FIFTH FIVE-YEAR REVIEW REPORT FOR HOOKER S-AREA SUPERFUND SITE NIAGARA COUNTY, NEW YORK

Prepared by

U.S. Environmental Protection Agency
Region 2
New York , New York

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Date

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LIST OF ABBREVIATIONS & ACRONYMS

ARAR	Applicable or Relevant and Appropriate Requirement
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
EPA	United States Environmental Protection Agency
FYR	Five-Year Review
ICs	Institutional Controls
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NPL	National Priorities List
O&M	Operation and Maintenance
OU	Operable Unit
PRP	Potentially Responsible Party
RAO	Remedial Action Objectives
ROD	Record of Decision
RPM	Remedial Project Manager
TBC	To be considered

I. INTRODUCTION

The purpose of a five-year review (FYR) is to evaluate the implementation and performance of a remedy in order to determine if the remedy is and will continue to be protective of human health and the environment. The methods, findings, and conclusions of reviews are documented in FYR reports such as this one. In addition, FYR reports identify issues found during the review, if any, and document recommendations to address them.

The U.S. Environmental Protection Agency (EPA) is preparing this FYR review pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Section 121, consistent with the National Contingency Plan (NCP)(40 CFR Section 300.430(f)(4)(ii)), and considering EPA policy.

This is the fifth FYR for the Hooker S-Area Superfund site (site), located in Niagara Falls, Niagara County, New York. The site remediation has been conducted as a single Operable Unit, in that all remedial activities were done as a single site-wide effort.

The triggering action for this statutory review is the date of the previous FYR for the site, which is September 30, 2014. A FYR is required at this site due to the fact that hazardous substances, pollutants or contaminants remain at the site above levels that allow for unlimited use and unrestricted exposure. The site consists of one operable unit, which is addressed in this FYR.

This review was conducted by EPA Remedial Project Manager (RPM), Kevin Willis. Participants included Kathryn Flynn, Geologist, Charles Nace, Ecological and Humann Health Risk Assessor, Michael Basile, Community Involvement Coordinator. The review began on December 12, 2018.

Site Background

The site is an eight acre industrial landfill owned by the Occidental Chemical Corporation (OCC). It is located at the southeast corner of OCC's Buffalo Avenue chemical plant in Niagara Falls, New York, along the Niagara River. Adjacent to the landfill is the City of Niagara Falls (City) drinking water treatment plant (DWTP). The Province of Ontario, Canada, is located across the Niagara River, a distance of approximately two miles. The site is located in a heavily industrialized area of Niagara Falls. There is a residential community of approximately 700 people within 1/4 mile northeast of the site. The DWTP serves an estimated 70,000 people.

In 1978, sampling of the structures at the S-Area facility and the adjacent DWTP intake tunnels revealed chemical contamination. On December 20, 1979, the United States Department of Justice, on behalf of the EPA, filed a civil action against the Hooker Chemicals & Plastics Corporation, now OCC, alleging an "imminent and substantial endangerment" at the site. The site was included on the National Priorities List (NPL) on September 1, 1983.

FIVE-YEAR REVIEW SUMMARY FORM

SITE IDENTIFICATION		
Site Name: Hooker S-Area		
EPA ID: NYD980654206		
Region: 2	**State:** NY	**City/County:** Niagara Falls, Niagara

SITE STATUS	
NPL Status: Final	
Multiple OUs? No	**Has the site achieved construction completion?** Yes

REVIEW STATUS
Lead agency: EPA ***[If "Other Federal Agency", enter Agency name]*:**
Author name (Federal or State Project Manager): Kevin Willis
Author affiliation: EPA
Review period: 9/29/2014 – 9/29/2019
Date of site inspection: 11/7/2018
Type of review: Statutory
Review number: 5
Triggering action date: 9/29/2014
Due date *(five years after triggering action date)*: 9/29/2019

II. RESPONSE ACTION SUMMARY

Basis for Taking Action

The initial enforcement agreement with OCC, the 1985 Settlement Agreement, included a process for conducting additional remedial investigations and determining what, if any, additional response actions were necessary. The process to evaluate various remedial alternatives was called a Requisite Remedial Technology (RRT) Study (*i.e.*, the equivalent of a CERCLA feasibility study). Based on the results of the additional investigations and the RRT Study, which were performed by OCC in the late 1980s, the parties negotiated a second agreement, the RRT Stipulation, to remediate those areas of contamination at the site which would not be addressed by the 1985 Settlement Agreement. The RRT Stipulation, which was lodged with the Court in September 1990 and entered by the Court in April 1990, outlined a remedy

which was conceptually consistent with the original remedy, but one that expanded and improved upon that remedy. The RRT Stipulation was incorporated into, supplemented and modified the 1985 Settlement Agreement. In December 1990, EPA documented that the RRT Stipulation was the equivalent of a Record of Decision (ROD).

The 1990 RRT/ROD determined that the site was a threat to human health and the environment and the site contamination be contained from further migration off-site and removed from within the site boundaries to be properly disposed. The contaminants of concern stated in the ROD included tetrachloroethylene (PCE) and "other VOCs" with action levels established for bedrock groundwater to include PCE at 5 ug/1 and 2,3,7,8-TCDD at 0.0005 ug/1.

Response Actions

A comprehensive remedy for the site has been implemented in accordance with the 1985 Settlement Agreement, as amended by the RRT Stipulation. It is being overseen jointly by EPA and the New York State Department of Environmental Conservation (NYSDEC) and the New York State Department of Health (NYSDOH) in accordance with a 1984 Memorandum of Understanding. The remedial action consists of multiple remedial systems and programs that are designed to contain aqueous phase liquid (APL) and nonaqueous phase liquid (NAPL) chemicals at the site, thereby preventing the further migration of those chemicals eastward toward the City's property and southward into and under the Niagara River. They are also designed to collect NAPL chemicals to the maximum extent practicable.

The 1990 ROD included the following remedial actions: decommissioning of the underground utility and service lines; closing and capping onsite lagoons; capping the landfill and surrounding area; constructing a site barrier wall containment system; installing a drain tile collection system; pumping and treatment of ground water and/or leachate from the landfill area, overburden, and bedrock using gravity separation to separate APLs from NAPLs; treating APL at an onsite carbon treatment facility with onsite discharge to a permitted outfall; treating NAPL and any associated sediment at an onsite incinerator; monitoring groundwater; closing and demolishing part of the adjacent drinking water treatment plant, and constructing a new drinking water treatment facility at another location.

No remediation goals were established for the site, however, action levels for bedrock ground water were established (5 ug/1 for PCE and 0.0005 ug/1 for 2,3,1,8-TCDD) to determine when operational modifications needed to be implemented.

The 1990 ROD called for three remedial systems to be employed to remediate the on-site contamination. These systems are the Site Containment System, the Overburden RRT System, and the Bedrock RRT System.

The design objectives of the Site Containment System were to: (1) to contain APL and NAPL; (2) to maximize the collection of NAPL within the Site Barrier Wall (as defined below) at the Landfill Site; and (3) to minimize the migration of chemicals toward the City's Drinking Water Treatment Plant (hereinafter "CWTP").

