**New York State Department of Environmental Conservation**
625 Broadway • Albany, NY 12233

## WEST SIDE CORPORATION
## OPERABLE UNIT No.2

# Final Offsite Plume Delineation and Investigation Report

Work Assignment No. D00443-10.1

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# Contents

## List of Tables



## List of Figures

# Appendices



# DATA CD

# 1. Executive Summary

This report summarizes the field investigation activities and data collected during the perchloroethene (PCE) offsite plume delineation related to the West Side Corporation site, Operable Unit #2 (OU-2) in Jamaica, Borough of Queens, New York from May 2008 through October 2008. These activities were performed under Work Assignment No.D004443 – 10.1. The purpose of the field investigation was three-fold: to further delineate the extent of PCE in the groundwater migrating off of the West Side site, to gather additional information on the potential formation of PCE vapors related to and located above the PCE plume, and to establish a permanent well network to monitor groundwater contamination for the long term. The onsite (source area) activities are grouped under Operable Unit #1 (OU-1), while the offsite contaminated groundwater is referred to as Operable Unit #2 (OU-2).

Between 1969 and 1992, the 4.5-acre West Side Corp. site was used as a storage and distribution center for laundromat supplies including large quantities of perchloroethylene (PCE). Improper handling of the chemicals has resulted in the release of hazardous waste into the groundwater, primarily PCE, which has migrated from the OU-1 area to residential areas to the south and west of the site.

A single unconfined sand and gravel aquifer occupies the permeable soils beneath OU-1 and OU-2. The regional direction of groundwater flow is south-southwest and depth to water (dtw) is typically 10 to 14 feet below ground surface (bgs).

Field investigations were conducted from May to September 2008. Laboratory analysis of PCE concentrations from the first phase of Geoprobe® investigation indicated that the plume's extent was greater than previously reported. PCE contaminated groundwater was initially detected at and beyond 172nd Street, which was originally thought to be ahead of the plume's leading edge. Based upon these findings, a phase of field investigation to complete plume delineation and establish locations for permanent monitoring wells.

Forty-four (44) groundwater monitoring wells were installed in clusters at shallow (~12-22 feet bgs), intermediate (~35-45 feet bgs), and deep (~70-80 feet bgs) intervals at 14 locations to complement the 25 existing wells. Levelogger® pressure transducers were installed to continuously measure water levels in intermediate depth wells. Passive Diffusion Bags (PDBs) were installed in new and existing monitoring wells to retrieve water quality samples for laboratory analyses during quarterly sampling events.

Water level data confirm that the direction of groundwater movement is to the south-southwest as would be expected based on regional conditions. No significant vertical gradient was observed between the shallow, intermediate and deep intervals under non-pumping conditions. The movement of the PCE plume follows the regional flow direction, implying that groundwater flow is the primary driver of PCE migration, which has moved further downgradient into OU-2 than previously reported.

PCE contamination reaches deeper into the aquifer and becomes more widely dispersed with increasing distance from OU-1, with much lower or no PCE concentrations at shallow depths. The highest concentrations of PCE were observed along 172nd Street, where PCE concentrations greater than 10,000 ppb were detected from 30 to 70 feet bgs. Contaminated groundwater at 169th Street shows PCE concentrations greater than 1,000ppb from 40 to 80 feet bgs. As currently mapped, the leading edge of the plume is located in the vicinity of 166th Street where low concentrations of PCE were detected in only one well.

The potential for vapor intrusion into basements of structures is expected to diminish with increasing plume depth and distance from OU-1. PCE contamination is moderate at shallow depths east of Merrick Boulevard between 172nd and 175th Streets. Vapor intrusion is not likely to occur west of Merrick Boulevard, where PCE was not detected at the water table and only low concentrations were detected at most locations at approximately 30 feet bgs or deeper.

The currently mapped length of the plume is approximately 4,320 feet, and assuming a release date in the late 1970's, the apparent rate of PCE migration is approximately 0.38 ft/day. Assuming this continued rate of movement, the PCE plume would be expected to migrate south-southwest at approximately 140 feet per year or 1/4 mile per decade under current non-pumping conditions.

When groundwater remediation begins, pumping conditions will create 1 foot of drawdown at the leading edge of the plume and 0.5 feet drawdown well beyond this extent. However, the resulting heads create a capture zone that reaches across Merrick Boulevard before developing a roughly east/west trending groundwater divide, running through 169th Street. This anticipated capture zone should be sufficient to capture the shallow and intermediate portions of the PCE plume, as well as capturing the bulk of the deep plume. However, the very leading edge of the deep portion of the plume, between 166th and 169th Streets appears to lie outside of the capture zone.

It is recommended that the NYSDEC:

- Evaluate options for recovery of the leading edge of the PCE plume.
- Consider options for alternate means of remediating the leading edge of the plume.
- Include wells 6A and 6B at Station 6 in the next sampling round.

# 2. Introduction

## 2.1. INTRODUCTION

This report summarizes the field investigation activities and data collected during the perchloroethene (PCE) offsite plume delineation related to the West Side Corporation (West Side) site, Operable Unit #2 (OU-2) in Jamaica, Borough of Queens, New York from May 2008 through October 2008. These activities were conducted under Work Assignment No.D004443 – 10.1. The purpose of the field investigation was three-fold: to further delineate the extent of PCE in groundwater migrating from the West Side site, to gather additional information on the potential formation of PCE vapors related to and located above the PCE groundwater plume, and to establish a permanent well network to monitor groundwater quality for the long term.

## 2.2. BACKGROUND

Between 1969 and 1992, the 4.5-acre West Side site was used as a storage and distribution center for laundromat supplies including large quantities of perchloroethene (PCE). Five 10,000-gallon aboveground storage tanks (ASTs) were located outside the southeast portion of the main building, and were used for bulk storage and transfer of PCE. Improper handling of the chemicals has resulted in the release of hazardous waste into the groundwater, primarily PCE, which has migrated from the OU-1 area to residential areas to the south and west of the site. The site is currently leased by Atlantic Express, a bus company that services, stores, and dispatches school buses. The components of both OU-1 and OU-2 are collectively referred to in this report as the ‘study area’.

## 2.3. PREVIOUS INVESTIGATIONS

Previous remedial investigations (RIs) have concluded that the source area of PCE is the West Side Corporation site, located at 107-10 180th Street in the city of Jamaica, New York (see Figure 1-1). The onsite (source area) activities are grouped under Operable Unit #1 (OU-1), which was partially remediated in 2005 by URS and Thermal Remediation Services (TRS) by using electrical resistance heating (ERH) and soil vapor extraction (SVE). Further loading of PCE into the groundwater and the migration of contaminated groundwater offsite should be reduced by this effort.

In 2000, GZA Environmental investigated the offsite migration of PCE and discovered groundwater contamination extending approximately 1/2 mile south of the West Side site, where dissolved PCE concentrations in shallow depths were as high as 4400 parts-per-billion (ppb) beneath a residential area. This residential area was designated Operable Unit #2 (OU-2), and a subsequent RI was conducted by URS between May 2005 and October 2006 to gather additional information. URS installed eight shallow groundwater monitoring wells (W-01 through W-08) and 39 permanent soil gas sampling points (SVPs) to monitor groundwater and soil gas conditions beneath the residential area. During the winter of 2006-07, URS collected indoor air and subslab vapor samples at 85 residences in OU-2. URS also conducted an expanded groundwater sampling effort beyond the downgradient edge of the shallow PCE plume in March 2007 with the installation and sampling of 49 direct-push groundwater probes (URS, June 2007).

## 2.4. OBJECTIVES OF THIS INVESTIGATION

Based on the results and findings of the previous investigations, the NYSDEC retained Malcolm Pirnie to conduct further delineation of the offsite PCE plume. The objectives of this investigation were to:

- More fully delineate the horizontal and vertical extent of the offsite PCE plume through a staged sequence of field investigations.
- Document the direction of groundwater movement and to further characterize the PCE plume limits by taking water quality and water level measurements.
- Determine if the currently delineated plume is within the capture zone of recovery wells planned for use in remediation of the plume.

## 2.5. MAJOR TASKS

Major tasks completed during the investigation included:

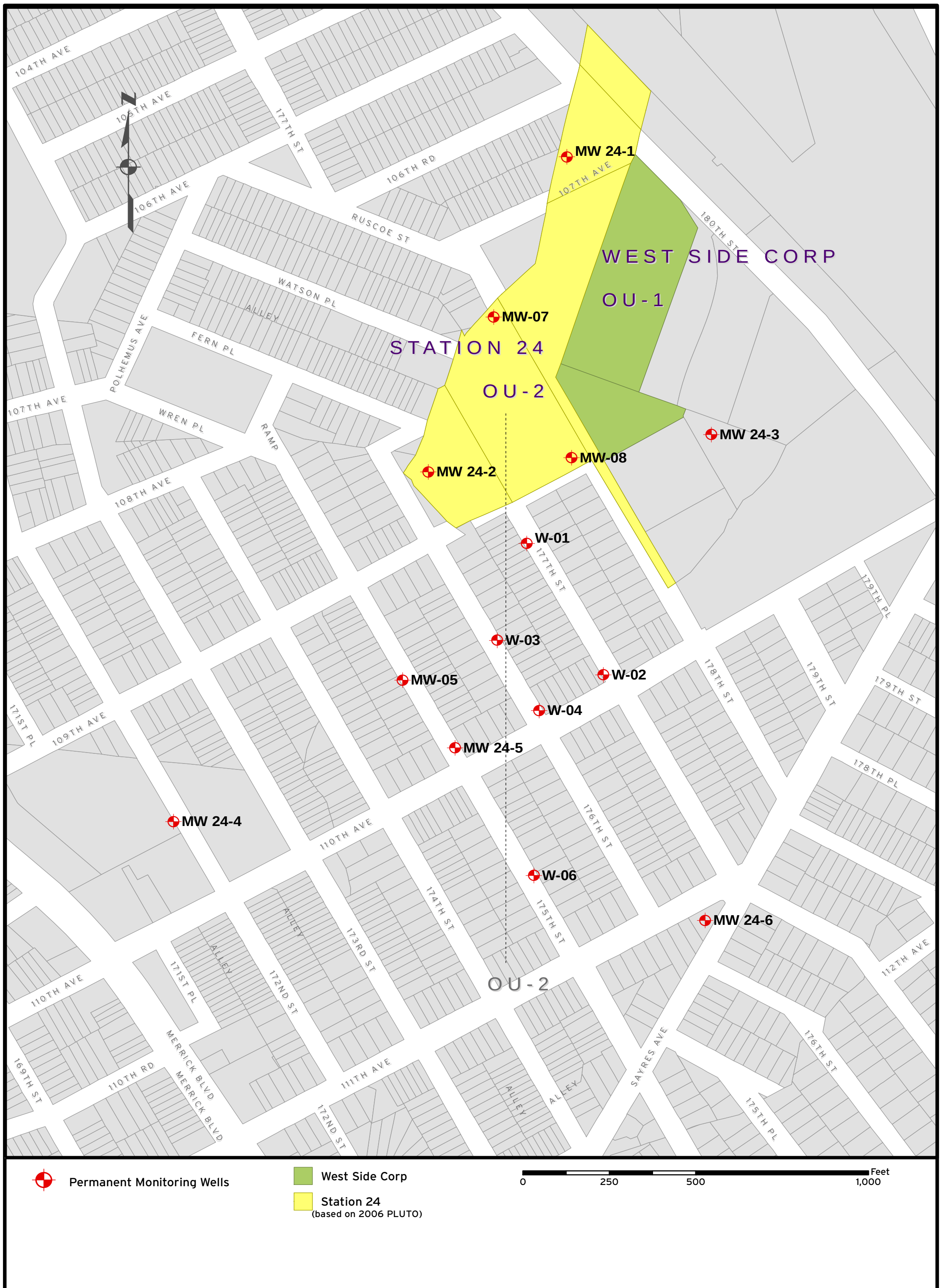
- Investigate subsurface conditions using direct-push grab sampling techniques to initially delineate plume extent and choose locations for monitoring wells.
- Install and develop new monitoring wells and redevelop existing wells to establish a monitoring network at shallow, intermediate and deep zones in and around the delineated PCE plume.
- Conduct synoptic groundwater level monitoring on a quarterly basis in all wells and continuously (using data logging pressure transducers) in selected wells.
- Collect an initial round of groundwater samples for laboratory analyses, to be followed by three additional quarterly rounds of sampling and analysis.

## 2.6. AVAILABLE INFORMATION

The following are available for review of background information, some of which were used to develop this report:

1. Final Remediation Certification Report: West Side Corporation Site OU No.1. URS, 2006.
2. Offsite Remedial Investigation: West Side Corporation Site No. 2-41-026. Volume 1. TAMS and GZA Joint Venture, May 2001.
3. Field Investigation Letter Report: "Groundwater Sediment and Soil Gas Investigation--West Side Corporation Site 2-41-026" URS, January 2007.
4. Field Investigation Report: "Groundwater and Residential Air Sampling - December 2006 through April 2007 Soil Vapor Intrusion Investigation" URS, June 2007.
5. Isbister, USGS WSP 1825. USGS 2006; SI map.
6. Harte, Philip T. "Simulation of Tetrachloroethene in Groundwater Aquifer Municipal Well Superfund Site Milford, NH" USGS Scientific Investigations Report # 5176, 2004.
7. NOAA Quality Controlled Local Climatological Data: JFK International Airport (94789) New York, NY. August, September, October 2008. http://cdo.ncdc.noaa.gov
8. Montgomery, John H. Groundwater Chemicals Desk Reference. Lewis Publishers, Michigan; 1990.

**Figure 2-1: Existing Offsite Monitoring Wells**




EXISTING OFFSITE MONITORING WELLS

# 3. Summary of Subsurface Conditions

## 3.1. GEOLOGY

The shallow geology beneath the study area consists of medium to coarse grained sands of Pleistocene age locally known as the Upper Glacial aquifer. Split-spoon and Geoprobe® sleeve-rod soil samples collected during the investigation showed this aquifer material to be very consistent throughout the study area. These sands were seen to a typical depth of approximately 70 feet below ground surface (bgs), where the top of the underlying Gardiner's clay layer was encountered. The depth to the top of the clay, which is an undulating surface throughout the study area, increases southward from OU-1 to OU-2, ranging from 62 feet to 105 feet bgs. Soil samples were logged by the onsite geologist (Appendix A) and found to be consistent with the previous studies conducted at OU-1 and OU-2. See Sections 5.3.1 and 5.4.1 for more information.

## 3.2. HYDROGEOLOGY

A single unconfined upper-glacial aquifer occupies the permeable soils beneath OU-1 and OU-2. From analysis of groundwater elevations taken in monitoring wells, the direction of groundwater flow is south-southwest from the West Side site. Depth to water is typically 10 to 14 feet bgs throughout the study area. Water table elevations range from 22 feet above msl onsite at OU-1 to 15 feet above msl at the south edge of OU-2. These elevations are consistent throughout shallow, intermediate and deep monitoring wells installed in both operable units. See Section 6.2 for more information.

The velocity of groundwater movement through this aquifer was estimated from water level measurements and existing hydrogeologic information for the study area. The horizontal groundwater gradient was measured to be 0.0018 feet/foot along the plume's south-southwest heading. Given this gradient, an average hydraulic conductivity of 1,000 gpd/ft2 and an average effective porosity of 30%, the rate of groundwater flow in this aquifer is estimated at 0.80 ft/day.

# 4. Summary of Field Investigations

## 4.1. INTRODUCTION

Field investigations were conducted by Miller Environmental Group (MEG) from May to September 2008 under NYSDEC Work Assignment No.D04443-10.1. MEG used YEC, Inc. and Utility Detection, Inc as subcontractors to complete the work. Malcolm Pirnie provided field oversight and coordination services, and received data from MEG to prepare this report.

## 4.2. UTILITY MARKOUT, GEOPHYSICAL SURVEY AND PERMITS

Utility Detection, Inc. (UDI), a subcontractor to MEG, located buried utility lines and structures at the proposed Geoprobe® and monitoring well locations prior to any intrusive activities. A combination of Ground Penetrating Radar (GPR) and Electromagnetic (EM) geophysical methods were used. MEG coordinated with the New York City Department of Transportation (NYCDOT) Bureau of Permit Management to obtain road opening permits prior to engagement in any intrusive activities.

## 4.3. GEOPROBE® INVESTIGATION

MEG conducted the plume delineation field work, which consisted of two separate mobilizations of Geoprobe® direct-push sampling. The first mobilization began in May 2008 and was intended to confirm the projected extent of the shallow PCE plume indicated by the June 2007 URS report.

Laboratory analysis of PCE concentrations from the first mobilization indicated that the plume's extent was greater than previously reported. Therefore, a second mobilization was initiated in July 2008 to complete plume delineation. Sample results were used to identify locations for future monitoring well installation within the plume's vertical and horizontal extent. See Section 4.1 for more information.

## 4.4. EXISTING MONITORING WELL REDEVELOPMENT

In May 2008, five (5) existing monitoring well triplets primarily located offsite in the residential area (MW 24-1, MW 24-2, MW 24-4, MW 24-5, and MW 24-6) and 6 existing shallow wells (W-01S, W-02S, W-03S, W-04S, W-05S, and W-06S) were redeveloped. The sixth existing monitoring well triplet (MW 24-3), located adjacent to the West Side parcel (OU-1), could not be located due to the recent placement of a gravel overburden as well as thick vegetation, and was therefore not included in this investigation.

Also included during the redevelopment of existing monitoring wells was the repair of the deteriorated concrete well apron from MW 24-2. See Table 4-1 for well details and Figure 1-1 for well locations.

## 4.5. SOIL VAPOR POINT ABANDONMENT

Several permanent soil vapor points (SVP) were abandoned in May 2008. The following 14 SVPs were removed and backfilled with cement to ground surface: SG25, SG26, SG27, SG28, SG29, SG30, SG31, SG32, SG33, SG35, SG36, SG37, SG38 and SG39. SVPs not listed were inaccessible for demolition. See Figure 3-1 for locations of abandoned and inaccessible SVPs.

## 4.6. MONITORING WELL INSTALLATION

Immediately following the first Geoprobe® mobilization, MEG installed groundwater monitoring wells in clusters at 8 locations within West Side OU-2 to complement the existing shallow well network installed by URS. Monitoring well installation was conducted from June 2008 to July 2008; see Section 5.1 for more information.

Additional monitoring well clusters were installed in 6 locations following the second Geoprobe® investigation in OU-2 from August 2008 to September 2008.

## 4.7. MONITORING PROGRAM

Upon completion of well installation and development, MEG installed Solinst Levelogger® pressure transducers in intermediate depth wells to provide continuous water level measurements. Passive Diffusion Bag samplers (PDBs) were then placed in all new and existing monitoring wells at OU-2, and in selected wells at OU-1, to obtain water quality samples for laboratory analyses. Table 3-2 provides a list of the wells fitted with PDBs. A total of 66 PDBs were installed for the initial round of sampling, which is the first of four scheduled quarterly sampling events. Specifications for the Levelogger® and PDBs are found in Appendix B and Appendix C, respectively. See Section 6.1 for more information.

**Table 4-1.**
**Existing Redeveloped Monitoring Wells**

| Well Number | *Screen Interval | | Casing Coordinates | | **TOC Elevation |
|---|---|---|---|---|---|
| | | | Northing | Easting | |
| MW 24-1 | S | 13-23 | 681651.653 | 692258.5296 | 33.01 |
| | I | 36-46 | | | 32.97 |
| | D | 59-69 | | | 32.99 |
| MW 24-2 | S | 11-21 | 680820.5569 | 691907.9768 | 29.04 |
| | I | 35-45 | | | 28.97 |
| | D | 60-70 | | | 28.98 |
| MW 24-3 | S | 8-18 | NOT FOUND | NOT FOUND | |
| | I | 28-38 | | | |
| | D | 54-64 | | | |
| MW 24-4 | S | 15-25 | 679689.2684 | 691178.3012 | 30.18 |
| | I | 38-48 | | | 30.19 |
| | D | 62-72 | | | 30.17 |
| MW 24-5 | S | 13-23 | 679896.0375 | 691997.5019 | 28.28 |
| | I | 36-46 | | | 28.29 |
| | D | 65-75 | | | 28.36 |
| MW 24-6 | S | 9-19 | 679442.7282 | 692774.0063 | 26.51 |
| | I | 33-43 | | | 26.57 |
| | D | 57-67 | | | 26.70 |

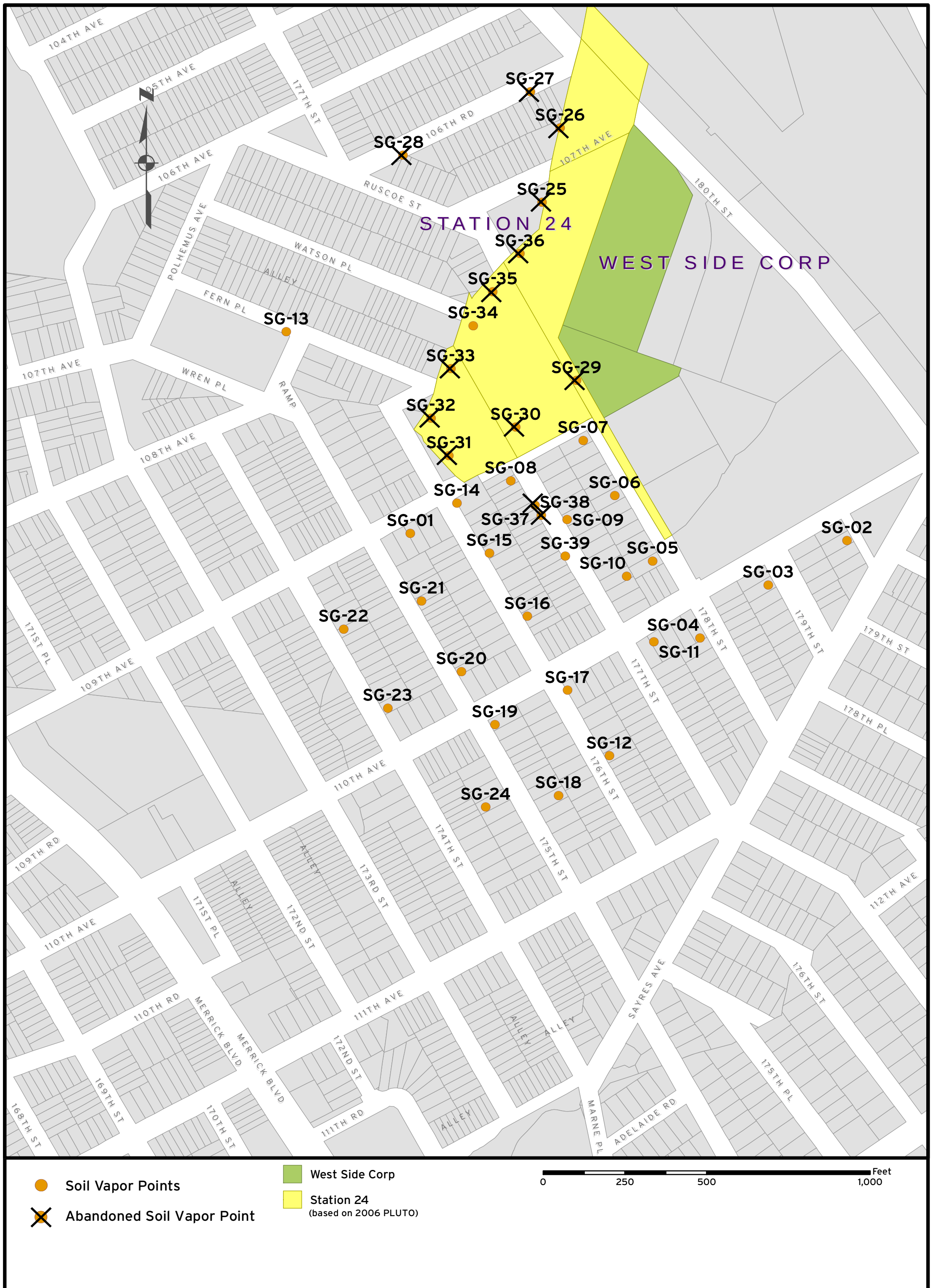
*Screen intervals S (Shallow), I (intermediate) and D (Deep) in feet (ft) below ground surface (bgs)

**TOC = Top of Casing elevation in feet (ft) above msl, surveyed by YEC on 7.01.08 and 9.08.08

**Table 4-2.**
## Monitoring Wells with PDB Samplers Installed

| Well Number | Well Number | Well Number | Well Number |
|---|---|---|---|
| MW 24-1 S | W-02 S | W-09 S | W-15 S |
| MW 24-1 I | W-02 I | W-09 I | W-15 I |
| MW 24-1 D | W-02 D | W-09 D | W-15 D |
| MW 24-2 S | W-03 S | W-10 S | MW 22 S |
| MW 24-2 I | W-03 I | W-10 I | MW 3 D |
| MW 24-2 D | W-03 D | W-10 D | MW 55 D |
| MW 24-4 S | W-04 S | W-11 S | MW 6 S |
| MW 24-4 I | W-04 I | W-11 I | MW 7 S |
| MW 24-4 D | W-04 D | W-11 D | MW 77 D |
| MW 24-5 S | W-06 S | W-12 S | MW-05 |
| MW 24-5 I | W-06 I | W-12 I | MW-07 |
| MW 24-5 D | W-06 D | W-12 D | MW-08 |
| MW 24-6 S | W-07 S | W-13 S | |
| MW 24-6 I | W-07 I | W-13 I | |
| MW 24-6 D | W-07 D | W-13 D | |
| W-01 S | W-08 S | W-14 S | |
| W-01 I | W-08 I | W-14 I | |
| W-01 D | W-08 D | W-14 D | |

**Figure 4-1: Soil Vapor Point Locaitons**




SOIL VAPOR POINT LOCATIONS

# 5. Geoprobe Investigation

## 5.1. INTRODUCTION

MEG conducted two separate Geoprobe® investigations in OU-2 to further delineate PCE contamination in the aquifer and to establish locations for new monitoring wells. The first investigation occurred in May 2008 along transects of 177th, 175th and 172nd Streets but did not reveal the plume's leading edge.

In July 2008, the second investigation was conducted to complete the horizontal and vertical delineation of the PCE plume. During the second investigation, Geoprobe® borings were conducted on transects along accessible streets until PCE was no longer detected in groundwater samples analyzed using MEG's mobile laboratory.

## 5.2. FIRST MOBILIZATION

### 5.2.1. Geoprobe® Borings B1 to B20

MEG completed borings B1 to B20 along three transects downgradient of OU-1 and along the plume's projected boundary (Figure 4-1):

1. B1 to B5 along 177th Street, between 109th Avenue and 110th Avenue
2. B6 to B10 along 175th Street, between 110th Avenue and 111th Avenue
3. B11 to B20 along 172nd Street, between 111th Road and Sayres Avenue

Groundwater samples were collected from two depths at each boring location; the first from the water table interface (10 to 12 feet bgs) and the second from approximately 25 to 27 feet bgs. Samples were collected in 1-liter (L) amber glass jars and analyzed by Phoenix Laboratories. PCE concentrations detected at each boring location are also shown on Figure 4-1.

### 5.2.2. Laboratory Analyses

Groundwater samples retrieved during the first mobilization were analyzed by Phoenix Laboratories for Volatile Organic Compounds (VOCs) using SW-846 EPA method 8260. Additional samples were collected for QA/QC purposes. Laboratory results from this mobilization can be found in the accompanying Data CD: 1.1.

### 5.2.3. First Mobilization Results

PCE concentrations varied depending on the depth at which groundwater samples were retrieved and the proximity to the source area at OU-1. PCE was typically not detected in shallow samples, except along the closest transect (177th Street) to OU-1, where PCE concentrations ranged from ‘non-detect’ to 110 ppb. Deeper samples (25 to 27 feet bgs) along the same transect had greater PCE concentrations with values ranging from 54 – 700 ppb.

Groundwater samples collected along the next transect, downgradient on 175th Street (B6 to B10), showed a similar trend. PCE was again typically not detected in the shallow samples, while the deeper samples consistently had PCE concentrations ranging from 120 - 990 ppb.

The final transect of the first investigation on 172nd Street was initially expected to lie beyond the leading edge of the plume. PCE was not detected in shallow samples at boring locations B11 – B20. However, deeper samples displayed a range of PCE concentrations from 7 – 3500 ppb. These results indicated that the leading edge of the plume extended beyond 172nd Street and most of its mass was deeper in the aquifer. While the extent of the dissolved-phase contamination near the ground surface was confirmed, the full extent of the plume in three dimensions was not yet delineated.

The high PCE concentrations in the 25 to 27 feet bgs samples indicated that the vertical extent of the plume was not known and that further investigation of the vertical delineation was warranted. Before demobilizing from the first investigations, two additional Geoprobe® borings (B3A and B8A) were advanced adjacent to boring locations B3 and B8 to investigate the plume’s thickness. Groundwater samples were retrieved at 30, 37, 44, 51 and 58 feet bgs and analyzed for VOCs. Laboratory results from these samples confirmed the presence of PCE at greater depths than previously investigated. PCE concentrations of 300 ppb or greater were observed up to the final sample depth (58 feet). See Table 4-1 for a summary of PCE concentrations by sampling location and depth.

## 5.3. SECOND MOBILIZATION

The second Geoprobe® investigation proceeded in a stepwise manner, moving downgradient along transects of the PCE plume until its leading edge was found. Borings were advanced into the soil, starting from the last known location of PCE and ending after completing three additional transects; two of which were south of Merrick Boulevard.

MEG used a mobile laboratory in this investigation with the intent of producing near real-time data on PCE concentrations in the groundwater samples. The speed of this testing strategy supported the ability to make field decisions regarding subsequent sampling locations and interpretation of plume delineation. Basing field operations on near real-time laboratory results enabled MEG to proceed uninterrupted along each of the plume transects. As a result, this mobilization was more comprehensive and efficient in delineating the plume's horizontal and vertical extent.

### 5.3.1. Geoprobe® Borings B21 to B50

Direct-push sampling continued along three transects until mobile laboratory data indicated that PCE was no longer being detected in the groundwater samples or until the limits of permitted street access were reached by the MEG field team:

1. B21 to B28 along 172nd Street, between 110th Avenue and 111th Road
2. B29 to B42 along 169th Street between 110th Avenue and Linden Blvd.
3. B43 to B50 along 166th Street between Nadal Place and Sayres Avenue

Groundwater samples were collected from the water table to the anticipated depth of the Gardiner's Clay layer (70 to 105 feet bgs, or to the maximum capable depth of the Geoprobe®) in 7 foot depth intervals and analyzed by MEG's onsite mobile laboratory. Geoprobe® boring locations are shown in Figure 4-2.

### 5.3.2. Interim Monitoring Well Sampling

An interim groundwater sampling event was conducted on July 23, 2008 to supplement the second Geoprobe® investigation. Samples were collected from selected six existing monitoring well clusters (also shown on Figure 4-2) and analyzed by MEG's onsite mobile laboratory. PCE concentrations in the monitoring wells were consistent with the ongoing Geoprobe® investigation and were used to aid in the plume delineation; results are provided in DATA CD: 2.1.

Water quality data from MW 24-4 were particularly helpful in guiding field activities. Analyses of groundwater samples from the shallow, intermediate, and deep wells at this cluster confirmed the plume's periphery to be in the vicinity of 110th Avenue at 172nd Street, where PCE was detected at low concentrations (4 to 47 ppb). From these results, it was determined that DOT permit acquisition to conduct direct-push sampling across 110th Avenue was not necessary.

### 5.3.3. Mobile Laboratory Analyses

During the second Geoprobe® investigation, groundwater samples were collected in 40mL vials and analyzed by MEG's onsite mobile laboratory by Gas Chromatography/Mass Selective Detection (GC/MSD) for target analytes: PCE, trichloroethene, and cis-1,2-dichloroethene. Additionally, one duplicate sample was collected from each Geoprobe® boring and delivered to Phoenix Laboratories for comparative purposes. Mobile laboratory and equipment photographs are shown in Figure 4-3 and Figure 4-4, respectively.

Duplicate groundwater quality samples were analyzed by Phoenix Laboratories (DATA CD: 2.2) and found PCE concentrations to be lower on average than MEG's mobile laboratory data (DATA CD: 2.3). Typically, PCE concentrations in the duplicate samples were lower than the mobile laboratory but were still within the same order of magnitude, indicating continuity between the two datasets.

### 5.3.4. Second Mobilization Results

#### 172nd Street Transect

Geoprobe® borings B21 to B28 extended north from boring B20 on the 172nd Street transect. Sampling location B27 yielded the highest and second highest PCE concentrations from the entire investigation at 20,991 ppb and 16,643 ppb at depths of 65 feet and 51 feet, respectively. The bulk of PCE contamination on this transect was discovered at depths of 30 feet and greater, where PCE concentrations were consistently in the 1,000 to 5,000 ppb range at depths ranging from 35 feet to 70 feet bgs. Shallow samples (16 to 23 feet bgs) continued to show low to 'non-detect' PCE concentrations compared to the deeper samples.

Laboratory analysis from this transect suggests the plume is bounded to the north and south by 110th Avenue and Sayres Avenue, respectively. Figure 4-3 displays this plume transect (B-B'), with PCE concentrations shown.

#### 169th Street Transect

Groundwater samples (B29 to B41) retrieved from the 169th Street transect revealed that the plume had migrated across Merrick Boulevard. The highest PCE concentrations were deeper into the aquifer compared to 172nd Street (greater than 40 feet bgs), but also less substantial at 4,700 ppb maximum. The highest PCE concentrations were detected at borings B39 and B29, where 111th Avenue intersects 169th Street.

Laboratory analysis suggests the plume is bounded to the north and south by 110th Avenue and Sayres Avenue at this transect also; PCE concentrations decrease into the 100 ppb range upon approaching 110th Avenue to the north and the single digit ppb values beyond Sayres Avenue to the south. Figure 4-4 displays this plume transect (C-C'), with PCE concentrations shown.

#### 166th Street Transect

All groundwater samples collected from the 166th street transect (B43 to B50) using the Geoprobe® were 'non-detect' for PCE at all depths. These results indicated that the leading edge of the PCE plume had been found, and was located between 166th Street and 169th Street. An outlying direct-push boring B35, located farther south on the corner of Marsden Street and 115th Avenue (not shown), also did not detect PCE at any depth. No cross-section was prepared since PCE was not detected at any of the sampling locations.

MEG mobile laboratory target analyte concentrations from borings B21 to B50 are provided in Data CD: 2.3. PCE concentrations detected are summarized in Table 4-2.

## 5.4. GEOPROBE® FINDINGS

Cross section A-A’ (see Figure 4-5) indicates that the leading edge of the plume is located downgradient of 169th Street, where PCE concentrations were low to ‘non-detect’ in many samples. As PCE was not detected on 166th Street, the leading edge of the plume was interpreted to be located between 169th and 166th Streets.

Cross-sections prepared from this dataset illustrate the greatest mass of PCE is located in the vicinity of 172nd Street. The highest concentrations of PCE were observed along this transect, where two distinct masses of dissolved PCE appear to lie from 30 to 70 feet bgs, with the highest concentrations greater than 5,000 ppb and 10,000 ppb (Figure 4-3). PCE contamination observed further downgradient at the 169th Street transect (Figure 4-4) appears to show one distinct mass from 40 to 80 feet bgs, with the highest PCE concentrations greater than 1,000 ppb.

**Table 5-1.**
## PCE Concentrations in Geoprobes B1 to B20

| BORE | B-1 | | B-2 | | B-3/3A | | B-4 | | B-5 | |
|---|---|---|---|---|---|---|---|---|---|---|
| 177th Street | Depth | PCE | Depth | PCE | Depth | PCE | Depth | PCE | Depth | PCE |
| | 12 | ND | 12 | 75 | 12 | 110 | 12 | 9 | 12 | ND |
| | 27 | 54 | 27 | 270 | 27 | 350 | 27 | 700 | 27 | 300 |
| | | | | | 30 | 63 | | | | |
| | | | | | 37 | 560 | | | | |
| | | | | | 44 | 830 | | | | |
| | | | | | 51 | 380 | | | | |
| | | | | | 58 | 170 | | | | |

| BORE | B-6 | | B-7 | | B-8/8A | | B-9 | | B-10 | |
|---|---|---|---|---|---|---|---|---|---|---|
| 177th Street | Depth | PCE | Depth | PCE | Depth | PCE | Depth | PCE | Depth | PCE |
| | 12 | 10 | 12 | ND | 12 | ND | 12 | ND | 12 | ND |
| | 27 | 850 | 27 | 990 | 27 | 820 | 27 | 430 | 27 | 120 |
| | | | | | 30 | 1200 | | | | |
| | | | | | 37 | 820 | | | | |
| | | | | | 44 | 580 | | | | |
| | | | | | 51 | 350 | | | | |
| | | | | | 58 | 300 | | | | |

| BORE | B-11 | | B-12 | | B-13 | | B-14 | | B-15 | |
|---|---|---|---|---|---|---|---|---|---|---|
| 172nd Street | Depth | PCE | Depth | PCE | Depth | PCE | Depth | PCE | Depth | PCE |
| | 12 | ND | 12 | ND | 12 | ND | 12 | ND | 12 | ND |
| | 27 | 230 | 27 | 61 | 27 | 30 | 27 | 20 | 27 | 7 |

| BORE | B-16 | | B-17 | | B-18 | | B-19 | | B-20 | |
|---|---|---|---|---|---|---|---|---|---|---|
| 172nd Street | Depth | PCE | Depth | PCE | Depth | PCE | Depth | PCE | Depth | PCE |
| | 12 | ND | 12 | ND | 12 | ND | 12 | ND | 12 | ND |
| | 27 | 180 | 27 | 210 | 27 | 330 | 27 | 970 | 27 | 3500 |

Notes:
Depths in feet (ft) below ground surface (bgs)
PCE concentrations in parts-per-billion (ppb)

**Table 5-2.**
## PCE Concentrations in Geoprobes B21 to B50

| BORE | B-21 | | B-22 | | B-23 | | B-24 | | B-25 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Depth | PCE | Depth | PCE | Depth | PCE | Depth | PCE | Depth | PCE |
| | 16 | 2.2 | 15 | 5.4 | 16 | 3.2 | 16 | 2.3 | 16 | 6.0 |
| | 23 | 427 | 22 | 2.3 | 23 | 1.5 | 23 | 132 | 23 | 500 |
| | 30 | 8320 | 29 | 548 | 30 | 87 | 30 | 1263 | 30 | 41 |
| | 37 | 6066 | 36 | 5505 | 37 | 397 | 37 | 6390 | 37 | 119 |
| | 44 | 3667 | 43 | 7105 | 44 | 91 | 45 | 6393 | 44 | 1125 |
| | 51 | - | 50 | 1957 | 51 | 1972 | 52 | 1875 | 51 | 1575 |
| | 58 | 2016 | 57 | 2144 | 58 | 809 | 59 | 670 | 58 | 534 |
| | 65 | 1560 | 64 | 263 | 65 | 220 | 66 | 262 | 65 | 132 |
| **BORE** | **B-26** | | **B-27** | | **B-28** | | **B-29** | | **B-30** | |
| | Depth | PCE | Depth | PCE | Depth | PCE | Depth | PCE | Depth | PCE |
| | 16 | 2.5 | 16 | ND | 16 | ND | 16 | ND | 16 | ND |
| | 23 | 3.8 | 23 | 49 | 23 | 4.7 | 23 | 3.5 | 23 | ND |
| | 30 | 1507 | 30 | 99 | 30 | 13 | 30 | 31 | 30 | 74 |
| | 37 | 3814 | 37 | 421 | 37 | 94 | 37 | 45 | 37 | 380 |
| | 44 | 13139 | 44 | 7227 | 44 | 172 | 44 | 4309 | 44 | 1235 |
| | 51 | 5064 | 51 | 16643 | 51 | 414 | 51 | 412 | 51 | 689 |
| | 58 | 2132 | 58 | 9215 | 58 | 1683 | 58 | 1374 | 58 | 200 |
| | 65 | 937 | 65 | 20991 | 66 | 238 | 66 | 1611 | 66 | 14 |
| **BORE** | **B-31** | | **B-32** | | **B-33** | | **B-34** | | **B-35** | |
| | Depth | PCE | Depth | PCE | Depth | PCE | Depth | PCE | Depth | PCE |
| | 16 | ND | 16 | ND | 16 | ND | 16 | ND | 16 | ND |
| | 23 | 2.1 | 23 | ND | 23 | ND | 23 | ND | 23 | ND |
| | 30 | 20 | 30 | 90 | 30 | 6.6 | 30 | ND | 30 | ND |
| | 37 | 157 | 37 | 109 | 37 | 8.9 | 37 | ND | 37 | ND |
| | 44 | 74 | 44 | 7.1 | 44 | 2.0 | 44 | 1.2 | 44 | ND |
| | 51 | 73 | 51 | 5.3 | 51 | 1.9 | 51 | 8.2 | 51 | ND |
| | 58 | 10 | 58 | 5.7 | 58 | 11 | 58 | 7.3 | 58 | ND |
| | 66 | 8.1 | 66 | 9.5 | 66 | 6.6 | 66 | 2.8 | 65 | ND |

Notes:
Depths in feet (ft) below ground surface (bgs)
PCE concentrations in parts-per-billion (ppb)

**Table 5-2 (Continued)**

| BORE | B-36 | | B-37 | | B-38 | | B-39 | | B-40 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Depth | PCE | Depth | PCE | Depth | PCE | Depth | PCE | Depth | PCE |
| | 16 | ND | 23 | ND | 16 | ND | 16 | ND | 23 | ND |
| | 23 | ND | 30 | 2.7 | 23 | ND | 23 | ND | 30 | ND |
| | 30 | ND | 37 | 7.4 | 30 | ND | 30 | 5.3 | 37 | ND |
| | 37 | 2.2 | 44 | 23 | 37 | ND | 37 | 12 | 44 | 6.7 |
| | 44 | 85 | 51 | 114 | 44 | 18 | 44 | 435 | 51 | 9.7 |
| | 51 | 15 | 58 | 160 | 51 | 117 | 51 | 1241 | 58 | 228 |
| | 58 | 335 | 65 | 784 | 58 | 758 | 58 | 853 | 65 | 238 |
| | 65 | 814 | - | - | 65 | 467 | 65 | 4743 | 72 | 1116 |
| **BORE** | **B-41** | | **B-42** | | **B-43** | | **B-44** | | **B-45** | |
| | Depth | PCE | Depth | PCE | Depth | PCE | Depth | PCE | Depth | PCE |
| | 23 | ND | 23 | ND | 16 | ND | 16 | ND | 16 | ND |
| | 30 | 5.4 | 30 | 1.5 | 23 | ND | 23 | ND | 23 | ND |
| | 37 | 7.4 | 37 | 3.4 | 30 | ND | 30 | ND | 30 | ND |
| | 44 | 26 | 44 | 17 | 37 | ND | 37 | ND | 37 | ND |
| | 51 | 73 | 51 | 36 | 44 | ND | 44 | ND | 45 | ND |
| | 58 | 171 | 58 | 161 | 51 | ND | 51 | ND | 51 | ND |
| | 65 | 334 | 66 | 256 | 58 | ND | 58 | ND | 58 | ND |
| | 72 | 100 | 72 | 147 | 66 | ND | 61 | ND | 66 | ND |
| **BORE** | **B-46** | | **B-47** | | **B-48** | | **B-49** | | **B-50** | |
| | Depth | PCE | Depth | PCE | Depth | PCE | Depth | PCE | Depth | PCE |
| | 16 | ND | 16 | ND | 16 | ND | 16 | ND | 16 | ND |
| | 23 | ND | 23 | ND | 23 | ND | 23 | ND | 23 | ND |
| | 30 | ND | 30 | ND | 30 | ND | 30 | ND | 30 | ND |
| | 37 | ND | 37 | ND | 37 | ND | 37 | ND | 37 | ND |
| | 44 | ND | 44 | ND | 44 | ND | 44 | ND | 44 | ND |
| | 51 | ND | 51 | ND | 51 | ND | 51 | ND | 51 | ND |
| | 58 | ND | 54 | ND | 58 | ND | 58 | ND | 58 | ND |
| | 66 | ND | - | - | - | - | 61 | ND | 66 | ND |

Notes:
Depths in feet (ft) below ground surface (bgs)
PCE concentrations in parts-per-billion (ppb)

