Central Hudson Gas & Electric Corporation

Tracer Study Reconnaissance Work Plan

Little Britain Road Service Center
610 Little Britain Road, New Windsor, New York

Brownfield Cleanup Program No. C336031

February 2024

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1 Introduction

Arcadis, on behalf of Central Hudson Gas and Electric Corporation (Central Hudson), has prepared this work plan as part of an ongoing investigation being conducted at Central Hudson's Little Britain Road Service Center (the site) located at 610 Little Britain Road in the Towns of New Windsor and Newburgh, Orange County, New York (Figure 1). As described in this plan, Arcadis will reconnoiter selected reaches of Quassaick Creek and an unnamed tributary to it, which lie to the north and east of the site (Figure 2). These reaches have been identified as possible areas where site groundwater may discharge (Arcadis 2023). The objective of the work will be to identify springs and other suitable locations along the streams to monitor during a future groundwater dye-trace study.

This document describes the scope of work to be performed, the data to be collected, the procedures to be followed, and the deliverable that will be prepared to present the collected data. It is anticipated that the findings of the reconnaissance will be integrated into a work plan for conducting a dye-trace study to further investigate the movement of groundwater in bedrock beneath the site.

1.1 Site Setting

The site comprises nine acres and is occupied by a building used as a service center. The building houses offices and truck service bays. Surrounding the building are truck parking areas, visitor and employee parking areas, and material and equipment storage areas. The Lockwood Basin, owned by the City of Newburgh, is located approximately 150 feet west of the site. Further west is Washington Lake, which is a potable water source for the City of Newburgh, although it is currently not in use. Lawns and landscaped areas exist on the south, east, and northeast sides of the facility. The facility is serviced by public water and sanitary sewer, natural gas, and electricity. Water mains for the City of Newburgh from Washington Lake pass under the southern half of the site. Land use near the site includes the Lockwood Basin to the west, undeveloped wooded areas to the north, commercial/industrial areas to the south, and commercial/residential areas to the southeast and southwest. Central Hudson purchased the facility in 1977. The previous occupant of the New Windsor portion of the property was J&H Smith Manufacturing Company, a producer of electronic and lighting equipment, which reportedly stored chemicals used for manufacturing on the property. When Central Hudson purchased the property in 1977, contamination already existed in the underlying soil, soil vapor, and groundwater from the previous industrial activities (NYSDEC 2020).

Quassaick Creek is located northeast of the site and flows southeastward (Figure 2), It is joined by an unnamed tributary that originates south of the site and flows northeasterly. Dams constructed along both streams have created several ponds.

1.2 Site Investigation and Cleanup

Central Hudson entered into the New York State Department of Environmental Conservation's (NYSDEC's) Voluntary Cleanup Program in 2000 under the site identification number #V00312. Several environmental investigations were conducted between 1995 and 2018 to evaluate the condition of the underlying soil, groundwater, and soil vapor and to identify the extent of the contamination. The NYSDEC dissolved its Voluntary Cleanup Program in 2018. Subsequently, Central Hudson applied to the Brownfield Cleanup Program, also administered by the NYSDEC, and executed a Brownfield Cleanup Agreement under site identification number

C336031. Under that program, Central Hudson prepared, and the NYSDEC approved, a *Remedial Investigation Work Plan* (Kleinfelder, Inc. 2020). The remedial investigation is ongoing. Details regarding the investigations completed at the site are contained in the *Remedial Investigation Summary Report* (Arcadis 2022).

Contaminants identified in the environmental media sampled are predominantly chlorinated volatile organic compounds (CVOCs). The investigations identified an area of impacted soil that was subsequently excavated and removed from the site in 2001. In 2008, soil vapors beneath the building were found to contain elevated concentrations of CVOCs. Central Hudson voluntarily installed a sub-slab depressurization system as a preventative measure against contaminated soil vapor entering the building. This system continues to operate.

Several phases of investigation have focused on site groundwater. As a result, 37 monitoring wells have been installed and sampled at the site. The first groundwater samples were collected in 1996, some of which contained concentrations of VOCs exceeding NYSDEC guidelines. Central Hudson continues to conduct quarterly groundwater sampling events at the 37 wells that comprise the current monitoring network. VOC concentrations in samples from some of the wells remain above applicable guidelines. Higher concentrations of VOCs were generally detected in samples collected from the monitoring wells screened in the bedrock.

