



Work Plan
Remedial Investigation & Feasibility Study
Hoosick Falls Landfill
NYSDEC Site No. 442007

Town of Hoosick, Rensselaer County, New York

Honeywell

March 2021

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I, Michael B. Teetsel, certify that I am currently a Qualified Environmental Professional as defined in 6 NYCRR Part 375 and that this Remedial Investigation and Feasibility Study Work Plan was prepared in accordance with all applicable statutes and regulations and in substantial conformance with the DER Technical Guidance for Site Investigation and Remediation (DER-10).

A handwritten signature in black ink, appearing to read "Michael B. Teetsel". The signature is fluid and cursive, with the first name "Michael" and last name "Teetsel" clearly distinguishable.

Michael B. Teetsel, NYPG No. 606
ERM Consulting & Engineering, Inc.

Date: 11 March 2021

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ACRONYMS AND ABBREVIATIONS

amsl	above mean sea level
APS	Advanced Profiling System
ASP	Analytical Services Protocol
AOPCs	Areas of Potential Concern
CAMP	Community Air Monitoring Plan
COPCs	Compounds of Potential Concern
CSM	Conceptual Site Model
DER	Division of Environmental Remediation
DSNY	Dig Safely New York
DUSR	Data Usability Summary Report
ERM	ERM Consulting and Engineering, Inc.
FSAP	Field Sampling and Analysis Plan
GAC	Granular Activated Carbon
gpd	gallons per day
IRM	Interim Remedial Measure
ng/L	Nanograms per liter (parts per trillion)
NJDEP	New Jersey Department of Environmental Protection
NPL	National Priorities List
NYS	New York State
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
NYSGS	New York State Geological Survey
PARCC	Precision, Accuracy, Reproducibility, Completeness, and Comparability
PCBs	Polychlorinated biphenyls
PDI	Pre-Design Investigation
PFAS	Per- and Polyfluoroalkyl Substances
PFOA	Perfluorooctanoic acid
PFOS	Perfluorooctane sulfonic acid
QA/QC	Quality Assurance / Quality Control
QAPP	Quality Assurance Project Plan
RI	Remedial Investigation
SC	Site Characterization
SCGs	Standards, Criteria and Guidance
SCOs	Soil Cleanup Objectives
SOP	Standard Operating Procedure
SVOCs	Semivolatile Organic Compounds
TAL	Target Analyte List
TCL	Target Compound List
TOGS	Technical Operations Guidance Series
TCE	Trichloroethene
µg/kg	Micrograms per kilogram (parts per billion)
USEPA	United States Environmental Protection Agency
VOCs	Volatile Organic Compounds

1.0

INTRODUCTION

Honeywell International Inc. (Honeywell) and the Village of Hoosick Falls (Village) entered into an Order on Consent and Administrative Settlement with the New York State Department of Environmental Conservation (NYSDEC) dated 16 March 2020 (the Order; Index Number CO 4-20190705-39). The Order required the performance of a Remedial Investigation (RI) and Feasibility Study (FS) for the Hoosick Falls Landfill (the Site). The location of the Site is shown on Figure 1. A Site layout is provided as Figure 2.

The Site has been listed on the Registry of Inactive Hazardous Waste Sites (the Registry) as a Class 2 site (Site No. 442007).

1.1

PURPOSE AND OBJECTIVES

The Site consists of a municipal sanitary landfill that operated from the mid-1930s until 1993. The facility also occasionally received industrial wastes. The landfill was closed in the early 1990s. That closure consisted of capping to restrict infiltration, eliminate dermal contact, reduce gaseous emissions to the atmosphere, plus installation of a leachate collection system to address the potential for releases to groundwater and surface water. This remedy is considered “presumptive” under Part 375¹ and DER-10² in that the issues related to landfills are well defined and consist of similar elements at most facilities. This allows similar remedies typical of landfills to be implemented without the broad-based investigations necessitated by an unknown waste source. The components required in a typical municipal landfill remedy generally include capping consistent with the waste type, management systems for gaseous emissions that are either passive or active, leachate management systems to reduce or eliminate releases to groundwater or surface water, institutional controls, and engineering controls. These components have been addressed to a significant degree in the 1990s closure of the landfill.

A Site Characterization was performed during 2017-2018 by TRC Engineers, Inc. under contract with NYSDEC. The associated report is provided in Appendix A. All media were sampled for Target Analyte List and Target Compound list (TAL/TCL) analysis. This work detected the presence of the following constituents at concentrations exceeding potentially applicable Standards, Criteria and Guidance (SCGs) where available:

- Per- and polyfluoroalkyl substances (PFAS) in:
 - surface water;
 - sediment; and
 - groundwater and leachate.

¹ 6 NYCRR Part 375: Environmental Remediation Programs

² DER-10 / Technical Guidance for Site Investigation and Remediation (NYSDEC, May 2010)

- PCBs in:
 - subsurface soil (one sample).
- Pesticides in:
 - surface soil (one sample).
- Metals in:
 - surface soil;
 - subsurface soil;
 - surface water;
 - sediment; and
 - groundwater and leachate.

Based on the site characterization results, NYSDEC classified the Site as Class 2 warranting additional investigations, including determining the nature and extent of the contaminants of concern (COCs), to complete the Remedial Investigation (RI) and perform a Feasibility Study (FS) to evaluate remedial alternatives to mitigate threats to human health and the environment that are identified in the RI.

Given the landfill closure, monitoring data collected in the past 25 years and the TRC site characterization, the Work Plan is focused on building on these known conditions. Additional investigatory measures to establish the nature and extent include the following:

- Review existing landfill information;
- Evaluate competency of cover system and gas emissions;
- Landfill vent and soil gas sampling;
- Perform a Hydrologic Evaluation of Landfill Performance (HELP) modeling evaluation for the existing cover system;
- Evaluate nature and volume of leachate seeps on the downgradient flanks of landfill;
- Video inspection of the leachate collection system piping;
- Surface water and sediment sampling of Thayer's Pond and Hoosic River;
- Collection of soil samples;
- Install monitoring wells to define impacts in groundwater;
- Human Health Exposure Assessment;
- Fish and Wildlife Resources Impact Assessment; and
- Draft RI Report

In addition, a Treatability Study to evaluate the removal of PFAS from the leachate collection system discharge will also be performed.

1.2

STANDARDS, CRITERIA AND GUIDANCE

The following NYS Standards, Criteria and Guidance (SCGs) apply to this project:

- 6 NYCRR Part 375 - Environmental Remediation Programs;
- 6 NYCRR Part 608 - Use and Protection of Waters;
- 6 NYCRR Parts 700-706 - Water Quality Standards; and
- 29 CFR Part 1910.120 - Hazardous Waste Operations and Emergency Response
- DER-10 – Technical Guidance for Site Investigation and Remediation (May 2010);
- USEPA Drinking Water Health Advisory for PFOA and perfluorooctane sulfonic acid (PFOS) dated May 2016 (USEPA, 2016a);
- NYSDEC Division of Spills Management - Sampling Guidelines and Protocols: Technologies Background and Quality Control/Quality Assurance for the NYSDEC Spill Response Program (NYSDEC, 1992);
- TOGS 1.1.1 - Ambient Water Quality Standards & Guidance Values and Groundwater Effluent Limitations (NYSDEC, 1998);
- Screening and Assessment of Contaminated Sediment, NYSDEC Division of Fish, Wildlife and Marine Resources, Bureau of Habitat dated 24 June 2014 (NYSDEC 2014);
- Fish & Wildlife Impact Analysis for Inactive Hazardous Waste Sites (NYSDEC, October 1994); and
- Guidelines for Sampling and Analysis of PFAS (NYSDEC, 2020)

Prior and future sample results were/will be compared to applicable NYS SCGs by media as summarized below.

1.2.1

Groundwater

Groundwater results will be compared to New York State Class GA ambient water quality standards and guidance values (NYSDEC, 1998) for target compound list (TCL) organic compounds and target analyte list (TAL) inorganic constituents. New York State does not currently have ambient water quality standards (AWQS) or guidance values³ for perfluorooctanoic acid (PFOA), perfluorooctane sulfonic acid (PFOS), or other PFAS.

The USEPA Lifetime Health Advisories of 70 ng/L for both PFOA and PFOS (individually and in total) are applicable only for drinking water (USEPA, 2016a).

³ Ambient water quality relates to water bodies such as lakes, rivers, and oceans. New York State has developed standards and guidance values for “specific classes of fresh and saline surface waters and fresh groundwaters for protection of the best uses assigned to each class”. See TOGS 1.1.1. (NYSDEC, 1998).

On July 29, 2020, the New York State Public Health and Health Planning Council voted to adopt Maximum Contaminant Levels of 10 ng/L for PFOA and PFOS, individually, in state drinking water. These new MCLs were promulgated on August 26, 2020 through amendment of Subpart 5-1 of Title 10 NYCRR.

1.2.2 *Surface Water*

Surface water samples will be compared to the applicable surface water quality standards in 6NYCRR Part 703 for the analysis of potential routes of exposure, such as human consumption of Fish [H(FC)], health (water source), etc. NYSDEC does not currently have SCGs for PFOA, PFOS or other PFAS in surface water; however, PFAS guidelines are in development and will be used for comparing against the sampling data when available. Ecological Screening Levels (ESLs) for PFAS in surface water will be developed as part of a Fish and Wildlife Resources Impact Analysis (FWRIA).

1.2.3 *Sediment*

Sediment data for TAL and TCL constituents collected during the RI will be compared to all applicable sediment guidance values (SGVs) presented in the document entitled “Screening and Assessment of Contaminated Sediment” (NYSDEC, June 2014). This applicable SGV screening shall be performed during the RI, including comparison to freshwater SGVs and bioaccumulation-based Sediment Guidance Values (BSGV) for the protection of human health (fish consumption) and wildlife. Screening values for PFOA and PFOS will be developed using the process described in Section 3.3.7.

2.0 PROJECT BACKGROUND

2.1 SITE DESCRIPTION

The Site is located at 9 Walnut Street, near the intersection with New York State Route 22, in the Town of Hoosick Falls, Rensselaer County, New York (see Figure 1). The Site is in a mixed residential, agricultural and commercial area approximately 0.5 mile north of the Village of Hoosick Falls. The Site is comprised primarily of a 28.55-acre parcel identified on the Town of Hoosick Tax Maps as Section 17, Block 2, Lot 16.2 (Parcel No. 17.-2-16.2) and includes Parcel No. 17.4-14-16 and a portion of 27.00-3-22). Surrounding land use includes the following:

- The Site is bordered to the north by undeveloped land;
- A railroad corridor for Pan Am Southern and the Hoosic River lie to the west;
- Residential and commercial properties accessible from Route 22 lie to the east;
- Undeveloped land and Thayer's Pond lie to the south.

The landfill is inactive, having been closed in the 1990s in accordance with 6 NYCRR 360. However, the Village operates a waste transfer station in the northeastern part of the Site. The transfer station includes a parking lot, two small storage sheds, roll-off containers, a waste staging pad and a loading platform. In addition, a 75,000 square foot solar electric generating facility is located on top of the southwest portion of the Site. It includes solar panels, inverters, conduit trenches, and a utility tie-in. Electric transmission lines run along the southern, eastern and northern perimeters of the Site. On the southwestern part of the property, a leachate collection vault and associated manhole are visible components of the leachate collection system installed as part of the landfill closure.

2.2 SITE HISTORY

The "Site Characterization Report" (TRC, January 2019) presents the following description of the landfill's operational history:

The Village of Hoosick Falls operated an "unlined" municipal landfill at the Site from the mid-1930s until it stopped accepting waste at the landfill in 1993. During this time, the landfill reportedly received an average of 23 tons of municipal and industrial waste per day from local residential and industrial communities. The municipal waste included sewage sludge from the Hoosick Falls Wastewater Treatment Plant and general household trash. The industrial waste included oil, wastepaper sludge, polymerized epoxy resin, thermoset molding flash, Teflon™ chips, and phenolic resin. The landfill reportedly operated more like an "open dump" rather than a planned facility. Historically, sludge piles, lagoons, and open metal drums were noted as being randomly placed throughout the Site and comingled with the general fill and waste material. The Hoosick Falls

Landfill closure system consists of an approximately 12-inch thick passive gas venting layer beneath an approximately 24-inch thick clay barrier layer. Above the clay barrier layer is an approximately 24-inch thick soil protection layer and an approximately 6-inch thick topsoil final cap surface layer.

2.3 PHYSICAL CONDITIONS

2.3.1 Topography

The Site slopes steeply to the west toward the Hoosic River. Elevations at the Site range from approximately 420 to 540 feet North American Vertical Datum (NAVD) 1988, with the highest elevations on the northern portion of the landfill and the lowest elevations near the Hoosic River. The majority of surface water runoff at the Site occurs via sheet flow to the west, although there are a few small ditches around the landfill perimeter. Runoff appears to drain to Thayer's Pond and the Hoosic River but will be evaluated further as part of the RI.

2.3.2 Surface Waters

Thayer's Pond is the closest surface water body to the Site, adjacent to the south. The Hoosic River is located less than 200 feet west of the Site. The Hoosic is a "protected stream" and designated as a Class C (T) water.

2.3.3 Geologic/Hydrogeologic Setting

Stratigraphy at the Site typically consists of:

- Fine to coarse grained alluvium deposited in the Hoosic River valley.
- Glacio-lacustrine silt and clay.
- In locations where bedrock is deeper, dense, compact, poorly-sorted mixture of silt, clay, sand, gravel and cobbles (glacial till) may be found.
- Bedrock; dark gray to black slate mapped by the NYSGS as the Walloomsac Formation (Potter, 1972).

