Performance Monitoring Plan Final Corrective Measures Revised June 2016

Occidental Chemical Corporation
Buffalo Avenue Plant
Niagara Falls, New York

Glenn Springs Holdings, Inc.

651 Colby Drive Waterloo Ontario N2V 1C2

007478 | Report No 65 | June 27 2016

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1. Introduction

A Corrective Action Program (CAP) has been implemented at the Occidental Chemical Corporation (OxyChem) Buffalo Avenue Plant (Plant) pursuant to the Plant's Resource Conservation and Recovery Act (RCRA)/Part 373 Permit dated September 29, 2008 (Permit). Glenn Springs Holdings, Inc. (GSH), an affiliate of OxyChem, is responsible for this remediation project, including implementation of this CAP. The final RCRA Facility Investigation (RFI) was completed in February 1995. The 2000 Permit stated that the CAP for the Plant would be implemented in four separate phases as Interim Corrective Measures (ICMs) addressing the following:

1. Bedrock groundwater flow regime
2. Overburden groundwater flow regime
3. Overburden soils
4. Off-Site areas

The ICMs implemented for each of the four phases, as presented in the document entitled "Final Corrective Measures Study", dated November 1998 (Final CMS), were as follows:

Bedrock Groundwater

- Extraction wells along the downgradient west and northwest Plant property boundaries in the D, C, and B-zones (hydraulic containment system).
- On-Site F-Area groundwater treatment system.
- Hydraulic monitoring program to monitor the effectiveness of the hydraulic containment system.
- Chemical monitoring program to verify long-term changes.
- Non-aqueous phase liquid (NAPL) collection from on-Site bedrock wells (where substantial quantities can be recovered).
- Off-Site Treatment of collected NAPL.

Overburden Groundwater

- Flow Zone 1 - Stages 1, 3, and 4 groundwater collection systems with treatment at the on-Site F-Area groundwater treatment system.
- Flow Zone 3 - Energy Boulevard Drain Tile System (EBDTS) with treatment at the on-Site F-Area groundwater treatment system.
- Hydraulic monitoring program to monitor the effectiveness of the hydraulic containment systems.
- Chemical monitoring program to verify long-term changes.
- Collection of groundwater via sanitary sewers and treatment at the Niagara Falls Water Board (NFWB) Wastewater Treatment Plant (WWTP).
- Monitoring groundwater infiltration into the outfall sewers as indicated by State Pollution Discharge Elimination System (SPDES) monitoring (and reduction where necessary).

Overburden Soil

- Maintenance of overburden groundwater ICM components.
- Deed restrictions.
- Institutional controls.
- Maintenance of Plant perimeter fence.
- Perimeter overburden NAPL monitoring.
- NAPL recovery (when sufficient quantity is encountered) and off-Site treatment of recovered NAPL.
- Maintenance of capped NAPL, dioxin, elemental phosphorus, and mercury areas and surface drainage control.
- Maintenance of capped and existing hard surfaced areas.
- Collection and off-Site treatment of any NAPL encountered during future maintenance and construction activities.

Off-Site Areas

- Collection of off-Site groundwater via the existing bedrock groundwater extraction system which will continue to draw chemicals back toward the Plant and prevent further off-Site chemical migration.
- Collection of off-Site groundwater via the Falls Street Tunnel (FST) which collected D-Zone groundwater until April 30, 2012. All dry weather flow in the FST up until closure was treated by the NFWB WWTP.
- Monitored natural attenuation. Monitoring of off-Site bedrock groundwater quality is already performed as part of on-Site bedrock groundwater Corrective Measures (CMs).

The performance monitoring programs developed for the CMs outlined above have been combined into one long-term performance monitoring program to ensure that the CMs continue to achieve remedial goals.

The purpose of this report is to define the long-term monitoring programs and reporting procedures required as part of the CAP. The long-term monitoring requirements included in this report are as follows:

Bedrock Systems

- Bedrock groundwater hydraulic monitoring
- Bedrock groundwater chemical monitoring
- Bedrock groundwater treatment system effluent monitoring
- Bedrock NAPL monitoring and collection

Overburden Systems

- Overburden groundwater hydraulic monitoring
- Overburden groundwater chemical monitoring

- Overburden groundwater treatment system effluent monitoring
- Sanitary and outfall sewer effluent monitoring
- Overburden NAPL monitoring and collection
- Overburden cover material monitoring

Table 1.1 presents a summary and schedule of activities that are to be completed at the Site each year.

This report also serves as a groundwater monitoring plan, as required by Module II, that defines the field activities, procedures, and sampling methods to be applied in the performance of the operation, maintenance, and sampling programs that are conducted by GSH personnel at the Site.

All sampling and analysis activities will be performed in accordance with the Quality Assurance Project Plan (QAPP), and the current Western New York Health and Safety Plan (HASP). The QAPP is contained in Appendix A of this report.

A summary of the well installation details for all extraction and monitoring wells involved in the CAP is presented in Table 1.2.

2. Bedrock Performance Monitoring

2.1 Bedrock Groundwater

A performance monitoring program has been implemented to evaluate the effectiveness of the bedrock groundwater extraction and treatment system. The bedrock groundwater system includes 13 extraction wells and a groundwater treatment system comprised of an air stripper, thermal oxidation unit, and carbon vessels. The original system had 19 wells, but C-Zone extraction wells BEW701C, BEW702C, and BEW703C were shut down on May 22, 2007 with New York State Department of Environmental Conservation (NYSDEC) approval and D-Zone extraction wells BEW701D, BEW702D, and BEW703D were shut down on October 9, 2008 with NYSDEC approval. Pumping from these extraction wells is no longer required to achieve hydraulic containment in the D- and C-Zones. Collected NAPL is transported off Site to an approved disposal facility.

The performance monitoring program includes hydraulic monitoring to establish the extent and continuity of plume capture, chemical monitoring to evaluate the changes in groundwater chemistry both on and off Site, effluent monitoring to ensure discharge limits are achieved, NAPL presence monitoring to observe any NAPL migration, and NAPL collection to remove collectable quantities of NAPL that are determined to be present in any wells.

The reporting requirements and additional activities associated with the inability to obtain representative samples, inaccessible wells, and dry wells are presented in Sections 6.2, 6.3, and 6.4, respectively.

2.1.1 Flow Monitoring

Although not required by the CAP, OxyChem monitors the total flow from each extraction well on a weekly basis.

2.1.2 Hydraulic Monitoring

The objective of the bedrock extraction system is to create a hydraulic barrier along the western Plant boundary and the western portion of the northern Plant boundary. Therefore, the primary emphasis of the performance monitoring program is hydraulic monitoring.

Hydraulic monitoring will be conducted on a quarterly basis at the wells listed in Table 2.1. The locations of these wells are shown on Figure 2.1.

Hydraulic monitoring of the wells will be performed along vectors perpendicular to the Plant boundary (i.e., wells OW667, OW666, OW407, and OW653) to allow simultaneous measurement of water levels. Each hydraulic monitoring event typically will be completed within a 3-hour period. The Niagara River level and the water level in New York Power Authority (NYPA) well OW139 will be measured once during each event.

Water levels will be measured in the D-Zone well first, followed by the C-Zone well and then the B-Zone well.

The resulting elevation data will be contoured to show groundwater flow patterns during system operation.

2.1.3 Chemical Monitoring

The purpose of the chemical monitoring program is to monitor bedrock groundwater chemistry in areas beyond the extent of the capture zone created by the extraction system. In addition, limited chemical monitoring within the capture zone will be used to monitor changes in bedrock groundwater chemistry.

Chemical monitoring will be performed on the seven extraction well nests and existing monitoring well nests listed in Table 2.2. The locations of these wells are shown on Figure 2.2. Each of these wells will be sampled annually for the list of parameters presented in Table 2.3.

2.1.4 Effluent Monitoring

Effluent from the F-Area Groundwater Treatment System discharges to the Plant's outfall sewer system (Outfall 007) and is monitored under the Plant's SPDES Permit. Sampling of the F-Area Groundwater Treatment System carbon beds are completed monthly.

2.2 Bedrock NAPL

The current ICM program to address the presence of NAPL in the bedrock involves annual NAPL monitoring in the bedrock wells in the bedrock monitoring network (monitoring wells listed in Table 2.4) and collection of NAPL where substantial quantities can be recovered. Notification requirements associated with the identification of NAPL in a well where it has not been previously observed are presented in Section 6.5. The bedrock NAPL monitoring and collection locations are shown on Figure 2.3.

3. Overburden Systems Performance Monitoring

3.1 Overburden Groundwater

A performance monitoring program has been implemented to evaluate the effectiveness of the overburden groundwater collection system as well as to monitor various overburden wells and sumps for NAPL presence. The Overburden Groundwater Collection System is comprised of Flow Zone 1, Flow Zone 3, and abandoned Outfall 005 collection systems.

The Flow Zone 1 collection system includes two groundwater collection systems that discharge directly to the F-Area treatment system via bedrock extraction well BEW700B. The first collector is 1,500 feet long, extends from MHA to MHF along the south boundary of the Plant, and includes Outfall 002. The second collector is 740 feet long and is located along the southwest corner of the Plant. It extends from CMH2 to MHA and drains to two wet wells (WW1 and WW2).

The Flow Zone 3 collection system consists of the EBDTS, which includes 500 feet of perforated collection tile, two wet wells, and a forcemain connecting WWB to extraction well BEW706C for treatment at the F-Area Groundwater Treatment System. Although not part of the CAP, OxyChem voluntarily converted an abandoned 360-foot section of sanitary sewer in the northern D-Area parallel to the north Plant boundary to a groundwater collection system that discharges to WWB of the EBDTS via MH301.

Although not part of the CAP, OxyChem voluntarily converted an abandoned section of Outfall 005 and parallel sanitary sewer to a groundwater collection system. This is connected to the F-Area Groundwater Treatment System via a pumping/forcemain system from MH159L. This system collects groundwater that infiltrates into the abandoned gravity sewer.

The performance monitoring program includes hydraulic monitoring to verify that hydraulic containment has been achieved, limited chemical monitoring to evaluate the changes in groundwater chemistry, NAPL presence monitoring to observe any NAPL migration, and NAPL collection to remove collectable quantities of NAPL that are determined to be present in any wells or other collection points.

The reporting requirements and additional activities associated with the inability to obtain representative samples, inaccessible wells, and dry wells are presented in Sections 6.2, 6.3, and 6.4, respectively.

3.1.1 Flow Monitoring

Although not required by the CAP, OxyChem monitors the flow rates in overburden pumping wet wells WW1 and WW2, as well as MH159L, MH301, and WWB (EBDTS) on a weekly basis.

3.1.2 Hydraulic Monitoring

General Description

The objective of each collection system is to create a hydraulic barrier along the corresponding section of the Plant perimeter. Therefore, the primary emphasis of the performance monitoring program is hydraulic monitoring.

The effectiveness of the groundwater collection systems will be evaluated by monitoring groundwater levels within the collection systems and adjacent overburden wells. The resulting elevation data will be contoured to show groundwater flow patterns during system operation. Hydraulic containment is demonstrated by a lower water level in the collection system compared to water levels in monitoring wells in the vicinity of the collection system.

The hydraulic monitoring program will involve manual water level monitoring. Water levels adjacent to the Flow Zone 1 and Flow Zone 3 collection systems will be monitored on a quarterly basis. Water levels will also be measured at a second set of monitoring wells on an annual basis to provide hydraulic monitoring data for areas where perimeter collection systems are not present. The wells included are presented in Table 3.1 and on Figure 3.1.

Specific Monitoring for CMH1 and CMH2

Monthly water level monitoring will be performed at CMH1 and CMH2 to assist in detecting obstructions in the overburden groundwater collection system.

3.1.3 Chemical Monitoring

Limited chemical monitoring within the capture zone will be performed to monitor changes in the groundwater chemical plume. It is anticipated that decreases in overburden groundwater chemical concentrations will occur slowly due to the large volume of groundwater within the overburden. Consequently, no changes in groundwater quality are expected in the short term. Therefore, the chemical monitoring will not be used to judge performance of the system.

Chemical monitoring will be performed annually at the wells and manholes listed in Table 3.2. The locations are shown on Figure 3.2.

Each of these wells will be sampled annually for the list of parameters presented in Table 3.3. The parameters presented in Table 3.3 are representative of the chemicals present in the overburden groundwater in the vicinity of the groundwater collection systems based on data received from previous sampling events.

3.1.4 Effluent Monitoring

Overburden groundwater is discharged to the F-Area Groundwater Treatment System, which discharges to the Plant's outfall sewer system (Outfall 007) and is monitored under the Plant's SPDES Permit. Sampling of the F-Area Groundwater Treatment System carbon beds are completed monthly.

3.2 Overburden NAPL

The current program to address the presence of NAPL in the overburden includes NAPL collection and/or monitoring of the wells in the overburden monitoring network for the presence of NAPL annually and select wells semi-annually. Collection trenches, sumps, and abandoned sewer manholes are also monitored for NAPL.

The various NAPL collection/monitoring locations and monitoring/collection frequency are presented in Table 3.4. Figure 3.3 shows the various NAPL collection/monitoring locations.

Notification requirements associated with the identification of NAPL in a well where it has not been previously observed are presented in Section 6.5.

3.3 Overburden Soil

3.3.1 Maintenance of Cover Materials

The areas covered with asphalt, gravel, or a soil/grass cap to address the presence of NAPL, dioxin, elemental phosphorus, or mercury will be inspected annually and maintained as necessary to insure their integrity. The locations of the areas to be inspected are shown on Figure 3.4.

3.3.2 Mercury Cell Area

To confirm the long-term effectiveness of the ICM implemented to address the Mercury Cell Area, a sample will be collected from monitoring well OW574 on a semi-annual basis and analyzed for mercury. The monitoring well is downgradient of former Building U-75. Existing monitoring wells OW304, OW305, and OW306 will be sampled on an annual basis and analyzed for mercury. The mercury monitoring locations are listed in Table 3.2 and shown on Figure 3.2. The results of the sampling will be presented in the performance reports described in Section 6.

4. Operation and Maintenance

4.1 Extraction and Treatment Systems

Procedures for operation and maintenance of the bedrock and overburden collection/treatment systems are presented "Operation Procedures Manual (OPM)", dated May 2016. Operations are monitored weekly, by recording the flow volume and inspecting the extraction system, the extraction well pumps, EBDTS sump, piping, and the filtration system. System downtime, maintenance issues, and the integrator flow readings are recorded in the logbook located on Site in the treatment building control center.

4.2 Monitoring Wells

All monitoring wells that are part of the Bedrock Monitoring Network, Overburden Monitoring Network, and additional perimeter wells, as identified in the CAP will be monitored for NAPL presence and well integrity on an annual basis. The well integrity inspections will include:

- An establishment of the ability of all wells and piezometers in the monitoring network to yield meaningful groundwater elevations when measured with an instrument accurate to within 0.01 feet. The ability of the wells to yield such information shall be based upon a comparison of the sounding of a well to its historical depth. Wells shall be considered obstructed if 20 percent or more of the well screen is covered or otherwise inaccessible. At a minimum, these wells will be redeveloped to remove sediments from the bottom of the well.
- An establishment of the ability of all groundwater wells to yield representative samples for determining the concentration of hazardous waste constituents that may be present in the groundwater. Physical examination of the well shall include removal and inspection of any dedicated sampling device to assure that the device is functioning as designed.

4.3 Cover Materials

The areas covered with asphalt, gravel, or a soil/grass cap to address the presence of NAPL, dioxin, elemental phosphorus, or mercury will be inspected annually and maintained as necessary to insure integrity.

5. Field Procedures

GSH field procedures (FPs) are listed below. Pertinent FPs that will be used or will potentially be used at the Site are contained in Appendix B of this report. Laboratory analytical methods and associated quality assurance and quality control requirements are presented in the QAPP.

FP-01a - Waste Management

FP-01b - Well Inspection

FP-02a - Groundwater Level Measurement

FP-03a - NAPL Presence Check

FP-03b - NAPL Thickness Measurement Procedure

FP-03c - NAPL Removal From Wells

FP-04a - Groundwater Sampling – Extraction Wells

FP-04b - Groundwater Sampling – Monitoring Wells

FP-06a - Decontamination Cleaners

FP-07a - Well Decommissioning

FP-08a - Well Redevelopment

6. Reporting Requirements

In accordance with the CAP for the Buffalo Avenue Plant, reporting for the various monitoring programs will be submitted to NYSDEC. The following sections describe the reporting requirements and corresponding activities associated with the inability to obtain representative samples, inaccessible wells, and dry wells, and the contents of the quarterly and annual reports to be submitted to the NYSDEC.

6.1 System Downtime Reporting

The remedial system is operated on a continuous basis. If any part of the groundwater treatment system which affects the ability of the system to achieve the remedial intent is inoperable (down) for a period of more than 3 days consecutively or 5 days in a calendar month, OxyChem shall notify NYSDEC. This notification shall be in writing via letter or electronically via e-mail and shall include a plan for restoring system operation as quickly as possible. All reportable downtimes in a given quarter, as well as subsequent notifications and resolutions, shall be summarized in the operating system quarterly report identified in Section 6.6.

6.2 Inability to Obtain Representative Groundwater Sample(s)

If it is determined that an active monitoring well may not provide representative samples or accurate piezometric values, may be damaged, or is inaccessible, the NYSDEC will be notified of the problem in writing and a remedy will be proposed within 7 days of such knowledge.

Within 14 days of such knowledge, OxyChem shall attempt to remedy the problem and, when appropriate, sample or re-sample the well. Within 21 days of such knowledge, OxyChem shall provide information which describes the nature of the problem by written notice to the NYSDEC. The notification shall also contain a description of how well the problem with the well has been rectified or a schedule for the rehabilitation or replacement of the well.

If a problem with the well prevented the collection of a scheduled sample, a sample shall be obtained within 14 days after the rehabilitation or replacement of the well. If there is knowledge that an error in either sampling or analytical methods has occurred, the affected samples shall be re-collected within 14 days as such knowledge, unless otherwise directed by the NYSDEC.

6.3 Inaccessible Wells

If wells in two or more pairs or clusters in one specific area are inaccessible during any quarter (due to snow, flooding, or other obstruction), or if any one well is inaccessible for two consecutive sampling periods, the NYSDEC will be notified of the problem in writing within 14 days of such knowledge. The written notification and subsequent actions will comply with the requirement presented in Section 6.2 for wells determined to be damaged.

6.4 Dry Wells

If a well does not contain sufficient water for sampling, the well may go unsampled for one sampling period. Prior to the next scheduled sampling of the well, a water level measurement will be collected to determine if the well contains sufficient water for sampling. If the measurement indicates that the well is not likely to contain a sufficient quantity of water for collection of a representative sample, a proposal (to eliminate or replace the well, or substitute with an existing well) will be submitted to the NYSDEC prior to the start of the next sampling round. The exception to this would be if the well is known to be seasonally dry during the following sampling event, in which case a proposal would not need to be submitted for one additional sampling period.

6.5 NAPL

If NAPL is observed in a well where it has not been observed before, the NYSDEC will be notified in writing within 30 days of observing NAPL. A proposed NAPL collection program for the well will be included with the notification.

6.6 Quarterly Reports

Quarterly reports will be submitted to the NYSDEC every January, April, July, and October presenting the results of the hydraulic and chemical monitoring programs for the previous quarter. The reports shall include the following information:

- Hydraulic monitoring data in tabular and electronic format.
- Chemical monitoring data in tabular and electronic format, if applicable for the quarter.

- Figures showing groundwater potentiometric surfaces for both overburden and bedrock groundwater.
- Pumping rate summary for each extraction well and collection system wet well in tabular and electronic format.
- Discussion of each pumping shutdown requiring notification, including the cause, duration, and action taken to prevent recurring operational interruptions.
- NAPL data collection during the quarter.

6.7 Annual Reports

Annual reports will be submitted to the NYSDEC every April summarizing the results of the hydraulic and chemical monitoring programs included in the four quarterly reports as well as the overburden and bedrock NAPL monitoring results for the previous year. The reports shall include the following information:

- A discussion of the performance of the groundwater collection systems and figures showing groundwater potentiometric surfaces for both overburden and bedrock groundwater.
- Overburden and bedrock NAPL monitoring/collection results in tabular format and discussion relating to any significant anomalies observed as a result of the NAPL monitoring and collection.
- A summary of the chemical data.
- Calculation and discussion of groundwater flow rate and direction.
- A summary of the monitoring results for both the Outfall Sewers (SPDES Permit No. NY0003336) and Sanitary Sewers (City of Niagara Falls Significant Industrial User Wastewater Discharge Permit No. 22).
- Results of annual inspections for cover materials implemented to address NAPL, dioxin, elemental phosphorus, and mercury in overburden soils.
- Discussion and recommendations for changes to the CAP.

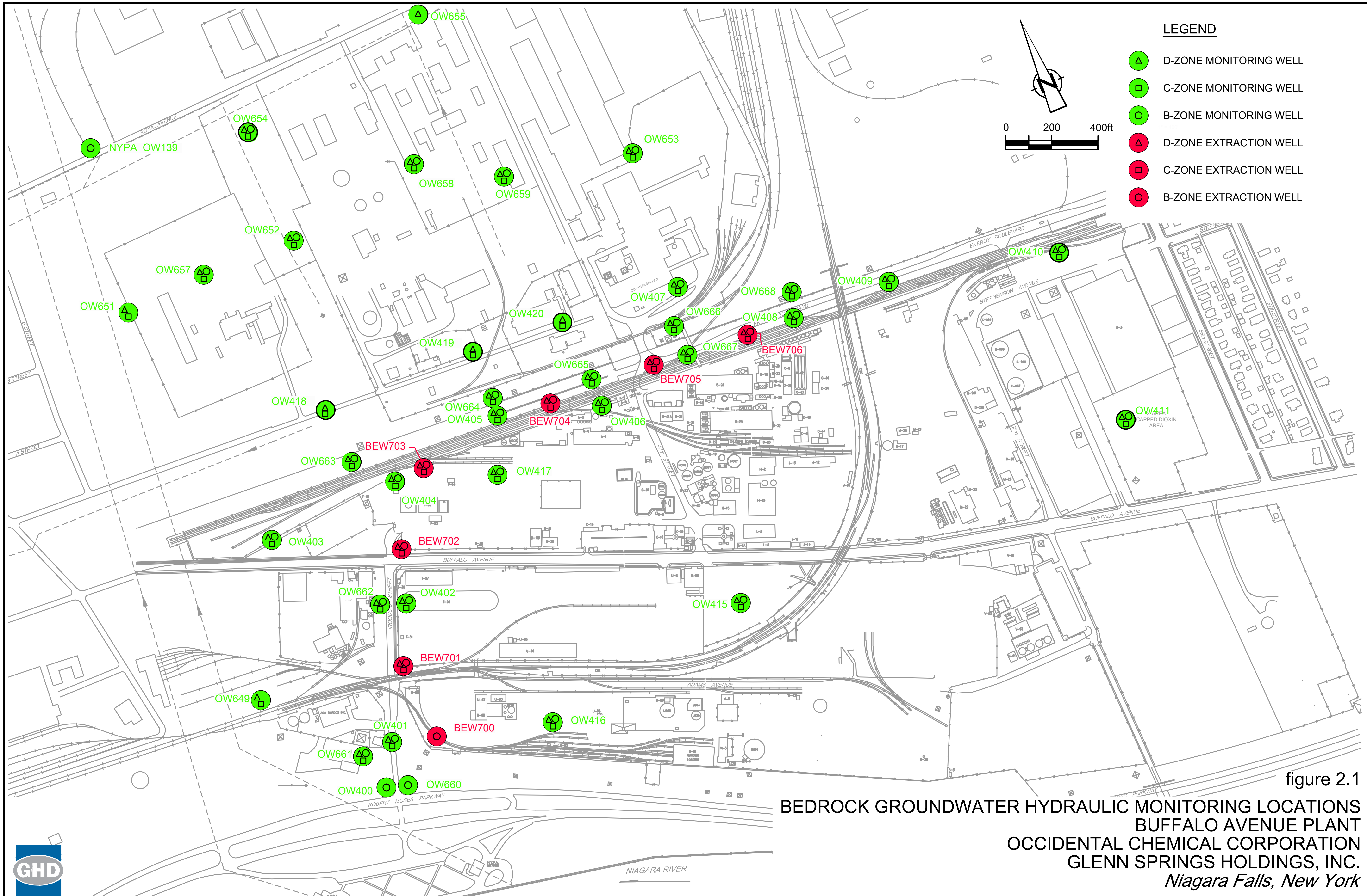

figure 2.1

BEDROCK GROUNDWATER HYDRAULIC MONITORING LOCATIONS
BUFFALO AVENUE PLANT
OCCIDENTAL CHEMICAL CORPORATION
GLENN SPRINGS HOLDINGS, INC.
Niagara Falls, New York

