MEMORANDUM

TO:	Richard Conforti	cc:	David Favero Kevin Schneider
FROM:	Clifford Yantz		
RE:	Additional PFAS Characterization Scope of Work		
FILE:	15388/68545/2		
DATE:	August 17, 2018		

This memorandum has been prepared on behalf of the Revitalizing Auto Communities Environmental Response Trust (RACER Trust) to provide a scope of work to further characterize per- and polyfluoroalkyl substances (PFAS) at the Coldwater Road Landfill and the adjoining Peregrine facility, both owned by RACER, located in Flint, Michigan (Site).

To evaluate the presence of PFAS at the Site, groundwater sampling was completed during several events listed below (see **Figure 1** for monitoring well locations):

- November 29, 2016 and November 30, 2016
  - Shallow (Perched) Zone – B-7, B-19Ar, MW-4-02, MW-18-13, and MW-19-13 were sampled as part of the initial PFAS sampling/evaluation activities.
  - Deep (Drift) Aquifer - MW-16-10 was sampled to evaluate if PFAS are present at the downgradient boundary of the Site within the regional Drift aquifer.
- June 19, 2017 and June 20, 2017
  - Perched Zone – perched zone monitoring wells B-9, B-18A, B-24r, B-28, OBG MW 7, and OBG MW 9 were sampled to evaluate the presence and/or distribution of PFAS in the shallow groundwater adjacent to the landfill.
  - Drift Aquifer - B-27D was sampled to evaluate if PFAS are present downgradient of the landfill in the Drift aquifer.
- December 8, 2017
  - Perched Zone - Three temporary monitoring wells (SBP-1-GW, SBP-2-GW, and SBP-3-GW) were installed and sampled along the western property line of the Site to evaluate if PFAS are leaving the Site above MDEQ drinking water criteria.
- June 12, 2018 and June 13, 2018
  - Perched Zone –annual sampling of the perched zone monitoring wells B-7, B-9, B-18A, B-19Ar, B-24r, B-28, and MW-19-13 was conducted to confirm the previous results and distribution of PFAS in the perched groundwater.
  - Drift Aquifer – B-27D and MW-16-10 were sampled to confirm the previous PFAS results in the Drift aquifer. In addition, upgradient monitoring well B-2D and on-Site monitoring well B-22D were sampled to evaluate if PFAS are present upgradient of the landfill and/or present in the Drift aquifer southeast of the landfill.
- June 28, 2018
  - Perched Zone – Two temporary monitoring wells (SBP-4 and SBP-5) were installed 200 feet and 400 feet north of SBP-2 to evaluate the distribution of PFAS north of SBP-2 along the western Site property line of the Site.

- July 19, 2018
  - Perched Zone – sampled monitoring well OBG-MW-11 installed adjacent to former temporary monitoring well SBP-2-GW to confirm the presence of PFAS along the western Site property line.
  - Drift Aquifer - B-2D was re-sampled to confirm the PFAS results in this monitoring well located upgradient of the landfill in the Drift aquifer.

During the various sampling events discussed above, PFAS were detected above the MDEQ drinking water criteria of 70 ng/L (0.070 µg/L) for the combined concentrations of PFOA (Perfluorooctanoic acid) and PFOS (Perfluorooctanesulfonic acid) in groundwater samples from perched zone monitoring wells B-7 and OBG MW-11, and from temporary monitoring wells SBP-1, SBP-2 (from the duplicate sample, as the initial sample was below criteria), and SBP-5, and from Drift aquifer monitoring well B-2D. **Table 1** provides a summary of the available PFAS data for the Site. **Figures 2** and **3** provides data box figures for the perched and drift monitoring well analytical results, respectively. **Figure 4** provides a north-south cross-section for the entire Site (cross-section A-A'), and **Figure 5** provides a north-south cross-section (B-B') along the western property line and a west-east cross-section (C-C') from SBP-3A to B-7.

Based on the sampling results and interpreted flow direction for the Drift aquifer (which is southward, see **Figure 3**), it does not appear that concentrations of PFAS above drinking water criteria are migrating off-Site within the Drift (regional glacial) aquifer. However, more investigation is required to confirm this hypothesis and to delineate the PFAS impacts in the perched zone at and migrating from the Site. The groundwater flow direction in the perched zone is complicated because the conceptual site model (CSM) for the Site is that the perched saturated zones within the otherwise clayey matrix are discontinuous. However, **Figure 2** provides interpreted contours for the groundwater elevation data collected during the June 2018 semiannual sampling event. Based on these contours, the groundwater flow direction in the perched zone appears to be predominantly toward the northwest.

ADDITIONAL PERCHED ZONE PFAS CHARACTERIZATION

Due to the elevated PFOS results (1,700 ng/l [ppt]) at perched zone temporary well SBP-1, we propose the installation of a perched monitoring well (OBG-MW-12) adjacent to SBP-1. The well will be installed and developed in accordance with the methods contained in the Post-Closure Care Plan (PCCP) for the site as specified in Section 5.1.4 Monitoring Well Installation Specifications, with 5-foot long well screen from 10 to 15 feet below grade (fbg) with no less than one foot and no more than two foot of sand pack above the screen.

In addition, we propose sampling perched monitoring wells OBG MW-6 and OBG MW-8, and resampling perched monitoring wells OBG-MW-7, and OBG-MW-9, to help delineate PFAS impacts within the former WWTP area and to confirm the previous results in OBG-MW-7, and OBG-MW-9.

In addition, to further characterize PFAS impacts along the western portion of the Site, we propose a serious of shallow direct push (*i.e.*, Geoprobe) borings be installed at approximately 200-foot intervals along the western property line and then the southern property line of the western part of the Site as shown on **Figure 6**. We propose utilizing the hydraulic profiling tool (HPT) to identify the relatively more permeable zones within the otherwise silty clay matrix to target the more permeable zones for sampling. We believe it may be possible to achieve depths of approximately 40 ft to evaluate the perched zone and will collect vertical profiling samples if multiple separated permeable zones exist or if a permeable zone exceeds 15 feet in thickness at a boring location. Should the HPT fail to achieve the necessary depths to evaluate the shallow perched zone, then standard Geoprobe® and possibly temporary well sampling will be utilized to collect the samples necessary to delineate the perched zone. Depending on the results of these property line characterization borings within the perched zone, and in consultation with MDEQ, up to three of these locations will be converted to permanent monitoring wells for possible continued PFAS sampling.

Furthermore, to help delineate the western extent of impacts already discovered in the SBP-1 and SBP-5 areas, we propose installation of additional shallow direct push borings similar to those discussed above within the

road right-of-ways for Temple, Cologne, Dunkirk, and Hartman streets at approximately 100-foot intervals as shown on **Figure 6**.

SURFACE WATER AND STORM WATER CHARACTERIZATION

We propose collection of two surface water samples within the wetlands at the Site, one immediately west of B-2D and a second sample at the western end of the wetlands near their overflow outlet. We also propose collecting a storm water sample from the storm sewer that traverses the Site, should water be present in the storm sewer. **Figure 6** provides a schematic of the storm sewer system that traverses the Site. Except for the very south end of the former Peregrine Facility where storm water is collected and discharged to the storm sewer beneath Coldwater Road, the storm water at the Site is collected in a series of storm sewers that join a main north-south line that traverses the Site until it reaches the remaining materials area (RMA) where the storm sewer turns from running north-south towards the west (and is joined by a smaller storm sewer coming from the former rail road spur to the east of the landfill) and goes off site joining the municipal storm sewer that runs in Klein Street. Not a lot of information is available for the depth of this storm sewer system, but it is believed to be generally above the perched zone groundwater table. Therefore, we propose the collection of invert elevations for several manholes along the main trunk and several smaller branch lines, to establish a better understanding of the elevation of the storm sewer system relative to groundwater, while the survey crew is on Site to collect location and elevation data for the borings and monitoring wells that are proposed herein.

The storm sewer sample will be collected from the manhole located in the RMA where the storm sewer turns from running north-south towards the west as described above (see **Figure 6**). The sampling will be in accordance with the methods specified in MDEQ's Wastewater PFAS Sampling Guidance (see **Attachment 1**). The samples will be collected directly from the surface water body (wetland) or storm sewer using extension rods with a clamping system that can directly immerse the laboratory sample bottle in the surface water or water within the storm sewer. Care will be taken to collect the surface water/storm sewer samples to avoid the collection of surface films by inserting an uncapped sampling container (polypropylene or HDPE) with the opening pointing down and collecting the water from within the water column. This may prove impossible in the storm sewer where the depth of water may be minimal, but will be attempted. Care will also be taken to ensure the water column and the base of the surface water body at the sampling location is not agitated during sampling.

DRIFT AQUIFER PFAS CHARACTERIZATION

Due to PFAS impacts reported in B-2D and within the perched zone along the western Site property line, we propose sampling of Drift aquifer monitoring wells B-20D, B-21D, B-23Dr, MW-15-10, and PFW-1 to further evaluate the Drift aquifer at and downgradient of the landfill and other former wastewater treatment operations that are potential source of PFAS.

In addition, we propose installation of a series of deep borings to further evaluate the distribution of PFAS impacts at the Site, and to confirm or refute the current CSM that PFAS impacts are currently not migrating off-Site in the Drift aquifer at concentrations greater than the drinking water criteria.

We propose attempting to use the HPT at deep boring locations at the northeast corner of the Site and adjacent to the eastern property line east of B-2D as shown on **Figure 6** to identify relatively more permeable zones within the otherwise silty clay matrix of the glacial drift present at the Site. It is noted that it may not be possible to achieve the depths necessary to fully penetrate these clayey soils (glacial tills) to the Drift aquifer. Should the HPT be able to penetrate to sufficient depths and the more permeable zones within either of these borings prove to exceed 20 feet thick, then vertical aquifer profiling (vertical aquifer sampling [VAS]) samples will be collected at approximately ten-foot intervals to characterize the PFAS vertical profile within each more permeable zone in these borings to guide potential installation of permanent monitoring wells.

Should HPT not be able to penetrate to the Drift aquifer, then Rotosonic drilling techniques and available tooling will be utilized to perform VAS down to and within the Drift aquifer should its thickness be greater than 20 feet in order to guide potential installation of permanent monitoring wells within the Drift aquifer.

Once the initial borings north and east of B-2D have been completed, then other deep borings are proposed along Stanley Road along the northern property line (see **Figure 6**) should the location north of B-2D be PFAS impacted. Additional exploratory locations are suggested adjacent to B-2D to evaluate the perched zone and the slightly thicker Drift zone observed at this location, south of B-2D near B-19Ar, due west of B-19Ar at the corner of the western and southern fence lines adjacent to the former RMA, further south near B-7, and adjacent to SBP-1 (or soon to be installed monitoring well OBG-MW-12). Borings will be temporarily double cased during drilling, as necessary and appropriate, to avoid potentially cross-contaminating the deeper zones from above. Any additional deep boring locations would be installed after consultation with MDEQ and based on the results from the shallow and deep boring programs discussed herein.

