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A Division of GZA

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TANNERY INTERCEPTOR SYSTEM CONCEPTUAL DESIGN

Rockford, Kent County, Michigan

March 20, 2020
File No. 16.0062335.60

PREPARED FOR:
Wolverine World Wide, Inc.
Rockford, Michigan

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1.0 INTRODUCTION

On behalf of Wolverine Worldwide, Inc. (Wolverine), Rose & Westra, a Division of GZA GeoEnvironmental, Inc. (R&W/GZA), prepared this Technical Memorandum to describe the goal, technical approach, and conceptual design for the interim remedy (IR), which includes groundwater interception, treatment, and discharge at Wolverine's former tannery site located at 123 North Main Street NE, Rockford, Michigan (Site).

2.0 BACKGROUND

The ongoing remedial investigation (RI) indicates groundwater north and south of Rum Creek generally flows to and likely discharges to the Rogue River. Figures 1 and 2 show groundwater contours (the groundwater flow direction is perpendicular to the contour lines) and the highest Perfluorooctanesulfonic acid (PFOS) concentrations measured in 2017 and 2018. The PFOS concentrations in groundwater exceed the generic groundwater-surface water interface cleanup criterion established under Part 201 of Michigan's Natural Resources and Environmental Protection Act.

The RI provided significant information utilized in the treatment system design, including on-site PFOS distribution, approximate groundwater flux to the Rogue River (estimated from slug tests performed in 2014 and pump tests performed in 2018), and concentrations of other groundwater constituents which can reasonably be predicted to affect perfluoroalkyl substances (PFAS) treatment or discharge.

3.0 OBJECTIVE

The objective of the IR is to reduce the mass of PFOS discharging with groundwater from the Site to the Rogue River. Groundwater will be stagnated east of the Rogue River, captured, treated, and discharged. The IR is not designed to remove all PFAS from groundwater at the Site, but to reduce PFOS migration to the Rogue River while further investigations and longer-term solutions are studied.

4.0 GROUNDWATER CAPTURE

Because the apparent bottom of the shallow groundwater formation north of Rum Creek is near the surface, most shallow groundwater north of Rum Creek will be captured using a French drain/interceptor trench. The trench will be set on the bottom of the shallow groundwater formation. One or more capture/purge wells may be used to collect groundwater from near Rum Creek where the bottom of the shallow groundwater formation is deeper. Groundwater from the trench and capture wells (if any) will be pumped to the treatment building.

The bottom of the shallow aquifer is deeper south than north of Rum Creek; therefore, a series of capture wells will likely be used in this area. The spacing and locations for these purge wells are based on hydraulic conductivity estimates from the slug and pump tests described previously and a particle tracking groundwater model. Several paired shallow and deep capture wells will be used in the southern portion of the Site where multiple interconnected groundwater formations are present. Figure 3 presents a tentative layout for the capture system. As indicated on this Figure, all locations are tentative at this time.

The testing and modeling performed to date suggest individual capture wells will produce less than 1 gallon per minute (gpm) on a continuous basis. R&W/GZA could not identify a variable speed pump having appropriate discharge characteristics for such small flow rates. Therefore, all pumps will be operated on an on-off basis. During startup and balancing for the first several months of operation, pumps in the French drain and capture

wells will be activated by a pressure transducer (level sensor) in the equalization tank. Pressure transducers in the French drain manhole and in all capture wells will stop individual pumps at an adjustable, pre-determined (low) water level. Therefore, each capture location will be controlled by both the equalization tank and their own individual water levels. When the equalization tank reaches its high-water elevation, all pumps will shut off until the equalization tank returns to its low-water level and this cycle will repeat continuously.

Captured groundwater will be pumped via a force main to the treatment building. The portion of the force main passing under Rum Creek will be installed using horizontal boring.

Pressure transducers will also be installed in a series of monitoring wells between the capture wells/French drain and Rogue River as well as one or more points within Rum Creek and/or the Rogue River. These will record water levels to assess the local groundwater flow direction between the surface water bodies and capture system. While not used to directly control the capture system, these measurements will be used to adjust the low-water set point in the capture wells and manhole to optimize/balance the capture system.