07478-D23101(065)GN-WA009 JUL 7, 2015

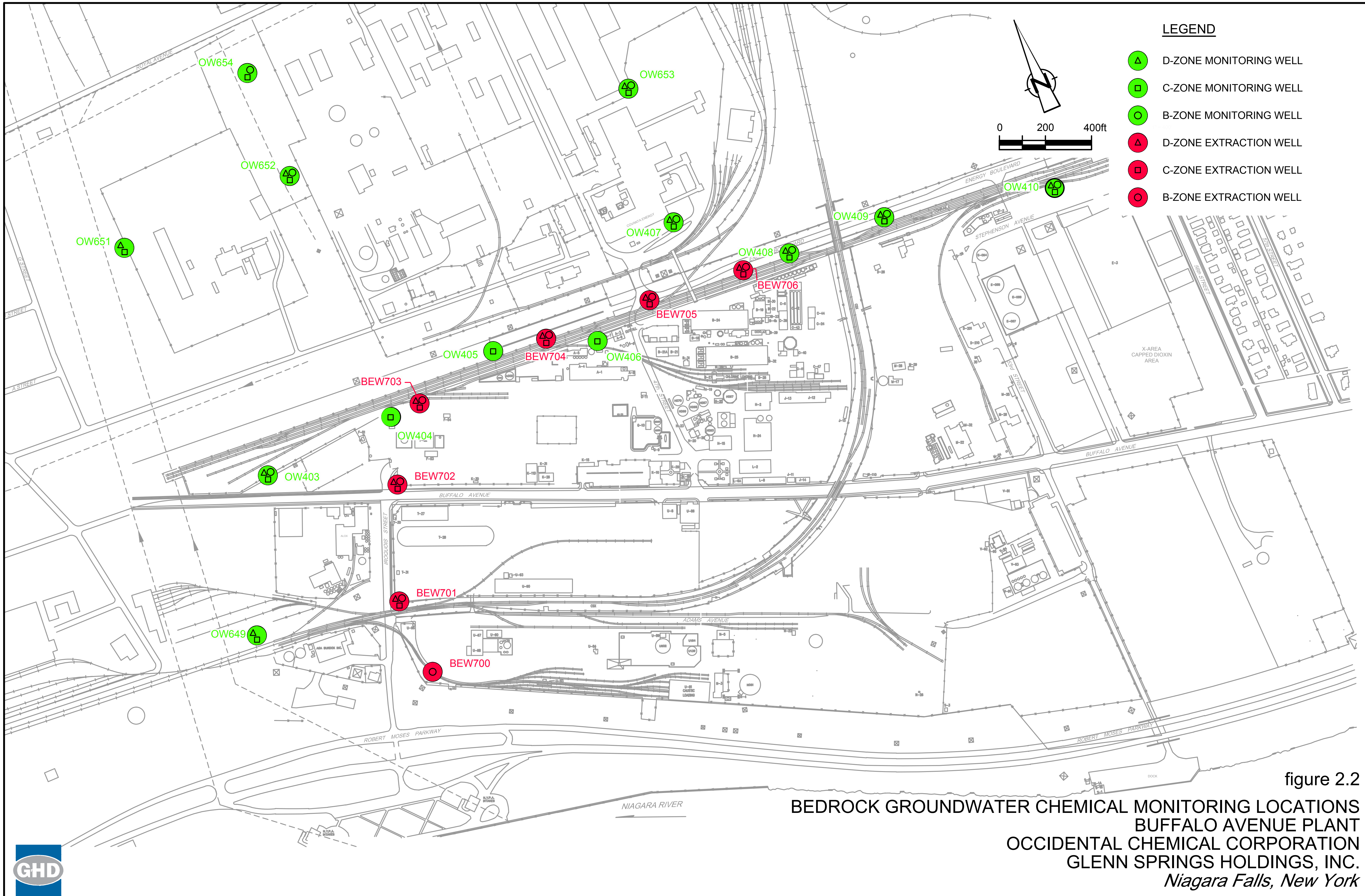

figure 2.2

BEDROCK GROUNDWATER CHEMICAL MONITORING LOCATIONS
BUFFALO AVENUE PLANT
OCCIDENTAL CHEMICAL CORPORATION
GLENN SPRINGS HOLDINGS, INC.
Niagara Falls, New York

07478-D23101(065)GN-WA010 JUL 7, 2015

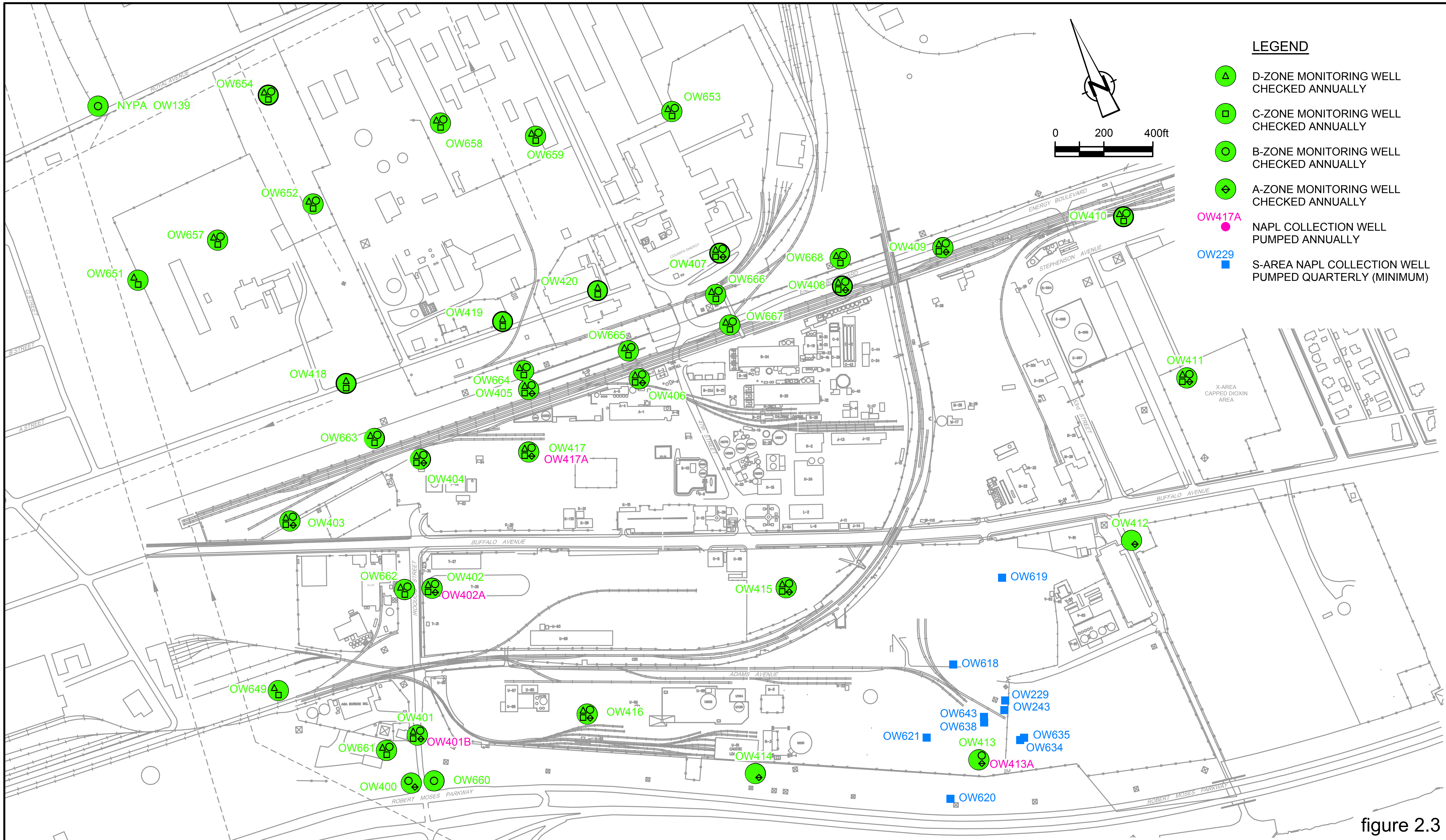

figure 2.3

BEDROCK NAPL MONITORING AND COLLECTION LOCATIONS
BUFFALO AVENUE PLANT
OCCIDENTAL CHEMICAL CORPORATION
GLENN SPRINGS HOLDINGS, INC.
Niagara Falls, New York

07478-D23101(065)GN-WA011 JUL 7, 2015

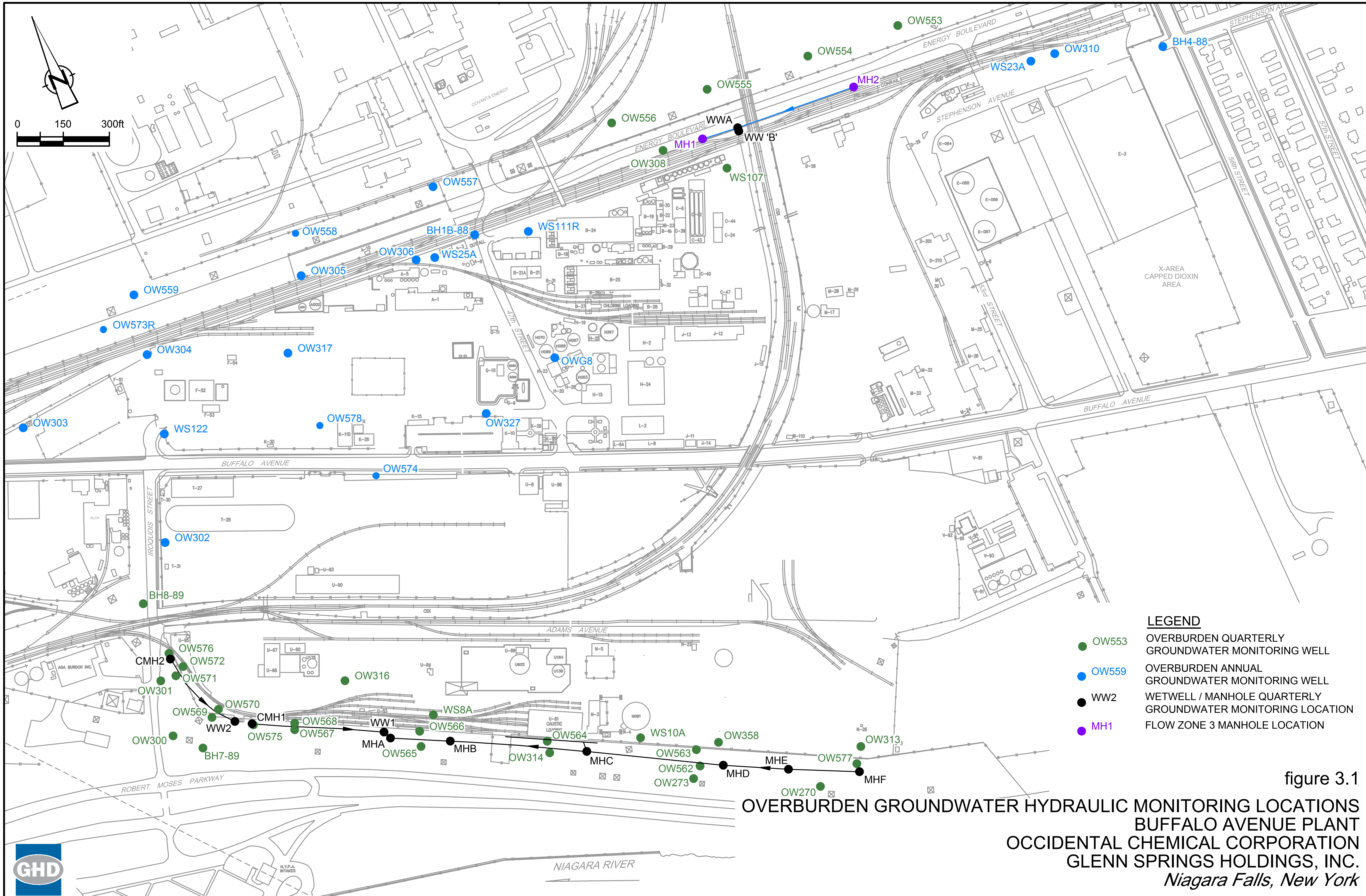

figure 3.1

OVERBURDEN GROUNDWATER HYDRAULIC MONITORING LOCATIONS
BUFFALO AVENUE PLANT
OCCIDENTAL CHEMICAL CORPORATION
GLENN SPRINGS HOLDINGS, INC.
Niagara Falls, New York

07478-D23101(065)GN-WA012 JUL 7, 2015

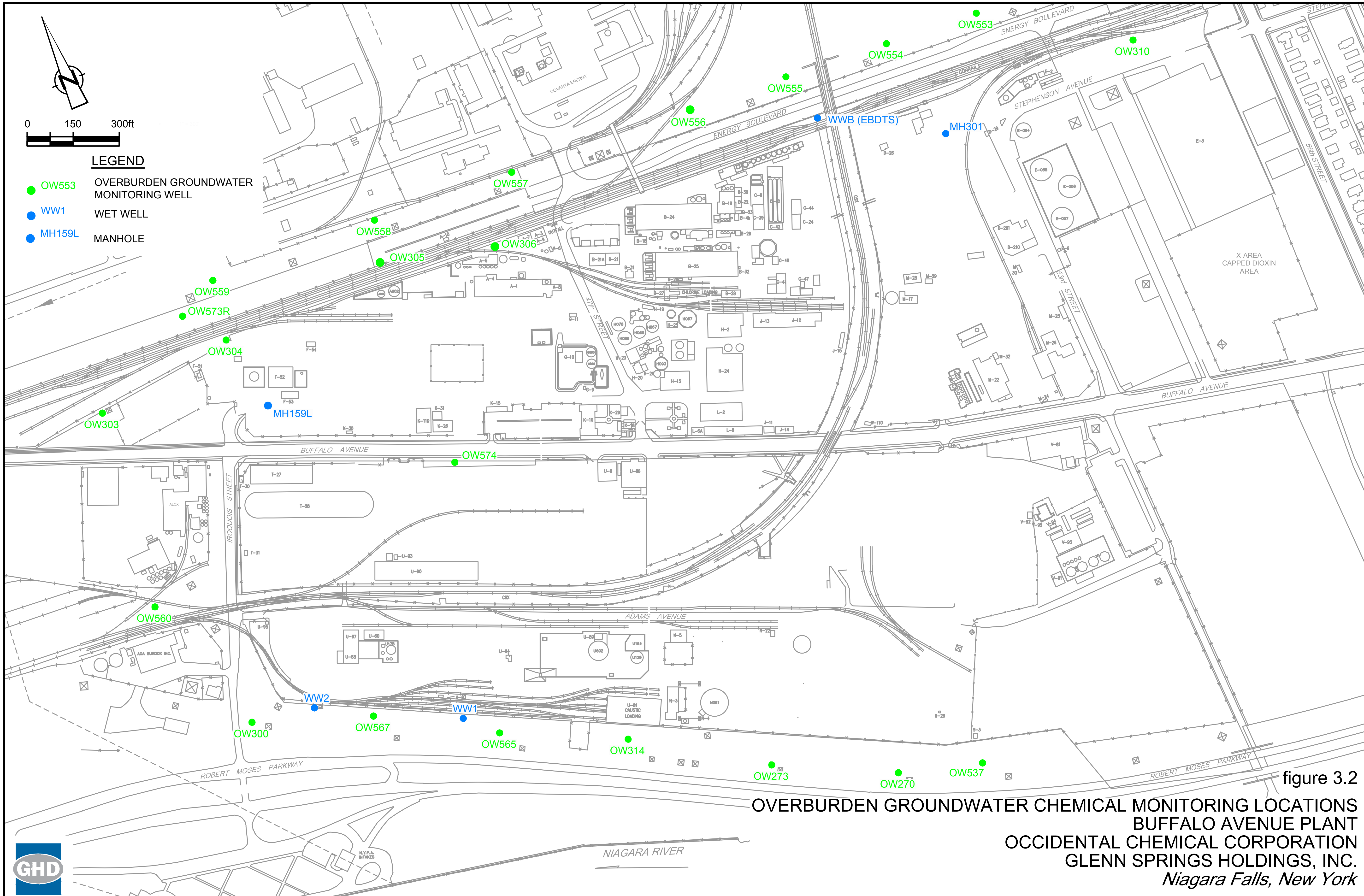

figure 3.2

OVERBURDEN GROUNDWATER CHEMICAL MONITORING LOCATIONS
BUFFALO AVENUE PLANT
OCCIDENTAL CHEMICAL CORPORATION
GLENN SPRINGS HOLDINGS, INC.
Niagara Falls, New York

07478-D23101(065)GN-WA013 JUL 7, 2015

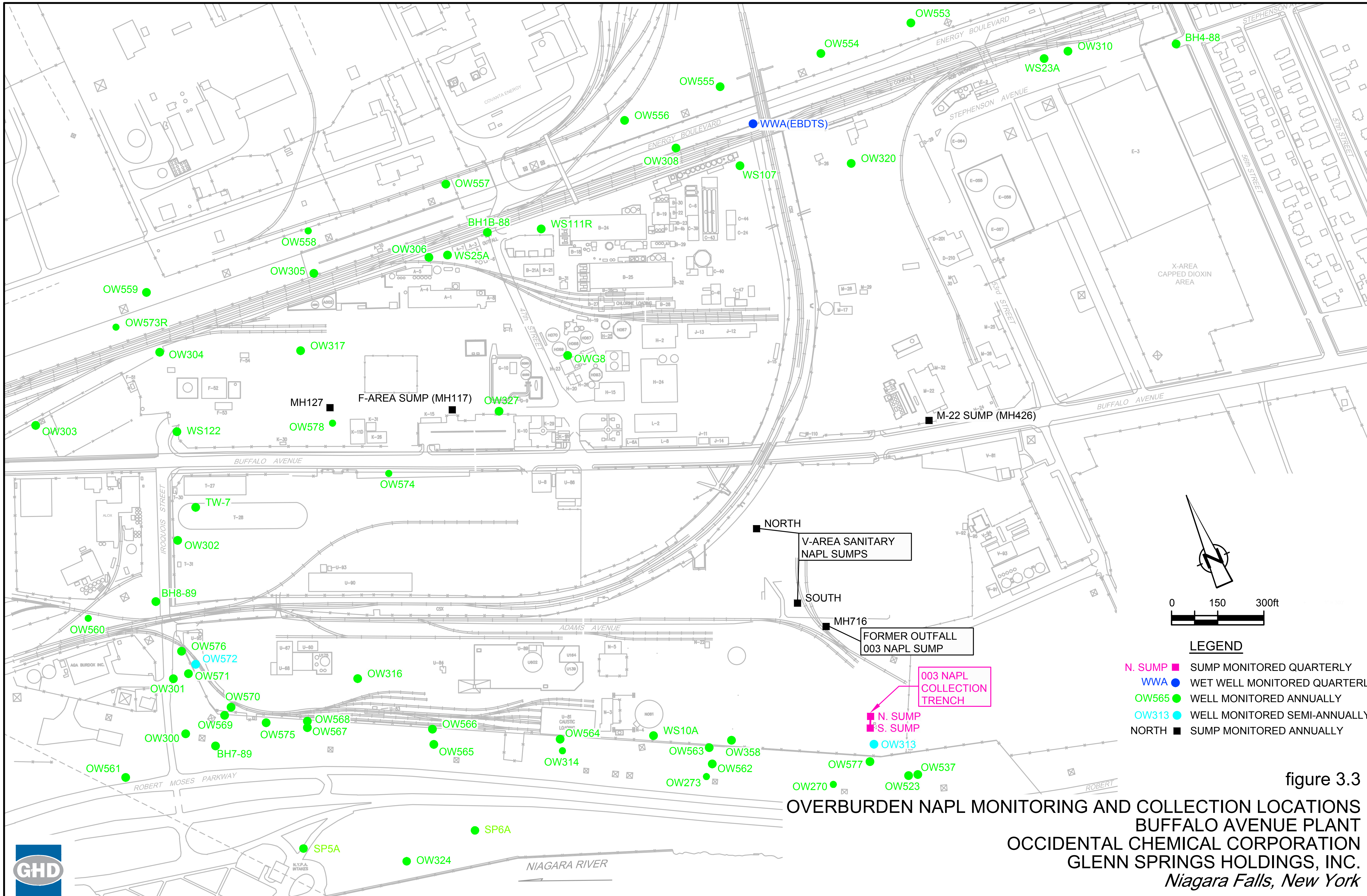

figure 3.3

OVERBURDEN NAPL MONITORING AND COLLECTION LOCATIONS
BUFFALO AVENUE PLANT
OCCIDENTAL CHEMICAL CORPORATION
GLENN SPRINGS HOLDINGS, INC.
Niagara Falls, New York

07478-D23101(065)GN-WA014 JUL 7, 2015

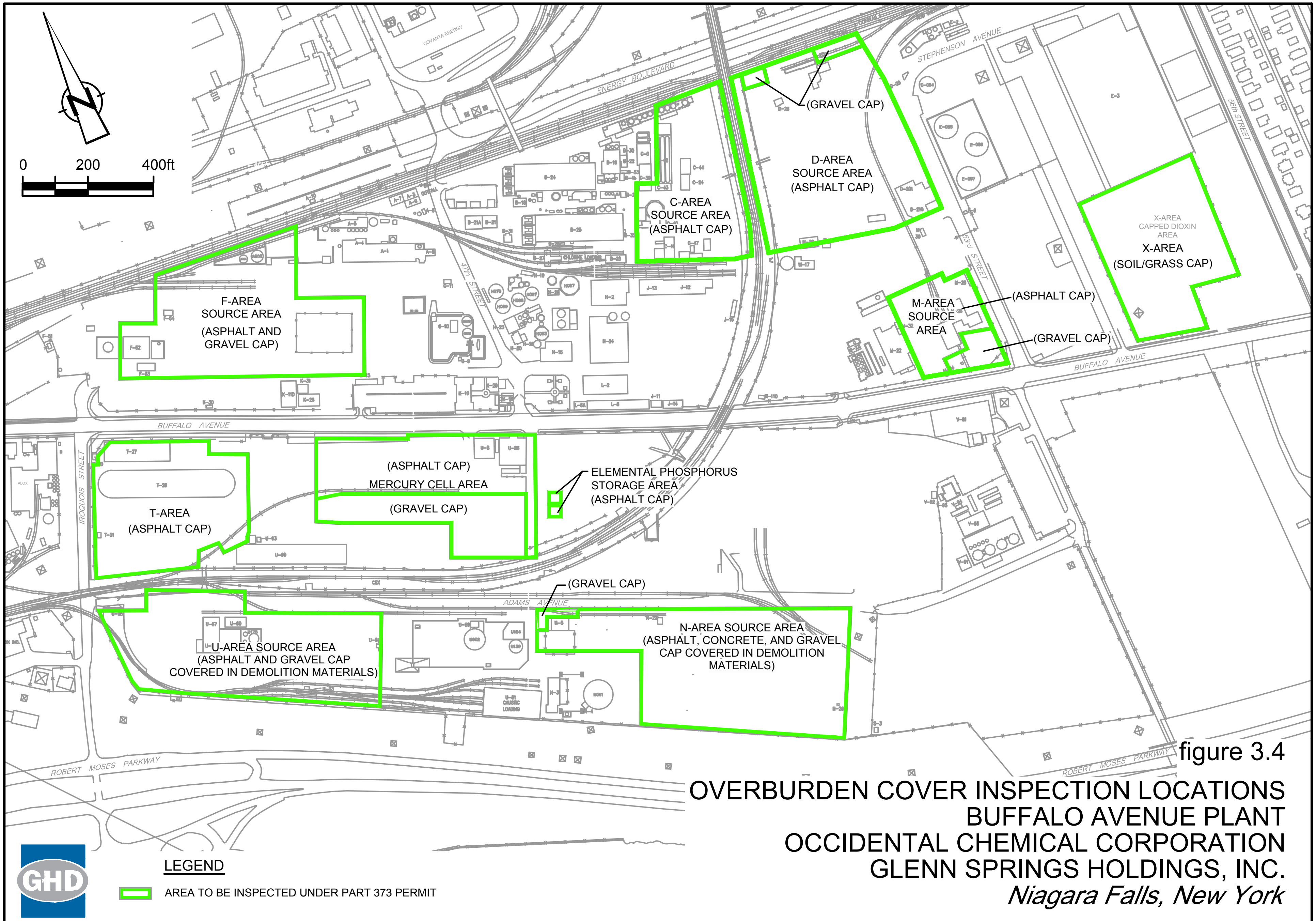

figure 3.4

OVERBURDEN COVER INSPECTION LOCATIONS
BUFFALO AVENUE PLANT
OCCIDENTAL CHEMICAL CORPORATION
GLENN SPRINGS HOLDINGS, INC.
Niagara Falls, New York