The reconnaissance work described in this work plan will support development and implementation of a dye-trace study to further characterize the movement of site groundwater. Results of that study will be used to update the conceptual site model and help focus the ongoing remedial investigation.

1.3 Karst Geology Considerations

As discussed in the memorandum entitled *Bedrock Conceptual Site Model, Little Britain Road Service Center* (Arcadis 2023), the bedrock beneath the site is karstic. The way in which groundwater moves through karst aquifers is different than in other geologic media. Most groundwater in karst aquifers moves through an integrated network of solution-widened features (referred to as a conduit network) that occupies a very small volume of the rock. Consequently, these important transport pathways are infrequently intercepted by monitoring wells. Groundwater moving through conduit networks typically discharges at the land surface, or sub-aqueously into surface water bodies, through springs (Ford and Williams 2007); that is, springs are the primary outflow points of karst aquifers. Important implications of this relative to the ongoing investigation at the site include:

- The common practice of estimating groundwater-flow directions using potentiometric maps is not very reliable in karst – the actual path that groundwater takes may be significantly different than that inferred from such maps.
- Groundwater velocities in the conduit networks of karst aquifers tend to be much higher than in other geologic media. Flow velocities of multiple feet per day, or more, are common.
- The quality of water samples collected from wells whose screens intercept zones of high permeability is most indicative of the quality of groundwater that is moving through the aquifer. Conversely, the quality of samples collected from wells that screen bedrock that is unfractured, or contains sparse, unweathered fractures is indicative of water that is moving slowly. Most of this water can be expected to move toward, and drain into, the conduit network at some point within the aquifer.
- Because of their convergent nature: 1. contaminated groundwater moving through conduit networks tends to be focused in the downgradient direction, rather than spread out, and 2. If the conduit network(s) extend beyond the source of contamination, contaminant concentrations in groundwater moving through the network(s) can be diluted as conduits carrying clean groundwater join the network.

- With distance from a contaminant source area, contaminated groundwater becomes increasingly confined to the conduit network.
- Given the unique nature of groundwater flow in karst aquifers, dye tracing is an important tool to supplement data from monitoring wells to better characterize groundwater movement, identify where groundwater-of-interest discharges at the land surface, and estimate groundwater flow velocities.