Should Drift monitoring wells be deemed necessary (such as in the B-19Ar, B-7, SBP-1 [OBG-MW-12], or any other areas), then the wells will be installed and developed in accordance with the methods contained in the PCCP for the Site as specified in Section 5.1.4 Monitoring Well Installation Specifications, with 5-foot long well screens and no less than one foot and no more than two foot of sand pack above the screen.

Standard (*i.e.*, four week) turnaround laboratory analyses proposed in this Scope of Work will be performed by TestAmerica Sacramento; however, if quicker (*i.e.*, rush) turnaround analyses are needed to facilitate field decisions then selected sample analysis may be performed by Eurofins Lancaster Laboratories, located in Lancaster, Pennsylvania.

SCHEDULE

RACER Trust and OBG are prepared to begin to implement the of scope of work to delineate the PFAS impacts at the Site upon MDEQ's approval of this proposed work.

If you have any questions or comments concerning this proposed work, please feel free to contact me at 313.333.0211 or Dave Favero at 734.879.9525.

Very truly yours,

O'BRIEN & GERE ENGINEERS, INC.

Clifford S. Yantz, PG
Senior Hydrogeologist

ENCLOSURES:
Table 1 – Per-and Polyfluoroalkyl Substances Sampling Results – Detections
Figure 1 –Monitoring Well Locations
Figure 2 – Perched Monitoring Wells PFAS Sample Locations
Figure 3 – Drift Monitoring Wells PFAS Sample Locations
Figure 4 – Geologic Cross-Section A-A'
Figure 5 – Geologic Cross-Section B-B'/C-C'
Figure 6 – Proposed Boring Locations
Attachment 1 – MDEQ Wastewater PFAS Sampling Guidance

TABLE 1

RACER Trust - Coldwater Road Landfill & Peregrine Facilities

Per-and Polyfluorinated Substances Sampling Results - Detections

Coldwater Rd Monitoring Wells - Perched Aquifer

Perfluorinated Compound	Well/Sample ID:	B-7	B-7 (Collocated)	B-7	B-9	B-9	B-18A	B-18A	B-19Ar	B-19Ar	B-24r	B-24r	B-28	B-28	OBG-MW-7	OBG-MW-9	OBG-MW-11
	Sample Date:	*11/30/2016*	*11/30/2016*	*6/12/2018*	*6/20/2017*	*6/12/2018*	*6/20/2017*	*6/12/2018*	*11/30/2016*	*6/12/2018*	*6/20/2017*	*6/12/2018*	*6/20/2017*	*6/12/2018*	*6/20/2017*	*6/20/2017*	*7/19/2018*
Perfluorobutanoic acid (PFBA)		9.2 J	7.1	8.2 B	14 B	9.5 B	4.2 B	1.1 J/B	1.0 J	1.2 J/B	14 B	8.9 B	2.9 B	1.5 J/B	8.0 B	1.4 J B	29 B
Perfluoropentanoic acid (PFPeA)		2.6	1.7 J	4.2	2.2	1.7 J	<0.94	0.51 J	<0.98 U	1.1 J	<0.93	2.0	<0.96	0.47 J	<0.96	<0.94	5.7
Perfluorohexanoic acid (PFHxA)		3.9	3.1	3.3	9.3	7.0	<0.75	<0.56	<0.78 U	<0.54	3.9	2.7	0.92 J	<0.55	1.0 J	<0.75	29
Perfluoroheptanoic acid (PFHpA)		2.4	1.6 J	2.3	4.2	<0.24	<0.76	<0.24	<0.80 U	0.33 J	1.7 J	<0.23	<0.78	<0.24	<0.78	<0.76	14
Perfluorooctanoic acid (**PFOA**)		9.2 JN	7.6	9	15	12	1.2 J	<0.82	0.84 JN	0.93 J	3.9	3.4	0.79 J	0.84 J	<0.72	1.1 J	54
Perfluorononanoic acid (PFNA)		0.87 J	0.79 J	0.82 J	<0.64	<0.26	<0.62	<0.26	<0.65 U	<0.25	<0.62	<0.25	<0.63	<0.26	<0.63	<0.62	<0.22
Perfluorotetradecanoic acid (PFTeA)		<0.20 U	<0.19 U	<0.28	1.2 J B	<0.27	<0.19	<0.28	<0.20 U	<0.27	<0.19	<0.27	<0.19	<0.28	1.0 J B	<0.19	<0.24
Perfluorobutanesulfonic acid (PFBS)		5.7	5.8	4.1	2.3	2.1	<0.87	<0.19	<0.91 U	0.28 J	3.7	1.5 J	<0.89	<0.19	<0.86	2.0	79
Perfluoropentanesulfonic acid (PFPeS)		--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	160
Perfluorohexanesulfonic acid (PFHxS)		23	22 JN	18 B	6.9	3.7 B	<0.83	0.27 J/B	<2.0 U	0.89 J/B	5.4	2.6 B	<0.84	0.27 J/B	<0.84	5.0	450 B
Perfluoroheptanesulfonic Acid (PFHpS)		3.8	3.9	3.0	0.70 J	0.33 J	<0.68	<0.18	1.0 J	0.31 J	<0.67	<0.18	<0.69	<0.18	<0.69	<0.68	13
Perfluorooctanesulfonic acid (**PFOS**)		220	230	130	13	9.3	1.3 J	<0.52	3.9	4.1	5.0	2.5	1.7 J	<0.51	<1.9	2.9	110
Perflouorooctance Sulfonamide (FOSA)		<0.64 UJ	<0.62 UJ	<0.34	3.3 J H	<0.33	<0.61	<0.34	<0.63 UJ	<0.33	0.66 J	<0.32	1.2 J	<0.33	<0.62	<0.61	<0.28
6:2FTS		<3.8	<3.7	--	<3.7	--	<3.6	--	<3.8	--	<3.6	--	<3.7	--	<3.7	<3.6	5.4 JB

Coldwater Rd Monitoring Wells - Drift Aquifer

Perfluorinated Compound	Well/Sample ID:	B-2D*	B-2D*	B-2D* (DUP-071918)	B-22D*	B-22D* (DUP-2)	B-27D*	B-27D*
	Sample Date:	*6/13/2018*	*7/19/2018*	*7/19/2018*	*6/13/2018*	*6/13/2018*	*6/20/2017*	*6/12/2018*
Perfluorobutanoic acid (PFBA)		1.8 J/B	2.7 B	2.8 B	0.72 J/B	0.63 J/B	2.0 B	0.47 J/B
Perfluoropentanoic acid (PFPeA)		1.2 J	<0.41	0.44 J	<0.48	<0.45	<0.95	0.26 J
Perfluorohexanoic acid (PFHxA)		0.78 J	<0.49	0.70 J	<0.57	<0.53	<0.75	<0.53
Perfluoroheptanoic acid (PFHpA)		0.52 J	0.47 J	0.42 J	<0.25	<0.23	<0.77	<0.23
Perfluorooctanoic acid (**PFOA**)		3.3	3.1	3.7	<0.83	<0.78	<0.72	<0.78
Perfluoroundecanoic acid (PFUnA)		<1.0	<0.93	<0.92	<1.1	<1.0	1.4 J	<1.0
Perfluorobutanesulfonic acid (PFBS)		1.5 J	1.0 J	0.97 J	<0.20	<0.18	<0.88	<0.18
Perfluoropentanesulfonic acid (PFPeS)		--	3.2	2.9	--	--	--	--
Perfluorohexanesulfonic acid (PFHxS)		13 B	13 B	12 B	<0.17	0.29 J/B	<0.83	0.23 J/B
Perfluoroheptanesulfonic Acid (PFHpS)		2.9	2.4	2.6	<0.19	<0.17	<0.68	<0.17
Perfluorooctanesulfonic acid (**PFOS**)		110	99	98	<0.53	<0.49	<1.2	<0.49

Peregrine Monitoring Wells & Temporary Monitoring Wells

Perfluorinated Compound	Well/Sample ID:	MW-4-02	MW-16-10*	MW-16-10* (Duplicate)	MW-16-10*	MW-18-13	MW-19-13	MW-19-13	SBP-1-GW	SBP-2-GW	SBP-2-GW/ SBP-DUP-1	SBP-3-GW	SBP-4	SBP-5	SBP-5 (DUP-1)
	Sample Date:	*11/30/2016*	*11/29/2016*	*11/29/2016*	*6/13/2018*	*11/29/2016*	*11/30/2016*	*6/12/2018*	*12/8/2017*	*12/8/2017*	*12/8/2017*	*12/8/2017*	*6/28/2018*	*6/28/2018*	*6/28/2018*
Perfluorobutanoic acid (PFBA)		4.7	<0.45 U	0.87 J	0.40 J/B	5.0	13	5.0 B	24 B	55 B	51 B	1.3 B	4.6	56	60
Perfluoropentanoic acid (PFPeA)		<0.94 U	<0.98 U	<0.97 U	<0.46	<0.93 U	16	3.0	4.2	7.1	7.5	<0.29	1.9 J	9.6	7.5
Perfluorohexanoic acid (PFHxA)		<0.75 U	<0.78 U	<0.77 U	<0.55	<0.74 U	29	6.0	5.8	12	16	<0.59	1.3 J	22	25
Perfluoroheptanoic acid (PFHpA)		<0.76 U	<0.79 U	<0.79 U	<0.24	<0.76 U	18	6.7	5.2	7.4	9.8	0.36 J	0.58 J	6.0	7.9
Perfluorooctanoic acid (**PFOA**)		<0.71 U	<0.74 U	<0.73 U	<0.80	3.9	39	16	38	25	28	<0.86	2.1 J	20	26
Perfluorononanoic acid (PFNA)		<0.62 U	<0.65 U	<0.64 U	<0.26	<0.62 U	<0.63	<0.25	0.49 J	<0.27	0.39 J	0.27 J	<0.30	<0.37	<0.34
Perfluorodecanoic acid (PFDA)		<0.42	<0.44	<0.43	<0.29	<0.42	<0.42	<0.29	<0.31	<0.31	<0.30	<0.31	0.71 J	0.86 J	<0.39
Perfluoroundecanoic acid (PFUnA)		<0.71	<0.74	<0.73	<1.0	<0.71	<0.72	<1.0	<1.1	<1.1	<1.1	<1.1	<1.2	2.2 J	<1.4
Perfluorododecanoic (PFDoA)		<0.56	<0.58	<0.57	<0.52	<0.55	<0.56	<0.51	<0.55	<0.55	<0.54	<0.56	<0.60	1.6 J	<0.69
Perfluorotetradecanoic acid (PFTeA)		0.65 J F1 B	0.42 J B	0.50 J B	<0.27	0.60 J B	0.54 J B	<0.27	0.49 J	<0.29	<0.29	<0.29	<0.32	1.3 J	<0.36
Perfluorobutanesulfonic acid (PFBS)		0.92 J	<0.91 U	<0.90 U	<0.19	2.8	13	9.0	21	150	130	0.48 J	1.7 J	36	42
Perfluoropentanesulfonic acid (PFPeS)		--	--	--	--	--	--	--	--	--	--	--	1.1	65	62
Perfluorohexanesulfonic acid (PFHxS)		<0.83 U	<0.86 U	<0.85 U	0.30 J/B	4.3	31	14 B	210 B	280 B	390 B	0.78 J	0.62 J	99	120
Perfluoroheptanesulfonic Acid (PFHpS)		<0.68 U	<0.71 U	<0.70 U	<0.18	0.78 J	1 J	0.46 J	50	3.2	6.1	<0.19	<0.21	13	16
Perfluorooctanesulfonic acid (**PFOS**)		3.5	<1.3 U	<1.3 U	<0.51	27	19	4.9	1700	30	55	4.1	1.2 J	340	360
6:2FTS		<3.5	<3.8	<3.7	--	<3.6	<3.7	--	--	--	--	--	<2.2	5.4 J	<2.5

see page 2 for notes.