07478-D23101(065)GN-WA015 JUL 7, 2015

Well Designation ______________________
Date of Inspection ______________________
Time of Inspection ______________________
Inspector's Initials ______________________

Item	***Types of Problems***	***Status****		***Comments***	***Action***	***Date***
		A	U			
Well Condition	Flagging Visibility (if applicable) Well Number Readable on Outer Casing Integrity of Surface Seal/Apron Integrity of Surface Casing Corrosion Inner Casing/Screen Integrity Measuring Point Visibility Total Depth Siltation Recharge Rate Other					
Security	Security Cap in Place Lock in Place Lock Functional Other					

Status* A = Acceptable
U = Unacceptable

figure 4.1

MONITORING WELL INSPECTION FORM
BUFFALO AVENUE PLANT
OCCIDENTAL CHEMICAL CORPORATION
GLENN SPRINGS HOLDINGS, INC.
Niagara Falls, New York

GHD

Table 1.1

Activity Summary
Buffalo Avenue Plant

Task	Frequency	Dates	Figure/Table Reference	Field Procedure	Report Section	Analytical Parameters
Monitoring:						
Bedrock Flow Monitoring (1)	Weekly	--	--	NA	2.1.1	NA
Overburden Flow Monitoring (2)	Weekly	--	--	NA	3.1.1	NA
F-Area Monthly Process Sampling - carbon beds	Monthly	--	--	FP-4A	2.1.4/3.1.4	VOC
Overburden NAPL Monitoring/Collection - 003 Collection Trench	Quarterly	Mar, Jun, Sep, and Dec	Figure 3.3/Table 3.4	FP-01A, 03A, 03B, and 03C	3.2	NA
Bedrock Chemical Monitoring	Annual	Mar	Figure 2.2/Table 2.2	FP-01A, 04A, 04B	2.1.3	Table 2.3
Bedrock Hydraulic and Chemical Wells - Inspections and NAPL Checks	Annual	Mar	Figures 2.2, 2.3/Tables 2.1,	FP-01A, 01B, and 03A	4.2	NA
Bedrock Water Levels	Quarterly	Mar, Jun, Sep, and Dec	Figure 2.1/Table 2.1	FP-01A and 02A	2.1.2	NA
Overburden Water Levels - Flow Zone 1 & 3	Quarterly	Mar, Jun, Sep, and Dec	Figure 3.1/Table 3.1	FP-01A and 02A	3.1.2	NA
Overburden Water Levels - CMH1 & CMH2	Monthly	--	Figure 3.1/Table 3.1	FP-01A and 02A	3.1.2	NA
EBDTS Wet Well (WWA) NAPL Monitoring/Collection	Quarterly	Mar, Jun, Sep, and Dec	Figure 3.3/Table 3.4	FP-01A, 03A, 03B, and 03C	3.2	NA
Overburden NAPL Monitoring/Collection - Select Wells (4)	Semi-annual	Mar and Sep	Figure 3.3/Table 3.4	FP-01A, 03A, 03B, and 03C	3.2	NA
Overburden NAPL Monitoring/Collection - Select Wells (5)	Annual	Sep	Figure 3.3/Table 3.4	FP-01A, 03A, 03B, and 03C	3.2	NA
Overburden Chemical Monitoring	Annual	May	Figure 3.2/Table 3.2	FP-01A and 04B	3.1.3	Table 3.3
Overburden Chemical Monitoring - Mercury Cell Area (OW304, OW305, and OW306)	Annual	May	Figure 3.2/Table 3.2	FP-01A and 04B	3.3.2	Mercury
Bedrock NAPL Monitoring and Collection (6)	Annual	Aug	Figure 2.3/Table 2.4	FP-01A, 03A, 03B, and 03C	2.2	NA
S-Area monitoring wells in N-area - NAPL monitoring and collection (3)	Quarterly	Feb/May/Aug/Nov	Figure 2.3/Table 2.4	FP-01A, 03A, 03B, and 03C	2.2	NA
Overburden Chemical Monitoring - Mercury Cell Area (OW574)	Semi-annual	May and Nov	Figure 3.2/Table 3.2	FP-01A and 04B	3.3.2	Mercury
Inspection / Maintenance of Cover Materials	Annual	Jul	Figure 3.4	NA	3.3.1	NA
Overburden Water Levels - Other Wells	Annual	Sep	Figure 3.1/Table 3.1	FP-01A and 02A	3.1.2	NA
Overburden NAPL Monitoring - Sump and Manholes	Quarterly/Annual/Semi-Annual	Sep	Figure 3.3/Table 3.4	FP-3A	3.2	NA
Overburden Hydraulic and Chemical Wells - Inspections and NAPL	Annual	Nov	Figures 3.1,3.2/Tables 3.1,3.2	FP-01A, 01B, and 03A	4.2	NA
Reporting:						
Data Report	Quarterly	Jan, Apr, July, and Oct		NA	6.6	NA
Corrective Measures Implementation Annual Performance Evaluation	Annual	Apr		NA	6.7	NA

Notes:

(1) Includes BEW700 through BEW706 (excepting BEW701C, BEW701D, BEW702C, BEW702D, BEW703C, BEW703D; extraction now shut down with NYSDEC approval).
(2) Includes WW1, WW2, WWB, MH301, MH159.
(3) Includes OW229, OW243, OW618, OW619, OW620, OW621, OW634, OW638, OW635, OW643.
(4) Includes OW313, OW572.
(5) Includes OW317, OW320, OW358, OW523, OW562, OW563, TW-7, OW306, OW537, OW577.
(6) Includes all bedrock monitoring wells. Only OW401B, OW402A, OW413A, and OW417A previously exhibited collectable quantities of NAPL.
NA Not Applicable.

Table 1.2

Well Construction And Installation Details
Buffalo Avenue Plant

Well	Installation Type (BR/OB)	Top of Riser Elevation	Ground Surface Elevation	Date of Installation	Riser Diameter (in inches)	Monitored Interval					
						Top (AMSL)		Bottom (AMSL)	Top (bgs)		Bottom (bgs)
BEW700B	BR	565.59	568.7	12/2/1994	8	457.1	-	414.0	111.6	-	154.7
BEW701B	BR	566.18	569.2	12/9/1994	8	458.8	-	413.8	110.4	-	155.4
BEW701C	BR	566.33	569.6	11/17/1994	8	498.4	-	460.9	71.2	-	108.7
BEW701D	BR	565.86	569.0	12/7/1994	8	545.9	-	500.9	23.1	-	68.1
BEW702B	BR	568.83	572.2	8/15/1994	8	452.9	-	415.9	119.3	-	156.3
BEW702C	BR	568.86	572.0	8/8/1994	8	496.4	-	455.9	75.6	-	116.1
BEW702D	BR	569.20	572.2	7/6/1994	8	548.6	-	499.4	23.6	-	72.8
BEW703B	BR	569.48	572.6	9/8/1994	8	450.8	-	410.8	121.8	-	161.8
BEW703C	BR	569.00	572.1	9/15/1994	8	501.8	-	453.7	70.3	-	118.4
BEW703D	BR	569.87	572.8	9/16/1994	8	550.0	-	504.2	22.8	-	68.6
BEW704B	BR	569.37	573.4	10/14/1994	8	452.3	-	417.3	121.1	-	156.1
BEW704C	BR	569.24	573.3	10/14/1994	8	498.3	-	454.3	75.0	-	119.0
BEW704D	BR	570.24	573.1	9/30/1994	8	546.3	-	501.3	26.8	-	71.8
BEW705B	BR	570.24	573.3	10/11/1994	8	453.7	-	416.0	119.6	-	157.3
BEW705C	BR	570.06	573.2	9/30/1994	8	502.0	-	456.5	71.2	-	116.7
BEW705D	BR	570.66	573.7	10/10/1994	8	550.2	-	505.2	23.4	-	68.4
BEW706B	BR	569.58	572.7	9/19/1994	8	452.9	-	416.4	119.8	-	156.3
BEW706C	BR	568.97	571.9	10/11/1994	8	504.1	-	455.6	67.8	-	116.3
BEW706D	BR	569.46	572.5	9/26/1994	8	550.7	-	504.2	21.8	-	68.3
OW139	BR	570.63	569.1	1958	12	559.2		435.2	9.9	-	133.9
OW400B	BR	579.25	579.6	5/10/1989	4	454.6	-	424.5	125.0	-	155.1
OW401B	BR	568.54	569.0	5/24/1989	4	462.9	-	413.9	106.1	-	155.1
OW401C	BR	568.55	568.9	5/25/1989	4	492.3	-	462.8	76.6	-	106.1
OW401D	BR	568.42	568.9	5/26/1989	6.25	545.9	-	507.9	23.0	-	61.0
OW402B	BR	569.46	570.3	6/28/1989	4	473.8	-	409.9	96.5	-	160.4
OW402C	BR	569.48	570.3	6/26/1989	4	488.5	-	473.8	81.8	-	96.5
OW402D	BR	569.22	570.0	6/29/1989	6.25	544.7	-	518.8	25.3	-	51.2
OW403B	BR	570.04	570.5	5/16/1989	4	457.8	-	427.8	112.7	-	142.7
OW403C	BR	570.02	570.3	5/22/1989	4	487.3	-	457.7	83.0	-	112.6
OW403D	BR	570.08	570.3	5/23/1989	6.25	546.8	-	502.8	23.5	-	67.5
OW404B	BR	571.03	571.5	6/9/1989	4	438.3	-	404.8	133.2	-	166.7
OW404C	BR	570.82	571.4	6/7/1989	4	498.5	-	468.2	72.9	-	103.2
OW404D	BR	570.45	571.9	6/23/1989	6.25	549.3	-	498.0	22.6	-	73.9
OW405B	BR	572.78	573.1	3/27/1989	4	453.3	-	408.3	119.8	-	164.8
OW405C	BR	572.70	573.1	5/31/1989	4	501.2	-	453.2	71.9	-	119.9
OW405D	BR	572.60	573.1	6/9/1989	6.25	545.6	-	501.2	27.5	-	71.9
OW406B	BR	571.52	571.8	6/8/1989	4	467.9	-	404.4	103.9	-	167.4
OW406C	BR	571.44	571.7	6/14/1989	4	497.6	-	467.8	74.1	-	103.9
OW406D	BR	571.81	572.1	6/16/1989	6.25	548.6	-	497.2	23.5	-	74.9
OW407B	BR	572.05	572.5	5/2/1989	4	465.4	-	450.4	107.1	-	122.1
OW407C	BR	571.27	572.1	5/1/1989	4	479.8	-	465.2	92.3	-	106.9
OW407D	BR	571.32	571.7	5/4/1989	6.25	552.9	-	510.4	18.8	-	61.3
OW408B	BR	575.04	572.0	7/20/1989	4	445.2	-	403.6	126.8	-	168.4
OW408C	BR	575.68	572.7	7/11/1989	4	494.5	-	445.9	78.2	-	126.8
OW408D	BR	576.20	573.1	7/6/1989	6.25	552.1	-	525.0	21.0	-	48.1
OW409B	BR	575.70	572.8	6/20/1989	3	461.8	-	415.9	111.0	-	156.9
OW409C	BR	575.57	573.0	6/26/1989	4	510.1	-	462.0	62.9	-	111.0
OW409D	BR	575.46	575.8	6/28/1989	6.25	552.0	-	509.8	23.8	-	66.0
OW410B	BR	572.32	572.6	6/26/1989	4	441.4	-	407.7	131.2	-	164.9
OW410C	BR	572.57	572.7	7/17/1989	4	486.5	-	471.5	86.2	-	101.2
OW410D	BR	571.96	572.6	6/27/1989	6.25	547.1	-	516.3	25.5	-	56.3
OW411B	BR	574.08	574.8	4/4/1989	4	454.9	-	406.6	119.9	-	168.2
OW411C	BR	574.39	574.8	4/11/1989	4	500.0	-	470.0	74.8	-	104.8
OW411D	BR	574.51	574.8	4/14/1989	6.25	546.7	-	515.2	28.1	-	59.6
OW415B	BR	571.38	571.7	5/31/1989	4	482.1	-	467.1	89.6	-	104.6
OW415C	BR	571.26	571.6	5/30/1989	4	511.9	-	497.1	59.7	-	74.5
OW415D	BR	571.30	571.6	5/31/1989	6.25	548.7	-	511.8	22.9	-	59.8
OW416B	BR	570.00	570.7	5/22/1989	6.25	470.8	-	455.8	99.9	-	114.9
OW416C	BR	569.90	570.6	~5/22/1989	6.25	500.7	-	470.7	69.9	-	99.9
OW416D	BR	569.68	570.3	~5/22/1989	6.25	539.6	-	500.5	30.7	-	69.8
OW417B	BR	572.93	572.7	~5/19/1989	6.25	461.1	-	412.6	111.6	-	160.1
OW417C	BR	572.23	572.9	~5/19/1989	6.25	490.1	-	460.8	82.8	-	112.1
OW417D	BR	572.26	572.5	~5/19/1989	6.25	545.5	-	505.9	27.0	-	66.6
OW418C	BR	569.62	570.1	5/29/2003	4	501.0	-	458.7	69.1	-	111.4
OW418D	BR	569.72	570.1	1/11/2002	6	547.0	-	504.3	23.1	-	65.8
OW419C	BR	570.40	570.7	6/4/2003	4	502.7	-	455.7	68.0	-	115.0
OW419D	BR	570.22	570.8	1/10/2002	6	550.3	-	505.6	20.5	-	65.2
OW420C	BR	571.03	571.3	6/2/2003	4	500.3	-	452.5	71.0	-	118.8
OW420D	BR	570.67	571.2	1/4/2002	6	548.7	-	503.1	22.5	-	68.1
OW649C	BR	567.52	568.0	~10/31/1991	4	488.5	-	458.1	79.6	-	110.0

Table 1.2

Well Construction And Installation Details
Buffalo Avenue Plant

Well	Installation Type (BR/OB)	Top of Riser Elevation	Ground Surface Elevation	Date of Installation	Riser Diameter (in inches)	Monitored Interval Top (AMSL)		Bottom (AMSL)	Top (bgs)		Bottom (bgs)
OW649D	BR	568.29	568.4	10/31/1991	4	549.2	-	510.4	19.1	-	57.9
OW651C	BR	568.62	568.9	10/10/1991	4	507.9	-	477.6	61.1	-	91.3
OW651D	BR	568.53	568.7	~9/16/1991	6	553.2	-	507.7	15.5	-	61.0
OW652B	BR	570.48	570.8	~9/16/1991	4	473.8	-	443.8	97.1	-	127.1
OW652C	BR	570.18	570.6	2/5/1993	4	509.4	-	477.4	61.3	-	93.3
OW652D	BR	569.98	570.3	9/16/1991	4	552.7	-	509.7	17.6	-	60.6
OW653B	BR	572.19	572.6	~2/12/1993	4	475.4	-	451.4	97.2	-	121.2
OW653C	BR	572.12	572.5	2/12/1993	4	503.1	-	478.1	69.4	-	94.4
OW653D	BR	572.00	572.4	9/10/1991	6	552.1	-	503.7	20.3	-	68.7
OW654B	BR	569.53	569.9	~8/27/1991	4	478.8	-	444.3	91.1	-	125.6
OW654C	BR	570.14	570.4	~8/27/1991	4	509.7	-	481.8	60.7	-	88.6
OW654D	BR	570.16	570.4	8/27/1991	6	556.0	-	510.7	14.4	-	59.7
OW655D	BR	571.23	571.5	8/22/1991	6	552.7	-	507.4	18.8	-	64.1
OW657B	BR	570.22	570.6	~4/9/1993	4	472.9	-	439.5	97.7	-	131.1
OW657C	BR	570.42	570.8	~4/9/1993	4	503.7	-	475.7	67.2	-	95.2
OW657D	BR	571.65	570.2	~4/9/1993	4	553.6	-	507.6	16.6	-	62.6
OW658B	BR	570.48	570.9	~4/6/1993	4	473.4	-	439.9	97.6	-	131.1
OW658C	BR	570.66	570.9	~4/6/1993	4	502.9	-	475.8	68.0	-	95.1
OW658D	BR	570.75	571.1	~4/6/1993	4	552.6	-	506.1	18.6	-	65.1
OW659B	BR	570.02	570.5	~3/30/1993	4	474.0	-	440.4	96.5	-	130.1
OW659C	BR	570.00	570.4	~3/30/1993	4	503.9	-	475.8	66.5	-	94.6
OW659D	BR	570.01	570.3	~3/30/1993	4	549.7	-	505.8	20.6	-	64.5
OW660B	BR	579.42	579.9	10/19/1994	4	454.8	-	409.5	125.0	-	170.3
OW661B	BR	568.63	569.1	12/15/1994	4	451.0	-	419.0	118.1	-	150.1
OW661C	BR	568.87	569.2	10/24/1994	4	502.2	-	454.2	67.0	-	115.0
OW661D	BR	568.88	569.3	11/1/1994	4	546.9	-	505.1	22.3	-	64.1
OW662B	BR	569.79	570.1	7/6/1994	4	456.1	-	415.1	114.0	-	155.0
OW662C	BR	569.75	570.0	7/5/1994	4	501.0	-	459.0	69.0	-	111.0
OW662D	BR	569.92	570.2	7/1/1994	4	546.1	-	503.2	24.1	-	67.0
OW663B	BR	571.79	572.2	8/9/1994	4	452.7	-	413.6	119.5	-	158.6
OW663C	BR	572.08	572.4	8/10/1994	4	501.4	-	455.9	71.0	-	116.5
OW663D	BR	572.21	572.3	8/9/1994	4	549.5	-	504.5	22.8	-	67.8
OW664B	BR	571.53	571.9	12/14/1994	4	449.9	-	418.9	122.0	-	153.0
OW664C	BR	571.50	571.8	12/5/1994	4	499.8	-	452.8	72.0	-	119.0
OW664D	BR	571.56	571.9	12/12/1994	4	548.1	-	502.9	23.8	-	69.0
OW665B	BR	573.06	573.4	7/22/1994	4	450.0	-	415.0	123.4	-	158.4
OW665C	BR	573.04	573.3	7/25/1994	4	498.9	-	453.4	74.4	-	119.9
OW665D	BR	573.13	573.4	7/22/1994	4	547.0	-	502.3	26.4	-	71.2
OW666B	BR	571.37	571.6	1/12/1995	4	453.2	-	410.2	118.4	-	161.4
OW666C	BR	571.29	571.7	1/10/1995	4	504.7	-	456.2	67.0	-	115.5
OW666D	BR	571.20	571.6	1/10/1995	4	552.5	-	507.1	19.1	-	64.5
OW667B	BR	576.28	573.5	10/6/1994	4	453.4	-	413.4	120.1	-	160.1
OW667C	BR	575.78	573.0	10/5/1994	4	503.8	-	456.2	69.2	-	116.8
OW667D	BR	576.31	573.5	10/6/1994	4	552.2	-	506.2	21.3	-	67.3
OW668B	BR	570.86	571.3	1/4/1995	4	454.3	-	420.8	117.0	-	150.5
OW668C	BR	570.95	571.2	1/4/1995	4	502.9	-	457.7	68.3	-	113.5
OW668D	BR	571.10	571.3	12/23/1994	4	551.0	-	506.0	20.3	-	65.3
BH1B-88	OB	572.53	572.7	12/20/1988	2	568.8	-	557.8	3.9	-	14.9
BH4-88	OB	572.12	572.5	12/9/1988	2	568.2	-	565.2	4.3	-	7.3
BH7-89	OB	572.32	572.7	5/24/1989	2	560.6	-	553.2	12.1	-	19.5
BH8-89	OB	568.00	568.2	1/6/1989	2	563.4	-	549.4	4.8	-	18.8
CMH1	OB	569.50	568.5	1997	NA	NA	-	558.0	NA	-	10.5
CMH2	OB	569.42	568.5	1997	NA	NA	-	562.5	NA	-	6.0
MH-A	OB	568.89	569.9	Unknown	NA	NA	-	556.5	NA	-	13.4
MH-B	OB	568.87	568.7	Unknown	NA	NA	-	556.5	NA	-	12.2
MH-C	OB	568.88	568.6	Unknown	NA	NA	-	557.0	NA	-	11.6
MH-D	OB	569.89	568.5	Unknown	NA	NA	-	556.3	NA	-	12.2
MH-E	OB	568.81	567.5	Unknown	NA	NA	-	555.8	NA	-	11.7
MH-F	OB	568.90	567.8	1998	NA	NA	-	553.5	NA	-	14.4
OW270	OB	571.55	570.9	10/16/1987	2	564.5	-	545.5	6.4	-	25.4
OW273	OB	570.00	570.3	10/20/1987	2	563.5	-	551.5	6.8	-	18.8
OW300	OB	567.07	567.6	5/25/1989	2	560.5	-	545.0	7.1	-	22.6
OW301	OB	568.38	569.0	7/24/1989	2	564.8	-	557.8	4.2	-	11.2
OW302	OB	569.98	570.1	10/26/1988	2	565.6	-	563.6	4.5	-	6.5
OW303	OB	570.42	570.1	11/2/1988	2	566.3	-	562.3	3.8	-	7.8
OW304	OB	571.50	571.4	10/20/1988	2	565.3	-	560.3	6.1	-	11.1
OW305	OB	572.75	573.2	10/31/1988	2	569.4	-	564.4	3.8	-	8.8
OW306	OB	571.85	571.9	11/15/1988	2	567.9	-	564.9	4.0	-	7.0
OW308	OB	574.24	571.4	11/17/1988	2	567.6	-	564.6	3.8	-	6.8
OW310	OB	572.28	572.8	11/22/1988	2	569.3	-	564.3	3.5	-	8.5