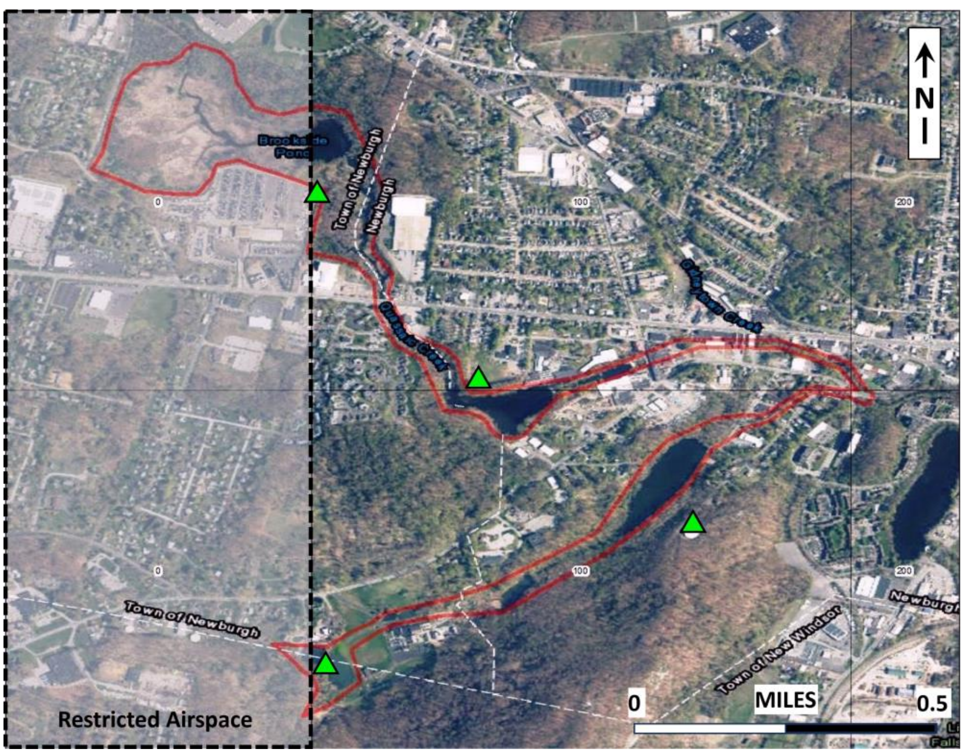
2 Scope of Work

To design a proper dye-trace study, the area where groundwater in the bedrock underlying the site may discharge from springs must be identified and examined to the extent practicable. The reconnaissance effort described in this section is designed to identify springs of potential interest to be monitored during a future dye-trace study. In developed areas, flow from springs is sometimes captured and piped to surface water bodies. For this reason, any pipes or other features discharging water to stream reaches of interest will also be identified and examined. The reconnaissance effort will be conducted in two phases. The first phase will involve surveying accessible portions of the area of interest (referred to hereafter as the “survey area”) using an unmanned aerial vehicle (UAV). Results from that survey will be examined in real time and used to inform the second phase of the reconnaissance, which will entail physically examining select reaches of streams to locate and document springs and other features of interest.

2.1 UAV Thermal Survey

During certain seasons of the year, there is a strong contrast between the temperature of emerging groundwater and surface water. This contrast can be used to identify thermal anomalies that may represent focused discharge of groundwater to the land surface, and in some instances, through the beds of streams and ponds.

Arcadis identified the survey area for the reconnaissance using potentiometric data from site bedrock monitoring wells, available topographic mapping for the area, and professional judgement. That area is shown on Inset 1. As shown on the inset, the westernmost portion of the survey area is within restricted airspace and,



Inset 1: Map of survey area (red outline) showing potential UAV launch points (green triangles) and restricted airspace.

therefore, cannot be flown by the UAV. Arcadis requested a waiver from the Federal Aviation Administration (FAA) so that the area could be flown; but the request was denied. Also shown on Inset 1 are potential UAV launch/land locations. For each leg of the survey, the UAV will launch and land from the same location. Outside the restricted area, UAV flight is limited by FAA to a height of 100’ above ground level. This distance is advantageous for locating features of interest; however, it limits the distance the UAV can be flown from each launch location because the pilot is required to maintain visual contact with the UAV. The number and locations of launch points may be modified in the field at the time of survey based on visibility and the availability of suitable, accessible launch points.

The survey will be conducted using a UAV equipped with thermal and standard sensors. The UAV will be either a Parrot ANAFI USA with standard, zoom, and thermal cameras, or a DJI Matrice 210 carrying Zenmuse XT and X4S cameras. Video will be collected over all areas accessible to the UAV. A subject matter expert will accompany the pilot to interpret thermal imagery in real time. When a feature of interest is spotted in the video, additional georeferenced still photos of the feature will be collected, including at least one at nadir (from directly above) to help pinpoint the geographic location.

2.2 Physical Reconnaissance

Following the UAV thermal survey, a physical, “boots on the ground” reconnaissance will be conducted. Results of the UAV thermal survey will be used to fine-tune the scope of the field reconnaissance.

The objectives of the field reconnaissance will be to:

1. Ground-truth accessible thermal anomalies (potential focused groundwater discharge points) identified by the UAV survey.
2. Reconnoiter accessible stream reaches that could not be flown by the UAV or where the stream was obscured (e.g., by trees).
3. Identify and characterize potential locations for dye monitoring.
4. Assess options for deploying dye-sampling devices at each targeted location.

The field reconnaissance will entail walking or boating, if feasible, accessible reaches of stream to identify springs, tributaries, and other discharge features (e.g., drainpipes). A hand-held infrared (thermal) camera will be used to inspect selected stream reaches and features.

For each spring, tributary, or flowing discharge feature identified, a characterization log will be completed to document conditions and a thermal image and standard photograph will be taken. A copy of the characterization log is contained in Appendix A. As can be seen from the log, the pH, temperature, and conductivity (i.e., field parameters) of the water discharging from the spring, tributary, or discharge feature will be measured and recorded. Also, field parameters will be measured in the adjacent stream immediately upstream of the confluence of the flow from the spring, tributary, or discharge feature. Sometimes springs discharge from the streambed itself. In such cases, field parameters will be taken by lowering the measurement probe so that it is within the flow of discharging spring water, provided that the feature can be safely accessed. An order-of-magnitude, visual estimate of the discharge rate of each spring or discharge feature will also be made and logged. All logged features will be located with a hand-held Global Positioning System (GPS) receiver.