**Figure 5-1: Geoprobe Sample Locations B1-B20 with PCE Detections**

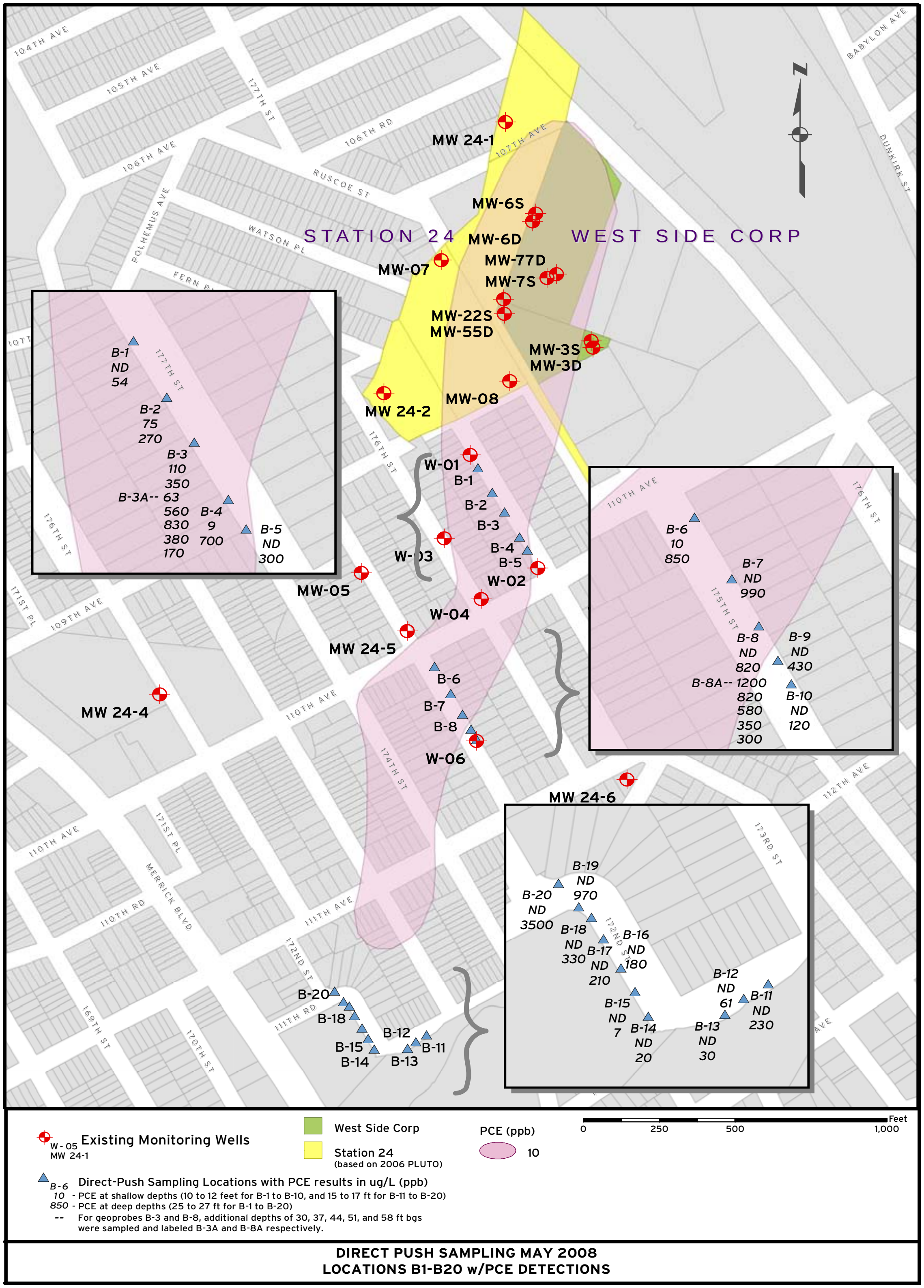
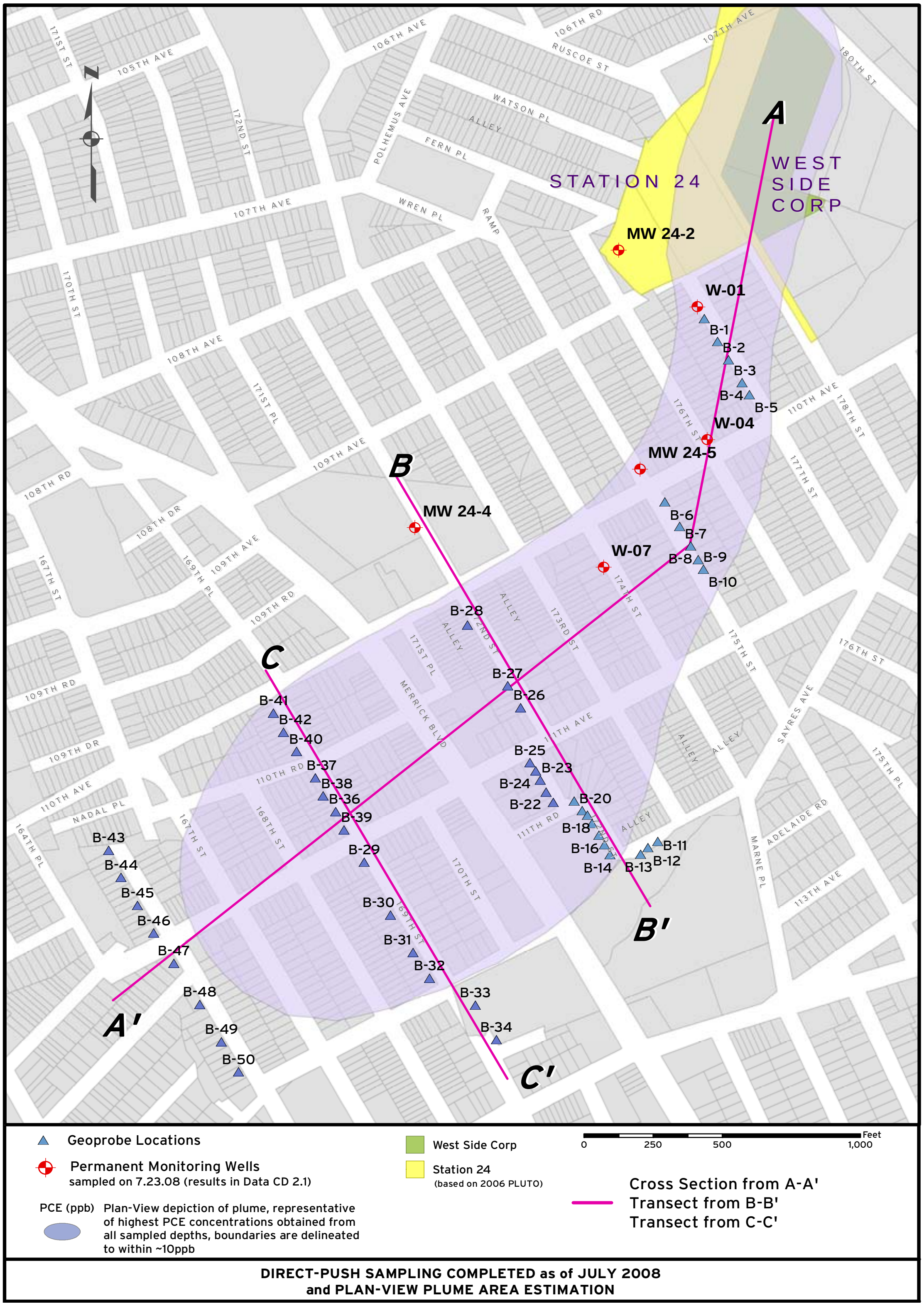
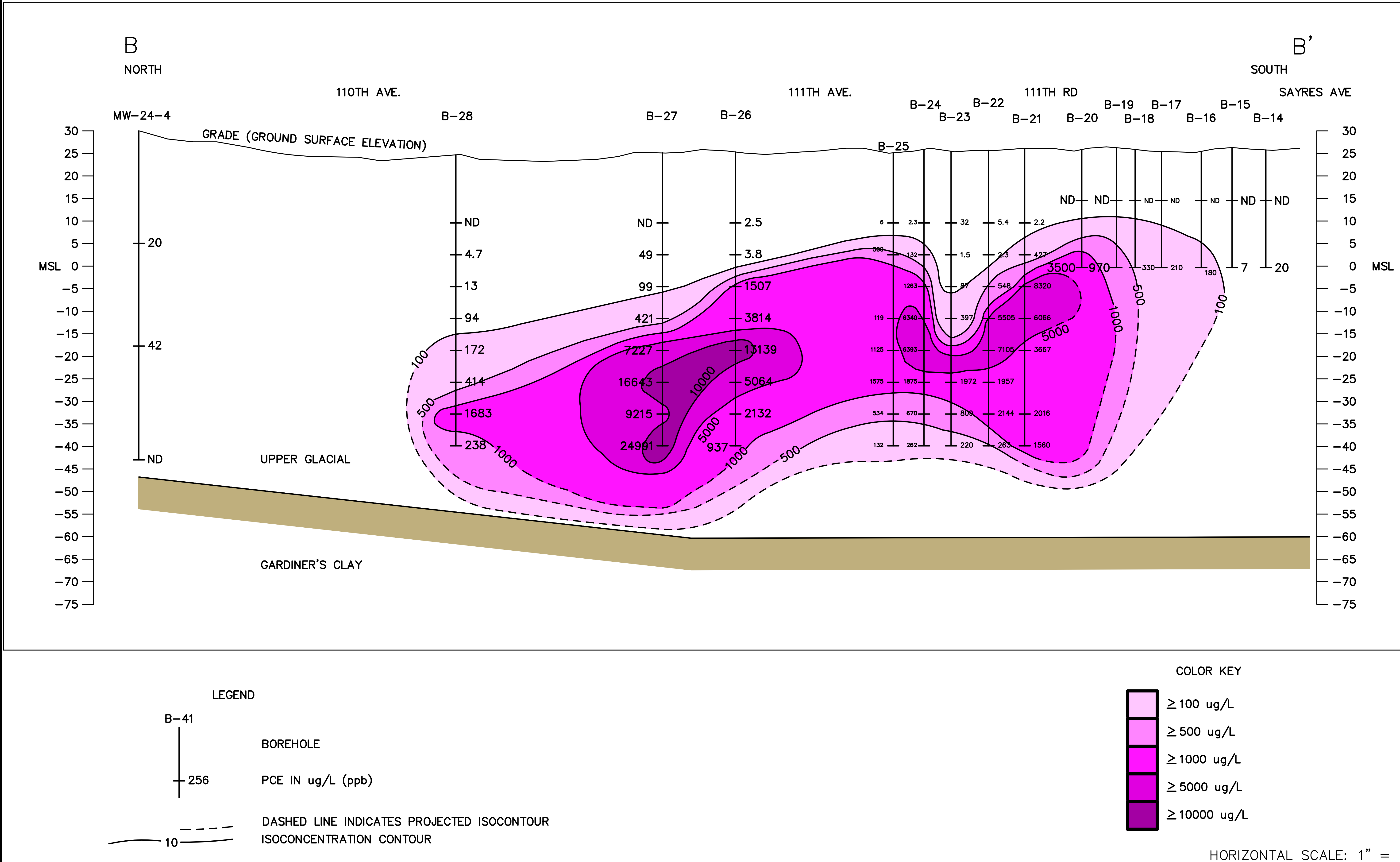


**Figure 5-2: Geoprobe Sample Locations B21-B50 with Plan-View PCE Plume and Transect Locations**





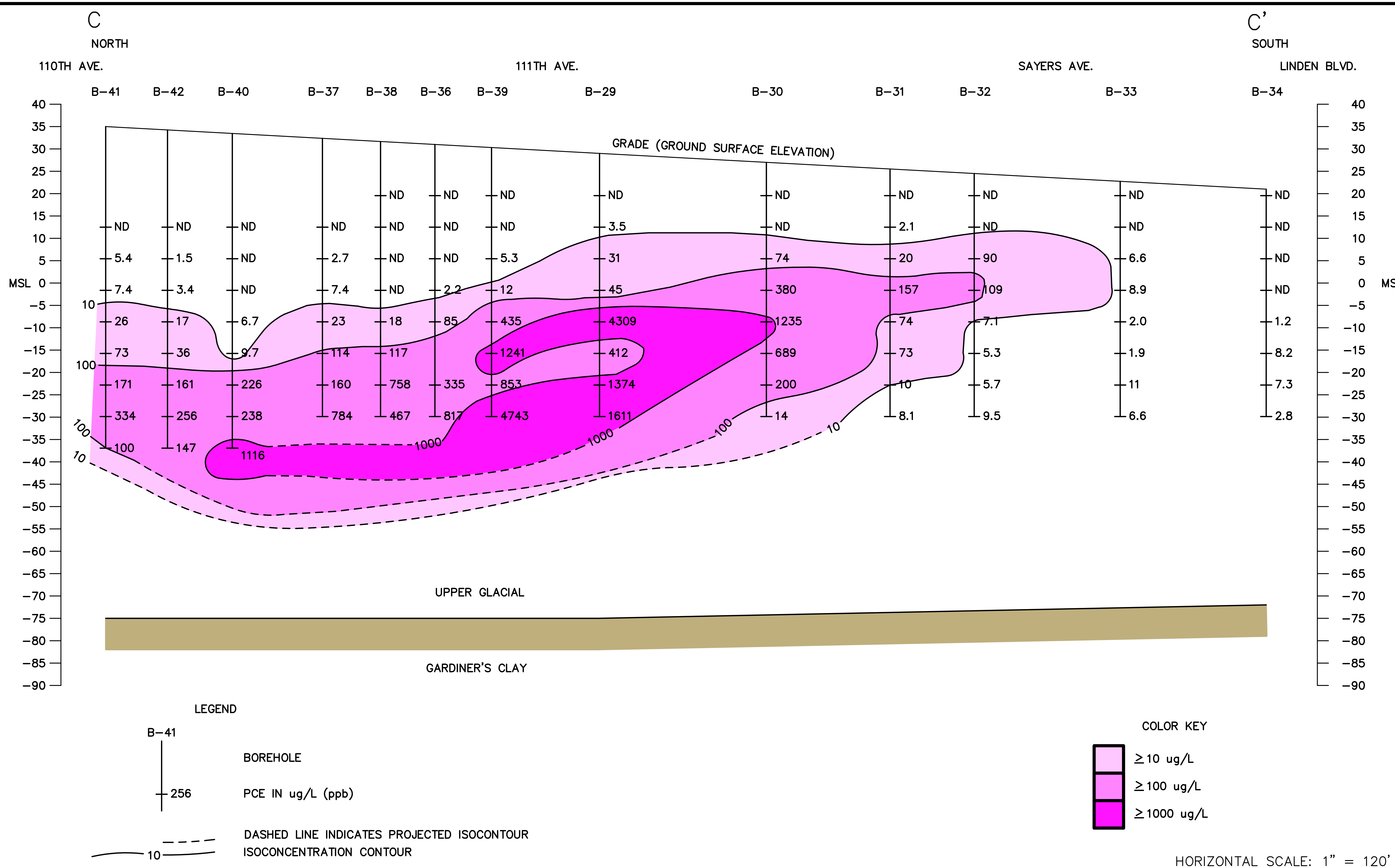

HORIZONTAL SCALE: 1" = 120'

MALCOLM PIRNIE

NYSDEC
WESTSIDE CORP. OU-2, JAMAICA, QUEENS
GROUNDWATER GRAB SAMPLING
**PERCHLOROETHENE (PCE) IN GROUNDWATER**
**TRANSECT ALONG 172TH STREET FROM 110TH AVE. TO SAYRES AVE. FROM B-B'**

MALCOLM PIRNIE, INC.

**FIGURE 5-3**



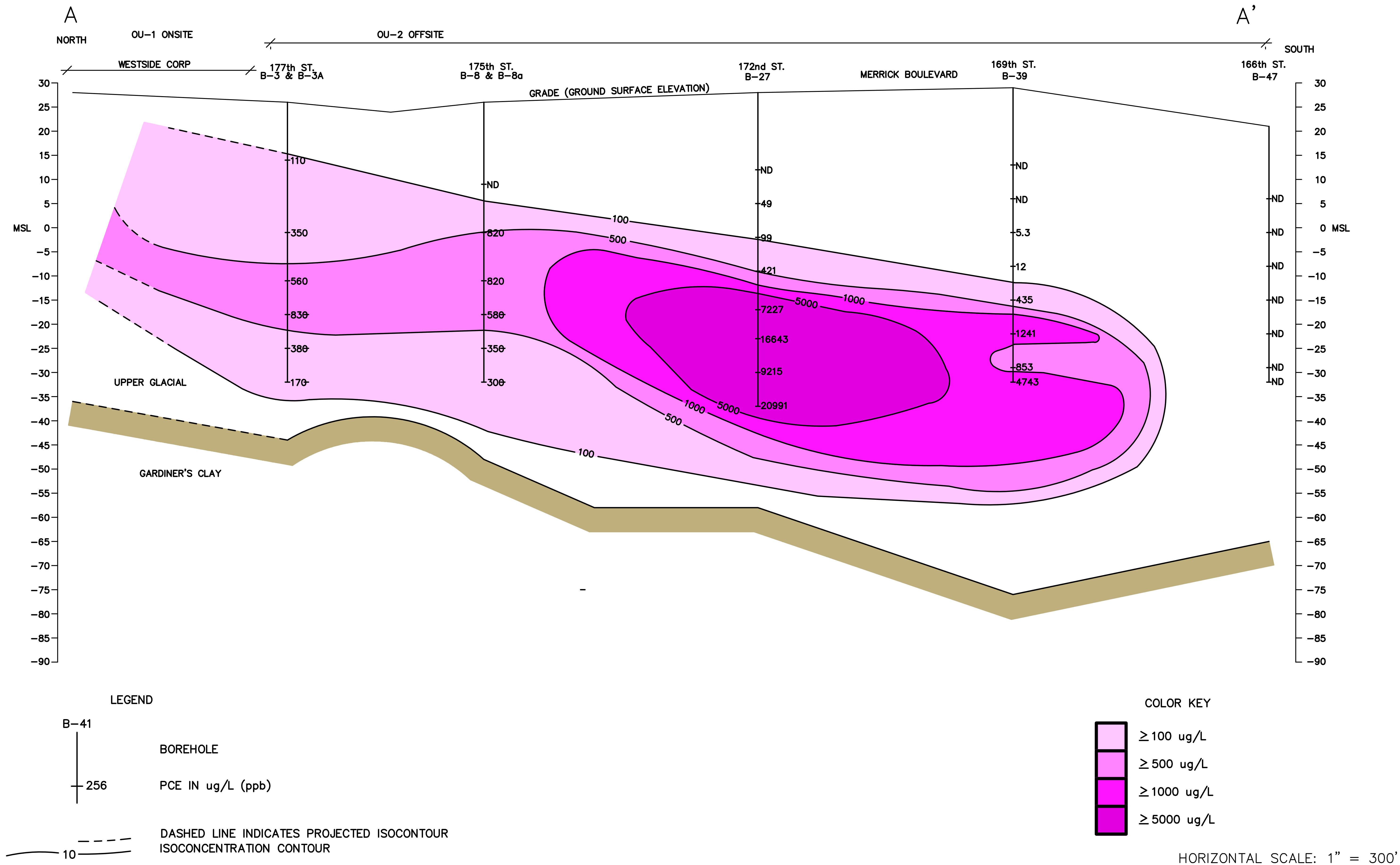

MALCOLM PIRNIE

NYSDEC
WESTSIDE CORP. OU-2, JAMAICA, QUEENS
GROUNDWATER GRAB SAMPLING

**PERCHLOROETHENE (PCE) IN GROUNDWATER**
**TRANSECT ALONG 169TH STREET BETWEEN 110TH AVE. AND LINDEN BOULEVARD FROM C-C'**

MALCOLM PIRNIE, INC.

**FIGURE 5-4**




MALCOLM PIRNIE

NYSDEC
WESTSIDE CORP. OU-2, JAMAICA, QUEENS
GROUNDWATER GRAB SAMPLING
**PERCHLOROETHENE (PCE) IN GROUNDWATER**
**CROSS SECTION LOOKING EAST INTO PLUME FROM CENTERLINE A-A'**

MALCOLM PIRNIE, INC.

**FIGURE 5-5**

**Figure 5-6: Mobile Laboratory (Exterior)**


**Figure 5-7: Mobile Laboratory (Interior Equipment)**

Equipment: Agilent 7890A/5975c Gas Chromatograph-Mass Selective Detector

# 6. Monitoring Well Installation

## 6.1. INTRODUCTION

Following each Geoprobe® mobilization, MEG installed new groundwater monitoring wells to establish permanent monitoring locations and to further characterize the geologic and hydrogeologic conditions in OU-2. Installation of new monitoring wells adjacent to existing shallow wells (W-01 to W-06; installed by URS in 2007) and new clusters (W-07 to W-09) were completed in June /July 2008 using either a 12 inch hollow stem auger or 2 inch Geoprobe® rods. Shallow, intermediate and deep wells were installed in clusters to monitor PCE concentrations as well as water levels.

In August 2008, MEG installed new groundwater monitoring well clusters at W-10 to W-15 after completion of the second Geoprobe® investigation. These new well clusters were also installed to establish permanent monitoring locations along the remainder of the PCE plume. These wells were installed exclusively using the 2 inch Geoprobe® rods to minimize investigation derived waste.

A top-of-casing (toc) topographical survey was conducted to determine coordinates and elevations of new and existing groundwater monitoring wells throughout OU-2 and for selected wells in OU-1.

Well installation equipment was decontaminated before the first use and between use at each new well location. The 12 inch drill augers were steam cleaned on a decontamination pad constructed at the West Side OU-1 site using a pressure washer. The 2 inch Geoprobe® rods were rinsed with de-ionized water onsite prior to being reloaded onto the Geoprobe®. Residual soil cuttings and wash water was drummed in labeled 55-gallon drums and stored at OU-1 until characterized and removed for waste disposal.

## 6.2. FIRST MOBILIZATION

In June and July 2008, following completion of the first Geoprobe® investigation, intermediate and deep well couplets were installed adjacent to the five existing offsite shallow wells (W-01, W-02, W-03, W-04 and W-06). These couplets were constructed as shown on the well construction logs presented in Appendix D. In addition, shallow, intermediate and deep well triplets were installed at new cluster locations W-07, W-08 and W-09. These construction logs are also presented in Appendix D.

For the purpose of maintaining clear nomenclature, existing offsite wells from previous investigations are referred to as 'MW' series wells and include MW-05, MW-07, MW-08 and MW-24 wells. Monitoring wells MW-07 and MW-08 are not to be confused with new clusters W-07 and W-08, respectively. A map indicating these monitoring well designations and locations is provided in Figure 5-1.

New well couplets were each constructed of 2 inch diameter casings with 20-slot PVC screens placed at intermediate and deep intervals within the Upper Glacial aquifer. The screen depths of these wells were determined based on the depth of the top of clay (deep) and the water table interface for the existing shallow; intermediate well screens were set approximately equidistant from shallow and deep screens. See Table 5-1 for more information.

Monitoring wells in cluster W-06 were the only wells installed using the Geoprobe® during the first mobilization; it was a pilot for an alternative installation method that would produce less investigation derived waste and, if successful, be used during the second mobilization. In this case, three additional 1 inch diameter wells (W-06I, W-06IT, W-06D) were installed adjacent to the existing 2 inch W-06 shallow well. Each of these wells was installed in a discrete borehole, with its own flushmount surface casing and well apron.

The intermediate depth well at W-06 was duplicated (‘I’ and ‘IT’); the narrow diameter of these wells did not permit the installation of both water level monitoring equipment (Leveloggers®) and a passive diffusion bag (PDB) into a single casing. See Section 6.2 for more information.

### 6.2.1. Stratigraphic Sampling

Soil samples were retrieved and archived by the onsite geologist during deep monitoring well installations to document stratigraphy and characterize subsurface conditions at OU-2. Samples were typically retrieved on alternating 5 foot intervals using a 2 foot long split-spoon sampler. Geologic boring logs from these well locations are included in Appendix A.

### 6.2.2. Well Development and Identification

New monitoring wells were developed using airlift, surge, and constant rate groundwater purge methods to remove silt and fine particles until the groundwater purged from the wall was less than 50 nephelometric turbidity units (NTU).

Each new and existing monitoring well was labeled under a unified identification system upon development by tagging each well casing (ex. W-07 S) and flushmount.

## 6.3. SECOND MOBILIZATION

In August 2008, following completion of the second Geoprobe® investigation, MEG installed new groundwater monitoring well clusters at locations W-10 through W-15. The

Geoprobe® was used to install 1 inch PVC wells at shallow, intermediate (x2), and deep intervals at each location. Well screen depths were determined based on the top of clay (deep) and water table interface (shallow). Both intermediate wells were set at the same depth, based in part on PCE concentrations in the intermediate zones. Well locations were chosen based upon an estimation of the plume's horizontal extent according to Geoprobe® investigative findings and are presented in Figure 5-2, additional information is provided in Table 5-2.

Each new monitoring well was installed in a discrete borehole, with its own flushmount surface casing and well apron adjacent to one another. A typical well cluster with this configuration is provided in Figure 5-3. Well construction logs are presented in Appendix D.

### 6.3.1. Stratigraphic Sampling

Soil samples were retrieved and archived by the onsite geologist during deep monitoring well installations to document stratigraphy and characterize subsurface conditions at OU-2. Samples were typically retrieved on alternating 5 foot intervals using 2 foot acetate sleeves within the Geoprobe® rod. Geologic boring logs from these well locations are included in Appendix A.

### 6.3.2. Well Development and Identification

Each new monitoring well was developed using constant rate peristaltic pump to remove silt and sediment until the water was less than 50 NTU. All wells were labeled upon development using a unified identification tag affixed to each well casing and flushmounted surface casing.

## 6.4. INVESTIGATION DERIVED WASTE DISPOSAL

Soil cuttings and purge water derived from the subsurface investigations were stored in labeled 55-gallon steel drums on the West Side premises until characterized and removed for waste disposal.

## 6.5. SURVEY CONTROL

New and existing onsite and offsite groundwater monitoring wells were surveyed by YEC on July 1, 2008 and September 8, 2008. Horizontal coordinates and vertical elevations for the top of each well casing are presented in Table 3-1, Table 5-1 and Table 5-2.

**Table 6-1.**
**First Mobilization Monitoring Well Detail: W-01 to W-09**

| Well Number | | **Screen Interval | Casing Coordinates | | ***TOC Elevation |
|---|---|---|---|---|---|
| | | | Northing | Easting | |
| W-01 | S* | 12-22 | 680522.8712 | 692209.4579 | 27.69 |
| | I | 35-45 | 680524.9267 | 692223.4906 | 27.74 |
| | D | 60-70 | 680524.9267 | 692223.4906 | 27.87 |
| W-02 | S* | 12-22 | 680117.5165 | 692440.7601 | 27.13 |
| | I | 34-44 | 680124.1746 | 692435.7627 | 27.23 |
| | D | 64-74 | 680124.1746 | 692435.7627 | 27.24 |
| W-03 | S* | 12-22 | 680236.185 | 692093.8228 | 25.27 |
| | I | 35-45 | 680208.6828 | 692111.0366 | 25.45 |
| | D | 60-70 | 680208.6828 | 692111.0366 | 25.44 |
| W-04 | S* | 12-22 | 680020.9783 | 692216.1521 | 25.67 |
| | I | 35-45 | 680029.4992 | 692211.7442 | 25.43 |
| | D | 50-60 | 680029.4992 | 692211.7442 | 25.48 |
| MW-05 | S* | 12-22 | 680166.7906 | 691837.9306 | 28.66 |
| W-06 | S* | 12-22 | 679500.7445 | 692214.1205 | 26.90 |
| | I | 30-40 | 679498.8897 | 692215.2335 | 27.12 |
| | IT | 30-40 | 679502.1676 | 692213.3908 | 27.19 |
| | D | 60-70 | 679497.6096 | 692215.8539 | 27.17 |
| W-07 | S | 12-22 | 679588.7041 | 691862.1503 | 27.31 |
| | I | 30-40 | 679588.7041 | 691862.1503 | 27.36 |
| | D | 75-85 | 679588.7041 | 691862.1503 | 27.22 |
| W-08 | S | 12-22 | 679584.3979 | 692149.3292 | 27.84 |
| | I | 30-40 | 679584.3979 | 692149.3292 | 27.90 |
| | D | 65-75 | 679584.3979 | 692149.3292 | 27.91 |
| W-09 | S | 12-22 | 680333.4549 | 692332.5959 | 28.90 |
| | I | 35-45 | 680333.4549 | 692332.5959 | 29.02 |
| | D | 60-70 | 680333.4549 | 692332.5959 | 28.72 |

*Wells installed by URS in 2005

**Screen intervals S (Shallow), I (intermediate) and D (Deep) in feet (ft) below ground surface (bgs)

***TOC denotes ‘top of casing’ elevation in feet (ft) above msl, surveyed by YEC on 7.01.08 and 9.08.08

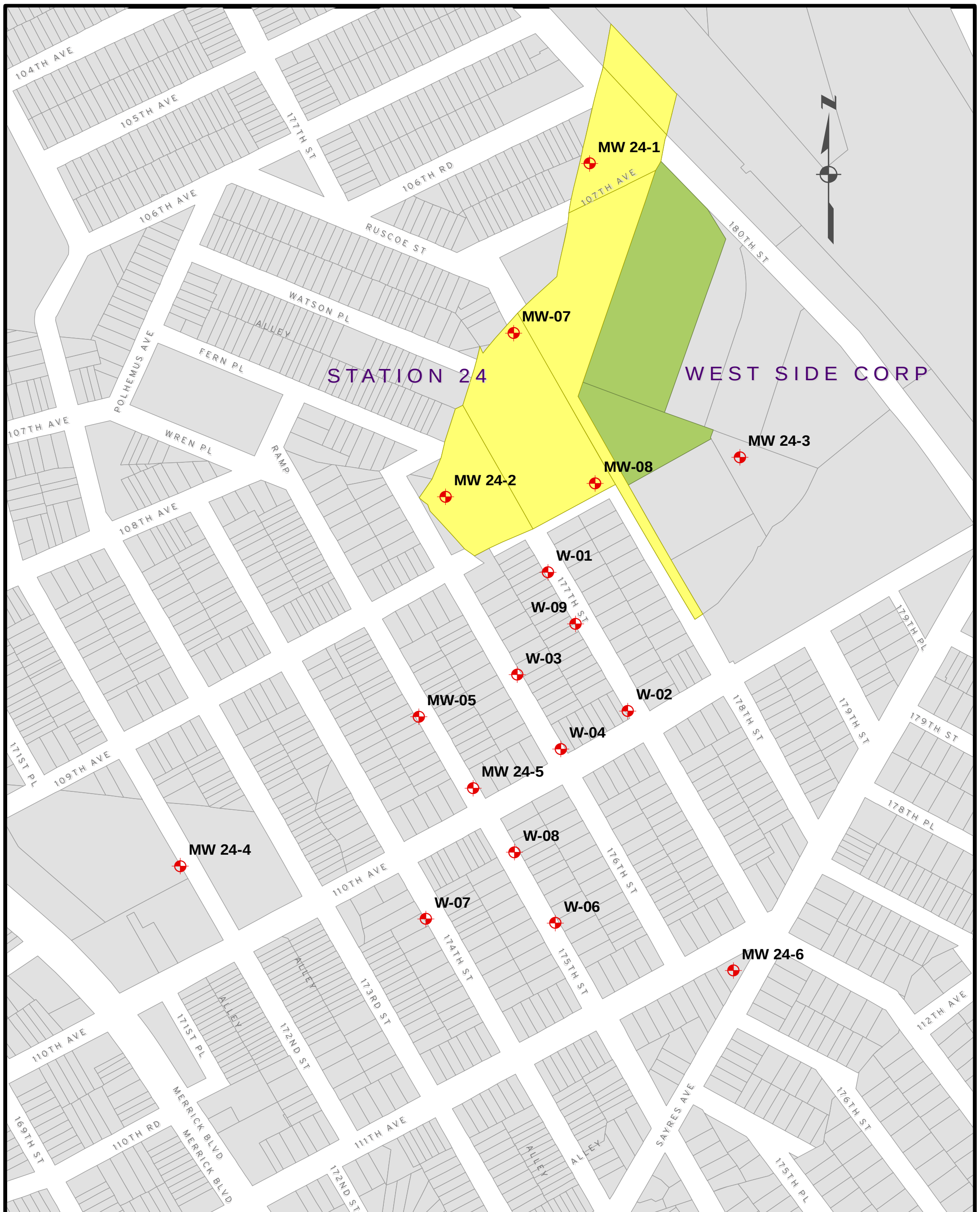
**Table 6-2.**
## Second Mobilization Monitoring Well Detail: W-10 to W-15

| Well Number | | *Screen Interval | Casing Coordinates | | **TOC Elevation |
|---|---|---|---|---|---|
| | | | Northing | Easting | |
| W-10 | S | 5-15 | 678469.2472 | 692048.1534 | 26.03 |
| | I | 35-45 | 678469.8335 | 692050.3831 | 26.06 |
| | IT | 35-45 | 678470.8217 | 692051.6225 | 26.11 |
| | D | 75-85 | 678472.3862 | 692053.8164 | 26.04 |
| W-11 | S | 5-15 | 679095.9758 | 691554.4699 | 28.42 |
| | I | 35-45 | 679094.8601 | 691555.3182 | 28.37 |
| | IT | 35-45 | 679092.0758 | 691556.5993 | 28.37 |
| | D | 75-85 | 679093.5567 | 691556.1055 | 28.02 |
| W-12 | S | 17-27 | 678987.5867 | 690678.4453 | 35.15 |
| | I | 45-55 | 678982.0821 | 690681.6977 | 35.01 |
| | IT | 45-55 | 678979.1614 | 690683.6302 | 34.86 |
| | D | 95-105 | 678984.5301 | 690679.9126 | 34.99 |
| W-13 | S | 5-15 | 677969.1016 | 691298.5972 | 21.95 |
| | I | 45-55 | 678136.6645 | 690466.6285 | 22.05 |
| | IT | 45-55 | 678137.9174 | 690469.1902 | 21.88 |
| | D | 92-102 | 678135.0645 | 690464.2343 | 21.76 |
| W-14 | S | 12-22 | 678465.8862 | 691016.5648 | 29.08 |
| | I | 35-45 | 678469.7824 | 691014.7433 | 29.12 |
| | IT | 35-45 | 678468.0806 | 691015.4194 | 29.18 |
| | D | 95-105 | 678472.571 | 691013.6218 | 29.10 |
| W-15 | S | 5-15 | 677877.2981 | 690414.5206 | 21.49 |
| | I | 35-45 | 677869.6865 | 690419.6535 | 21.61 |
| | IT | 35-45 | 677873.5401 | 690416.9433 | 21.55 |
| | D | 77-87 | 677867.3493 | 690420.3839 | 21.37 |

*Screen intervals S (Shallow), I (intermediate), IT (Intermediate with Transducer) and D (Deep) in feet (ft) below ground surface (bgs)

**TOC denotes 'top of casing' elevation in feet (ft) above msl, surveyed by YEC on 7.01.08 and 9.08.08

**Figure 6-1: First Mobilization Monitoring Well Locations: W-01 to W-09**




Permanent Monitoring Wells

NOTE: All well locations shown are clusters (ie shallow, intermediate, deep), excluding MW-05, MW-07 and MW-08.

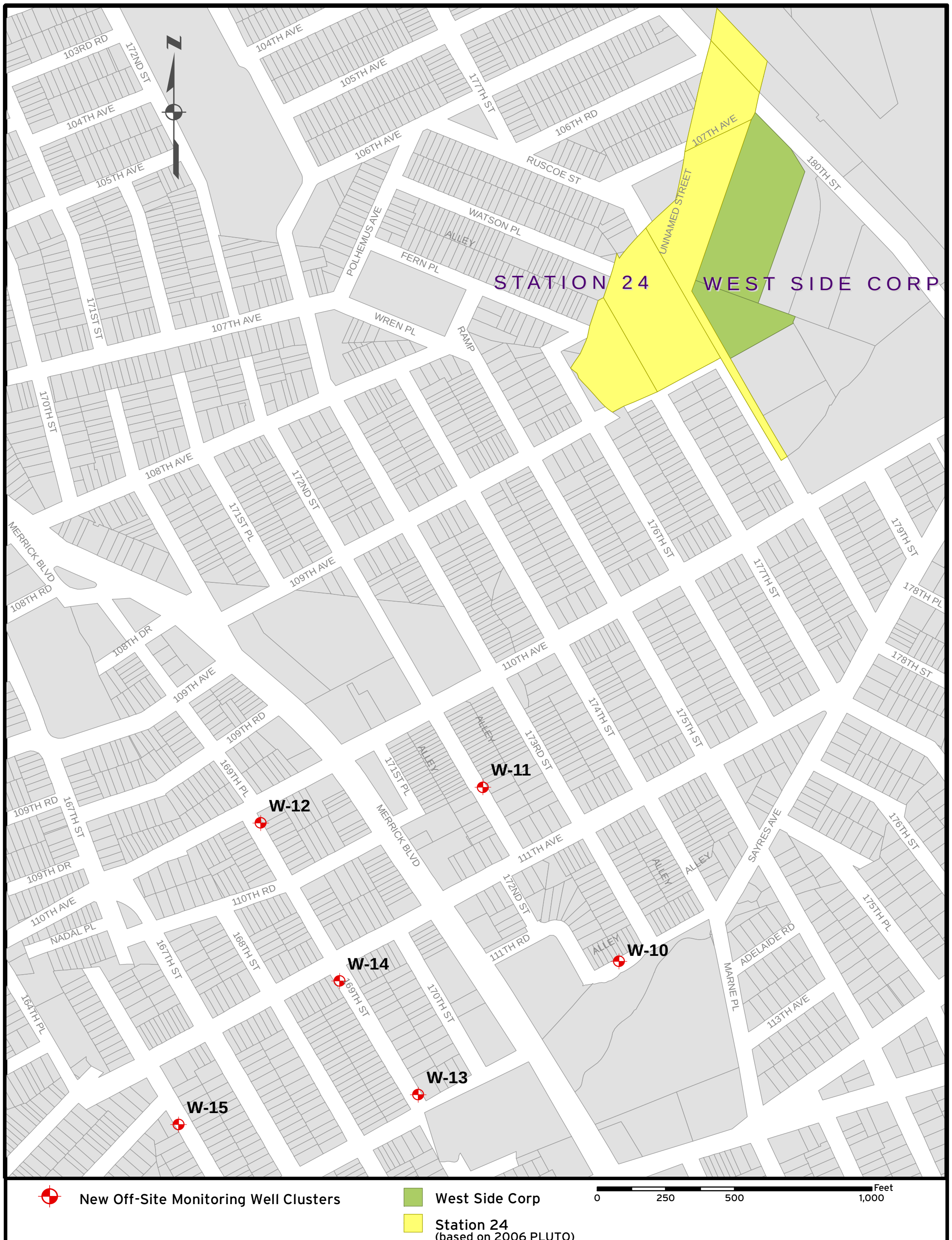
West Side Corp

Station 24
(based on 2006 PLUTO)

Feet: 0 250 500 1,000

FIRST MOBILIZATION: MONITORING WELL LOCATIONS
EXISTING AND NEW W-01 to W-09 and MW 24 SERIES

**Figure 6-2: Second Mobilization Monitoring Well Locations: W-10 to W-15**




**SECOND MOBILIZATION: MONITORING WELL LOCATIONS W-10 to W-15**

**Figure 6-3: Typical Monitoring Well Cluster**


W-14: D (Deep), I (Intermediate), IT (Intermediate with Transducer) and S (Shallow) wells

# 7. Monitoring Program

## 7.1. INTRODUCTION

The new monitoring well network was installed to establish permanent monitoring locations within and around the delineated boundaries of the PCE plume. Monitoring activities include quarterly groundwater sampling events and synoptic water level measurements in all wells, and continuous water level monitoring in selected wells.

The current monitoring program began in August 2008 and will continue through August 2009 at which point a decision will be made regarding the frequency and scope of subsequent monitoring events. This monitoring program will document the rate and direction of PCE migration within the aquifer under non-pumping conditions, as well as seasonal variations in water table elevation at OU-1 and OU-2. Data collected during the monitoring program will provide critical baseline information needed prior to remediation of the study area. This data will also provide ongoing information needed for the vapor intrusion studies being conducted by the NYSDEC.

## 7.2. WATER LEVEL MEASUREMENTS

MEG installed Levelogger® pressure transducers (see Appendix B) in OU-2 intermediate depth wells on August 14th and September 8th 2008 following the completion of the first and second rounds of monitoring well installation. Therefore, water level data from monitoring wells W-10 through W-15 (excluding W-11) begins later into the first monitoring quarter.

Leveloggers® were set within the well casing approximately 30 feet bgs and calibrated to record head pressure of groundwater on 1-hour time intervals. Locations of installed pressure transducers is presented in Figure 6-1.

The diameter constraints of 1 inch monitoring wells (W-06I, W-10I to W-15I) did not permit the installation of both a PDB and Levelogger® in the same casing. Thus, the intermediate depth well was duplicated and labeled “IT” to indicate its purpose of housing only a pressure transducer.

Prior to installation, manual water level measurements were obtained from shallow, intermediate and deep wells throughout the study area as baseline information and for Levelogger® calibration; these measurements were also used to determine the direction of groundwater flow.

One of four scheduled water level monitoring events was completed as part of this investigation. The water level information was retrieved from the Leveloggers® by downloading data via software onto a laptop computer. Groundwater elevations during the first quarterly monitoring event are presented in DATA CD: 3.1. Depth-to-water (DTW) measurements  and groundwater elevations recorded by MEG are presented in Appendix E.

## 7.3. WATER QUALITY SAMPLING

Passive Diffuser Bags (PDBs) were installed in all shallow, intermediate and deep groundwater monitoring wells in July 2008. PDBs were used to minimize investigation derived waste by eliminating the need to purge the monitoring wells prior to sample collection. (See Appendix C for background information and standard installation operating procedure ‘SOP’ for PDBs). PDBs were installed at the midpoint of each well screen and allowed to equilibrate for approximately one month prior to retrieval of samples. See Figure 6-2 for PDB sampling locations.

Two different size PDBs were required due to variations in well casing diameter. The 2 inch wells received 1.5 inch PDBs, while 1 inch wells received 3/4 inch PDBs. The 2 inch wells were of sufficient diameter to house both a PDB and Levelogger®. The placement of both devices in the same casing did not impede proper function.

The first scheduled water quality sampling event was completed on October 6, 2008. Groundwater samples collected from the PDBs were analyzed by Phoenix Laboratories for VOCs by SW-846 EPA Method 8260. Laboratory deliverable results were compiled in ASP-B format for data validation. The non-validated data package is presented in Data CD: 4.1. A summary of all VOCs detected from PDB analysis is presented in Table 6-1; results of PDB sampling are discussed in Section 7.2.

## 7.4. DATA VALIDATION

Data Validation Services (DVS) generated a data usability summary report (DUSR) from review of raw sample deliverables produced by Phoenix Laboratories. The DUSR and its narrative have determined that the results for most of the samples are usable as reported while other samples were determined usable with minor qualification. The narrative is provided in Appendix H.

The DUSR also notes that eight sample values are potentially the result of external contamination, due to a carry-over from antecedent sample analysis. The affected samples W-02S, W-09D, W-01D, W-03S, W-03D, W-06S, W-07 and W-14D are therefore considered as potential false positives or falsely elevated. (Note: the affected W-07 sample data was not used in generating this report, due to a discrepancy in field identification).

The DUSR narrative states that the actual constituency of the affected samples below the reported concentrations is unknown, as all or none of the detected values may be a result of carryover. While these samples constitute a small portion of the dataset and are relatively low in PCE compared to non-affected samples, the PDB sample data summary (Table 7-1) and PCE isoconcentration maps were constructed using the original data to produce a ‘worst case’ scenario.

The fully validated data package reflects edits made by the validator to the affected analyte results and is provided in Data CD 4.2.

## TABLE 7-1

WESTSIDE OU-1, OU-2: GROUNDWATER PDB SAMPLE DATA

1st ROUND: October 06, 2008

| Well No. | DETECTED PARAMETERS | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | PCE | TCE | THF | MTBE | Toluene | Acetone | Vinyl Chloride | 1-1-1 trichloro ethane | 1-1 dichloro ethane | 1-1 dichloro ethene | cis 1-2 dichloro ethene |
| MW 24-1S | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| MW 24-1I | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| MW 24-1D | **130** | ND | ND | ND | ND | ND | ND | **7.3** | **7.7** | **7.1** | ND |
| MW 24-2S | **15** | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| MW 24-2I | **32** | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| MW 24-2D | ND | ND | ND | ND | ND | ND | ND | ND | **11** | ND | ND |
| MW 24-4S | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| MW 24-4I | **6.8** | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| MW 24-4D | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| MW 24-5S | **14** | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| MW 24-5I | **1700** | **12** | ND | ND | ND | ND | ND | ND | ND | ND | **25** |
| MW 24-5D | **55** | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| MW 24-6S | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| MW 24-6I | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| MW 24-6D | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| W-01S | **28** | **7.2** | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| W-01I | **1500** | **35** | ND | ND | ND | **100** | ND | ND | ND | ND | **120** |
| W-01D | **7.4** UC | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| W-02S | **32** UC | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| W-02I | **910** | **32** | ND | ND | ND | ND | ND | ND | ND | ND | **32** |
| W-02D | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | **63** |
| W-03S | **18** UC | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| W-03I | **460** | **14** | ND | ND | ND | ND | ND | ND | ND | ND | **15** |
| W-03D | **28** UC | ND | **20** | ND | ND | ND | ND | ND | ND | ND | ND |
| W-04S | **1200** | **15** | ND | ND | ND | ND | ND | ND | ND | ND | **7.8** |
| W-04I | **330** | **110** | ND | ND | ND | ND | ND | ND | ND | ND | **42** |
| W-04D | **380** | **55** | ND | ND | ND | ND | ND | ND | ND | ND | **16** |
| W-06S | **7.7** UC | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| W-06I | **120** | ND | **23** | ND | ND | ND | ND | ND | ND | ND | ND |
| W-06D | **620** | **16** | **18** | ND | ND | ND | ND | ND | ND | ND | **11** |
| W-07S | **470** | **62** | ND | ND | ND | ND | ND | ND | ND | ND | **90** |
| W-07I | **1100** | **9.7** | ND | ND | ND | ND | ND | ND | ND | ND | **16** |
| W-07D | **73** | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| W-08S | **1100** | **180** | ND | ND | ND | ND | ND | ND | ND | ND | **800** |
| W-08I | **290** | **150** | ND | ND | ND | ND | ND | ND | ND | ND | **500** |
| W-08D | **270** | **120** | ND | ND | ND | ND | ND | ND | ND | ND | **290** |
| W-09S | **66** | **16** | ND | ND | ND | ND | **6.3** | ND | ND | ND | **61** |
| W-09I | **1700** | **350** | ND | ND | ND | ND | ND | ND | ND | ND | **190** |
| W-09D | **110** UC | **21** | ND | ND | ND | ND | ND | ND | ND | ND | **32** |
| W-10S | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| W-10I | **170** | **27** | ND | ND | ND | ND | ND | ND | ND | ND | **32** |
| W-10D | **47** | ND | ND | ND | ND | ND | ND | ND | ND | ND | **11** |
| W-11S | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| W-11I | **470** | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| W-11D | **560** | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |

Notes:
All values in parts-per-billion (ppb)
'ND' denotes 'non-detect', or absence of compound from sample

Qualifiers:
UC: Compound detected, may be due to carry-over. Concentration below reported value is unknown

## TABLE 7-1

WESTSIDE OU-1, OU-2: GROUNDWATER PDB SAMPLE DATA

1st ROUND: October 06, 2008

| Well | PARAMETERS | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | PCE | TCE | THF | MTBE | Toluene | Acetone | Vinyl Chloride | 1-1-1 trichloro ethane | 1-1 dichloro ethane | 1-1 dichloro ethene | cis 1-2 dichloro ethene |
| W-12S | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| W-12I | **17** | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| W-12D | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| W-13S | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| W-13I | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| W-13D | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| W-14S | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| W-14I | **680** | **8.3** | ND | ND | ND | ND | ND | ND | ND | ND | **21** |
| W-14D | **56** UC | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| W-15S | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| W-15I | ND | ND | ND | **490** | ND | ND | ND | ND | ND | ND | ND |
| W-15D | **16** | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| MW-05 | **9** | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| MW 22S | **16** | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| MW 3D | **22** | ND | ND | ND | **7.3** | ND | ND | ND | ND | ND | ND |
| MW 55D | **49** | ND | ND | ND | ND | ND | ND | ND | ND | ND | **12** |
| MW 6S | **12** | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| MW 7S | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| MW 77D | **330** | **170** | ND | ND | ND | ND | ND | ND | ND | ND | **300** |
| MW-07 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| MW-08 | **97** | **10** | ND | ND | ND | ND | ND | ND | ND | ND | **18** |

Notes:
All values in parts-per-billion (ppb)
'ND' denotes 'non-detect', or absence of compound from sample

Qualifiers:
UC: Compound detected, may be due to carry-over.
Concentration below reported value is unknown

**Figure 7-1: Pressure Transducer Locations**

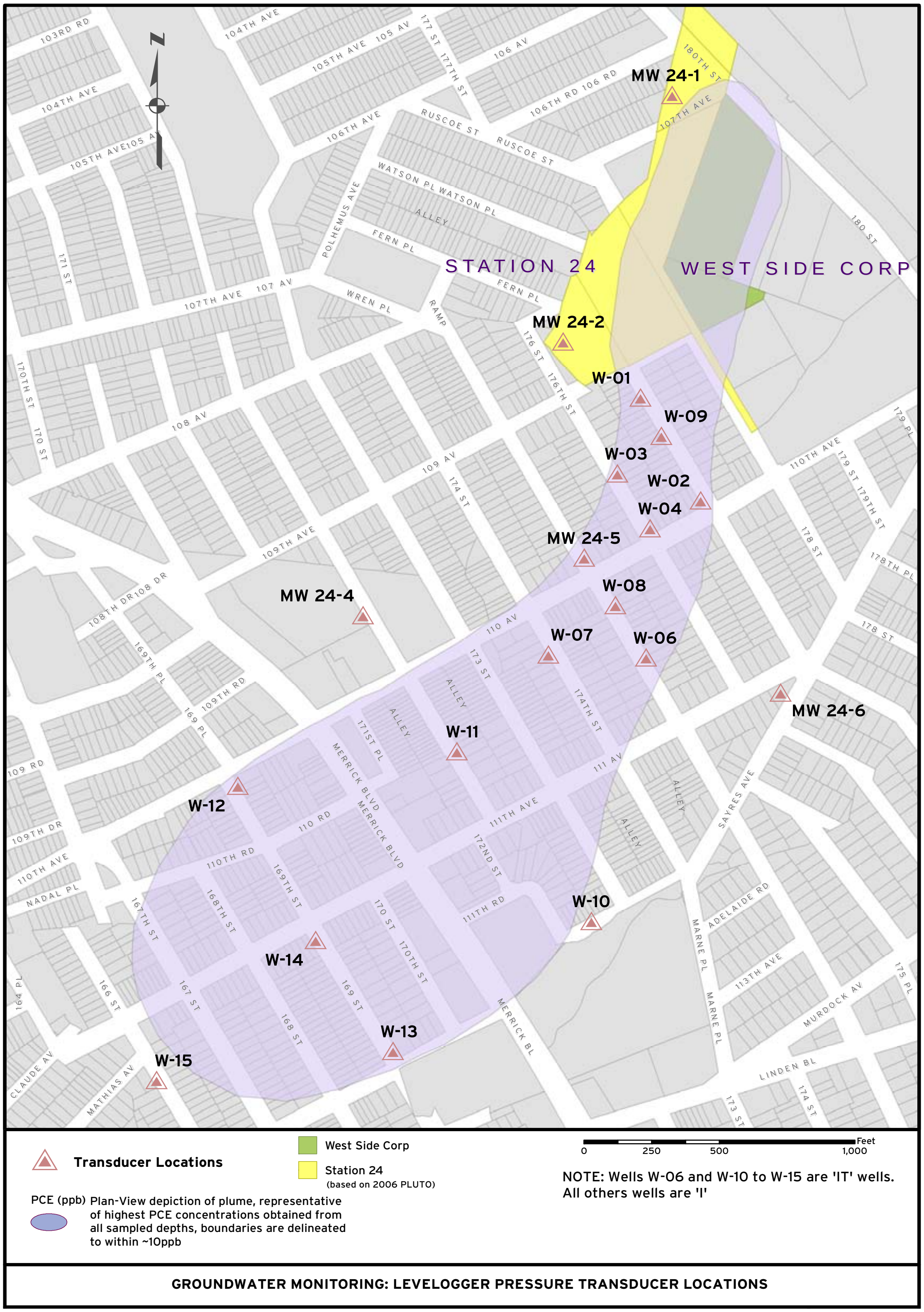
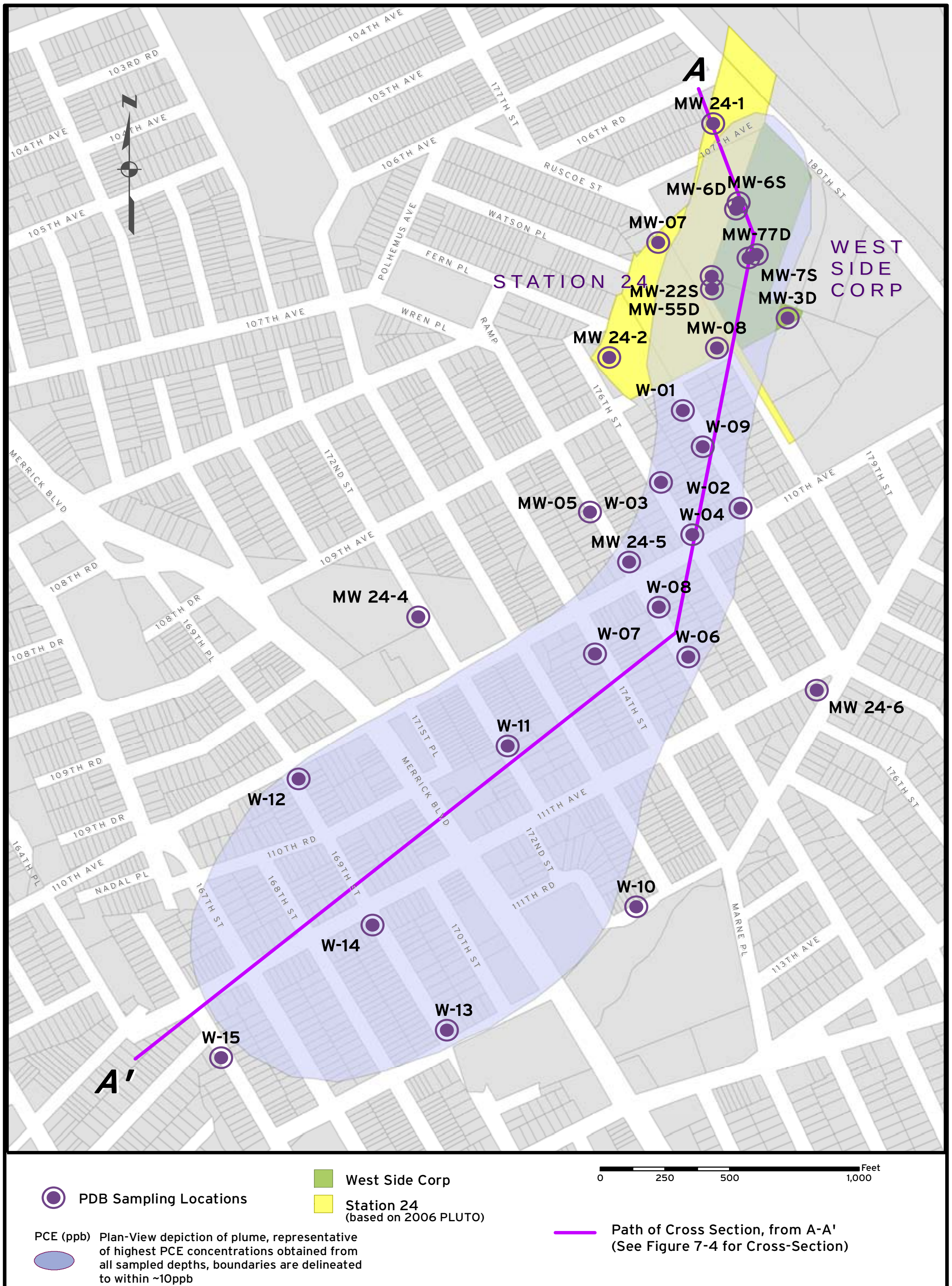


**Figure 7-2: Passive Diffuser Bag Locations**




GROUNDWATER SAMPLING - MONITORING WELLS WITH PASSIVE DIFFUSION BAGS (PDBs) INSTALLED

# 8. Investigation Findings

## 8.1. HYDROGEOLOGY

Water level data show that the direction of groundwater movement is to the south-southwest, consistent with previous investigations and as expected based on regional conditions. Water table elevations range from 22 feet above msl onsite at OU-1 to 15 feet above msl at the south edge of OU-2. The horizontal groundwater gradient is 0.0018 feet/foot along this heading. Contoured water table elevation maps for shallow, intermediate, and deep wells from the first sampling event (October 6, 2008) are presented in Figure 7-1, Figure 7-2 and Figure 7-3, respectively.

