Site Characterization Work Plan

Former Franklen Auto Garage
2586 Coney Island Avenue, Brooklyn, New York
NYSDEC Class P Site No. 224164

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Addendum to Site Characterization Work Plan

Former Franklen Auto Garage Site No. 224164

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The following changes have been made to the above referenced document at the request of NYS DEC on July 21, 2021:

1). On page 1 of text – Introduction paragraph 2, the words “if appropriate” were added. The sentence now reads ‘After the acceptance of this document by DEC, and any work proposed by the Site Characterization Work Plan is completed, if appropriate, an Interim Remedial Action Work Plan will be prepared.’

2). Page 7 of text – Section 4.2 Site Characterization, a sentence fragment ‘that has previously been identified’ was deleted. The new statement ‘This Site Characterization Work Plan will:’ was added to paragraph 1 of Section 4.2.

3). Page 10 of text – Section 4.3.2 – Soil Sampling, the 3 borings for the new monitoring wells and the 1 new soil boring will utilize EPA Method 8270 SIM to analyze soil for 1,4-dioxane.

4). Page 17 of text – Section 4.7.1 – Field Sampling Requirements/Soil Sampling Handling and Analysis. – the list of the soil analytical methods to be used should include 1,4-dioxane by EPA Method 8270 SIM.

5). Page 18 of text – Section 4.7.1 - Field Sampling Requirements/Groundwater Sampling and Analysis - the list of the groundwater analytical methods to be used should include 1,4-dioxane by EPA Method 8270 SIM.

6)). Page 18 of text – Section 4.7.2 – QA/QC Samples/Trip Blanks – at the end of the first paragraph there is a statement, ‘The following have been identified as potential sources of contamination for trip blanks’. This sentence has been deleted.

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LIST OF ACRONYMS

Acronym	Definition
AOC	Area of Concern
AST	Aboveground Storage Tank
CAMP	Community Air Monitoring Plan
COC	Contaminant of Concern
CPP	Citizen Participation Plan
DEC	NYS Dept of Environmental Conservation
DER-10	Department of Environmental Conservation Technical Guide 10
ESA	Environmental Site Assessment
FER	Final Engineering Report
HASP	Health and Safety Plan
HAZWOPER	Hazardous Waste Operations and Emergency Response
IRM	Interim Remedial Measure
NYS DOH ELAP	New York State Department of Health Environmental Laboratory Accreditation Program
OSHA	Occupational Safety and Health Administration
PID	Photoionization Detector
QEP	Qualified Environmental Professional
RAO	Remedial Action Objective
REC	Recognized Environmental Concern (in Phase I ESA)
RI	Remedial Investigation
RIR	Remedial Investigation Report
SC	Site Characterization
SCO	Soil Cleanup Objective
SCR	Site Characterization Report
SVOCs	Semi-Volatile Organic Compounds
MTBE	Methyl Tertiary Butyl Ether
PCE	Perchloroethylene (aka Tetrachloroethylene)
SC	Site Characterization
TCE	Trichloroethylene
TOGS GA	Technical and Operational Guidance Series 1.1.1 – Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations.
UST	Underground Storage Tank
VOCs	Volatile Organic Compounds

Site Characterization Work Plan

NYSDEC Class P Site No. 224164

2586 Coney Island Avenue, Brooklyn, New York

1 Introduction

The former Franklen Auto Garage site is at 2586 Coney Island Avenue in Brooklyn, New York, is currently not under any active remediation. A full Site Characterization per DER-10 Chapter 3 has been ordered by the New York State Department of Environmental Conservation (DEC) under an Order on Consent. This Site Characterization will present the:

- history of the site pertaining to efforts to investigate and remediate the site
- Current conditions of the site
- Possible risk to the environment and local population on and off the site, and
- A plan to investigate the site to generate an accurate picture of the soil, groundwater and vapor contamination that may exist be on the site.

After the acceptance of this document by DEC, and any work proposed by the Site Characterization Work Plan is completed, an Interim Remedial Action Work Plan will be prepared to address identified contamination of the site to bring the site into compliance and to preclude the listing of the site as a New York State Inactive Hazardous Waste Site. A detail listing of most major milestones and documents is located in Appendix B. All documents cited in this document are included in the DVD in Appendix A .

2 Site History and Description

2.1 Site Description

The subject property is located on the southwest corner to Coney Island Avenue and Avenue W, in Brooklyn, New York. The property is approximately 0.462 acre and is on Block 7184 Lots 25 and 26. The site is in a mixed use commercial and residential area with commercial development on Coney Island Avenue and predominantly residential development west along Avenue W and Lancaster Avenue. Across Coney Island Avenue to the east, there is commercial development on Coney Island Avenue and residential development to the east along Avenue W and Lancaster Avenue. See Figure 1 topographic location map and Figure 2 Site Location Map.

2.2 Previous Investigation Activities performed by Clayton Group

A Phase I Environmental Site Assessment was conducted in July of 2006 by Clayton Group Services, Inc. for Unicorp National Development a developer of properties for Walgreens Drug Stores. The property at the time of the Phase I ESA (2006) contained a hardware/lumber distribution and retail store and an auto repair garage. The Phase I ESA was ordered by Unicorp National Development as part of the due diligence process to purchase the property and develop it with construction of a Walgreens Drug store. The Phase I ESA noted a number of Recognized Environmental Concerns including:

- Current and Former On-site, in-Ground hydraulic Lifts, two lifts were currently in service and two lifts had previously been removed with one or both were probably leaking.
- Former Underground Storage Tanks - one gasoline UST and one fuel oil UST located in the area of the hardware store building. There may have been a total of three underground tanks in that area.
- Current Used Oil UST – 200 gallon UST containing waste oil, located in northwestern corner of the auto garage.
- Current and Historical Use as an Automobile Repair Shop – stained concrete and general poor housekeeping elevated this to a REC.

A Limited Subsurface Investigation was conducted by Clayton Group Services, Inc. to investigate the four RECs as found in the Phase I ESA. Six borings were advanced with a soil and groundwater sample retained for analysis from each boring. PCE was found in 2 soil samples, SB-1 and SB-2. MTBE was found in all six groundwater samples and no soil samples. PCE was found in 2 groundwater samples. A spill report was made to NYSDEC on July 19, 2006 and Spill number 0604337 was assigned. NYSDEC closed the spill administratively. In a letter dated June 24, 2008, the case was reopened by DEC after reviewing a copy of the Clayton Group Limited Subsurface Investigation.

2.3 Investigation Activities by Galli Engineering

A Remedial Closure Report was prepared in March of 2008 by Galli Engineering, PC to report on UST and Hydraulic Lift closure. A 275 gallon #2 fuel oil AST, three hydraulic lifts and a 200 gallon waste oil UST were removed prior to inspectors being on site. Soil samples were obtained in the area of these tanks.. An additional 550 gallon gasoline UST was cleaned, removed and disposed of properly. Groundwater samples were retained from five temporary wells. MTBE was found in 3 of the 5 groundwater samples and PCE was found in 1 of the 5 temporary wells.

Galli Engineering, PC submitted a Remedial Investigation Work Plan in October of 2008. Work commenced on site in November of 2008 advancing three soil borings and the collection of two soil samples per boring. The three borings were completed as monitoring wells. Results are reported in the Remedial Investigation Report dated June 2009 revised January 2010. PCE and TCE in soil are found in one of the borings (SB-2). Minor amounts of MTBE is found in soil samples from SB-1 and SB-3. No VOC's were found in any of the three water samples.

Additional groundwater sampling was accomplished in June of 2011 and reported in an RIR in July of 2011.All three monitoring wells were sampled and the samples were analyzed for VOCs, SVOCs and Metals. MW-1 was slightly over TOGS GA standard for selenium. MW-3 had a result of 99 ug/L for bis(2-ethylhexyl)phthalate which is over the limit of 5 ug/L. For MTBE, MW-2 (448 ug/L) and MW-3 (205 ug/L) were over the limit of 10 ug/L and MW-1 had a result of 8.8 ug/L which met the 10.0 ug/L limit. For PCE, MW-1 returned a result of 43.0 ug/L which exceeded the standard of 5 ug/L. Results for MW-2 (1.99 ug/L) and MW-3 (4.45 ug/L) did meet the TOGS GA standard for PCE. MW-1 also exceeded the standard of 5ug/L for TCE with a result of 9.73 ug/L. Samples from MW-2 and MW-3 were non-detect for TCE.

Raphael Ketani of DEC requested additional work, including an additional Work Plan on November 4, 2011. This work plan was submitted to Mr. Ketani on December 9, 2011. It included six additional soil borings and two additional groundwater wells. All the wells were resampled and two soil samples were retained from each soil boring and from the borings for the two new monitoring wells. There were a total of 18 soil samples that were retained and analyzed. Significant soil results for PCE was found in two soil results from SB-6 at 3,340 ug/kg and 5,060 ug/kg. TCE was also detected in SB-6 at 114 ug/kg. MTBE was detected in one soil sample (26.1 ug/kg). MTBE and TCE were not detected in seventeen soil samples and PCE was not detected in sixteen additional soil samples. PCE in groundwater was detected in MW-1 at 17 ug/L and below the TOGS GA standard of 5 ug/L in MW-2 and MW-4. PCE was not detected in MW-3 and MW-5. TCE was detected in MW-1 at 19 ug/L, above the TOGS GA limit of 5 ug/L and not detected in MW-2 through MW-5. MTBE was detected at high levels in MW-1 (430 ug/L), MW-2 (260 ug/L), MW-4 (49 ug/L) and MW-5 (1,400 ug/L).

This is the most recent investigative work that was accomplished on this site by Galli Engineering.

2.4 Consent Order

An Order on Consent was issued in 2019. The parties agreed that "the primary goals of this Order are to appropriately characterize the contamination at the Site and provide a mechanism for the Respondent to implement any necessary interim remedial measures and associated site management".

2.5 Necessity of Full Site Characterization

The above body of work has demonstrated that there is sufficient evidence that a full Site Characterization is necessary and that additional Interim Remedial Measures will probably be required. Three volatile organic compounds impact the soil and groundwater of the site. Soil is impacted in the area of the former Franklen Auto Garage by two VOCs, Perchloroethylene (PCE) at 5,700 ug/kg that is above Part 375 Unrestricted and Protection of Groundwater SCO of 1,300 ug/kg. Also, there is minor TCE impact to groundwater. Trichloroethylene (TCE) at 114 ug/kg meets the Part 375 Unrestricted SCO of 470 ug/kg and the Protection of Groundwater at 470 ug/kg. Methyl tert-butyl ether (MTBE) is present in groundwater on the site, but is present in only one soil sample. The TOGS GA standard for MTBE in groundwater of 10 ug/L, is exceeded in samples from four of the five existing monitoring wells.

3 Summary and Impacts to the Site

The site is historically and currently a commercial site. A Walgreens Drugstore and parking lot now occupy the site. There has been no construction on the site since 2012. The site had originally contained a lumber yard and hardware store with storage and the Franklen Auto Garage.

3.1 Soil Impacts

Historic invasive studies demonstrate that there is PCE and TCE contamination in the soil that could have originated from a waste oil UST in the northwestern part of the auto repair garage near the current MW-1 and in the north central part of the garage at MW-2 and SB-6. The contamination at MW-2 and SB-6 have high PCE (5,700 ug/kg & 5,060 ug/kg) as shown on figure 5 (PCE soil results map). These results should be delineated further with six soil borings that are stepped out from the MW-2 and SB-6 area. This area is currently bounded on three sides by MW-3, MW-5 and SB-5 which had non-detect results for PCE in soil. Soil borings to the north, west and southwest of these areas of PCE contamination will be advanced to determine the extent of the contamination in this area. The only shows of TCE in soil were from boring SB-6 (114 ug/kg) and a soil sample from the boring for MW-1(11.2 ug/kg) that was installed in 2009. Soil borings SB-1 through SB-5 (installed in 2011) all returned results of TCE in soil that were non-detect.

MTBE was not found in any soil sample result that was above the Part 375 Unrestricted / Protection of Groundwater SCO of 930 ug/kg (see figure 6). Shows of MTBE in all soil results from MW-1 (11.2 ug/kg), MW-3 (7.56 ug/kg) and SB-2 (26.1 ug/kg) were below the SCO of 930 ug/kg.

3.2 Groundwater Impacts

Impacts to groundwater for PCE (see figure 8) are mostly below TOGS GA limit of 5 ug/L. MW-1 had a result of 43 ug/L in May 2011 and a lower result in March 2012 of 17 ug/L. Both results exceed the TOGS GA standard of 5 ug/L. MW-2 had a result of 1.1 ug/L, MW-4 had a result of 1.5 ug/L and MW-3 and MW-5 had a results of non-detect. MW 2 through MW-5 are below the 5 ug/L TOGS GA standard.

Impacts to groundwater by TCE (see figure 9) are varied but similar to PCE. MW-1 is currently the highest at 19 ug/L. In MW-2 through MW-5, TCE results from March 2012 are all below the 5 ug/L standard from TOGS GA.

MTBE impacts to groundwater are significantly different (see figure 10). MW-5 had the highest result of 1,400 ug/L, MW-2 had a result of 448 ug/L, MW-1 had a result of 430 ug/L, MW-4 had a result of 49 ug/L and MTBE was not detected in MW-3. All results are from the March 2012 sampling event.

3.3 Soil Vapor Impacts

No soil vapor studies have been accomplished as of the date of this document.

4 Site Characterization Work Plan

All three media, soil, groundwater and soil vapor need further characterization and delineation. The goal of the Site Characterization Work Plan (SCWP) is to gather sufficient data to effectively accomplish additional remedial work to protect residents bordering on the property to the west, protect workers and customers in the existing commercial building on site and determine if additional remedial work would contribute to the goals of meeting Part 375 Protection of Groundwater Soil Cleanup Objectives as well as preventing the listing of this site as a NYS DEC Inactive Hazardous List Site.

4.1 Issues That Require Further Characterization

As shown by soil results in figure 5, there is an area of high concentrations of PCE in soil. MW-2 and SB-6 both show high concentrations of PCE in soil. TCE (fig 6) is also found in soil, but is less often an issue. MTBE has exceedances in soil in MW-1 and SB-2. In all other soil samples, both current and historical, MTBE was not found.

There is one large area of PCE contamination in soil. The area of SB-6 (5,060 ug/kg) and MW-2 (5,700 ug/kg), both exceed the Protection of Groundwater SCO of 1,300 ug/kg. This area of high PCE is bordered by SB-5, MW-3, and MW-5 which all returned a result of non-detect of PCE in soil. TCE is also found in MW-2 (11.2 ug/kg) and SB-6 (114 ug/kg) but at levels that do not exceed the Protection of Groundwater SCO of 470 ug/kg. Excavation of contaminated soil in the area that includes MW-2 and SB-6, may remove a substantial source of residual PCE and TCE. The area around MW-1 and SB-2 appears to be slightly impacted by MTBE in soil. MW-1 (11.2 ug/kg) and SB-2 (26.1 ug/kg) show MTBE in soil but both results are below the Protection of Groundwater SCO of 930 ug/kg. This show of MTBE is limited as it is bounded by SB-1, SB-3 and SB-5 which all returned a result of non-detect.

This above observations may change when additional soil and soil gas samples are collected.

Groundwater has been impacted and characterization is necessary to determine souces of the groundwater contaminataion . There are three contaminants in groundwater that should be reviewed, PCE, TCE and MTBE. Only MW-1 had analytical results that were above TOGS 1.1.1 standards for PCE and TCE as shown in figures 8 and 9 (PCE and TCE in groundwater). The principal organic contaminant standard of 5 ug/L is met in all monitoring wells, except for MW-1. However, no PCE or TCE in soil from MW-1, SB-1, SB-2 and SB-3 was found as shown in figures 5 and 6

The 2012 groundwater sampling event shows that MTBE has been found in all but one of the groundwater samples. The exception is for MW-3 which returned a result of non-detect. The highest amount of MTBE in groundwater (1,400 ug/L) was found in MW-5 in the northeast corner of the lot and generally decreased to the southwest with MW-4 showing results of 49 ug/L. The only soil samples that had any positive results were MW-1 and SB-2 and they both met the Part 375 Unrestricted/Protection of Groundwater SCO of 930 ug/kg. Direction of groundwater flow is generally to the southwest as shown in figure 11, the groundwater contour map from the 2011 report. The source of the MTBE is still a question, but is probably not on site.

Soil Gas Sampling has not been accomplished on the site at this time. The risk from various Volatile Organic Compounds, to residents along the western property line and workers in Walgreens, has not been investigated. A soil gas sampling program to investigate the indoor air quality of the basement of Walgreens with sub-slab sampling should be accomplished to indicate if there are issues in the building. Soil gas sampling along the western border of the site will be accomplished to give an indication of the spread of the VOCs toward the residential properties.

4.2 Site Characterization

The intent of the Site Characterization is to further delineate and identify contamination and determine if the site poses a significant threat to human health and the environment. that has previously been identified.

- more precisely target areas of onsite PCE/TCE contamination in soil,
- demonstrate if contamination is spreading to the west toward residential properties,
- investigate if soil vapor is impacting the drug store building putting workers and customers at risk and
- Investigate the source of the MTBE in groundwater contamination.

4.2.1 Site Characterization of Soil

The target of additional borings is to delineate the PCE/TCE in soil mass that includes MW-2 and SB-6. Both of these have high amounts of PCE with MW-2 having a soil sample result of 5,700 ug/kg and SB-6 returning a result of 5,060 ug/kg in the deeper soil sample. These sample locations are bounded by MW-3, SB-5 and MW-5 which had results of non-detect for PCE in soil. A ring of soil borings will step out from the two locations of highest impact. The goal will be to determine the extent of the contamination and generate a more accurate estimate of the volume of soil that is impacted. Figure12 shows the proposed soil boring locations. Soil samples will be retained at approximately 2’ below grade and within 1’ of the top of groundwater. PID readings will be taken from the soil cores prior to sampling. Soil samples retained will be analyzed for Volatile Organic Compounds and Semi-volatile Organic Compounds. Soil samples from the borings for the new monitoring wells will be retained in a similar manner as the proposed new soil borings.

4.2.2 Groundwater Characterization

As described in earlier sections, there is contamination of groundwater on the site. Samples taken in March of 2012, show that PCE is found in MW-1 in amounts exceeding the 5 ug/L TOGS GA limit. The remaining four monitoring wells have sample results where PCE was not detected or was below the 5 ug/L limit. TCE was only found in MW-1 and exceeded the 5 ug/L limit and was not detected in the remaining four wells. According to the March 2012 sampling event, MTBE is found in groundwater samples from 4 of the 5 existing monitoring wells. Results are from 1,400 ug/L in MW-5 to 49 ug/L in MW-4 (see figure 10) with no MTBE found in MW-3. There is a general northeast to southwest trend in the amounts of MTBE found in the samples. In addition, figure 11 shows that on site groundwater flow is also to the southwest.

Three additional monitoring wells are proposed for the site as shown in figure 12. The previously presented data suggests that the MTBE is originating off site.

4.2.3 Soil Vapor Characterization

No soil vapor sampling has been accomplished during the project. Investigating soil vapor is necessary to determine if there is a possibility of soil vapor encroaching onto the residential properties to the west. Additional soil vapor testing will conducted in and around the Walgreens building in order to evaluate the risk to customers and workers. Sub-slab sampling will be accomplished around the perimeter of the building and in the partial basement. An indoor air test will also be accomplished in the basement. These tests will be conducted according to NYS Department of Health guidelines. Figure 12 shows the proposed soil vapor sampling locations.

4.3 Soil Borings and Sampling

4.3.1 Soil Borings

Soils samples will be collected utilizing a Geoprobe drill rig. A Geoprobe is a track mounted hydraulic unit capable of driving a 2" diameter Macro Core Sampler down to depths of up to 70 feet or more, depending on soil characteristics. The apparatus is designed to allow collection of soil or groundwater samples at selected depths, consistent with equipment and physical limitations. The driller who operates the Geoprobe shall have experience in utilizing this type of drill rig. An experienced field geologist will log all soil samples in accordance with industry standards and will collect all soil samples for lab analysis.

The Geoprobe Macro-core sampler will be decontaminated prior to drilling each boring and sample.. The soil cuttings and rinse water generated through the equipment decontamination activities will be collected in DOT-approved 55-gallon drums for characterization and disposal at the conclusion of the field investigation program. This collected material may be disposed of along with other material when remediation begins.

4.3.2 Soil Sampling

Soil samples will be obtained using a two-inch diameter Geoprobe Macro-Core sampler. The sampler is a 5’ long steel sampling tool and utilizes a plastic liner to contain the soil sample. The liner contains the sample and is removed from the sampler. The plastic tube is split and PID readings and soil samples are retained from the split plastic tubes. Samples will be collected to a depth of 0 to 2’ and at the top of the observed water table. A Mini-Rae 2000 photoionization detector with a 10.6 eV lamp will be used to screen the split cores for soil vapor.

A minimum of two samples will be collected for lab analysis from each boring, including one to be collected from 0-2’ below grade and at the capillary fringe. If PID readings indicate a large amount of contamination in a section of sample tube, an additional sample will be collected from the interval with the most evident contamination. If product is encountered in any of the soil borings, representative samples of the product will be collected for laboratory analysis.

The samples will be collected in laboratory-supplied containers and will be sealed, labeled, and placed in a cooler containing ice (to maintain a temperature of approximately 4 degrees Celsius) for delivery to a New York State Department of Health (NYSDOH) Environmental Laboratory

Accreditation Program (ELAP)-certified analytical laboratory. As part of the Site Characterization, all soil samples will be analyzed for:

Volatile Organic Compounds - EPA Method 8260
Semi Volatile Organic Compounds - EPA Method 8270
TAL Metals – EPA Method 6010 and 7471
PCBs/Pesticides – EPA Method 8081/8082
Hexavalent Chromium – EPA Method 3060A
Total Cyanide - EPA Method 9014
DRO - EPA Method 8015

All three borings for new monitoring wells and one new boring for soil samples, will have their soil samples also analyzed for:

Full TCLP – SW-846 Method 1311
Hazardous Waste Characteristics (Reactivity, Ignitability, and Corrosivity)
1,4-Dioxane EPA Method 8270
PFAS EPA Method 537.1

Quality Assurance/ Quality Control (QA/QC) procedures to be followed are described in the QAPP.

The proposed soil sampling boring locations are shown on the Proposed Sampling Location Plan (Figure 12). There has been a significant amount of previous soil investigation work. However, Site Characterization is required as a significant amount of time has elapsed since soil sampling was last accomplished.

4.4 Groundwater Monitoring Wells

The following subsections describe the installation and development of the groundwater monitoring wells. Groundwater is anticipated at 15' – 20' below ground surface (bgs) as the Site elevation is 9' above MSL and previous 10' deep borings did not encounter the groundwater table.

4.4.1 Monitoring Well Installation

To better define potentiometric relationships in the vicinity of the site and evaluate the extent of groundwater contamination, three monitoring wells will be installed. Proposed locations for the new wells are shown on the Proposed Sample Location Plan (fig 12). Monitoring wells will be installed with 2" diameter Schedule 40 PVC. Well screens will be 10 feet long, with 20 mil slots and set to intersect the water table. Well depths are anticipated to be 20 feet below grade based on the depth of existing groundwater wells. The final depth of wells will be based on in-field conditions observed and the actual depth to the groundwater table for proper well installation. The wells will be completed with 2" diameter Schedule 40 PVC riser. Each boring annular space will be backfilled with #2 sand to a depth at least one foot above the screen. A one-foot Bentonite seal will be placed above the sand. Monitoring wells will be completed with well cap locks and flush mount protective manholes. No solvents or glues will be used in the installation of the monitoring wells.

After installation, new wells will be developed by pumping and surging until the water turbidity is less than 50 NTU. Existing wells will also be developed if turbidity is an issue. An experienced geologist from Galli Engineering, P.C. (Galli) will be present to monitor all field activities. Drilling logs and well construction logs will be prepared for all borings and wells. A minimum of one week after development of the wells, Galli Engineering will collect groundwater samples from the newly installed groundwater monitoring wells.

New monitoring wells will be surveyed by a New York State licensed surveyor to establish horizontal location and elevation of the water level measuring points. Elevation measurements will be taken on the riser pipe with the measuring point designated by a mark. All elevations will be referenced to the NAVD 1998 datum. All wells will be located horizontally to within plus or minus 0.5 feet. Vertical elevations of measuring points will be made to the nearest 0.01 foot. All wells, existing and newly installed, will be surveyed.

Existing monitoring wells will be inspected by the driller during the installation of the newly proposed monitoring wells. If repair or replacement is necessary it will be accomplished prior to the surveying of the monitoring wells.

4.4.2 Groundwater Sampling

Each monitoring well will be gauged for depth to product/water and purged until the water quality parameters stabilize, prior to sampling. An electric water level indicator graduated in 0.01-foot increments will be used.

Groundwater samples will be collected a minimum of one week after the development of each monitoring well is completed. Monitoring wells will be purged and sampled using low-flow procedures in accordance with the EPA Region 1 Low-Stress (Low-Flow) SOP (EQASOP-GW 004 Revised: September 19, 2017). Purging will be done at a minimal flow rate until field parameters stabilize. Groundwater samples will be collected as described in Appendix D – Low Flow Sampling Procedures. One round of groundwater sampling will be conducted at the site to assess groundwater contamination. Samples from the three new monitoring wells, (MW-12, MW-13 & MW-14), in addition to MW-2, will be analyzed for TOGS GA criteria plus PFAS and 1,4-Dioxane. Samples from the remaining monitoring wells will only be analyzed for Volatile Organic Compounds.

- Groundwater samples will be collected in order; first from monitoring wells considered least impacted, followed by those considered most impacted. The order of sample collection will be PFAS, VOC, SVOC, metals, PCBs, pesticides/herbicides.

- Measurements of total organic vapor concentrations, using a Photoionization Detector (PID), will be performed by removing the well cap slightly and placing the instrument probe beneath the cap. After the reading has been obtained, the well cap will be completely removed and the well will be allowed to ventilate for a period of three to five minutes. After the well has been ventilated, a measurement in the breathing zone will be made.

- Depth to water will be measured from the mark at the top of the PVC well casing to the top of the water surface to the nearest 0.01 ft. prior to sampling. Depth to the bottom of the well will be obtained from boring logs and verified by measurement.

- Ground surface and top of casing elevations will be surveyed by a NYS Licensed Surveyor to within 0.01 ft. so that groundwater elevations can be calculated. The survey shall provide x,y,z coordinate data for each monitoring well. Elevation data shall be referenced to the 1998 NAVD datum.

- The low-flow pump intake will be positioned in the middle or slightly above the middle of the saturated screen interval in order to minimize stress to the system as measured by minimal drawdown (<0.1m) during purging. Flow rates on the order of 0.1 to 0.5 liters/min are typically used to achieve minimal drawdown.

- Stabilization is achieved when there is no drawdown and three successive readings taken every three to five minutes are within ± 0.1 units for pH; ± 3% for conductivity; ± 10 mv for ORP; and ± 10% for turbidity, DO, and temperature.

- The same device will be used for sampling as was used for purging at the same stabilized flow rate.

- The procedures for collection of groundwater samples using low-flow sampling methods are presented in Appendix C (EQA-SOP-GW4 Region 1 Low-Stress SOP Rev 4).

- The elevation of groundwater in feet will be calculated and recorded with the reference elevation of the top of the PVC well casing and depth to water measurement.

- The purge water generated during sampling activities will be collected in DOT-approved 55-gallon drums for characterization and disposal at the conclusion of the field investigation program.

Information obtained from the new and existing monitoring wells will be used to study the likely path of contaminant migration, to determine the vertical and lateral extent of the contamination, and to evaluate groundwater extraction and/or treatment alternatives.

