
Date Started: 04/21/2022
Logger: C. Weaver
Project Number: 30080642
Date Completed: 04/21/2022
Editor: C. Weaver
Project Location: Livonia, MI
Weather Conditions: 54° F, Light Rain





Depth (feet)	Sample Interval	Blow Counts	Recovery (in.)	Sample ID	PID (ppm)	USCS Class	Description	Construction Details	Well
1					NM		(0.0-0.2') ASPHALT. (0.2-4.0') SAND, fine to medium, subrounded to subangular; little to trace sand, coarse, subrounded to subangular; trace pebbles, small, subrounded to subangular; well sorted; dry; brown (10YR 5/3).	8.0" dia. Flush Mount (0.5-1.0') Sand 2.0" dia. SCH-40 PVC Casing	
2					0.0				
3			60		0.0				
4					0.0				
5					0.0		(4.0-9.0') SAND, fine to medium, subrounded to subangular; trace sand, coarse, subrounded to subangular; well sorted; moist to wet; light brownish gray (10YR 6/2).		
6					0.0		Note: Boring appears wet at 5.0' bgs.	(1.0-9.5') Bentonite Pellets	
7					0.0		Note: Little coarse sand present from 6.0-6.8' bgs.	8.0" dia. drilled hole	
8			48		0.0				
9					0.3		Note: Little coarse sand present from 8.0-8.2' bgs.		
10					0.2		(9.0-9.5') GRANULES, subrounded to subangular; and PEBBLES, small, subrounded to subangular; well sorted; wet; light brownish gray (10YR 6/2).	(9.5-13.0') Filter Pack Sand	
11					0.8		(9.5-10.0') SAND, fine to medium, subrounded to subangular; little silt; wet; well sorted; gray (10YR 6/1). (10.0-13.0') SAND, very coarse, subrounded to subangular; and GRANULES, subrounded to subangular; some pebbles, small, subrounded to subangular; poorly sorted; wet; gray (10YR 6/1).	(10.0-13.0') 2.0" dia. PVC 0.010 Slot Well Screen	
12					0.9				
13			45		1.3				
14					2.3		(13.0-17.5') SILT, nonplastic, rapid dilatancy; some sand, very fine; wet; soft; gray (10YR 6/1).		
15					2.8				
16					2.3				
17					4.5				
18			56		3.8		(17.5-18.0') CLAY, high plasticity, slow dilatancy; little silt; moist; soft; gray (10YR 6/1).		
19					1.2		(18.0-18.2') SILT, nonplastic, rapid dilatancy; some sand, very fine to fine; wet; soft; gray (10YR 6/1).		
20					0.8		(18.2-20.0') CLAY, high plasticity, slow dilatancy; little silt; moist; soft; gray (10YR 6/1). End of boring at 20.0' bgs.		

Drilling Co.: Fibertec
Driller: Nick Wiseman
Drilling Method: Hand Auger / Direct Push
Drilling Fluid: None
Remarks: ' / ft = feet; " / in = inch; bgs = below ground surface.
Hand Auger to 5.0' bgs.

Sampling Method: 5' Macrocore
Sampling Interval: Continuous
Water Level Start (ft. bgs.): 5.0
Water Level Finish (ft. btoc.): NA
Converted to Well: ☒ Yes ☐ No
Surface Elev.:
North Coor:
East Coor:

ARCADIS Design & Consultancy for natural and built assets

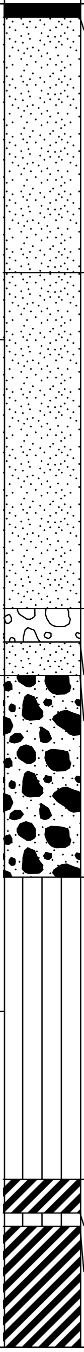
Soil Boring Log

Boring No.: DR-2D

Sheet: 1 of 1

Project Name: Ford Livonia Automatic Transmissions Plant
Date Started: 04/21/2022
Logger: C. Weaver
Project Number: 30080642
Date Completed: 04/21/2022
Editor: C. Weaver
Project Location: Livonia, MI
Weather Conditions: 54° F, Light Rain

Depth (feet)	Sample Interval	Blow Counts	Recovery (in.)	Sample ID	PID (ppm)
0-5	0-5		60		NM 0.0 0.0 0.0 0.0
5-10	5-10		48		0.0 0.0 0.0 0.3 0.2
10-15	10-15		45		0.8 0.9 1.3 2.3 2.8
15-20	15-20		56		2.3 4.5 3.8 1.2 0.8



Description

(0.0-0.2') ASPHALT.

(0.2-4.0') SAND, fine to medium, subrounded to subangular; little to trace sand, coarse, subrounded to subangular; trace pebbles, small, subrounded to subangular; well sorted; dry; brown (10YR 5/3).

(4.0-9.0') SAND, fine to medium, subrounded to subangular; trace sand, coarse, subrounded to subangular; well sorted; moist to wet; light brownish gray (10YR 6/2).

Note: Boring appears wet at 5.0' bgs.

Note: Little coarse sand present from 6.0-6.8' bgs.

Note: Little coarse sand present from 8.0-8.2' bgs.

(9.0-9.5') GRANULES, subrounded to subangular; and PEBBLES, small, subrounded to subangular; well sorted; wet; light brownish gray (10YR 6/2).

(9.5-10.0') SAND, fine to medium, subrounded to subangular; little silt; wet; well sorted; gray (10YR 6/1).

(10.0-13.0') SAND, very coarse, subrounded to subangular; and GRANULES, subrounded to subangular; some pebbles, small, subrounded to subangular; poorly sorted; wet; gray (10YR 6/1).

(13.0-17.5') SILT, nonplastic, rapid dilatancy; some sand, very fine; wet; soft; gray (10YR 6/1).

(17.5-18.0') CLAY, high plasticity, slow dilatancy; little silt; moist; soft; gray (10YR 6/1).

(18.0-18.2') SILT, nonplastic, rapid dilatancy; some sand, very fine to fine; wet; soft; gray (10YR 6/1).

(18.2-20.0') CLAY, high plasticity, slow dilatancy; little silt; moist; soft; gray (10YR 6/1).
End of boring at 20.0' bgs.

Construction Details

8.0" dia. Flush Mount

(0.5-1.0') Sand

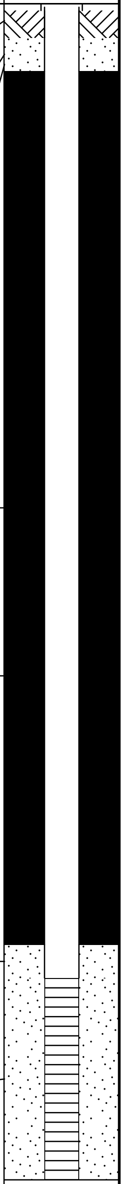
2.0" dia. SCH-40 PVC Casing

(1.0-14.0') Bentonite Pellets

8.0" dia. drilled hole

(14.0-17.5') Filter Pack Sand

(14.5-17.5') 2.0" dia. PVC 0.010 Slot Well Screen



Drilling Co.: Fibertec
Driller: Nick Wiseman
Drilling Method: Hand Auger / Direct Push
Drilling Fluid: None
Remarks: ' / ft = feet; " / in = inch; bgs = below ground surface.
Hand Auger to 5.0' bgs.

Sampling Method: 5' Macrocore
Sampling Interval: Continuous
Water Level Start (ft. bgs.): 5.0
Water Level Finish (ft. btoc.): NA
Converted to Well: ☒ Yes ☐ No
Surface Elev.:
North Coor:
East Coor:

ARCADIS Design & Consultancy for natural and built assets

Soil Boring Log

Boring No.: PMW-1

Sheet: 1 of 1

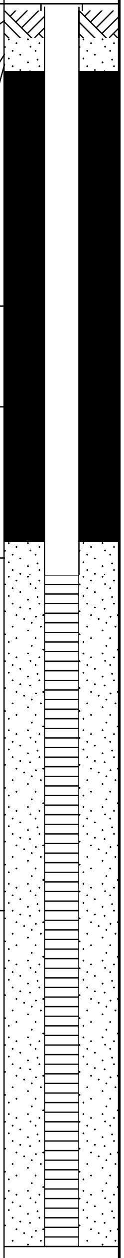
Project Name: Ford Livonia Automatic Transmissions Plant
Date Started: 04/21/2022
Logger: C. Weaver
Project Number: 30080642
Date Completed: 04/21/2022
Editor: C. Weaver
Project Location: Livonia, MI
Weather Conditions: 54° F, Light Rain

Depth (feet)	Sample Interval	Blow Counts	Recovery (in.)	Sample ID	PID (ppm)	USCS Class	Description
0–5			60		NM 0.0 0.0 0.0 0.1		(0.0-0.2') ASPHALT. (0.2-5.0') SAND, fine to medium, subrounded to subangular; little to trace sand, coarse, subrounded to subangular; well sorted; wet; brown (10YR 5/3).
5–10			48		0.0 0.0 0.0 0.0 0.0		(5.0-6.2') SAND, medium to coarse, subrounded to subangular; trace pebbles, small, subrounded to subangular; poorly sorted; wet; brown (10YR 5/3). (6.2-10.5') SAND, fine to medium, subrounded to subangular; little silt; well sorted; wet; brown (10YR 5/3). Note: Organics present at 8.8' bgs.
10–15			45		0.0 0.0 1.5 2.3 7.6		(10.5-13.0') GRANULES, subrounded to subangular; some pebbles, small, subrounded to subangular; poorly sorted; wet; gray (10YR 6/1). (13.0-18.8') SILT, nonplastic, rapid dilatancy; some sand, very fine to fine; wet; soft; gray (10YR 5/1).
15–20			49		8.5 0.3 0.2 0.0 0.0		Note: Some medium sand present from 17.0-17.5' bgs. (18.8-20.0') CLAY, high plasticity, slow dilatancy; moist; soft; gray (10YR 6/1). End of boring at 20.0' bgs.

Construction Details

8.0" dia. Flush Mount
(0.5-1.0') Sand
2.0" dia. SCH-40 PVC Casing
(1.0-8.0') Bentonite Pellets
8.0" dia. drilled hole
(8.0-18.5') Filter Pack Sand
(8.5-18.5') 2.0" dia. PVC 0.010 Slot Well Screen

Well



Drilling Co.: Fibertec
Driller: Nick Wiseman
Drilling Method: Hand Auger / Direct Push
Drilling Fluid: None
Remarks: ' / ft = feet; " / in = inch; bgs = below ground surface.
Hand Auger to 5.0' bgs.