Water levels measured between shallow, intermediate and deep wells in each monitoring well cluster were consistent, with differences ranging from 0.01 to 0.18 feet, indicating no significant vertical gradient under non-pumping conditions. This is important information given that vertical gradients are expected to change significantly once pumping for groundwater remediation begins.

Hydrographs constructed from Levelogger® data indicate less than an 18 inch fluctuation in water table elevation during the first monitoring quarter, even with two significant precipitation events (over 2 inches in a 24-hour period) in September (NOAA, JFK). The hydrographs also reflect the effects of moderate precipitation events through an increase in groundwater elevation that is consistent between well clusters; correlation between precipitation events and increases in water levels is inconclusive for this short time period. Hydrographs presented in Appendix G show representative trends in water table elevations during the first monitoring quarter.

Hydrographs also indicate an overall increasing trend in groundwater elevation, ranging from 0.5 to 0.9 feet above msl, from August to October 2008. Wells W-10 to W-15 (excluding W-11) are exceptional, displaying a decrease in elevation, due to their pressure transducers being installed later (September 8, 2008) in the monitoring quarter and following a significant precipitation event.

## 8.2. PCE PLUME

Plan-view PCE isoconcentration maps indicate variation in plume configuration with depth. Figure 7-4 indicates that shallow contamination extends from the OU-1 source area to approximately 2000 feet downgradient in the vicinity of 173rd Street, where PCE was no longer detected in shallow (~12-22 ft bgs) depths. The highest concentrations were observed between 177th and 176th Street, where wells W-04S and W-08S indicated significant shallow groundwater contamination at 1200 ppb and1100 ppb, respectively. Several other shallow wells indicated relatively low PCE concentrations (less than 100 ppb) between OU-1 and 173rd Street. Beyond this point, PCE was not detected in the shallow monitoring wells.

Intermediate depth monitoring wells indicate that the PCE plume extends further south and west in this intermediate zone. Monitoring well W-14I, located on 169th Street, may be close to the leading edge of the plume in the intermediate zone as indicated by a PCE concentration of 680 ppb. PCE was no longer detected along 166th Street, indicating that the leading edge of the plume in the intermediate zone is located between 169th and 166th Streets.

The highest concentrations in the intermediate zone (~ 40-50 ft bgs) were observed from 177th Street to 174th Street, where several wells indicate PCE concentrations greater than 1000 ppb (see Figure 7-5). Low to ‘non-detect’ PCE concentrations were observed in monitoring wells near 110th Avenue to the northwest and Sayres Avenue to the southeast, indicating that the plume lies within these boundaries at intermediate depths.

Analysis of groundwater samples from deep monitoring wells indicates that contamination extends still farther to the south-southwest in the deepest interval (Figure 7-6). Although the Geoprobe® data indicated that the leading edge of the plume in the deep interval should be located between 166th and 169th Streets, PCE was detected at low concentrations (16 ppb) in W-15D which is located on 166th Street. The detection of PCE at this location indicates that the leading edge of the plume in the deep zone is located slightly further downgradient than 166th Street.

The highest PCE concentrations in deep wells were seen in wells W-06D and W-11D at 560 ppb and 620 ppb, respectively, indicating that the bulk of PCE contamination in the deep zone is located between 172nd and 175th Streets. Deep zone contamination appears to also be bounded by 110th Avenue and Sayres Avenue to the northwest and southeast, respectively.

The direction of plume movement as shown in these figures indicates that groundwater contamination follows the southeasterly regional flow direction. Groundwater samples from the monitoring wells were consistent in showing that PCE contamination extends deeper into the aquifer and becomes more widely dispersed with increasing distance from OU-1. Figure 7-7 illustrates this trend, showing a cross-section through the plume along centerline A-A’ (see Figure 4-2). Water quality data obtained from monitoring wells along this centerline indicates that shallow and intermediate PCE contamination predominates to the north of 174th Street, while deeper contamination is seen extending at depth to 166th Street.

## 8.3. VAPOR INTRUSION

Based upon the distribution of dissolved PCE mass beneath the residential area (OU-2), and the presence of clean groundwater above the PCE plume downgradient of 172nd Street, the potential for vapor intrusion into basements of structures is expected to diminish with increasing distance from the West Side site. PCE contamination is moderate (~100 ppb) at shallow depths east of Merrick Boulevard between the 175th and 172nd Street transects and may continue to be a source of soil gas at these locations until groundwater remediation begins. Vapor intrusion is not likely to occur west of 173rd Street, where PCE was not detected at the water table and only low concentrations were detected at most locations at approximately 30 feet bgs.

## 8.4. PLUME MIGRATION

Shallow groundwater sample results confirm that the highest PCE contamination is in close proximity to OU-1. The presence of degradation products (trichloroethene and cis 1-2 dichloroethene) in most of the monitoring wells near OU-1 (W-01 to W-10) suggest that the PCE has been present in the vicinity of the West Side Site for a greater time, indicating proximity to the source area. Since the degradation products were not observed with similar abundance in wells further offsite (W-10 to W-15), this suggests that PCE has persisted near OU-1 longer than at the more distal locations.

The estimated time frame of PCE release into the groundwater was the late 1970’s. Assuming non-pumping conditions over an approximate 30 year period and the current plume extent from OU-1 to the vicinity of 166th Street, the apparent observed rate of PCE migration is approximately 0.38 ft/day. Assuming this continued rate of movement, the PCE will continue to migrate south-southwest approximately 1/4 mile per decade. The tendency of PCE to disperse and descend within the aquifer as observed between the 172nd Street and 169th Street transects, will likely continue until groundwater remediation begins.

Given the measured groundwater gradient of 0.0018 ft/ft, an average hydraulic conductivity of 1,000 gallons-per-day per square-foot (gpd/ft2) and an average effective porosity of 30%, the rate of groundwater flow in this aquifer is estimated at 0.80 ft/day. Based on these calculated values, the retardation factor, or attenuation factor, for PCE at this location is approximately 0.5, where PCE moves through the aquifer approximately 1/2 the rate of groundwater. This is consistent with published literature on PCE movement in groundwater (USGS, 2004).

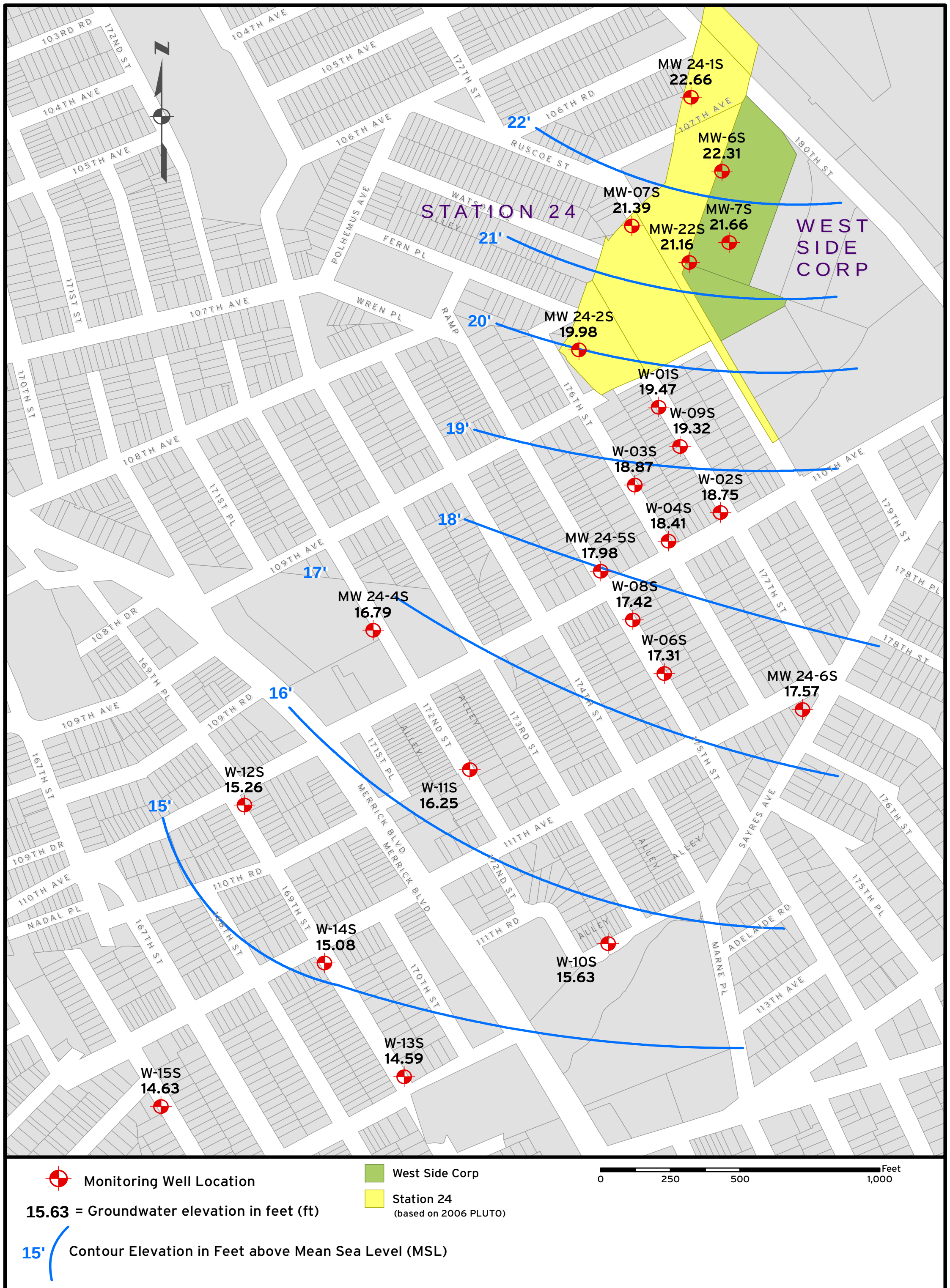
## 8.5. PLUME RECOVERY

Groundwater modeling indicates that the pumping of the proposed groundwater recovery system will create 1 foot of drawdown at the leading edge of the plume and 0.5 feet drawdown well beyond this extent (Figure 7-8). Given the regional gradient, however, resulting heads create a capture zone that reaches across Merrick Boulevard before developing a roughly east/west groundwater divide, running through the intersection of 169th Street and 111th Avenue (Figure 7-9). This anticipated capture zone should be sufficient to capture the shallow and intermediate depth portions of the PCE plume, as well as capturing the bulk of the deep plume. However, the very leading edge of the deep portion of the plume, between 169th and 166th Streets, appears to lie outside of the capture zone of the two recovery wells. While further analysis and evaluation is required to confirm the capture zone of these wells, other options for containing/capturing the leading edge of the plume's deeper portion should be explored.

## 8.6. RECOMMENDATIONS

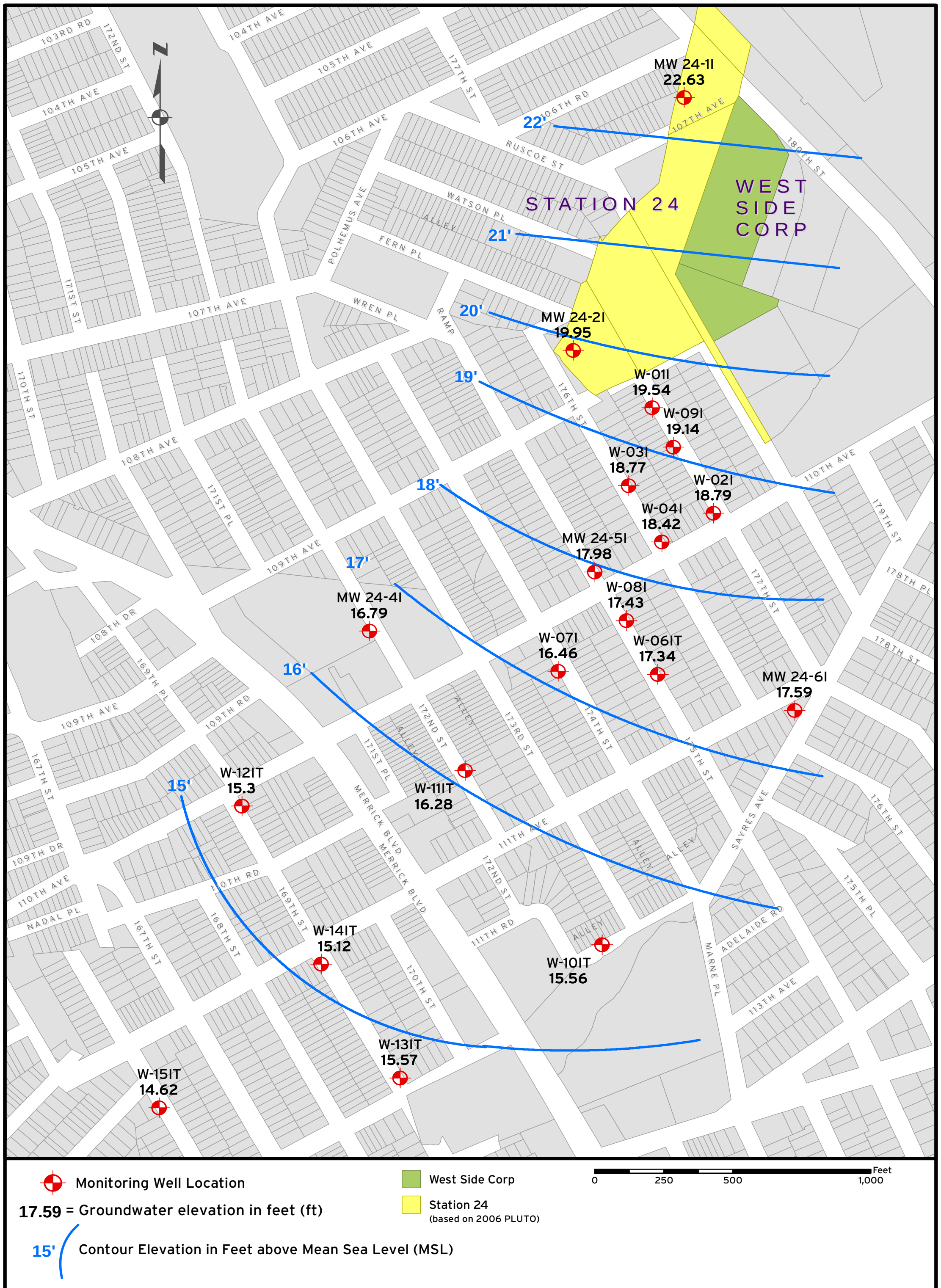
- Conduct additional evaluation of the vertical flow field to assure capture of deep portions of the PCE plume.
- Evaluate options for recovery of the leading edge of the PCE plume. Issues that should be included in this evaluation, among others, are:
  - Available property for additional recovery well locations.
  - Delivery of recovered contaminated groundwater to a treatment location.
  - Treatment options for contaminated groundwater.
  - Sewer capacity for handling treated groundwater discharge.
  - Ultimate discharge locations and permitting (SPDES equivalent requirements and limitations).
- Consider options for alternate means of remediating the leading edge of the plume, such as chemical oxidation, reactive walls or other in-situ remediation technologies.
- Include wells 6A and 6B at Station 6 in the next sampling round to aid in the overall plume delineation.

**Figure 8-1: Groundwater Elevation: Shallow Monitoring Wells**



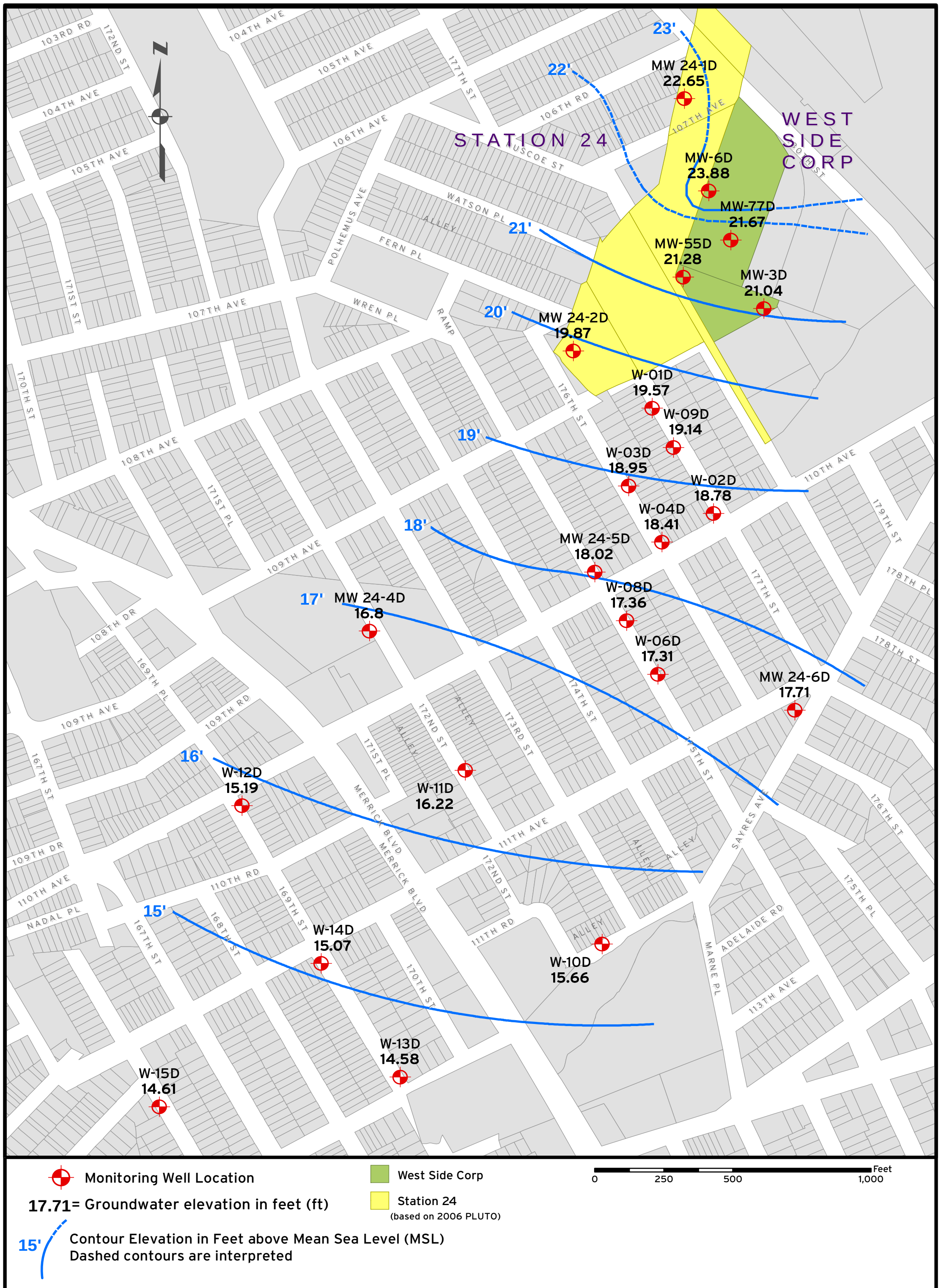

**SHALLOW WELL GROUNDWATER ELEVATIONS, 1st SAMPLING EVENT OCTOBER 6, 2008**

**Figure 8-2: Groundwater Elevation: Intermediate Monitoring Wells**



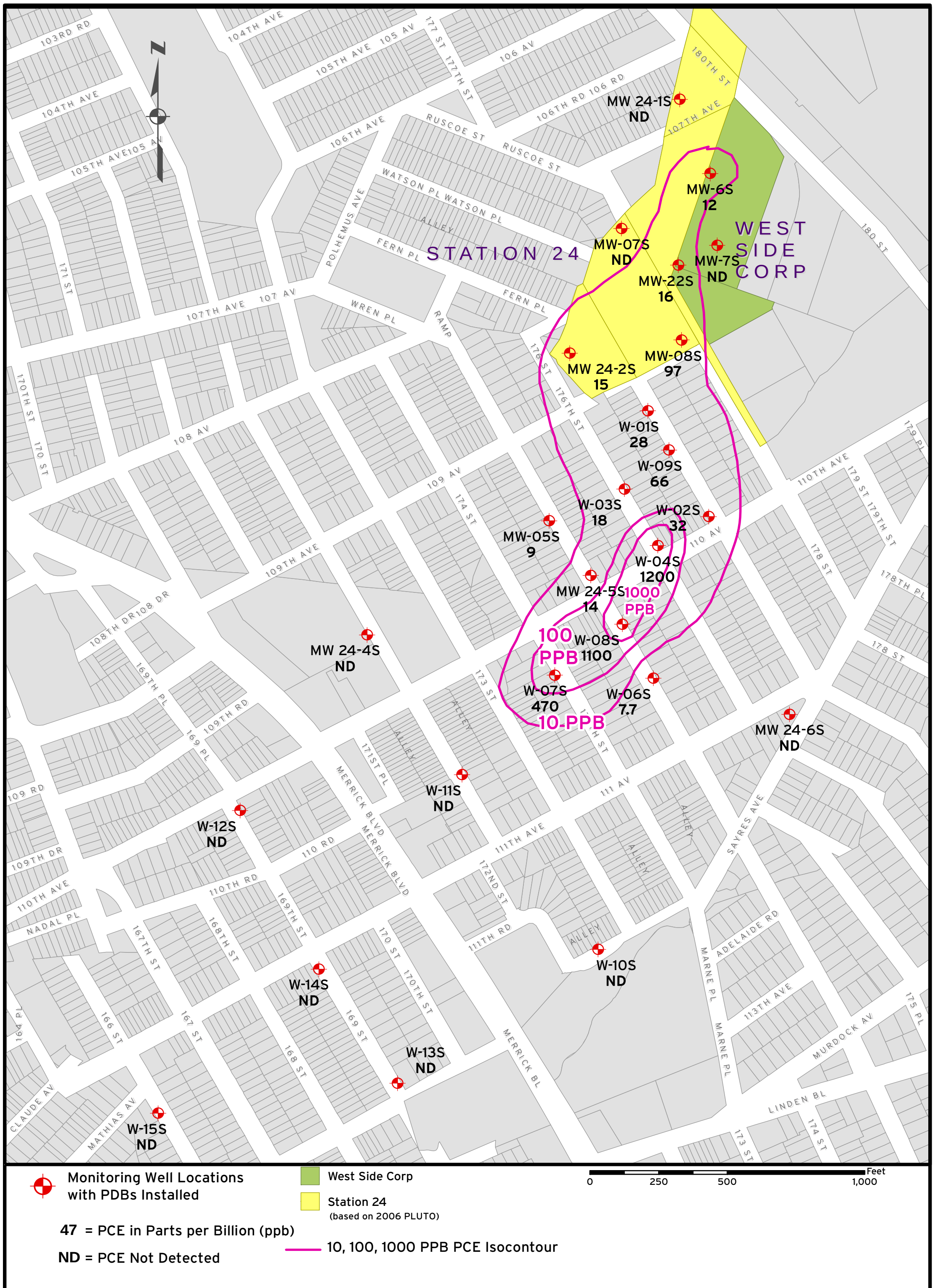

INTERMEDIATE WELL GROUNDWATER ELEVATIONS, 1st SAMPLING EVENT OCTOBER 6, 2008

**Figure 8-3: Groundwater Elevations: Deep Monitoring Wells**



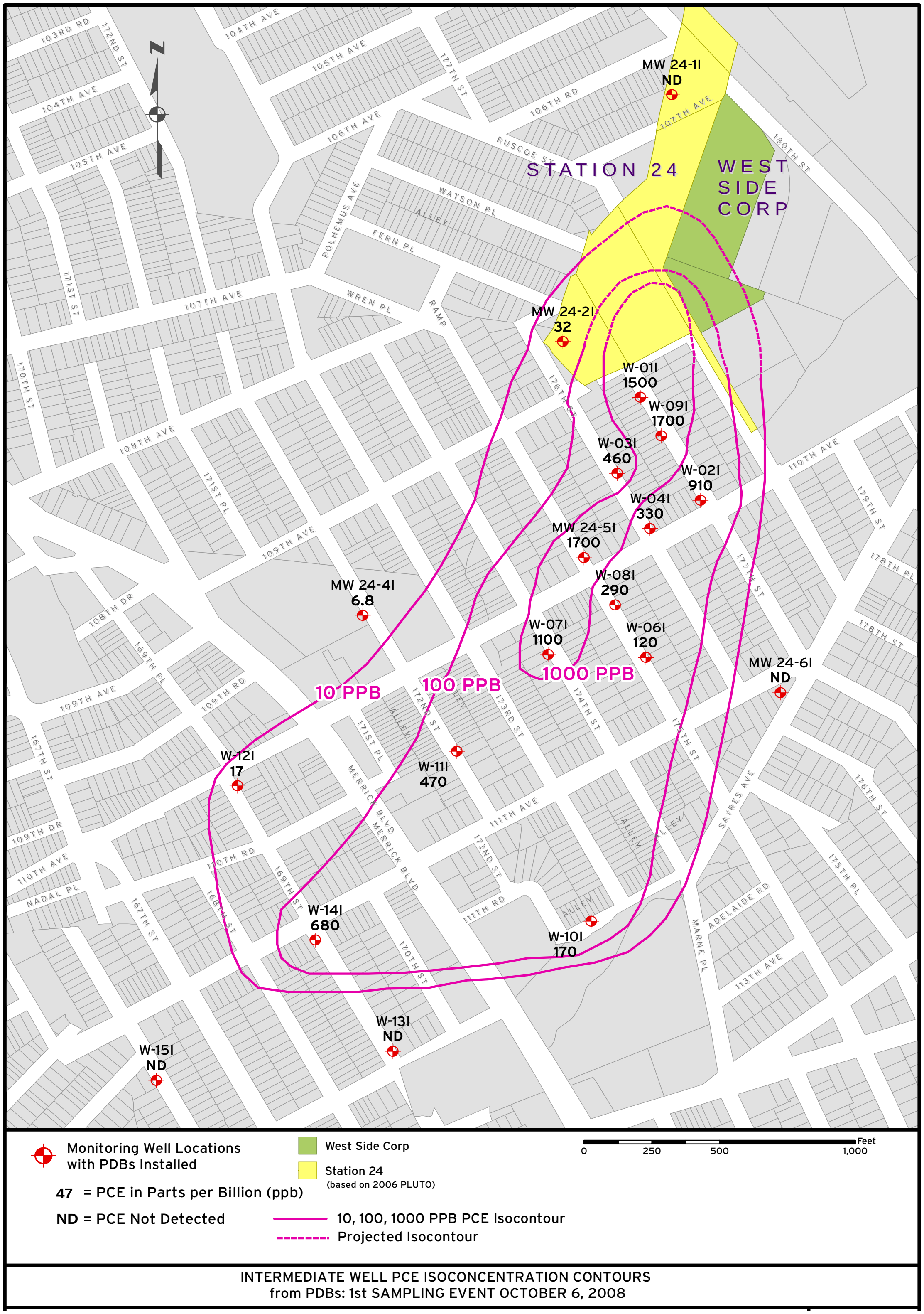

DEEP WELL GROUNDWATER ELEVATIONS, 1st SAMPLING EVENT OCTOBER 6, 2008

## Figure 8-4: PCE in Shallow Monitoring Wells

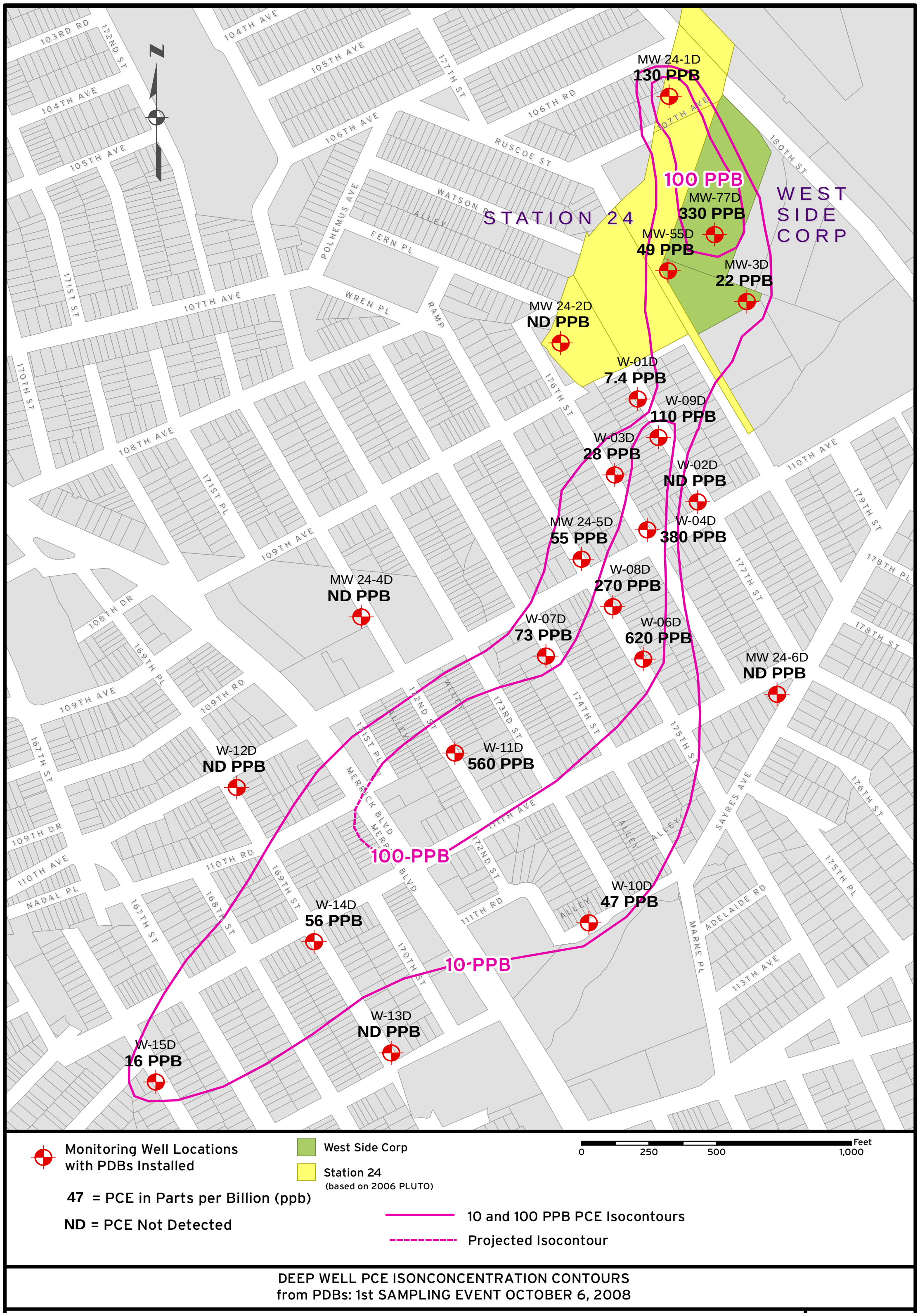


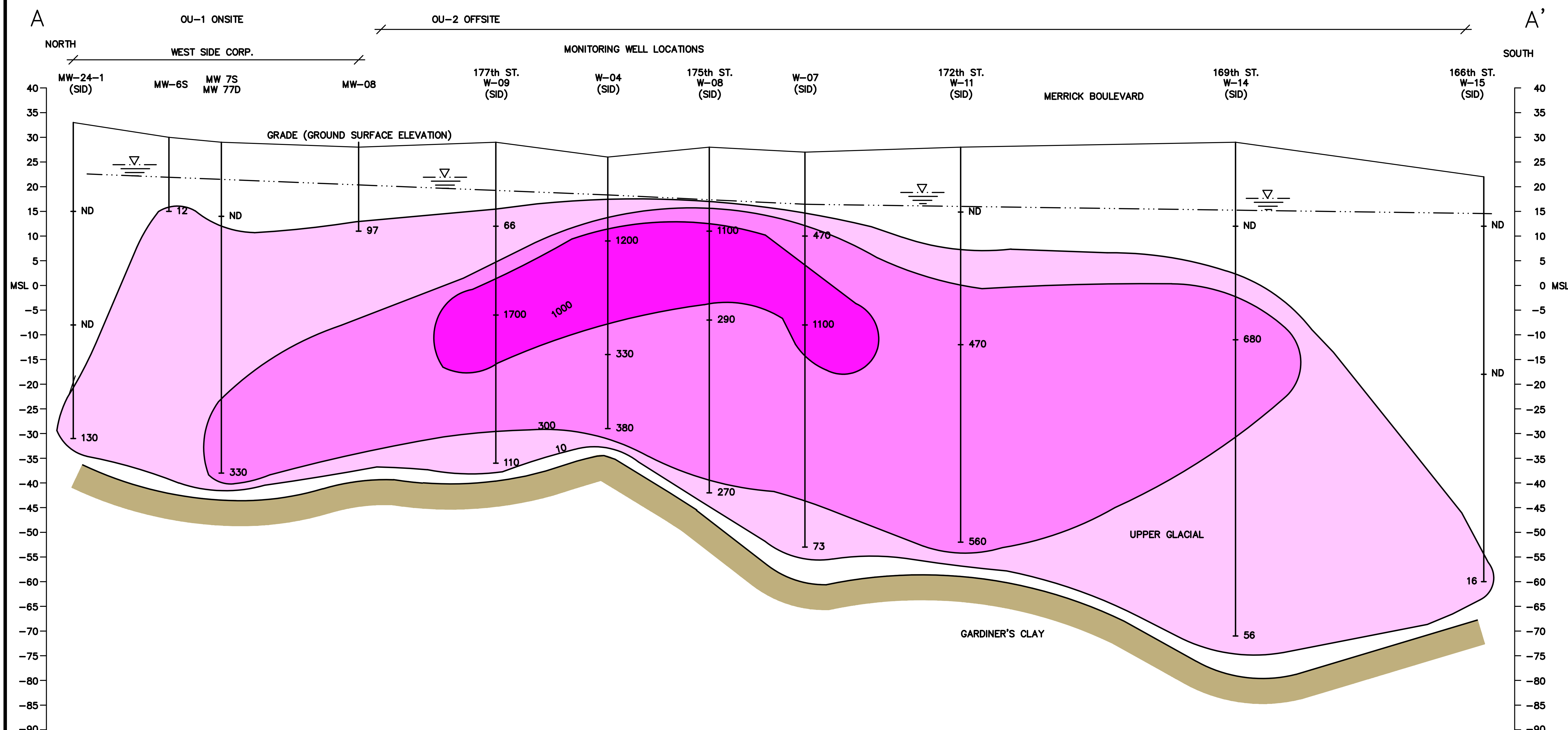

SHALLOW WELL PCE ISOCONCENTRATION CONTOURS
from PDBs: 1st SAMPLING EVENT OCTOBER 6, 2008

**Figure 8-5: PCE in Intermediate Monitoring Wells**



## Figure 8-6: PCE in Deep Monitoring Wells






LEGEND

B-41

BOREHOLE

256 PCE IN ug/L (ppb)

DASHED LINE INDICATES PROJECTED ISOCONTOUR

10 ISOCONCENTRATION CONTOUR

NOTE: DEPTHS OF PDBs AND (PCE) ARE AT WELL SCREEN MIDPOINT.

COLOR KEY

≥ 10 ug/L

≥ 300 ug/L

≥ 1000 ug/L

HORIZONTAL SCALE: 1" = 320'

MALCOLM PIRNIE

NYSDEC
WESTSIDE CORP. OU-2, JAMAICA, QUEENS
PASSIVE DIFFUSION BAG SAMPLING DATE 10.06.08
**PERCHLOROETHENE (PCE) IN GROUNDWATER**
**CROSS SECTION LOOKING EAST INTO PLUME FROM CENTERLINE A-A'**

MALCOLM PIRNIE, INC.

