FOURTH FIVE-YEAR REVIEW REPORT
LOVE CANAL SUPERFUND SITE
CITY OF NIAGARA FALLS
NIAGARA COUNTY, NEW YORK

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

Approved by:

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Date

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LIST OF ABBREVIATIONS AND ACRONYMS

CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
DM	EPA 1982 Decision Memorandum
EDA	Emergency Declaration Area
ESD	Explanation of Significant Differences
EPA	U.S. Environmental Protection Agency
FYR	Five-Year Review
HD	NYSDOH Decision on Habitability of the ED
IC	Institutional Controls
LTMP	Long-Term Monitoring Program
LC	Love Canal
LCARA	Love Canal Area Revitalization Agency
LCHS	1988 Love Canal EDA Habitability Study
LCL	Love Canal Landfill
LCTF	Love Canal Leachate Collection and Treatment Facility
NAPL	Non-Aqueous Phase Liquid
NCP	National Contingency Plan
NFBE	Niagara Falls Board of Education
NPL	National Priorities List
NYS	New York State
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
O&M	Operation and Maintenance
OXY	Occidental Chemical Corporation
PRP	Potentially Responsible Party
RPM	Remedial Project Manager
ROD	Record of Decision
SARA	Superfund Amendments and Reauthorization Act

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 FYRs are documented in FYR reports, such as this one. In addition, FYR reports identify issues found during this 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 fourth FYR for the Love Canal Superfund site (Site), located in the City of Niagara Falls, Niagara County, New York. It is the policy of the EPA to conduct FYRs of pre-Superfund Amendments and Reauthorization Act of 1986 (SARA) remedies which result in hazardous substances remaining on-site. The triggering action for this policy review is the completion date of the previous FYR. Previous FYRs for this Site have defined Operable Unit One (OU1) as the sitewide OU for the Site so this FYR addresses OU1.

The EPA FYR team was led by Damian Duda, remedial project manager (RPM), and includes Sharissa Singh, hydrogeologist, Marian Olsen, risk assessor, Chuck Nace, ecological risk assessor, Henry Guzman, site attorney and Mike Basile, community involvement coordinator (CIC). The relevant entities, such as the potentially responsible parties (PRPS) and the New York State Department of Environmental Conservation (NYSDEC) and the New York State Department of Health (NYSDOH), were notified of the initiation of this FYR. The FYR process began on September 6, 2018.

Site Background

The Site is located in an urban area in the southeast corner of Niagara Falls, approximately 1/4 mile north of the Niagara River (see **Figure 1**). Approximately 2,000 people live within a mile of the Love Canal Landfill (LCL) area and are served by a public water supply system.

The Site includes a 3,200 feet-by-80 feet canal section (one of two discontinuous sections) that was excavated by Mr. William T. Love in the late 1800's for a proposed direct current hydroelectric power project. Subsequently, the project was abandoned.

Between 1942 and 1952, the Hooker Chemicals & Plastics Corporation (now Occidental Chemical Corporation (OXY)) disposed of approximately 22,000 tons of drummed and liquid chemical wastes, including polycyclic aromatic hydrocarbons (PAHs), halogenated organics, pesticides, chlorobenzenes and trichlorophenols, containing 2,3,7,8- tetrachlorodibenzo-p-dioxin (TCDD or dioxin), into the abandoned canal.

In 1953, when the dumping ceased, the original disposal area was covered with soil and deeded by Hooker Chemicals to the Niagara Falls Board of Education (NFBE). Subsequently, a

residential neighborhood, along with the 99th Street School, was developed in the area adjacent to the original disposal site. The term "Emergency Declaration Area" (EDA) was used to describe the 350-acre residential neighborhood which developed around the original LCL. The vast majority of families in this area were eventually relocated as part of two emergency declarations (see discussion below). Subsequently, the NYSDOH issued its Habitability Decision which indicated that some of the former EDA neighborhood could be resettled for residential purposes which the remining three area could be used for commercial purposes.

FIVE-YEAR REVIEW SUMMARY FORM

SITE IDENTIFICATION		
Site Name: Love Canal		
EPA ID: NYD980768717		
Region: 2	**State:** NY	**City/County:** Niagara Falls/Niagara
SITE STATUS		
NPL Status: Deleted		
Multiple OUs? Yes	**Has the site achieved construction completion?** Yes	
REVIEW STATUS		
Lead agency: EPA **If "Other Federal Agency" was selected above, enter Agency name:** N/A		
Author name (Federal or State Project Manager): Damian Duda		
Author affiliation: EPA		
Review period: 01/15/2014 – 02/22/2019		
Date of site inspection: 07/11/2018		
Type of review: Policy		
Review number: 4		
Triggering action date: 01/15/2014		
Due date *(five years after triggering action date)*: 01/15/2019		

II. RESPONSE ACTION SUMMARY

Basis for Taking Action

Problems with odors and residues in the basements and backyards of residential properties in the area were first reported in the 1970s. Also, during this time, unusually high precipitation in the region caused the water table within the original disposal area to rise, which allowed contaminants to spread laterally in surficial soils and along utility bedding, eventually seeping into the basements of nearby homes. Various studies verified that numerous toxic chemicals had migrated into the surrounding area directly adjacent to the LCL. Dioxin and other contaminants also migrated from the original disposal area to the sanitary and storm sewers which extended beyond the boundary of the original disposal area and had outfalls into nearby Black, Bergholtz and Cayuga creeks. Extensive investigation of the groundwater was conducted via the numerous monitoring wells, both on-site and off-site.

In 1978, NYSDOH identified more than 80 chemicals in the original disposal area and adjacent soils. After NYSDOH and NYSDEC had requested the EPA provide technical assistance at the Site, the EPA and NYSDOH sampled indoor air, stream sediments, biota, soils, groundwater, surface water and residential sumps. The EPA also evaluated ambient air and storm sewers around the original disposal area. This additional sampling showed significant chemical contamination in the area of the Rings I and II homes, adjacent to the original disposal area. These homes were, subsequently, demolished.

These early investigations resulted in the issuance of two presidential declarations of emergency for the Site in 1978 and 1980 (see discussion below). These provided the basis for the implementation of several early response actions.

A very, extensive investigative report, Environmental Monitoring at Love Canal, identified numerous organic chemicals at high levels in the LCL, nearby soils, groundwater, sewers and sediments; the contaminants included dioxin, total BHCs, Beta BHC, Gamma BHC, chlorobenzene, 1 ,2-dichlorobenzene, 1,2,4-trichlorobenzene, 1,2,3,4-tetrachlorobenzene and 2-chloronaphthalene. 2-chlorotoluene, monochlorobenzene and 4-chlorotoluene. High concentrations of dioxin were found in the area sewers, some of which discharged into nearby creeks which resulted in the creeks also being contaminated with dioxin. Concentrations of dioxin in creek sediments and soils exceeding one part per billion (ppb) served as the basis for taking action on sewer, creek and soil cleanups. No ecological risk assessment was performed as part of the Environmental Monitoring report.

The nearby 93rd Street School was eventually considered as part of the Love Canal also placed under the Love Canal project. The baseline risk assessment for the 93rd Street School site found cancer risks posed by the ingestion of soils at 2.3×10^{-4} and 1.3×10^{-3} for the undisturbed and disturbed site scenarios, respectively. The primary contaminants contributing to this unacceptable risk were arsenic, PAHs and dioxin, and the primary route of exposure for these contaminants was through inadvertent ingestion of soils.

Response Actions

In August 1978, the NYS Commissioner of Health to order the closure of the 99th Street School and to recommend that pregnant women and children under two years of age who lived in the Rings I and II homes immediately evacuate the area and that residents avoid the use of their basements as much as possible and avoid consuming home-grown produce.

Also, in August 1978, President Carter issued the first of two emergency declarations at the Site. The first emergency declaration provided Federal funding for remedial work to contain the chemical wastes at the Site and for the relocation of the residents living in Rings I and II.

In May 1980, President Carter issued the second emergency declaration at the Site, which specifically established the boundaries of the EDA and authorized $20 million of federal funds for the purchase of homes for those residents who were evacuated and/or who wanted to leave. All but two families within Rings I and II were evacuated. After the evacuation, the Rings I and II vacant houses were demolished. The resulting nonhazardous debris materials were either placed under the cap or used as fill on-site. Overall, approximately 950 families, of the more than 1,050 families affected, were eventually evacuated.

In addition, in 1980, a 22-acre clay cap, with a minimum three-foot thickness, was installed over the original disposal area after a barrier drain collection system was installed to intercept and collect any chemicals that were migrating from the area.

In 1981, the EPA proposed adding the Site to the NPL, making it available for funding under the Superfund legislation. The Site was added to the NPL in 1983.

By 1982, a number of remedial cleanup measures had been conducted at the Site by NYSDEC and its contractors. The Rings I and II homes and the 99th Street School, adjacent to the LCL, had been demolished. These early remedial activities were formally memorialized and documented by the EPA in its 1982 Decision Memorandum which identified further necessary response actions. These future cleanup measures were specifically identified in the succeeding Records of Decision (RODs) which were issued for the Site and are discussed below.

In 1983, the EPA initiated the Love Canal Habitability Study (LCHS) to determine whether any chemicals from the original disposal area had migrated or were transported to the EDA in order to determine whether the EDA areas had been specifically impacted by the original disposal area and not some other contamination area. Love Canal Indicator Chemicals (LCICs) were identified: total BHCs, Beta BHC, Gamma BHC, Chlorobenzene, 1 ,2-Dichlorobenzene, 1,2,4-Trichlorobenzene, 1,2,3,4-Tetrachlorobenzene and 2-Chloronaphthalene. 2-Chlorotoluene, Monochlorobenzene and 4-Chlorotoluene. These LCICs were culled from the entire list of various chemical compounds which were known to have been disposed of in the original open canal. The Habitability Study included testing soil and residential indoor air samples for evidence of chemical contamination in the EDA. This data was compared to results from areas sampled outside the EDA. The results of the analysis were used to evaluate current and potential routes of exposure.

In December 1984, technical and structural modifications were made to the Love Canal Treatment Facility (LCTF). In 1985, a second and expanded engineered 40-acre cap consisting

of a 40-millimeter high density polyethylene liner was installed over the already existing clay cap to further reduce infiltration of precipitation. Additionally, approximately 18 inches of clean soil and vegetation were installed over the 40-acre cap to create the present configuration. The overall fenced LCL area is 70 acres and includes a vegetated buffer zone outside of the boundaries of the 40-acre cap.

In May 1985, the EPA issued a ROD to remediate the sediments in the sewers and the creeks in the EDA. The selected remedy for this ROD included the following:

- Hydraulically cleaning the sewers;
- Dredging and hydraulically cleaning the Black Creek culverts;
- Removing Black and Bergholtz creeks' sediments with dioxin concentrations exceeding one ppb;
- Constructing an on-site interim storage facility for the creek and sewer sediments; and
- Remediating the 102nd Street outfall area (which was subsequently addressed under the remedial action performed on the 102nd Street Landfill Superfund site, a separate NPL site).

In October 1987, the EPA issued a second ROD to address the destruction and disposal of the dioxin-contaminated sediments from the sewers and creeks. This ROD called for the following:

- Construction of an on-site facility to dewater the sewer and creek sediments and to contain the dewatered sediments;
- Construction of a separate on-site facility to treat the dewatered sediments through high temperature thermal destruction;
- On-site thermal treatment of the residuals stored at the Site from the leachate treatment facility and other associated Love Canal waste materials; and
- On-site disposal of any nonhazardous residuals from the thermal treatment or incineration process.

In July 1988, the EPA issued the final LCHS. In September 1988, using the results of the LCHS, the NYS Commissioner of Health issued a Decision on Habitability (HD), which identified appropriate land uses for the seven designated areas of the EDA. Areas 1 through 3 were declared not suitable for residential use unless remediated, *i.e.*, non-habitable, but were suitable for commercial and/or industrial use. Areas 4 through 7 were deemed habitable, *i.e.*, suitable for residential use.

In September 1988, the EPA issued a ROD, selecting a remedy for the 93rd Street School site. This remedy included excavation of approximately 7,500 cubic yards of contaminated soils, followed by on-site solidification/stabilization and placement of this material with a low permeability cover.