5.0 GROUNDWATER TREATMENT

While multiple emerging technologies are being researched and tested for PFAS treatment, R&W/GZA selected granular activated carbon (GAC) sorption for the primary treatment technology because its effectiveness has been thoroughly demonstrated and systems using GAC can be designed, constructed, and implemented promptly. In addition to numerous literature studies, the Point-of-Entry Treatment filters installed at selected homes in the House Street and Wolven-Jewell study areas demonstrate the effectiveness of the proposed GAC treatment.

Initially, treated groundwater will be discharged to the City of Rockford sanitary sewer leading to the North Kent Sewer Authority (NKSA) treatment plant. NKSA has conditionally approved the proposed discharge and treatment scheme. Based on the substantial groundwater test results, only PFAS treatment is required to comply with the NKSA discharge limits.

Based on estimated iron concentrations from groundwater sampling performed to date, iron removal prior to the GAC treatment will be cost effective. Therefore, the groundwater treatment system will include:

- Iron removal - aeration, chemical feed, and settling
- Equalization
- Sediment filtration
- Ultra-Violet sanitizer (to reduce potential bacteriological fouling on the GAC)
- Two-stage GAC
- Sediment filtration
- Effluent metering and sampling

Figure 4 presents the treatment schematic. Because the flow to the treatment system will be increased over time, the design accommodates two different size GAC vessels. The system is designed to accommodate flow from 3 to 50 gpm and includes an effluent clear well to provide water for re-bedding and backwashing the GAC columns. The Treatment System Basis of Design is Attachment 1.

The system will also have connections for full-scale, two-stage, resin (ion exchange) sorption as an alternative or supplement to the GAC. The design accommodates resin sorption before, after, or in place of the GAC.

Sludge from iron removal will be stored prior to off-site disposal in the liquid/semi-solid state.

6.0 IMPLEMENTATION

The IR is subject to local, state, and federal permit requirements. These include, but are not limited to:

- Local zoning, site plan approval and building codes
- Surface water/utility crossing
- Capture well, pipe and conduit installation within the former railroad right-of-way owned by Michigan Department of Transportation.
- Effluent discharge

Wolverine already has conditional discharge approval. All other approvals will be obtained prior to construction.

The conditional discharge approval from NKSA requires the system to be started incrementally, i.e., the flow will be increased stepwise. Therefore, the capture wells south of Rum Creek will be installed in phases (currently two phases are proposed).

7.0 ANTICIPATED SCHEDULE

The design is complete to the 50-percent stage which is sufficient for site plan approval, permitting, and cost estimating. Wolverine will apply for all approvals in Spring 2020.

Construction will likely commence once approvals have been received. We anticipate approximately four months until substantial completion and startup will commence immediately thereafter.

FIGURES

N

W E

S

RR-3
691.5

TA-GW-09
691.5

TMW-111
691.2*

TA-GW-05
692.0

TMW-110
691.5*

TA-GW-02
691.7

TMW-109
691.5*

TN-MW-308B
691.5*

TN-MW-308C
691.4*

TN-MW-308A
691.6*

TMW-102
691.2*

TN-MW-307A
692.1

TN-MW-307B
692.2

TMW-108
691.1*

RR-2
691.5

TN-MW-306A
692.3

TN-MW-306B
692.2

692

692.5

693

TN-MW-304B
692.4

TN-MW-304A
693.2

TA-GW-06
692.4

TN-P-4
692.8

RC-1
691.7

TMW-105
691.1*

TN-MW-305B
692.5

TN-MW-5
693.0

TA-GW-03
691.8

TN-MW-3
692.5

693.5

TN-P-3
692.4

TN-MW-305C
692.5

TN-MW-2
694.0

TN-MW-4
692.5

RC-2
692.1

TMW-103
693.18*

TN-MW-303A
692.2

TN-MW-303B
692.2

TN-MW-303E
688.4

TN-MW-303C
692.2

TN-MW-303D
688.4

694

TN-P-2
692.4

694.5

695

TN-MW-1
693.7

TN-P-5
695.2

TA-GW-01
692.2

TN-MW-302A
693.5

TA-GW-04
692.7

TN-MW-302B
692.3

TN-P-1
692.7

TA-GW-07
693.2

TMW-104
693.4*

N Main St

TMW-101
691.3*

TN-MW-301B
692.9

TN-MW-301C
692.6

TN-MW-301D
688.8

TA-GW-08
693.1

TN-MW-309A
692.6

TN-MW-309B
692.8

TN-MW-309C
692.0

TN-MW-309D
692.0

TN-MW-310A
693.3

TN-MW-310B
693.2

TN-MW-310C
690.3

RR-1
691.5

Legend

- Ground Water Sample Location
- Estimated Hydraulic Head Contour
- Inferred Direction of Groundwater Flow