**FIGURE 8-7**

**Figure 8-8: Station 24 Proposed Recovery Well Drawdown Following 1-year of Pumping**

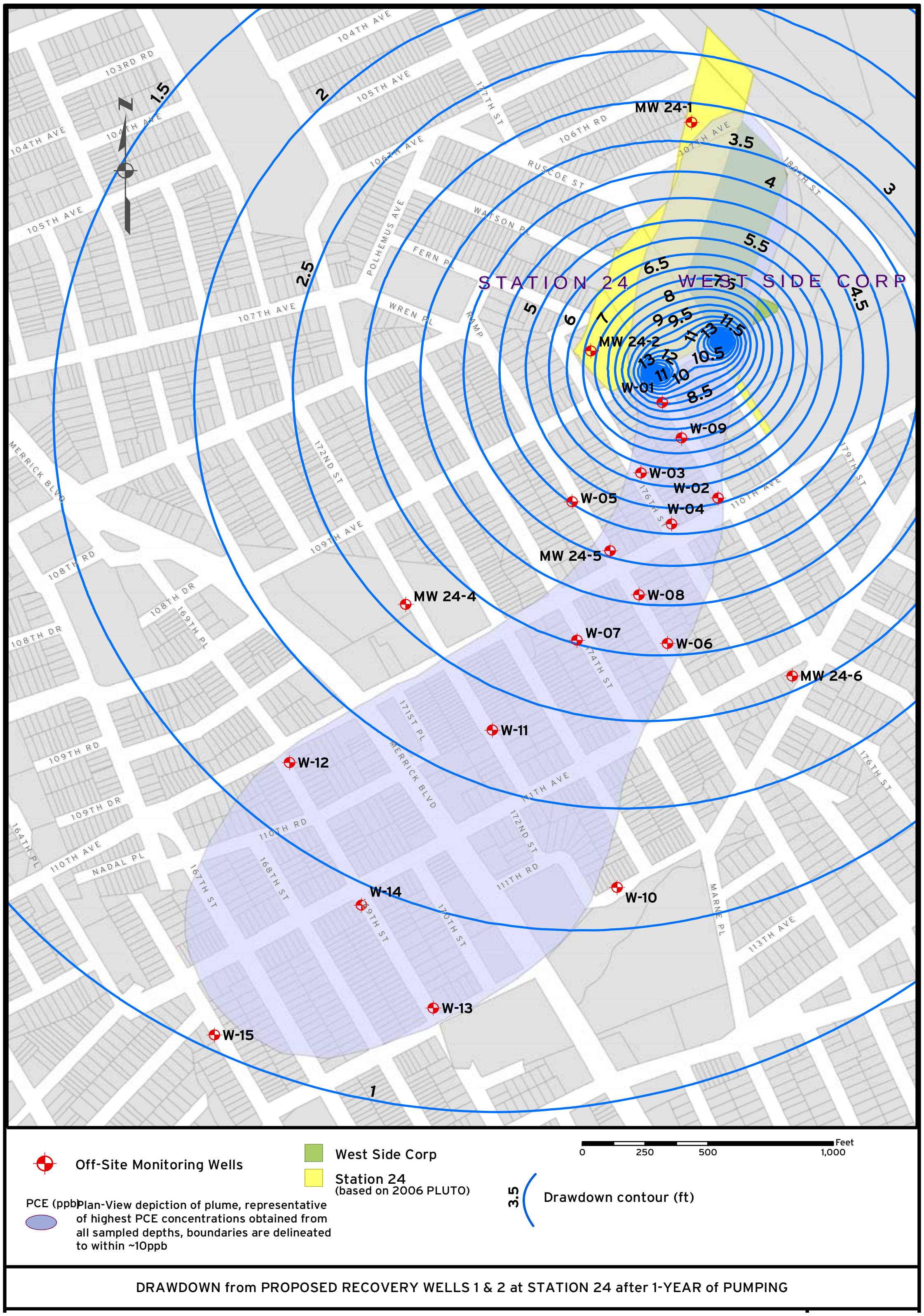
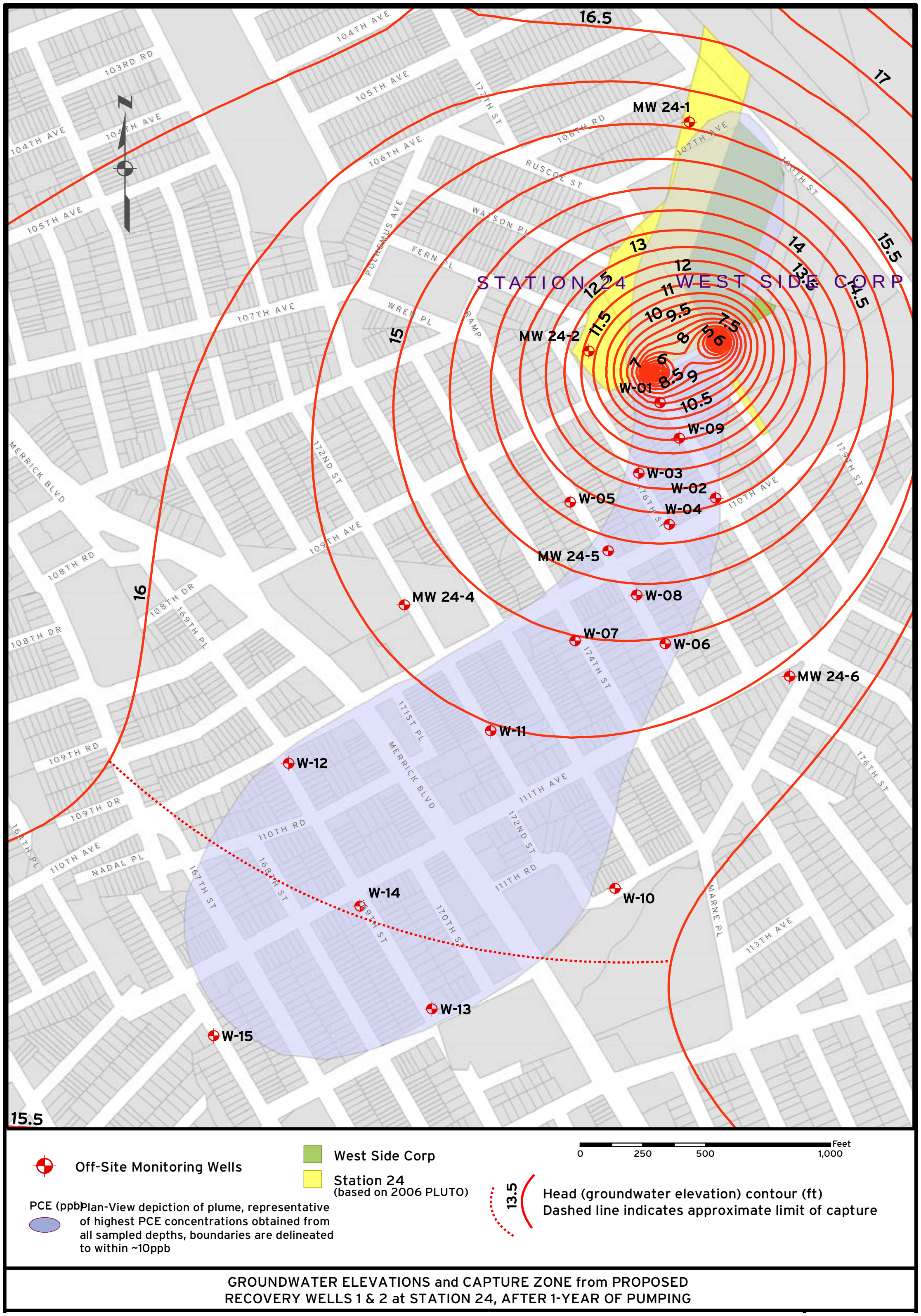


**Figure 8-9: OU-1 and OU-2 Groundwater Elevation Following 1-year of Pumping**




GROUNDWATER ELEVATIONS and CAPTURE ZONE from PROPOSED RECOVERY WELLS 1 & 2 at STATION 24, AFTER 1-YEAR OF PUMPING

# APPENDIX A

## Field Boring Logs:
## Monitoring Wells W-01 to W-15

## MALCOLM PIRNIE, INC.

17-17 ROUTE 208 NORTH, FAIRLAWN, NEW JERSEY 07410

**BORING:** W-01

| | | | |
|---|---|---|---|
| PROJECT NAME: | WESTSIDE CORP OU-2 | DATE: | 6/04/09 |
| JOB NUMBER: | 0266375 | LOCATION: | Jamaica, Queens, NY |
| DRILLING FIRM: | Miller Env | WEATHER: | 60F RAIN FORECAST |
| DRILLING METHOD: | HOLLOW STEM AUGER | ELEVATION: | |
| DRILLER: | JOHN | DATUM: | Ground Surface |
| HELPER: | CHRIS, ROB S. | Inspector/Logger: | C. SNYDER |

| SAMPLE INFORMATION No. | Depth | Rec | Blows per 6" | | | | Depth | SOIL DESCRIPTION | WELL CONS | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|
| 00 | 0-5' | | | | | | | Asphalt chunks + road bedding - coarse | | |
| 01 | 5-7' | 50% | 7 | 1 | 1 | 2 | | TOP BROWN ASPHALT GRAINS COARSE<br>BLACK CLAY w/PEBBLES<br>MEDIUM LIGHT BROWN SAND<br>w/PEBBLES + COBBLES | | PETROL/TAR ODOR FROM BLACK COARSE ROAD BED MATERIAL |
| 02 | 10-12' | 10% | 14 | 14 | 5 | 3 | | LOW RECOVERY - ROCK IN SHOE<br>SAMPLE (WET)<br>BLACK CLAY TO COARSE TAN SAND<br>W/GRAVEL + COBBLES | | WET |
| 03 | 15-17' | 85% | 10 | 5 | 5 | 5 | | TAN COARSE SAND w/LOTS OF<br>PEBBLES<br>SOME STREAKS OF BLACK CLAY | | |
| 04 | 20-22' | 45% | 9 | 9 | 6 | 8 | | TAN MED SANDS w/LOTS PEBBLES<br>BLACK 2" CLAY STRIP<br>LARGE COBBLE SEMI ROUND<br>COARSE SAND FEW PEBBLES | | |
| 05 | 25-27' | 90% | 7 | 9 | 8 | 6 | | COARSE SAND w/PEBBLES (TAN)<br>TO GRAVEL<br>TO MEDIUM SAND NO PEBBLES | | |
| 06 | 30-32' | 100% | 19 | 18 | 12 | 9 | | TAN MED SAND NO PEBBLES<br>TO MED SAND w/PEBBLES<br>STREAK OF BLACK CLAY<br>TO MED SAND NO PEBB. | | NO ODOR |
| 07 | 35-37' | 100% | 12 | 9 | 9 | 10 | | TO COARSE SAND w/LOTS PEBB.<br>TO MED SAND<br>TAN COARSE SAND w/LOTS PEBBLES | | 35'<br>NO ODOR |
| 08 | 40-42' | 40% | 14 | 10 | 9 | 7 | | TAN MED SAND w/MANY PEBBLES<br>TO FINE TAUPE SAND NO PEBBLES<br>WHITE | | |
| | | | | | | | | END PAGE | ↓<br>45' | |

**MALCOLM PIRNIE, INC.**

17-17 ROUTE 208 NORTH, FAIRLAWN, NEW JERSEY 07410

BORING: W-01

| | | | |
|---|---|---|---|
| PROJECT NAME: | WESTSIDE CORP OU-2 | DATE: | 6/4/08 |
| JOB NUMBER: | 0266375 | LOCATION: | Jamaica, Queens, NY |
| DRILLING FIRM: | Miller Env | WEATHER: | 60F OVERCAST RAIN |
| DRILLING METHOD: | HOLLOW STEM AUGER | ELEVATION: | |
| DRILLER: | JOHN | DATUM: | Ground Surface |
| HELPER: | RICK + CHRIS | Inspector/Logger: | C. SNYDER |

| Sample No. | Depth | Rec | Blows per 6" | | | | Depth | SOIL DESCRIPTION | WELL CONS | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|
| 09 | 45-47' | 70% | 10 | 14 | 12 | 8 | | TAN -> DARK BROWN MED SAND FEW LARGE PEBBLES TO LIGHT GRAY FINE SAND | | 45' CHUNKS OF BLACK COAL FOUND 2x4oz samples taken w/ no more 8oz jars |
| 10 | 50-52' | 85% | 11 | 23 | 12 | 7 | | LIGHT GREY SAND w/ BLACK GRAINS - FINE THIN LENS OF BLACK COAL | | 2x4oz JARS |
| 11 | 55-57' | 90% | 9 | 18 | 14 | 8 | | LT GREY FINE SAND w/ FEW SEMI ROUND COBBLES | | 2x4oz JARS 60' |
| 12 | 60-62' | 50% | 9 | 25 | 20 | 21 | | LT GREY SAND w/ FEW PEBBLES TO GREY CLAYEY SAND V. FINE | | 2x4oz JARS |
| 13 | 65-67' | 60% | 12 | 10 | 31 | 14 | | GREY/TAN SAND - FINE COAL STREAK @ 66' TO CLAYEY GREY SAND w/ BLACK GRAINS | | 2x4oz JARS 70' |
| 14 | 70-72' | 70% | 8 | 30 | 47 | 20 | | GREY SAND TO DARK GREY/BLACK CLAY w/ PEBBLES 2" SOLID CLAY - PEBBLES + BLACK MATER INCLUDED | | OPERATOR NOTES THAT THE RIG HAS DIFFICULTY PAST THIS CLAY + IS MOST LIKELY THE CLAY LAYER WE SEEK. DEPTH IS ON THE MONEY. 2x4oz JARS |
| | | | | | | | | END BORE C.S. | | |

## MALCOLM PIRNIE, INC.

17-17 ROUTE 208 NORTH, FAIRLAWN, NEW JERSEY 07410

**BORING:** W-02

| | | | |
|---|---|---|---|
| PROJECT NAME: | WESTSIDE CORP OU-2 | DATE: | 6/2/03 |
| JOB NUMBER: | 0266375 | LOCATION: | Jamaica, Queens, NY |
| DRILLING FIRM: | Miller Env | WEATHER: | 72F Sunny |
| DRILLING METHOD: | Hollow Stem Auger | ELEVATION: | |
| DRILLER: | John | DATUM: | Ground Surface |
| HELPER: | Chris | Inspector/Logger: | Cody Snyder |

| SAMPLE INFORMATION | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| No. | Depth | Rec. | Blows per 6" | | | | Depth | SOIL DESCRIPTION | WELL CONS | REMARKS |
| 01 | 5-7' | 10% | 7 | 2 | 2 | 3 | [illegible]1' | Asphalt, coarse road debris | | |
| | | | | | | | | Brown - Black fine sand w/pebbles | | |
| | | | | | | | | Light brown sand/silt streak | | |
| | | | | | | | | Black silty clay - moist (1" @ end) | | |
| 02 | 10-12' | 80% | 10 | 3 | 5 | 6 | 10-11' | Black-brown clay silt, few pebbles - dry | | |
| | | | | | | | 11-12' | Wet, Interbedded brown-black sand med→coarse, few pebbles | | Grndwtr @ 11' |
| | | | | | | | 11.5' | — Gray clay interbedded for 2", wet and dense | | |
| | | | | | | | | 2-3" Tan Brown very coarse sand to gravel | | ↓ Upper Glacial Formation |
| | | | | | | | | 1" Gray clay wet + dense | | |
| | | | | | | | | 1" Brown Tan fine sand + silt | | |
| 03 | 15-17' | 70% | 8 | 6 | 5 | 8 | | Tan - Brown coarse sand w/ gravel interbedded in middle grading to medium sand @ spoon end | | |
| 04 | 20-22' | 95% | 18 | 5 | 6 | 4 | | Tan Brown coarse sand w/gravel | | Large cobble, rounded |
| | | | | | | | | 3-4" Black silt/sand | | |
| | | | | | | | | Tan - Brown medium sand w/ few pebbles | | |
| | | | | | | | | Grades to coarse sand | | |
| 05 | 25-27' | 90% | 2 | 1 | 2 | 6 | | Tan Medium - Fine sand Alternating between maturities Few pebbles | | |
| 06 | 30-32 | 100% | 2 | 6 | 50 | 35 | 31' | Tan Medium→Coarse sand | | |
| | | | | | | | | Low spoon half gravelly sand w/ silty matrix | 34' | |
| 07 | 35-37 | 100 | 2 | 2 | 2 | 5 | | Tan medium sand grading to coarse with pebbles | 37' ↓ | |
| | | | | | | | | END PAGE | | |

**MALCOLM PIRNIE, INC.** BORING: W-02

17-17 ROUTE 208 NORTH, FAIRLAWN, NEW JERSEY 07410

| | | | |
|---|---|---|---|
| PROJECT NAME: | WESTSIDE CORP OU-2 | DATE: | 6/02/07 |
| JOB NUMBER: | 0266375 | LOCATION: | Jamaica, Queens, NY |
| DRILLING FIRM: | Miller Env | WEATHER: | 75F SUNNY |
| DRILLING METHOD: | HOLLOW STEM AUGER | ELEVATION: | |
| DRILLER: | JOHN | DATUM: | Ground Surface |
| HELPER: | CHRIS | Inspector/Logger: | C SNYDER |

| No. | Depth | Rec. | Blows per 6" | | | | Depth | SOIL DESCRIPTION | WELL CONS | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|
| 08 | 40-42 | 65% | 2 | 2 | 1 | 1 | | Tan medium grades to coarse sand few pebbles | | 44' |
| 09 | 45-47 | 50% | 1 | 1 | 2 | 4 | | Tan-brown medium sand no pebbles until end spoon | | |
| 10 | 50-52' | 95% | 1 | 2 | 8 | 14 | 50-51 | Tan medium-fine sand w/few pebbles | | |
| | | | | | | | 51-52 | Coarse sand w/gravel | | |
| 11 | 55-57 | 80% | 1 | 1 | 1 | 5 | | Tan fine sand grades into coarse w/pebbles @56'. | | |
| | | | | | | | 56' | Coarse sand w/lots of pebbles-gravel | | |
| 12 | 60-62' | 70% | 1 | 1 | 1 | 1 | | Tan fine sand grades into medium then coarse w/pebbles @spoon bottom | | 64' |
| 13 | 65-67' | 100% | 1 | 3 | 20 | 47 | | Tan medium grade sand w/few pebbles until 66' have rounded gravel w/sand | | DRILLER BELIEVES CLAY @62-63' |
| 14 | 70-72' | 50% | 6 | 10 | 37 | 71 | | 2" grey clay lens @ 71' followed by medium grade tan sand to coarse w/pebbles | | 74' |
| 15 | 75-77 | 90% | 7 | 6 | 16 | 17 | | 3" grey clay lens @ 75.5' to Medium dark brown sand to coarse gravelly sand | | Dark grey clay is found but not yet solid - close to aquifer boundary |
| | | | | | | | | END OF BORING @77' (CS) | | |

## MALCOLM PIRNIE, INC.

17-17 ROUTE 208 NORTH, FAIRLAWN, NEW JERSEY 07410

**BORING:** W-03

PROJECT NAME: WESTSIDE CORP OU-2 — DATE: 6/9/08
JOB NUMBER: 0266375 — LOCATION: Jamaica, Queens, NY
DRILLING FIRM: Miller Env — WEATHER: 80F SUNNY
DRILLING METHOD: HOLLOW STEM AUGER — ELEVATION:
DRILLER: JOHN — DATUM: Ground Surface
HELPER: CHRIS + ROB — Inspector/Logger: C. SNYDER

| No. | Depth | Rec | Blows per 6" | | | | Depth | SOIL DESCRIPTION | WELL CONS | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|
| 00 | 0-4 | | | | | | | Asphalt debris, road cuttings + tan clay | | |
| 01 | 5-7 | 30% | 8 | 17 | 17 | 20 | | BROWN CLAY w/ PEBB to COARSE SAND w/ MANY PEBBLES -TAN-GRAY | | |
| 02 | 10-12' | 05% | 7 | 6 | 8 | 9 | | GRAY MED SAND LT BROWN CLAY LENS to GREY COARSE GRAVELLY SAND w/ LARGE PEBBLES | | SAMPLE WET |
| 03 | 15-17' | 15% | 7 | 12 | 13 | 18 | | COARSE TAN SAND LOTS / PEBB + LT BROWN CLAYEY SAND to FINE TAN SAND LENS | | LARGE COBBLE IN SHOE |
| 04 | 20-22 | 40% | 10 | 12 | 11 | 9 | | COARSE - MED TAN SAND w/ SOME PEBBLES, COBBLES | | |
| 05 | 25-27 | 55% | 20 | 11 | 11 | 7 | | COARSE TAN SAND w/ PEBBLES RUST BROWN SAND LENS @ 26' to FINE TAN SAND | | |
| 06 | 30-32 | 40% | 21 | 8 | 9 | 9 | | COARSE TAN SAND w/ PEBBLES LENS OF BLACK COARSE SAND to MED TAN SAND | | |
| 07 | 35-37' | 65% | 7 | 7 | 10 | 14 | | FINE TAN SAND NO PEBB TO COARSE TAN SAND TO V. COARSE GRAVELLY SAND | | 35' |
| 08 | 40-42' | 95% | 5 | 13 | 12 | 11 | | TAN COARSE SAND, FEW PEBBLES to GREY MED SAND NO PEBB | | 45' |
| 09 | 45-47' | 60% | 6 | 4 | 17 | 21 | | TAN + GREY MED SAND w/ PEBB / TAN MED SAND NO PEBBLES | | |
| 10 | 50-52 | 40% | 9 | 11 | 20 | 17 | | TAN MED SAND NO PEBBLES TO TAN-GREY MED SAND w/ PEBBLES | | |
| 11 | 55-57 | 60% | 9 | 8 | 16 | 18 | | | | |
| | | | | | | | | END PAGE | | |

## MALCOLM PIRNIE, INC.

17-17 ROUTE 208 NORTH, FAIRLAWN, NEW JERSEY 07410

**BORING:** W-03

| | | | |
|---|---|---|---|
| PROJECT NAME: | WESTSIDE CORP 0U-2 | DATE: | 6-9-08 |
| JOB NUMBER: | 0266375 | LOCATION: | Jamaica, Queens, NY |
| DRILLING FIRM: | Miller Env | WEATHER: | 94F SUNNY |
| DRILLING METHOD: | HOLLOW STEM AUGER | ELEVATION: | |
| DRILLER: | JOHN T | DATUM: | Ground Surface |
| HELPER: | RUSS, CHRIS N | Inspector/Logger: | C SNYDER |

| SAMPLE INFORMATION No. | Depth | Rec. | Blows per 6" | | | | Depth | SOIL DESCRIPTION | WELL CONS | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|
| 12 | 60-62 | 75% | 7 | 5 | 20 | 33 | | TAN MED SAND NO PEBB TO TAN MED SAND FEW PEBBLES | | 60.5' |
| 13 | 65-67 | 50% | 8 | 8 | 18 | 19 | | TAN MED SAND NO PEBBLES | | |
| 14 | 70-72 | 50% | 6 | 9 | 18 | 19 | | TAN MED → FINE SAND NO PEBBLES | | 70.5' |
| 15 | 75-77 | 60% | 7 | 14 | 18 | 27 | | TAN-GREY MED-FINE SAND FEW PEBBLES | | |
| 16 | 80-82 | 10% | 12 | 14 | 20 | 23 | | TAN-GREY MED SAND NO PEBBLES | | |
| 17 | 85-87 | 40% | 14 | 22 | 31 | 18 | | SOUPY GREY CLAY | | |
| | | | | | | | | END BORING | | |

# MALCOLM PIRNIE, INC.

17-17 ROUTE 208 NORTH, FAIRLAWN, NEW JERSEY 07410

**BORING:** W-04

| | | | |
|---|---|---|---|
| PROJECT NAME: | WESTSIDE CORP OU-2 | DATE: | 6/11/08 |
| JOB NUMBER: | 0266375 | LOCATION: | Jamaica, Queens, NY |
| DRILLING FIRM: | Miller Env | WEATHER: | 85F Sunny |
| DRILLING METHOD: | HSA | ELEVATION: | |
| DRILLER: | John | DATUM: | Ground Surface |
| HELPER: | Chris + Rob | Inspector/Logger: | L. McKenna |

| SAMPLE INFORMATION | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| No. | Depth | Rec | Blows per 6" | | | | Depth | SOIL DESCRIPTION | WELL CONS | REMARKS |
| 00 | 0-4 | | | | | | | Asphalt debris, road cuttings. | | |
| 01 | 5-7 | 60% | 6 | 6 | 7 | 9 | 5.5-6'<br>6-7' | Road debris, clay: asphalt<br>Dry, orange-brown, f-m SAND, Typical upper glacial sand | | |
| 02 | 10-12 | 55% | 4 | 4 | 4 | 5 | 10.5-10.7'<br>10.7-11.2<br>11.2-12 | Wet, orange-brown, f-m SAND<br>wet, light brown-gray, m-c SAND + GRAVEL, poorly sorted<br>wet, lt brown-gray, m-SAND w/ some coarse Gravel | | Water @ 11' |
| 03 | 15-17 | 60% | 7 | 7 | 6 | 5 | 15.5-16.5<br>16.5-17 | Wet, lt brown-gray, m-SAND w/ some coarse gravel, poorly sorted<br>wet, lt brown-orange, m-SAND w/ some c-gravel, poorly sorted | | |
| 04 | 20-22 | 40% | 9 | 8 | 8 | 9 | 21-21.5<br>21.5-22 | wet, lt-brown-gray, c-SAND w/ some gravel<br>wet, lt-brown-org: c-SAND w/ some gravel, tr pebbles | | |
| 05 | 25-27 | 45% | 8 | 9 | 6 | 5 | 26-26.5<br>26.5-27 | Same as 21.5-22<br>wet, Brown/Orange, fine SAND, tr fine gravel, no pebbles | | |
| 06 | 30-32 | 60% | 8 | 8 | 9 | 8 | 30.5-31.5<br>31.5-32 | wet, Brown w/ orange/tan, m-SAND w/ some gravel, few pebbles<br>wet, lg brown-gray, fine to med SAND, tr gravel, no pebbles | | |
| 07 | 35-37 | 70% | 11 | 9 | 10 | 9 | | wet, lg brown/gray, medium SAND grades to f-SAND, tr c-gravel thru m-SAND | 35' | |
| 08 | 40-42 | 80% | 12 | 8 | 12 | 10 | | Gray w/ tan, m-f SAND, tr c-sand, grades to lighter gray, tr pebbles, dense | 45' | |
| 09 | 45-47 | | 6 | 18 | 12 | 12 | 45.5-46.5<br>46.5-47 | Gray/tan, f-m SAND, tr c-gravel, dense, wet<br>Gray, silt, tr f-SAND, tr clay → grades to m-SAND w few pebbles. | | |

**MALCOLM PIRNIE, INC.**

17-17 ROUTE 208 NORTH, FAIRLAWN, NEW JERSEY 07410

**BORING:** W-04

| | | | |
|---|---|---|---|
| PROJECT NAME: | WESTSIDE CORP OU-2 | DATE: | 6/11/08 |
| JOB NUMBER: | 0266376 | LOCATION: | Jamaica, Queens, NY |
| DRILLING FIRM: | Miller Env | WEATHER: | 85 F SUNNY |
| DRILLING METHOD: | HSA | ELEVATION: | |
| DRILLER: | John T | DATUM: | Ground Surface |
| HELPER: | Chris N. Rob S. | Inspector/Logger: | J. McKeown |

| SAMPLE INFORMATION No. | Depth | Rec | Blows per 6" | | | | Depth | SOIL DESCRIPTION | WELL CONS | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|
| 10 | 50-52 | 90% | 14 | 14 | 18 | 28 | 50-51 | Lt brown/gray, f-m SAND, tr gravel and pebble | | 50' |
| | | | | | | | 51-52 | Lt tan, f-m SAND w/ gravel, few pebbles, poorly sorted | | |
| 11 | 55-57 | 70% | 16 | 30 | 27 | 29 | | Lt brown/gray, f-m SAND w/ some gravel, few pebbles, poorly sorted | | 60' |
| 12 | 60-62 | 100% | 40 | 5 | 14 | 27 | 60-61 | Lt brown/gray, f-m SAND w/ gravel. Pebble lens @ 61' | | |
| | | | | | | | 61-62 | Black-gray CLAY, dense, very tightly packed (almost dry in places) | | |
| | | | | | | | | END BORING | | |

**MALCOLM PIRNIE, INC.**

17-17 ROUTE 208 NORTH, FAIRLAWN, NEW JERSEY 07410

**BORING:** W-06 I

| | | | |
|---|---|---|---|
| PROJECT NAME: | WESTSIDE CORP 0U-2 | DATE: | 7/3/08 |
| JOB NUMBER: | 0266375 | LOCATION: | Jamaica, Queens, NY |
| DRILLING FIRM: | Miller Env. | WEATHER: | 85F SUNNY |
| DRILLING METHOD: | GEOPROBE | ELEVATION: | |
| DRILLER: | CAMERON | DATUM: | Ground Surface |
| HELPER: | KIEN | Inspector/Logger: | C SNYDER |

| SAMPLE INFORMATION No. | Depth | Rec. | Blows per 6" | | | | Depth | SOIL DESCRIPTION | WELL CONS | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|
| | 0-10' | | | | | | | 1" PVC 10-SLOT SCREEN SET @ 30-40' BGS | | NO STRATIGRAPHY SAMPLES TAKEN AT THIS BORE HOLE |
| | 10-20' | | | | | | | | | |
| | 20-30' | | | | | | | 30' | | |
| | 30-40' | | | | | | | 40' | | SCREEN CAP |
| | | | | | | | END | | | |

# MALCOLM PIRNIE, INC.

17-17 ROUTE 208 NORTH, FAIRLAWN, NEW JERSEY 07410

**BORING:** W-06 IT*

| | | | |
|---|---|---|---|
| PROJECT NAME: | WESTSIDE CORP OU-2 | DATE: | |
| JOB NUMBER: | 0266375 | LOCATION: | Jamaica, Queens, NY |
| DRILLING FIRM: | Miller Env | WEATHER: | |
| DRILLING METHOD: | | ELEVATION: | |
| DRILLER: | | DATUM: | Ground Surface |
| HELPER: | | Inspector/Logger: | |

| SAMPLE INFORMATION | | | | Depth | SOIL DESCRIPTION | WELL CONS | REMARKS |
|---|---|---|---|---|---|---|---|
| No. | Depth | Rec. | Blows per 6" | | | | |
| | 0-10' | | | | 1" PVC 10-SLOT SCREEN SET @ 30-40' BGS | | STRATIGRAPHY NOT RECORDED @ THIS BORE HOLE |
| | 10-20' | | | | | | |
| | 20-30' | | | | 30' | | |
| | 30-40' | | | | 40' | | |
| | | | | END | | | SCREEN CAP |

*NOTE: "IT" DESIGNATES 'INTERMEDIATE' DEPTH WELL DEDICATED TO A 'TRANSDUCER'

# MALCOLM PIRNIE, INC.

17-17 ROUTE 208 NORTH, FAIRLAWN, NEW JERSEY 07410

**BORING:** W-06 D

| | | | |
|---|---|---|---|
| PROJECT NAME: | WESTSIDE CORP 8U-2 | DATE: | 9/2/08 |
| JOB NUMBER: | 0266376 | LOCATION: | Jamaica, Queens, NY |
| DRILLING FIRM: | Miller Env | WEATHER: | 85F SUNNY |
| DRILLING METHOD: | GEOPROBE | ELEVATION: | |
| DRILLER: | CAMERON | DATUM: | Ground Surface |
| HELPER: | WEN | Inspector/Logger: | SNYDER |

| SAMPLE INFORMATION No. | Depth | Rec. | Blows per 6" | | | | Depth | SOIL DESCRIPTION | WELL CONS | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|
| | 0-10' | | | | | | | 1" PVC W/10' OF 10-SLOT SCREEN INSTALLED ~~59-69~~ 59-69' BGS | | NO STRATIGRAPHY SAMPLES TAKEN AT THIS BORE HOLE. |
| | 10-20' | | | | | | | | | |
| | 20-30' | | | | | | | | | |
| | 30-40' | | | | | | | | | |
| | 40-50' | | | | | | | | | |
| | 50-60' | | | | | | | 59' | | |
| | 60-69' | | | | | | | | | |
| | | | | | | | END | 69' | | SCREEN CAP |

**MALCOLM PIRNIE, INC.**

17-17 ROUTE 208 NORTH, FAIRLAWN, NEW JERSEY 07410

**BORING:** W-07

| | | | |
|---|---|---|---|
| PROJECT NAME: | WESTSIDE CORP OU-2 | DATE: | 6/16/08 |
| JOB NUMBER: | 0266375 | LOCATION: | Jamaica, Queens, NY |
| DRILLING FIRM: | Miller Env | WEATHER: | 70 F Partly Cloudy |
| DRILLING METHOD: | HSA | ELEVATION: | |
| DRILLER: | John T | DATUM: | Ground Surface |
| HELPER: | Chris W. Rob S | Inspector/Logger: | J. McKenna |

| No. | Depth | Rec | Blows per 6" | | | | Depth | SOIL DESCRIPTION | WELL CONS | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|
| 00 | 0-4 | | | | | | | Asphalt Debris | | |
| 01 | 5-7 | 50% | 11 | 20 | 22 | 20 | 5.5-6 | Road/Asphalt Debris | | |
| | | | | | | | 6-7 | Lt Brown/tan, Dry, to moist, f-m SAND w/ gravel, few pebbles, poorly sorted | | |
| 02 | 10-12 | 60% | 9 | 9 | 6 | 10 | 10-11.5 | Wet, Lt Brown/tan, f-m SAND, w/ some angular gravel, grades to → | | Wet @ 10.5' |
| | | | | | | | 11.5-12 | Brown/orange, f-SAND w/ some m-gravel. Few s-large pebbles thru-out | | 12' |
| 03 | 15-17 | 70% | 6 | 8 | 12 | 18 | 15.5-16 | Lt Brown, wet, f-m SAND, tr gravel, poorly sorted | | |
| | | | | | | | 16-16.5 | Lt Brown/gray, m-C SAND, few pebbles | | |
| | | | | | | | 16.5-17 | Lt Brown, f-m SAND, w/ m-c gravel, few pebbles, two subangular clasts (>1") | | |
| 04 | 20-22 | 50% | 9 | 14 | 9 | 12 | 21-21.5 | Lt Brown/tan, f-m SAND, w/ m-angular gravel, grades to → | | |
| | | | | | | | 21.5-22 | Lt Brown/tan, f-m SAND, tr gravel Few pebbles throughout | | 22' |
| 05 | 25-27 | 80% | 11 | 14 | 10 | 8 | 25-26 | Lt Brown, f-m SAND, tr m-gravel, no pebbles | | |
| | | | | | | | 26-27 | Lt Brown, f-m SAND, some m-c angular and subangular gravel, few small pebbles, poorly sorted | | 30' |
| 06 | 30-32 | 60% | 12 | 11 | 16 | 14 | 30-31 | Lt Brown, f-m SAND, tr m-c gravel, few pebbles | | |
| | | | | | | | 31-32 | Brown/orange, f-SAND, tr m gravel | | |
| 07 | 35-37 | 60% | 10 | 6 | 3 | 4 | 35-36 | Lt Brown/tan, f-m SAND, grades to m-c SAND, no pebbles | | |
| | | | | | | | 36-37 | Lt Brown, m-SAND w/ m-c gravel, few pebbles (med to large), lens of vf-sand @ 36.5. Grains are sub-angular to angular. | | 40' |
| | | | | | | | | END PAGE | | |

# MALCOLM PIRNIE, INC.

17-17 ROUTE 208 NORTH, FAIRLAWN, NEW JERSEY 07410

**BORING:** W-07

| | | | |
|---|---|---|---|
| PROJECT NAME: | WESTSIDE CORP OU-2 | DATE: | 6/16/08 |
| JOB NUMBER: | 0266375 | LOCATION: | Jamaica, Queens, NY |
| DRILLING FIRM: | Miller Env | WEATHER: | 70 F Partly Cloudy |
| DRILLING METHOD: | HSA | ELEVATION: | |
| DRILLER: | John T | DATUM: | Ground Surface |
| HELPER: | Doris W. Robs | Inspector/Logger: | L McKenna |

| No. | Depth | Rec | Blows per 6" | | | | Depth | SOIL DESCRIPTION | WELL CONS | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|
| 08 | 40-42 | 70% | 8 | 12 | 12 | 10 | 40-41<br>41-42 | Lt Brown, f-m SAND, some m-c gravel/small pebbles, poorly sorted. Grades to → Lt Brown/gray f-m SAND, tr gravel, few to no pebbles | | |
| 09 | 45-47 | 100% | 12 | 10 | 10 | 16 | 45-47 | Lt Brown/tan, f-SAND, w/ tr to some m-c gravel thru-out. no pebbles, wet and dense | | PID = 3.0 ppm |
| 10 | 50-52 | 25% | 5 | 9 | 16 | 14 | | Lt Brown/Gray, f-SAND, tr gravel, no pebbles | | |
| 11 | 55-57 | 60% | 8 | 9 | 12 | 15 | | Tan, f-m SAND, some f-m gravel, tr pebbles | | PID = 8.4 ppm |
| 12 | 60-62 | 60% | 4 | 14 | 18 | | 60-61.8<br>61.8-62 | Lt Brown + gray, f-m SAND, tr gravel, no pebbles, Lt Brown, f-SAND, tr gravel @ bottom of spoon | | |
| 13 | 65-67 | 40% | 6 | 8 | 14 | 21 | | Brown/orange and gray, f-m SAND, tr f-c gravel, | | |
| 14 | 70-72 | 0% | 7 | 14 | 20 | 24 | | No Recovery | | |
| 15 | 75-77 | 30% | 3 | 12 | 8 | 16 | | Gray, f-m SAND, no pebbles, tr to no gravel | | 75' |
| 16 | 80-82 | 40% | 7 | 8 | 12 | 17 | | SAME AS ABOVE | | 85' |
| 17 | 85-87 | | 6 | 10 | 23 | 38 | | some gray silt/clay brought up in spoon. Mostly SAND, ~~but silt~~ - Clay (recovered from bit) → Purple/gray/red, solid clay, medium plasticity. | | Driller believes sand is just fill and we are actually in clay @ 85! Clay recovered in bit. |
| | | | | | | | | End of BORING | | |

# MALCOLM PIRNIE, INC.

17-17 ROUTE 208 NORTH, FAIRLAWN, NEW JERSEY 07410

**BORING:** W-08

| | | | |
|---|---|---|---|
| PROJECT NAME: | WESTSIDE CORP OU-2 | DATE: | 6/12/08 |
| JOB NUMBER: | 0266375 | LOCATION: | Jamaica, Queens, NY |
| DRILLING FIRM: | Miller Env | WEATHER: | 80F SUNNY |
| DRILLING METHOD: | HSA | ELEVATION: | |
| DRILLER: | John T | DATUM: | Ground Surface |
| HELPER: | Chris N. Robs | Inspector/Logger: | L. McKenna |

| No. | Depth | Rec | Blows per 6" | | | | Depth | SOIL DESCRIPTION | WELL CONS | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|
| 00 | 0-4 | | | | | | | Asphalt debris | | |
| 01 | 5-7 | 50% | 14 | 14 | 12 | 9 | 5.5-6 | Asphalt, road debris | | |
| | | | | | | | 6-7 | Dry, lt brown, orange, f-m SAND, some gravel (pebble @ 6'-6.3' and poorly sorted → grades to finer sand to 7') | | |
| 02 | 10-12 | 60% | 2 | 5 | 8 | 8 | 10.5-11.0 | Moist, lt brown, f-m SAND, tr gravel | | |
| | | | | | | | 11-11.2 | Moist, orange-brown, c SAND w/ gravel some pebbles | | 12' |
| | | | | | | | 11.2-12 | Moist, lt brown-gray f-m SAND grades to c-SAND, tr pebbles | | Water table @ 12-13' |
| 03 | 15-17 | 60% | 6 | 5 | 12 | 12 | 15.5-16 | Wet, lt brown, f SAND, tr silt | | |
| | | | | | | | 16-16.5 | wet, lt brown-orange, c-SAND and gravel w/ pebbles, poorly sorted | | |
| | | | | | | | 16.5-17 | Lt brown, m-SAND w/ some gravel, few pebbles | | 22' |
| 04 | 20-22 | 70% | 9 | 7 | 6 | 7 | 20-21 | Lt Brown/gray, m-SAND w/ gravel, few pebbles, poorly sorted | | |
| | | | | | | | 21-22 | Brown/orange, c-SAND w/ gravel some to few pebbles, poorly sorted, loose | | |
| 05 | 25-27 | 80% | 8 | 14 | 11 | 15 | 25-26.5 | Lt brown/orange, f-m SAND w/ gravel, few pebbles, | | |
| | | | | | | | 26.5-27 | Brown/orange, f-SAND w/ gravel, tr pebbles -Angular grains + poorly sorted thru-out | | 30' |
| 06 | 30-32 | 25% | 18 | 10 | 6 | 5 | | Lt brown/gray, f SAND w/ some gravel, few pebbles @ spoon bottom | | |
| 07 | 35-37 | 85% | 6 | 15 | 19 | 7 | 35.5-36 | Gray, f-m SAND, tr gravel, well sorted | | |
| | | | | | | | 36-36.5 | Lt brown/orange, m-SAND w/ gravel, some pebbles (1" Brown, f-SAND w/ SILT lense btwn 36.5 and 36.8) | | |
| | | | | | | | 36.5-37 | Gray, f-SAND w/ some gravel and few pebbles | | 40' |
| 08 | 40-42 | 50% | 4 | 14 | 14 | 9 | 40-41 | Gray, f-SAND w/ some gravel, few pebbles → color grades to Lt Brown/orange @ 41-42. | | PID = 1.0 ppm |
| | | | | | | | 41-42 | Brown f-SAND @ end of spoon | | |
| 09 | 45-47 | 70% | 6 | 11 | 14 | 19 | | Gray, f-m SAND w/ some sub-angular gravel, few pebbles thru-out spoon, (pebbles are angular.) END PAGE | | PID = 0.6 ppm |

**MALCOLM PIRNIE, INC.**

17-17 ROUTE 208 NORTH, FAIRLAWN, NEW JERSEY 07410

**BORING:** W-08

| | | | |
|---|---|---|---|
| PROJECT NAME: | WESTSIDE CORP OU-2 | DATE: | 6/12/08 |
| JOB NUMBER: | 0266375 | LOCATION: | Jamaica, Queens, NY |
| DRILLING FIRM: | Miller Env | WEATHER: | 80°F Sunny |
| DRILLING METHOD: | HSA | ELEVATION: | |
| DRILLER: | Tom T | DATUM: | Ground Surface |
| HELPER: | Chris N., Bob S. | Inspector/Logger: | L. McKenna |

| No. | Depth | Rec | Blows per 6" | | | | Depth | SOIL DESCRIPTION | WELL CONS | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|
| 10 | 50-52 | 50% | 2 | 8 | 12 | 16 | | Gray-tan, f-m SAND w/ some m-gravel; grades to f-SAND tr gravel tr to no pebbles throughout | | PID = 7.6 ppm |
| 11 | 55-57 | 90% | 3 | 14 | 12 | 19 | | Gray, f-SAND w/ trace gravel grades to gray/tan m-SAND w/ some angular gravel. Few angular pebbles from 56.5-57 | | PID = 6.1 ppm |
| 12 | 58-60 | 100% | 18 | 19 | 45 | 33 | 58-59 | Gray-tan, f-m SAND w/ some m-c angular gravel, no pebbles | | Driller felt clay so took extra spoon from 58-60. |
| | | | | | | | 59-59.5 | Gray, f-m SAND, tr gravel | | |
| | | | | | | | 59.5-60 | Gray-tan, m-SAND and c-gravel, some pebbles, poorly sorted. Traces of clay @ spoon bottom | | * No clay recovered |
| 13 | 60-62 | 100% | 2 | 3 | 16 | 24 | 60-61 | Lt brown/gray, f-m SAND w/ some med angular gravel, few pebbles (more toward to of spoon) | | |
| | | | | | | | 61-62 | grades to dark tan, f-SAND tr gravel. Very dense clay spot/small lens @ 61.7' | | |
| 14 | ~~65-67~~ 65-67 | 25% | 12 | 16 | 22 | 19 | | Tan, f-SAND, tr. f-gravel, well sorted, no pebbles | 65' | |
| 15 | ~~70-72~~ 70-72 | 50% | 22 | 19 | 21 | 17 | | Tan/Gray; f-SAND grades to m-SAND, no gravel or pebbles | | |
| 16 | ~~75-77~~ 75-77 | 90% | 9 | 16 | 16 | 35 | 75-76 | Gray-tan f-SAND w m-gravel grades to f-SAND tr gravel. | 75' | |
| | | | | | | | 76-77 | Gray-tan, CLAY, dense, tightly packed * Pebble layer between sand and clay. | | |
| | | | | | | | | END OF BORING | | |

**MALCOLM PIRNIE, INC.**
17-17 ROUTE 208 NORTH, FAIRLAWN, NEW JERSEY 07410

BORING: W-09

| | | | |
|---|---|---|---|
| PROJECT NAME: | WESTSIDE CORP OU-2 | DATE: | 6/16/08 |
| JOB NUMBER: | 0266375 | LOCATION: | Jamaica, Queens, NY |
| DRILLING FIRM: | Miller Env | WEATHER: | 60F OVERCAST |
| DRILLING METHOD: | HOLLOW STEM AUGER | ELEVATION: | |
| DRILLER: | JOHN T | DATUM: | Ground Surface |
| HELPER: | CHRIS N. ROBS | Inspector/Logger: | C SNYDER |

| No. | Depth | Rec | Blows per 6" | | | | Depth | SOIL DESCRIPTION | WELL CONS | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|
| 0D | 0-4 | — | | | | | | Asphalt + road bed debris, wood chips, gravel | | |
| 01 | 5-7' | 100% | 3 | 3 | 3 | 4 | | TOP - SANDY BLACK CLAY TO DARK BROWN SOME ANGULAR GREY STONE + PEBBLES TO MEDIUM LIGHT BROWN SAND w/ PEBBLES | | |
| 02 | 10-12 | 5% | 0 | 2 | 1 | 1 | | TOP - DARK BROWN MED SANDY SILT (S) w/ SUB ROUND PEBBLES TO TAN COARSE SAND w/ PEBBLES | | SAMPLE WET<br>12' |
| 03 | 15-17 | 70% | 3 | 7 | 8 | 12 | | TOP DARK BROWN MED SANDY SILT w/ LARGE STONE (S) COBBLES (ROUNDED) TO COARSE TAN SAND w/ FEW PEBBLES | | |
| 04 | 20-22 | 60% | 10 | 2 | 11 | 10 | | GREY COARSE SAND w/ PEBBLES TO ORANGE COARSE SAND w/ SOME CLAY + LARGE PEBBLES | | 22' |
| 05 | 25-27 | 80 | 8 | 6 | 7 | 9 | | ORANGE COARSE SAND w/ CLAY TO VERY COARSE GRAVELLY ORANGE SAND | | |
| 06 | 30-32 | 40% | 11 | 14 | 7 | 10 | | TAN GRAVELLY SAND COARSE TO MED TAN SAND FEW PEBBLES TO DARK BROWN FINE SAND NO PEBBLES | | |
| | | | | | | | | END PAGE | | |

## MALCOLM PIRNIE, INC.

17-17 ROUTE 208 NORTH, FAIRLAWN, NEW JERSEY 07410

BORING: W-09

| | | | |
|---|---|---|---|
| PROJECT NAME: | WESTSIDE CORP OU-2 | DATE: | 4/6/03 |
| JOB NUMBER: | 0266375 | LOCATION: | Jamaica, Queens, NY |
| DRILLING FIRM: | Miller Env | WEATHER: | CLF OVERCAST |
| DRILLING METHOD: | HOLLOW STEM AUGER | ELEVATION: | |
| DRILLER: | JOHN T | DATUM: | Ground Surface |
| HELPER: | ROSS, CHRIS N. | Inspector/Logger: | C SNYDER |

| No. | Depth | Rec | Blows per 6" | | | | Depth | SOIL DESCRIPTION | WELL CONS | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|
| 07 | 35-37 | 80 | 12 | 10 | 8 | 11 | | TAN MED SAND W/FEW PEBBLES TO FINE LIGHT BROWN SAND | | 35' RUST RED 1" STREAK @ 35.5' |
| 08 | 40-42 | 95 | 11 | 14 | 11 | 9 | | FINE LT TAN SAND NO PEBBLES TO FINE LT BROWN SAND NO PEBBLES | | 45' |
| 09 | 45-47 | 80 | 11 | 20 | 14 | 12 | | TAN MED SAND W/INTERBEDDED GRAY MED SAND TO LT GRAY COARSE SAND - NO PEBBLES IN SPOON | | |
| 10 | 50-52 | 80 | 11 | 30 | 9 | 8 | | TAN MED SAND TO LT GREY MED SAND TO FINE GREY SAND TO GRAVELLY GREY SAND | | |
| 11 | 55-57 | 85 | 17 | 32 | 24 | 26 | | GREY MED-FINE SAND W/TAN VERTICAL STREAK TO GREY COARSE SAND W/PEBBLES FEW COBBLES | | RUST STREAK 1/4" @ 56.5' |
| 12 | 60-62 | 90% | 9 | 16 | 30 | 26 | | FINE GREY SAND NO PEBB TO COARSE SAND W/LARGE PEBB TO TAN COARSE SAND NO PEBB | | 60' 20 SLOT SCREEN |
| 13 | 65-67 | 95% | 14 | 16 | 38 | 20 | | MED TAN SAND NO PEBB TO MED TAN W/PEBB TO GREY SILTY CLAY (2") | | 70' |
| 14 | 70-72' | 50 | 3 | 10 | 28 | 37 | | LT BROWN MED SAND TO DARK GREY COARSE SAND | | MACHINE INDICATES THAT WE ARE IN CLAY OPERATOR CONCURS |
| | | | | | | | | END BORE @ 70' CLAY | | |

# MALCOLM PIRNIE, INC.

17-17 ROUTE 208 NORTH, FAIRLAWN, NEW JERSEY 07410

**BORING:** W-10D

| | | | |
|---|---|---|---|
| PROJECT NAME: | WESTSIDE CORP OU-2 | DATE: | 8/27/08 |
| JOB NUMBER: | 0266375 | LOCATION: | Jamaica, Queens, NY |
| DRILLING FIRM: | Miller Env | WEATHER: | 80s SUN |
| DRILLING METHOD: | [illegible] | ELEVATION: | |
| DRILLER: | [illegible] | DATUM: | Ground Surface |
| HELPER: | MILES SMITH | Inspector/Logger: | [illegible] |

| No. | Depth | Rec | Blows per 6" | | | | Depth | TOP SOIL DESCRIPTION BOTTOM | WELL CONS | 5' REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|
| 01 | 5-10' | 40% | | | | | | RED SILTY SAND W/ANGULAR COBBLES + PEBBLES to BROWN SILTY FINE SAND to TAN FINE SAND w/PEBBLES to GRAY SILTY CLAY | | SHALLOW WELL SET @15' BGS |
| 02 | 15-20' | 85% | | | | | | COARSE TAN SAND TO MED TAN SAND w/PEBBLES | 15' | SAMPLE WET @15' |
| 03 | 25-30' | 80% | | | | | | TAN MED SAND w/PEBBLES | 35' | INTERMEDIATE WELL SET @ 45' BGS |
| 04 | 35-40' | >80% | | | | | | TAN MED SAND w/PEBBLES | | SAMPLE RECORDED IN JAR BY MEG |
| 05 | 45-50' ~~[illegible]~~ | >80% | | | | | | FINE GRAY SAND | 45' | |
| 06 | 50-55' | >80% | | | | | | MEDIUM GRAY SAND | | |
| 07 | 55-60' | >80% | | | | | | MEDIUM GRAY-TAN SAND | | |
| 08 | 60-65' | >80% | | | | | | FINE GRAY-TAN SAND w/ FEW COBBLES + SOME SILT | | |
| 09 | 65-70' | 85% | | | | | | FINE GRAY SAND w/PEBBLES to GRAY SILTY ~~FINE SAND~~ CLAY | | SAMPLE TAKEN ON 8.28.08 |
| 10 | 70-75' | 50% | | | | | | GRAY SOUPY SILTY CLAY | 75' | |
| 11 | 75-80' | 100% | | | | | | FINE TAN-GREY SAND to COARSE GRAVELLY SAND FINE to SILTY FINE TAN SAND | | |

# MALCOLM PIRNIE, INC.

17-17 ROUTE 208 NORTH, FAIRLAWN, NEW JERSEY 07410

**BORING:** W-10D

PROJECT NAME: WESTSIDE CORP OU-2
JOB NUMBER: 0266375
DRILLING FIRM: Miller Env
DRILLING METHOD: GEOPROBE
DRILLER: THIBLING
HELPER: NILES, SMITH

DATE: 8/28/07
LOCATION: Jamaica, Queens, NY
WEATHER: 70F SUN
ELEVATION:
DATUM: Ground Surface
Inspector/Logger: COX/SNYDER

| No. | Depth | Rec | Blows per 6" | | | | Depth | SOIL DESCRIPTION (TOP TO BOTTOM) | WELL CONS | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|
| 12 | 80-85' | 90% | | | | | | FINE TAN SILTY SAND to RED CLAY | | DENSE RED CLAY CAPTURED IN SHOE @85 BGS, SET DEEP WELL |
| | | | | | | | | END BORE | 85' | |

# MALCOLM PIRNIE, INC.

17-17 ROUTE 208 NORTH, FAIRLAWN, NEW JERSEY 07410

**BORING:** W-11D

PROJECT NAME: WESTSIDE CORP OU-2
JOB NUMBER: 0266376
DRILLING FIRM: Miller Env
DRILLING METHOD: GEOPROBE
DRILLER: THIESING
HELPER: NILES SMITH

DATE: 3-29-07
LOCATION: Jamaica, Queens, NY
WEATHER: 75°F SUNNY
ELEVATION:
DATUM: Ground Surface
Inspector/Logger: C. SNYDER

| No. (Sample Information) | Depth | Rec | Blows per 6" | Depth | SOIL DESCRIPTION | WELL CONS. | REMARKS |
|---|---|---|---|---|---|---|---|
| 01 | 20-25' | 90% | | | COARSE → FINE TAN SAND W/PEBBLES | 15' 35' | SAMPLE IS WET SHALLOW WELL SET @15' BGS |
| 02 | 40-45' | 100% | | | GREY FINE SAND W/FEW PEBBLES | | INTERMEDIATE WELLS SET @45' BGS |
| 03 | 60-65' | 100% | | | MED TAN SAND W/MANY PEBBLES & FEW COBBLES | 45' | |
| 04 | 65-70' | 100% | | | FINE SILTY GREY SAND W/ & W/O PEBBLES | | |
| 05 | 70-75' | 85% | | | FINE GREY SILTY SAND W/SOME CLAY & PEBBLES | 75' | |
| 06 | 75-80' | 100% | | | MED TAN SAND W/PEBBLES | | |
| 07 | 80-85' | 85% | | | COARSE → MED GREY SAND W/PEBBLES TO LENS OF RED SAND TO RED CLAY | | RED CLAY IN SHOE. |
| | | | | | END BORE. | 85' | SET WELL @ 85' BGS |