Sampling Method: 5' Macrocore
Sampling Interval: Continuous
Water Level Start (ft. bgs.): 5.0
Water Level Finish (ft. btoc.): NA
Converted to Well: ☒ Yes ☐ No
Surface Elev.:
North Coor:
East Coor:

Soil Boring and Construction Log

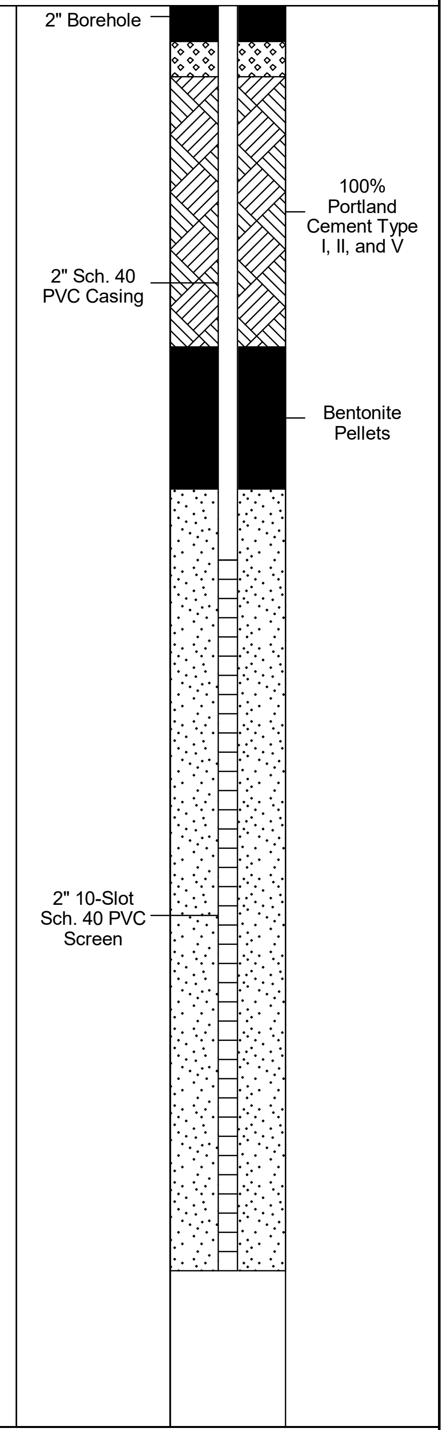
Boring No.: PMW-2

Sheet: 1 of 1

Client Name: Ford Motor Company
Project Number: 30144174
Project Name: Ford LTP Utility Corridor On Going Support
Date Started: 11-01-2022
Date Completed: 11-01-2022
Total Depth: 20.0 ft bgs
Logger: Seth Turner
Reviewer:

Depth (feet)	Sample ID	Rec. (ft)	PID (ppm)	Blow Counts	Description	Drilling Fluid and Notes
		0.21	0		(0-0.2 ft) NOTE: Asphalt. (0.2-5 ft) SAND, fine to very coarse, subangular to subround; little small pebbles, angular to subangular; well sorted; wet; loose; 10YR 5/3 - brown.	
1			0			
2		5				
3			0			
4			0			
5			0		(5-6.2 ft) SAND, medium to coarse, subangular to subround; little small pebbles, angular to subangular; poorly sorted; wet; loose; 10YR 5/3 - brown.	
6			0		(6.2-10.5 ft) SAND, fine to medium, subangular to subround; some silt; well sorted; wet; 10YR 5/3 - brown.	
7		4	0			
8			0			
9			0			
10			0		(10.5-13 ft) GRANULES, subangular to subround; some small pebbles, subangular to subround; poorly sorted; wet; 10YR 6/1 - gray.	
11			0			
12		3.75	0			
13			0		(13-17.8 ft) SILT, no plasticity, rapid dilatancy; some very fine to fine sand; wet; medium stiff; 10YR 6/1 - gray.	
14			0			
15			0			
16			0			
17		4.67	0			
18			0		(17.8-20 ft) CLAY, high plasticity, slow dilatancy; moist; medium stiff; 10YR 6/1 - gray.	
19			0			
20					20 ft. bgs End of Boring	

Construction Details



Drilling Company: Fibertec
Driller: Nick Wiseman
Drilling Method: Hand Auger
Drill Rig: Geoprobe
Remarks: bgs = below ground surface; ft = feet; PID = photo-ionization detector; ppm = parts per million; Rec. = recovery.

Sampling Method: Macrocore
Sampling Dimensions: 5
First Encountered Water (ft bgs): NA
Static Water Level (ft bgs): NA
Top of Casing Elevation: NA
Surface Elevation: NA
North Coordinate: NA
East Coordinate: NA

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Soil Boring and Construction Log

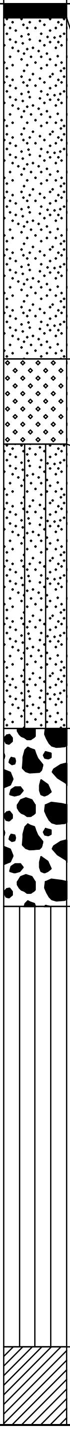
Boring No.: PMW-3

Sheet: 1 of 1

Client Name: Ford Motor Company
Date Started: 11-01-2022
Logger: Seth Turner
Project Number: 30144174
Date Completed: 11-01-2022
Reviewer:
Project Name: Ford LTP Utility Corridor On Going Support
Total Depth: 20.0 ft bgs

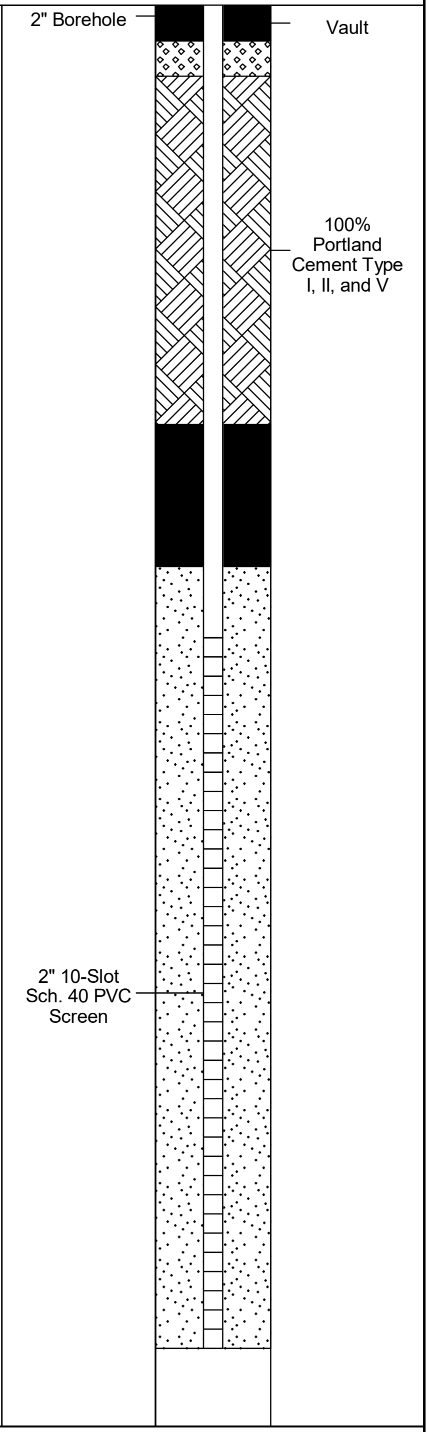
Depth (feet)	Sample ID	Rec. (ft)	PID (ppm)	Blow Counts	Description	Drilling Fluid and Notes
0		0.21	0		(0-0.2 ft) NOTE: Asphalt. (0.2-5 ft) SAND, fine to very coarse, subangular to subround; little small pebbles, angular to subangular; well sorted; wet; loose; 10YR 5/3 - brown.	
1			0			
2		5				
3			0			
4			0			
5			0		(5-6.2 ft) SAND, medium to coarse, subangular to subround; little small pebbles, angular to subangular; poorly sorted; wet; loose; 10YR 5/3 - brown.	
6			0		(6.2-10.2 ft) SAND, fine to medium, subangular to subround; some silt; well sorted; wet; 10YR 5/3 - brown.	
7		4.17	0			
8			0			
9			0			
10			0		(10.2-12.7 ft) GRANULES, subangular to subround; some small pebbles, subangular to subround; poorly sorted; wet; 10YR 6/1 - gray.	
11			0			
12		3.75	0		(12.7-18.9 ft) SILT, no plasticity, rapid dilatancy; some very fine to fine sand; wet; medium stiff; 10YR 6/1 - gray.	
13			0			
14			0			
15			0			
16			0			
17		4.67	0			
18			0		(18.9-20 ft) CLAY, high plasticity, slow dilatancy; moist; medium stiff; 10YR 6/1 - gray.	
19			0			
20						

Graphic



20 ft. bgs End of Boring

Construction Details



Drilling Company: Fibertec
Driller: Nick Wiseman
Drilling Method: Hand Auger
Drill Rig: Geoprobe
Remarks: bgs = below ground surface; ft = feet; PID = photo-ionization detector; ppm = parts per million; Rec. = recovery.