NOTES

1. CALCULATED VALUES OF OVERBURDEN GROUNDWATER HYDRAULIC HEAD ARE BASED ON DEPTH TO GROUNDWATER MEASUREMENTS MADE BY R&W/GZA ON AUGUST 29, 2018. CALCULATED VALUES OF OVERBURDEN GROUNDWATER HYDRAULIC HEAD BASED ON MEASUREMENTS MADE ON OTHER DATES INCLUDING MARCH 14, 2018 AND AUGUST 3, 2018 WERE INCLUDED FOR LOCATIONS THAT WERE NOT INCLUDED IN THE AUGUST 29, 2018 MEASUREMENT ROUND AND ARE DENOTED WITH "*".
2. ESTIMATED HYDRAULIC HEAD CONTOURS ARE BASED ON DEPTH TO WATER LEVEL MEASUREMENTS MADE IN WELLS SCREENED WITHIN THE UPPER APPROXIMATELY 10 FEET OF THE SATURATED ZONE. CALCULATED VALUES OF HYDRAULIC HEAD BASED ON DEPTH TO WATER LEVEL MEASUREMENTS MADE IN WELLS SCREENED WITHIN DEEPER INTERVALS ARE ALSO SHOW BUT WERE NOT USED IN THE ESTIMATION OF THE HYDRAULIC HEAD CONTOURS DEPICTED HEREON. FOR LOCATIONS WITH MULTIPLE WELLS THE DEPTH TO WATER LEVEL MEASUREMENT FROM THE WELL WITH THE SHALLOWEST WELL SCREEN WAS USED IN THE ESTIMATION OF THE HYDRAULIC HEAD CONTOURS.
3. CALCULATED VALUES OF OVERBURDEN GROUNDWATER HYDRAULIC HEAD FOR WELLS SCREENED AT DEPTHS WITHIN THE SATURATED ZONE GREATER THAN APPROXIMATELY 10 FEET ARE INCLUDED ON THE FIGURE FOR COMPARISON TO THE SHALLOW SCREENED WELLS.
4. ESTIMATED HYDRAULIC HEAD CONTOURS AND INFERRED DIRECTIONS OF GROUNDWATER FLOW ASSUME HOMOGENOUS ISOTROPIC POROUS MEDIA CONDITIONS. LOCALIZED VARIATIONS IN HYDRAULIC HEAD AND THE DIRECTION OF GROUNDWATER FLOW WILL OCCUR DUR TO SPATIAL VARIATIONS IN AQUIFER PROPERTIES.
5. BASEMAP CONTAINS GEOREFERENCED AERIAL IMAGERY PROVIDED BY GOOGLE EARTH DATED TO 2017.

0 25 50 100

SCALE IN FEET

WOLVERINE WORLDWIDE / WARNER, NORCROSS AND JUDD
FORMER TANNERY SITE
123 MAIN STREET, ROCKFORD, MI
2018 DATA SUMMARY REPORT