# MALCOLM PIRNIE, INC.

17-17 ROUTE 208 NORTH, FAIRLAWN, NEW JERSEY 07410

**BORING:** W-12D

| | | | |
|---|---|---|---|
| PROJECT NAME: | WESTSIDE CORP OU-2 | DATE: | 8/25/08 |
| JOB NUMBER: | 0266378 | LOCATION: | Jamaica, Queens, NY |
| DRILLING FIRM: | Miller Env | WEATHER: | 85F SUN |
| DRILLING METHOD: | SONIC [illegible] | ELEVATION: | |
| DRILLER: | THOMAS | DATUM: | Ground Surface |
| HELPER: | NILES, SMITH | Inspector/Logger: | CORY SNYDER |

| SAMPLE INFORMATION No. | Depth | Rec. | Blows per 6" | Depth | TOP TO BOTTOM SOIL DESCRIPTION | WELL CONS | REMARKS |
|---|---|---|---|---|---|---|---|
| 01 | 5-10' | 80% | | | FINE ORANGE/RED SAND to COARSE TAN SAND to FINE RED SAND | | TWO x 4OZ JARS SAMPLE TAKEN A+B (B IS BOTTOM) |
| 02 | 15-20' | 100% | | | FINE RED SAND to COARSE RED SAND w/PEBBLES & COBBLES to TAN COARSE GRAVELLY SAND w/COBBLES to BROWN COARSE SAND | 17' | 2x4oz JARS A+B SAMPLE MOIST @18' SHALLOW WELL SET @27' BGS |
| 03 | 25-30' | 95% | | | COARSE RED SAND w/LOTS OF PEBBLES | 27' | SAMPLE WET @25' 2x4oz A+B |
| 04 | 35-40' | 100% | | | COARSE BROWN SAND w/PEBBLES to MED BROWN SAND to SILTY TAN SAND | 45' | 2x4oz A+B |
| 05 | 45-50' | 90% | | | SILTY TAN MED SAND to TAN COARSE SAND w/ PEBBLES + COBBLES to TAN MED SAND to BROWN FINE SILTY SAND | | INTERMEDIATE WELLS SET @55' BGS |
| 06 | 50-55' | 80% | | | SORTED FINE SAND w/FEW PEBBLES | | |
| 07 | 55-60' | 100% (S) | | | SORTED FINE SILTY SAND w/NO PEBBLES | 55' | |
| 08 | 60-65' | 60% | | | TAN MED SAND w/FEW PEBBLES | | |
| | | | | | END PAGE | | |

# MALCOLM PIRNIE, INC.

17-17 ROUTE 208 NORTH, FAIRLAWN, NEW JERSEY 07410

**BORING:** W-12D

| | | | |
|---|---|---|---|
| PROJECT NAME: | WESTSIDE CORP OU-2 | DATE: | 8/25/08 |
| JOB NUMBER: | 0266375 | LOCATION: | Jamaica, Queens, NY |
| DRILLING FIRM: | Miller Env | WEATHER: | 85°F OVERCAST |
| DRILLING METHOD: | [illegible] | ELEVATION: | |
| DRILLER: | [illegible] | DATUM: | Ground Surface |
| HELPER: | MILES SMITH | Inspector/Logger: | CASEY SNYDER |

| SAMPLE INFORMATION No. | Depth | Rec | Blows per 6" | | | | Depth | SOIL DESCRIPTION | WELL CONS | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|
| 09 | 65-70' | 70% | | | | | | TAN MED SAND w/FEW PEBBLES | | 2oz A,B,C,D |
| 10 | 70-75' | 90% | | | | | | MED-FINE TAN SAND w/PEBBLES to FINE GRAY SILTY SAND | | 2oz A,B,C,D |
| 11 | 75-80' | 5% | | | | | | RED MED SAND to SILTY GRAY FINE SAND | | UNSUCCESSFUL SAMPLE RECOVERY 2oz A,D (TOP + SHOE) |
| 12 | 80-85' | 30% | | | | | | FINE TAN SAND WELL SORTED | | SAMPLE RETRIEVAL DIFFICULT |
| 13 | 85-90' | 85% | | | | | | FINE TAN SAND to MED TAN SAND w/PEBBLES | | |
| 14 | 90-95' | 15% | | | | | | MED TAN SAND to SOUPY SILTY BROWN SAND | 95' | MAJORITY SAMPLE FELL OUT SLEEVE DUE TO HIGH LIQUID CONTENT |
| 15 | 95-100' | 90% | | | | | | FINE GRAY SAND to FINE GRAY SAND w/ PEBBLES to COARSE SILTY GRAY SAND | | |
| 16 | 100-105' | 5% | | | | | | SOUPY SILTY ULTRAFINE TAN SAND to GRAY CLAYEY SAND | | DEEP WELL SCREEN SET @105' BGS |
| | | | | | | | | END BORE | 105' | |

# MALCOLM PIRNIE, INC.

17-17 ROUTE 208 NORTH, FAIRLAWN, NEW JERSEY 07410

**BORING:** 6-13D

| | | | |
|---|---|---|---|
| PROJECT NAME: | WESTSIDE CORP OU-2 | DATE: | 8/18/08 |
| JOB NUMBER: | 0266375 | LOCATION: | Jamaica, Queens, NY |
| DRILLING FIRM: | Miller Env | WEATHER: | 83F SUN |
| DRILLING METHOD: | GEOPROBE | ELEVATION: | |
| DRILLER: | J. THIELING | DATUM: | Ground Surface |
| HELPER: | L. SMITH C. NILES | Inspector/Logger: | C. SNYDER |

| SAMPLE INFORMATION No. | Depth | Rec. | Blows per 6" | Depth | TOP SOIL DESCRIPTION TO BOTTOM | WELL CONS | REMARKS |
|---|---|---|---|---|---|---|---|
| 01 | 5-10 | 80% | | | COARSE BROWN GRAVELLY SAND TO BLACK COARSE SAND to TAN MED SAND w/FEW PEBBLES | 5' | SAMPLE MOIST @ 8' SHALLOW WELL SET @ 15' BGS |
| 02 | 15-20' | 100% | | | WET TAN MED SAND to VERY COARSE GRAVELLY RED SAND to MED/COARSE TAN SAND | 15' | WT REACHED |
| 03 | 25-30' | 100% | | | TAN MED SAND w/PEBBLES to COARSE TAN w/PEBBLES to GRAVELLY TAN SAND | | |
| 04 | 35-40' | 100% | | | TAN COARSE GRAVELLY SAND | 45' | |
| 05 | 45-50' | 100% | | | TAN MEDIUM SAND - SORTED | | INTERMEDIATE WELLS SET @ 55' BGS |
| 06 | 50-55' | 100% | | | SORTED MED/FINE TAN SAND | | CONTINUOUS SAMPLING |
| 07 | 55-60' | 100% | | | TAN MED/FINE SAND w/ FEW PEBBLES | 55' | |
| 08 | 60-65' | 100% | | | WELL SORTED FINE TAN SAND | | |
| 09 | 65-70' | 100% | | | TAN FINE SAND w/FEW PEBBLES | | |
| 10 | 70-75' | 100% | | | TAN MED SAND | | |
| 11 | 75-80' | 100% | | | TAN → GRAY MED SANDS w/ LENS OF GRAVELLY SAND | | |
| | | | | | END DAY, SEE PAGE 2 OF 2 FOR 8.19.08 80-85' | | |

# MALCOLM PIRNIE, INC.

17-17 ROUTE 208 NORTH, FAIRLAWN, NEW JERSEY 07410

**BORING:** W-13D

| | | | |
|---|---|---|---|
| PROJECT NAME: | WESTSIDE CORP OU-2 | | |
| JOB NUMBER: | 0266376 | DATE: | 8-19-08 |
| DRILLING FIRM: | Miller Env | LOCATION: | Jamaica, Queens, NY |
| DRILLING METHOD: | GEOPROBE | WEATHER: | 87F SUN |
| DRILLER: | THOMAS | ELEVATION: | |
| HELPER: | NILES, SMITH | DATUM: | Ground Surface |
| | | Inspector/Logger: | [illegible] SNYDER |

| SAMPLE INFORMATION No. | Depth | Rec. | Blows per 6" | Depth | SOIL DESCRIPTION | WELL CONS | REMARKS |
|---|---|---|---|---|---|---|---|
| 12 | 85-88 | 100% | | | TAN → GRAY FINE SAND w/V. FEW PEBBLES | | PRECURSOR TO CLAY |
| 13 | 90-95' | 100% | | | TAN FINE SAND to TAN MED SAND w/PEBBLES to TAN GRAVELLY SAND to GRAY SILTY CLAY w/FINE SAND | 92' | |
| 14 | 95-100' | 100% | | | GRAY FINE SAND TO MED SAND w/PEBBLES TO MED/FINE GRAY SAND TO GRAY SILTY CLAY w/FINE SAND | | |
| 15 | 100-105' | 80% | | | GRAY CLAY @ 102' | | 102' WELL SCREEN SET @ 102' BGS |
| | | | | | END BORE | 102' | |

# MALCOLM PIRNIE, INC.

17-17 ROUTE 208 NORTH, FAIRLAWN, NEW JERSEY 07410

**BORING:** W-14D

| | | | |
|---|---|---|---|
| PROJECT NAME: | WESTSIDE CORP OU-2 | DATE: | 2/20/08 |
| JOB NUMBER: | 0266376 | LOCATION: | Jamaica, Queens, NY |
| DRILLING FIRM: | Miller Env | WEATHER: | 20s SUN |
| DRILLING METHOD: | [illegible] | ELEVATION: | |
| DRILLER: | THIELKE | DATUM: | Ground Surface |
| HELPER: | OLSEN, MILES | Inspector/Logger: | CORY SNYDER |

| No. | Depth | Rec | Blows per 6" | Depth | SOIL DESCRIPTION | WELL CONS | REMARKS |
|---|---|---|---|---|---|---|---|
| 01 | 5-10 | 75% | | | LT BROWN MED SAND TO BROWN/BLACK COARSE SAND w/PEBBLES to MED TAN SAND | 12' | |
| 02 | 15-20 | 75% | | | BROWN/BLACK GRAVELLY SAND LENS OF FINE TAN SAND to BROWN GRAVELLY SAND to BLACK GRAVELLY SAND w/ COBBLES to RED GRAVELLY SAND | | SAMPLE WET @ 12' BGS SHALLOW WELL SET @ 22' BGS |
| 03 | 25-30 | 15% | | | UNRECOVERABLE FROM SAMPLER LIMITED INFORMATION FOR DESCRIPTION - MED TAN GRAVELLY SAND | 22' | |
| 04 | 35-40' | 50% | | | TAN MED SAND w/LOTS OF PEBBLES | 35' | INTERMEDIATE WELLS SET @ 45' BGS |
| 05 | 45-50 | 40% | | | TAN FINE SAND w/FEW PEBBLES | 45' | |
| 06 | 50-55 | 80% | | | TAN FINE SAND w/FEW PEBBLES | | |
| 07 | 55-60' | 100% | | | TAN FINE SAND w/FEW PEBBLES | | |
| 08 | 60-65' | 100% | | | TAN MED SAND w/FEW PEBBLES | | |
| 09 | 65-70' | 100% | | | FINE TAN SAND WELL SORTED NO PEBBLES | | |

# MALCOLM PIRNIE, INC.

17-17 ROUTE 208 NORTH, FAIRLAWN, NEW JERSEY 07410

**BORING:** W-14D

| | | | |
|---|---|---|---|
| PROJECT NAME: | WESTSIDE CORP OU-2 | DATE: | 8/20/08 |
| JOB NUMBER: | 0266376 | LOCATION: | Jamaica, Queens, NY |
| DRILLING FIRM: | Miller Env | WEATHER: | 85° SUN |
| DRILLING METHOD: | GEOPROBE | ELEVATION: | |
| DRILLER: | [illegible] | DATUM: | Ground Surface |
| HELPER: | [illegible] OLSEN | Inspector/Logger: | [illegible] |

| SAMPLE INFORMATION No. | Depth | Rec | Blows per 6" | Depth | SOIL DESCRIPTION | WELL CONS | REMARKS |
|---|---|---|---|---|---|---|---|
| 10 | 70-75' | 100% | | | TAN GRAVELLY SAND, COARSE W/COBBLES | | |
| 11 | 75-80' | 90% | | | TAN WELL-SORTED FINE SAND W/FEW PEBBLES | | THIS DEPTH SAMPLED ON 8.21.08 |
| 12 | 80-85' | 0% | | | UNRECOVERABLE | | SAMPLE EMBEDDED IN SAMPLER FLIGHT |
| 13 | 85-90' | 30% | | | TAN FINE SAND W/SOME PEBBLES to GRAY FINE SAND W/SILT | | SAMPLE STUCK IN SAMPLER FLIGHT |
| 14 | 90-95' | 100% | | | TAN-GRAY MED SAND W/ COBBLES to FINE SAND W/FEW PEBBLES | 95' | |
| 15 | 95-100' | 100% | | | TAN-GRAY FINE SAND | | |
| 16 | 100-105' | 100% | | | GRAY FINE SAND W/CLAY IN SHOE @105' | | THIS DEPTH SAMPLED ON 8.22.08 |
| | | | | | END BORE | 105' | WELL SCREEN SET @105' BGS |

# MALCOLM PIRNIE, INC.

17-17 ROUTE 208 NORTH, FAIRLAWN, NEW JERSEY 07410

**BORING:** W-15 D

| | | | |
|---|---|---|---|
| PROJECT NAME: | WESTSIDE CORP OU-2 | DATE: | 8/14/08 |
| JOB NUMBER: | 0266375 | LOCATION: | Jamaica, Queens, NY |
| DRILLING FIRM: | Miller Env | WEATHER: | 80F SUN |
| DRILLING METHOD: | GEOPROBE PUSH | ELEVATION: | |
| DRILLER: | TRAN THIEUNG | DATUM: | Ground Surface |
| HELPER: | CHRIS NILES | Inspector/Logger: | C. SNYDER |

| SAMPLE INFORMATION No. | Depth | Rec | Blows per 6" | Depth | SOIL DESCRIPTION (TOP → BOTTOM) | WELL CONS | REMARKS |
|---|---|---|---|---|---|---|---|
| 01 | 5-10' | 70% | | | TAN COARSE SAND SORTED TO GRAVELLY SAND (COARSE) TO GRAY V. COARSE SAND w/ PEBBLES | | SOIL WET @ 7' SHALLOW WELL SET @ 5-15' BGS |
| 02 | 15-20' | 95% | | | V. COARSE SORTED GRAY SAND to TAN GRAVELLY SAND to BLACK + RED COARSE SAND to RED SORTED SAND w/ COBBLES | 15' | |
| 03 | 25-30' | 85% | | | DARK TAN COARSE SAND WELL SORTED, MUD TAN SILT | 35' | |
| 04 | 35-40' | 0% | | | ~~TAN MED SAND w/ PEBBLES~~ CS | | SAMPLE STUCK INSIDE FLIGHT - UNRETRIEVABLE |
| 05 | 45-50' | 95% | | | TAN MED SAND w/ PEBBLES to TAN GRAVELLY SAND that is COARSE to WELL SORTED MED. TAN SAND w/ MUDDY TAN SILT | 45' | INTERMEDIATE WELLS SET @ 45' BGS |
| 06 | 50-55 | 100% | | | TAN FINE SAND SORTED TO TAN MED SAND w/ FEW PEBBLES | | RESISTANCE TO 55' FELT ON PROBE - DENSE SANDS |
| 07 | 55-60' | 100% | | | TAN FINE → MED SANDS w/ FEW COBBLES + PEBBLES to GRAYISH SAND w/ SOME CLAY | | |

# MALCOLM PIRNIE, INC.

17-17 ROUTE 208 NORTH, FAIRLAWN, NEW JERSEY 07410

**BORING:** W-15D

PROJECT NAME: WESTSIDE CORP 8U-2 | DATE: 8/15/03 #11 →
JOB NUMBER: 0266375 | LOCATION: Jamaica, Queens, NY
DRILLING FIRM: Miller Env | WEATHER: 85°
DRILLING METHOD: [illegible]
ELEVATION:
DRILLER: S. THIELING | DATUM: Ground Surface
HELPER: C. NILES, C. SMITH | Inspector/Logger: C. SNYDER

| No. | Depth | Rec | Blows per 6" | Depth | SOIL DESCRIPTION | WELL CONS | REMARKS |
|---|---|---|---|---|---|---|---|
| 08 | 60-65' | 90% | | | GRAY-TAN FINE SANDS WELL SORTED, SOME COBBLES | | |
| 09 | 65-70' | 100% | | | LIGHT TAN MED-FINE SANDS w/ SOME GREY CLAY CLINGING TO FLIGHT INNARDS | | |
| 10 | 70-75' | 100% | | | LIGHT TAN FINE SAND, SOME GRAY CLAY ON OUTSIDE OF FLIGHT + INSIDE TUBE | | |
| 11 | 75-80' | 100% | | | SORTED COARSE TAN SAND | 77' | |
| 12 | 80-85' | 100% | | | COARSE GRAY SAND w/ FEW PEBBLES | | |
| 13 | 85-90' | 100% | | | DARK GRAY SAND TO SANDY CLAY TO PURE CLAY @ 87' | 87' | CLAY @ 87' WELL SCREEN SET @87' BGS |
| | | | | | END BORE | | |

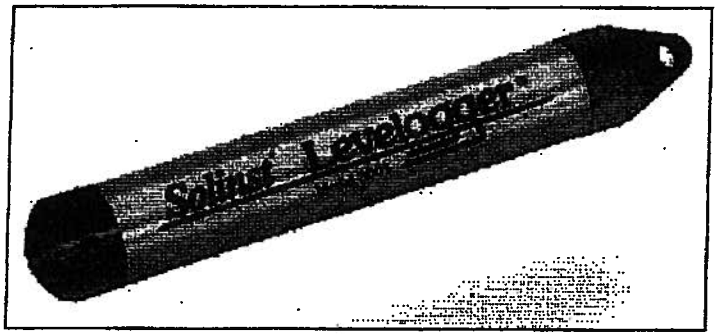
# APPENDIX B

Levelogger® Specification

GENEQ > Environment > Water Level

# Levelogger Junior

## model 3001 junior





The Levelogger® Junior is the newest addition to the Levelogger Family. The Levelogger Junior provides an inexpensive alternative for measuring groundwater and surface water levels. It combines a data logger, temperature sensor, pressure transducer, and 5-year battery, in a small, maintenance free, waterproof stainless steel housing.
The Levelogger Junior features a non-volatile memory, with a capacity of 32,000 sets of temperature and water level data points. Readings are linear at a user-defined interval between 0.5 seconds to 99 hours. Accuracy is 0.1% FS, with a lifetime factory calibration.
If greater accuracy, sampling options, or ranges are required, the Solinst Levelogger Gold has the functionality to suit your application. (For more details, see Model 3001 Data Sheet.)
Compatible with Levelogger Gold software and accessories, the Levelogger Junior is also SDI-12 compatible, can communicate using a Leveloader Gold data transfer unit, and is able to integrate into Solinst Telemetry Systems.

### Features

- Low cost
- 5 year battery life
- 32,000 data points
- Accuracy of 0.1% FS
- Real Time View
- Compatible with Levelogger Gold Series software and accessories

### Operation

Programming the Levelogger Junior is the same as with the Levelogger Gold. An Optical Reader or PC Interface Cable connects the Levelogger to a laptop or desktop PC. The intuitive Levelogger Gold Software automatically detects the type of Levelogger that is connected. Programming, downloading, data management and export are easy. The Real Time View option allows immediate viewing of live water level and temperature readings. These compact data loggers are very easy to deploy. Installation can be with direct read cables or by wire line suspension, avoiding the use of vented cables. (See Model 3001 Data Sheet.) The Levelogger Junior outputs temperature and compensated water level readings. The Barologger Gold and Levelogger software allow easy barometric compensation. The Levelogger Junior also features helpful utilities such as self-test capability, a robust EEPROM memory and FRAM backup memory for increased data integrity, also the ability to upgrade firmware for increased function and features.

### Applications

- Pump and slug tests
- Reservoir and stormwater runoff management
- Watershed and drainage basin monitoring
- Stream gauging, lake and wetland monitoring
- Tank level measurement

# APPENDIX C

## Passive Diffuser Bag (PDB) Specification and Installation Standard Operating Procedure (SOP)

# Passive Diffusion Bag (PDB) Samplers

*Frequently Asked Questions*

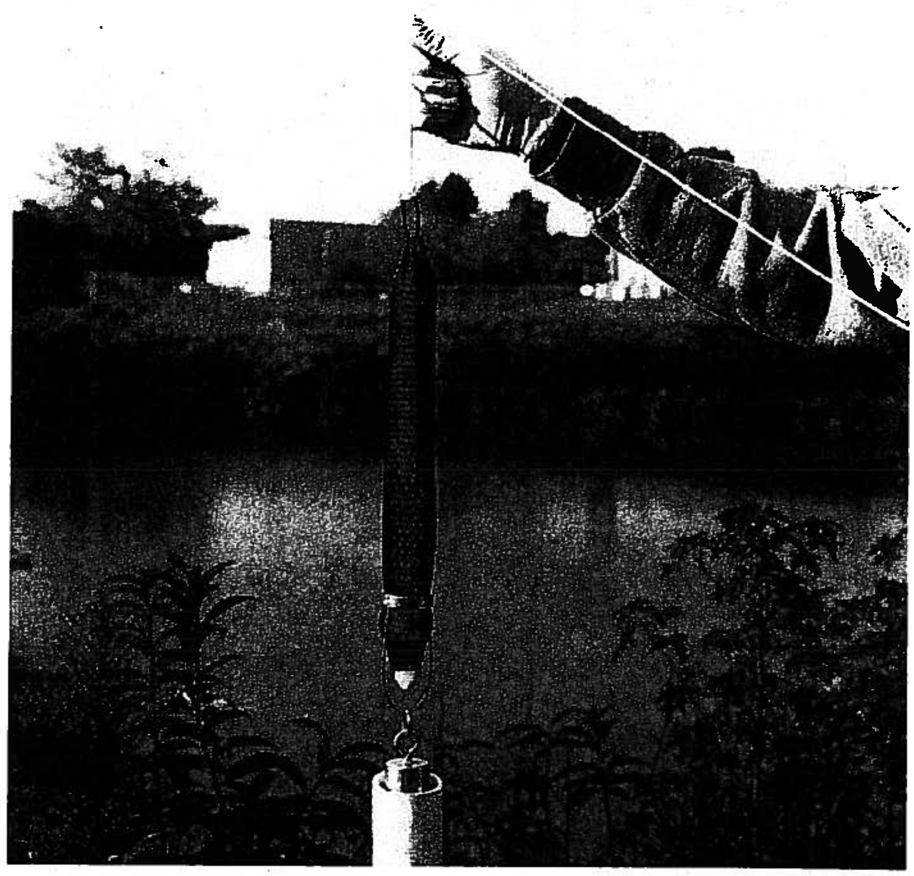
Passive diffusion bag (PDB) sampling is a cost-effective alternative to standard (or low-flow) purge and sample techniques for collecting concentrations of a variety of volatile organic compounds (VOCs) in groundwater at monitoring wells. Using PDB samplers can result in significant cost savings at sites where VOCs are the constituents of concern and particularly where long-term monitoring of groundwater is required. PDB sampling can also provide inexpensive and precise vertical contaminant concentration profiles that can be used to optimize remedial systems. The Interstate Technology and Regulatory Council (ITRC) Diffusion Sampler Team has gathered the following information about this technology and its uses.

## How does a PDB sampler work?

A PDB sampler is a low-density polyethylene bag filled with deionized water, which acts as a semipermeable membrane and is suspended in a well to passively collect groundwater samples. PDB samplers rely on the free movement of groundwater from the aquifer or water-bearing zone through the well screen. VOCs in groundwater will diffuse across the bag material until constituent concentrations within the bag reach equilibrium with concentrations in the surrounding groundwater.

## What are the advantages of PDB samplers?

PDB samplers are inexpensive and have the potential to eliminate or substantially reduce the amount of purge water associated with sampling. The samplers are easy to deploy and recover. Because PDB samplers are disposable, there is no down-hole equipment to be decontaminated between wells. PDB samplers require a minimal amount of field equipment. Sampler recovery is rapid. Because of the small amount of time and equipment required for the sampling event, the method is practical for use where access is a problem or where discretion is desirable (for example, residential communities, business districts, or busy streets where traffic control is a concern). Multiple PDB samplers distributed vertically along the screened or open interval may be used in conjunction with bore-hole flow meter testing to gain insight on the movement of contaminants into and out of the well screen or open interval or to locate the zone of highest concentration in the well. As the pore size of low-density polyethylene is only 10 angstroms or less, sediment does not pass through the membrane into the bag. Thus, PDB samplers are not subject to interference from turbidity. Finally, because alkalinity-contributing solutes do not pass through the membrane, the samplers enable collection of VOCs in a nonalkaline matrix, even if the well is in a limestone aquifer. This feature eliminates the VOC losses seen when highly alkaline water "foams" upon attempting to preserve samples by acidificaton.



## *What are the limitations of PDB samplers?*

PDB samplers are not appropriate for all compounds. PDB samplers also integrate concentrations over time, which may be a limitation if the goal of sampling is to collect a representative sample at a point of time in an aquifer where VOC concentrations substantially change more rapidly than the samplers equilibrate. Finally, PDB samplers rely on the free movement of water through the well screen. In situations where groundwater flows horizontally through the well screen, the VOC concentrations in the open interval of the well are probably representative of the aquifer water in the adjacent formation. However, if the well screen is less permeable than the aquifer or the sandpack than under nonpumping conditions, flow lines may be diverted around the screen. In this case, the VOC concentrations in the PDB samplers may not represent concentrations in the formation water because of inadequate exchange across the well screen.

## *For what constituents can PDB samplers be used?*

Field and lab testing have shown that PDB samplers are effective for a number of VOCs, including chlorinated aliphatic compounds and petroleum hydrocarbons. A list of the VOCs evaluated is included in the accompanying table. The majority of VOCs evaluated were shown to readily diffuse into the sample bag.

## *For which constituents are PDB samplers not suited? What about natural attenuation parameters?*

PDB samplers should not be used for the compounds listed at the bottom of the accompanying table (those showing poor replication). They are also unsuitable for inorganic ions and have a limited applicability for non-VOCs and for some VOCs. For example, although methyl-*tert*-butyl ether, acetone, and most semivolatile compounds are transmitted through the polyethylene bag, laboratory tests have shown that the resulting concentrations are lower than in ambient water. The samplers should not be used to sample for phthalates because of the potential for the low-density polyethylene to contribute phthalates to the water sample. They are not useful for inorganic polar molecules because the membrane is nonpolar organic. PDB samplers are also inappropriate for ionic natural attenuation parameters, e.g., nitrates and sulfates. They are effective for the nonionic natural attenuation parameter methane; however, if natural attenuation monitoring is required, a combination of sampling techniques could be considered. For example, annual monitoring of natural attenuation parameters can be performed using a traditional sampling method, while quarterly monitoring of VOCs can be accomplished using diffusion sampling technology.

**COMPOUNDS SHOWING GOOD CORRELATION IN LABORATORY TESTS**
**(average differences in concentration of 11 percent or less between diffusion sampler water and test vessel water)**

| | | |
|---|---|---|
| Benzene | 1,3-Dichlorobenzene | Naphthalene |
| Bromodichloromethane | 1,4-Dichlorobenzene | 1,1,2,2-Tetrachloroethane |
| Bromoform | Dichlorodifluoromethane | Tetrachloroethene |
| Chlorobenzene | 1,2-Dichloroethane | Toluene |
| Carbon tetrachloride | 1,1-Dichloroethene | 1,1,1-Trichloroethane |
| Chloroethane | *cis*-1,2-Dichloroethene | 1,1,2-Trichloroethane |
| Chloroform | *trans*-1,2-Dichloroethene | Trichloroethene |
| Chloromethane | 1,2-Dichloropropane | Trichlorofluoromethane |
| 2-Chlorovinyl ether | *cis*-Dichloropropene | 1,2,3-Trichloropropane |
| Dibromochloromethane | Dibromochloromethane | Vinyl chloride |
| Dibromomethane | *trans*-1,3-Dichloropropene | Total xylenes |
| 1,2-Dichlorobenzene | Ethyl benzene | |

**COMPOUNDS SHOWING POOR CORRELATION IN LABORATORY TESTS**
**(average differences in concentration greater than 20 percent between diffusion sampler water and test vessel water)**

| | | | |
|---|---|---|---|
| Acetone* | Methyl-*tert*-butyl ether | MIBK* | Styrene |

*Source:* Compounds tested under laboratory conditions for use with passive diffusion bag samplers (Vroblesky and Campbell, 2001).
*T. M. Sivavec and S. S. Baghel, 2000, General Electric Company, written communication.

## *In what types of aquifers or water-bearing zones can PDB samplers be used?*

PDB samplers can be used in most formations, but they are not currently recommended for use in low-permeability formations because the flow of water through the well screen is restricted if the rate of VOC change in the well (by volatilization) is less than the rate that the VOCs are replaced by movement into the well screen. In this case, the VOC concentrations in the well water may not be representative of the VOC concentrations in the formation. PDB sampling relies on self-purging of wells to maintain concentrations within a well that are representative of the surrounding aquifer conditions. However, it should be noted that sampling of low-yielding wells is problematic for any currently available groundwater sampling method. PDB samplers work on the principle of diffusion. In low-permeability formations, diffusion is major mechanism for contaminant transport. Under these conditions, PDB samplers may indeed represent a viable sampling approach compared to other more conventional methods, but not enough data are currently available to support their use in low-permeability formations. Wells often do not adequately self-purge within a two-week period in low-permeability aquifers to allow diffusion sampling to be effective. As a general rule, diffusion sampling should not be used in water-bearing zones with a hydraulic conductivity of less than $1 \times 10^{-6}$ cm/s.

### How are PDB samplers deployed?

PDB samplers can come prefilled or can be filled in the field with laboratory-grade deionized water immediately prior to deployment. Appropriate weight, connectors, and line are attached to the sampler, and it is set at the desired depth in the screened interval. Licensed diffusion bag suppliers can provide more specific installation and recovery instructions. See below for information on using these samplers in wells with varying screen lengths.

### How much time is required to collect a PDB sample?

It takes about 10 minutes to collect a groundwater sample from a diffusion bag and about the same amount of time to install a new bag. If quarterly sampling is being done, another bag can be installed immediately after the sample is collected. If annual or semiannual sampling is being done, another bag can be installed immediately after the sample is collected in some situations. PDB samplers have successfully been left in place for a year with no obvious loss of bag integrity. The longevity of PDB samplers in a variety of potentially hostile groundwater environments has not yet been tested, however, so the user should be alert for potential losses of bag integrity during recovery. If a single event is being done, a separate trip will be required to install the bags at least two weeks prior to sample collection.

PDB samplers should be left in place for a minimum of two weeks prior to sample collection to ensure that the deionized water in the diffusion bag has reached equilibrium with the surrounding groundwater. Under low-flow conditions, the PDB should be left in place longer prior to sample collection.

### How much do the samplers cost? And where do I get them?

Cost information is available from vendors. There currently are two authorized distributors from whom passive diffusion bags can be obtained. EON Products (www.eonpro.com, 1-800-474-2490) are filled in the field. Columbia Analytical Services (www.caslab.com, 1-800-695-7222) samplers come prefilled with deionized water. PDB samplers employ patented technology (U.S. patent number 5,804,743) and therefore require that the user purchase commercially produced samplers from a licensed manufacturer or negotiate a nonexclusive license for sampler construction from the United States Geological Survey (USGS).

The cost savings resulting from the decreased time required to collect diffusion samples (relative to standard purge or low-flow purge and sample techniques) often more than offset the cost of the PDB sampler and replacement bags. Prices vary based on volume, hardware, and optional accessories, but the overall cost of a diffusion sampler generally ranges $16 to $35 per bag, plus reusable hardware (approximately $20 to $25).

### Do I need to do a field comparison or validation study at my site before they can be used there?

A validation study typically includes conducting a side-by-side test with both PDB samples and conventional sampling (typically low-flow sampling). In wells showing little temporal variability in concentrations, a validation study may not be needed. PDB sampling results can be compared to historical data from samples collected using other techniques, but the results are less conclusive than those of a side-by-side test. The biggest uncertainties associated with PDB sampling are the presence of vertical stratification within the well and vertical flow within the well itself. Stratification can produce PDB sampler results that do not always agree with pumped results because PDB samplers represent approximate points (about 1 foot long) and tend to show the stratification with high precision, while the pumped sample often is a mixture of waters from different parts of the stratification. In this situation, it is advisable initially to delineate the stratification with diffusion samplers to decide on the optimum deployment depth. Vertical flow within the well means that the water may be coming from a horizon not adjacent to the PDB sampler and, therefore, not representative of the formation immediately adjacent to the PDB sampler. In this situation, a validation study should be completed to determine whether diffusion sampling is appropriate for the site conditions.

### How can PDB samplers be used for detection monitoring at facilities currently using conventional sampling methods without introducing statistical variability due to the change in sampling method?

It is practically impossible not to introduce statistical variability when you switch sampling methods. For sites that are in compliance monitoring and using statistics to demonstrate a decreasing trend, PDB samplers may not be appropriate. However, if there is already a strong decreasing trend established in the data, switching methodologies would be less critical because there is good evidence that the plume concentrations are decreasing. If good correlation with existing results was obtained, the decision to switch methodologies is not scientifically complex. In a more complicated case where data do not correlate well, additional work would be required to document why there is poor correlation (e.g., vertical profiling, bore-hole flow testing, review of hydrogeology and well construction information). It should be noted that some of the questions regarding PDB-sample data correlation and use, such as vertical placement of the sampler, also can apply to low-flow samples. PDB samplers have the potential to generate detailed data that may not always agree with the existing database of samples that have undergone some degree of mixing during pumping. The significance of these new data, in terms of contaminant fate, transport, and site management, is a site-specific consideration.

## Are any guidance documents or user guides available?

Yes. In collaboration with USGS, U.S. Air Force, U.S. Naval Facilities Engineering Command, U.S. Environmental Protection Agency (U.S. EPA), Federal Remediation Technologies Roundtable, Defense Logistics Agency, and U.S. Army Corps of Engineers, ITRC has published *The User's Guide for Polyethylene Based Passive Diffusion Bag Samplers to Obtain Volatile Organic Concentrations in Wells* (Vroblesky, D. A. March 2001). The document can be obtained at www.itrcweb.org and other Web sites. The purposes of this document are to present methods for PDB sampler deployment and recovery, discuss approaches for determining the applicability of passive diffusion samplers, and discuss various factors influencing interpretation of the data. The intended audience for the methodology sections of the report includes managers and field personnel involved in using PDB samplers. The discussion of PDB sampler applicability and interpretation of the data is suited for project managers, technical personnel, and the regulatory community. Part 2 of the document presents case studies of PDB-sampler field applications.

## Is PDB sampler training available?

In collaboration with the U.S EPA/ Technology Innovation Office (TIO) and USGS, ITRC has developed Internet-based training on the *User's Guide*. See www.itrcweb.org for details. In conjunction with U.S. EPA/TIO, ITRC hosts these two-hour training courses via the Internet to reach a geographically diverse audience of regulators, consultants, and other members of the environmental community. The sessions are also archived on the Web at http://clu-in.org/studio/seminar.cfm.

## Where can I get more information about PDB samplers?

ITRC has developed a "Diffusion Sampler Information Center" Web site http://DiffusionSampler.itrcweb.org. The site contains information on diffusion samplers, recent news, deployments, cost and performance data, technical documents, lessons learned, technology advances, available training, frequently asked questions, and contacts. The Web site also has links to other sources of information about PDB samplers. There is a growing body of data from numerous facilities comparing the results of diffusion sampling with other techniques such as bailing and low-flow sampling. This information is summarized in numerous technical reports that are being published or produced. The ITRC Web site will track and summarize this technical information on diffusion sampler deployments nationwide.

## Whom can I contact for additional information?


George Nicholas
ITRC Diffusion Sampler Team Leader
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Gnichola@dep.state.nj.us

Dr. Don Vroblesky
Research Geochemist
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(703) 610-2509
wberger@mitretek.org

Dr. Barry Weand
ITRC Program Advisor
(703) 610-1745
bweand@mitretek.org

MILLER ENVIRONMENTAL GROUP INC.

# STANDARD OPERATING PROCEDURE FOR FIELD TECHNICIANS
# PASSIVE DIFFUSER BAG SAMPLE COLLECTION PROTOCOLS

[*This protocol is applicable to sampling projects utilizing 1" and 2" monitoring wells*]

**For the purpose of practicality the two (2) principal type of PDB's may be referred to in this document by the well diameter sizes each will be suspended within, 2' and 1".**

**For cluster wells it is advisable to repeat the sampling sequence from location to location.**

## 1.0 Scope

The introduction and sample retrieval procedures outlined here are designed to conform to design requirements of the EON Products® GSD 150 and GSD 200 Passive Diffusion Sampling Bags (PDB). The purpose is to ***a***) ensure membrane integrity from the point of collection to prevent loss of sample volume, ***b***) ensure proper techniques for sample collection in properly delineated procedures and steps, ***c***) safeguarding laboratory generated data by eliminating potential contamination which might cause analytical interference.

## 2.0 PDB and Ancillary Equipment

The Passive Diffusion Bags are designed as sealed polyethylene membranes filled without air gaps with deionized water. The PDB resides in a vertical column of water designated for sampling. Available volatile organic compounds (VOC's) diffuse through the sampler wall during the residence time of immersion. The semi-permeable membrane allows the interior volume of deionized water to equilibrate by diffusion the concentration of VOC's in the vertical dimension of the borehole or other designated sampling area.

### 2.1 **Sampling Equipment** (***as a kit or in some combination***)

1) Passive diffuser bag
2) Cable or synthetic rope
3) Zip (cable) ties
4) Split ring clips
5) Stainless steel weight
6) Deionized water
7) disposable gloves
8) 40 ml borosilicate glass vials (2 per sample with appropriate preservative)
9) cooler with ice or icepacks (other methods for keeping samples between 4° and 6° Centigrade are admissible for laboratory acceptance)

## 3.0 GSD 150 and GSD 200 Specifications

| Designation | Length | Volume | Diameter |
|---|---|---|---|
| GSD 150 | 42" | 200ml | 0.75" |
| GSD 200 | 18" | 350ml | 1.75" |

## 4.0 PDB Installation Procedure

Field installation of the PDB's should follow a logical sequence. Portions of the setup train are reusable such as the weighs. The PDB is not. Since in standard applications retrieval of the PDB is simply the reverse of its insertion, care must be exercised as to the initial disposition of its placement (presumed borehole.) ***It is recommended that the weights and tethers be affixed on the 2" PDB prior to willing the membrane with DI water to enhance maneuverability and prevent volume loss due to leakage.***

4.1 Cables, ties and weights must be properly attached to the PDB prior to borehole insertion.

Since the PDB's are buoyant even when filled, the appropriate weight should be selected to ensure "sinking" of the bag once it impacts the groundwater interface. Based upon experience the eight (8) ounce weight has the most practical application. It is best to apply the following steps in sequence as they are better recalled in the event of multiple well projects and because it is easier to manipulate the PDB during installation, removal and sample procurement.

1) for the GSD 150 and GSD 200, loop and fasten the end of the suspension rope to the Insert Plug end of the PDB. Make sure this connection is secure: though the weight of the filled PDB's are comparatively negligible relative to the variety of securing mechanisms, the technician must take into consideration the stress points of the cable tie to the top of the borehole and the tie binding the weight at the PBD bottom. The PDB will be presumable hanging in the water column for a defined period of time, therefore secure attachments are essential.

2) the length of the suspension rope or cord may be pre-measured or spooled to the depth of the screen zone.

3) secure appropriate weight at the reverse (bottom) end of the PDB by means of a stainless steel split rig. (A handle is provided for the 2" sample and a split rig for the 1".)

*4)* for the 2" PDB's, if the tether set up is not supplied by the manufacturer is used, insert and loop two cable ties though the protective mesh on opposite sides against the rigid dome at the top of the sampler. Loop a rope through both ties and secure the ***directly*** over the top of the insert plug. Snip the excess tie length as close to the cable zip lock as possible. Even slight excesses could snag against the sides of the well. In this way the vertical stress will be equally distributed on the mesh and the weigh will not tip the PDB into a position where it may wedge in the vertical dimension of the well shaft.

***Special considerations must be made for the 1" PDB.***

a) Unlike the 2' PDB, the 1" version does not have a protective mesh overlay. The membrane is longer and less rigid. After attaching the weight to the supplied split ring at the bottom of the PDB, it is recommended to fill the membrane to volume capacity with DI water. Applying slight pressure to the membrane as it is being filled will coax air pockets and bubbles to the top, similar to filling a 40ml vial for VOA sampling.
b) After the insert plug is capped into the top of the sampler, loop the suspension rope through the connecting ring at the throat of the diffusion sampler. (It is advisable to cable tie the bottom of the loop to the connecting ring or added security against slippage.) Draw the end of the rope upwards until it extends past the insert plug. ***It is important that the downward and upward lengths of the suspension rope is cable-tied against the short tube at the sampler top.*** The rope should be knotted or secured directly over the insert plug. By securing the rope against the sample top tube, you will prevent the neck of the sampler from bending and/o folding in the well. Snip the excess tie length(s) as close to the cable zip lock as possible.
c) Note that the sampler to consists of a short neoprene–like tube and a smaller pour tube located inside the throat. Each may become dislodged with excess movement.

The Passive Diffusion System has been engineered for a two (2) week or greater residence time.

**5.0 Sample Retrieval**

Retrieval is accomplished by slowly withdrawing the PDB by use of the suspension rope. Liquid sample from both the 1" and 2" PDB's are accomplished by pressing one end of the discharge tube into a point at the bottom of the sampler. Once the polyethylene membrane is pierced the flow can be regulated by the downward angle of the discharge tube. Discharge as soon as possible.

It is advisable to have glassware pre-labeled to eliminate possible confusion,

a. Liquid sampling usually consists of volatile, semi-volatile, metal and other environmental methodologies. Glassware so dedicated may contain at last one acid, caustic, or other preservative which may, if improperly handles, produce a burns, eye injury, or other deleterious effect if not handled properly. It only takes a small volume of chemical to cause a major injury. At the least never sample without disposable gloves or other type of hand protection.

***Volatiles***

b. The 40 ml borosilicate glass vials with Teflon septas are usually designated for volatile and fuel oxygenate analysis and are pre-prepared with Hydrochloric Acid (HCL) or Trisodium Phosphate (TSP) respectively. Two (2) vials are required for each for volatile and fuel oxygenate sample. It is extremely important that these vials contain **no air bubbles** once the sample has been placed in them. If a pump is being utilized, draw the samples with a reduced flow rate or transfer into another certified glass container and pour from it.

c. Fill the bottles slowly until a convex meniscus at the mouth of the bottle. Do not permit overflow to occur. Replace the cap (straight down, not at an angle) over the meniscus to tighten. Tighten firmly but not too snugly in order to avoid distorting the shape of the cap. Also the caps and vials may crack with over-tightening.

d. Shake vigorously for 1 minute. Invert the bottle and tap gently against your hand to check for air bubbles (bubbles sometime are rapped in the cap threads.) If no bubbles form you have sampled correctly. If bubbles form, carefully add more water (sweeping bubble off the meniscus with the edge of the cap-never your glove- if necessary,) recap, and check for bubbles again. Air bubbles in the samples may invalidate the analysis.

e. Affix labels to each vial identifying the sample. Use indelible ink if necessary.

f. Place the vials into the cooler carefully. Use bubble wrap if necessary to protect them in transport. Enclose frozen gelpaks, blue-ice, or regular ice. Be careful to avoid direct contact between vials and frozen gelpaks. Direct contact between ice and the glass may result in frozen samples and broken bottles. If paperwork is to be retained in the cooler be sure to place it in a zip-lock bag.

**6.0 Chain of Custody (COC)**

If it is necessary for a sample technician to fill out a laboratory chain-of-custody form for environmental samples, the following data must be provided as the COC is a legal document that accompanies samples through the remainder of their routing until eventual sample disposal:

a) Date and time of <u>*each*</u> sample collection (more than 1 sample may be put on a single COC)
b) Signature of sample collector
c) Billable or responsible party
d) Exact location or designation of sample origin
e) Container type (*glass, 40ml, preserved, etc.*)
f) Container size
g) the sampler's signature,
h) date of sampling,
i) time of sampling for each sample listed on the COC,
j) date received,
k) MEG job number,
l) analytical sequential batch number(s),
m) client name or ID,
n) method or testing requirement(s),
o) number and type of sample collection containers,
p) type of preservation method (ice, acid, etc.),
q) sample collection location,
r) signature and time of responsible on-site party,
s) signature and time of Mobile Laboratory sample receiver,
t) *any additional reference information including samples designated for "HOLD" or delayed analyses and accelerated turnaround times.*

NYSDOH regulations specify that samples are at verified time of sample receipt cooled to a temperature of between 4° and 6° centigrade (39.2° and 42.8° Fahrenheit.)