Sampling Method: Macrocore
Sampling Dimensions: 5
First Encountered Water (ft bgs): NA
Static Water Level (ft bgs): NA
Top of Casing Elevation: NA
Surface Elevation: NA
North Coordinate: NA
East Coordinate: NA

Appendix B

Injection and Sampling Logs

Injection Pilot Test

Ford Livonia

Injection Log

Injection Well: IW-1
Injection Event: Nov 2022 Tracer Study
Injection Phase: Injection
Screened Interval: 19-Sep ft bgs
Target Injection Volume: 5,290 gallons
Initial Target Injection Rate: (<5 psi)
Injection Start Date/Time: 11/1/22; 1647

Injection Start/Stop Log

Date	Time	Action
11/1/2022	1647	Injection start
11/1/2022	1729	Stop pump
11/1/2022	1753	Stop injection
11/2/2022	1002	Start
11/2/2022	1553	Stop
11/3/2022	1002	Start
11/3/2022	1313	Stop

Date	Time	Flow Totalizer	Total Gallons Injected	Flow (GPM)	Injection Pressure (psi)	Comments
11/1/2022	1645	38.38	0	0	0	Baseline / pre-injection
11/1/2022	1648	44	5.6	3.75	0.5	--
11/1/2022	1700	91	52.6	5.5	0.5	--
11/1/2022	1719	204	165.6	5.9	0.5	Increased flow rate after reading
11/1/2022	1729	289	250.6	8.5	1.5	PSI generally bouncing up to 1
11/1/2022	1753	411	372.6	5	0	Dye water was siphoning into well with valve open
11/2/2022	1005	441	402.6	8	3	Bouncing 0-3 psi
11/2/2022	1012	493	454.6	10	--	Pressure bouncing a lot
11/2/2022	1022	580	541.6	8.7	5	Bouncing 0-5 psi
11/2/2022	1041	708	669.6	6.7	0	No pressure
11/2/2022	1046	738	699.6	~5	0	--
11/2/2022	1050	759	720.6	5.25	0	--
11/2/2022	1120	969	930.6	7	0	--
11/2/2022	1150	1194	1155.6	7.5	0.5	Bouncing 0-0.5 psi
11/2/2022	1220	1423	1394.6	~8	0	Bouncing 0-0.5 psi
11/2/2022	1250	1685	1646.6	8.4	0	Bouncing 0-0.5 psi
11/2/2022	1320	1937	1898.6	8.4	0	Bouncing 0-0.5 psi
11/2/2022	1350	2198	2159.6	8.7	0	Bouncing 0-0.5 psi
11/2/2022	1420	2435	2396.6	7.9	0	Bouncing 0-0.5 psi
11/2/2022	1450	2682	2643.6	8.2	0	Bouncing 0-0.5 psi
11/2/2022	1520	2934	2895.6	8.4	0	Bouncing 0-0.5 psi
11/2/2022	1550	3190	3151.6	8.5	0	Bouncing 0-0.5 psi
11/2/2022	1553	3212.5	3174	0	0	Gallons at injection stop 11/2/22
11/3/2022	1003	3218	3179.6	5	1	--
11/3/2022	1033	3388	3349.6	~5.7	0-2	Bouncing 0-2 psi
11/3/2022	1045	3477	3438.6	~10	0-4	Bouncing 0-4 psi
11/3/2022	1103	3647	3608.6	~8.5-9.5	0-4.5	Bouncing 0-4.5 psi
11/3/2022	1127	--	--	~10.5	0-4.5	Bouncing 0-4.5 psi, measured with timer
11/3/2022	1135	3975	3936.6	10.25	0.5	Bouncing 0-5 psi
11/3/2022	1205	4279	4240.6	10.13	0-5	Bouncing 0-5 psi
11/3/2022	1235	4587	4548.6	10.26	0-3	Boucing 0-3 psi
11/3/2022	1308	4936	4897.6	10.6	0-3	Bouncing 0-3 psi
11/3/2022	1313	4987	4948.6	0	0	Gallons at injection stop 11/3/22

Injection Phase Samples
Ford Motor Company
Livonia Transmission Plan

	Sample ID	Date	Time	Estimated Tracer Dilution	Comments
DR-1S	DR-1S_250_110222*	11/1/2022	1735	10X	Cloudy
	DR-1S_500_110222	11/2/2022	1023	10X-20X	Cloudy 10X-20X
	DR-1S_612_110222	11/2/2022	1032	10X-20X	Cloudy 10X-20X
	DR-1S_750_110222	11/2/2022	1058	10X	
	DR-1S_890_110222	11/2/2022	1120	2X-10X	Cloudy 2X-10X
	DR-1S_1000_110222	11/2/2022	1130	2X-10X	Cloudy 2X-10X
	DR-1S_1246_110222*	11/2/2022	1201	2X-10X	Cloudy 2X-10X
	DR-1S_1250_110222	11/2/2022	1206	2X-10X	Cloudy 2X-10X
	DR-1S_1346_110222	11/2/2022	1214	2X	Cloudy 2X
	DR-1S_1500_110222	11/2/2022	1238	2X	Cloudy 2X
	DR-1S_1695_110222*	11/2/2022	1257	2X	Cloudy 2X
	DR-1S_1750_110222	11/2/2022	1310	2X	Cloudy 2X
	DR-1S_2000_110222	11/2/2022	1341	2X	Cloudy 2X
	DR-1S_2225_110222	11/2/2022	1355	2X	Cloudy 2X
	DR-1S_2250_110222	11/2/2022	1408	2X	Cloudy 2X
	DR-1S_2407_110222	11/2/2022	1420	2X	Cloudy 2X
	DR-1S_2836_110222*	11/2/2022	1513	2X-0X	Retrieved bailer; Cloudy 2X-0X
	DR-1S_3000_110222	11/2/2022	1538	2X-0X	Cloudy 2X-0X
	DR-1S_3250_110322	11/3/2022	1021	2X-0X	Cloudy 2X-0X
	DR-1S_3500_110322	11/3/2022	1056	2X-0X	Cloudy 2X-0X
	DR-1S_3750_110322	11/3/2022	1120	2X-0X	Cloudy 2X-0X
	DR-1S_4000_110322	11/3/2022	1143	2X-0X	Cloudy 2X-0X
	DR-1S_4250_110322	11/3/2022	1208	0X	Cloudy 0X Bright
	DR-1S_4500_110322	11/3/2022	1232	0X	Cloudy 0X Bright
	DR-1S_4750_110322	11/3/2022	1255	0X	Cloudy 0X Bright
	DR-1S_4949_110322*	11/3/2022	1325	0X	Cloudy 0X Bright
DR-1D	DR-1D_250_110122	11/1/2022	1738	>100X	Faint dye color
	DR-1D_500_110222	11/2/2022	1024	>100X	Zero dye color
	DR-1D_750_110222	11/2/2022	1103	>100X	Zero dye color
	DR-1D_1000_110222	11/2/2022	1134	>100X	Zero dye color
	DR-1D_1250_110222	11/2/2022	1206	>100X	Zero dye color
	DR-1D_1500_110222	11/2/2022	1235	>100X	Zero dye color
	DR-1D_1750_110222	11/2/2022	1307	>100X	Zero dye color; Cloudy brown
	DR-1D_2000_110222	11/2/2022	1336	>100X	Zero dye color; Cloudy brown
	DR-1D_2250_110222	11/2/2022	1407	>100X	Zero dye color; Cloudy brown
	DR-1D_2500_110222	11/2/2022	1436	>100X	Zero dye color; Cloudy brown
	DR-1D_2750_110222*	11/2/2022	1505	100X	Maybe faint dye
	DR-1D_3000_110222	11/2/2022	1535	50X-100X	50X-100X; Faint dye
	DR-1D_3250_110322	11/3/2022	1023	>100X	Maybe faint dye
	DR-1D_3500_110322*	11/3/2022	1058	50X	Cloudy 50X
	DR-1D_3750_110322	11/3/2022	1121	20X-50X	Cloudy 20X-50X
	DR-1D_4000_110322	11/3/2022	1149	20X	Cloudy-ish 20X
	DR-1D_4250_110322*	11/3/2022	1209	20X	20X
	DR-1D_4500_110322	11/3/2022	1235	10X	10X
	DR-1D_4750_110322	11/3/2022	1254	10X	10X
	DR-1D_4949_110322*	11/3/2022	1320	10X	10X

Injection Phase Samples
Ford Motor Company
Livonia Transmission Plan

	Sample ID	Date	Time	Estimated Tracer Dilution	Comments
DR-2S	DR-2S_250_110122	11/1/2022	1740	>100X	None to 100X
	DR-2S_500_110222*	11/2/2022	1022	50X	Cloudy
	DR-2S_750_110222	11/2/2022	1100	20X	Cloudy 10-20X
	DR-2S_1000_110222*	11/2/2022	1135	20X	Cloudy 20X
	DR-2S_1250_110222	11/2/2022	1205	20X	Cloudy 10X-20X
	DR-2S_1500_110222	11/2/2022	1235	10X-20X	Cloudy 10X-20X
	DR-2S_1750_110222*	11/2/2022	1307	10X-20X	Cloudy 10X-20X
	DR-2S_2000_110222	11/2/2022	1334	10X	Cloudy 10X
	DR-2S_2250_110222	11/2/2022	1404	10X	Cloudy 10X
	DR-2S_2500_110222	11/2/2022	1435	2X-10X	Cloudy 2X-10X
	DR-2S_2750_110222	11/2/2022	1506	2X	Cloudy 2X
	DR-2S_3000_110222	11/2/2022	1540	2X	Cloudy 2X
	DR-2S_3250_110322*	11/3/2022	1020	2X-10X	Cloudy 2X-10X
	DR-2S_3500_110322	11/3/2022	1054	2X-10X	Cloudy 2X-10X
	DR-2S_3750_110322	11/3/2022	1119	2X	Cloudy 2X
	DR-2S_4000_110322	11/3/2022	1150	2X	Cloudy 2X
	DR-2S_4250_110322	11/3/2022	1210	2X-0X	Cloudy 2X-0X
	DR-2S_4500_110322	11/3/2022	1233	2X-0X	Cloudy 2X-0X
	DR-2S_4750_110322	11/3/2022	1257	2X-0X	Cloudy 2X-0X Bright
	DR-2S_4949_110322*	11/3/2022	1329	2X-0X	Cloudy 2X-0X Bright
DR-2D	DR-2D_250_110122	11/1/2022	1742	100X	Cloudy
	DR-2D_500_110222	11/2/2022	1025	>100X	Zero dye color; Cloudy
	DR-2D_750_110222	11/2/2022	1100	>100X	Zero dye color; Cloudy
	DR-2D_1500_110222	11/2/2022	1240	>100X	Zero dye color; Cloudy
	DR-2D_1750_110222	11/2/2022	1310	>100X	Zero dye color; Cloudy brown
	DR-2D_2000_110222	11/2/2022	1338	>100X	Zero dye color; Cloudy brown
	DR-2D_2250_110222	11/2/2022	1410	>100X	Zero dye color; Cloudy
	DR-2D_2500_110222	11/2/2022	1440	>100X	Cloudy; Maybe very faint dye
	DR-2D_2750_110222	11/2/2022	1506	>100X	Cloudy; Maybe very faint dye
	DR-2S_3000_110222	11/2/2022	1542	>100X	Zero dye color; Cloudy
	DR-2D_3250_110322	11/3/2022	1024	>100X	Zero dye color; Cloudy
	DR-2D_3500_110322	11/3/2022	1056	>100X	Zero dye color; Cloudy brownish
	DR-2D_3750_110322	11/3/2022	1122	>100X	Zero dye color; Cloudy brownish
	DR-2D_4000_110322	11/3/2022	1145	>100X	Zero dye color; Cloudy brownish
	DR-2D_4250_110322*	11/3/2022	1211	>100X	Zero dye color; Cloudy
	DR-2D_4500_110322	11/3/2022	1234	>100X	Zero dye color; Cloudy brownish
	DR-2D_4750_110322	11/3/2022	1300	>100X	Cloudy brownish
	DR-2D_4949_110322*	11/3/2022	1326	100X	Cloudy/murky; Maybe faint dye
MW-23	MW-23_1000_110222	11/2/2022	1137	>100X	Zero dye color; Turbid/cloudy brown
	MW-23_2000_110222	11/2/2022	1340	>100X	Zero dye color; Turbid/cloudy dark brown
	MW-23_3000_110222	11/2/2022	1540	>100X	Zero dye color; Turbid/cloudy dark brown
	MW-23_4000_110322*	11/3/2022	1143	>100X	Zero dye color
	MW-23_4949_110322*	11/3/2022	1329	10X-20X	10-20X Dye color present

