WORK PLAN

Date:	September 21, 2016	**Project No:**	013-6052-011
To:	Debbie Rossi, RPM – USEPA-Region 3	**Company:**	USEPA
From:	Theresa Miller, PG, LSP and Ross Bennett, PE		
cc:	Doug Sutton, PhD, PE, LEED AP (HGL)		
RE:	**PERFLUORINATED COMPOUNDS – WELL PURGING,GROUNDWATER SAMPLING AND ANALYSIS PROGRAM DELAWARE SAND & GRAVEL SUPERFUND SITE, NEW CASTLE, DELAWARE**		

1.0 INTRODUCTION

Golder Associates Inc. (Golder), on behalf of the Delaware Sand & Gravel (DS&G) Remedial Trust (Trust), prepared this work plan to provide our monitoring well purging, sampling and analysis program for perfluorinated compounds (PFCs) in groundwater at and downgradient of the DS&G Site. This work plan is being provided to the United States Environmental Protection Agency (USEPA) for review and approval prior to commencement of our semi-annual monitoring program on September 26, 2016.

The following sections provide details regarding site-specific Standard Operating Procedures (SOPs) for PFC groundwater monitoring programs and additional details regarding the groundwater monitoring program for the DS&G Site as it relates to PFC monitoring.

2.0 PFC PROGRAM

The proposed PFC sampling locations are summarized on Table 1 (see Figures 1 and 2 for well locations). These locations were chosen to evaluate the distribution of PFCs in the Upper Potomac Aquifer at and downgradient of the DS&G Site.

Due to the extremely low method detection limits associated with PFC analysis and the numerous potential sources of trace concentrations of PFCs, sampling programs for PFCs require the development and implementation of detailed operating procedures to reduce the potential for cross contamination and false positive sample results. Therefore, all PFC sampling activities will be performed in accordance with the general methods and procedures described in *SOP – 1: General Field Methods for PFC Sampling Programs* (Appendix A).

Golder will purge each well using low-flow sampling procedures in accordance with the USEPA-approved Feasibility Study Work Plan Revision 2 (FSWP Rev 2) Sampling and Analysis Plan (SAP) dated October 2011 and in accordance with *SOP-2: PFC Program Monitoring Well Purging and Sampling Protocols* (Appendix B) prior to groundwater sample collection. Groundwater samples will be collected using standard low-flow techniques. Golder will submit groundwater samples to Eurofins/Lancaster Laboratory for analysis

Golder Associates Inc.
670 N. Commercial Street, Suite 103
Manchester, NH 03101 USA
Tel: (603) 668-0880 Fax: (603) 668-1199 www.golder.com

Golder Associates: Operations in Africa, Asia, Australasia, Europe, North America and South America

Golder, Golder Associates and the GA globe design are trademarks of Golder Associates Corporation

of PFCs via EPA Method 537 Revision 1.1 Modified. Eurofins/Lancaster Laboratory anticipates the following detection limits:

Compound	Method Detection Limit (ng/l)
N-ethyl perfluorooctanesulfonamidoacetic acid (NEtFOSAA)	5
N-methyl perfluorooctanesulfonamidoacetic acid (NMeFOSAA)	4
Perfluorooctane sulfonate (PFOS)	5
Perfluorobutane sulfonate (PFBS)	4
Perfluorodecanoic acid (PFDA)	1
Perfluorododecanoic acid (PFDoA)	3
Perfluoroheptanoic acid (PFHpA)	1
Perfluorohexane sulfonate (PFHxS)	4
Perfluorohexanoic acid (PFHxA)	1
Perfluorononanoic acid (PFNA)	1
Perfluorooctanoic acid (PFOA)	1
Perfluorotetradecanoic acid (PFTA)	3
Perfluorotridecanoic acid (PFTrDA)	2
Perfluoroundecanoic acid (PFUnA)	2

Golder will collect equipment blanks, field duplicates, field blanks, and trip blanks, as summarized on Table 1 for QA/QC purposes. QA/QC samples will be collected in accordance with *SOP-3: Quality Assurance / Quality Control Protocols for PFC Sampling Programs* (Appendix C). These samples will also be submitted to Eurofins/Lancaster Laboratory for analysis of PFCs via EPA Method 537 Revision 1.1 Modified.

3.0 SCHEDULE AND REPORTING

Golder anticipates performing the PFC Program outlined in this Work Plan during the October 2016 semi-annual sampling event that is currently scheduled for September 26 through October 14, 2016. Golder will validate the data and report it in the July-December 2016 Semi-Annual Report which is due in March 2017. The July-December 2016 Semi-Annual Report will also include recommendations for additional sampling, if appropriate.