TABLE 1

RACER Trust - Coldwater Road Landfill & Peregrine Facilities

Per-and Polyfluorinated Substances Sampling Results - Detections

Sumps & Vaults

Perfluorinated Compound	Well/Sample ID:	SUMP A	SUMP B	SUMP C	SUMP D	SUMP E	SUMP F	Vault A	Vault A	Vault B	Vault C	Vault C	Vault C (DUP-1)	Vault D	Vault E	Vault E (DUP-1)	Vault E	Vault F
	Sample Date:	*6/19/2017*	*6/19/2017*	*6/19/2017*	*11/29/2016*	*6/19/2017*	*6/19/2017*	*6/19/2017*	*6/12/2018*	*6/19/2017*	*6/19/2017*	*6/12/2018*	*6/12/2018*	*6/19/2017*	*6/19/2017*	*6/19/2017*	*6/12/2018*	*6/19/2017*
Perfluorobutanoic acid (PFBA)		220 B	480 B	490 B	440 J	48 B	260 B	18.0 B	13 B	4.6 B	19 B	13 B	13 B	5.3 B	8.6 B	8.0 B	6.3 B	6.8 B
Perfluoropentanoic acid (PFPeA)		260	410	1100 Cl	300 J	86	330	1.9	3.1	<0.98	<0.94	1.7 J	2.4	7	<0.96	4.7	4.1	15
Perfluorohexanoic acid (PFHxA)		110	280	390	99 JN	65	150	4.9	4.7	0.79 J	6.0	2.4	2.4	<0.80	6.5	6.3	4.5	13
Perfluoroheptanoic acid (PFHpA)		<0.78	17	80	24	77	67	4.4	3.4	<0.79	3.3	2.7	2.2	<0.96 J	5.5	5.3	4.1	12
Perfluorooctanoic acid (**PFOA**)		54	230	230	130 JN	95	80	16.0	15	4.1	12	12	12	9.9	24	25	22	57
Perfluorononanoic acid (PFNA)		<0.64	29 Cl	18	7.1 JN	21	9.7	<0.64	<0.24	<0.65	<0.62	<0.26	<0.26	<0.67	<0.63	0.6 J	0.60 J	1.2 J
Perfluorodecanoic acid (PFDA)		<0.43	<0.43	<0.43	<4.2	1.6 J	1.0 J	<0.43	<0.28	<0.44	<0.42	<0.30	<0.30	<0.45	<0.43	<0.43	<0.28	<0.42
Perfluoroundecanoic acid (PFUnA)		<0.73	<0.73	<0.73	<7.2	1.7 J	<0.74	<0.73	<0.98	<0.74	<0.71	<1.1	<1.1	<0.76	<0.72	<0.74	<1.0	<0.71
Perfluorotetradecanoic acid (PFTeA)		<0.19	0.37 J B	<0.19	<1.9	0.21 J B	<0.20	<0.19	0.45 J	<0.20	0.21 J B	<0.28	<0.28	0.25 J B	<0.19	0.4 J B	<0.27	<0.19
Perfluorobutanesulfonic acid (PFBS)		310 Cl	190 J	410	74	57	100	9.3	8.5	4.1	<0.88	7.4	4.7	11	13	12	11	12
Perfluorohexanesulfonic acid (PFHxS)		410	650	1200	370	170	390	32	27 B	12	<0.83	19 B	19 B	33	65	63	53 B	35
Perfluoroheptanesulfonic Acid (PFHpS)		150	140	200	83	55	82	7.2	6.5	2.4	<0.68	6.0	5.6	8.4	15	15.0	15	7.3
Perflouorodecanesulfonic acid (PFDS)		4.3	2.6	1.9	<12	1.2 J	<1.2	<1.2	<0.29	<1.2	<1.2	<0.31	<0.31	<1.2	<1.2	<1.2	<0.29	<1.2
Perfluorooctanesulfonic acid (**PFOS**)		13000	9600	12000	5,800 J	3400	5400	450	460	150.0	440	380	400	350	730	730	680	300
Perflouorooctance Sulfonamide (FOSA)		8.1 J B	6.1 J B	8.2 J B	<6.1	4.7 J B	6.1 J B	<0.62	<0.31	<0.63	<0.61	0.65 J	0.71 J	<0.65	3.5 J H	16 J B	1.2 J	22 J H

Quality Assurance / Quality Control Samples

Perfluorinated Compound	Well/Sample ID:	Watera Rinsate Blank	Equipment Blank-1 (Low Flow	EB-01 Bladder Pump	Equipment Blank-1 (Low Flow	Equipment Blank-1	Equipment Blank-2	Equipment Blank 071918	Field Blank	FB-01	Field Blank-1	Field Blank-1	Field Blank-2	Field Blank-1	Field Blank 071918
	Sample Date:	*11/29/2016*	*11/29/2016*	*6/20/2017*	*12/8/2017*	*6/12/2018*	*6/13/2018*	*7/19/2018*	*11/30/2016*	*6/19/2017*	*12/8/2017*	*6/12/2018*	*6/13/2018*	*6/28/2018*	*7/19/2018*
Perfluorobutanoic acid (PFBA)		<1.8 U	<0.44 U	0.59 J/B	<0.35	0.33 J/B	<0.32	1.1 JB	<0.46	0.92 J B	0.38 J B	0.37 J/B	0.33 J/B	<0.29	1.3 JB
Perfluorotetradecanoic acid (PFTeA)		0.31 J N	0.61 J B	0.89 J B	<0.29	<0.26	<0.27	<0.25	0.93 J	<0.19	<0.29	<0.26	<0.26	<0.24	<0.25
Perfluorohexanesulfonic acid (PFHxS)		<0.80 U	<0.76 U	<0.86	0.28 J B	0.24 J/B	<0.16	0.22 JB	<0.88	<0.84	0.40 J B	0.18 J/B	0.22 J/B	<0.14	0.21 JB
Perfluorooctanesulfonic acid (**PFOS**)		<1.2 U	<1.2 U	<1.3	<0.54	<0.49	<0.50	<0.46	<1.3	1.4 J	<0.53	<0.48	<0.49	<0.45	<0.46
6:2FTS		<3.5	<3.7	<3.8	--	--	--	2.6 JB		<3.7	--	--	--	<1.7	<1.7

Notes

1) Concentrations in ng/L.
2) < = Not detected at specified reporting limit.
3) -- = Not analyzed.
4) * Indicates Drift Aquifer monitoring well.
5) Dup = Duplicate sample.
6) B = Compound was found in the blank and the sample.
7) Cl = The peak identified in the data system exhibited chromatographic interference that could not be resolved. There is reason to suspect there may be high bias.
8) H = Sample was Prepped or analyzed beyond the specified holding time.
9) J - Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value.
10) JN - Indicates that the traget analyte has been "tentatively identified" as present and the associated numerical value is the estimated concentration in the sample.
11) U - Indicates that the analyte was not detected and the sample RL is presented. This qualifier is alsoused to signify blank excursions.
12) F1 - MS and/or MSD Recovery is outside acceptance limits.
13) Concentrations above the USEPA advisory level (70 ng/L PFOA+PFOS) and/or MDEQ proposed drinking water criteria (70 ng/L PFOA+PFOS) are highlighted in yellow.

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I:\Racer-Trust.15388\68545.Coldwater-Rd-LfDocs\Reports\PFAS Reports\June 2018\001 - Figure 1 Well Locations-080618.mxd

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LEGEND

- LEACHATE COLLECTION SUMP
- ACCESS PORT FOR LEAK DETECTION VAULT
- PERCHED MONITORING WELL
- DRIFT MONITORING WELL
- TEMPORARY MONITORING WELL

RACER TRUST
COLDWATER ROAD
LANDFILL FACILITY
FLINT, MICHIGAN

MONITORING WELL LOCATIONS

0 200 400 600 800
Feet

AUGUST 2018
15388/68545/002

O'BRIEN & GERE ENGINEERS, INC.

PLOTDATE: 08/17/18 10:29:36 AM SchneiKB

Perfluorinated Compound	Well/Sample ID: SBP-5 Sample Date: 6/28/2018	SBP-5 6/28/2018
Perfluorobutanoic acid (PFBA)	56	60
Perfluoropentanoic acid (PFPeA)	9.6	7.5
Perfluorohexanoic acid (PFHxA)	22	25
Perfluoroheptanoic acid (PFHpA)	6.0	7.9
Perfluorooctanoic acid (**PFOA**)	20	26
Perfluorodecanoic acid (PFDA)	0.86 J	<0.39
Perfluoroundecanoic acid (PFUnA)	2.2 J	<1.4
Perfluorododecanoic (PFDoA)	1.6 J	<0.69
Perfluorotetradecanoic acid (PFTeA)	1.3 J	<0.36
Perfluorobutanesulfonic acid (PFBS)	36	42
Perfluoropentanesulfonic acid (PFPeS)	65	62
Perfluorohexanesulfonic acid (PFHxS)	99	120
Perfluoroheptanesulfonic Acid (PFHpS)	13	16
Perfluorooctanesulfonic acid (**PFOS**)	340	360
6:2FTS	5.4 J	<2.5

Perfluorinated Compound	Well/Sample ID: SBP-4 Sample Date: 6/28/2018
Perfluorobutanoic acid (PFBA)	4.6
Perfluoropentanoic acid (PFPeA)	1.9 J
Perfluorohexanoic acid (PFHxA)	1.3 J
Perfluoroheptanoic acid (PFHpA)	0.58 J
Perfluorooctanoic acid (**PFOA**)	2.1 J
Perfluorodecanoic acid (PFDA)	0.71 J
Perfluorobutanesulfonic acid (PFBS)	1.7 J
Perfluoropentanesulfonic acid (PFPeS)	1.1
Perfluorohexanesulfonic acid (PFHxS)	0.62 J
Perfluorooctanesulfonic acid (**PFOS**)	1.2 J

