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December 1, 2022
File No. 16.0062961.02

Ms. Karen Vorce, District Supervisor
Grand Rapids District Office
Remediation and Redevelopment Division
Michigan Department of Environment, Great Lakes, and Energy
350 Ottawa Avenue NW, Unit 10
Grand Rapids, MI 49503
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Re: Wolverine World Wide, Inc. Consent Decree Court Case No. 1:18-cv-00039
Tannery Interceptor System Response Activity Plan Addendum

Dear Ms. Vorce:

Rose & Westra, a Division of GZA GeoEnvironmental, Inc. (R&W/GZA) submits this Tannery Interceptor System Response Activity Plan Addendum (RAP Addendum) under Paragraph 7.14(b) of the Wolverine Consent Decree (W.D. Mich. Case No. 1:18-cv-39; Consent Decree). This RAP Addendum summarizes modifications to the Final Tannery Interceptor System Response Activity Plan dated March 31, 2022 (RAP) and includes the proposed interceptor system design changes and an updated implementation schedule based upon proposed changes.

If you need additional information, please contact Mark Westra at 616.258.7201.

Very truly yours,

Rose & Westra, a Division of GZA GeoEnvironmental, Inc.

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TANNERY INTERCEPTOR SYSTEM RESPONSE ACTIVITY PLAN ADDENDUM

DRAFT – FOR REVIEW ONLY

Disclaimer: This document is a DRAFT document that has not received approval from the Michigan Department of Environment, Great Lakes, and Energy (EGLE). This document was prepared pursuant to a court Consent Decree. The opinions, findings and conclusions expressed are those of the authors and not those of EGLE.

December 1, 2022
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PREPARED FOR:
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TABLE OF CONTENTS

TABLES IN THE BODY OF THE REPORT

TABLE OF CONTENTS

FIGURES IN THE BODY OF TEXT

PLOTS IN THE BODY OF TEXT

FIGURES/SHEETS

APPENDICES

1.0 INTRODUCTION

On behalf of Wolverine World Wide, Inc. (Wolverine), R&W/GZA prepared this Tannery Interceptor System Response Action Plan Addendum (RAP Addendum) for the proposed Interceptor System at the former Wolverine Tannery, 181 North Main Street, Rockford, Michigan (Site). This RAP Addendum includes the proposed interceptor system design and implementation schedule changes to the Final Tannery Interceptor System Response Activity Plan (RAP), dated March 31, 2022 (RAP). The objective of the RAP and this RAP Addendum is to develop initial design parameters for a groundwater interceptor system that will ultimately meet the performance objective in Paragraph 7.7(b) of the Consent Decree (CD).

On March 31, 2022, Wolverine submitted the Michigan Department of Environment, Great Lakes, and Energy (EGLE)-approved RAP. The initial design presented in the RAP consisted of a network of pumping wells to induce inward hydraulic gradients and therefore preventing groundwater from venting to the surface water. The proposed system included 14 shallow extraction wells, 3 deep extraction wells south of Rum Creek, and 5 shallow extraction wells north of Rum Creek.

As proposed in the RAP, Section 12.0 Pre-Design Investigation Data, R&W/GZA conducted aquifer performance testing to further inform the System design. In lieu of slug tests, GZA conducted performance testing with pump tests, following RAP approval in early 2022, using the three extraction wells and three piezometers north of Rum Creek. The objective of the performance testing was to evaluate the well capacity and monitor the hydraulic influence in the adjacent piezometers. The availability of the installed extraction wells provided the opportunity to conduct the performance pumping as pilot-scale testing of the extraction system effectiveness.

The aquifer test data identified a lack of continuity of permeable zones which facilitate groundwater extraction and hydraulic control. In September 2022, R&W/GZA communicated with EGLE address the concern, based on the results of the pump tests, that the EGLE-approved design in the RAP likely would not be effective at meeting the performance objective under the CD. In the September 27, 2022, correspondence from R&W/GZA to EGLE, R&W/GZA explained as follows:

> "…these recent pumping tests indicate that successful implementation of such an extraction well system will likely be limited by aquifer heterogeneity and long-term operation and maintenance requirements. Given the practical limitations of the Site conditions, and the information gathered from recent pumping tests, we now believe a combination of groundwater pumping wells and trench collection systems will provide more reliable hydraulic control at the Site."

Rather than proceed to install a system that would not be effective, R&W/GZA's September 27, 2022, correspondence to EGLE proposed submitting an amended RAP for a revised system and committed to providing this RAP Addendum with a schedule and sequence for the phased installation and performance monitoring of the groundwater extraction system.

R&W/GZA has conducted numerous modeling runs to balance extraction rates with effective hydraulic control while limiting induced recharge from the Rogue River and Rum Creek. The 2022 performance pumping tests indicated greater spatial variability of lithology and resulting hydraulic conductivity than previously measured or modeled. Based on combining the model output and pumping data with the performance objectives, a combination of groundwater collection trenches and extraction wells results in better performance (more likely to successfully capture the groundwater), and therefore, require less modification during the two-year demonstration period than either trenches or extraction wells alone.

To help address these highly heterogeneous lithologies and hydraulic conductivities, R&W/GZA has revised the groundwater interceptor system by utilizing groundwater collection trenches and extraction wells. The implementation of over 2,000 feet of groundwater collection trenches and paired extraction wells is significant but will provide the most effective means for intercepting groundwater reaching the Rogue River. This RAP Addendum provides a summary of the performance pumping testing, evaluation of groundwater interception and proposed system design changes, and an updated implementation schedule, all in satisfaction of the October 19, 2022, *Violation Notice Regarding the Tannery Interceptor System Response Activity Plan*.

2.0 PERFORMANCE PUMPING TESTS

The overall objective of designing a groundwater extraction system for the Site is to control the potential for perfluorinated alkyl substances (PFAS) to discharge via groundwater to the Rogue River. Presently, as shown during the Site investigation activities, shallow groundwater contains certain dissolved-phase PFAS that under regional groundwater flow gradients can migrate laterally and potentially discharge to surface water. To address this condition, active pumping and treatment of the shallow groundwater system is planned through an extraction system that is efficiently designed in close consideration of Site constraints and subsurface variabilities. As discussed, in the EGLE-approved RAP, R&W/GZA followed standard practice to form the preliminary extraction system design by evaluating geology and hydrogeology, conducting pumping tests south of Rum Creek, and performing groundwater flow modeling. The design process is typically an iterative process as new Site data is collected, and this system is no different. As discussed for Pre-Design investigation in the RAP to better refine the extraction system, R&W/GZA conducted aquifer performance tests in April and May 2022 to better characterize hydraulic conductivity variations and improve our ability to predict hydraulic influence during pumping. Based upon the RAP preliminary design, three groundwater extraction and recovery wells (EW-1, EW-2, and EW-3) and three piezometers (PZ-1, PZ-2, and PZ-3) were installed north of Rum Creek. **Sheet No. 1** indicates the locations of the installed extraction wells, piezometers, and the monitoring well network. Soil boring and well installation logs for EW-1 through EW-3 and PZ-1 through PZ-3 are included in **Appendix A**.

2.1 METHODOLOGIES

To complete the performance pumping tests, electric submersible groundwater pumps (Grundfos SQ 3-inch 1/2-horsepower single-phase 230 VAC pump and variable frequency drive) were used to withdraw groundwater from each of the groundwater extraction and recovery wells. Initial step- and 72-hour pump tests utilized a portable electric generator as the power source for the pumps; however, to complete the extended seven-day performance pumping, hard-wire electrical connections were utilized to power the pumps. The pumps were suspended in the wells with the bottom of the pump approximately 1 foot from the bottom of the well screen. Discharge tubing extended from the pump out of the extraction well casing and was routed to a centralized manifold where a series of valves were installed for each extraction well. The valves and sample ports installed in the discharge line for each of the pumps were used to collect volumetric measurement of flow rates. The speed of the pumps was adjusted accordingly to maintain constant pumping rates within each of the pumping wells. Discharge lines were then routed into a 21,000-gallon, steel-closed top-storage tank prior to off-Site disposal.

Each of the pumping wells and the observation wells/piezometers were equipped with pressure transducers equipped with data loggers to monitor the effects of the groundwater extraction on the hydraulic head (groundwater elevation). Static water levels were also collected utilizing an electronic water level meter before, during, and after the testing periods.

2.2 IMPLEMENTATION

A step-drawdown aquifer performance test was conducted in April 2022 to evaluate the capacities and hydraulic influence of EW-1, EW-2, and EW-3. The following table provides a summary of the screen interval below ground surface (bgs), pumping durations, designed flow rates, and the sustained flow rates in gallons per minute (GPM) observed in April 2022.

Extraction Well	Screen Interval (ft bgs)	Pump Start	Pump Shutdown	Designed Flow Rate (GPM)	Sustained Flow Rate (GPM)
EW-1	4 to 14	NA	NA	3	<1
EW-2	13 to 23	4/12/2022 8:10 AM	4/14/2022 10:00 PM	3	1
EW-3	4 to 14	4/12/2022 8:10 AM	4/14/2022 10:00 PM	4	4

Table 2-1: Summary of Initial Performance Pumping

To stress the aquifer for a longer duration, a seven-day pumping test was performed on EW-2 and EW-3 north of Rum Creek and TA-RW-1 south of Rum Creek. Pressure transducers were installed in these extraction wells and the nearby groundwater monitoring wells/piezometers to measure water level changes before, during, and after the pumping. Barometric pressures were measured for data compensation. Transducers were installed in the following observation wells/piezometers:

Wells Located North of Rum Creek	Wells Located South of Rum Creek
EW-1	RP-4
EW-2 (Pumping Well)	TA-RW-1 (Pumping Well)
EW-3 (Pumping Well)	TA-MW-2
PZ-1	TA-GW-06
PZ-2	TA-PMW-07
PZ-3	TA-MW-303A
TA-MW-308B	TA-MW-303B
	TA-P-2

Table 2-2: List of Pumping Test Observation Wells/Piezometers

Table 2-3 provides a summary of the pump start, shutdown, and pumping rates.

Extraction Well	Pump Start	Pump Shutdown	Pumping Rate, GPM
EW-2	5/9/2022 12:30 PM	5/16/2022 12:50 PM	1
EW-3	5/9/2022 12:30 PM	5/16/2022 12:50 PM	3 to 4
TA-RW-1	5/9/2022 12:30 PM	5/16/2022 12:50 PM	2.5

Table 2-3: Summary of Pumping Test Periods

The following sections provide a discussion of the results from the performance pumping test.

2.2 AQUIFER CONDITIONS

Refer to **Appendix A** for boring logs for the new wells. Soil at EW-1 was sand and clean fill from ground surface to approximately 6.5 feet bgs, underlain by fine-grained soil (clay and silt) from 6.5 to 20 feet bgs. Groundwater was encountered at approximately 4.4 bgs. A 10-foot well screen was set to a bottom depth of approximately 14 feet bgs. Due to the presence of fine-grained soil below 6.5 feet bgs, the saturated zone was approximately 2 feet. As a result, EW-1 pumped dry during well development at a rate 1 GPM and is not suitable for groundwater extraction.

Soil at EW-2 was alternating layers of clean fill, sand, and fine-grained soil (silt and clay). Groundwater was approximately 4.2 feet bgs. A 10-foot well screen was set to a bottom depth of approximately 23 feet bgs. Of the 10-foot screen length, the total thickness of sandy soil was approximately 2 feet, and the fine-grained soil was approximately 8 feet. The limited thickness of sandy soil resulted in a reduced aquifer transmissivity at this location, low pumping potential, and limited hydraulic influence.

At EW-3, sand was noted from ground surface to approximately 9.6 feet bgs, fine-grained soil (silt and clay) from 9.6 to 18 feet bgs, sand from 18 to 21 feet bgs, fine-grained soil (silt) from 21 to 22 feet bgs, and sand from 22 to 24 feet bgs. Groundwater was approximately 5 feet bgs. A 10-foot well screen was set to a bottom depth of approximately 14 feet bgs. The top half of the well screen is within coarse-grained saturated soil and the lower half of the well screen is within fine-grained soil. Given the thickness of the coarse-grained soil in the saturated zone, EW-3 has a higher production potential to capture groundwater than either EW-1 or EW-2. However, if the water level is drawn down to near the top of the fine-grained soil stratum, the saturated thickness around the well will be reduced, resulting in decreasing groundwater flow to the well. The pumping capacity of EW-3 is limited due to the presence of fine-grained soil at 9.6 feet bgs.

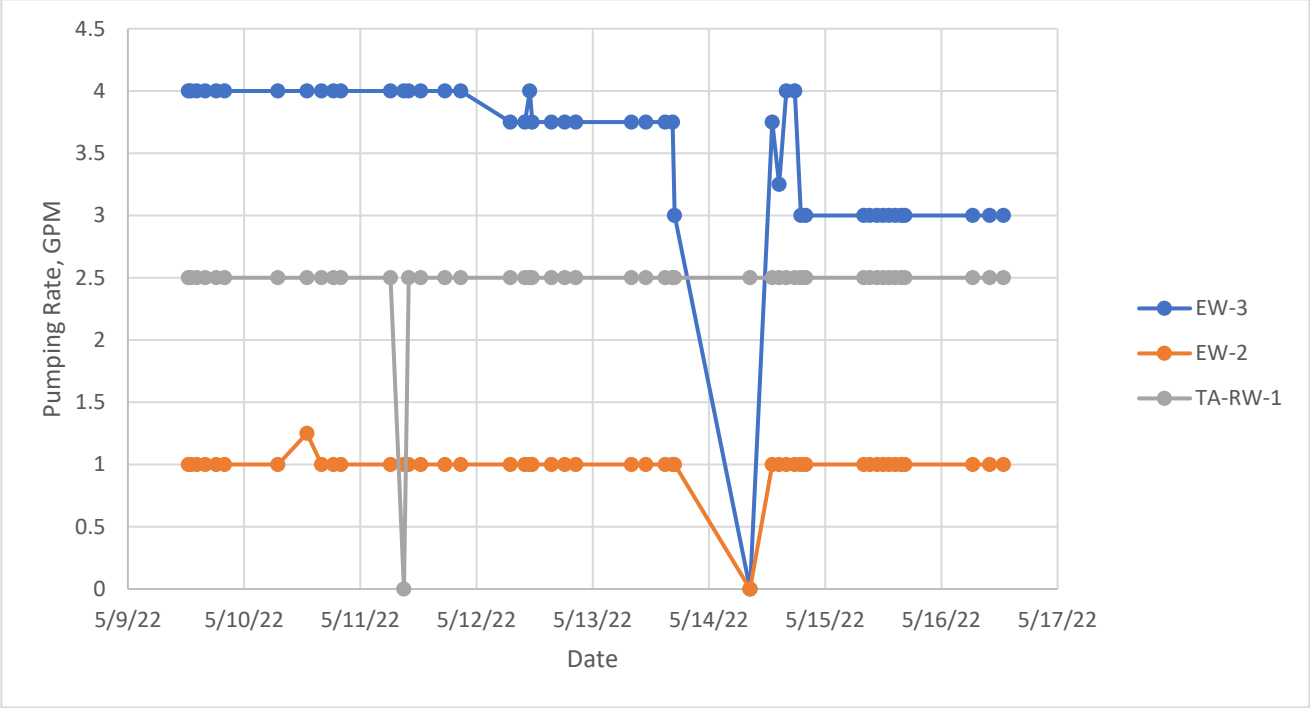
Soils encountered at PZ-1 and PZ-2 (PZ-2 is more like EW-3 than EW-1 with coarse-grained soil to 9 feet) were similar to EW-1, consisting of coarse-grained soil (sand or gravel), underlain by fine-grained soil (silt and clay). Soils at PZ-3 consisted of 5 feet of coarse-grained soil (sand and gravel), underlain by 5 feet of fine-grained soil (silt and clay), and 5 feet of coarse-grained soil (sand).

During installation, EW-1 produced less than 1 GPM for periods longer than 45 minutes before pumping dry. Step pumping rate tests indicated that EW-2 sustained approximately 1 to 1.25 GPM without lowering water levels to the pump intake. EW-3 sustained approximately 4 GPM. The initial 72-hour pump step test conducted at EW-2 and EW-3 did not influence water levels at the adjacent piezometer (PZ-2) located between the two pumping wells (EW-2 and EW-3).