Geologic conditions vary across the Site. In the lower elevation area west of the landfill, bedrock is deeper, up to greater than 100 feet. The higher surface elevations to the east are characterized by: (a) shallower bedrock (~60 feet) at much higher elevation; (b) the lacustrine material appears to be absent; and (c) till is more widespread. Bedrock outcrops south of the landfill along the eastern shore of Thayer's Pond.

Groundwater in both the overburden and bedrock flows toward the Hoosic River. Bedrock flow occurs predominantly through joints, fractures, faults, and foliations.

2.3.4 *Local Potable Water Sources*

The drinking water supply for the Village derives from a groundwater source located approximately 2 miles south of the Site. Some homes and businesses within the Site vicinity are serviced by private supply wells and septic systems.

The Village water supply system has an approximate capacity of 1.0 million gallons per day (gpd). Produced water is treated through a membrane filtration plant. Additionally, granular activated carbon (GAC) is utilized to remove PFAS from the water since February 2016.

2.4 *PREVIOUS INVESTIGATION ACTIVITIES*

A summary of previous investigations at the Site is provided below, based on information provided in the “Site Characterization Report” (TRC, January 2019). See Appendix A for additional detail.

2.4.1 *Wehran Engineering, P.C. Phase I Investigation*

Wehran Engineering, P.C. was retained by NYSDEC in 1987 to complete a Phase I investigation to evaluate the potential for environmental or public health hazards associated with past disposal activities at the Site. The Phase I consisted of a file review, site inspection and development of a preliminary Hazard Ranking System (HRS) score. The file review identified a history of compliance issues. The inspection discovered several items of concern including sludge piles, exposed debris (including near Thayer’s Pond) and numerous seeps.

2.4.2 *Gibbs & Hill, Inc. Phase II Investigation*

Gibbs & Hill, Inc. was retained by NYSDEC in 1991 to perform a Phase II Investigation for gathering field data and to calculate a Final HRS score. Phase II field investigation activities included a geophysical investigation; installation of four (4) overburden groundwater monitoring wells; and the collection and analysis of groundwater, surface water, sediment and soil samples. All samples were analyzed for the Target Analyte List and Target Compound List (TAL/TCL) parameters. The salient findings were as follows:

- Several chlorinated VOCs were detected in groundwater at concentrations above applicable standards in one groundwater sample;
- Cadmium, chromium, lead, and manganese were detected in groundwater at concentrations above applicable standards in three groundwater samples, but may have been due to turbidity in the samples;
- Three surface water samples were collected, two from the Hoosic River and one from a small stream draining to Thayer’s Pond:
 - All detections of organic compounds were also found in the blank samples and, therefore, are not confirmed;

- Inorganic analytes in the Hoosic River samples with the highest detected concentrations included aluminum, calcium, iron magnesium and sodium. The downstream sample contained approximately the same levels as the upstream sample.
- Inorganic results in the stream draining to Thayer's Pond indicated concentrations similar to the Hoosic River, except for slightly higher levels of manganese and zinc.
- The above results suggested no adverse impact to surface water quality at these locations;
- Three (3) sediment samples were co-located with surface water sample locations. The pesticide lindane was found in one sample. Lead and zinc were found in individual samples at levels elevated in comparison with the other samples; and
- No HRS score was assigned indicating there was insufficient information available to draw a conclusion.

2.4.3 *Laberge Engineering Closure Investigation*

On behalf of the Village, Laberge Engineering and Consulting Group completed additional investigation activities in 1991 in connection with closure planning. Except where noted otherwise, all samples were analyzed for 6 NYCRR Part 360 Baseline Parameters. A summary of results is presented below.

- A private water well survey was conducted over an area up to one mile downgradient of the Site and up to one-half mile upgradient of the Site. Thirty-five private wells were identified;
- Six groundwater samples were collected from shallow overburden monitoring wells. Several chlorinated VOCs were detected in two samples above applicable standards. Various metals were detected with higher concentrations found downgradient of the Site;
- Four leachate samples were collected. VOCs were found at low levels. Metals were present at widely varying levels. Dissolved solids were detected at concentrations up to 3,230 mg/l;
- One surface water sample was collected from Thayer's Pond. No evidence of contamination was detected; and
- Twenty soil gas samples were collected and field screened for VOCs, lower explosive limit (LEL), percent oxygen, percent methane, and hydrogen sulfide. Two locations exhibited excessive levels of landfill gasses and low oxygen levels.

2.4.4 *Laberge Engineering Construction Certification*

Completion of the landfill closure in accordance with NYSDEC Part 360 requirements was certified by Laberge Engineering in this document dated September 1995.

2.4.5 NYSDEC Fish Sampling Program

NYSDEC conducted a fish sampling program in 2016 at various locations in the vicinity of Hoosick Falls. Sportfish samples (i.e., edible fillets) were analyzed for PFAS. See Section 3.3.2 for discussion of these results. As a result of this program, NYSDEC maintained the existing fish advisory for the Hoosick River, which relates to PCBs, and added an advisory for Thayer's Pond warning against consuming fish due to the concentrations of PFOS detected in fish tissues.

2.4.6 TRC Engineers, Inc. Site Characterization

The "Site Characterization Report" (TRC, January 2019) is summarized in this section. See Appendix A for additional detail. A sample summary by media is provided below:

Media	Number of Samples
Surface Soil	5
Subsurface Soil	6
Surface Water	12
Sediment	12
Groundwater (Overburden)	15
Groundwater (Bedrock)	5
Leachate	2

Surface water and sediment samples were collected at coincident locations. Two rounds of groundwater samples were collected from 10 overburden and five bedrock monitoring wells. Additionally, two rounds of leachate samples were obtained from the collection vault on the southwest corner of the Site. All samples were analyzed for TAL/TCL parameters, plus PFAS and subject to data validation.

The key findings of the site characterization report were utilized in scoping the RI and are summarized below:

"With the exception of 4,4'-DDT in one (1) surface soil sample (HFL-SS-101) and PCBs in one (1) subsurface soil sample (HFL-MW-103 (6'-10')), there were no VOCs, SVOCs, pesticides or PCBs detected at concentrations above applicable screening criteria in surface soil, subsurface soil, sediment, surface water or groundwater."

"Arsenic was detected in one (1) surface soil sample, HFL-SS-101, at a concentration (18.6 mg/kg) above the Commercial Use SCO of 16 mg/kg. Barium, chromium, copper, iron, lead, mercury, nickel, and zinc were detected at concentrations above the Residential Use or Unrestricted Use SCOs in surface soil."

"...chromium, iron, and nickel were detected at concentrations above the Unrestricted Use SCOs. Chromium was detected in one (1) subsurface soil sample

at a concentration marginally above the Residential Use SCO (based on “the more stringent SCOs for hexavalent chromium).”

“...lead and mercury (mercury in one (1) sample only, HFL-SD-104, collected from a drainage ditch southeast of the Villages’ Transfer Station) were detected at concentrations exceeding the Class A SGVs in sediment samples”

“...aluminum, cadmium, cobalt, copper, iron, lead, nickel, vanadium, and zinc were detected in surface water at concentrations above the comparison criteria. Generally, the highest concentrations of metals were detected in the surface water sample (HFL-WS-102) collected from a ditch in the southeastern part of the Site between the Village’s Transfer Station and the limits of the landfill cap and in the surface water sample collected from the manhole on the western side of the landfill.”

“...arsenic, chromium, iron, lead, magnesium, manganese, and sodium were detected at concentrations above the Class GA Values in groundwater samples. Chromium and lead were detected at concentrations above the Class GA Values in the groundwater sample collected from off-site bedrock well HFL-MW-105C. Arsenic was detected at a concentration above the Class GA Value in the groundwater sample collected from HFL-MW-101. (Note: all groundwater samples were analyzed unfiltered.)”

Although “There were no PFAS detected in surface and subsurface soil at concentrations above the NYSDOH preliminary Residential Use SCO of 140 µg/kg developed for a potential site or sites in the Hoosick Falls area,” PFAS was detected in all other sampled media.

The primary PFAS detections in sampled media were PFOA and PFOS. The tables below provide a summary of the PFOA and PFOS concentrations reported in the samples.

PFOA	Minimum Concentration	Median of Detected Concentrations	Maximum Detected Concentration
Surface Soil	0.53 ug/kg	1.7 ug/kg	14 ug/kg
Subsurface Soil	0.23 ug/kg	0.35 ug/kg	1.6 ug/kg
Groundwater Overburden	94 ng/l	930 ng/l	25000 ng/l
Groundwater Bedrock	< 1.9 ng/l	7.7 ng/l	28 ng/l
Sediment	0.5 ug/kg	4.8 ug/kg	20 ug/kg
Leachate	43 ng/l	-	1300 ng/l
Surface Water	150 ng/l	920 ng/l	24000 ng/l

PFOS	Minimum Concentration	Median of Detected Concentrations	Maximum Detected Concentration
Surface Soil	< 0.63 ug/kg	1.3 ug/kg	2.9 ug/kg
Subsurface Soil	< 0.25 ug/kg	-	-
Groundwater Overburden	< 1.9 ng/l	2.5 ng/l	46 ng/l
Groundwater Bedrock	< 1.9 ng/l	-	-
Sediment	< 0.24 ug/kg	0.97 ug/kg	2.7 ug/kg
Leachate	2.2 ng/l	-	10 ng/l
Surface Water	3.4 ng/l	10 ng/l	150 ng/l

Graphic summaries of the Site Characterization data, noting where results exceed applicable soil cleanup objectives (SCOs), are provided as Figure 3:

- Figure 3a – Groundwater Exceedances - PFAS
- Figure 3b – Groundwater Exceedances - Metals
- Figure 3c – Soil Exceedances – Industrial SCOs
- Figure 3d – Sediment Exceedances – Class A Sediment Guidance

The site characterization findings will be integrated into the RI and used to expand the existing database via additional sample locations in all media except soil for targeted analyses (see Section 3.0).

2.5

CONCEPTUAL SITE MODEL

The site characterization data were used to develop a preliminary conceptual site model (CSM). This preliminary CSM represents the initial understanding of the relationships between various environmental media, the fate and transport of contaminants and potential receptors. Additional data collection will support the further development of these initial CSM in order to make appropriate risk-management decisions.

The Site is situated on a bluff along the east bank of the Hoosic River. Surface drainage is to the west with discharge points at the river and Thayer's Pond. Similarly, groundwater in both the overburden and bedrock flows west to northwest toward these same discharge points (see Appendix A, Figures 11 and 12). Infiltration of precipitation through the landfill generates leachate which can impact groundwater quality; therefore, groundwater and leachate are the primary media of concern.

3.0

REMEDIAL INVESTIGATION – FEASIBILITY STUDY WORK PLAN

The NYSDEC acknowledges “presumptive remedies” under Part 375 and DER-10 for addressing municipal landfill sites. This guidance suggests that the issues related to landfills are well defined and consist of similar properties at most facilities. This allows similar remedies typical of landfills to be implemented without the broad-based investigations necessitated by an unknown waste source. The components required in a typical municipal landfill remedy generally include capping consistent with the waste type, management systems for gaseous emissions that are either passive or active, leachate management systems to reduce or eliminate releases to groundwater or surface water, and engineering controls. It is believed that these components have been addressed to a significant degree in the 1990s closure of the landfill.

Given the landfill closure, monitoring data collected in the past 25 years and the NYSDEC’s site characterization, a focused Remedial Investigation/Feasibility Study (RI/FS) will build on known data.

The elements of the additional investigations described in this section align with NYSDEC DER-10 requirements to generate data of sufficient quantity and quality to:

- determine fate and transport of contaminants;
- evaluate if potential threats to human health and the environment exist; and
- support the Feasibility Study and identification of appropriate remedial actions.

3.1

RI/FS STRATEGY

The primary purpose of RI/FS will be to validate the performance of the landfill cap and identify upgrades needed to reduce future releases to the environment. Such upgrades could take the form of: (a) reducing infiltration through the cap; (b) improving site drainage to direct surface water runoff away from the leachate collection system; (c) improving the performance of the leachate collection system; and (d) treating the leachate to remove COCs. The RI, coupled with historical data, will establish nature and extent of contamination in all environmental media which may lead to other remedial needs that will be evaluated in the FS.

Based on the currently available data, the RI/FS is anticipated to focus primarily on identifying and mitigating discharges to groundwater and surface water by more fully capturing and treating leachate from the Site and mitigate releases, if any, to the Hoosic River and Thayer’s Pond. For purposes of the RI/FS, biota in these surface waters are considered receptors of concern.

3.2 ***CONTAMINANTS OF POTENTIAL CONCERN/AREAS OF POTENTIAL CONCERN***

Except where the scope of work presented below indicates otherwise, samples will be analyzed for full TAL/TCL constituents, plus PFAS. These analytes constitute the contaminants of potential concern (COPCs) for the project.

The project setting (i.e.; municipal landfill) dictates that areas of potential concern (AOPCs) are best organized by media. Specifically, these include:

- Landfill cap;
- Landfill gas;
- Surface water and sediment;
- Soil and groundwater;
- Leachate; and
- Biota.

3.3 ***REMEDIAL INVESTIGATION SCOPE OF WORK***

The proposed scope of work for the additional investigations to complete an RI at the Site is summarized in this section. NYSDEC's Project Manager will be notified via e-mail a minimum of seven days prior to the start of field activities. The e-mail will describe the scope of fieldwork and timing of activities planned.

3.3.1 ***Supporting Project Documents***

Field activities will be supported by the following appended documents and key project personnel responsible for implementing the work.

RI Community Air Monitoring Plan

The Community Air Monitoring Plan (CAMP) for the RI is presented in Appendix B. The CAMP describes monitoring requirements and response action levels associated with monitoring of particulates (i.e., dust) downwind of RI activities. The CAMP contains action levels for additional monitoring, corrective actions to abate emissions, and/or work stoppage if necessary.