4.5 Soil Vapor Sampling

The objective of the Soil Vapor Characterization will be to evaluate the potential for VOC vapor migration from the subsurface. The Vapor Intrusion Investigation will be completed in accordance with applicable guidelines in the New York State Department of Health (NYSDOH) Final Guidance for Evaluating Soil Vapor Intrusion in the State of New York (NYSDOH Guidance Document) dated October 2006. The scope of the investigation shall include:

- a subsurface utility survey;

- the installation of a total of 6 soil vapor points, followed by the collection of 6 sub-slab soil vapor samples (SV-1 through (SV-6).

- the collection of a corresponding indoor air sample in the one building where a sub-slab vapor sample is collected (SV-7), and;

- the collection of one outdoor ambient air sample immediately outside the building (SV-8).

Subsurface Utility Clearance for Sub-Slab Soil Vapor Sampling Points

Prior to invasive activities associated with the installation of the soil vapor sampling points, a geophysical survey will be conducted to identify subsurface utilities at proposed sample locations.

Soil Vapor Sample Point Installation

The Soil Vapor Investigation will include the installation of six soil vapor points (SV-1 though SV-6). The soil vapor points will be installed under the supervision of a Galli geologist. Proposed soil vapor locations are provided on Figure 12. Installation of all soil vapor points will conform with the NYSDOH Soil Vapor Guidance Document dated October 2006.

Outdoor Soil Vapor Point Installation

The outdoor subsurface soil vapor point will be installed at a depth one foot below the asphalt paving or concrete slab. At each subsurface location, a soil vapor implant attached to dedicated polyethylene tubing will be inserted into each boring. The annulus around the probe/tubing will be filled with clean No. 1 Morie sand to a minimum depth of approximately one foot above the probe. Bentonite slurry will be then injected into the hole to the top of the boring.

The indoor sub-slab soil vapor points will be installed from beneath the building slab at a depth of no more than 2 inches below the bottom of the slab. At each sub-slab location, dedicated polyethylene tubing will be inserted into each sampling location and the annulus around the tubing and filled with clean No. 1 Morie sand to just below the underside of the floor slab. Bentonite slurry will then be used to seal the top of the sample point.

Sub-Slab Soil Vapor Sample Point Collection

Each soil vapor point will be purged at a rate not to exceed 0.2 liters per minutes (L/min) to evacuate a minimum of three tubing volumes prior to sample collection. Soil vapor samples will be collected into laboratory-supplied, batch-certified Summa® canisters equipped with flow controllers calibrated for a sampling rate of less than 0.2 L/min, for a minimum of 4 hours of sampling. As a Quality Assurance/Quality Control (QA/QC) measure, an inert tracer gas (helium) will be introduced into an above-grade sampling chamber to ensure that the soil vapor sampling points are properly sealed above the target sampling depth thereby preventing sub-surface infiltration of ambient air. The sample chamber will be sealed above the sample point with hydrated Bentonite.

Indoor Ambient Air Sample Collection

Indoor-air samples will also be collected in each interior room where sub-slab vapor sampling is performed. The indoor-air samples will be collected for over a minimum period of 4-hours concurrently with sub-slab vapor sample collection.

Outdoor Ambient Air Sample Collection

The one outdoor ambient air sample will be collected simultaneously with the soil vapor samples to evaluate the potential influence, if any, of outdoor air on indoor air quality.

All air sampling canisters will be properly labeled and transported via courier to a certified laboratory by NYSDOH Environmental Laboratory Approval Program (ELAP). Samples will be analyzed for VOCs via United States Environmental Protection Agency (USEPA) Method TO-15.

4.6 Site Characterization Report

The results of the Site Characterization will be summarized in a Site Characterization Report (SCR) as part of this task. The SCR shall be prepared in accordance with Section 3.1 of DER-10 and Section 3.10 of the BCP Guide and shall be prepared by a Qualified Environmental Professional. The report will include text that documents the fieldwork, an evaluation of analytical results in the context of previous Site data/off-Site data, and recommendations for additional investigations or assessments, if required. The report will also include figures and summary tables of analytical results and project data. This report will include the following:

- Documentation of the observations and investigation activities performed including boring logs, well installation diagrams, well development logs, well sampling logs, and a PID log;
- Evaluation of the distribution of contaminants
- Tabulated summaries of soil, groundwater and soil vapor sample analytical data;
- Updated figures and figure presentations that include horizontal and vertical distribution of constituents in the soil and groundwater at the Site;
- Site photographs;
- Data Usability Summary Report (see Section 5.2.5); and
- Recommendations for further investigation activities necessary to complete characterization of the Site or provide recommendations for preliminary selection of remedial alternatives.

Supporting documentation will be provided as appendices to this report. The appendices will include the field logs, and laboratory analytical reports. All data will be supplied to DEC in EQuIS format.

4.7 Quality Assurance/Quality Control

The field sampling and analysis requirements provide the methods by which the site characterization activities will be performed. The field sampling and analysis sections below provide methods and procedures for field sampling activities, laboratory analytical methods, and data evaluation procedures. These methods and procedures will be implemented to provide the data necessary to meet the overall objectives of this investigation.

4.7.1 Field Sampling Requirements

<u>Sampling Objectives</u>

The sampling objectives for the Site Characterization are to:

- Provide data necessary to further evaluate the nature and extent of impacted subsurface soil, groundwater and soil vapor associated with the historical uses and operations at the Site.
- Provide data to be used for a qualitative risk assessment.
- Characterize on-site soils and materials for proper disposal off-site.

<u>Soil Sampling Handling and Analysis</u>

Each of the soil samples collected during the drilling program will be screened for total organic vapors with a PID. Each soil sample will be collected, handled, and stored as if it were to be analyzed, even though selected soil samples will be submitted for laboratory analysis. The macro core soil sampler will be opened and a representative soil sample of the depth interval sampled will be placed directly into a laboratory-provided sample container using a stainless steel or single use disposable spatula or trowel. Immediately after collection, each soil sample will be labeled with the following information and placed in a cooler to be held at a temperature of approximately 4°C until delivery to the laboratory:

- sample designation;
- site name;
- sampling location;
- job number;

- date;
- time; and
- initials of person collecting sample.

Each sample will be tracked by means of a Chain-of-Custody form that will be initiated at the time of sample collection and will be maintained with the sample until delivery to the laboratory. Laboratory analytical services associated with this program will be provided by a New York State ELAP-certified laboratory. All soil samples will be analyzed for TCL VOCs, TCL SVOCs, and TAL Metals. In order to meet disposal acceptance requirements, some soil samples will also be sampled for TAL metals, PCBs, Pesticides, Hexavalent Chromium, Total Cyanide, TCLP Metals, and DRO. Three soil samples will be analyzed for 1,4 Dioxane and PFAS.

The soil analytical methods to be used are:

- Target Compound List (TCL) Volatile Organic Compounds (VOCs) plus tentatively identified compounds (TICs) via U.S. Environmental Protection Agency (EPA) Method 8260C
- Target Compound List (TCL) Semi Volatile Organic Compounds (SVOCs) plus tentatively identified compounds (TICs) via EPA Method 8270D
- TAL Metals via EPA Method 6010 and 7471
- PCBs/pesticides/herbicides via EPA Method 8081/8082/8151
- Hexavalent Chromium by EPA Method 3060A
- PFAS via EPA Method 537.1 Modified
- TPH-DRO EPA Method 8015
- TCLP Metals SW-846 Method 8015D

The laboratory analytical data package will be NYSDEC ASP Category B data deliverables. A Data Usability Summary Report will be prepared and included in the Site Characterization Report. All data will be provided in the Department's Electronic Data Deliverable (EDD) EQuIS format.

Groundwater Sampling and Analysis

Groundwater samples will be placed directly into the laboratory supplied pre-cleaned glass containers. The groundwater sample containers will be labeled with the information described in Section 6.1.3 immediately following placement of the sample into the appropriate containers. Sample preservation methods will be performed and the samples will be placed in a cooler to be maintained at a temperature of approximately 4°C until delivery to the laboratory under chain of custody protocol, Samples from the new monitoring wells will be analyzed for the full list for TOGS GA and PFAS. Samples from MW-2 will also be analyzed for TOGS GA and PFAS. Samples from the remaining existing monitoring wells will be analyzed for Volatile Organic Compounds. The groundwater samples will also be tracked from the time of collection through delivery at the laboratory by means of completing and maintaining a Chain-of-Custody form with the samples.

Soil Vapor Handling and Analysis

Each soil vapor point will be purged at a rate of less than 0.2 liters per minutes (L/min) to evacuate a minimum of three tubing volumes prior to sample collection. Soil vapor samples will be collected into ELAP laboratory-supplied, batch-certified Summa® canisters, certified as "level A" decontaminated containers, calibrated for a sampling rate of a minimum of 2 hours of sampling. The sample chamber will be sealed above the sample point with hydrated Bentonite grout. Soil vapor samples will be submitted for analysis via EPA Method TO-15 for volatile organic compounds.

4.7.2 QA / QC Samples

QA/QC samples will be prepared by the laboratory and collected in the field as part of the sampling requirements and data validation program. Various types of QA/QC samples will be prepared or collected including: trip blanks, field blanks, tool blanks and if necessary, duplicate aqueous samples. The QA/QC samples are discussed in more detail below.

Trip Blank

The primary purpose of a trip blank is to detect additional sources of contamination that may potentially influence compound detection and concentration values reported in actual samples both quantitatively and qualitatively. Trip blanks serve as a mechanism of control on sample bottle preparation and blank water quality, as well as sample handling. The trip blank travels to the Site with the empty sample containers and back from the Site with the collected samples in an effort to simulate sample handling controls. Contaminated trip blanks may indicate inadequate bottle cleaning or that the water used to prepare the blank was of questionable quality. The following have been identified as potential sources of contamination for trip blanks:

A trip blank consists of a set of sample containers filled at the laboratory with laboratory demonstrated analyte-free water. Trip blanks should be handled, transported, and analyzed in the same manner as the samples acquired that day, except that the sample containers themselves are not opened in the field.

Field Blank

A field blank is a sample that is prepared in the field to evaluate the potential for contamination of a sample by site contaminants from a source not associated with the sample collected (for example air-borne dust or organic vapor which could contaminate a soil sample). Laboratory supplied organic-free water is taken to the field in sealed containers at pre-designated locations at the site. Field blanks should be collected in dusty environments and/or from areas where volatile organic contamination is present in the atmosphere and originating from a source other than the source being sampled.

Equipment Blank

Equipment rinsate blanks are collected when sampling equipment is field cleaned between samples. After the piece of sampling equipment has been field cleaned and prior to its being used for sample operations, it will be rinsed with laboratory supplied organic-free water. The rinse water will be collected and submitted for analysis of all constituents for which normal samples collected with that piece of equipment are being analyzed.

If water or soil samples are being retained for PFAS analysis, specific QA/QC samples must be retained. These QA/QC samples are specific to the laboratory' PFAS analytical method due to very low reporting limits (1ng/L). When Equipment Blanks and Field Blanks are being collected for PFAS QA/QC, instead of organic free water, the laboratory will be supplying the samplers with PFAS free water in HDPE containers. Coordination with the lab is critical.

4.7.3 Data Validation

All samples will be submitted to the laboratory for Category B deliverables. Laboratory analytical data generated through the implementation of this investigation will be submitted for independent analysis in accordance with NYSDEC guidance for completion of a Data Usability Summary Report (DUSR) presented in Appendix 2B of DER-10, "Guidance for the Development of Data Usability Summary Reports." The DUSR will contain copies of results forms with any changes made to the results by the data validator/DUSR preparer. Environmental data will be reported electronically using the database software application EQuIS as part of NYSDEC's Environmental Information Management System (EIMS). We will be submitting our laboratory data Lab Data Consultants, Inc. of Carlsbad, California.

The full Quality Assurance Project Plan is attached.

5 Quality Assurance Project Plan

This Site Characterization Work Plan will cover work on 2586 Coney Island Avenue, Brooklyn, New York. This work is done under the Order on Consent CO-2-20190604 which requires a Site Characterization per DER-10. Previous investigative work demonstrated that risk to the environment and local populations warranted additional investigative work.

The work of the SCWP will involve additional soil borings, groundwater wells and soil vapor sampling. The goals are:

- to produce enough soil analytical data to localize contaminants of concern hot spots for effective remediation
- install upgradient and downgradient monitoring wells to determine the source of MTBE contamination of groundwater and
- plan a soil vapor investigation to determine if there is a risk to the onsite commercial building and adjacent residential properties.

Project Organization

Richard Galli, PE – president of Galli Engineering, PC
Frank Gehrling, PG – Project Manager and technical lead
Dave Cornell – Environmental Engineer
Nicol Goloff – Scientist

Performance of the work will be guided by the attached Quality Assurance Project Plan (QAPP).

Figures

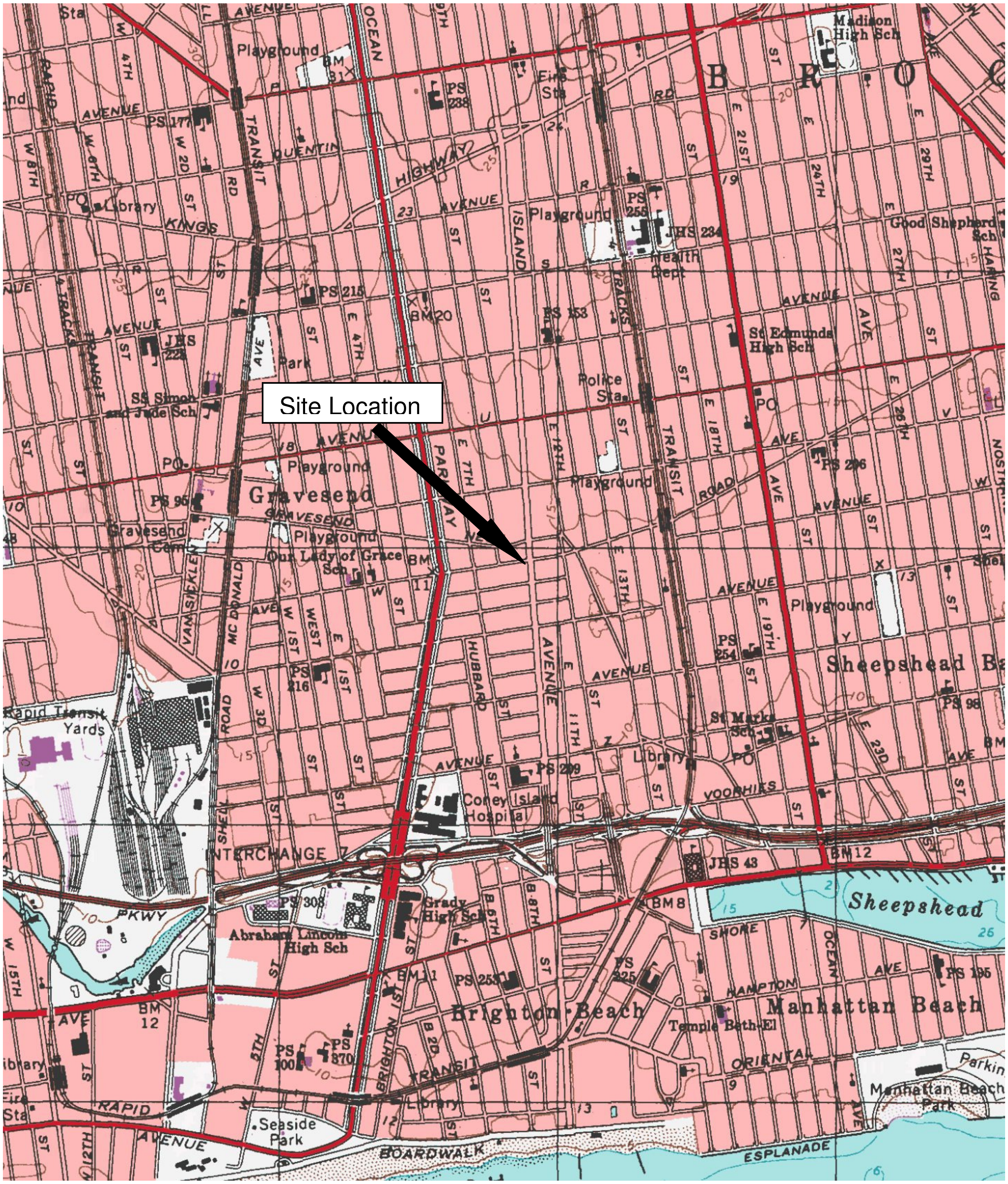
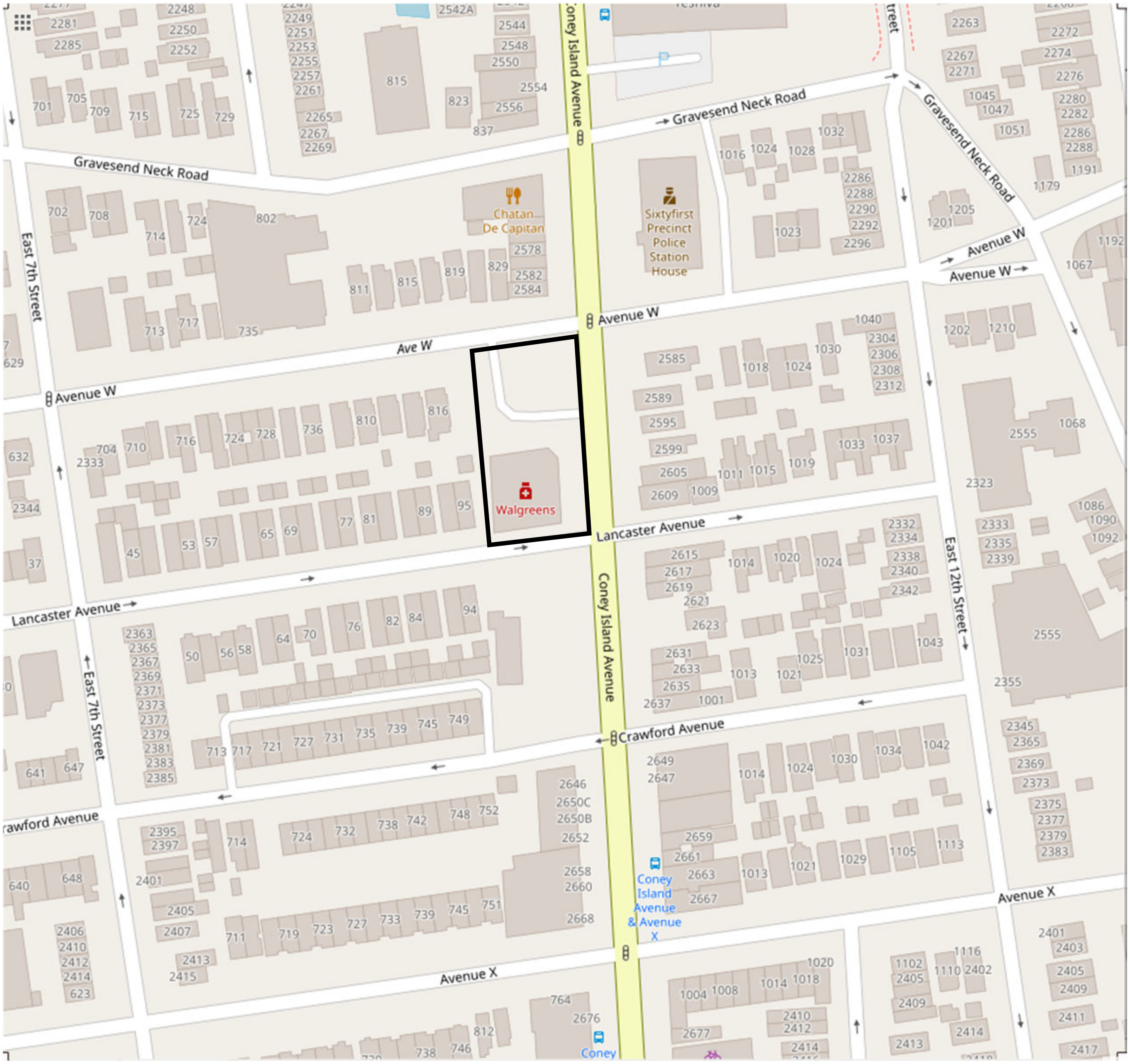


Figure 1 - Site Location Map

Avenue W and Coney Island Avenue
Brooklyn, New York



Former Franklyn Auto Garage / Walgreens

2586 Coney Island Avenue, Brooklyn, NY 11223

Figure 2 Site Location

Galli Engineering, PC
35 Pinelawn Road Suite 209E
Melville, NY 11747
2590 Coney Island Avenue

SCHEDULE A - LEGAL DESCRIPTION

ALL that certain plot, piece or parcel of land, situate, lying and being in the Borough of Brooklyn, County of Kings, City and State of New York, bounded and described as follows:

BEGINNING at a point formed by the intersection of the southerly line of Avenue W with the westerly line of Coney Island Avenue, said point being the northeasterly corner of the herein described parcel, from said point of beginning;

RUNNING THENCE along the westerly line of said Coney Island Avenue, south 03 degrees 00 minutes 00 seconds east, a distance of 200.73 feet to a point formed by the intersection of the northerly line of Lancaster Avenue with the westerly line of said Coney Island Avenue;

THENCE along the northerly line of Lancaster Avenue, south 82 degrees 06 minutes 57 seconds west, a distance of 100.36 feet to a point at the southeasterly corner of Lot 36, Block 7184 (N/F reputed owner Dmitry Bekker, Reel 4850 Page 1428);

THENCE along the easterly line of said Lot 36, Block 7184 and along the easterly line of Lot 22, Block 7184 (N/F reputed owner Silya Levy, Reel 2929 Page 1050), north 03 degrees 00 minutes 00 seconds west, a distance of 200.73 feet to a point on the southerly line of Avenue W;

THENCE along the southerly line of Avenue W, north 83 degrees 06 minutes 57 seconds east, a distance of 100.36 feet to the point and place of BEGINNING.

SURVEYOR'S CERTIFICATE

Certified to Signature Bank

I, the undersigned being a duly licensed and qualified surveyor in and for the State of New York, do hereby certify to the aforesaid parties, their successors and assigns, that I made a survey of the above described land and improvements on the 31st day of July, 2009 and this survey fully and correctly represents the property owned by Walgreens Eastern Co., Inc., a New York corporation, known as Block 7184, Lot 26 including all buildings, structures and improvements thereon.

There are no known easements and right-of-ways of record either furnished to me by the title insurance company or examining attorney, (with reference to recording data) or of which I have knowledge or have been advised, whether or not of record, affecting the property and, unless otherwise shown, or physical evidence and recorded description of such easements. All of said buildings, structures and improvements, including location and dimensions are correctly depicted and are fully completed, except as shown hereon.

I further certify there are no (i) easements, (ii) rights-of-way across said property, (iii) encroachments on adjoining properties or streets by any of said buildings, structures or improvements situated on adjoining property, except as shown hereon: there are no streams, rivers, springs, ponds, lakes, ditches or drains located or bordering on or running through the subject premises, except as shown: there or no gaps, gores or overlaps between parcels or roads, highways, streets or alleys and all parcels which compromise the whole subject premises are contiguous.

None of the above described land (except as noted hereon), lies within flood hazard areas in accordance with any maps published by either the Federal Emergency Management Agency, or the U.S Department of Housing and Urban Development.

All public roads, highways, streets and alleys running adjacent to or upon the subject premises are shown; all physical evidence of boundary lines and lines of possession or occupancy have been shown and proper notation made where in conflict with the legal description; there are no boundary line discrepancies and no deficiencies in the quantity of the land described in the legal description furnished by the title insurance company or examining attorney and is true and correct. Also, this certifies that the property contains 0.46 acres.

I further certify that this survey complies with the Minimum Standard Detail Requirements for ALTA/ACSM Land Title Surveys as adoptede by the American Land Title Association and American Congress of Surveying and Mapping and contains items 1, 3, 4, 6, 7a, 7b1, 7b2, 8, 9, 10, 11, 11a, 11b of Table A thereof.

The parties listed above are entitled to rely on the survey and this certificate is being true and accurate.

Name of Surveyor ______________________________
Joseph M. Petito, LS

License No. 050335
Dated: September 23, 2009

SCHEDULE B - EXCEPTIONS FROM COVERAGE & STATEMENT OF ENCROACHMENTS

This policy does not insure against loss or damage (and the Company will not pay costs, attorneys fees or expenses) which arise by reason of the following:

1. a. The following items encroach upon or project over Lancaster Avenue, the extents of which are not shown:

1)	Siamese connections	Not located
2)	Metal grates	Not located
3)	Metal cover	Not located
4)	Air conditioner unit	Not located

b. Overhead wires along a portion of the westerly line of record. Policy will except the possible rights of the utility companies and other by reason thereof.

c. Encroachments upon subject premises if any by 1 story frame garage, concrete ramp and paver patio situate of premises adjoining subject premises to the west.

d. Variations between location of masonary wall and portions of the northerly and westerly lines of record.

e. The following items encroach upon or project over Avenue W the extents of which are not shown:

1)	Roll down security gate	Not located
2)	Gas vent	Not located
3)	Signs	Not located

f. The following items encroach upon or project over Coney Island Avenue the extents of which are not shown:

1)	Roll down security gate	Not located
2)	Gas vent	Not located
3)	Signs	Not located

As shown on a survey by Control Point Associates, Inc., dated 4/10/2007.

Subject to changes since said date.

2. Terms, Covenants, Conditions, Agreements and Rights of First Offer of Lease made between 2586-2608 Coney Island Avenue, LLC and W 10 Coney Island, LLC, a Memorandum of which was dated 5/16/2007 and recorded 7/12/2007 under CRFN 2007000357269.

With respect thereto:

a. Leasehold Mortgage and Security Agreement made by W 10 Coney Island, LLC -to- Regions Bank, in the amount of $2,428,684.47, dated as of 11/30/2007 and recorded on 12/6/2007 under CRFN 2007000601468.

Receipt for Additional Funds and Mortgage Modification Agreement made between W 10 Coney Island LLC, -and- Rregions Bank, dated as of 5/4/2009 and recorded on 5/12/2009 under CRFN 2009000140773. Modifies Mortgage by providing an additional $505,000.00 for a New Principal amount of $2,933,684.47.

b. Leasehold Mortgage and Security Agreement made by W 10 Coney Island, LLC -to- Regions Bank, in the a mount of $866,315.53, dated as of 11/30/2007 and recorded on 12/6/2007 under CRFN 2007000601470.

With respect thereto:

i. Assignment of Leases, Rents and Profits dated 11/30/2007 from W 10 Coney Island LLC -to- Regions Bank, recorded 12/6/2007 under CRFN 2007000601471.

ii. UCC Financing Statement No. 2007000600981
Secured Party: Regions Bank
Debtor: W 10 Coney Island, LLC
Filing Date: 12/6/2007
Covers: All leases, etc., Block 7184 Lot 26.

iii. UCC Financing Statement No. 2007000600982
Secured Party: Regions Bank
Debtor: W 10 Coney Island, LLC
Filing Date: 12/6/2007
Covers: Fixtures, etc., Block 7184 Lot 26.

3. Terms, Covenants, Conditions, Agreements and Rights of First Offer of Lease made between W 10 Coney Island LLC and Walgreen Eastern Col., Inc., a Memorandum of which was dated 5/16/2007 and recorded 7/12/2007 under CRFN 2007000357271.

4. THE FOLLOWING AFFECT THE FEE ESTATE:

a. Mortgage made by 2586-2608 Coney Island Avenue, LLC -to-Morgan Stanely Mortgage Capital Holdings LLC, in the amount of $5,640,000.00, dated 6/27/2007 recorded under CRFN 2007000357267.

Assignment of Mortgage made by Morgan Stanley Mortgage Capital Holdings LLC, successor-in-interest by merger to Morgan S tanley Mortgage Capital Inc., -to-LaSalle Bank National Association, as trustee for the Holders of Morgan Stanley Capital I Inc., Commercial Mortgage Pass-Through Certificates, Series 2007-IQ16, dated as of 11/29/2007 and recorded on 4/28/2008 under CRFN 2008000168949.