EW-1 and EW-2 were unable to sustain the designed flow rates presented in the RAP. The designed flow rates were based on the groundwater model, calibrated to the Site static water level data set, using hydraulic conductivity values interpreted from previous pumping tests at TA-RW-1, TA-RW-2, and TA-RW-3. Hydraulic properties between well locations or beyond the areas evaluated by the pumping tests at TA-RW-1, TA-RW-2, and TA-RW-3 are unknown. The estimated hydraulic conductivities from the calibrated model were representative of a greater scale than the localized pump test observations. As is common with many groundwater modeling scenarios, the calibrated groundwater model tends to lack the resolution to simulate specific flow conditions that are driven by localized subsurface heterogeneities such as those observed at EW-1, EW-2, and EW-3.

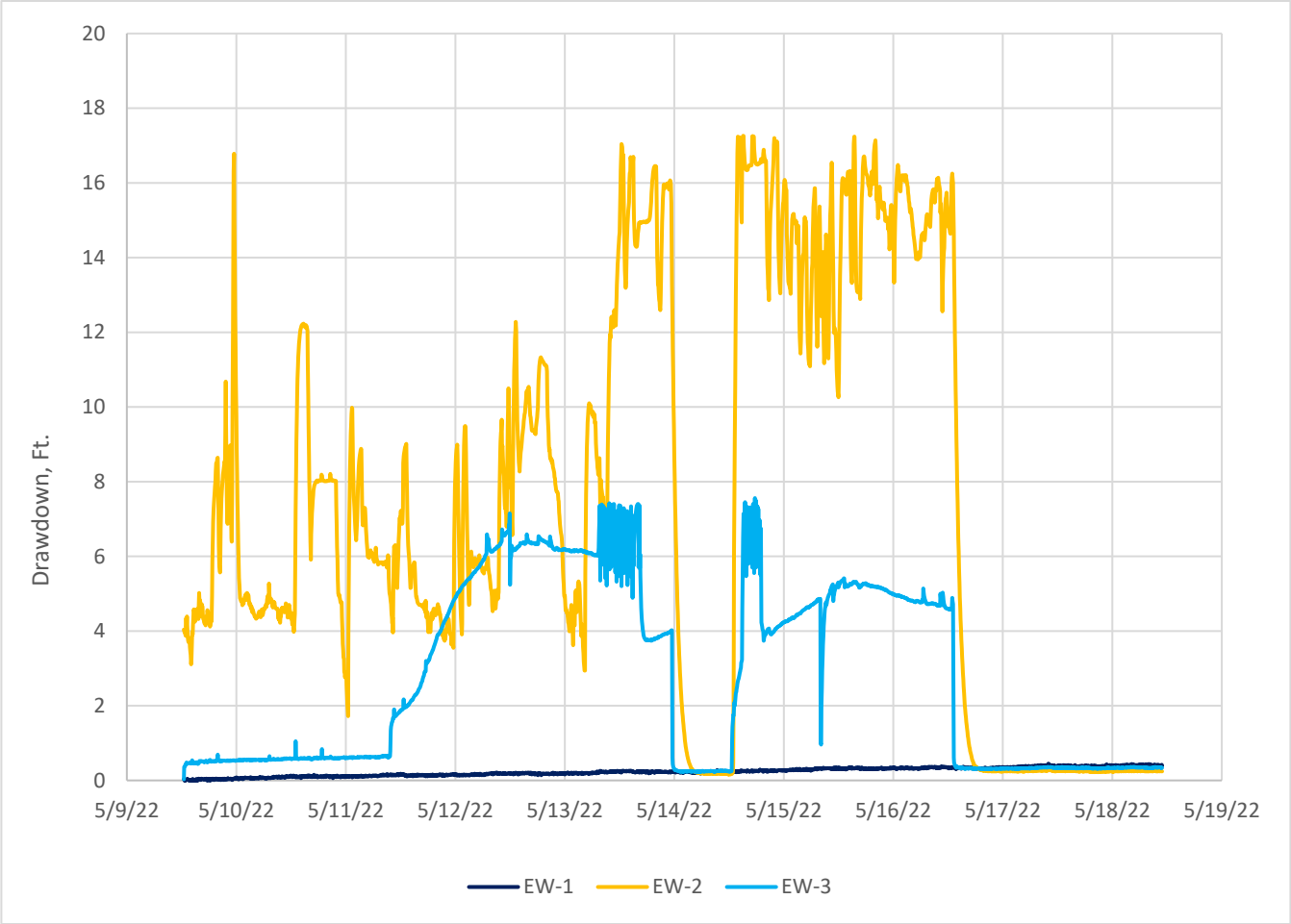
2.3 PUMPING RATES OVER TIME

The pumping rates over time are plotted below. Drawdowns were corrected for barometric pressure that was obtained on-Site by a barometric transducer (**Plot 1)**.



Plot 1: Pumping Rates Over Time

The flow rates were generally constant at EW-2 and RW-1 except for power outages at RW-1 on May 11, 2022 and EW-2 and EW-3 on May 14, 2022. The pumping rates at EW-3 decreased from 4, the first 2.5 days of pumping, to 3.75 GPM and eventually to 3 GPM for most of the final two days of pumping. As the drawdown reached approximately 6 feet at EW-3 on May 12, 2022 (**Plot 2**), the saturated thickness became limited around EW-3 and the pumping rate was decreased to sustain continued pumping at EW-3.

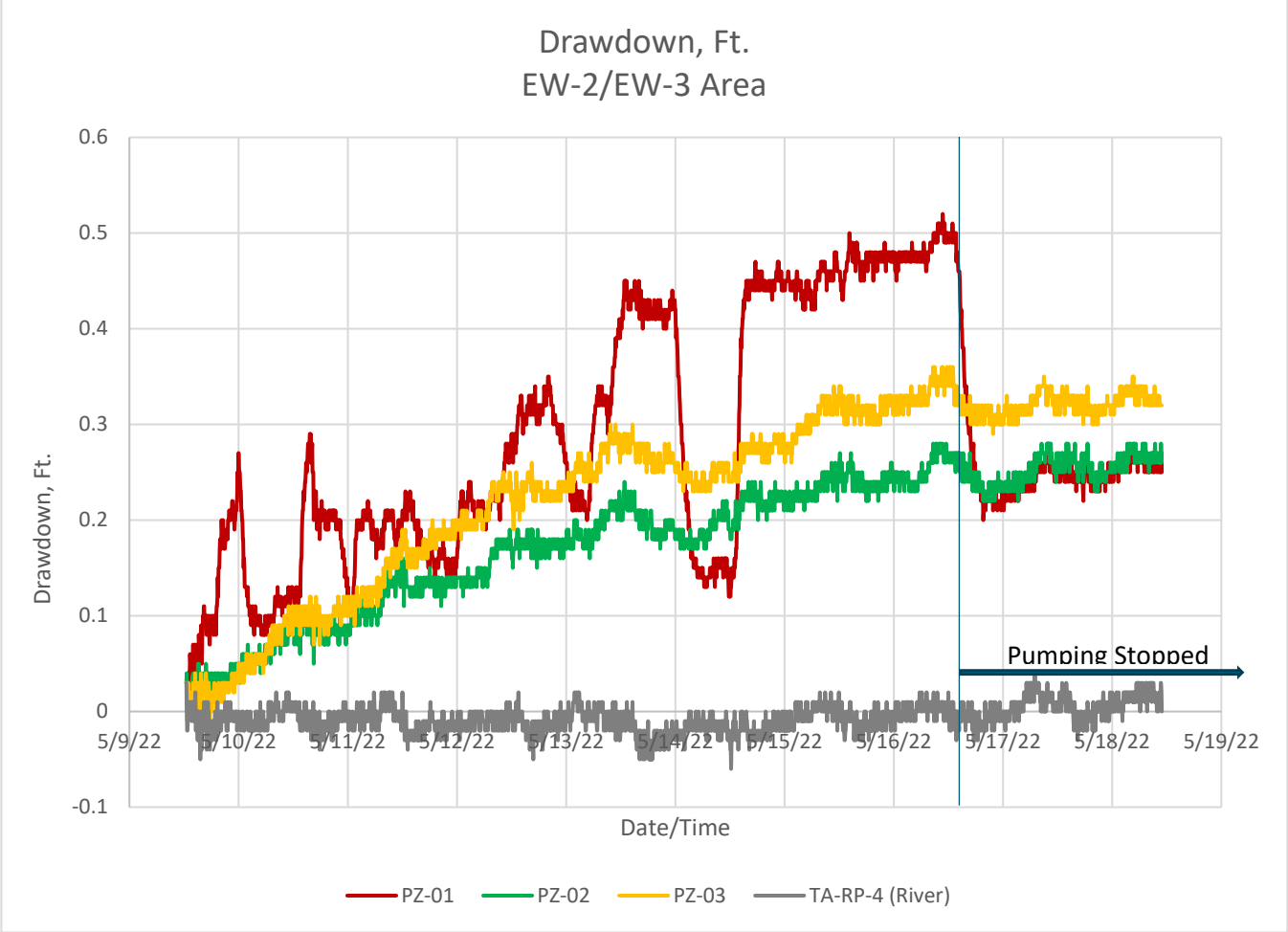


Plot 2: Corrected Drawdowns Over Time at EW-1, EW-2, and EW-3

The drawdown at EW-2 fluctuated over the course of the performance test likely because the well screen is in alternating layers of sand and silt with varying clay content. Groundwater flow to EW-2 is primarily from three thin layers of sand, not a continuous, permeable formation. As pumping lowered the groundwater level to below one or more layers of saturated layers, the layers were hydraulically disconnected to the well and the overall saturated thickness around the well was reduced, further reducing well capacity and resulting in enhanced drawdown. As groundwater recharged these layers, groundwater flow would cascade into the wellbore, resulting in a relatively notable water level rise. As this cycle continued, the drawdown responses fluctuated.

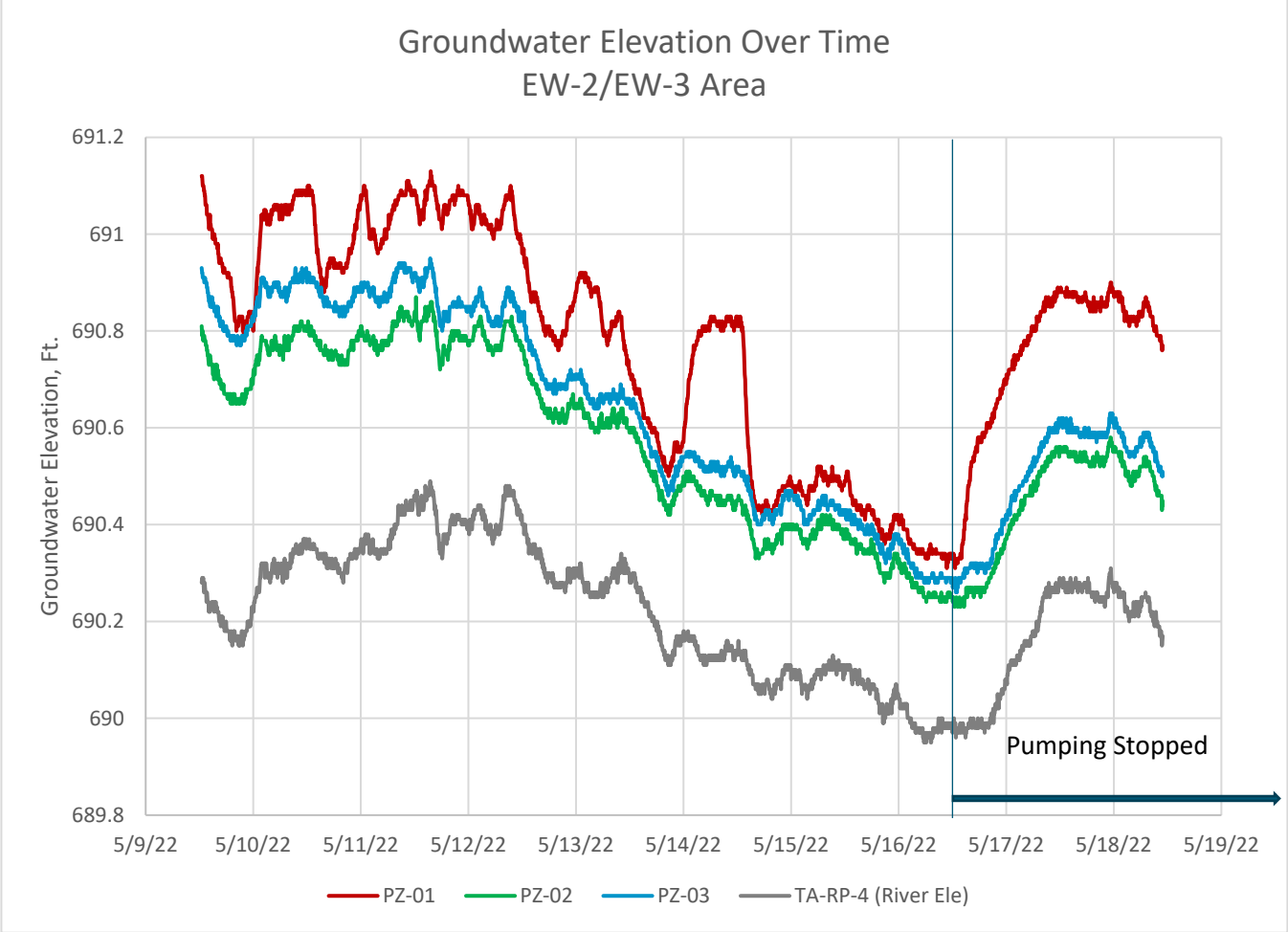
2.4 DRAWDOWN IN THE AREA OF EW-2 AND EW-3

Drawdown responses in the piezometers near EW-2 and EW-3 are plotted below (**Plot 3**).



Plot 3: Corrected Drawdowns Over Time at EW-2/EW-3 Area

The drawdown at PZ-01 was the greatest among the three piezometers. The maximum drawdown reached approximately 0.5 foot at PZ-01, approximately 0.35 foot at PZ-03, and approximately 0.27 foot at PZ-02 on May 16, 2022.

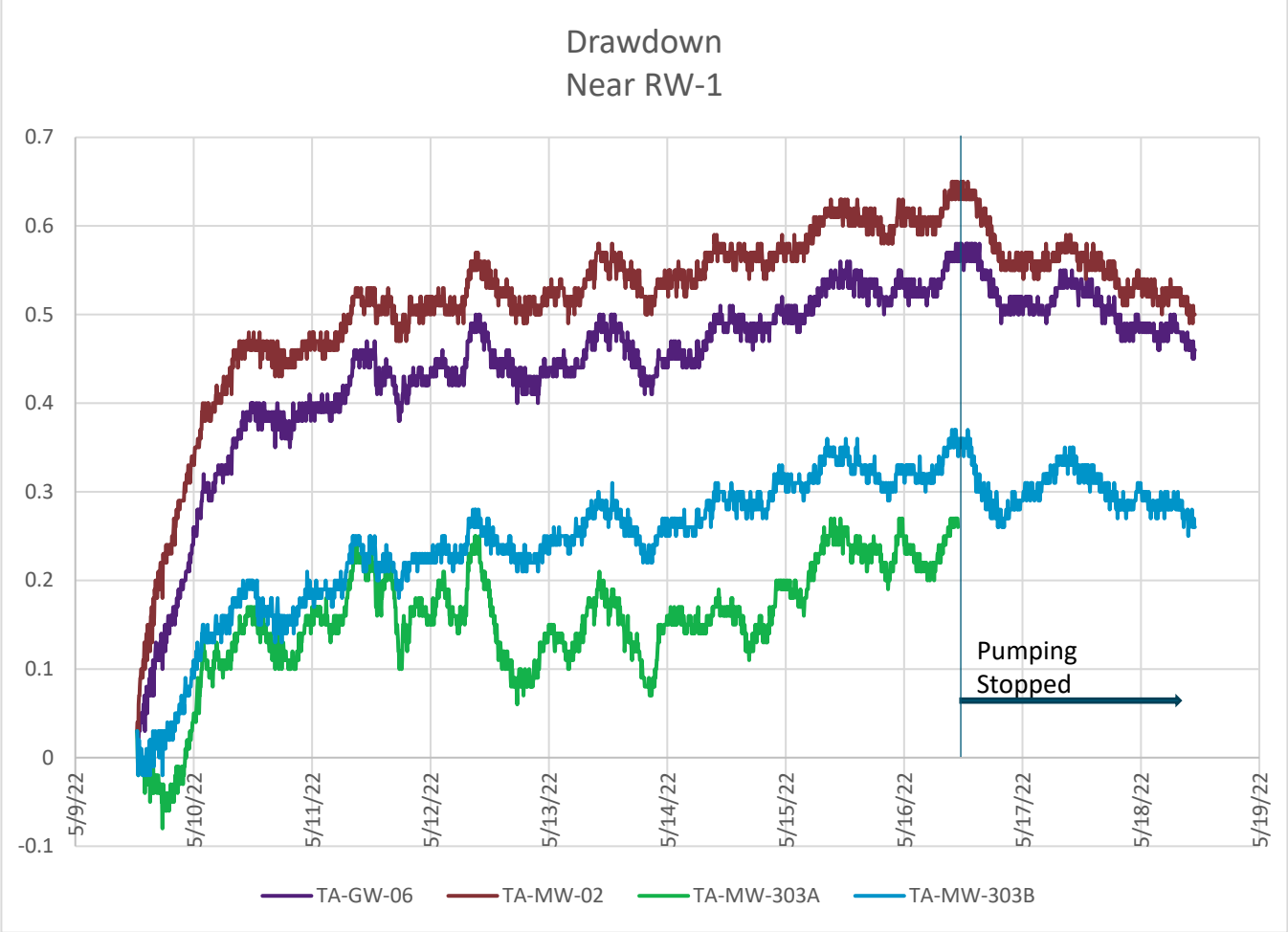


Plot 4: Groundwater Elevations Over Time at EW-2/EW-3 Area

Piezometers at the groundwater-surface water interface (GSI) were not available for comparison to the groundwater elevations at PZ-01, PZ-2, and PZ-03. Compared to the river elevation collected at TA-RP-4, the groundwater elevations at PZ-01, PZ-02, and PZ-03 were still greater than the Rogue River elevation at TA-RP-4 (**Plot 4**). It is unclear whether pumping at EW-2 and EW-3 was able to create an inward hydraulic gradient from the GSI to the EW-2 and EW-3 area necessary to contain groundwater flow from discharging to the river.