In June 1989, the EPA published an Explanation of Significant Differences (ESD) to the 1985 and 1987 RODs, which specified that creek sediments were to be dewatered at creek side, placed in polyethylene bags along with the stored sewer sediments and then transported to OXY's Niagara Falls Main Plant for temporary storage, followed by thermal destruction in a high temperature thermal destruction unit to be constructed at the plant.

On September 19, 1989, a Partial Consent Decree was issued between the United States and OXY, whereby, OXY would undertake the processing, transport and temporary storage of sewer and creek sediments and other wastes excavated from the area around the LCL and is obligated to provide for their thermal destruction or other permanent treatment.

In May 1991, the EPA issued an amendment to the 1988 ROD for the 93rd Street School (1991 Amendment), which modified the 1988 remedy to indicated that all excavated soils would be disposed of off-site at approved disposal facilities.

In November 1996, the EPA issued a second ESD for the 1987 ROD which authorized thermal treatment and/or land disposal of the stored Love Canal waste materials at an off-site commercial incinerator and landfill rather than at OXY's Niagara Falls Main Plant.

In December 1998, the EPA issued a third ESD which provided notice that the EPA was granting a treatability variance to OXY to permit the stored Love Canal waste materials, containing between one ppb and 10 ppb of dioxin, be disposed at a commercial hazardous waste landfill without treatment. Materials containing dioxin at concentrations greater than 10 ppb were required to be incinerated and residues approved for disposal to a permitted landfill.

For a more complete history of important response actions, other Site activities and documents issued, please consult **Table 1**: Chronology of Love Canal Site Events.

Status of Implementation

With the exception of the ongoing operations of the Love Canal Leachate Collection and Treatment Facility (LCTF), all remedial activities have been completed. The EPA, through two cooperative agreements with the Love Canal Area Revitalization Agency (LCARA), also funded 1) the purchase and 2) the maintenance of many of the extant properties in the EDA. Some of these properties were rehabilitated, and some were demolished because of safety reasons. Overall, LCARA demolished over 250 homes and rehabilitated and sold over 260 homes. By 2003, all rehabilitation, demolition and sale efforts of LCARA had been completed, and the agency was formally abolished on August 31, 2003 by the NYS legislature.

Institutional Controls

The NFBE and Niagara Falls are the owners of the property within the containment area of LCL. Niagara Falls granted NYS a permanent easement on the Site property, providing NYS with exclusive use and occupancy of the Site property. NYS, pursuant to a 1994 Consent Decree (CD), granted OXY exclusive use and occupancy of the Site property for the purpose of providing continued operation and monitoring (O&M) and groundwater monitoring for the remedy of the Site. OXY will retain exclusive use and occupancy as long as the CD remains in effect.

EDA Areas 1 through 3 remain limited to commercial and/or industrial use only. The institutional controls (ICs) are maintained by 1) notices that were placed on the deeds and 2) the area zoning in order to comply with the original HD. The deeds also indicate that all identified use limitations shall run with the land and bind the current owner and any successors in perpetuity or until such time as NYSDEC shall determine that such ICs are no longer necessary

for the protection of human health and the environment. If any use, other than what is specified above, is considered for these properties, a minimum of six inches of surface soil must be removed and a minimum of six inches of new clean soil must be placed back on the property before any such use can be initiated. Prior to any redevelopment in this area, the EPA and NYSDEC will be notified about its intended use.

Operation, Monitoring and Maintenance

In April 1995, responsibility of the O&M of the Site was transferred from NYSDEC to OXY, reflecting the 1994 CD. Currently, Glenn Springs Holdings, Inc. (Glenn Springs), a subsidiary of Occidental Petroleum Corporation, contracts with GHD (formerly CRA Services) to perform the daily operation, maintenance and monitoring activities.

The O&M of the remedial systems at the Site ensures that there is no off-site migration of chemical contaminants from the Site. **Figure 2** shows the overall Site plan. The leachate is treated at the on-site treatment facility and subsequently discharged into the Niagara Falls sanitary sewer system. Quarterly effluent sampling is conducted. All results are well below the permitted discharge limits.

NYSDEC oversees Glenn Springs' O&M activities and provides direction to Glenn Springs on the scope and extent of the annual monitoring and reporting tasks, including groundwater quality monitoring at various wells on or around the Site to evaluate the effectiveness of the LCL containment system; groundwater elevation measurement at piezometers located on the Site; O&M of the LCTF; and an annual performance assessment of the LCTF and the associated barrier drain system and appurtenances. **Table 2** identifies the various repair, maintenance and cleanup activities conducted at the Site in 2018.

The Site Management Periodic Review Report (PRR) or O&M report, that is completed annually by Glenn Springs, provides an overview of the long-term monitoring program that is in effect for the Site and examines both the hydrogeologic and the chemical data from the Site in order to evaluate the effectiveness of the containment system.

Hazardous wastes that are generated at the Site include the following:

1) Spent carbon from the treatment process;
2) Debris, filters and personal protective equipment;
3) Non-aqueous phase liquid or NAPL and other sludge-type materials from both the LCL and 102nd Street Landfill; and
4) Soil and debris from sampling activities. These wastes are transported to a permitted incinerator and/or landfill for final disposal.

During 2018, both hazardous and nonhazardous waste was generated from various activities and disposed of off-site, in accordance with applicable laws and regulations. The hazardous wastes disposed of in 2018 consisted of soil/debris, spent carbon, and NAPL as follows:

- Soil/Debris: 1,625 pounds (consisting of personal protective equipment [PPE], spent filter bags, and debris from the drum barn).
- Spent Carbon: 5,280 pounds (collected from LCTF process).
- NAPL Sludge: 22,800 pounds (collected from LCTF process).

In summary, a total of 29,705 pounds of hazardous waste was generated from the activities listed above. Wastes generated in 2018 were disposed of through incineration or landfill impoundment.

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

III. PROGRESS SINCE LAST FIVE-YEAR REVIEW

The third FYR concluded that "the implemented remedies for the Site protect human health and the environment." The Site has ongoing O&M activities which are subject to routine modifications and/or adjustments. The previous FYR did not require any recommendations or follow-up actions which would be necessary to protect human health or the environment.

IV. FIVE-YEAR REVIEW PROCESS

Community Notification and Involvement

On October 1, 2018, the 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, New Jersey, Puerto Rico, and the U.S. Virgin Islands, including the Love Canal site. The announcement can be found at the following web address: https://www.epa.gov/sites/production/files/2018-10/documents/five_year_reviews_fy2019_for_web_posting.pdf.

In addition, the EPA published a notice on November 14, 2018 on the City of Niagara Falls website, notifying the community of the FYR process. The notice indicated that the EPA would be conducting the fourth FYR of the remedy for the Site to ensure that the implemented remedy remains protective of human health and the environment and is functioning as designed. It also indicated that once the FYR is completed, the results will be made available at: https://www.epa.gov/superfund/love-canal and in the EPA Public Information Office, the local Site repository, located in the EPA's Western New York Public Information Office at 186 Exchange Street, Buffalo, New York 14204. In addition, the notice included the RPM's address, telephone number and e-mail address for questions related to the FYR process for the Site.

Data Review

In order to provide as thorough an assessment as possible of the Site, **Appendix C** of this FYR provides a list of references which outline the major documents that were produced during the roughly 40-year period of the various project activities that have been conducted at the Site. Many of these documents were referenced during the preparation of this FYR report.

Groundwater Treatment System and Effluent Sampling

The LCTF (see **Figure 3**) consists of the following: clarification through gravity settling of the collected leachate which separates out the sludges and NAPLs from the contaminated wastewater; removal of solids through bag filtration; and, and filtration of organics through 40,000 pounds of granular activated carbon prior to the effluent discharge to the sanitary sewer system under a permit issued by Niagara Falls. Any collected sludges and NAPLs are sent off-site to OXY's permitted Niagara Falls liquids incinerator or to out of state RCRA-permitted incinerators.

During this FYR period, approximately 19 million gallons of groundwater from the Love Canal Site was treated by the LCTF. Sampling of the effluent discharged to the NFWB sanitary sewer system occurs quarterly, as per the Site's Significant Industrial User Permit. For this FYR period (2014 through 2018), effluent sample results were in compliance with requirements of the Site's discharge permit.

Groundwater Quality

Chemical monitoring is performed annually by sampling select overburden and bedrock monitoring wells. The groundwater samples are analyzed for site specific volatile organic compound (VOCs), semi volatile organic compounds (SVOCs), pesticides and polychlorinated biphenyls (PCBs).

Currently, there are 153 active monitoring wells for the Site (132 overburden and 21 bedrock). Chemical monitoring is performed annually by sampling select overburden and bedrock monitoring wells at the Site. Historically, NYSDEC selected the monitoring wells which it would require OXY to sample each year. As of 2010, a list of monitoring wells to be sampled each year was developed and agreed upon by NYSDEC and OXY: 1) 18 named bedrock wells and 2) four named overburden wells. Also, two additional groups of overburden wells were selected to be sampled on a biannual basis: Group I – 17 overburden wells and Group II – eight overburden wells. Additionally, Glenn Springs may add other monitoring wells to the annual sampling list which is, ultimately, provided to NYSDEC prior to any sampling activity. An areawide view of the Site (**see Figure 4**) identifies the locations of the select monitoring wells which were sampled in 2018, both inside and outside of the fenced containment area.

Groundwater analytical results for the overburden monitoring wells during this FYR period are consistent with previous long-term monitoring analytical results and were either non-detect or were detected at low levels with the exception of groundwater from monitoring well (MW) 10135, which is installed in an area of known Site impacts. Historically, MW-10135 has had the most detected compounds and the highest concentrations. This well is located in the southwestern portion of the Site and within the fenced boundaries of the Site.

Although located outside the barrier drain, MW-10135 is within the influence of the barrier drain based on hydraulic monitoring conducted at the adjacent nested-piezometer string 1160. MW-10135 is located in an isolated area of known contamination and is sampled annually as an indicator well. In 2018, 17 compounds were detected in MW-10135, including bromodichloromethane. Bromodichloromethane was detected at MW-10135 for the first time at a concentration of 38 micrograms per liter (µg/L), which is below the regulatory guidance value of 50 µg/L. The relatively low concentration of bromodichloromethane in this well, as well as the fact that it was not detected in nearby wells, indicates that it does not appear to be a concern. Overburden and bedrock monitoring wells located farther west of MW-10135 (MW-10178A and MW-10278, respectively) are sampled annually and have shown no impact which further confirms that the contamination at MW-10135 is isolated to the immediate area around the well. MW-10135 will continue to be monitored annually for groundwater quality.

Groundwater analytical results for the bedrock monitoring wells during this FYR period are consistent with previous long-term monitoring analytical results. Contaminant concentrations were either non-detect or detected at low levels. In 2012, hexachlorobenzene was detected at MW-10225A for the first time at a concentration of 3.6 µg/L. This concentration of 3.6 µg/L is within the historical non-detect range of 1.9 U µg/L to 10 U µg/L. From 2014-18, hexachlorobenzene was non-detect at MW-10225A (1.9 U µg/L in 2014, 9.6 U µg/L in 2015, 9.4 U µg/L in 2016, and 9.4 U µg/L in 2017 and 2018). In addition, hexachlorobenzene was not detected in the adjacent bedrock MW-10225B and MW-10225C. Based on these data, the 2012 detection appears to be an anomalous data point and does not warrant additional evaluation. MW-10225A will continue to be monitored annually for groundwater quality.

Overburden MW-3 was installed on July 1, 2011, within the bedding material of a newly repaired sanitary sewer line on Colvin Boulevard. The purpose of this well was to monitor for the presence of residual non-aqueous phase liquid (NAPL) that was observed during construction/repair activities in the bedding material. Following well development, MW-3 was monitored for the presence of NAPL on a weekly basis from July 19, 2011 to October 7, 2011. No NAPL or visible sheen was detected during these weekly monitoring events. Based on these results, the conclusion was made that the NAPL, which had been observed sporadically during the sewer repair activities, was likely limited in volume and mobility. Since November 5, 2012, MW-3 has been monitored on a quarterly basis for the presence of NAPL. As of December 2018, no NAPL or visible sheen has been detected in this well.