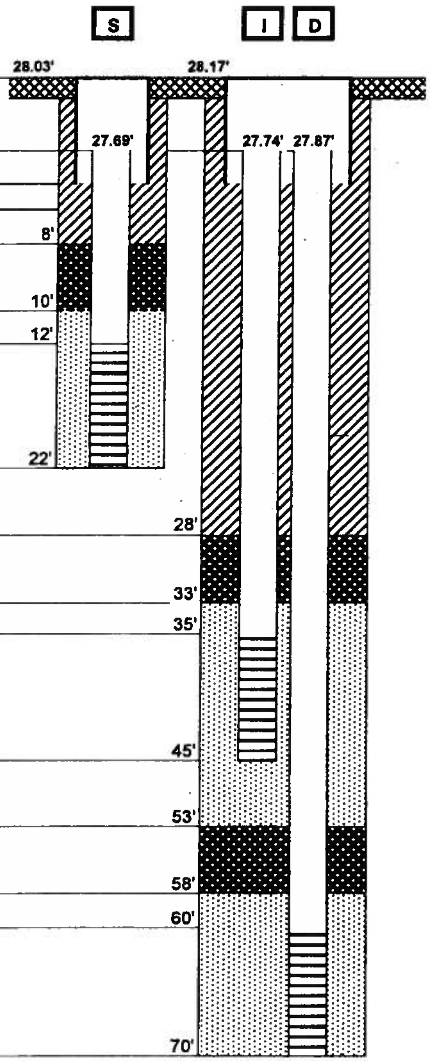
# APPENDIX D

Monitoring Well Construction Logs: W-01 to W-15

| | |
|---|---|
| **Project:** | Westside Corp OU-2 |
| **Client:** | NYSDEC |
| **Drilling Company:** | Miller Environmental Group |
| **Drilling Method:** | 12-inch Hollow Stem Auger |
| **Development:** | AirLance, Peristaltic |
| **Date Installation:** | 06.04.2008 |

**S** = Shallow Screen Interval
**I** = Intermediate Screen Interval
**D** = Deep Screen Interval

**WELL ID:** W-01




Flushmount Elevation*: 28.03' 28.17'

TOC/MP Elevation*:

| ITEM | DEPTH |
|---|---|
| Top of Seal: | 8' |
| Top of Filter Pack: | 10' |
| Top of Screen: | 12' |
| Base of Screen: | 22' |
| Top of Seal: | 28' |
| Top of Filter Pack: | 33' |
| Top of Screen: | 35' |
| Base of Screen: | 45' |
| Top of Seal: | 53' |
| Top of Filter Pack: | 58' |
| Top of Screen: | 60' |
| Base of Screen: | 70' |

**DESCRIPTION**

| | |
|---|---|
| Flushmount Diameter: | **S** - 5-inch, **I, D** - 8-inch |
| Surface Seal Type: | Portland Cement |
| Backfill/Grout Type: | Natural/Grout |
| Riser Pipe Type: | 2-inch PVC Schedule 40 |
| Borehole Diameter: | **S** - 4-inch **I, D** - 12-inch |
| Type of Seal: | Bentonite |
| Screen Length: | 10-feet |
| Screen Type: | 2-inch PVC Schedule 40 |
| Screen Slot Size: | 0.020-inch |
| Filter Pack: | Morie #1 |

**NOTES:**
Construction log not drawn to scale.
Depths are approximated from field measurements.
* Elevations surveyed by YEC on 09/15/08 to NAD 1983 datum
Shallow 'S' well was installed by URS on 08.31.06.
Variant Construction details: *0.010-inch screen* , #00 Filter Pack

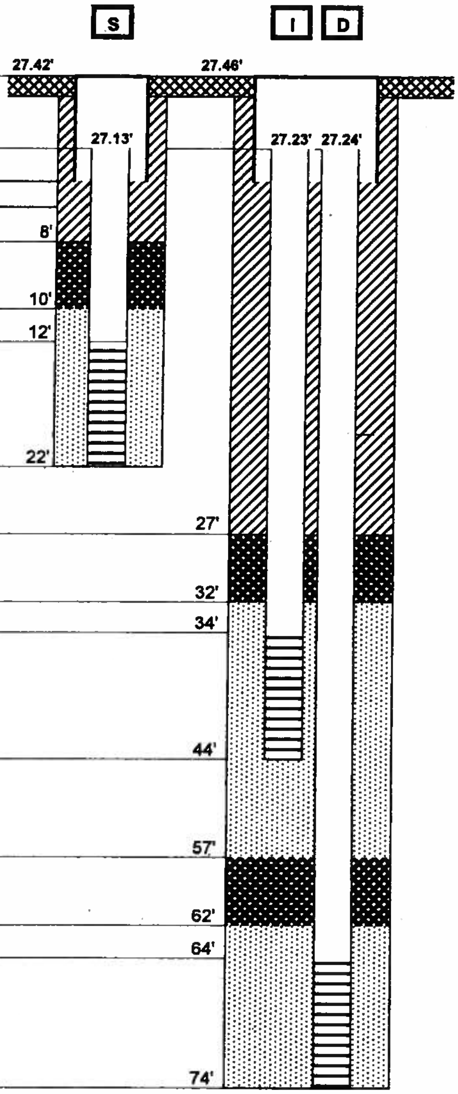
| | |
|---|---|
| **Project:** | Westside Corp OU-2 |
| **Client:** | NYSDEC |
| **Drilling Company:** | Miller Environmental Group |
| **Drilling Method:** | 12-inch Hollow Stem Auger |
| **Development:** | AirLance, Peristaltic |
| **Date Installation:** | 06.02.2008 |

**WELL ID:** W-02

**S** = Shallow Screen Interval
**I** = Intermediate Screen Interval
**D** = Deep Screen Interval

Flushmount Elevation*:

TOC/MP Elevation*:




| ITEM | DEPTH |
|---|---|
| Top of Seal: | 8' |
| Top of Filter Pack: | 10' |
| Top of Screen: | 12' |
| Base of Screen: | 22' |
| Top of Seal: | 27' |
| Top of Filter Pack: | 32' |
| Top of Screen: | 34' |
| Base of Screen: | 44' |
| Top of Seal: | 57' |
| Top of Filter Pack: | 62' |
| Top of Screen: | 64' |
| Base of Screen: | 74' |

**DESCRIPTION**

| | |
|---|---|
| Flushmount Diameter: | **S** - 5-inch, **I, D** - 8-inch |
| Surface Seal Type: | Portland Cement |
| Backfill/Grout Type: | Natural/Grout |
| Riser Pipe Type: | 2-inch PVC Schedule 40 |
| Borehole Diameter: | **S** - 4-inch **I, D** - 12-inch |
| Type of Seal: | Bentonite |
| Screen Length: | 10-feet |
| Screen Type: | 2-inch PVC Schedule 40 |
| Screen Slot Size: | 0.020-inch |
| Filter Pack: | Morie #1 |

**NOTES:**

Construction log not drawn to scale.
Depths are approximated from field measurements.
* Elevations surveyed by YEC on 09/15/08 to NAD 1983 datum
Shallow 'S' well was installed by URS on 08.31.06.
Variant Construction details: *0.010-inch screen*, #00 Filter Pack

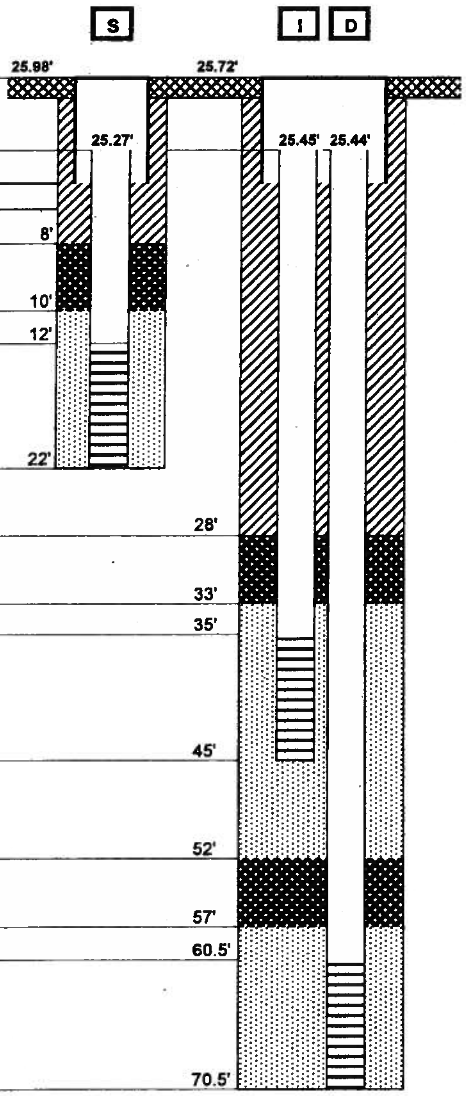
| | |
|---|---|
| **Project:** | Westside Corp OU-2 |
| **Client:** | NYSDEC |
| **Drilling Company:** | Miller Environmental Group |
| **Drilling Method:** | 12-inch Hollow Stem Auger |
| **Development:** | AirLance, Peristaltic |
| **Date Installation:** | 06.09.2008 |

**S** = Shallow Screen Interval
**I** = Intermediate Screen Interval
**D** = Deep Screen Interval

**WELL ID:** W-03

Flushmount Elevation*: 25.98' 25.72'

TOC/MP Elevation*:




| ITEM | DEPTH |
|---|---|
| Top of Seal: | 8' |
| Top of Filter Pack: | 10' |
| Top of Screen: | 12' |
| Base of Screen: | 22' |
| Top of Seal: | 28' |
| Top of Filter Pack: | 33' |
| Top of Screen: | 35' |
| Base of Screen: | 45' |
| Top of Seal: | 52' |
| Top of Filter Pack: | 57' |
| Top of Screen: | 60.5' |
| Base of Screen: | 70.5' |

**DESCRIPTION**

| | |
|---|---|
| Flushmount Diameter: | **S** - 5-inch, **I, D** - 8-inch |
| Surface Seal Type: | Portland Cement |
| Backfill/Grout Type: | Natural/Grout |
| Riser Pipe Type: | 2-inch PVC Schedule 40 |
| Borehole Diameter: | **S** - 4-inch **I, D** - 12-inch |
| Type of Seal: | Bentonite |
| Screen Length: | 10-feet |
| Screen Type: | 2-inch PVC Schedule 40 |
| Screen Slot Size: | 0.020-inch |
| Filter Pack: | Morie #1 |

**NOTES:**
Construction log not drawn to scale.
Depths are approximated from field measurements.
* Elevations surveyed by YEC on 10/07/08 to NAD 1983 datum
Shallow 'S' well was installed by URS on 08.23.06.
Variant Construction details: *0.010-inch screen*, #00 Filter Pack

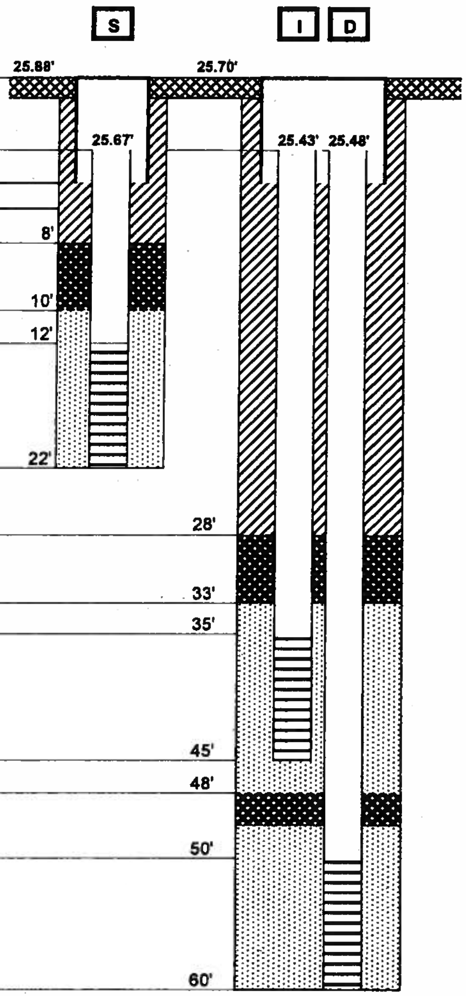
| | | |
|---|---|---|
| **Project:** | Westside Corp OU-2 | |
| **Client:** | NYSDEC | |
| **Drilling Company:** | Miller Environmental Group | |
| **Drilling Method:** | 12-inch Hollow Stem Auger | |
| **Development:** | AirLance, Peristaltic | |
| **Date Installation:** | 06.11.2008 | |

**WELL ID:** W-04

S = Shallow Screen Interval
I = Intermediate Screen Interval
D = Deep Screen Interval

Flushmount Elevation*:

TOC/MP Elevation*:




| ITEM | DEPTH |
|---|---|
| Top of Seal: | 8' |
| Top of Filter Pack: | 10' |
| Top of Screen: | 12' |
| Base of Screen: | 22' |
| Top of Seal: | 28' |
| Top of Filter Pack: | 33' |
| Top of Screen: | 35' |
| Base of Screen: | 45' |
| Top of Seal: | 48' |
| Top of Screen: | 50' |
| Base of Screen: | 60' |

**DESCRIPTION**

| | |
|---|---|
| Flushmount Diameter: | **S** - 5-inch, **I, D** - 8-inch |
| Surface Seal Type: | Portland Cement |
| Backfill/Grout Type: | Natural/Grout |
| Riser Pipe Type: | 2-inch PVC Schedule 40 |
| Borehole Diameter: | **S** - 4-inch **I, D** - 12-inch |
| Type of Seal: | Bentonite |
| Screen Length: | 10-feet |
| Screen Type: | 2-inch PVC Schedule 40 |
| Screen Slot Size: | 0.020-inch |
| Filter Pack: | Morie #1 |

**NOTES:**

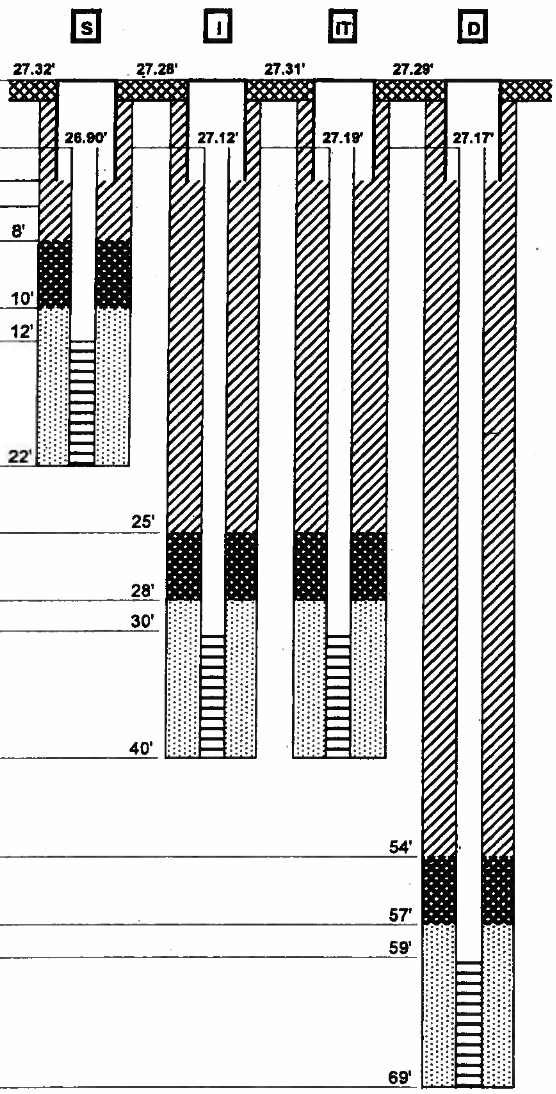
Construction log not drawn to scale.
Depths are approximated from field measurements.
* Elevations surveyed by YEC on 09/15/08 to NAD 1983 datum
Shallow 'S' well was installed by URS on 08.25.06.

Variant Construction details: *0.010-inch screen*, #00 Filter Pack

| | |
|---|---|
| **Project:** | Westside Corp OU-2 |
| **Client:** | NYSDEC |
| **Drilling Method:** | Geoprobe Push Method |
| **Development:** | Peristaltic w/Surge |
| **Date Installation:** | 07.08.2008 |

**S** = Shallow Screen Interval
**I** = Intermediate Screen Interval
**IT** = Intermediate Interval with Dedicated Transducer
**D** = Deep Screen Interval

**WELL ID:** W-06




Flushmount Elevation*: 27.32' (S), 27.28' (I), 27.31' (IT), 27.29' (D)

TOC/MP Elevation*: 26.90' (S), 27.12' (I), 27.19' (IT), 27.17' (D)

| ITEM | DEPTH |
|---|---|
| Top of Seal: | 8' |
| Top of Filter Pack: | 10' |
| Top of Screen: | 12' |
| Base of Screen: | 22' |
| Top of Seal: | 25' |
| Top of Filter Pack: | 28' |
| Top of Screen: | 30' |
| Base of Screen: | 40' |
| Top of Seal: | 54' |
| Top of Filter Pack: | 57' |
| Top of Screen: | 59' |
| Base of Screen: | 69' |

**DESCRIPTION**

| | |
|---|---|
| Flushmount Diameter: | **S** - 5-inch, **I, IT, D** - 3-inch |
| Surface Seal Type: | Portland Cement |
| Backfill/Grout Type: | Natural |
| Riser Pipe Type: | 1-inch PVC Schedule 40 |
| Borehole Diameter: | **S** - 4-inch **I, IT, D** - 2-inch |
| Type of Seal: | Bentonite |
| Screen Length: | 10-feet |
| Screen Type: | 1-inch PVC Schedule 40 |
| Screen Slot Size: | 0.020-inch |
| Filter Pack: | Morie #1 |

**NOTES:**

Construction log not drawn to scale.

Depths are approximated from field measurements.

* Elevations surveyed by YEC on 10/07/08 to NAD 1983 datum

Shallow 'S' well was installed by URS on 08.24.06.

Variant Construction details: *2-inch PVC, 0.010-inch screen, Backfill w/Bentonite, #00 Filter Pack*

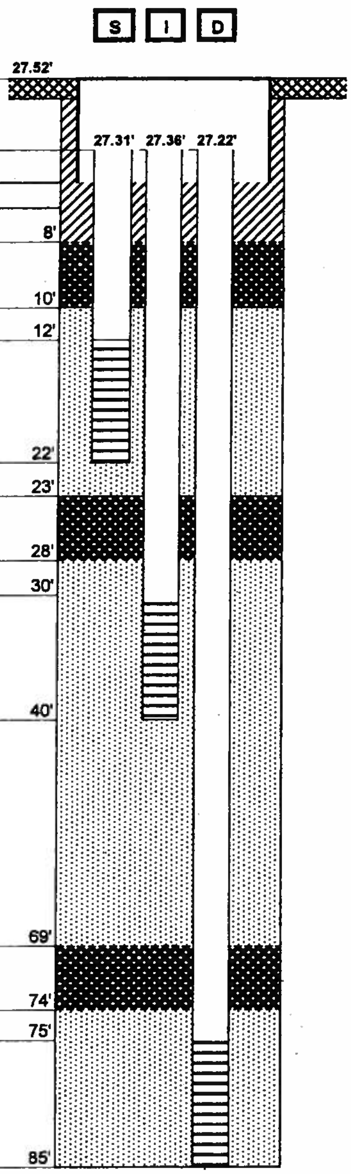
| | |
|---|---|
| **Project:** | Westside Corp OU-2 |
| **Client:** | NYSDEC |
| **Drilling Company:** | Miller Environmental Group |
| **Drilling Method:** | 12-inch Hollow Stem Auger |
| **Development:** | AirLance, Peristaltic |
| **Date Installation:** | 06.16.2008 |

**WELL ID:** W-07

**S** = Shallow Screen Interval
**I** = Intermediate Screen Interval
**D** = Deep Screen Interval

Flushmount Elevation*: 27.52'

TOC/MP Elevation*:




| ITEM | DEPTH |
|---|---|
| Top of Seal: | 8' |
| Top of Filter Pack: | 10' |
| Top of Screen: | 12' |
| Base of Screen: | 22' |
| Top of Seal: | 23' |
| Top of Filter Pack: | 28' |
| Top of Screen: | 30' |
| Base of Screen: | 40' |
| Top of Seal: | 69' |
| Top of Filter Pack: | 74' |
| Top of Screen: | 75' |
| Base of Screen: | 85' |

**DESCRIPTION**

| | |
|---|---|
| Flushmount Diameter: | 12-inch |
| Surface Seal Type: | Portland Cement |
| Backfill/Grout Type: | Natural/Grout |
| Riser Pipe Type: | 2-inch PVC Schedule 40 |
| Borehole Diameter: | 12-inch |
| Type of Seal: | Bentonite |
| Screen Length: | 10-feet |
| Screen Type: | 2-inch PVC Schedule 40 |
| Screen Slot Size: | 0.020-inch |
| Filter Pack: | Morie #1 |

**NOTES:**
Construction log not drawn to scale.
Depths are approximated from field measurements.
* Elevations surveyed by YEC on 09/15/08 to NAD 1983 datum

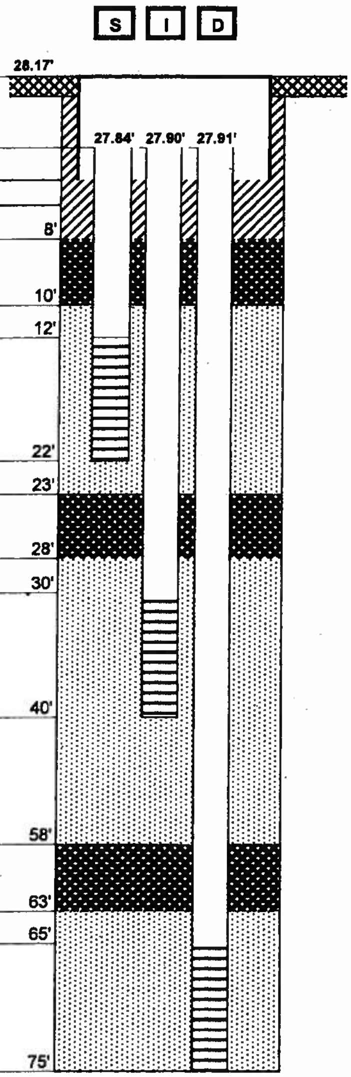
| | |
|---|---|
| **Project:** | Westside Corp OU-2 |
| **Client:** | NYSDEC |
| **Drilling Company:** | Miller Environmental Group |
| **Drilling Method:** | 12-inch Hollow Stem Auger |
| **Development:** | AirLance, Peristaltic |
| **Date Installation:** | 06.12.2008 |

**S** = Shallow Screen Interval
**I** = Intermediate Screen Interval
**D** = Deep Screen Interval

**WELL ID:** W-08

Flushmount Elevation*: 28.17'

TOC/MP Elevation*:




| ITEM | DEPTH |
|---|---|
| Top of Seal: | 8' |
| Top of Filter Pack: | 10' |
| Top of Screen: | 12' |
| Base of Screen: | 22' |
| Top of Seal: | 23' |
| Top of Filter Pack: | 28' |
| Top of Screen: | 30' |
| Base of Screen: | 40' |
| Top of Seal: | 58' |
| Top of Filter Pack: | 63' |
| Top of Screen: | 65' |
| Base of Screen: | 75' |

**DESCRIPTION**

| | |
|---|---|
| Flushmount Diameter: | 12-inch |
| Surface Seal Type: | Portland Cement |
| Backfill/Grout Type: | Natural/Grout |
| Riser Pipe Type: | 2-inch PVC Schedule 40 |
| Borehole Diameter: | 12-inch |
| Type of Seal: | Bentonite |
| Screen Length: | 10-feet |
| Screen Type: | 2-inch PVC Schedule 40 |
| Screen Slot Size: | 0.020-inch |
| Filter Pack: | Morie #1 |

**NOTES:**

Construction log not drawn to scale.

Depths are approximated from field measurements.

* Elevations surveyed by YEC on 09/15/08 to NAD 1983 datum

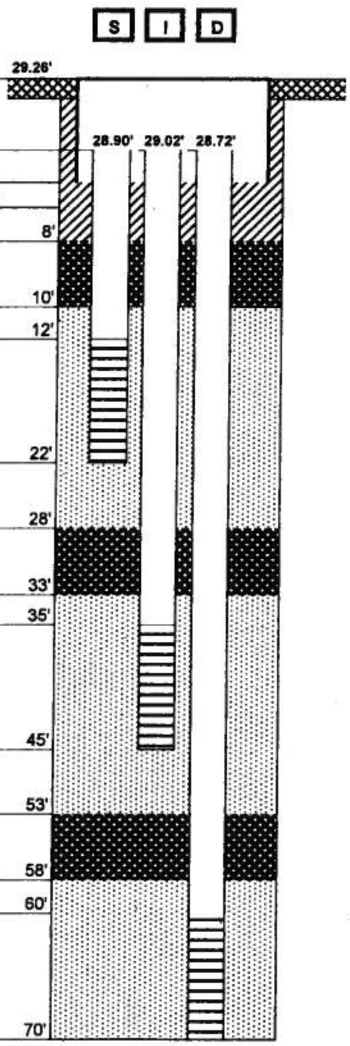
| | |
|---|---|
| **Project:** | Westside Corp OU-2 |
| **Client:** | NYSDEC |
| **Drilling Company:** | Miller Environmental Group |
| **Drilling Method:** | 12-inch Hollow Stem Auger |
| **Development:** | AirLance, Peristaltic |
| **Date Installation:** | 06.06.2008 |

**WELL ID:** W-09

S = Shallow Screen Interval
I = Intermediate Screen Interval
D = Deep Screen Interval

Flushmount Elevation*: 29.26'

TOC/MP Elevation*:




| ITEM | DEPTH |
|---|---|
| Top of Seal: | 8' |
| Top of Filter Pack: | 10' |
| Top of Screen: | 12' |
| Base of Screen: | 22' |
| Top of Seal: | 28' |
| Top of Filter Pack: | 33' |
| Top of Screen: | 35' |
| Base of Screen: | 45' |
| Top of Seal: | 53' |
| Top of Filter Pack: | 58' |
| Top of Screen: | 60' |
| Base of Screen: | 70' |

**DESCRIPTION**

| | |
|---|---|
| Flushmount Diameter: | 12-inch |
| Surface Seal Type: | Portland Cement |
| Backfill/Grout Type: | Natural/Grout |
| Riser Pipe Type: | 2-inch PVC Schedule 40 |
| Borehole Diameter: | 12-inch |
| Type of Seal: | Bentonite |
| Screen Length: | 10-feet |
| Screen Type: | 2-inch PVC Schedule 40 |
| Screen Slot Size: | 0.020-inch |
| Filter Pack: | Morie #1 |

**NOTES:**

Construction log not drawn to scale.

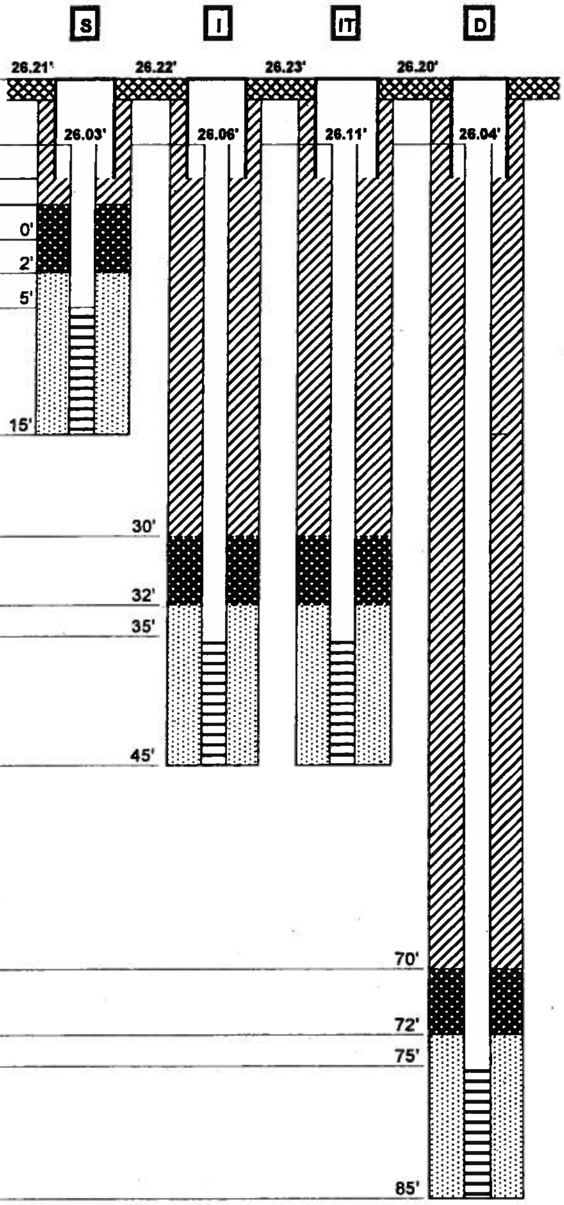
Depths are approximated from field measurements.

* Elevations surveyed by YEC on 09/15/08 to NAD 1983 datum

**WELL ID:** W-10

| | |
|---|---|
| **Project:** | Westside Corp OU-2 |
| **Client:** | NYSDEC |
| **Drilling Company:** | Miller Env. Group |
| **Drilling Method:** | Geoprobe Push Method |
| **Development:** | Peristaltic w/Surge |
| **Date Installation:** | 08/28/08 |

S = Shallow Screen Interval
I = Intermediate Screen Interval
IT = Intermediate Interval with Dedicated Transducer
D = Deep Screen Interval




Flushmount Elevation*: 26.21' (S), 26.22' (I), 26.23' (IT), 26.20' (D)

TOC/MP Elevation*: 26.03' (S), 26.06' (I), 26.11' (IT), 26.04' (D)

| ITEM | DEPTH |
|---|---|
| Top of Seal | 0' |
| Top of Filter Pack: | 2' |
| Top of Screen: | 5' |
| Base of Screen: | 15' |
| Top of Seal: | 30' |
| Top of Filter Pack: | 32' |
| Top of Screen: | 35' |
| Base of Screen: | 45' |
| Top of Seal: | 70' |
| Top of Filter Pack: | 72' |
| Top of Screen: | 75' |
| Base of Screen: | 85' |

**DESCRIPTION**

| | |
|---|---|
| Flushmount Diameter: | 5-inch |
| Surface Seal Type: | Portland Cement |
| Backfill/Grout Type: | Natural |
| Riser Pipe Type: | 1-inch PVC Schedule 40 |
| Borehole Diameter: | 2-inch |
| Type of Seal: | Bentonite |
| Screen Length: | 10-feet |
| Screen Type: | 1-inch PVC Schedule 40 |
| Screen Slot Size: | 0.020-inch |
| Filter Pack: | Morie #1 |

**NOTES:**

Construction log not drawn to scale.

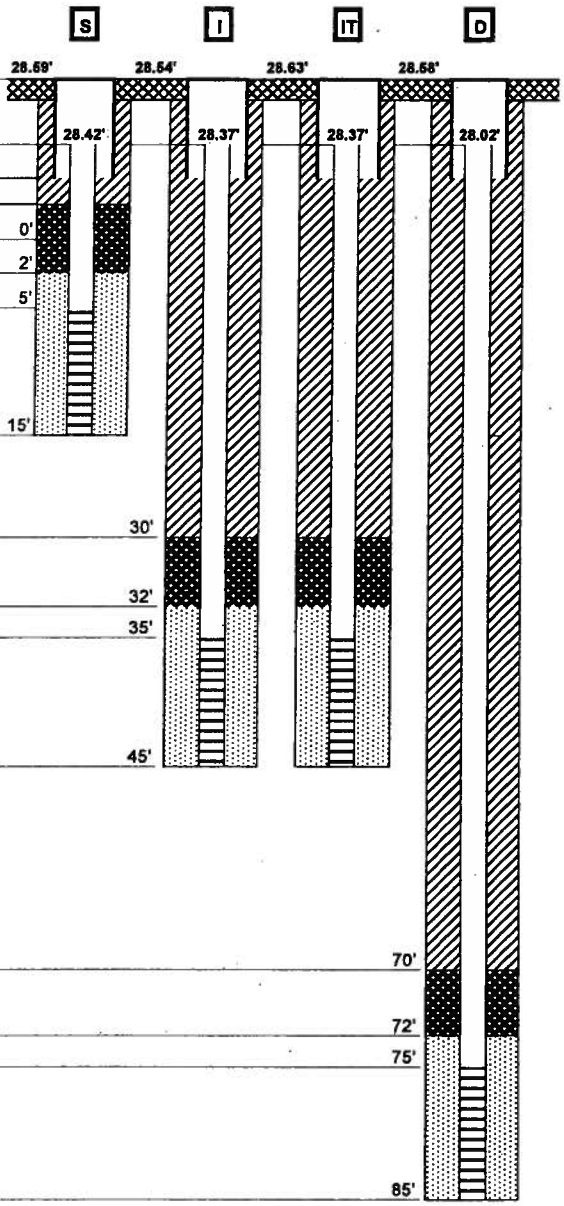
Depths are approximated from field measurements.

* Elevations surveyed by YEC on 09/15/08 to NAD 1983 datum

| | |
|---|---|
| **Project:** | Westside Corp OU-2 |
| **Client:** | NYSDEC |
| **Drilling Company:** | Miller Env. Group |
| **Drilling Method:** | Geoprobe Push Method |
| **Development:** | Peristaltic w/Surge |
| **Date Installation:** | 08/29/08 |

S = Shallow Screen Interval
I = Intermediate Screen Interval
IT = Intermediate Interval with Dedicated Transducer
D = Deep Screen Interval

**WELL ID:** W-11




Flushmount Elevation*:

TOC/MP Elevation*:

| ITEM | DEPTH |
|---|---|
| Top of Seal | 0' |
| Top of Filter Pack: | 2' |
| Top of Screen: | 5' |
| Base of Screen: | 15' |
| Top of Seal: | 30' |
| Top of Filter Pack: | 32' |
| Top of Screen: | 35' |
| Base of Screen: | 45' |
| Top of Seal: | 70' |
| Top of Filter Pack: | 72' |
| Top of Screen: | 75' |
| Base of Screen: | 85' |

**DESCRIPTION**

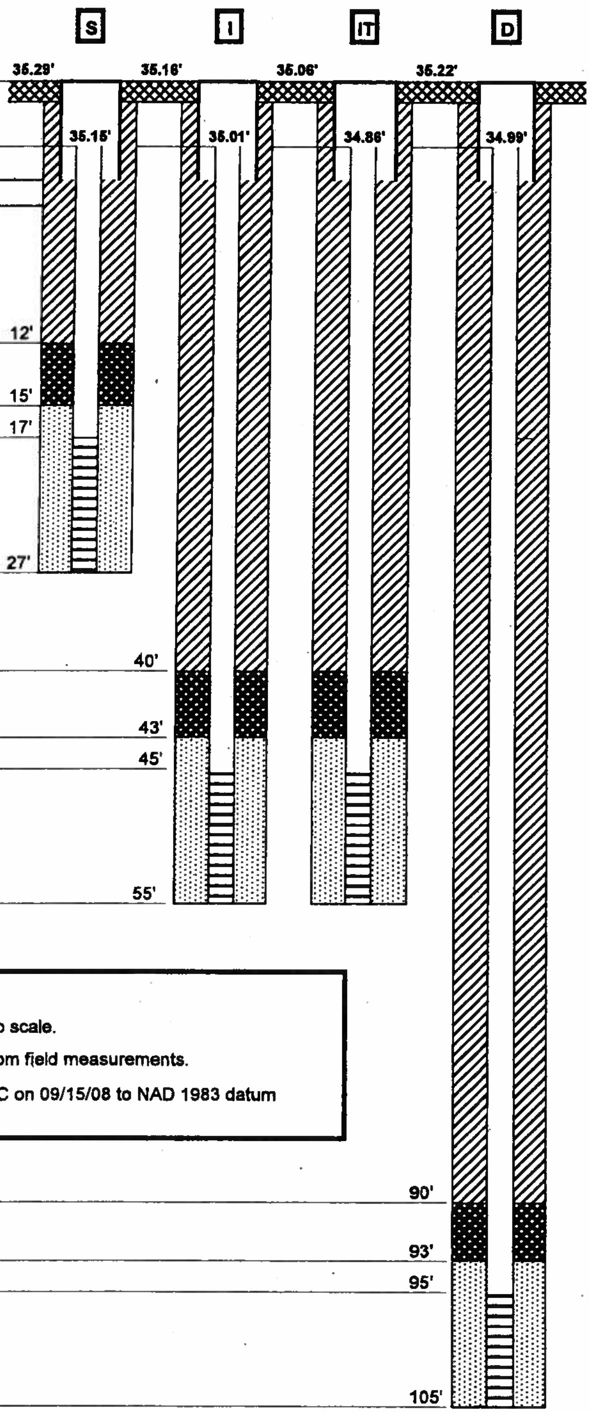
| | |
|---|---|
| Flushmount Diameter: | 5-inch |
| Surface Seal Type: | Portland Cement |
| Backfill/Grout Type: | Natural |
| Riser Pipe Type: | 1-inch PVC Schedule 40 |
| Borehole Diameter: | 2-inch |
| Type of Seal: | Bentonite |
| Screen Length: | 10-feet |
| Screen Type: | 1-inch PVC Schedule 40 |
| Screen Slot Size: | 0.020-inch |
| Filter Pack: | Morie #1 |

**NOTES:**
Construction log not drawn to scale.
Depths are approximated from field measurements.
* Elevations surveyed by YEC on 09/15/08 to NAD 1983 datum

| | |
|---|---|
| **Project:** | Westside Corp OU-2 |
| **Client:** | NYSDEC |
| **Drilling Company:** | Miller Env. Group |
| **Drilling Method:** | Geoprobe Push Method |
| **Development:** | Peristaltic w/Surge |
| **Date Installation:** | 08/25/08 |

| | |
|---|---|
| **S** | = Shallow Screen Interval |
| **I** | = Intermediate Screen Interval |
| **IT** | = Intermediate Interval with Dedicated Transducer |
| **D** | = Deep Screen Interval |

**WELL ID:** W-12




Flushmount Elevation*:

TOC/MP Elevation*:

| ITEM | DEPTH |
|---|---|
| Top of Seal | 12' |
| Top of Filter Pack: | 15' |
| Top of Screen: | 17' |
| Base of Screen: | 27' |
| Top of Seal | 40' |
| Top of Filter Pack: | 43' |
| Top of Screen: | 45' |
| Base of Screen: | 55' |
| Top of Seal | 90' |
| Top of Filter Pack: | 93' |
| Top of Screen: | 95' |
| Base of Screen: | 105' |

**NOTES:**

Construction log not drawn to scale.

Depths are approximated from field measurements.

* Elevations surveyed by YEC on 09/15/08 to NAD 1983 datum

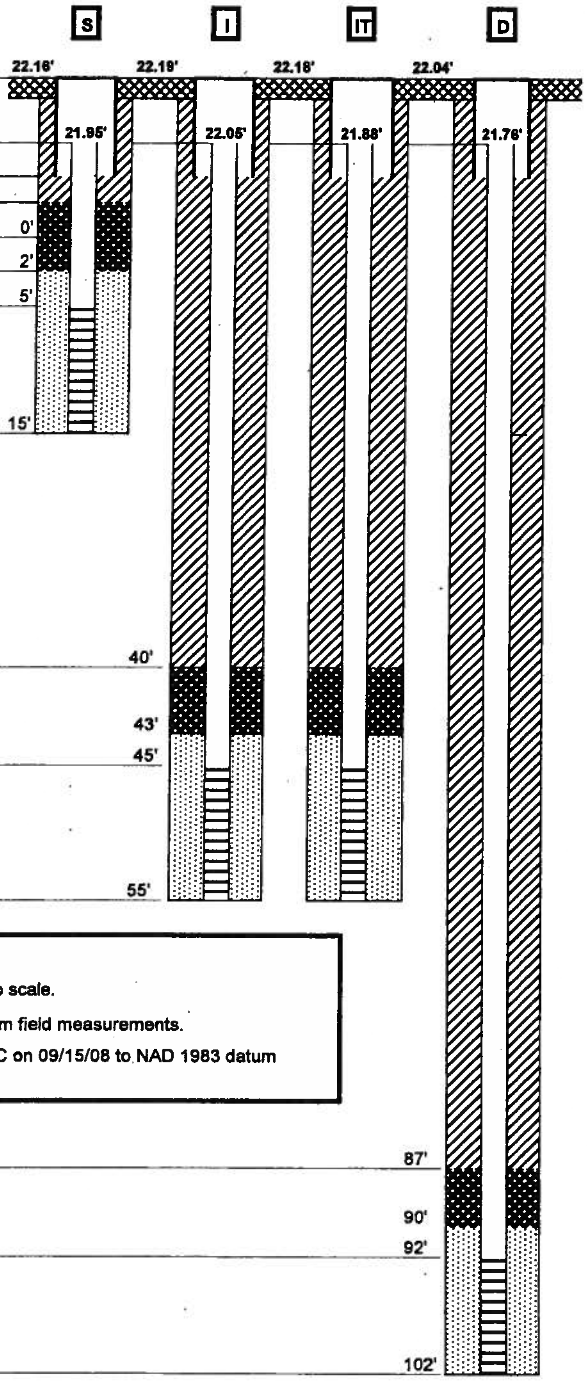
## DESCRIPTION

| | |
|---|---|
| Flushmount Diameter: | 5-inch |
| Surface Seal Type: | Portland Cement |
| Backfill/Grout Type: | Natural |
| Riser Pipe Type: | 1-inch PVC Schedule 40 |
| Borehole Diameter: | 2-inch |
| Type of Seal: | Bentonite |
| Screen Length: | 10-feet |
| Screen Type: | 1-inch PVC Schedule 40 |
| Screen Slot Size: | 0.020-inch |
| Filter Pack: | Morie #1 |

| | |
|---|---|
| **Project:** | Westside Corp OU-2 |
| **Client:** | NYSDEC |
| **Drilling Company:** | Miller Env. Group |
| **Drilling Method:** | Geoprobe Push Method |
| **Development:** | Peristaltic w/Surge |
| **Date Installation:** | 08/19/08 |

S = Shallow Screen Interval
I = Intermediate Screen Interval
IT = Intermediate Interval with Dedicated Transducer
D = Deep Screen Interval

**WELL ID: W-13**




| | S | I | IT | D |
|---|---|---|---|---|
| Flushmount Elevation*: | 22.16' | 22.19' | 22.18' | 22.04' |
| TOC/MP Elevation*: | 21.95' | 22.05' | 21.88' | 21.76' |

| ITEM | DEPTH |
|---|---|
| Top of Seal | 0' |
| Top of Filter Pack: | 2' |
| Top of Screen: | 5' |
| Base of Screen: | 15' |
| Top of Seal: | 40' |
| Top of Filter Pack: | 43' |
| Top of Screen: | 45' |
| Base of Screen: | 55' |
| Top of Seal: | 87' |
| Top of Filter Pack: | 90' |
| Top of Screen: | 92' |
| Base of Screen: | 102' |

**NOTES:**

Construction log not drawn to scale.

Depths are approximated from field measurements.

* Elevations surveyed by YEC on 09/15/08 to NAD 1983 datum

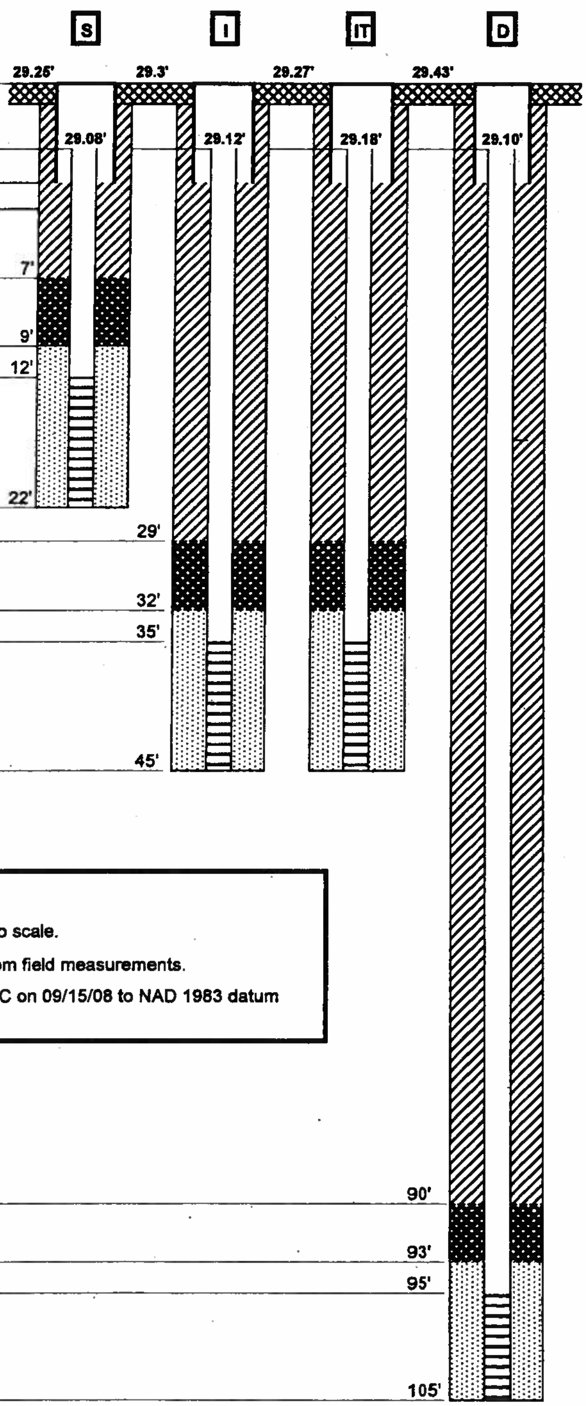
**DESCRIPTION**

| | |
|---|---|
| Flushmount Diameter: | 5-inch |
| Surface Seal Type: | Portland Cement |
| Backfill/Grout Type: | Natural |
| Riser Pipe Type: | 1-inch PVC Schedule 40 |
| Borehole Diameter: | 2-inch |
| Type of Seal: | Bentonite |
| Screen Length: | 10-feet |
| Screen Type: | 1-inch PVC Schedule 40 |
| Screen Slot Size: | 0.020-inch |
| Filter Pack: | Morie #1 |

| | |
|---|---|
| **Project:** | Westside Corp OU-2 |
| **Client:** | NYSDEC |
| **Drilling Company:** | Miller Env. Group |
| **Drilling Method:** | Geoprobe Push Method |
| **Development:** | Peristaltic w/Surge |
| **Date Installation:** | 08/20/08 |

**S** = Shallow Screen Interval
**I** = Intermediate Screen Interval
**IT** = Intermediate Interval with Dedicated Transducer
**D** = Deep Screen Interval

**WELL ID:** W-14




Flushmount Elevation*: 29.25' (S), 29.3' (I), 29.27' (IT), 29.43' (D)

TOC/MP Elevation*: 29.08' (S), 29.12' (I), 29.18' (IT), 29.10' (D)

| ITEM | DEPTH |
|---|---|
| Top of Seal | 7' |
| Top of Filter Pack: | 9' |
| Top of Screen: | 12' |
| Base of Screen: | 22' |
| Top of Seal: | 29' |
| Top of Filter Pack: | 32' |
| Top of Screen: | 35' |
| Base of Screen: | 45' |
| Top of Seal: | 90' |
| Top of Filter Pack: | 93' |
| Top of Screen: | 95' |
| Base of Screen: | 105' |

**NOTES:**

Construction log not drawn to scale.

Depths are approximated from field measurements.

* Elevations surveyed by YEC on 09/15/08 to NAD 1983 datum

**DESCRIPTION**

| | |
|---|---|
| Flushmount Diameter: | 5-inch |
| Surface Seal Type: | Portland Cement |
| Backfill/Grout Type: | Natural |
| Riser Pipe Type: | 1-inch PVC Schedule 40 |
| Borehole Diameter: | 2-inch |
| Type of Seal: | Bentonite |
| Screen Length: | 10-feet |
| Screen Type: | 1-inch PVC Schedule 40 |
| Screen Slot Size: | 0.020-inch |
| Filter Pack: | Morie #1 |

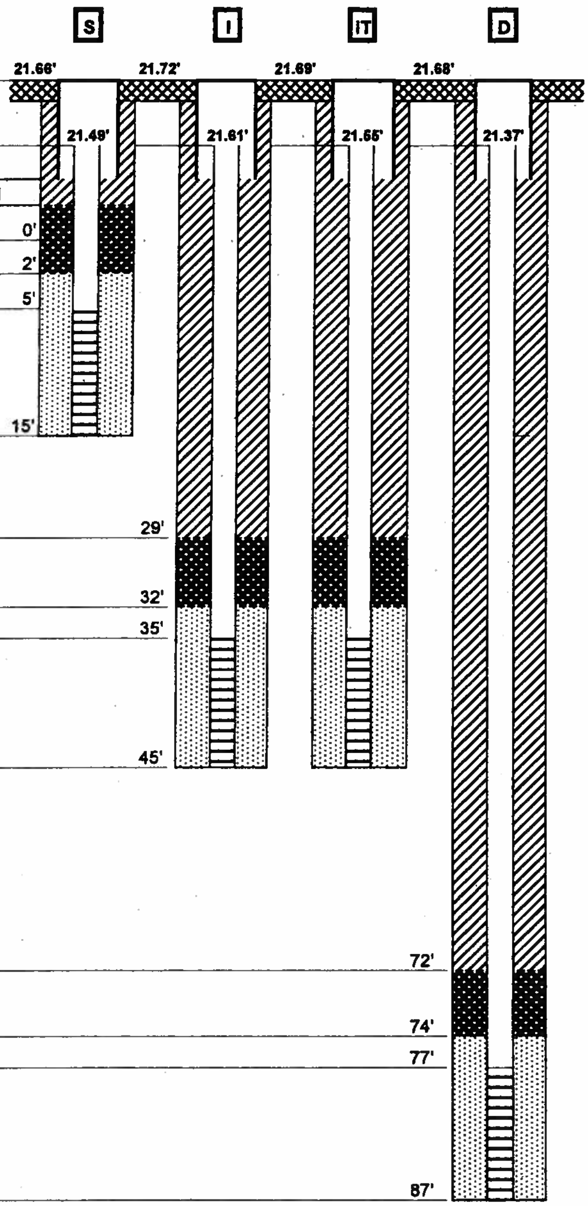
| | | |
|---|---|---|
| **Project:** | Westside Corp OU-2 | |
| **Client:** | NYSDEC | |
| **Drilling Company:** | Miller Env. Group | |
| **Drilling Method:** | Geoprobe Push Method | |
| **Development:** | Peristaltic w/Surge | |
| **Date Installation:** | 08/15/08 | |

**WELL ID:** W-15

- **S** = Shallow Screen Interval
- **I** = Intermediate Screen Interval
- **IT** = Intermediate Interval with Dedicated Transducer
- **D** = Deep Screen Interval

Flushmount Elevation*:

TOC/MP Elevation*:




| ITEM | DEPTH |
|---|---|
| Top of Seal | 0' |
| Top of Filter Pack: | 2' |
| Top of Screen: | 5' |
| Base of Screen: | 15' |
| Top of Seal: | 29' |
| Top of Filter Pack: | 32' |
| Top of Screen: | 35' |
| Base of Screen: | 45' |
| Top of Seal: | 72' |
| Top of Filter Pack: | 74' |
| Top of Screen: | 77' |
| Base of Screen: | 87' |

**DESCRIPTION**

| | |
|---|---|
| Flushmount Diameter: | 5-inch |
| Surface Seal Type: | Portland Cement |
| Backfill/Grout Type: | Natural |
| Riser Pipe Type: | 1-inch PVC Schedule 40 |
| Borehole Diameter: | 2-inch |
| Type of Seal: | Bentonite |
| Screen Length: | 10-feet |
| Screen Type: | 1-inch PVC Schedule 40 |
| Screen Slot Size: | 0.020-inch |
| Filter Pack: | Morie #1 |

**NOTES:**

Construction log not drawn to scale.