Table 1.2

Well Construction And Installation Details
Buffalo Avenue Plant

Well	Installation Type (BR/OB)	Top of Riser Elevation	Ground Surface Elevation	Date of Installation	Riser Diameter (in inches)	Monitored Interval Top (AMSL)		Bottom (AMSL)	Top (bgs)		Bottom (bgs)
OW313	OB	569.26	568.7	10/13/1988	2	550.8	-	545.8	17.9	-	22.9
OW314	OB	569.04	568.9	6/12/1989	2	565.4	-	553.4	3.5	-	15.5
OW316	OB	569.77	570.1	11/9/1988	2	566.1	-	559.1	4.0	-	11.0
OW317	OB	572.60	572.5	9/26/1988	2	568.8	-	563.8	3.7	-	8.7
OW327	OB	570.75	571.4	2/9/1990	2	567.4	-	565.4	4.0	-	6.0
OW358	OB	571.49	569.0	9/26/1989	2	563.9	-	550.9	5.1	-	18.1
OW553	OB	573.51	573.8	8/27/1991	2	570.1	-	565.1	3.7	-	8.7
OW554	OB	573.83	572.4	9/3/1991	2	568.4	-	563.4	4.0	-	9.0
OW555	OB	571.51	571.7	9/3/1991	2	568.5	-	563.5	3.2	-	8.2
OW556	OB	571.73	571.9	8/30/1991	2	567.8	-	562.8	4.1	-	9.1
OW557	OB	571.69	572.2	5/16/1991	2	567.5	-	562.5	4.7	-	9.7
OW558	OB	571.28	571.2	5/16/1991	2	567.4	-	562.4	3.8	-	8.8
OW559	OB	569.73	570.4	9/10/1991	2	566.7	-	561.7	3.7	-	8.7
OW562	OB	568.49	568.5	12/9/1996	2	555.2	-	550.2	13.3	-	18.3
OW563	OB	567.67	568.0	12/5/1996	2	560.6	-	555.6	7.4	-	12.4
OW564	OB	569.05	569.6	12/11/1996	2	560.4	-	555.4	9.2	-	14.2
OW565	OB	568.89	569.5	12/10/1996	2	557.0	-	552.0	12.5	-	17.5
OW566	OB	568.55	568.8	12/5/1996	2	559.4	-	554.4	9.4	-	14.4
OW567	OB	569.12	569.2	4/23/1998	2	560.1	-	555.1	9.0	-	14.0
OW568	OB	568.26	569.0	4/23/1998	2	560.3	-	555.3	8.7	-	13.7
OW569	OB	567.20	567.7	4/23/1998	2	562.7	-	559.7	5.0	-	8.0
OW570	OB	568.46	568.7	4/23/1998	2	563.6	-	560.6	5.1	-	8.1
OW571	OB	567.80	568.5	4/24/1998	2	566.2	-	561.2	2.3	-	7.3
OW572	OB	567.95	568.3	4/24/1998	2	565.9	-	560.9	2.4	-	7.4
OW573R	OB	573.02	573.5	6/29/2004	2	569.0	-	564.0	4.5	-	9.5
OW574	OB	571.16	571.2	11/15/1999	2	560.8	-	555.8	10.4	-	15.4
OW575	OB	568.40	568.5	1/15/2002	1	564.6	-	559.8	3.9	-	8.7
OW576	OB	568.32	568.5	1/15/2002	1	565.6	-	560.9	2.9	-	7.6
OW577	OB	567.53	567.6	1/15/2002	1	563.3	-	558.0	4.3	-	9.6
OW578	OB	572.21	572.5	6/6/2002	1	568.6	-	564.6	3.9	-	7.9
OWG8	OB	570.66	571.1	6/3/1986	2	566.2	-	564.2	4.9	-	6.9
WS107	OB	573.18	573.7	7/30/1980	1.5	565.6	-	563.6	8.1	-	10.1
WS10A	OB	572.58	569.8	1/16/1979	1.5	567.9	-	552.9	1.9	-	16.9
WS111R	OB	572.35	572.7	6/6/2002	1	568.2	-	565.2	4.5	-	7.5
WS122	OB	571.57	572.3	7/7/1980	1.5	564.6	-	562.6	7.7	-	9.7
WS23A	OB	572.30	572.7	1/29/1979	1.5	570.5	-	565.5	2.2	-	7.2
WS25A	OB	571.10	571.7	1/26/1979	1.5	569.3	-	564.3	2.4	-	7.4
WS7A	OB	569.97	570.0	1/12/1979	1.5	568.4	-	553.4	1.6	-	16.6
WS8A	OB	570.10	570.2	3/19/1979	1.5	566.3	-	551.3	3.9	-	18.9
WW1	OB	570.30	569.3	1997	NA	NA	-	545.3	NA	-	24.0
WW2	OB	569.27	568.8	1997	NA	NA	-	553.8	NA	-	15.0
WWB	OB	573.74	572.7	1980	NA	NA	-	556.7	NA	-	16.0
OW402A	BR	569.34	570.1	1/26/1989	4	409.8	-	380.1	160.3	-	190.0
OW413A	BR	568.71	569.1	5/17/1989	4	390.4	-	368.4	178.7	-	200.7
OW417A	BR	571.70	572.1	5/19/1989	4	412.0	-	387.0	160.1	-	185.1
OW229	BR	568.98	569.6	1/12/1988	4	540.2	-	512.3	29.4	-	57.3
OW243	BR	568.73	569.4	7/23/1987	6	539.4	-	510.5	30.0	-	58.9
OW618	BR	569.36	569.7	9/20/1990	6	541.6	-	511.5	28.1	-	58.2
OW619	BR	574.65	571.33	9/24/1990	6	542.6	-	511.5	28.7	-	59.8
OW620	BR	571.79	571.8	10/26/1994	4	540.6	-	510.6	31.2	-	61.2
OW621	BR	577.56	573.7	7/30/1993	4	542.3	-	512.3	31.4	-	61.4
OW634	BR	578.63	575.2	4/5/1995	8	494.8	-	447.0	80.4	-	128.2
OW638	BR	569.66	569.9	10/28/1993	4	512.6	-	442.8	57.3	-	127.1
OW635	BR	579.93	577.4	4/7/1995	8	436.4	-	408.7	141.0	-	168.7
OW643	BR	573.35	570.1	11/11/1993	4	436.0	-	370.3	134.1	-	199.8
OW320	OB	573.89	574.3	10/3/1988	2	569.6	-	564.6	4.7	-	9.7
OW523	OB	569.53	569.8	12/10/1990	2	548.3	-	543.3	21.5	-	26.5
TW-7	OB	569.76	570.4	10/18/1991	2	565.1	-	562.6	5.3	-	7.8
OW537	OB	570.60	570.9	1/16/1995	2	549.0	-	544.0	21.9	-	26.9

Notes:

ft btoc	Feet below top of casing.
ft AMSL	Feet above mean sea level.
MH	Manhole chamber.
NA	Not applicable.
"--"	Not measured per monitoring schedule.
bgs	Below ground surface.

Table 2.1

Bedrock Groundwater Hydraulic Monitoring Locations
Buffalo Avenue Plant

Well No. [(1)]	Well No. [(1)]
NYPA OW139	OW416 D
BEW700 B	OW417 B
BEW701 B	OW417 C
BEW701 C	OW417 D
BEW701 D	OW418 C
BEW702 B	OW418 D
BEW702 C	OW419 C
BEW702 D	OW419 D
BEW703 B	OW420 C
BEW703 C	OW420 D
BEW703 D	OW649 C
BEW704 B	OW649 D
BEW704 C	OW651 C
BEW704 D	OW651 D
BEW705 B	OW652 B
BEW705 C	OW652 C
BEW705 D	OW652 D
BEW706 B	OW653 B
BEW706 C	OW653 C
BEW706 D	OW653 D
OW400 B	OW654 B
OW401 B	OW654 C
OW401 C	OW654 D
OW401 D	OW655 D
OW402 B	OW657 B
OW402 C	OW657 C
OW402 D	OW657 D
OW403 B	OW658 B
OW403 C	OW658 C
OW403 D	OW658 D
OW404 B	OW659 B
OW404 C	OW659 C
OW404 D	OW659 D
OW405 B	OW660 B
OW405 C	OW661 B
OW405 D	OW661 C
OW406 B	OW661 D
OW406 C	OW662 B
OW406 D	OW662 C
OW407 B	OW662 D
OW407 C	OW663 B
OW407 D	OW663 C
OW408 B	OW663 D
OW408 C	OW664 B
OW408 D	OW664 C
OW409 B	OW664 D
OW409 C	OW665 B

Table 2.1

Bedrock Groundwater Hydraulic Monitoring Locations
Buffalo Avenue Plant

Well No. [1]	Well No. [1]
OW409 D	OW665 C
OW410 B	OW665 D
OW410 C	OW666 B
OW410 D	OW666 C
OW411 B	OW666 D
OW411 C	OW667 B
OW411 D	OW667 C
OW415 B	OW667 D
OW415 C	OW668 B
OW415 D	OW668 C
OW416 B	OW668 D
OW416 C	

Note:

(1) All wells are monitored quarterly.

Table 2.2

Bedrock Groundwater Chemical Monitoring Locations
Buffalo Avenue Plant

Well No.	Well No.
BEW700 B	OW407 B
BEW701 B	OW407 C
BEW701 C	OW407 D
BEW701 D	OW408 B
BEW702 B	OW408 C
BEW702 C	OW408 D
BEW702 D	OW409 B
BEW703 B	OW409 C
BEW703 C	OW409 D
BEW703 D	OW410 B
BEW704 B	OW410 C
BEW704 C	OW410 D
BEW704 D	OW649 C
BEW705 B	OW649 D
BEW705 C	OW651 C
BEW705 D	OW651 D
BEW706 B	OW652 B
BEW706 C	OW652 C
BEW706 D	OW652 D
OW403 B	OW653 B
OW403 C	OW653 C
OW403 D	OW653 D
OW404 C	OW654 B
OW405 C	OW654 C
OW406 C	

Note:

(1) All wells are monitored annually.

Table 2.3

Bedrock Groundwater Chemical Monitoring Parameters
Buffalo Avenue Plant

Parameters	Units	Reporting Limit
1,2,3-Trichlorobenzene	µg/L	1
1,2,4-Trichlorobenzene	µg/L	1
1,2-Dichlorobenzene	µg/L	1
1,3-Dichlorobenzene	µg/L	1
1,4-Dichlorobenzene	µg/L	1
2,3,6-Trichlorotoluene	µg/L	1
2,3/3,4-Dichlorotoluene	µg/L	1
2,4,5-Trichlorotoluene	µg/L	1
2,4-Dichlorobenzotrifluoride	µg/L	1
2,4/2,5/2,6-Dichlorotoluene	µg/L	1
2-Chlorotoluene	µg/L	1
3,4-Dichlorobenzotrifluoride	µg/L	1
4-Chlorotoluene	µg/L	1
Benzene	µg/L	1
Chlorobenzene	µg/L	1
2-Monochlorobenzotrifluoride	µg/L	1
4-Monochlorobenzotrifluoride	µg/L	1
Tetrachloroethene	µg/L	1
Toluene	µg/L	1
Trichloroethene	µg/L	1
Vinyl chloride	µg/L	1
1,2,3,4-Tetrachlorobenzene	µg/L	5
1,2,4,5-Tetrachlorobenzene	µg/L	5
2,4,5-Trichlorophenol	µg/L	10
Hexachlorobenzene	µg/L	5
Hexachlorobutadiene	µg/L	5
Hexachlorocyclopentadiene	µg/L	5
Octachlorocyclopentene	µg/L	5
alpha-BHC	µg/L	0.05
beta-BHC	µg/L	0.05
delta-BHC	µg/L	0.05
gamma-BHC (Lindane)	µg/L	0.05
Mirex	µg/L	0.05
Alkalinity, Total (As CaCO3)	mg/L	5,000

Note:

BHC Benzene Hexachloride

Table 2.4

Bedrock NAPL Monitoring and Collection Locations
Buffalo Avenue Plant

Well No.	Well No.
NYPA OW139	OW419 C
OW400 A	OW419 D
OW400 B	OW420 C
OW401 A	OW420 D
OW401 B	OW649 C
OW401 C	OW649 D
OW401 D	OW651 C
OW402 A	OW651 D
OW402 B	OW652 B
OW402 C	OW652 C
OW402 D	OW652 D
OW403 A	OW653 B
OW403 B	OW653 C
OW403 C	OW653 D
OW403 D	OW654 B
OW404 A	OW654 C
OW404 B	OW654 D
OW404 C	OW657 B
OW404 D	OW657 C
OW405 A	OW657 D
OW405 B	OW658 B
OW405 C	OW658 C
OW405 D	OW658 D
OW406 A	OW659 B
OW406 B	OW659 C
OW406 C	OW659 D
OW406 D	OW660 B
OW407 A	OW661 B
OW407 B	OW661 C
OW407 C	OW661 D
OW407 D	OW662 B
OW408 A	OW662 C
OW408 B	OW662 D
OW408 C	OW663 B
OW408 D	OW663 C
OW409 A	OW663 D
OW409 B	OW664 B
OW409 C	OW664 C
OW409 D	OW664 D
OW410 B	OW665 B
OW410 C	OW665 C
OW410 D	OW665 D
OW411 A	OW666 B
OW411 B	OW666 C
OW411 C	OW666 D
OW411 D	OW667 B

Table 2.4

Bedrock NAPL Monitoring and Collection Locations
Buffalo Avenue Plant

Well No.	Well No.
OW412 A	OW667 C
OW413 A	OW667 D
OW413 B	OW668 B
OW414 A	OW668 C
OW415 A	OW668 D
OW415 B	
OW415 C	**S-area Bedrock**
OW415 D	**Wells in N-Area**
OW416 A	OW229
OW416 B	OW243
OW416 C	OW618
OW416 D	OW619
OW417 A	OW620
OW417 B	OW621
OW417 C	OW634
OW417 D	OW638
OW418 C	OW635
OW418 D	OW643

Notes:

S-area bedrock wells in N-area monitored quarterly.
All other wells monitoring annually.

Table 3.1

Overburden Groundwater Hydraulic Monitoring Locations
Buffalo Avenue Plant

Well No.	Monitoring Frequency	Well No.	Monitoring Frequency
BH7-89	quarterly	OW572	quarterly
BH8-89	quarterly	OW575	quarterly
CMH1	monthly	OW576	quarterly
CMH2	monthly	OW577	quarterly
MHA	quarterly	WS8A	quarterly
MHB	quarterly	WS10A	quarterly
MHC	quarterly	WS107	quarterly
MHD	quarterly	WW'B'	quarterly
MHE	quarterly	WW1	quarterly
MHF	quarterly	WW2	quarterly
OW270	quarterly	BH1B-88	annually
OW273	quarterly	BH4-88	annually
OW300	quarterly	OWG8	annually
OW301	quarterly	OW302	annually
OW308	quarterly	OW303	annually
OW313	quarterly	OW304	annually
OW314	quarterly	OW305	annually
OW316	quarterly	OW306	annually
OW358	quarterly	OW310	annually
OW553	quarterly	OW317	annually
OW554	quarterly	OW327	annually
OW555	quarterly	OW557	annually
OW556	quarterly	OW558	annually
OW562	quarterly	OW559	annually
OW563	quarterly	OW573R	annually
OW564	quarterly	OW574	annually
OW565	quarterly	OW578	annually
OW566	quarterly	WS23A	annually
OW567	quarterly	WS25A	annually
OW568	quarterly	WS111R	annually
OW569	quarterly	WS122	annually
OW570	quarterly		
OW571	quarterly		

Table 3.2

Overburden Groundwater Chemical Monitoring Locations
Buffalo Avenue Plant

Well No.	Monitoring Frequency	Monitoring Frequency (Mercury)
MH159L	annual	--
MH301	annual	--
OW270	annual	--
OW273	annual	--
OW300	annual	--
OW303	annual	--
OW304	annual	annual
OW305	annual	annual
OW306	annual	annual
OW310	annual	--
OW314	annual	--
OW537	annual	--
OW553	annual	--
OW554	annual	--
OW555	annual	--
OW556	annual	--
OW557	annual	--
OW558	annual	--
OW559	annual	--
OW560	annual	--
OW565	annual	--
OW567	annual	--
OW573R	annual	--
OW574	annual	semi-annual
WWB (EBDTS)	annual	--
WW1	annual	--
WW2	annual	--

Note:

-- Not applicable.

Table 3.3

Overburden Groundwater Chemical Monitoring Parameters
Buffalo Avenue Plant

Parameters	**Units**	**Reporting Limit**
1,2,4-Trichlorobenzene	µg/L	1
1,2-Dichlorobenzene	µg/L	1
1,3-Dichlorobenzene	µg/L	1
1,4-Dichlorobenzene	µg/L	1
2,4/2,5/2,6-Dichlorotoluene	µg/L	1
2-Chlorotoluene	µg/L	1
3,4-Dichlorobenzotrifluoride	µg/L	1
4-Chlorotoluene	µg/L	1
Benzene	µg/L	1
Chlorobenzene	µg/L	1
Mercury (1)	µg/L	0.4
o-Monochlorobenzotrifluoride	µg/L	1
p-Monochlorobenzotrifluoride	µg/L	1
Tetrachloroethene	µg/L	1
Toluene	µg/L	1
Trichloroethene	µg/L	1
1,2,3,4-Tetrachlorobenzene	µg/L	5
1,2,4,5-Tetrachlorobenzene	µg/L	5
2,4,5-Trichlorophenol	µg/L	10
alpha-BHC	µg/L	0.05

Note:

(1) Groundwater samples collected from monitoring wells OW304, OW305, OW306, and OW574 are analyzed for mercury, in addition to remaining parameters.

Table 3.4

Overburden NAPL Monitoring and Collection Locations
Buffalo Avenue Plant

Well No.	Monitoring Frequency	Well No.	Monitoring Frequency
003 N. Sump	quarterly	OW327	annual
003 S. Sump	quarterly	OW553	annual
WWA (EBDTS)	quarterly	OW554	annual
OW306	annual	OW555	annual
OW313	semi-annual	OW556	annual
OW317	annual	OW557	annual
OW320	annual	OW558	annual
OW358	annual	OW559	annual
OW523	annual	OW560	annual
OW537	annual	OW561	annual
OW562	annual	OW564	annual
OW563	annual	OW565	annual
OW572	semi-annual	OW566	annual
OW577	annual	OW567	annual
TW-7	annual	OW568	annual
BH1B-88	annual	OW569	annual
BH4-88	annual	OW570	annual
BH7-89	annual	OW571	annual
BH8-89	annual	OW574	annual
MH117 (F-area Sump)	annual	OW575	annual
MH127	annual	OW576	annual
MH426 (M-22 Sump)	annual	OW578	annual
MH716 (Former 003)	annual	SP5A	annual
OWG8	annual	SP6A	annual
OW270	annual	V-area N. Sump	annual
OW273	annual	V-area S. Sump	annual
OW300	annual	WS7A	annual
OW301	annual	WS10A	annual
OW302	annual	WS23A	annual
OW303	annual	WS25A	annual
OW304	annual	WS111R	annual
OW305	annual	WS122	annual
OW310	annual		
OW314	annual		
OW316	annual		
OW324	annual		

Appendices

Appendix A
Quality Assurance Project Plan

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Table Index

1. Introduction

This Quality Assurance Project Plan (QAPP) is Site-specific and has been prepared for the Bedrock Groundwater Monitoring Program and the Overburden Groundwater Monitoring Program for the Occidental Chemical Buffalo Avenue Plant (Site), located in Niagara Falls, New York.

The objectives of this QAPP are to provide data and documentation to meet the groundwater monitoring requirements in the Performance Monitoring Plan; Final Corrective Measures (revised March 2003). This QAPP provides comprehensive information regarding the project personnel responsibilities, and sets forth specific procedures to be used during sampling of groundwater and analyses of data.

2. Project Background

A detailed description of the history and background information for the Site is presented in the Performance Monitoring Plan; Final Corrective Measures, revised March 2003.

2.1 General

This QAPP provides quality assurance/quality control (QA/QC) criteria for work efforts associated with sample analyses of groundwater. Methods for sample analyses have been selected to provide results which characterize the samples, such that the sampling objectives can be met.

3. Project Organization and Responsibility

A brief description of the duties of the key project personnel is presented below.

Project Manager – John Pentilchuk

- Provides day-to-day project management.
- Provides managerial guidance to the QA/QC Officer - Sampling and Analytical Activities.
- Prepares and reviews reports.
- Conducts preliminary chemical data interpretation and assessment.
- Responsible for overall project completion in accordance with the approved design.

QA/QC Officer - Sampling and Analytical Activities – Susan Scrocchi

i) Oversees and reviews laboratory activities.

ii) DeterminPes laboratory data corrective action.

iii) Performs analytical data validation and assessment.

iv) Reviews laboratory QA/QC.

v) Assists in preparation and review of final report.

vi) Provides technical representation for analytical activities.

vii) Provides managerial and technical guidance to the Field Sampling Supervisor.

Field Sampling Supervisor

i) Provides immediate supervision of all on-Site activities.

ii) Provides field management of sample collection and field QA/QC.

iii) Provides technical representation for field activities.

iv) Is responsible for maintenance of the field equipment.

Laboratory - Project Manager, Analytical Contractor

i) Ensures resources of laboratory are available on an as-required basis.

ii) Coordinates laboratory analyses.

iii) supervises laboratory's in-house Chain of Custody.

iv) Schedules analyses of samples.

v) Oversees review of data.

vi) Oversees preparation of analytical reports.

vii) Approves final analytical reports.

Laboratory - Quality Assurance/Quality Control Officer, Analytical Contractor

i) Overviews laboratory QA/QC.

ii) Overviews QA/QC documentation.

iii) Conducts detailed data review.

iv) Decides laboratory corrective actions, if required.

v) Provides technical representation for laboratory QA/QC procedures.

Laboratory - Sample Custodian - Analytical Contractor

i) Receives and inspects the sample containers.

ii) Records the condition of the sample containers.

iii) Signs appropriate documents.

iv) Verifies Chain of Custody and their correctness.

v) Notifies laboratory Project Manager and laboratory QA/QC Officer of sample receipt and inspection.

vi) Assigns a unique laboratory identification number correlated to the field sample identification number, and enters each into the sample receiving log.

vii) Initiates transfer of samples to the appropriate lab sections with assistance from the laboratory project manager.

viii) Controls and monitors access to and storage of samples and extracts.

The analytical laboratory selected to perform the environmental analyses will be performed by a New York State Department of Health (NYSDOH) approved laboratory, under the National Environmental Laboratory Approval Program (NELAP).

4. Project Objectives

4.1 Quality Assurance Objectives for Measurement Data

The overall QA objective is to develop and implement procedures for sample collection and analyses which will provide data with an acceptable level of accuracy and precision.

Quality assurance measures for this project will begin with sample containers. Sample containers for waters will be purchased from a certified manufacturer and will be precleaned (I-Chem Series 200 or equivalent).

4.2 Laboratory Quality Assurance

The following subsections define the QA goals required to meet the Data Quality Objectives (DQOs) of the project.

4.2.1 Accuracy, Precision, and Sensitivity of Analyses

The fundamental QA objective with respect to the accuracy, precision, and sensitivity of analytical data is to meet the QC acceptance criteria of each analytical protocol. Analytical methods and targeted detection limits listed have been specified to meet the groundwater protection standards.

A summary of the targeted detection limits is provided in Tables A.4.1 and A.4.2. It should be noted that these limits are targeted detection limits only; limits are highly matrix dependent and may not always be achieved.

The method accuracy (percent recovery) will be determined by spiking selected samples (matrix spikes) with the method recommended spiking compounds. Accuracy will be reported as the percent recovery of the spiking compound(s) and will compare with the criteria given in the appropriate methods, as identified in Section 7.0.

The method(s) precision (reproducibility between duplicate analyses) will be determined based on the duplicate analysis of matrix spike samples for organic parameters and duplicate sample analyses for inorganic parameters. Precision will be reported as Relative Percent Differences (RPDs) between duplicate analyses; acceptance criteria will be as specified in the appropriate methods identified in Section 7.0.

4.2.2 Completeness, Representativeness and Comparability

A completeness requirement of 90 percent will be targeted for the program (see Section 13.1.3 for definition of completeness).

The quantity of samples to be collected has been estimated in an effort to effectively represent the population being studied. A summary of the sampling and analysis program is presented in Table A.4.3.

5. Sampling Procedures

The sample collection procedures are described in the Groundwater Monitoring Plan.

The sample container, preservation, shipping, and packaging requirements are identified in Table A.5.1 and Section 6.3.

6. Sample Custody and Document Control

The following documentation procedures will be used during sampling and analysis to provide Chain of Custody control during transfer of samples from collection through storage. Recordkeeping documentation will include use of the following:

i) Field logbooks (bound with numbered pages) to document sampling activities in the field.

ii) Labels to identify individual samples.

iii) Chain of Custody record sheet to document analyses to be performed.

iv) Laboratory sample custody logbook.

6.1 Field Logbook

The field team may use bound notebooks, sample collection logs, or electronic journals to record daily logs, sampling events, and field observations. Regardless of the media, entries should be dated and signed (or initialed) by the person making the entry. Entries on paper should be made with waterproof ink. The type of information to be recorded in the field includes:

i) Date.

ii) Time.

iii) Field calibrations performed during the sampling.

iv) Location and Sample ID.

v) Pertinent health and safety concerns.

vi) Up/downgradient or clean/contaminated designation.

vii) Physical condition of well.

viii) Depth of well (both installed and measured).

ix) Weather conditions (temperature, cloud cover, humidity, wind, etc.).

x) Sample crew and/or Agency names.

xi) Work progress.

xii) Measuring point elevation.

xiii) Depth to water.

xiv) Purge volume.

xv) Purge time (start/stop).

xvi) Recharge time.

xvii) Time of sample collection.

xviii) Important field observations regarding purge or sample water or conditions related to sample integrity.

xix) QA/QC samples.

xx) Name of laboratory(ies) performing analysis.

xxi) Delays.

xxii) Comments (e.g., unusual situations, well damage, departure from established QA/QC field procedures, instrument problems, accidents, etc.).

6.2 Sample Numbering

A sample numbering system will be used to uniquely identify each collected sample. This system will provide a tracking number to allow retrieval and cross-referencing of sample information. An example sample numbering system is described as follows:

Example: GW-7478-081007– AA–XXX

Where:

GW: Designates sample type
(GW=Groundwater) (S=Soil) (SE=Sediment)

7478: Project number

081007: Date of collection (mm/dd/yy)

AA: Sampler initials

XXX: Unique sample number

QC samples will also be numbered with a unique sample number, with the exception of matrix spikes and matrix spike duplicates.