Injection Phase Samples
Ford Motor Company
Livonia Transmission Plan

	Sample ID	Date	Time	Estimated Tracer Dilution	Comments
PMW-1	PMW-1_1000_110222	11/2/2022	1143	>100X	Zero dye color; Cloudy
	PMW-1_2000_110222	11/2/2022	1348	>100X	Zero dye color; Cloudy brown
	PMW-1_3000_110222	11/2/2022	1533	>100X	Zero dye color; Cloudy
	PMW-1_4000_110322	11/3/2022	1149	>100X	Zero dye color
	PMW-1_4949_110322*	11/3/2022	1326	100X	Faint dye color
PMW-2	PMW-2_1000_110222	11/2/2022	1131	>100X	Zero dye color; Cloudy
	PMW-2_2000_110222	11/2/2022	1339	>100X	Zero dye color; Cloudy
	PMW-2_3000_110222	11/2/2022	1528	>100X	Zero dye color; Cloudy brown
	PMW-2_4000_110322	11/3/2022	1146	>100X	Zero dye color; Cloudy brownish
	PMW-2_4949_110322*	11/3/2022	1335	>100X	Zero dye color; Murky brownish
PMW-3	PMW-3_1000_110222	11/2/2022	1135	>100X	Zero dye color; Cloudy
	PMW-3_2000_110222	11/2/2022	1335	>100X	Zero dye color; Cloudy
	PMW-3_3000_110222	11/2/2022	1530	>100X	Zero dye color; Cloudy
	PMW-3_4000_110322	11/3/2022	1147	>100X	Zero dye color
	PMW-3_4949_110322	11/3/2022	1330	>100X	Zero dye color; Murky brownish

Notes:
Sample IDs marked with an * were submitted for laboratory analysis

Appendix C

Analytical Data

Ozark UNDERGROUND LABORATORY 1572 Aley Lane • Protem, MO 65733 • (417) 785-4289 • fax (417) 785-4290 • contact@ozarkundergroundlab.com

Certificate of Analysis

Date of certificate: November 28, 2022

Client: ARCADIS
28550 Cabot Dr #500
Novi, MI 48377

Contact people: Matthew.Williams@arcadis.com
Erika.Jarchow@arcadis.com
Ryan.Oesterreich@arcadis.com

Project name/location: Ford LTP, Livonia, MI

Project number: 30144174.20

Samples collected by:

Date samples shipped: November 15, 2022

Date samples rec'd at OUL: November 16, 2022

Date analyzed by OUL: November 18 and 21, 2022

Included with certificate of analysis: Table of results, copy of chain of custody records

Results for water samples analyzed for the presence of fluorescein dye.

Peak wavelengths are reported in nanometers (nm); dye concentrations are reported in parts per billion (ppb).

OUL Number	Sample ID	Date/Time Collected	Fluorescein Results	
			Peak (nm)	Conc. (ppb)
G0743	IW-01_0_110122	11/1/22 1340	ND	
G0744	DR-1D_0_110122	11/1/22 1350	ND	
G0745	DR-1D_2750_110222	11/2/22 1505	507.5	382
G0746	DR-1D_3500_110322	11/3/22 1058	507.5	785
G0747	DR-1D_4250_110322	11/3/22 1209	507.5	2,010
G0748	DR-1D_4949_110322	11/3/22 1320	507.5	3,400
G0749	DR-1S_0_110122	11/1/22 1345	ND	
G0750	DR-1S_250_110122	11/1/22 1735	507.5	5,040
G0751	DR-1S_1246_110222	11/2/22 1201	507.5	19,400
G0752	DR-1S_1695_110222	11/2/22 1257	507.5	25,500
G0753	DR-1S_2836_110222	11/2/22 1513	507.5	32,700
G0754	DR-1S_4949_110322	11/3/22 1325	507.4	28,300
G0755	DR-2D_0_110122	11/1/22 1400	ND	
G0756	DR-2D_4250_110322	11/3/22 1211	507.5	568
G0757	DR-2D_4949_110322	11/3/22 1326	507.4	558
G0758	DR-2S_0_110122	11/1/22 1402	ND	
G0759	DR-2S_500_110222	11/2/22 1022	507.5	2,480
G0760	Laboratory control water blank			
G0761	DR-2S_1000_110222	11/2/22 1135	507.6	4,550
G0762	DR-2S_1750_110222	11/2/22 1307	507.5	9,840
G0763	DR-2S_3250_110322	11/3/22 1020	507.5	14,200
G0764	DR-2S_4949_110322	11/3/22 1329	507.5	20,700
G0765	MW-23_0_110122	11/1/22 1405	ND	
G0766	MW-23_4000_110322	11/3/22 1143	507.5	285
G0767	MW-23_4949_110322	11/3/22 1329	507.4	3,100

OUL Number	Sample ID	Date/Time Collected	Fluorescein Results	
			Peak (nm)	Conc. (ppb)
G0768	PMW-01_0_110122	11/1/22 1400	ND	
G0769	PMW-01_4949_110322	11/3/22 1326	507.5	415
G0770	PMW-02_0_110222	11/2/22 0934	ND	
G0771	PMW-03_0_110222	11/2/22 0936	ND	

Note: Dye concentrations are based upon standards used at the OUL. The standard concentrations are based upon the as sold weight of the dye that the OUL uses. If the client is not using OUL dyes, the client should provide the OUL with a sample of the dye to compare to the OUL dyes.

Footnotes: ND = No dye detected

Thomas J. Aley, PHG and RG

Thomas Aley

Address: ______________________

Chain of Custody Record

595897

eurofins | Environment Testing TestAmerica

Report to: Matthew.Williams@arcadis.com
Erika.Jarchow@arcadis.com
Ryan.Oesterreich@arcadis.com

Regulatory Program: ☐ DW ☐ NPDES ☐ RCRA ☐ Other:

TAL-8210

Client Contact
Company Name: Arcadis
Address: 28550 Cabot Dr #500
City/State/Zip: Novi, MI 48377
Phone:
Fax:
Project Name: Ford LTP
Site: Livonia, MI
P O # 30144174.20

Project Manager: Matt Williams
Tel/Email:

Analysis Turnaround Time
☐ CALENDAR DAYS ☐ WORKING DAYS
TAT if different from Below ________
☐ 2 weeks
☐ 1 week
☐ 2 days
☐ 1 day
Standard

Site Contact:
Lab Contact:
Date:
Carrier:

COC No:
1 of 3 COCs OUL
Sampler:
For Lab Use Only:
Walk-in Client:
Lab Sampling:
Job / SDG No.:

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Filtered Sample (Y / N)	Perform MS / MSD (Y / N)	FL Tracer	# Charcoal Samples rec'd	# water Samples rec'd	Sample Specific Notes:
IW-01_0_110122	11/1/22	1340	G	GW	1			X	0	1	G0743
DR-1D_0_110122	11/1/22	1350	G	GW	1			X	0	1	G0744
DR-1D_2750_110222	11/2/22	1505	G	GW	1			X	0	1	G0745
DR-1D_3500_110322	11/3/22	1058	G	GW	1			X	0	1	G0746
DR-1D_4250_110322	11/3/22	1209	G	GW	1			X	0	1	G0747
DR-1D_4949_110322	11/3/22	1320	G	GW	1			X	0	1	G0748
DR-1S_0_110122	11/1/22	1345	G	GW	1			X	0	1	G0749
DR-1S_250_110122	11/1/22	1735	G	GW	1			X	0	1	G0750
DR-1S_1246_110222	11/2/22	1201	G	GW	1			X	0	1	G0751
DR-1S_1695_110222	11/2/22	1257	G	GW	1			X	0	1	G0752
DR-1S_2836_110222	11/2/22	1513	G	GW	1			X	0	1	G0753
DR-1S_4949_110322	11/3/22	1325	G	GW	1			X	0	1	G0754

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other ________

Possible Hazard Identification:
Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample.
☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)
☐ Return to Client ☐ Disposal by Lab ☐ Archive for ________ Months

Special Instructions/QC Requirements & Comments:
Custody seal intact upon Arrival AG/OUL
All project #1987 analyzed by AC/OUL 11/18/22
analysis graphs proofed by Ca/OUL

Custody Seals Intact: ☒ Yes ☐ No
Custody Seal No.:
Cooler Temp. (°C): Obs'd: ________ Corr'd: ________ Therm ID No.: ________

Relinquished by: Sommer	Company: Arcadis	Date/Time: 11/15/22 1500	Received by: FedEx	Company: FedEx	Date/Time: 11/15/22 1500
Relinquished by:	Company:	Date/Time:	Received by: A. Goers/OUL	Company: OUL	Date/Time: 11/16/22 1500
Relinquished by:	Company:	Date/Time:	Received in Laboratory by:	Company:	Date/Time:

Address: ____________________

Chain of Custody Record

595898 eurofins Environment Testing TestAmerica

Regulatory Program: ☐ DW ☐ NPDES ☐ RCRA ☐ Other:

TAL-8210

Client Contact

Company Name: Arcadis

Address:

City/State/Zip:

Phone:

Fax:

Project Name: Ford LTP

Site:

P O # 30144174.20

Project Manager:

Tel/Email:

Site Contact:

Lab Contact:

Date:

Carrier:

COC No: 2 of 3 COCs

Sampler:

For Lab Use Only:

Walk-in Client:

Lab Sampling:

Job / SDG No.:

Analysis Turnaround Time

☐ CALENDAR DAYS ☐ WORKING DAYS

TAT if different from Below ________

☐ 2 weeks

☐ 1 week

☐ 2 days

☐ 1 day

Standard

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Filtered Sample (Y / N)	Perform MS / MSD (Y / N)	FL Tracer	# charcoal samples rec'd	# water samples rec'd	Sample Specific Notes:
DR-2D-0-110122	11/1/22	1400	G	GW	1			X	0	1	G0755
DR-2D_4250_110322	11/3/22	1211	G	GW	1			X	0	1	G0756
DR-2D-4949-110322	11/3/22	1326	G	GW	1			X	0	1	G0757
DR-2S_0_110122	11/1/22	1402	G	GW	1			X	0	1	G0758
DR-2S_500_110222	11/2/22	1022	G	GW	1			X	0	1	G0759
DR-2S_1000_110222	11/2/22	1135	G	GW	1			X	0	1	G0761
DR-2S_1750_110222	11/2/22	1307	G	GW	1			X	0	1	G0762
DR-2S_3250_110322	11/3/22	1020	G	GW	1			X	0	1	G0763
DR-2S_4949_110322	11/3/22	1329	G	GW	1			X	0	1	G0764
MW-23_0_110122	11/1/22	1405	G	GW	1			X	0	1	G0765
MW-23_4000_110322	11/3/22	1143	G	GW	1			X	0	1	G0766
MW-23_4949_110322	11/3/22	1329	G	GW	1			X	0	1	G0767

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other ________

Possible Hazard Identification:

Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample.

☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)

G0760 OUL Water Blank

☐ Return to Client ☐ Disposal by Lab ☐ Archive for ________ Months

Special Instructions/QC Requirements & Comments: OUL project #1987 Analyzed by AC/OUL 11/21/22

analyses graphs proofed by CC/OUL

Custody Seals Intact: ☒ Yes ☐ No

Custody Seal No.:

Cooler Temp. (°C): Obs'd:________ Corr'd:________

Therm ID No.:________

Relinquished by: Sommer Guy	Company: Arcadis	Date/Time: 11/15/22 1500	Received by: FedEx	Company: FedEx	Date/Time: 11/15/22 1500
Relinquished by:	Company:	Date/Time:	Received by: A. Groers	Company: OUL	Date/Time: 11/16/22 1500
Relinquished by:	Company:	Date/Time:	Received in Laboratory by:	Company:	Date/Time:

Chain of Custody Record

595899 eurofins Environment Testing TestAmerica

Address: ______________________

Regulatory Program: ☐ DW ☐ NPDES ☐ RCRA ☐ Other:

TAL-8210

Client Contact	**Project Manager:**	**Site Contact:**	**Date:**	COC No:
Company Name: Arcadis	**Tel/Email:**	**Lab Contact:**	**Carrier:**	3 of 3 COCs OUL
Address:	**Analysis Turnaround Time**			Sampler:
City/State/Zip:	☐ CALENDAR DAYS ☐ WORKING DAYS			**For Lab Use Only:**
Phone:	TAT if different from Below Standard			Walk-in Client:
Fax:	☐ 2 weeks			Lab Sampling:
Project Name: Ford LTP	☐ 1 week			
Site:	☐ 2 days			Job / SDG No.:
P O # 30144174.20	☐ 1 day			

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Filtered Sample (Y / N)	Perform MS / MSD (Y / N)	FL Tracer	#chemical samples rec'd	#water samples rec'd	Sample Specific Notes:
PMW-01_0_110122	11/1/22	1400	G	GW	1			X	0	1	G0768
PMW-01_4949_110322	11/3/22	1326	G	GW	1			X	0	1	G0769
PMW-02_0_110222	11/2/22	0934	G	GW	1			X	0	1	G0770
PMW-03_0_110222	11/2/22	0936	G	GW	1			X	0	1	G0771

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other ______

Possible Hazard Identification:
Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample.

☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)

☐ Return to Client ☐ Disposal by Lab ☐ Archive for ______ Months

Special Instructions/QC Requirements & Comments: OUL project #1987 Analyzed by AC/OUL 11/21/22 analysis graphs proofed by CA/OUL

Custody Seals Intact: ☒ Yes ☐ No

Custody Seal No.:

Cooler Temp. (°C): Obs'd: ______ Corr'd: ______ Therm ID No.: ______

Relinquished by: Sommer Shay	Company: Arcadis	Date/Time: 11/15/22 1500	Received by: Fed Ex	Company: Fed Ex	Date/Time: 11/15/22 1500
Relinquished by:	Company:	Date/Time:	Received by: A. Goers	Company: OUL	Date/Time: 11/16/22 1500
Relinquished by:	Company:	Date/Time:	Received in Laboratory by:	Company:	Date/Time:

Ozark
UNDERGROUND
LABORATORY 1572 Aley Lane • Protem, MO 65733 • (417) 785-4289 • fax (417) 785-4290 • contact@ozarkundergroundlab.com

Certificate of Analysis

Date of certificate: January 13, 2023

Client: ARCADIS
28550 Cabot Dr #500
Novi, MI 48377

Contact people: Matthew.Williams@arcadis.com
Erika.Jarchow@arcadis.com
Ryan.Oesterreich@arcadis.com

Project name/location: Ford LTP, Livonia, MI

Project number: 30144174.20

Samples collected by: Lehua Ferreim

Date samples shipped: January 6, 2023

Date samples rec'd at OUL: January 9, 2023

Date analyzed by OUL: January 12, 2023

Included with certificate of analysis: Table of results, copy of chain of custody records

Results for water samples analyzed for the presence of fluorescein dye.

Peak wavelengths are reported in nanometers (nm); dye concentrations are reported in parts per billion (ppb).

OUL Number	Sample ID	Date/Time Collected	Fluorescein Results	
			Peak (nm)	Conc. (ppb)
G2299	DR-2D_111722	11/17/22 0945	507.4	547
G2300	Laboratory control water blank			
G2301	DR-2D_120222	12/2/22 1025	507.6	481
G2302	DR-2D_120722	12/7/22 1048	507.5	3,380
G2303	DR-2D_122822	12/28/22 1125	507.6	4,370
G2304	DR-2S_110822	11/8/22 1112	507.7	16,600
G2305	DR-2S_111522	11/15/22 1015	507.9	13,700
G2306	DR-2S_112122	11/21/22 1015	507.9	5,480
G2307	DR-2S_112822	11/28/22 1025	507.7	446
G2308	DR-2S_120222	12/2/22 1020	507.9	1,830
G2309	DR-2S_121322	12/13/22 1400	507.9	2,360
G2310	DR-2S_122122	12/21/22 1043	507.9	1,310
G2311	MW-23_110822	11/8/22 1121	508.1	2,780
G2312	MW-23_111022	11/10/22 1215	508.1	5,380
G2313	MW-23_111522	11/15/22 1035	507.9	3,900
G2314	MW-23_111722	11/17/22 0845	508.0	2,770
G2315	MW-23_112122	11/21/22 0930	508.0	2,070
G2316	MW-23_112322	11/23/22 1000	508.1	1,330
G2317	MW-23_112822	11/28/22 1030	504.6 **	1.77
G2318	PMW-1_110822	11/8/22 1130	507.4	5,690
G2319	PMW-1_111022	11/10/22 1226	507.7	6,310
G2320	Laboratory control water blank			
G2321	PMW-1_111522	11/15/22 1030	507.6	2,970
G2322	PMW-1_111722	11/17/22 0855	507.7	1,950
G2323	PMW-1_112122	11/21/22 0920	507.4	1,240

OUL Number	Sample ID	Date/Time Collected	Fluorescein Results	
			Peak (nm)	Conc. (ppb)
G2324	PMW-1_112322	11/23/22 0930	507.3	921
G2325	PMW-1_112822	11/28/22 1025	507.5	416
G2326	PMW-2_110822	11/8/22 1138	507.5	5,100
G2327	PMW-2_111522	11/15/22 0920	507.4	3,790
G2328	PMW-2_111722	11/17/22 0825	507.5	4,120
G2329	PMW-2_112122	11/21/22 0910	507.4	2,400
G2330	PMW-2_3000_110222	11/2/22 1528	507.6	1.59
G2331	PMW-2_112322	11/23/22 0920	507.4	1,750
G2332	PMW-2_112822	11/28/22 1015	507.4	1,050
G2333	PMW-3_112122	11/21/22 0915	507.5	45.3
G2334	PMW-3_112822	11/28/22 1020	507.5	24.0

Note: Dye concentrations are based upon standards used at the OUL. The standard concentrations are based upon the as sold weight of the dye that the OUL uses. If the client is not using OUL dyes, the client should provide the OUL with a sample of the dye to compare to the OUL dyes.

Footnotes: ** = A fluorescence peak is present that does not meet all the criteria for this dye. However, it has been calculated as a positive dye result.

Thomas J. Aley, PHG and RG

Thomas Aley

Page 1 of 3
OUL

Pace Analytical®
www.pacelabs.com

UPPER MIDWEST REGION
MN: 612-607-1700 **WI:** 920-469-2436

CHAIN OF CUSTODY

*Preservation Codes
A=None B=HCL C=H2SO4 D=HNO3 E=DI Water F=Methanol G=NaOH
H=Sodium Bisulfate Solution I=Sodium Thiosulfate J=Other

(Please Print Clearly)

Company Name: Arcadis
Branch/Location: Novi MI 48377
Project Contact: Erika Jarchow
Phone: 612-373-0213
Project Number: 30144174
Project Name: Ford LTP-Drift phase Monitoring
Project State: MI
Sampled By (Print): Lehicia Ferreira
Sampled By (Sign):
PO #: 30144174.20
Regulatory Program:

Quote #:
Mail To Contact:
Mail To Company:
Mail To Address: 28550 Cabot Dr #500
Novi, MI 48377
Invoice To Contact: ~~Erik~~ Matt Williams,
Invoice To Company:
Invoice To Address: Matthew.williams@arcadis.com; ~~Erika.Jarchow@arcadis.com~~
Erika.Jarchow@arcadis.com
Invoice To Phone: 989-859-6645

Data Package Options (billable)
☐ EPA Level III
☐ EPA Level IV

MS/MSD
☐ On your sample (billable)
☐ NOT needed on your sample

Matrix Codes
A = Air
B = Biota
C = Charcoal
O = Oil
S = Soil
Sl = Sludge
W = Water
DW = Drinking Water
GW = Ground Water
SW = Surface Water
WW = Waste Water
WP = Wipe

FILTERED? (YES/NO) — Y/N
PRESERVATION (CODE)* — Pick Letter

PACE LAB #	CLIENT FIELD ID	COLLECTION DATE	COLLECTION TIME	MATRIX	Analyses Requested: FL Tracer	# Charcoal rcvd @ OUL	# water rcvd @ OUL	CLIENT COMMENTS	LAB COMMENTS (Lab Use Only)
G2299	DR-2D_111722	11/17/22	0945	GW	X	0	1	1 Container	G2300 OUL
G2301	DR-2D-120222	12/02/22	1025	GW	X	0	1	↑	Water Blank
G2302	DR-2D-120722	12/07/22	1048	GW	X	0	1		
G2303	DR-2D_122822	12/28/22	1125	GW	X	0	1		
G2304	DR-2S_110822	11/08/22	1112	GW	X	0	1		
G2305	DR-2S-111522	11/15/22	1015	GW	X	0	1		
G2306	DR-2S-112122	11/21/22	1015	GW	X	0	1		
G2307	DR-2S-112822	11/28/22	1025	GW	X	0	1		analysis graphs
G2308	DR-2S-120222	12/02/22	1020	GW	X	0	1		proofed by cafour
G2309	DR-2S-121322	12/13/22	1400	GW	X	0	1		
G2310	DR-2S-122122	12/21/22	1043	GW	X	0	1		OUL project #1987
G2311	MW-23_110822	11/08/22	1121	GW	X	0	1		Analyzed by Ac/OUL
G2312	MW-23_111022	11/10/22	1215	GW	X	0	1	↓	1/12/23

Profile #

Rush Turnaround Time Requested - Prelims
(Rush TAT subject to approval/surcharge)
Date Needed:

Transmit Prelim Rush Results by (complete what you want):
Email #1:
Email #2:
Telephone:
Fax:

Samples on HOLD are subject to special pricing and release of liability

Relinquished By:	Date/Time:	Received By:	Date/Time:
Lehicia Ferreira (Arcadis)	01/06/23 12:30	FedX	01/06/23 12:30
		C. Alex / OUL	1-9-23 1430

PACE Project No.