Enclosures

Table 1 Proposed October 2016 PFCs Sampling Program
Figure 1 DDA Vicinity Monitoring Well Locations
Figure 2 Downgradient Monitoring Well Locations
Appendix A SOP-1: General Field Methods for PFC Sampling
Appendix B SOP-2: PFC Program Monitoring Well Purging and Sampling Protocols
Appendix C SOP-3: Quality Assurance / Quality Control Protocols for PFC Sampling Programs

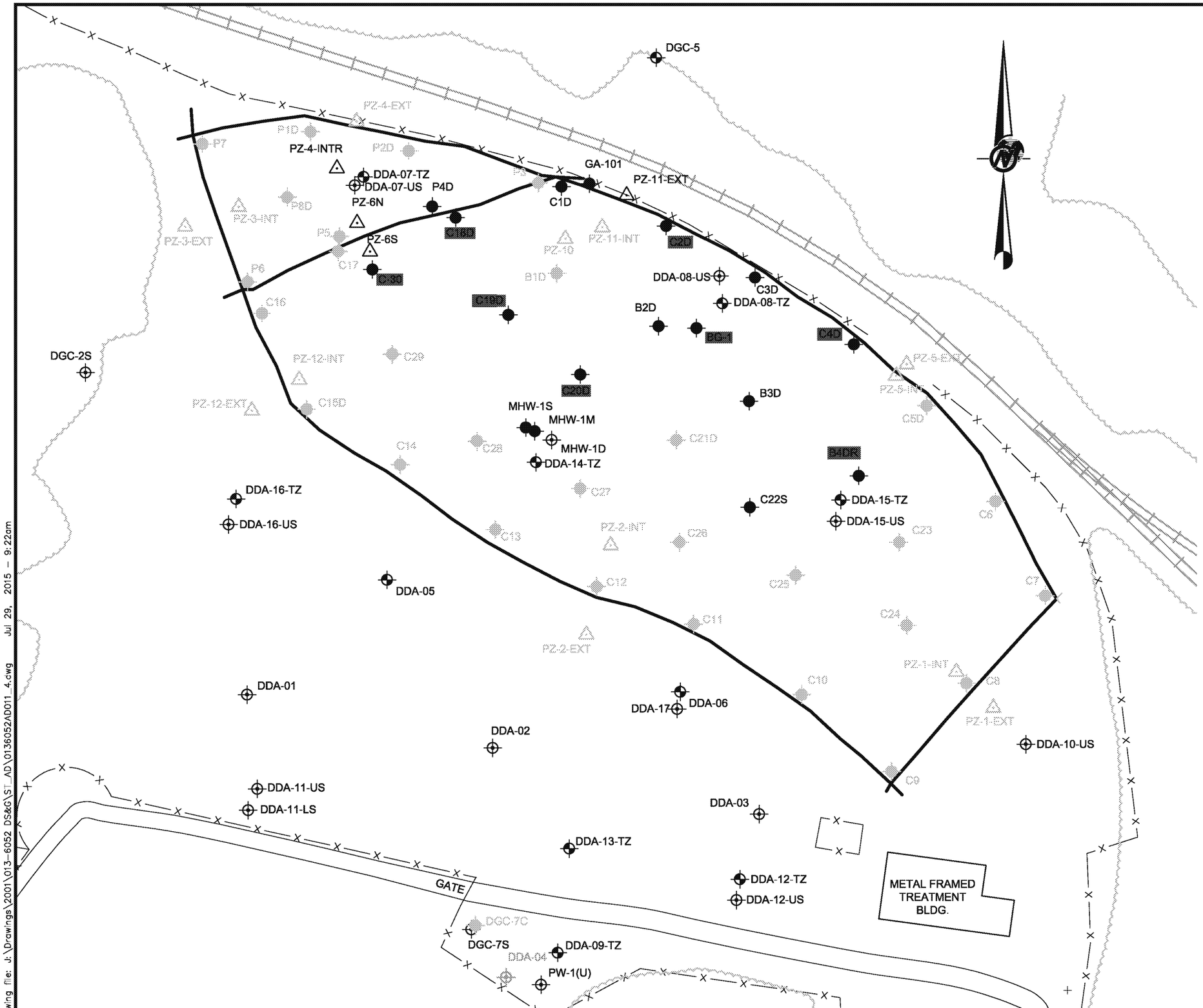
TABLE 1
PROPOSED OCTOBER 2016 PFCs SAMPLING PROGRAM
DELAWARE SAND & GRAVEL SUPERFUND SITE
NEW CASTLE, DELAWARE