The design and remedial objectives of the Overburden RRT System were to: (1) to contain APL and NAPL within the existing S-Area Overburden NAPL plume; and (2) to collect NAPL outside the Site Barrier Wall to the maximum extent practicable.

Finally, the design and remedial objectives of the Bedrock RRT System were: (1) to contain APL and NAPL within the existing S-Area Bedrock NAPL plume; (2) to prevent further NAPL migration in the bedrock under the Niagara River; and (3) to collect NAPL within this plume to the maximum extent practicable.

Status of Implementation

The remedial systems and programs consist of the following: (A) the S-Area Overburden Remedial Systems; (B) the S-Area Bedrock RRT System; (C) the Remedial Waste Management Program; and (D) the DWTP Remedial Program. The remedy components are discussed for each system below.

A. S-Area Overburden Remedial Systems

Barrier Wall

The Barrier Wall encompasses the entire landfill and those areas adjacent to the landfill where S-Area NAPL chemicals migrated through overburden soils to the Niagara River and the former DWTP. The Barrier Wall is designed to remain indefinitely as an effective barrier to chemical migration. Construction of the northern, southern and western portions of the Barrier Wall were completed in 1995. The eastern wall was completed in June 1998 once the new Drinking Water Treatment Plant was completed. The barrier wall does not require maintenance and its effectiveness is monitored as part of the quarterly monitoring program.

Drain Collection System (DCS)

The DCS is comprised of a network of drains located in overburden soils within the Barrier Wall and sloped to a central collection well for recovery of groundwater and NAPL. It is operated to create and maximize an upward hydraulic gradient from the underlying bedrock into the overburden soil within the area encompassed by the Barrier Wall. The construction of the DCS was completed in March 2000, and continues to operate and is maintained by OCC contractors. Monitoring of this system is done as part of the quarterly sampling program.

Site Containment Purge Wells

The installation of the Containment Purge Wells network was included as part of the plans contained in Appendix I of the RRT Stipulation. Well installation was completed in 1994 and the force mains for piping the collected APL and NAPL (*i.e.*, leachate) to the on-site Leachate Storage and Handling Facility were completed in 1995. The site Containment Purge Wells and their effectiveness is monitored under the quarterly sampling program.

Capping

The purpose of capping the landfill is to provide a physical barrier for the protection of human health and the environment, and to minimize the volume of leachate generated in overburden soils within the Barrier Wall. The site capping program consisted of a Perimeter Cap, which extends to all areas within the Barrier Wall, and a Landfill Cap for the actual landfill. Construction of the Perimeter Cap was completed in April 2002 and the Landfill Cap was completed in May 2002. The caps are maintained by OCC contractors.

B. S-Area Bedrock RRT System

The objectives for the Bedrock RRT System are: to contain APL and NAPL hydraulically within the existing area of bedrock NAPL contamination (*i.e.*, bedrock NAPL plume), to prevent further NAPL migration in the bedrock under the Niagara River, and to collect NAPL within this plume to the maximum extent practicable.

The Bedrock RRT System is designed to remediate three distinct water-bearing zones within the bedrock aquifer: (1) a Shallow Bedrock Zone consisting of the more-highly fractured upper 30 feet of bedrock, (2) an Intermediate Bedrock Zone between the depths of approximately 30 and 100 feet below the top of bedrock, and (3) a Deep Bedrock Zone between the depths of approximately 100 and 150 feet below the top of bedrock. To achieve its objectives, the Bedrock RRT System is comprised of groundwater pumping wells, NAPL recovery wells, and monitoring wells for each of the three zones. A network of force mains is used for piping leachate from the wells to the on-site Leachate Storage and Handling Facility.

The Final Bedrock RRT System Design was completed June 2002. This system undergoes minor modifications to optimize the system operation and maintenance regularly.

C. Remedial Waste Management Program

The Remedial Waste Management Program was developed to address all solid and semi-solid waste materials, APL and NAPL generated during the construction and operation of the site remedial programs. This program includes: (1) the disposal of solid and semi-solid remedial wastes atop the landfill, (2) the construction and operation of the Leachate Storage and Handling Facility, (3) the construction and operation of a water treatment facility to treat APL chemicals (hereinafter the "APL Treatment Facility"), and (4) the collection and destruction of S-Area NAPL at the Liquids Hazardous Waste Incinerator (Liquids Incinerator), located at OCC's Buffalo Avenue Chemical Plant.

Remedial Waste Disposal

All solid and semi-solid waste materials generated during performance of the remedial work have been placed atop the landfill in accordance with approved waste staging plans. Semi-solid wastes were first stabilized prior to placement. The bottom of the waste cells were lined with compacted clay prior to waste placement and all wastes were covered with a permanent clay cap.

Leachate Storage and Handling Facility

The on-site Leachate Storage and Handling Facility is designed to store all the leachate collected by the site remedial systems prior to treatment. The Leachate Storage and Handling Facility was completed in January 1994. The facility continues to receive and store all leachate being collected by the remedial systems in operation at the site.

APL Treatment Facility

The APL Treatment Facility utilizes granular activated carbon for treating APL generated by the site remedial systems. The construction of the facility began October 1992 and was fully operational by March 1995. All waters collected by the operating remedial systems and decanted from the Leachate Storage and Handling Facility are currently sent to the APL Treatment Facility for treatment prior to discharge to the Niagara River.

NAPL Characterization and Authorization to Incinerate

OCC collected representative NAPL samples from the site in 1992 for characterization and to obtain authorization to incinerate. EPA and NYSDEC permitting authorities approved the burning of S-Area NAPL at OCC's Liquids Incinerator in 1993. The results of trial burns conducted by OCC in 1994 and 1995 indicated that the NAPL was a difficult waste to burn due to a high ash and chlorine content and a low British thermal unit (BTU) value. OCC elected not to burn S-Area NAPL at the Liquids Incinerator, but continued to store it on site while assessing the availability of permitted commercial incinerators. In 1999, OCC entered into an agreement with a commercial facility located in Deerpark, Texas, to incinerate the S-Area NAPL. This facility was used until permit changes were approved which allowed OCC to use the adjacent OCC Main Plant NAPL Incineration Unit for destruction of the site's NAPL beginning in April 2001. To date, approximately 280,000 gallons of NAPL have been treated. At present, approximately 900 gallons of NAPL per month are sent for incineration.

D. Drinking Water Treatment Plant (DWTP) Remedial Program

This program consists of the construction of a new DWTP for the City at a new location and the closure and remediation of the former DWTP and property. The closure and remedial programs selected for the former DWTP include plant demolition, construction of the eastern portion of the site Barrier Wall, construction of an APL Containment and Collection System to prevent APL from flowing into the Niagara River and eastward toward the City's property, a program to remove NAPL within the bedrock raw water intake structure, the securement of the overburden and bedrock raw water intake structures, and capping of the former DWTP property. This newly discovered area of contamination was then designated as the V-Area.

New Drinking Water Treatment Plant

For the siting of the new DWTP, the City selected a 25.8-acre parcel of land owned by the New York Power Authority (NYPA) and located adjacent to the former DWTP along Buffalo Avenue (hereinafter the "Buffalo Avenue site").