Receipt Temp = °C

Sample Receipt pH
OK / Adjusted

Cooler Custody Seal
[✓ Present] / Not Present
Intact / Not Intact

Page 2 of 3 OUL

Pace Analytical®
www.pacelabs.com

UPPER MIDWEST REGION
MN: 612-607-1700 WI: 920-469-2436

CHAIN OF CUSTODY

(Please Print Clearly)

Company Name:
Branch/Location:
Project Contact:
Phone:
Project Number:
Project Name:
Project State:
Sampled By (Print):
Sampled By (Sign):
PO #:
Regulatory Program:

Quote #:
Mail To Contact:
Mail To Company:
Mail To Address:
Invoice To Contact:
Invoice To Company:
Invoice To Address:
Invoice To Phone:

*Preservation Codes
A=None B=HCL C=H2SO4 D=HNO3 E=DI Water F=Methanol G=NaOH
H=Sodium Bisulfate Solution I=Sodium Thiosulfate J=Other

FILTERED? (YES/NO) — Y/N
PRESERVATION (CODE)* — Pick Letter

Data Package Options (billable)
☐ EPA Level III
☐ EPA Level IV

MS/MSD
☐ On your sample (billable)
☐ NOT needed on your sample

Matrix Codes
A = Air
B = Biota
C = Charcoal
O = Oil
S = Soil
Sl = Sludge
W = Water
DW = Drinking Water
GW = Ground Water
SW = Surface Water
WW = Waste Water
WP = Wipe

Analyses Requested

PACE LAB #	CLIENT FIELD ID	COLLECTION DATE	COLLECTION TIME	MATRIX	FL Tracer		# charcoal rcvd @ OUL	# water rcvd @ OUL					CLIENT COMMENTS	LAB COMMENTS (Lab Use Only)	Profile #
G2313	MW-23_111522	11/15/22	10:35	GW	X		0	1					1 container	G2320 OUL	
G2314	MW-23-111722	11/17/22	0845	GW	X		0	1						Water Blank	
G2315	MW-23_112122	11/21/22	0930	GW	X		0	1							
G2316	MW-23_112322	11/23/22	10:00	GW	X		0	1							
G2317	MW-23_112822	11/28/22	10:30	GW	X		0	1							
G2318	PMW-1_110822	11/08/22	1130	GW	X		0	1							
G2319	PMW-1_111022	11/10/22	12:26	GW	X		0	1						Analysis graphs	
G2321	PMW-1_111522	11/15/22	1030	GW	X		0	1						proofed by CA/OUL	
G2322	PMW-1_111722	11/17/22	0855	GW	X		0	1							
G2323	PMW-1_112122	11/21/22	0920	GW	X		0	1							
G2324	PMW-1_112322	11/23/22	0930	GW	X		0	1						OUL project #1987	
G2325	PMW-1_112822	11/28/22	10:25	GW	X		0	1						Analyzed by AC/OUL	
G2326	PMW-2_110822	11/08/22	1138	GW	X		0	1						1/12/23	

Rush Turnaround Time Requested - Prelims
(Rush TAT subject to approval/surcharge)
Date Needed:

Transmit Prelim Rush Results by (complete what you want):
Email #1:
Email #2:
Telephone:
Fax:

Samples on HOLD are subject to special pricing and release of liability

Relinquished By:	Date/Time:	Received By:	Date/Time:
Alicia Ferreira (Arcadis)	01/06/23 12:30	FedX	01/06/23 12:30
		C. Aley / OUL	1-9-23 1430

PACE Project No.

Receipt Temp = °C

Sample Receipt pH
OK / Adjusted

Cooler Custody Seal
[✓ Present] / Not Present
[✓ Intact] / Not Intact

Pace Analytical®
www.pacelabs.com

UPPER MIDWEST REGION
MN: 612-607-1700 WI: 920-469-2436

Page 3 of 3 OUL

CHAIN OF CUSTODY

(Please Print Clearly)

Company Name:
Branch/Location:
Project Contact:
Phone:
Project Number:
Project Name:
Project State:
Sampled By (Print):
Sampled By (Sign):
PO #:
Regulatory Program:

Quote #:
Mail To Contact:
Mail To Company:
Mail To Address:
Invoice To Contact:
Invoice To Company:
Invoice To Address:
Invoice To Phone:

***Preservation Codes**
A=None B=HCL C=H2SO4 D=HNO3 E=DI Water F=Methanol G=NaOH
H=Sodium Bisulfate Solution I=Sodium Thiosulfate J=Other

Data Package Options (billable)
☐ EPA Level III
☐ EPA Level IV

MS/MSD
☐ On your sample (billable)
☐ NOT needed on your sample

Matrix Codes
A = Air W = Water
B = Biota DW = Drinking Water
C = Charcoal GW = Ground Water
O = Oil SW = Surface Water
S = Soil WW = Waste Water
Sl = Sludge WP = Wipe

FILTERED? (YES/NO) | Y/N
PRESERVATION (CODE)* | Pick Letter

PACE LAB #	CLIENT FIELD ID	COLLECTION DATE	COLLECTION TIME	MATRIX	Analyses Requested	FL Tracer		# charcoal rcvd @ OUL	# water rcvd @ OUL				CLIENT COMMENTS	LAB COMMENTS (Lab Use Only)	Profile #
	~~PMW-2_111022~~	~~11/10/22~~	~~1244~~	~~GW~~		X		0	0				1 container		
G2327	PMW-2_111522	11/15/22	0920	GW		X		0	1						
G2328	PMW-2_111722	11/17/22	0825	GW		X		0	1						
G2329	PMW-2_112122	11/21/22	0910	GW		X		0	1						
G2330	PMW-2_3000_110222	11/02/22	1528	GW		X		0	1						
G2331	PMW-2_112322	11/23/22	0920	GW		X		0	1					Analysis graphs	
G2332	PMW-2-112822	11/28/22	1015	GW		X		0	1					proofed by CA/OUL	
G2333	PMW-3_112122	11/21/22	0915	GW		X		0	1						
G2334	PMW-3_112822	11/28/22	1020	GW		X		0	1						
														OUL project #1987	
														Analyzed by AC/OUL	
														1/12/23	

Rush Turnaround Time Requested - Prelims
(Rush TAT subject to approval/surcharge)
Date Needed:

Transmit Prelim Rush Results by (complete what you want):
Email #1:
Email #2:
Telephone:
Fax:

Samples on HOLD are subject to special pricing and release of liability

Relinquished By:	Date/Time:	Received By:	Date/Time:
Chris Ferreira (Arcadis)	01/06/23 12:30	FedX	01/06/23 12:30
		C. Caley / OUL	1-9-23 1430

PACE Project No.