RI Field Sampling and Analysis Plan

The Field Sampling and Analysis Plan (FSAP) for the RI is presented in Appendix C. The FSAP is consistent with the requirements of DER-10 Section 2.4. The FSAP describes field operations protocols and sampling and analysis procedures for implementation of the RI.

RI Quality Assurance Project Plan

The Quality Assurance Project Plan (QAPP) for the RI is presented in Appendix D. The QAPP is consistent with the requirements of DER-10 Section 2.4. The QAPP describes sampling and analysis procedures for implementation of the RI

along with QA/QC criteria. The QAPP will facilitate generation of data with acceptable precision, accuracy, representativeness, comparability, and completeness (PARCC).

RI Personnel and Qualifications

The experience and qualifications of key ERM project personnel who will be involved in implementing the RI are presented in Appendix E.

3.3.2 *Investigation Overview*

Subsurface Clearance

Dig Safely New York (DSNY) will be notified prior to the initiation of intrusive activities at the properties and requested to identify, locate, and mark member-company utilities in areas proposed for subsurface intrusive investigation. A private utility location subcontractor will be retained to evaluate proposed drilling locations using ground penetrating radar (GPR), magnetometry/metal detection, inductive cable/pipe location, or other appropriate techniques. A minimum 10-foot diameter around each planned drilling location will be scanned for subsurface utilities prior to the initiation of the work.

Proposed sampling locations will be adjusted in the field as necessary based on the results of subsurface clearance efforts.

Landfill Cap Evaluation

The existing landfill cap will be investigated to evaluate whether there are options for stormwater runoff modification and/or cap enhancement to reduce the amount of leachate generation. The cap evaluation will be done in concert with the leachate treatability study (see Section 3.5).

A visual inspection of the existing cap will initially be conducted to assess and document its overall condition, the presence of erosional features, evidence of surface water ponding, vegetative growth and other factors indicating general performance. The nominal thickness of the cap will then be evaluated in a series of up to 15 shallow borings on an approximate 300-foot(±) grid spacing (access permitting), or to target identified suspect areas where the cap may not reach full thickness. Each boring will extend through the cap and terminate at the underlying waste. Samples of the entire thickness of the cap system will be obtained for inspection and potential laboratory testing for conformance with the original specifications. From these samples, a range of tests will be conducted on select samples to define the performance of the cap materials, as follows:

Test	Test Method	Sample Method	Approximate # of Tests
Permeability	ASTM D-5084	Shelby Tube	5
Atterberg Limits	ASTM D-4318	Shelby Tube	5
Moisture Content	ASTM D2216, 4643, or 4959.	Shelby Tube	10
Dry Density	ASTM D-7263	Shelby Tube	10
Particle-Size Distribution (with hydrometer)	ASTM D-6913 and 7928	Shelby Tube	5
Soil Classification	ASTM D-2487	Shelby Tube	5
Compaction	ASTM D-1557	Bulk ⁴	1
PFAS (21) Analysis	EPA Method 537.1 (modified)	Hand Auger or Direct Push	30 (minimum)

Soil samples collected from the direct-push borings will be logged for geologic characteristics and any observations of waste materials. Samples for PFAS analysis will be collected from each boring at 0-2 and 2-12 inches below grade to determine whether the imported fine-grained material used for cap construction contained these substances. Should a change in lithology be encountered (e.g., an engineered coarse layer for landfill gas propagation), a third deeper sample will be collected in each boring that encounters such material. Boreholes will be grouted upon completion.

Concurrent with the assessment of the landfill cap thickness, a topographic survey of the landfill surface, extending a minimum of 100 feet beyond the waste boundary, will be completed to national map accuracy standards by a New York State licensed surveyor⁵. This topographic survey will be used to provide:

- A current base map for the design of any remedial action improvements necessitated for the landfill cap system;
- A comparison against the initial closure documentation to assess surface subsidence of the landfill cap and any erosional features that have developed; and
- A surface configuration for evaluating surface drainage for the assessment of run-off as well as use in the evaluation of cap infiltration.

The topographic survey will tie in existing and proposed monitoring well, piezometer and sampling point locations with respect to horizontal and vertical control.

⁴ One typical location will be identified to collect a bulk (i.e., 50-pound) sample of the barrier layer material for compaction testing. This location will be selected as representative of the cap after the boring program is complete.

⁵ Survey will be accurate to 0.02 feet horizontally and 0.04 feet vertically.

Data derived from the landfill cap thickness study, topographic survey and other sources will be used to perform an evaluation of leachate generation using the Hydrologic Evaluation of Landfill Performance (HELP) model, or alternative model(s), as needed. The information developed from the updated survey, storm water drainage assessment and leachate generation evaluation will be used to consider interim measures to reduce the volume of leachate that is generated and captured by the collection system.

Landfill Gas Evaluation

A site inspection will be performed to assess the presence and condition of landfill gas vents. Potential migration of landfill gas beyond the existing cap will be evaluated by conducting measurements of headspace air in shallow monitoring wells (i.e., wells with screens straddling the water table) surrounding the landfill during planned groundwater sampling events. In addition, selected landfill gas vents will also be tested for comparison purposes emphasizing vents on the eastern side of the landfill that are closest to the neighboring residences. See Figure 4 for locations of the existing landfill gas vents. These measurement will be collected in the field using a multi-gas meter (e.g., Landtec-GEM2000, or equivalent) to measure the percentage of methane present with respect to its lower explosive limit (LEL), the concentration of hydrogen sulfide, and other basic gases.

In addition, three temporary soil gas sampling points will be installed east of the landfill. Proposed locations are depicted on Figure 4; final locations will be field-determined in consultation with NYSDEC. Samples will be collected approximately 5 to 6 feet below ground surface to ensure they are below the frost line. Stainless steel rods equipped with a detachable stainless steel sampling point will be driven to the sampling depth. Dedicated Nylaflo® tubing will be attached to each sampling point. Boreholes will be backfilled with glass beads to a minimum of 6 inches above the soil vapor sampling point. The remainder of the annular space will be filled with bentonite chips and hydrated with potable water. Sampling points will set for a minimum of 24-hours. The sampling point and tubing will be purged prior to sampling. An enclosed container will be placed over each soil vapor sampling point to create a seal. A helium tracer gas test will be performed to confirm a tight seal between the bentonite and soils at each location. Soil gas from the two temporary points will be tested using the multi-gas meter described above.

Based on the potential presence of landfill gas, consideration will be given during the FS to installing passive or active gas management components to be installed through or around the landfill cap.

Surface Water & Sediment Sampling

Surface water and sediment sampling data currently exist for Site drainage ditches and Thayer's Pond. Some uncertainty exists regarding the flow directions and discharge points of these structures; however, the topographic survey will confirm this critical information and facilitate better understanding of the existing data and potential receptors. Proposed co-located surface water

and sediment sample locations are shown on Figure 5. Actual locations may vary due to access considerations.

One new drainage ditch sampling station will be established on the eastern perimeter of the Site to represent upgradient conditions. It is located on a swale that drains the area upslope to the east. A reconnaissance of the area will be performed with NYSDEC personnel to determine a second appropriate upgradient location for sampling.

The existing data from Thayer's Pond are limited to its northern reaches. Therefore, six additional sediment and surface water sampling stations will be established along the mid-line of the Pond in the central and southern portions. In addition, a bathymetric survey of the water depths will be conducted from a small boat to better understand the physical conditions of the Pond. If water depths in the Pond are greater than approximately 10 feet, a sonar scan will also likely be conducted to identify potential bottom structures or obstructions that may interfere with sample collection operations.

Sediment sampling in Thayer's Pond will include collection of three sediment samples from three depth intervals at each location: (a) 0 to 6-inch; (b) 6 to 12-inch; and (c) 12 to 24-inch. Samples will be collected using a coring device from a small boat/barge. In addition, co-located surface water samples will be collected at sediment sampling locations on the Pond using either a peristaltic pump or bottle sampler, such as a Kemmerer or Van Dorn sampler.

Surface water and sediment will be sampled at seven locations in the River – two upstream, three approximately opposite the Site, and two downstream. Grab surface water samples from the river will be collected directly into laboratory-supplied sample containers if shallow water conditions are encountered. A water sampling device, such as a Kemmerer or Van Dorn sampler, will be used for deeper water conditions. Sediment samples will be obtained from the river by hand auger or hand-held Ponar dredge from the same three depth intervals indicated above for Thayer's Pond, or to refusal.

Samples will be analyzed in accordance with Table 1. It is recognized that erosion of local soils into Thayer's Pond or the Hoosic River could impact sediment quality in these water bodies. Existing surface soil data from the site characterization will be used as a comparison benchmark to evaluate this relationship.

Additional details regarding the surface water and sediment sampling work are provided as part of the Field Sampling and Analysis Plan (FSAP) in Appendix C.

Geophysics

Existing groundwater data north of the Site indicates PFOA occurrences in the shallow overburden along Hoosick Junction Road (see Figure 6). Surface geophysics (resistivity and seismic) will be used to better understand subsurface geology (e.g., depth to bedrock and rough stratigraphy) and guide location of a

new monitoring well cluster in the area between the Site and Hoosick Junction Road (see below for further detail).

Soil & Groundwater Investigation

Up to 15 new overburden monitoring wells will be installed at the approximate locations proposed in Figure 6. Actual locations may vary due to access considerations. Existing bedrock groundwater quality data from the Site Characterization (TRC, January 2019) demonstrated little to no impact in this unit; therefore, no new bedrock wells are proposed. Nevertheless, the existing bedrock wells will be utilized to provide additional data.

Soil samples will be collected for laboratory analysis from 0-2 and 2-12 inches below grade, as well as at significant lithologic changes, at each drilling location.

New wells will be installed using the rotosonic drilling method. Pilot borings will extend to bedrock for geologic characterization. Following installation, the wells will be developed and surveyed by a New York State licensed surveyor. Well installations, drilling, construction and development will be directed by a geologist.

It is noted that recent construction on the railroad right-of-way west of the Site may have destroyed existing monitoring wells MW-002 and MW-004. Current conditions will be confirmed in the field and if necessary, these wells will be replaced in kind. Positions of the replacement wells may shift slightly to ensure safe locations.

An overview of the proposed well installation program is provided in the table below:

Location	Proposed Potential Screen Settings
A	Upper water bearing zone Deep overburden *
B	Upper water bearing zone Deep overburden *
C	Upper water bearing zone Deep overburden *
D	Upper water bearing zone Deep overburden *
E	Upper water bearing zone Deep overburden *
F	Upper water bearing zone Deep overburden well already exists (MW-102)
MW-002	Upper water bearing zone ** Deep overburden *
MW-004	Upper water bearing zone ** Deep overburden *

* Assumes overburden is thick enough to warrant a deeper well. Screen zone will be selected based on geology.

** Assumes existing shallow well is destroyed.

To evaluate groundwater discharges to surface water, shallow groundwater samples will be collected from beneath the stream from temporary well points at two locations along the Hoosic River and five in Thayer's Pond (see Figure 6). The temporary well points will be installed in support of a one-time groundwater sampling event with samples obtained immediately below the sediment layer. The work includes the following steps:

- Install a temporary Solinst 615N (or similar) well point with stainless steel riser pipe to a maximum depth of 3 feet into the sediment bed at each location using a slide hammer, or similar handheld device. A New York State-licensed surveyor will survey each temporary well point to determine its location and the elevation of the top of casing.
- Measure groundwater temperature in the temporary well point and in the surface water outside the point.
- Measure the groundwater level within the temporary well point and a surface water elevation outside the point from the top of the pipe.
- Collect a groundwater sample from each temporary well point using low-flow procedures, including collection of the typical field parameters. A concurrent surface water sample will be collected immediately adjacent to each temporary well point at a targeted depth of six inches above the sediment bed.

Two semi-annual groundwater sampling events will be performed during which groundwater samples will be collected from permanent monitoring wells

associated with the Site using low-flow well purging/sample collection techniques. Samples will be analyzed in accordance with Table 1.

The groundwater conditions will be assessed in an attempt to target conditions that are not uncharacteristically low while recognizing the steep gradient between the landfill and the pond. The data collected as part of this work plan scope will be evaluated prior to determining if additional rounds of sampling are required.

Leachate Evaluation

A visual inspection of the river banks and topographic slopes at the Site will be conducted to identify seeps, which will be mapped and sampled if adequate flow is observed. Leachate samples will be collected from the collection vault concurrently with the two groundwater sampling events referenced above. Additional samples will be collected if seeps are present. Samples will be analyzed in accordance with Table 1.

In addition, a video inspection of the existing leachate collection and transmission piping will be conducted to assess its condition and any obvious failures or maintenance needs.

See Section 3.5 for additional investigation related to leachate.

Biota Evaluation

See Section 3.3.7.

Sample Analysis

The laboratory analysis of samples collected during the RI will be as specified in Table 1 and performed by NYSDOH-approved environmental laboratories using analytical methods consistent with the methods outlined in the QAPP (Appendix D).

The laboratory analytical report will contain NYSDEC Analytical Services Protocol (ASP) Category B deliverables to facilitate data validation or usability evaluation. Electronic data deliverables (EDDs) will also be provided by the project laboratory.

3.3.3

Hydrogeologic Evaluation

Water level monitoring and aquifer testing will be performed to evaluate hydrogeological conditions in overburden and shallow bedrock at the Site. Ideally, this work should be conducted with the leachate collection system in operation so its impact can be assessed. The goals of the hydrogeological evaluation task are to:

- Measure water levels in all wells and calculate groundwater elevations for contour mapping of the water table surface and other water bearing units, as appropriate;

- Calculate horizontal hydraulic gradients in the overburden and bedrock;
- Calculate vertical hydraulic gradients between hydrogeologic units and surface water (where applicable); and
- Obtain a range of hydraulic conductivity values for the overburden and shallow bedrock.