Perfluorinated Compound	Well/Sample ID: SBP-2-GW Sample Date: 12/8/2017	SBP-2-GW/ SBP-DUP-1 12/8/2017	OBG-MW-11 7/19/2018
Perfluorobutanoic acid (PFBA)	55 B	51 B	29 B
Perfluoropentanoic acid (PFPeA)	7.1	7.5	5.7
Perfluorohexanoic acid (PFHxA)	12	16	29
Perfluoroheptanoic acid (PFHpA)	7.4	9.8	14
Perfluorooctanoic acid (**PFOA**)	25	28	54
Perfluorononanoic acid (PFNA)	<0.27	0.39 J	<0.22
Perfluorobutanesulfonic acid (PFBS)	150	130	79
Perfluoropentanesulfonic acid (PFPeS)	--	--	160
Perfluorohexanesulfonic acid (PFHxS)	280 B	390 B	450 B
Perfluoroheptanesulfonic Acid (PFHpS)	3.2	6.1	13
Perfluorooctanesulfonic acid (**PFOS**)	30	55	110
6:2FTS	--	--	5.4 JB

Perfluorinated Compound	Well/Sample ID: SBP-3-GW Sample Date: 12/8/2017
Perfluorobutanoic acid (PFBA)	1.3 B
Perfluoroheptanoic acid (PFHpA)	0.36 J
Perfluorooctanoic acid (**PFOA**)	<0.86
Perfluorononanoic acid (PFNA)	0.27 J
Perfluorobutanesulfonic acid (PFBS)	0.48 J
Perfluorohexanesulfonic acid (PFHxS)	0.78 J
Perfluorooctanesulfonic acid (**PFOS**)	4.1

Perfluorinated Compound	Well/Sample ID: SBP-1-GW Sample Date: 12/8/2017
Perfluorobutanoic acid (PFBA)	24 B
Perfluoropentanoic acid (PFPeA)	4.2
Perfluorohexanoic acid (PFHxA)	5.8
Perfluoroheptanoic acid (PFHpA)	5.2
Perfluorooctanoic acid (**PFOA**)	38
Perfluorononanoic acid (PFNA)	0.49 J
Perfluorotetradecanoic acid (PFTeA)	0.49 J
Perfluorobutanesulfonic acid (PFBS)	21
Perfluorohexanesulfonic acid (PFHxS)	210 B
Perfluoroheptanesulfonic Acid (PFHpS)	50
Perfluorooctanesulfonic acid (**PFOS**)	1700

Notes
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6) Dup = Duplicate sample.
7) B = Compound was found in the blank and the sample.
8) CI = The peak identified in the data system exhibited chromatographic interference that could not be resolved. There is reason to suspect there may be high bias.
9) H = Sample was Prepped or analyzed beyond the specified holding time.
10) J - Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value.
11) U - Indicates that the analyte was not detected and the sample RL is presented. This qualifier is alsoused to signify blank excursions.
12) F1 - MS and/or MSD Recovery is outside acceptance limits.
13) F2 - MS/MSD RPD exceeds control limits.
14) Concentrations above the USEPA advisory level (70 ng/L PFOA+PFOS) and/or MDEQ proposed drinking water criteria (70 ng/L PFOA+PFOS) are highlighted in yello

Perfluorinated Compound	Well/Sample ID: B-19Ar Sample Date: 11/30/2016	B-19Ar 6/12/2018
Perfluorobutanoic acid (PFBA)	1.0 J	1.2 J/B
Perfluoropentanoic acid (PFPeA)	<0.98 U	1.1 J
Perfluoroheptanoic acid (PFHpA)	<0.80 U	0.33 J
Perfluorooctanoic acid (**PFOA**)	0.84 JN	0.93 J
Perfluorobutanesulfonic acid (PFBS)	<0.91 U	0.28 J
Perfluorohexanesulfonic acid (PFHxS)	<2.0 U	0.89 J/B
Perfluoroheptanesulfonic Acid (PFHpS)	1.0 J	0.31 J
Perfluorooctanesulfonic acid (**PFOS**)	3.9	4.1

Perfluorinated Compound	Well/Sample ID: B-18A Sample Date: 6/20/2017	B-18A 6/12/2018
Perfluorobutanoic acid (PFBA)	4.2 B	1.1 J/B
Perfluoropentanoic acid (PFPeA)	<0.94	0.51 J
Perfluorooctanoic acid (**PFOA**)	1.2 J	<0.82
Perfluoropentanesulfonic acid (PFPeS)	--	--
Perfluorohexanesulfonic acid (PFHxS)	<0.83	0.27 J/B
Perfluorooctanesulfonic acid (**PFOS**)	1.3 J	<0.52

Perfluorinated Compound	Well/Sample ID: B-24r Sample Date: 6/20/2017	B-24r 6/12/2018
Perfluorobutanoic acid (PFBA)	14 B	8.9 B
Perfluoropentanoic acid (PFPeA)	<0.93	2.0
Perfluorohexanoic acid (PFHxA)	3.9	2.7
Perfluoroheptanoic acid (PFHpA)	1.7 J	<0.23
Perfluorooctanoic acid (**PFOA**)	3.9	3.4
Perfluorobutanesulfonic acid (PFBS)	3.7	1.5 J
Perfluorohexanesulfonic acid (PFHxS)	5.4	2.6 B
Perfluorooctanesulfonic acid (**PFOS**)	5.0	2.5
Perfluorooctane Sulfonamide (FOSA)	0.66 J	<0.32

Perfluorinated Compound	Well/Sample ID: B-7 Sample Date: 11/30/2016	B-7 (Collocated) 11/30/2016	B-7 6/12/2018
Perfluorobutanoic acid (PFBA)	9.2 J	7.1	8.2 B
Perfluoropentanoic acid (PFPeA)	2.6	1.7 J	4.2
Perfluorohexanoic acid (PFHxA)	3.9	3.1	3.3
Perfluoroheptanoic acid (PFHpA)	2.4	1.6 J	2.3
Perfluorooctanoic acid (**PFOA**)	9.2 JN	7.6	9
Perfluorononanoic acid (PFNA)	0.87 J	0.79 J	0.82 J
Perfluorobutanesulfonic acid (PFBS)	5.7	5.8	4.1
Perfluorohexanesulfonic acid (PFHxS)	23	22 JN	18 B
Perfluoroheptanesulfonic Acid (PFHpS)	3.8	3.9	3.0
Perfluorooctanesulfonic acid (**PFOS**)	220	230	130

Perfluorinated Compound	Well/Sample ID: B-9 Sample Date: 6/20/2017	B-9 6/12/2018
Perfluorobutanoic acid (PFBA)	14 B	9.5 B
Perfluoropentanoic acid (PFPeA)	2.2	1.7 J
Perfluorohexanoic acid (PFHxA)	9.3	7.0
Perfluoroheptanoic acid (PFHpA)	4.2	<0.24
Perfluorooctanoic acid (**PFOA**)	15	12
Perfluorotetradecanoic acid (PFTeA)	1.2 J B	<0.27
Perfluorobutanesulfonic acid (PFBS)	2.3	2.1
Perfluorohexanesulfonic acid (PFHxS)	6.9	3.7 B
Perfluoroheptanesulfonic Acid (PFHpS)	0.70 J	0.33 J
Perfluorooctanesulfonic acid (**PFOS**)	13	9.3
Perfluorooctane Sulfonamide (FOSA)	3.3 J H	<0.33

Perfluorinated Compound	Well/Sample ID: B-28 Sample Date: 6/20/2017	B-28 6/12/2018
Perfluorobutanoic acid (PFBA)	2.9 B	1.5 J/B
Perfluoropentanoic acid (PFPeA)	<0.96	0.47 J
Perfluorohexanoic acid (PFHxA)	0.92 J	<0.55
Perfluorooctanoic acid (**PFOA**)	0.79 J	0.84 J
Perfluorohexanesulfonic acid (PFHxS)	<0.84	0.27 J/B
Perfluorooctanesulfonic acid (**PFOS**)	1.7 J	<0.51
Perfluorooctane Sulfonamide (FOSA)	1.2 J	<0.33

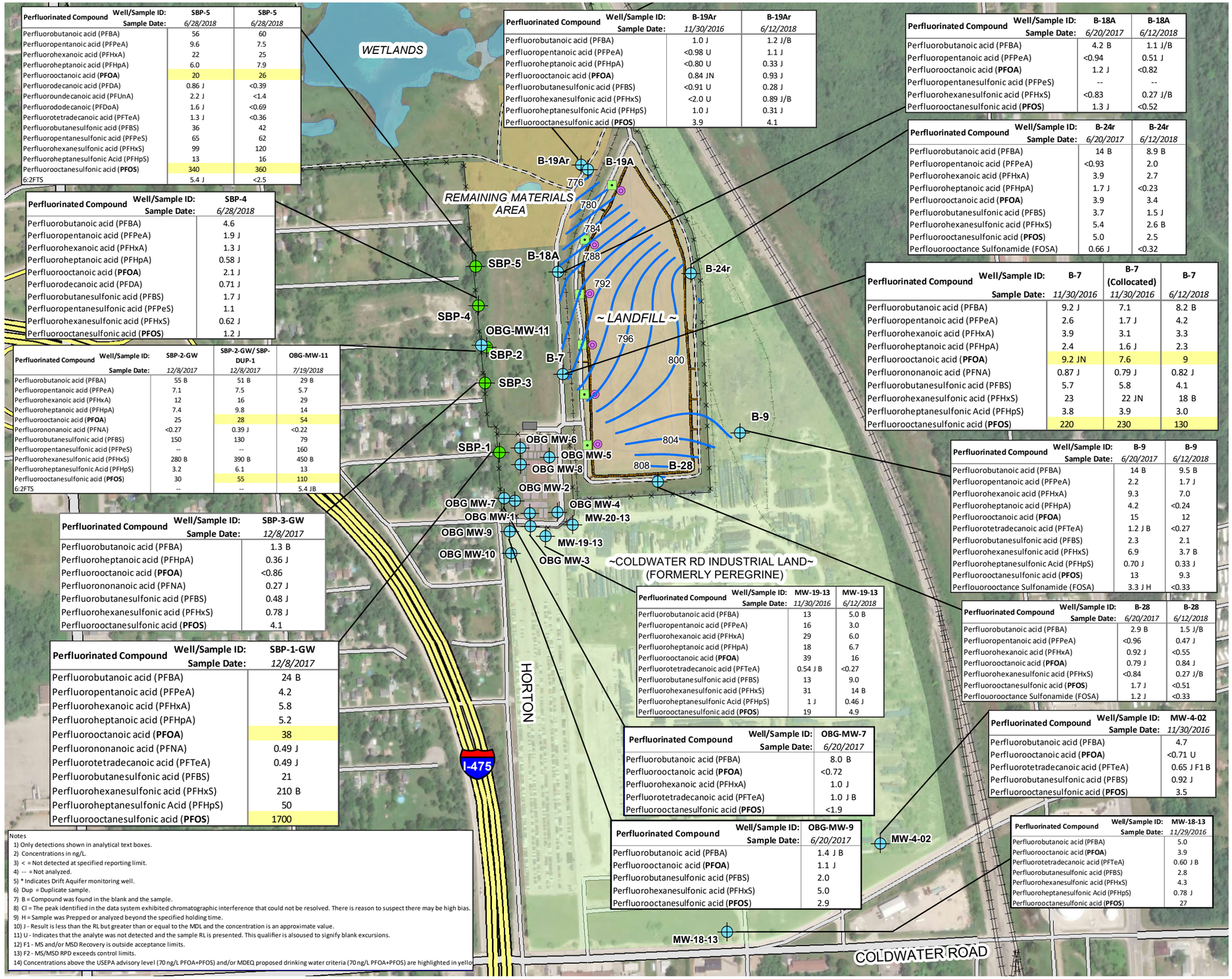
Perfluorinated Compound	Well/Sample ID: MW-19-13 Sample Date: 11/30/2016	MW-19-13 6/12/2018
Perfluorobutanoic acid (PFBA)	13	5.0 B
Perfluoropentanoic acid (PFPeA)	16	3.0
Perfluorohexanoic acid (PFHxA)	29	6.0
Perfluoroheptanoic acid (PFHpA)	18	6.7
Perfluorooctanoic acid (**PFOA**)	39	16
Perfluorotetradecanoic acid (PFTeA)	0.54 J B	<0.27
Perfluorobutanesulfonic acid (PFBS)	13	9.0
Perfluorohexanesulfonic acid (PFHxS)	31	14 B
Perfluoroheptanesulfonic Acid (PFHpS)	1 J	0.46 J
Perfluorooctanesulfonic acid (**PFOS**)	19	4.9