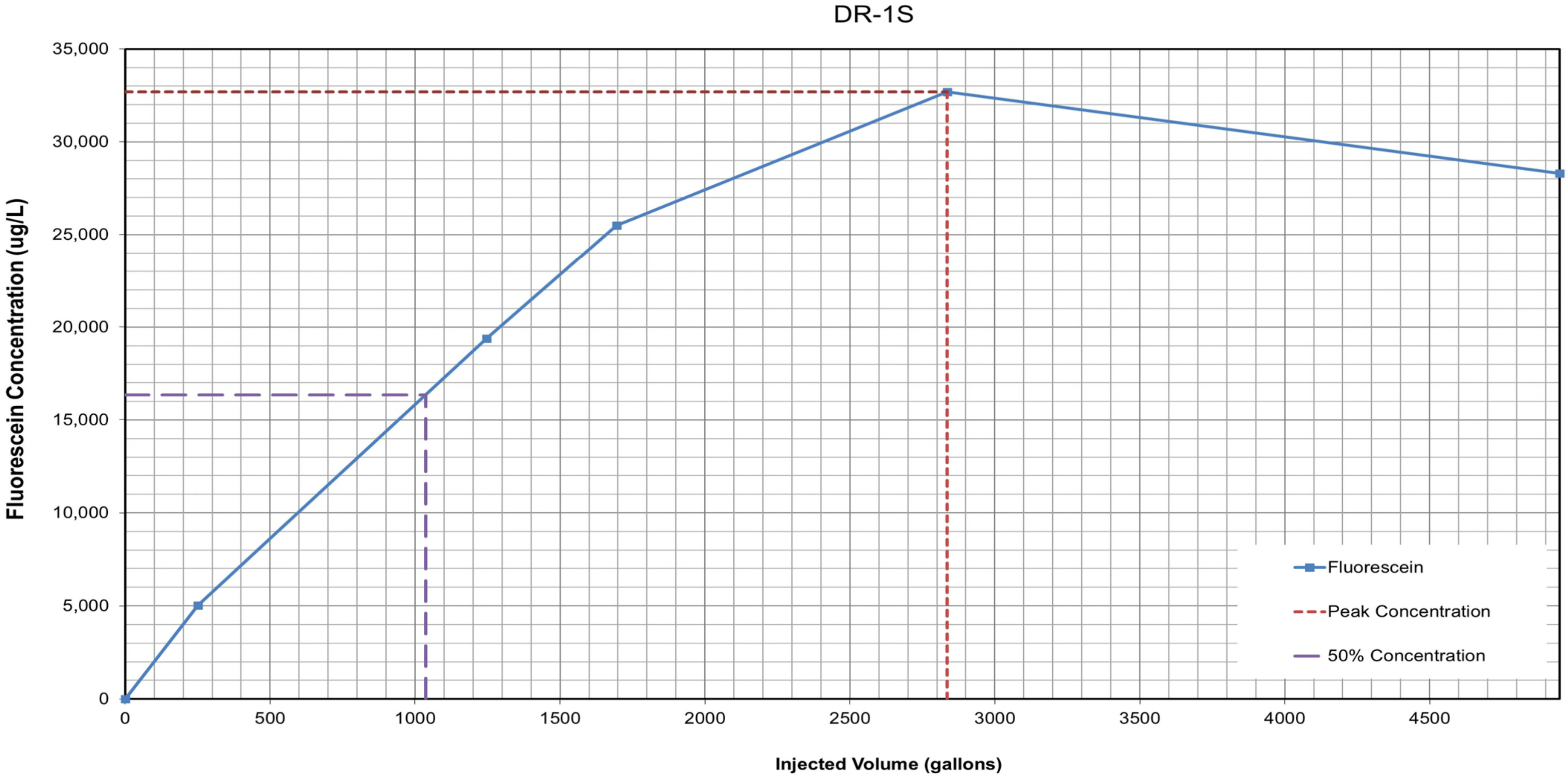
Receipt Temp = °C

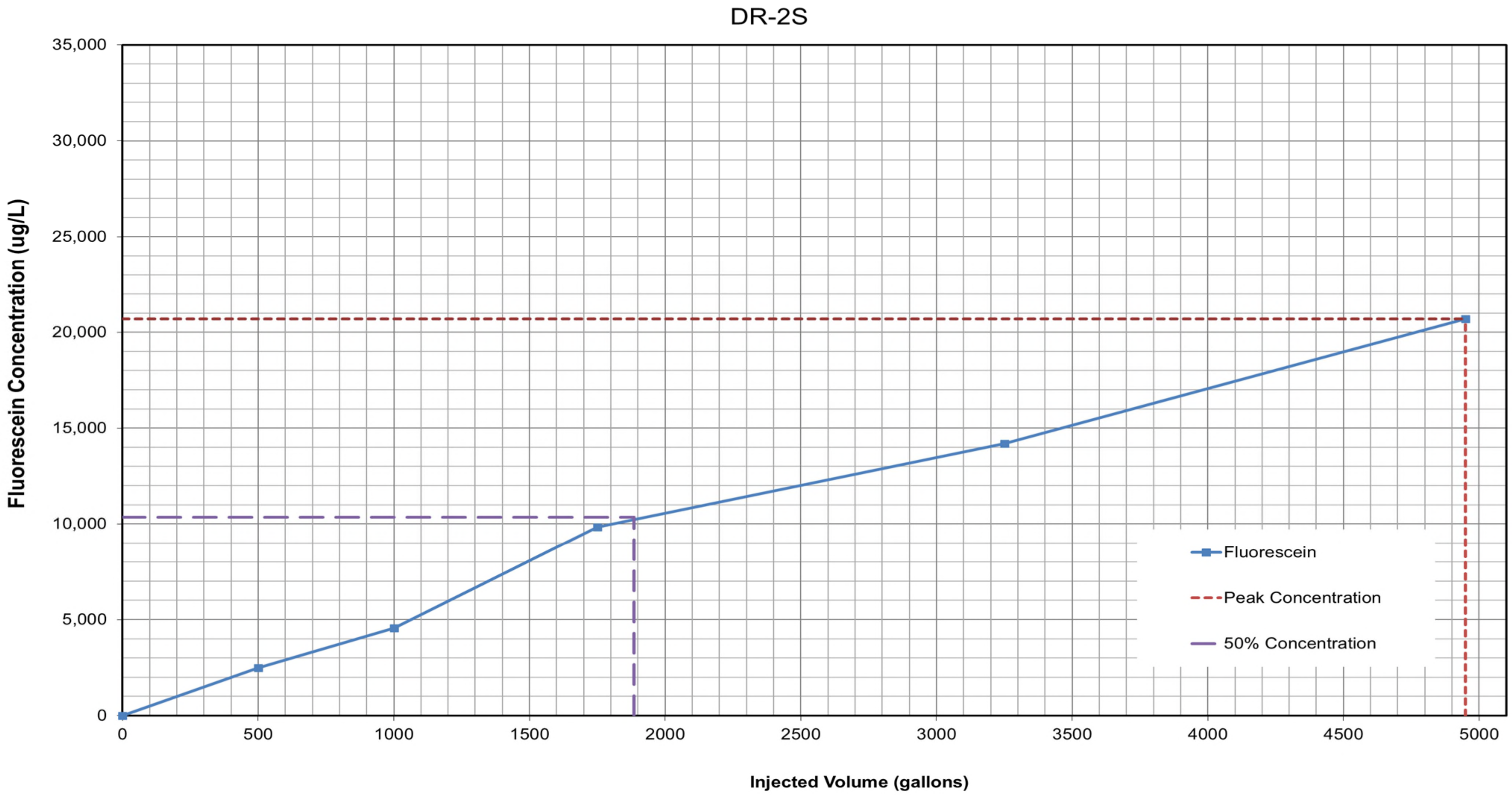
Sample Receipt pH
OK / Adjusted

Cooler Custody Seal
[✓ Present] / Not Present
[✓ Intact] / Not Intact

Appendix D

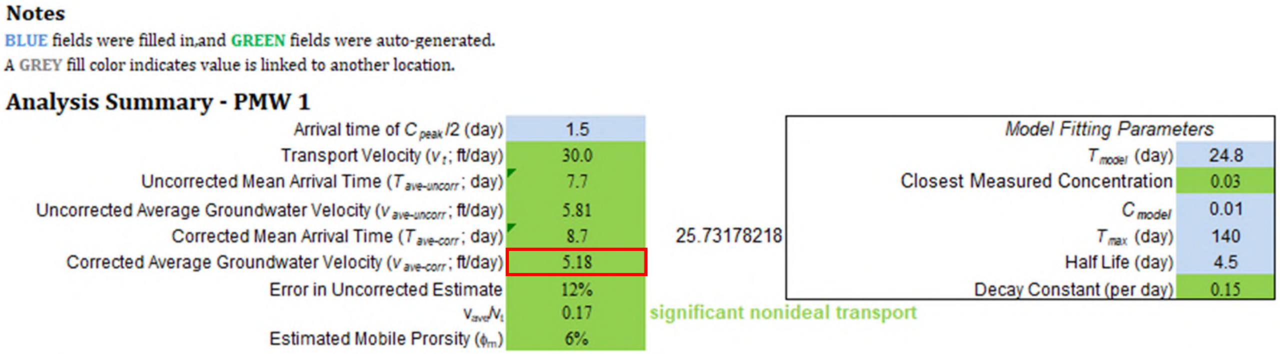
Mobile Porosity Calculations


DR-1S
Fluorescein Concentration (ug/L)
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
0
500
1000
1500
2000
2500
3000
3500
4000
4500
Injected Volume (gallons)
Fluorescein
Peak Concentration
50% Concentration


DR-2S
Fluorescein Concentration (ug/L)
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
Injected Volume (gallons)
Fluorescein
Peak Concentration
50% Concentration

Appendix E

Groundwater Velocity Calculations



Notes

BLUE fields were filled in,and GREEN fields were auto-generated.

A GREY fill color indicates value is linked to another location.

Analysis Summary - PMW 1

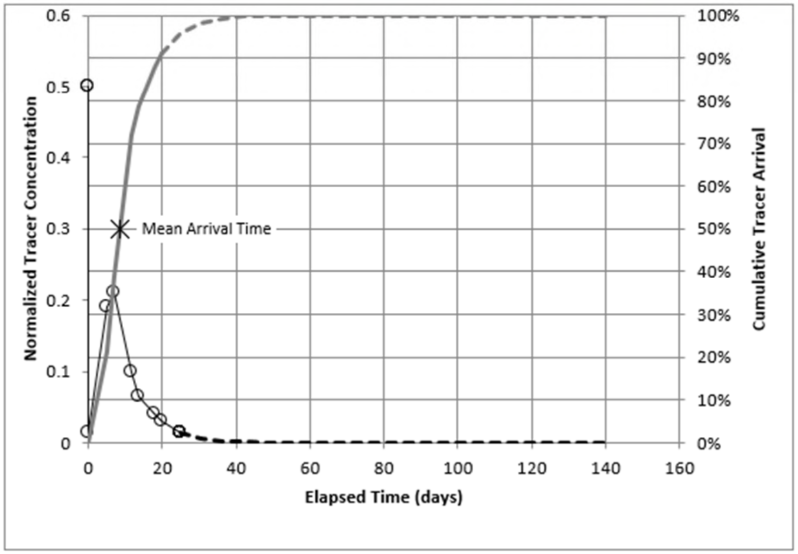
Arrival time of $C_{peak}/2$ (day)	1.5
Transport Velocity (v_t; ft/day)	30.0
Uncorrected Mean Arrival Time ($T_{ave\text{-}uncorr}$; day)	7.7
Uncorrected Average Groundwater Velocity ($v_{ave\text{-}uncorr}$; ft/day)	5.81
Corrected Mean Arrival Time ($T_{ave\text{-}corr}$; day)	8.7
Corrected Average Groundwater Velocity ($v_{ave\text{-}corr}$; ft/day)	5.18
Error in Uncorrected Estimate	12%
V_{ave}/V_t	0.17
Estimated Mobile Prorsity (ϕ_m)	6%