2.3 Environmental Footprint Analysis

Central Hudson, Arcadis, and the NYSDEC are committed to minimizing the environmental footprint of activities involved in addressing environmental conditions at the site.

The U.S. Environmental Protection Agency's (EPA's) *Principles for Greener Cleanups* (USEPA. 2016) outlines the U.S. EPA's policy for evaluating and minimizing the environmental footprint of activities involved in cleaning up contaminated sites and will be followed during implementation of this work plan. The core elements of greener cleanups are:

- Reduce total energy use and increase the percentage of energy from renewable resources.
- Reduce air pollutants and greenhouse gas emissions.
- Reduce water use and preserve water quality.
- Conserve material resources and reduce waste.
- Protect land and ecosystem services.

The first two elements in the list above are relevant to the scope of work described in this work plan. Given that the scope of work is relatively small and non-intrusive, a qualitative environmental footprint analysis comprised of describing the best management practices (BMPs) that will be implemented is appropriate.

To minimize the environmental footprint when implementing this work plan, the following green remediation BMPs will be employed:

1. Reduce travel through teleconferencing and compressed work hours. Both prior to conducting the field work and following the field work, all meetings will be held through teleconferencing. Also, the final deliverable will be distributed in electronic form, rather than as hard copies. All field work will be performed in one mobilization, if feasible. Staff will strive to carpool and employ electric or hybrid rental vehicles when practicable.
2. Integrate sources of renewable energy to power the UAV, hand-held thermal imager, hand-held GPS receiver, and field parameter meter to the extent practicable.
3. Use a dynamic work plan that involves real-time field measurements that immediately provide data to help determine the next activity during the field reconnaissance event. All equipment used will be direct sensing and non-invasive. Results of the UAV survey will be used in real time to adjust the scope of the physical reconnaissance.
4. Compress the number of days needed to complete the work. Field workdays will extend beyond eight hours provided there is sufficient daylight to perform the work safely.

The field work described herein will not generate solid or liquid wastes that will require management/disposal.

3 Schedule and Reporting

Scheduling is an important element for the scope of work described herein. Thermal imaging is a useful and expeditious way to identify springs and other potentially important groundwater-discharge features; however, there are only certain times of the year where the technique can be successfully applied. Because the method relies on a good contrast between the temperature of groundwater and surface water, and to a lesser extent, a limited amount of leaf cover, the best time to conduct a thermal survey is during the winter and early spring.

During this season the temperature contrast between warmer groundwater and colder surface water is at a maximum, foliage is at a minimum, and spring flow is typically high. For these reasons, the reconnaissance effort is scheduled to occur as soon as possible this year, and not after the temperature of the water in the streams reaches approximately 13 °C (55 °F) – anticipated to be approximately late April. This season is also conducive to physical reconnaissance because springs and other discharge features (e.g., drainpipes) are less likely to be obscured by vegetation.

The field reconnaissance is anticipated to require one week to complete, with the UAV survey portion requiring three of those days, assuming weather conditions are suitable for flight.

The results of the reconnaissance will be used to develop, and be reported in, a dye-trace study work plan. The work plan is anticipated to be submitted to the NYSDEC approximately two months after completing the field work.