Initial hydrogeological evaluation methods include both water level gauging events and single well slug tests. The data collected from the slug tests will be reduced and analyzed using: 1) the aquifer test analysis software program Aqtesolv™, and 2) analytical methods set forth by Bouwer and Rice (1976, 1989).

3.3.4 Contingency Plan

If unknown containers, drums, underground storage tanks, or other previously unidentified sources of potential contaminants are discovered during subsurface intrusive activities, work activities will be suspended until NYSDEC is notified and properly trained personnel are mobilized to address the condition. An exclusion zone will be set up immediately around the work area to control access.

If the above conditions are identified during these investigations, the information will be communicated to the NYSDEC's field representative, or if a NYSDEC field representative is not present, verbally by phone to the NYSDEC's Project Manager. Reportable quantities of petroleum product will also be reported to the NYSDEC Spill Hotline (800-457-7362).

3.3.5 Data Usability

Data usability will be evaluated following procedures for the preparation of Data Usability Summary Reports (DUSRs). The usability evaluation will be performed consistent with NYSDEC guidance contained in DER-10 Appendix 2B (NYSDEC, 2010a) and NYSDEC data review guidance for PFAS (NYSDEC, 2020). The results of the data usability evaluation will be presented in an Electronic Data Summary consistent with the requirements of DER-10 Section 3.14.

3.3.6 Qualitative Human Health Exposure Assessment

A Qualitative Human Health Exposure Assessment will be completed to meet the substantive requirements of DER-10 paragraph 3.3(c) 4 and Appendix 3B using available data collected during SC and RI activities.

The qualitative exposure assessment will identify populations potentially or currently exposed and describe the reasonably anticipated future land use of the properties. The exposure assessment will evaluate the following elements associated with exposure pathways and describe how each of these elements pertains to the site are being evaluated.

- 1) Source of Contamination - a description of the contaminant source(s) including the location of the contaminant release to the environment or if the

original source is unknown, the contaminated environmental medium at the point of exposure;

- 2) Environmental Media & Transport Mechanisms - an explanation of the contaminant release and transport mechanisms to the exposed population;
- 3) Point of Exposure - identification of potential exposure point(s) where actual or potential human contact with a contaminated medium may occur;
- 4) Route of Exposure - description(s) of the route(s) of exposure (i.e., ingestion, inhalation, dermal absorption); and
- 5) Receptor Population - a characterization of the receptor populations who may be exposed to contaminants at a point of exposure.

The results of the assessment will be summarized to provide an overview of the affected environmental media/exposure route and corresponding current and potential human exposure assessment to those media.

3.3.7 Ecological Resources Assessment

A Fish and Wildlife Resources Impact Analysis (FWRIA) will be conducted in accordance with Fish and Wildlife Impact Analysis for Inactive Hazardous Waste Sites (NYSDEC, 1994) and DER-10 Technical Guidance for Site Investigation and Remediation (NYSDEC, 2010), Section 3.10. This guidance divides a FWRIA into two parts, Part 1: Resource Characterization (Section 3.10.1), and Part 2: Ecological Impact Assessment (Section 3.10.2). The purpose of the FWRIA is to identify actual or potential impacts to fish and wildlife resources from Site-related contaminants of potential ecological concern (COPECs). Per DER-10, Part 1 of the FWRIA involves the following five steps:

- Step I – Fish and Wildlife Resource Identification;
- Step II – Identified Fish and Wildlife Resource Description;
- Step III – Contaminant Migration/Exposure Pathway Identification;
- Step IV – Identification of COPECs; and
- Step V – Conclusions Regarding Impacts, Potential or Actual, to Identified Resources.

The five steps of a Part 1 FWRIA will be conducted for the Site, Thayer's Pond and the Hoosic River. Steps I and II of the FWRIA will include the identification of the fish and wildlife resources within one-half mile and a detailed description of those resources within one-quarter mile, including a discussion of rare, threatened and endangered species or communities. As part of this effort, the FWRIA will utilize the results of the 2016-2017 NYSDEC study of fish in the Hoosic River and Thayer's Pond (summary provided in Appendix F), which indicate that various species of pelagic and benthic fish will be among those resources identified. In addition to these known resources, the biological assemblages associated with the identified aquatic, semi-aquatic and terrestrial

habitats on or proximal to the Site will be characterized, including potential piscivorous bird and mammal populations. Once relevant fish and wildlife resources have been documented, contaminant migration and exposure pathways will be identified as part of an ecological CSM (Step III). The ecological CSM will depict the relationship between sources, migration pathways, receptor populations, and the potential exposure pathways and routes associated with the contaminants at the Site.

Step IV of the Resource Characterization will include the identification of COPECs. This step will be accomplished by comparing detected concentrations in each medium of concern to ecological risk-based screening levels. Ecological Screening Levels (ESLs) for sediment will be obtained from the NYSDEC's Screening and Assessment of Contaminated Sediment (NYSDEC, 2014). Surface water ESLs will be the Freshwater Fish Propagation values obtained from the New York State Ambient Water Quality Standards and Guidance published in the DEC's Division of Water Technical and Operational Guidance Series (TOGS 1.1.1).

ESLs for PFAS are not well established, and certain PFAS have been shown to bioaccumulate in aquatic and terrestrial biota tissue. Although NYSDEC does not currently provide ecological SCGs for PFAS in surface water, sediment, soil or biota, as part of Step IV of the Part 1 FWRIA, ERM will review the available published literature to identify appropriate screening levels for comparison to PFAS concentrations in biotic and abiotic media of concern. A technical memo detailing the process for developing PFAS ESLs will be developed for NYSDEC review and will include a list of literature sources. These sources may include, but would not be limited to the recently published "Guidance for Assessing the Ecological Risks of PFASs to Threatened and Endangered Species at Aqueous Film Forming Foam-Impacted Sites" (Conder et al., 2020). To identify the PFAS COPECs, the results of the 2016-2017 NYSDEC sampling of sport and forage fish from Thayer's Pond and the Hoosic River (as applicable) will be incorporated into the screening process.

The results of the FWRIA Part 1 will be used to develop the scope for additional ecological evaluation as part of a FWRIA Part 2 Ecological Impact Assessment, which NYSDEC has already determined to be necessary. Critical to this task will be the integration of the RI data and NYSDEC PFAS fish tissue screening results, with the full characterization of potentially impacted resources, including upper trophic level biota. Scoping activities will include developing a work plan for review by NYSDEC to refine and streamline FWRIA Part 2 activities.

3.3.8

RI Report

A Draft RI Report will be prepared at the completion of the RI scope of work. It will present a summary of historical investigative findings, combining the results of the SC, the IRM PDI and subsequent RI activities to satisfy the requirements of DER-10 Section 3.14. The RI Report will include comparison of the soil, sediment, groundwater and surface water analytical data to relevant Standards, Criteria and Guidance. Potential contribution from contamination sources unrelated to the landfill will also be considered. The RI Report will

summarize areas of concern, identify potential exposure pathways, and recommend additional work, if necessary. A preview of remedial alternatives to be considered in the FS will be provided that are consistent with presumptive remedies at municipal solid waste landfills, plus other measures (if any) deemed necessary based on the RI findings.

3.3.9 *Progress Reporting*

Written monthly progress reports (MPR) will continue to be submitted to the NYSDEC by the tenth day of each month and continuing until termination. The MPRs will include actions undertaken by Honeywell and the Village, including approved modifications, e.g., changes in work scope and/or schedule relative to the RI during the reporting period, and those actions anticipated for the next reporting period.

3.4 *FEASIBILITY STUDY SCOPE OF WORK*

Many of the components required in a typical municipal landfill remedy (i.e., presumptive remedial actions) have already been addressed to a significant degree in the 1990s closure of the Hoosick Falls landfill. As such, the Feasibility Study (FS) will be focused toward building on these completed remedial activities.

The FS will be prepared to evaluate potential remedial alternatives to address the human health and ecological risks presented by the Site. The FS will be prepared in accordance with DER-10, including screening criteria development, evaluation of technologies, assembly of remedial alternatives, and detailed and comparative analysis for remedial alternatives.

Supporting components integral to remediation will be also considered in the FS, including stormwater management, site security, recycling of surface debris, grading, dust control, leachate/groundwater management, surface water management, wetlands mitigation, sediment and riparian restoration, and monitoring programs. Sustainable green technologies will also be given a preference.

3.5 *TREATABILITY STUDY SCOPE OF WORK*

As part of post-closure operation and maintenance, leachate is collected and conveyed to the Village of Hoosick Falls Publicly Owned Treatment Works (POTW) prior to discharge to the Hoosic River pursuant to a State Pollution Discharge Elimination System (SPDES) permit. PFAS have been identified in leachate. Therefore, a Treatability Study will be performed to evaluate technologies to reduce PFAS concentrations prior to pumping it to the POTW. The Treatability Study will be conducted in parallel with the RI and includes the tasks described in the following subsections. The results of the Treatability Study will be submitted to the NYSDEC for review in a stand-alone Treatability Study report(s) to establish a parallel track to address migration of PFAS through the landfill leachate (see Section 3.5.4).

The purpose of the treatability study (TS) is twofold: (1) build on the results of the landfill cap study which evaluates whether there are options to reduce or redirect stormwater runoff and/or infiltration through the landfill cap in order to reduce the volume of leachate that is conveyed to the WWTP; and (2) identify potential technologies that may be capable of meeting applicable SCGs for media affected by the on-going release of landfill leachate. The results of the TS will be applied to identify technologies that are scalable depending on remedial objectives that will be developed with input from the NYSDEC and NYSDOH and take into account site-specific conditions such as influent volume, influent quality, receiving water parameters, operation and maintenance requirements, etc.

The TS will be expedited to facilitate early implementation of an IRM to reduce the release of PFAS from the landfill through the leachate.

The first part of the TS, evaluation of options to minimize or redirect stormwater runoff and/or infiltration through the landfill cap in order to further reduce the volume of leachate that is conveyed to the WWTP, was previously described in Section 3.2.2; specifically, Landfill Cap Evaluation. The second part of the TS, identification of potential technologies that may be capable of meeting applicable SCGs for media affected by the on-going release of landfill leachate, is described in the following sections.

3.5.1 *Review of Existing Data*

Existing sampling analyses of the leachate will be assembled and reviewed to inform the need for, and nature of, additional characterization sampling. Known existing data sources include:

- “Engineering Report for Feasibility Study of PFOA Treatment Alternatives for Village WTP Filter Backwash and Landfill Leachate” (MRB Group, December 2018;
- “Site Characterization Report” (TRC, January 2019); and
- Miscellaneous surface water and leachate data collected by NYSDEC (undated) and transmitted to ERM by e-mail on 22 July 2016.

3.5.2 *Data Collection*

Water treatment for PFAS has been historically focused on drinking water sources, which are comparatively much cleaner than wastewater streams and landfill leachate. The chemical constituents found in landfill leachate can vary significantly depending on factors such as site location and the nature of wastes disposed at the facility, but leachate streams will tend to quickly foul treatment process dedicated to PFAS (e.g., granular activated carbon, ion exchange resins, and reverse osmosis systems).

Therefore, significant leachate pre-treatment (such as removal of suspended solids or reduction in organic content) may be required prior to PFAS removal. To identify technologies for leachate treatment through treatability studies and

other laboratory-scale tests, data will be collected relating to the water quality parameters of the leachate.

The available data (see Section 3.5.1) will be reviewed for completeness against typical water quality parameters needed for leachate treatment plant design. Because leachate can vary with time, additional water samples will be obtained for a complete water quality analysis⁶. Efforts are currently underway to obtain a representative sample to expedite the leachate characterization analysis. Since the pump station that conveys leachate to the Village's wastewater treatment plant is currently down, an attempt was made to sample a manhole located approximately 15 feet above the pump station where the collection system piping interconnects before flowing to the pump station. At the time of manhole inspection (10/5/2020), no leachate was observed in the collection system. Alternatively, these data needs may be addressed by sampling the pump station discharge once it is repaired and back in service as described in the "Leachate Collection System Pump Station Interim Remedial Measures Work Plan" prepared on behalf of the Village by Sterling Environmental Engineering, P.C. (August 2020). Leachate characterization samples will be analyzed for PFAS, TAL/TCL, 1,4-dioxane and other analytes in accordance with Table 1.

A desktop analysis will be performed to pre-screen potentially applicable treatment technologies. If non-PFAS hazardous substances in the leachate are identified they will also be evaluated for treatment.

Manufacturers of treatment reagents and or equipment will be solicited to determine testing requirements. Bulk water samples for treatability studies will be collected from the leachate pump station at the landfill once back in service. These samples will be sent to a central laboratory for treatability studies and, in some cases, distributed to specific vendors for treatability testing in the vendor's laboratory.

This task also includes collection of leachate flow measurements to assist in the sizing of an eventual full-scale system.

3.5.3 *Treatability Tests*

Selection of technologies for treatability testing will be based on the water quality of the leachate, the potential need for pre-treatment⁷, the PFAS mass removal requirements, and developmental status of the technologies. Final selections of technologies to be tested will be made in consultation with NYSDEC or its representatives.

To expedite evaluation of potential leachate treatment as a prospective IRM; the TS will initially evaluate technologies for PFAS reduction that do not require pre-treatment. A single technology that can successfully reduce PFAS

⁶ Typical turnaround time for sample collection, analysis, validation and reporting is approximately two months.