2.5 DRAWDOWN IN THE AREA OF TA-RW-1

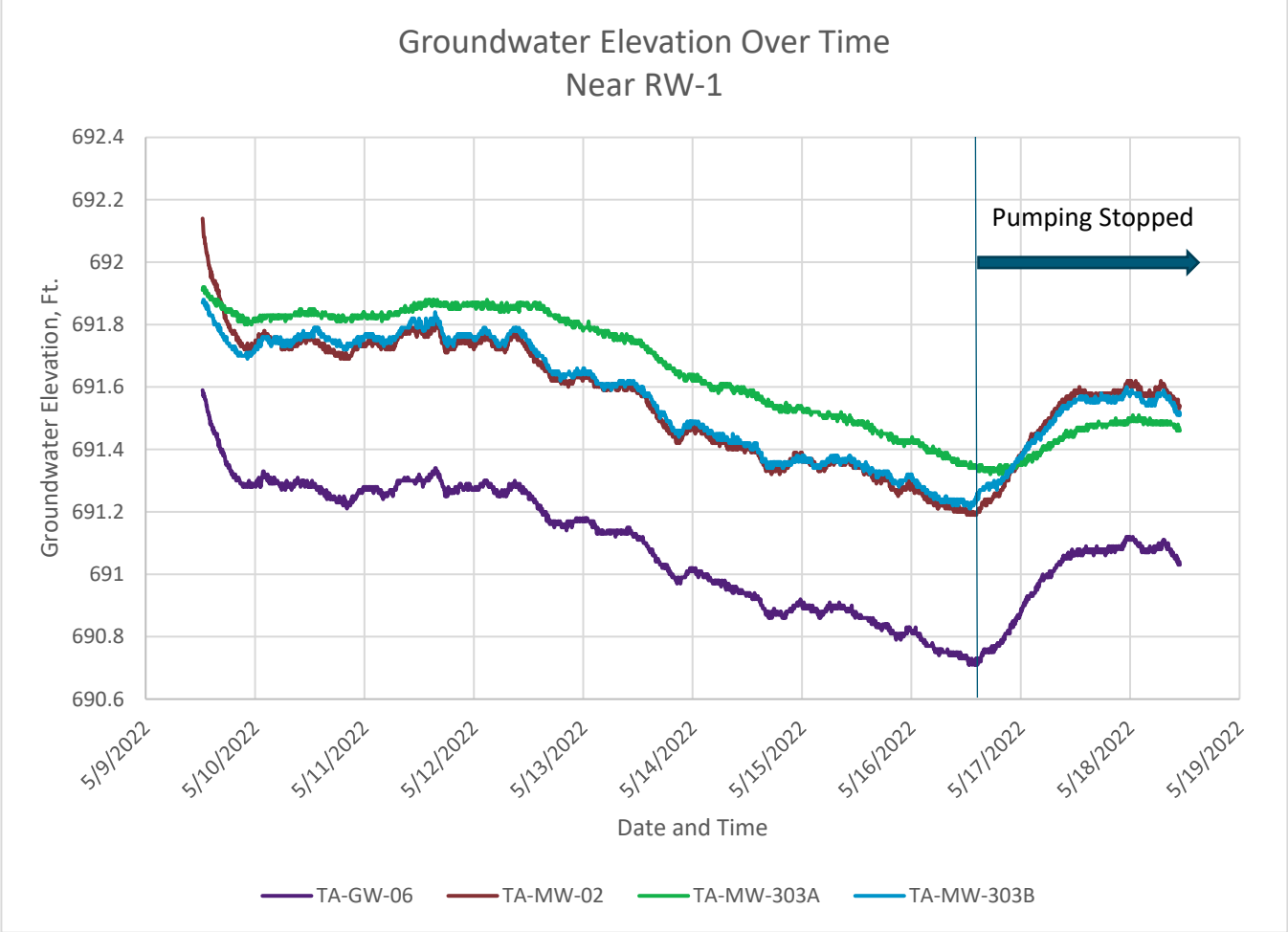
The observation well drawdown responses near TA-RW-1 are plotted below (**Plot 5)**.



Plot 5: Corrected Drawdowns Over Time Near TA-RW-1

The maximum drawdowns were approximately 0.65 feet at TA-MW-02, approximately 0.57 feet at TA-GW-06, approximately 0.37 feet at TA-MW-303B, and approximately 0.26 feet at TA-MW-303A on May 16, 2022.

The surface water elevations will vary along the Rogue River; therefore, the surface water elevations measured at TA-RP-4 may not represent the area immediately west of TA-RW-1. The groundwater elevation data at TA-MW-303A was presumed to be the water elevation at the GSI. As shown in **Plot 6**, groundwater elevations at TA-GW-06, TA-MW-02, and TA-MW-303B were lower than TA-MW-303A, indicating hydraulic influence during and the establishment of an inward hydraulic gradient due to the pumping at TA-RW-1.



Plot 6: Groundwater Elevations Over Time Near TA-RW-1

The performance pumping tests in April and May 2022 provided additional data for the design and implementation of the groundwater interceptor system. The data revealed that lithologies and hydraulic conductivity at the Site are more variable than prior performance tests and modeling suggested. The results of the performance pumping indicates this heterogeneity will affect the efficacy of the groundwater extraction well network that was approved by EGLE in the RAP. Even with an expansion in number of additional wells and performance tests, an extraction well may be located in an area with fine-grained soil and limited hydraulic conductivity and low transmissivity, resulting in inadequate well capacity and an inability to create sufficient hydraulic influence (similar to EW-1 and EW-2). On the other hand, if an extraction well intercepts a relatively permeable zone, like TA-RW-1, groundwater pumping will create measurable hydraulic influence for the more efficient extraction of impacted groundwater. Also note that monitoring wells installed to observe and demonstrate hydraulic influence of the pumping system will also be affected by these variable conditions. While it is possible to relocate an extraction well and/or add additional wells with those proposed in the RAP, the total number of wells could become impractical for implementation. Additionally, based on our experience, low-capacity pumping wells with high frequency of activation and large drawdowns result in more frequent biofouling that could significantly increase the long-term operations and maintenance (O&M) requirements of the system. Overall, the drilling, re-installation, abandonment, and O&M requirements of numerous poor-performing extraction wells would be inefficient, cost prohibitive, and ultimately delay achievement of the performance objectives under the CD.

3.0 BASIS FOR DESIGN CHANGES

As documented in the EGLE-approved RAP, R&W/GZA collected and evaluated geological and hydrogeological data, performed pumping tests at three extraction wells in 2019, and designed the groundwater extraction system utilizing groundwater flow modeling and capture zone evaluation in 2021. The RAP was designed and approved using best-available information. But given the potential for uncertainty associated with aquifer heterogeneity, R&W/GZA performed the 2022 performance pumping tests to refine the system design as part of the iterative process of data collection and system design evaluation. As described above, the 2022 performance pumping tests indicated greater spatial variability of lithology and resulting hydraulic conductivity than previously measured or modeled. Due to the spatial variability, successful implementation of a stand-alone extraction well system is likely to be impractical and result in onerous long-term extraction well O&M requirements and not meet the necessary performance objectives. Extraction wells installed in low permeability zones will result in several undesirable conditions including:

1. Lower sustainable flow rates;

2. Small lateral hydraulic influence, potentially requiring an impracticable number of extraction wells;

3. Difficulty in reliably confirming hydraulic control in nearby observation wells/piezometers, which may also be installed in or near lower permeability zones; and

4. Typically, extraction wells with low-flow rates will experience large drawdowns which will introduce oxygen into the area of the well screen and require more frequent maintenance/rehabilitation than extraction wells with higher flow rates.

To overcome these performance concerns, the use of groundwater collection trenches in the design is proposed which results in a more uniform permeable conduit that effectively bridges subsurface heterogeneities and exploits the most permeable zones. By creating a uniform permeable conduit, more effective hydraulic control can be established across key areas of the Site. The primary objectives of altering the groundwater interceptor system design with trenches include the following:

1. A groundwater collection trench provides a highly permeable conduit running parallel to the Rogue River. The continuous conduit overcomes the high degree of heterogeneity by intercepting thin permeable layers with limited horizontal extent while achieving more consistent hydraulic control.

2. The lateral hydraulic influence of trenches can be maintained with relatively constant pumping rates and limited drawdowns. This will improve the long-term O&M efforts that are required compared to that of many low-efficiency extraction wells. Basically, the more extraction wells needed to meet performance objectives, the more advantageous trenches become.

4.0 GROUNDWATER INTERCEPTOR SYSTEM EVALUATION (MODIFICATION TO RAP SECTION 8.0)

Several interceptor system design scenarios were evaluated. R&W/GZA used the following evaluation criteria:

- Technical Feasibility: It is technically feasible for the groundwater interceptor system to achieve hydraulic influence across the Site and control PFAS-impacted groundwater from discharging to Rum Creek and the Rogue River abutting the Site.

- Implementability: The system design of trenches and paired extraction wells is implementable in terms of system construction and treatment system flow capacity.

- Ability to measure effectiveness: The effectiveness of the groundwater interceptor system can be monitored and measured, and the operation of the system can be adjusted to achieve hydraulic control.

- Ease of long-term O&M: The long-term O&M requirement is typical of a groundwater control and treatment systems.

Perfluorooctanesulfonic acid (PFOS) is primarily present in the top 10 feet of groundwater, from elevations approximately 680 to 690 feet (approximately 5 to 15 feet bgs). Because PFOS currently has the lowest Rule 57 surface water criterion, its distribution and concentration were emphasized during the groundwater interception system evaluation. The vertical extent of PFOS-containing groundwater varies, depending on lithology and location on-Site. Where an underlying fine-grained soil stratum is observed, relatively higher PFOS concentrations are limited to the top of the fine-grained soil stratum. For example, the PFOS concentration was 33,000 nanograms per liter (ng/L) at MW-303C, which is screened from elevation 672 to 677 feet, but the presence of fine-grained soil stratum from elevation 651 to 672 feet appears to limit the vertical migration of PFOS. The PFOS concentration at nested well MW-303E, which is screened from elevation 643 to 646 feet, was three orders of magnitude lower at approximately 23 ng/L. Where underlying fine-grained soil stratum is not observed, PFOS concentrations were more uniform at depth. For example, PFOS concentrations ranging from 13,000 to 62,000 ng/L were measured in well cluster TA-MW-309 from the shallow saturated zone to an elevation of approximately 650 feet.

4.1 INTERCEPTOR SYSTEM DESIGN (MODIFICATION TO RAP SECTION 8.1)

R&W/GZA conducted numerous modeling runs to balance extraction rates with effective hydraulic control while limiting induced recharge from the Rogue River and Rum Creek. Based on combining the model output and pumping data with the performance objectives, a combination of groundwater collection trenches for the shallow groundwater and extraction wells, primarily in the deeper aquifer, results in better performance than either trenches or extraction wells alone. The revised proposed trench and extraction well capture system includes:

1. For the Site area north of Rum Creek, two groundwater collection trenches with permeable backfill, such as pea gravel, installed from an elevation of approximately 693 feet to an elevation of approximately 685 feet.

2. For the Site area south of Rum Creek, four groundwater collection trenches with permeable backfill installed from an elevation of approximately 693 feet to an elevation of approximately 685 feet; and three groundwater collection trenches with permeable backfill installed from an elevation of 693 feet to approximately 670; and

3. South of Rum Creek, two shallow extraction wells screened from elevations approximately from 690 to 670 feet, and four deep extraction wells screened from elevations of approximately 670 to 650 feet

Sheet No. 2 presents the proposed trench layout and extraction well locations. These locations may be altered during final design and installation.

The model estimated flow rates of the groundwater collection trenches and extraction wells as referenced on **Sheet No. 2** are provided in the following table.

Trench / Well	Trench Bottom Elevation / Well Screen Zone, ft.	Trench Length, ft.	Flow Rate, GPM
Trench-1 (T1)	685	420	27
Trench-2 (T2)	685	161	2
Trench-3 (T3)	685	223	7
Trench-4 (T4)	685	112	6
Trench-5 (T5)	685	213	4
Trench-6 (T6)	670	246	6
Trench-7 (T7)	670	325	5
Trench-8 (T8)	670	157	5
Trench-9 (T9)	685	210	3
DEW-1	650-670	Not Applicable	3
DEW-2	650-670	Not Applicable	1
DEW-3	650-670	Not Applicable	1
DEW-4	650-670	Not Applicable	2
EW-5	670-690	Not Applicable	3
EW-6	670-690	Not Applicable	2
Total Flow Rate			77

Table 4-1: Collection Design Flow Rates

R&W/GZA obtained design flow rates through numerous modeling trials using various trench/well layouts and pumping rates with the goal of preventing groundwater from venting to the Rogue River while minimizing pumping water from the Rogue River. During the modeling trials, R&W/GZA reviewed the model calculated groundwater contours, drawdowns, and forward particle tracking pathlines to evaluate capture zones of the trenches and wells (refer to the RAP for a further discussion of the model development). See **Section 4.2** for a summary of the capture zone evaluation. The RAP design flow rate for the 22 extraction wells was estimated at 48.5 GPM. The revised total pumping rate from the groundwater collection trenches and extraction wells based upon the updated model is approximately 77 GPM.

4.2 CAPTURE ZONE EVALUATION (MODIFICATION TO RAP SECTION 8.2)

This section provides a summary of the capture zone evaluation for the proposed groundwater interceptor system. The forward particle tracking pathlines, along with model computed groundwater contours, for model Layers 1 through 4 are depicted in **Figures 4-1** through **4-4**. The following table summarizes the approximate model layer top and bottom elevations.

Model Layer	Top Elevation, Ft.	Bottom Elevation, Ft.
1	695	672
2	672	653
3	653	632
4	632	608
5	608	584
6	584	560

Table 4-2: Model Layer Elevations

The forward particle tracking pathlines for Model Layers 5 and 6 are not presented because PFOS was not detected in groundwater deeper than elevation 610 feet. The model calculated path lines (dark blue on **Figures 4-1** through **4-5**) indicate the particle travel paths from their starting positions to the end of a particle path line which typically reflects groundwater discharge, such as to trenches, extraction wells, or surface waters. A particle pathline stops at a trench or at an extraction well when it is hydraulically captured.