Perfluorinated Compound	Well/Sample ID: OBG-MW-7 Sample Date: 6/20/2017
Perfluorobutanoic acid (PFBA)	8.0 B
Perfluorooctanoic acid (**PFOA**)	<0.72
Perfluorohexanoic acid (PFHxA)	1.0 J
Perfluorotetradecanoic acid (PFTeA)	1.0 J B
Perfluorooctanesulfonic acid (**PFOS**)	<1.9

Perfluorinated Compound	Well/Sample ID: OBG-MW-9 Sample Date: 6/20/2017
Perfluorobutanoic acid (PFBA)	1.4 J B
Perfluorooctanoic acid (**PFOA**)	1.1 J
Perfluorobutanesulfonic acid (PFBS)	2.0
Perfluorohexanesulfonic acid (PFHxS)	5.0
Perfluorooctanesulfonic acid (**PFOS**)	2.9

Perfluorinated Compound	Well/Sample ID: MW-4-02 Sample Date: 11/30/2016
Perfluorobutanoic acid (PFBA)	4.7
Perfluorooctanoic acid (**PFOA**)	<0.71 U
Perfluorotetradecanoic acid (PFTeA)	0.65 J F1 B
Perfluorobutanesulfonic acid (PFBS)	0.92 J
Perfluorooctanesulfonic acid (**PFOS**)	3.5

Perfluorinated Compound	Well/Sample ID: MW-18-13 Sample Date: 11/29/2016
Perfluorobutanoic acid (PFBA)	5.0
Perfluorooctanoic acid (**PFOA**)	3.9
Perfluorotetradecanoic acid (PFTeA)	0.60 J B
Perfluorobutanesulfonic acid (PFBS)	2.8
Perfluorohexanesulfonic acid (PFHxS)	4.3
Perfluoroheptanesulfonic Acid (PFHpS)	0.78 J
Perfluorooctanesulfonic acid (**PFOS**)	27



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LEGEND

- LEACHATE COLLECTION SUMP
- ACCESS PORT FOR LEAK DETECTION VAULT
- PERCHED MONITORING WELL
- TEMPORARY MONITORING WELL
- GROUNDWATER CONTOUR (JUNE 12, 2018)

RACER TRUST
COLDWATER ROAD
LANDFILL FACILITY
FLINT, MICHIGAN

PERCHED MONITORING WELLS PFAS SAMPLE LOCATIONS

0 200 400 600 800
Feet

AUGUST 2018
15388/68545/002

O'BRIEN & GERE ENGINEERS, INC.

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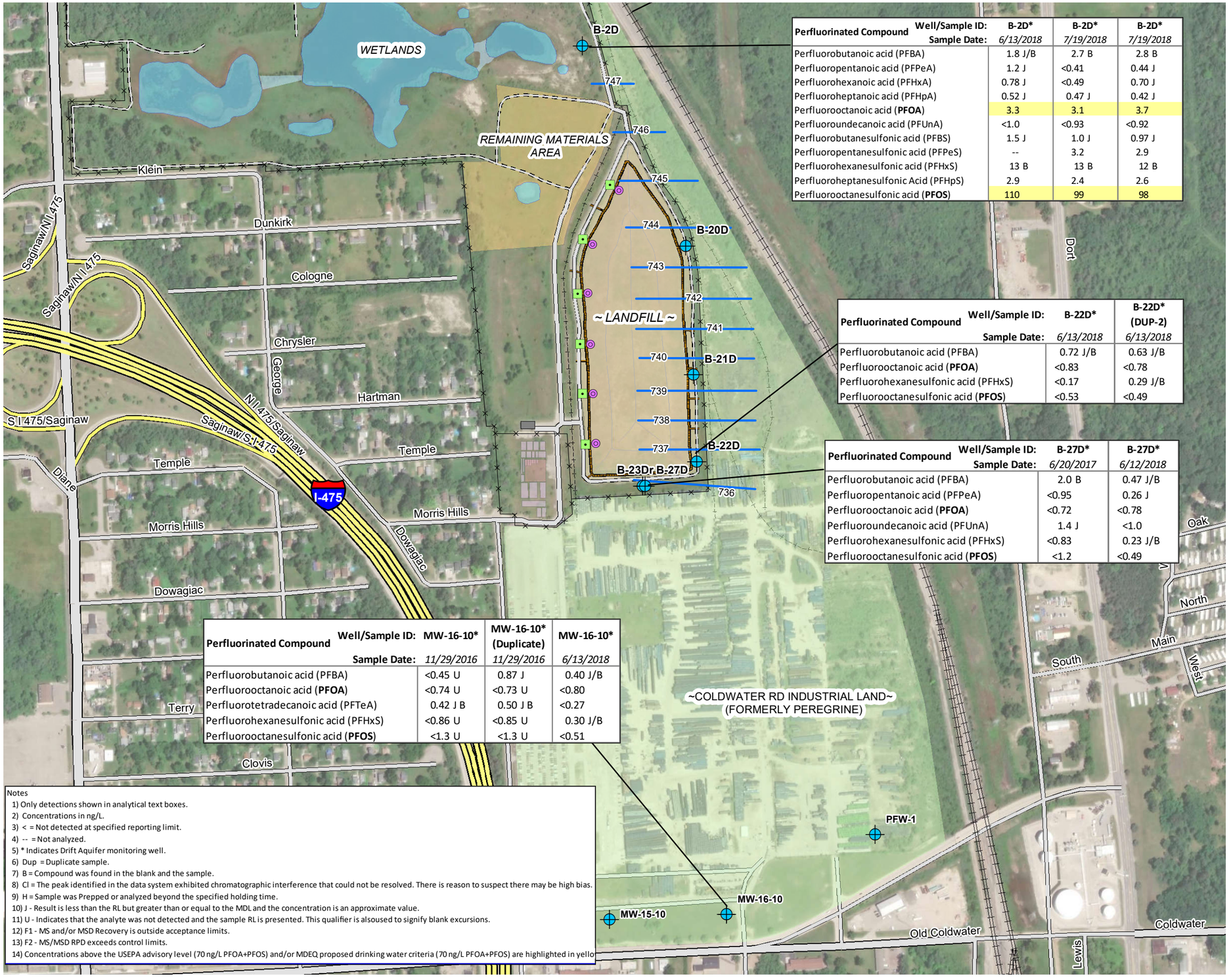

Perfluorinated Compound	Well/Sample ID: B-2D* Sample Date: 6/13/2018	B-2D* 7/19/2018	B-2D* 7/19/2018
Perfluorobutanoic acid (PFBA)	1.8 J/B	2.7 B	2.8 B
Perfluoropentanoic acid (PFPeA)	1.2 J	<0.41	0.44 J
Perfluorohexanoic acid (PFHxA)	0.78 J	<0.49	0.70 J
Perfluoroheptanoic acid (PFHpA)	0.52 J	0.47 J	0.42 J
Perfluorooctanoic acid (**PFOA**)	3.3	3.1	3.7
Perfluoroundecanoic acid (PFUnA)	<1.0	<0.93	<0.92
Perfluorobutanesulfonic acid (PFBS)	1.5 J	1.0 J	0.97 J
Perfluoropentanesulfonic acid (PFPeS)	--	3.2	2.9
Perfluorohexanesulfonic acid (PFHxS)	13 B	13 B	12 B
Perfluoroheptanesulfonic Acid (PFHpS)	2.9	2.4	2.6
Perfluorooctanesulfonic acid (**PFOS**)	110	99	98

Perfluorinated Compound	Well/Sample ID: B-22D* Sample Date: 6/13/2018	B-22D* (DUP-2) 6/13/2018
Perfluorobutanoic acid (PFBA)	0.72 J/B	0.63 J/B
Perfluorooctanoic acid (**PFOA**)	<0.83	<0.78
Perfluorohexanesulfonic acid (PFHxS)	<0.17	0.29 J/B
Perfluorooctanesulfonic acid (**PFOS**)	<0.53	<0.49

Perfluorinated Compound	Well/Sample ID: B-27D* Sample Date: 6/20/2017	B-27D* 6/12/2018
Perfluorobutanoic acid (PFBA)	2.0 B	0.47 J/B
Perfluoropentanoic acid (PFPeA)	<0.95	0.26 J
Perfluorooctanoic acid (**PFOA**)	<0.72	<0.78
Perfluoroundecanoic acid (PFUnA)	1.4 J	<1.0
Perfluorohexanesulfonic acid (PFHxS)	<0.83	0.23 J/B
Perfluorooctanesulfonic acid (**PFOS**)	<1.2	<0.49

Perfluorinated Compound	Well/Sample ID: MW-16-10* Sample Date: 11/29/2016	MW-16-10* (Duplicate) 11/29/2016	MW-16-10* 6/13/2018
Perfluorobutanoic acid (PFBA)	<0.45 U	0.87 J	0.40 J/B
Perfluorooctanoic acid (**PFOA**)	<0.74 U	<0.73 U	<0.80
Perfluorotetradecanoic acid (PFTeA)	0.42 J B	0.50 J B	<0.27
Perfluorohexanesulfonic acid (PFHxS)	<0.86 U	<0.85 U	0.30 J/B
Perfluorooctanesulfonic acid (**PFOS**)	<1.3 U	<1.3 U	<0.51

Notes
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4) -- = Not analyzed.
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6) Dup = Duplicate sample.
7) B = Compound was found in the blank and the sample.
8) Cl = The peak identified in the data system exhibited chromatographic interference that could not be resolved. There is reason to suspect there may be high bias.
9) H = Sample was Prepped or analyzed beyond the specified holding time.
10) J - Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value.
11) U - Indicates that the analyte was not detected and the sample RL is presented. This qualifier is alsoused to signify blank excursions.
12) F1 - MS and/or MSD Recovery is outside acceptance limits.
13) F2 - MS/MSD RPD exceeds control limits.
14) Concentrations above the USEPA advisory level (70 ng/L PFOA+PFOS) and/or MDEQ proposed drinking water criteria (70 ng/L PFOA+PFOS) are highlighted in yello

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LEGEND

- LEACHATE COLLECTION SUMP
- ACCESS PORT FOR LEAK DETECTION VAULT
- DRIFT MONITORING WELL
- GROUNDWATER CONTOUR (NOVEMBER 6, 2017)

RACER TRUST
COLDWATER ROAD
LANDFILL FACILITY
FLINT, MICHIGAN

DRIFT MONITORING WELLS PFAS SAMPLE LOCATIONS

0 200 400 600 800
Feet

AUGUST 2018
15388/68545/002

O'BRIEN & GERE ENGINEERS, INC.