As part of the design review process, EPA requested that the entire raw water intake system be designed with a second level of protection against contamination. To provide such protection, the City designed the intake system with a Prestressed Concrete Cylinder Pipe (PCCP) consisting of a steel, cylindrical pipe within prestressed concrete. The PCCP was placed inside the bedrock tunnel from the intake shaft to the low-lift pump station. Additionally, as an added layer of protection, the annular space between the pipe and the intake tunnel wall was also grouted with a light-weight concrete.

The design for the new DWTP was approved by NYSDOH on November 19, 1993 and EPA on December 9, 1993. Construction of the new plant by the City's contractors commenced on August 22, 1994. NYSDOH issued an "Approval of Completed Works" on February 21, 1997. The City of Niagara Falls continues to use and maintain this new DWTP to date.

NAPL Removal from Bedrock Raw Water Intake Tunnel

The purpose of the NAPL Removal Program is to inspect the bedrock raw water intake tunnel of the former DWTP for the presence of NAPL, and remove any collectable quantities of NAPL from the tunnel prior to grouting. In April 1996, OCC's contractor performed a video inspection of the first 1,060 feet of the bedrock tunnel. The inspection revealed the presence of collectable quantities of NAPL approximately 860 feet into the tunnel from the Shore Shaft. NAPL removal activities were conducted in March 2000 prior to the Tunnel Grouting action. No further operation, maintenance or monitoring is required.

Securement of Raw Water Intake Structures

A program was designed to secure the former DWTP's overburden and bedrock raw water intake structures. The overburden intake, a 48-inch diameter emergency intake, was closed by severing the pipe at the south property line. The overburden intake structure was removed from the Niagara River coincident with the bedrock intake structures in August 2000.

Mobilization of the Tunnel Grouting field activities occurred in July 2000. The grouting proceeded as designed with exception of a portion of the tunnel underlying Buckhorn Island. It was confirmed by borings that the tunnel was grouted floor to ceiling for the majority of the extent of the tunnel with the exception of a length of tunnel at a distance of approximately 3,800 feet from the shore shaft. The void extends from 120 to 500 feet from this point under Buckhorn Island. The final segment beyond this point was also shown to be properly grouted.

EPA and NYSDEC agreed in an April 17, 2002 meeting that the portion of the tunnel that had not been grouted was not a threat to the migration of NAPL from the site and that it was unnecessary to grout this void. A monitoring well was installed to sample the water in the ungrouted portion of the tunnel and is being monitored as part of the bi-annual Shallow Bedrock Sampling Program. Monitoring results in the well indicated that water in this ungrouted portion of the tunnel was contaminated with volatile organic compounds (VOCs). It was agreed that sodium permanganate would be injected into the tunnel void to address the contamination. The injections of the sodium permanganate began in March 2004 and the subsequent monitoring data have demonstrated that this action has been effective. Four injections of permanganate were done, the last being August 2006, when EPA and OCC agreed that no further injections were necessary. The well continues to be monitored as part of the Quarterly Sampling Plan.

Capping

The cap consists of a composite cover for the area inside of the eastern Barrier Wall and a clay cap for the remaining portion of the DWTP property. The DWTP Cap construction commenced in April 1998, the construction was completed in April 2002. Maintenance of this area is part of the overall cap maintenance program.

Eastern Portion Study

In accordance with the RRT Stipulation, the Eastern Portion of the former DWTP property was addressed by the City under the State of New York's Inactive Hazardous Waste Disposal Site Program. In 1995 and 1996, the City performed the Eastern Portion Study to determine the nature and extent of contamination and whether such contamination poses a threat to human health and the environment. The results revealed the presence of S-Area chemicals in the groundwater beneath the Eastern Portion. The DWTP drain collection system was extended across the Eastern Portion to contain and collect the S-Area chemicals present in the groundwater.

At the same time of the Eastern Portion Study, the City also performed an investigation of the one-acre parcel located at the new DWTP. The one-acre parcel was determined to be contaminated but not related to the S-Area. This parcel has been listed as a separate State of New York Inactive Hazardous Waste Disposal Site and is not considered to be part of the S-Area site and is not covered by this review.

DWTP NAPL Investigations

During the installation of the S-Area Prototype Bedrock System monitoring wells in 1997, NAPL was encountered in an area of the bedrock at the former DWTP which was not previously identified. An investigation was performed by OCC to redefine the extent of NAPL. This area was then designated as the V-Area. Bedrock wells were installed on both the western and eastern portions of the property. The results showed the presence of NAPL in the Shallow Bedrock Zone extending as a linear, "finger-like" feature eastward approximately 300 feet from the previously defined NAPL plume boundary. OCC has installed two pumping wells along the NAPL finger and discharge lines to the S-Area Leachate Storage and Handling Facility. Wet Well A and Wet Well B are currently in operation to control the APL and NAPL plumes hydraulically at this portion of the property and collect NAPL.

NAPL Tracer Program

As required by the RRT Stipulation, a NAPL Tracer Program (NTP) was established at the Hooker S-Area site and was implemented in two stages. The first stage began in October 1992 and was completed in 1999. A second stage using different tracers and a modified set of observation wells was completed in 2008. The objective of the two stage NTP was to collect data on volume and velocity of potential southward NAPL plume migration in shallow bedrock zone across a line of NAPL recovery wells installed just north of the Niagara River prior to installation and operations of the Purge Bedrock System. The tracer was only detected once in any APL/NAPL samples collected over the entire NTP.

Subsequent to the second stage NTP, EPA and NYSDEC informed OCC that the evaluation did not provide the information necessary to conclude that the remedial action objectives related to the NAPL plume migration had been met.

As a result, OCC submitted an "Effectiveness Evaluation - Shallow Bedrock NAPL Recovery System" report to provide a comprehensive discussion of the multiple lines of evidence to satisfy the requirements of the RRT. In 2015, EPA and NYSDEC informed OCC that revisions to the report were necessary. In 2017, an Evaluation report was submitted by GSH. EPA and NYSDEC provided comments to this report on June 10, 2019. A response to comments was received in September 2019 and is under review.

System Operations/Operations & Maintenance

There are five sampling programs at the site - one in the overburden and four in the bedrock. The overburden sampling program (V-Area Chemical Monitoring Program) is performed voluntarily on an annual basis at 22 monitoring wells within the former city DWTP. Samples are analyzed for site-specific VOCs, semi-volatile organic compounds (SVOCs), pesticides, and organic acids, and total organic carbon (TOC) and total organic halides (TOX).

The bedrock sampling programs include the environmental monitoring program (EMP), shallow bedrock chemical program (SBCP), intermediate/deep chemical program (IDCP), and NAPL tracer program (NTP). The EMP is performed quarterly at eight monitoring wells. Samples are analyzed for site-specific VOCs, SVOCs, and pesticides, and dioxin/furans. The SBCP is performed annually at six inner-ring monitoring wells and semi-annually at 22 middle and outer-ring monitoring wells. Samples are analyzed for site-specific VOCs, SVOCs and TOX. The IDCP is performed annually at eight intermediate monitoring wells, four deep monitoring wells, and one monitoring well installed in the former DWTP intake tunnel. Samples are analyzed for site-specific VOCs, SVOCs and TOX. The NTP is performed annually at 13 wells. Both APL samples and NAPL samples (if present) are collected.

The site Containment Purge Wells network is monitored as part of the quarterly sampling program. Wells have been added to this network over time if they showed appreciable NAPL production.