Sample ID	Sampling Depth Interval (ft-bgs)	October 2016 Routine	October 2016 Additional
		VOCs+ll-1,4-dioxane, SVOCs+ll-BCEE, d-Fe/Mn	PFCs
DDA Vicinity UPA and UPCUTZ Monitoring Locations (See Figure 1)			
DDA-01	89	X	X
DDA-02	89	X	X
DDA-03	85	X	X
DDA-04	85		
DDA-05	59	X	X
DDA-06	51	X	
DDA-07-TZ	47		
DDA-07-US	68	X	X
DDA-08-TZ	54		
DDA-08-US	67	X	
DDA-09-TZ	67		
DDA-10-US	47	X	X
DDA-11-LS	110	X	X
DDA-11-US	80	X	X
DDA-12-TZ	47		
DDA-12-US	72	X	X
DDA-13-TZ	53		
DDA-14-TZ	54		
DDA-15-TZ	59		
DDA-15-US	90	X	X
DDA-16-TZ	56		
DDA-16-US	68	X	X
DDA-17	72	X	X
DGC-2S	60	X	X
DGC-5	45	X	X
DGC-7S	70	X	X
MHW-1D	70	X	X
PW-1(U)	NA	X	
Downgradient UPA and UPCUTZ Wells (See Figure 2)			
DGC-10D	133	X	X
DGC-10S	103	X	X
DGC-11D	110	X	X
DGC-11S	75	X	X
DGC-8D	117	X	X
DGC-8S	75	X	X
RT-1-UP	100	X	X
UPA-01	95	X	X
UPA-02D	156	X	X
UPA-02S	102	X	X
UPA-03D	160	X	X
UPA-101-TZ	75	X	X
UPA-101-US	106	X	X

Sample ID	Sampling Depth Interval (ft-bgs)	October 2016 Routine	October 2016 Additional
		VOCs+ll-1,4-dioxane, SVOCs+ll-BCEE, d-Fe/Mn	PFCs
AWC Wells (See Figure 2)			
AWC-E1	132	X	X
AWC-E1	156	X	X
AWC-E2	140	X	X
AWC-E2	165	X	X
AWC-2	NA	Active extraction wells sampled by AWC	
AWC-6	NA		
AWC-7	NA		
AWC-G3R	NA		
AWC-K1	160	X	X
NCC UPA Monitoring Wells (See Figure 2)			
MW-18	85	X	X
MW-22N	149		
MW-26N	138	X	X
MW-28	50	X	X
MW-29	39	X	X
MW-31	75	X	X
MW-34	100	X	X
MW-38N	102		
MW-40	125		
MW-49N	135		X
P-6	105	X	X
BW-1	126	X	X
BW-2	133	X	X
BW-3	92		
P-4	120	X	X
P-5L	131	X	X
P-5U	75		X
RW-10	90		

Notes:
1) A synoptic round of water levels will be collected after sampling for the monitoring event.
2) The following quality assurance/quality control (QA/QC) samples will be collected during each monitoring event:
   a) field duplicates, matrix spikes and matrix spike duplicates at a rate of 1 per 20 primary samples.
   b) One equipment blank will be collected per equipment setup used.
   c) Trip blanks and field blanks will accompany each shipment of VOC and/or PFC samples (1 per day).
3) ll = low level
4) d-Fe/Mn = dissolved iron and manganese
5) FSWP = Feasibility Study Work Plan
6) VOCs = volatile organic compounds
7) SVOCs = semi-volatile organic compounds
8) BCEE = bis (2-chloroethyl) ether
9) ft-bgs = feet below ground surface
10) DDA = Drum Disposal Area
11) UPA = Upper Potomac Aquifer
12) UPCUTZ = Upper Potomac Confining Unit Transition Zone
13) NCC = New Castle County
14) AWC = Artesian Water Company
15) PFCs = perfluorinated compounds

Prepared by: RWB
Checked by: TAM



LEGEND

–X——X——X——X	FENCELINE
	CENTERLINE OF SLURRY WALL AROUND DRUM DISPOSAL AREA
	RAILROAD
	DDA LOW-FLOW EXTRACTION SYSTEM (LFExS) WELL
DGC-2S	MONITORING WELL SCREENED IN UPPER POTOMAC AQUIFER
DDA-05	UPPER POTOMAC CONFINING UNIT TRANSITION ZONE MONITORING WELLS
PZ-10	DDA PIEZOMETERS
C1D	COLUMBIA MONITORING WELLS

NOTES

1.) LOCATIONS OF WELLS AND BORINGS ARE APPROXIMATE.

REFERENCES

1.) BASE MAP TAKEN FROM DIGITAL U.S.G.S. 7.5 MINUTE QUADRANGLES OF WILMINGTON SOUTH, DELAWARE/NEW JERSEY (DATED 1984), DELAWARE CITY, DELAWARE (DATED 1984), NEWARK EAST, DELAWARE (DATED 1984) AND SAINT GEORGES, DELAWARE (DATED 1984).