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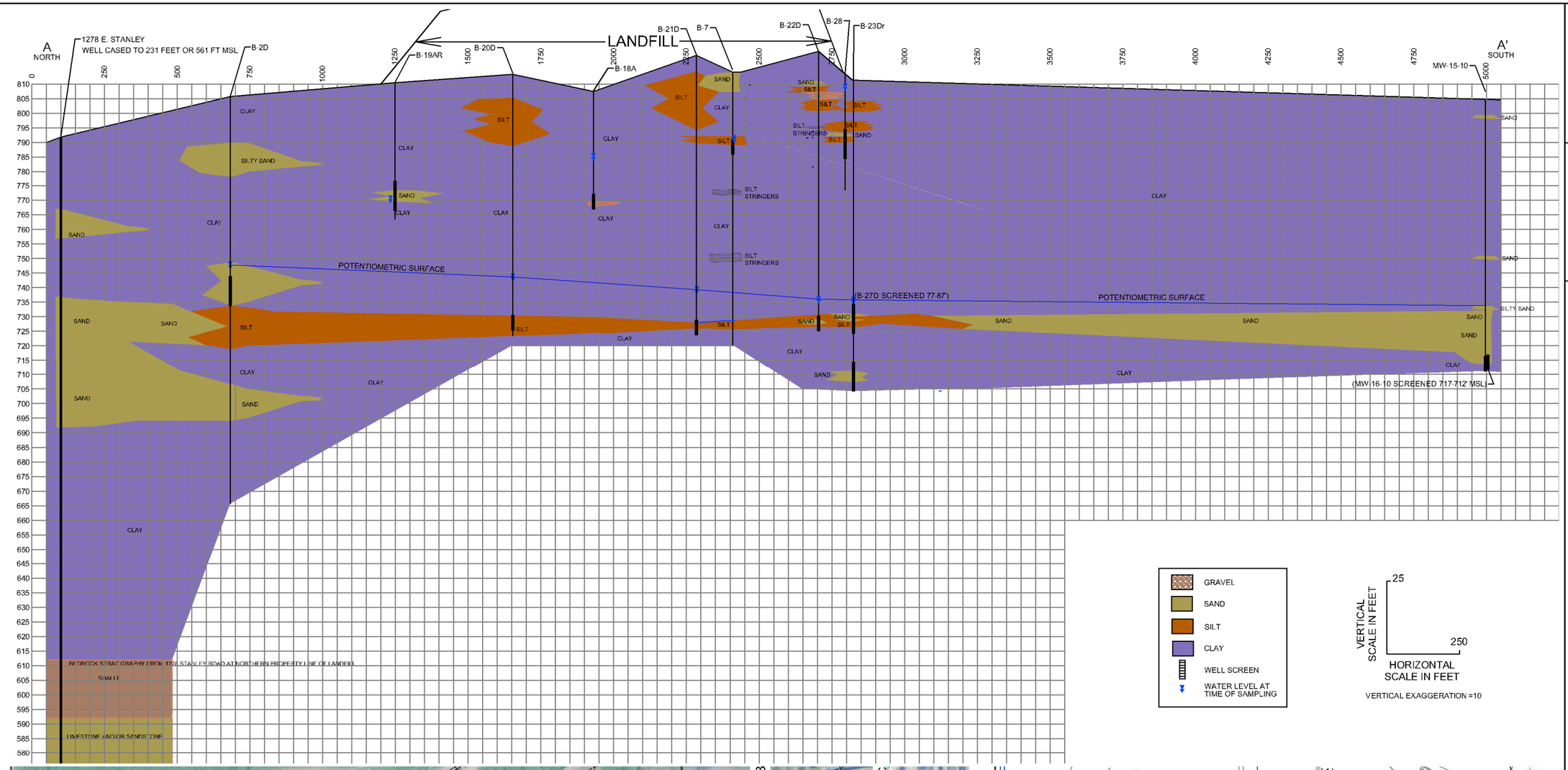

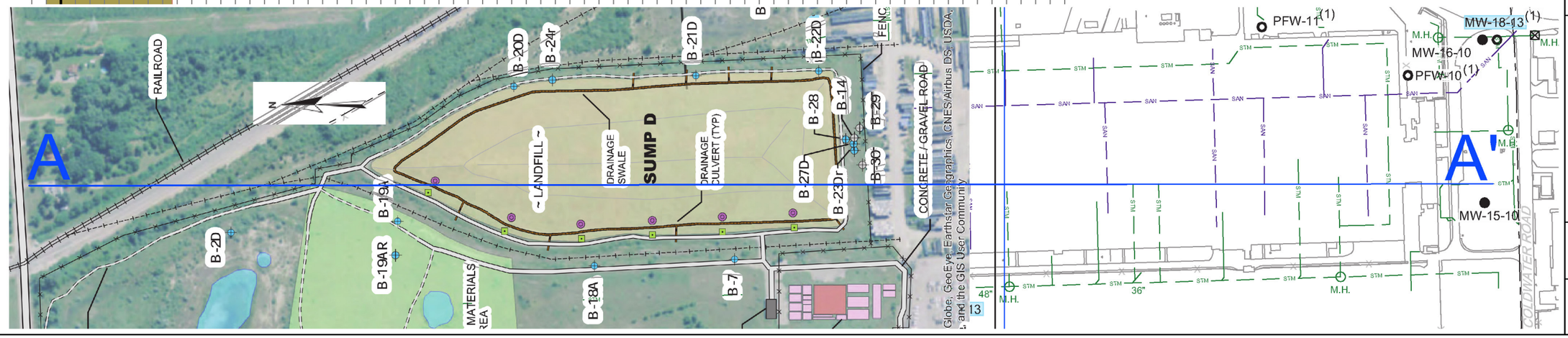

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CHECKED BY:	CSY	DATE: 01/16/2018
APPROVED BY:	CSY	DATE: 07/24/2018
DRAWING NO:		
REFERENCE:		

GEOLOGIC CROSS-SECTION A-A'

RACER
COLDWATER ROAD LANDFILL SITE
FLINT, MICHIGAN

OBRIEN & GERE

PROJECT NO.
68545

FIGURE NO.
4

Jul 25, 2018 - 9:07am PLOTTED BY: YantzCS SAVED BY: YantzCS
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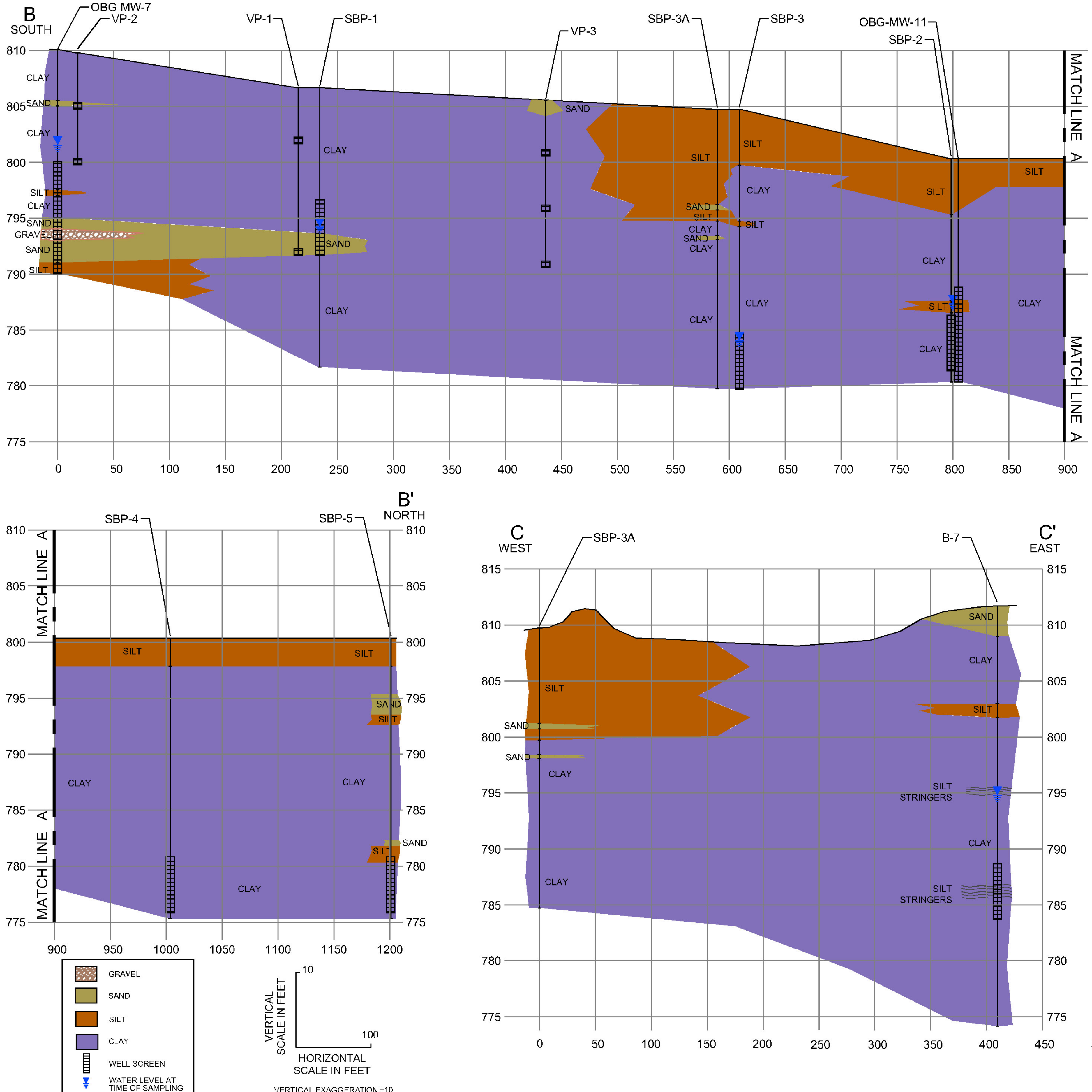