Depths are approximated from field measurements.

* Elevations surveyed by YEC on 09/15/08 to NAD 1983 datum

# APPENDIX E

## Monitoring Well 'Depth to Water' and Groundwater Elevation Measurements - $1^{st}$ Sampling Event: October 6-7, 2008

# APPENDIX E

**Depth-to-Water and Groundwater Elevation Measurements during Sampling Round #1 (10.06.08 - 10.07.08)**

| Well | DTW (ft) | GW Elevation (ft) | Date |
|---|---|---|---|
| MW 24-1S | 10.35 | 22.66 | 10.06.08 |
| MW 24-1I | 10.34 | 22.63 | 10.06.08 |
| MW 24-1D | 10.34 | 22.65 | 10.06.08 |
| MW 24-2S | 9.06 | 19.98 | 10.06.08 |
| MW 24-2I | 9.02 | 19.95 | 10.06.08 |
| MW 24-2D | 9.11 | 19.87 | 10.06.08 |
| MW 24-4S | 13.39 | 16.79 | 10.07.08 |
| MW 24-4I | 13.4 | 16.79 | 10.07.08 |
| MW 24-4D | 13.37 | 16.80 | 10.07.08 |
| MW 24-5S | 10.3 | 17.98 | 10.06.08 |
| MW 24-5I | 10.31 | 17.98 | 10.06.08 |
| MW 24-5D | 10.34 | 18.02 | 10.06.08 |
| MW 24-6S | 8.94 | 17.57 | 10.07.08 |
| MW 24-6I | 8.98 | 17.59 | 10.07.08 |
| MW 24-6D | 8.99 | 17.71 | 10.07.08 |
| W-01S | 8.22 | 19.47 | 10.06.08 |
| W-01I | 8.2 | 19.54 | 10.06.08 |
| W-01D | 8.3 | 19.57 | 10.06.08 |
| W-02S | 8.38 | 18.75 | 10.06.08 |
| W-02I | 8.44 | 18.79 | 10.06.08 |
| W-02D | 8.46 | 18.78 | 10.06.08 |
| W-03S | 6.4 | 18.87 | 10.06.08 |
| W-03I | 6.68 | 18.77 | 10.06.08 |
| W-03D | 6.49 | 18.95 | 10.06.08 |
| W-04S | 7.27 | 18.40 | 10.06.08 |
| W-04I | 7.01 | 18.42 | 10.06.08 |
| W-04D | 7.07 | 18.41 | 10.06.08 |
| W-06S | 9.6 | 17.30 | 10.07.08 |
| W-06I | 9.82 | 17.30 | 10.07.08 |
| W-06IT | 9.85 | 17.34 | 10.06.08 |
| W-06D | 9.86 | 17.31 | 10.07.08 |
| W-07I | 10.9 | 16.46 | 10.06.08 |
| W-08S | 10.42 | 17.42 | 10.07.08 |
| W-08I | 10.47 | 17.43 | 10.07.08 |
| W-08D | 10.55 | 17.36 | 10.07.08 |

| Well | DTW (ft) | GE Elevation (ft) | Date |
|---|---|---|---|
| W-09S | 9.58 | 19.32 | 10.06.08 |
| W-09I | 9.88 | 19.14 | 10.06.08 |
| W-09D | 9.58 | 19.14 | 10.06.08 |
| W-10S | 10.4 | 15.63 | 10.07.0B |
| W-10I | 10.4 | 15.66 | 10.07.08 |
| W-10IT | 10.55 | 15.56 | 10.07.08 |
| W-10D | 10.38 | 15.66 | 10.07.08 |
| W-11S | 12.17 | 16.25 | 10.07.08 |
| W-11I* | | | |
| W-11IT | 12.09 | 16.28 | 10.06.08 |
| W-11D | 11.8 | 16.22 | 10.07.08 |
| W-12S | 19.89 | 15.26 | 10.07.08 |
| W-12I | 19.8 | 15.21 | 10.07.08 |
| W-12IT | 19.56 | 15.3 | 10.06.08 |
| W-12D | 19.8 | 15.19 | 10.07.08 |
| W-13S | 7.36 | 14.59 | 10.07.08 |
| W-13I | 7.45 | 14.6 | 10.07.08 |
| W-13IT | 6.31 | 15.57 | 10.06.08 |
| W-13D | 7.18 | 14.58 | 10.07.08 |
| W-14S | 14 | 15.08 | 10.07.08 |
| W-14I | 14 | 15.12 | 10.07.08 |
| W-14IT | 14.06 | 15.12 | 10.06.08 |
| W-14D | 14.03 | 15.07 | 10.07.08 |
| W-15S | 6.86 | 14.63 | 10.07.08 |
| W-15I | 7 | 14.61 | 10.07.08 |
| W-15IT | 6.93 | 14.62' | 10.06.08 |
| W-15D | 6.76 | 14.61 | 10.07.08 |
| MW 22S | 7.69 | 21.16 | 10.06.08 |
| MW 3D | 6.22 | 21.04 | 10.06.08 |
| MW 55D | 7.65 | 21.28 | 10.06.08 |
| MW 6S | 8.24 | 22.31 | 10.06.08 |
| MW 6D | 6.22 | 23.88 | 10.06.08 |
| MW 7S | 7.38 | 21.66 | 10.06.08 |
| MW 7D | 7.43 | 21.67 | 10.06.08 |
| MW-07 | 8.06 | 21.39 | 10.06.08 |

Notes: GW elevations based on surveyed measuring points.
Survey conducted by YEC on 7.1.08 and 9.8.08.
Wells W-06 and W-10 through W-15 have two intermediate wells; one dedicated to a transducer (IT) and the other dedicated to a PDB.

*W-11I well casing was damaged and subsequently replaced on 11.20.08

# APPENDIX F

## JFK Airport Precipitation Data:
## August, September, October 2008

Q…LITY CONTROLLED LOCAL
C…MATOLOGICAL DATA
(final)
NOAA, National Climatic Data Center
Month: 08/2008

…on Location: JOHN F KENNEDY INTERNATIONAL AIRPORT (9…)
NEW YORK , NY
Lat. 40.655 Lon. -73.796
Elevation(Ground): 11 ft. above sea level

| Date | Temperature (Fahrenheit) Max. | Min. | Avg. | Dep From Normal | Avg. Dew pt. | Avg Wet Bulb | Degree Days Base 65 Degrees Heating | Cooling | Sun Sunrise LST | Sunset LST | Significant Weather | Snow/Ice on Ground(In) 1200 UTC Depth | 1800 UTC Water Equiv | Precipitation (In) 2400 LST Snow Fall | 2400 LST Water Equiv | Pressure(inches of Hg) Avg. Station | Avg. Sea Level | Wind: Speed=mph Dir=tens of degrees Resultant Speed | Res Dir | Avg. Speed | max 5-second Speed | max 5-second Dir | max 2-minute Speed | max 2-minute Dir | Date |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 |
| 01 | 88 | 71 | 80 | 5 | 63 | 69 | 0 | 15 | 0452 | 1912 | | 0 | M | 0.0 | 0.00 | 29.66 | 29.69 | 0.8 | 12 | 7.1 | 20 | 360 | 15 | 180 | 01 |
| 02 | 83 | 69 | 76 | 1 | 64 | 68 | 0 | 11 | 0453 | 1911 | RA HZ | 0 | M | 0.0 | 0.14 | 29.70 | 29.72 | 2.5 | 19 | 6.6 | 22 | 350 | 18 | 350 | 02 |
| 03 | 85 | 67 | 76 | 1 | 57 | 64 | 0 | 11 | 0454 | 1909 | | 0 | M | 0.0 | 0.00 | 29.78 | 29.81 | 12.2 | 33 | 12.6 | 24 | 310 | 18 | 320 | 03 |
| 04 | 87 | 69 | 78 | 3 | 56 | 65 | 0 | 13 | 0455 | 1908 | | 0 | M | 0.0 | 0.00 | 29.88 | 29.92 | 10.9 | 31 | 11.4 | 24 | 300 | 20 | 290 | 04 |
| 05 | 81 | 69 | 75 | 0 | 62 | 67 | 0 | 10 | 0455 | 1907 | RA | 0 | M | 0.0 | T | 29.93 | 29.96 | 5.3 | 13 | 8.7 | 16 | 130 | 15 | 150 | 05 |
| 06 | 90* | 73 | 82* | 7 | 62 | 69 | 0 | 17 | 0456 | 1906 | RA HZ | 0 | M | 0.0 | 0.05 | 29.78 | 29.79 | 4.7 | 29 | 11.7 | 28 | 300 | 24 | 310 | 06 |
| 07 | 82 | 67 | 75 | 0 | 63 | 68 | 0 | 10 | 0457 | 1905 | BR | 0 | M | 0.0 | 0.00 | 29.72 | 29.74 | 5.7 | 18 | 9.6 | 25 | 180 | 21 | 180 | 07 |
| 08 | 82 | 66 | 74 | -1 | 56 | 63 | 0 | 9 | 0458 | 1904 | TSRA | 0 | M | 0.0 | 0.05 | 29.66 | 29.69 | 7.4 | 31 | 9.5 | 33 | 260 | 28 | 280 | 08 |
| 09 | 80 | 65 | 73 | -2 | 56 | 63 | 0 | 8 | 0459 | 1902 | | 0 | M | 0.0 | 0.00 | 29.80 | 29.84 | 4.7 | 24 | 10.4 | 21 | 190 | 18 | 170 | 09 |
| 10 | 81 | 66 | 74 | -1 | 59 | 64 | 0 | 9 | 0500 | 1860 | RA | 0 | M | 0.0 | 0.10 | 29.85 | 29.87 | 5.8 | 17 | 7.7 | 23 | 150 | 20 | 150 | 10 |
| 11 | 76 | 62 | 69 | -6 | 56 | 61 | 0 | 4 | 0501 | 1859 | TSRA | 0 | M | 0.0 | 0.26 | 29.75 | 29.77 | 4.6 | 35 | 8.0 | 30 | 200 | 24 | 200 | 11 |
| 12 | 83 | 62 | 73 | -2 | 54 | 62 | 0 | 8 | 0502 | 1857 | TSRA | 0 | M | 0.0 | 0.07 | 29.73 | 29.77 | 10.0 | 30 | 10.5 | 30 | 300 | 23 | 300 | 12 |
| 13 | 79 | 66 | 73 | -1 | 59 | 64 | 0 | 8 | 0503 | 1856 | | 0 | M | 0.0 | 0.00 | 29.80 | 29.83 | 4.0 | 16 | 7.1 | 17 | 160 | 14 | 150 | 13 |
| 14 | 82 | 65 | 74 | 0 | 63 | 67 | 0 | 9 | 0504 | 1855 | TSRA RA | 0 | M | 0.0 | 0.96 | 29.80 | 29.82 | 3.7 | 18 | 7.4 | 31 | 360 | 26 | 360 | 14 |
| 15 | 78 | 66 | 72 | -2 | 62 | 66 | 0 | 7 | 0505 | 1853 | TS TSRA RA BR HZ | 0 | M | 0.0 | 1.02 | 29.94 | 29.97 | 2.6 | 15 | 5.7 | 17 | 020 | 15 | 020 | 15 |
| 16 | 83 | 64 | 74 | 0 | 56 | 63 | 0 | 9 | 0506 | 1852 | BR HZ | 0 | M | 0.0 | 0.00 | 29.93 | 29.96 | 4.1 | 29 | 6.0 | 23 | 280 | 20 | 260 | 16 |
| 17 | 84 | 66 | 75 | 1 | 57 | 64 | 0 | 10 | 0507 | 1850 | | 0 | M | 0.0 | 0.00 | 29.93 | 29.96 | 7.8 | 22 | 10.3 | 22 | 180 | 20 | 180 | 17 |
| 18 | 85 | 69 | 77 | 3 | 61 | 67 | 0 | 12 | 0508 | 1849 | HZ | 0 | M | 0.0 | 0.00 | 29.93 | 29.94 | 11.7 | 20 | 12.6 | 26 | 190 | 22 | 180 | 18 |
| 19 | 87 | 65 | 76 | 2 | 56 | 64 | 0 | 11 | 0509 | 1848 | HZ | 0 | M | 0.0 | 0.00 | 29.90 | 29.95 | 7.9 | 31 | 12.5 | 26 | 310 | 22 | 320 | 19 |
| 20 | 75 | 59* | 67* | -7 | 47 | 56 | 0 | 2 | 0510 | 1846 | | 0 | M | 0.0 | 0.00 | 30.16 | 30.19 | 0.6 | 23 | 9.5 | 23 | 010 | 20 | 020 | 20 |
| 21 | 78 | 61 | 70 | -4 | 55 | 61 | 0 | 5 | 0511 | 1845 | | 0 | M | 0.0 | 0.00 | 30.24 | 30.27 | 6.0 | 18 | 7.7 | 18 | 180 | 15 | 190 | 21 |
| 22 | 79 | 64 | 72 | -2 | 56 | 62 | 0 | 7 | 0512 | 1843 | | 0 | M | 0.0 | 0.00 | 30.32 | 30.35 | 4.3 | 16 | 6.2 | 16 | 150 | 13 | 120 | 22 |
| 23 | 78 | 62 | 70 | -4 | 60 | 64 | 0 | 5 | 0513 | 1842 | | 0 | M | 0.0 | 0.00 | 30.27 | 30.28 | 5.1 | 11 | 6.7 | 16 | 140 | 13 | 120 | 23 |
| 24 | 79 | 68 | 74 | 0 | 63 | 66 | 0 | 9 | 0514 | 1840 | | 0 | M | 0.0 | 0.00 | 30.04 | 30.04 | 9.8 | 19 | 10.4 | 24 | 180 | 21 | 170 | 24 |
| 25 | 85 | 67 | 76 | 2 | 61 | 67 | 0 | 11 | 0515 | 1839 | | 0 | M | 0.0 | 0.00 | 29.86 | 29.89 | 6.1 | 26 | 11.5 | 24 | 360 | 20 | 010 | 25 |
| 26 | 80 | 60 | 70 | -3 | 45 | 56 | 0 | 5 | 0516 | 1837 | | 0 | M | 0.0 | 0.00 | 30.01 | 30.04 | 8.4 | 01 | 9.6 | 26 | 010 | 22 | 360 | 26 |
| 27 | 77 | 60 | 69 | -4 | 49 | 57 | 0 | 4 | 0517 | 1836 | | 0 | M | 0.0 | 0.00 | 30.08 | 30.10 | 3.2 | 09 | 6.5 | 21 | 120 | 16 | 150 | 27 |
| 28 | 82 | 61 | 72 | 0 | 50 | 59 | 0 | 7 | 0518 | 1834 | | 0 | M | 0.0 | 0.00 | 30.03 | 30.05 | 3.6 | 13 | 6.0 | 16 | 120 | 14 | 160 | 28 |
| 29 | 78 | 63 | 71 | -1 | 58 | 63 | 0 | 6 | 0519 | 1833 | RA | 0 | M | 0.0 | T | 30.00 | 30.02 | 5.9 | 12 | 7.3 | 16 | 150 | 13 | 160 | 29 |
| 30 | 83 | 69 | 76 | 4 | 65 | 69 | 0 | 11 | 0520 | 1831 | RA BR | 0 | M | 0.0 | 0.56 | 29.98 | 30.00 | 0.6 | 34 | 6.3 | 20 | 320 | 16 | 320 | 30 |
| 31 | 85 | 65 | 75 | 3 | 52 | 62 | 0 | 10 | 0521 | 1829 | | 0 | M | 0.0 | 0.00 | 30.09 | 30.12 | 5.7 | 35 | 8.1 | 22 | 010 | 17 | 360 | 31 |
| | 81.8 | 65.4 | 73.6 | | 57.5 | 63.9 | 0.0 | 8.8 | <-----Monthly Averages \| Totals----> | | | | M | 0.0 | 3.21 | 29.92 | 29.95 | 1.4 | 24 | 8.7 | <Monthly Average | | | | |
| | 0.0 | -0.9 | -0.5 | | <-----------Departure From Normal-----------> | | | | | | | | -0.43 | | | | | | | | | | | | |

| Degree Days | Monthly Total | Monthly Departure | Season to Date Total | Season to Date Departure |
|---|---|---|---|---|
| Heating: | 0 | -4 | 0 | -10 |
| Cooling: | 273 | -27 | 928 | 118 |

Greatest 24-hr Precipitation: 1.03 Date: 14-15
Greatest 24-hr Snowfall: M Date: M
Greatest Snow Depth: M Date: M

| Sea Level Pressure | | Date | Time (LST) |
|---|---|---|---|
| Maximum | 30.38 | 22 | 1131 |
| Minimum | 29.64 | 01 | 0322 |

Number of Days with -------->
Max Temp >=90: 1
Max Temp <=32: 0
Thunderstorms : 6
Min Temp <=32: 0
Min Temp <=0 : 0
Heavy Fog : 0
Precipitation >=.01 inch: 9
Precipitation >=.10 inch:
Snowfall >=1.0 inch : 0

* EXTREME FOR THE MONTH - LAST OCCURRENCE IF MORE THAN ONE.

Data Version: VER3

# QUALITY CONTROLLED LOCAL CLIMATOLOGICAL DATA
(final)

NOAA, National Climatic Data Center

Month: 09/2008



Station Location: JOHN F KENNEDY INTERNATIONAL AIRPORT (94789)
NEW YORK , NY

Lat. 40.655 Lon. -73.796

Elevation(Ground): 11 ft. above sea level

| Date | Temperature (Fahrenheit) | | | | | | Degree Days Base 65 Degrees | | Sun | | Significant Weather | Snow/Ice on Ground(In) | | Precipitation (In) | | Pressure(inches of Hg) | | Wind: Speed=mph Dir=tens of degrees | | | max 5-second | | max 2-minute | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Max. | Min. | Avg. | Dep From Normal | Avg. Dew pt. | Avg Wet Bulb | Heating | Cooling | Sunrise LST | Sunset LST | | 1200 UTC Depth | 1800 UTC Water Equiv | 2400 LST Snow Fall | 2400 LST Water Equiv | Avg. Station | Avg. Sea Level | Resultant Speed | Res Dir | Avg. Speed | Speed | Dir | Speed | Dir |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 |
| 01 | 85 | 65 | 75 | 4 | 51 | 61 | 0 | 10 | 0522 | 1828 | | 0 | M | 0.0 | 0.00 | 30.12 | 30.14 | 8.1 | 36 | 8.6 | 24 | 350 | 20 | 360 |
| 02 | 88* | 67 | 78* | 7 | 58 | 65 | 0 | 13 | 0523 | 1826 | | 0 | M | 0.0 | 0.00 | 30.01 | 30.03 | 1.9 | 05 | 8.2 | 17 | 040 | 14 | 040 |
| 03 | 79 | 68 | 74 | 3 | 61 | 66 | 0 | 9 | 0524 | 1825 | | 0 | M | 0.0 | 0.00 | 29.93 | 29.95 | 7.6 | 17 | 9.3 | 22 | 190 | 18 | 190 |
| 04 | 84 | 70 | 77 | 7 | 67 | 70 | 0 | 12 | 0525 | 1823 | BR | 0 | M | 0.0 | 0.00 | 29.96 | 29.99 | 8.8 | 18 | 9.8 | 21 | 170 | 17 | 170 |
| 05 | 83 | 70 | 77 | 7 | 69 | 71 | 0 | 12 | 0526 | 1821 | RA FG+ BR | 0 | M | 0.0 | 0.38 | 30.04 | 30.07 | 10.8 | 16 | 11.3 | 26 | 170 | 22 | 160 |
| 06 | 81 | 72 | 77 | 7 | 71 | 73 | 0 | 12 | 0527 | 1820 | RA FG+ BR HZ | 0 | M | 0.0 | 2.51 | 29.79 | 29.77 | 5.6 | 12 | 12.9 | 41 | 320 | 33 | 320 |
| 07 | 81 | 69 | 75 | 5 | 57 | 64 | 0 | 10 | 0528 | 1818 | | 0 | M | 0.0 | 0.00 | 29.86 | 29.93 | 12.2 | 27 | 13.5 | 29 | 270 | 24 | 300 |
| 08 | 80 | 66 | 73 | 3 | 55 | 62 | 0 | 8 | 0529 | 1816 | | 0 | M | 0.0 | 0.00 | 30.11 | 30.14 | 4.8 | 21 | 9.2 | 20 | 180 | 18 | 170 |
| 09 | 75 | 66 | 71 | 2 | 64 | 66 | 0 | 6 | 0530 | 1815 | RA | 0 | M | 0.0 | 0.77 | 29.99 | 30.02 | 5.8 | 20 | 10.2 | 33 | 310 | 29 | 310 |
| 10 | 74 | 60 | 67 | -2 | 50 | 58 | 0 | 2 | 0531 | 1813 | | 0 | M | 0.0 | 0.00 | 30.17 | 30.23 | 4.8 | 03 | 7.9 | 22 | 360 | 18 | 360 |
| 11 | 73 | 61 | 67 | -2 | 53 | 59 | 0 | 2 | 0532 | 1811 | | 0 | M | 0.0 | 0.00 | 30.32 | 30.34 | 5.1 | 13 | 8.6 | 17 | 160 | 14 | 160 |
| 12 | 71 | 65 | 68 | -1 | 58 | 62 | 0 | 3 | 0533 | 1810 | RA BR | 0 | M | 0.0 | 0.63 | 30.14 | 30.13 | 11.7 | 18 | 12.1 | 24 | 190 | 21 | 200 |
| 13 | 79 | 67 | 73 | 5 | 65 | 68 | 0 | 8 | 0534 | 1808 | BR HZ | 0 | M | 0.0 | T | 29.91 | 29.93 | 3.5 | 16 | 5.9 | 14 | 160 | 12 | 160 |
| 14 | 83 | 70 | 77 | 9 | 69 | 71 | 0 | 12 | 0535 | 1806 | RA BR HZ | 0 | M | 0.0 | T | 29.78 | 29.77 | 12.0 | 17 | 12.1 | 25 | 180 | 21 | 180 |
| 15 | 85 | 67 | 76 | 8 | 57 | 65 | 0 | 11 | 0535 | 1805 | | 0 | M | 0.0 | 0.00 | 29.73 | 29.80 | 11.9 | 29 | 15.9 | 33 | 270 | 26 | 270 |
| 16 | 71 | 61 | 66 | -1 | 53 | 59 | 0 | 1 | 0536 | 1803 | | 0 | M | 0.0 | 0.00 | 30.08 | 30.13 | 4.1 | 03 | 5.6 | 18 | 360 | 16 | 350 |
| 17 | 75 | 58 | 67 | 0 | 51 | 58 | 0 | 2 | 0537 | 1801 | | 0 | M | 0.0 | 0.00 | 30.11 | 30.13 | 1.2 | 36 | 6.1 | 15 | 190 | 13 | 200 |
| 18 | 76 | 59 | 68 | 1 | 47 | 56 | 0 | 3 | 0538 | 1760 | | 0 | M | 0.0 | 0.00 | 30.14 | 30.20 | 10.4 | 36 | 12.0 | 29 | 360 | 23 | 360 |
| 19 | 68 | 53 | 61 | -5 | 44 | 51 | 4 | 0 | 0539 | 1758 | | 0 | M | 0.0 | 0.00 | 30.40 | 30.43 | 8.9 | 06 | 10.1 | 21 | 120 | 17 | 120 |
| 20 | 69 | 52* | 61* | -5 | 48 | 54 | 4 | 0 | 0540 | 1756 | | 0 | M | 0.0 | 0.00 | 30.29 | 30.29 | 2.4 | 06 | 5.2 | 15 | 200 | 13 | 220 |
| 21 | 77 | 55 | 66 | 0 | 54 | 59 | 0 | 1 | 0541 | 1755 | | 0 | M | 0.0 | 0.00 | 30.20 | 30.23 | 3.0 | 22 | 5.4 | 14 | 200 | 13 | 180 |
| 22 | 74 | 57 | 66 | 1 | 54 | 59 | 0 | 1 | 0542 | 1753 | | 0 | M | 0.0 | 0.00 | 30.32 | 30.36 | 9.9 | 03 | 10.4 | 21 | 030 | 20 | 030 |
| 23 | 71 | 55 | 63 | -2 | 47 | 54 | 2 | 0 | 0543 | 1751 | | 0 | M | 0.0 | 0.00 | 30.42 | 30.45 | 8.8 | 04 | 9.2 | 20 | 060 | 17 | 060 |
| 24 | 72 | 53 | 63 | -2 | 48 | 54 | 2 | 0 | 0544 | 1749 | | 0 | M | 0.0 | 0.00 | 30.41 | 30.42 | 7.0 | 07 | 8.3 | 17 | 110 | 15 | 110 |
| 25 | 69 | 55 | 62 | -2 | 49 | 55 | 3 | 0 | 0545 | 1748 | RA | 0 | M | 0.0 | 0.18 | 30.37 | 30.38 | 14.9 | 04 | 15.1 | 32 | 040 | 24 | 040 |
| 26 | 70 | 60 | 65 | 1 | 61 | 63 | 0 | 0 | 0546 | 1746 | RA BR | 0 | M | 0.0 | 2.03 | 30.14 | 30.15 | 14.8 | 04 | 15.0 | 32 | 040 | 28 | 040 |
| 27 | 71 | 66 | 69 | 6 | 65 | 66 | 0 | 4 | 0547 | 1744 | RA BR | 0 | M | 0.0 | 0.07 | 30.03 | 30.03 | 5.8 | 06 | 6.4 | 16 | 060 | 14 | 060 |
| 28 | 76 | 66 | 71 | 8 | 64 | 66 | 0 | 6 | 0548 | 1743 | RA BR HZ | 0 | M | 0.0 | 0.16 | 29.87 | 29.89 | 1.5 | 11 | 4.1 | 13 | 180 | 12 | 180 |
| 29 | 77 | 61 | 69 | 6 | 57 | 62 | 0 | 4 | 0549 | 1741 | RA | 0 | M | 0.0 | 0.01 | 29.89 | 29.93 | 10.2 | 35 | 10.7 | 25 | 350 | 21 | 360 |
| 30 | 71 | 61 | 66 | 3 | 55 | 60 | 0 | 1 | 0550 | 1739 | | 0 | M | 0.0 | 0.00 | 29.86 | 29.88 | 2.7 | 15 | 6.7 | 17 | 160 | 15 | 170 |
| | 76.3 | 62.5 | 69.4 | | 56.7 | 61.9 | 0.5 | 5.1 | <----Monthly Averages \| Totals----> | | | | M | 0.0 | 6.75s | 30.08 | 30.11 | 1.6 | 07 | 9.5 | <Monthly Average | | | |
| | 1.4 | 3.0 | 2.2 | <----------Departure From Normal----------> | | | | | | | | | 3.25 | | | | | | | | | | | |

**Degree Days**

| | Monthly Total | Monthly Departure | Season to Date Total | Season to Date Departure |
|---|---|---|---|---|
| Heating: | 15 | -28 | 15 | -38 |
| Cooling: | 153 | 28 | 1081 | 146 |

Greatest 24-hr Precipitation: 2.89s Date: 05-06
Greatest 24-hr Snowfall: M Date: M
Greatest Snow Depth: M Date: M

| Sea Level | Pressure | Date | Time (LST) |
|---|---|---|---|
| Maximum | 30.49 | 23 | 1043 |
| Minimum | 29.43 | 06 | 2053 |

Number of Days with --------->
Max Temp >=90: 0
Max Temp <=32: 0
Thunderstorms : 0
Min Temp <=32: 0
Min Temp <=0 : 0
Heavy Fog : 2
Precipitation >=.01 inch: 9
Precipitation >=.10 inch:
Snowfall >=1.0 inch : 0

* EXTREME FOR THE MONTH - LAST OCCURRENCE IF MORE THAN ONE.

**Data Version: VER**

# QUALITY CONTROLLED LOCAL CLIMATOLOGICAL DATA

**(may be updated)**

**NOAA, National Climatic Data Center**

**Month: 10/2008**

**Station Location:** JOHN F KENNEDY INTERNATIONAL AIRPORT (94789)
NEW YORK , NY

Lat. 40.655 Lon. -73.796

Elevation(Ground): 11 ft. above sea level

| Date | Temperature (Fahrenheit) Max. | Min. | Avg. | Dep From Normal | Avg. Dew pt. | Avg Wet Bulb | Degree Days Base 65 Degrees Heating | Cooling | Sun Sunrise LST | Sunset LST | Significant Weather | Snow/Ice on Ground(In) 1200 UTC Depth | 1800 UTC Water Equiv | Precipitation (In) 2400 LST Snow Fall | 2400 LST Water Equiv | Pressure(inches of Hg) Avg. Station | Avg. Sea Level | Wind: Speed=mph Dir=tens of degrees Resultant Speed | Res Dir | Avg. Speed | max 5-second Speed | max 5-second Dir | max 2-minute Speed | max 2-minute Dir |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 |
| 01 | 73 | 59 | 66 | 4 | 57 | 61 | 0 | 1 | 0551 | 1738 | TSRA RA HZ | 0 | M | 0.0 | 0.70 | 29.65 | 29.65 | 6.1 | 22 | 8.2 | 30 | 260 | 28 | 260 |
| 02 | 65 | 54 | 60 | -1 | 42 | 51 | 5 | 0 | 0552 | 1736 | | 0 | M | 0.0 | 0.01 | 29.64 | 29.69 | 15.5 | 27 | 16.0 | 35 | 280 | 25 | 290 |
| 03 | 67 | 49 | 58 | -3 | 41 | 50 | 7 | 0 | 0553 | 1735 | | M | M | M | 0.00 | 29.91 | 29.96 | 12.6 | 25 | 14.0 | 32 | 260 | 26 | 260 |
| 04 | 64 | 46 | 55 | -6 | 40 | 49 | 10 | 0 | 0554 | 1733 | | 0 | M | 0.0 | 0.00 | 30.17 | 30.21 | 5.0 | 26 | 6.5 | 17 | 210 | 15 | 220 |
| 05 | 66 | 53 | 60 | 0 | 51 | 54 | 5 | 0 | 0555 | 1731 | RA BR | 0 | M | 0.0 | 0.16 | 30.22 | 30.25 | 6.4 | 03 | 7.0 | 24 | 320 | 18 | 320 |
| 06 | 66 | 49 | 58 | -2 | 40 | 49 | 7 | 0 | 0556 | 1730 | | 0 | M | 0.0 | T | 30.27 | 30.32 | 7.4 | 01 | 8.0 | 25 | 360 | 21 | 360 |
| 07 | 65 | 45 | 55 | -5 | 35 | 45 | 10 | 0 | 0558 | 1728 | | 0 | M | 0.0 | 0.00 | 30.31 | 30.32 | 7.1 | 34 | 7.4 | 21 | 330 | 16 | 320 |
| 08 | 65 | 44 | 55 | -4 | 45 | 51 | 10 | 0 | 0559 | 1726 | RA | 0 | M | 0.0 | T | 30.13 | 30.13 | 8.1 | 20 | 8.9 | 22 | 200 | 20 | 200 |
| 09 | 75 | 60 | 68 | 9 | 58 | 61 | 0 | 3 | 0560 | 1725 | RA DZ BR | 0 | M | 0.0 | 0.10 | 29.95 | 29.97 | 12.1 | 22 | 12.3 | 24 | 210 | 18 | 230 |
| 10 | 76 | 55 | 66 | 7 | 44 | 54 | 0 | 1 | 0601 | 1723 | | 0 | M | 0.0 | 0.00 | 30.14 | 30.20 | 2.7 | 31 | 4.7 | 16 | 330 | 14 | 320 |
| 11 | 73 | 53 | 63 | 5 | 45 | 53 | 2 | 0 | 0602 | 1722 | | 0 | M | 0.0 | 0.00 | 30.37 | 30.41 | 2.2 | 05 | 6.8 | 17 | 040 | 14 | 030 |
| 12 | 70 | 52 | 61 | 3 | 50 | 55 | 4 | 0 | 0603 | 1720 | | 0 | M | 0.0 | 0.00 | 30.47 | 30.49 | 2.7 | 17 | 6.8 | 14 | 220 | 12 | 220 |
| 13 | 78 | 57 | 68 | 11 | 52 | 58 | 0 | 3 | 0604 | 1719 | | 0 | M | 0.0 | 0.00 | 30.30 | 30.31 | 2.4 | 31 | 7.9 | 17 | 320 | 14 | 090 |
| 14 | 68 | 56 | 62 | 5 | 55 | 59 | 3 | 0 | 0605 | 1717 | | 0 | M | 0.0 | 0.00 | 30.19 | 30.19 | 8.1 | 17 | 9.3 | 22 | 170 | 18 | 170 |
| 15 | 73 | 59 | 66 | 9 | 51 | 57 | 0 | 1 | 0606 | 1716 | | 0 | M | 0.0 | 0.00 | 30.06 | 30.08 | 0.9 | 36 | 6.7 | 16 | 330 | 14 | 360 |
| 16 | 79* | 56 | 68* | 12 | 55 | 61 | 0 | 3 | 0607 | 1714 | BR HZ | 0 | M | 0.0 | 0.00 | 29.92 | 29.95 | 4.8 | 27 | 11.6 | 29 | 320 | 24 | 320 |
| 17 | 61 | 51 | 56 | 0 | 36 | 46 | 9 | 0 | 0608 | 1713 | | M | M | M | 0.00 | 30.06 | 30.08 | 10.6 | 36 | 11.1 | 25 | 360 | 20 | 020 |
| 18 | 59 | 45 | 52 | -4 | 31 | 42 | 13 | 0 | 0609 | 1711 | | 0 | M | 0.0 | 0.00 | 30.14 | 30.19 | 13.7 | 02 | 14.0 | 25 | 020 | 21 | 030 |
| 19 | 57 | 44 | 51 | -4 | 28 | 40 | 14 | 0 | 0610 | 1710 | | 0 | M | 0.0 | 0.00 | 30.27 | 30.31 | 14.1 | 02 | 14.4 | 32 | 050 | 28 | 040 |
| 20 | 62 | 39 | 51 | -4 | 29 | 42 | 14 | 0 | 0611 | 1708 | | 0 | M | 0.0 | 0.00 | 30.18 | 30.18 | 4.5 | 31 | 9.4 | 21 | 360 | 17 | 350 |
| 21 | 64 | 45 | 55 | 0 | 34 | 45 | 10 | 0 | 0613 | 1707 | RA | 0 | M | 0.0 | T | 29.93 | 29.95 | 15.4 | 26 | 16.5 | 40 | 290 | 33 | 300 |
| 22 | 55 | 42 | 49 | -5 | 30 | 40 | 16 | 0 | 0614 | 1705 | | 0 | M | 0.0 | 0.00 | 30.16 | 30.25 | 16.8 | 34 | 18.1 | 36 | 360 | 29 | 350 |
| 23 | 54 | 39 | 47 | -7 | 30 | 39 | 18 | 0 | 0615 | 1704 | | 0 | M | 0.0 | 0.00 | 30.58 | 30.60 | 6.3 | 01 | 7.2 | 18 | 020 | 16 | 020 |
| 24 | 56 | 35* | 46 | -8 | 38 | 44 | 19 | 0 | 0616 | 1703 | | M | M | M | 0.00 | 30.46 | 30.47 | 3.9 | 16 | 4.9 | 16 | 190 | 13 | 190 |
| 25 | 66 | 52 | 59 | 6 | 55 | 57 | 6 | 0 | 0617 | 1701 | RA BR | 0 | M | 0.0 | 0.61 | 30.03 | 30.01 | 14.8 | 13 | 19.6 | 46 | 150 | 36 | 150 |
| 26 | 63 | 50 | 57 | 4 | 42 | 49 | 8 | 0 | 0618 | 1660 | | 0 | M | 0.0 | 0.00 | 29.83 | 29.88 | 8.3 | 25 | 10.5 | 20 | 230 | 17 | 230 |
| 27 | 66 | 47 | 57 | 4 | 42 | 49 | 8 | 0 | 0619 | 1658 | RA | 0 | M | 0.0 | 0.00 | 29.86 | 29.86 | 5.8 | 34 | 9.5 | 25 | 360 | 23 | 360 |
| 28 | 52 | 40 | 46 | -7 | 37 | 42 | 19 | 0 | 0620 | 1657 | RA SN BR | 0 | M | T | 1.91 | 29.41 | 29.43 | 16.0 | 30 | 21.4 | 41 | 280 | 33 | 270 |
| 29 | 47 | 39 | 43* | -9 | 26 | 36 | 22 | 0 | 0622 | 1656 | | 0 | M | 0.0 | 0.03 | 29.74 | 29.81 | 16.6 | 28 | 17.4 | 40 | 280 | 31 | 270 |
| 30 | 50 | 37 | 44 | -8 | 21 | 35 | 21 | 0 | 0623 | 1655 | | 0 | M | 0.0 | 0.00 | 30.27 | 30.34 | 13.0 | 30 | 13.6 | 28 | 310 | 22 | 310 |
| 31 | 62 | 38 | 50 | -2 | 32 | 42 | 15 | 0 | 0624 | 1653 | | 0 | M | 0.0 | 0.00 | 30.37 | 30.37 | 10.8 | 24 | 11.1 | 22 | 230 | 20 | 220 |
| | 64.4 | 48.1 | 56.3 | | 41.0 | 48.9 | 8.9 | 0.4 | <----Monthly Averages \| Totals----> | | | | M | Ts | 3.52s | 30.09 | 30.12 | 3.9 | 29 | 11.0 | <Monthly Average | | | |
| | 0.1 | -0.6 | -0.2 | <----------Departure From Normal----------> | | | | | | | | | 0.49 | | | | | | | | | | | |

**Degree Days**

| | Monthly Total | Monthly Departure | Season to Date Total | Season to Date Departure |
|---|---|---|---|---|
| Heating: | 275 | 11 | 290 | -27 |
| Cooling: | 12 | -1 | 1093 | 145 |

Greatest 24-hr Precipitation: 1.91 Date: 28
Greatest 24-hr Snowfall: Ts Date: M
Greatest Snow Depth: 28 Date: M

| Sea Level Pressure | Pressure | Date | Time (LST) |
|---|---|---|---|
| Maximum | 30.66 | 23 | 0933 |
| Minimum | 29.19 | 28 | 1200 |

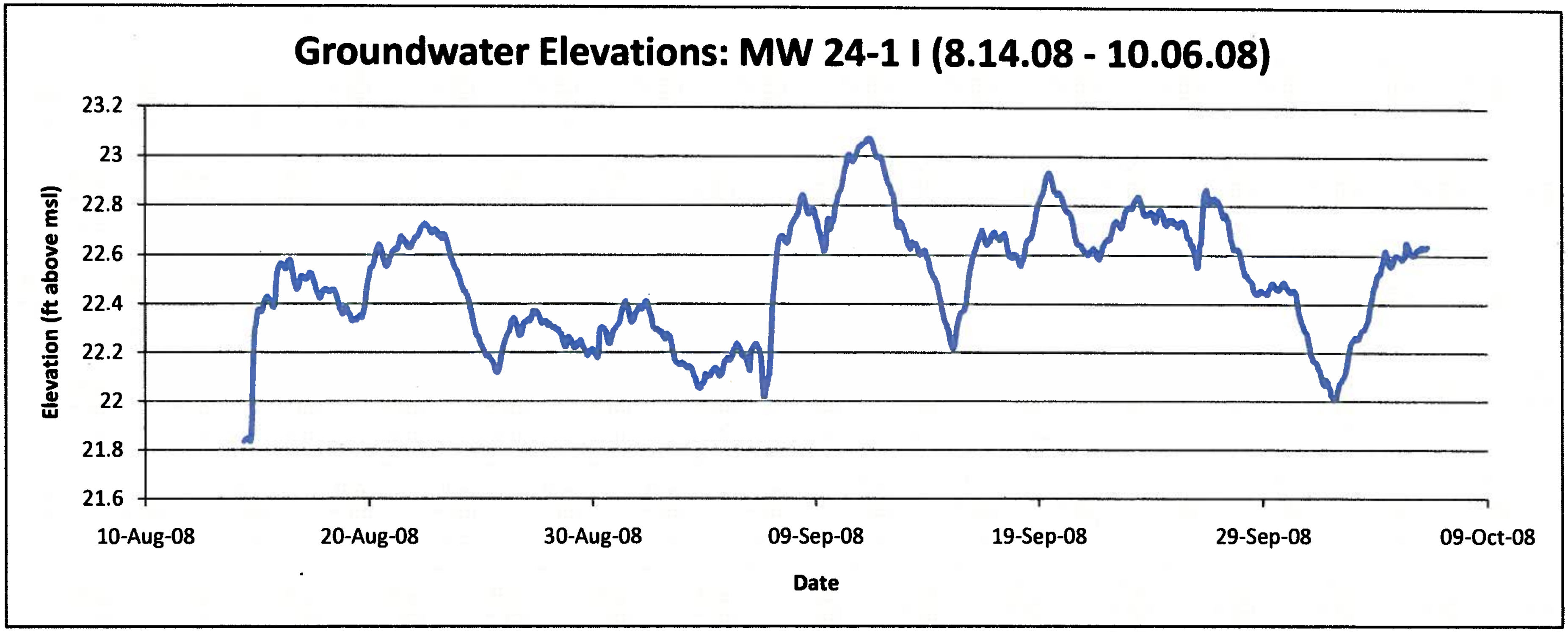
Number of Days with -------->
Max Temp >=90: 0
Max Temp <=32: 0
Thunderstorms : 1
Min Temp <=32: 0
Min Temp <=0 : 0
Heavy Fog : 0
Precipitation >=.01 inch: 8s
Precipitation >=.10 inch:
Snowfall >=1.0 inch : 0

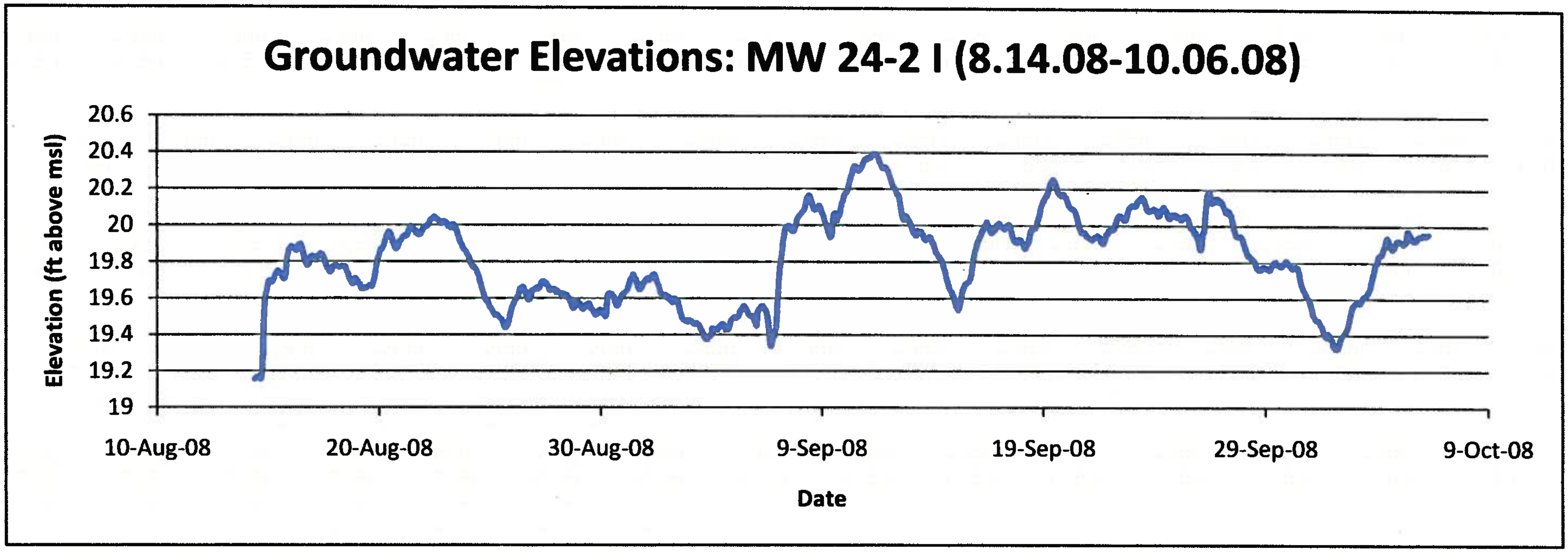
* EXTREME FOR THE MONTH - LAST OCCURRENCE IF MORE THAN ONE.