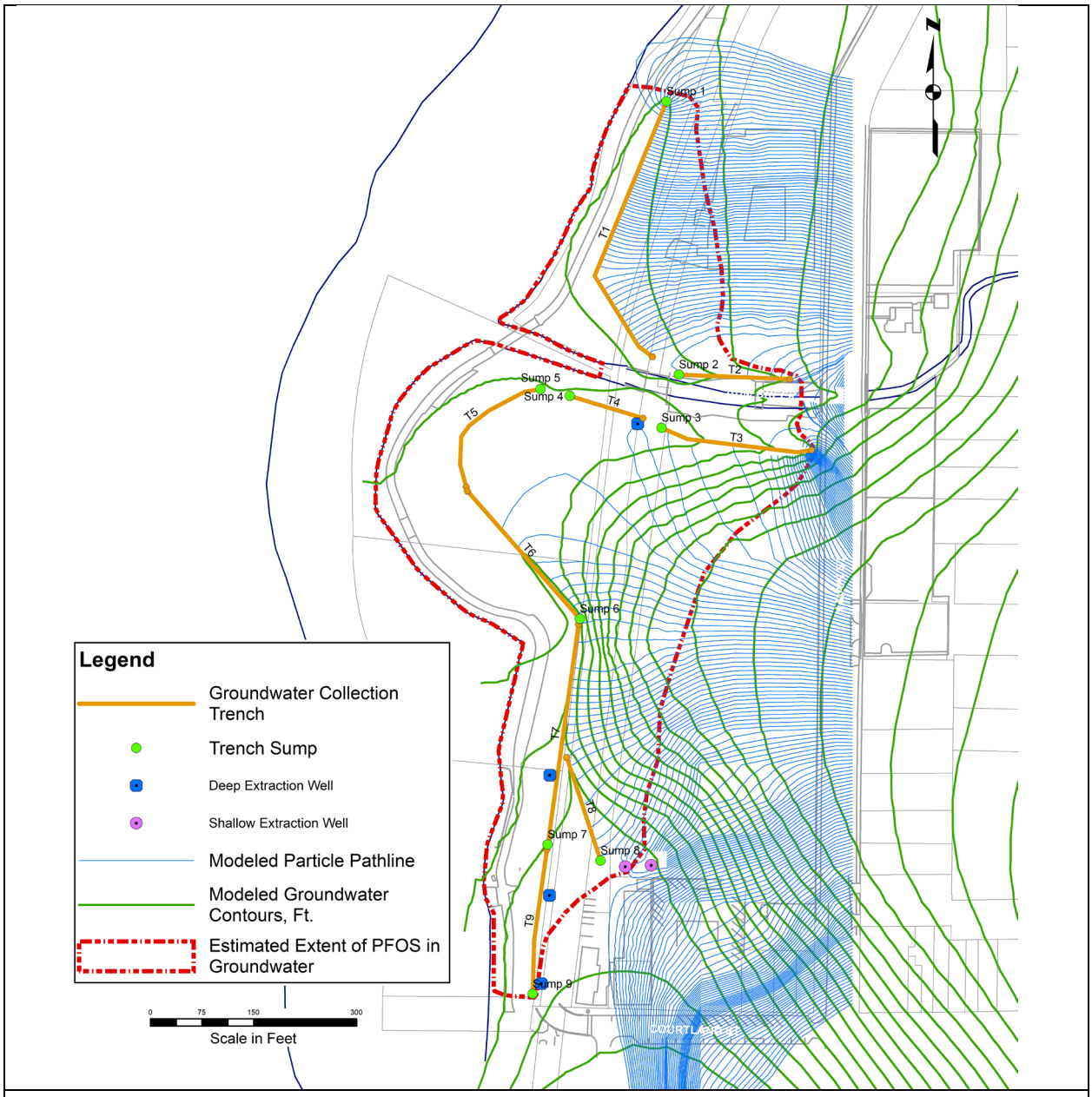


Figure 4-1: Model Computed Forward Particle Pathlines, Layer 1, Elevations from Approximately 672 to 695 feet.

Figure 4-1 depicts the modeled effects of the interceptor system showing drawdowns from the trenches and extraction wells and an inward hydraulic gradient that intercepts groundwater flow to Rum Creek and Rogue River in Model Layer 1.

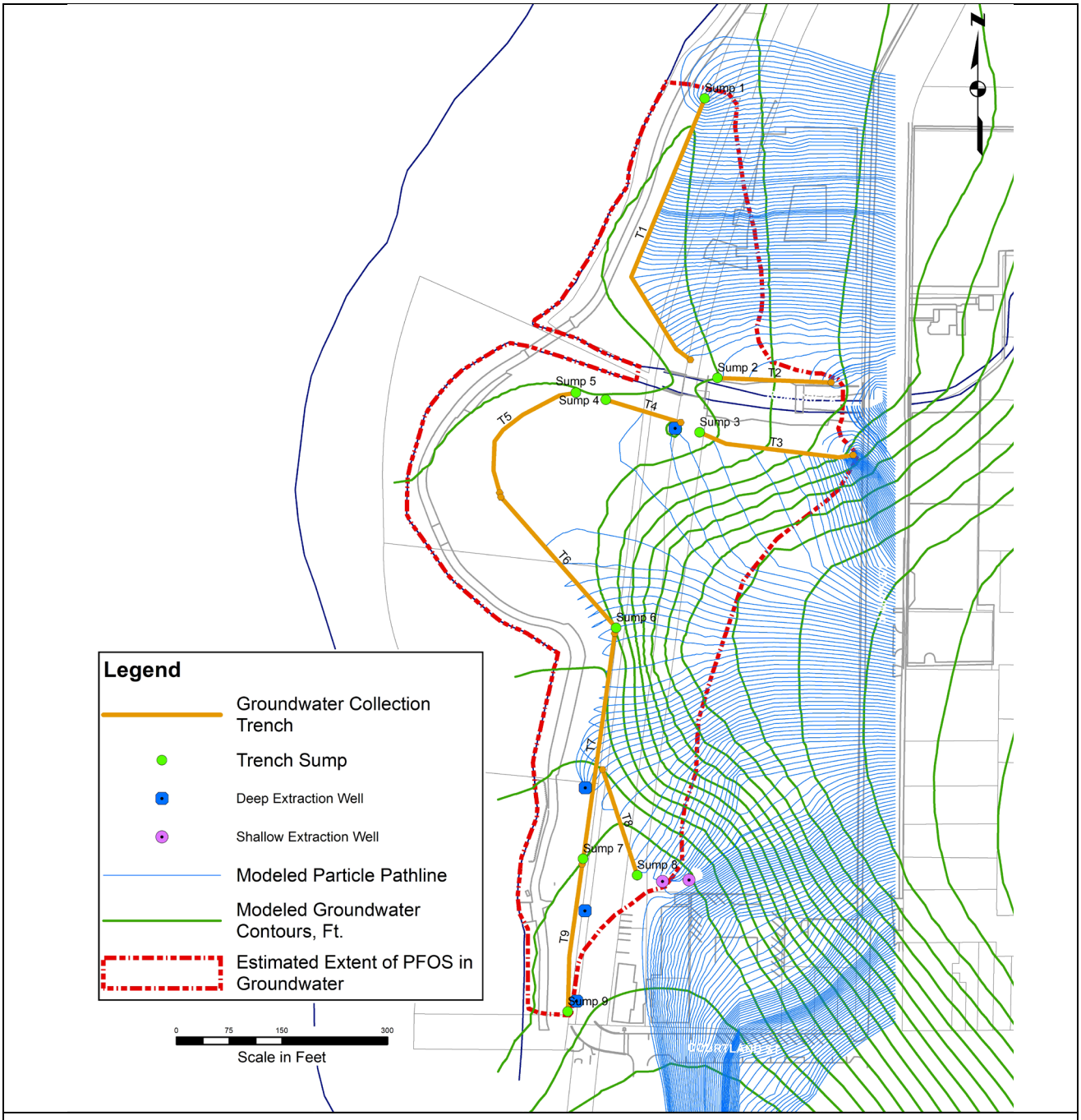


Figure 4-2: Model Computed Forward Particle Pathlines, Layer 2, Elevations from Approximately 653 to 672 feet.

As shown in **Figure 4-2**, the model shows the interceptor system will produce inward hydraulic gradients which intercept groundwater flow to Rum Creek and Rogue River in Model Layer 2.

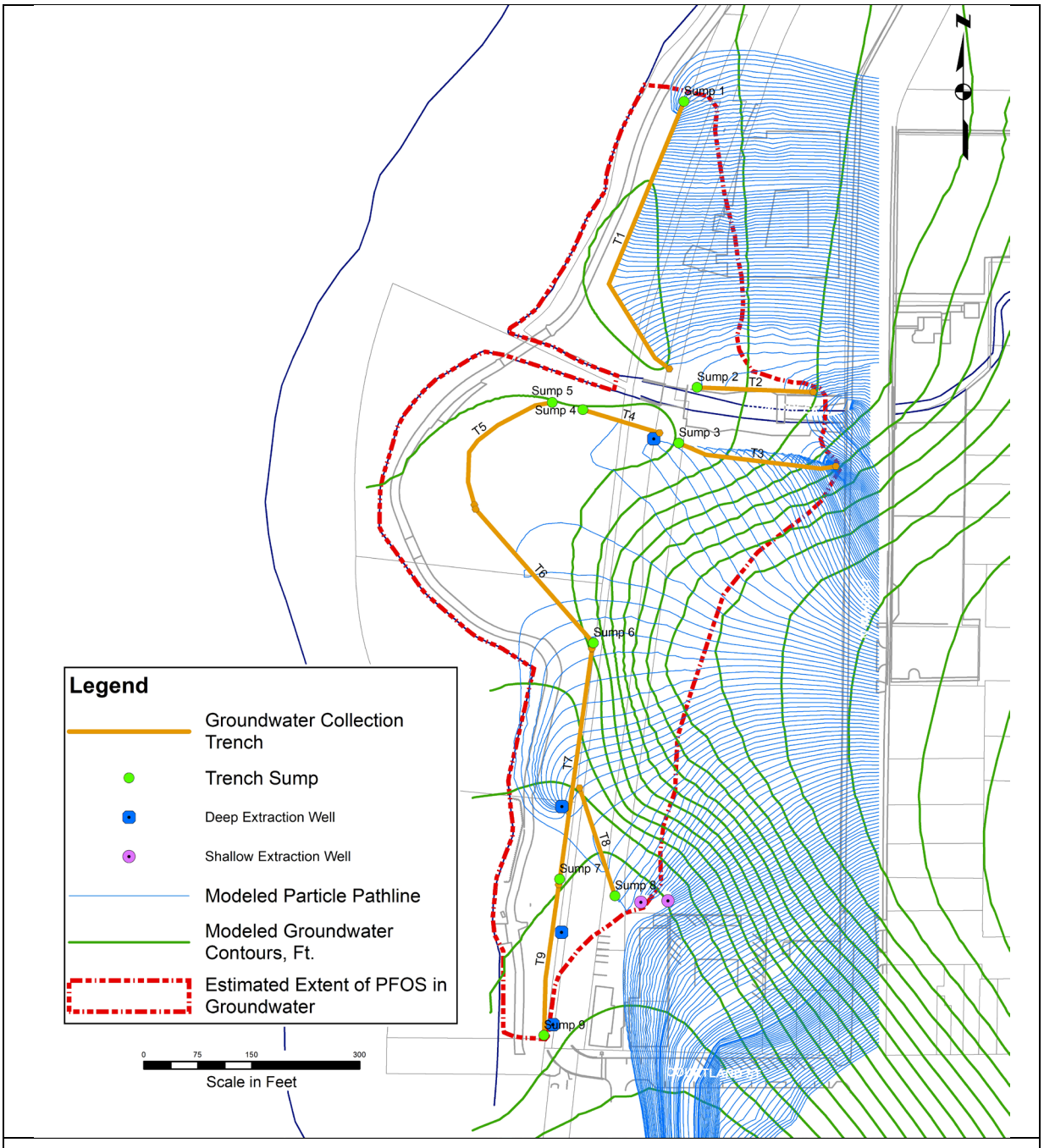


Figure 4-3: Model Computed Forward Particle Pathlines, Layer 3, Elevations from Approximately 632 to 652 feet.

As shown in **Figure 4-3,** the model shows the interceptor system creates inward hydraulic gradients to intercept groundwater flow to Rum Creek and Rogue River in Model Layer 3.

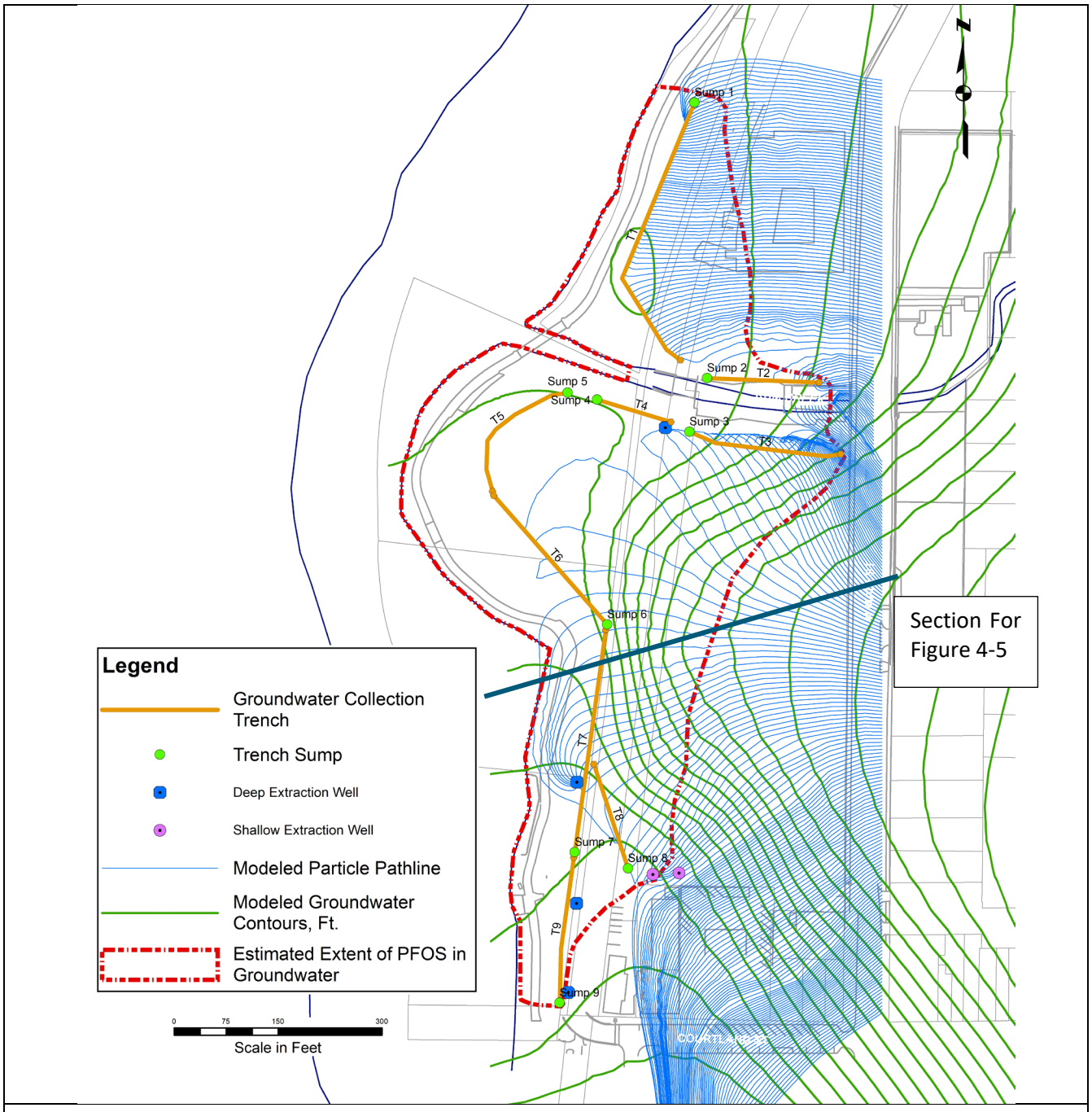


Figure 4-4: Model Computed Forward Particle Pathlines, Layer 4, Elevations from Approximately 608 to 632 feet.

Figure 4-4 shows the interceptor system is also able to create inward hydraulic gradients and intercept groundwater flow to Rum Creek and Rogue River in Model Layer 4.

Figure 4-5 shows modeled path lines in vertical profile, the vertical capture zone reaches to Layer 4 (bottom elevation 608 feet).