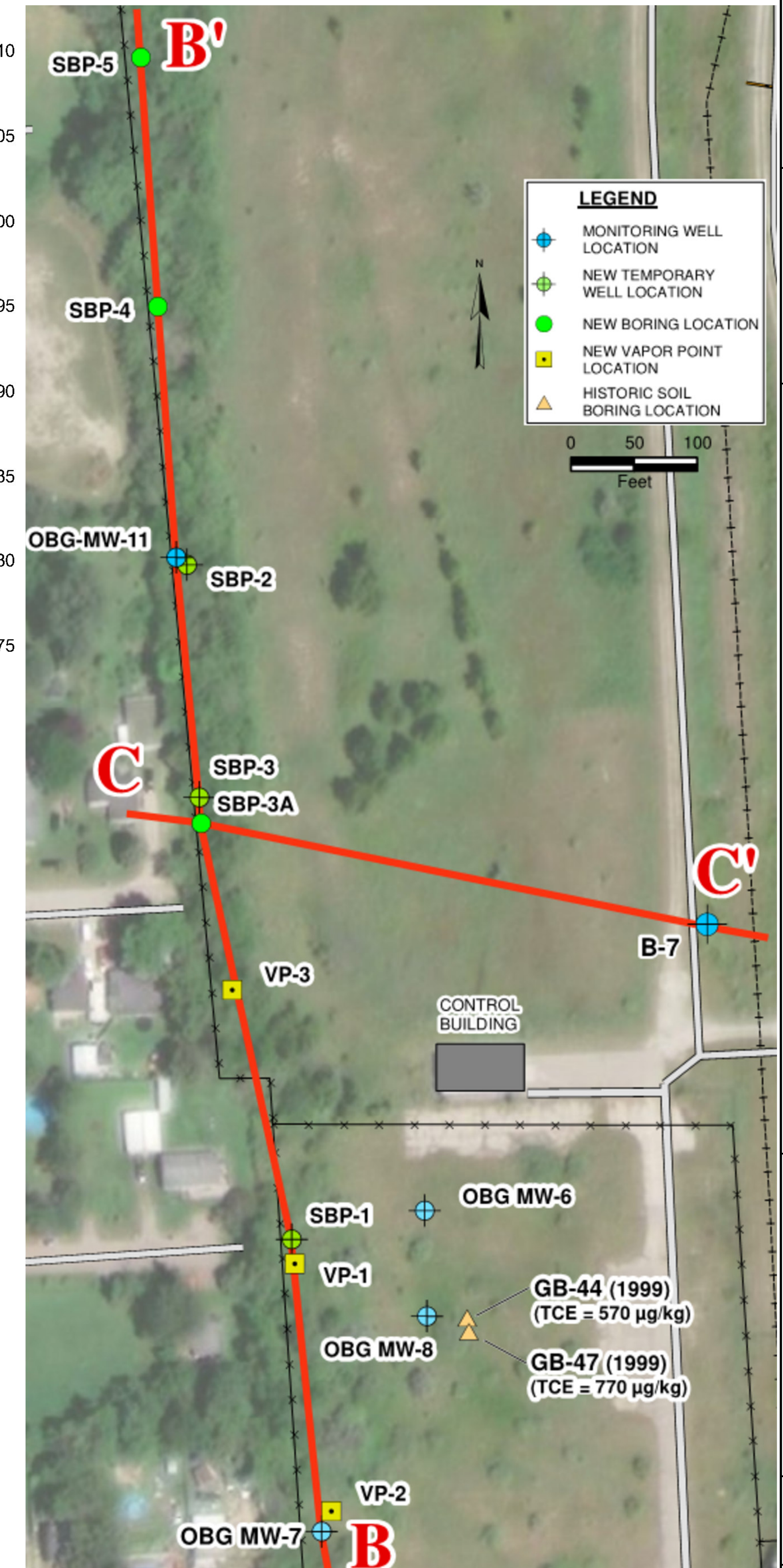

Aug 14, 2018 1:14pm PLOTTED BY: JohnesSL SAVED BY: JohnesSL
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CHECKED BY: CSY	DATE: 01/16/2018
APPROVED BY: CSY	DATE: 01/16/2018
DRAWING NO:	
REFERENCE: .	

GEOLOGIC CROSS-SECTION B-B'
GEOLOGIC CROSS-SECTION C-C'

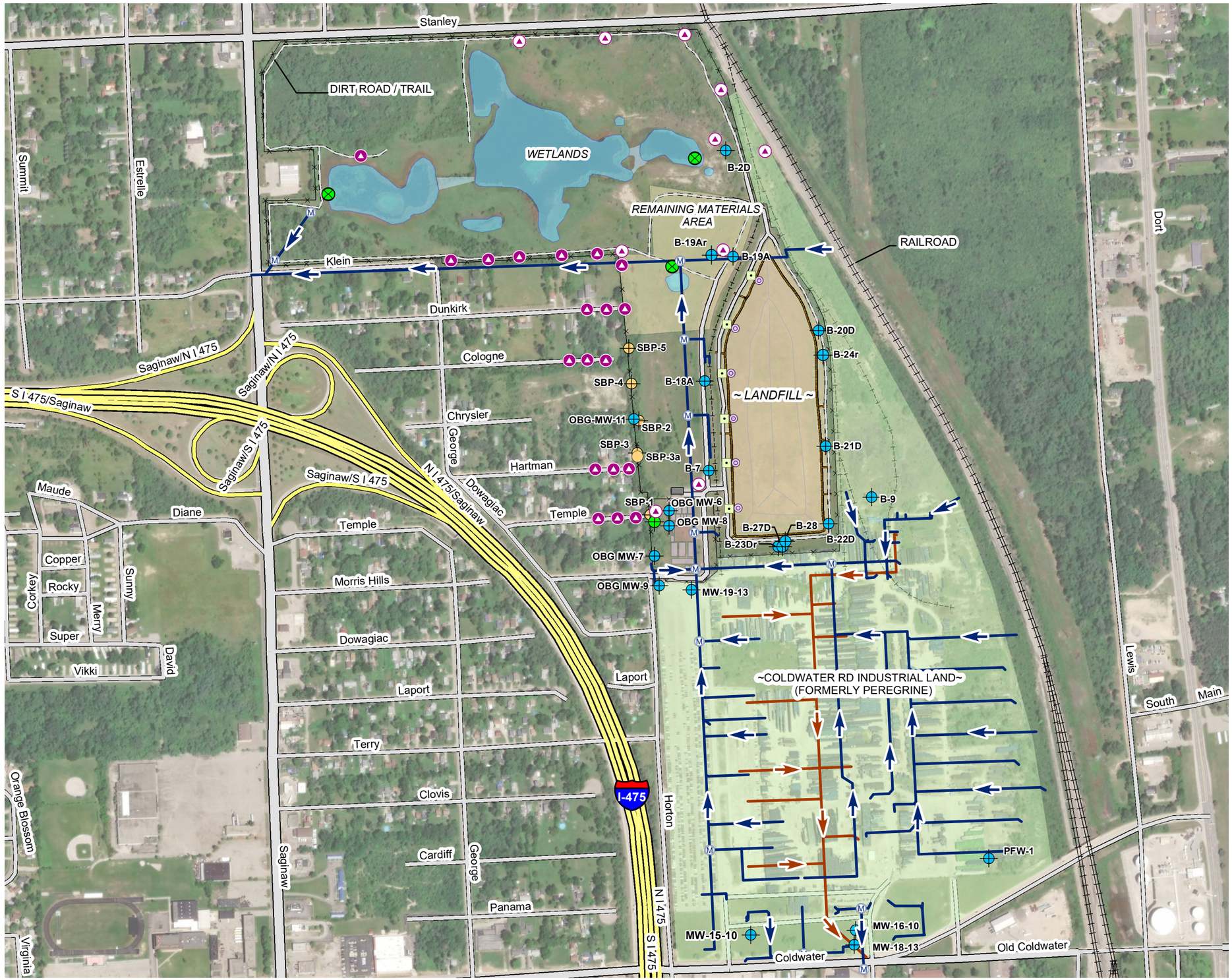
RACER
COLDWATER ROAD LANDFILL SITE
FLINT, MICHIGAN

O'BRIEN & GERE

PROJECT NO.
68545

FIGURE NO.
5

PLOTDATE: 08/22/11 3:14:42 PM SchneiKB



N

LEGEND

- LEACHATE COLLECTION SUMP
- ACCESS PORT FOR LEAK DETECTION VAULT
- NEW BORING LOCATION
- MONITORING WELL
- TEMPORARY WELL LOCATION
- PROPOSED DEEP BORING LOCATION
- PROPOSED SHALLOW BORING LOCATION
- PROPOSED PERMANENT MONITORING WELL LOCATION
- PROPOSED SURFACE/STORM WATER SAMPLE LOCATION
- STORM SEWER MANHOLE
- STORM SEWER LINE
- SANITARY SEWER LINE

RACER TRUST
COLDWATER ROAD
LANDFILL FACILITY
FLINT, MICHIGAN

PROPOSED BORING LOCATIONS

0 200 400 600 800
Feet

AUGUST 2018
15388/68545/002

O'BRIEN & GERE ENGINEERS, INC.

I:\Racer-Trust.15388\68545.Coldwater-Rd-Lf\Docs\Reports\PFAS Reports\June 2018\006 - Figure 6 Proposed PFAS Locations.mxd

WASTEWATER PFAS SAMPLING

Guidance

Introduction

This guidance document contains the processes, decontamination procedures, and acceptable materials for sampling wastewater for Per- and Polyfluoroalkyl Substances (PFAS). In addition, this guidance will be used to support the sampling objectives and procedures based on the Quality Assurance Project Plan (QAPP) developed prior to sampling activities.

Note: Sections 1 through 4 of the General PFAS Sampling Guidance should be reviewed prior to reviewing this guidance document.

The Michigan Department of Environmental Quality (DEQ) intends to update the information contained within this PFAS Sampling Guidance document as new information becomes available. The user of this PFAS Sampling Guidance is encouraged to visit the Michigan PFAS Action Response Team webpage (www.michigan.gov/PFASresponse) to access the current version of this document.

Wastewater sampling may require the use of non-dedicated equipment (i.e., equipment used for sampling at multiple locations), such as stainless steel or glass beakers and dippers, which must be decontaminated prior to first use and between samples to avoid cross-contamination per Section 3.1 of the General PFAS Sampling Guidance. Any disposable equipment must be known to be PFAS-free.

This guidance document covers the collection of wastewater PFAS samples related to municipal and industrial discharges and storm water and contains methods to prevent cross-contamination that can occur from:

- Field clothing and personal protective equipment (PPE)
- Sampling equipment
- Equipment decontamination
- Sample collection and handling
- Sample shipment

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1. Prohibited and Allowable Items and Materials

A general overview of field clothing and PPE can be found in Section 4.2 of the General PFAS Sampling Guidance. Any items or materials utilized that are not identified in this guidance or not discussed in Section 4.2.2 should be evaluated as described in Section 4.2.1.