With respect thereto:

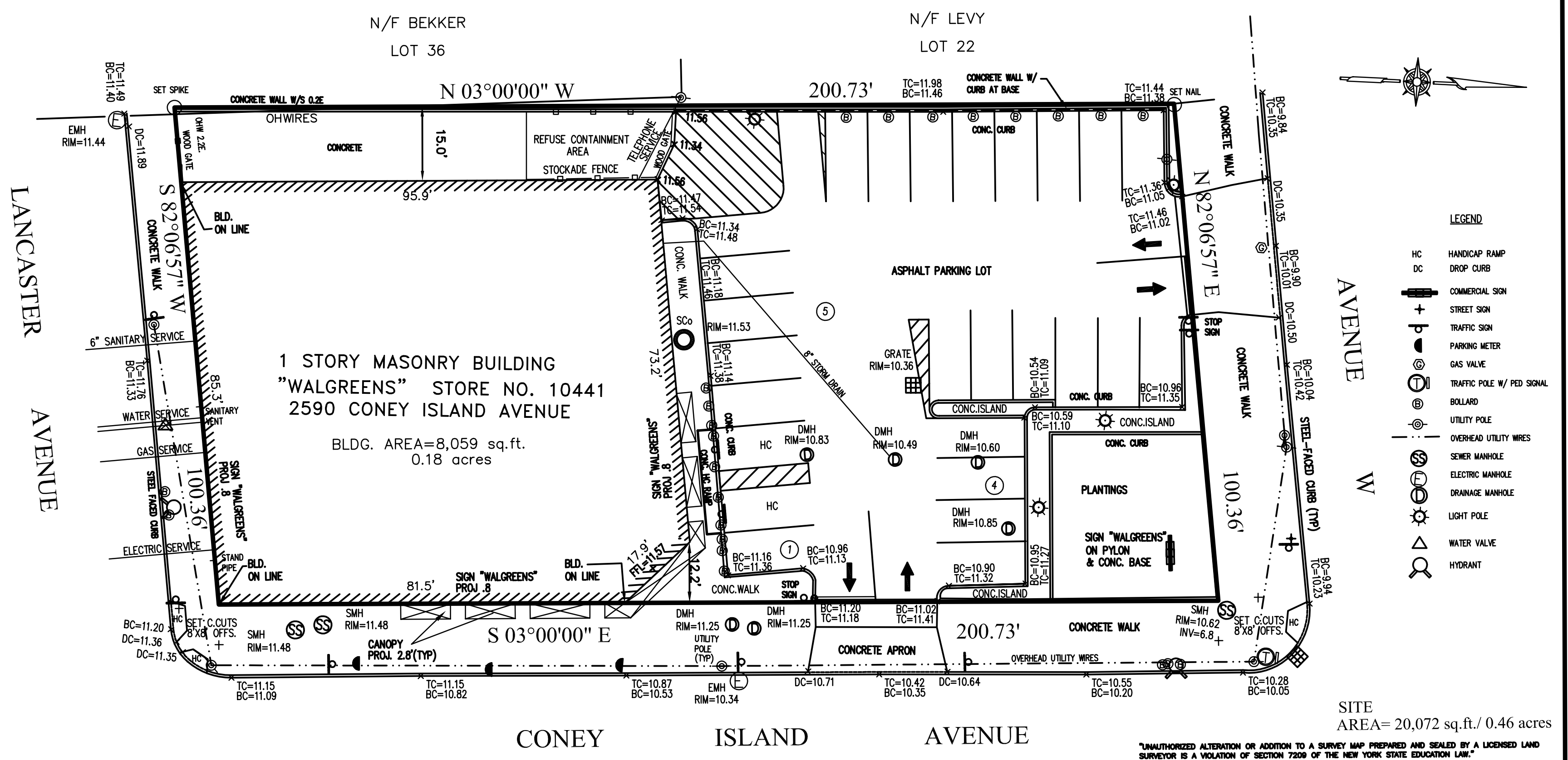
i. Assignment of Leases and Rents made by 2586-2608 Coney Island Avenue LLC to Morgan Stanley Mortgage Capital Holdings LLC, dated 7/5/207 ad recorded 7/12/2007 under CRFN 2007000357268.

With regard thereto:

1) Assignment of Assignment of Leases and Rents dated as of 11/29/2007 from Morgan Stanley Mortgage Capital Holdings LLC successor-in-interest by merger to Morgan Stanley Mortgage Capital Inc. -to- LaSalle Bank National Association, as Trustee for The Holders of Morgan Stanley Capital I Inc. Commercial Mortgage Pass Through Certificate, Series 2007-IQ16, recorded on 4/28/2008 under CRFN 2008000168950.

ii. UCC Financing Statement filed under CRFN 2007000348903
Secured Party: Morgan Stanley Mortgage Capital Holdings LLC
Debtor: 2586-2608 Coney Island Avenue LLC
Filing Date: 7/9/2007
Covers: Fixtures, etc.

Assignment filed on 4/28/2008 under CRFN 2008000168951 to Lasalle Bank National Association, as Trustee for the Holders of Morgan Stanley Capital I Inc., Commercial Mortgage Pass-Through Certificates, Series 2007-IQ16.



"UNAUTHORIZED ALTERATION OR ADDITION TO A SURVEY MAP PREPARED AND SEALED BY A LICENSED LAND SURVEYOR IS A VIOLATION OF SECTION 7209 OF THE NEW YORK STATE EDUCATION LAW."

"COPIES FROM THE ORIGINAL OF THIS SURVEY MAP NOT MARKED WITH AN ORIGINAL OF THE LAND SURVEYOR'S INKED SEAL OR HIS EMBOSSED SEAL SHALL NOT BE CONSIDERED A VALID TRUE COPY." "CERTIFICATION INDICATED HEREON SIGNIFY THAT THIS SURVEY WAS PREPARED IN ACCORDANCE WITH THE EXISTING CODE OF PRACTICE FOR LAND SURVEYS ADOPTED BY THE NEW YORK STATE ASSOCIATION OF PROFESSIONAL LAND SURVEYORS. SAID CERTIFICATIONS SHALL RUN ONLY TO THE PERSON FOR WHOM THE SURVEY IS PREPARED, AND ON HIS BEHALF TO THE TITLE COMPANY, GOVERNMENTAL AGENCY AND LENDING INSTITUTION. CERTIFICATIONS ARE NOT TRANSFERABLE TO ADDITIONAL INSTITUTIONS OR SUBSEQUENT OWNERS."

NOTES:

1. THE SUBJECT PARCEL IS DESIGNATED ON THE BROOKLYN/KINGS COUNTY TAX MAP AS BLOCK 7184, LOT 26.
2. VERTICAL DATUM SHOWN HEREON REFER TO BROOKLYN, KINGS COUNTY ELEVATIONS, WHICH IS 2.55 FEET ABOVE N.G.V.P. 1929.
3. ZONED C 8-1 OP RE: ZONING MAP NO. 28 C
4. FLOOD ZONE DESIGNATION "X" AS PER FEDERAL FLOOD INSURANCE RATE MAP.
   MAP NO. 3604970354F DATED: REV: SEPT. 5, 2007
   SEE PANEL NO. 354 OF 457
5. THIS IS TO CERTIFY THERE ARE NO STREAMS OR NATURAL WATER COURSES IN THE PROPERTY AS SHOWN ON THIS SURVEY.
6. THE USER OF THIS MAP IS CAUTIONED THAT THE UNDERGROUND UTILITY LOCATIONS ARE NOT GUARANTEED NOR IS THERE ANY GUARANTEE THAT ALL EXISTING UTILITIES, WHETHER EXISTING OR ABANDONED, WITHIN THE PROJECT AREA ARE AS SHOWN ON THIS MAP. THE UTILITIES SHOWN HEREON WERE OBTAINED FROM RECORD INFORMATION AND/OR ACTUAL FIELD MEASUREMENTS.
7. PROPERTY AND UTILITY INFORMATION SHOWN HEREON WERE OBTAINED FROM RECORD INFORMATION AND ACTUAL FIELD MEASUREMENTS BY O'CONNOR-PETITO, LLP IN JULY 2009.
8. EXISTING PARKING SPACES = 25
   EXISTING HANDICAP PARKING SPACES = 2
   REQUIRED PARKING SPACES = 25
   REQUIRED HANDICAP PARKING SPACES = 2

CERTIFIED TO:

W 10 CONEY ISLAND, LLC, A FLORIDA LIMITED LIABILITY COMPANY
WALGREENS EASTERN CO., INC., A NEW YORK CORPORATION
REGIONS BANK
STUMP, DIETRICH, SPEARS & NORMAN, P.A.
COMMONWEALTH LAND TITLE INSURANCE COMPANY
TITLE NO. NY090614

ALTA/ASCM LAND TITLE SURVEY
WALGREENS
STORE NO. 10441
SITUATED IN
KINGS COUNTY
BOROUGH OF BROOKLYN STATE OF NEW YORK

O'Connor - Petito, L.L.P.
Land Surveying
Civil Engineering
27 Forest Avenue
Locust Valley, NY 11560
(516) 676-3260

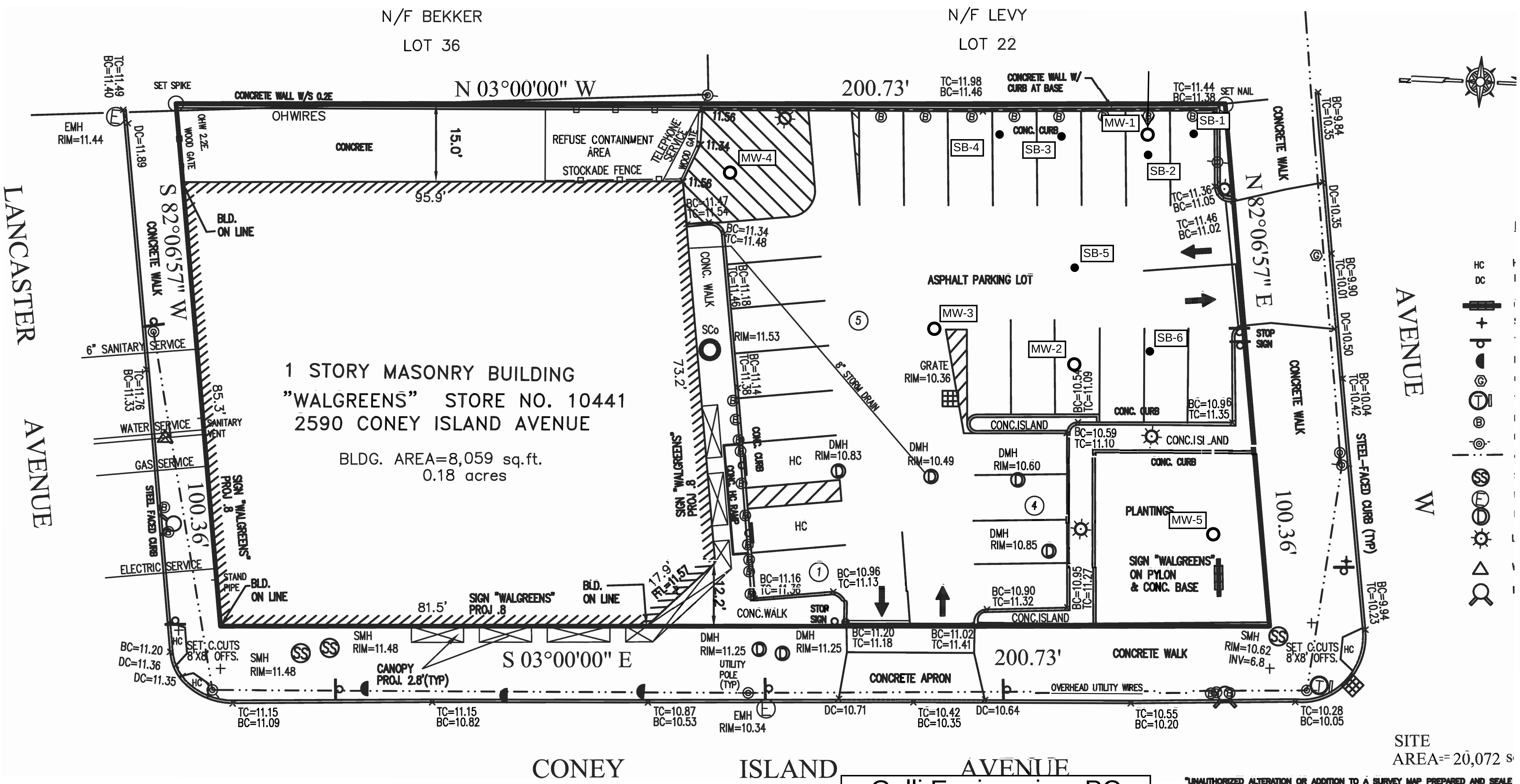
MAP DESCRIPTIVE PROPERTY
SEC. -
BLK. 7184
LOT 26
DATE: JULY 31, 2009
REVISED:
DATE: SEPT.22, 2009
SCALE: 1"=20'
SHEET: 1 OF 1

Name of Surveyor ____________________
Joseph M. Petito, LS

License No. 050335
Dated: September 23, 2009

Debtor: 2586-2608 Coney Island Avenue LLC
Filing Date: 7/9/2007
Covers: Fixtures, etc.

Assignment filed on 4/28/2008 under CRFN 2008000168951 to Lasalle Bank National Association, as Trustee for the Holders of Morgan Stanley Capital I Inc., Commercial Mortgag
Certificates, Series 2007-IQ16.



OTES:

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MAP NO. 3604970354F DATED: REV: SEPT. 5, 2007
SEE PANEL NO. 354 OF 457

Galli Engineering, PC
35 Pinelawn Road Suite 209E
Melville, NY 11747
2590 Coney Island Avenue
figure 4
Base Map

"UNAUTHORIZED ALTERATION OR ADDITION TO A SURVEY MAP PREPARED AND SEALE
SURVEYOR IS A VIOLATION OF SECTION 7209 OF THE NEW YORK STATE EDUCATION

"COPIES FROM THE ORIGINAL OF THIS SURVEY MAP NOT MARKED WITH AN ORIGINAL
INKED SEAL OR HIS EMBOSSED SEAL SHALL NOT BE CONSIDERED A VALID TRUE C
INDICATED HEREON SIGNIFY THAT THIS SURVEY WAS PREPARED IN ACCORDANCE WIT
PRACTICE FOR LAND SURVEYS ADOPTED BY THE NEW YORK STATE ASSOCIATION OF
SURVEYORS. SAID CERTIFICATIONS SHALL RUN ONLY TO THE PERSON FOR WHOM
AND ON HIS BEHALF TO THE TITLE COMPANY, GOVERNMENTAL AGENCY AND LENDIN
CERTIFICATIONS ARE NOT TRANSFERABLE TO ADDITIONAL INSTITUTIONS OR SUBSEQU

SCM LAND TITLE SURVEY
WALGREENS

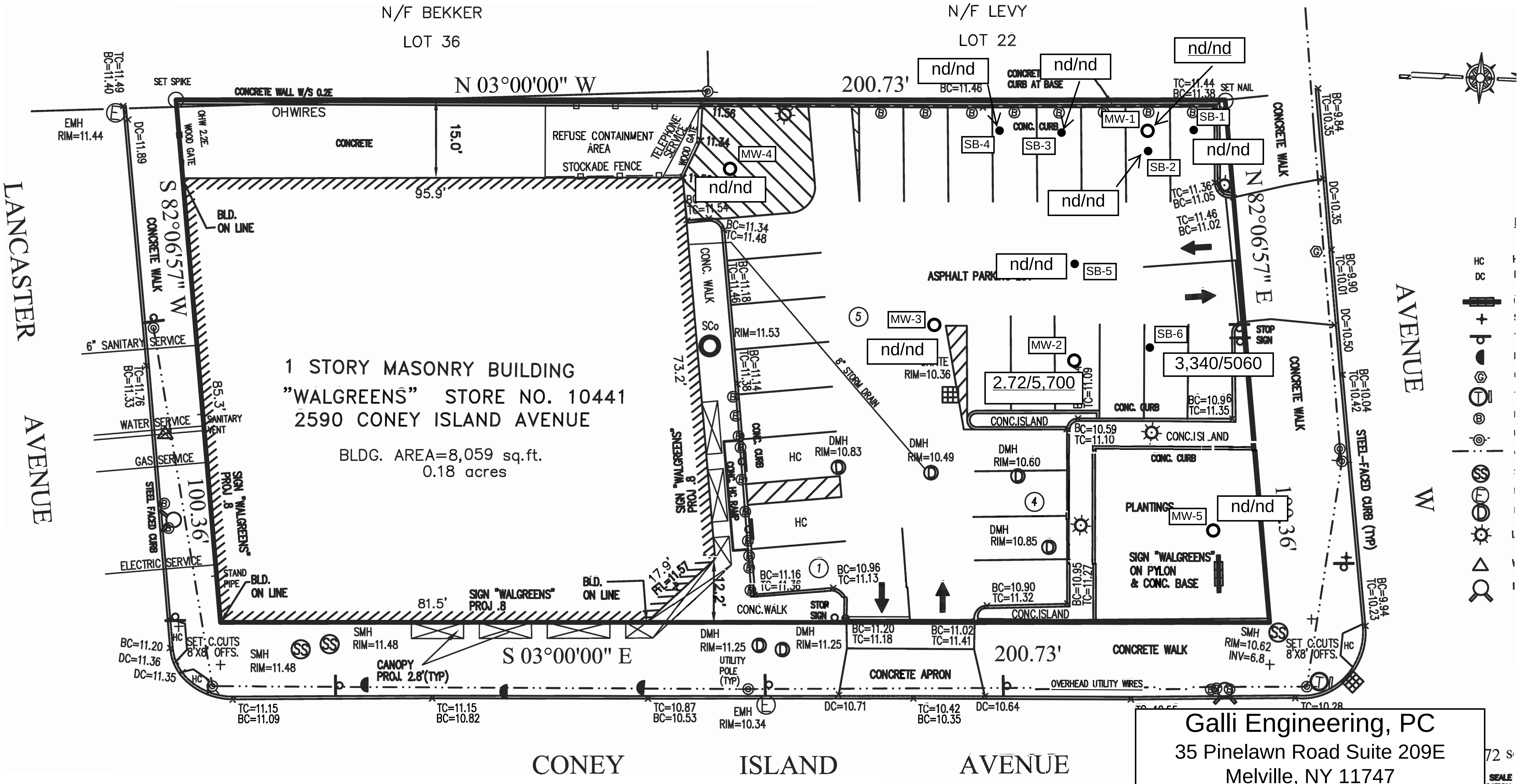
Debtor: 2586-2608 Coney Island Avenue LLC
Filing Date: 7/9/2007
Covers: Fixtures, etc.

Assignment filed on 4/28/2008 under CRFN 2008000168951 to Lasalle Bank National Association, as Trustee for the Holders of Morgan Stanley Capital I Inc., Commercial Mortgag
Certificates, Series 2007-IQ16.

Name of Surveyor Joseph M. Petito, LS

License No. 050335
Dated: September 23, 2009

PCE in Soil Samples
Figure 5



nd/nd = upper and lower soil samples ug/kg

nd/nd = upper and lower soil samples ug/kg
Sample results for soil in MW-1, MW-2 & MW-3 are from the initial installation of these Monitoring Wells in 2009

OTES:

. THE SUBJECT PARCEL IS DESIGNATED ON THE BROOKLYN/KINGS COUNTY TAX MAP AS BLOCK 7184, LOT 26.
. VERTICAL DATUM SHOWN HEREON REFER TO BROOKLYN, KINGS COUNTY ELEVATIONS, WHICH IS 2.55 FEET ABOVE N.G.V.P. 1
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MAP NO. 3604970354F DATED: REV: SEPT. 5, 2007
SEE PANEL NO. 354 OF 457

ALTA

Galli Engineering, PC
35 Pinelawn Road Suite 209E
Melville, NY 11747
2590 Coney Island Avenue

Boring and Well Locations
Tetrachloroethene (PCE) Soil and
Groundwater Results

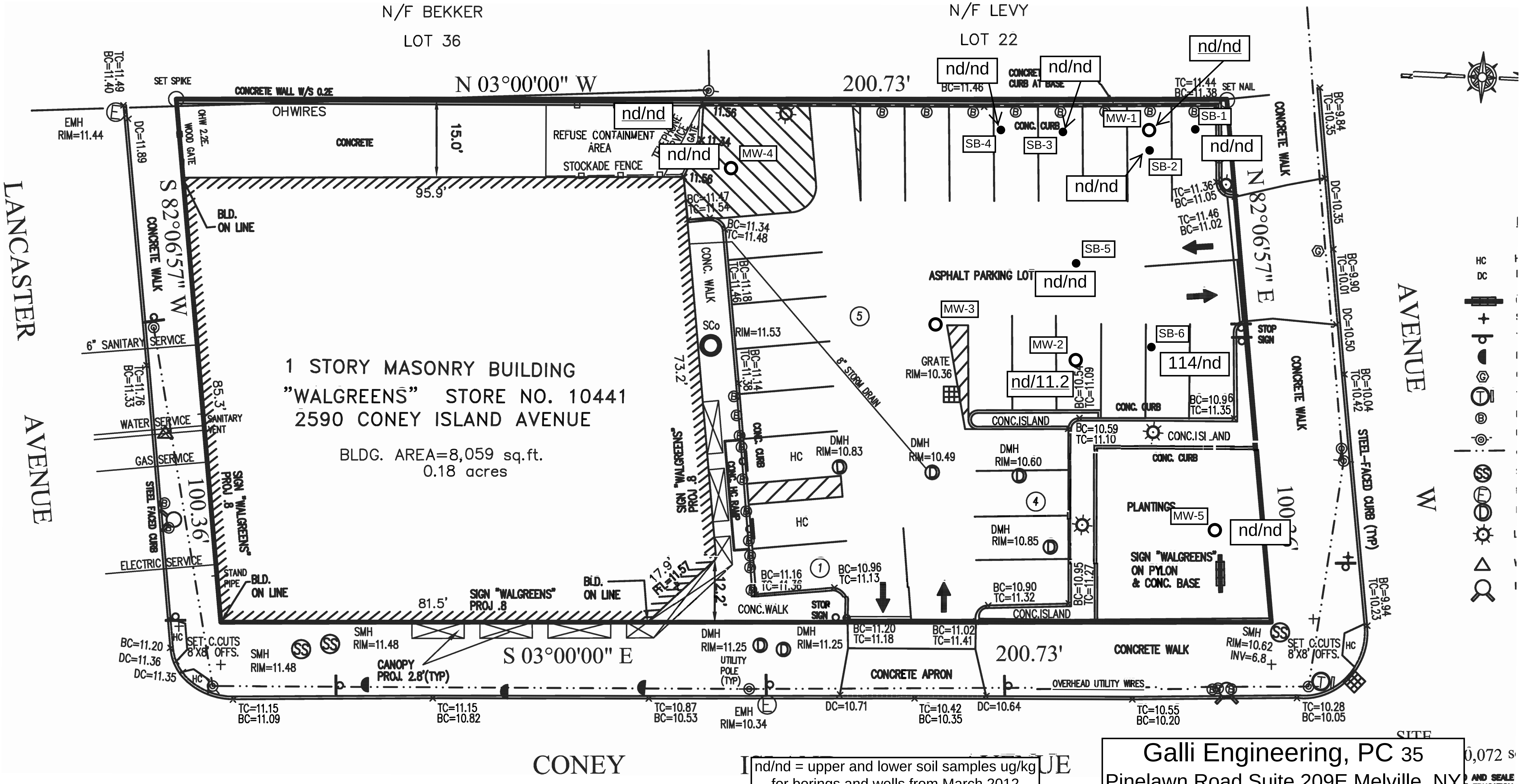
Debtor: 2586-2608 Coney Island Avenue LLC
Filing Date: 7/9/2007
Covers: Fixtures, etc.

Assignment filed on 4/28/2008 under CRFN 2008000168951 to Lasalle Bank National Association, as Trustee for the Holders of Morgan Stanley Capital I Inc., Commercial Mortgag
Certificates, Series 2007-IQ16.

Name of Surveyor ____________________
Joseph M. Petito, LS

License No. 050335
Dated: September 23, 2009

TCE in Soil Samples
figure 6



nd/nd = upper and lower soil samples ug/kg for borings and wells from March 2012

nd/nd = upper and lower soil samples ug/kg. Sample results for soil in MW-1, MW-2 & MW-3 are from the initial installation of these Monitoring Wells in 2009

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Pinelawn Road Suite 209E Melville, NY
11747 2590 Coney Island Avenue

Boring and Well Locations
Trichloroethylene Soil Results

OTES:

. THE SUBJECT PARCEL IS DESIGNATED ON THE BROOKLYN/KINGS COUNTY TAX MAP AS BLOCK 7184, LOT 26.
. VERTICAL DATUM SHOWN HEREON REFER TO BROOKLYN, KINGS COUNTY ELEVATIONS, WHICH IS 2.55 FEET ABOVE N.G.V.P. 1929.
. ZONED C 8-1 OP RE: ZONING MAP NO. 28 C
. FLOOD ZONE DESIGNATION "X" AS PER FEDERAL FLOOD INSURANCE RATE MAP.
MAP NO. 3604970354F DATED: REV: SEPT. 5, 2007
SEE PANEL NO. 354 OF 457

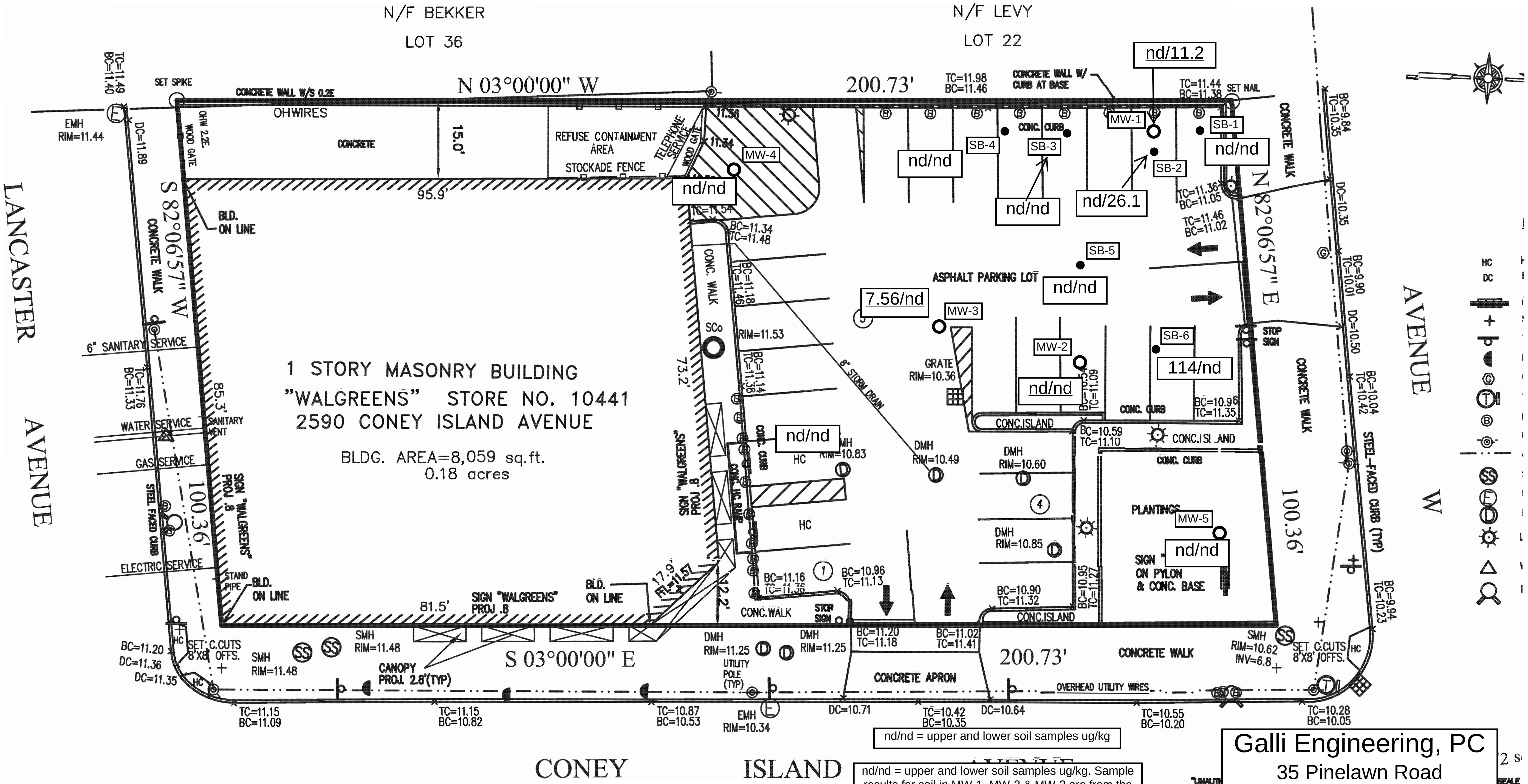
Debtor: 2586-2608 Coney Island Avenue LLC
Filing Date: 7/9/2007
Covers: Fixtures, etc.