Sample labels shall be affixed to each sample container (not the caps). The labels shall be completed in waterproof ink. All labels (except weatherproof labels) should be taped to the sample containers with clear package sealing tape. The labels will include the following information:

i) Sample number/identification code.

ii) Name/initials of sampler.

iii) Date and time of sample collection.

iv) Site name.

v) Project number.

vi) Required analysis.

vii) Type of preservation (if applicable).

6.2.1 Chain of Custody Records

Chain of Custody forms will be completed for all samples collected during the program.

The Chain of Custody form will document the transfer of sample containers. Custody seals will be placed on each cooler. The cooler will then be sealed with packing tape. Sample container labels will include sample number, place of collection and date and time of collection. All samples will be refrigerated using wet ice at <6°C and delivered to the analytical laboratory within 24 to 48 hours of collection. All samples will be delivered to the laboratory by commercial courier or Contractor personnel. All samples will be stored at <6°C at the laboratory.

The Chain of Custody record, completed at the time of sampling, will contain, but not be limited to, the sample number, date and time of sampling, and the name of the sampler. The Chain of Custody document will be signed, timed, and dated by the sampler when transferring the samples.

Each sample cooler being shipped to the laboratory will contain a Chain of Custody form. The Chain of Custody form will consist of two originals which will be distributed as follows:

i) The shipper will maintain one original while the other will be enclosed in a waterproof envelop within the cooler with the samples.

ii) The cooler will then be sealed properly for shipment.

iii) The laboratory, upon receiving the samples, will complete the original and make copies.

iv) The laboratory will maintain a copy for their records.

v) One copy will be returned to the Laboratory QA/QC Officer upon receipt of the samples by the laboratory.

vi) The laboratory original will be returned to the Data Management Consultant with the data deliverables package.

6.3 Transfer of Custody and Shipment

The following procedures will be used when transferring custody of samples:

- Samples will always be transferred with a Chain of Custody record. When transferring samples, the individuals relinquishing and receiving them will sign, date, and note the time on the record. This record documents sample custody transfer from the sampler, often through another person, to the laboratory. Upon arrival at the laboratory, internal custody procedures will be followed.
- Samples will be packaged properly for shipment and be dispatched to the appropriate laboratory for analysis, with a separate custody record accompanying each shipment. Shipping containers will be sealed for shipment to the laboratory. At least one copy of the Chain of Custody should be sealed within the shipping container. One copy should be retained at the Site, and a photocopy should be transmitted to the Laboratory Coordinator listed in Table A.5.1. The method of shipment, courier name, tracking number, and other pertinent information will be entered in the remarks section of the custody record.
- All shipments will be accompanied by the Chain of Custody record, which identifies the contents of the containers. The original record will accompany the shipment and a copy will be retained by the field sampler.

- Proper documentation will be maintained for shipments by common carrier (i.e., waybills or bills of lading). (Note: Most common carriers [i.e., FedEx or UPS] will not sign Chain of Custody records.)

The following procedures will be followed when shipping samples for laboratory analysis:

- Samples requiring refrigeration will be promptly chilled with wet ice to a temperature of 4°C and packaged (with bubble wrap to prevent bottle breakage) in an insulated cooler for transport to the analytical laboratory.
- Only shipping containers, which meet all applicable State and Federal standards for safe shipment, will be used.
- The shipping containers will be sealed with tape and a Chain of Custody seal. Tape is wrapped around the cooler in two locations (across hinges), and the custody seal is placed across the cooler opening. This allows the receiver to quickly identify any tampering that may have taken place during transport to the laboratory.
- A copy of the field Chain of Custody document will be placed inside the shipping container in a sealed plastic envelope (ziplock bag).
- Shipping of all analytical samples will be by overnight courier. Samples should be shipped to the laboratory within 48 hours of collection.

6.4 Sample Documentation In the Laboratory

Upon receipt of the cooler at the laboratory, the shipping cooler and the custody seal will be inspected by the Sample Custodian. The condition of the cooler and the custody seal will be noted on the Chain of Custody record sheet by the Sample Custodian. The Sample Custodian will record the temperature of one sample (or temperature blank) from each cooler and the temperature will be noted on the Chain of Custody. If the shipping cooler seal is intact, the sample containers will be accepted for analyses. The Sample Custodian will document the date and time of receipt of the container, and sign the form.

If damage or discrepancies are noticed (including sample temperature exceedances), they will be recorded in the remarks column of the record sheet, dated and signed. Any damage or discrepancies will be reported to the Laboratory Project Manager and Laboratory QA/QC Officer before samples are processed.

Each sample or group of samples shipped to the laboratory for analysis will be given a unique identification number. The Sample Custodian will record the client name, number of samples and date of receipt of samples in the Sample Control Logbook. Samples removed from storage for analyses will be documented in the Sample Control Logbook.

The laboratory will be responsible for maintaining analytical logbooks and laboratory data as well as a sample (on hand) inventory for submittal to Glenn Springs Holdings, Inc. (GSHI) on an "as required" basis. Raw laboratory data produced from the analysis of samples submitted for this program will be inventoried and maintained by the laboratory for a period of 5 years at which time GSHI will advise the laboratory regarding the need for additional storage.

6.5 Storage of Samples

After the Sample Custodian has completed the Chain of Custody forms and the incoming sample log, the Chain of Custody will be checked to ensure that all samples are stored in the appropriate locations. All samples will be stored within an access controlled custody room and will be maintained at <6°C until all analytical work is complete.

7. Analytical Procedures for Chemical Analyses

Samples collected for laboratory chemical analyses will be analyzed for the parameters listed in Tables A.4.1 and A.4.2, using the methods cited in Table A.4.3. These methods have been selected to meet the DQOs for each sampling activity. Table A.9.1 describes the minimum of deliverables required by the laboratory. However, supplemental requests for additional QA/QC data including raw chromatograms and spectra, etc., may be made periodically by GSHI or its representative.

All sample results will be calculated using external standards with the exception of the samples analyzed by gas chromatograph/mass spectrometer (GC/MS); these methods employ the use of internal standards or isotopic dilution for analyte quantitation. The specific procedures for target analyte quantitation are detailed in the appropriate analytical methods.

8. Calibration Procedures and Frequency

Calibration of instrumentation is required to ensure that the analytical system is operating correctly and functioning at the proper sensitivity to meet established reporting limits. Each instrument is calibrated with standard solutions appropriate to the type of instrument and the linear range established for the analytical method. The frequency of calibration and the concentration of calibration standards is determined by the manufacturers guidelines, the analytical method, or the requirements of special contracts.

A bound notebook will be kept with each instrument requiring calibration in which the activities associated with QA monitoring and repairs program will be recorded. These records will be checked during periodic equipment review and internal and external QA/QC audits.

8.1 Gas Chromatography/Mass Spectrometry (GC/MS)

It is necessary to establish that a given GC/MS meets the standard mass spectral abundance criteria prior to initiating any ongoing data collection. This is accomplished through the analyses of tuning compounds as specified in the analytical methods.

Calibration of the GC/MS system will be performed daily at the beginning of the day or with each 12 hours of instrument operating time. All method-specified calibration criteria must be met prior to sample analyses. All calibrations must be performed using either average response factors or first-order linear regression (with a correlation coefficient requirement of ≥0.995). Higher order fits will not be allowed.

8.2 High Resolution Gas Chromatography/High Resolution Mass Spectrometry (HRGC/HRMS)

All calibration and quantitation will be in accordance with the cited method.

8.3 Gas Chromatography (GC)

Quantification of samples that are analyzed by GC/MS with element selective detectors shall be performed by external standard calibration. Standards containing the compounds of interest will be analyzed at a minimum of three concentrations to establish the linear range of the detector. Single point calibration will be performed at the beginning of each day and at every tenth injection. The response factors from the single point calibration will be checked against the average response factors from multi-level calibration. If deviations in response factors are greater than those allowed by the analytical method protocols, then system recalibration will be performed. Alternatively, fresh calibration standards will be prepared and analyzed to verify instrument calibration.

All method-specified calibration criteria must be met prior to sample analyses. All calibrations must be performed using either average response factors or first-order linear regression (with a correlation coefficient requirement of ≥0.995). Higher order fits will not be allowed.

8.4 Instrumentation for Inorganic Analyses

Inductively coupled argon plasma (ICAP) instrumentation, including inductively coupled plasma/mass spectrometer (ICP/MS), will be calibrated using a minimum of a blank and one standard. Mercury and cyanide instrumentation will be calibrated using a blank and a minimum of three calibration standards (four for mercury), with a correlation coefficient requirement of ≥0.995. All remaining method-specified calibration procedures will be performed and acceptance criteria will be met prior to sample analyses.

9. Data Reduction, Validation Assessment and Reporting

9.1 General

The contract laboratory will perform analytical data reduction and validation in-house under the direction of the Laboratory QA/QC Officer. The Laboratory QA/QC Officer will be responsible for assessing data quality and advising of any data which were rated "preliminary" or "unacceptable" or other qualifications based on the QC criteria outlined in the relevant methods, which would caution the data user of possible unreliability. Data reduction, validation and reporting by the laboratory will be conducted as detailed in the following:

i) Raw data produced and checked by the responsible analysts is turned over for independent review by another analyst.

ii) The area supervisor reviews the data for attainment of quality control criteria presented in the referenced analytical methods.

iii) Upon completion of all reviews and acceptance of the raw data by the laboratory operations manager, a computerized report will be generated and sent to the Laboratory QA/QC Officer.

iv) The Laboratory QA/QC Officer will complete a thorough inspection of all reports.

v) The Laboratory QA/QC Officer and area supervisor will decide whether any sample reanalysis is required.

vi) Upon acceptance of the preliminary reports by the Laboratory QA/QC Officer, final reports will be generated and signed by the Laboratory Project Manager.

Validation of the analytical data will be performed by the QA/QC Officer - Sampling and Analytical Activities. The data validation will be performed in accordance with the following documents: "USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Superfund Data Review", United States Environmental Protection Agency (USEPA) 540-R-10-011, January 2010; and "USEPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review", USEPA 540-R-08-01, June 2008.

Assessment of analytical and in-house data will include checks on data consistency by looking for comparability of duplicate analyses, comparability to previous data from the same sampling location (if available), adherence to accuracy and precision control criteria detailed in this QAPP and anomalously high or low parameter values. The results of these data validations will be reported to the Project Manager and the contract laboratory, noting any discrepancies and their effect upon acceptability of the data.

Raw data from field measurements and sample collection activities that are used in project reports will be appropriately identified and appended to the report. Where data have been reduced or summarized, the method of reduction will be documented in the report. Field data will be audited for anomalously high or low values that may appear to be inconsistent with other data.

9.2 Laboratory Reporting, Data, Presentation and Final Report

Reporting and deliverables shall include, but not be limited to, all items listed in Table A.9.1.

All sample data and corresponding QA/QC data as specified in the analytical methods, shall be maintained accessible either in hard copy or on magnetic tape or disk (computer data files).

The laboratory will submit one copy of the final analytical report within 10 business days of receipt of the final sample included in the sample delivery group (SDG). An electronic copy of the results and QC in EQuIS format will also be required with the hard copy.

9.3 Document Control System

A document control system ensures that all documents are accounted for when the project is complete.

A project number will be assigned to the project. This number will appear on sample identification tags, logbooks, data sheets, control charts, project memos and analytical reports, document control logs, corrective action forms and logs, QA plans, and other project analytical records.

9.4 QC Check Points and Data Flow

The following specific QC check points will be common to all metals, GC, and GC/MS analyses. They are presented with the decision points.

Chemist - Bench Level checks:

- Systems check: sensitivity, linearity, and reproducibility within specified limits.
- Duplicate analyses within control limits.
- Matrix spike results within control limits.
- Surrogate spike results within control limits (organics only).
- Calculation/data reduction checks: calculations cross-checked, any discrepancies between forms and results evident, results tabulated sequentially on the correct forms.

Laboratory Project Manager:

- Systems operating within limits.
- Data transcription correct.
- Data complete.
- Data acceptable.

Sample Control:

- Samples returned to sample control following analysis.

Laboratory QA/QC Officer:

- QA objectives met.
- QC checks are completed.
- Final data and report package is complete.

10. Internal Quality Control Checks and Frequency

10.1 QC for Laboratory Analyses

Specific procedures related to internal laboratory QC samples are described in the following subsections.

10.1.1 Reagent Blanks

A reagent blank will be analyzed by the laboratory at a frequency of one blank per analytical batch. The reagent blank, an aliquot of analyte-free water or solvent, will be carried through the entire analytical procedure.

10.1.2 Matrix Spike/Matrix Spike Duplicate (MS/MSD)/Analyses

An MS/MSD sample will be analyzed for organic parameters and a duplicate and MS will be analyzed for inorganic parameters at a minimum frequency of one per analytical batch. Acceptable criteria and analytes that will be used for MS are identified in the methods. Where method specified limits were not available, general control limits were used. Percent spike recoveries will be used to evaluate analytical accuracy while percent relative standard deviation or the RPD between duplicate analyses will be used to assess analytical precision.

10.1.3 Surrogate Analyses

Surrogates are organic compounds which are similar to the analytes of interest, but which are not normally found in environmental samples. Surrogates are added to samples to monitor the effect of the matrix on the accuracy of the analysis. Every blank, standard and environmental sample analyzed by GC or GC/MS, including MS/MSD samples, will be spiked with surrogate compounds prior to sample preparation.

The compounds that will be used as surrogates and the levels of recommended spiking are specified in the methods. Surrogate spike recoveries must fall within the control limits specified in the methods. If surrogate recoveries are excessively low (<10 percent), the laboratory will contact the QA/QC Officer-Sampling and Analytical Activities for further instructions. Dilution of samples to bring the analyte concentration into the linear range of calibration may dilute the surrogates out of the quantification limit. Reanalysis of these samples is not required. Assessment of analytical quality in these cases will be based on the MS/MSD sample analysis results.

10.2 QC for Field Sampling

To assess the quality of data resulting from the field sampling program, field duplicate and field blank samples will be collected (where appropriate) and submitted to the analytical laboratory as samples.

10.2.1 Field (Rinse) Blanks

When well-dedicated equipment is not used and/or on the first sampling event in which non-certified clean equipment is used, field blanks will be used during the sampling programs to detect contamination introduced through sample collection procedures and equipment, external field conditions, sample transport, sample container preparation, sample storage, and/or the analytical process.

10.2.2 Trip Blanks

Trip blanks for volatile analyses will be prepared by the laboratory using analyte-free water and submitted with the sample collection containers. Trip blanks will be kept unopened in the field with sample bottles. Two trip blanks will be transported to the laboratory on a daily basis with each batch of aqueous volatile samples. The laboratory will analyze trip blanks as samples.

10.2.3 Field Duplicate Samples

Field duplicate samples will be collected and used to assess the aggregate precision of sampling techniques and laboratory analysis. For every 20 investigative samples, a field duplicate sample will be collected using standard sampling procedures. This duplicate will be packed and shipped to the laboratory for analysis.

11. Performance and System Audits

For the purpose of external evaluation, performance evaluation check samples are analyzed periodically by the laboratory. Internally, the evaluation of data from these samples is done on a continuing basis over the duration of a given project.

The QA/QC Officer-Sampling and Analytical Activities may carry out performance and/or systems audits to insure that data of known and defensible quality are consistently produced during this program.

Systems audits are qualitative evaluations of all components of field and laboratory quality control measurement systems. They determine if the measurement systems are being used appropriately. The audits may be carried out before all systems are operational, during the program, or after completion of the program. Such audits typically involve a comparison of the activities given in the QA/QC Plan described herein, with activities actually scheduled or performed. A special type of systems audit is the data management audit. This audit addresses only data collection and management activities.

The performance audit is a quantitative evaluation of the measurement systems used for a monitoring program. It requires testing the measurement systems with samples of known composition or behavior to quantitatively evaluate precision and accuracy. A performance audit may be carried out by or under the auspices of the QA/QC Officer-Sampling and Analytical Activities without the knowledge of the analyst during each sampling event for this program.

It should be noted, however, that any additional external QA audits will only be performed if deemed necessary.

12. Preventative Maintenance

This section applies to both field and laboratory equipment. Specific preventive maintenance procedures for field equipment will be consistent with the manufacturer's guidelines. Specific preventive maintenance protocols for laboratory equipment will be consistent with the contract laboratory's Standard Operating Procedures (SOPs).

All analytical instruments to be used in this project will be serviced by laboratory personnel at regularly scheduled intervals in accordance with the manufacturers' recommendations. Instruments may also be serviced at other times due to failure. Requisite servicing beyond the abilities of laboratory personnel will be performed by the equipment manufacturer or their designated representative.

Routine maintenance of the instruments will be performed as per manufacturers' recommendations. The Laboratory Project Manager is responsible for the preventive maintenance of the instruments.

13. Specific Routine Procedures Uses to Assess Data Precision, Accuracy and Completeness

13.1 QA Measurement Quality Indicators

13.1.1 Precision

Precision will be assessed by comparing the analytical results between duplicate spike analyses. Precision as percent relative difference will be calculated as follows for values significantly greater than the associated detection limit:

$$\text{Precision} = \left| \frac{(D_2 - D_1)}{(D_1 + D_2)/2} \right| \times 100$$

Where:

D_1 = Matrix spike recovery

D_2 = Matrix spike duplicate spike recovery

For results near the associated detection limits, precision will be assessed based on the following criteria:

$$\text{Precision} = \left| \text{Original result - duplicate result} \right| < \text{CRDL}^{1}$$

13.1.2 Accuracy

Accuracy will be assessed by comparing a set of analytical results to the accepted or "true" values that would be expected. In general, MS/MSD and check sample recoveries will be used to assess accuracy. Accuracy as percent recovery will be calculated as follows:

$$\text{Accuracy} = \frac{A - B}{C} \times 100$$

Where:

A = The analyte determined experimentally from the spike sample.

B = The background level determined by a separate analysis of the unspiked sample.

C = The amount of spike added.

In some cases, MS and/or MSD recoveries may not be available due to elevated levels of the spiked analyte in the investigative sample. In such cases, accuracy will be assessed based on surrogate spike recoveries and/or laboratory control samples.

13.1.3 Completeness

Completeness is a measure of the amount of valid data obtained from a measurement system compared with the amount that was expected to be obtained under normal conditions.

[1] CRDL - Contract Required Detection Limit.

To be considered complete, the data set must contain all QC check analyses verifying precision and accuracy for the analytical protocol. In addition, all data are reviewed in terms of stated goals in order to determine if the database is sufficient.

When possible, the percent completeness for each set of samples will be calculated as follows:

$$\text{Completeness} = \frac{\text{usable data obtained}}{\text{total data planned}} \times 100 \text{ percent}$$

13.1.4 Outliers

Procedures discussed previously will be followed for documenting deviations. In the event that a result deviates significantly from method established control limits, this deviation will be noted and its effect on the quality of the remaining data assessed and documented.

14. Corrective Action

The need for corrective action may be identified by system or performance audits or by standard QC procedures. The essential steps in the corrective actions system will be:

i) Checking the predetermined limits for data acceptability beyond which corrective action is required.

ii) Identifying and defining problems.

iii) Assigning responsibility for investigating the problem.

iv) Investigating and determining the cause of the problem.

v) Determination of a corrective action to eliminate the problem (this may include reanalysis or resampling and analyses).

vi) Assigning and accepting responsibility for implementing the corrective action.

vii) Implementing the corrective action and evaluating the effectiveness.

viii) Verifying that the corrective action has eliminated the problem.

ix) Documenting the corrective action taken.

For each measurement system, the laboratory QA/QC Officer will be responsible for initiating the corrective action and the Laboratory Project Manager will be responsible for implementing the corrective action.

15. Quality Assurance Reports

Final reports will contain a discussion on QA/QC summarizing the quality of the data collected and/or used as appropriate for each phase of the project. The Project Manager who has responsibility for these summaries, will rely on written reports/memoranda documenting the data assessment activities, performance and systems audits and footnotes identifying qualifications to the data, if any.

Each summary of sampling activities will include a tabulation of the data including:

i) Field blank and field duplicate sample results.

ii) Maps showing well locations.

iii) An explanation of any sampling conditions or quality assurance problems and their effect on data quality.

QA reports will be prepared by the QA/QC Officer - Sampling and Analytical Activities following receipt of all analytical data. These reports will include discussions of the following and their effects on the quality of the data reported:

i) Sample holding times.

ii) Laboratory/reagent blank data.

iii) Surrogate spike, MS and MSD data.

iv) Field QA/QC data.

v) Pertinent instrument performance per method protocols.

vi) Audit results (if performed).

In addition, the QA reports will summarize all QA problems, and give a general assessment of QA results versus control criteria for such parameters as accuracy, precision, etc.

The QA reports will be forwarded to the Project Manager.

Table A.4.1

Target Quantitation Limits - Overburden Wells
Bedrock and Overburden Groundwater Monitoring Program
Occidental Chemical Corporation
Buffalo Avenue Plant
Niagara Falls, New York

	CAS Number	Targeted Quantitation Limits (µg/L)
Volatile Organic Compounds		
Benzene	71-43-2	1
Toluene	108-88-3	1
Chlorobenzene	108-90-7	1
Trichloroethylene	79-01-6	1
Tetrachloroethylene	127-18-4	1
2-Chlorotoluene	95-49-8	1
4-Chlorotoluene	106-43-4	1
2,4/2,5-Dichlorotoluene	95-73-8	1
1,2-Dichlorobenzene	95-50-1	1
1,3-Dichlorobenzene	541-73-1	1
1,4-Dichlorobenzene	106-46-7	1
1,2,4-Trichlorobenzene	120-82-1	1
2-Chlorobenzotrifluoride	88-16-4	1
4-Chlorobenzotrifluoride	98-56-6	1
3,4-Dichlorobenzotriflouride	328-84-7	1
Semi-Volatile Organic Compounds		
1,2,3,4-Tetrachlorobenzene	634-66-2	5
1,2,4,5-Tetrachlorobenzene	95-94-3	5
2,4,5-Trichlorophenol	95-95-4	10
Pesticides		
a-Hexachlorocyclohexane	319-84-6	0.05
Metals		
Mercury	7439-97-6	0.4
General Chemistry		
Phenolics (Total)	-	1.0

Notes:

- \- Not applicable.
- CAS Chemical Abstract System.

Table A.4.2

Target Quantitation Limits - Bedrock Wells
Bedrock and Overburden Groundwater Monitoring Program
Occidental Chemical Corporation
Buffalo Avenue Plant
Niagara Falls, New York

	CAS Number	Targeted Quantitation Limits (μg/L)
Volatile Organic Compounds		
Vinyl Chloride	75-01-4	1
Benzene	71-43-2	1
Toluene	108-88-3	1
Chlorobenzene	108-90-7	1
Trichloroethylene	79-01-6	1
Tetrachloroethylene	127-18-4	1
1,2-Dichlorobenzene	95-50-1	1
1,3-Dichlorobenzene	541-73-1	1
1,4-Dichlorobenzene	106-46-7	1
1,2,4-Trichlorobenzene	120-82-1	1
1,2,3-Trichlorobenzene	87-61-6	1
2-Chlorotoluene	95-49-8	1
4-Chlorotoluene	106-43-4	1
2,4/2,5-Dichlorotoluene	95-73-8	1
2,6-Dichlorotoluene	118-69-4	1
2,3/3,4-Dichlorotoluene	95-75-0	1
2,3,6-Trichlorotoluene	2077-46-5	1
2,4,5-Trichlorotoluene	6639-30-1	1
2-Chlorobenzotrifluoride	88-16-4	1
4-Chlorobenzotrifluoride	98-56-6	1
3,4-Dichlorobenzotriflouride	328-84-7	1
2,4-Dichlorobenzotrifluoride	320-60-5	1
Semi-Volatile Organic Compounds		
1,2,3,4-Tetrachlorobenzene	634-66-2	5
1,2,4,5-Tetrachlorobenzene	95-94-3	5
2,4,5-Trichlorophenol	95-95-4	10
Hexachlorobenzene	118-74-1	5
Hexachlorobutadiene	87-68-3	5
Hexachlorocyclopentadiene	77-47-4	5
Octachlorocyclopentene	706-78-5	5
Pesticides		
a-Hexachlorocyclohexane	319-84-6	0.05
b-Hexachlorocyclohexane	319-85-7	0.05
g-Hexachlorocyclohexane	58-89-9	0.05
d-Hexachlorocyclohexane	319-86-8	0.05
Perchloropentacyclodecane (Mirex)	56449-78-6	0.05
General Chemistry		
Alkalinity	-	5000

Notes:

- \- Not applicable.
- CAS Chemical Abstract System.