⁷ The term pre-treatment refers to the removal of solids and other non-PFAS constituents prior to treatment of leachate for PFAS.

concentrations to acceptable levels prior to conveyance to the WWTP would be the simplest solution and implementable in the least amount of time.

PFAS treatment technologies vary in their stages of development, treatment efficiencies for different PFAS, target concentration range, and the need for pretreatment for solids and organic removal. A preliminary list of PFAS technologies, currently available or under development, is presented in Table 2.

A bench test scope of work will be prepared in consultation with the vendors of those technologies that are deemed to offer the best chance of success in bulk removal/reduction of PFAS in leachate as stand-alone-technology t. The bench test scope of work will be finalized within two weeks after receipt and validation of the leachate analytical results, the critical path item to finalizing the bench-scale tests. At that time the scope of work is finalized, the schedule contemplates a call with agency representatives to discuss scope of work and the final list of technologies for testing.

Of the eight (8) prospective technologies referenced in Table 2, the most promising technologies will be selected for bench-scale testing. The number of promising technologies selected for detailed bench-testing will balance the effort and time required to complete the testing, compile and evaluate the result, compare the performance with the intended goal of expediting the TS schedule.

The bench testing program includes two stages. Stage 1 will provide an initial assessment of the technologies ability to reduce/remove PFAS from the leachate. Stage 2 testing is intended to enable the technology vendors to refine treatment dosing to maximize the reduction/removal of PFAS.

3.5.4 *Treatability Test Reporting*

The results of bulk testing program will be presented in a Treatability Study report, according to the RI-FS schedule (Table 3), to facilitate design and early implementation of a prospective IRM to minimize PFAS levels in leachate prior to conveyance to the WWTP.

4.0

PROJECT SCHEDULE

An estimated overall project schedule is presented in Table 3. A detailed schedule for the Treatability Study portion of the program is provided as Table 4.

- Bouwer, H., 1989. The Bouwer and Rice Slug Test - An Update. *Ground Water*, Vol. 27, No. 3. May-June, 1989.
- Bouwer, H. and R.C. Rice, 1976. A Slug Test for Determining Hydraulic Conductivity of Unconfined Aquifers with Completely or Partially Penetrating Wells. *Water Resources Research*, V. 12, pp. 423-428.
- Conder et al., 2020. Guidance for Assessing the Ecological Risks of PFASs to Threatened and Endangered Species at Aqueous Film Forming Foam-Impacted Sites. Department of Defense Strategic Environmental Research and Development Program (SERDP), Project ER18-1614, January 2020.
- Gibbs & Hill, 1991. Engineering Investigations at Inactive Hazardous Waste Sites, Phase II Investigation, Hoosick Falls Landfill, Site No. 442007. Gibbs & Hill, Inc., New York, March 1991.
- Laberge, 1991. Village of Hoosick Falls Landfill, Rensselaer County, New York, Closure Investigation Report. Laberge Engineering and Consulting Group LTD, Albany, December 1991.
- MRB, 2018. Engineering Report for the Feasibility Study of PFOA Treatment Alternatives for Village WTP Membrane Filter Backwash Water and Landfill Leachate, NYSEFC Engineering Planning Grant #68571. MRB Group, Syracuse, December 2018.
- NYSDEC, 1992. Sampling Guidelines and Protocols: Technologies Background and Quality Control/Quality Assurance for the NYSDEC Spill Response Program. NYSDEC Division of Spills Management, Albany, September 1992.
- NYSDEC, 1994. Fish and Wildlife Impact Analysis for Inactive Hazardous Waste Sites. NYSDEC Division of Fish and Wildlife, Albany, October 1994.
- NYSDEC, 1998. Ambient Water Quality Standards & Guidance Values and Groundwater Effluent Limitations. NYSDEC Division of Water Technical and Operational Guidance Series (1.1.1), Albany, June 1998.
- NYSDEC, 2010. DER-10: Technical Guidance for Site Investigation and Remediation. NYSDEC Division of Environmental Remediation, Albany, May 2010.
- NYSDEC, 2014. Screening and Assessment of Contaminated Sediment. NYSDEC Division of Fish, Wildlife and Marine Resources, Bureau of Habitat, Albany, June 2014.

- NYSDEC, 2016. PFOS Concentrations in Fish Collected in 2016, Thayer's Pond & Hoosic River - Hoosick Falls, New York. NYSDEC Division of Fish and Wildlife, Albany, August 2016.
- NYSDEC, 2020. Guidelines for Sampling and Analysis of Per- and Polyfluoroalkyl Substances (PFAS) Under NYSDEC's Part 375 Remedial Programs. NYSDEC Division of Environmental Remediation, Albany, January 2020.
- Potter, D.B., Jr., 1972. Stratigraphy and Structure of the Hoosick Falls Area, New York-Vermont, East-Central Taconics. New York State Museum and Science Service, Map and Chart Series 19, 1972.
- TRC, 2019. Site Characterization Report, Hoosick Falls Landfill Site, NYSDEC Site No. 442007. TRC Engineers, Inc., Clifton Park, January 2019.
- USEPA, 2016. Drinking Water Health Advisory for Perfluorooctanoic Acid (PFOA). USEPA Office of Water (4304T), Health and Ecological Criteria Division, EPA 822-R-16-005, May 2016.
- USEPA, 2016. Drinking Water Health Advisory for Perfluorooctane Sulfonate (PFOS). USEPA Office of Water (4304T), Health and Ecological Criteria Division, EPA 822-R-16-004, May 2016.
- Wehran, 1987. Engineering Investigations at Inactive Hazardous Waste Sites in the State of New York, Phase I Investigations, Hoosick Falls Landfill, NYSDEC Site Code: 442007. Wehran Engineering, P.C., Middletown, May 1987.

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- 3C Soil Exceedances - Industrial SCOs***
- 3D Sediment Exceedance - Class A Guidance***
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- 4 Treatability Study Schedule***

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- B RI Community Air Monitoring Plan***
- C RI Field Sampling & Analysis Plan***
- D Quality Assurance Project Plan***
- E RI Personnel and Qualifications***
- F Fish Sampling Data***

Appendix A

Site Characterization Report (TRC, January 2019)

Appendix B

RI Community Air Monitoring Plan

Appendix C

RI Field Sampling & Analysis Plan

Appendix D

RI Quality Assurance Project Plan

Appendix E

RI Personnel and Qualifications

Appendix F

Fish Sampling Data

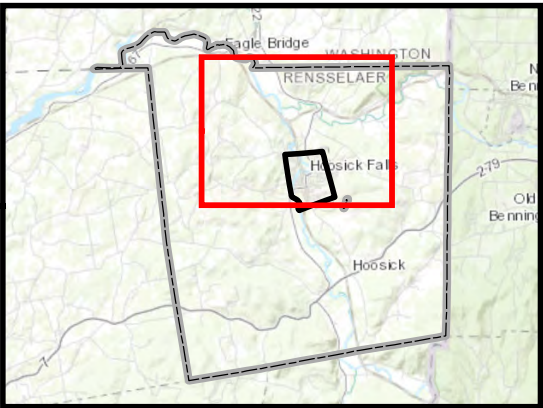
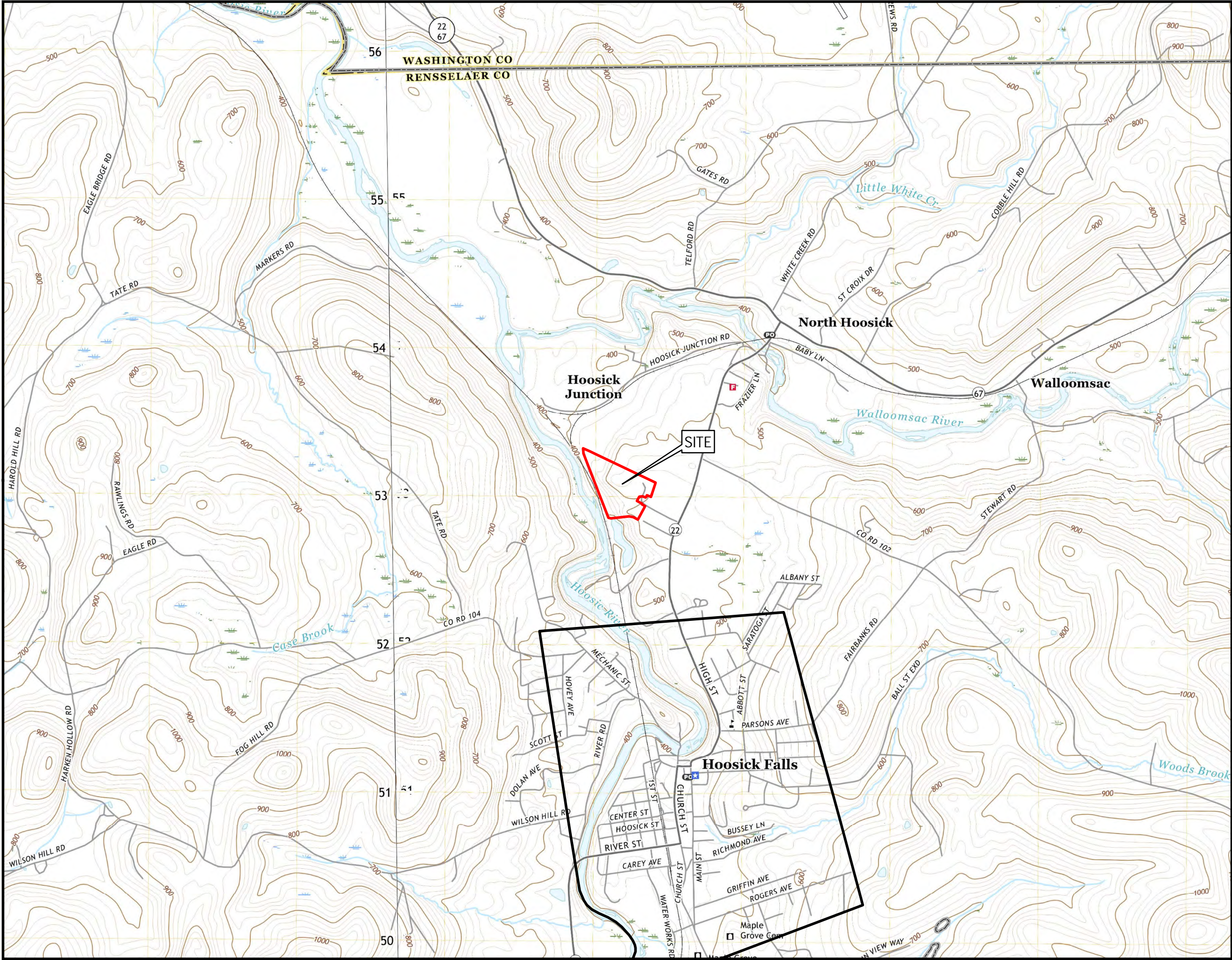
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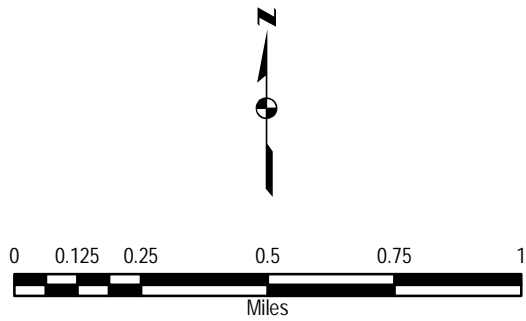
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Legend

- Approximate Site Boundary
- Village of Hoosick Falls Boundary
- Hoosick Town Boundary

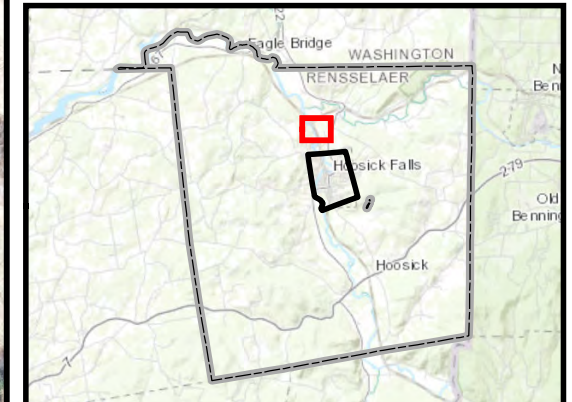
NOTES:
- USGS quad maps from 2019



PRIVILEGED - ATTORNEY WORK PRODUCT;
PREPARED IN ANTICIPATION OF LITIGATION

Figure 1: Location Map
Town of Hoosick
New York





- Legend
- Approximate Site Boundary
 - Hoosick Town Boundary
- Location Type
- Monitoring Well
 - Sediment
 - Surface Water