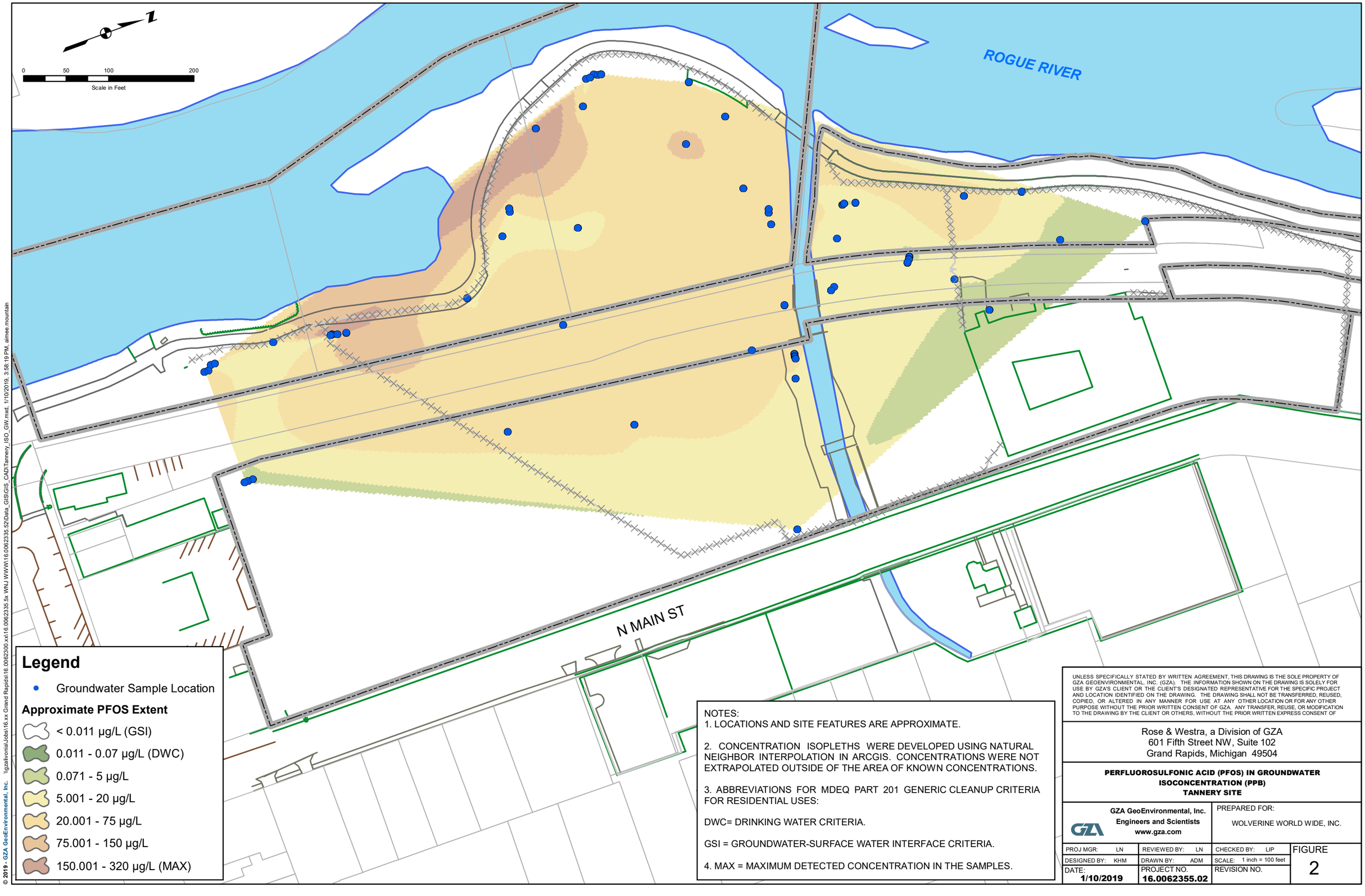
GROUNDWATER POTENTIOMETRIC CONTOUR MAP SHALLOW OVERBURDEN

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

PREPARED FOR:
WOLVERINE WORLD WIDE / WARNER, NORCROSS & JUDD

PROJ MGR:	LN	REVIEWED BY:	LN	CHECKED BY:	JW	FIGURE	
DESIGNED BY:	JW	DRAWN BY:	MD	SCALE:	1 in = 50 ft		1
DATE:	October 26, 2018	PROJECT NO:	16.0062335.02	REVISION NO:			

 \\GZABEDFORD\Jobs\BranchOffices\Wolverine Tannery 16.0062335.00\Figures\Tannery Sample Locations\MD_WWW_Groundwater_Contours.mxd, October 26, 2018 - 2:15:16 PM, aimee.mountain



NOTES:
1. LOCATIONS AND SITE FEATURES ARE APPROXIMATE.

2. CONCENTRATION ISOPLETHS WERE DEVELOPED USING NATURAL NEIGHBOR INTERPOLATION IN ARCGIS. CONCENTRATIONS WERE NOT EXTRAPOLATED OUTSIDE OF THE AREA OF KNOWN CONCENTRATIONS.

3. ABBREVIATIONS FOR MDEQ PART 201 GENERIC CLEANUP CRITERIA FOR RESIDENTIAL USES:

DWC= DRINKING WATER CRITERIA.