Table A.4.3

Sampling and Analysis Summary
Bedrock and Overburden Groundwater Monitoring Program
Occidental Chemical Corporation
Buffalo Avenue Plant
Niagara Falls, New York

Monitoring Program	Frequency	Analytical Parameters	Analytical Method	Estimated Number of Samples	Field Duplicates	Trip Blanks	MS/MSD/Dup
Overburden	Annual	Volatiles	SW-846 8260	24	1	1/day	1/1/0
		Semi-Volatiles	SW-846 8270	24	1	-	1/1/0
		Pesticides	SW-846 8081	24	1	-	1/0/1
		Mercury	SW-846 7470	4	1	-	1/0/1
Overburden	Semi-Annual	Mercury	SW-846 7470	1	-	-	-
Bedrock	Annual	Volatiles	SW-846 8260	46	2	1/day	2/2/0
		Semi-Volatiles	SW-846 8270	46	2	-	2/2/0
		Pesticides	SW-846 8081	46	2	-	2/2/0
		Alkalinity	USEPA 310.1	46	2	-	2/0/2

Note:

Dup Field Duplicate.

Table A.5.1

Sample Container, Preservation, and Holding Time Periods
Bedrock and Overburden Groundwater Monitoring Program
Occidental Chemical Corporation
Buffalo Avenue Plant
Niagara Falls, New York

Analyses	Sample Containers	Preservation	Maximum Holding Time	Notes
Groundwater				
VOCs	Two 40 mL glass vials Teflon-lined septum	pH <2, HCl Cool 4°C	14 days from collection to analysis	Fill completely with no head space
SVOCs	Two 1L amber glass	Cool 4°C	7 days from collection to extraction, 40 days from extraction to analysis.	Fill completely
Pesticides	Two 1L amber glass	Cool 4°C	7 days from collection to extraction, 40 days from extraction to analysis.	Fill completely
Mercury	One 500ml HDPE bottle	pH<2, HNO3 Cool 4°C	28 days from collection to analysis	Fill completely
General Chemistry (Alkalinity)	One 250ml HDPE	Cool 4°C	14 days from collection to analysis	Fill completely

Notes:

HDPE High Density Polyethylene.
SVOCs Semi-Volatile Organic Compounds.
VOCs Volatile Organic Compounds.

Table A.9.1

Laboratory Reporting Deliverables - Standard Data Package
Bedrock And Overburden Groundwater Monitoring Program
Occidental Chemical Corporation
Buffalo Avenue Plant
Niagara Falls, New York

A detailed report narrative should accompany each submission, summarizing the contents, and results.

A. Chain of Custody Documentation and Detailed Narrative [(1)]

B. Sample Information
- i) date collected
- ii) date extracted or digested
- iii) date analyzed
- iv) analytical method and reference

C. Final Results
- i) samples
- ii) laboratory duplicates [(2)]
- iii) method blanks
- iv) spikes, spike duplicates [(2), (3)]
- v) surrogate recoveries [(2)]
- vi) internal standard recoveries
- vii) TICs (if applicable)

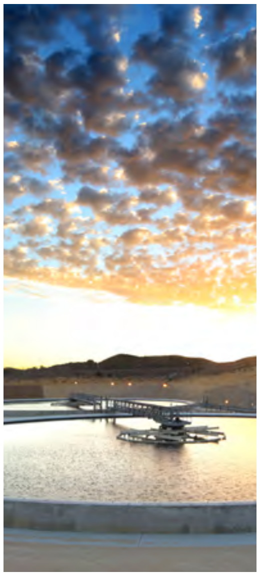
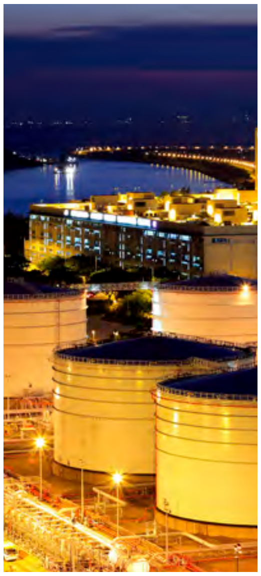
D. Miscellaneous
- i) method detection limits and/or instrument detection limits
- ii) percent solids (where applicable)
- iii) metals run logs
- iv) dates of extraction or digestion and analysis for method blanks and blank spikes

All sample data and its corresponding (QA/QC) data shall be maintained accessible to GHD either in hard copy or on magnetic tape or disc (computer data files). All solid sample results must be reported on a dry-weight basis.

Notes:

[(1)] Any quality control outliers must be addressed and corrective action taken must be specified.
[(2)] Laboratory must specify applicable control limits for all quality control sample results.
[(3)] A blank spike must be prepared and analyzed with each sample batch.
TICs Tentatively Identified Compounds.

Appendix B
Glenn Springs Holdings, Inc. Field Procedures


Field Procedures Manual

Western New York Sites

Revised June 2016

Glenn Springs Holdings, Inc.

2055 Niagara Falls Boulevard Suite 3 Niagara Falls New York 14304

053716 | Report No 3 | June 27 2016

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Appendices

1. Introduction

GHD Services Inc. (GHD) has updated the Field Procedures developed by Glenn Springs Holdings, Inc. (GSH) for use at their Western New York sites (Sites) and compiled them into this Field Procedure Manual (FPM). GHD is currently conducting Operation, Maintenance, and Monitoring (OM&M) activities at the Sites on behalf of GSH. The Sites in WNY include the Love Canal Landfill, the Hyde Park Landfill, the 102nd Street landfill, the former Durez North Tonawanda Facility, the Durez Inlet Site, the Durez Packard Road Site, the OxyChem Niagara Plant, and the S-Area Landfill.

1.1 Site Operations

The Sites are located at the following addresses.

- Love Canal – 805 97th Street, Niagara Falls, New York
- Hyde Park Landfill – 4825 Hyde Park Boulevard, Niagara Falls, New York
- Durez North Tonawanda – 700 Walck Road, North Tonawanda, New York
- Durez Inlet – 512 River Road, North Tonawanda, New York
- OxyChem Niagara Plant – 47th Street and Buffalo Avenue, Niagara Falls, New York
- S-Area Landfill – 100 53rd Street, Niagara Falls, New York
- 102nd Street Landfill – 9857 Buffalo Avenue, Niagara Falls, New York
- Durez Packard Road – 5000 Packard Road, Niagara Falls, New York

1.2 Field Procedure Development

The field procedures were developed using previous GSH Field Procedures updated to reflect applicable GHD's Standard Operating Procedures, United States Environmental Protection Agency (USEPA), and New York State Department of Environmental Conservation (NYSDEC) guidelines,.

2. General

2.1 General Procedures

Certain activities can adversely affect the sample quality; therefore, it is imperative that the following rules are obeyed during implementation of field activities.

1. Do not smoke.
2. Do not use insect repellents.
3. Do not use wasp/hornet spray near a well.
4. Do not use after-shaves, cologne, or astringents.
5. Be aware of wind direction. Do not run a vehicle or small engines upwind of a well that is being sampled.

6. Be cognizant of traffic fumes and nearby activities. Suspend sampling if fumes are strong. Make a notation of any such observations on the field log.
7. Do not handle or pour gasoline or fuel oils near sampling locations.

2.2 Health and Safety

Prior to the commencement of any field activities, all sampling personnel shall have read the Site-specific Health and Safety Plan (HASP) for Operation and Maintenance Activities. Health and Safety monitoring requirements and appropriate Personal Protective Equipment (PPE) are defined in the HASP. A copy of the HASP is available at each of the individual Sites.

During sample collection or monitoring, the basic health and safety rules listed below should be applied.

1. Wear, at a minimum, modified OSHA Level D PPE, which includes safety glasses, full-length pants, and industrial quality work boots.
2. Wear hardhats in any areas where there is a potential for objects falling from overhead or where there is fixed piping or obstructions at head level.
3. Do not eat, drink, or smoke during monitoring or sampling.
4. Be aware of potential slip, trip, and fall hazards and uneven terrain.
5. Be aware of any hazards of working with portable machinery, electrically operated equipment, gasoline-powered equipment, and high-pressure air.
6. Use proper lifting techniques when lifting is required.
7. Be aware of moving vehicles when sampling or monitoring at locations along roads; use safety cones and a flagman as necessary.
8. Handle sediment and water removed during sampling activities as if contaminated.
9. Use caution when opening protective covers on wells as wasps, hornets, bees, snakes, or other wildlife may be present.

2.3 Field Calibration of Equipment

In addition to factory/laboratory calibration of field equipment, certain instruments require field calibration prior to use and as field conditions (temperature, humidity, wind, etc.) change throughout the day. The manufacturer generally defines the schedule for such calibration. The manufacturer's recommendations should be available to field personnel for review and should be conformed to, to the extent practicable.

2.4 Cleaning/Decontamination Requirements

Any equipment not dedicated for use at a specific location must be cleaned prior to use and decontaminated between sampling locations. Cleaning/decontamination protocols are defined in the Field Procedures included in this document.

The following cleaners/solvents are used for decontamination. A short summary of the use and precautions to follow when using these cleaners is presented for each cleaner. These summaries are not complete, the manufacturer's guidelines and Material Safety Data Sheets (MSDS) should be read and understood before using any of these cleaners.

Low-Phosphate Soap: Alconox® or Equivalent

Alconox® is formulated to be "free rinsing" (e.g., easily rinsed off with running tap or distilled water) with virtually no redeposition of removed (and unwanted) materials, all of which translates to virtually a complete absence of residues.

Use Alconox® at a 1-percent solution, which is equivalent to approximately 2 1/2 tablespoons (1 1/4 ounces) per gallon of cold, warm, or hot water. Alconox® is not formulated for spray machines since it will foam. For critical cleaning, do final or all rinsing with distilled, deionized, or purified water.

Alconox® has a shelf life of 2 years after the date of manufacture.

Citri-Clean

Protective gloves and goggles should be worn when using Citri-Clean. Do not use near fire, flame, spark, or any ignition source. It is harmful if swallowed.

Heavily caked grease/NAPL areas should be scraped before application.

The standard solution for Citri-Clean is 15 percent (20 ounces of Citri-Clean concentrate in 1 gallon of water). Citri-Clean may be used at up to 100 percent concentrate to remove heavy contamination. Citri-Clean can be applied with sprayer or other conventional means. Following application, allow the materials to stand for 2 to 10 minutes. After allowing the materials to stand, scrub the contaminated area, and flush with water to remove loose particles. Reapply to areas where stains remain or where heavy accumulations of oil, grease, or other contaminants have occurred.

Sprayon Flash Free Electrical Degreaser

Sprayon brand Flash Free Electrical Degreaser (Sprayon Degreaser) is used to remove NAPL from equipment. Protective gloves and goggles should be worn when using Sprayon Degreaser.

Heavily caked grease/NAPL areas should be scraped before application. Once NAPL is removed from the article being decontaminated, the article should be wiped clean, rinsed with distilled water, and allowed to dry thoroughly to remove any residual Sprayon Degreaser remaining.

2.5 Documentation

Field conditions, collection, and handling of samples, as well as information regarding each sample collected, will be recorded and stored on standardized forms and/or in a designated project field notebook, paper, or electronic journal. Certain information is recorded in the field directly on a standardized form (e.g., Groundwater Field Sample Purge Record form or Chain of Custody form) while other information is recorded and remains in the field notebook (i.e., weather conditions, description of Site activities, etc.) This type of documentation along with Chain of Custody documentation provides a permanent record of all significant activities completed during a field investigation. All notebooks and logs should be completed using waterproof pens to prevent smudging should the notes get wet while in the field. Once complete, the notebooks, standardized forms, and logs should be signed and dated on the bottom of each page. All field notes shall be maintained at the GHD Niagara Falls Office.

2.6 Training

All personnel performing field monitoring/sampling are required to have completed 40 hours of health and safety training in compliance with Occupational Safety and Health Administration (OSHA) 1910.120. Annually, an 8-hour health and safety training class must be attended to maintain compliance with current OSHA 1910.120 requirements. Further, all field personnel must be familiar with the health and safety requirements defined in the Site-specific HASP for Operation and Maintenance Activities.

Field personnel must be thoroughly trained before using any field sampling equipment that they are responsible to operate. This includes the operation and calibration of all instruments.

2.7 Equipment Preparation

Approximately 2 weeks prior to sampling, the equipment required for the monitoring program should be checked to ensure that it is clean and operates properly. Any missing or broken equipment or accessories should be replaced or repaired. The equipment condition and calibration will also be checked before being used in the field.

Most instruments require routine calibration. Calibration may be performed as part of routine equipment maintenance or during field activities. Recommended calibration schedules are typically provided in equipment owner's manuals. Vendor's data and/or user manuals are available at the GSH Love Canal office for all equipment as well as GHD's Niagara Falls Office. Records of calibrations performed as part of routine equipment maintenance, as well as factory calibrations, should be maintained in GSH files.

2.8 Sample Containers

Bottles for all regularly scheduled sampling events will be provided by the laboratory. The GHD Project Chemist is responsible for contacting the laboratory to order the appropriate sample bottles, with preservatives, if required.

3. Field Procedures

3.1 FP-01A – Waste Management

Disposables (PPE, towels, tubing, etc.)

All field disposables will be placed plastic bags at point of use. At the end of each day, these wastes will be placed in an approved/labeled 55-gallon waste disposal drum at the site for management as Hazardous Solid Waste.

Purge Water

All purge water from sampling will be disposed of at the relevant GSH site water treatment system. Water will be discharged to an appropriate sump or drainage feature that connects to the Site water treatment system. The discharge locations should be discussed with the Site Operator to determine the appropriateness of the discharge location prior to the collection of purge water.

Decontamination Liquids

Alconox Wash: All decontamination wash is contained and disposed of in the same Site location as purge water.

Solvents: minimal volumes of solvents are used. Small quantities of solvents (Citri-Clean and electrical degreaser [spray on]) that are spilled during decontamination may be washed into the decontamination containment area. These areas are connected to the site water treatment system.

NAPL/solvent coated Disposables (PPE, towels, tubing, etc.)

NAPL coated disposables will be managed in the same manner as described above for non-NAPL coated disposables.

3.2 FP-01B – Maintenance Inspection

Monitoring Wells

Each monitoring well and piezometer should be inspected annually to ensure that the cap is secure from unauthorized entry, that rain and surface water cannot enter the casing, and that the well/piezometer condition is satisfactory for the desired monitoring objectives, including the monitoring of total well depths for possible infilling. A "Well Maintenance Inspection Form", or a similar form, will be completed during each inspection. The inspection forms should be copied or scanned to an Adobe Acrobat PDF format, stored in the Project File maintained at the GHD Niagara Falls office.

Upon completing the inspection, a memorandum should be prepared which documents the inspection findings, including a summary of required maintenance items, if needed and submitted to the Project Manager.

The memo, as well as copies of the Well Maintenance Inspection Forms, should be submitted to the GHD Project Coordinator (either electronic or hard copy is acceptable).

Landfill Cap

The following list summarizes the areas for Landfill Cap inspection.

Table 3.1 Areas for Landfill Cap Inspection

Feature	Inspect for:
Vegetation and Topsoil	Erosion, bare areas, washouts, dead/dying vegetation, remove woody growth
Access Roads	Erosion, obstructions, potholes, puddles, debris
Drainage Ditches	Sediment buildup, erosion, condition of erosion
	Protection, obstructions, dead/dying vegetation
Drainage Culverts	Obstructions, plugging
Riprap	Missing, erosion, excessive vegetation or woody growth

All personnel should be aware of these inspection guidelines. If problems are identified at any time, the Project Coordinator and Site Operator should be notified and the problem promptly corrected. Log sheets for this inspection are available in the Operation and Maintenance (O&M) Manual for each site. Inspection forms should be stored in the Project file at the Site.

Landfill Fence

Access to the landfill (e.g., fences and gates) should be secure. Gates must be intact and locked, and the fence must be free of openings that would allow access. All posted signs on the fence should be secure and readable.

All personnel should be aware of these access security requirements and should report any breach in the fence or gates immediately. Problems should be promptly corrected. If the fence or locks appear to have been intentionally cut for access, the breach must be documented for the Project file and the Project Manager and Site Operator must be immediately notified.

3.3 FP-02A – Groundwater Level Measurement

Equipment

1. PPE (according to the HASP)
2. Keys to the wells/piezometers
3. Water level indicator
4. Low phosphate soap (Alconox® or equivalent)
5. Decontamination solvents (Citri-Clean and electrical degreaser [spray-on])
6. Distilled water
7. Paper towels, cotton rags
8. Buckets
9. Water level measurement form or log-book
10. Trash bags,
11. Site map
12. Table of well/piezometer depths and previous water level(s)

Pre-field Activities

1. Collect Equipment.
2. Using a glass of water, check that the water level indicator is functioning. Measure the distance from the reference point on the indicator probe to the 2-foot mark on the tape – this should be 2 feet.
3. Decontaminate the water level indicator. Wash the probe and entire length of the tape with a low phosphate soap solution followed by a tap water rinse. Dry with a clean cloth or paper towel. If the tape or probe has been in contact with NAPL, remove NAPL with a rag soaked in Citri-Clean or electrical degreaser, followed by the soap wash described above, and a distilled or deionized water rinse. Any liquid wastes will be contained and disposed of as described below.

Field Procedures

1. Check well/piezometer ID. If there is any uncertainty that the correct well/piezometer is being measured, measure the total depth of the well using a separate decontaminated tape with a solid weight. Compare the measured depth to the reported depth of the well.
2. Check condition of the protective casing, cement, etc. and make notes as necessary. Serious problems regarding the well condition (e.g., the protective housing has been broken into) should be called in to the GHD Project Manager. Problems that require general maintenance should be documented and added to the Well Maintenance List.
3. Remove cap from well, if there was a sound of air entering or escaping make a note of this and check to see if there is a vent hole in the cap.
4. Check for the measuring point mark on the well riser and for any sharp edges, which may damage the indicator tape.
5. Slowly lower the water level indicator probe until contact with the water surface is indicated, either by audible alarm or by light. To the extent possible, avoid dragging the indicator cable on the top edge of the well casing, this can damage the cable and potentially introduce shavings from the cable into the well/piezometer.
6. Read the depth to water at the measuring point and record the measurement to the nearest 0.01 foot.
7. Retract the tape by winding onto the spool, holding a clean paper towel to remove water and/or debris.
8. For newly installed wells and wells with known contamination, decontaminate the probe and tape between wells with soap and water wash. Rinse with distilled or deionized water. If necessary, decontamination solvents may be used to remove heavy contamination.
9. Replace the well cap and relock the well.

Note: Whenever possible, water level measurements should be collected from least to most contaminated wells.

Decontamination of the Water Level Indicator

At the end of each day, decontaminate the water level indicator as described under Pre-field Activity, above.

Disposal of Wastes

All materials will be handled according to Field Procedure FP-01A.

Reporting

Field data will be entered into the field database management system or an Excel spreadsheet. The GHD Project Manager will specify formats and procedures.

3.4 FP-03A – NAPL Presence Check

Equipment

1. PPE (according to the HASP)
2. Keys to the wells/piezometers
3. A 250-foot measuring tape with weighted end and cotton rope attachment to help determine NAPL presence dedicated for wells containing NAPL.
4. Solvents: Citri-Clean or electrical degreaser
5. Tap water
6. Paper towels, cotton rags
7. Bucket
8. NAPL presence form or log-book
9. Site-map
10. Well-depth information.

Field Procedure

1. Check well ID against Site map to determine if you have the correct well. If there is any uncertainty that the correct well/piezometer is being measured, measure the total depth of the well using a separate decontaminated tape with a solid weight. Compare the measured depth to the reported depth recorded of that well.
2. Inspect well condition and note apparent problems requiring maintenance.
3. Remove cap from well and check for the measuring point mark on the well riser. Check for any rough or sharp edges that might damage the measuring tape.
4. Lower the weighted tape down into the center of the well until contact with the bottom of the well. Verify this by checking the depth of the tape against the known well depth.
5. Retract the tape to the top to check amount of NAPL present on the measuring tape. If no NAPL is present, check the attached cotton rope for NAPL.
6. Note the NAPL presence (yes or no) on the form or in the log book.
7. Replace well cap.
8. Decontaminate tape. Tape will be wiped clean with paper towels and rinsed with water. If necessary, wipe tape with a rag soaked in Citri-Clean or electrical degreaser. Wipe solvents from the tape with clean paper towels or cotton rags and rinse with water.
9. Replace cotton rope with a clean piece of rope between well measurements to avoid cross-contamination.

Disposal of Wastes

All materials will be handled according to Field Procedure FP-01A.

Reporting

Field data will be entered into the field database management system or an Excel spreadsheet. The GHD Project Manager will specify formats and procedures.

3.5 FP-03B – NAPL Thickness Measurement Procedure

Equipment

1. PPE (according to the HASP).
2. Keys to the wells/piezometers.
3. Solvents: Citri-Clean or electrical degreaser.
4. Tap water.
5. Paper towels, cotton rags.
6. Bucket.
7. NAPL thickness form or log-book.
8. Site map.
9. A 250-foot measuring tape with 1-foot piece of 1/4-inch rebar dedicated for wells containing NAPL. Attach rebar to the measuring tape with duct tape.

Field Procedure

1. Check well ID against Site map to determine if you have the correct well. If there is any uncertainty that the correct well/piezometer is being measured, measure the total depth of the well using a separate decontaminated tape with a solid weight. Compare the measured depth to the reported depth recorded of that well.
2. Inspect well condition and note apparent problems requiring maintenance.
3. Remove cap from well and check for the measuring point mark on the well riser. Check for any rough or sharp edges that might damage the measuring tape.
4. Lower the measuring tape until the rebar contacts the bottom of the well.
5. Record the depth to the bottom of the well from top of casing (or the appropriate reference used for water level measurements).
6. Slowly rewind tape and record NAPL thickness based on visual inspection of NAPL on the tape or rebar.
7. Decontaminate tape. Tape will be wiped clean with a rag soaked in Citri-Clean or electrical degreaser. Wipe solvents from the tape with clean paper towels or cotton rags and rinsed with water.
8. Repeat for next well.

Disposal of Wastes

All materials will be handled according to Field Procedure FP-01A.

Reporting

Field data will be entered into the field database management system or an Excel spreadsheet. The GHD Project Manager will specify formats and procedures.

3.6 FP-03C – NAPL Removal from Wells

Equipment

1. PPE (according to the HASP).
2. Keys to the wells/piezometers.
3. Solvents: Citri-Clean or electrical degreaser.
4. Tap water.
5. Paper towels, cotton rags.
6. Bucket.
7. NAPL recovery form or log-book.
8. Site map.
9. A 250-foot measuring tape with 1-foot piece of 1/4-inch rebar dedicated for wells containing NAPL. Attach rebar to the measuring tape with duct tape.
10. Tubing and foot valve by hand or using a gasoline or electric powered pump actuators (Waterra Hydrolift or equivalent), persitaltic pump, or bailer

Field Procedure

1. Check well ID against Site map to determine if you have the correct well. If there is any uncertainty that the correct well/piezometer is being measured, measure the total depth of the well using a separate decontaminated tape with a solid weight. Compare the measured depth to the reported depth recorded of that well.
2. Inspect well condition and note apparent problems requiring maintenance.
3. Open monitoring well.
4. Send tubing down or bailer to the bottom of the well.
5. Purge monitoring well location with selected purge equipment until the NAPL has been removed.
6. Collect NAPL in plastic carboys or other appropriate containers.
7. Remove purging equipment unless tubing or bailer are dedicated.
8. Close monitoring well.
9. Record amount on NAPL removed.
10. Transfer NAPL from carboys site treatment system decanters or to 55-gallon drums.
11. Decontaminate tape if used. Tape will be wiped clean with a rag soaked in Citri-Clean or electrical degreaser. Wipe solvents from the tape with clean paper towels or cotton rags and rinsed with water.

Disposal of Wastes

All materials will be handled according to Field Procedure FP 01A.

Reporting

Field data will be entered into the field database management system or an Excel spreadsheet. The Project Manager will specify formats and procedures.

3.7 FP-04A – APL Sampling - Pressurized Taps

Equipment

1. PPE (according to the HASP)
2. Bucket for purge water
3. Sampling forms or field notebook
4. Site map

Pre-Field Activities

1. Contact GHD Project Chemist to acquire sample bottles
2. Prepare bottle labels
3. Prepare Chain of Custody forms

Field Procedure

1. Identify proper sample tap
2. Place purge bucket under sample tap
3. Slowly open sample valve and purge enough into bucket to sufficiently clear the line of stagnant water
4. Place sample bottle under the tap and close-down the valve to achieve a slow, steady stream of water
5. Fill sample bottles
6. Close sample tap valve
7. Securely pack samples in ice filled coolers for shipment to the appropriate laboratory. Coolers must:
    - Have chain-of-custody forms in a zip-lock bag in the cooler
    - Be securely taped closed with security seals across the cooler opening

Disposal of Wastes

All materials will be handled according to Field Procedure FP-01A.