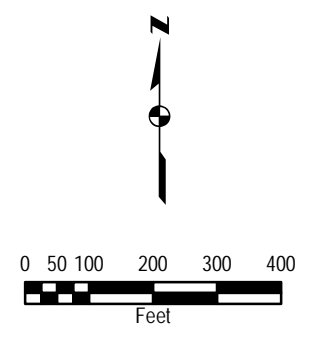

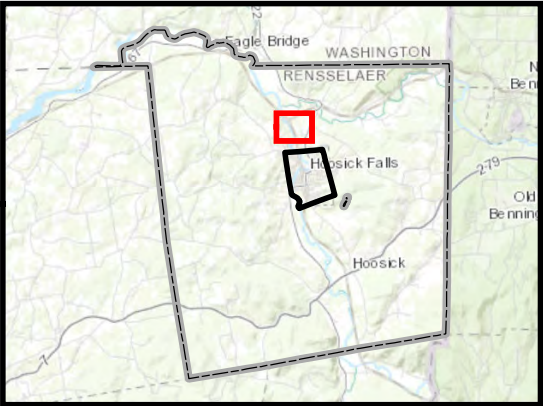
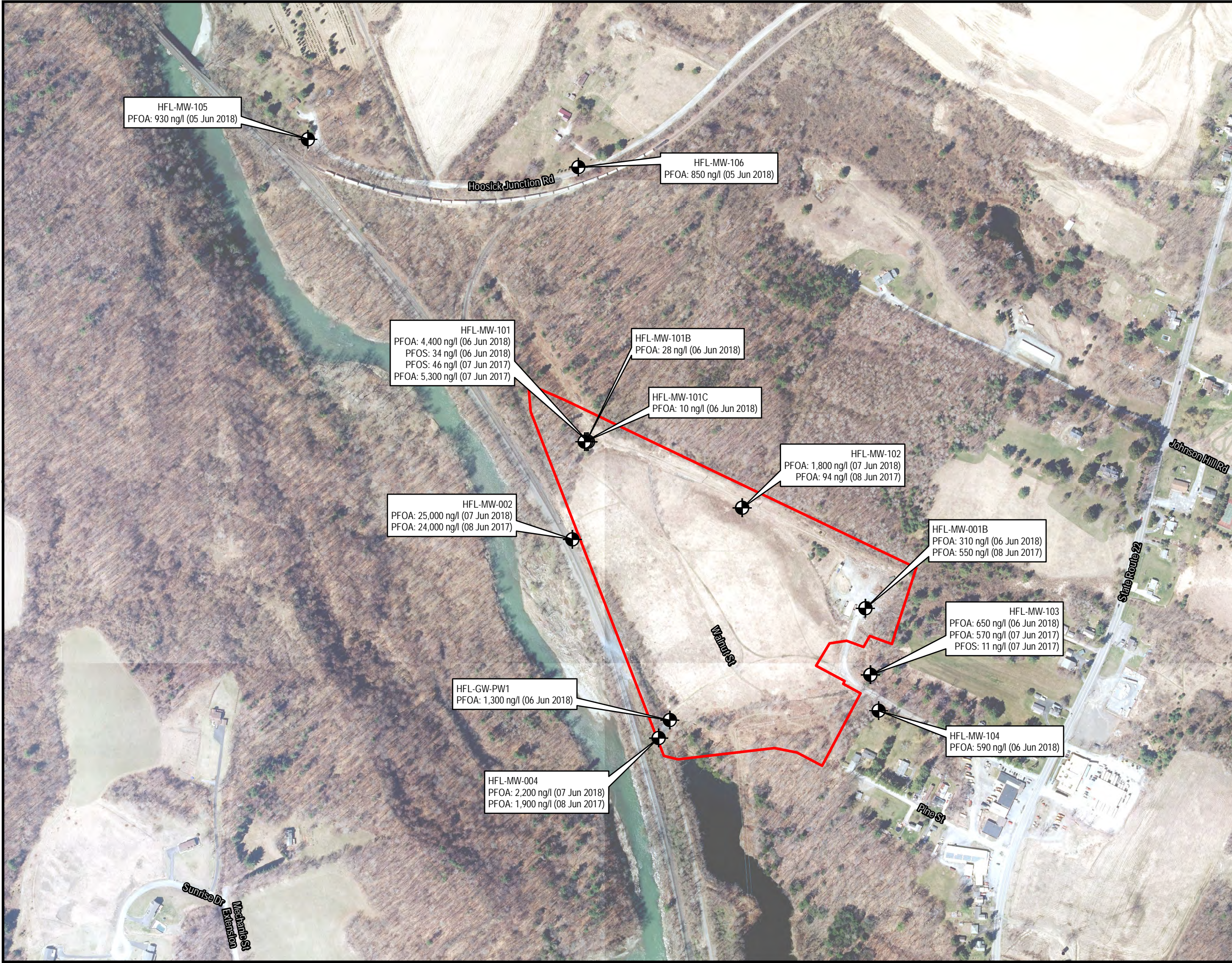


Figure 2: Previous Investigation Locations
Hoosick Falls Village Landfill
Town of Hoosick
New York





- Legend
- PFAS Exceedances in Groundwater
 - Approximate Site Boundary
 - Hoosick Town Boundary

NOTES:

1. PFAS detections exceeding SCGs includes PFOA above 10 ng/L and PFOS above 10 ng/L

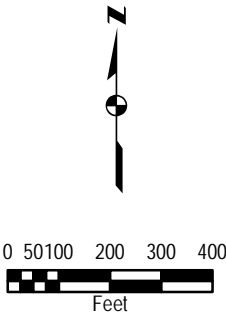
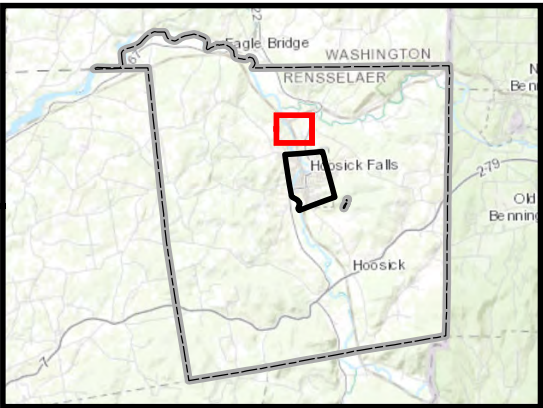
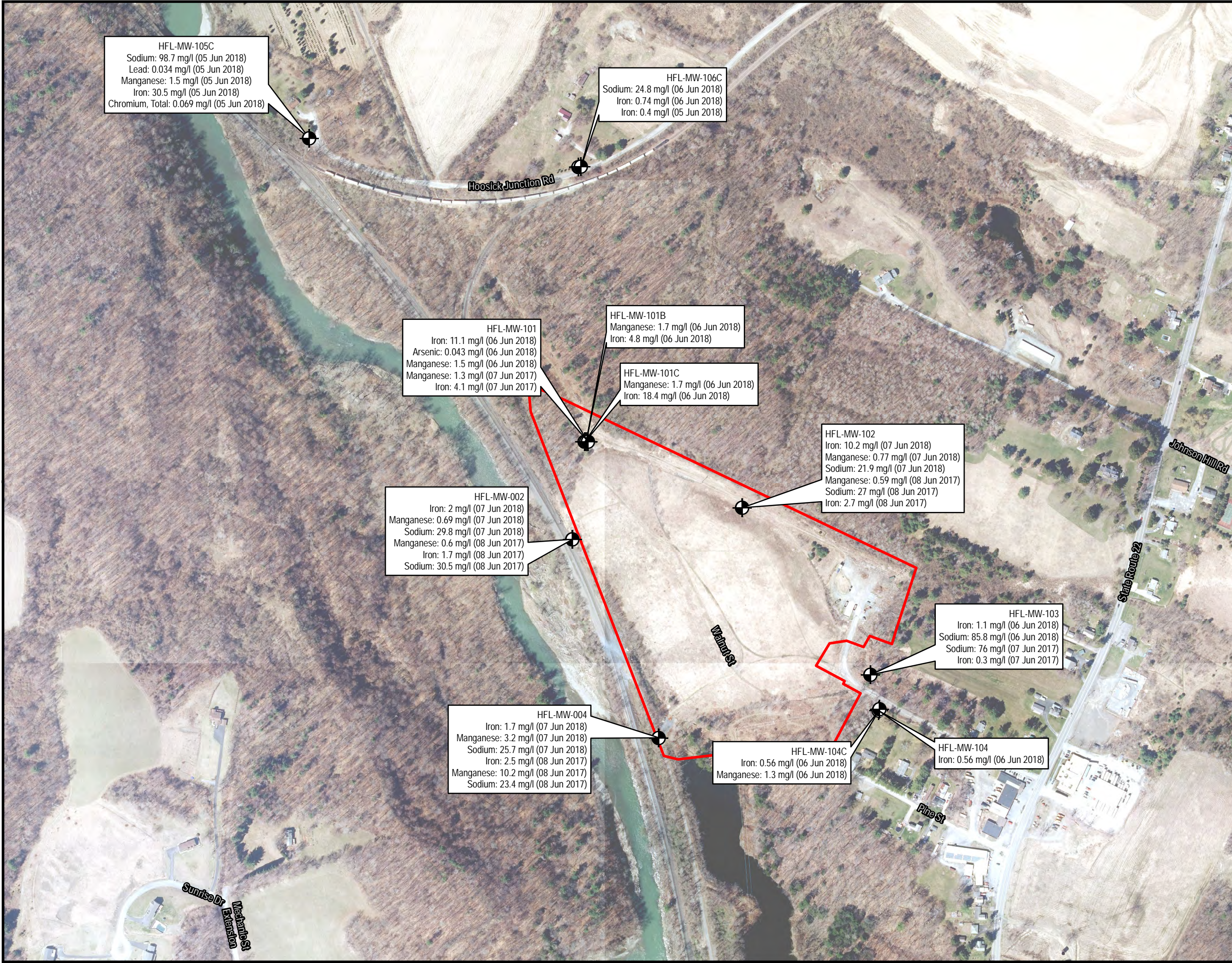


Figure 3A: Groundwater Exceedances - PFAS
Hoosick Falls Village Landfill
Town of Hoosick
New York





- Legend
- Location Exceeding TOGS 1.1.1 for Metals
 - Approximate Site Boundary
 - Hoosick Town Boundary

NOTES:
Locations shown exceed NYDEC TOGS 1.1.1 Water Class GA Standard; Protection for Source of Drinking Water (groundwater) unless otherwise noted

NYDEC TOGS111 GA STANDARD
Arsenic: 0.025 mg/L
Chromium, Total: 0.05 mg/L
Iron: 0.3 mg/L
Lead: 0.025 mg/L
Manganese: 0.3 mg/L
Sodium: 20 mg/L

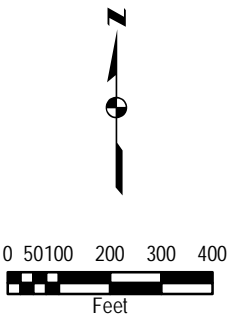
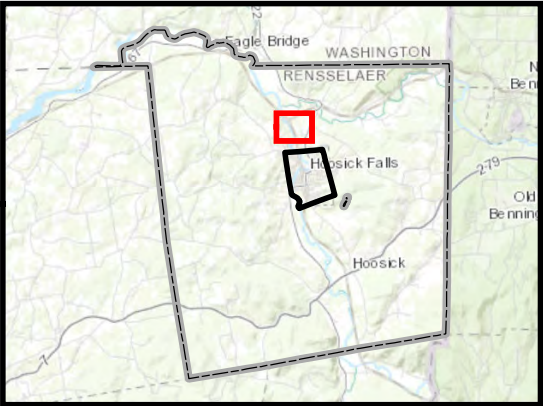


Figure 3B: Groundwater Exceedances - Metals
Hoosick Falls Village Landfill
Town of Hoosick
New York





- Legend
- Location Exceeding Industrial SCOs
 - Approximate Site Boundary
 - Hoosick Town Boundary

NOTES:
Locations shown exceed 6NYCRR
P375 Restricted SCO-Industrial

6NYCRR P375 Restricted SCO-Industrial
Arsenic: 16 mg/kg

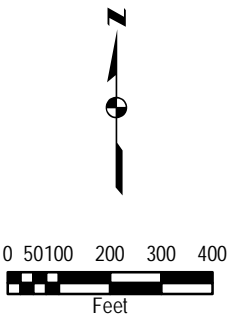
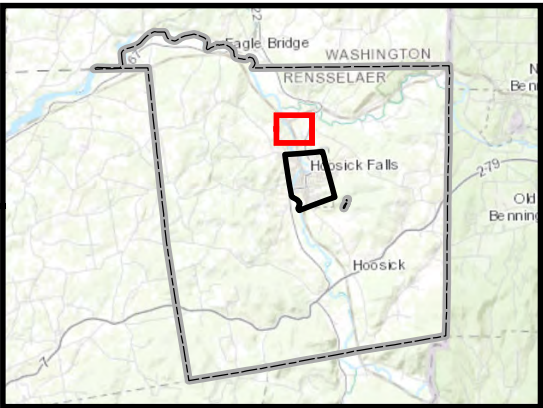
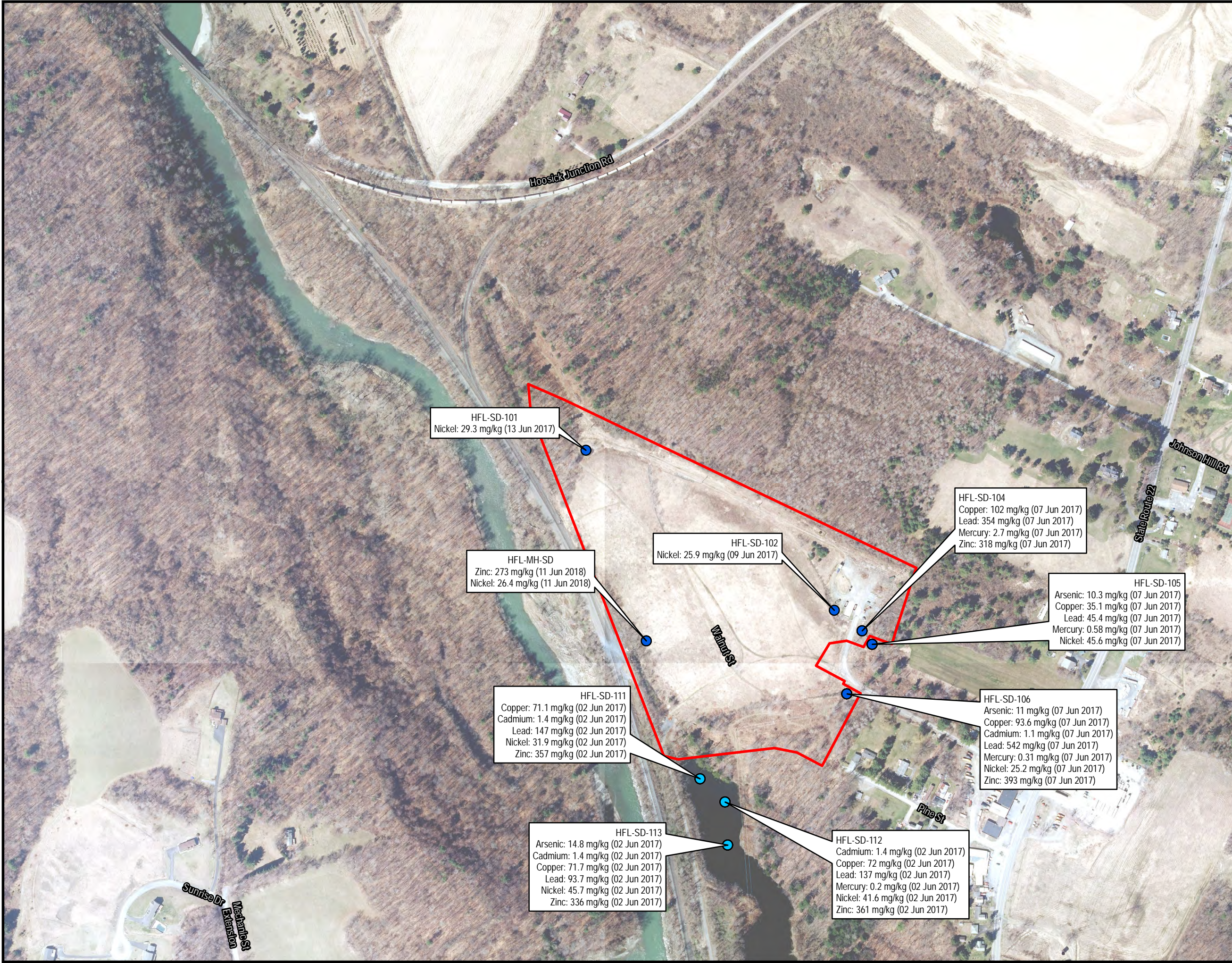