GSI = GROUNDWATER-SURFACE WATER INTERFACE CRITERIA.

4. MAX = MAXIMUM DETECTED CONCENTRATION IN THE SAMPLES.

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PERFLUOROSULFONIC ACID (PFOS) IN GROUNDWATER ISOCONCENTRATION (PPB) TANNERY SITE

GZA GeoEnvironmental, Inc.
Engineers and Scientists
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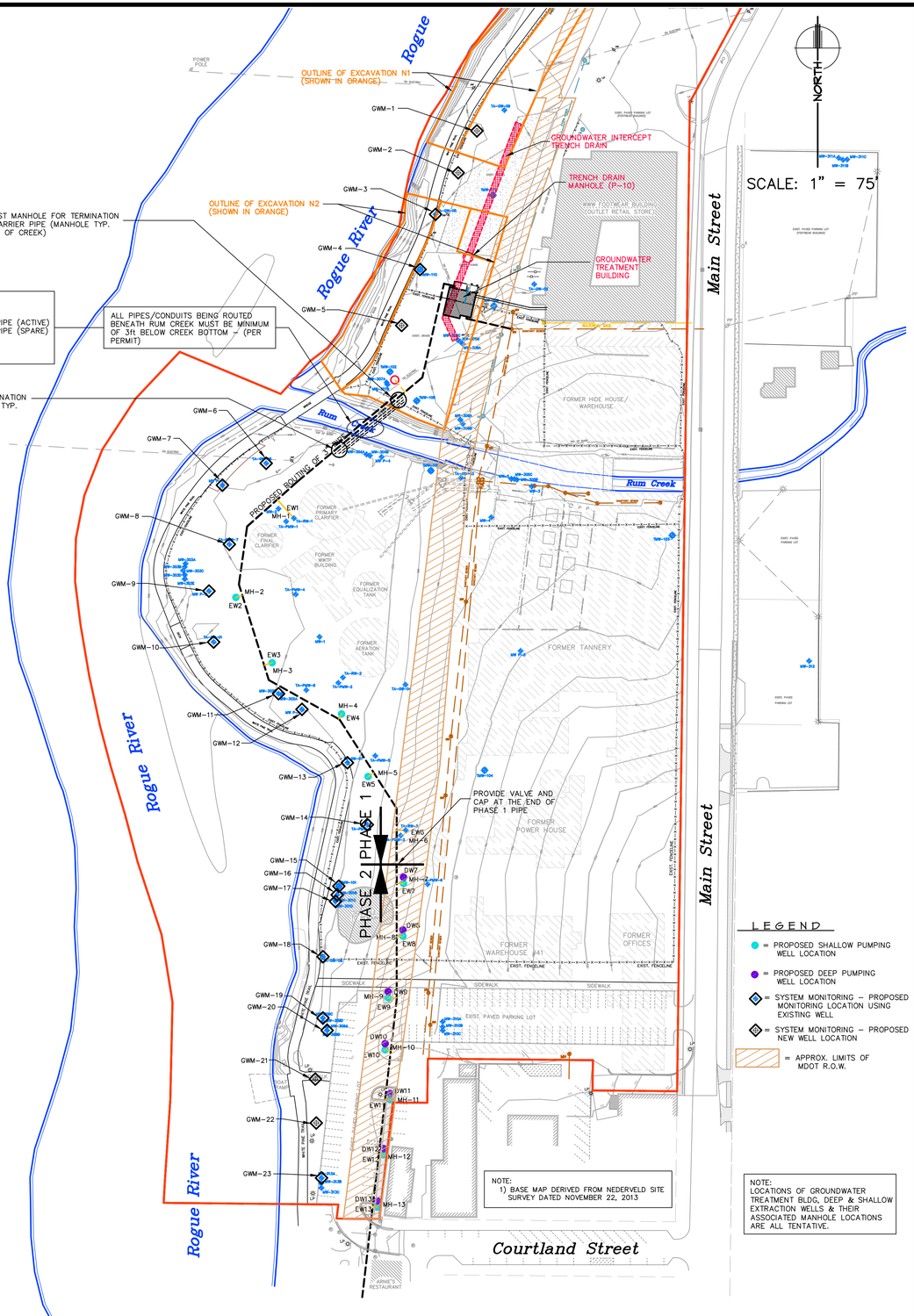
PREPARED FOR:
WOLVERINE WORLD WIDE, INC.