Maintenance of the systems is an ongoing effort. Extraction wells are refurbished or replaced when flow into the well decreases substantially. Trends of contaminant inflow within the containment area are continually evaluated to determine what modifications to the extraction and collection systems can be made.

Potential site impacts from climate change have been assessed, and the performance of the remedy is currently not at risk due to the expected effects of climate change in the region and near the site.

IC Summary Table

There are no institutional controls required by decision documents for this site. The site is fenced and guarded to assure no unauthorized access to the property.

III. PROGRESS SINCE THE LAST REVIEW

This section includes the protectiveness determinations and statements from the last FYR as well as the recommendations from the last FYR and the current status of those recommendations.

Table 2: Protectiveness Determinations/Statements from the 2014 FYR

OU #	Protectiveness Determination	Protectiveness Statement
1	Protective	The remedy is protective of human health and the environment.

Table 3: Status of Recommendations from the 2014 FYR

OU #	Issue	Recommendations	Current Status	Current Implementation Status Description	Completion Date (if applicable)
1	Issue: Determination that NAPL is no longer migrating into Canadian territory should be finalized.	Complete determination of NAPL migration utilizing the submitted NAPL Tracer Study Report.	Ongoing	EPA and NYSDEC provided comments on GSH's 2017 updated evaluation report on 5/22/2019.	1/20/2021

IV. FIVE-YEAR REVIEW PROCESS

Community Notification, Involvement & Site Interviews

On October 1, 2018, EPA Region 2 posted a notice on its website indicating that it would be reviewing site cleanups and remedies at 42 Superfund sites in New York and New Jersey, including the Hooker S-Area site. The announcement can be found at the following web address: https://www.epa.gov/aboutepa/fiscal-year-2019-five-year-reviews.

In addition to this notification, a public notice was made available by placing on the City of Niagara Falls website, on 3/25/2019, stating that there was a FYR and inviting the public to submit any comments to the U.S. EPA. The results of the review and the report will be made available at the Site information repository located at Western New York Public Information Office, 186 Exchange Street, Buffalo, New York 14204 and https://www.epa.gov/superfund/hooker-s-area.

Data Review

NAPL Presence Monitoring

NAPL is checked annually at overburden wells outside the barrier wall to evaluate NAPL migration. NAPL was not found at the overburden wells in this review period. In the shallow bedrock, there are quarterly checks of NAPL presence at wells within 200 feet of the historic NAPL plume boundaries, plus the outer piezometers used for the hydraulic monitoring program and the shallow bedrock monitoring wells on the eastern property boundary. In 2018, there were 11 wells inside the plume at which NAPL was observed. Well OW674 outside the plume showed NAPL in 2018, consistent with previous years. In the intermediate and bedrock wells, there are annual NAPL presence checks at all

wells within 400 feet of their respective plume boundaries plus the intermediate wells on the eastern property boundary. NAPL was observed at three intermediate bedrock wells; it was not observed in any deep bedrock wells in the plumes in 2018. NAPL was also observed in six shallow bedrock wells, two intermediate, and two deep bedrock wells outside the NAPL plume boundaries in 2018. NAPL from these wells is removed on a regular basis and added to the off-site NAPL disposal system. Two of these wells are expected be added into the automatic NAPL collection system.

Groundwater Chemical Monitoring

Groundwater data are collected from a network of monitor wells located in and adjacent to the S-Area landfill and within the V-Area that lies outside and east of the landfill barrier wall. As per the RTT, different long-term monitoring programs have been established to evaluate the chemical concentrations in the APL in groundwater, the presence of NAPL in groundwater, and the effectiveness of purge/recovery wells in containing APL/NAPL migration relative to historic S-Area NAPL plume footprints. The discussion of groundwater data in this section focuses on the data collected during this past five year period (2014-2018).

Overburden

A chemical sampling monitoring program was established for V-Area and the former DWTP area in the overburden aquifer to evaluate water-quality conditions and to monitor chemicals that move toward the DWTP and toward the Niagara River. The wells are generally aligned along the eastern and western boundaries of the former DWTP property as well as outside the site barrier wall. The ambient overburden groundwater flow direction across V-Area is from north to south toward the Niagara River; S-Area chemicals migrate with groundwater southward. (The V-Area drainage collection system was installed across this groundwater flow path to intercept overburden groundwater APL and prevent potential migration of S-Area chemicals to the Niagara River.)

For the last five years (2014-2019), 13 wells have been sampled on an annual basis. Generally, concentrations of total organic constituents in each of the wells were stable with no apparent trends observed. OBG597R, located near the southeastern side of the former DWTP, had increased in concentration during the previous review period but in 2018 had 0.01 ppb. The highest total VOC concentrations occurred at OBG-4R in this period and ranged from 3,849 ug/l to 5,125 ug/l. This well is in the middle of the V-Area. The other overburden wells had a stable trend of concentrations below 50 ug/l during this period. The wells along the river, OW262 and OW260, revealed 12 ug/l and non-detect concentrations, respectively.

Shallow Bedrock

A chemical monitoring program was established to evaluate water-quality conditions in the shallow zone bedrock. The objective is to monitor selected VOC and semi-VOC concentrations, on a semi-annual basis, in the APL inside and outside of the S-area shallow bedrock NAPL plume. The ambient groundwater direction in the shallow bedrock is from the southeast and moves northwest. The monitoring wells are located around the fringe of the historic NAPL plume footprint (in the shallow bedrock) and are aligned in roughly three concentric ‘arcs’ along its western-northern-eastern boundaries.

Total organic constituent concentrations were generally stable or decreasing at the shallow bedrock wells in this period. At the inner arc wells, the highest concentration well OW806 has declined in concentration compared to the previous review periods. Concentrations in the outer arc of wells continued to have the lowest concentrations of total organic constituents in this period. There were increases in three wells located on the north side in 2015, possibly related to limited pumping at the Niagara Plant extraction system. These levels have been decreasing since 2016.

Intermediate/Deep Bedrock

A chemical monitoring program was also established for the intermediate and deep zone bedrock. The objective of the program is to monitor the chemical concentrations in APL outside the S-area intermediate and deep bedrock NAPL plumes. Eight wells are used to monitor conditions in the intermediate zone whereas four wells monitor the deep bedrock zone. The wells are sampled semi-annually for selected VOCs and SVOCs, but with fewer analytes than the shallow bedrock.

The wells in the upper intermediate bedrock mostly did not have organic constituents detected during this review period, including OW693 and OW800 located on the sides of S-Area adjacent to the river. In the lower intermediate bedrock, wells OW694 and OW685R north of the NAPL plume had stable concentrations that are similar to the averages in the previous review period. Well OW634 on the west edge of the NAPL plume continued to have the highest concentration of total organics, ranging from 170 ug/l to 994 ug/l during this period.

The deep bedrock wells had fluctuating concentrations during this period, but did not generally increase or decrease. As in the previous period, OW630 located 300 feet southeast of the plume had the highest concentrations. However the average value declined to 8,700 ug/l compared to the previous review period average of 12,331 ug/l.

Groundwater samples are also collected from well OW808, installed into the ungrouted portion of the bedrock intake tunnel, located on Buckhorn Island. Data showed average TVOC concentrations of 7.5 ppb, consistent with concentrations seen in the historical site sampling record of areas that had not been directly affected (background levels).