Figure 3C: Soil Exceedances
Industrial SCOs
Hoosick Falls Village Landfill
Town of Hoosick
New York





Legend

- Location Exceeding Class A Sediment Guidance
- Location Characterized as sediment sample in 2018 SC Report
- Approximate Site Boundary
- Hoosick Town Boundary

NYDEC; Screening and Assessment of Contaminated Sediment; Division of Fish, Wildlife and Marine Resources, Bureau of Habitat; June 24, 2014; Table 5, Class A Sediment: Freshwater Sediment Guidance Values

Arsenic: 10 mg/kg
Cadmium: 1 mg/kg
Copper: 32 mg/kg
Lead: 36 mg/kg
Mercury: 0.2 mg/kg
Nickel: 23 mg/kg
Zinc: 120 mg/kg

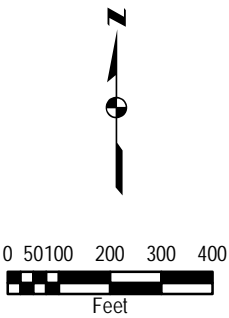
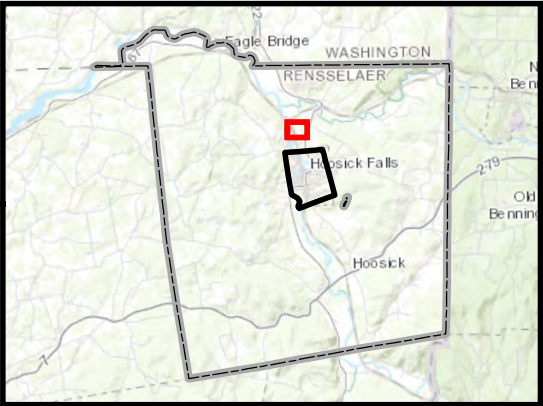


Figure 3D: Sediment Exceedances
Class A Sediment Guidance
Hoosick Falls Village Landfill
Town of Hoosick
New York





- Legend
- Proposed Soil Gas Sampling Points
 - Landfill Gas Vents
 - Landfill Underdrain
 - Approximate Site Boundary
 - Hoosick Town Boundary

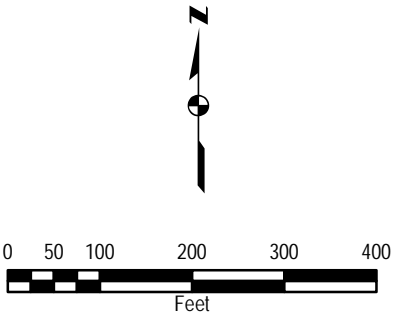
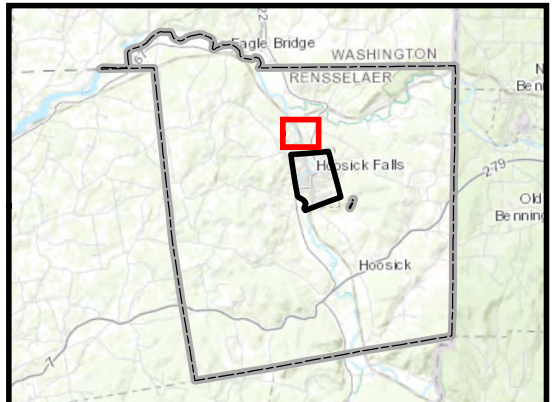
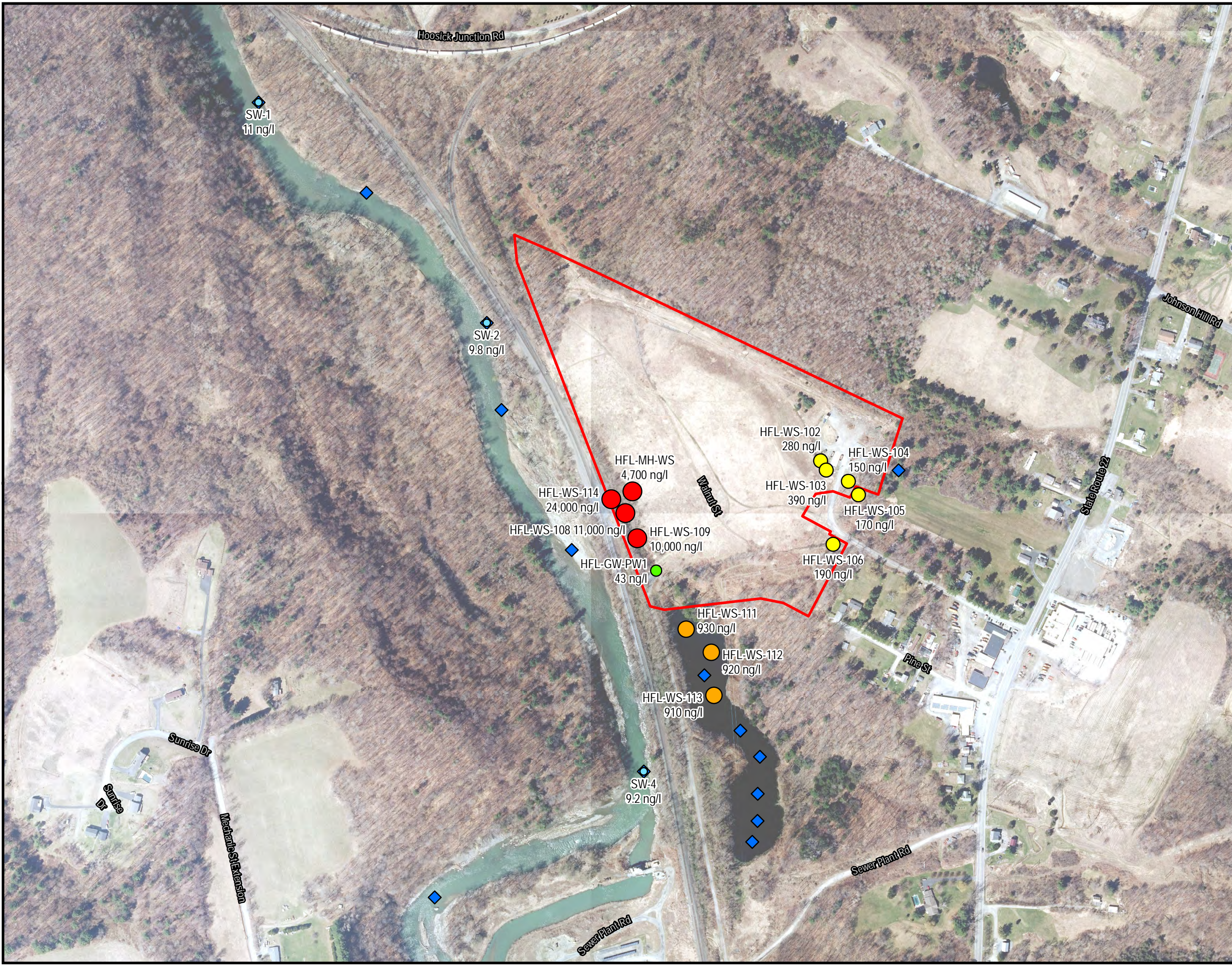


Figure 4: Soil Gas Sampling Locations
Hoosick Falls Village Landfill
Town of Hoosick
New York





Legend

- ◆ Proposed Sediment and Surface Water Sample Location
- Approximate Site Boundary
- Hoosick Town Boundary

PFOA in Surface Water (ng/L) 2017/2018

- Non-Detect
- <20
- 20 - 70
- 70 - 500
- 500 - 1,000
- >1,000

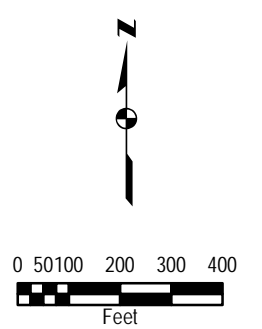
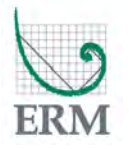
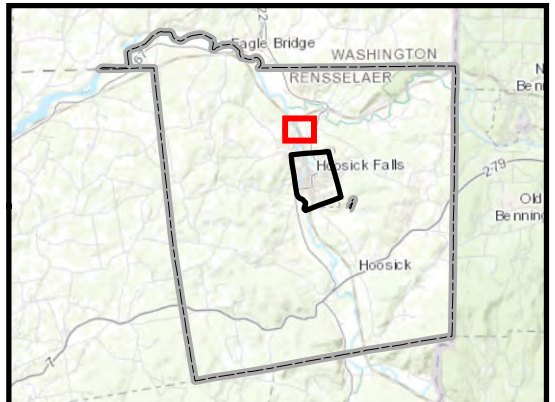
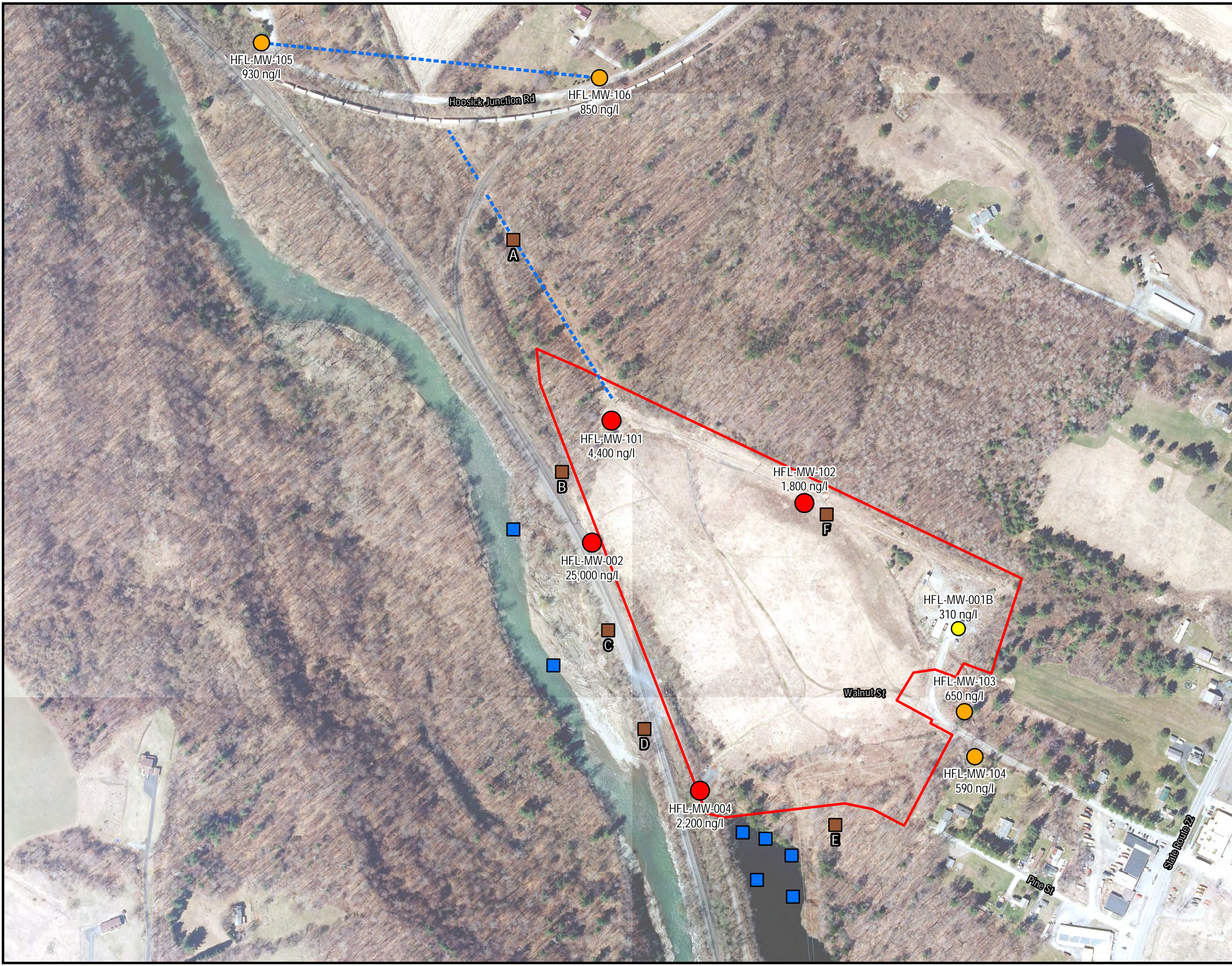