PROJ MGR: LN	REVIEWED BY: LN	CHECKED BY: LIP	FIGURE 2
DESIGNED BY: KHM	DRAWN BY: ADM	SCALE: 1 inch = 100 feet	
DATE: 1/10/2019	PROJECT NO. 16.0062355.02	REVISION NO.	

 \\gzaltvonia\Jobs\16.xx Grand Rapids\16.0062300.xx\16.0062335.5x WNJ WWW\16.0062335.52\Data_GIS\GIS_CAD\Tannery_ISO_GW.mxd, 1/10/2019, 3:58:19 PM, aimee.mountain



SITE PLAN W/ PROPOSED GROUNDWATER INTERIM REMEDY

DRAFT COPY

DRAWN BY | DESIGN BY | DATE 3/12/20

FILE NO.: 62335.60_SITEPLAN

NO.	BY	DATE

REVISIONS

REVISED IN ACCORDANCE WITH CONSTRUCTION RECORDS

WOLVERINE WORLD WIDE/WNJ
FORMER TANNERY SITE, ROCKFORD, MICHIGAN
GROUNDWATER INTERIM REMEDY

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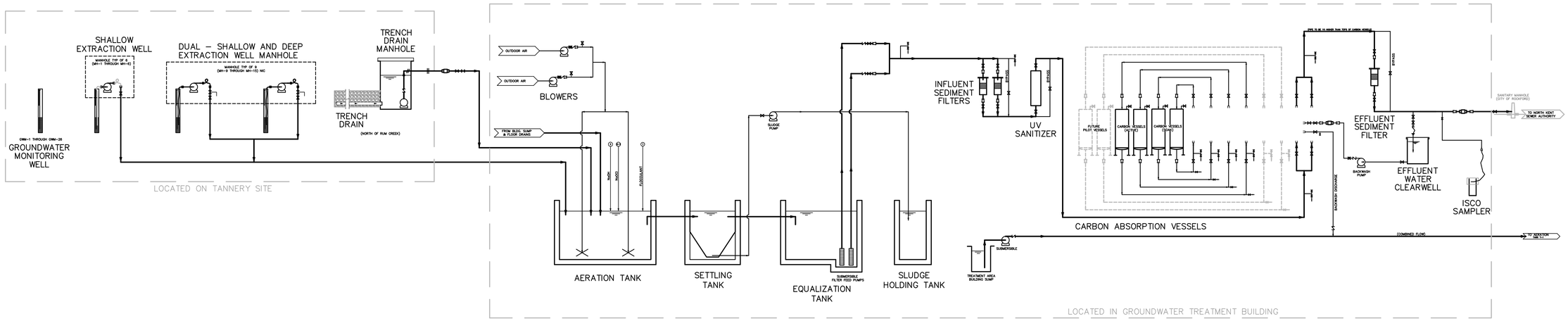
Grand Rapids, Michigan
GEOTECHNICAL- ENVIRONMENTAL- ECOLOGICAL- WATER- CONSTRUCTION MANAGEMENT

PROJECT NO.
16.0062335.60

SHEET NO.
3



GROUNDWATER INTERIM REMEDY - PROCESS FLOW DIAGRAM

DRAFT COPY

DRAWN BY	DESIGN BY	DATE
KJB	BLR	3/18/20

FILE NO.: 62335_60_F5

NO.	REVISIONS	BY	DATE
	REVISED IN ACCORDANCE WITH CONSTRUCTION RECORDS		

WOLVERINE WORLD WIDE/WNJ
FORMER TANNERY SITE, 123 MAIN ST. ROCKFORD, MI.
GROUNDWATER INTERIM REMEDY

ROSE & WESTRA
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Grand Rapids, Michigan
GEOTECHNICAL- ENVIRONMENTAL- ECOLOGICAL- WATER- CONSTRUCTION MANAGEMENT

PROJECT NO.
16.0062335.05

SHEET NO.
4

ATTACHMENT 1

TREATMENT SYSTEM BASIS OF DESIGN

Wolverine Tannery IR
Wastewater Treatment
Last Revised: 1/24/2020 - MAW

Influent Flow-	gpm	gpd
Phase I - NKSA discharge	7	10080
Phase II - NPDES discharge (includes Phase I)	28	40320
Phase III (Phase I & II + Unknown future)	50	72000

Extraction Wells	gpm	gpd
Phase I (5-6) MH-1 to MH-6 + North Trench Drain	7	10080
Phase II (~ 18 additional extaction wells)	21	30240
Subtotal	28	40320

Influent Concentrations

PFAS - GW	28740	ppt
Fe - GW	1.27	mg/l
Ammonia - GW	1.18	mg/l
Chloride	133	mg/l

Effluent Required for NKSA discharge	
PFAS	ND

Aeration Tank

Design Objective - oxidize iron for precipitation and settling.