60 0 60
SCALE FEET

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW

PROJECT
DELAWARE SAND AND GRAVEL
SUPERFUND SITE
NEW CASTLE, DELAWARE

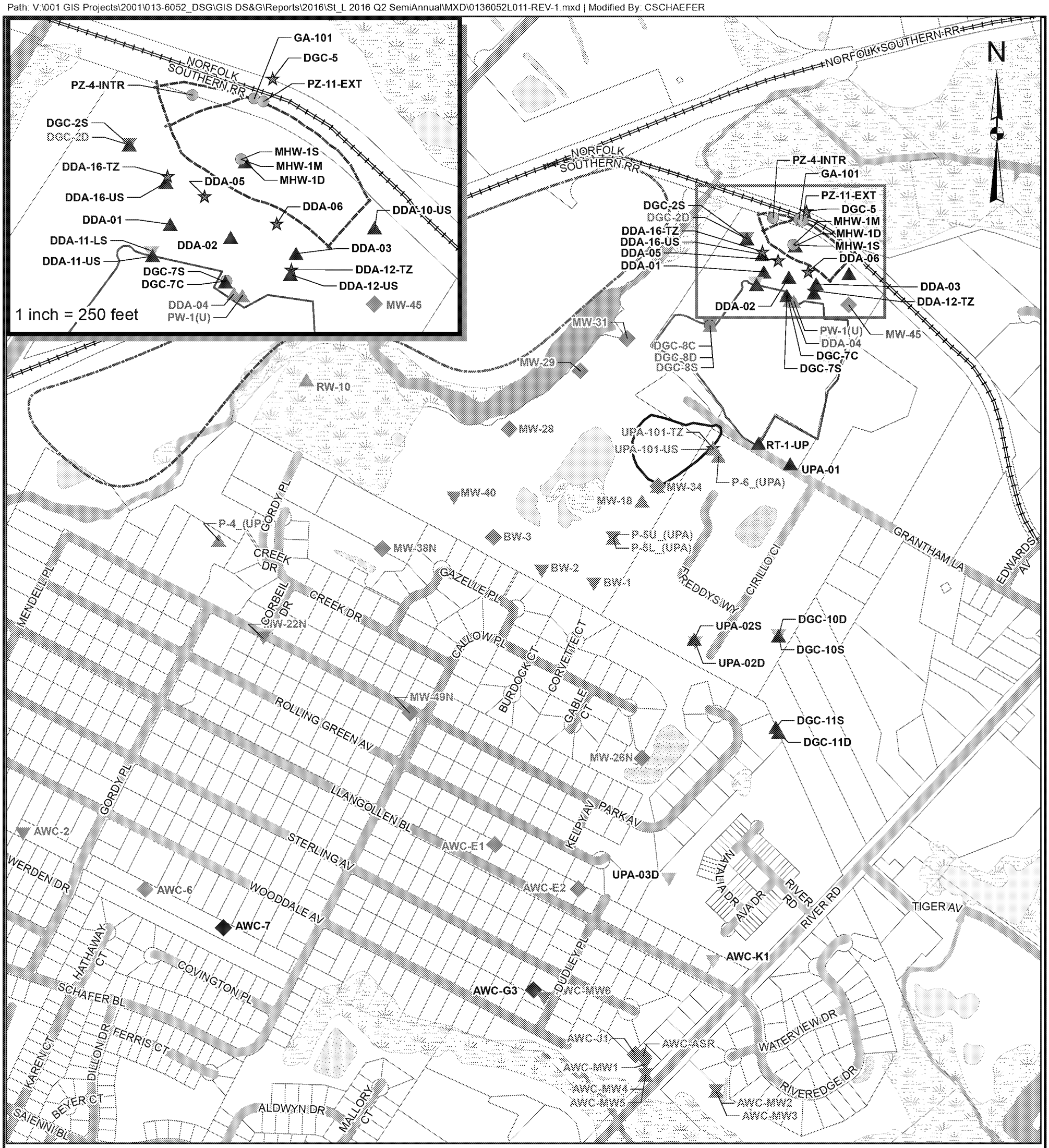
TITLE
DDA VICINITY MONITORING WELL LOCATIONS

Golder Associates
Manchester, New Hampshire

PROJECT No.		013-6052	FILE No.	0136052AD011_4
DESIGN	RWB	06/10/2015	SCALE AS SHOWN	REV. 0
CADD	CDS	06/11/2015		
CHECK	RWB	07/27/2015	**FIGURE 1**	
REVIEW	TAM	07/27/2015		

Drawing file: J:\Drawings\2001\013-6052 DS&G\ST_AD\0136052AD011_4.dwg Jul 29, 2015 – 9:22am

Path: V:\001 GIS Projects\2001\013-6052_DSG\GIS DS&G\Reports\2016\St_L 2016 Q2 SemiAnnual\MXD\0136052L011-REV-1.mxd | Modified By: CSCHAEFER



LEGEND

- Well screened in UPCU Transition Zone included in DS&G's approved 2011 monitoring program
- Well screened in UPA Upper Sand included in DS&G's approved 2011 monitoring program
- Well screened in UPA Upper Sand not included in DS&G's approved 2011 monitoring program
- Well screened in UPA Lower Sand included in DS&G's approved 2011 monitoring program
- Well screened in UPA Lower Sand not included in DS&G's approved 2011 monitoring program
- Well screened across UPA Upper Sand and Lower Sand included in DS&G's approved 2011 monitoring program
- Well screened across UPA Upper Sand and Lower Sand not included in DS&G's approved 2011 monitoring program
- Well screened in Columbia Aquifer included in DS&G's approved 2011 monitoring program
- Well screened in Columbia Aquifer not included in DS&G's approved 2011 monitoring program

REFERENCE

Base data from New Castle County Delaware, Department of Land Use, "eParcel View Map" web site GIS data download. Data acquired 01/18/2012.