Hydraulic Containment

Hydraulic monitoring consists of water level measurements conducted quarterly from six nested-piezometer strings (1140, 1150, 1160, 1170, 1180, and 1190) per the NYSDEC-approved LTGMP, as well as water level measurements collected from three wells (MW-7161, MW-9130, and MW-9140). During this FYR period, groundwater contours indicate that the inward gradient ranged from 0.98 feet to 3.70 feet outside of the barrier drain at each of the six nested-piezometer strings in the various geologic units. Groundwater flow on the inside of the barrier drain is also towards the barrier drain; therefore, the barrier drain and the lateral trenches are capturing both leachate from the landfill area and a portion of groundwater outside the barrier drain. This capture is, thereby, preventing off-site migration of chemicals and off-site groundwater from migrating into the landfill area.

The 2018 summary of detected compounds in sampled monitoring wells is presented in **Table 3**. NYSDEC can split sample select monitoring wells at its discretion. Compounds, detected during 2018, were found to be at similar concentrations to those compounds detected in previous years. Some monitoring wells, as part of the long-term monitoring program, are routinely sampled every year, *i.e.*, 10210A, 10210B, 10210C and 10135. 2018 data from the overburden wells, including MW-10135 are shown in **Table 4**.

Historically, as discussed above, MW-10135 is the most contaminated of the various long-term monitoring wells located within the Love Canal containment area. Although located outside the barrier drain, MW-10135 is within the influence of the barrier drain based on hydraulic monitoring. MW-10135 is also sampled as a representative control well and is used as a comparison well in order to confirm any potential presence of low levels of contamination that may be found in other monitoring wells.

Site Inspection

A Site inspection of the landfill cap and the LCTF was conducted on November 7, 2018. The Site inspection team included the following personnel: from the EPA: Damian Duda (RPM), Mike Basile (CIC), Sharissa Singh (hydrogeologist) and Henry Guzman (attorney); from NYSDEC: Brian Sadowski, Stan Radon and Andrew Zwack; from NYSDOH: Sara Bogardus and Scarlett McLaughlin; Niagara County Health Department: Elise Jancef; from Glenn Springs: Clint Babcock and Joseph Branch and from GHD: John Pentilchuk and Darrell Crockett. Glenn Springs, together with its contractor, GHD, prepares the annual O&M reports.

The LCTF, which include both the Operations Building and the Administration Building, was inspected, and the various segments of the collection, treatment and discharge process were identified. It was noted during the treatment process tour that very little sludge or NAPL is being collected. The bag filters are changed twice a year, and the spent carbon in one of the two carbon beds is replaced every other year. The entire process treats and discharges an average of 125 gallons per minute up to approximately three to four million gallons per year, as reflected in the annual O&M reports.

The inspection team also performed a walk-through across the cap and inspected some of the monitoring wells, wet wells and piezometers, both immediately within the Site fence line and outside the Site fence line in the former EDA. The inspection team also performed a drive-through of the former EDA area, including both the Black and Bergholtz creeks and the 93rd Street School site locations. No deficiencies were observed.

V. TECHNICAL ASSESSMENT

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

Yes, the remedy is functioning as intended by the 1985 ROD (including the 1982 DM), the 1987 ROD, the 1988 ROD, the 1991 ROD Amendment and the 1989, 1996 and 1998 ESDs.

The remedies involved a number of actions, including installation of a landfill cap, fencing, Site drainage, a leachate collection and treatment system and many monitoring wells to identify

contaminant concentrations at the edge of the LCL. The remedies described above are all intact and in good repair. The barrier drain is successfully capturing leachate from the Site and preventing off-site migration of chemicals. The data from the on-site monitoring wells and those surrounding the Site indicate that contaminated groundwater and NAPL releases from the LCL are being contained by the collection and treatment system. Proper institutional controls are in place. Overall, the remediation system for the Site is functioning as designed. Continued O&M activities at the Site ensures that no exposures to human or environmental receptors will occur in the future.

The NYSDEC Division of Environmental Remediation performs yearly oversight sampling and overview of operations at the LCTF. NYSDEC provides the oversight information, including any split-sampling data and Site inspections, and its review of Glenn Springs O&M reports to the EPA. In each annual O&M report for the 2013-2017 period, NYSDEC concluded that, for both inside and outside the containment area, the Site remedy continues to be effective.

The Site community receives its potable drinking water from the Niagara Falls public water supply. The groundwater in the EDA is not used for drinking water purposes. Monitoring wells, located both inside and outside the LCL property throughout the Site, indicate that contaminated groundwater and NAPL released from the LCL are being contained by the collection and treatment system and that exposure to the contaminated groundwater, on-site, is not occurring.

Institutional controls, in the form of deed notices and zoning restrictions, are in place on the vacant parcels of land in EDA Areas 1 through 3 to comply with the Habitability Decision, identifying commercial and/or industrial use only, unless the parcels are remediated. There are no such restrictions on the land use for EDA Areas 4 through 7. The remedial actions and institutional controls have addressed or interrupted the direct exposure pathways of direct contact with the contaminated groundwater and soils. The remedies are functioning as intended in the decision documents.

Question B: Are the exposure assumptions, toxicity data, cleanup levels and remedial action objectives used at the time of the remedy, still valid?

Remedial actions have been conducted at the Site to interrupt potential exposures. These actions included the following: containing Site contaminants; limiting discharges to various media; installation of a barrier drain to intercept and collect any chemicals migrating from the LCL; placement of cap over the original LCL to reduce water infiltration and to retard the formation of leachate, consisting of the original 22-acre three-foot clay cap, a second 40-acre 40-mil high density polyethylene cap and approximately 18 inches of clean soil and vegetation to create the present configuration; the cleaning and plugging of the sewers within Rings I and II and removing them from further service to prevent the spread of contamination into nearby creeks and the Niagara River; and, the removal and disposal of contaminated sewer and creek sediments.

<u>Changes in standards identified as applicable or relevant and appropriate requirements (ARARs), newly promulgated standards, and/or changes in to-be-considereds (TBCs) compounds.</u>

As discussed in the previous FYR, the 1985 ROD for OU1 did not identify RAOs for the Site. However, the document discussed a one ppb level for dioxin in soils and sediments, *i.e.*, a

cleanup goal of one ppb for dioxin in soils and sediments as a basis for taking remedial action. The surface soils and sediments exceeding this value were excavated, treated and disposed of off-site or placed under the LCL cap. Since the last FYR, which discussed the 2012 changes in toxicity values for dioxin in detail, there have been no further changes in the toxicity of this compound that would impact the protectiveness of the remedy.

Human Exposure Assumptions

Since the last FYR, the standard default exposure assumptions used in calculating risks and non-cancer hazards were updated. On February 2, 2014, the EPA issued OSWER Directive 9200.1-120 which provided updates to several exposure factors, including the duration of exposure that was changed from 30 years for the adult and child resident to 26 years. Other changes include the following: the water consumption rate was modified from one liter/day to 0.78 liters/day for the young child and from two liters/day to 2.5 liters/day for the adult. These changes do not change the overall protectiveness of the remedy.

Soils: Since the cap and fencing are maintained and exposures to soils are interrupted, the remedy remains protective. Deed notices on properties in EDA Areas 1 through 3 remain in place to prevent potential residential land use until remediation is performed. The EPA and the NYSDEC will review any planned development in these areas to ensure that these institutional controls, such as deed restrictions, are enforced. As such, the exposure assumptions for these areas are still valid.

Sediments: The removal of the sediments from Black and Bergholtz creeks ensures that these water bodies are no longer sources of contamination and do not present a direct exposure threat.

Groundwater: Both NAPLs and groundwater contamination continue to be contained on-site through the use of an extensive barrier drain system and a leachate collection and monitoring system. In addition, residents in the area obtain their drinking water from the Niagara Falls public water supply. The ongoing Site O&M continues to ensure that exposures to the contaminated groundwater does not occur.

Vapor intrusion: Indoor air sampling was performed as part of LCHS which did not find any indoor air issues within the homes in the EDA. The current groundwater VOC data, collected at off-site monitoring wells, are primarily non-detect. Buildings on-site include project administration offices and the LCTF. The closest residential buildings to the Site are over 100 feet away. Consistent with the updated the EPA vapor intrusion guidance (OSWER Publication 9200.2-154), inhabited buildings located more than 100 feet laterally or vertically from known or interpolated soil gas or groundwater are screened from further consideration for monitoring for soil vapors. Therefore, further evaluation of vapor intrusion is not necessary.

Changes in Toxicity Values

The 1988 93rd Street School ROD identified several metals (antimony, arsenic, lead, and mercury), PAHs (benzo(a)anthracene, benzo(b)fluoranthene, benzo(a)pyrene, chrysene, and indeno(1,2,3-cd)pyrene), pesticides (BHC isomers) and dioxin as contaminants of concern (COC).

Metals: The toxicity assessment for arsenic is currently being updated through the integrated risk information system or IRIS process (www.epa.gov/iris). IRIS is the Agency's consensus database of toxicity values for chemical compounds and any changes in the toxicity values will be evaluated in the next FYR. Lead was identified as a COC in the 1988 ROD. In 2016, the EPA issued a memo titled "Updated Scientific Considerations for Lead in Soil Cleanups" (OLEM Directive 9200.2-167) that recommended consideration of blood lead levels between 2 and 8 micrograms/deciliter. This represents a change from the previous recommendation of 5% or less of the population with blood lead levels below 10 µg/dL.

In September 1992, all contaminated soils, located at the 93rd Street School site, were excavated, removed and used as alternate grading material below the final cap that was installed at the 102nd Street Landfill Superfund site. The remedial action has interrupted potential exposures to soils; therefore, further evaluation of lead is not necessary.

Mercury was identified as a COC in the 1988 ROD. Currently, the mercury IRIS chemical file is being updated through the IRIS process (www.epa.gov/iris). Any changes in toxicity values will be evaluated in the next FYR.

PAHs: The toxicity assessment for benzo(a)pyrene was updated through the IRIS process in 2017. The resulting changes were decreases in the cancer slope factor and Inhalation Unit Risk Factor. This change also affects the other PAHs with Relative Potency Factors, *e.g.*, the carcinogenic PAH factors are based on benzo(a)pyrene. This change in toxicity value with lower potential cancer risks does not impact the protectiveness of the remedy.

Dioxin: The oral RfD for dioxin was updated in 2012, which was evaluated in detail in the last FYR, and there have been not additional changes in the toxicity values. The remedy remains protective.

Ecological Risk

Ecological risk assessments were not conducted for the Site. However, the potential for exposure to ecological receptors has been eliminated, *i.e.*, any potentially completed pathways have been remediated or interrupted. Specifically, the excavation and removal of the Black and Bergholtz creek bed sediments, as well as the placement of clean backfill and rip/rap in the beds, prevent any exposure to potential residual contamination. Also, substantial portions of the creeks' banks were also removed and newly sodded which also provided assurances that no further contamination remains. The sewers were scoured of contaminated sediments, and those which were interior to the LCL/Rings I and II were cut off from the LCL EDA. The contaminated soils at the 93rd·Street School were excavated and removed. Hence, any potential pathways for ecological receptors have been interrupted.

Conclusions

Actions taken at the Site, including all remediation actions and the establishment of institutional controls, have interrupted exposures to Site contaminants. The remedy remains protective.

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

Based on the evaluation of the potential exposures to human and ecological receptors at the Site, there is no new information which could call into question the protectiveness of this remedy.

VI. ISSUES, RECOMMENDATIONS AND FOLLOW-UP ACTIONS

No issues were identified as part of this FYR. The following suggestions are provided here to improve the accuracy of the data reporting for all sampling events and of any Site investigatory and inspection activities.

- Consider developing separate groundwater contour maps for the overburden aquifer and for the bedrock aquifer in future annual reports.
- Provide trend analysis of the contaminants in MW-10135, since it continues to be the well that is most impacted.
- Add MW-10135 to the hydraulic monitoring events in order to ensure that there is an inward gradient from this well to the barrier wall.

VII. PROTECTIVENESS STATEMENT

Protectiveness Statement(s)		
Operable Unit: 01	*Protectiveness Determination:* Protective	*Addendum Due Date (if applicable):* N/A
Protectiveness Statement: The OU-1 remedy at the Love Canal site is protective of human health and the environment.		

Sitewide Protectiveness Statement (if applicable)	
For sites that have achieved construction completion, enter a sitewide protectiveness determination and statement.	
Protectiveness Determination: Protective	*Addendum Due Date (if applicable):* *N/A*
Protectiveness Statement: The implemented remedies for the Site protect human health and the environment.	