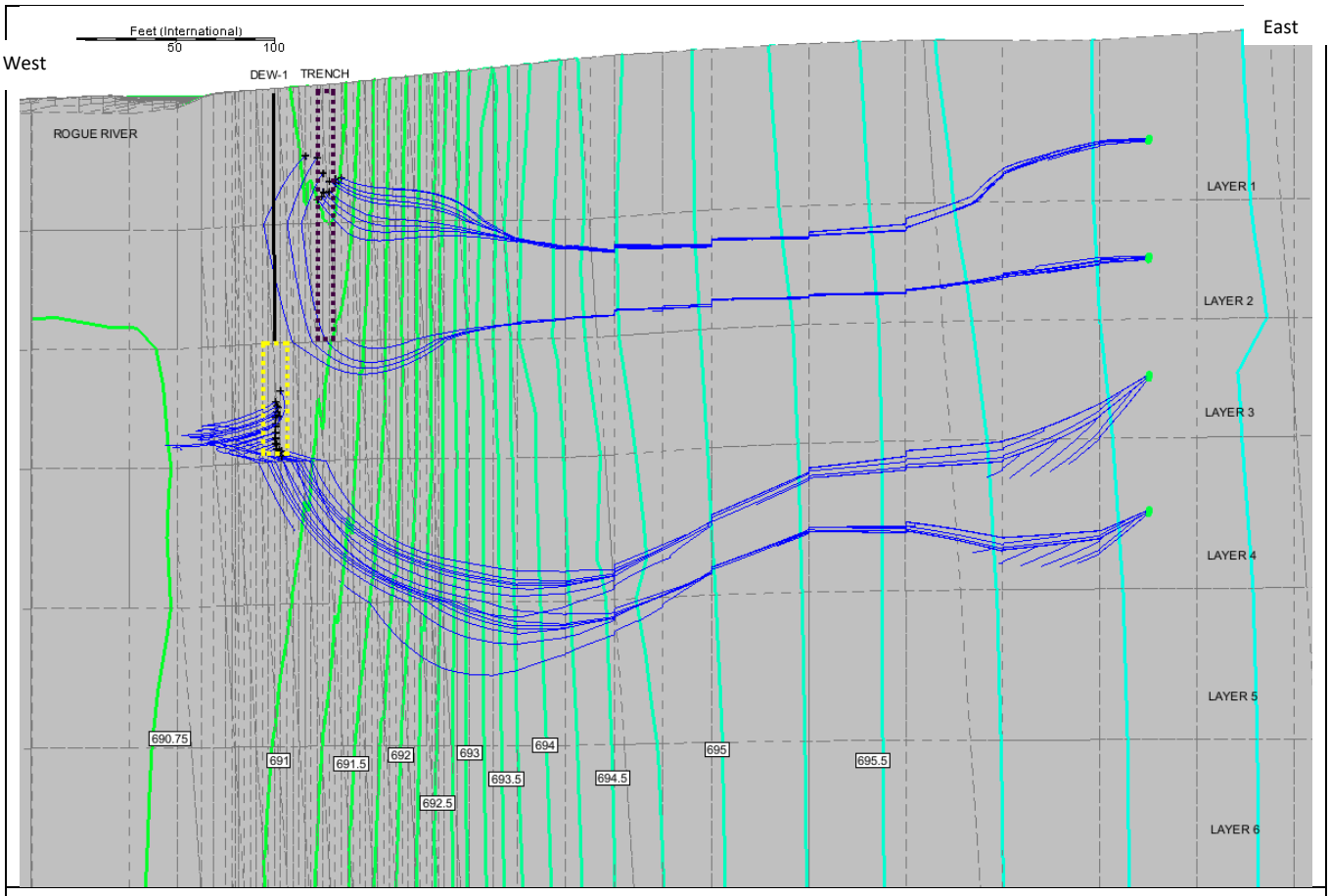


Figure 4-5: Model Computed Pathlines, West-East Cross-Section Profile

The modeled particle pathlines indicate the designed trench, extraction well layout, and pumping rates are expected to provide hydraulic control of PFOS in groundwater on-Site and prevent groundwater from venting to the surface water along the downgradient Site boundary.

The groundwater collection trench, extraction well layout, and design were modeled using the calibrated model, which includes approximately 15.2 inches per year (in/yr) groundwater recharge, representing a reasonably high end of the groundwater recharge range. The use of April 2019 groundwater recharge is conservative (i.e., results in higher groundwater extraction rates) relative to average recharge conditions. Under high recharge rates, greater groundwater pumping rates are needed to intercept groundwater flux and prevent groundwater from venting to the surface water.

To evaluate modeled groundwater capture sensitivity to recharge value, the same collection trench and extraction well layout was also evaluated with a higher groundwater recharge rate. A multiplier of 1.4 was used in the recharge module of the calibrated model to simulate a groundwater recharge rate of 21.4 in/yr. This modeling result predicted a total pumping rate of 80 GPM with capture zone and flow pathlines similar to those presented in **Figures 4-1** through **4-5.**

As discussed previously, the groundwater model was calibrated to the static water level data set (see RAP) and is expected to represent the aquifer at Site-scale with the heterogeneities indicated by the existing monitoring well data. The model is expected to provide improved accuracy in the evaluation of the overall system capture zone and overall pumping rate due to ability of the trench design to better average subsurface hydraulic properties across the Site. However, with the heterogeneity discussed in **Section 2.0**, the actual pumping rates from individual trench sumps and extraction wells are expected to differ from the model estimates. Therefore, the total pumping rate of the groundwater interceptor system may be less than or greater than the estimated high end pumping rate of 80 GPM.

It has been determined that the on-Site retail building has a foundation sump-pump system which aids in dewatering the building basement. During the period of additional investigation conducted as part of the aquifer evaluation, flow meters were installed on the pumps to measure average flow. The groundwater pumping rate from the building foundation sump-pump is expected to be approximately 10 GPM. This additional groundwater volume will be incorporated into the final treatment system design.

Considering the uncertainty associated with highly heterogeneous aquifers and its effect on groundwater collection system flow rates and capture zones, the groundwater interceptor trenches and extraction wells will be installed prior to the completion of the final treatment design. Performance pumping tests will be performed in the installed groundwater collection trenches and extraction wells. The data will be used to evaluate pumping flow rates, and hydraulic influences of the installed trenches and extraction wells. The collected groundwater will be treated in an interim treatment system. Treatment system design will be continued based upon the modeled flow volume included in this RAP Addendum, but final design of the treatment system will be modified and based upon the data gathered from the interceptor trench and extraction well pump testing and treatment.

4.3 GROUNDWATER INTERCEPTOR DESCRIPTION (MODIFICATION TO RAP SECTION 9.0)

The groundwater interceptor system will be a combination of groundwater collection trenches, extraction wells, sumps, and intermediary cisterns. In general, the trenches will be located to avoid existing subsurface structures and to overcome the variable permeability of differing native and fill material present adjacent to the river. The locations of extraction wells were selected to either address deeper groundwater or to avoid damage to, or relocation of, existing subsurface structures (i.e., the sanitary sewer which runs parallel to the Rouge River). Because the extraction well and trench network south of Rum Creek is more expansive than north of the creek, the interceptor system includes multiple collection sumps. The intermediary cisterns will consolidate groundwater from several trench sumps and/or extraction wells and deliver a single discharge to the groundwater treatment building. The following sections describe generalized interceptor system components. **Sheet No. 2** shows the layout of the proposed groundwater collection trenches and extractions wells. During construction, the location and length of trenches, wells, pipe runs, sumps, cisterns, and other components will be adjusted based upon field conditions with R&W/GZA's review and approval.

4.4 INTERCEPTOR SYSTEM (MODIFICATION TO RAP SECTION 9.1)

The following sections describe the general component changes of the interceptor system.

4.4.1 Groundwater Collection Trenches

Each groundwater interceptor trench incorporates a sump at one end constructed with a 10-foot-long, 12-inch diameter, stainless-steel slotted well screen and solid-riser pipe. This well screen will be intercepted by a 6-inch diameter, corrugated, and slotted drainage pipe installed within a few inches of the bottom of the trench. Each trench will be backfilled with pea gravel to surround the drainage pipe which will extend to grade surface, be

covered with topsoil, and seeded. Each sump location will be finished at grade surface in either a fiberglass manhole for sumps located within grassed areas or in a traffic-rated manhole for areas currently paved. All sumps will be equipped with a groundwater extraction pump, level controls, and valves. Electrical service and signal cables will be routed from the treatment building to the sumps in conduit. Depending upon the location of the trench, discharge piping will be either routed directly to the treatment system or to an intermediary collection cistern.

4.4.2 Extraction Wells (Modification to RAP Section 9.1.1)

Both shallow and deep groundwater extraction wells will be installed south of Rum Creek. The locations and the screen intervals of the extraction wells may be adjusted during installation based on the soil conditions observed during drilling. **Sheet No. 2** includes the proposed groundwater collection trench and extraction well location plan.

Each extraction well will be constructed of a 4- to 6-inch diameter, stainless-steel, slotted wire-wrapped screen. Filter-pack sand will be filled to approximately 2 to 3 feet above the top of the well screen, followed by a bentonite plug. The remaining annulus will be filled with bentonite/cement grout and native soil to grade surface. During the detailed design phase, the filter-pack sand specifications and well screen slot sizes may be modified based on field observations of lithology and grain-size analyses.

4.4.3 Collection Cisterns

Two underground cisterns will be installed south of Rum Creek within the longest trench alignment. The purpose of the cisterns is to limit the extraction well pump size and to consolidate flow from the groundwater extraction wells and trench sumps of the interceptor system. Final construction of each cistern will be on either a hold down slab, tied down using dead man-type anchors, or equivalent support structure. The cisterns will be equipped with a duplex pump system, or equivalent, and will be controlled based on water flow and rate of infiltration. Access to the cisterns will be via concrete manhole with appropriate ring and cover ratings.

4.4.4 Piping (Modification to RAP Section 9.1.3)

The main piping run will be buried approximately 4 feet bgs. The locations of the piping runs will be surveyed and located with tracer wire to help prevent damage during future Site work. The piping run will enter the treatment building, passing through a flow meter, flow control valve, and pressure switch. Heat cables will be wrapped around the piping run starting from the extraction well and ending at the tank inlet located inside of the building. A thermostat will be installed to control the heat cables, which will be powered through a ground fault-interrupter breaker. In the event of a breaker trip, a signal will be sent to the programable logic controller (PLC) and an alarm event triggered. The portion of the force main passing under Rum Creek will be installed using a horizontal boring. This crossing has already been permitted through EGLE (Permit No. WRP021885, expires May 26, 2025) and permit compliance will be addressed during the final design process.

4.4.5 Piezometers (Modification to RAP Section 9.1.3)

To measure interceptor system performance via groundwater level elevations, ten trench piezometers (TPZs) will be installed in the groundwater collection trenches; three deep piezometers (PZDs) will be installed to monitor the performance of the deep extraction wells; and five river piezometers (RPZs) will be installed to monitor GSI water elevations. Existing river piezometers TA-SG-RC and TA-RP-5 will be used to measure Rum Creek and Rogue River water elevations. Groundwater elevations in the trench piezometers will be compared to the creek and RPZ elevations. One existing deep monitoring well, TA-MW-309D, will be used to supplement the three deep PZDs. **Sheet No. 3** indicates a location plan for the TPZs, PZDs, and RPZs.

The TPZs will be constructed of 2-foot long, 2-inch diameter polyvinyl chloride (PVC) screens. The bottom of the piezometer screens will be set at approximately 688 feet for TPZ-1 through TPZ-5 and TPZ-9. The bottom of the piezometer screens will be set at approximately 685 feet for TPZ-6 through TPZ-8. The PZDs will be constructed of 5-foot long, 2-inch diameter PVC screens, and bottom of the screens will be set at 650 feet. The RPZs will be constructed of 5-foot long, 2-inch diameter PVC screens installed near the shoreline, and bottom of the screens will be set at approximately 685 feet.

4.4.6 Pressure Transducers (Modification to RAP Section 9.1.5)

A pressure transducer, hard-wired to the control panel, will be installed in each extraction well and trench sumps to measure the water elevation. Pressure transducers will also be installed in each of the RPZs. The groundwater elevations in the RPZs will be considered groundwater elevations at the GSI and each RPZ will be paired with trench sumps and extraction wells so that hydraulic control can be directly monitored and controlled. Water elevation data collected by the transducers will be output to a programable logic controller which will control pump operation.

4.4.7 System Process (Modification to RAP Section 9.1.11)

The system will generally be operated in automatic control mode with the option of a hand-control mode. A hand-control mode operation will be primarily for system troubleshooting and/or debugging.

In automatic mode, the system will operate, shutdown, or send alarm alerts according to the PLC and the configuration settings. The system's primary objective is to maintain the trench and deep PZDs water elevations at or below the corresponding RPZs water elevation. The elevation differences between the trench sumps and its corresponding RPZ will be set at a user-specified value termed as the DELTA value. During the two-year demonstration period, the system performance data will be evaluated, and DELTA values will be varied and evaluated for each extraction well. The following table provides a tentative summary of the RPZs and corresponding trench sumps, extraction wells, and PZDs.

River PZDs (GSI)	Paired Trench Sumps/Extraction Wells	Paired PZDs
RPZ-10	Trench Sump 1	TPZ-1N
TA-SG-RC	Trench Sump 2/Trench Sump 3	TPZ-2 / TPZ-3
TA-RP-5	Trench Sump 4/Trench Sump 1	TPZ-4 / TPZ-1S
RPZ-11	Trench Sump 5	TPZ-5
RPZ-12	Trench Sump 6	TPZ-6
RPZ-13	Trench Sump 7	TPZ-7
RPZ-14	Trench Sump 9	TPZ-9
RPZ-13	DEW-1	PZD-1
Average of RPZ-13 and RPZ-14	DEW-1 and DEW-2	TA-MW-309D
RPZ-14	DEW-2 and DEW-3	PZD-2
Average of TA-SG-RC and TA-RP-5	DEW-4	PZD-3

Table 4-3: Performance Monitoring River Piezometers, Paired Trench Sumps/Extraction Wells, Paired Piezometers

The objective is to maintain the groundwater elevation in the paired piezometers at or below the river piezometers. It is important to note that river elevations will temporally fluctuate during intermittent periods in response to precipitation and snow melt intensity. These periodic conditions may result in a corresponding appearance of reversed groundwater flow or bank storage conditions; however, such conditions will not materially affect the long-term overall effects of the extraction systems to control PFAS.

The system components as described above are preliminary and subject to change during detailed design phase.

4.4.8 Groundwater Treatment System (Modification to RAP Section 9.2)

Following the installation of groundwater interceptor trenches and extraction wells, performance pumping tests will be performed, and the collected groundwater will be treated in an interim treatment system prior to the completion of the treatment system design. A temporary modular system is anticipated to be used during groundwater collection trench and extraction well performance pumping tests. The temporary system design will most likely consist of granular activated carbon. System components are expected to remain similar to the Treatment System Basis of Design (RAP, Appendix C). Effluent of the temporary treatment system will be discharged in accordance with the National Pollutant Discharge Elimination System (NPDES) permit and associated limits.

The final groundwater treatment system design will be refined based upon the performance pumping test results for the installed groundwater collection trenches and extraction wells. Start-up and operation of the groundwater collection and treatment systems will be sequenced. Because of the number of groundwater recovery points (wells and trenches), start-up operations of the final system will likely proceed with a small number of pumps turned on initially. Once the pumping rates from this smaller subset of recovery points approach steady-state, the next set of wells and/or trenches will be brought online with the same approach until all wells and trenches are started. The Treatment System Basis of Design (RAP, Appendix C) and primary system components are expected to remain similar to RAP Appendix C but will be confirmed upon completion of Final Design.

5.0 SCHEDULE (MODIFICATION TO RAP SECTION 11.0)

To implement the work most efficiently and commence operations as soon as possible, Wolverine will undertake a phased approach to complete the final system design and operation. Phase One will install the groundwater interceptor system, including the trenches and extraction wells described in this RAP Addendum. Phase Two will consist of commencing operation of the groundwater interceptor system to treat water on an expedited schedule by using a temporary, modular treatment system. During this phase, the operation and performance pilot testing of the interceptor system will be used to evaluate the groundwater flow, volume, and chemical data obtained to optimize design, installation, and operation of a long-term treatment system. The third and final phase of the implementation will consist of the design, construction, and transition of the temporary treatment system to the long-term, on-Site treatment system. All water collected through the interceptor system will be treated and discharged in accordance with a NPDES permit.