Assignment filed on 4/28/2008 under CRFN 2008000168951 to Lasalle Bank National Association, as Trustee for the Holders of Morgan Stanley Capital I Inc., Commercial Mortgag
Certificates, Series 2007-IQ16.

Name of Surveyor ______________________
Joseph M. Petito, LS

License No. 050335
Dated: September 23, 2009

MTBE in Soil Samples
figure 7



nd/nd = upper and lower soil samples ug/kg

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SEE PANEL NO. 354 OF 457

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WALG

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Suite 209E
Melville, NY 11747

2590 Coney Island Avenue
Boring and Well Locations
MTBE Results

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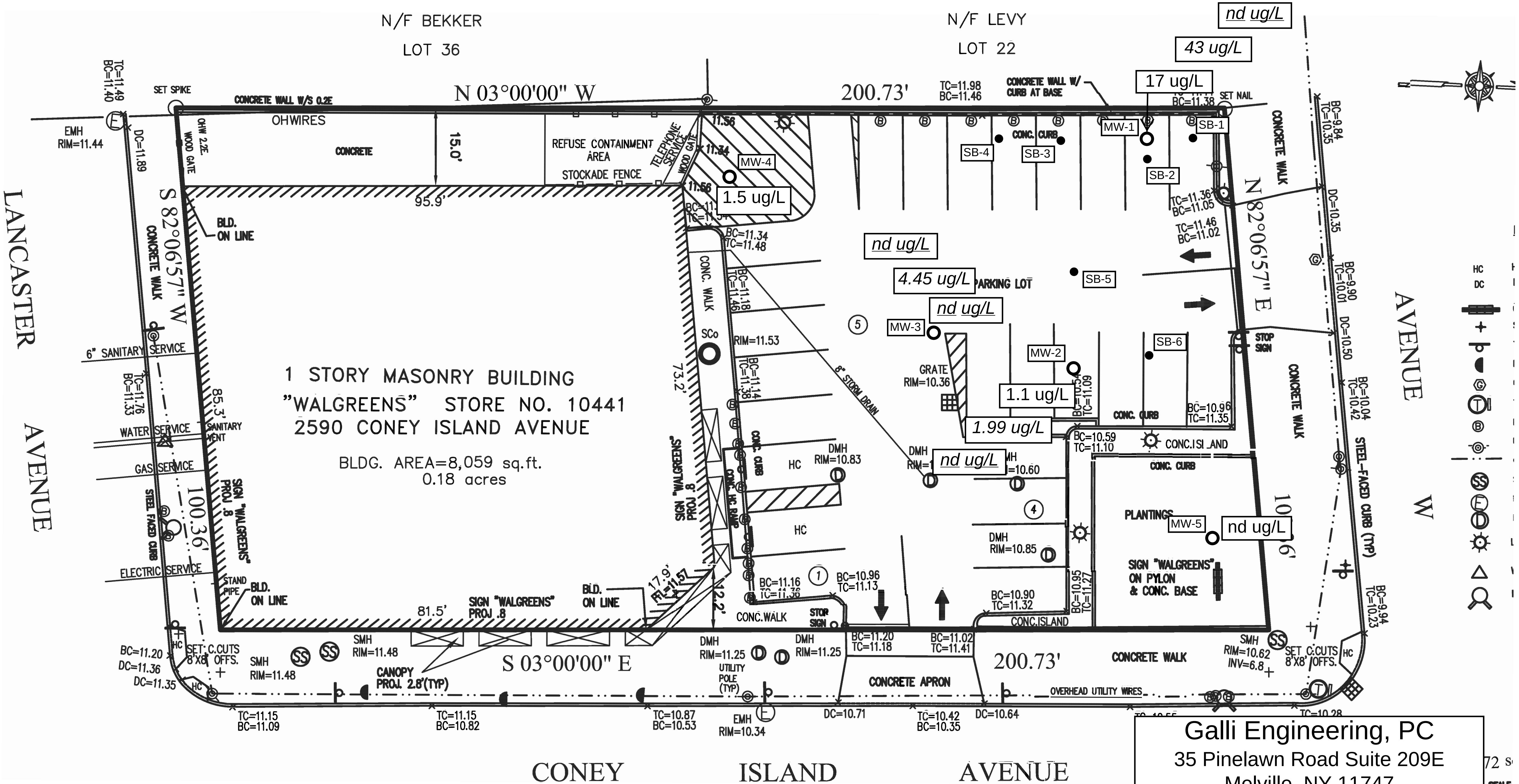
Name of Surveyor Joseph M. Petito, LS

License No. 050335
Dated: September 23, 2009

PCE in Groundwater Samples
Figure 8



17 ug/L	March 2012 Groundwater Sampling Event
43 ug/L	May 2011 Groundwater Sampling Event
nd ug/L	May 2009 Groundwater Sampling Event

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MAP NO. 3604970354F DATED: REV: SEPT. 5, 2007
SEE PANEL NO. 354 OF 457

ALTA

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Melville, NY 11747
2590 Coney Island Avenue

Boring and Well Locations
Tetrachloroethene (PCE)
Groundwater Results

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Covers: Fixtures, etc.

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Name of Surveyor ______________________
Joseph M. Petito, LS

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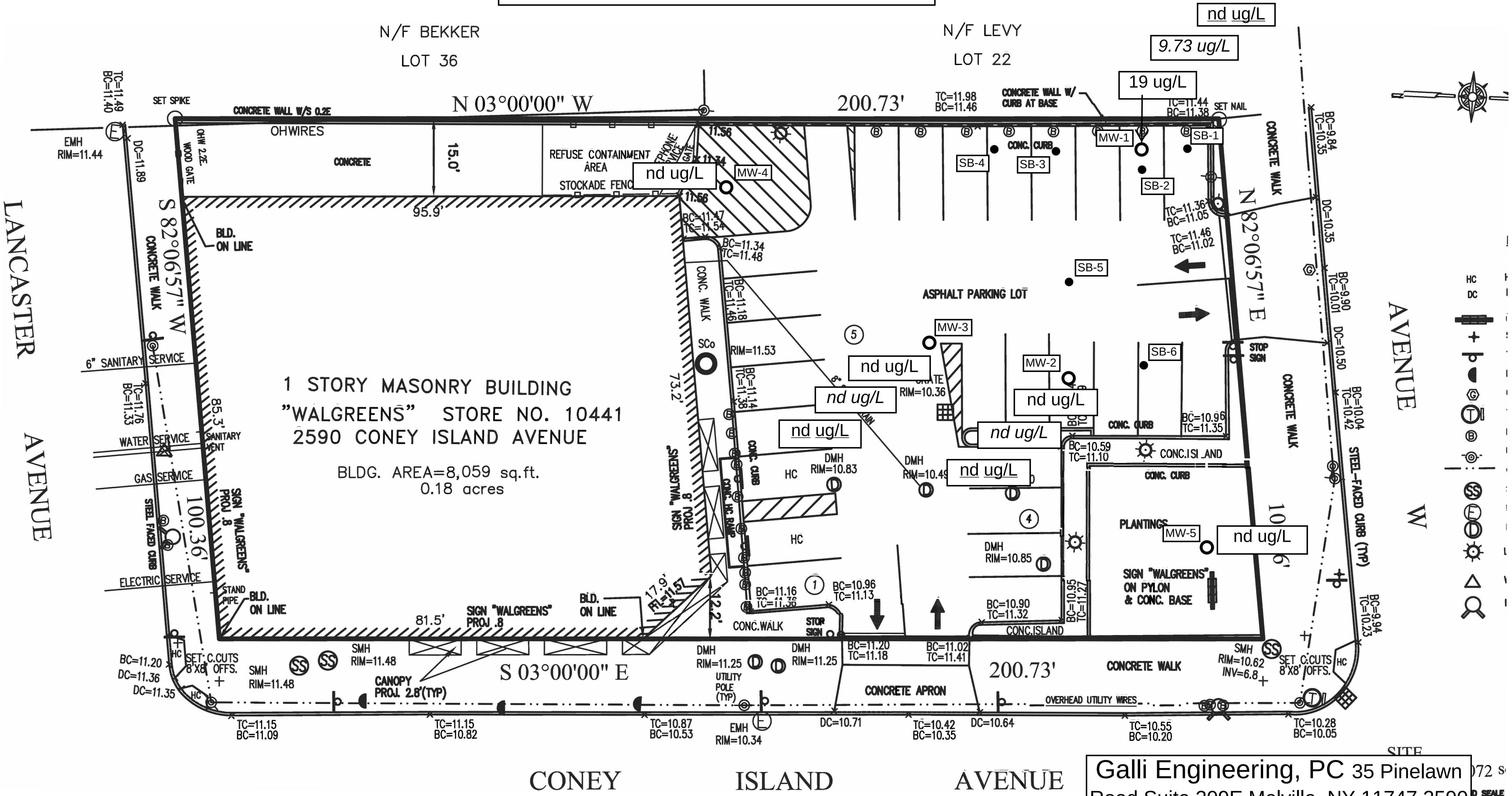
Dated: September 23, 2009

TCE in Groundwater Samples
figure 9



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MAP NO. 3604970354F DATED: REV: SEPT. 5, 2007
SEE PANEL NO. 354 OF 457

260 ug/L	March 2012 Groundwater Sampling Event
448 ug/L	May 2011 Groundwater Sampling Event
nd ug/L	May 2009 Groundwater Sampling Event

Galli Engineering, PC 35 Pinelawn Road Suite 209E Melville, NY 11747 2590 Coney Island Avenue

Boring and Well Locations
Trichloroethylene Groundwater Results
Figure ?

Debtor: 2586-2608 Coney Island Avenue LLC
Filing Date: 7/9/2007
Covers: Fixtures, etc.

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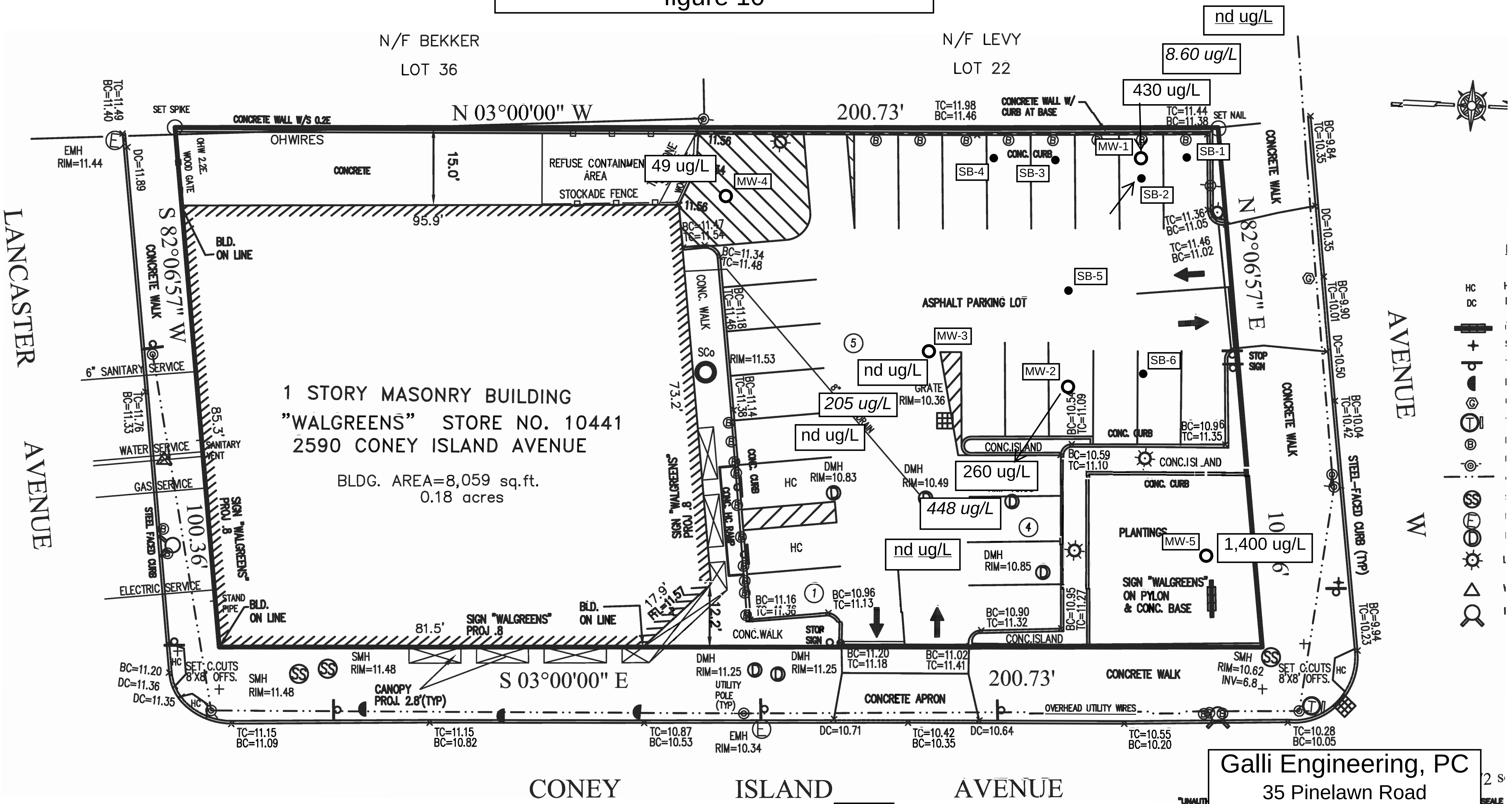
Certificates, Series 2007-IQ16.

Name of Surveyor ____________________
Joseph M. Petito, LS

License No. 050335
Dated: September 23, 2009

MTBE in Groundwater Samples
figure 10



260 ug/L	March 2012 Groundwater Sampling Event
448 ug/L	May 2011 Groundwater Sampling Event
nd ug/L	May 2009 Groundwater Sampling Event

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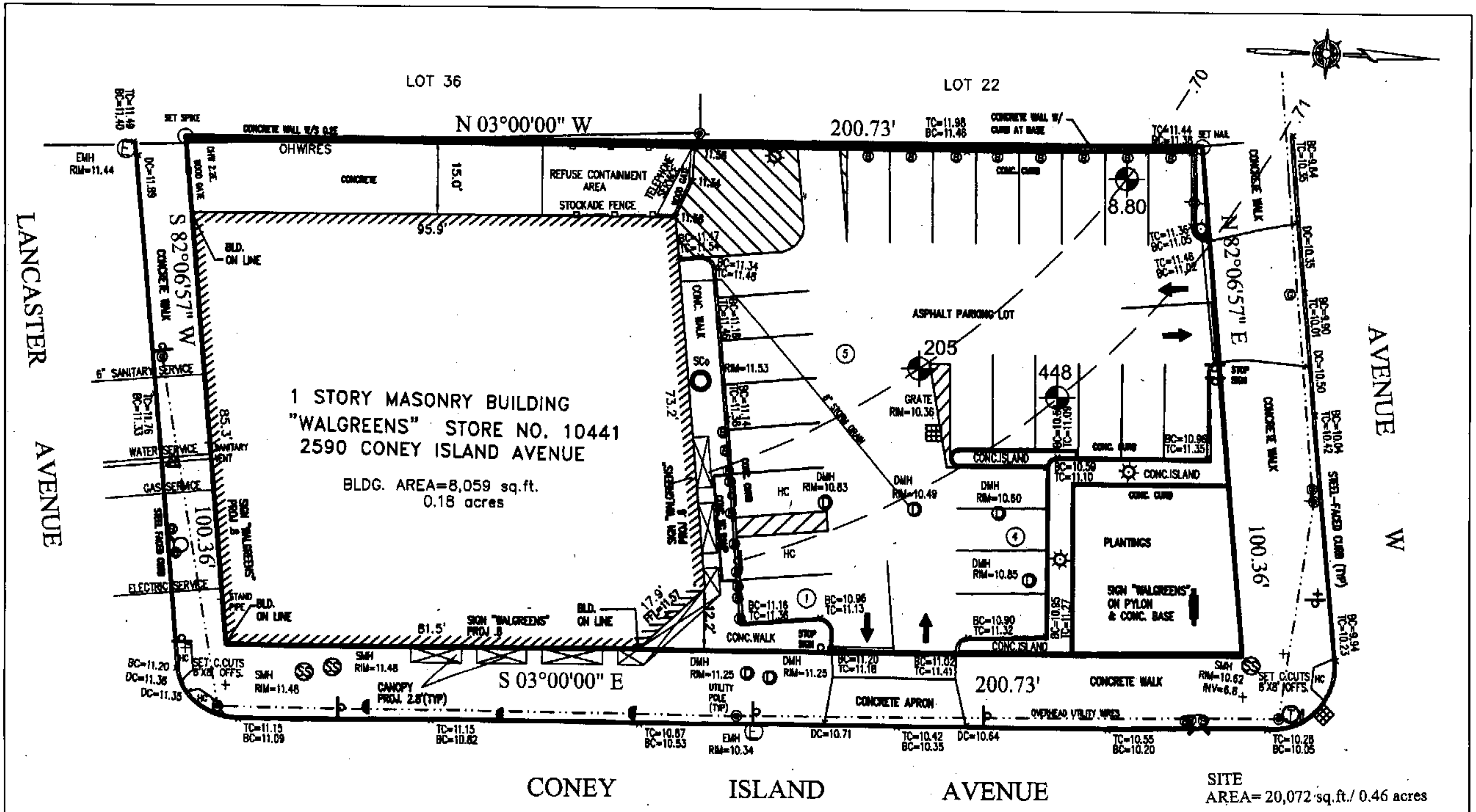
Suite 209E
Melville, NY 11747

2590 Coney Island Avenue
Boring and Well Locations
MTBE Results



LEGEND

HC HANDICAP RAMP
DC DROP CURB
COMMERCIAL SIGN
+ STREET SIGN
TRAFFIC SIGN
PARKING METER
GAS VALVE
TRAFFIC POLE W/ PED SIGNAL
BOLLARD
UTILITY POLE
OVERHEAD UTILITY WIRES
SEWER MANHOLE
ELECTRIC MANHOLE
DRAINAGE MANHOLE
LIGHT POLE
△ WATER VALVE
HYDRANT

734 Walt Whitman Road
Suite 402A
Melville, New York 11747

Galli engineering, P.C.

2590 CONEY ISLAND AVENUE SITE PLAN AND GROUNDWATER CONTOUR MAP

figure 11

Debtor: 2586-2608 Coney Island Avenue LLC
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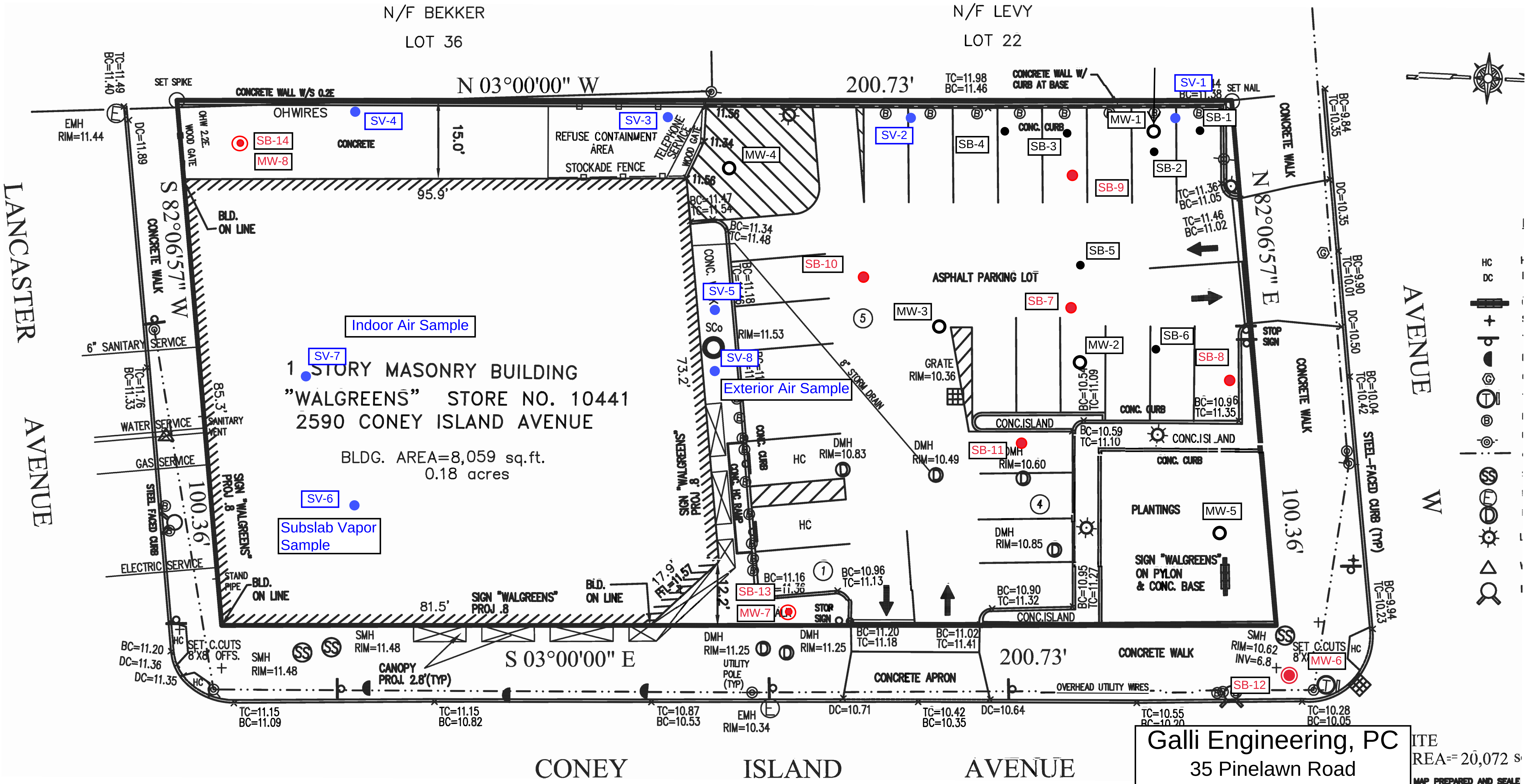
Name of Surveyor Joseph M. Petito, LS

License No. 050335
Dated: September 23, 2009

Additional Sample Locations
figure 12



- ● Exiting Soil Borings and Monitoring Wells
- 🔴 New Soil Borings and Monitoring Wells
- 🔵 New Soil Vapor Sampling Points

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SEE PANEL NO. 354 OF 457

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Galli Engineering, PC
35 Pinelawn Road
Suite 209E
Melville, NY 11747

2590 Coney Island Avenue
Additional Sample Locations
2021-04-26

Appendices

Appendix A

Digital Copies of All Historic Documents

Appendix B

Timeline of Previous Remedial Work

The following is a historical review of on-site remedial activities
2586 Coney Island Avenue, Brooklyn, NY

8/2006 – Clayton Group performed a Phase I Environmental Site Assessment (ESA) on the subject property, dated August 9, 2006. Recognized environmental conditions (RECs) were identified in the Phase I ESA as being:

- Current and Former On-site In-Ground Hydraulic Lifts
- Former Underground Storage Tanks (USTs)/Gasoline Pump
- Current Used Oil UST
- Current and Historical Use as a Automobile Repair/Service Shop/Garage

9/7/2006 - A Limited Subsurface Investigation dated September 7, 2006; was prepared by Clayton Group Services, Inc. The Limited Subsurface Investigation indicated environmental impacts from the onsite current and former in-ground hydraulic lifts and auto services operations near the northern side of the garage building. Soil impacts appear to be associated with the UST discovered near the northwestern most lift and corner of the garage building. MTBE was found at elevated concentrations near the northwest corner of the garage building.

Clayton Group Services conclusions included:

- Samples of soils were found to be above the NYSDEC Recommended Soil Cleanup Objective (RSCO) for Semi Volatile Organic Compounds in SB-1 and SB-2.
- Pesticide contaminants were found to be above the RSCO in SB-2.
- Contaminants in groundwater were detected above the NYSDEC Part 703 Groundwater Quality Standards for Methyl Tertiary Butyl Ether (MTBE) at the subject property."
- Clayton Group Services, Inc. calls in a spill to the NYSDEC Spill Hotline on July 19, 2006 at 12:01 p.m. Spill # 06-04377 is assigned to the subject property. NYSDEC requests field notes and a copy of the soil and groundwater sampling report.

11/2006 – NYSDEC closes spill # 06-04377, administratively. No reports were sent to the NYSDEC documenting the Clayton Group's Limited Subsurface Investigation.

1/2008 – Unicorp National Development, Inc. and Mr. Gene Flotteron enter into a land lease agreement to build a Walgreen's. Unicorp hires McAlpine Construction as the General Contractor. McAlpine hires B&A Demolition and Removal as a sub-contractor to demolish all structures on the subject property. The subject property contained 4 hydraulic lifts, one 200-gallon waste oil UST, one 275-gallon #2 heating oil AST and one 550-gallon gasoline UST. Additionally, three 55-gallon drums of used oil were located on the subject property.

2/2008 – Unicorp hires Galli Engineering, P.C. to remove all subsurface structures at the subject property. Galli schedules a field visit to view its scope of services. Galli meets with McAlpine Construction and is informed that all ASTs and USTs have been removed by B&A Demolition and Removal except for the 550-gallon gasoline UST and three 55-gallon drums. Galli in conjunction with Tyree Brothers and 95, Inc. performs the necessary remedial cleanup procedures for the UST and drums. Galli collects representative end point samples around and beneath the UST. Galli also collected groundwater samples to ensure the subject property is clean. Additionally, Galli dug three trenches along the northern portion of the subject property to ensure the subsurface structures identified in the Clayton Group report had actually been removed by B&A Demolition and Removal.

3/2008 – Galli Engineering, P.C. submits a remedial closure report to Unicorp National Development, Inc. revealing groundwater contamination in the northern portion of the subject. Mr. Gene Flotteron is concerned with the groundwater contamination and contacts the NYSDEC for more information.

6/4/2008 Spill #06-04377 is reopened in letter to Eugene Flatteron
7/2008 – NYSDEC reopens spill case # 06-04377. NYSDEC requests that Galli submit a copy of their Remedial Closure Report. NYSDEC reviews Galli's remedial closure report and responds in an email stating comments, questions and requirements.

8/7/2008 – Galli Engineering, P.C. submits a response to comments, questions, and requirements along with a Remedial Investigation Work Plan to characterize and delineate petroleum related impacts at the subject property.