VIII. NEXT FIVE-YEAR REVIEW

The next FYR for the Love Canal Superfund site is required five years from the completion date of this FYR.

APPENDIX A

TABLES

TABLE 1 – Chronology of Love Canal Site Events	
Event	**Date**
President Carter issued the first Emergency Declaration at the Love Canal landfill.	August 1978
Construction of the LC leachate collection system and treatment facility (LCTF).	October 1978 - December 1979
President Carter issued the second Emergency Declaration at the LCL. The Emergency Declaration Area (EDA) surrounding the Love Canal landfill was established.	May 1980
Love Canal Area Revitalization Agency (LCARA) created to revitalize the EDA.	June 18, 1980
The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) enacted. A National Priorities List (NPL) of Superfund sites established.	December 1980
NYSDEC assumes control of LCTF from Elia Construction Company, using contractor Conestoga Rovers and Associates.	March 1981
Love Canal site proposed to the NPL.	1981
EPA issued Environmental Monitoring at Love Canal study.	May 1982
Rings I and II homes and 99th Street School demolished.	June 1982
EPA issued a Decision Memorandum: Cooperative Agreement with the State of New York for Love Canal (1982 DM), a precursor to the Superfund Record of Decision (ROD).	July 1982
EPA opened a Public Information Office in Niagara Falls to manage Superfund sites in the City of Niagara Falls area.	September 1982
New York State Department of Environmental Conservation (NYSDEC) opened a Public Information Office in the EDA.	March 1983
EPA initiated Love Canal EDA Habitability Study (LCHS).	1983
Love Canal Superfund site was added to the NPL.	1983
EPA established multi-agency Love Canal Technical Review Committee (TRC) [EPA, Centers for Disease Control, NYSDOH and NYSDEC].	August 1983
Collection system cleaned [high pressure] by OH Materials with NYSDEC oversight.	1983
NYSDEC installed 40-acre high-density polyethylene liner cap over the Love Canal landfill.	November 1984

Technical modifications made to the LCTF.	December 1984
EPA issued a ROD (ROD 1985) to remediate the EDA sewers and Black Creek and Bergholtz Creek.	May 1985
Superfund Amendments and Reauthorization Act (SARA): Section 312 Provisions for Love Canal: Love Canal EDA Habitability Study (LCHS), Property Acquisition and Maintenance and Technical Assistance Cooperative Agreements.	1986
Sewer sediments' remediation.	1986-1987
Construction of a new Administration Building at the LCTF.	1987
EPA entered into first cooperative agreement with LCARA to implement the property acquisition mandates of Section 312 of SARA.	June 1987
EPA issued ROD (ROD 1987) to address final disposal of sewer and creek sediments.	October 1987
EPA issued a ROD (ROD 1988) for the 93rd Street School selected remedy [separate study].	September 1988
The NYS Commissioner of Health issued a Decision on Habitability of the EDA, determining that EDA Areas 1-3 were nonhabitable but available for commercial and/or industrial use; EDA Areas 4-7 were deemed habitable.	September 1988
Creek sediments remediation: 1) dewatered, 2) stabilized and 3) bagged at 93rd Street School staging facility. Previously remediated sewer sediments were bagged during this operation.	1987-1989
All dewatered, stabilized and bagged sewer and creek sediments stored at Occidental Chemical Corporation's (OXY) Niagara Falls Main Plant.	1989-1998
OXY and EPA sign partial consent decree for OXY to perform part of the Love Canal cleanup activities.	May 1989
EPA entered into second cooperative agreement with LCARA to implement the maintenance assistance mandates of Section 312 of SARA.	May 1989
EPA published an Explanation of Significant Differences (1989 ESD) to the 1985 and 1987 RODs.	1989
Rehabilitated EDA homes offered for sale by LCARA.	1990
EPA issued an amendment to the 1988 ROD for the 93rd Street School to excavate soils and dispose of off-site.	May 1991
Programmable Logic Controller system installed at LCTF to operate field pumps, holding tank and process tanks.	Summer 1991

Collection system was high pressure cleaned and videotaped with NYSDEC oversight.	November 1991
93rd Street School soils' remediation completed, as identified in the 1991 ROD Amendment.	September 1992
NYSDEC closed its public information office in the EDA.	March 1993
NYSDEC cost recovery settlement with OXY: $130 million.	1995
OXY begins operation of LCTF monitoring program and issuance of periodic operation and maintenance reports.	April 1995
EPA cost recovery settlement with OXY: $129 million plus interest.	March 1996
EPA issued the second ESD (ESD 1996), authorizing thermal treatment and/or land disposal of Love Canal waste materials at off-site commercial incinerator and landfill.	November 1996
OXY shipped bagged Love Canal wastes for final disposal.	February 1998-August 1999
EPA issued the third ESD (1998 ESD), granting a treatability variance to OXY to eliminate requirement that Love Canal waste materials containing dioxin at concentrations between 1 ppb and 10 ppb be incinerated.	December 1998
Love Canal Preliminary Close-Out Report [construction completion].	September 1999
Bagged Love Canal wastes incineration [completed].	October 1999
First Five-Year Review Site Inspection.	June 2003
LCARA, as an agency of NYS, formally dissolved by NYS statute.	August 27, 2003
Five-Year Review Report issued.	September 30, 2003
Remedial Action Report for LCARA.	September 30, 2003
Love Canal Final Close Out Report.	March 4, 2004
Love Canal Superfund Site was deleted from the NPL.	September 30, 2004
Second Five-Year Review Site Inspection.	April 10, 2008
Second Five-Year Review Report issued	September 29, 2008
Third Five-Year Review Site Inspection.	July 11, 2013
Third Five-Year Review Report issued.	January 15, 2014
Fourth Five-Year Review Site Inspection.	November 7, 2018

TABLE 2

LOVE CANAL MAINTENANCE/ REPLACEMENT /REPAIR ACTIVITIES CONDUCTED DURING 2018

PROCESS ACTIVITIES

- Removal and disposal of hazardous and non-hazardous wastes.
- Cleaning of all pump chambers.
- Cleaning of all storage tanks.
- Cleaning of sludge from clarifier.

NON-PROCESS ACTIVITIES

- Preventative maintenance.
- Repair and maintenance of pump chambers and flow meters.
- Landscape maintenance, including grass cutting and tree and flower bed maintenance.
- Maintenance and cleanup of fencing area, inside and outside.
- Heating and cooling system maintenance.
- Installation of a new front door on the treatment building.
- Replacement of the leak detection switch float balls in manholes 8 and 9.
- Replacement of the backflow preventer in the drum barn.
- Replacement of lights and exit lights.

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TABLE 3

Summary of Detected Compounds - 2018
Love Canal Long-Term Monitoring Program
Glenn Springs Holdings, Inc.

		Number of Parameters Detected			
Overburden Wells	**Well Group**	**VOCs**	**SVOCs**	**PCBs**	**Pesticides**
7115	B	1	U	U	U
7125	B	1	U	U	U
7130	A	1	U	U	U
7132	A	1	U	U	U
8106	A	U	1	U	U
8115	B	U	U	U	U
8125	B	U	U	U	U
9105	B	U	U	U	U
9113	B	U	U	U	U
9118	B	U	U	U	U
10135	A	9	4	U	4
10178A	B	U	U	U	U
Subtotal Overburden		**13**	**5**	**0**	**4**
Bedrock Wells		**VOCs**	**SVOCs**	**PCBs**	**Pesticides**
3257	A	1	U	U	U
5221	A	1	U	U	U
6209	A	1 (2)	5 (U)	U	U
7205	A	U	U	U	1
8210	A	2	U	U	U
9205	A	U	U	U	U
9210	A	2	U	U	1
10205	A	U (3)	U	U	U (1)
10210A	A	2	U	U	2
10210B	A	2	U	U	U
10210C	A	1	U	U	U
10215	A	4	U	U	U
10225A	A	3	U	U	3
10225B	A	3	U	U	3
10225C	A	4	1	U	3
10270	A	2	U	U	U
10272	A	2	U	U	U
10278	A	2	U	U	1
MW-01	X	1	U	U	U
MW-02	X	1	U	U	U
Subtotal Bedrock Well Detections		**34 (38)**	**6 (1)**	**0**	**14 (15)**
Total # of Detections		**47 (51)**	**11 (6)**	**0**	**18 (19)**

Notes:

U	- No parameters detected at or above detection limits
A	- Annual Well
B	- Biannual Well
X	- Additional annual well added to program in 2011
( )	- Results for duplicate sample, if different from parent sample
PCBs	- Polychlorinated Biphenyls
SVOCs	- Semi-volatile Organic Compounds
VOCs	- Volatile Organic Compounds

TABLE 4

2018 Analytical Results Summary-Overburden
Love Canal Long-Term Monitoring Program
Glenn Springs Holdings, Inc.

Sample Location:		7115	7125	7130	7132	8106	8115	8125	9105
Sample ID:		WG-9954-070518-SG-001	WG-9954-070518-SG-002	WG-9954-070518-SG-003	WG-9954-070518-SG-004	WG-9954-071118-SG-013	WG-9954-070518-SG-005	WG-9954-070618-SG-007	WG-9954-070618-SG-008
Sample Date:		7/5/2018	7/5/2018	7/5/2018	7/5/2018	7/11/2018	7/5/2018	7/6/2018	7/6/2018
Parameters	**Units**								
Volatile Organic Compounds									
1,1,1-Trichloroethane	µg/L	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
1,1,2,2-Tetrachloroethane	µg/L	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
1,1,2-Trichloroethane	µg/L	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
1,1-Dichloroethane	µg/L	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
1,1-Dichloroethene	µg/L	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
1,2-Dichloroethane	µg/L	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
1,2-Dichloropropane	µg/L	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
2-Butanone (Methyl ethyl ketone) (MEK)	µg/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2-Hexanone	µg/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
4-Methyl-2-pentanone (Methyl isobutyl ketone) (MIBK)	µg/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Acetone	µg/L	10 U	10 U	3.4 J	3.4 J	10 U	10 U	10 U	10 U
Benzene	µg/L	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Bromodichloromethane	µg/L	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Bromoform	µg/L	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Bromomethane (Methyl bromide)	µg/L	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Carbon disulfide	µg/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Carbon tetrachloride	µg/L	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Chlorobenzene	µg/L	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Chloroethane	µg/L	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Chloroform (Trichloromethane)	µg/L	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Chloromethane (Methyl chloride)	µg/L	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
cis-1,2-Dichloroethene	µg/L	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
cis-1,3-Dichloropropene	µg/L	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Dibromochloromethane	µg/L	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Ethylbenzene	µg/L	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Methylene chloride	µg/L	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Styrene	µg/L	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Tetrachloroethene	µg/L	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Toluene	µg/L	0.21 J	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
trans-1,2-Dichloroethene	µg/L	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
trans-1,3-Dichloropropene	µg/L	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Trichloroethene	µg/L	5.0 U	3.7 J	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Vinyl acetate	µg/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Vinyl chloride	µg/L	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Xylenes (total)	µg/L	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Discrete Compounds Detected:		1	1	1	1	0	0	0	0
Semi-volatile Organic Compounds									
1,2,4-Trichlorobenzene	µg/L	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U
1,2-Dichlorobenzene	µg/L	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U
1,3-Dichlorobenzene	µg/L	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U
1,4-Dichlorobenzene	µg/L	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U
2,2'-Oxybis(1-chloropropane) (bis(2-Chloroisopropyl) ether)	µg/L	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U
2,4,5-Trichlorophenol	µg/L	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U
2,4,6-Trichlorophenol	µg/L	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U
2,4-Dichlorophenol	µg/L	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U
2,4-Dimethylphenol	µg/L	9.4 UJ	9.4 UJ	9.4 UJ	9.4 UJ	9.4 U	9.4 UJ	9.4 UJ	9.4 UJ
Semi-volatile Organic Compounds-Continued									
2,4-Dinitrophenol	µg/L	47 U	47 U	47 U	47 U	47 U	47 U	47 U	47 U
2,4-Dinitrotoluene	µg/L	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U
2,6-Dinitrotoluene	µg/L	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U
2-Chloronaphthalene	µg/L	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U
2-Chlorophenol	µg/L	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U
2-Methylnaphthalene	µg/L	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U
2-Methylphenol	µg/L	9.4 UJ	9.4 UJ	9.4 UJ	9.4 UJ	9.4 U	9.4 UJ	9.4 UJ	9.4 UJ
2-Nitroaniline	µg/L	47 U	47 U	47 U	47 U	47 U	47 U	47 U	47 U
2-Nitrophenol	µg/L	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U
3&4-Methylphenol	µg/L	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U
3,3'-Dichlorobenzidine	µg/L	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U