0 300 600 1,200 Feet

1 inch = 600 feet

FIGURE 2

REVIEW	TAM	8/28/2016
CHECK	RWB	8/28/2016
GIS	AM	8/31/2016
DESIGN	TAM	07/16/2015
REV. 1	SCALE: AS SHOWN	
FILE No. 0136052L011-REV-1		
PROJECT No. 013-6052.007		

TITLE

DOWNGRADIENT MONITORING WELL LOCATIONS

PROJECT

Delaware Sand and Gravel Superfund Site New Castle, Delaware

Golder Associates
Manchester, New Hampshire

APPENDIX A

SOP-1: GENERAL FIELD METHODS FOR PFC SAMPLING

Title: General Field Methods for PFC Sampling Programs

1.0 GENERAL APPLICABILITY

The purpose of this Standard Operating Procedure (SOP) is to describe the procedures that shall be used during implementation of this perfluorinated compound (PFC) sampling program.

Due to the extremely low method detection limits associated with PFC analysis (i.e., nanograms per liter [ng/l]) and the many potential sources of trace levels of PFCs, field personnel shall employ the greatest caution by strictly following the protocols described herein. Frequent replacement of nitrile gloves and decontamination of non-dedicated sampling equipment in accordance with the appropriate procedures will reduce the potential for false detections of PFCs.

This SOP includes the following:

- Considerations regarding food packaging and food consumption during PFC sampling programs
- Field gear and clothing restrictions
- Personal hygiene requirements
- Sample area access restrictions
- Field equipment decontamination

Some of the provisions of the PFC sampling program requirements described herein may conflict with standard health and safety procedures (e.g., use of insect repellant or sunscreen). Therefore, prior to implementation of a field program subject to these General Provisions, an Addendum to the site-specific Health and Safety Plan (HASP) shall be prepared to address any potential conflicts between the requirements described herein and standard health and safety procedures.

2.0 RESPONSIBILITIES

The Field Team Leader and field personnel have the shared responsibility to oversee and ensure that the PFC sampling program is performed in accordance with the program-specific protocols described in this SOP. The Field Team Leader shall ensure that on-site personnel, including subcontractors and third parties that may have direct access to the sampling area, understand and comply with this SOP. Field personnel shall be notified of these requirements a minimum of three days prior to the start of field work in order to have the time to appropriately comply with many of the food and clothing requirements prior to arriving at the site.

3.0 GENERAL FIELD METHODS

3.1 Food Consumption

Components of some food packages have been treated to resist wetting. Historically, this is achieved through the use of PFCs. Accordingly, field personnel shall avoid the use of paper bags and other paper packaging to transport food to the site, including pre-wrapped foods and snacks (e.g., chocolate bars, energy bars, granola bars, potato chips, etc.). Field personnel shall not bring any fast food to the site that uses any form of paper wrapping such as sandwiches or paper drinking cups. If possible, field personnel shall use hard plastic or stainless steel food containers. Field personnel shall not use aluminum foil, wax paper, or coated textiles to transport food to the site.

The Teflon® coating on some frying pans contains fluorinated compounds and as such represents a potential source of PFCs. Field personnel shall not transport to or consume food at the site that has been prepared using a Teflon® coated cooking utensil.

Field personnel shall not consume food or beverages in the field vehicle or in the immediate vicinity of the sample location. Prior to consuming food or beverages, field personnel shall remove their nitrile gloves and coveralls and move to a location a minimum distance of 35 feet away from the sample location, preferably in the downwind direction. When finished eating or drinking, field personnel shall wash their hands, put their coveralls back on and put on a new pair of nitrile gloves prior to returning to the work area.

3.2 Field Gear and Clothing Restrictions

Because treatments to provide water resistant, water proof, or stain-resistant clothing include the use of PFCs, field personnel shall not wear any water resistant, water proof, stain-resistant treated clothing or Tyvek clothing during the field program. Permissible field clothing for PFC sampling programs includes clothing made from natural fibers, preferably cotton. Clothing made of synthetic fibers shall be avoided (i.e., reflective vests).

Field clothing shall be laundered with a minimal amount of detergent and no fabric softener or scented products shall be used. Once field clothing has been washed appropriately, field clothing shall be washed a second time on a rinse-only cycle, using only water, prior to drying. Anti-static dryer sheets shall not be used when drying field clothing. Field clothing shall preferably be old cotton clothing that has been laundered many times, as new clothing may contain PFC related treatments. Clothing containing Gore-Tex™ shall not be worn during the sampling program, as Gore-Tex™ clothing contains a PFC membrane.