9/2008 – Galli Engineering, P.C. received eight comments from the NYSDEC on the Remedial Investigation Work Plan submitted in 8/2008.
10/2008 – Galli Engineering, P.C. submits a revised Remedial Investigation Work Plan (October, 2008) to NYSDEC.

11/2008 – Galli Engineering, P.C. commences installation of soil borings on site.

1/23/2009 – NYSDEC sends a letter to Mr. Eugene Flotteron and Galli Engineering approving the Remedial Investigation Work Plan of October, 2008. (Mr. Mark Tibbe of Region 2 NYSDEC had previously sent an email on October 31, 2008 approving the RIWP and authorizing the start of work.

3/3/2009-Letter from Galli Engineering to NYSDEC Division of Environmental Remediation updating investigative activities.

5/2009 – Galli Engineering, P.C. samples groundwater from previously installed monitoring wells.

6/2009 – Galli Engineering, P.C. submits Remedial Investigation Report.
1/2010 - Galli Engineering, P.C. resubmits Remedial Investigation Report
3/2011 - MW-2 was replaced and street boxes for MW-1 and MW-3 were repaired.
5/2011 – All monitoring wells are developed; Various attempts to sample wells.
6/2011 – All three wells successfully sampled, lab results received and reviewed.
7/2011 – Remedial Investigation Report prepared and sent to DEC
11/4/2011 – DEC replies via email and requests additional investigative work
12/2011 – Galli Engineering submits Remedial Work Plan to NYSDEC
4/2012 – Galli Engineering submits Remedial Investigation Report for Activities in February-March 2012.

Appendix C

Sampling, Analysis and Assessment of Per- And Polyfluoroalkyl Substances (PFAS)

January 2021

NEW YORK STATE OF OPPORTUNITY.

Department of Environmental Conservation

SAMPLING, ANALYSIS, AND ASSESSMENT OF PER- AND POLYFLUOROALKYL SUBSTANCES (PFAS)

Under NYSDEC’s Part 375 Remedial Programs

January 2021

www.dec.ny.gov

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January 2021

ERRATA SHEET for

SAMPLING, ANALYSIS, AND ASSESSMENT OF PER- AND POLYFLUOROALKYL SUBSTANCES (PFAS) Under NYSDEC's Part 375 Remedial Programs Issued January 17, 2020

Citation and Page Number	Current Text	Corrected Text	Date
Title of Appendix I, page 32	Appendix H	Appendix I	2/25/2020
Document Cover, page 1	Guidelines for Sampling and Analysis of PFAS	Sampling, Analysis, and Assessment of Per- and Polyfluoroalkyl Substances (PFAS) Under NYSDEC's Part 375 Remedial Programs	9/15/2020
Routine Analysis, page 9	"However, laboratories analyzing environmental samples…PFOA and PFOS in drinking water by EPA Method 537, 537.1 or ISO 25101."	"However, laboratories analyzing environmental samples…PFOA and PFOS in drinking water by EPA Method 537, 537.1, ISO 25101, or Method 533."	9/15/2020
Additional Analysis, page 9, new paragraph regarding soil parameters	None	"In cases where site-specific cleanup objectives for PFOA and PFOS are to be assessed, soil parameters, such as Total Organic Carbon (EPA Method 9060), soil pH (EPA Method 9045), clay content (percent), and cation exchange capacity (EPA Method 9081), should be included in the analysis to help evaluate factors affecting the leachability of PFAS in site soils."	9/15/2020
Data Assessment and Application to Site Cleanup Page 10	Until such time as Ambient Water Quality Standards (AWQS) and Soil Cleanup Objectives (SCOs) for PFAS are published, the extent of contaminated media potentially subject to remediation should be determined on a case-by-case basis using the procedures discussed below and the criteria in DER-10. Target levels for cleanup of PFAS in other media, including biota and sediment, have not yet been established by the DEC.	Until such time as Ambient Water Quality Standards (AWQS) and Soil Cleanup Objectives (SCOs) for PFOA and PFOS are published, the extent of contaminated media potentially subject to remediation should be determined on a case-by-case basis using the procedures discussed below and the criteria in DER-10. Preliminary target levels for cleanup of PFOA and PFOS in other media, including biota and sediment, have not yet been established by the DEC.	9/15/2020

Citation and Page Number	Current Text	Corrected Text	Date
Water Sample Results Page 10	PFAS should be further assessed and considered as a potential contaminant of concern in groundwater or surface water (…) If PFAS are identified as a contaminant of concern for a site, they should be assessed as part of the remedy selection process in accordance with Part 375 and DER-10.	PFOA and PFOS should be further assessed and considered as potential contaminants of concern in groundwater or surface water (…) If PFOA and/or PFOS are identified as contaminants of concern for a site, they should be assessed as part of the remedy selection process in accordance with Part 375 and DER-10.	9/15/2020
Soil Sample Results, page 10	“The extent of soil contamination for purposes of delineation and remedy selection should be determined by having certain soil samples tested by Synthetic Precipitation Leaching Procedure (SPLP) and the leachate analyzed for PFAS. Soil exhibiting SPLP results above 70 ppt for either PFOA or PFOS (individually or combined) are to be evaluated during the cleanup phase.”	“Soil cleanup objectives for PFOA and PFOS will be proposed in an upcoming revision to 6 NYCRR Part 375-6. Until SCOs are in effect, the following are to be used as guidance values. “ [Interim SCO Table] “PFOA and PFOS results for soil are to be compared against the guidance values listed above. These guidance values are to be used in determining whether PFOA and PFOS are contaminants of concern for the site and for determining remedial action objectives and cleanup requirements. Site-specific remedial objectives for protection of groundwater can also be presented for evaluation by DEC. Development of site-specific remedial objectives for protection of groundwater will require analysis of additional soil parameters relating to leachability. These additional analyses can include any or all the parameters listed above (soil pH, cation exchange capacity, etc.) and/or use of SPLP. As the understanding of PFAS transport improves, DEC welcomes proposals for site-specific remedial objectives for protection of groundwater. DEC will expect that those may be dependent on additional factors including soil pH, aqueous pH, % organic carbon, % Sand/Silt/Clay, soil cations: K, Ca, Mg, Na, Fe, Al, cation exchange capacity, and anion exchange capacity. Site-specific remedial objectives should also consider the dilution attenuation factor (DAF). The NJDEP publication on DAF can be used as a reference: https://www.nj.gov/dep/srp/guidance/rs/daf.pdf. ”	9/15/2020

Citation and Page Number	Current Text	Corrected Text	Date
Testing for Imported Soil Page 11	Soil imported to a site for use in a soil cap, soil cover, or as backfill is to be tested for PFAS in general conformance with DER-10, Section 5.4(e) for the PFAS Analyte List (Appendix F) using the analytical procedures discussed below and the criteria in DER-10 associated with SVOCs. If PFOA or PFOS is detected in any sample at or above 1 µg/kg, then soil should be tested by SPLP and the leachate analyzed for PFAS. If the SPLP results exceed 10 ppt for either PFOA or PFOS (individually) then the source of backfill should be rejected, unless a site-specific exemption is provided by DER. SPLP leachate criteria is based on the Maximum Contaminant Levels proposed for drinking water by New York State's Department of Health, this value may be updated based on future Federal or State promulgated regulatory standards. Remedial parties have the option of analyzing samples concurrently for both PFAS in soil and in the SPLP leachate to minimize project delays. Category B deliverables should be submitted for backfill samples, though a DUSR is not required.	Testing for PFAS should be included any time a full TAL/TCL analyte list is required. Results for PFOA and PFOS should be compared to the applicable guidance values. If PFOA or PFOS is detected in any sample at or above the guidance values then the source of backfill should be rejected, unless a site-specific exemption is provided by DER based on SPLP testing, for example. If the concentrations of PFOA and PFOS in leachate are at or above 10 ppt (the Maximum Contaminant Levels established for drinking water by the New York State Department of Health), then the soil is not acceptable. PFOA, PFOS and 1,4-dioxane are all considered semi-volatile compounds, so composite samples are appropriate for these compounds when sampling in accordance with DER-10, Table 5.4(e)10. Category B deliverables should be submitted for backfill samples, though a DUSR is not required.	9/15/2020

Citation and Page Number	Current Text	Corrected Text	Date
Footnotes	None	[1] TOP Assay analysis of highly contaminated samples, such as those from an AFFF (aqueous film-forming foam) site, can result in incomplete oxidation of the samples and an underestimation of the total perfluoroalkyl substances. [2] The movement of PFAS in the environment is being aggressively researched at this time; that research will eventually result in more accurate models for the behaviors of these chemicals. In the meantime, DEC has calculated the soil cleanup objective for the protection of groundwater using the same procedure used for all other chemicals, as described in Section 7.7 of the Technical Support Document (http://www.dec.ny.gov/docs/remediation_hudson_pdf/techsuppdoc.pdf).	9/15/2020
Additional Analysis, page 9	In cases… soil parameters, such as Total Organic Carbon (EPA Method 9060), soil…	In cases… soil parameters, such as Total Organic Carbon (Lloyd Kahn), soil…	1/8/2021
Appendix A, General Guidelines, fourth bullet	List the ELAP-approved lab(s) to be used for analysis of samples	List the ELAP- certified lab(s) to be used for analysis of samples	1/8/2021
Appendix E, Laboratory Analysis and Containers	Drinking water samples collected using this protocol are intended to be analyzed for PFAS by ISO Method 25101.	Drinking water samples collected using this protocol are intended to be analyzed for PFAS by EPA Method 537, 537.1, 533, or ISO Method 25101	1/8/2021

Sampling, Analysis, and Assessment of Per- and Polyfluoroalkyl Substances (PFAS) Under NYSDEC's Part 375 Remedial Programs

Objective

New York State Department of Environmental Conservation's Division of Environmental Remediation (DER) performs or oversees sampling of environmental media and subsequent analysis of PFAS as part of remedial programs implemented under 6 NYCRR Part 375. To ensure consistency in sampling, analysis, reporting, and assessment of PFAS, DER has developed this document which summarizes currently accepted procedures and updates previous DER technical guidance pertaining to PFAS.

Applicability

All work plans submitted to DEC pursuant to one of the remedial programs under Part 375 shall include PFAS sampling and analysis procedures that conform to the guidelines provided herein.

As part of a site investigation or remedial action compliance program, whenever samples of potentially affected media are collected and analyzed for the standard Target Analyte List/Target Compound List (TAL/TCL), PFAS analysis should also be performed. Potentially affected media can include soil, groundwater, surface water, and sediment. Based upon the potential for biota to be affected, biota sampling and analysis for PFAS may also be warranted as determined pursuant to a Fish and Wildlife Impact Analysis. Soil vapor sampling for PFAS is not required.

Field Sampling Procedures

DER-10 specifies technical guidance applicable to DER's remedial programs. Given the prevalence and use of PFAS, DER has developed "best management practices" specific to sampling for PFAS. As specified in DER-10 Chapter 2, quality assurance procedures are to be submitted with investigation work plans. Typically, these procedures are incorporated into a work plan, or submitted as a stand-alone document (e.g., a Quality Assurance Project Plan). Quality assurance guidelines for PFAS are listed in Appendix A - Quality Assurance Project Plan (QAPP) Guidelines for PFAS.

Field sampling for PFAS performed under DER remedial programs should follow the appropriate procedures outlined for soils, sediments or other solids (Appendix B), non-potable groundwater (Appendix C), surface water (Appendix D), public or private water supply wells (Appendix E), and fish tissue (Appendix F).

QA/QC samples (e.g. duplicates, MS/MSD) should be collected as specified in DER-10, Section 2.3(c). For sampling equipment coming in contact with aqueous samples only, rinsate or equipment blanks should be collected. Equipment blanks should be collected at a minimum frequency of one per day per site or one per twenty samples, whichever is more frequent.

Analysis and Reporting

As of October 2020, the United States Environmental Protection Agency (EPA) does not have a validated method for analysis of PFAS for media commonly analyzed under DER remedial programs (non-potable waters, solids). DER has developed the following guidelines to ensure consistency in analysis and reporting of PFAS.

The investigation work plan should describe analysis and reporting procedures, including laboratory analytical procedures for the methods discussed below. As specified in DER-10 Section 2.2, laboratories should provide a full Category B deliverable. In addition, a Data Usability Summary Report (DUSR) should be prepared by an independent, third party data validator. Electronic data submissions should meet the requirements provided at: https://www.dec.ny.gov/chemical/62440.html.

DER has developed a *PFAS Analyte List* (Appendix F) for remedial programs to understand the nature of contamination at sites. It is expected that reported results for PFAS will include, at a minimum, all the compounds listed. If lab and/or matrix specific issues are encountered for any analytes, the DER project manager, in consultation with the DER chemist, will make case-by-case decisions as to whether certain analytes may be temporarily or permanently discontinued from analysis at each site. As with other contaminants that are analyzed for at a site, the *PFAS Analyte List* may be refined for future sampling events based on investigative findings.

Routine Analysis

Currently, New York State Department of Health's Environmental Laboratory Approval Program (ELAP) does not offer certification for PFAS in matrices other than finished drinking water. However, laboratories analyzing environmental samples for PFAS (e.g., soil, sediments, and groundwater) under DER's Part 375 remedial programs need to hold ELAP certification for PFOA and PFOS in drinking water by EPA Method 537, 537.1, ISO 25101, or Method 533. Laboratories should adhere to the guidelines and criteria set forth in the DER's laboratory guidelines for PFAS in non-potable water and solids (Appendix H - Laboratory Guidelines for Analysis of PFAS in Non-Potable Water and Solids). Data review guidelines were developed by DER to ensure data comparability and usability (Appendix H - Data Review Guidelines for Analysis of PFAS in Non-Potable Water and Solids).

LC-MS/MS analysis for PFAS using methodologies based on EPA Method 537.1 is the procedure to use for environmental samples. Isotope dilution techniques should be utilized for the analysis of PFAS in all media. Reporting limits for PFOA and PFOS in aqueous samples should not exceed 2 ng/L. Reporting limits for PFOA and PFOS in solid samples should not exceed 0.5 µg/kg. Reporting limits for all other PFAS in aqueous and solid media should be as close to these limits as possible. If laboratories indicate that they are not able to achieve these reporting limits for the entire *PFAS Analyte List*, site-specific decisions regarding acceptance of elevated reporting limits for specific PFAS can be made by the DER project manager in consultation with the DER chemist.

Additional Analysis

Additional laboratory methods for analysis of PFAS may be warranted at a site, such as the Synthetic Precipitation Leaching Procedure (SPLP) and Total Oxidizable Precursor Assay (TOP Assay).

In cases where site-specific cleanup objectives for PFOA and PFOS are to be assessed, soil parameters, such as Total Organic Carbon (Lloyd Kahn), soil pH (EPA Method 9045), clay content (percent), and cation exchange capacity (EPA Method 9081), should be included in the analysis to help evaluate factors affecting the leachability of PFAS in site soils.

SPLP is a technique used to determine the mobility of chemicals in liquids, soils and wastes, and may be useful in determining the need for addressing PFAS-containing material as part of the remedy. SPLP by EPA Method 1312 should be used unless otherwise specified by the DER project manager in consultation with the DER chemist.

Impacted materials can be made up of PFAS that are not analyzable by routine analytical methodology. A TOP Assay can be utilized to conceptualize the amount and type of oxidizable PFAS which could be liberated in the environment, which approximates the maximum concentration of perfluoroalkyl substances that could be generated if all polyfluoroalkyl substances were oxidized. For example, some polyfluoroalkyl substances may degrade or transform to form perfluoroalkyl substances (such as PFOA or PFOS), resulting in an increase in perfluoroalkyl substance concentrations as contaminated groundwater moves away from a source. The TOP Assay converts, through oxidation, polyfluoroalkyl substances (precursors) into perfluoroalkyl substances that can be detected by routine analytical methodology.[1]

Commercial laboratories have adopted methods which allow for the quantification of targeted PFAS in air and biota. The EPA's Office of Research and Development (ORD) is currently developing methods which allow for air emissions characterization of PFAS, including both targeted and non-targeted analysis of PFAS. Consult with the DER project manager and the DER chemist for assistance on analyzing biota/tissue and air samples.

Data Assessment and Application to Site Cleanup

Until such time as Ambient Water Quality Standards (AWQS) and Soil Cleanup Objectives (SCOs) for PFOA and PFOS are published, the extent of contaminated media potentially subject to remediation should be determined on a case-by-case basis using the procedures discussed below and the criteria in DER-10. Preliminary target levels for cleanup of PFOA and PFOS in other media, including biota and sediment, have not yet been established by the DEC.

Water Sample Results

PFOA and PFOS should be further assessed and considered as potential contaminants of concern in groundwater or surface water if PFOA or PFOS is detected in any water sample at or above 10 ng/L (ppt) and is determined to be attributable to the site, either by a comparison of upgradient and downgradient levels, or the presence of soil source areas, as defined below. In addition, further assessment of water may be warranted if either of the following screening levels are met:

a. any other individual PFAS (not PFOA or PFOS) is detected in water at or above 100 ng/L; or
b. total concentration of PFAS (including PFOA and PFOS) is detected in water at or above 500 ng/L

If PFOA and/or PFOS are identified as contaminants of concern for a site, they should be assessed as part of the remedy selection process in accordance with Part 375 and DER-10.

Soil Sample Results

Soil cleanup objectives for PFOA and PFOS will be proposed in an upcoming revision to 6 NYCRR Part 375-6. Until SCOs are in effect, the following are to be used as guidance values.

Guidance Values for Anticipated Site Use	**PFOA (ppb)**	**PFOS (ppb)**
Unrestricted	0.66	0.88
Residential	6.6	8.8
Restricted Residential	33	44
Commercial	500	440
Industrial	600	440
Protection of Groundwater[2]	1.1	3.7

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[1] TOP Assay analysis of highly contaminated samples, such as those from an AFFF (aqueous film-forming foam) site, can result in incomplete oxidation of the samples and an underestimation of the total perfluoroalkyl substances.

[2] The movement of PFAS in the environment is being aggressively researched at this time; that research will eventually result in more accurate models for the behaviors of these chemicals. In the meantime, DEC has calculated the guidance value for the protection of groundwater using the same procedure used for all other chemicals, as described in Section 7.7 of the Technical Support Document (http://www.dec.ny.gov/docs/remediation_hudson_pdf/techsuppdoc.pdf).

PFOA and PFOS results for soil are to be compared against the guidance values listed above. These guidance values are to be used in determining whether PFOA and PFOS are contaminants of concern for the site and for determining remedial action objectives and cleanup requirements. Site-specific remedial objectives for protection of groundwater can also be presented for evaluation by DEC. Development of site-specific remedial objectives for protection of groundwater will require analysis of additional soil parameters relating to leachability. These additional analyses can include any or all the parameters listed above (soil pH, cation exchange capacity, etc.) and/or use of SPLP.

As the understanding of PFAS transport improves, DEC welcomes proposals for site-specific remedial objectives for protection of groundwater. DEC will expect that those may be dependent on additional factors including soil pH, aqueous pH, % organic carbon, % Sand/Silt/Clay, soil cations: K, Ca, Mg, Na, Fe, Al, cation exchange capacity, and anion exchange capacity. Site-specific remedial objectives should also consider the dilution attenuation factor (DAF). The NJDEP publication on DAF can be used as a reference: https://www.nj.gov/dep/srp/guidance/rs/daf.pdf.

Testing for Imported Soil

Testing for PFAS should be included any time a full TAL/TCL analyte list is required. Results for PFOA and PFOS should be compared to the applicable guidance values. If PFOA or PFOS is detected in any sample at or above the guidance values then the source of backfill should be rejected, unless a site-specific exemption is provided by DER based on SPLP testing, for example. If the concentrations of PFOA and PFOS in leachate are at or above 10 ppt (the Maximum Contaminant Levels established for drinking water by the New York State Department of Health), then the soil is not acceptable.

PFOA, PFOS and 1,4-dioxane are all considered semi-volatile compounds, so composite samples are appropriate for these compounds when sampling in accordance with DER-10, Table 5.4(e)10. Category B deliverables should be submitted for backfill samples, though a DUSR is not required.

Appendix A - Quality Assurance Project Plan (QAPP) Guidelines for PFAS

The following guidelines (general and PFAS-specific) can be used to assist with the development of a QAPP for projects within DER involving sampling and analysis of PFAS.

General Guidelines in Accordance with DER-10

- Document/work plan section title – Quality Assurance Project Plan
- Summarize project scope, goals, and objectives
- Provide project organization including names and resumes of the project manager, Quality Assurance Officer (QAO), field staff, and Data Validator
    - The QAO should not have another position on the project, such as project or task manager, that involves project productivity or profitability as a job performance criterion
- List the ELAP certified lab(s) to be used for analysis of samples
- Include a site map showing sample locations
- Provide detailed sampling procedures for each matrix
- Include Data Quality Usability Objectives
- List equipment decontamination procedures
- Include an "Analytical Methods/Quality Assurance Summary Table" specifying:
    - Matrix type
    - Number or frequency of samples to be collected per matrix
    - Number of field and trip blanks per matrix
    - Analytical parameters to be measured per matrix
    - Analytical methods to be used per matrix with minimum reporting limits
    - Number and type of matrix spike and matrix spike duplicate samples to be collected
    - Number and type of duplicate samples to be collected
    - Sample preservation to be used per analytical method and sample matrix
    - Sample container volume and type to be used per analytical method and sample matrix
    - Sample holding time to be used per analytical method and sample matrix
- Specify Category B laboratory data deliverables and preparation of a DUSR

Specific Guidelines for PFAS

- Include in the text that sampling for PFAS will take place
- Include in the text that PFAS will be analyzed by LC-MS/MS for PFAS using methodologies based on EPA Method 537.1
- Include the list of PFAS compounds to be analyzed (*PFAS Analyte List*)
- Include the laboratory SOP for PFAS analysis
- List the minimum method-achievable Reporting Limits for PFAS
    - Reporting Limits should be less than or equal to:
        - Aqueous – 2 ng/L (ppt)
        - Solids – 0.5 µg/kg (ppb)
- Include the laboratory Method Detection Limits for the PFAS compounds to be analyzed
- Laboratory should have ELAP certification for PFOA and PFOS in drinking water by EPA Method 537, 537.1, EPA Method 533, or ISO 25101
- Include detailed sampling procedures
    - Precautions to be taken
    - Pump and equipment types
    - Decontamination procedures
    - Approved materials only to be used
- Specify that regular ice only will be used for sample shipment
- Specify that equipment blanks should be collected at a minimum frequency of 1 per day per site for each matrix

Appendix B - Sampling Protocols for PFAS in Soils, Sediments and Solids

General

The objective of this protocol is to give general guidelines for the collection of soil, sediment and other solid samples for PFAS analysis. The sampling procedure used should be consistent with Sampling Guidelines and Protocols – Technological Background and Quality Control/Quality Assurance for NYS DEC Spill Response Program – March 1991 (http://www.dec.ny.gov/docs/remediation_hudson_pdf/sgpsect5.pdf), with the following limitations.

Laboratory Analysis and Containers

Samples collected using this protocol are intended to be analyzed for PFAS using methodologies based on EPA Method 537.1.

The preferred material for containers is high density polyethylene (HDPE). Pre-cleaned sample containers, coolers, sample labels, and a chain of custody form will be provided by the laboratory.

Equipment

Acceptable materials for sampling include stainless steel, HDPE, PVC, silicone, acetate, and polypropylene. Additional materials may be acceptable if pre-approved by New York State Department of Environmental Conservation's Division of Environmental Remediation.

No sampling equipment components or sample containers should come in to contact with aluminum foil, low density polyethylene, glass, or polytetrafluoroethylene (PTFE, Teflon™) materials including sample bottle cap liners with a PTFE layer.

A list of acceptable equipment is provided below, but other equipment may be considered appropriate based on sampling conditions.

- stainless steel spoon
- stainless steel bowl
- steel hand auger or shovel without any coatings

Equipment Decontamination

Standard two step decontamination using detergent (Alconox is acceptable) and clean, PFAS-free water will be performed for sampling equipment. All sources of water used for equipment decontamination should be verified in advance to be PFAS-free through laboratory analysis or certification.

Sampling Techniques

Sampling is often conducted in areas where a vegetative turf has been established. In these cases, a pre-cleaned trowel or shovel should be used to carefully remove the turf so that it may be replaced at the conclusion of sampling. Surface soil samples (e.g. 0 to 6 inches below surface) should then be collected using a pre-cleaned, stainless steel spoon. Shallow subsurface soil samples (e.g. 6 to ~36 inches below surface) may be collected by digging a hole using a pre-cleaned hand auger or shovel. When the desired subsurface depth is reached, a pre-cleaned hand auger or spoon shall be used to obtain the sample.

When the sample is obtained, it should be deposited into a stainless steel bowl for mixing prior to filling the sample containers. The soil should be placed directly into the bowl and mixed thoroughly by rolling the material into the middle until the material is homogenized. At this point the material within the bowl can be placed into the laboratory provided container.

Sample Identification and Logging

A label shall be attached to each sample container with a unique identification. Each sample shall be included on the chain of custody (COC).

Quality Assurance/Quality Control

- Immediately place samples in a cooler maintained at 4 ± 2º Celsius using ice
- Collect one field duplicate for every sample batch, minimum 1 duplicate per 20 samples. The duplicate shall consist of an additional sample at a given location
- Collect one matrix spike / matrix spike duplicate (MS/MSD) for every sample batch, minimum 1 MS/MSD per 20 samples. The MS/MSD shall consist of an additional two samples at a given location and identified on the COC
- Request appropriate data deliverable (Category B) and an electronic data deliverable

Documentation

A soil log or sample log shall document the location of the sample/borehole, depth of the sample, sampling equipment, duplicate sample, visual description of the material, and any other observations or notes determined to be appropriate. Additionally, care should be performed to limit contact with PFAS containing materials (e.g. waterproof field books, food packaging) during the sampling process.

Personal Protection Equipment (PPE)

For most sampling Level D PPE is anticipated to be appropriate. The sampler should wear nitrile gloves while conducting field work and handling sample containers.

Field staff shall consider the clothing to be worn during sampling activities. Clothing that contains PTFE material (including GORE-TEX®) or that have been waterproofed with PFAS materials should be avoided. All clothing worn by sampling personnel should have been laundered multiple times.

Appropriate rain gear (PVC, polyurethane, or rubber rain gear are acceptable), bug spray, and sunscreen should be used that does not contain PFAS. Well washed cotton coveralls may be used as an alternative to bug spray and/or sunscreen.

PPE that contains PFAS is acceptable when site conditions warrant additional protection for the samplers and no other materials can be used to be protective. Documentation of such use should be provided in the field notes.

Appendix C - Sampling Protocols for PFAS in Monitoring Wells

General

The objective of this protocol is to give general guidelines for the collection of groundwater samples for PFAS analysis. The sampling procedure used should be consistent with Sampling Guidelines and Protocols – Technological Background and Quality Control/Quality Assurance for NYS DEC Spill Response Program – March 1991 (http://www.dec.ny.gov/docs/remediation_hudson_pdf/sgpsect5.pdf), with the following limitations.

Laboratory Analysis and Container

Samples collected using this protocol are intended to be analyzed for PFAS using methodologies based on EPA Method 537.1.

The preferred material for containers is high density polyethylene (HDPE). Pre-cleaned sample containers, coolers, sample labels, and a chain of custody form will be provided by the laboratory.

Equipment

Acceptable materials for sampling include: stainless steel, HDPE, PVC, silicone, acetate, and polypropylene. Additional materials may be acceptable if pre-approved by New York State Department of Environmental Conservation's Division of Environmental Remediation.

No sampling equipment components or sample containers should come in contact with aluminum foil, low density polyethylene, glass, or polytetrafluoroethylene (PTFE, Teflon™) materials including plumbers tape and sample bottle cap liners with a PTFE layer.

A list of acceptable equipment is provided below, but other equipment may be considered appropriate based on sampling conditions.