TABLE 4 (cont'd)

2018 Analytical Results Summary-Overburden
Love Canal Long-Term Monitoring Program
Glenn Springs Holdings, Inc.

Sample Location:		7115	7125	7130	7132	8106	8115	8125	9105
Sample ID:		WG-9954-070518-SG-001	WG-9954-070518-SG-002	WG-9954-070518-SG-003	WG-9954-070518-SG-004	WG-9954-071118-SG-013	WG-9954-070518-SG-005	WG-9954-070618-SG-007	WG-9954-070618-SG-008
Sample Date:		7/5/2018	7/5/2018	7/5/2018	7/5/2018	7/11/2018	7/5/2018	7/6/2018	7/6/2018
Parameters	**Units**								
3-Nitroaniline	µg/L	47 U	47 U	47 U	47 U	47 U	47 U	47 U	47 U
4,6-Dinitro-2-methylphenol	µg/L	47 U	47 U	47 U	47 U	47 U	47 U	47 U	47 U
4-Bromophenyl phenyl ether	µg/L	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U
4-Chloro-3-methylphenol	µg/L	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U
4-Chloroaniline	µg/L	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U
4-Chlorophenyl phenyl ether	µg/L	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U
4-Nitroaniline	µg/L	47 U	47 U	47 U	47 U	47 U	47 U	47 U	47 U
4-Nitrophenol	µg/L	47 U	47 U	47 U	47 U	47 U	47 U	47 U	47 U
Acenaphthene	µg/L	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U
Acenaphthylene	µg/L	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U
Anthracene	µg/L	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U
Benzo(a)anthracene	µg/L	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U
Benzo(a)pyrene	µg/L	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U
Benzo(b)fluoranthene	µg/L	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U
Benzo(g,h,i)perylene	µg/L	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U
Benzo(k)fluoranthene	µg/L	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U
Benzoic acid	µg/L	47 U	47 U	47 U	47 U	47 U	47 U	47 U	47 U
Benzyl alcohol	µg/L	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U
bis(2-Chloroethoxy)methane	µg/L	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U
bis(2-Chloroethyl)ether	µg/L	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U
bis(2-Ethylhexyl)phthalate (DEHP)	µg/L	9.4 U	9.4 U	9.4 U	9.4 U	26	9.4 U	9.4 U	9.4 U
Butyl benzylphthalate (BBP)	µg/L	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U
Chrysene	µg/L	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U
Dibenz(a,h)anthracene	µg/L	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U
Dibenzofuran	µg/L	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U
Diethyl phthalate	µg/L	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U
Dimethyl phthalate	µg/L	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U
Di-n-butylphthalate (DBP)	µg/L	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U
Di-n-octyl phthalate (DnOP)	µg/L	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U
Fluoranthene	µg/L	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U
Fluorene	µg/L	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U
Hexachlorobenzene	µg/L	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U
Hexachlorobutadiene	µg/L	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U
Hexachlorocyclopentadiene	µg/L	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U
Hexachloroethane	µg/L	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U
Indeno(1,2,3-cd)pyrene	µg/L	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U
Isophorone	µg/L	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U
Semi-volatile Organic Compounds-Continued									
Naphthalene	µg/L	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U
Nitrobenzene	µg/L	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U
N-Nitrosodi-n-propylamine	µg/L	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U
N-Nitrosodiphenylamine	µg/L	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U
Pentachlorophenol	µg/L	47 U	47 U	47 U	47 U	47 U	47 U	47 U	47 U
Phenanthrene	µg/L	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U
Phenol	µg/L	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U
Pyrene	µg/L	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U
Discrete Compounds Detected:		0	0	0	0	1	0	0	0
Polychlorinated Biphenyls (PCBs)									
Aroclor-1016 (PCB-1016)	µg/L	0.94 U	0.94 UJ	0.94 UJ	0.94 UJ	0.94 U	0.94 U	0.94 UJ	0.94 UJ
Aroclor-1221 (PCB-1221)	µg/L	1.9 U	1.9 UJ	1.9 UJ	1.9 UJ	1.9 U	1.9 U	1.9 UJ	1.9 UJ
Aroclor-1232 (PCB-1232)	µg/L	0.94 U	0.94 UJ	0.94 UJ	0.94 UJ	0.94 U	0.94 U	0.94 UJ	0.94 UJ
Aroclor-1242 (PCB-1242)	µg/L	0.94 U	0.94 UJ	0.94 UJ	0.94 UJ	0.94 U	0.94 U	0.94 UJ	0.94 UJ
Aroclor-1248 (PCB-1248)	µg/L	0.94 U	0.94 UJ	0.94 UJ	0.94 UJ	0.94 U	0.94 U	0.94 UJ	0.94 UJ
Aroclor-1254 (PCB-1254)	µg/L	0.94 U	0.94 UJ	0.94 UJ	0.94 UJ	0.94 U	0.94 U	0.94 UJ	0.94 UJ
Aroclor-1260 (PCB-1260)	µg/L	0.94 U	0.94 UJ	0.94 UJ	0.94 UJ	0.94 U	0.94 U	0.94 UJ	0.94 UJ
Discrete Compounds Detected:		0	0	0	0	0	0	0	0

TABLE 4 (cont'd)

2018 Analytical Results Summary-Overburden
Love Canal Long-Term Monitoring Program
Glenn Springs Holdings, Inc.

Sample Location:		7115	7125	7130	7132	8106	8115	8125	9105
Sample ID:		WG-9954-070518-SG-001	WG-9954-070518-SG-002	WG-9954-070518-SG-003	WG-9954-070518-SG-004	WG-9954-071118-SG-013	WG-9954-070518-SG-005	WG-9954-070618-SG-007	WG-9954-070618-SG-008
Sample Date:		7/5/2018	7/5/2018	7/5/2018	7/5/2018	7/11/2018	7/5/2018	7/6/2018	7/6/2018
Parameters	**Units**								
Pesticides									
4,4'-DDD	µg/L	0.047 UJ	0.047 U	0.047 U	0.047 U	0.047 U	0.047 UJ	0.047 UJ	0.047 U
4,4'-DDE	µg/L	0.047 UJ	0.047 U	0.047 U	0.047 U	0.047 U	0.047 UJ	0.047 UJ	0.047 U
4,4'-DDT	µg/L	0.047 UJ	0.047 U	0.047 U	0.047 U	0.047 U	0.047 UJ	0.047 UJ	0.047 U
Aldrin	µg/L	0.047 UJ	0.047 U	0.047 U	0.047 U	0.047 U	0.047 UJ	0.047 UJ	0.047 U
alpha-BHC	µg/L	0.047 UJ	0.047 U	0.047 U	0.047 U	0.047 U	0.047 UJ	0.047 UJ	0.047 U
alpha-Chlordane	µg/L	0.047 UJ	0.047 U	0.047 U	0.047 U	0.047 U	0.047 UJ	0.047 UJ	0.047 U
beta-BHC	µg/L	0.047 UJ	0.047 U	0.047 U	0.047 U	0.047 U	0.047 UJ	0.047 UJ	0.047 U
delta-BHC	µg/L	0.047 UJ	0.047 U	0.047 U	0.047 U	0.047 U	0.047 UJ	0.047 UJ	0.047 U
Dieldrin	µg/L	0.047 UJ	0.047 U	0.047 U	0.047 U	0.047 U	0.047 UJ	0.047 UJ	0.047 U
Endosulfan I	µg/L	0.047 UJ	0.047 U	0.047 U	0.047 U	0.047 U	0.047 UJ	0.047 UJ	0.047 U
Endosulfan II	µg/L	0.047 UJ	0.047 U	0.047 U	0.047 U	0.047 U	0.047 UJ	0.047 UJ	0.047 U
Endosulfan sulfate	µg/L	0.047 UJ	0.047 U	0.047 U	0.047 U	0.047 U	0.047 UJ	0.047 UJ	0.047 U
Endrin	µg/L	0.047 UJ	0.047 U	0.047 U	0.047 U	0.047 U	0.047 UJ	0.047 UJ	0.047 U
Endrin ketone	µg/L	0.047 UJ	0.047 U	0.047 U	0.047 U	0.047 U	0.047 UJ	0.047 UJ	0.047 U
gamma-BHC (lindane)	µg/L	0.047 UJ	0.047 U	0.047 U	0.047 U	0.047 U	0.047 UJ	0.047 UJ	0.047 U
gamma-Chlordane	µg/L	0.047 UJ	0.047 U	0.047 U	0.047 U	0.047 U	0.047 UJ	0.047 UJ	0.047 U
Heptachlor	µg/L	0.047 UJ	0.047 U	0.047 U	0.047 U	0.047 U	0.047 UJ	0.047 UJ	0.047 U
Heptachlor epoxide	µg/L	0.047 UJ	0.047 U	0.047 U	0.047 U	0.047 U	0.047 UJ	0.047 UJ	0.047 U
Methoxychlor	µg/L	0.047 UJ	0.047 U	0.047 U	0.047 U	0.047 U	0.047 UJ	0.047 UJ	0.047 U
Toxaphene	µg/L	0.50 UJ	0.50 U	0.50 U	0.50 U	0.50 U	0.50 UJ	0.50 UJ	0.50 U
Discrete Compounds Detected:		0	0	0	0	0	0	0	0

Notes:

J - Estimated concentration
U - Not detected at the associated reporting limit
UJ - Not detected; associated reporting limit is estimated

TABLE 4 (cont'd)