Waterproof field books shall not be used; field notes shall be recorded on loose paper using aluminum clip boards. Plastic clip boards, self-sticking notes, binders or spiral hard cover notebooks shall not be used. Field notes shall be recorded in pen or pencil. Markers shall not be used.

Most safety footwear is constructed of leather and synthetic materials that have been treated to provide some degree of waterproofing and/or increased durability. Therefore, footwear materials represent a potential source of trace PFCs. Field personnel contact with safety footwear including donning footwear or tying laces shall not occur within 35-feet of the sampling area. If footwear must be adjusted, field personnel shall re-locate to an area a minimum of 35-feet from the sampling area, preferably in a downwind direction, and make the necessary adjustments. Nitrile gloves shall be worn when contacting footwear. The nitrile gloves worn while contacting footwear shall be removed and new nitrile gloves shall be put on prior to re-entering the sampling area.

Disposable nitrile gloves shall be worn at all times. A new pair of nitrile gloves shall be donned prior to the following activities at each sample location:

- Contact with laboratory-suppled sample containers or PFC-free water containers
- Decontamination of sampling equipment
- Insertion of anything into the well (e.g., HDPE tubing, HydraSleeve, bailer, etc.)
- Insertion of silicon tubing into the peristaltic pump

- Completion of monitoring well purging
- Sample collection
- Handling of QA/QC samples including field blanks and equipment blanks
- After the handling of any non-dedicated sampling equipment or contact with non-decontaminated surfaces

Because field vehicle seats may have been treated with PFC-containing products for stain resistance, the seats of field vehicles shall be covered with a well laundered cotton sheet or blanket for the duration of the field program in order to avoid direct contact between field personnel clothing and vehicle seat fabric. Measures taken to mitigate field personnel contact with field vehicle seat fabric shall not in any way interfere with the functionality or impede the use of vehicle safety belts.

3.3 Personal Hygiene

Field personnel shall not use shampoo, conditioner, body gel, cosmetic cream, or hand cream as part of their personal showering routine on the day of a sampling event, as these products may contain surfactants and represent a potential source of PFCs. Field personnel shall follow their normal hygiene routine the night before a sampling event and then rinse with water only the morning before a sampling event. The use of bar soap is acceptable; however, bar soap including moisturizers shall be avoided.

Field personnel shall not use moisturizers, cosmetics, dental floss, sunscreen, and/or insect repellent for the duration of the field program, either on-site or off-site, as these products may contain trace PFCs. Appropriate accommodation to address the prohibition of the use of these substances must be incorporated into a site-specific HASP.

3.4 Sample Area Access

Visitors, including contractors or site personnel, who are not following these general PFC sampling program protocols shall not be allowed to approach within 35 feet of the sample area until PFC sample collection activities are complete and the PFC sample container has been enclosed in a Ziploc® storage bag and placed in the sample cooler.

3.5 Field Equipment Decontamination

Use the procedures in this section to decontaminate all non-dedicated sampling equipment (e.g., submersible pumps, bladder pump components, tubing shears, etc.) used to collect samples:

- Rinse thoroughly with Citranox solution
- Rinse thoroughly with de-ionized (DI) water
- Rinse with methanol
- Rinse with DI water
- Allow to air dry
- Store equipment in clean Ziploc® storage bag until needed for sampling

Decontamination fluids used to clean equipment including Citranox, DI water, and methanol shall not be reused during field decontamination and shall be collected and discharged to the publicly-owned treatment works at the on-site treatment building.

APPENDIX B

SOP-2: PFC PROGRAM MONITORING WELL PURGING AND SAMPLING PROTOCOLS

Title: PFC Program Monitoring Well Purging and Sampling Protocols

1.0 GENERAL APPLICABILITY

The purpose of this Standard Operating Procedure (SOP) is to describe the procedures that shall be followed during monitoring well purging and the collection of groundwater samples for analysis of perfluorinated compounds (PFCs).

This SOP includes the following:

- Monitoring Well Groundwater Elevation Measurement
- Monitoring Well Purge
- Sample Container Considerations
- Groundwater Sample Collection Procedures
- Sample Shipping Requirements

With the exceptions provided in these SOPs, field personnel shall follow the monitoring well purge protocols included in the USEPA-approved Feasibility Study Work Plan Revision 2 (FSWP Rev 2) Sampling and Analysis Plan (SAP) dated October 2011. Sampling depths for the monitoring wells Is included in this sampling program are included on Table 1.

2.0 RESPONSIBILITIES

The Field Team Leader and field personnel have the shared responsibility to oversee and ensure that the monitoring well purge and PFC groundwater sampling program is performed in accordance with the program-specific protocols described in this SOP. The Field Team Leader shall ensure that field personnel understand and comply with this SOP.