- stainless steel inertia pump with HDPE tubing
- peristaltic pump equipped with HDPE tubing and silicone tubing
- stainless steel bailer with stainless steel ball
- bladder pump (identified as PFAS-free) with HDPE tubing

Equipment Decontamination

Standard two step decontamination using detergent (Alconox is acceptable) and clean, PFAS-free water will be performed for sampling equipment. All sources of water used for equipment decontamination should be verified in advance to be PFAS-free through laboratory analysis or certification.

Sampling Techniques

Monitoring wells should be purged in accordance with the sampling procedure (standard/volume purge or low flow purge) identified in the site work plan, which will determine the appropriate time to collect the sample. If sampling using standard purge techniques, additional purging may be needed to reduce turbidity levels, so samples contain a limited amount of sediment within the sample containers. Sample containers that contain sediment may cause issues at the laboratory, which may result in elevated reporting limits and other issues during the sample preparation that can compromise data usability. Sampling personnel should don new nitrile gloves prior to sample collection due to the potential to contact PFAS containing items (not related to the sampling equipment) during the purging activities.

Sample Identification and Logging

A label shall be attached to each sample container with a unique identification. Each sample shall be included on the chain of custody (COC).

Quality Assurance/Quality Control

- Immediately place samples in a cooler maintained at 4 ± 2º Celsius using ice
- Collect one field duplicate for every sample batch, minimum 1 duplicate per 20 samples. The duplicate shall consist of an additional sample at a given location
- Collect one matrix spike / matrix spike duplicate (MS/MSD) for every sample batch, minimum 1 MS/MSD per 20 samples. The MS/MSD shall consist of an additional two samples at a given location and identified on the COC
- Collect one equipment blank per day per site and minimum 1 equipment blank per 20 samples. The equipment blank shall test the new and decontaminated sampling equipment utilized to obtain a sample for residual PFAS contamination. This sample is obtained by using laboratory provided PFAS-free water and passing the water over or through the sampling device and into laboratory provided sample containers
- Additional equipment blank samples may be collected to assess other equipment that is utilized at the monitoring well
- Request appropriate data deliverable (Category B) and an electronic data deliverable

Documentation

A purge log shall document the location of the sample, sampling equipment, groundwater parameters, duplicate sample, visual description of the material, and any other observations or notes determined to be appropriate. Additionally, care should be performed to limit contact with PFAS containing materials (e.g. waterproof field books, food packaging) during the sampling process.

Personal Protection Equipment (PPE)

For most sampling Level D PPE is anticipated to be appropriate. The sampler should wear nitrile gloves while conducting field work and handling sample containers.

Field staff shall consider the clothing to be worn during sampling activities. Clothing that contains PTFE material (including GORE-TEX®) or that have been waterproofed with PFAS materials should be avoided. All clothing worn by sampling personnel should have been laundered multiple times.

Appropriate rain gear (PVC, polyurethane, or rubber rain gear are acceptable), bug spray, and sunscreen should be used that does not contain PFAS. Well washed cotton coveralls may be used as an alternative to bug spray and/or sunscreen.

PPE that contains PFAS is acceptable when site conditions warrant additional protection for the samplers and no other materials can be used to be protective. Documentation of such use should be provided in the field notes.

Appendix D - Sampling Protocols for PFAS in Surface Water

General

The objective of this protocol is to give general guidelines for the collection of surface water samples for PFAS analysis. The sampling procedure used should be consistent with Sampling Guidelines and Protocols – Technological Background and Quality Control/Quality Assurance for NYS DEC Spill Response Program – March 1991 (http://www.dec.ny.gov/docs/remediation_hudson_pdf/sgpsect5.pdf), with the following limitations.

Laboratory Analysis and Container

Samples collected using this protocol are intended to be analyzed for PFAS using methodologies based on EPA Method 537.1.

The preferred material for containers is high density polyethylene (HDPE). Pre-cleaned sample containers, coolers, sample labels, and a chain of custody form will be provided by the laboratory.

Equipment

Acceptable materials for sampling include: stainless steel, HDPE, PVC, silicone, acetate, and polypropylene. Additional materials may be acceptable if pre-approved by New York State Department of Environmental Conservation’s Division of Environmental Remediation.

No sampling equipment components or sample containers should come in contact with aluminum foil, low density polyethylene, glass, or polytetrafluoroethylene (PTFE, Teflon™) materials including sample bottle cap liners with a PTFE layer.

A list of acceptable equipment is provided below, but other equipment may be considered appropriate based on sampling conditions.

- stainless steel cup

Equipment Decontamination

Standard two step decontamination using detergent (Alconox is acceptable) and clean, PFAS-free water will be performed for sampling equipment. All sources of water used for equipment decontamination should be verified in advance to be PFAS-free through laboratory analysis or certification.

Sampling Techniques

Where conditions permit, (e.g. creek or pond) sampling devices (e.g. stainless steel cup) should be rinsed with site medium to be sampled prior to collection of the sample. At this point the sample can be collected and poured into the sample container.

If site conditions permit, samples can be collected directly into the laboratory container.

Sample Identification and Logging

A label shall be attached to each sample container with a unique identification. Each sample shall be included on the chain of custody (COC).

Quality Assurance/Quality Control

- Immediately place samples in a cooler maintained at 4 ± 2º Celsius using ice
- Collect one field duplicate for every sample batch, minimum 1 duplicate per 20 samples. The duplicate shall consist of an additional sample at a given location
- Collect one matrix spike / matrix spike duplicate (MS/MSD) for every sample batch, minimum 1 MS/MSD per 20 samples. The MS/MSD shall consist of an additional two samples at a given location and identified on the COC
- Collect one equipment blank per day per site and minimum 1 equipment blank per 20 samples. The equipment blank shall test the new and decontaminated sampling equipment utilized to obtain a sample for residual PFAS contamination. This sample is obtained by using laboratory provided PFAS-free water and passing the water over or through the sampling device and into laboratory provided sample containers
- Request appropriate data deliverable (Category B) and an electronic data deliverable

Documentation

A sample log shall document the location of the sample, sampling equipment, duplicate sample, visual description of the material, and any other observations or notes determined to be appropriate. Additionally, care should be performed to limit contact with PFAS containing materials (e.g. waterproof field books, food packaging) during the sampling process.

Personal Protection Equipment (PPE)

For most sampling Level D PPE is anticipated to be appropriate. The sampler should wear nitrile gloves while conducting field work and handling sample containers.

Field staff shall consider the clothing to be worn during sampling activities. Clothing that contains PTFE material (including GORE-TEX®) or that have been waterproofed with PFAS materials should be avoided. All clothing worn by sampling personnel should have been laundered multiple times.

Appropriate rain gear (PVC, polyurethane, or rubber rain gear are acceptable), bug spray, and sunscreen should be used that does not contain PFAS. Well washed cotton coveralls may be used as an alternative to bug spray and/or sunscreen.

PPE that contains PFAS is acceptable when site conditions warrant additional protection for the samplers and no other materials can be used to be protective. Documentation of such use should be provided in the field notes.

Appendix E - Sampling Protocols for PFAS in Private Water Supply Wells

General

The objective of this protocol is to give general guidelines for the collection of water samples from private water supply wells (with a functioning pump) for PFAS analysis. The sampling procedure used should be consistent with Sampling Guidelines and Protocols – Technological Background and Quality Control/Quality Assurance for NYS DEC Spill Response Program – March 1991 (http://www.dec.ny.gov/docs/remediation_hudson_pdf/sgpsect5.pdf), with the following limitations.

Laboratory Analysis and Container

Drinking water samples collected using this protocol are intended to be analyzed for PFAS by EPA Method 537, 537.1, 533, or ISO Method 25101. The preferred material for containers is high density polyethylene (HDPE). Pre-cleaned sample containers, coolers, sample labels, and a chain of custody form will be provided by the laboratory.

Equipment

Acceptable materials for sampling include stainless steel, HDPE, PVC, silicone, acetate, and polypropylene. Additional materials may be acceptable if pre-approved by New York State Department of Environmental Conservation's Division of Environmental Remediation.

No sampling equipment components or sample containers should come in contact with aluminum foil, low density polyethylene, glass, or polytetrafluoroethylene (PTFE, Teflon™) materials (e.g. plumbers tape), including sample bottle cap liners with a PTFE layer.

Equipment Decontamination

Standard two step decontamination using detergent (Alconox is acceptable) and clean, PFAS-free water will be performed for sampling equipment. All sources of water used for equipment decontamination should be verified in advance to be PFAS-free through laboratory analysis or certification.

Sampling Techniques

Locate and assess the pressure tank and determine if any filter units are present within the building. Establish the sample location as close to the well pump as possible, which is typically the spigot at the pressure tank. Ensure sampling equipment is kept clean during sampling as access to the pressure tank spigot, which is likely located close to the ground, may be obstructed and may hinder sample collection.

Prior to sampling, a faucet downstream of the pressure tank (e.g., washroom sink) should be run until the well pump comes on and a decrease in water temperature is noted which indicates that the water is coming from the well. If the homeowner is amenable, staff should run the water longer to purge the well (15+ minutes) to provide a sample representative of the water in the formation rather than standing water in the well and piping system including the pressure tank. At this point a new pair of nitrile gloves should be donned and the sample can be collected from the sample point at the pressure tank.

Sample Identification and Logging

A label shall be attached to each sample container with a unique identification. Each sample shall be included on the chain of custody (COC).

Quality Assurance/Quality Control

- Immediately place samples in a cooler maintained at 4 ± 2º Celsius using ice
- Collect one field duplicate for every sample batch, minimum 1 duplicate per 20 samples. The duplicate shall consist of an additional sample at a given location
- Collect one matrix spike / matrix spike duplicate (MS/MSD) for every sample batch, minimum 1 MS/MSD per 20 samples. The MS/MSD shall consist of an additional two samples at a given location and identified on the COC
- If equipment was used, collect one equipment blank per day per site and a minimum 1 equipment blank per 20 samples. The equipment blank shall test the new and decontaminated sampling equipment utilized to obtain a sample for residual PFAS contamination. This sample is obtained by using laboratory provided PFAS-free water and passing the water over or through the sampling device and into laboratory provided sample containers.
- A field reagent blank (FRB) should be collected at a rate of one per 20 samples. The lab will provide a FRB bottle containing PFAS free water and one empty FRB bottle. In the field, pour the water from the one bottle into the empty FRB bottle and label appropriately.
- Request appropriate data deliverable (Category B) and an electronic data deliverable
- For sampling events where multiple private wells (homes or sites) are to be sampled per day, it is acceptable to collect QC samples at a rate of one per 20 across multiple sites or days.

Documentation

A sample log shall document the location of the private well, sample point location, owner contact information, sampling equipment, purge duration, duplicate sample, visual description of the material, and any other observations or notes determined to be appropriate and available (e.g. well construction, pump type and location, yield, installation date). Additionally, care should be performed to limit contact with PFAS containing materials (e.g. waterproof field books, food packaging) during the sampling process.

Personal Protection Equipment (PPE)

For most sampling Level D PPE is anticipated to be appropriate. The sampler should wear nitrile gloves while conducting field work and handling sample containers.

Field staff shall consider the clothing to be worn during sampling activities. Clothing that contains PTFE material (including GORE-TEX®) or that have been waterproofed with PFAS materials should be avoided. All clothing worn by sampling personnel should have been laundered multiple times.

Appendix F - Sampling Protocols for PFAS in Fish

This appendix contains a copy of the latest guidelines developed by the Division of Fish and Wildlife (DFW) entitled “General Fish Handling Procedures for Contaminant Analysis” (Ver. 8).

Procedure Name: General Fish Handling Procedures for Contaminant Analysis

Number: FW-005

Purpose: This procedure describes data collection, fish processing and delivery of fish collected for contaminant monitoring. It contains the chain of custody and collection record forms that should be used for the collections.

Organization: Environmental Monitoring Section
Bureau of Ecosystem Health
Division of Fish and Wildlife (DFW)
New York State Department of Environmental Conservation (NYSDEC)
625 Broadway
Albany, New York 12233-4756

Version: 8

Previous Version Date: 21 March 2018

Summary of Changes to this Version: Updated bureau name to Bureau of Ecosystem Health. Added direction to list the names of all field crew on the collection record. Minor formatting changes on chain of custody and collection records.

Originator or Revised by: Wayne Richter, Jesse Becker

Date: 26 April 2019

Quality Assurance Officer and Approval Date: Jesse Becker, 26 April 2019

NEW YORK STATE
DEPARTMENT OF ENVIRONMENTAL CONSERVATION

GENERAL FISH HANDLING PROCEDURES FOR CONTAMINANT ANALYSES

A. Original copies of all continuity of evidence (i.e., Chain of Custody) and collection record forms must accompany delivery of fish to the lab. A copy shall be directed to the Project Leader or as appropriate, Wayne Richter. All necessary forms will be supplied by the Bureau of Ecosystem Health. Because some samples may be used in legal cases, it is critical that each section is filled out completely. Each Chain of Custody form has three main sections:

1. The top box is to be filled out **and signed** by the person responsible for the fish collection (e.g., crew leader, field biologist, researcher). This person is responsible for delivery of the samples to DEC facilities or personnel (e.g., regional office or biologist).

2. The second section is to be filled out **and signed** by the person responsible for the collections while being stored at DEC, before delivery to the analytical lab. This may be the same person as in (1), but it is still required that they complete the section. Also important is the **range of identification numbers** (i.e., tag numbers) included in the sample batch.

3. Finally, the bottom box is to record any transfers between DEC personnel and facilities. Each subsequent transfer should be **identified, signed, and dated**, until laboratory personnel take possession of the fish.

B. The following data are required on each **Fish Collection Record** form:

1. Project and Site Name.

2. DEC Region.

3. All personnel (and affiliation) involved in the collection.

4. Method of collection (gill net, hook and line, etc.)

5. Preservation Method.

C. The following data are to be taken on each fish collected and recorded on the **Fish Collection Record** form:

1. Tag number - Each specimen is to be individually jaw tagged at time of collection with a unique number. Make sure the tag is turned out so that the number can be read without opening the bag. Use tags in sequential order. For small fish or composite samples place the tag inside the bag with the samples. The Bureau of Ecosystem Health can supply the tags.

2. Species identification (please be explicit enough to enable assigning genus and species). Group fish by species when processing.

3. Date collected.

4. Sample location (waterway and nearest prominent identifiable landmark).

5. Total length (nearest mm or smallest sub-unit on measuring instrument) and weight (nearest g or

smallest sub-unit of weight on weighing instrument). Take all measures as soon as possible with calibrated, protected instruments (e.g. from wind and upsets) and prior to freezing.

6. Sex - fish may be cut enough to allow sexing or other internal investigation, but do not eviscerate. Make any incision on the right side of the belly flap or exactly down the midline so that a left-side fillet can be removed.

D. General data collection recommendations:

1. It is helpful to use an ID or tag number that will be unique. It is best to use metal striped bass or other uniquely numbered metal tags. If uniquely numbered tags are unavailable, values based on the region, water body and year are likely to be unique: for example, R7CAY11001 for Region 7, Cayuga Lake, 2011, fish 1. If the fish are just numbered 1 through 20, we have to give them new numbers for our database, making it more difficult to trace your fish to their analytical results and creating an additional possibility for errors.

2. Process and record fish of the same species sequentially. Recording mistakes are less likely when all fish from a species are processed together. Starting with the bigger fish species helps avoid missing an individual.

3. If using Bureau of Ecosystem Health supplied tags or other numbered tags, use tags in sequence so that fish are recorded with sequential Tag Numbers. This makes data entry and login at the lab and use of the data in the future easier and reduces keypunch errors.

4. Record length and weight as soon as possible after collection and before freezing. Other data are recorded in the field upon collection. An age determination of each fish is optional, but if done, it is recorded in the appropriate “Age” column.

5. For composite samples of small fish, record the number of fish in the composite in the Remarks column. Record the length and weight of each individual in a composite. All fish in a composite sample should be of the same species and members of a composite should be visually matched for size.

6. Please submit photocopies of topographic maps or good quality navigation charts indicating sampling locations. GPS coordinates can be entered in the Location column of the collection record form in addition to or instead for providing a map. These records are of immense help to us (and hopefully you) in providing documented location records which are not dependent on memory and/or the same collection crew. In addition, they may be helpful for contaminant source trackdown and remediation/control efforts of the Department.

7. When recording data on fish measurements, it will help to ensure correct data recording for the data recorder to call back the numbers to the person making the measurements.

E. Each fish is to be placed in its own individual plastic bag. For small fish to be analyzed as a composite, put all of the fish for one composite in the same bag but use a separate bag for each composite. It is important to individually bag the fish to avoid difficulties or cross contamination when processing the fish for chemical analysis. Be sure to include the fish’s tag number inside the bag, preferably attached to the fish with the tag number turned out so it can be read. Tie or otherwise secure the bag closed. **The Bureau of Ecosystem Health will supply the bags.** If necessary, food grade bags may be procured from a suitable vendor (e.g., grocery store). It is preferable to redundantly label each bag with a manila tag tied between the knot and the body of the bag. This tag should be labeled with the project name, collection location, tag number, collection date, and fish species. If scales are collected, the scale envelope should be labeled with the same information.

F. Groups of fish, by species, are to be placed in one large plastic bag per sampling location. **<u>The Bureau of Ecosystem Health will supply the larger bags</u>.** Tie or otherwise secure the bag closed. Label the site bag with a manila tag tied between the knot and the body of the bag. The tag should contain: project, collection location, collection date, species and **tag number ranges**. Having this information on the manila tag enables lab staff to know what is in the bag without opening it.

G. Do not eviscerate, fillet or otherwise dissect the fish unless specifically asked to. If evisceration or dissection is specified, the fish must be cut along the exact midline or on the right side so that the left side fillet can be removed intact at the laboratory. If filleting is specified, the procedure for taking a standard fillet (SOP PREPLAB 4) must be followed, including removing scales.

H. Special procedures for PFAS: Unlike legacy contaminants such as PCBs, which are rarely found in day to day life, PFAS are widely used and frequently encountered. Practices that avoid sample contamination are therefore necessary. While no standard practices have been established for fish, procedures for water quality sampling can provide guidance. The following practices should be used for collections when fish are to be analyzed for PFAS:

No materials containing Teflon.
No Post-it notes.
No ice packs; only water ice or dry ice.
Any gloves worn must be powder free nitrile.
No Gore-Tex or similar materials (Gore-Tex is a PFC with PFOA used in its manufacture).
No stain repellent or waterproof treated clothing; these are likely to contain PFCs.
Avoid plastic materials, other than HDPE, including clipboards and waterproof notebooks.
Wash hands after handling any food containers or packages as these may contain PFCs. Keep pre-wrapped food containers and wrappers isolated from fish handling.
Wear clothing washed at least six times since purchase.
Wear clothing washed without fabric softener.
Staff should avoid cosmetics, moisturizers, hand creams and similar products on the day of sampling as many of these products contain PFCs (Fujii et al. 2013). Sunscreen or insect repellent should not contain ingredients with “fluor” in their name. Apply any sunscreen or insect repellent well downwind from all materials. Hands must be washed after touching any of these products.

I. All fish must be kept at a temperature <45° F (<8° C) immediately following data processing. As soon as possible, freeze at -20° C ± 5° C. Due to occasional freezer failures, daily freezer temperature logs are required. The freezer should be locked or otherwise secured to maintain chain of custody.

J. In most cases, samples should be delivered to the Analytical Services Unit at the Hale Creek field station. Coordinate delivery with field station staff and send copies of the collection records, continuity of evidence forms and freezer temperature logs to the field station. For samples to be analyzed elsewhere, non-routine collections or other questions, contact Wayne Richter, Bureau of Ecosystem Health, NYSDEC, 625 Broadway, Albany, New York 12233-4756, 518-402-8974, or the project leader about sample transfer. Samples will then be directed to the analytical facility and personnel noted on specific project descriptions.

K. A recommended equipment list is at the end of this document.

page ______ of ______

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
DIVISION OF FISH AND WILDLIFE
FISH COLLECTION RECORD

Project and Site Name ____ DEC Region ____________

Collections made by (include all crew) ____

Sampling Method: ☐Electrofishing ☐Gill netting ☐Trap netting ☐Trawling ☐Seining ☐Angling ☐Other ____________________________

Preservation Method: ☐Freezing ☐Other ______________________ Notes (SWFDB survey number): ______________________________

FOR LAB USE ONLY- LAB ENTRY NO.	COLLECTION OR TAG NO.	SPECIES	DATE TAKEN	LOCATION	AGE	SEX &/OR REPROD. CONDIT	LENGTH ( )	WEIGHT ( )	REMARKS

richter: revised 2011, 5/7/15, 10/4/16, 3/20/17; becker: 3/23/17, 4/26/19

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
CHAIN OF CUSTODY

I, ______________________________, of ____ collected the
(Print Name) (Print Business Address)

following on ____________________, 20____ from ____
(Date) (Water Body)

in the vicinity of ____
(Landmark, Village, Road, etc.)

Town of ____, in __________________________________ County.

Item(s) ____

____

Said sample(s) were in my possession and handled according to standard procedures provided to me prior to collection. The sample(s) were placed in the custody of a representative of the New York State Department of Environmental Conservation on ____________________________________, 20______.

____ ____________________________
Signature Date

I, ___________________________________, received the above mentioned sample(s) on the date specified and assigned identification number(s) ____ to the sample(s). I have recorded pertinent data for the sample(s) on the attached collection records. The sample(s) remained in my custody until subsequently transferred, prepared or shipped at times and on dates as attested to below.

____ ____________________
Signature Date

SECOND RECIPIENT (Print Name)	TIME & DATE	PURPOSE OF TRANSFER
SIGNATURE	UNIT	
THIRD RECIPIENT (Print Name)	TIME & DATE	PURPOSE OF TRANSFER
SIGNATURE	UNIT	
FOURTH RECIPIENT (Print Name)	TIME & DATE	PURPOSE OF TRANSFER
SIGNATURE	UNIT	
RECEIVED IN LABORATORY BY (Print Name)	TIME & DATE	REMARKS
SIGNATURE	UNIT	
LOGGED IN BY (Print Name)	TIME & DATE	ACCESSION NUMBERS
SIGNATURE	UNIT	

richter: revised 21 April 2014; becker: 23 March 2017, 26 April, 2019

NOTICE OF WARRANTY

By signature to the chain of custody (reverse), the signatory warrants that the information provided is truthful and accurate to the best of his/her ability. The signatory affirms that he/she is willing to testify to those facts provided and the circumstances surrounding the same. Nothing in this warranty or chain of custody negates responsibility nor liability of the signatories for the truthfulness and accuracy of the statements provided.

HANDLING INSTRUCTIONS

On day of collection, collector(s) name(s), address(es), date, geographic location of capture (attach a copy of topographic map or navigation chart), species, number kept of each species, and description of capture vicinity (proper noun, if possible) along with name of Town and County must be indicated on reverse.

Retain organisms in manila tagged plastic bags to avoid mixing capture locations. Note appropriate information on each bag tag.

Keep samples as cool as possible. Put on ice if fish cannot be frozen within 12 hours. If fish are held more than 24 hours without freezing, they will not be retained or analyzed.

Initial recipient (either DEC or designated agent) of samples from collector(s) is responsible for obtaining and recording information on the collection record forms which will accompany the chain of custody. This person will seal the container using packing tape and writing his signature, the time and the date across the tape onto the container with indelible marker. Any time a seal is broken, for whatever purpose, the incident must be recorded on the Chain of Custody (reason, time, and date) in the purpose of transfer block. Container then is resealed using new tape and rewriting signature, with time and date.

EQUIPMENT LIST

Scale or balance of appropriate capacity for the fish to be collected.

Fish measuring board.

Plastic bags of an appropriate size for the fish to be collected and for site bags.

Individually numbered metal tags for fish.

Manila tags to label bags.

Small envelops, approximately 2” x 3.5”, if fish scales are to be collected.

Knife for removing scales.

Chain of custody and fish collection forms.

Clipboard.

Pens or markers.

Paper towels.

Dish soap and brush.

Bucket.

Cooler.

Ice.

Duct tape.

Appendix G – PFAS Analyte List

Group	Chemical Name	Abbreviation	CAS Number
Perfluoroalkyl sulfonates	Perfluorobutanesulfonic acid	PFBS	375-73-5
	Perfluorohexanesulfonic acid	PFHxS	355-46-4
	Perfluoroheptanesulfonic acid	PFHpS	375-92-8
	Perfluorooctanesulfonic acid	PFOS	1763-23-1
	Perfluorodecanesulfonic acid	PFDS	335-77-3
Perfluoroalkyl carboxylates	Perfluorobutanoic acid	PFBA	375-22-4
	Perfluoropentanoic acid	PFPeA	2706-90-3
	Perfluorohexanoic acid	PFHxA	307-24-4
	Perfluoroheptanoic acid	PFHpA	375-85-9
	Perfluorooctanoic acid	PFOA	335-67-1
	Perfluorononanoic acid	PFNA	375-95-1
	Perfluorodecanoic acid	PFDA	335-76-2
	Perfluoroundecanoic acid	PFUA/PFUdA	2058-94-8
	Perfluorododecanoic acid	PFDoA	307-55-1
	Perfluorotridecanoic acid	PFTriA/PFTrDA	72629-94-8
	Perfluorotetradecanoic acid	PFTA/PFTeDA	376-06-7
Fluorinated Telomer Sulfonates	6:2 Fluorotelomer sulfonate	6:2 FTS	27619-97-2
	8:2 Fluorotelomer sulfonate	8:2 FTS	39108-34-4
Perfluorooctane-sulfonamides	Perfluroroctanesulfonamide	FOSA	754-91-6
Perfluorooctane-sulfonamidoacetic acids	N-methyl perfluorooctanesulfonamidoacetic acid	N-MeFOSAA	2355-31-9
	N-ethyl perfluorooctanesulfonamidoacetic acid	N-EtFOSAA	2991-50-6

Appendix H - Laboratory Guidelines for Analysis of PFAS in Non-Potable Water and Solids

General

New York State Department of Environmental Conservation's Division of Environmental Remediation (DER) developed the following guidelines for laboratories analyzing environmental samples for PFAS under DER programs. If laboratories cannot adhere to the following guidelines, they should contact DER's Quality Assurance Officer, Dana Barbarossa, at dana.barbarossa@dec.ny.gov prior to analysis of samples.

Isotope Dilution

Isotope dilution techniques should be utilized for the analysis of PFAS in all media.

Extraction

For water samples, the entire sample bottle should be extracted, and the sample bottle rinsed with appropriate solvent to remove any residual PFAS.

For samples with high particulates, the samples should be handled in one of the following ways:

1. Spike the entire sample bottle with isotope dilution analytes (IDAs) prior to any sample manipulation. The sample can be passed through the SPE and if it clogs, record the volume that passed through.
2. If the sample contains too much sediment to attempt passing it through the SPE cartridge, the sample should be spiked with isotope dilution analytes, centrifuged and decanted.
3. If higher reporting limits are acceptable for the project, the sample can be diluted by taking a representative aliquot of the sample. If isotope dilution analytes will be diluted out of the sample, they can be added after the dilution. The sample should be homogenized prior to taking an aliquot.

If alternate sample extraction procedures are used, please contact the DER remedial program chemist prior to employing. Any deviations in sample preparation procedures should be clearly noted in the case narrative.

Signal to Noise Ratio

For all target analyte ions used for quantification, signal to noise ratio should be 3:1 or greater.

Blanks

There should be no detections in the method blanks above the reporting limits.

Ion Transitions

The ion transitions listed below should be used for the following PFAS:

PFOA	413 > 369
PFOS	499 > 80
PFHxS	399 > 80
PFBS	299 > 80
6:2 FTS	427 > 407
8:2 FTS	527 > 507
N-EtFOSAA	584 > 419
N-MeFOSAA	570 > 419

Branched and Linear Isomers

Standards containing both branched and linear isomers should be used when standards are commercially available. Currently, quantitative standards are available for PFHxS, PFOS, NMeFOSAA, and NEtFOSAA. As more standards become available, they should be incorporated in to the method. All isomer peaks present in the standard should be integrated and the areas summed. Samples should be integrated in the same manner as the standards.