<u>Groundwater Piezometric Monitoring</u>

Water level data are collected on a quarterly basis from a network of monitor wells located in and adjacent to the S-Area landfill to confirm hydraulic control of groundwater APL and NAPL. As per the RTT, monitoring and purge wells are used to evaluate the hydraulic conditions in the overburden and in different depths in the bedrock to confirm containment of contaminated groundwater.

Over the last five years, quarterly measurements taken in overburden well pairs or river stage-well pairs located across the Barrier Wall showed flow inward flow gradients at most of the well pairs. However, OW552/OW551 and River/OW551 pairs are outward in March and some December events. The River/OW551 outward gradient was also observed in the previous review. The range of outward gradients between OW551 and the river was -2.77 to -19.06 feet in this period. In 2018, the River/OW536 pair also had an outward gradient in December.

Upward gradients are also determined by comparing groundwater elevations in overburden and shallow bedrock. Isopach contour maps derived from water-level differences are constructed on a quarterly

basis; the most recent data show a net upward hydraulic gradient in most of the southern portion of S-Area (the northern portion of S-Area has a thick underlying clay layer that precludes downward groundwater flow) indicating that containment is largely achieved within the Barrier Wall. The overburden purge wells OPW512, OPW513, and OPW514 were shut down in 2016 on a trial bais, but reactivated in 2017 to restore the upward gradient in this area. However, there is an area under Robert Moses Parkway and along the river outside of the clay later that does not have an upward gradient.

The objective of the Shallow Bedrock Hydraulic Monitoring Program (SBHP) is to evaluate the effectiveness of the Bedrock RRT System in maintaining an inward hydraulic gradient across the shallow bedrock NAPL plume boundary, thus eliminating the potential for groundwater to migrate from the NAPL plume as APL. The SBHP consists of 12 pairs of monitoring wells, designated as performance piezometer pairs, the inner location being within or directly adjacent to the NAPL plume boundary and the outer location being within approximately 400 feet outside the NAPL plume boundary. In addition to the 12 performance piezometer pairs, hydraulic monitoring is performed at all available S-Area shallow bedrock wells to evaluate the overall groundwater flow regime. Data from this period show inward gradients in most of the shallow bedrock well pairs in most quarters. Groundwater elevation maps of the shallow bedrock aquifer show drawdown in the area of the shallow bedrock NAPL plume (except for September 2018 when the system was not operating).

Hydraulic gradient monitoring is also performed in the intermediate and deep bedrock zones relative to the respective bedrock NAPL plume boundaries. The objective is to maintain inward gradients across the NAPL plume boundaries and eliminate the potential for groundwater to migrate from the NAPL as APL. There are six well pairs in each of the intermediate and deep bedrock zones. For the last five years, hydraulic head differences in well pairs located around the boundaries of the shallow and intermediate/deep NAPL plumes showed an outward gradient in at least two well pairs in every quarter, and some quarters with four well pairs showing outward gradients. Although quarterly groundwater elevation maps of the intermediate and deep bedrock aquifers show that there is drawdown in the area of the NAPL plume, there does not appear to be continuous inward gradients.

In addition to hydraulic monitoring, a series of purge wells is installed to control NAPL/APL migration in various zones in the bedrock. Hydraulic control is exerted across the purge well field by generating a sufficient drawdown through individually set target pumping rates. Seven APL bedrock purge wells are located along the southern edge of the shallow bedrock NAPL plume boundary and intercept groundwater from the southeast passing under the S-Area landfill through the shallow bedrock. A series of seven recovery wells is also installed along the southern edge of the shallow bedrock NAPL plume boundary. The wells remove available NAPL coming from the north from the landfill via dipping fractures. Five additional recovery wells are located along the eastern boundary of the shallow bedrock NAPL plume; these wells remove available NAPL coming from the west and prevent migration toward the new DWTP. Based on quarterly monitoring reports and annual evaluation reports for the 2014-2018 period, all wells are fully operational and generally operate within the target flow ranges. The shallow overburden pumping system was slightly below the target pumping range in 2016 through 2018. The shallow bedrock wells operated at or slightly above the target range of 85-110 gpm in this period, except for 2018 when the average flow rate was 79 gpm. The intermediate and bedrock wells operated within the target flow range for this period.

Summary

The landfill drainage systems are operating as designed based on the monitoring of site operations. The S-Area Overburden Remediation System currently contains APL and NAPL. The Overburden Remedial System has collected approximately 280,000 gallons of NAPL from the site since its startup in 1996. Collection of NAPL has been maximized as demonstrated by the conversion of certain monitoring wells into NAPL recovery wells and the subsequent increase in NAPL collection quantity. Migration of contaminants to the City DWTP has been eliminated. Groundwater monitoring data shows stable concentrations of organic constituents. The overburden remedial system needs to be optimized to obtain consistent the inward and upward gradients within the barrier wall.

Based on the summarized monitoring data, the bedrock systems have largely attained the remedial objectives set forth in the RRT Stipulation. The Shallow, Intermediate and Deep Bedrock systems have all achieved inward hydraulic gradients across most of the existing NAPL plume boundary within each of those zones. Although the target pumping rates are maintained, adjustments should be made to ensure hydraulic containment.

One of the requirements of the RRT that requires further evaluation is whether the extraction of the NAPL mass is stopping the migration of the NAPL plume under the Niagara River. The NAPL Tracer Program, originally conducted beginning in October 1992, was modified and the test was subsequently conducted again in August 2003 since the first attempt did not provide useful information. EPA determined that the results of the tracer study were inconclusive. EPA is currently evaluating additional lines of evidence to evaluate potential migration of NAPL under the river. NYSDEC and EPA sent comments on the Effectiveness Evaluation - Shallow Bedrock NAPL Recovery System report to OCC on June 10, 2019.

Site Inspection

The inspection of the Site was conducted on 11/8/2018. In attendance were Damian Duda, EPA, Michael Basile, EPA, Benjamin McPherson, NYSDEC, Joseph Branch, OCC, and John Pentilchuk, GHD. The purpose of the inspection was to assess the protectiveness of the remedy.

Participants toured the site and observed the operation. No problems were observed.

V. TECHNICAL ASSESSMENT

QUESTION A: Is the remedy functioning as intended by the decision documents?

As described in the RRT, the remedy consists of the Overburden Remedial Systems, the Bedrock RRT System, and the Remedial Waste Management Program. The remedial objectives are to contain APL and NAPL within existing NAPL plume boundaries, to maximize the collection of NAPL within the site barrier wall, to collect NAPL outside the Barrier Wall to the extent practicable, and to minimize potential migration of chemicals toward the DWTP and into the Niagara River. The Overburden Remedial Systems manages contaminated groundwater in three distinct areas: the Site Containment System, which addresses the area beneath and adjacent to the S-Area site; the Overburden RRT System,

which addresses areas outside the Site Containment System (south of S-Area); and the City DWTP Remedial Program, which addresses the property east of S-Area, the V-Area. The Site Containment System consists of a barrier wall that surrounds the S-Area Landfill, a drain collection system within the wall, a series site contaminant purge and recovery wells, and perimeter caps made of asphalt & composite material. The system functions to collect and contain APL/NAPL, and to minimize the migration of chemicals toward the city DWTP by maintaining inward gradients with respect to the barrier walls. The Bedrock RRT System is comprised of a network of groundwater pumping wells, NAPL recovery wells, and monitoring wells for the shallow, intermediate, and deep bedrock zones. The purpose of the Bedrock RRT System is to contain and collect APL/NAPL hydraulically within existing area of bedrock NAPL plume, and to prevent NAPL migration in bedrock under Niagara River. The system is designed to remediate three distinct water bearing zones and achieve inward hydraulic gradients across existing plume boundary in each zone.