3.0 PURGING AND SAMPLING PROCEDURES

3.1 Water Level Measurement

Under normal conditions, the first step in conducting a groundwater sampling program is to collect a synoptic round of static water level measurements and monitoring well sounded depths. However, due to the extremely low detection limits for PFCs, collection of a synoptic round of groundwater elevation measurements shall only be conducted after the groundwater sampling program has been completed to help mitigate the possibility of cross-contamination.

Field personnel shall record a depth to water measurement in each well prior to initiating well purge procedures.

3.2 Monitoring Well Purge

Field personnel shall not use Teflon® or low-density polyethylene (LDPE) tubing or other equipment containing these materials for purging or sample collection. High-density polyethylene (HDPE) tubing is preferred. Field personnel shall not re-use materials between well sample locations. Following completion of monitoring well purge activities at a monitoring well location, field personnel shall place all

disposable materials in heavy-duty (i.e., lawn waste) garbage bags for disposal. Field personnel shall wear nitrile gloves at all times.

Field personnel shall purge monitoring wells using a submersible pump and HDPE tubing. Field personnel shall inquire of the manufacturer and identify a submersible pump model whose construction does not include any Teflon® components (e.g., check balls, O-rings, compression fittings, etc.). New HDPE tubing shall be used to purge groundwater at each bedrock well. Field personnel shall determine and cut the appropriate length of HDPE tubing to be used in each well using the previously measured arm span of the individual performing the monitoring well purge to avoid contact with any materials other than the well and submersible pump. Field personnel shall decontaminate non-dedicated components and sampling equipment (including pumps, tubing shears, etc.) in accordance with SOP-1 between well purge locations.

Purge water shall be collected and discharged to the publicly-owned treatment works at the on-site treatment building.

3.3 Sample Containers

Groundwater samples shall be collected in HDPE sample containers provided by the laboratory specifically for use in the collection samples for analysis of PFCs (i.e., HDPE without a Telfon® liner). Glass containers shall not be used due to the potential for loss of PFCs through adsorption.

Groundwater sample container lids shall remain on the sample container until immediately prior to sample collection and lids shall be resealed immediately following sample collection. Field personnel shall hold the sample container lid in their hand until the lid is replaced on the sample container. Field personnel shall not rinse groundwater sample container bottles during groundwater sample collection. Groundwater sample container labels shall be completed using a pen or a pencil after the lid has been re-secured on the sample container. Field personnel shall not use markers to complete sample container labels.

3.4 Sample Collection

With the exceptions provided in these SOPs, field personnel shall follow the groundwater sampling protocols included in the USEPA-approved FSWP Rev 2 SAP dated October 2011. Field personnel shall wash their hands and put on a new pair of nitrile gloves prior to sample collection. Once the nitrile gloves are put on, field personnel shall not handle papers, pens, clothes, etc. prior to the collection of groundwater samples. If field personnel need to take notes or handle anything other than the sample container prior to collecting the sample, the old nitrile gloves with which contact was made shall be removed and new nitrile gloves put on.

Field personnel shall hold the sample container in such a manner that the sample container does not come in direct contact with the HDPE tubing or pump equipment. The sampling container shall be filled completely. If field personnel observe suspended solids in the collected groundwater sample, a new sample shall be collected, if possible. If it is not possible to collect a sample with minimal suspended solids (i.e., no evidence of solids settling at the bottom of the sampling container), field personnel shall contact the project manager and, if the sample is submitted for analysis, indicate the presence of suspended solids as a note on the chain-of-custody.

Groundwater samples shall be placed directly into the laboratory-supplied HDPE containers. Once the groundwater sample container lid has been resealed, groundwater sample containers are to be placed into individual new Ziploc® storage bags. Following groundwater sample collection, groundwater sample containers enclosed within their Ziploc® storage bags shall be placed on ice in the laboratory-provided sample cooler. Field personnel shall minimize sample exposure to sunlight during sample handling and storage.

All sampling materials shall be treated as single use and disposed of following completion of groundwater sampling at each monitoring well location.

3.5 Sample Shipping

Groundwater sample containers shall be stored on ice and maintained at approximately 4 degrees Celsius (°C) and transported by overnight courier to the laboratory. Field personnel shall only use new, fresh ice. Reusable chemical or gel ice packs shall not be used, as these may contain PFCs. Tracking numbers for all shipments shall be provided once the sample coolers have been shipped to ensure their timely delivery.

APPENDIX C

SOP-3: QUALITY ASSURANCE / QUALITY CONTROL PROTOCOLS FOR PFC SAMPLING PROGRAMS

Title: Quality Assurance / Quality Control Sampling Program Protocols

1.0 GENERAL APPLICABILITY

The purpose of this Standard Operating Procedure (SOP) is to describe the Quality Assurance / Quality Control (QA/QC) samples that shall be collected during a perfluorinated compound (PFC) sampling program.

This SOP includes protocols for the collection of the following QA/QC samples:

- Equipment Blanks
- De-ionized Water Blanks
- Field Duplicates
- Field Blanks
- Trip Blanks
- Analytical QA/QC

2.0 RESPONSIBILITIES

The Field Team Leader and field personnel have the shared responsibility to oversee and ensure that the PFC QA/QC sampling program is performed in accordance with the program-specific protocols described in this SOP. The Field Team Leader shall ensure that field personnel understand and comply with this SOP.