Reporting

Field data will be entered into the field database management system via completion of a Field Sample Key (FSK). The GHD Project Manager will specify formats and procedures.

A copy of the Chain of Custody forms must be sent to the GHD Laboratory Coordinator.

3.8 FP-04B – APL Sampling – 3 Well Volume Method

Equipment

1. PPE (according to the HASP).
2. Keys to the wells/piezometers.
3. Water level indicator.
4. Purging equipment: water level meter, pumps (Grundfos, peristaltic pumps, hand bailers, or bladder pumps), generator, and compressor. Enough decontaminated pumps will be taken to the field to complete the day's sampling schedule. Water storage tank for purge water.
5. Field Parameter Monitoring Instruments: Multi-parameter (pH, specific conductance, and temperature) flow-through cell.
6. Decontamination Equipment/Supplies: Sheet plastic, low phosphate soap (Alconox®), distilled water (DI), paper towels or cotton rags, and buckets.
7. Sampling forms or field notebook.
8. Site map.

Pre-Field Activities

1. Contact GHD Project Chemist to acquire sample bottles.
2. Prepare bottle labels.
3. Prepare Chain of Custody forms.
4. Print field log/data recording sheets (pre-printed with location IDs).
5. Calibrate field parameter monitoring instruments and record calibration results.
6. Acquire table of locations to be sampled including total piezometer depth.
7. Decontaminate enough pumps to complete at least 1 day's sampling schedule. For peristaltic pumps, decontamination is replacement of used tubing with new tubing cleaned by the manufacturer. For inertial pumps (Waterra), decontaminate the check valves and replace the tubing. The following procedure is for any submersible pumps. Wearing appropriate PPE:
   - Remove all visible sediment/soil by hand brush scrubbing or power washing
   - Remove drain plug from pump and drain trapped water. Refill pump with deionized water and replace the drain plug.
   - Submerge pump in a 5-gallon bucket of low-phosphate soap water and recirculate soap solution for 5 minutes.
   - Remove drain plug from pump and drain trapped water. Replace the drain plug.
   - Submerge pump in a 5-gallon bucket of tap water and recirculate water for 5 minutes.
   - Rinse equipment with deionized water.
   - Allow equipment to air dry.
   - When dry - reassemble equipment and place in plastic bag for storage to avoid re-contaminating equipment.

- An equipment blank may be required. The equipment blank is collected by pouring deionized water in the top of the pump and catching the water as it runs off the bottom of the pump in a labeled sample jar. Equipment blanks should be managed consistent with water samples as described below.

If the pump is contaminated with NAPL, the pump will be cleaned outside with Citri-Clean, pressure-washed outside, the drain plug removed to drain residual water and replaced, run through a 5-minute recirculation with a Citri-Clean solution, and then pressure-washed. Following this aggressive cleaning, the procedure defined above will be completed.

Field Procedures

1. Check well/piezometer ID. If there is any uncertainty that the correct well/piezometer is being measured, measure the total depth of the well using a separate decontaminated tape with a solid weight. Compare the measured depth to the reported depth of the well.
2. Inspect well/piezometer for damage or problems that require maintenance or may compromise the integrity of the water sample to be collected.
3. Check for the measuring point mark on the well riser and for any sharp edges, which may damage the indicator tape.
4. Measure water level and record on the field log. Determine the volume of water to be purged according to diameter of the well and formulas on the sample collection forms.
5. Install pump into well for purging. Lower pump deep enough that the well/piezometer does not go dry during the purging; but as close to the top of the water column as possible to remove all stagnant water.
    - Purge tubing is dedicated to each well and remains in the well between sampling events. A decontaminated pump will be used for each well purging. The dedicated tubing is pulled from the well and connected the decontaminated pump.
    - Care must be taken to ensure that the dedicated tubing is not contaminated when it is removed from the well, and that no debris is introduced to the well when the pump is lowered.
6. Start pump and purge as follows:
    - Start pump and adjust flow rate to a rate sustainable by the well. The goal of the sampling is to purge and sample without drying up the well/piezometer.
    - Monitor field parameters (pH, specific conductance, and temperature), water level, and pumping rate, and record in the field log including the time of the measurements. One set of readings will be taken at the start of purging and an additional set will be taken after removal of each standing well volume.
        – If the well goes dry, purge 3 consecutive days to dryness and then sample. Full recovery is not necessary. Sampling can commence on Day 3 if water is available and can be conducted over the next 4 days if required to fill the sample bottles.
        – If the well goes dry, a sustainable pumping rate should be determined for future sampling events. Contact the GHD Project Manager or Coordinator regarding adjustment of pumping rates.

7. Samples shall be collected by use of a bailer or directly from pump discharge tubing.
   - Note: If possible, sampling in the rain should be avoided to avoid cross-contamination from airborne contaminants picked up by the precipitation.
   - Wells should be sampled beginning with lowest concentration wells, progressing to highest concentrations. This minimizes the potential for cross-contamination.
   - Securely pack samples in ice filled coolers for shipment to the appropriate laboratory. Coolers must:
     – Have chain-of-custody forms in a zip-lock bag in the cooler
     – Be securely taped closed with security seals across the cooler opening
8. Remove pump and disconnect from purge tubing. Purge tubing should be returned to the well.
   - Care must be taken to ensure that the dedicated tubing is not contaminated when it is removed from the well, and that no debris is introduced to the well when the tubing and pump is lowered into the well.
9. Manage purge water and sampling disposables as described below.

Disposal of Wastes

All materials will be handled according to Field Procedure FP-01A.

Reporting

Field data will be entered into the field database management system via completion of a FSK. The GHD Project Manager will specify formats and procedures.

A copy of the Chain of Custody forms must be sent to the GHD Laboratory Coordinator.

3.9 FP-04C – APL Sampling - T_{95} Piezometer Sampling Method

Background

The T_{95} Purge Sampling Protocol is designed to collect a representative groundwater sample from the Hyde Park piezometers. The protocol specifies a recommended pumping rate and a fixed purge time. The purge time and rate based on a mathematical analysis to ensure that more than 95 percent of the water sampled is collected from the formation outside of the well, and less than 5 percent from wellbore storage.

An important element of the T_{95} sampling protocol is consistency. A table is included as Appendix A of this Field Procedure Manual defining a purge time and pumping rate for each piezometer. The purge time and pumping rate are to be followed as closely as possible. Field testing has proven that the recommended purge rates can be sustained. If a field sampling pump cannot provide the recommended pumping rate, then a different sampling pump should be acquired.

The time (t_{95}) to achieve this target was calculated based on a piezometer-specific transmissivity and storage coefficient determined prior to the sampling event. The maximum purge rate was determined based on the available drawdown (static water level – top of the well screen) in the piezometer. An upper limit of 1.0 liters per minute (L/min) was defined for purging. For piezometers with a calculated t_{95} less than 5 minutes, a 5-minute minimum purge time is required; this ensures that the entire screened interval will be flushed with formation water. As a practical limit, piezometers requiring more than 90 minutes to purge were eliminated from the sampling program. Piezometers that exceed this time limit are either in very low transmissivity areas of the formation, or have very little standing water.

In the event that it is not possible to purge at the pumping rate recommended on the included table, a minimum purge volume must be calculated. The calculation is included near the end of this field procedure. Reducing the pumping rate from the values listed on the attached table will require calculations to be performed in the field and may significantly increase the time to collect samples. Any deviations from the sampling requirements are acceptable only on a temporary basis, and only if sampling cannot be delayed until proper equipment is available.

Equipment

1. PPE (according to the HASP).
2. Keys to the wells/piezometers.
3. Water level indicator.
4. Purging equipment: Waterra pump and generator. Water storage tank for purge water.
5. Field Parameter Monitoring Instruments: Multi-parameter (pH, dissolved oxygen (DO), oxygen reduction potential (ORP), temperature, turbidity, and conductivity) flow-through cell.
6. Decontamination Equipment/Supplies: Sheet plastic, low phosphate soap (Alconox®), distilled water (DI), paper towels or cotton rags, and buckets.
7. Sampling forms or field notebook.
8. Site map.

The Hyde Park piezometers are 1-inch diameter stainless steel or polyvinyl chloride (PVC) with a 2-foot long screen. They will be purged using a Waterra inertial pump. Peristaltic pumps are not acceptable.

Pre-Field Activities

1. Contact GHD Project Chemist to acquire sample bottles.
2. Prepare labels for sample bottles.
3. Prepare chain-of-custody forms.
4. Print field log/data recording sheets (pre-printed with location IDs).
5. Calibrate flow-through Cell instrument according to the manufacture's specifications.
6. The Waterra pump is decontaminated by washing the check valve in a low-phosphate water solution and rinsing with DI water. Discharge tubing will be either dedicated to the piezometers, or new tubing will be used for each sample.
7. Acquire table of locations to be sampled including total piezometer depth.

Field Procedures

1. Check well/piezometer ID. If there is any uncertainty that the correct well/piezometer is being measured, measure the total depth of the well using a separate decontaminated tape with a solid weight. Compare the measured depth to the reported depth of the well.
2. Inspect well/piezometer for damage or problems that require maintenance or may compromise the integrity of the water sample to be collected.
3. Check for the measuring point mark on the well riser and for any sharp edges, which may damage the indicator tape.
4. Measure water level and record on the field log.
5. Lower dedicated Waterra inertial pump intake to the center of the screened interval of the piezometer (1 foot above the bottom of the piezometer).
6. Begin purging and adjust pumping rates as soon as possible.
   - Pumping rate should be adjusted to match, or be slightly less than, the defined maximum pumping rates. Pumping at higher rates to purge or sample will cause the piezometer to go dry.
   - During purging, the following field parameters will be collected:
     - pH, DO, ORP, temperature, turbidity, and conductivity using a flow-through cell
     - Total water volume purged
   - Field parameter measurements should be recorded at 1-minute intervals for the first 5 minutes, and at a regular interval determined by field personnel after 5 minutes. The total volume purged should be checked with a graduated container. The container should have 1-milliliter (mL) graduations.
   - The piezometers must be purged for the predefined t_{95} time before sample collection is initiated. Stabilization of field parameters is not a requirement or an endpoint for purging.
   - **If a piezometer goes dry during the purging DO NOT COLLECT A SAMPLE. The field data should be compiled and sent to the GHD Project Manager at the end of the sampling day. The data will be reviewed and a revised pumping rate will be proposed. Based on the review, the piezometer may be purged again using a lower pumping rate.**
7. Following purging, the flow through cell should be removed from the pump discharge and sample containers shall be filled directly from the pump discharge. The total volume of sample collected and the time that the last sample bottle was filled shall be recorded. The pumping rate used to purge the piezometer must be maintained during sampling. The defined purge rate for each piezometer is the maximum sustainable pumping rate, the piezometer will likely go dry at a higher pumping rate.
8. Following sample collection reconnect the discharge tube to the flow-through cell and take two sets of post sample field parameters 1 minute apart.
9. Securely pack samples in ice filled coolers for shipment to the appropriate laboratory. Coolers must:
   - Have chain-of-custody forms in a zip-lock bag in the cooler
   - Be securely taped closed with security seals across the cooler opening

10. Manage purge water and sampling disposables as described below.

Pumping less than the Recommended Pumping Rates

Purging at less than the maximum pumping rate is acceptable only on a temporary basis and only if: a) sampling cannot be delayed, or b) the piezometer can no longer sustain the recommended pumping rates.

The t_{95} time is dependent on the transmissivity and well construction, but it is independent of the pumping rate. When pumping rates are reduced, however, a minimum volume to pump becomes an issue. An extreme example demonstrates the issue. For a well with a t_{95} of 5 minutes, purging at 1 milliliters per minute (mL/min) the water will result in a stabilized water level after 5 mL of water have been recovered. The 2-foot long, 1-inch diameter piezometer screen contains 320 mL of water. The 5 mL purge volume has not flushed the pre-purge water from the screened interval. It is recommended that at a minimum, three full screen volumes are pumped before sampling. If both the minimum purge volume and the t_{95} time are satisfied, then the screen has been flushed and >=95% of the water entering the pump intake is formation water.

The minimum purge volume has been set equal to the volume of water removed from wellbore storage during purging, plus three screen volumes. Three screen volumes is three times the volume per foot in a 2-foot long screen, or six times the volume in a 1-inch diameter pipe. The volume taken from wellbore storage is dependent on the stabilized drawdown in the piezometer. Previous analyses have shown that the stabilized drawdown in the 1-inch piezometers is approximately:

$$s_w = 0.083\ Q/T$$

Where:

s_w = stabilized drawdown (ft)

Q = pumping rate (mL/min)

T = transmissivity (ft^2/day)

Therefore, minimum purge volume is then:

$$V_{purge} = V_{ft} * (6 + 0.083\ Q/T)$$

Where:

V_{ft} = volume per foot of the 1-inch diameter pipe = 160 mL/ft
V_{purge} = 160 mL/ft * (6 + 0.083 Q/T)

Sample Calculation for G1-02:

Q recommended = 216 mL/min but assume that Q actual = 50 mL/min
T = 0.7 ft^2/day

V_{purge} = 160 * (6 + 0.083*50/0.7)
= 160 * (6 + 5.9)
= 1,900 mL

For G1-02, pumping this volume at 50 mL/min takes 38 min. For G1-02, t95 is 47.1 min. The well is ready to sample as soon as the minimum purge volume, and t95 have been satisfied, i.e., after 47.1 minutes. If the pumping rate were 20 ml/min, then V_{purge} would be 1,190 mL and would take 67 minutes to purge at 20 mL/min. Then, the V_{purge} is the limiting factor, not t_{95}. In general, if:

Q (mL/min) < 48 T (ft^2/day)   or Q (mL/min) < 1580 / t_{95} (min)

Then, minimum purge volume will take precedence over the t_{95}.

REMINDER: NEVER INCREASE PUMPING RATES AFTER THE PURGING REQUIREMENTS HAVE BEEN SATISFIED. THE SYSTEM HAS STABILIZED FOR THE PURGE RATE USED (OR A LOWER RATE), BUT IT IS NOT STABLIZED IF THE PUMPING RATE IS INCREASED.

Disposal of Wastes

All materials will be handled according to Field Procedure FP-01A.

Reporting

Field data will be entered into the field database management system via completion of a FSK. The GHD Project Manager will specify formats and procedures.

A copy of the Chain of Custody forms must be sent to the GHD Laboratory Coordinator.

3.10 FP-04D – APL Sampling - Surface Water and Seeps

Equipment

1. PPE (according to the HASP)
2. sampling forms or field logbook
3. Site map

Pre-Field Activities

1. Contact GHD Project Chemist to acquire sample bottles
2. Prepare bottle labels
3. Prepare Chain of Custody forms

Sample Collection Procedure

1. Place sample bottle under seep or surface stream to be sampled.
    - In shallow running water, look for a flow with minimal aeration
    - If possible, submerge the entire sample bottle and expel all air
2. Securely pack samples is ice filled coolers for shipment to the appropriate laboratory. Coolers must:
    - Have chain-of-custody forms in a zip-lock bag in the cooler
    - Be securely taped closed with security seals across the cooler opening

Disposal of Wastes

All materials will be handled according to Field Procedure FP-01A.

Reporting

Field data will be entered into the field database management system via completion of a FSK. The GHD Project Manager will specify formats and procedures.

A copy of the Chain of Custody forms must be sent to the GHD Laboratory Coordinator.

3.11 FP-04E: Groundwater Sampling – Low-Flow Purge and Sampling

Equipment

1. PPE (according to the HASP).
2. Keys to the wells/piezometers.
3. Water level indicator.
4. Purging equipment: water level indicator, pumps (Grundfos, peristaltic pumps, hand bailers, or bladder pumps), generator, and air compressor. Enough decontaminated pumps will be taken to the field to complete the day's sampling schedule. Water storage tank or buckets for purged water.
5. Field parameter monitoring instruments: flow-though cell and water level measurement tape.
6. Decontamination equipment: plastic sheeting, low phosphate soap (Alconox®), distilled water, paper towels, and buckets.
7. Groundwater sampling forms or field logbook.
8. Site map.

Pre-Field Activities

1. Contact GHD Project Chemist Coordinator to acquire sample bottles.
2. Prepare bottle labels.
3. Prepare Chain of Custody
4. Print field log/data recording sheets.
5. Calibrate field parameter meters; record calibration results.
6. Acquire table of locations to be sampled including total piezometer depth.
7. Decontaminate enough pumps to complete at least 1 day's sampling schedule. For peristaltic pumps, decontamination is replacement of used tubing with new tubing cleaned by the manufacturer. The following procedure is for any submersible pumps. Wearing appropriate PPE:
    - Remove all visible sediment/soil by hand brush scrubbing or power washing.
    - Remove drain plug from pump and drain trapped water. Replace the drain plug.
    - Submerge pump in a 5-gallon bucket of low-phosphate soap water, and recirculate soap solution for 5 minutes.

- Remove drain plug from pump and drain trapped water. Replace the drain plug.
- Submerge pump in a 5-gallon bucket of tap water, and recirculate water for 5 minutes.
- Rinse equipment with tap water.
- Allow equipment to air dry.
- When dry - reassemble equipment and place in plastic bag for storage to avoid re-contaminating equipment
- An equipment blank may be required. The equipment blank is collected by pouring de-ionized water into the top of the pump and collecting the water in sample jars as it runs off the clean pump. Equipment blanks should be managed consistent with water samples as described below.

If the pump is contaminated with NAPL, the pump will be cleaned outside with Citri-Clean, pressure washed outside, the drain plug removed to drain residual water and replaced, run through a 5-minute recirculation with a Citri-Clean solution, and then pressure washed. Following this aggressive cleaning, the procedure defined above will be completed.

Field Procedures

1. Check well/piezometer ID. If there is any uncertainty that the correct well/piezometer is being measured, measure the total depth of the well using a separate decontaminated tape with a solid weight. Compare the measured depth to the reported depth of the well.
2. Inspect well/piezometer for damage or problems that require maintenance or may compromise the integrity of the water sample to be collected.
3. Check for the measuring point mark on the well riser and for any sharp edges, which may damage the indicator tape.
4. Measure the water level and record on the field log. Determine the volume of water in the well bore.
5. Install pump/tubing into well for purging. Lower pump/tubing to center of the screened interval.
6. Start pump and purge as follows:
    - Start pump and adjust flow rate to a rate sustainable by the well, if possible and no greater than 500 mL/min. The goal of the sampling is to purge and sample without significantly lowering the water level of the well.
    - Monitor field parameters (pH, specific conductance, ORP, DO, turbidity, and temperature), water level, and pumping rate, and record on the field log in five minute intervals. One set of readings will be taken at the start of purging and an additional set of readings will be taken after each 5-minute interval.
    - Groundwater stabilization is considered as having been achieved when three consecutive readings for each of the field parameters, taken at 5-minute intervals, are within the following limits:

pH	±0.1 pH units of the average value of the three readings
Temperature	±3 percent of the average value of the three readings
Conductivity	±3 percent of the average value of the three readings

ORP	±10 millivolts (mV) of the average value of the three readings
DO	±10 percent of the average value of the three readings
Turbidity	±10 percent of the average value of the three readings, or a final value of less than 5 nephelometric turbidity unit (NTU)

- Stabilization will be considered as being complete when the field parameters have stabilized as indicated in the above table. Purging will continue if stabilization does not occur until a maximum of 20-screen volumes have been removed. The screen volume is based on screen length.
- If the recharge to the well is insufficient to conduct low-flow sampling, the well will be pumped dry and allowed to recharge sufficiently for the collection of the groundwater sample volume. Wells that are purged dry are not required to meet the stabilization criteria detailed above.

7. Samples shall be collected directly from the pump discharge immediately after stabilization:
   - Note: if possible, sampling in the rain should be avoided to avoid cross-contamination from airborne contaminants picked up in the precipitation.
   - Wells should be sampled beginning with the lowest concentration wells, progressing to the highest concentration wells. This minimizes the potential for cross-contamination.
8. Securely pack samples in ice-filled coolers for shipment to the appropriate laboratory. Coolers must:
   - Have completed Chain of Custody forms in a zip-lock bag in the cooler.
   - Be securely taped closed with security seals across the cooler opening.
9. Remove pump/tubing. Purge tubing can be returned to the well for reuse:
   - Care must be taken to ensure that the dedicated tubing is not contaminated when it is removed from the well, and that no debris is introduced to the well when the tubing is lowered into the well.
10. Manage purge water and sampling disposables as described below.

Disposal of Wastes

All materials will be handled according to Field Procedure FP-01A.

Reporting

Field data will be entered into the field database management system via completion of a FSK. The Field Manager will specify formats and procedures.

A copy of the Chain of Custody forms must be sent to the GHD Laboratory Coordinator.

3.12 FP-05A – Vapor Sampling - Community Monitoring Wells

Equipment

1. PPE
2. Keys to the wells
3. Water level indicator

4. Organic Vapor Analyzer (OVA)
5. Tubing
6. Forms or field logbook
7. Site map

Pre-Field Activities

1. Print field log/data recording sheet.
2. Install vapor monitoring caps on all community monitoring wells at least 1 month before vapor sampling. Only the overburden wells need these caps.
3. Connect 5 feet of clean sample tubing to the OVA.
4. Calibrate the OVA according to the manufacturer's recommendations, with sample tubing connected.

Field Procedure

1. Locate proper well and open flush-mount access. DO NOT REMOVE VAPOR SAMPLING CAP UNTIL AN OVA READING HAS BEEN COLLECTED.
2. Start the OVA pump. Before connecting sample tubing to the cap, collect and record an ambient OVA reading.
3. Record OVA readings at 1-minute intervals for 10 minutes on filed form (Appendix B).
4. Remove OVA.
5. Remove Vapor Sampling Cap.
6. Measure depth to water and record.
7. Close and lock the well.

Follow-up Procedure

1. Review completed field form.
2. If vapor monitoring results are more than 50 parts per billion above background, field staff will notify project manager immediately.
3. Follow-up actions may be implemented to verify the measurements. These actions may include checking the OVA if it is suspected that water or debris may have entered the unit which could provide erroneous readings, recalibration of the OVA, and/or re-measurement with the recalibrated OVA or replacement OVA.
4. If the vapor monitoring results are more than 50 parts per billion above background and determined to be valid, a groundwater sample will be collected from the monitoring well where the measurement was obtained within 2 weeks. The groundwater sample will be collected using field procedure FP-04B.

Notes:

The vapor sampling protocol is defined to collect vapor near the end of the sample tubing. The purge time for sampling must be long enough to evacuate one tubing volume, but not long enough to draw vapors from outside of the well. The Community Monitoring Wells are 12-inch diameter wells. A sampling pump operating at 400 cc/minute will evacuate a 1-foot column of air from a

12-inch diameter pipe in about 55 minutes. Pumping 400 cc/min will evacuate a 10-foot length of a 0.25-inch ID tubing (5 feet in the well and 5 feet to the OVA) in approximately 15 seconds. The sampling schedule, 1-minute intervals for 10 minutes, with the intake 5 feet below the top of the well casing, will ensure that the connecting tubing has been purged for the first sample at 1 minute and that no atmospheric air will be drawn into the OVA.

Pipe/Tube ID (inches)	Volume (cc/foot)
0.25	10
0.5	39
1	154
2	618
4	22,481
6	5,560
12	22,240

3.13 FP-07A – Monitoring Well Decommissioning Procedure

Although it is not part of routine activities at the Site, it may be necessary to decommission environmental monitoring wells when they are no longer needed or when their integrity is suspect or compromised. The draft document, *Groundwater Monitoring Well Decommissioning Procedures,* (NYSDEC Guidance) provides guidelines for decommissioning (abandoning, plugging) environmental monitoring wells. The following procedure summarizes these guidelines as they apply to the Site.

Preparation

Well information including current conditions, well logs, and laboratory analytical data collected from soil and/or groundwater will be reviewed. This information will aid in developing a scope of work, establishing health and safety protocol(s), developing an appropriate abandonment technique, and aid in real-time field decisions, if necessary, during the decommissioning process.