- **Phase One**

  The construction of trenches and extraction wells during Phase One is expected to begin within eight months of RAP Addendum approval. This phase will include the installation of over 2,000 linear feet of trenches that vary in depth from 8 to 25 feet deep, off-Site disposal of excavated soil, backfill of granular material, installation of six extraction wells, placement of pumps in each trench and extraction well, and routing of the electrical conduit and piping below Rum Creek using horizontal directional drilling technique to the proposed treatment system location, and is expected to be implemented in less than six months.

- **Phase Two**

  The temporary treatment and pilot testing of the installed interceptor system during Phase Two will begin following the permitting and installation of a discharge outfall in the Rogue River. This permit is issued by EGLE, and regulatory approval of the discharge outfall is projected by the Spring of 2024. Performance testing of each of the trenches will consist of several weeks of pilot testing for each of the nine trench sections and six extraction wells. The tests will be conducted incrementally toward full-scale operation. During this phase, water will be treated by using a temporary, modular treatment system.

- **Phase Three**

  Phase Three, Permanent treatment system operation, is expected to be complete within approximately 31 months of RAP Addendum approval. During the period of temporary treatment of Phase Two, the final treatment system design will be optimized and completed. The design will go through the bid process and construction of the building system will begin following contract award and receipt of all required permits and approvals. The contractor's schedules for completion of the work will be provided in their bid submittals.

Critical path items for the schedule outlined above include RAP Addendum approval and regulatory permit approvals; these will provide the basis for the construction schedules. In addition, system operation and treatment will be dependent upon receipt of an approved and attainable NPDES permit and outfall discharge permit. The two-year performance monitoring described in the following section will start upon completion of the interceptor system as referenced in Phase Two.

When possible, work is scheduled in parallel to shorten the schedule.

The following outline generally summarizes the design, permitting, and construction tasks and durations anticipated; the reference to days is business days (Monday through Friday without weekend or Holiday work).

- Revise Interceptor System Design and Specifications–concurrent with EGLE review of Tannery RAP Addendum.
- Finalize Interceptor System Design and Specifications–within 60 days of RAP Addendum approval.

  Note: Permitting required to install and operate the interceptor and discharge systems are on the critical path and entirely dependent upon regulatory approval within defined agency review and approval timeframes.
- NPDES Permit Submittals – Permit Application was submitted on June 22, 2022.
  - EGLE review period will be through January 18, 2023.
  - Wolverine review and public comment period will be completed within approximately 60 days after the draft NPDES permit is issued.
  - EGLE response and revisions will be within 30 days of public comment period close.
- Lakes and Streams Permit for Outfall Discharge.
  - Application will be submitted within 60 days of RAP Addendum approval subject to review of NPDES draft permit. Outfall discharge design is contingent on the NPDES discharge permit limits.
  - EGLE Permit Processing and Approval will be within 180 Days of the Lakes and Streams Permit Application submission.
- White Pine Trail Permitting will be submitted within 30 days of the Lakes and Streams Permit for Outfall Discharge Application completion.

- Additional Permits will be completed throughout design period for approval prior to construction.
  - Soil Erosion and Sedimentation Control will be submitted within 30 days of Interceptor Design Completion.
  - Michigan Department of Transportation – Work within a Right-of-Way will be submitted within 30 days of Interceptor Design Completion.
  - Rockford Building Permits will be submitted within 30 days of Treatment System Design Completion.
- General Bid Process:
  - Bid Documents will be provided to potential bidders within 30 days following Final Design completion.
  - Bid submittals are anticipated to be within 30 days of solicitation.
  - Contract award will be within 45 days of bid submittal.
  - Construction-phase work is anticipated to begin within 30 days after award. Contractor's proposed schedules will be provided in their Bid Submittals and will be based on specified constraints (i.e., Department of Transportation frost laws, weather, contractor, subcontractor, material, and supply chain issues) that will be included in the Contractor's response and Contractor Work Plans.

6.0 PERFORMANCE MONITORING PLAN (MODIFICATION TO RAP SECTION 13.0)

The Performance Monitoring Plan is consistent with the previous RAP and updated for the combined trench and extraction well layout. As previously described, the purpose of the interceptor system is to effectively interrupt the natural discharge of PFAS-impacted groundwater to Rum Creek which transects the northern portion of the Site and the Rogue River abutting the Site to the west. The interceptor system will result in inward hydraulic gradients to intercept groundwater flow and control the potential discharge of PFAS-containing groundwater to Rum Creek or the Rogue River. Therefore, system performance will be monitored by groundwater elevation measurements to evaluate hydraulic gradient. It is important to emphasize the interceptor system performance will not be measured by changes to PFAS concentrations in groundwater on-Site, but rather, the induced physical changes to the Site groundwater flow system.

Based on these monitoring goals and following installation of the system, R&W/GZA will implement a performance monitoring program to evaluate the effectiveness of the system for the initial two years of operation. Following the initial two years of operation, the CD requires a submittal documenting the effectiveness of the system. A long-term system monitoring plan will be included in that submittal. Unless modified during the detailed design process, the performance monitoring will consist of the following:

- Collecting groundwater elevation data from the trench sumps, trench piezometers, deep piezometers, extraction wells, river piezometers, using pressure transducers. **Table 6-1** includes the lists of the monitoring sections, piezometers, and performance criteria.
- Collecting monthly elevation data from two staff gauges in Rum Creek (TA-RP-5 and TA-SG-RC).
- Comparing and evaluating groundwater flow direction in seven monitoring sections monthly (**Sheet No. 3** indicates the locations of the monitoring sections) to evaluate the effectiveness of groundwater collection trenches in preventing PFAS-containing groundwater discharge to the Rogue River and Rum Creek.

- Comparing groundwater elevation at PZD-1, PZD-2, PZD-3, and TA-MW-309D to their corresponding water elevations in RPZs or surface water elevation at TA-RP-5 to evaluate the effectiveness of deep extraction wells. See **Table 6-2** for the list of river piezometers and pair piezometers.

- The monitoring sections and evaluation criteria are summarized in the following table:

Monitoring Sections	River Piezometers (GSI)	Paired Piezometers	Performance Criteria
MS-1	RPZ-10	TPZ-1N	Groundwater elevation at TPZ-1N less than or equal to RPZ-10
MS-3 and MS-2	TA-SG-RC	TPZ-2, TPZ-3	Groundwater elevations at TPZ-2 and TPZ-3 less than or equal to TA-SG-RC
MS-4 and MS-1	TA-RP-5	TPZ-4, TPZ-1S	Groundwater elevation at TPZ-4 and TPZ-1S less than or equal to TA-RP-5
MS-5	RPZ-11	TPZ-5	Groundwater elevation at TPZ-5 less than or equal to RPZ-11
MS-6	RPZ-12	TPZ-6	Groundwater elevation at TPZ-6 less than or equal to RPZ-12
MS-7	RPZ-13	TPZ-7	Groundwater elevation at TPZ-7 less than or equal to RPZ-13
MS-9	RPZ-14	TPZ-9	Groundwater elevation at TPZ-9 less than or equal to RPZ-14

Table 6-1: Rogue River Monitoring Sections and Performance Monitoring Criteria

- The performance monitoring evaluation criteria for the deep extraction wells are summarized below:

River Piezometers (GSI)	Paired Piezometers	Performance Criteria
RPZ-13	PZD-1	Groundwater elevation at PZD-1 less than or equal to RPZ-13
Average of RPZ-13 and RPZ-14	TA-MW-309D	Groundwater elevations at TA-MW-309D less than or equal to the average of surface water elevations at RPZ-13 and RPZ-14
RPZ-14	PZD-2	Groundwater elevation at PZD-2 less than or equal to RPZ-14
Average of TA-SG-RC and TA-RP-5	PZD-3	Groundwater elevation at PZD-3 less than or equal to the average of surface water elevations at TA-SG-RC and TA-RP-5

Table 6-2: Deep Extraction Well Performance Monitoring Criteria

- Monthly progress reports will be prepared and submitted to EGLE to document the system operation and performance monitoring evaluation.

If performance monitoring indicates the whole system, a trench, or individual extraction well is either drawing too much water from the river or creek or conversely not controlling groundwater to a level below the observed RPZ elevations; operational modification(s) will be carried out, as appropriate. This performance assessment will also consider short-term conditions such as increased surface water levels that could create temporary bank storage or similar conditions that are not indicative of steady state flow.

A long-term system monitoring plan will be included in the two-year effectiveness demonstration submittal.

7.0 GROUNDWATER SAMPLING (MODIFICATION TO RAP SECTION 15.0)

The objective of the groundwater sampling program is to monitor the potential spatial and temporal change of the PFAS-containing groundwater plume, independent of the system performance monitoring and effectiveness demonstration. The proposed groundwater sampling program is described below and remains generally consistent with the approved RAP. Groundwater sampling and analyses will be completed in accordance with analytical methods and quality assurance/quality control procedures outlined in the project Quality Assurance Project Plan (QAPP) approved by the U.S. Environmental Protection Agency in May 2018, as revised (R&W/GZA, 2019C, R&W/GZA, 2020, R&W/GZA, 2022).

A set of wells, designated as "Boundary Wells", will be monitored quarterly for the first two years of system operation. These wells will provide temporal trends at the approximate boundaries of hydraulic influence of the groundwater collection system. **Table 8-1** provides the list of proposed Boundary Wells. Proposed Boundary Wells are included on **Sheet No. 4**.

Pursuant to EGLE's prior request, additional groundwater monitoring wells and/or piezometers will be selected for annual sampling to monitor groundwater PFAS concentrations. The groundwater extraction system is designed to hydraulically control groundwater flux and influence groundwater venting to the surface waters by balancing inward gradients with induced recharge from the Rogue River or Rum Creek. As such, the hydraulic gradient between the Rogue River or Rum Creek and the extraction system will generally be small and groundwater velocity low resulting in few pore-water volume changes in years. It is unlikely that the constituent concentrations in the monitoring wells/piezometers will exhibit noticeable decreases in the short term; therefore, the annual sampling frequency is proposed in the long term.

The following groundwater monitoring wells/piezometers will be sampled and analyzed for PFAS. The sampling procedures and laboratory analytical method will follow the approved QAPP.

Area	Monitoring Wells	Sample Frequency	Laboratory Analysis
North of Rum Creek–Boundary Wells	TA-MW-308B, two additional wells to be installed north of the Footwear Depot	Quarterly for the first two years; Annually after two years.	PFAS
North of Rum Creek	PZ-1, PZ-2, PZ-3, TA-MW-306A, TA-MW-306B, TA-TMW-109, TA-GW-02	Annually	PFAS
South of Rum Creek–Boundary Wells	TA-MW-303E, TA-MW-316D, one additional deep well in the middle of the Site.	Quarterly for the first two years; Annually after two years.	PFAS
South of Rum Creek	TA-MW-3, TA-MW-304A, TA-MW-304B, TA-GW-06, TA-MW-303A, TA-MW-303B, TA-MW-303D, TA-MW-302A, TA-MW-302B, TA-MW-301B, TA-MW-301C, TA-MW-301D, TA-GW-08, TA-MW-309A, TA-MW-309B, TA-MW-309C, TA-MW-309D, TA-TMW-103, TA-MW-1, TA-GW-04, TA-P-5, TA-MW-313A, TA-MW-313B, TA-MW-313C, TA-TMW-104	Annually	PFAS

Table 8-1: Groundwater Quality Assessment - Sampling and Analysis Plan

In addition, groundwater elevations will be manually measured quarterly.

If groundwater PFAS concentrations decrease to concentrations less than the Part 201 GSI criteria at a location being hydraulically contained by the system, potential system modification will be evaluated to stop or reduce groundwater extraction near this location.

Annual groundwater monitoring reports will be prepared and submitted to EGLE.

8.0 BIBLIOGRAPHY

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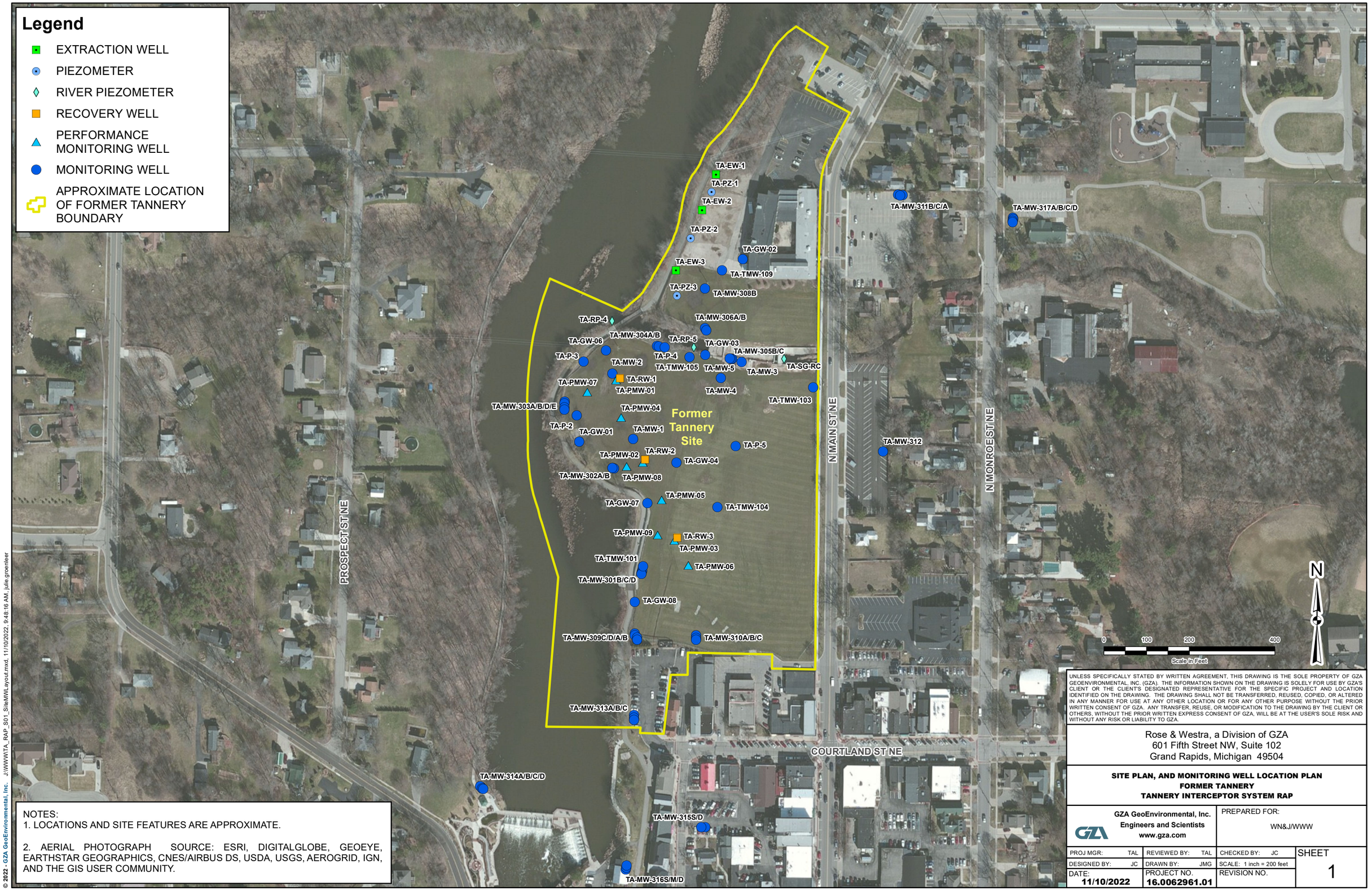
FIGURES



NOTES:
1. LOCATIONS AND SITE FEATURES ARE APPROXIMATE.

2. AERIAL PHOTOGRAPH SOURCE: ESRI, DIGITALGLOBE, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGRID, IGN, AND THE GIS USER COMMUNITY.