2018 Analytical Results Summary-Overburden
Love Canal Long-Term Monitoring Program
Glenn Springs Holdings, Inc.

Sample Location:		9113	9113	9118	10135	10178A
Sample ID:		WG-9954-070618-SG-009	WG-9954-070618-SG-010	WG-9954-071018-SG-011	WG-9954-071018-SG-012	WG-9954-070618-SG-006
Sample Date:		7/6/2018	7/6/2018	7/10/2018	7/10/2018	7/6/2018
			Duplicate			
Parameters	**Units**					
Volatile Organic Compounds						
1,1,1-Trichloroethane	µg/L	5.0 U	5.0 U	5.0 U	500 U	5.0 U
1,1,2,2-Tetrachloroethane	µg/L	5.0 U	5.0 U	5.0 U	500 U	5.0 U
1,1,2-Trichloroethane	µg/L	5.0 U	5.0 U	5.0 U	500 U	5.0 U
1,1-Dichloroethane	µg/L	5.0 U	5.0 U	5.0 U	500 U	5.0 U
1,1-Dichloroethene	µg/L	5.0 U	5.0 U	5.0 U	500 U	5.0 U
1,2-Dichloroethane	µg/L	5.0 U	5.0 U	5.0 U	500 U	5.0 U
1,2-Dichloropropane	µg/L	5.0 U	5.0 U	5.0 U	500 U	5.0 U
2-Butanone (Methyl ethyl ketone) (MEK)	µg/L	10 U	10 U	10 U	1000 U	10 U
2-Hexanone	µg/L	10 U	10 U	10 U	1000 U	10 U
4-Methyl-2-pentanone (Methyl isobutyl ketone) (MIBK)	µg/L	10 U	10 U	10 U	1000 U	10 U
Acetone	µg/L	10 U	10 U	10 U	1000 U	10 U
Benzene	µg/L	5.0 U	5.0 U	5.0 U	6200	5.0 U
Bromodichloromethane	µg/L	5.0 U	5.0 U	5.0 U	38 J	5.0 U
Bromoform	µg/L	5.0 U	5.0 U	5.0 U	500 U	5.0 U
Bromomethane (Methyl bromide)	µg/L	5.0 U	5.0 U	5.0 U	500 U	5.0 U
Carbon disulfide	µg/L	10 U	10 U	10 U	1000 U	10 U
Carbon tetrachloride	µg/L	5.0 U	5.0 U	5.0 U	500 U	5.0 U
Chlorobenzene	µg/L	5.0 U	5.0 U	5.0 U	2400	5.0 U
Chloroethane	µg/L	5.0 U	5.0 U	5.0 U	500 U	5.0 U
Chloroform (Trichloromethane)	µg/L	5.0 U	5.0 U	5.0 U	230 J	5.0 U
Chloromethane (Methyl chloride)	µg/L	5.0 U	5.0 U	5.0 U	500 U	5.0 U
cis-1,2-Dichloroethene	µg/L	5.0 U	5.0 U	5.0 U	39 J	5.0 U
cis-1,3-Dichloropropene	µg/L	5.0 U	5.0 U	5.0 U	500 U	5.0 U
Dibromochloromethane	µg/L	5.0 U	5.0 U	5.0 U	500 U	5.0 U
Ethylbenzene	µg/L	5.0 U	5.0 U	5.0 U	500 U	5.0 U
Methylene chloride	µg/L	5.0 U	5.0 U	5.0 U	500 U	5.0 U
Styrene	µg/L	5.0 U	5.0 U	5.0 U	500 U	5.0 U
Tetrachloroethene	µg/L	5.0 U	5.0 U	5.0 U	500 U	5.0 U
Toluene	µg/L	5.0 U	5.0 U	5.0 U	21000	5.0 U
trans-1,2-Dichloroethene	µg/L	5.0 U	5.0 U	5.0 U	34 J	5.0 U
trans-1,3-Dichloropropene	µg/L	5.0 U	5.0 U	5.0 U	500 U	5.0 U
Trichloroethene	µg/L	5.0 U	5.0 U	5.0 U	71 J	5.0 U
Vinyl acetate	µg/L	10 U	10 U	10 U	1000 U	10 U
Vinyl chloride	µg/L	5.0 U	5.0 U	5.0 U	500 U	5.0 U
Xylenes (total)	µg/L	5.0 U	5.0 U	5.0 U	35 J	5.0 U
Discrete Compounds Detected:		0	0	0	9	0
Semi-volatile Organic Compounds						
1,2,4-Trichlorobenzene	µg/L	9.4 U	9.4 U	9.4 U	470 U	9.4 U
1,2-Dichlorobenzene	µg/L	9.4 U	9.4 U	9.4 U	470 U	9.4 U
1,3-Dichlorobenzene	µg/L	9.4 U	9.4 U	9.4 U	470 U	9.4 U
1,4-Dichlorobenzene	µg/L	9.4 U	9.4 U	9.4 U	470 U	9.4 U
2,2'-Oxybis(1-chloropropane) (bis(2-Chloroisopropyl) ether)	µg/L	9.4 U	9.4 U	9.4 U	470 U	9.4 U
2,4,5-Trichlorophenol	µg/L	9.4 U	9.4 U	9.4 U	470 U	9.4 U
2,4,6-Trichlorophenol	µg/L	9.4 U	9.4 U	9.4 U	470 U	9.4 U
2,4-Dichlorophenol	µg/L	9.4 U	9.4 U	9.4 U	120 J	9.4 U
2,4-Dimethylphenol	µg/L	9.4 UJ	9.4 UJ	9.4 U	470 U	9.4 UJ
Semi-volatile Organic Compounds-Continued						
2,4-Dinitrophenol	µg/L	47 U	47 U	47 U	2400 U	47 U
2,4-Dinitrotoluene	µg/L	9.4 U	9.4 U	9.4 U	470 U	9.4 U
2,6-Dinitrotoluene	µg/L	9.4 U	9.4 U	9.4 U	470 U	9.4 U
2-Chloronaphthalene	µg/L	9.4 U	9.4 U	9.4 U	470 U	9.4 U
2-Chlorophenol	µg/L	9.4 U	9.4 U	9.4 U	470 U	9.4 U
2-Methylnaphthalene	µg/L	9.4 U	9.4 U	9.4 U	470 U	9.4 U
2-Methylphenol	µg/L	9.4 UJ	9.4 UJ	9.4 U	470 U	9.4 UJ
2-Nitroaniline	µg/L	47 U	47 U	47 U	2400 U	47 U
2-Nitrophenol	µg/L	9.4 U	9.4 U	9.4 U	470 U	9.4 U
3&4-Methylphenol	µg/L	9.4 U	9.4 U	9.4 U	80 J	9.4 U
3,3'-Dichlorobenzidine	µg/L	9.4 U	9.4 U	9.4 U	470 U	9.4 U

TABLE 4 (cont'd)

2018 Analytical Results Summary-Overburden
Love Canal Long-Term Monitoring Program
Glenn Springs Holdings, Inc.

Sample Location:		9113	9113	9118	10135	10178A
Sample ID:		WG-9954-070618-SG-009	WG-9954-070618-SG-010	WG-9954-071018-SG-011	WG-9954-071018-SG-012	WG-9954-070618-SG-006
Sample Date:		7/6/2018	7/6/2018	7/10/2018	7/10/2018	7/6/2018
			Duplicate			
Parameters	**Units**					
3-Nitroaniline	µg/L	47 U	47 U	47 U	2400 U	47 U
4,6-Dinitro-2-methylphenol	µg/L	47 U	47 U	47 U	2400 U	47 U
4-Bromophenyl phenyl ether	µg/L	9.4 U	9.4 U	9.4 U	470 U	9.4 U
4-Chloro-3-methylphenol	µg/L	9.4 U	9.4 U	9.4 U	470 U	9.4 U
4-Chloroaniline	µg/L	9.4 U	9.4 U	9.4 U	470 U	9.4 U
4-Chlorophenyl phenyl ether	µg/L	9.4 U	9.4 U	9.4 U	470 U	9.4 U
4-Nitroaniline	µg/L	47 U	47 U	47 U	2400 U	47 U
4-Nitrophenol	µg/L	47 U	47 U	47 U	2400 U	47 U
Acenaphthene	µg/L	9.4 U	9.4 U	9.4 U	470 U	9.4 U
Acenaphthylene	µg/L	9.4 U	9.4 U	9.4 U	470 U	9.4 U
Anthracene	µg/L	9.4 U	9.4 U	9.4 U	470 U	9.4 U
Benzo(a)anthracene	µg/L	9.4 U	9.4 U	9.4 U	470 U	9.4 U
Benzo(a)pyrene	µg/L	9.4 U	9.4 U	9.4 U	470 U	9.4 U
Benzo(b)fluoranthene	µg/L	9.4 U	9.4 U	9.4 U	470 U	9.4 U
Benzo(g,h,i)perylene	µg/L	9.4 U	9.4 U	9.4 U	470 U	9.4 U
Benzo(k)fluoranthene	µg/L	9.4 U	9.4 U	9.4 U	470 U	9.4 U
Benzoic acid	µg/L	47 U	47 U	47 U	6000	47 U
Benzyl alcohol	µg/L	9.4 U	9.4 U	9.4 U	280 J	9.4 U
bis(2-Chloroethoxy)methane	µg/L	9.4 U	9.4 U	9.4 U	470 U	9.4 U
bis(2-Chloroethyl)ether	µg/L	9.4 U	9.4 U	9.4 U	470 U	9.4 U
bis(2-Ethylhexyl)phthalate (DEHP)	µg/L	9.4 U	9.4 U	9.4 U	470 U	9.4 U
Butyl benzylphthalate (BBP)	µg/L	9.4 U	9.4 U	9.4 U	470 U	9.4 U
Chrysene	µg/L	9.4 U	9.4 U	9.4 U	470 U	9.4 U
Dibenz(a,h)anthracene	µg/L	9.4 U	9.4 U	9.4 U	470 U	9.4 U
Dibenzofuran	µg/L	9.4 U	9.4 U	9.4 U	470 U	9.4 U
Diethyl phthalate	µg/L	9.4 U	9.4 U	9.4 U	470 U	9.4 U
Dimethyl phthalate	µg/L	9.4 U	9.4 U	9.4 U	470 U	9.4 U
Di-n-butylphthalate (DBP)	µg/L	9.4 U	9.4 U	9.4 U	470 U	9.4 U
Di-n-octyl phthalate (DnOP)	µg/L	9.4 U	9.4 U	9.4 U	470 U	9.4 U
Fluoranthene	µg/L	9.4 U	9.4 U	9.4 U	470 U	9.4 U
Fluorene	µg/L	9.4 U	9.4 U	9.4 U	470 U	9.4 U
Hexachlorobenzene	µg/L	9.4 U	9.4 U	9.4 U	470 U	9.4 U
Hexachlorobutadiene	µg/L	9.4 U	9.4 U	9.4 U	470 U	9.4 U
Hexachlorocyclopentadiene	µg/L	9.4 U	9.4 U	9.4 U	470 U	9.4 U
Hexachloroethane	µg/L	9.4 U	9.4 U	9.4 U	470 U	9.4 U
Indeno(1,2,3-cd)pyrene	µg/L	9.4 U	9.4 U	9.4 U	470 U	9.4 U
Isophorone	µg/L	9.4 U	9.4 U	9.4 U	470 U	9.4 U
Semi-volatile Organic Compounds-Continued						
Naphthalene	µg/L	9.4 U	9.4 U	9.4 U	470 U	9.4 U
Nitrobenzene	µg/L	9.4 U	9.4 U	9.4 U	470 U	9.4 U
N-Nitrosodi-n-propylamine	µg/L	9.4 U	9.4 U	9.4 U	470 U	9.4 U
N-Nitrosodiphenylamine	µg/L	9.4 U	9.4 U	9.4 U	470 U	9.4 U
Pentachlorophenol	µg/L	47 U	47 U	47 U	2400 U	47 U
Phenanthrene	µg/L	9.4 U	9.4 U	9.4 U	470 U	9.4 U
Phenol	µg/L	9.4 U	9.4 U	9.4 U	470 U	9.4 U
Pyrene	µg/L	9.4 U	9.4 U	9.4 U	470 U	9.4 U
Discrete Compounds Detected:		0	0	0	4	0
Polychlorinated Biphenyls (PCBs)						
Aroclor-1016 (PCB-1016)	µg/L	0.94 UJ	0.94 UJ	0.94 UJ	0.94 UJ	0.94 UJ
Aroclor-1221 (PCB-1221)	µg/L	1.9 UJ	1.9 UJ	1.9 UJ	1.9 UJ	1.9 UJ
Aroclor-1232 (PCB-1232)	µg/L	0.94 UJ	0.94 UJ	0.94 UJ	0.94 UJ	0.94 UJ
Aroclor-1242 (PCB-1242)	µg/L	0.94 UJ	0.94 UJ	0.94 UJ	0.94 UJ	0.94 UJ
Aroclor-1248 (PCB-1248)	µg/L	0.94 UJ	0.94 UJ	0.94 UJ	0.94 UJ	0.94 UJ
Aroclor-1254 (PCB-1254)	µg/L	0.94 UJ	0.94 UJ	0.94 UJ	0.94 UJ	0.94 UJ
Aroclor-1260 (PCB-1260)	µg/L	0.94 UJ	0.94 UJ	0.94 UJ	0.94 UJ	0.94 UJ
Discrete Compounds Detected:		0	0	0	0	0

TABLE 4 (cont'd)