Based upon the review of the monitoring data, it appears that the remedy is functioning as intended in relation to eliminating exposure pathways for ecological and human receptors. The groundwater concentrations are stable and the design target rates are generally achieved. However, the inward and upward gradient in the overburden aquifer needs to be maintained throughout the site, and the inward gradient in the shallow, intermediate, and deep bedrock aquifers needs to be consistently achieved. The NAPL observed outside of the bedrock plumes needs to be addressed.

QUESTION B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedy selection still valid?

Human Health – (a and b) Historic documents that identify exposure assumptions or toxicity data that were used to evaluate the potential risk and hazards associated with the site and are not available. Given that the exposure pathways have been eliminated (i.e., capping, municipal water supply) through the implementation of the remedial actions, exposure parameters and toxicity values would not be utilized in a current evaluate.

Previous five-year reviews evaluated the potential for vapor intrusion at the site. The vapor intrusion pathway was determined to be incomplete due to the lack of buildings over the plume. Currently, there are no buildings located over the plume and this pathway remains incomplete. Future five-year reviews should continue to evaluate if buildings are built over the plume.

Ecological – It is unclear if an ecological risk assessment was conducted for the site. However, based on the implementation of the remedy, any potential pathways for ecological receptors have been eliminated through capping and groundwater control. The discharge of NAPL to the Niagara River has been eliminated through the installation of a barrier wall. Therefore, based upon review of the past and current data, there are no completed exposure pathways for ecological receptors. The remedial actions objectives used at the time of the remedy selection are still valid and protective of the environment.

QUESTION C: Has any other information come to light that could call into question the protectiveness of the remedy?

No other information has come to light that could call into question the protectiveness of the remedy.

VI. ISSUES/RECOMMENDATIONS

Issues/Recommendations
OU(s) without Issues/Recommendations Identified in the Five-Year Review:
None

Issues and Recommendations Identified in the Five-Year Review:				
OU(s): 1	**Issue Category: Operations and Maintenance**			
	Issue: Remedial systems need to be optimized to attain more consistent inward and upward gradients of APL and NAPL removal at the site.			
	Recommendation: Optimize the APL/NAPL Remedial Systems to attain consistent inward and upward gradients			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
No	Yes	PRP	EPA/State	7/15/2020

VII. PROTECTIVENESS STATEMENT

Protectiveness Statement(s)		
Operable Unit: 1	*Protectiveness Determination:* Short-term Protective	*Planned Addendum Completion Date:* Click here to enter a date
Protectiveness Statement: The remedy is protective of human health and the environment in the short-term because all exposure pathways have been addressed and the groundwater concentrations are stable. However, in order for the remedy to be protective in the long term, the APL/NAPL remedial systems need to be optimized to maintain a consistent inward and upward gradient.		

Sitewide Protectiveness Statement	
Protectiveness Determination: Short-term Protective	*Planned Addendum Completion Date:* Click here to enter a date
Protectiveness Statement:	

The remedy is protective of human health and the environment in the short-term because all exposure pathways have been addressed and the groundwater concentrations are stable. However, in order for the remedy to be protective in the long term, the APL/NAPL remedial systems need to be optimized to maintain a consistent inward and upward gradient.

VIII. NEXT REVIEW

The next FYR report for the Hooker S-Area Superfund Site is required five years from the completion date of this review.

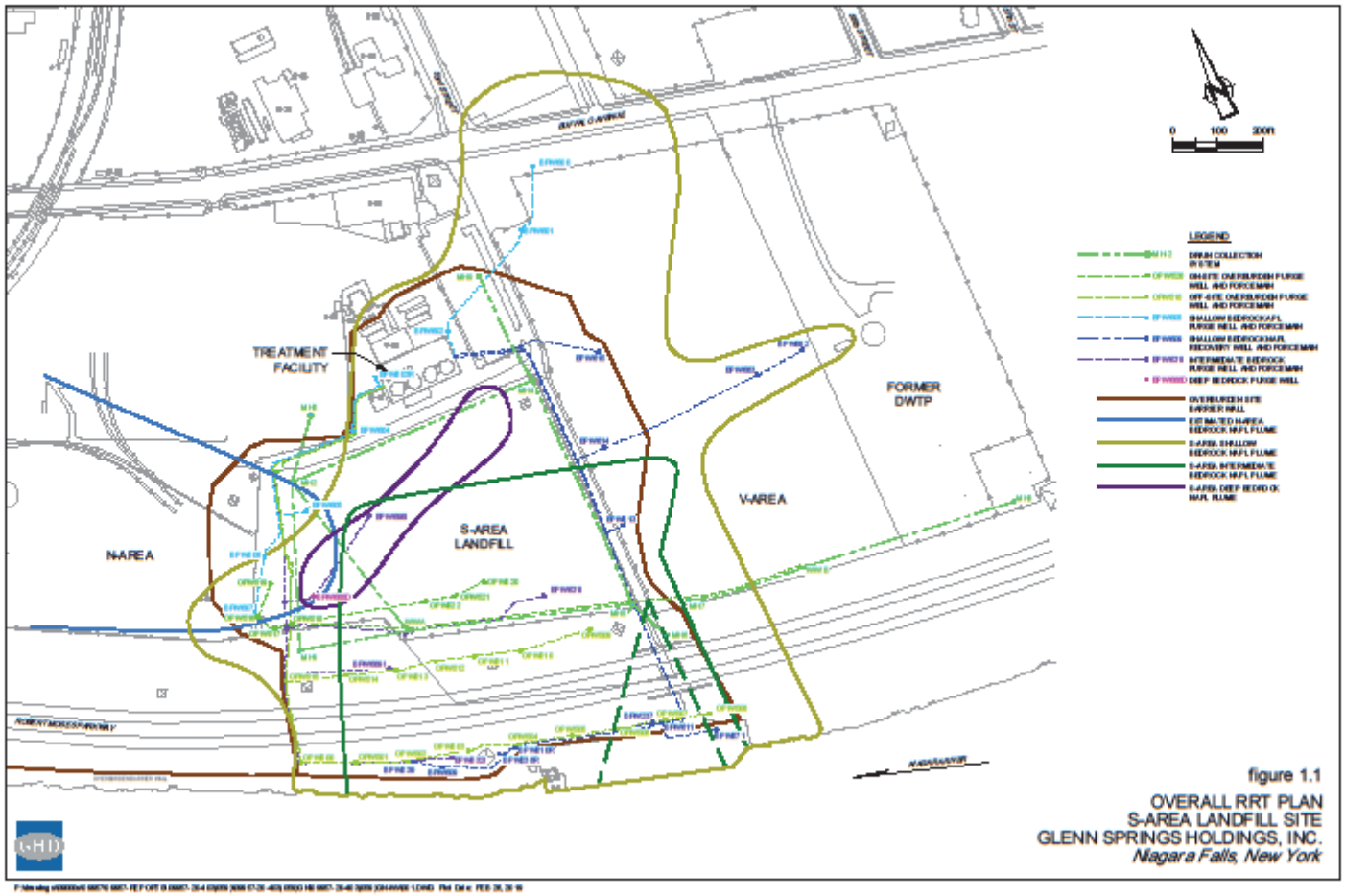


figure 1.1
OVERALL RRT PLAN
S-AREA LANDFILL SITE
GLENN SPRINGS HOLDINGS, INC.
Niagara Falls, New York