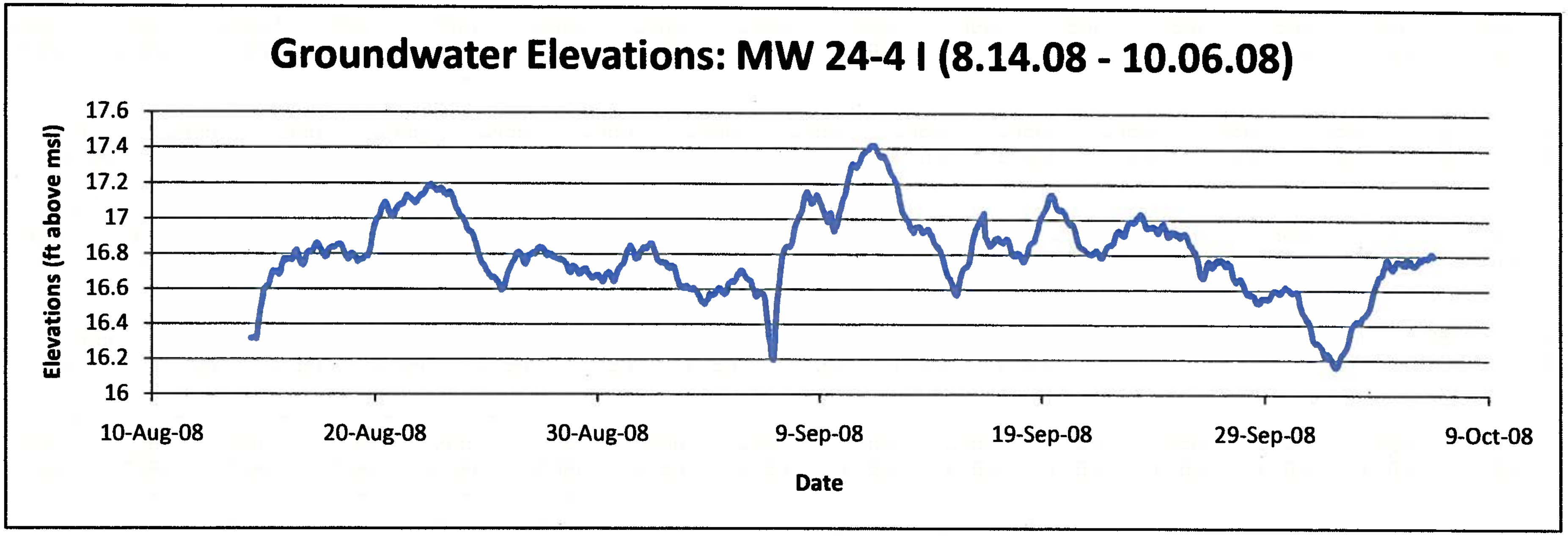
**Data Version VER**

# APPENDIX G

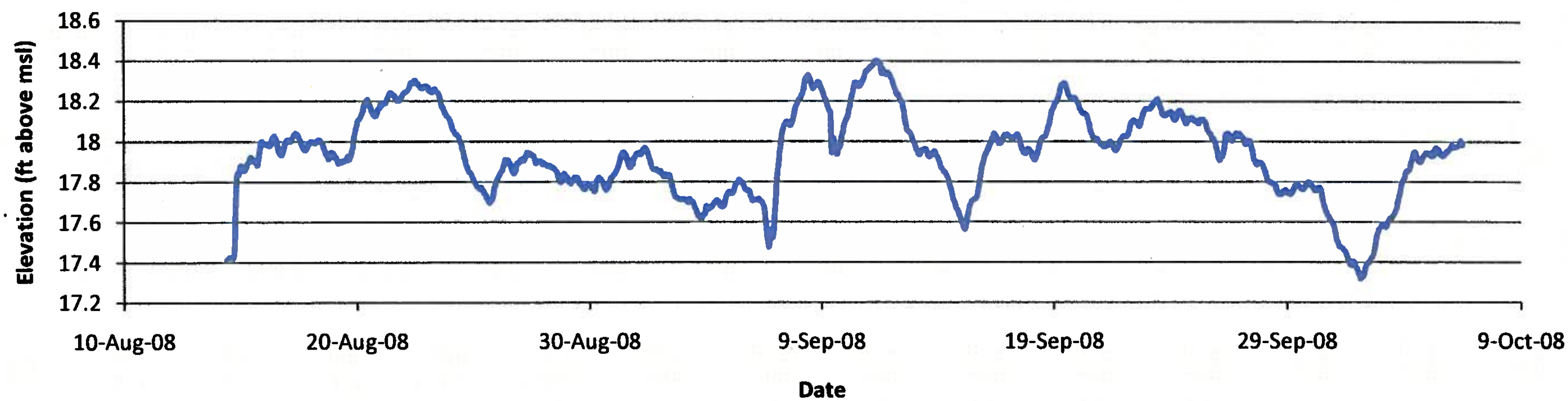
## Hydrographs - Groundwater Elevations in Intermediate Wells: 1st Sampling Quarter

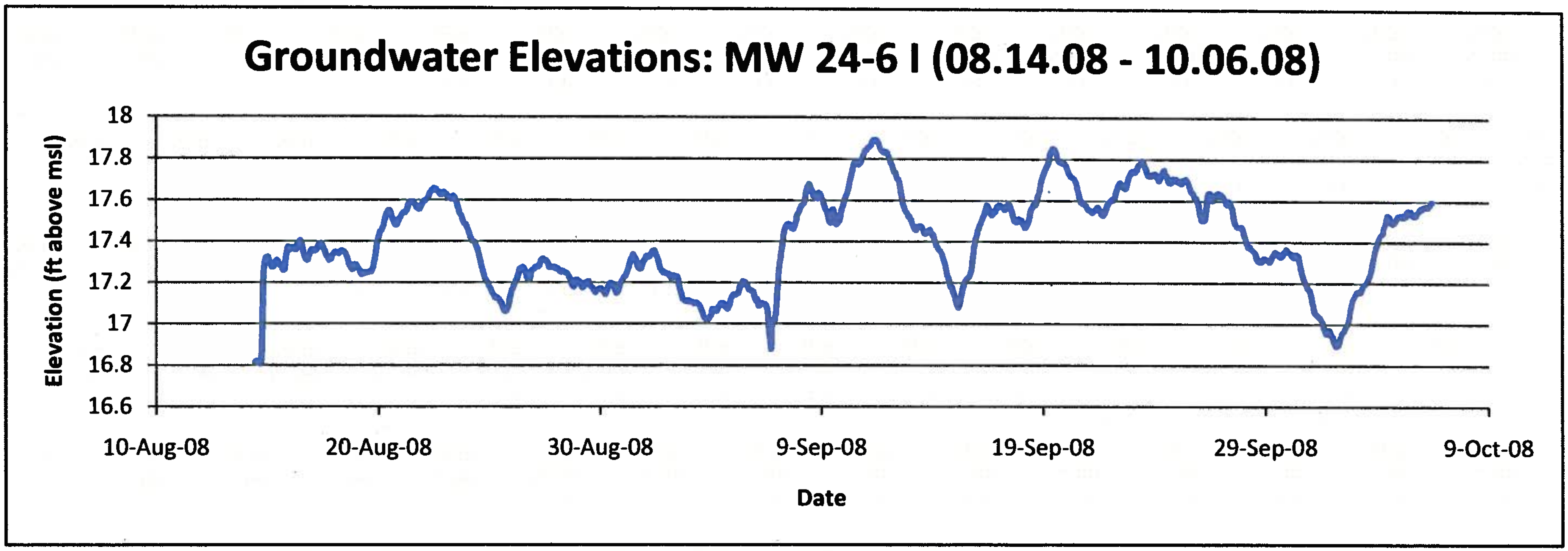

Groundwater Elevations: MW 24-1 I (8.14.08 - 10.06.08)
Elevation (ft above msl)
23.2
23
22.8
22.6
22.4
22.2
22
21.8
21.6
10-Aug-08
20-Aug-08
30-Aug-08
09-Sep-08
19-Sep-08
29-Sep-08
09-Oct-08
Date

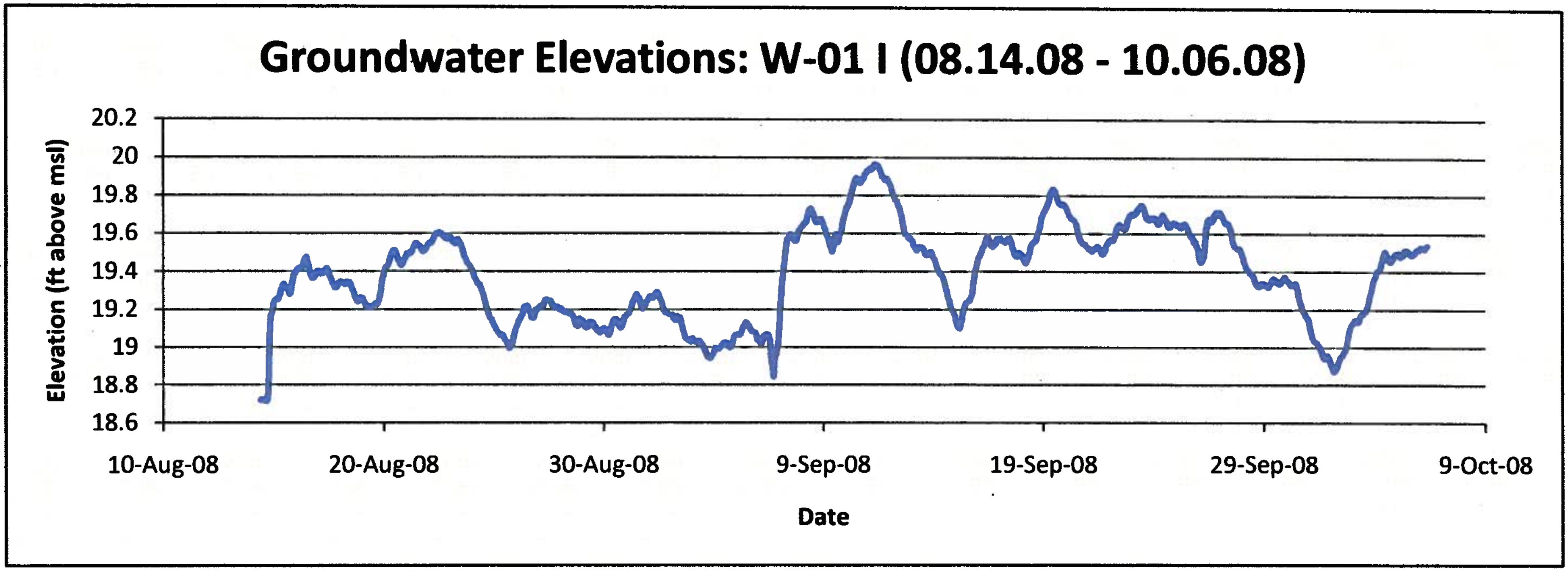

Groundwater Elevations: MW 24-2 I (8.14.08-10.06.08)
Elevation (ft above msl)
20.6
20.4
20.2
20
19.8
19.6
19.4
19.2
19
10-Aug-08
20-Aug-08
30-Aug-08
9-Sep-08
19-Sep-08
29-Sep-08
9-Oct-08
Date

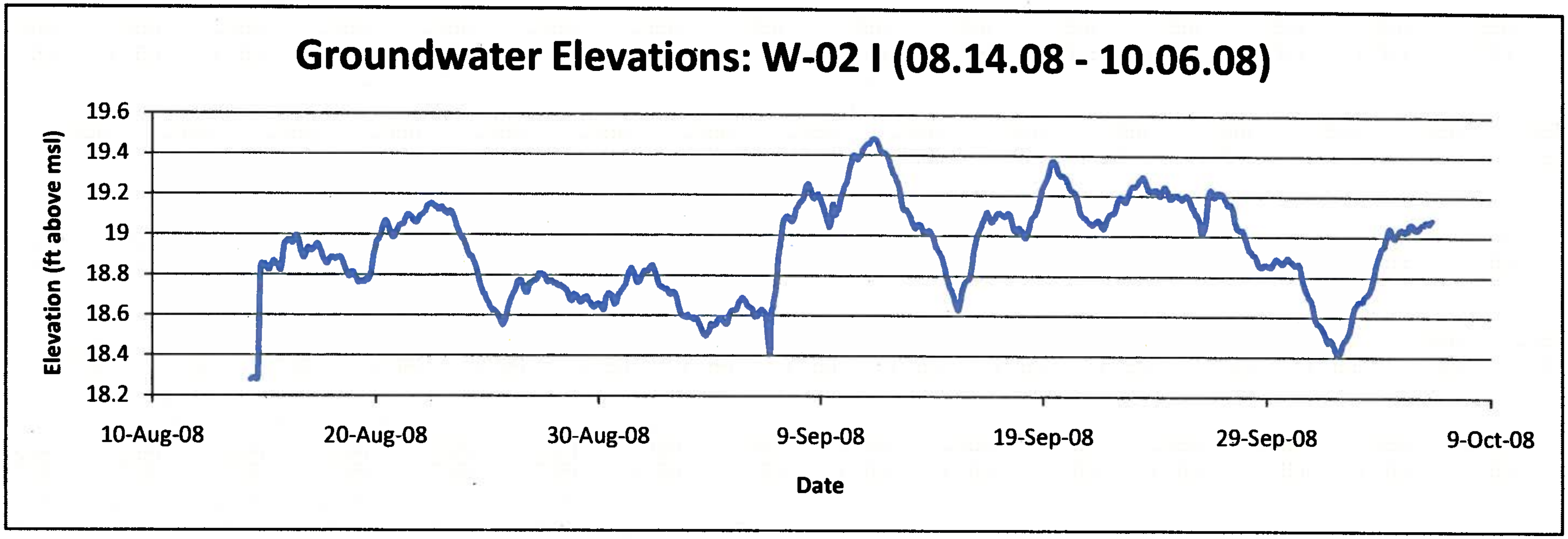

Groundwater Elevations: MW 24-4 I (8.14.08 - 10.06.08)
Elevations (ft above msl)
17.6
17.4
17.2
17
16.8
16.6
16.4
16.2
16
10-Aug-08
20-Aug-08
30-Aug-08
9-Sep-08
19-Sep-08
29-Sep-08
9-Oct-08
Date

## Groundwater Elevations: MW 24-5 I (08.14.08 - 10.06.08)

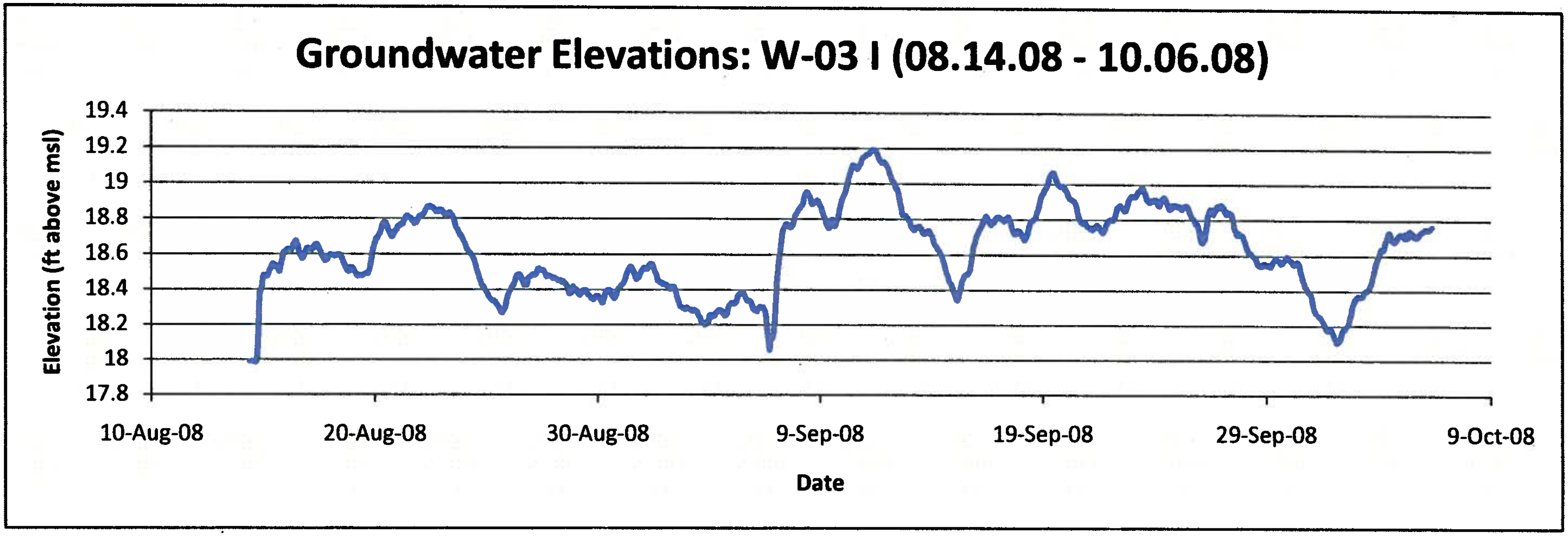



Groundwater Elevations: MW 24-6 I (08.14.08 - 10.06.08)
Elevation (ft above msl)
18
17.8
17.6
17.4
17.2
17
16.8
16.6
10-Aug-08
20-Aug-08
30-Aug-08
9-Sep-08
19-Sep-08
29-Sep-08
9-Oct-08
Date

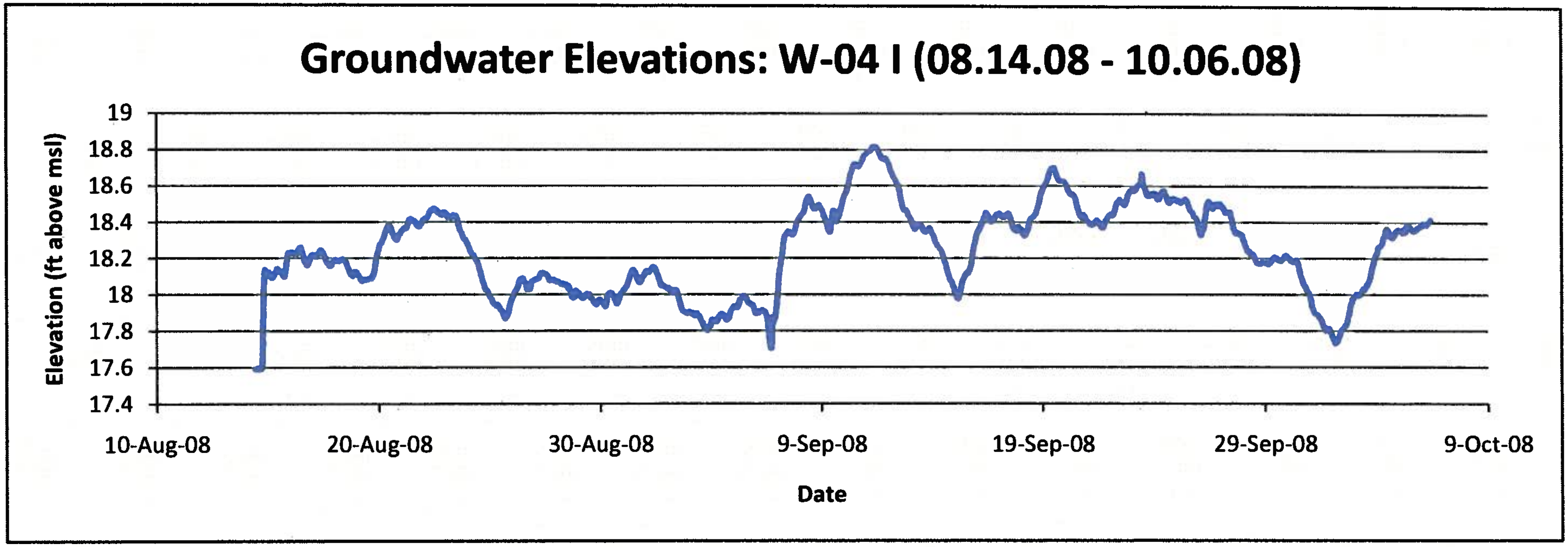

Groundwater Elevations: W-01 I (08.14.08 - 10.06.08)
Elevation (ft above msl)
20.2
20
19.8
19.6
19.4
19.2
19
18.8
18.6
10-Aug-08
20-Aug-08
30-Aug-08
9-Sep-08
19-Sep-08
29-Sep-08
9-Oct-08
Date



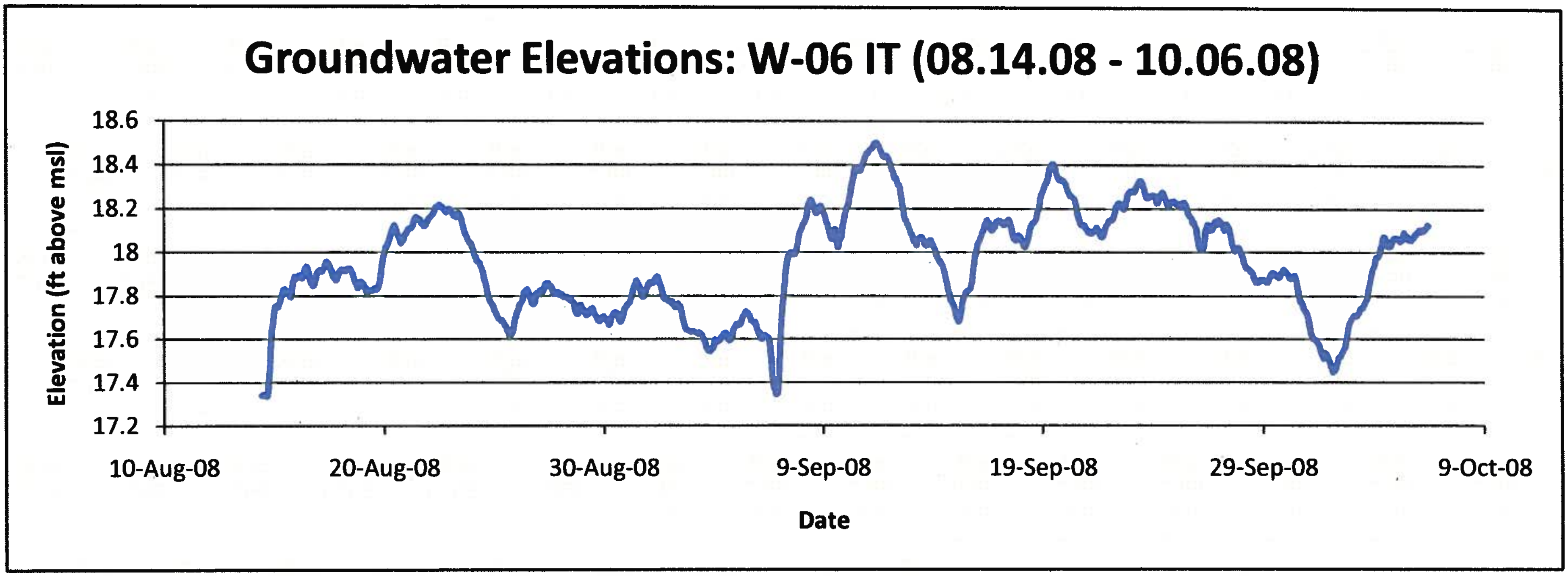
Groundwater Elevations: W-02 I (08.14.08 - 10.06.08)
Elevation (ft above msl)
19.6
19.4
19.2
19
18.8
18.6
18.4
18.2
10-Aug-08
20-Aug-08
30-Aug-08
9-Sep-08
19-Sep-08
29-Sep-08
9-Oct-08
Date



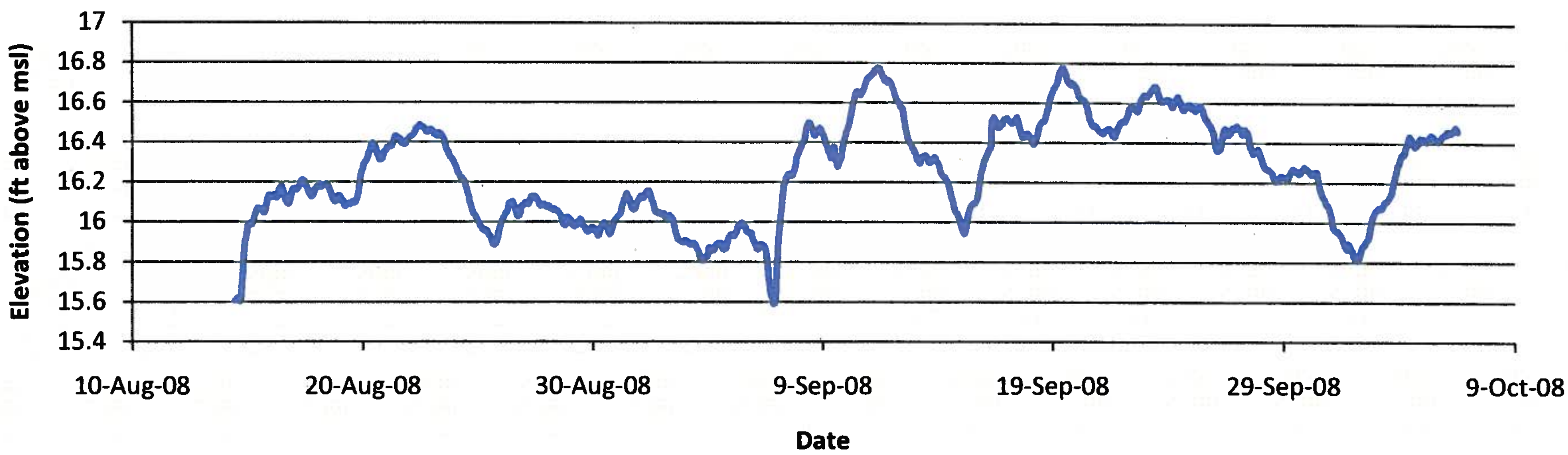
Groundwater Elevations: W-03 I (08.14.08 - 10.06.08)
Elevation (ft above msl)
19.4
19.2
19
18.8
18.6
18.4
18.2
18
17.8
10-Aug-08
20-Aug-08
30-Aug-08
9-Sep-08
19-Sep-08
29-Sep-08
9-Oct-08
Date

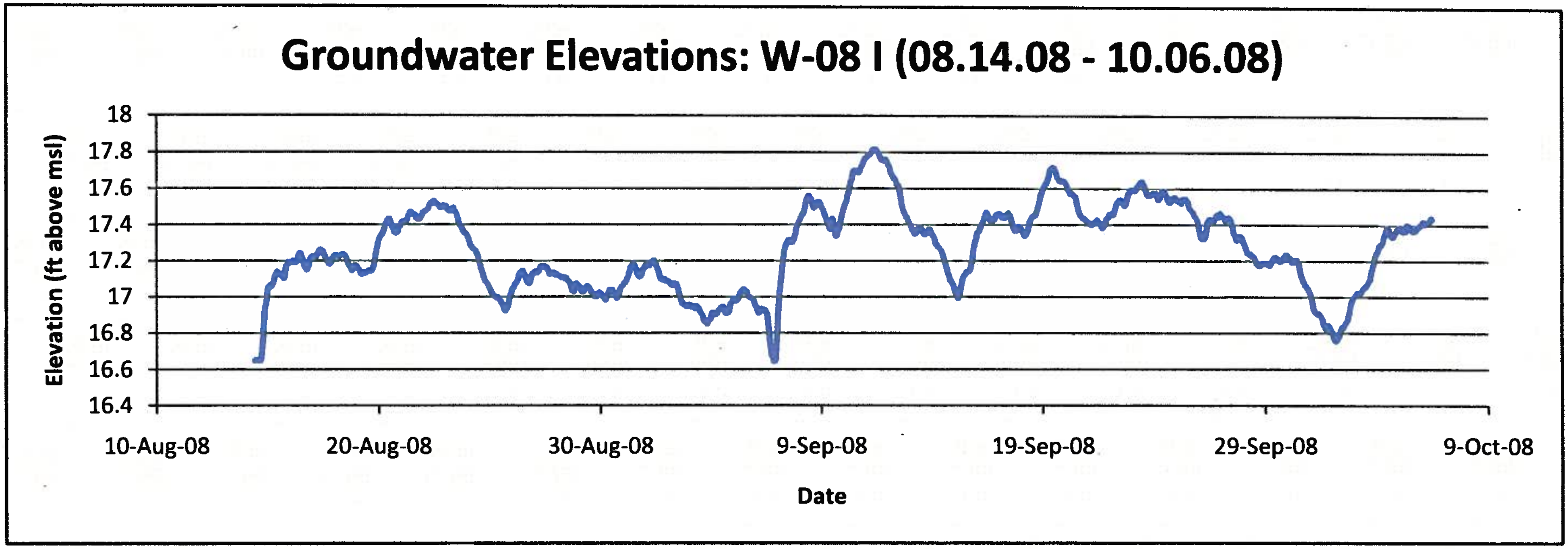


Groundwater Elevations: W-04 I (08.14.08 - 10.06.08)
Elevation (ft above msl)
19
18.8
18.6
18.4
18.2
18
17.8
17.6
17.4
10-Aug-08
20-Aug-08
30-Aug-08
9-Sep-08
19-Sep-08
29-Sep-08
9-Oct-08
Date

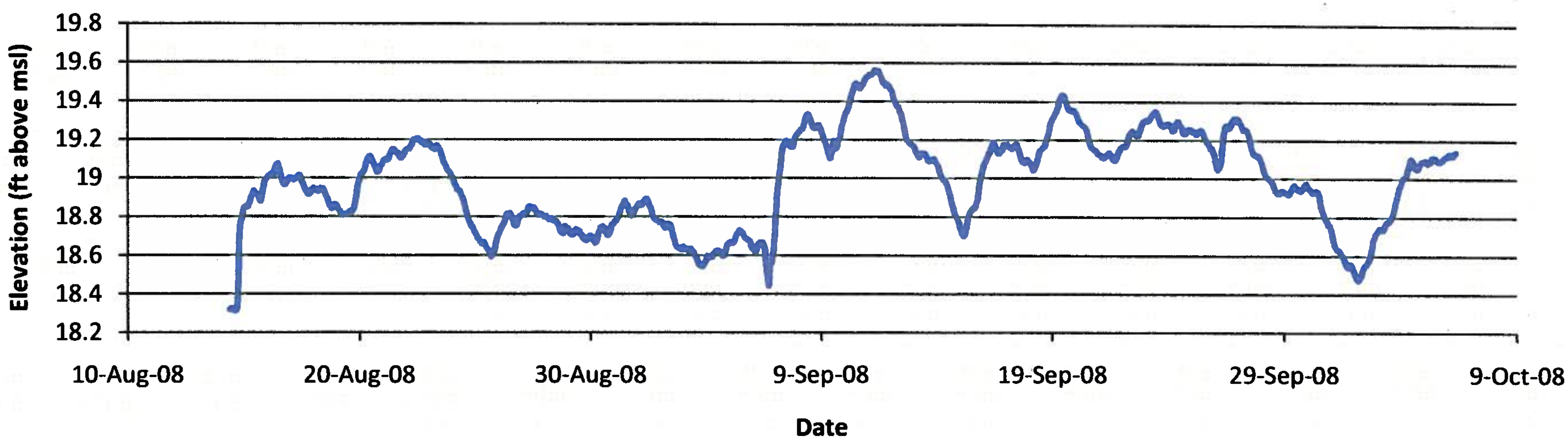

Groundwater Elevations: W-06 IT (08.14.08 - 10.06.08)
Elevation (ft above msl)
18.6
18.4
18.2
18
17.8
17.6
17.4
17.2
10-Aug-08
20-Aug-08
30-Aug-08
9-Sep-08
19-Sep-08
29-Sep-08
9-Oct-08
Date

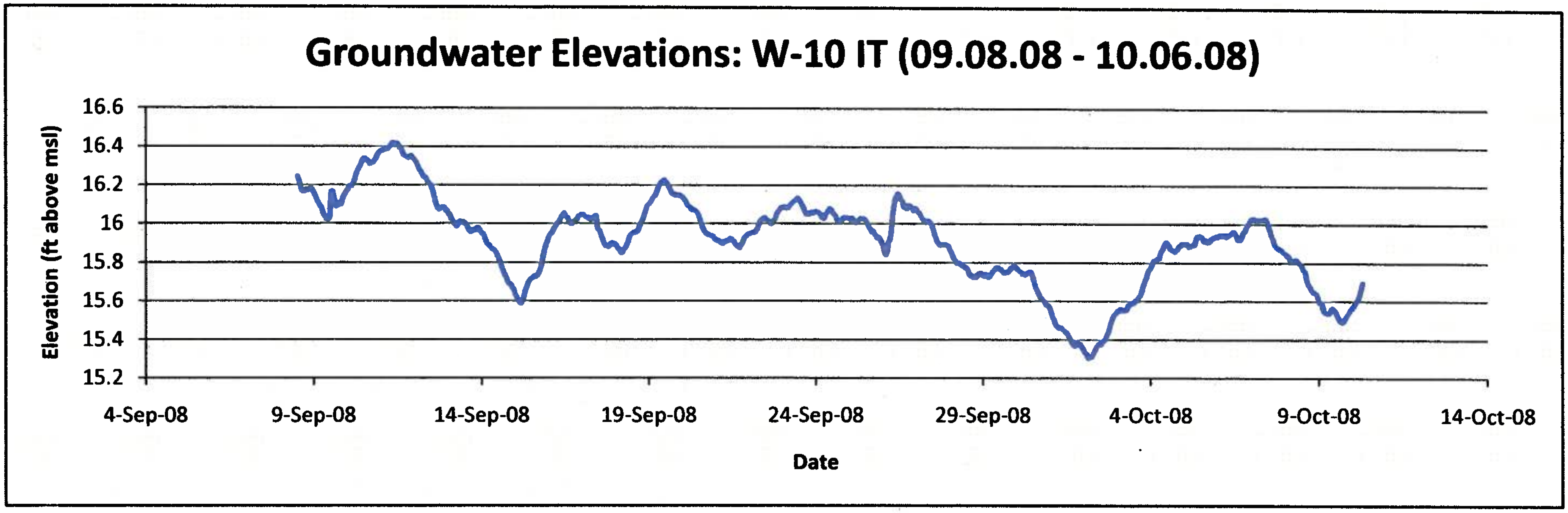
## Groundwater Elevations: W-07 I (08.14.08 - 10.06.08)

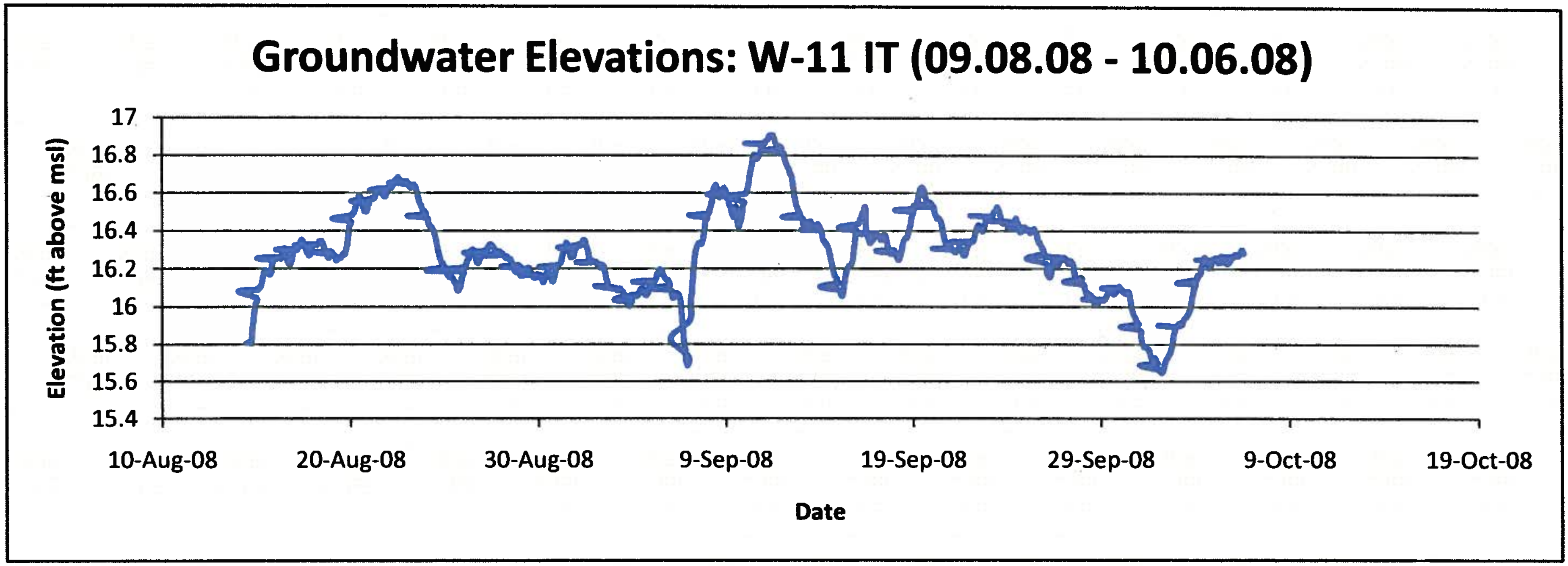


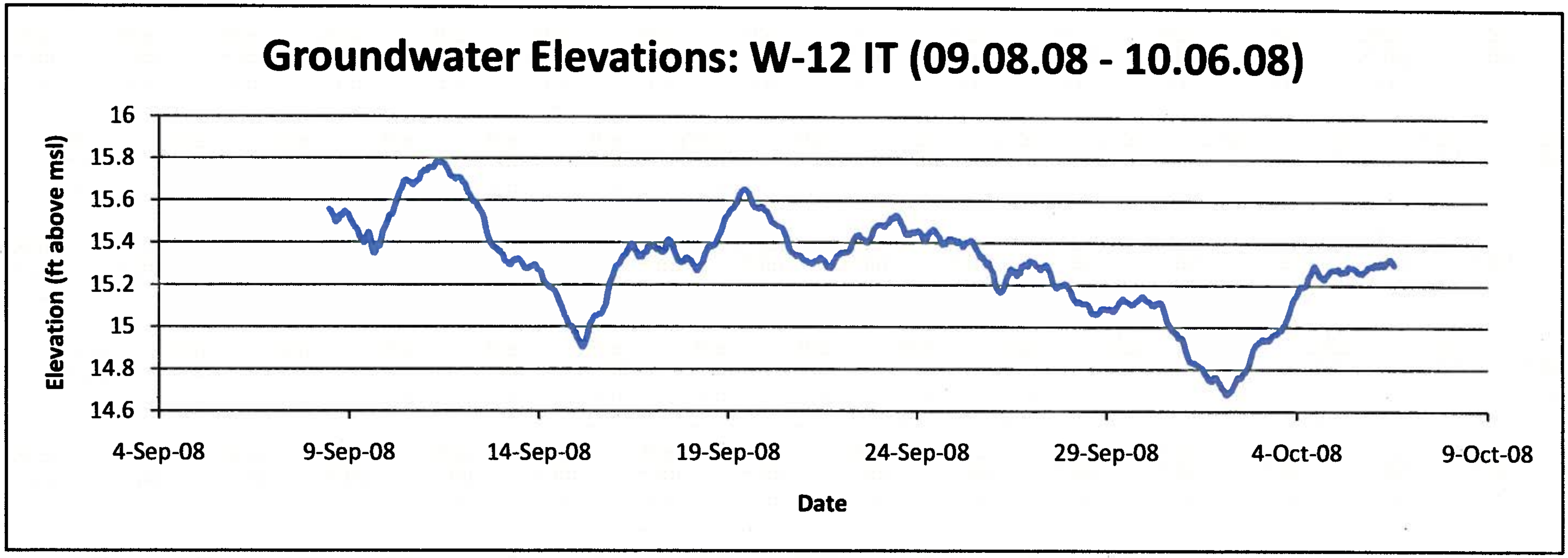

Groundwater Elevations: W-08 I (08.14.08 - 10.06.08)
Elevation (ft above msl)
18
17.8
17.6
17.4
17.2
17
16.8
16.6
16.4
10-Aug-08
20-Aug-08
30-Aug-08
9-Sep-08
19-Sep-08
29-Sep-08
9-Oct-08
Date

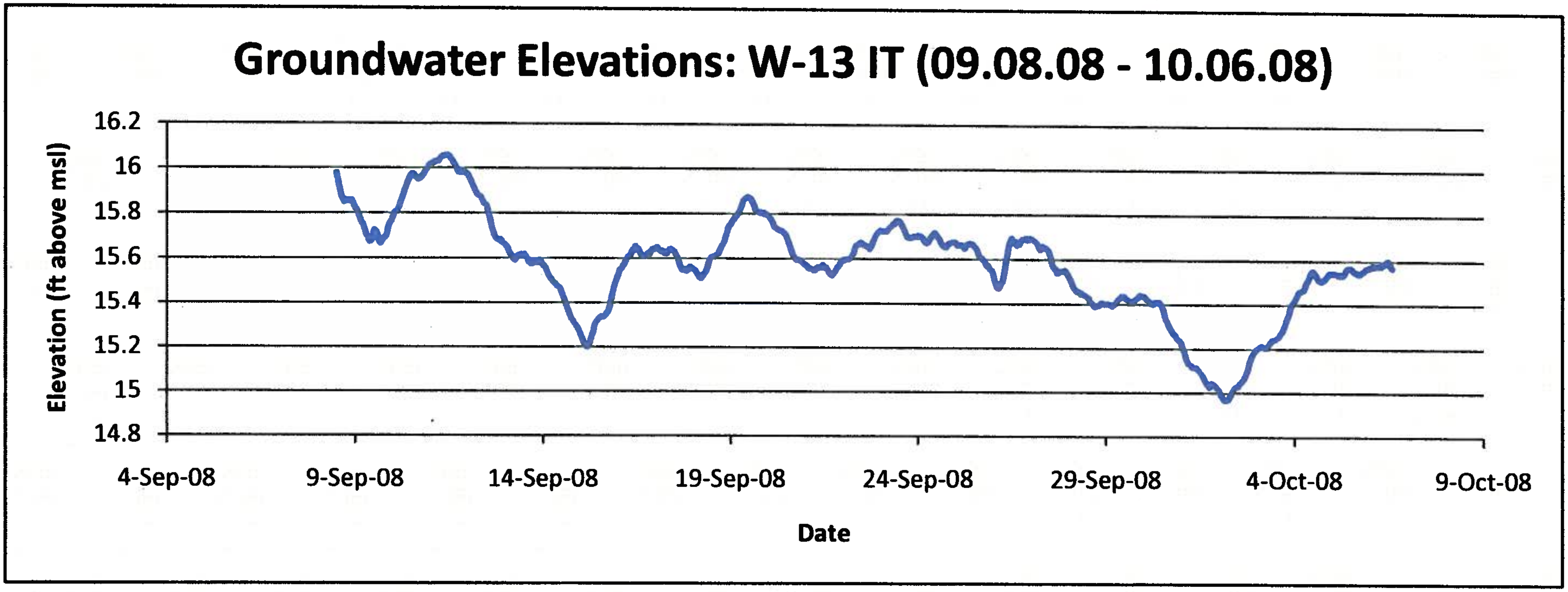
## Groundwater Elevations: W-09 I (08.14.08 - 10.06.08)

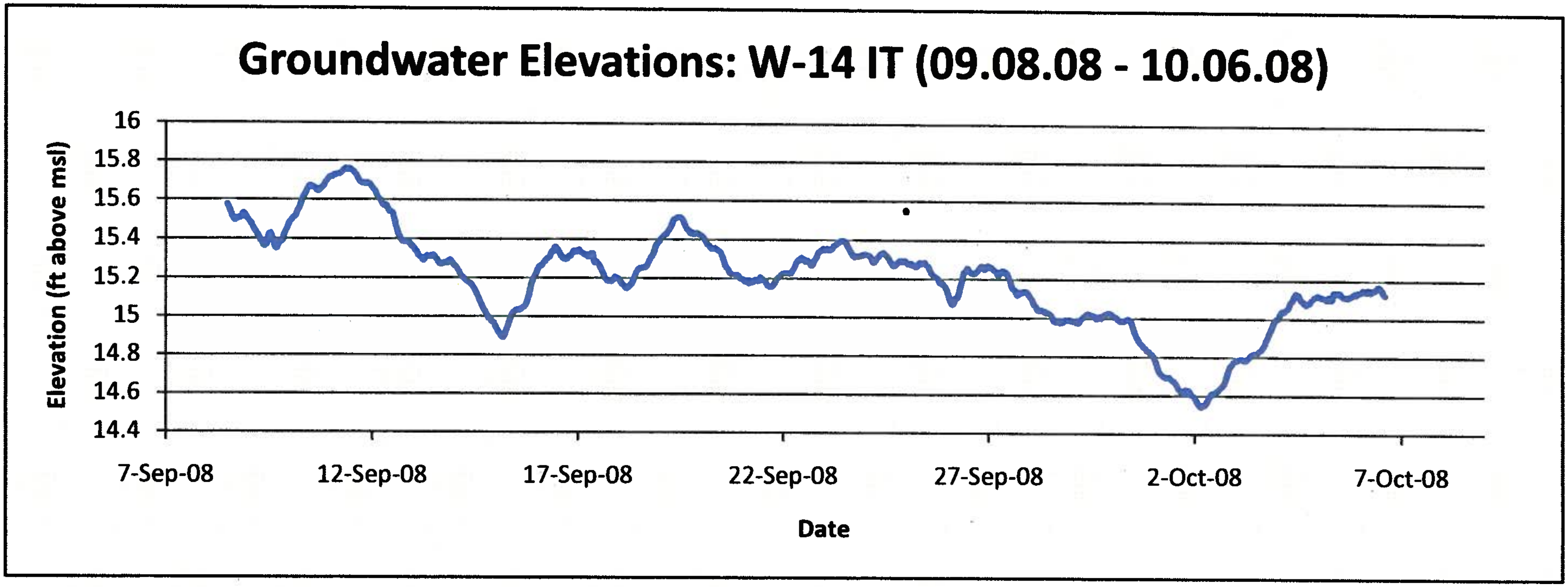


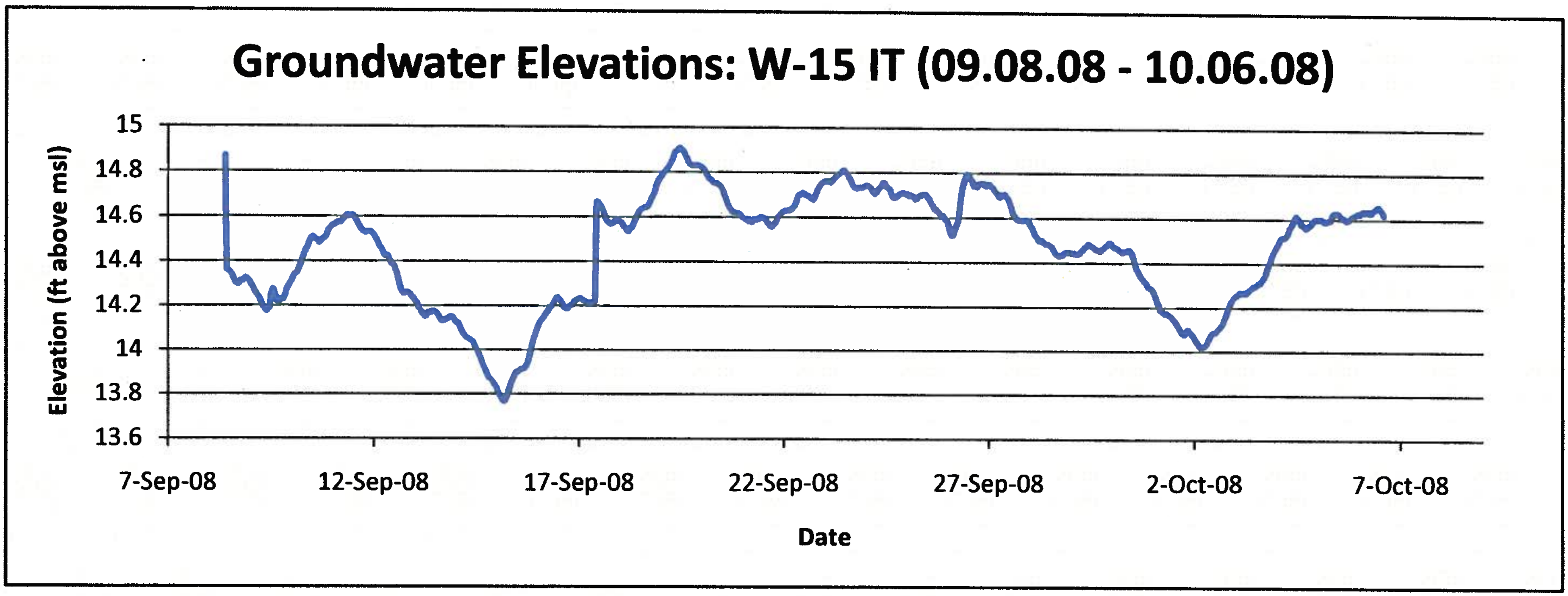

Groundwater Elevations: W-10 IT (09.08.08 - 10.06.08)
Elevation (ft above msl)
16.6
16.4
16.2
16
15.8
15.6
15.4
15.2
4-Sep-08
9-Sep-08
14-Sep-08
19-Sep-08
24-Sep-08
29-Sep-08
4-Oct-08
9-Oct-08
14-Oct-08
Date


Groundwater Elevations: W-11 IT (09.08.08 - 10.06.08)
Elevation (ft above msl)
17
16.8
16.6
16.4
16.2
16
15.8
15.6
15.4
10-Aug-08
20-Aug-08
30-Aug-08
9-Sep-08
19-Sep-08
29-Sep-08
9-Oct-08
19-Oct-08
Date


Groundwater Elevations: W-12 IT (09.08.08 - 10.06.08)
Elevation (ft above msl)
16
15.8
15.6
15.4
15.2
15
14.8
14.6
4-Sep-08
9-Sep-08
14-Sep-08
19-Sep-08
24-Sep-08
29-Sep-08
4-Oct-08
9-Oct-08
Date


Groundwater Elevations: W-13 IT (09.08.08 - 10.06.08)
Elevation (ft above msl)
16.2
16
15.8
15.6
15.4
15.2
15
14.8
4-Sep-08
9-Sep-08
14-Sep-08
19-Sep-08
24-Sep-08
29-Sep-08
4-Oct-08
9-Oct-08
Date


Groundwater Elevations: W-14 IT (09.08.08 - 10.06.08)
Elevation (ft above msl)
16
15.8
15.6
15.4
15.2
15
14.8
14.6
14.4
7-Sep-08
12-Sep-08
17-Sep-08
22-Sep-08
27-Sep-08
2-Oct-08
7-Oct-08
Date


Groundwater Elevations: W-15 IT (09.08.08 - 10.06.08)
Elevation (ft above msl)
15
14.8
14.6
14.4
14.2
14
13.8
13.6
7-Sep-08
12-Sep-08
17-Sep-08
22-Sep-08
27-Sep-08
2-Oct-08
7-Oct-08
Date