2018 Analytical Results Summary-Overburden
Love Canal Long-Term Monitoring Program
Glenn Springs Holdings, Inc.

Sample Location:		9113	9113	9118	10135	10178A
Sample ID:		WG-9954-070618-SG-009	WG-9954-070618-SG-010	WG-9954-071018-SG-011	WG-9954-071018-SG-012	WG-9954-070618-SG-006
Sample Date:		7/6/2018	7/6/2018	7/10/2018	7/10/2018	7/6/2018
			Duplicate			
Parameters	**Units**					
Pesticides						
4,4'-DDD	µg/L	0.047 U	0.047 U	0.047 U	0.94 U	0.047 U
4,4'-DDE	µg/L	0.047 U	0.047 U	0.047 U	0.94 U	0.047 U
4,4'-DDT	µg/L	0.047 U	0.047 U	0.047 U	0.94 U	0.047 U
Aldrin	µg/L	0.047 U	0.047 U	0.047 U	0.94 U	0.047 U
alpha-BHC	µg/L	0.047 U	0.047 U	0.047 U	23	0.047 U
alpha-Chlordane	µg/L	0.047 U	0.047 U	0.047 U	0.94 U	0.047 U
beta-BHC	µg/L	0.047 U	0.047 U	0.047 U	4.3	0.047 U
delta-BHC	µg/L	0.047 U	0.047 U	0.047 U	7.2	0.047 U
Dieldrin	µg/L	0.047 U	0.047 U	0.047 U	0.94 U	0.047 U
Endosulfan I	µg/L	0.047 U	0.047 U	0.047 U	0.94 U	0.047 U
Endosulfan II	µg/L	0.047 U	0.047 U	0.047 U	0.94 U	0.047 U
Endosulfan sulfate	µg/L	0.047 U	0.047 U	0.047 U	0.94 U	0.047 U
Endrin	µg/L	0.047 U	0.047 U	0.047 U	0.94 U	0.047 U
Endrin ketone	µg/L	0.047 U	0.047 U	0.047 U	0.94 U	0.047 U
gamma-BHC (lindane)	µg/L	0.047 U	0.047 U	0.047 U	3.3	0.047 U
gamma-Chlordane	µg/L	0.047 U	0.047 U	0.047 U	0.94 U	0.047 U
Heptachlor	µg/L	0.047 U	0.047 U	0.047 U	0.94 U	0.047 U
Heptachlor epoxide	µg/L	0.047 U	0.047 U	0.047 U	0.94 U	0.047 U
Methoxychlor	µg/L	0.047 U	0.047 U	0.047 U	0.94 U	0.047 U
Toxaphene	µg/L	0.50 U	0.50 U	0.50 U	10 U	0.50 U
Discrete Compounds Detected:		0	0	0	4	0
Notes:						
J - Estimated concentration						
U - Not detected at the associated reporting limit						
UJ - Not detected; associated reporting limit is estimated						

APPENDIX B

FIGURES

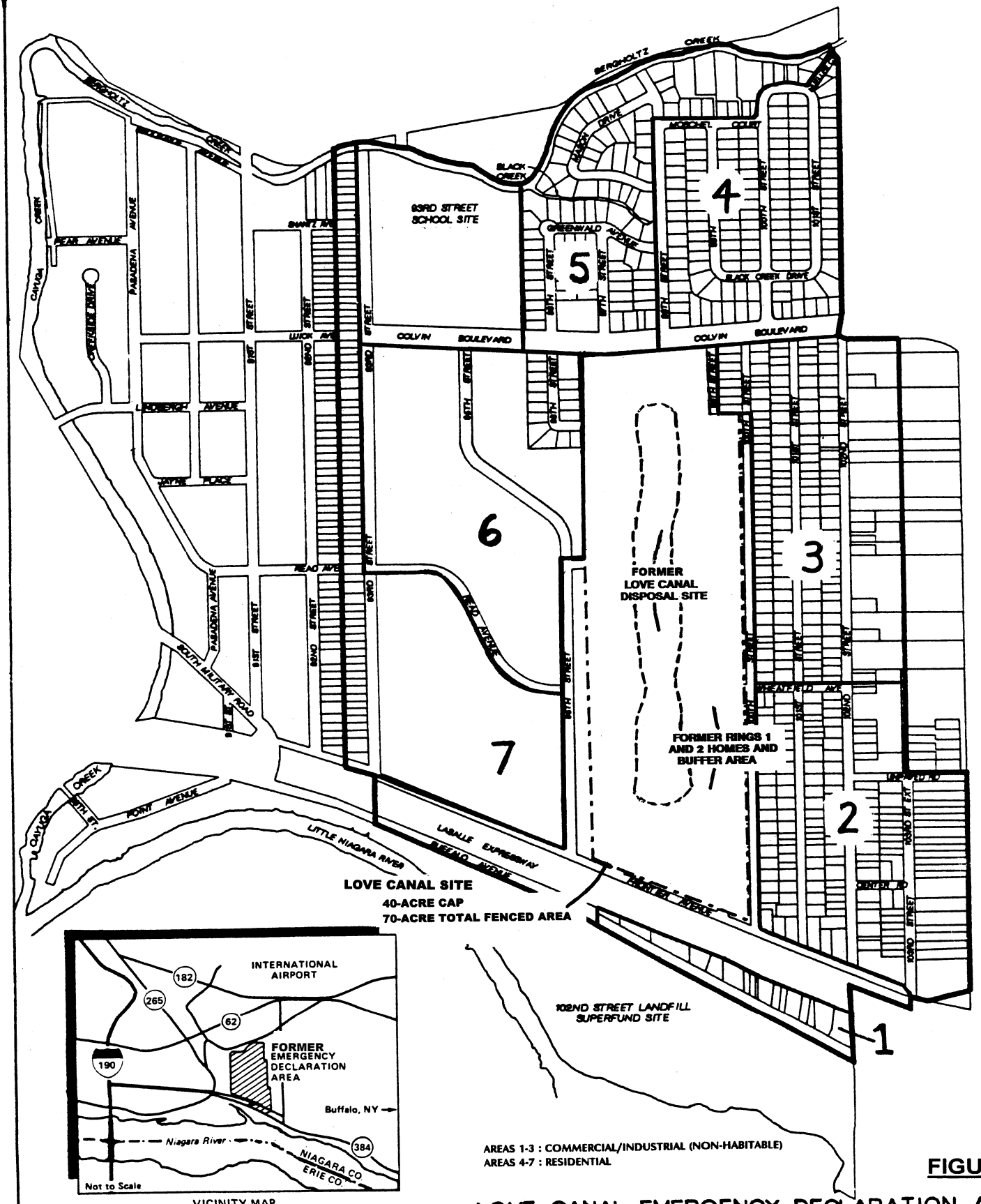


FIGURE 1

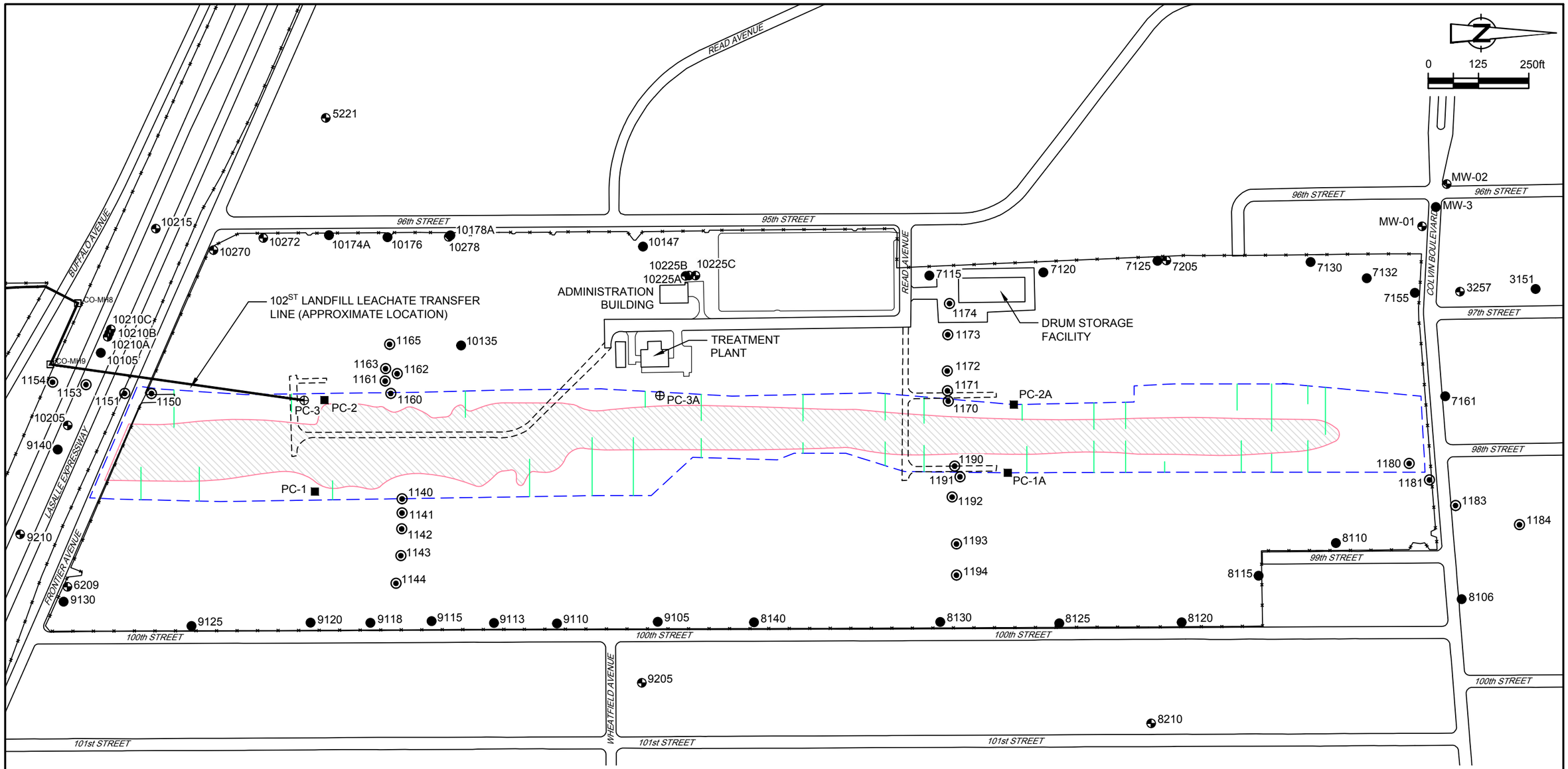
LOVE CANAL EMERGENCY DECLARATION AREA

NIAGARA FALLS, NEW YORK SCALE: 1"=750' (SEVEN EDA NEIGHBORHOODS)

LEGEND

EMERGENCY DECLARATION AREA (EDA) BOUNDARY

SOURCE:
EDA BOUNDARIES TAKEN FROM NEW YORK STATE REAL PROPERTY TAX LAW ARTICLE 17, SECTION 1702



LEGEND

- FENCE LINE
- BARRIER DRAIN
- LATERAL TRENCH
- 7105 PIEZOMETER
- 9120 OVERBURDEN OBSERVATION WELL
- 10270 BEDROCK OBSERVATION WELL
- PC-1 PUMP CHAMBER FOR LEACHATE COLLECTION
- PC-3 PUMP CHAMBER / UNDERGROUND LEACHATE STORAGE TANK FOR LEACHATE COLLECTION AND TRANSFER
- CO-MH3 FORCEMAIN CLEAN OUT MANHOLE
- APPROXIMATE LIMITS OF DISPOSED WASTE

NOTE:
WELL 3151 IS UNABLE TO BE LOCATED
(ASSUMED TO BE PAVED OVER)