Figure 5: Proposed Sediment and Surface Water Sampling Locations
Hoosick Falls Village Landfill
Town of Hoosick
New York



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- Legend**
- Proposed Geophysical Survey Line
 - Approximate Site Boundary
 - Hoosick Town Boundary
- Proposed Locations**
- Proposed Overburden Monitoring Well Location
 - Proposed In-Stream Temporary Well Location
- PFOA in Overburden Groundwater (ng/l) - June 2018**
- Non-Detect
 - <20
 - 20 - 70
 - 70 - 500
 - 500 - 1,000
 - >1,000

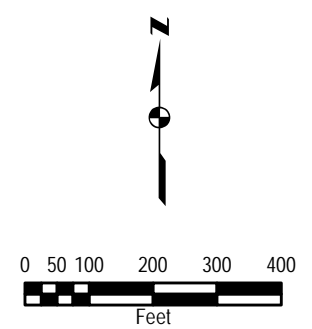


Figure 6: Proposed Monitoring Well Locations
Hoosick Falls Village Landfill
Town of Hoosick
New York

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Table 1
RI Sampling and Analysis Plan
Village of Hoosick Falls Landfill



Sample Media	Sampling Location	Methods/Work Scope Summary	Number of Samples (excluding QA/QC)	Analytical Parameters	Sampling Method
Landfill Cap Soil	Random Cap Locations	Install 15 shallow borings through the cap terminating at the underlying waste on an approximate 300-foot(±) grid spacing (access permitting). - Collect shelby tube samples of soil comprising the cap for geotechnical testing. - Collect two surface soil samples from each boring at the 0-2 and 2-12 inches below grade for PFAS analysis. - Should a change in lithology be encountered (e.g., an engineered coarse layer for landfill gas propagation), a third deeper sample will be collected in each boring that encounters such material.	# varies by analyte	- Geotechnical Parameters: Permeability, Atterberg Limits, Moisture Content, Dry Density Particle-Size Distribution (with hydrometer), Soil Classification and Compaction - PFAS (21)	Direct Push Rig
Landfill Gas	See Figure 4	Headspace air will be field sampled with a multi-gas meter (e.g., Landtec-GEM2000, or equivalent) at the following locations: - All shallow monitoring wells; - Selected landfill gas vents (biased to vents on the east side of the landfill closest to the neighboring residences); and - Three temporary soil gas sampling points .	~15	- % Methane relative to its lower explosive limit (LEL); - Hydrogen sulfide gas concentration	Direct-read field instrumentation
Surface Water	See Figure 5 See Figure 6	14 grab surface water samples will be collected directly into laboratory-supplied sample containers. Kemmerer or Van Dorn samplers will be used for deeper water (Figure 4). Grab surface water samples will be collected in association with the sampling of the seven in-water temporary well points described below under Overburden Groundwater (Figure 5).	21	- TAL/TCL + 1,4-dioxane - Total & dissolved metals - PFAS (21) - pH, TOC - Hardness - Field Parameters	- Grab sample direct to lab containers - Field filter for dissolved metals
Sediment	See Figure 5	Sediment sampling in Thayer’s Pond and the Hoosic River will include collection of sediment samples by hand auger or Ponar dredge from three depth intervals at each location: (a) 0 to 6-inch; (b) 6 to 12-inch; and (c) 18 to 24-inch.	40	- TAL/TCL + 1,4-dioxane - PFAS (21) - pH, TOC (Lloyd Kahn Method)	Hand auger, dredge, or similar
Overburden Groundwater	See Figure 6	Up to 15 new permanent overburden monitoring wells will be installed; plus seven temporary well points in surface water. All permanent and temporary wells will be sampled using low-flow well purging/sample collection techniques. Two semi-annual groundwater sampling events will be performed during which all on-site and off-site groundwater monitoring wells will be sampled.	53	- TAL/TCL + 1,4-dioxane - PFAS (21) - pH, TOC - Field Parameters	Rotosonic Rig and Low-flow Sampling
Soil	See Figure 6	Two soil samples will be collected at each monitoring well drilling location (8) at the following depths: - Surface (0 to 2 inch); - Near surface (2 to 12 inch); and - At significant lithologic changes (assume two samples per location).	32	- TAL/TCL +1,4-dioxane - PFAS (21) - pH, TOC - Field PID Screening	Hand auger and Rotosonic Rig
Leachate	TBD	Two leachate grab samples will be collected concurrently with the two groundwater sampling events. Additional samples may be collected if seeps are present.	4 (plus seeps if present)	- PFAS (21) - pH, TOC - TAL Metals (total & dissolved) - TCL Organics + 1,4 dioxane - TOP Assay - Total and Dissolved Fe, Mn - DOC, BOD ₅ , COD - Total Suspended Solids - Total Dissolved Solids - Ionic strength - Field Parameters - Geochemical Parameters	- Grab sample direct to lab containers - Field filter for dissolved metals

Notes and Abbreviations:

DER-10 = DER-10/ Technical Guidance for Site Investigation and Remediation, 5/3/2010.

Geotechnical Parameters - Permeability, Atterberg Limits, Moisture Content, Dry Density, Sieve Analysis, Soil Classification, Compaction

PFAS - Per- and Polyfluoroalkyl Substances

TOP - Total Oxidizable Precursors

TOC - Total Organic Carbon; DOC - Dissolve Organic Carbon; BOD5 - Biological Oxygen Demand; COD - Chemical Oxygen Demand

Geochemical Parameters - Major Cations (calcium, magnesium, sodium, and potassium); Major Anions (chloride, carbonate, bicarbonate and sulfate); fluoride, phosphorus, phosphate, total Kjeldahl Nitrogen, ammonium, nitrate, nitrite, sulfur, sulfite, hardness, alkalinity

Field Parameters - Specific Conductance (SpC), pH, Dissolved Oxygen (DO), Turbidity, and Oxidation-Reduction Potential (ORP)

Table 2
Preliminary List of PFAS Treatment Technologies
Village of Hoosick Falls Landfill



PFAS Treatment Technology	Vendor	Description of Technology
Biochar	Multiple	<ul style="list-style-type: none"> Biochar is a carbon material that is produced by pyrolysis of agricultural and forestry wastes (biomass). Like removal using GAC, PFAS can be removed from water by binding to biochar. Exhausted media can be sent off-site for final disposition.
PerfluorAd®	Tersus Environmental	<ul style="list-style-type: none"> Technology consists of a liquid that is dosed into the water within a tank. PerfluorAd is a plant-based oleic compound that binds with PFAS and then precipitates. The precipitate solids containing PFAS are removed from the process flow. Vendor indicates that the reagent is selective for PFAS and may not require pretreatment to remove solids or BOD. Collected solids can be sent off-site for final disposition.
Fluoro-Sorb®	Cetco	<ul style="list-style-type: none"> Technology consists of filtration through organo-clay based media. As the water passes through the media, PFAS adsorb to the organo-clay. Exhausted media can be sent off-site for final disposition.
PQ-Osorb®	ABS Materials	<ul style="list-style-type: none"> Technology consists of filtration through a swellable organically modified silica (SOMS) media. As the water passes through the media, PFAS adsorb to the SOMS. Exhausted media can be sent off-site for final disposition.
CD-PFAS	Cyclo-Pure	<ul style="list-style-type: none"> Fluorine-selective adsorbent polymer (β-cyclodextrin) for PFAS removal; received SBIR grant in 2017 for development of technology. Batch test on groundwater from HF Landfill showed reductions of PFOA from 278 to 1.7 ng/L.
Membrane Filtration (Reverse Osmosis and Nanofiltration)	Multiple	<ul style="list-style-type: none"> Technology uses membranes to filter PFAS from water. While most require pretreatment of leachate, some newer RO systems can treat raw leachate. The majority of the water passes through the membrane as the treated effluent (permeate). PFAS is concentrated in the reject water (rejectate) as a higher concentration waste stream. Rejectate can be sent off-site for final disposition, treated using a destruction technology, or thermally evaporated with residual disposal.

Table 2
Preliminary List of PFAS Treatment Technologies
Village of Hoosick Falls Landfill



PFAS Treatment Technology	Vendor	Description of Technology
Granular Activated Carbon (GAC)	Multiple	<ul style="list-style-type: none"> Technology consists of granular activated carbon (GAC) media placed into a vessel. As the water passes through the media in the vessel, PFAS adsorb to the GAC. GAC has lower capacity for short-chain PFAS than for long-chain PFAS. High dissolved organic carbon may reduce capacity. Exhausted media can be sent off-site for regeneration or final disposition.
Ion Exchange	Multiple	<ul style="list-style-type: none"> Technology consists of an ion exchange resin placed into a vessel. As the water passes through the resin in the vessel, PFAS are removed through ion exchange and adsorption mechanisms. Different resins may have different capacities for individual PFAS. High organic content in water may foul resin. Some resins are one-time use and are sent off-site for final disposition; other resins can be regenerated on-site/ off-site using an alkali/ alcohol solution, with the production of a high PFAS concentration liquid waste, which can be sent off-site for regeneration or final disposition. Pretreatment of the water may be required.

Table 3
Estimated Project Schedule for RI-FS Work Plan and Field Work Initiation
Village of Hoosick Falls Landfill

Milestone	Estimated Completion Date ¹
Submittal of Draft 1 RI-FS Work Plan to NYSDEC	27 May 2020
Receipt of NYSDEC Comments on Treatability Study Section of Draft 1 RI-FS Work Plan	7 July 2020
Receipt of NYSDEC Comments on Draft 1 RI-FS Work Plan	24 July 2020
Submittal of Draft 2 RI-FS Work Plan	24 August 2020
Receipt of NYSDEC Comments on Draft 2 RI-FS Work Plan	19 October 2020
Submittal of Draft 3 RI-FS Work Plan	18 November 2020
Receipt of NYSDEC Comments on Draft 3 RI-FS Work Plan	8 January 2021
NYSDEC Conditional Approval of RI-FS Work Plan	11 March 2021
Submittal of Final RI-FS Work Plan	17 March 2021
Filing of RI-FS Work Plan in Document Repositories	31 March 2021
Initiate RI & Treatability Study	1 May 2021
Phase 1 Treatability Study Report	Approximately 6 months after NYSDEC approval of RI-FS Work Plan
Draft IRM Work Plan	Within 45 days of NYSDEC approval of the Treatability Study Report
Submittal of Draft RI Report to NYSDEC	TBD
Initiate FS	TBD

¹ The schedule is estimated and is subject to change based on NYSDEC review and approval, site access and other conditions.

Table 4 - Treatability Study Schedule

ID	Task Name	Duration	Weeks																																					
			W-6	W-5	W-4	W-3	W-2	W-1	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12	W13	W14	W15	W16	W17	W18	W19	W20	W21	W22	W23	W24	W25	W26	W27	W28	W29	W30	W31	W32
1	Treatability Study Phase 1 - Bulk Removal Technologies	170 days																																						
2	DEC Approval & Receipt of Leachate Data	0 days																																						
3	Landfill Cap Evaluation	50 days																																						
4	Clearing and Grubbing	30 days																																						
5	Topographic Survey	20 days																																						
6	Inspection of Cap and Drainage Features	10 days																																						
7	Installation of Soil Borings	10 days																																						
8	Bench Test Scope of Work	45 days																																						
9	Prepare Scope of Work	40 days																																						
10	Discussions with Technology Vendors	40 days																																						
11	Call/Meeting with DEC	5 days																																						
12	Bench Test Scope of Work Complete	0 days																																						
13	Prep for Testing	5 days																																						
14	Collect Bulk Leachate Sample for Testing	1 day																																						
15	Ship Samples to Specified Laboratories	4 days																																						
16	Bench Testing of Leachate	120 days																																						
17	Testing of PFAS Treatment - Bulk Removal (Multiple Vendors)	100 days																																						
18	Analysis of Bulk Sample	20 days																																						
19	Setup and Testing - Stage 1	10 days																																						
20	Laboratory Analysis - Stage 1	20 days																																						
21	Stage 1 Data Review / Planning for Stage 2	10 days																																						
22	Stage 1 Complete	0 days																																						
23	Setup and Testing - Stage 2	10 days																																						
24	Laboratory Analysis - Stage 2	20 days																																						
25	Stage 2 Data Review	10 days																																						
26	Stage 2 Complete	0 days																																						
27	Bench Testing Summary Memo	20 days																																						
28	Prepare Summary Memo	20 days																																						

Project: Draft - Bench Scale Tes
Date: Tue 7/28/20

Task

Split

Milestone

Summary

Project Summary

Inactive Task

Inactive Milestone

Inactive Summary

Manual Task

Duration-only

Manual Summary Rollup

Manual Summary

Start-only

Finish-only

External Tasks

External Milestone

Deadline

Progress

Manual Progress

Note: Additional bench testing may be required during the pre-design phase to determine final design criteria.

Page 1