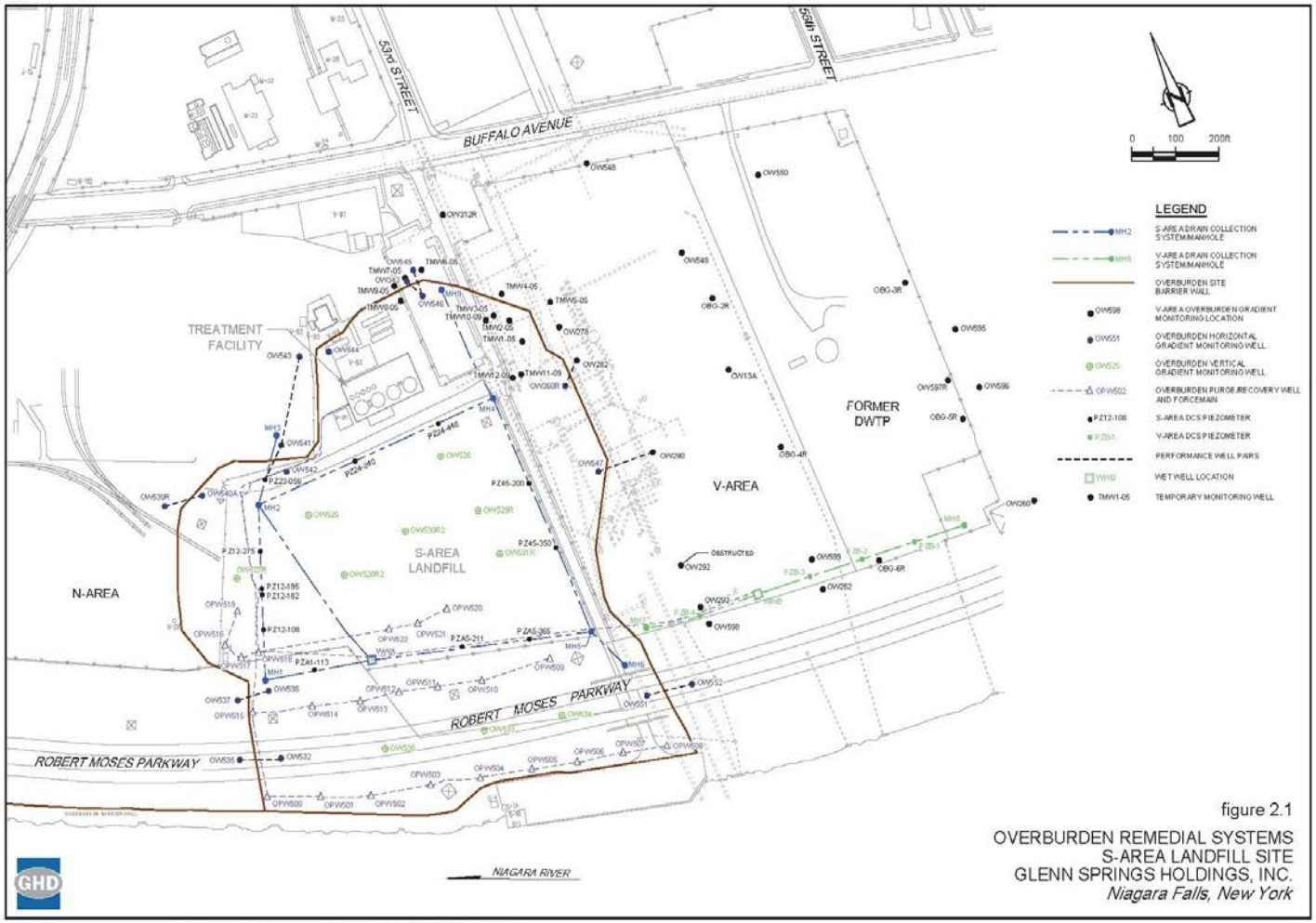
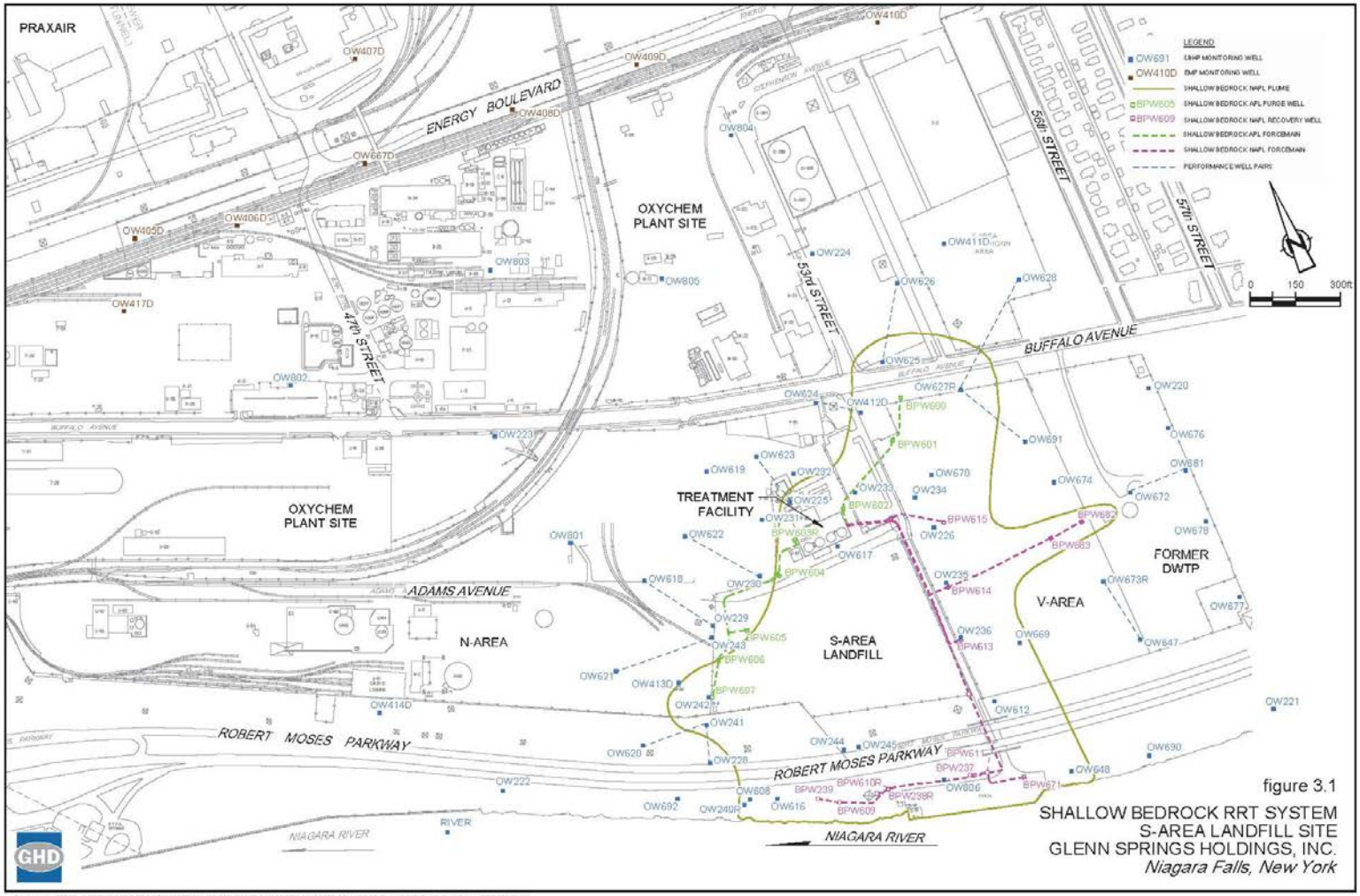