FIGURE 2

SITE PLAN
LOVE CANAL SITE
GLENN SPRINGS HOLDINGS, INC.
Niagara Falls, New York

09954-D23101(034)GN-WA001 JUN 14, 2018

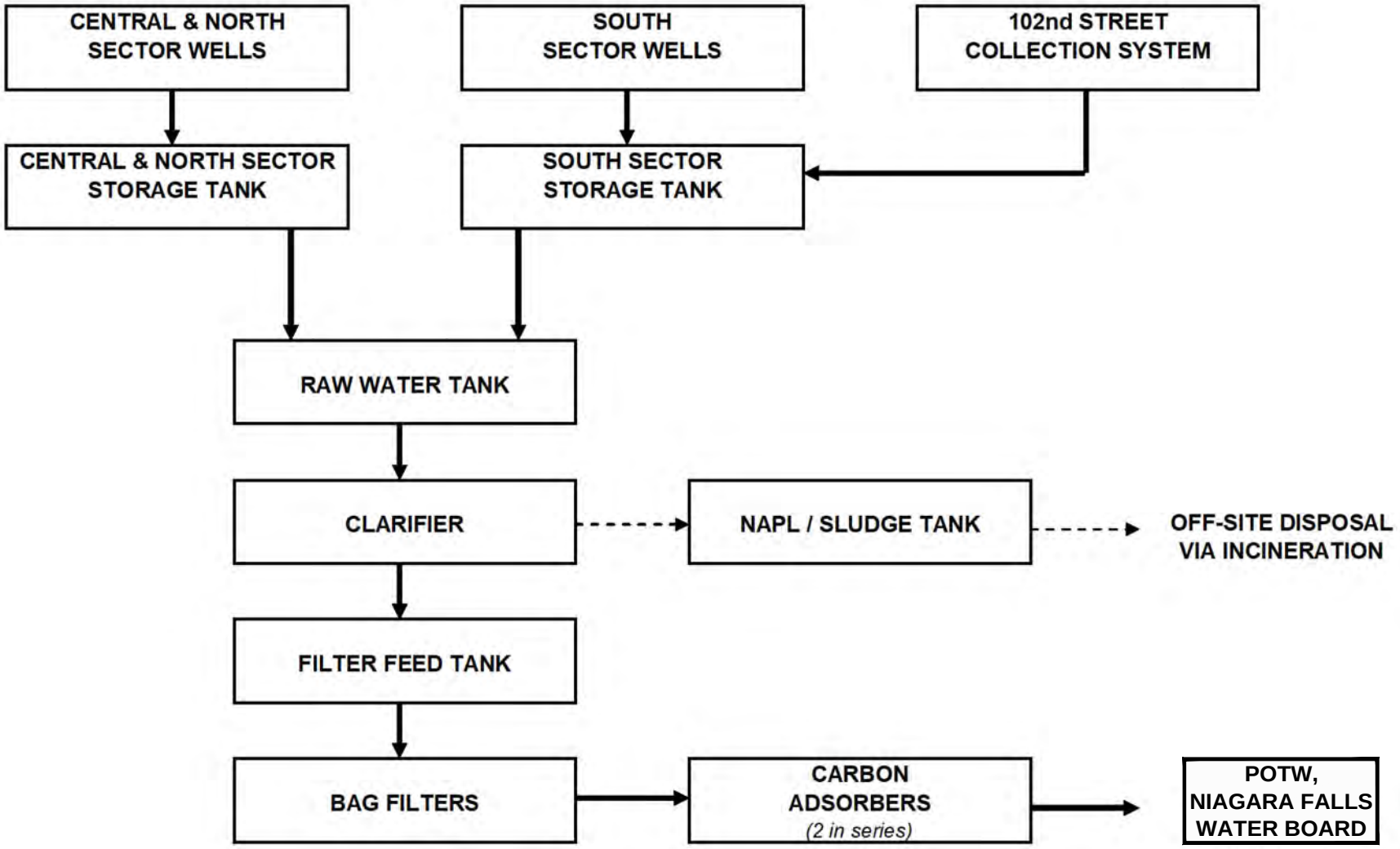
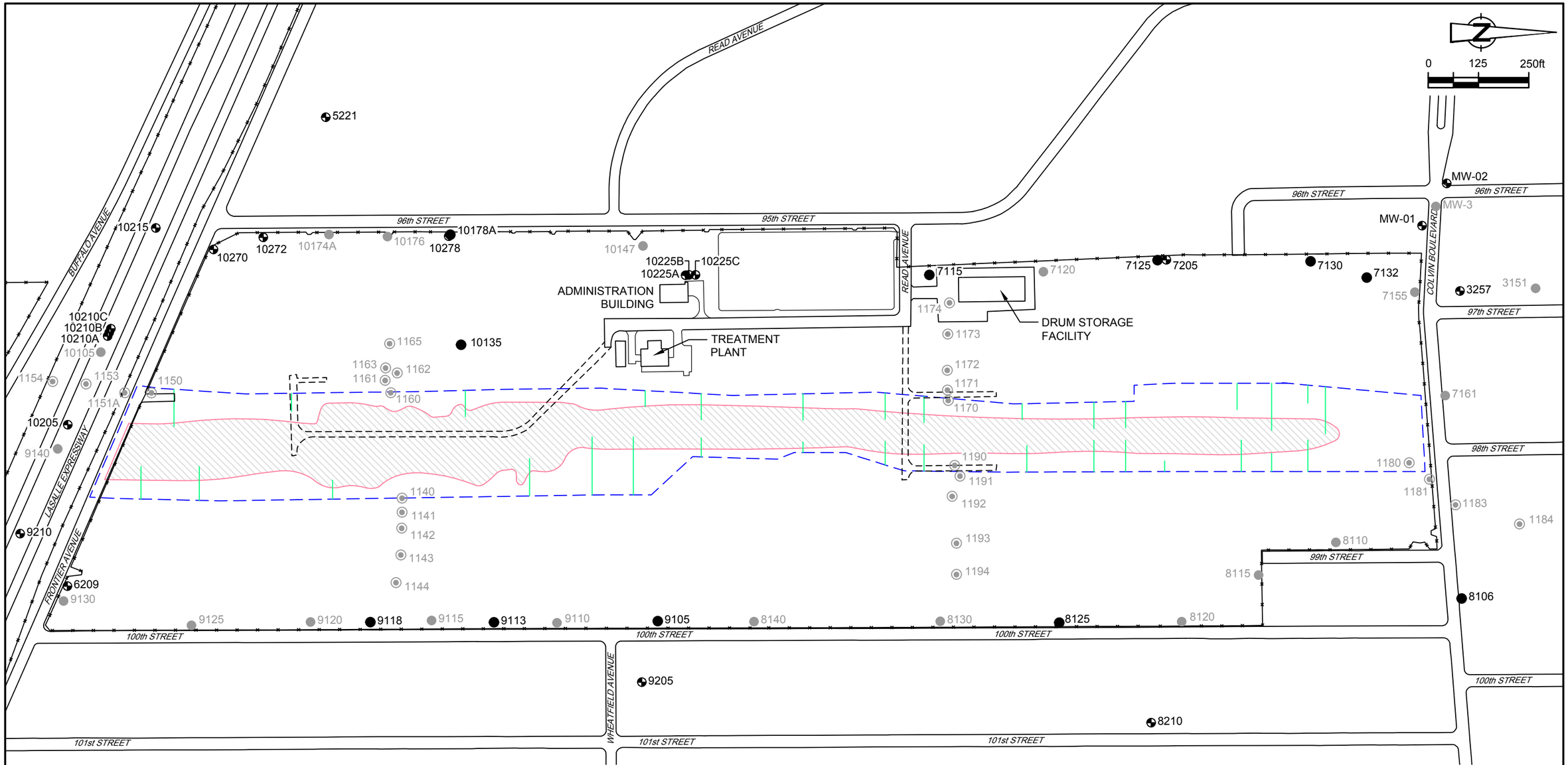


FIGURE 3

PROCESS SCHEMATIC
LOVE CANAL SITE
GLENN SPRINGS HOLDINGS, INC.
Niagara Falls, New York



LEGEND

- FENCE LINE
- BARRIER DRAIN
- LATERAL TRENCH
- 7105 PIEZOMETER
- 9122 OVERBURDEN OBSERVATION WELL
- 5222 BEDROCK OBSERVATION WELL
- 7115 OVERBURDEN OBSERVATION WELL SAMPLED IN 2018
- 10270 BEDROCK OBSERVATION WELL SAMPLED IN 2018
- APPROXIMATE LIMITS OF DISPOSED WASTE

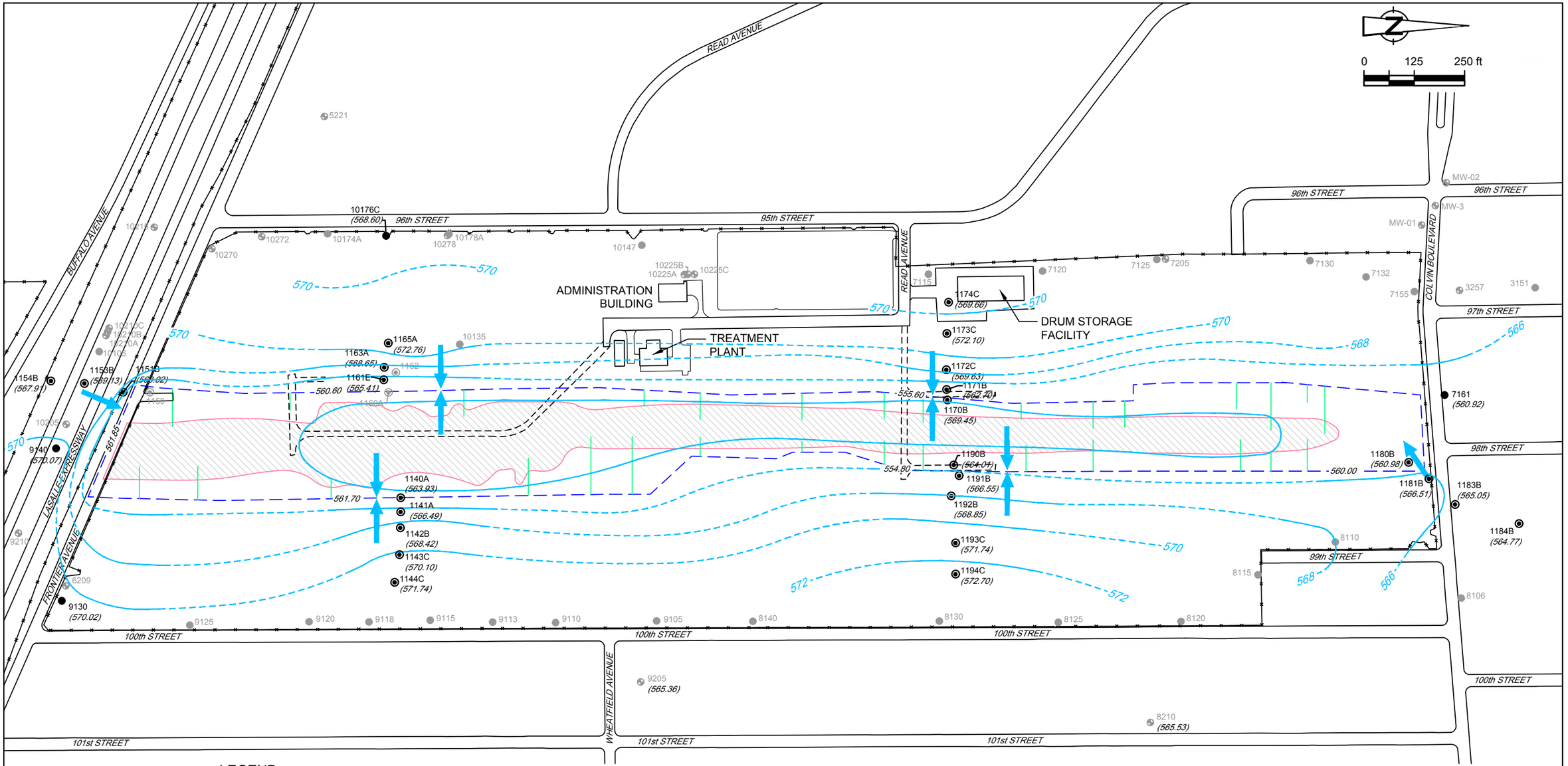
NOTE:
WELL 3151 IS UNABLE TO BE LOCATED
(ASSUMED TO BE PAVED OVER)

FIGURE 4

2018 GROUNDWATER MONITORING LOCATIONS

LOVE CANAL SITE
GLENN SPRINGS HOLDINGS, INC.
Niagara Falls, New York

09954-D23101(034)GN-WA004 JAN 8, 2019



LEGEND

- FENCE LINE
- BARRIER DRAIN
- LATERAL TRENCH
- 7105 PIEZOMETER
- 9120 OVERBURDEN OBSERVATION WELL
- 7105 PIEZOMETER (NOT PART OF HYDRAULIC MONITORING PROGRAM)
- 9120 OVERBURDEN OBSERVATION WELL (NOT PART OF HYDRAULIC MONITORING PROGRAM)
- 5222 BEDROCK OBSERVATION WELL (NOT PART OF HYDRAULIC MONITORING PROGRAM)
- APPROXIMATE LIMITS OF DISPOSED WASTE
- (565.36) GROUNDWATER ELEVATION
- 566 GROUNDWATER CONTOUR
- INFERRED GROUNDWATER CONTOUR
- GROUNDWATER FLOW DIRECTION
- 554.80 ELEVATION OF THE BOTTOM OF THE BARRIER DRAIN

FIGURE 5

MAY 29, 2018 GROUNDWATER CONTOURS

LOVE CANAL SITE
GLENN SPRINGS HOLDINGS, INC.
Niagara Falls, New York

09954-D23101(034)GN-WA011 JAN 8, 2019

APPENDIX C

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