Field personnel shall inquire of the submersible pump manufacturer and identify a pump model whose construction does not include any Teflon® components (e.g., check balls, O-rings, compression fittings, etc.).

3.0 QA/QC PROTOCOLS

3.1 Equipment Blanks

Equipment blanks shall be collected at a rate of one per setup per event for non-dedicated sampling equipment (i.e., submersible pumps). Equipment blanks shall be collected using laboratory-supplied PFC-free water and shall be collected in laboratory-supplied high-density polyethylene (HDPE) containers.

After decontamination of the submersible pump in accordance with the procedure described in SOP-1, equipment blanks will be collected by pouring the laboratory supplied PFC-free water into a new and unused HDPE sample bottle and then pumping the PFC-free water through new HDPE tubing and new silicon tubing with the submersible pump into the sample container. When the sample container is full, replace the sample container lid and re-seal. Equipment blank container lids shall remain in the hand of field personnel until replaced on the sample container. Sample container labels shall be completed using a pen or pencil after the sample container lid has been resealed. Field personnel shall not use markers to complete sample container labels.

3.2 De-ionized Water Blanks

De-ionized (DI) water blanks shall be collected at a rate of one per setup per event for non-dedicated sampling equipment (i.e., submersible pumps). DI water blanks shall be collected using DI water and shall be collected in laboratory-supplied HDPE containers.

After decontamination of the submersible pump in accordance with the procedure described in SOP-1, DI water blanks will be collected by pouring the DI water used for decontamination over the external portion of the submersible pump into the sample container. When the sample container is full, replace the sample container lid and re-seal. DI water blank container lids shall remain in the hand of field personnel until replaced on the sample container. Sample container labels shall be completed using a pen or pencil after the sample container lid has been resealed. Field personnel shall not use markers to complete sample container labels.

3.3 Field Duplicates

Field personnel shall collect one blind field duplicate for every 20 primary field samples collected. Field personnel shall collected field duplicates immediately after collection of the primary field samples. Field duplicates shall be collected in the laboratory-supplied PFC-free HDPE sample containers. Field duplicate container lids shall remain in the hand of field personnel until replaced on the sample container. Sample container labels shall be completed as described above.

Field personnel shall collect groundwater field duplicates for analysis of PFCs using the following procedures:

- Field personnel shall stabilize groundwater parameters in accordance with the FSWP Rev 2 SAP and SOP-2.
- Field personnel shall collect the primary sample in accordance with the FSWP Rev 2 SAP and SOP-2.
- Following collection of the primary sample, change gloves and prepare to collect the field duplicate.
- Field duplicates shall be collected immediately following collection of the primary sample.
- Completely fill the laboratory-provided HDPE groundwater sample container.
- Replace and re-seal the lid on the groundwater sample containers and then complete the sample container label as described above.

3.4 Field Blanks

Field personnel shall submit of one field blank per day of sampling. Field blanks shall consist of PFC-free water containerized in an HDPE sample container filled at the laboratory prior to beginning the field program. Field blank sample containers shall be opened during the collection of a sample and the laboratory-supplied PFC-free water contained therein shall be poured directly into a laboratory-supplied HDPE sample container and then resealed. Field blank container lids shall remain in the hand of field personnel until replaced on the sample container. Sample container labels shall be completed as described above.

3.5 Trip Blanks

Field personnel shall submit one laboratory-supplied trip blank per day of sampling. Trip blanks shall consist of PFC-free water containerized in an HDPE sample container filled at the laboratory prior to the beginning of the field program. Field personnel shall place one trip blank container in the sample cooler at the beginning of the day and the trip blank shall remain in the cooler for the duration of sampling activities conducted on that day. Trip blank containers shall be submitted to the laboratory with the daily field sample shipment.

3.6 Analytical QA/QC

Internal laboratory QA/QC shall consist of one laboratory blank and one matrix spike / matrix spike duplicate (MS/MSD) for every 20 primary field samples collected for analysis. Field personnel shall collected MS/MSDs immediately after collection of the primary field samples as described above for field duplicates.

As part of the internal QA/QC, relative percent difference (RPD) shall be calculated between samples and corresponding field or laboratory duplicates. The laboratory quality assurance portion of the laboratory certificates shall be reviewed to verify that all calculations/recoveries were within acceptable limits as established by the laboratory method.

3.7 Sample Shipping

QA/QC samples shall be maintained at a temperature between 0 and 4 °C during shipping. Only new, fresh ice may be used in sample coolers. Field personnel shall not use reusable chemical or gel ice packs, as these may contain PFCs. Samples shall be shipped via courier service with priority overnight delivery. Tracking numbers for all shipments shall be provided once they have been sent out so to ensure their timely delivery.