Since a quantitative standard does not exist for branched isomers of PFOA, the instrument should be calibrated using just the linear isomer and a technical (qualitative) PFOA standard should be used to identify the retention time of the branched PFOA isomers in the sample. The total response of PFOA branched and linear isomers should be integrated in the samples and quantitated using the calibration curve of the linear standard.

Secondary Ion Transition Monitoring

Quantifier and qualifier ions should be monitored for all target analytes (PFBA and PFPeA are exceptions). The ratio of quantifier ion response to qualifier ion response should be calculated for each target analyte and the ratio compared to standards. Lab derived criteria should be used to determine if the ratios are acceptable.

Reporting

Detections below the reporting limit should be reported and qualified with a J qualifier.

The acid form of PFAS analytes should be reported. If the salt form of the PFAS was used as a stock standard, the measured mass should be corrected to report the acid form of the analyte.

Appendix I - Data Review Guidelines for Analysis of PFAS in Non-Potable Water and Solids

General

These guidelines are intended to be used for the validation of PFAS analytical results for projects within the Division of Environmental Remediation (DER) as well as aid in the preparation of a data usability summary report. Data reviewers should understand the methodology and techniques utilized in the analysis. Consultation with the end user of the data may be necessary to assist in determining data usability based on the data quality objectives in the Quality Assurance Project Plan. A familiarity with the laboratory's Standard Operating Procedure may also be needed to fully evaluate the data. If you have any questions, please contact DER's Quality Assurance Officer, Dana Barbarossa, at dana.barbarossa@dec.ny.gov.

Preservation and Holding Time

Samples should be preserved with ice to a temperature of less than 6°C upon arrival at the lab. The holding time is 14 days to extraction for aqueous and solid samples. The time from extraction to analysis for aqueous samples is 28 days and 40 days for solids.

Temperature greatly exceeds 6ºC upon arrival at the lab*	Use professional judgement to qualify detects and non-detects as estimated or rejected
Holding time exceeding 28 days to extraction	Use professional judgement to qualify detects and non-detects as estimated or rejected if holding time is grossly exceeded

*Samples that are delivered to the lab immediately after sampling may not meet the thermal preservation guidelines. Samples are considered acceptable if they arrive on ice or an attempt to chill the samples is observed.

Initial Calibration

The initial calibration should contain a minimum of five standards for linear fit and six standards for a quadratic fit. The relative standard deviation (RSD) for a quadratic fit calibration should be less than 20%. Linear fit calibration curves should have an R^2 value greater than 0.990.

The low-level calibration standard should be within 50% - 150% of the true value, and the mid-level calibration standard within 70% - 130% of the true value.

%RSD >20%	J flag detects and UJ non detects
R^2 >0.990	J flag detects and UJ non detects
Low-level calibration check <50% or >150%	J flag detects and UJ non detects
Mid-level calibration check <70% or >130%	J flag detects and UJ non detects

Initial Calibration Verification

An initial calibration verification (ICV) standard should be from a second source (if available). The ICV should be at the same concentration as the mid-level standard of the calibration curve.

ICV recovery <70% or >130%	J flag detects and non-detects

Continuing Calibration Verification

Continuing calibration verification (CCV) checks should be analyzed at a frequency of one per ten field samples. If CCV recovery is very low, where detection of the analyte could be in question, ensure a low level CCV was analyzed and use to determine data quality.

CCV recovery <70 or >130%	J flag results

Blanks

There should be no detections in the method blanks above the reporting limits. Equipment blanks, field blanks, rinse blanks etc. should be evaluated in the same manner as method blanks. Use the most contaminated blank to evaluate the sample results.

Blank Result	Sample Result	Qualification
Any detection	<Reporting limit	Qualify as ND at reporting limit
Any detection	>Reporting Limit and >10x the blank result	No qualification
>Reporting limit	>Reporting limit and <10x blank result	J+ biased high

Field Duplicates

A blind field duplicate should be collected at rate of one per twenty samples. The relative percent difference (RPD) should be less than 30% for analyte concentrations greater than two times the reporting limit. Use the higher result for final reporting.

RPD >30%	Apply J qualifier to parent sample

Lab Control Spike

Lab control spikes should be analyzed with each extraction batch or one for every twenty samples. In the absence of lab derived criteria, use 70% - 130% recovery criteria to evaluate the data.

Recovery <70% or >130% (lab derived criteria can also be used)	Apply J qualifier to detects and UJ qualifier to non detects

Matrix Spike/Matrix Spike Duplicate

One matrix spike and matrix spike duplicate should be collected at a rate of one per twenty samples. Use professional judgement to reject results based on out of control MS/MSD recoveries.

Recovery <70% or >130% (lab derived criteria can also be used)	Apply J qualifier to detects and UJ qualifier to non detects of parent sample only
RPD >30%	Apply J qualifier to detects and UJ qualifier to non detects of parent sample only

Extracted Internal Standards (Isotope Dilution Analytes)

Problematic analytes (e.g. PFBA, PFPeA, fluorotelomer sulfonates) can have wider recoveries without qualification. Qualify corresponding native compounds with a J flag if outside of the range.

Recovery <50% or >150%	Apply J qualifier
Recovery <25% or >150% for poor responding analytes	Apply J qualifier
Isotope Dilution Analyte (IDA) Recovery <10%	Reject results

Secondary Ion Transition Monitoring

Quantifier and qualifier ions should be monitored for all target analytes (PFBA and PFPeA are exceptions). The ratio of quantifier ion response to qualifier ion response should be calculated from the standards for each target analyte. Lab derived criteria should be used to determine if the ratios are acceptable. If the ratios fall outside of the laboratory criteria, qualify results as an estimated maximum concentration.

Signal to Noise Ratio

The signal to noise ratio for the quantifier ion should be at least 3:1. If the ratio is less than 3:1, the peak is discernable from the baseline noise and symmetrical, the result can be reported. If the peak appears to be baseline noise and/or the shape is irregular, qualify the result as tentatively identified.

Branched and Linear Isomers

Observed branched isomers in the sample that do not have a qualitative or quantitative standard should be noted and the analyte should be qualified as biased low in the final data review summary report. Note: The branched isomer peak should also be present in the secondary ion transition.

Reporting Limits

If project-specific reporting limits were not met, please indicate that in the report along with the reason (e.g. over dilution, dilution for non-target analytes, high sediment in aqueous samples).

Peak Integrations

Target analyte peaks should be integrated properly and consistently when compared to standards. Ensure branched isomer peaks are included for PFAS where standards are available. Inconsistencies should be brought to the attention of the laboratory or identified in the data review summary report.

Appendix D

EPA Region 1 - Low Flow Sampling

Revision 4 - 2017

U.S. ENVIRONMENTAL PROTECTION AGENCY REGION I

LOW STRESS (low flow) PURGING AND SAMPLING PROCEDURE FOR THE COLLECTION OF GROUNDWATER SAMPLES FROM MONITORING WELLS

Quality Assurance Unit
U.S. Environmental Protection Agency – Region 1
11 Technology Drive
North Chelmsford, MA 01863

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Prepared by:___________________________________ ____________
(Robert Reinhart, Quality Assurance Unit) Date

Approved by:___________________________________ ____________
(John Smaldone, Quality Assurance Unit) Date

Revision Page

Date	**Rev #**	**Summary of changes**	**Sections**
7/30/96	1	Finalized	
01/19/10	2	Updated	All sections
3/23/17	3	Updated	All sections
9/20/17	4	Updated	Section 7.0

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1.0 USE OF TERMS

Equipment blank: The equipment blank shall include the pump and the pump's tubing. If tubing is dedicated to the well, the equipment blank needs only to include the pump in subsequent sampling rounds. If the pump and tubing are dedicated to the well, the equipment blank is collected prior to its placement in the well. If the pump and tubing will be used to sample multiple wells, the equipment blank is normally collected after sampling from contaminated wells and not after background wells.

Field duplicates: Field duplicates are collected to determine precision of the sampling procedure. For this procedure, collect duplicate for each analyte group in consecutive order (VOC original, VOC duplicate, SVOC original, SVOC duplicate, etc.).

Indicator field parameters: This SOP uses field measurements of turbidity, dissolved oxygen, specific conductance, temperature, pH, and oxidation/reduction potential (ORP) as indicators of when purging operations are sufficient and sample collection may begin.

Matrix Spike/Matrix Spike Duplicates: Used by the laboratory in its quality assurance program. Consult the laboratory for the sample volume to be collected.

Potentiometric Surface: The level to which water rises in a tightly cased well constructed in a confined aquifer. In an unconfined aquifer, the potentiometric surface is the water table.

QAPP: Quality Assurance Project Plan

SAP: Sampling and Analysis Plan

SOP: Standard operating procedure

Stabilization: A condition that is achieved when all indicator field parameter measurements are sufficiently stable (as described in the “Monitoring Indicator Field Parameters” section) to allow sample collection to begin.

Temperature blank: A temperature blank is added to each sample cooler. The blank is measured upon receipt at the laboratory to assess whether the samples were properly cooled during transit.

Trip blank (VOCs): Trip blank is a sample of analyte-free water taken to the sampling site and returned to the laboratory. The trip blanks (one pair) are added to each sample cooler that contains VOC samples.

2.0 SCOPE & APPLICATION

The goal of this groundwater sampling procedure is to collect water samples that reflect the total mobile organic and inorganic loads (dissolved and colloidal sized fractions) transported through the subsurface under ambient flow conditions, with minimal physical and chemical alterations from sampling operations. This standard operating procedure (SOP) for collecting groundwater samples will help ensure that the project's data quality objectives (DQOs) are met under certain low-flow conditions.

The SOP emphasizes the need to minimize hydraulic stress at the well-aquifer interface by maintaining low water-level drawdowns, and by using low pumping rates during purging and sampling operations. Indicator field parameters (e.g., dissolved oxygen, pH, etc.) are monitored during purging in order to determine when sample collection may begin. Samples properly collected using this SOP are suitable for analysis of groundwater contaminants (volatile and semi-volatile organic analytes, dissolved gases, pesticides, PCBs, metals and other inorganics), or naturally occurring analytes. This SOP is based on Puls, and Barcelona (1996).

This procedure is designed for monitoring wells with an inside diameter (1.5-inches or greater) that can accommodate a positive lift pump with a screen length or open interval ten feet or less and with a water level above the top of the screen or open interval (Hereafter, the "screen or open interval" will be referred to only as "screen interval"). This SOP is not applicable to other well-sampling conditions.

While the use of dedicated sampling equipment is not mandatory, dedicated pumps and tubing can reduce sampling costs significantly by streamlining sampling activities and thereby reducing the overall field costs.

The goal of this procedure is to emphasize the need for consistency in deploying and operating equipment while purging and sampling monitoring wells during each sampling event. This will help to minimize sampling variability.

This procedure describes a general framework for groundwater sampling. Other site specific information (hydrogeological context, conceptual site model (CSM), DQOs, etc.) coupled with systematic planning must be added to the procedure in order to develop an appropriate site specific SAP/QAPP. In addition, the site specific SAP/QAPP must identify the specific equipment that will be used to collect the groundwater samples.

This procedure does not address the collection of water or free product samples from wells containing free phase LNAPLs and/or DNAPLs (light or dense non-aqueous phase liquids). For this type of situation, the reader may wish to check: Cohen, and Mercer (1993) or other pertinent documents.

This SOP is to be used when collecting groundwater samples from monitoring wells at all Superfund, Federal Facility and RCRA sites in Region 1 under the conditions described herein. Request for modification of this SOP, in order to better address specific situations at individual wells, must include adequate technical justification for proposed changes. All changes and modifications must be approved and included in a revised SAP/QAPP before implementation in field.

3.0 BACKGROUND FOR IMPLEMENTATION

It is expected that the monitoring well screen has been properly located (both laterally and vertically) to intercept existing contaminant plume(s) or along flow paths of potential contaminant migration. Problems with inappropriate monitoring well placement or faulty/improper well installation cannot be overcome by even the best water sampling procedures. This SOP presumes that the analytes of interest are moving (or will potentially move) primarily through the more permeable zones intercepted by the screen interval.

Proper well construction, development, and operation and maintenance cannot be overemphasized. The use of installation techniques that are appropriate to the hydrogeologic setting of the site often prevent "problem well" situations from occurring. During well development, or redevelopment, tests should be conducted to determine the hydraulic characteristics of the monitoring well. The data can then be used to set the purging/sampling rate, and provide a baseline for evaluating changes in well performance and the potential need for well rehabilitation. Note: if this installation data or well history (construction and sampling) is not available or discoverable, for all wells to be sampled, efforts to build a sampling history should commence with the next sampling event.

The pump intake should be located within the screen interval and at a depth that will remain under water at all times. It is recommended that the intake depth and pumping rate remain the same for all sampling events. The mid-point or the lowest historical midpoint of the saturated screen length is often used as the location of the pump intake. For new wells, or for wells without pump intake depth information, the site's SAP/QAPP must provide clear reasons and instructions on how the pump intake depth(s) will be selected, and reason(s) for the depth(s) selected. If the depths to top and bottom of the well screen are not known, the SAP/QAPP will need to describe how the sampling depth will be determined and how the data can be used.

Stabilization of indicator field parameters is used to indicate that conditions are suitable for sampling to begin. Achievement of turbidity levels of less than 5 NTU, and stable drawdowns of less than 0.3 feet, while desirable, are not mandatory. Sample collection may still take place provided the indicator field parameter criteria in this procedure are met. If after 2 hours of purging indicator field parameters have not stabilized, one of three optional courses of action may be taken: a) continue purging until stabilization is achieved, b) discontinue purging, do not collect any samples, and record in log book that stabilization could not be achieved (documentation must describe attempts to achieve stabilization), c) discontinue purging, collect samples and provide full explanation of attempts to achieve stabilization (note: there is a risk that the analytical data obtained, especially metals and strongly hydrophobic organic analytes, may reflect a sampling bias and therefore, the data may not meet the data quality objectives of the sampling event).

It is recommended that low-flow sampling be conducted when the air temperature is above 32°F (0°C). If the procedure is used below 32°F, special precautions will need to be taken to prevent the groundwater from freezing in the equipment. Because sampling during freezing temperatures may adversely impact the data quality objectives, the need for water sample collection during months when these conditions are likely to occur should be evaluated during site planning and special sampling measures may need to be developed. Ice formation in the flow-through-cell will cause the monitoring probes to act erratically. A transparent flow-through-cell needs to be used to observe if ice is forming in the cell. If ice starts to form on the other pieces of the sampling equipment, additional problems may occur.

4.0 HEALTH & SAFETY

When working on-site, comply with all applicable OSHA requirements and the site's health/safety procedures. All proper personal protection clothing and equipment are to be worn. Some samples may contain biological and chemical hazards. These samples should be handled with suitable protection to skin, eyes, etc.

5.0 CAUTIONS

The following cautions need to be considered when planning to collect groundwater samples when the below conditions occur.

If the groundwater degasses during purging of the monitoring well, dissolved gases and VOCs will be lost. When this happens, the groundwater data for dissolved gases (e.g., methane, ethene, ethane, dissolved oxygen, etc.) and VOCs will need to be qualified. Some conditions that can promote degassing are the use of a vacuum pump (e.g., peristaltic pumps), changes in aperture along the sampling tubing, and squeezing/pinching the pump's tubing which results in a pressure change.

When collecting the samples for dissolved gases and VOCs analyses, avoid aerating the groundwater in the pump's tubing. This can cause loss of the dissolved gases and VOCs in the groundwater. Having the pump's tubing completely filled prior to sampling will avoid this problem when using a centrifugal pump or peristaltic pump.

Direct sun light and hot ambient air temperatures may cause the groundwater in the tubing and flow-through-cell to heat up. This may cause the groundwater to degas which will result in loss of VOCs and dissolved gases. When sampling under these conditions, the sampler will need to shade the equipment from the sunlight (e.g., umbrella, tent, etc.). If possible, sampling on hot days, or during the hottest time of the day, should be avoided. The tubing exiting the monitoring well should be kept as short as possible to avoid the sun light or ambient air from heating up the groundwater.

Thermal currents in the monitoring well may cause vertical mixing of water in the well bore. When the air temperature is colder than the groundwater temperature, it can cool the top of the water column. Colder water which is denser than warm water sinks to the bottom of the well and the warmer water at the bottom of the well rises, setting up a convection cell. "During low-flow sampling, the pumped water may be a mixture of convecting water from within the well casing and aquifer water moving inward through the screen. This mixing of water during low-flow sampling can substantially increase equilibration times, can cause false stabilization of indicator parameters, can give false indication of redox state, and can provide biological data that are not representative of the aquifer conditions" (Vroblesky 2007).

Failure to calibrate or perform proper maintenance on the sampling equipment and measurement instruments (e.g., dissolved oxygen meter, etc.) can result in faulty data being collected.

Interferences may result from using contaminated equipment, cleaning materials, sample containers, or uncontrolled ambient/surrounding air conditions (e.g., truck/vehicle exhaust nearby).

Cross contamination problems can be eliminated or minimized through the use of dedicated sampling equipment and/or proper planning to avoid ambient air interferences. Note that the use of dedicated sampling equipment can also significantly reduce the time needed to complete each sampling event, will promote consistency in the sampling, and may reduce sampling bias by having the pump's intake at a constant depth.

Clean and decontaminate all sampling equipment prior to use. All sampling equipment needs to be routinely checked to be free from contaminants and equipment blanks collected to ensure that the equipment is free of contaminants. Check the previous equipment blank data for the site (if they exist) to determine if the previous cleaning procedure removed the contaminants. If contaminants were detected and they are a concern, then a more vigorous cleaning procedure will be needed.

6.0 PERSONNEL QUALIFICATIONS

All field samplers working at sites containing hazardous waste must meet the requirements of the OSHA regulations. OSHA regulations may require the sampler to take the 40 hour OSHA health and safety training course and a refresher course prior to engaging in any field activities, depending upon the site and field conditions.

The field samplers must be trained prior to the use of the sampling equipment, field instruments, and procedures. Training is to be conducted by an experienced sampler before initiating any sampling procedure.

The entire sampling team needs to read, and be familiar with, the site Health and Safety Plan, all relevant SOPs, and SAP/QAPP (and the most recent amendments) before going onsite for the sampling event. It is recommended that the field sampling leader attest to the understanding of these site documents and that it is recorded.

7.0 EQUIPMENT AND SUPPLIES

A. Informational materials for sampling event

A copy of the current Health and Safety Plan, SAP/QAPP, monitoring well construction data, location map(s), field data from last sampling event, manuals for sampling, and the monitoring instruments’ operation, maintenance, and calibration manuals should be brought to the site.

B. Well keys.

C. Extraction device

Adjustable rate, submersible pumps (e.g., centrifugal, bladder, etc.) which are constructed of stainless steel or polytetrafluoroethylene (PTFE, i.e. Teflon®) are preferred. PTFE, however, should not be used when sampling for per- and polyfluoroalkyl substances (PFAS) as it is likely to contain these substances.

Note: If extraction devices constructed of other materials are to be used, adequate information must be provided to show that the substituted materials do not leach contaminants nor cause interferences to the analytical procedures to be used. Acceptance of these materials must be obtained before the sampling event.

If bladder pumps are selected for the collection of VOCs and dissolved gases, the pump setting should be set so that one pulse will deliver a water volume that is sufficient to fill a 40 mL VOC vial. This is not mandatory, but is considered a "best practice". For the proper operation, the bladder pump will need a minimum amount of water above the pump; consult the manufacturer for the recommended submergence. The pump's recommended submergence value should be determined during the planning stage, since it may influence well construction and placement of dedicated pumps where water-level fluctuations are significant.

Adjustable rate, peristaltic pumps (suction) are to be used with caution when collecting samples for VOCs and dissolved gases (e.g., methane, carbon dioxide, etc.) analyses. Additional information on the use of peristaltic pumps can be found in Appendix A.
If peristaltic pumps are used, the inside diameter of the rotor head tubing needs to match the inside diameter of the tubing installed in the monitoring well.

Inertial pumping devices (motor driven or manual) are not recommended. These devices frequently cause greater disturbance during purging and sampling, and are less easily controlled than submersible pumps (potentially increasing turbidity and sampling variability, etc.). This can lead to sampling results that are adversely affected by purging and sampling operations, and a higher degree of data variability.

D. Tubing

PTFE (Teflon®) or PTFE-lined polyethylene tubing are preferred when sampling is to include VOCs, SVOCs, pesticides, PCBs and inorganics. As discussed in the previous section, PTFE tubing should not be used when sampling for PFAS. In this case, a suitable alternative such as high-density polyethylene tubing should be used.

PVC, polypropylene or polyethylene tubing may be used when collecting samples for metal and other inorganics analyses.

Note: If tubing constructed of other materials is to be used, adequate information must be provided to show that the substituted materials do not leach contaminants nor cause interferences to the analytical procedures to be used. Acceptance of these materials must be obtained before the sampling event.

The use of 1/4 inch or 3/8 inch (inside diameter) tubing is recommended. This will help ensure that the tubing remains liquid filled when operating at very low pumping rates when using centrifugal and peristaltic pumps.

Silastic tubing should be used for the section around the rotor head of a peristaltic pump. It should be less than a foot in length. The inside diameter of the tubing used at the pump rotor head must be the same as the inside diameter of tubing placed in the well. A tubing connector is used to connect the pump rotor head tubing to the well tubing. Alternatively, the two pieces of tubing can be connected to each other by placing the one end of the tubing inside the end of the other tubing. The tubing must not be reused.

E. The water level measuring device

Electronic ”tape”, pressure transducer, water level sounder/level indicator, etc. should be capable of measuring to 0.01 foot accuracy. Recording pressure transducers, mounted above the pump, are especially helpful in tracking water levels during pumping operations, but their use must include check measurements with a water level “tape” at the start and end of each sampling event.

F. Flow measurement supplies

Graduated cylinder (size according to flow rate) and stopwatch usually will suffice.

Large graduated bucket used to record total water purged from the well.

G. Interface probe

To be used to check on the presence of free phase liquids (LNAPL, or DNAPL) before purging begins (as needed).

H. Power source (generator, nitrogen tank, battery, etc.)

When a gasoline generator is used, locate it downwind and at least 30 feet from the well so that the exhaust fumes do not contaminate samples.

I. Indicator field parameter monitoring instruments

Use of a multi-parameter instrument capable of measuring pH, oxidation/reduction potential (ORP), dissolved oxygen (DO), specific conductance, temperature, and coupled with a flow-through-cell is required when measuring all indicator field parameters, except turbidity. Turbidity is collected using a separate instrument. Record equipment/instrument identification (manufacturer, and model number).

Transparent, small volume flow-through-cells (e.g., 250 mLs or less) are preferred. This allows observation of air bubbles and sediment buildup in the cell, which can interfere with the operation of the monitoring instrument probes, to be easily detected. A small volume cell facilitates rapid turnover of water in the cell between measurements of the indicator field parameters.

It is recommended to use a flow-through-cell and monitoring probes from the same manufacturer and model to avoid incompatibility between the probes and flow-through-cell.

Turbidity samples are collected before the flow-through-cell. A “T” connector coupled with a valve is connected between the pump’s tubing and flow-through-cell. When a turbidity measurement is required, the valve is opened to allow the groundwater to flow into a container. The valve is closed and the container sample is then placed in the turbidimeter.

Standards are necessary to perform field calibration of instruments. A minimum of two standards are needed to bracket the instrument measurement range for all parameters except ORP which use a Zobell solution as a standard. For dissolved oxygen, a wet sponge used for the 100% saturation and a zero dissolved oxygen solution are used for the calibration.

Barometer (used in the calibration of the Dissolved Oxygen probe) and the conversion formula to convert the barometric pressure into the units of measure used by the Dissolved Oxygen meter are needed.

J. Decontamination supplies

Includes (for example) non-phosphate detergent, distilled/deionized water, isopropyl alcohol, etc.

K. Record keeping supplies

Logbook(s), well purging forms, chain-of-custody forms, field instrument calibration forms, etc.

L. Sample bottles

M. Sample preservation supplies (as required by the analytical methods)

N. Sample tags or labels

O. PID or FID instrument

If appropriate, to detect VOCs for health and safety purposes, and provide qualitative field evaluations.

P. Miscellaneous Equipment

Equipment to keep the sampling apparatus shaded in the summer (e.g., umbrella) and from freezing in the winter. If the pump's tubing is allowed to heat up in the warm weather, the cold groundwater may degas as it is warmed in the tubing.

8.0 EQUIPMENT/INSTRUMENT CALIBRATION

Prior to the sampling event, perform maintenance checks on the equipment and instruments according to the manufacturer's manual and/or applicable SOP. This will ensure that the equipment/instruments are working properly before they are used in the field.

Prior to sampling, the monitoring instruments must be calibrated and the calibration documented. The instruments are calibrated using U.S Environmental Protection Agency Region 1 *Calibration of Field Instruments (temperature, pH, dissolved oxygen, conductivity/specific conductance, oxidation/reduction [ORP], and turbidity),* March 23, 2017, or latest version or from one of the methods listed in 40CFR136, 40CFR141 and SW-846.

The instruments shall be calibrated at the beginning of each day. If the field measurement falls outside the calibration range, the instrument must be re-calibrated so that all measurements fall within the calibration range. At the end of each day, a calibration check is performed to verify that instruments remained in calibration throughout the day. This check is performed while the instrument is in measurement mode, not calibration mode. If the field instruments are being used to monitor the natural attenuation parameters, then a calibration check at mid-day is highly recommended to ensure that the instruments did not drift out of calibration. Note: during the day if the instrument reads zero or a negative number for dissolved oxygen, pH, specific conductance, or turbidity (negative value only), this indicates that the instrument drifted out of calibration or the instrument is malfunctioning. If this situation occurs the data from this instrument will need to be qualified or rejected.

9.0 PRELIMINARY SITE ACTIVITIES (as applicable)

Check the well for security (damage, evidence of tampering, missing lock, etc.) and record pertinent observations (include photograph as warranted).

If needed, lay out a sheet of clean polyethylene for monitoring and sampling equipment, unless equipment is elevated above the ground (e.g., on a table, etc.).

Remove well cap and if appropriate measure VOCs at the rim of the well with a PID or FID instrument and record reading in field logbook or on the well purge form.

If the well casing does not have an established reference point (usually a V-cut or indelible mark in the well casing), make one. Describe its location and record the date of the mark in the logbook (consider a photographic record as well). All water level measurements must be recorded relative to this reference point (and the altitude of this point should be determined using techniques that are appropriate to site's DQOs.

If water-table or potentiometric surface map(s) are to be constructed for the sampling event, perform synoptic water level measurement round (in the shortest possible time) before any purging and sampling activities begin. If possible, measure water level depth (to 0.01 ft.) and total well depth (to 0.1 ft.) the day before sampling begins, in order to allow for re-settlement of any particulates in the water column. This is especially important for those wells that have not been recently sampled because sediment buildup in the well may require the well to be redeveloped. If measurement of total well depth is not made the day before, it should be measured after sampling of the well is complete. All measurements must be taken from the established referenced point. Care should be taken to minimize water column disturbance.

Check newly constructed wells for the presence of LNAPLs or DNAPLs before the initial sampling round. If none are encountered, subsequent check measurements with an interface probe may not be necessary unless analytical data or field analysis signal a worsening situation. This SOP cannot be used in the presence of LNAPLs or DNAPLs. If NAPLs are present, the project team must decide upon an alternate sampling method. All project modifications must be approved and documented prior to implementation.

If available check intake depth and drawdown information from previous sampling event(s) for each well. Duplicate, to the extent practicable, the intake depth and extraction rate (use final pump dial setting information) from previous event(s). If changes are made in the intake depth or extraction rate(s) used during previous sampling event(s), for either portable or dedicated extraction devices, record new values, and explain reasons for the changes in the field logbook.