Selection of Decommissioning Method

The primary rationale for well decommissioning is to prevent contaminant migration along the disturbed construction zone created by the original well boring. This requires selection of a procedure that considers such factors as:

- Hydrogeological conditions at the well site
- Presence/absence of contamination in the groundwater
- Original construction details

The four primary decommissioning procedures are:

1. Grouting the casing in place
2. Perforating the casing followed by grouting in place
3. Casing pulling
4. Overdrilling

Detailed discussion of the decommissioning selection process and methods are presented in the NYSDEC Guidance. The procedures for overburden and bedrock wells are discussed below.

Overburden Wells:

The procedures that will be used to decommission overburden wells are the casing pulling method. In this method, the well casing is lifted out of the borehole while grout is added into the borehole using positive placement techniques to ground surface. If the situation is encountered where the well casing is unable to be pulled, an alternate method involving grouting in-place will be used. This procedure involves filling the casing with grout using positive placement techniques to a level of 2 feet below the land surface, cutting the well casing at the 2-foot depth, and removing the top portion of the casing and associated well materials from the ground. In addition, the upper 2 feet of the borehole will be filled to land surface.

Based on a review of the NYSDEC Guidance, grouting in place appears to be the most appropriate technology for bedrock monitoring wells at the Site.

Bedrock Monitoring Wells: Grouting In Place

Grouting in place is the simplest decommissioning procedure. This method is preferred for bedrock wells with casings 2 inches or greater in diameter. The method involves filling the casing and open interval with a cement-bentonite grout. Unless special conditions, e.g., grout flowing into fractures and not filling the borehole, or grout entry into the filter pack of a screened well, is desired, the following grout mixture will be used:

- One 94-pound bag of Type I Portland Cement
- 3.9 pounds powdered bentonite
- 7.8 gallons of water

Based on past experience in the Lockport Bedrock, where there can be significant vertical flow in the open interval of a well, the flow may create "piping" conditions (an erosion of the cement-bentonite grout). The piping may result in an interconnection of flow zones within the abandoned well. Therefore, in wells with significant vertical flow, GSH will modify the NYSDEC procedure as described below. The GSH procedure is satisfactory for all wells; however, it is more time-consuming than the NYSDEC procedure. In wells with no apparent vertical flow, the NYSDEC Groundwater Monitoring Well Decommissioning Procedures may be followed.

Bedrock Wells: NYSDEC Procedure

The grout mixture will be placed using a tremie pipe at least 1 inch in diameter lowered to within 5 feet of the bottom of the borehole. The borehole will be filled with the grout mixture to the top of bedrock or 5 feet below grade, whichever is closer to grade. Any groundwater displaced during the placement of the grout will be containerized and managed according to Field Procedure FP-01A.

The grout will be allowed to set for a minimum of 24 hours. The casing will then be cut off at 5 feet below grade or at the top of bedrock. If the grout level has settled from the target 5 feet below grade or top of bedrock, additional grout will be added. To allow future location of the abandoned well, an iron marker detectable with a metal detector will be left in place. If steel casing (carbon or stainless) is left in the ground, this is a sufficient marker. Otherwise, a marker such as a large bolt should be placed on top of the grout. After adding the grout and iron marker, the unfilled portion of the borehole will be filled to ground surface with material appropriate to the intended land use. For example, concrete or asphalt will be patched with concrete or asphalt of the same type and thickness; grassed areas will be seeded; and topsoil – similar to native soil – will be used to restore the Site.

Bedrock Wells: GSH Modification for Wells with Significant Vertical Flow

The GSH modification replaces the cement-bentonite grout in the well open interval with bentonite chips. The well open interval will be filled with bentonite chips to at least 2 feet into the well casing. The chips will be introduced in 5-foot lifts. A predetermined volume of bentonite chips will be added to the well to create a 5-foot thickness of bentonite. Following the addition of each lift, a heavy cylindrical "tamp" will be lowered on a cable to the top of the bentonite chips and allowed to rest on the bentonite chips. The purpose of the tamp is to ensure that the bentonite chips are fully in place. A tape measure attached to the top of the tamp will be used to check that the actual thickness of bentonite is consistent with the expected thickness of the volume of chips added. The addition of bentonite chips will continue until the seal extends at least 2 feet into the well casing.

Field Oversight and Documentation

Oversight personnel will document all well decommissioning activities in the field book. Additionally, a memorandum will be prepared to document the decommissioning activities and submitted to the Project Manager.

Disposal of Wastes

All materials will be handled according to Field Procedure FP-01A.

3.14 FP-08A – Well Redevelopment

Occasionally a monitoring or purge well may require redevelopment or rehabilitation. Indications of the need for redevelopment may include a decrease in purge well pumping rate, siltation occurring in the screened intervals of wells, or lack of hydraulic response.

Preparation

Well information including current conditions, well logs, sampling logs, historical transmissivity or hydraulic conductivity values, and pumping rates will be reviewed. This information will aid in developing a scope of work, establishing health and safety protocol(s), determine whether redevelopment or rehabilitation is required, and aid in real-time field decisions, if necessary, during the redevelopment/rehabilitation process.

Equipment

1. PPE (according to the HASP)
2. Purging equipment: water level indicator, pumps (Grundfos, hand bailers, air lift), generator, air compressor, and surge block
3. Water storage tank
4. Field parameter monitoring instruments (pH, specific conductance, temperature, and turbidimeter)

5. Decontamination equipment: plastic sheeting, low phosphate soap (Alconox®), distilled water, paper towels, and buckets

Pre-Field Activities

1. Print field log/data recording sheets (preprinted with location IDs).
2. Calibrate pH, specific conductance, and turbidimeter instruments; record calibration results.
3. Decontaminate enough pumps to complete at least 1 day's redevelopment schedule. Use decontamination procedure defined in FP-04B.

Field Procedure – Well Redevelopment

1. Measure the water level and record on the field log. Determine the volume of water to be purged according to formulas on the well redevelopment form.
2. Install pump and surge block into well for purging. Lower pump to approximately 5 feet below the water surface:
   - Purge tubing is dedicated to each well and remains in the well between uses. A decontaminated pump will be used for well redevelopment. The dedicated tubing is pulled from the well and connected to the decontaminated pump.
   - Care must be taken to ensure that the dedicated tubing is not contaminated when it is removed from the well, and that no debris is introduced into the well when the pump is lowered
3. Start the pump and purge as follows:
   - Start pump and adjust flow rate to the maximum sustainable by the well.
   - Surge the pump up and down over a 3- to 5-foot interval for 5 minutes. At the end of 5 minutes, lower the pump approximately 5 feet deeper into the well. Repeat this until the bottom of the well is reached.
   - Monitor field parameters (pH, conductivity, temperature, and turbidity), water level, pumping rate, and record on field log including the time of the measurements. One set of readings will be taken at the start of purging, and an additional set of readings will be taken after the removal of each standing well volume.
4. Remove pump and surge block and disconnect from purge tubing. Purge tubing should be returned to the well:
   - Care must be taken to ensure that the dedicated tubing is not contaminated when it is removed from the well, and that no debris is introduced to the well when the tubing is lowered.
5. Manage purge water as described in FP-04B above.

Disposal of Wastes

All materials will be handled according to Field Procedure FP-01A.

Reporting

Field data will be entered into the field database management system or an Excel spreadsheet. The GHD Project Manager will specify formats and procedures.

Appendices

Appendix A
FP-04C Piezometer Sample Rates and Duration Table

FP-04C

Piezometer Sample Rates and Duration
Performance Monitoring Program

Location	Flow Zone	Transmissivity ft^2/day	Typical Water over Screen (ft)	Sustainable Pumping Rate (mL/min)	Recommended Pumping Rate (mL/min)	$^{t}95$ Time 1[a] (min)	Time 2[b] (min)	Recommended Purge Time[c] (min)	Total Volume Purged (L)
G1U-01	1	66	13.5	10,740	1,000	0.5	**1.2**	**5**	5.0
G6-01	1	70	12.6	10,564	1,000	0.5	**1.2**	**5**	5.0
H2U-01	1	80	18.1	17,396	1,000	0.4	**1.1**	**5**	5.0
H5-01	1	75	17.8	16,032	1,000	0.4	**1.1**	**5**	5.0
I1-01	1	0.5	12.9	77	77	**66**	39	**66**	5.1
F2U-02	2	30	1.9	677	677	1.1	**1.9**	**5**	3.4
F4U-02	2	14	9.9	1,659	1,000	**2.4**	1.9	**5**	5.0
G1-02	2	0.7	25.8	217	217	**47**	23	**47**	10.2
G6-02	2	240	27.9	80,401	1,000	0.1	**1.0**	**5**	5.0
H2U-02	2	0.5	18.1	109	109	**66**	35	**66**	7.2
H5-02	2	1.6	22.5	432	432	**21**	11	**21**	8.9
I1-02	2	9	13.6	1,471	1,000	**3.7**	2.4	**5**	5.0
J2U-02	2	44	9.5	5,033	1,000	0.8	**1.3**	**5**	5.0
J5U-02	2	75	14.7	13,226	1,000	0.4	**1.1**	**5**	5.0
J6-02	2	71	3.4	2,921	1,000	0.5	**1.1**	**5**	5.0
AFW-2U-04	4	77	2.3	2,171	1,000	0.4	**1.1**	**5**	5.0
D1U-04	4	49	9.4	5,539	1,000	0.7	**1.2**	**5**	5.0
D2U-04	4	28.5	9.4	3,208	1,000	1.2	**1.4**	**5**	5.0
E6-04	4	1.4	4.5	75	75	**24**	22	**24**	1.8
F2U-04	4	422	20.4	103,279	1,000	0.1	**1.0**	**5**	5.0
F4U-04	4	0.3	26.2	94.28	94	**110**	55	**110**	10.4
F6-04	4	40.2	16.8	8,118	1,000	0.8	**1.3**	**5**	5.0
G1U-04	4	0.009	37.5	4.06	4.1	**3,667**	1,717	**3,667**	14.9
G6-04	4	190	40.3	91,914	1,000	0.2	**1.0**	**5**	5.0
H5-04	4	0.6	37.5	271	271	**55**	26	**55**	14.9
I1-04	4	3.1	26.5	988	988	**11**	5.3	**11**	10.5
J2U-04	4	140	44.8	75,296	1,000	0.2	**1.1**	**5**	5.0
J5U-04	4	0.01	20.3	2.44	2.4	**3,300**	1,726	**3,300**	8.1
J6-04	4	4	6	287	287	**8.3**	6.7	**8**	2.4
AFW-2U-05	5	13	10.2	1,595	1,000	**2.5**	2.0	**5**	5.0
AGW-1U-05	5	360	16.6	71,915	1,000	0.1	**1.0**	**5**	5.0
D1U-05	5	21.9	18.0	4,743	1,000	1.5	**1.6**	**5**	5.0
D2U-05	5	30.3	16.6	6,047	1,000	1.1	**1.4**	**5**	5.0
E6-05	5	0.7	16.4	138	138	**47**	26	**47**	6.5
F2U-05	5	0.07	29.0	24.36	24	**471**	230	**471**	11.5
F4U-05	5	0.03	31.7	11.41	11.41	**1,100**	528	**1,100**	12.6
F6-05	5	0.3	24.7	89	89	**110**	55	**110**	9.8

Piezometer Sample Rates and Duration
Performance Monitoring Program

Location		Flow Zone	Transmissivity ft^2/day	Typical Water over Screen (ft)	Sustainable Pumping Rate (mL/min)	Recommended Pumping Rate (mL/min)	t_{95} Time 1[a] (min)	Time 2[b] (min)	Recommended Purge Time[c] (min)	Total Volume Purged (L)
G6-05		5	8	48.2	4,632	1,000	**4.1**	2.6	**5**	5.0
H2M-05		5	0.001	42.0	0.51	0.51	**33,000**	15,228	**33,000**	16.7
H5-05		5	16	43.3	8,327	1,000	**2.1**	1.8	**5**	5.0
I1-05		5	0.2	3.9	9.41	9.4	165	**169**	**169**	1.6
J2U-05		5	300	16.8	60,560	1,000	0.1	**1.0**	**5**	5.0
J5U-05		5	66	20.6	16,342	1,000	0.5	**1.2**	**5**	5.0
J6-05		5	64	13.2	10,176	1,000	0.5	**1.2**	**5**	5.0
PMW-1U-05		5	2.1	13.4	338	338	**16**	9.2	**16**	5.3
ABP-7-06	dry	6	0.5	0.1	0.54	0.5	66	**1,818**	**1,818**	1.0
AFW-1U-06	dry	6	2.3	0.4	12.40	12	14	**83**	**83**	1.0
AFW-2U-06	dry	6	0.3	0.0	0.36	0.4	110	**2,708**	**2,708**	1.0
AGW-1U-06		6	6.7	1.3	103	103	4.9	**11**	**11**	1.2
B2U-06		6	0.001	2.4	0.03	0.03	33,000	**46,843**	**46,843**	1.3
C3-06	dry	6	0.07	0.0	0.08	0.08	471	**11,604**	**11,604**	1.0
D1U-06	dry	6	1	1.0	12.10	12.10	33	**93**	**93**	1.1
D2U-06	dry	6	0.44	0.4	1.97	2.0	75	**518**	**518**	1.0
E6-06		6	218	31.9	83,451	1,000	0.2	**1.0**	**5**	5.0
F2M-06		6	0.001	51.0	0.61	0.6	**33,000**	14,896	**33,000**	20.2
F4M-06		6	0.007	17.2	1.45	1.4	**4,714**	2,568	**4,714**	6.8
F6-06		6	134	35.1	56,529	1,000	0.2	**1.1**	**5**	5.0
G1M-06		6	58	36.8	25,656	1,000	0.6	**1.2**	**5**	5.0
G6-06		6	79	45.0	42,745	1,000	0.4	**1.1**	**5**	5.0
H2M-06		6	16	45.9	8,829	1,000	**2.1**	1.8	**5**	5.0
H5-06		6	0.04	25.6	12.33	12	**825**	411	**825**	10.2
I1-06		6	0.06	15.5	11.21	11.21	**550**	308	**550**	6.2
J2M-06		6	280	3.5	11,708	1,000	0.1	**1.0**	**5**	5.0
J5M-06		6	11	1.4	192	192	3.0	**6.2**	**6**	1.2
J6-06		6	0.001	7.7	0.09	0.09	**33,000**	23,688	**33,000**	3.1
PMW-1U-06		6	0.001	1.4	0.02	0.02	33,000	**70,243**	**70,243**	1.2
ABP-1-07		7	0.001	2.9	0.03	0.03	33,000	**41,111**	**41,111**	1.1
ABP-7-07		7	1.5	1.0	18.72	19	22	**60**	**60**	1.1
AFW-1M-07	dry	7	0.001	0.0	0.00	0.00	33,000	**812,271**	**812,271**	1.0
AFW-2M-07	dry	7	0.001	0.0	0.00	0.00	33,000	**812,271**	**812,271**	1.0
AGW-1M-07		7	140	22.3	37,507	1,000	0.2	**1.1**	**5**	5.0
B2M-07		7	0.05	18.2	10.95	11	**660**	354	**660**	7.2
C3-07		7	13	6.5	1,019	1,000	**2.5**	2.0	**5**	5.0
D1M-07		7	0.3	12.1	43.78	44	**110**	66	**110**	4.8
D2M-07		7	0.001	2.4	0.03	0.03	33,000	**46,995**	**46,995**	1.3

Piezometer Sample Rates and Duration
Performance Monitoring Program

Location		Flow Zone	Transmissivity ft^2/day	Typical Water over Screen (ft)	Sustainable Pumping Rate (mL/min)	Recommended Pumping Rate (mL/min)	t_{95} Time 1[a] (min)	Time 2[b] (min)	Recommended Purge Time[c] (min)	Total Volume Purged (L)
E6-07		7	0.15	34.9	62.82	63	**220**	104	**220**	13.8
F2M-07		7	0.001	37.9	0.46	0.5	**33,000**	15,437	**33,000**	15.0
F4M-07		7	0.001	19.8	0.24	0.2	**33,000**	17,365	**33,000**	7.8
F6-07		7	0.001	59.9	0.72	0.7	**33,000**	14,661	**33,000**	23.8
G1M-07		7	0.004	42.6	2.05	2.0	**8,250**	3,801	**8,250**	16.9
G6-07		7	1.1	60.9	804	804	**30**	13	**30**	24.1
H5-07		7	219	39.0	102,663	1,000	0.2	**1.0**	**5**	5.0
I1-07		7	39.5	39.2	18,591	1,000	0.8	**1.3**	**5**	5.0
J5M-07		7	220	31.2	82,463	1,000	0.2	**1.0**	**5**	5.0
J6-07		7	65	23.4	18,247	1,000	0.5	**1.2**	**5**	5.0
PMW-1M-07	dry	7	0.001	0.0	0.00	0.00	33,000	**812,271**	**812,271**	1
ABP-1-09		9	2.6	3.7	115	115	13	**13**	**13**	1.5
ABP-7-09		9	67	7.7	6,166	1,000	0.5	**1.2**	**5**	5.0
AFW-1M-09	dry	9	0.6	0.0	0.72	0.7	55	**1,354**	**1,354**	1.0
AFW-2M-09		9	0.001	5.0	0.06	0.06	**33,000**	29,337	**33,000**	2.0
AGW-1M-09		9	150	33.3	60,019	1,000	0.2	**1.0**	**5**	5.0
B2M-09	dry	9	38	0.0	45.66	46	0.9	**21**	**21**	1.0
C3-09		9	117	14.5	20,334	1,000	0.3	**1.1**	**5**	5.0
D1M-09		9	184	3.2	7,093	1,000	0.2	**1.0**	**5**	5.0
D2M-09		9	160.4	2.8	5,436	1,000	0.2	**1.0**	**5**	5.0
E6-09		9	4.9	53.7	3,159	1,000	**6.7**	3.7	**7**	6.7
F2M-09		9	110	14.3	18,892	1,000	0.3	**1.1**	**5**	5.0
F4M-09		9	30	10.6	3,834	1,000	1.1	**1.4**	**5**	5.0
F6-09		9	0.001	28.4	0.34	0.3	**33,000**	16,140	**33,000**	11.3
G1M-09		9	0.001	45.8	0.55	0.6	**33,000**	15,072	**33,000**	18.2
G6-09		9	0.003	68.2	2.46	2.5	**11,000**	4,833	**11,000**	27.0
H2M-09		9	16	47.1	9,050	1,000	**2.1**	1.8	**5**	5.0
H5-09		9	132	50.6	80,247	1,000	0.3	**1.1**	**5**	5.0
I1-09		9	0.001	15.8	0.19	0.19	**33,000**	18,388	**33,000**	6.3
J2M-09		9	1.7	31.9	652	652	**19**	9.3	**19**	12.7
J5M-09		9	150	40.7	73,301	1,000	0.2	**1.0**	**5**	5.0
J6-09		9	0.002	33.9	0.81	0.8	**16,500**	7,842	**16,500**	13.4
PMW-1M-09		9	57.6	1.2	802	802	0.6	**1.4**	**5**	4

Piezometer Sample Rates and Duration
Performance Monitoring Program

Location	Flow Zone	Transmissivity ft^2/day	Typical Water over Screen (ft)	Sustainable Pumping Rate (mL/min)	Recommended Pumping Rate (mL/min)	t95 Time 1[a] (min)	Time 2[b] (min)	Recommended Purge Time[c] (min)	Total Volume Purged (L)
AFW-1L-11	11	3.2	11.8	454.66	455	**10**	6.3	**10**	4.7
AFW-2L-11	11	0.007	3.0	0.26	0.3	4,714	**5,667**	**5,667**	1.4
AGW-1L-11	11	0.005	63.1	3.79	3.8	**6,600**	2,919	**6,600**	25.0
B2L-11	11	16	13.3	2,548	1,000	**2.1**	1.8	**5**	5.0
D1L-11	11	15.2	17.8	3,254	1,000	**2.2**	1.8	**5**	5.0
D2L-11	11	2.1	40.8	1,031	1,000	**16**	7.3	**16**	15.7
E6-11	11	68.2	55.6	45,530	1,000	0.5	**1.2**	**5**	5.0
F2L-11	11	1.3	77.9	1,216	1,000	**25**	11	**25**	25.4
F4L-11	11	0.001	55.5	0.67	0.67	**33,000**	14,768	**33,000**	22.0
F6-11	11	13.8	63.1	10,463	1,000	**2.4**	1.9	**5**	5.0
G1L-11	11	55	106.7	70,534	1,000	0.6	**1.2**	**5**	5.0
G6-11	11	1.6	105.1	2,021	1,000	**21**	9.3	**21**	20.6
H2L-11	11	0.1	56.8	68.30	68	**330**	147	**330**	22.5
H5-11	11	1.3	95.6	1,494	1,000	**25**	11	**25**	25.4
I1-11	11	0.001	40.6	0.49	0.5	**33,000**	15,294	**33,000**	16.1
J5L-11	11	7	67.8	5,706	1,000	**4.7**	2.9	**5**	5.0
J6-11	11	21	72.9	18,399	1,000	1.6	**1.6**	**5**	5.0
PMW-1L-11	11	1.4	20.5	345.68	346	**24**	12	**36**	12.4

Notes:

a. Time1 is the time required for the formation to contribute 95% of the water to the pump - this time is independent of pumping rate.

b. Time2 is the time required to remove wellbore storage plus 3 screen volumes at Recommended Pumping Rate

c. Recommended Purge Time at the Recommended Pumping Rate = Maximum of Time1, Time2, or 5 minutes, whichever is greater

Note: the piezometer must be purged to satisfy both the Time1 (or 9t5) and a minimum purge volume.

If the purge flow rate is less than Recommended Pumping Rate, then calculate a minimum purge a volume as follows: Vpurge = 160 * (6+0.083*Q/T)

Where

Vpurge is in ml

Q is the actual pumping rate in ml/min

T is transmissivity in ft2/day

Q and A indicate a quarterly or an Annual Sample

"dry" indicates that this well is generally dewatered and it cannot be sampled

Appendix B
FP-05A Community Monitoring Well Soil Vapor Monitoring Form

FP-05A

Community Monitoring Well Soil Vapor Monitoring
Community Monitoring Program
Hyde Park Landfill Site
Town of Niagara, New York

Field Team: ______________________ **Date:** ______________

Wind Speed & Direction: ______________________ **Temperature:** ______________

Instructions:

- Using an organic vapor analyzer capable of detecting 10 parts per billion by volume (ppbv) or lower, collect a stabilized background reading, followed by readings from the monitoring point at 1-minute intervals for 10 minutes.

- If any of the stabilized readings exceed 50 ppbv, notify the project manager immediately so follow-up actions can be initiated.

- Submit this form directly to the project staff within 2 days of the event.

Well ID	Time Intervals	Sampling Time (hhmm)	VOC Readings (ppbv)	Well ID	Time Intervals	Sampling Time (hhmm)	VOC Readings (ppbv)
SVP-1	Background			SVP-2	Background		
	At 1 minute				At 1 minute		
	At 2 minutes				At 2 minutes		
	At 3 minutes				At 3 minutes		
	At 4 minutes				At 4 minutes		
	At 5 minutes				At 5 minutes		
	At 6 minutes				At 6 minutes		
	At 7 minutes				At 7 minutes		
	At 8 minutes				At 8 minutes		
	At 9 minutes				At 9 minutes		
	At 10 minutes				At 10 minutes		

FP-05A

Community Monitoring Well Soil Vapor Monitoring
Community Monitoring Program
Hyde Park Landfill Site
Town of Niagara, New York

Well ID	Time Intervals	Sampling Time (hhmm)	VOC Readings (ppbv)	Well ID	Time Intervals	Sampling Time (hhmm)	VOC Readings (ppbv)
SVP-3	Background			**SVP-4**	Background		
	At 1 minute				At 1 minute		
	At 2 minutes				At 2 minutes		
	At 3 minutes				At 3 minutes		
	At 4 minutes				At 4 minutes		
	At 5 minutes				At 5 minutes		
	At 6 minutes				At 6 minutes		
	At 7 minutes				At 7 minutes		
	At 8 minutes				At 8 minutes		
	At 9 minutes				At 9 minutes		
	At 10 minutes				At 10 minutes		
CMW-7OB	Background			**CMW-8OB**	Background		
	At 1 minute				At 1 minute		
	At 2 minutes				At 2 minutes		
	At 3 minutes				At 3 minutes		
	At 4 minutes				At 4 minutes		
	At 5 minutes				At 5 minutes		
	At 6 minutes				At 6 minutes		
	At 7 minutes				At 7 minutes		
	At 8 minutes				At 8 minutes		
	At 9 minutes				At 9 minutes		
	At 10 minutes				At 10 minutes		

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