Since the rate of the reaction is pH dependent, pH adjustment equipment will be installed to raise the pH, if required.

At pH 6 - requires > 100 hours.
At pH of 7.0 - 90% Fe+2 oxidation requires 1 hour at 21C - requires 10 hours at 5C
At pH of 8 - 90% Fe+2 oxidation in 30 seconds.

However, the aeration tank will be designed to provide 30 minutes of detention at a pH of 7.5 based on no addition of hydroxide.

Average pH of Groundwater	7.5	
Detention Time (minimum)	30	minutes

Tank volume based on Phase III - 50 gpm	1500	gallon	
Type	Concrete		
Size (cu ft) required	201		
width	3	ft	
length	14	ft	
depth	6	ft (swd)	
Cubic foot designed	252		

Oxygen Required:

TOC	4	mg/l	assume 3lb Oxygen/lb TOC
Fe	1.27	mg/l	assume 1lb/lb
Increase DO	6	mg/l	
Oxygen Required	11.6	lb/day	
	0.4833333	lb oxygen/hour	
say 4% transfer	0.04		
say .21 percent oxygen in air	0.21		
Air required	57.5	lb air/hour	
Air density	0.0765	lb/cu ft	
	752	cu ft/hr	
	13	CFM	

Notes: Use NaOCl to inhibit nitrification if needed

Air Supply

Type	Rotary Vane	
Number	2	installed Standby
Equal to	PB Gast	
Diffusers	removable for cleaning hand drilled orifices - Fabricate with 1" SS pipe	

Settling Tank

Overflow Rate (OR)	0.5	gpm/sf
Surface Area Required at 50 gpm influent flow	100	SF
Area provided		
length	18	

width	6	
Area provided	108	SF

Wet Well/Equalization

Purpose - on-off control of PD pumps discharging to treatment		
Size - on-off cycle, dwell in tankage when all off, re-bed backwash	8078	gallon
Available for re-bed backwash	6000	gallon
Pumps		
P-1 - 1 standby (on shelf) for NKSA	7	gpm
P-2 - NPDES Phase II	28	gpm

Control

Set flow rate and control pump speed to maintain flow rate.

Solids Generation

Iron hydroxide solids	1.27	mg/l
Fe-OH Solids	0.7626096	lb/day
Fe-OH Solids	0.7626096	lb/day
Chemical/conditioning	2.5	Multiplier
Total Solids 50 gpm	1.906524	lb/day
Monthly	57.19572	lbs/month
underflow (2-5%) use 3	0.03	
volume	228.6	gallons/month
Tank size - 3' wide, 6' deep, 18' long =	2424	gallons
Months of storage	10.601575	
Ultimate disposal	Pump and Haul	

Pre-Carbon Sediment Filters

Number	2	
One operating, one standby		
Polyester Felt Bag	20-25	micron
Mesh basket	40	micron

UV Sanitizer

UV Viqua Pro 50

Design flow	50	gpm

GAC Vessels

	Phase I NKSA	Phase II NPDES
Concentration ppt	28740	28740
Lead size CF	24	38
Peak flow (gpm)	10	28
Avg Flow (gpm)	7	28
# columns in lead	1	1
Column height (in)	72	72
Column dia (in)	30	48
Column Area (SF)	4.9	12.6
HLR Average	1.4	2.2
HLR Peak	2.0	2.2
EBCT min	18	10
tb (time to breakthrough, days)	88	35

Post-Carbon Sediment Filters

Number	1	
Polyester Felt Bag	20-25	micron
Mesh basket	40	micron

Sampling/Metering

ISCO Refrigerated Model 5800 - Flow Proportional Sampling

GZA GeoEnvironmental, Inc.