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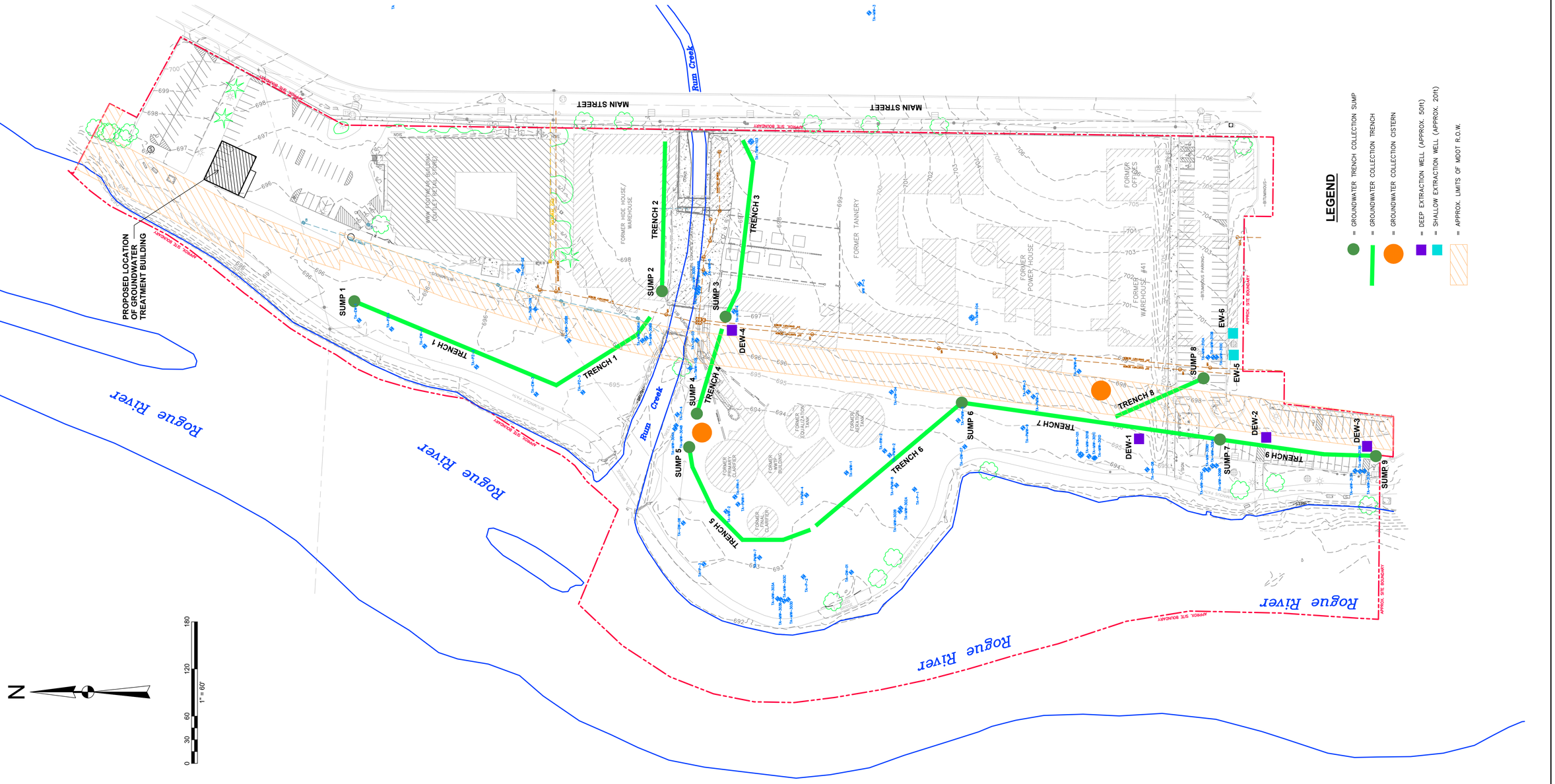
SITE PLAN, AND MONITORING WELL LOCATION PLAN
FORMER TANNERY
TANNERY INTERCEPTOR SYSTEM RAP

GZA GeoEnvironmental, Inc. Engineers and Scientists www.gza.com		PREPARED FOR: WN&J/WWW	
PROJ MGR: TAL	REVIEWED BY: TAL	CHECKED BY: JC	SHEET 1
DESIGNED BY: JC	DRAWN BY: JMG	SCALE: 1 inch = 200 feet	
DATE: 11/10/2022	PROJECT NO. 16.0062961.01	REVISION NO.	



NO.	ISSUE/DESCRIPTION	BY	DATE

TANNERY SITE
MAIN STREET, ROCKFORD, MICHIGAN

RAP ADDENDUM
PROPOSED GROUNDWATER COLLECTION TRENCH, EXTRACTION WELLS & TREATMENT BUILDING

PREPARED BY: GZA GeoEnvironmental, Inc. Engineers and Scientists www.gza.com		PREPARED FOR: WWW/WN&J	
PROJ MGR: TAL	REVIEWED BY: TAL	CHECKED BY: JC	SHEET 2
DESIGNED BY: JC	DRAWN BY: KJB	SCALE: 1" = 60'	
DATE: 11/21/22	PROJECT NO. 16.0062961.02	REVISION NO. NA	SHEET NO.

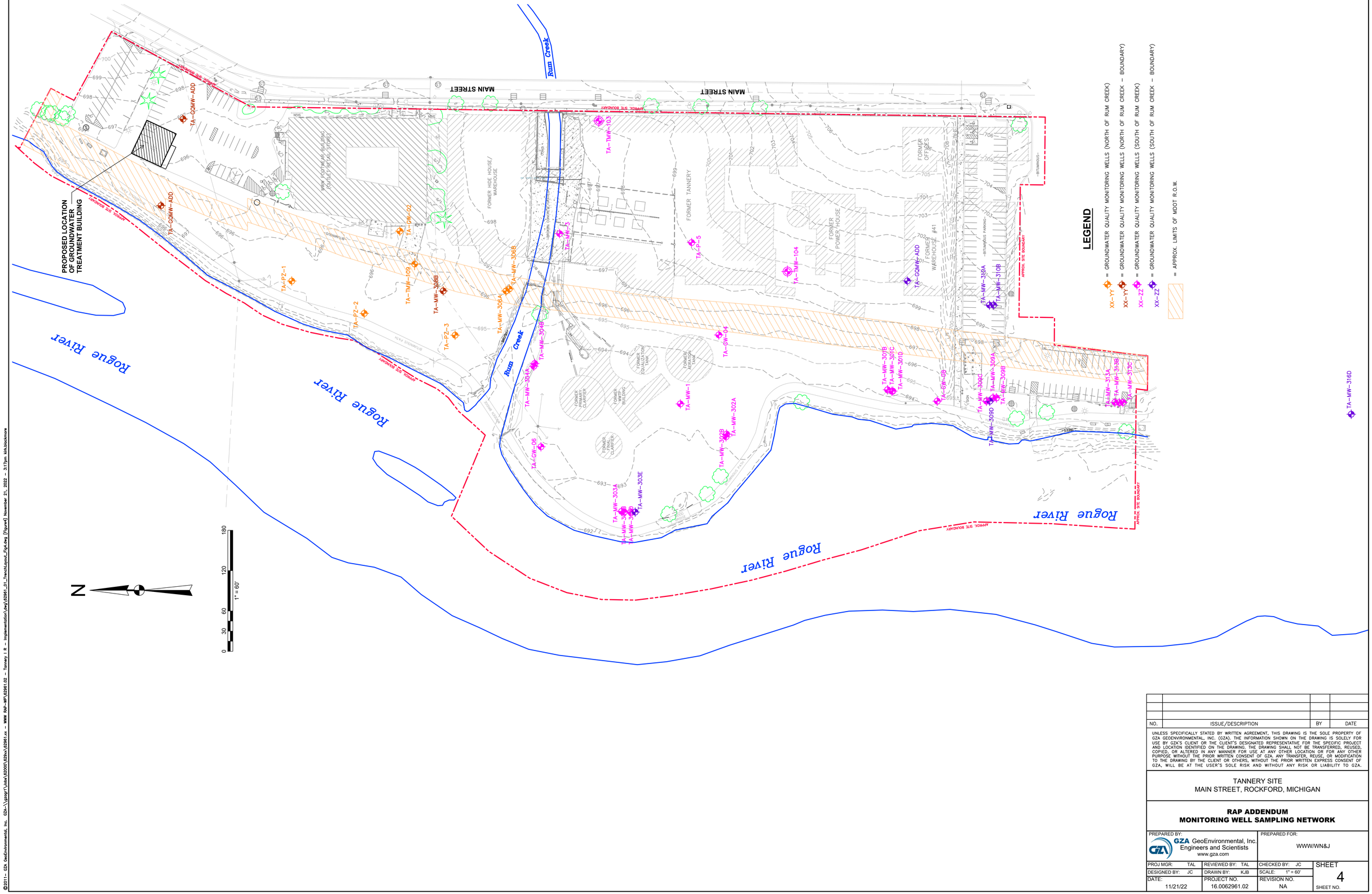
NO.	ISSUE/DESCRIPTION	BY	DATE

TANNERY SITE
MAIN STREET, ROCKFORD, MICHIGAN

RAP ADDENDUM
PROPOSED PERFORMANCE MONITORING
PIEZOMETERS AND TRANSECTS

PREPARED BY:	PREPARED FOR:
GZA GeoEnvironmental, Inc. Engineers and Scientists www.gza.com	WWW/WN&J

PROJ MGR: TAL	REVIEWED BY: TAL	CHECKED BY: JC	SHEET
DESIGNED BY: JC	DRAWN BY: KJB	SCALE: 1" = 60'	3
DATE: 11/21/22	PROJECT NO. 16.0062961.02	REVISION NO. NA	SHEET NO.



LEGEND

- XX–YY = GROUNDWATER QUALITY MONITORING WELLS (NORTH OF RUM CREEK)
- XX–YY = GROUNDWATER QUALITY MONITORING WELLS (NORTH OF RUM CREEK – BOUNDARY)
- XX–ZZ = GROUNDWATER QUALITY MONITORING WELLS (SOUTH OF RUM CREEK)
- XX–ZZ = GROUNDWATER QUALITY MONITORING WELLS (SOUTH OF RUM CREEK – BOUNDARY)
- = APPROX. LIMITS OF MDOT R.O.W.

NO.	ISSUE/DESCRIPTION	BY	DATE

TANNERY SITE
MAIN STREET, ROCKFORD, MICHIGAN

RAP ADDENDUM
MONITORING WELL SAMPLING NETWORK

PREPARED BY:
GZA GeoEnvironmental, Inc.
Engineers and Scientists
www.gza.com

PREPARED FOR:
WWW/WN&J

PROJ MGR: TAL	REVIEWED BY: TAL	CHECKED BY: JC	SHEET
DESIGNED BY: JC	DRAWN BY: KJB	SCALE: 1" = 60'	4
DATE: 11/21/22	PROJECT NO. 16.0062961.02	REVISION NO. NA	SHEET NO.

APPENDIX A – SOIL BORING LOGS AND WELL INSTALLATION LOGS

GZA GeoEnvironmental, Inc.
Engineers and Scientists

Wolverine World Wide, LLC
Tannery
Rockford, Michigan

Boring No.: TA-PZ-1
Page: 1 of 1
File No.: 16.0062961.01
Check: J. Groenleer

Contractor: Stearns Drilling Company
Foreman: D. Krause
Logged by: C. Melby
Date Start/Finish: 12-8-21 / 12-8-21
Boring Location: 594,264.9139 N; 12,804,629.842 E
GS Elev.: 695.06' **Datum:** NAD83/NAVD88

	Auger/ Casing	Sampler
Type:	Hollow Stem Auger	NA
O.D. / I.D.:	4.25"	NA
Hammer Wt.:	NA	NA
Hammer Fall:	NA	NA
TOC Elev.:	694.81'	NA

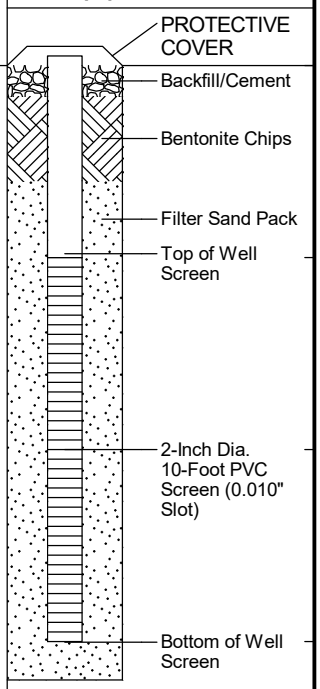
GROUNDWATER READINGS

Date	Time	Depth	Casing	Stab
12/8/21	-	4.5'	0	<15 min

Surveyed By: EXXEL **Survey Date:** 12/29/2021

Depth	Sample Info: No.	Pen./ Rec. (in.)	Depth (Ft.)	Blows (/6")	Test Data	Sample Description & Classification	Stratum Desc.	Remarks
1	1	48/48	0-4			GRAVEL and fine to coarse Sand (FILL), dry.	GRAVEL (FILL)	1
4	2	24/2	4-6	2-2 4-21		Medium stiff, gray, SILT & CLAY, some fine to medium Sand, dry.	4' SILT & CLAY	
9	3	24/20	9-11	WOH/6"-5 8-10		Stiff, brown and gray, SILT & CLAY, some fine to medium Sand, moist to wet.		2
14	4	24/20	14-16	3-4 4-9		Medium stiff to stiff, brown and gray, SILT & CLAY, some fine to medium Sand, moist to wet.	16'	
16						Bottom of Borehole at 16.0 Feet		3

Equipment Installed



REMARKS

1. Soil descriptions from approximately 0.0 to 4.0 feet are based on auger cuttings.
2. Groundwater was encountered at approximately 9.0 feet below ground surface.
3. Monitoring well was installed in borehole upon completion. Well screen set from approximately 5.0 to 15.0 feet below ground suface.

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

GZA GeoEnvironmental, Inc.
Engineers and Scientists

Wolverine World Wide, LLC
Tannery
Rockford, Michigan

Boring No.: TA-PZ-2
Page: 1 of 1
File No.: 16.0062961.01
Check: J. Groenleer

Contractor: Stearns Drilling Company
Foreman: D. Krause
Logged by: C. Melby
Date Start/Finish: 12-8-21 / 12-8-21
Boring Location: 594,157.0613 N; 12,804,581.7218 E
GS Elev.: 695.47' **Datum:** NAD83/NAVD88

	Auger/ Casing	Sampler
Type:	Hollow Stem Auger	NA
O.D. / I.D.:	4.25"	NA
Hammer Wt.:	NA	NA
Hammer Fall:	NA	NA
TOC Elev.:	694.98'	NA

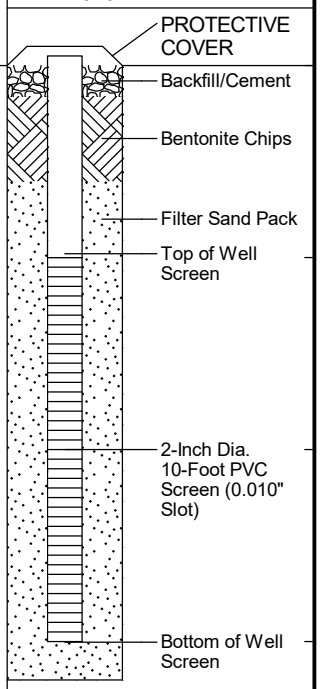
GROUNDWATER READINGS

Date	Time	Depth	Casing	Stab
12/8/21	-	4.5'	0	<15 min

Surveyed By: EXXEL **Survey Date:** 12/29/2021

Depth	Sample Information: No.	Pen./ Rec. (in.)	Depth (Ft.)	Blows (/6")	Test Data	Sample Description & Classification	Stratum Desc.	Remarks
1	1	48/48	0-4			GRAVEL and fine to coare Sand (FILL), dry.	GRAVEL	1
4	2	24/10	4-6	5-6 9-6		Medium dense, gray, GRAVEL and fine to medium Sand, trace Silt, moist.		
9	3	24/22	9-11	4-7 9-11		Very stiff, brown, SILT& CLAY, little fine to medium Sand, moist to wet.	9' SILT & CLAY	2
14	4	24/20	14-16	6-10 14-14		Very stiff, brown and gray, SILT & CLAY, little fine to medium Sand, moist to wet with interbedded Sand seams and lenses.	16'	
16						Bottom of Borehole at 16.0 Feet		3

Equipment Installed



REMARKS

1. Soil descriptions from approximately 0.0 to 4.0 feet are based on auger cuttings.
2. Groundwater was encountered at approximately 9.0 feet below ground surface.
3. Monitoring well was installed in borehole upon completion. Well screen set from approximately 5.0 to 15.0 feet below ground suface.