figure 2.1

OVERBURDEN REMEDIAL SYSTEMS
S-AREA LANDFILL SITE
GLENN SPRINGS HOLDINGS, INC.
Niagara Falls, New York

P:\drawings\09000s\09957\09957-REPORTS\09957-20-403059\09957-20-403059GN\09957-20-403059GNWA002.DWG Plot Date: FEB 26, 2019



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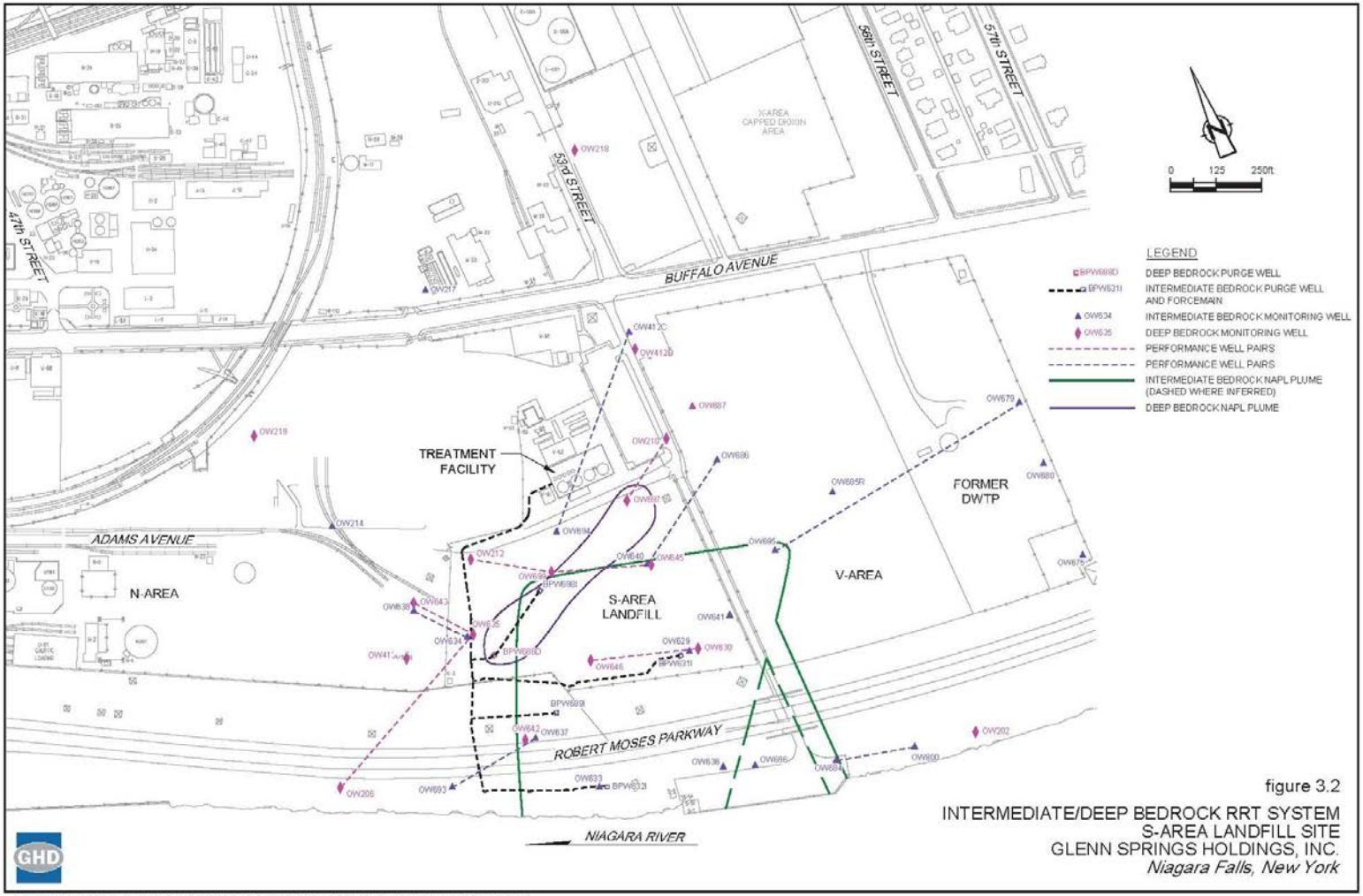
47th STREET
53rd STREET
BUFFALO AVENUE
X-AREA CAPPED DISPOSAL AREA
56th STREET
57th STREET
0 125 250ft
LEGEND
DEEP BEDROCK PURGE WELL
INTERMEDIATE BEDROCK PURGE WELL AND FORCEMAIN
INTERMEDIATE BEDROCK MONITORING WELL
DEEP BEDROCK MONITORING WELL
PERFORMANCE WELL PAIRS
PERFORMANCE WELL PAIRS
INTERMEDIATE BEDROCK NAPL PLUME (DASHED WHERE INFERRED)
DEEP BEDROCK NAPL PLUME
TREATMENT FACILITY
FORMER DWTP
V-AREA
S-AREA LANDFILL
N-AREA
ADAMS AVENUE
ROBERT MOSES PARKWAY
NIAGARA RIVER
OW218
OW217
OW412C
OW412B
OW687
OW679
OW219
OW210
OW686
OW685R
OW680
OW214
OW694
OW695
OW675
OW212
OW640
OW645
OW696
BPW698I
OW643
OW638
OW635
OW641
OW634
OW629
OW630
OW412A
BPW698D
OW646
BPW631I
BPW699I
OW642
OW637
OW202
OW638
OW696
OW684
OW800
OW206
OW693
OW633
BPW632I
figure 3.2
INTERMEDIATE/DEEP BEDROCK RRT SYSTEM
S-AREA LANDFILL SITE
GLENN SPRINGS HOLDINGS, INC.
Niagara Falls, New York
GHD
P:\drawings\09000s\09957\09957-REPORTS\09957-20-403(059)\09957-20-403(059)GN\09957-20-403(059)GN-WA004.DWG Plot Date: FEB 26, 2019