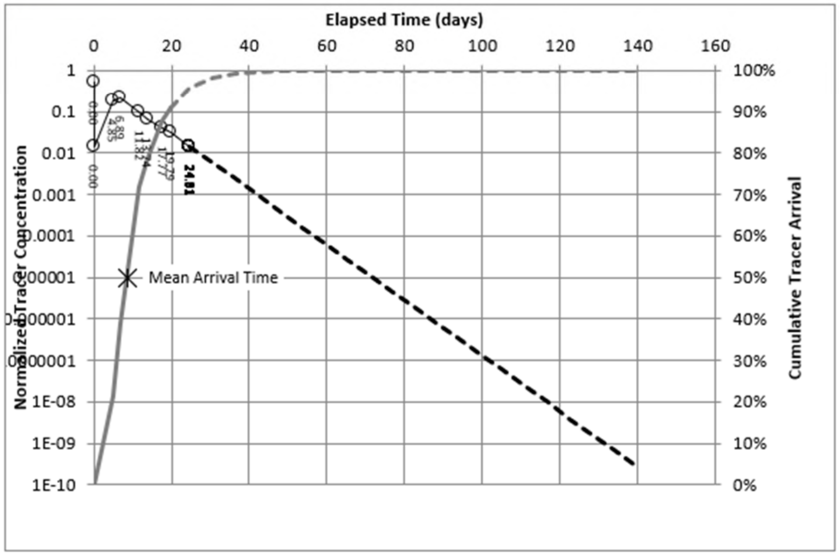
25.73178218

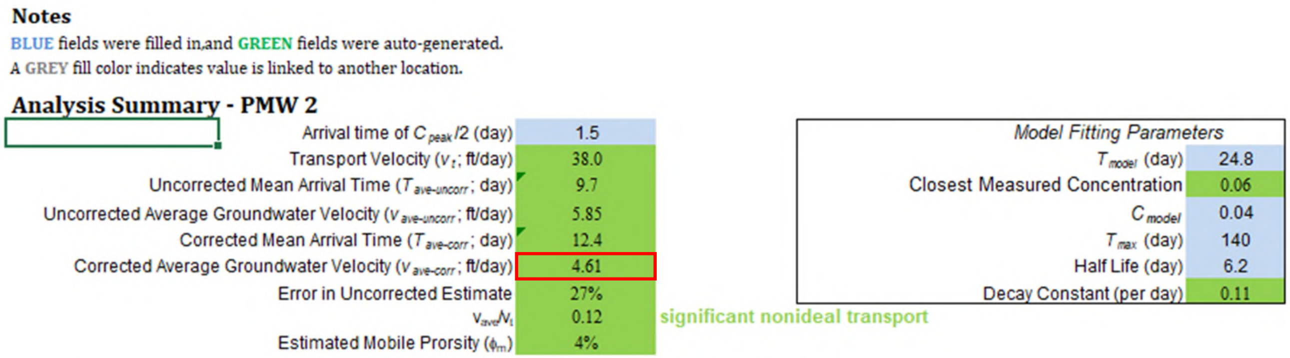
significant nonideal transport

Model Fitting Parameters

T_{model} (day)	24.8
Closest Measured Concentration	0.03
C_{model}	0.01
T_{max} (day)	140
Half Life (day)	4.5
Decay Constant (per day)	0.15







Notes

BLUE fields were filled in,and GREEN fields were auto-generated.
A GREY fill color indicates value is linked to another location.

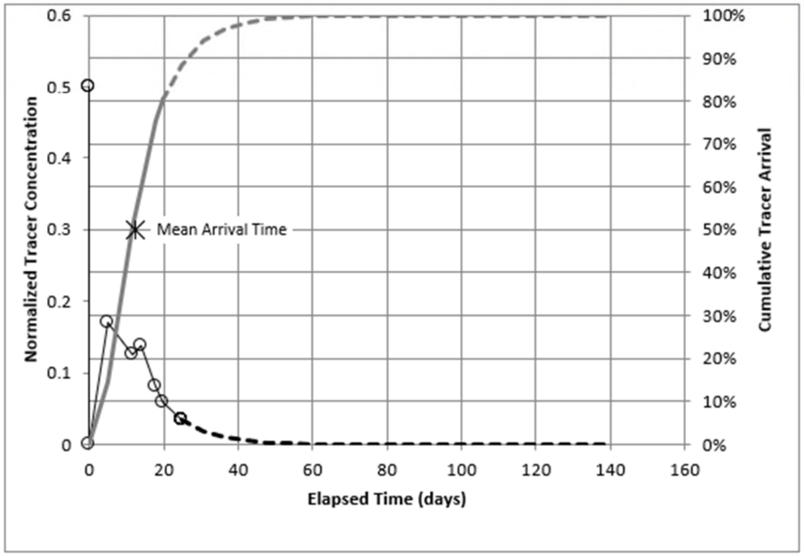
Analysis Summary - PMW 2

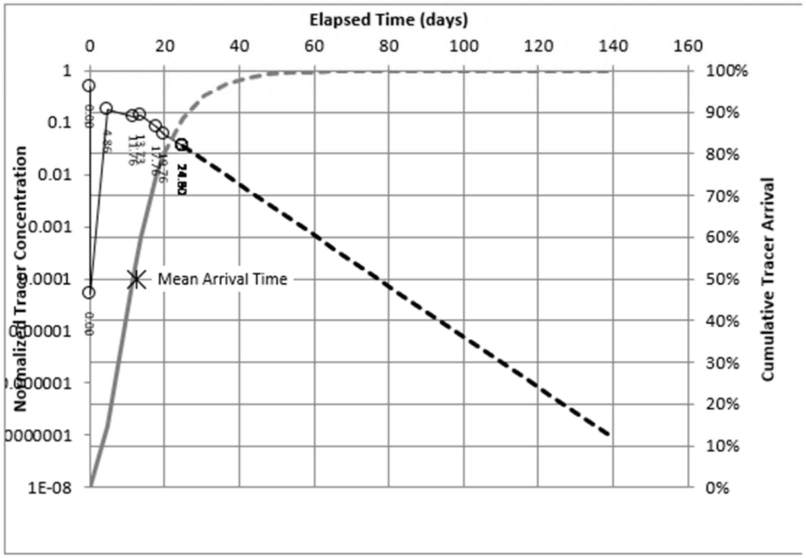
Arrival time of $C_{peak}/2$ (day)	1.5
Transport Velocity (v_t; ft/day)	38.0
Uncorrected Mean Arrival Time ($T_{ave\text{-}uncorr}$; day)	9.7
Uncorrected Average Groundwater Velocity ($v_{ave\text{-}uncorr}$; ft/day)	5.85
Corrected Mean Arrival Time ($T_{ave\text{-}corr}$; day)	12.4
Corrected Average Groundwater Velocity ($v_{ave\text{-}corr}$; ft/day)	4.61
Error in Uncorrected Estimate	27%
V_{ave}/V_t	0.12
Estimated Mobile Prorsity (ϕ_m)	4%

significant nonideal transport

Model Fitting Parameters

T_{model} (day)	24.8
Closest Measured Concentration	0.06
C_{model}	0.04
T_{max} (day)	140
Half Life (day)	6.2
Decay Constant (per day)	0.11





Appendix F

Molasses Safety Data Sheet

Westway

MATERIAL SAFETY DATA SHEET
MOLASSES/MOLASSES BLENDS

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Chemical Name	Chemical Formula	Molecular Weight
NA	Mixture of liquid Agricultural commodities	No data

Trade Name – Molasses/Molasses Blends

Synonyms	DOT Identification No.
Liquid animal supplement	NA

Company Identification:

Westway Trading Corporation
365 Canal Street, Suite 2900
New Orleans, Louisiana 70130
(504) 525-9741

2. COMPOSITION, INFORMATION ON INGREDIENTS

Component(s), Chemical Name	CAS Registry No.	%(Approx.)	ACGIH TLV-TWA
Proprietary **See ingredient tag**	NA	No data	No data

3. HAZARDS IDENTIFICATION

Emergency Overview

This material should be stored in a vented tank designed to contain a material with a specific gravity of 1.3 or greater. Material can ferment if excessive moisture contamination is allowed. Fermentation can yield carbon dioxide with possible traces of ethanol or volatile fatty acids (e.g. acetic, propionic, lactic, or butyric) and if exposed to a spark or flame may result in an explosion. These conditions should be avoided. If maintenance of tank requires entry by personnel, OSHA's Confined Space standard (29CFR1910.146) shall be complied with. If welding is to be performed, the tank should be gas freed and only certified welders shall perform welding operations.

Potential Health Effects

Eyes - Mild irritant
Skin - None
Inhalation – Insufficient oxygen may be present in vessels containing the product due to the generation of carbon monoxide during fermentation

4. FIRST AID MEASURES

Eyes: Flush eyes for 15 minutes.
Skin: Wash with soap and water.
Ingestion: No data

5. FIRE FIGHTING MEASURES

Flashpoint (Method used)	Flammable Limits in Air
Non-flammable Non-combustible	Non-flammable Non-combustible

Extinguishing Agents - NA

Unusual Fire and Explosion Hazards – Fermentation occurs when diluted with water and is accelerated by heat. During fermentation carbon monoxide with possible traces of ethanol or volatile fatty acids (e.g., acetic, propionic, lactic, or butryic) is given off, which produces inhalation hazards and possible explposion hazards.

6. ACCIDENTAL RELEASE MEASURES

Steps to be Taken in Case Material is Released or Spilled

Small spills - Stop the source of the spill. Recover as much product as possible for reuse. Absorb remaining spill and dispose solids in waste container.

Large spills - Stop the source of the spill. Create diversionary structures to minimize the extent of the release. Prevent the release from entering a waterway or sewer. Recover useable product. Absorb remaining spill and dispose of at an approved facility such as a municipal landfill or land application site.

7. HANDLING AND STORAGE

This material should be stored in a vented tank designed to contain a material with a specific gravity of 1.3 or greater. Material can ferment if excessive moisture contamination is allowed.

8. EXPOSURE CONTROLS, PERSONAL PROTECTION

Respiratory Protection - None

Ventilation – Provide adequate ventilation to prevent accumulation of vapors.

Skin Protection - Rubber gloves

Eye Protection - Safety glasses

Hygiene - Wash any exposed area promptly with soap and water. Launder contaminated clothing.

Other Control Measures - None

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance Dark brown syrupy liquid	Odor Sweet
Physical State Liquid	Specific Gravity 1.45
Boiling Point Very high	Freezing/Melting Point Varies
Vapor Pressure Low	% Volatile, by Volume No data
Evaporation Rate No data	Vapor Density in Air Water vapor only
Solubility in Water Soluble	pH 2.25 to 6.0

10. STABILITY AND REACTIVITY

Chemical Stability - Stable

Conditions to Avoid – Excess moisture or heat. Unventilated containers.

Incompatibility with Other Materials -

Reacts with concentrated nitric acid or concentrated sulphuric acid. Ferments when diluted with water.

Hazard Decomposition Products – Carbon monoxide, alcohol or fatty acid vapors

Hazardous Polymerization - NA

11. ECOLOGICAL INFORMATION

Prevent releases to land or water. Results in high Biological Oxygen Demand (BOD) and potential oxygen depletion of aquatic systems.

12. DISPOSAL CONSIDERATIONS

Dispose of waste material at an approved municipal landfill or land application site.

13. TRANSPORT INFORMATION

Hazardous Materials Description/ Proper Shipping Name - NA

DOT Hazard Class - NA

DOT Identification Number - NA

X This product is not a DOT hazardous material.

14. REGULATORY INFORMATION

Discharges to a water of the U.S. are regulated by the Environmental Protection Agency.

15. OTHER INFORMATION

None.

Date of Preparation: 3/15/96 **REVISED: 10/12/01**

Prepared by: Jane Besch, Director - HSE

Disclaimer:

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