Sampling staff should take practical and appropriate precautions to avoid items that are likely to contain PFAS at the sampling site as well as avoid specific items during the sampling event (see below).

1.1 Field Clothing and PPE

Prior to sampling, staff should refer to Section 4.2.2 of the General PFAS Sampling Guidance for approved field clothing as well as any requirements in a Health and Safety Plan (HASP). Personal safety is paramount. Any deviation from this guidance, including those necessary to ensure the health and safety of sampling personnel, must be recorded in field notes and discussed in the final report.

1.2 Sampling Equipment

Sampling equipment is categorized in two different ways:

Category 1: Any item that will directly contact the wastewater, including samplers, tubing, or materials.

These items should be known to be PFAS-free. Tubing must always be kept in the original cardboard container or bag in which it was shipped and must always be stored in a clean location free of dust.

Category 2: Any item that will not directly contact the wastewater, including GPS receivers and clipboards.

Although these items will not directly contact wastewater samples, cross-contamination may still occur. Every effort should be made to ensure these items are PFAS-free. Be aware, surfaces of this field equipment or the containers in which they are kept may contain PFAS. Care should be taken to prevent cross-contamination in these cases.

Do not use any equipment that contains any known fluoropolymers including, but not limited to:

- Polytetrafluoroethylene (PTFE) that includes the trademark Teflon®
- Polyvinylidene fluoride (PVDF) that includes the trademark Kynar®
- Fluorinated ethylene propylene (FEP) that includes the trademark Neoflon®
- Ethylene-tetrafluoro-ethylene (ETFE) that includes the trademark Tefzel®

3. Sampling Methods

Wastewater sample collection can be divided into two methods: grab and automatic sampling.

2.1 Grab Sampling

Grab sampling is used to collect wastewater samples directly into the sample container from locations that are easily accessible. Grab sampling is preferred.

Note: PFAS are expected to accumulate at the air/water interface. Unless specifically required in the QAPP, it is not advisable to collect samples from the very top layer of any wastewater.

Various types of immersion sampling equipment are available for wastewater sampling, including extension rods that can be used to immerse the laboratory sample bottle, beakers, and peristaltic pumps with tubing that extends into the wastewater.

The most common extension rods are telescoping or swing samplers. Both of these types of rods are similar in design and concept; the rods facilitate the immersion of either the sampling bottle, beaker, or scoop. Examples of extension rod designs include:

- Pendulum or angular beaker
- Fixed scoop
- Fixed or rotatable head bottle holder

A peristaltic pump can also be used with extension rods by attaching the tubing to the extension rods and immersing both the rod and the connected tubing to the desired depth in the wastewater.

- ■ Cable ties used to secure the sample bottle should be made of natural rubber or nylon or uncoated metal springs.
- ■ Use only sample collection bottles, tubing, beakers, and/or scoop materials that are known to be PFAS-free such as stainless steel, glass, high-density polyethylene (HDPE), polypropylene, polyvinyl chloride (PVC), or silicone.
- ■ Use only extension rods made of materials that are known to be PFAS-free, such as aluminum and steel.

2.2 Automatic Sampling

Automatic sampling equipment is used to collect either composite samples during a defined time interval or discrete samples at defined times without the presence of a technician. Automatic sampling should be avoided due to the increased potential for cross-contamination. It should only be used if a representative sample cannot otherwise be collected.

Typical automatic sampling equipment includes:

- A strainer used to strain large solids and avoid plugging of the equipment; the strainer is typically weighted to keep the suction line (i.e. tubing) at the desired depth and location;
- Suction line made of a flexible tubing that is run through a peristaltic pump;
- Distribution nozzle made of flexible tubing that discharges the sample into the sample bottle; and
- Sample bottle which is used for sample collection.

Note: The strainer should be decontaminated or replaced between each sampling event. The suction line, distribution nozzle and sample bottle should always be replaced between each sampling event.

● - Prohibited ■ - Allowable ▲ - Caution

The materials described above are **Category 1**; therefore, the following apply:

- ● Do not use any materials that are suspected or known to contain PFAS;
- ■ Use stainless-steel couplings; and
- ■ Use sampling materials (e.g, sample bottle, tubing, strainer, etc.) made of HDPE, polypropylene, silicone, PVC, or other PFAS-free materials.

4. Equipment Decontamination

Disposable **Category 1** sampling equipment should be used, especially for sample bottles and tubing that are used in automatic samplers where the wastewater sample may be in contact with the sampling equipment for an extended period of time. Field sampling equipment used at multiple sites or sampling locations can become highly contaminated with PFAS. Decontamination procedures must be implemented to prevent cross-contamination, especially between individual sample locations.

For non-dedicated **Category 1** sampling equipment, the following materials and procedures must be used for decontamination:

- ● Do not use Decon 90®.
- ■ Laboratory supplied PFAS-free deionized water is preferred for decontamination.
- ■ Alconox®, Liquinox®, and Citranox® can be used for equipment decontamination.
- ■ Sampling equipment can be scrubbed using a polyethylene or PVC brush to remove particulates.
- ■ Decontamination procedures must include triple rinsing with PFAS-free water.
- ▲ Commercially available deionized water in an HDPE container may be used for decontamination. However, it is recommended that it be tested to ensure it is PFAS-free.
- ▲ Municipal drinking water may be used for decontamination purposes if it is known to be PFAS-free.

5. Sample Collection and Handling

The following must be observed for sample collection:

- ● Dust and fibers must be kept out of sample bottles.
- ● The sample cap should never be placed directly on the ground during sampling. If sampling staff must set the sample bottle cap down during sample collection and a second member of the sampling crew (wearing a fresh pair of powderless nitrile gloves) is not available, set the cap on a clean surface (cotton sheeting, HDPE sheeting, triple rinsed cooler lid, etc.).
- ● Do not sample without powderless nitrile gloves.
- ● Markers (Sharpie® or otherwise) are to be avoided.
- ■ Bottles should only be opened immediately prior to sampling.
- ■ Hands should be well washed and gloved.
- ■ Use HDPE sample bottles with Teflon-free caps, provided by the laboratory.

● - Prohibited ■ - Allowable ▲ - Caution

- Commercialy bought sample bottles used with automatic sampling equipment should be decontaminated prior to sampling and equipment blank samples should be collected using laboratory supplied PFAS-free water.
- Ballpoint pens may be used when labeling sample containers. If ballpoint pens do not write on the sample container labels, preprinted labels from the laboratory may be used.
- Samples should be double bagged using resealable low density polyethelene (LDPE) bags (e.g., Ziploc®).
- In the absence of a United States Environmental Protection Agency (USEPA) approved method, staff should contact the laboratory performing the sample analysis to obtain values for thermal preservation and holding time consistent with the analytical method to be used. At a minimum, samples must be chilled during shipment and must not exceed 10°C during the first 48 hours after collection. Samples should be shipped expeditiously.

If site specific information is available, sampling should be conducted from the least to the most contaminated location. Additional guidance on the sampling sequence can be found in Section 4.3.3 of the General PFAS Sampling Guidance.

If possible, collect PFAS samples prior to collecting non-PFAS samples or field parameters (pH, temperature, etc.).

Powderless nitrile gloves must be changed any time there is an opportunity for cross-contamination during sampling, including, but not limited to:

- Immediately prior to sample collection
- Each time sampling equipment is placed in and removed from wastewater (e.g., various wastewater samplers, water quality meter, turbidity meter, pump, tubing, etc.)
- Placing sampling tubing into the wastewater
- Handling of any sample, including quality assurance/quality control (QA/QC) samples
- After the handling of any non-dedicated sampling equipment
- After contact with non-decontaminated surfaces
- After decontamination of sampling equipment
- When judged necessary by field personnel

6. Sample Shipment

The following procedures should be used for sample shipment:

- Do not use chemical or blue ice.
- Refresh with regular ice double bagged in LDPE (Ziploc®) storage bags.
- Chain of Custody and other forms should be double bagged in LDPE (Ziploc®)storage bags and taped to the inside of the cooler lid.
- The cooler should be taped closed with a custody seal and shipped by overnight courier.

● - Prohibited ■ - Allowable ▲ - Caution

MDEQ PFAS Sampling: Prohibited and Allowable Items and Materials

Pumps, Tubing, and Sampling Equipment

Prohibited	Allowable
Teflon®, Other fluoropolymer containing materials, pipe thread seal tape, [2]Low-density polyethylene (LDPE)	[1]High-density polyethylene (HDPE), silicone, peristaltic or stainless-steel submersible pumps, any items used to secure sampling bottles that are made from: • Natural rubber • Nylon (cable ties) • Uncoated metal springs

Decontamination

Prohibited	Allowable
Decon 90	Alconox®, Liquinox®, or Citranox® Triple rinsed with PFAS-free deionized water

Sample Storage and Preservation

Prohibited	Allowable
Bottles: LDPE or glass. Cap lining: Teflon® Polytetrafluoroethylene (PTFE) Ice: chemical/blue ice packs Aluminum foil	Bottles: HDPE or polypropylene – PFAS-Free • Laboratory-provided Ice: regular ice double bagged (LDPE – Ziploc®), Thin HDPE sheeting

Field Documentation

Prohibited	Allowable
Waterproof/treated or recycled paper, field books, plastic clipboards, binders, Sharpie® type markers (all kinds/brands), Post-It® notes or other adhesive paper products	Loose plain paper, aluminium or masonite clipboards, ballpoint pens

Clothing, Boots, Rain Gear, and PPE

Prohibited	Allowable
New or unwashed clothing Anything made of or with: • Gore-Tex™ or other water-resistant synthetics • Coated Tyvek® Anything applied or washed with: • Fabric softeners • Fabric protectors, including UV protection • Insect resistant chemicals • Stain resistant chemicals	Well-laundered synthetic or 100% cotton clothing, washed more than six times with no fabric softeners Made of or with: • Polyurethane • Polyvinyl chloride (PVC) • Rubber • Neoprene • Uncoated Tyvek®

[3]Personal Care Products (PCPs) - for day of sample collection

Prohibited	Allowable
Cosmetics, moisturizers, hand creams, etc., most sunscreens, most insect repellents, dental floss and plaque removers	Sunscreens: See the General PFAS Sampling Guidance Insect Repellents: Deep Woods OFF or Sawyer Permethrin

Food and Beverages

Prohibited	Allowable
Pre-packaged food, fast food wrappers or containers, aluminum foil, non-stick cookware & containers	Brought and consumed only outside the vicinity of the sampling area: • Bottled water • Hydration drinks (i.e. Gatorade®, Powerade®)

[1]Do not assume HDPE tubing is PFAS-free until tested.

[2]LDPE must not come in direct contact with the sample; however, it may be used for indirect purposes.

[3]Based on evidence, avoidance of PCPs is considered to be precautionary as they have not recorded cross contamination of samples due to their use. However, if used, application of PCPs must be done at the staging area and away from sampling bottles and equipment. Hands must be thoroughly washed after the use of any PCPs prior to sampling.

● - Prohibited ■ - Allowable ▲ - Caution