10.0 PURGING AND SAMPLING PROCEDURE

Purging and sampling wells in order of increasing chemical concentrations (known or anticipated) are preferred.

The use of dedicated pumps is recommended to minimize artificial mobilization and entrainment of particulates each time the well is sampled. Note that the use of dedicated sampling equipment can also significantly reduce the time needed to complete each sampling event, will promote consistency in the sampling, and may reduce sampling bias by having the pump's intake at a constant depth.

A. Initial Water Level

Measure the water level in the well before installing the pump if a non-dedicated pump is being used. The initial water level is recorded on the purge form or in the field logbook.

B. Install Pump

Lower pump, safety cable, tubing and electrical lines slowly (to minimize disturbance) into the well to the appropriate depth (may not be the mid-point of the screen/open interval). The Sampling and Analysis Plan/Quality Assurance Project Plan should specify the sampling depth (used previously), or provide criteria for selection of intake depth for each new well. If possible keep the pump intake at least two feet above the bottom of the well, to minimize mobilization of particulates present in the bottom of the well.

Pump tubing lengths, above the top of well casing should be kept as short as possible to minimize heating the groundwater in the tubing by exposure to sun light and ambient air temperatures. Heating may cause the groundwater to degas, which is unacceptable for the collection of samples for VOC and dissolved gases analyses.

C. Measure Water Level

Before starting pump, measure water level. Install recording pressure transducer, if used to track drawdowns, to initialize starting condition.

D. Purge Well

From the time the pump starts purging and until the time the samples are collected, the purged water is discharged into a graduated bucket to determine the total volume of groundwater purged. This information is recorded on the purge form or in the field logbook.

Start the pump at low speed and slowly increase the speed until discharge occurs. Check water level. Check equipment for water leaks and if present fix or replace the affected equipment. Try to match pumping rate used during previous sampling event(s). Otherwise, adjust pump speed until there is little or no water level drawdown. If the minimal drawdown that can be achieved exceeds 0.3 feet, but remains stable, continue purging.

Monitor and record the water level and pumping rate every five minutes (or as appropriate) during purging. Record any pumping rate adjustments (both time and flow rate). Pumping rates should, as needed, be reduced to the minimum capabilities of the pump to ensure stabilization of the water level. Adjustments are best made in the first fifteen minutes of pumping in order to help minimize purging time. During pump start-up, drawdown may exceed the 0.3 feet target and then "recover" somewhat as pump flow adjustments are made. Purge volume calculations should utilize stabilized drawdown value, not the initial drawdown. If the initial water level is above the top of the screen do not allow the water level to fall into the well screen. The final purge volume must be greater than the stabilized drawdown volume plus the pump’s tubing volume. If the drawdown has exceeded 0.3 feet and stabilizes, calculate the volume of water between the initial water level and the stabilized water level. Add the volume of the water which occupies the pump’s tubing to this calculation. This combined volume of water needs to be purged from the well after the water level has stabilized before samples are collected.

Avoid the use of constriction devices on the tubing to decrease the flow rate because the constrictor will cause a pressure difference in the water column. This will cause the groundwater to degas and result in a loss of VOCs and dissolved gasses in the groundwater samples.

Note: the flow rate used to achieve a stable pumping level should remain constant while monitoring the indicator parameters for stabilization and while collecting the samples.

Wells with low recharge rates may require the use of special pumps capable of attaining very low pumping rates (e.g., bladder, peristaltic), and/or the use of dedicated equipment. For new monitoring wells, or wells where the following situation has not occurred before, if the recovery rate to the well is less than 50 mL/min., or the well is being essentially dewatered during purging, the well should be sampled as soon as the water level has recovered sufficiently to collect the volume needed for all anticipated samples. The project manager or field team leader will need to make the decision when samples should be collected, how the sample is to be collected, and the reasons recorded on the purge form or in the field logbook. A water level measurement needs to be performed and recorded before samples are collected. If the project manager decides to collect the samples using the pump, it is best during this recovery period that the pump intake tubing not be removed, since this will aggravate any turbidity problems. Samples in this specific situation may be collected without stabilization of indicator field parameters. Note that field conditions and efforts to overcome problematic situations must be recorded in order to support field decisions to deviate from normal procedures described in this SOP. If this type of problematic situation persists in a well, then water sample collection should be changed to a passive or no-purge method, if consistent with the site's DQOs, or have a new well installed.

E. Monitor Indicator Field Parameters

After the water level has stabilized, connect the "T" connector with a valve and the flow-through-cell to monitor the indicator field parameters. If excessive turbidity is anticipated or encountered with the pump startup, the well may be purged for a while without connecting up the flow-through-cell, in order to minimize particulate buildup in the cell (This is a judgment call made by the sampler). Water level drawdown measurements should be made as usual. If possible, the pump may be installed the day before purging to allow particulates that were disturbed during pump insertion to settle.

During well purging, monitor indicator field parameters (turbidity, temperature, specific conductance, pH, ORP, DO) at a frequency of five minute intervals or greater. The pump's flow rate must be able to "turn over" at least one flow-through-cell volume between measurements (for a 250 mL flow-through-cell with a flow rate of 50 mLs/min., the monitoring frequency would be every five minutes; for a 500 mL flow-through-cell it would be every ten minutes). If the cell volume cannot be replaced in the five minute interval, then the time between measurements must be increased accordingly. <u>Note: during the early phase of purging, emphasis should be put on minimizing and stabilizing pumping stress, and recording those adjustments followed by stabilization of indicator parameters. Purging is considered complete and sampling may begin when all the above indicator field parameters have stabilized. Stabilization is considered to be achieved when three consecutive readings are within the following limits:</u>

Turbidity (10% for values greater than 5 NTU; if three Turbidity values are less than 5 NTU, consider the values as stabilized),
Dissolved Oxygen (10% for values greater than 0.5 mg/L, if three Dissolved Oxygen values are less than 0.5 mg/L, consider the values as stabilized),
Specific Conductance (3%),
Temperature (3%),
pH (± 0.1 unit),
Oxidation/Reduction Potential (±10 millivolts).

All measurements, except turbidity, must be obtained using a flow-through-cell. Samples for turbidity measurements are obtained before water enters the flow-through-cell. Transparent flow-through-cells are preferred, because they allow field personnel to watch for particulate build-up within the cell. This build-up may affect indicator field parameter values measured within the cell. If the cell needs to be cleaned during purging operations, continue pumping and disconnect cell for cleaning, then reconnect after cleaning and continue monitoring activities. Record start and stop times and give a brief description of cleaning activities.

The flow-through-cell must be designed in a way that prevents gas bubble entrapment in the cell. Placing the flow-through-cell at a 45 degree angle with the port facing upward can help remove bubbles from the flow-through-cell (see Appendix B Low-Flow Setup Diagram). Throughout the measurement process, the flow-through-cell must remain free of any gas bubbles. Otherwise, the monitoring probes may act erratically. When the pump is turned off or cycling on/off (when using a bladder pump), water in the cell must not drain out. Monitoring probes must remain submerged in water at all times.

F. Collect Water Samples

When samples are collected for laboratory analyses, the pump's tubing is disconnected from the "T" connector with a valve and the flow-through-cell. The samples are collected directly from the pump's tubing. Samples must not be collected from the flow-through-cell or from the "T" connector with a valve.

VOC samples are normally collected first and directly into pre-preserved sample containers. However, this may not be the case for all sampling locations; the SAP/QAPP should list the order in which the samples are to be collected based on the project's objective(s). Fill all sample containers by allowing the pump discharge to flow gently down the inside of the container with minimal turbulence.

If the pump's flow rate is too high to collect the VOC/dissolved gases samples, collect the other samples first. Lower the pump's flow rate to a reasonable rate and collect the VOC/dissolved gases samples and record the new flow rate.

During purging and sampling, the centrifugal/peristaltic pump tubing must remain filled with water to avoid aeration of the groundwater. It is recommended that 1/4 inch or 3/8 inch (inside diameter) tubing be used to help ensure that the sample tubing remains water filled. If the pump tubing is not completely filled to the sampling point, use the following procedure to collect samples: collect non-VOC/dissolved gases samples first, then increase flow rate slightly until the water completely fills the tubing, collect the VOC/dissolved gases samples, and record new drawdown depth and flow rate.

For bladder pumps that will be used to collect VOC or dissolved gas samples, it is recommended that the pump be set to deliver long pulses of water so that one pulse will fill a 40 mL VOC vial.

Use pre-preserved sample containers or add preservative, as required by analytical methods, to the samples immediately after they are collected. Check the analytical methods (e.g. EPA SW-846, 40 CFR 136, water supply, etc.) for additional information on preservation.

If determination of filtered metal concentrations is a sampling objective, collect filtered water samples using the same low flow procedures. The use of an in-line filter (transparent housing preferred) is required, and the filter size (0.45 µm is commonly used) should be based on the sampling objective. Pre-rinse the filter with groundwater prior to sample collection. Make sure the filter is free of air bubbles before samples are collected. Preserve the filtered water sample immediately. Note: filtered water samples are not an acceptable substitute for unfiltered samples when the monitoring objective is to obtain chemical concentrations of total mobile contaminants in groundwater for human health or ecological risk calculations.

Label each sample as collected. Samples requiring cooling will be placed into a cooler with ice or refrigerant for delivery to the laboratory. Metal samples after acidification to a pH less than 2 do not need to be cooled.

G. Post Sampling Activities

If a recording pressure transducer is used to track drawdown, re-measure water level with tape.

After collection of samples, the pump tubing may be dedicated to the well for re-sampling (by hanging the tubing inside the well), decontaminated, or properly discarded.

Before securing the well, measure and record the well depth (to 0.1 ft.), if not measured the day before purging began. Note: measurement of total well depth annually is usually sufficient after the initial low stress sampling event. However, a greater frequency may be needed if the well has a “silting” problem or if confirmation of well identity is needed.

Secure the well.

11.0 DECONTAMINATION

Decontaminate sampling equipment prior to use in the first well, and then following sampling of each subsequent well. Pumps should not be removed between purging and sampling operations. The pump, tubing, support cable and electrical wires which were in contact with the well should be decontaminated by one of the procedures listed below.

The use of dedicated pumps and tubing will reduce the amount of time spent on decontamination of the equipment. If dedicated pumps and tubing are used, only the initial sampling event will require decontamination of the pump and tubing.

Note if the previous equipment blank data showed that contaminant(s) were present after using the below procedure or the one described in the SAP/QAPP, a more vigorous procedure may be needed.

Procedure 1

Decontaminating solutions can be pumped from either buckets or short PVC casing sections through the pump and tubing. The pump may be disassembled and flushed with the decontaminating solutions. It is recommended that detergent and alcohol be used sparingly in the decontamination process and water flushing steps be extended to ensure that any sediment trapped in the pump is removed. The pump exterior and electrical wires must be rinsed with the decontaminating solutions, as well. The procedure is as follows:

Flush the equipment/pump with potable water.

Flush with non-phosphate detergent solution. If the solution is recycled, the solution must be changed periodically.

Flush with potable or distilled/deionized water to remove all of the detergent solution. If the water is recycled, the water must be changed periodically.

Optional - flush with isopropyl alcohol (pesticide grade; must be free of ketones {e.g., acetone}) or with methanol. This step may be required if the well is highly contaminated or if the equipment blank data from the previous sampling event show that the level of contaminants is significant.

Flush with distilled/deionized water. This step must remove all traces of alcohol (if used) from the equipment. The final water rinse must not be recycled.

Procedure 2

Steam clean the outside of the submersible pump.

Pump hot potable water from the steam cleaner through the inside of the pump. This can be accomplished by placing the pump inside a three or four inch diameter PVC pipe with end cap. Hot water from the steam cleaner jet will be directed inside the PVC pipe and the pump exterior will be cleaned. The hot water from the steam cleaner will then be pumped from the PVC pipe through the pump and collected into another container. Note: additives or solutions should not be added to the steam cleaner.

Pump non-phosphate detergent solution through the inside of the pump. If the solution is recycled, the solution must be changed periodically.

Pump potable water through the inside of the pump to remove all of the detergent solution. If the solution is recycled, the solution must be changed periodically.

Pump distilled/deionized water through the pump. The final water rinse must not be recycled.

12.0 FIELD QUALITY CONTROL

Quality control samples are required to verify that the sample collection and handling process has not compromised the quality of the groundwater samples. All field quality control samples must be prepared the same as regular investigation samples with regard to sample volume, containers, and preservation. Quality control samples include field duplicates, equipment blanks, matrix spike/matrix spike duplicates, trip blanks (VOCs), and temperature blanks.

13.0 FIELD LOGBOOK

A field log shall be kept to document all groundwater field monitoring activities (see Appendix C, example table), and record the following for each well:

Site name, municipality, state.

Well identifier, latitude-longitude or state grid coordinates.

Measuring point description (e.g., north side of PVC pipe).

Well depth, and measurement technique.

Well screen length.

Pump depth.

Static water level depth, date, time and measurement technique.

Presence and thickness of immiscible liquid (NAPL) layers and detection method.

Pumping rate, drawdown, indicator parameters values, calculated or measured total volume pumped, and clock time of each set of measurements.

Type of tubing used and its length.

Type of pump used.

Clock time of start and end of purging and sampling activity.

Types of sample bottles used and sample identification numbers.

Preservatives used.

Parameters requested for analyses.

Field observations during sampling event.

Name of sample collector(s).

Weather conditions, including approximate ambient air temperature.

QA/QC data for field instruments.

Any problems encountered should be highlighted.

Description of all sampling/monitoring equipment used, including trade names, model number, instrument identification number, diameters, material composition, etc.

14.0 DATA REPORT

Data reports are to include laboratory analytical results, QA/QC information, field indicator parameters measured during purging, field instrument calibration information, and whatever other field logbook information is needed to allow for a full evaluation of data usability.

Note: the use of trade, product, or firm names in this sampling procedure is for descriptive purposes only and does not constitute endorsement by the U.S. EPA.

15.0 REFERENCES

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U.S Environmental Protection Agency, EPA SW-846.

U.S Environmental Protection Agency, 40 CFR 136.

U.S Environmental Protection Agency, 40 CFR 141.

Vroblesky, Don A., Clifton C. Casey, and Mark A. Lowery, Summer 2007, Influence of Dissolved Oxygen Convection on Well Sampling, *Ground Water Monitoring & Remediation* 27, no. 3: 49-58.

APPENDIX A

PERISTALTIC PUMPS

Before selecting a peristaltic pump to collect groundwater samples for VOCs and/or dissolved gases, (e.g., methane, carbon dioxide, etc.) consideration should be given to the following:

- The decision of whether or not to use a peristaltic pump is dependent on the intended use of the data.
- If the additional sampling error that may be introduced by this device is NOT of concern for the VOC/dissolved gases data's intended use, then this device may be acceptable.
- If minor differences in the groundwater concentrations could affect the decision, such as to continue or terminate groundwater cleanup or whether the cleanup goals have been reached, then this device should NOT be used for VOC/dissolved gases sampling. In these cases, centrifugal or bladder pumps are a better choice for more accurate results.

EPA and USGS have documented their concerns with the use of the peristaltic pumps to collect water sample in the below documents.

- "Suction Pumps are not recommended because they may cause degassing, pH modification, and loss of volatile compounds" *A Compendium of Superfund Field Operations Methods*, EPA/540/P-87/001, December 1987.
- "The agency does not recommend the use of peristaltic pumps to sample ground water particularly for volatile organic analytes" *RCRA Ground-Water Monitoring Draft Technical Guidance*, EPA Office of Solid Waste, November 1992.
- "The peristaltic pump is limited to shallow applications and can cause degassing resulting in alteration of pH, alkalinity, and volatiles loss", *Low-flow (Minimal drawdown) Ground-Water Sampling Procedures*, by Robert Puls & Michael Barcelona, April 1996, EPA/540/S-95/504.
- "Suction-lift pumps, such as peristaltic pumps, can operate at a very low pumping rate; however, using negative pressure to lift the sample can result in the loss of volatile analytes", USGS Book 9 Techniques of Water-Resources Investigation, Chapter A4. (Version 2.0, 9/2006).

APPENDIX B

SUMMARY OF SAMPLING INSTRUCTIONS

These instructions are for using an adjustable rate, submersible pump or a peristaltic pump with the pump's intake placed at the midpoint of a 10 foot or less well screen or an open interval. The water level in the monitoring well is above the top of the well screen or open interval, the ambient temperature is above 32°F, and the equipment is not dedicated. Field instruments are already calibrated. The equipment is setup according to the diagram at the end of these instructions.

1. Review well installation information. Record well depth, length of screen or open interval, and depth to top of the well screen. Determine the pump's intake depth (e.g., mid-point of screen/open interval).

2. On the day of sampling, check security of the well casing, perform any safety checks needed for the site, lay out a sheet of polyethylene around the well (if necessary), and setup the equipment. If necessary a canopy or an equivalent item can be setup to shade the pump's tubing and flow-through-cell from the sun light to prevent the sun light from heating the groundwater.

3. Check well casing for a reference mark. If missing, make a reference mark. Measure the water level (initial) to 0.01 ft. and record this information.

4. Install the pump's intake to the appropriate depth (e.g., midpoint) of the well screen or open interval. Do not turn-on the pump at this time.

5. Measure water level and record this information.

6. Turn-on the pump and discharge the groundwater into a graduated waste bucket. Slowly increase the flow rate until the water level starts to drop. Reduce the flow rate slightly so the water level stabilizes. Record the pump's settings. Calculate the flow rate using a graduated container and a stop watch. Record the flow rate. Do not let the water level drop below the top of the well screen.

If the groundwater is highly turbid or discolored, continue to discharge the water into the bucket until the water clears (visual observation); this usually takes a few minutes. The turbid or discolored water is usually from the well-being disturbed during the pump installation. If the water does not clear, then you need to make a choice whether to continue purging the well (hoping that it will clear after a reasonable time) or continue to the next step. Note, it is sometimes helpful to install the pump the day before the sampling event so that the disturbed materials in the well can settle out.

If the water level drops to the top of the well screen during the purging of the well, stop purging the well, and do the following:

> Wait for the well to recharge to a sufficient volume so samples can be collected. This may take a while (pump may be removed from well, if turbidity is not a problem). The project manager will need to make the decision when samples should be collected and the reasons recorded in the site's log book. A water level measurement needs to be performed and recorded before samples are collected. When samples are being collected, the water level must not drop below the top of the screen or open interval. Collect the samples from the pump's tubing. Always collect the VOCs and dissolved gases samples first. Normally, the samples requiring a small volume are collected before the large volume samples are collected just in case there is not sufficient water in the well to fill all the sample containers. All samples must be collected, preserved, and stored according to the analytical method. Remove the pump from the well and decontaminate the sampling equipment.

If the water level has dropped 0.3 feet or less from the initial water level (water level measure before the pump was installed); proceed to Step 7. If the water level has dropped more than 0.3 feet, calculate the volume of water between the initial water level and the stabilized water level. Add the volume of the water which occupies the pump's tubing to this calculation. This combined volume of water needs to be purged from the well after the water level has stabilized before samples are be collected.

7. Attach the pump's tubing to the "T" connector with a valve (or a three-way stop cock). The pump's tubing from the well casing to the "T" connector must be as short as possible to prevent the groundwater in the tubing from heating up from the sun light or from the ambient air. Attach a short piece of tubing to the other end of the end of the "T" connector to serve as a sampling port for the turbidity samples. Attach the remaining end of the "T" connector to a short piece of tubing and connect the tubing to the flow-through-cell bottom port. To the top port, attach a small piece of tubing to direct the water into a calibrated waste bucket. Fill the cell with the groundwater and remove all gas bubbles from the cell. Position the flow-through-cell in such a way that if gas bubbles enter the cell they can easily exit the cell. If the ports are on the same side of the cell and the cell is cylindrical shape, the cell can be placed at a 45-degree angle with the ports facing upwards; this position should keep any gas bubbles entering the cell away from the monitoring probes and allow the gas bubbles to exit the cell easily (see Low-Flow Setup Diagram). Note:

make sure there are no gas bubbles caught in the probes' protective guard; you may need to shake the cell to remove these bubbles.

8. Turn-on the monitoring probes and turbidity meter.

9. Record the temperature, pH, dissolved oxygen, specific conductance, and oxidation/reduction potential measurements. Open the valve on the "T" connector to collect a sample for the turbidity measurement, close the valve, do the measurement, and record this measurement. Calculate the pump's flow rate from the water exiting the flow-through-cell using a graduated container and a stop watch, and record the measurement. Measure and record the water level. Check flow-through-cell for gas bubbles and sediment; if present, remove them.

10. Repeat Step 9 every 5 minutes or as appropriate until monitoring parameters stabilized. Note: at least one flow-through-cell volume must be exchanged between readings. If not, the time interval between readings will need to be increased. Stabilization is achieved when three consecutive measurements are within the following limits:

Turbidity (10% for values greater than 5 NTUs; if three Turbidity values are less than 5 NTUs, consider the values as stabilized),
Dissolved Oxygen (10% for values greater than 0.5 mg/L, if three Dissolved Oxygen values are less than 0.5 mg/L, consider the values as stabilized),
Specific Conductance (3%),
Temperature (3%),
pH (± 0.1 unit),
Oxidation/Reduction Potential (±10 millivolts).

If these stabilization requirements do not stabilize in a reasonable time, the probes may have been coated from the materials in the groundwater, from a buildup of sediment in the flow-through-cell, or a gas bubble is lodged in the probe. The cell and the probes will need to be cleaned. Turn-off the probes (not the pump), disconnect the cell from the "T" connector and continue to purge the well. Disassemble the cell, remove the sediment, and clean the probes according to the manufacturer's instructions. Reassemble the cell and connect the cell to the "T" connector. Remove all gas bubbles from the cell, turn-on the probes, and continue the measurements. Record the time the cell was cleaned.

11. When it is time to collect the groundwater samples, turn-off the monitoring probes, and disconnect the pump's tubing from the "T" connector. If you are using a centrifugal or peristaltic pump check the pump's tubing to determine if the tubing is completely filled with water (no air space).

All samples must be collected and preserved according to the analytical method. VOCs and dissolved gases samples are normally collected first and directly into pre-preserved sample containers. However, this may not be the case for all sampling locations; the SAP/QAPP should list the order in which the samples are to be collected based on the project's objective(s). Fill all sample containers by allowing the pump discharge to flow gently down the inside of the container with minimal turbulence.

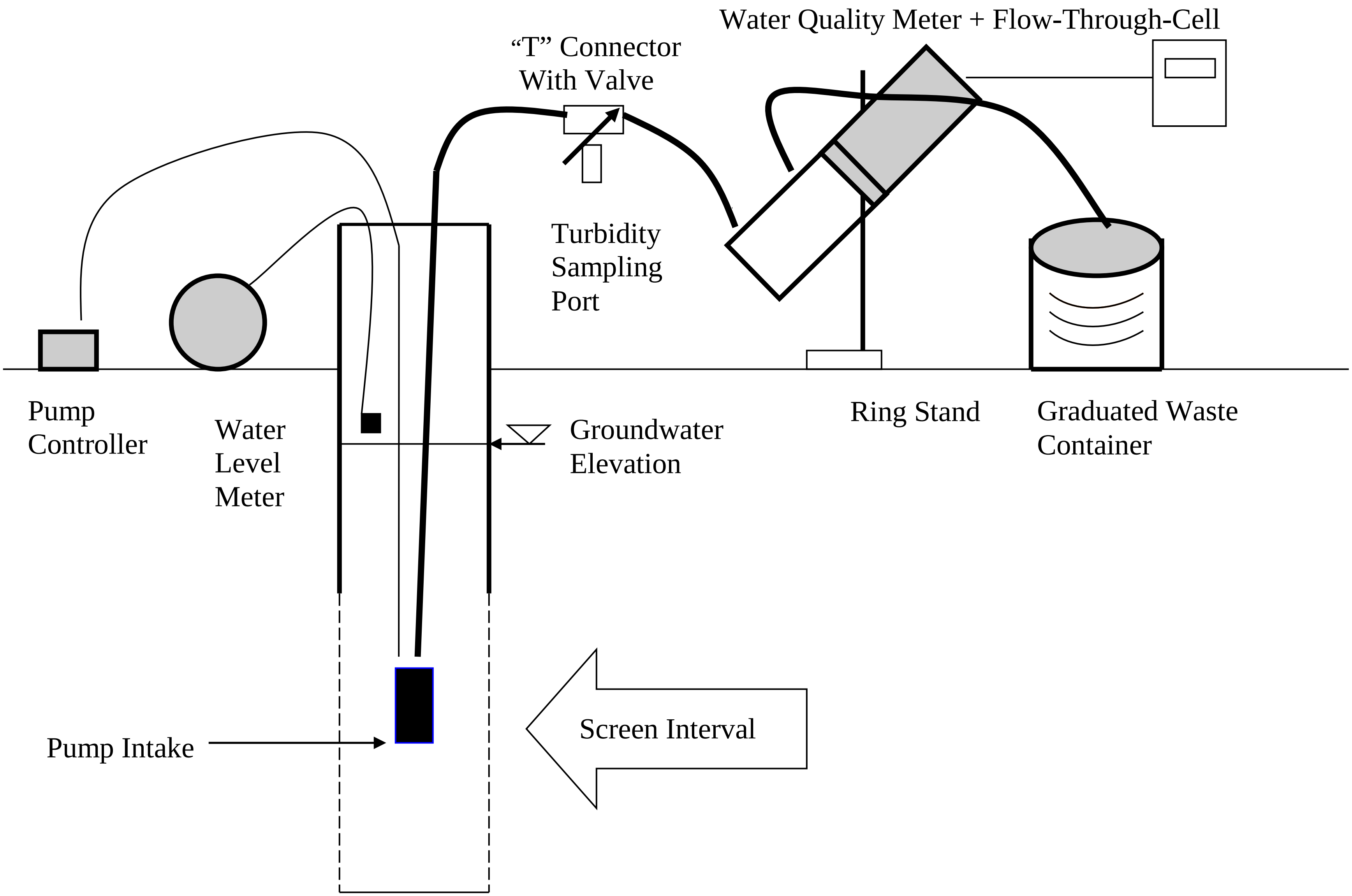
If the pump's tubing is not completely filled with water and the samples are being collected for VOCs and/or dissolved gases analyses using a centrifugal or peristaltic pump, do the following:

> All samples must be collected and preserved according to the analytical method. The VOCs and the dissolved gases (e.g., methane, ethane, ethene, and carbon dioxide) samples are collected last. When it becomes time to collect these samples increase the pump's flow rate until the tubing is completely filled. Collect the samples and record the new flow rate.

12. Store the samples according to the analytical method.

13. Record the total purged volume (graduated waste bucket). Remove the pump from the well and decontaminate the sampling equipment.

Low-Flow Setup Diagram



APPENDIX C

EXAMPLE (Minimum Requirements)

WELL PURGING-FIELD WATER QUALITY MEASUREMENTS FORM

Location (Site/Facility Name)________________________________
Well Number_________________ Date________________________
Field Personnel____
Sampling Organization______________________________________
Identify MP____

Depth to ________/_________ of screen
(below MP) top bottom
Pump Intake at (ft. below MP)_________
Purging Device; (pump type)__________
Total Volume Purged ________________

Clock Time 24 HR	Water Depth below MP ft	Pump Dial[1]	Purge Rate ml/min	Cum. Volume Purged liters	Temp. "C	Spec. Cond.[2] µS/cm	pH	ORP[3] mv	DO mg/L	Tur-bidity NTU	Comments
Stabilization Criteria					3%	3%	±0.1	±10 mv	10%	10%	

1. Pump dial setting (for example: hertz, cycles/min, etc).
2. µSiemens per cm(same as µmhos/cm)at 25°C.
3. Oxidation reduction potential (ORP)