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

GZA GeoEnvironmental, Inc.
Engineers and Scientists

Wolverine World Wide, LLC
Tannery
Rockford, Michigan

Boring No.: TA-PZ-3
Page: 1 of 1
File No.: 16.0062961.01
Check: J. Groenleer

Contractor: Stearns Drilling Company
Foreman: D. Krause
Logged by: C. Melby/T. Litwiller
Date Start/Finish: 2-7-21 / 2-8-21
Boring Location: 594,021.9799 N; 12,804,549.3323 E
GS Elev.: 694.82' **Datum:** NAD83/NAVD88

	Auger/ Casing	Sampler
Type:	Hollow Stem Auger	NA
O.D. / I.D.:	4.25"	NA
Hammer Wt.:	NA	NA
Hammer Fall:	NA	NA
TOC Elev.:	694.48'	NA

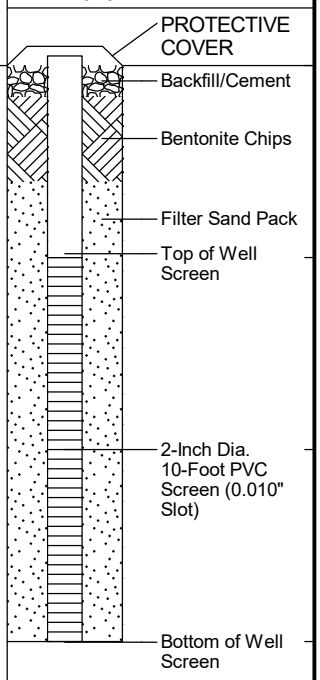
GROUNDWATER READINGS

Date	Time	Depth	Casing	Stab
12/7/21	-	6.5'	0	<15 min

Surveyed By: EXXEL **Survey Date:** 12/29/2021

Depth	Sample Information: No.	Pen./ Rec. (in.)	Depth (Ft.)	Blows (/6")	Test Data	Sample Description & Classification	Stratum Desc.	Remarks
1							SAND	
2	1	24/18	2-4	5-9 12-13		FILL: Medium dense, brown, SAND and Gravel, dry.		
3								
4	2	24/18	4-6	8-10 13-10		Gray, GRAVEL, some fine to medium Sand, dry. Changing at 5.0 feet to: Gray, SILT & CLAY, moist to wet.	4' GRAVEL 5' SILT & CLAY	1
5								
6	3	24/12	6-8	3-3 7-4		Stiff, gray and brown, SILT & CLAY, some fine to medium Sand, moist to wet.		
7								
8	4	24/12	8-10	2-2 1-1		Soft, gray and brown, SILT & CLAY, some fine to Sand, wet.		
9								
10	5	24/8	10-12	5-7 7-10		Medium dense, brown and gray, fine to medium SAND and Silt, wet.	10' SAND	
11								
12								
13	6	24/10	13-15	4-14 16-17		Medium dense to dense, brown and gray, fine to medium SAND and Silt, wet.		
14								
15						Bottom of Borehole at 15.0 Feet	15'	2
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								
28								
29								

Equipment Installed



REMARKS

1. Groundwater was encountered at approximately 5.0 feet below ground surface.
2. Monitoring well was installed in borehole upon completion. Well screen set from approximately 5.0 to 15.0 feet below ground suface.

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

GZA GeoEnvironmental, Inc.
Engineers and Scientists

Wolverine World Wide, LLC
RAP
Rockford, Michigan

Boring No.: TA-EW-1
Page: 1 of 1
File No.: 16.0062961.02
Check: J. Groenleer

Contractor: Stearns Drilling Company
Foreman: J. Gryska
Logged by: D. Watt
Date Start/Finish: 3-16-22 / 3-18-22
Boring Location: 594,306.2106 N; 12,804,640.9216 E
GS Elev.: 695.26' **Datum:** NAD83/NAVD88

	Auger/ Casing	Sampler
Type:	Hollow Stem Auger	Split Spoon
O.D. / I.D.:	14"/10.25"	2.0" / 1 3/8"
Hammer Wt.:	140lbs	NA
Hammer Fall:	30.0"	NA
TOC Elev.:	694.76'	NA

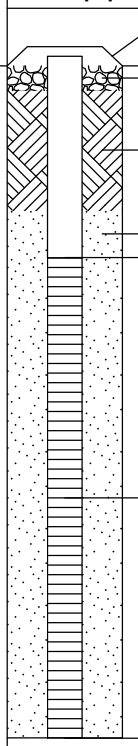
GROUNDWATER READINGS

Date	Time	Depth	Casing	Stab
3/18/22	0930	4.4'	Well	16 hrs

Surveyed By: EXXEL **Survey Date:** 3/30/2022

Depth	Sample Information: No.	Pen./ Rec. (in.)	Depth (Ft.)	Blows (/6")	Test Data	Sample Description & Classification	Stratum Desc.	Remarks
1	1	24/16	0-2	2-8 7-3		Dark brown, TOPSOIL. Changing at 0.8 feet to: Medium dense, brown, fine to coarse SAND, little Gravel, dry.	TOPSOIL 0.8' SAND	
2	2	24/16	2-4	4-5 5-5		Loose, tan, Tannery Waste Scraps, moist (FILL). Changing at 2.5 feet to: Black, FILL, Cinders, Slag, moist.	2' FILL	
4	3	24/12	4-6	1-2 1-7		Very loose, brown and black, fine to medium SAND, little Silt, trace Gravel, brick Cinders, wet.	4' SAND	1
6	4	24/10	6-8	1-2 3-2		Loose, green and brown, fine to medium SAND, little Silt, trace Gravel, wet. Changing at 6.5 feet to: Gray and brown, CLAY & SILT, trace Sand, trace Gravel, moist.	6.5' CLAY & SILT	
8	5	24/16	8-10	1-2 2-6		Gray and brown, CLAY & SILT, trace Sand, trace Gravel, moist. Changing at 9.0 feet to: Brown, SILT & CLAY, trace Sand, moist.	9' SILT & CLAY	
10	6	24/20	10-12	2-4 6-9		Stiff, gray, CLAY & SILT, trace fine Sand, moist.	10' CLAY & SILT	
12	7	24/22	12-14	3-5 8-8		Stiff, gray, CLAY & SILT, trace fine Sand, moist.		
14	8	24/23	14-16	2-5 6-7		Stiff, gray, CLAY & SILT, trace fine Sand, moist.		
16	9	24/10	16-18	7-8 12-12		Very stiff, gray, SILT & CLAY, little fine to medium Sand, trace Gravel, moist.	16' SILT & CLAY	
18	10	24/24	18-20	3-8 12-19		Very stiff, gray, SILT & CLAY, little fine to medium Sand, trace Gravel, moist.		
20						Bottom of Borehole at 20.0 Feet	20'	2

Equipment Installed



REMARKS

1. Groundwater was encountered at approximately 4.0 feet below ground surface.
2. Monitoring well was installed in borehole upon completion. Well screen was set from approximately 4.0 to 14.0 feet below ground surface.

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

GZA GeoEnvironmental, Inc.
Engineers and Scientists

Wolverine World Wide, LLC
RAP
Rockford, Michigan

Boring No.: TA-EW-2
Page: 1 of 1
File No.: 16.0062961.02
Check: J. Groenleer

Contractor: Stearns Drilling Company
Foreman: J. Gryska
Logged by: D. Watt
Date Start/Finish: 3-16-22 / 3-17-22
Boring Location: 594,222.9608 N; 12,804,607.9419 E
GS Elev.: 695.10' **Datum:** NAD83/NAVD88

	Auger/ Casing	Sampler
Type:	Hollow Stem Auger	Split Spoon
O.D. / I.D.:	14"/10.25"	2.0" / 1 3/8"
Hammer Wt.:	140lbs	NA
Hammer Fall:	30.0"	NA
TOC Elev.:	694.69'	NA

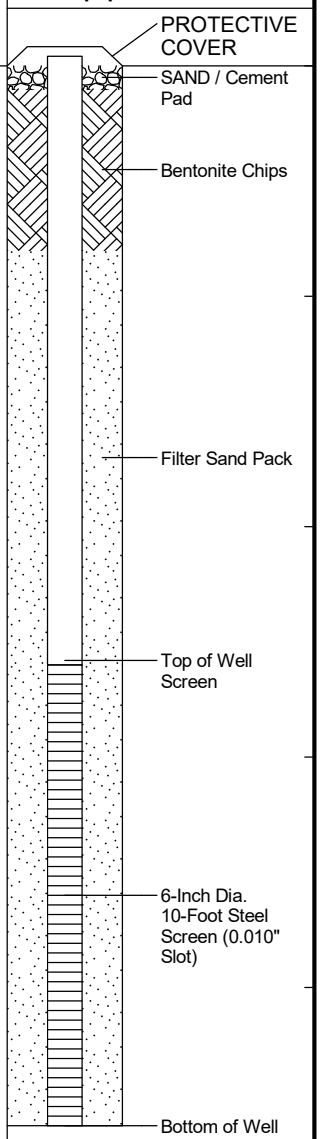
GROUNDWATER READINGS

Date	Time	Depth	Casing	Stab
3/18/22	0900	4.2'	Well	19 hrs

Surveyed By: EXXEL **Survey Date:** 3/30/2022

Depth	Sample Information: No.	Pen./ Rec. (in.)	Depth (Ft.)	Blows (/6")	Test Data	Sample Description & Classification	Stratum Desc.	Remarks
1	1	24/22	0-2	9-9 7-7		Medium dense, brown, fine to coarse SAND, little Gravel, trace Silt, moist (FILL). Changing at 0.2 feet to: Black, FILL, Cinders and Coal fragments, moist.	FILL	
2	2	24/15	2-4	4-5 4-4		Loose, black and brown, FILL, Cinders, Slag, Coal, moist.		
4	3	24/14	4-6	2-3 3-3		Loose, black and brown, FILL, Cinders, Slag, Coal, wet. Changing at 5.0 feet to: Green and brown, SILT, little fine to medium Sand, moist.	5' SILT	1
6	4	24/0	6-8	1-2 6-7		NO RECOVERY.		
8	5	24/24	8-10	9-6 9-12		Stiff to very stiff, brown, CLAY & SILT, trace fine to medium Sand, trace Gravel, moist.	8' CLAY & SILT	
10	6	24/19	10-12	5-7 9-13		Very stiff, brown, CLAY & SILT, trace fine to medium Sand, trace Gravel, moist.		
12	7	24/20	12-14	5-6 9-11		Stiff to very stiff, gray, SILT & CLAY, trace fine to medium Sand, moist. Changing at 13.5 feet to: Gray, fine SAND, little Silt, wet.	12' SILT & CLAY 13.5' SAND	
14	8	24/24	14-16	5-8 10-14		Very stiff, gray, SILT & CLAY, trace fine to medium Sand, moist. Changing at 15.5 feet to: Medium dense, gray, fine to medium SAND, trace Silt, wet.	14' SILT & CLAY 15.5'	
16	9	24/20	16-18	7-5 10-13		Stiff to very stiff, gray, SILT & CLAY, trace fine to medium Sand, moist. Changing at 17.0 feet to: Medium dense, gray, fine to medium SAND, trace Silt, wet.	16' SAND SILT & CLAY 17' SAND	
18	10	24/19	18-20	4-6 11-13		Very stiff, gray, SILT & CLAY, some fine to medium Sand, moist.	18' SILT & CLAY	
20	11	24/17	20-22	10-9 13-16		Very stiff, gray, SILT & CLAY, some fine to medium Sand, moist.		
22	12	12/12	22-23	8-8		Very stiff, gray, SILT & CLAY, some fine to medium Sand, moist.	23'	
23						Bottom of Borehole at 23.0 Feet		2

Equipment Installed



REMARKS

1. Groundwater was encountered at approximately 4.0 feet below ground surface.
2. Monitoring well was installed in borehole upon completion. Well screen was set from approximately 13.0 to 23.0 feet below ground surface.

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

GZA GeoEnvironmental, Inc.
Engineers and Scientists

Wolverine World Wide, LLC
RAP
Rockford, Michigan

Boring No.: TA-EW-3
Page: 1 of 1
File No.: 16.0062961.02
Check: J. Groenleer

Contractor: Stearns Drilling Company
Foreman: J. Gryska
Logged by: D. Watt
Date Start/Finish: 3-18-22 / 3-18-22
Boring Location: 594,081.4277 N; 12,804,546.8572 E
GS Elev.: 695.43' **Datum:** NAD83/NAVD88

	Auger/ Casing	Sampler
Type:	Hollow Stem Auger	Split Spoon
O.D. / I.D.:	14"/10.25"	2.0" / 1 3/8"
Hammer Wt.:	140lbs	NA
Hammer Fall:	30.0"	NA
TOC Elev.:	694.98'	NA

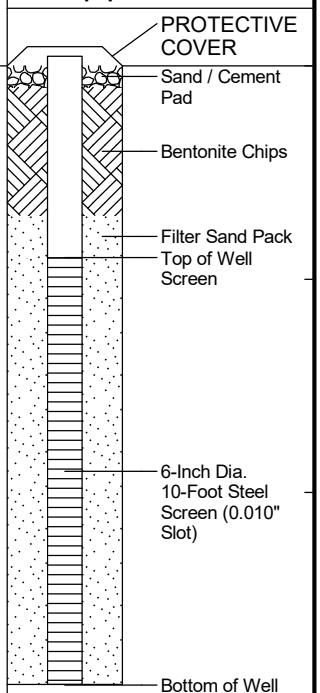
GROUNDWATER READINGS

Date	Time	Depth	Casing	Stab
3/21/22	0830	4.7'	Well	72 hrs

Surveyed By: EXXEL **Survey Date:** 3/30/2022

Depth	Sample Information No.	Pen./ Rec. (in.)	Depth (Ft.)	Blows (/6")	Test Data	Sample Description & Classification	Stratum Desc.	Remarks
1	1	24/20	0-2	3-12 7-6		Medium dense, TOPSOIL. Changing at 0.8 feet to: Medium dense, brown, fine to coarse SAND, little Gravel, trace Silt, moist.	TOPSOIL 0.8' SAND	
2	2	24/16	2-4	9-16 25-19		Dense, light brown, fine to coarse SAND, some Gravel, trace Silt, moist.		
3								
4	3	24/12	4-6	8-11 8-8		Dense, light brown, fine to coarse SAND, some Gravel, trace Silt, moist. Changing at 5.5 feet to: Dense, light brown, fine to coarse SAND, some Gravel, trace Silt, wet.		1
5								
6	4	12/0	6-7	3-1-50/0"		NO RECOVERY.		2
7								
8	5	24/15	8-10	4-2 2-4		Loose, green and brown, fine to medium SAND, little Silt, trace Gravel, wet. Changing at 9.6 feet to: Brown, SILT & CLAY, little fine to medium Sand, trace Gravel, moist.		
9							9.6' SILT & CLAY	
10	6	24/16	10-12	8-39 9-11		Hard, brown, SILT & CLAY, trace fine Sand, moist.		
11								
12	7	24/22	12-14	19-11 16-20		Very stiff, brown, SILT & CLAY, trace fine Sand, moist.		
13								
14	8	24/21	14-16	22-11 14-19		Very stiff, gray, SILT & CLAY, trace fine Sand, moist.		
15								
16	9	24/15	16-18	18-9 13-15		Very stiff, gray, SILT & CLAY, trace fine Sand, moist.		
17								
18	10	24/22	18-20	7-8 9-11		Medium dense, gray, fine SAND and Silty Clay, trace Gravel, moist.	18' SAND	
19								
20	11	24/16	20-22	14-8 11-12		Medium dense, gray, fine SAND and Silty Clay, trace Gravel, moist. Changing at 21.0 feet to: Very stiff, gray, Clayey SILT, trace fine Sand, moist.	21' SILT	
21								
22	12	24/20	22-24	13-10 13-13		Medium dense, gray, fine SAND and Silt & Clay, trace Gravel, moist.	22' SAND	
23								
24							24'	
25						Bottom of Borehole at 24.0 Feet		3
26								

Equipment Installed



REMARKS

1. Groundwater was encountered at approximately 5.5 feet below ground surface.
2. Spoon refusal at approximately 7.0 feet below ground surface. Driller augered past obstruction and resumed sampling.
3. Monitoring well was installed in borehole upon completion. Well screen was set from approximately 4.5 to 14.5 feet below ground surface.

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.