4 References

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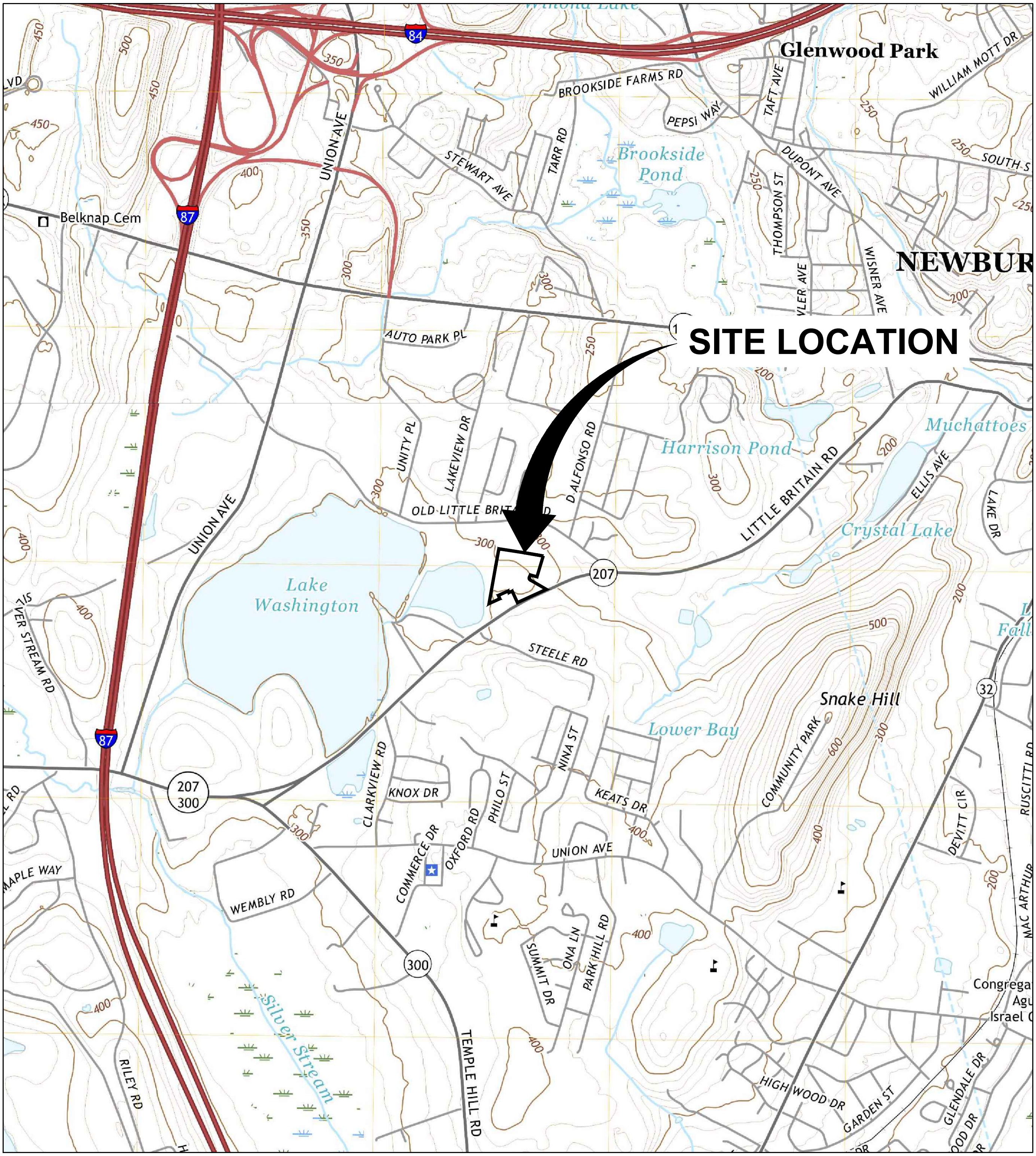
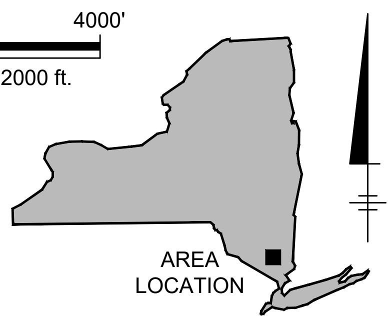
Figures



REFERENCE: BASE MAP USGS 7.5. MIN. TOPO. QUAD., CORNWALL-ON-HUDSON, NY, 2019 AND NEWBURGH, 2019, NY.

0 2000' 4000'

Approximate Scale: 1 in. = 2000 ft.



CENTRAL HUDSON GAS & ELECTRIC CORPORATION
LITTLE BRITAIN ROAD SERVICE CENTER
NEW WINDSOR, NEW YORK
TRACER STUDY RECONNAISSANCE WORK PLAN

SITE LOCATION MAP

ARCADIS

FIGURE
1

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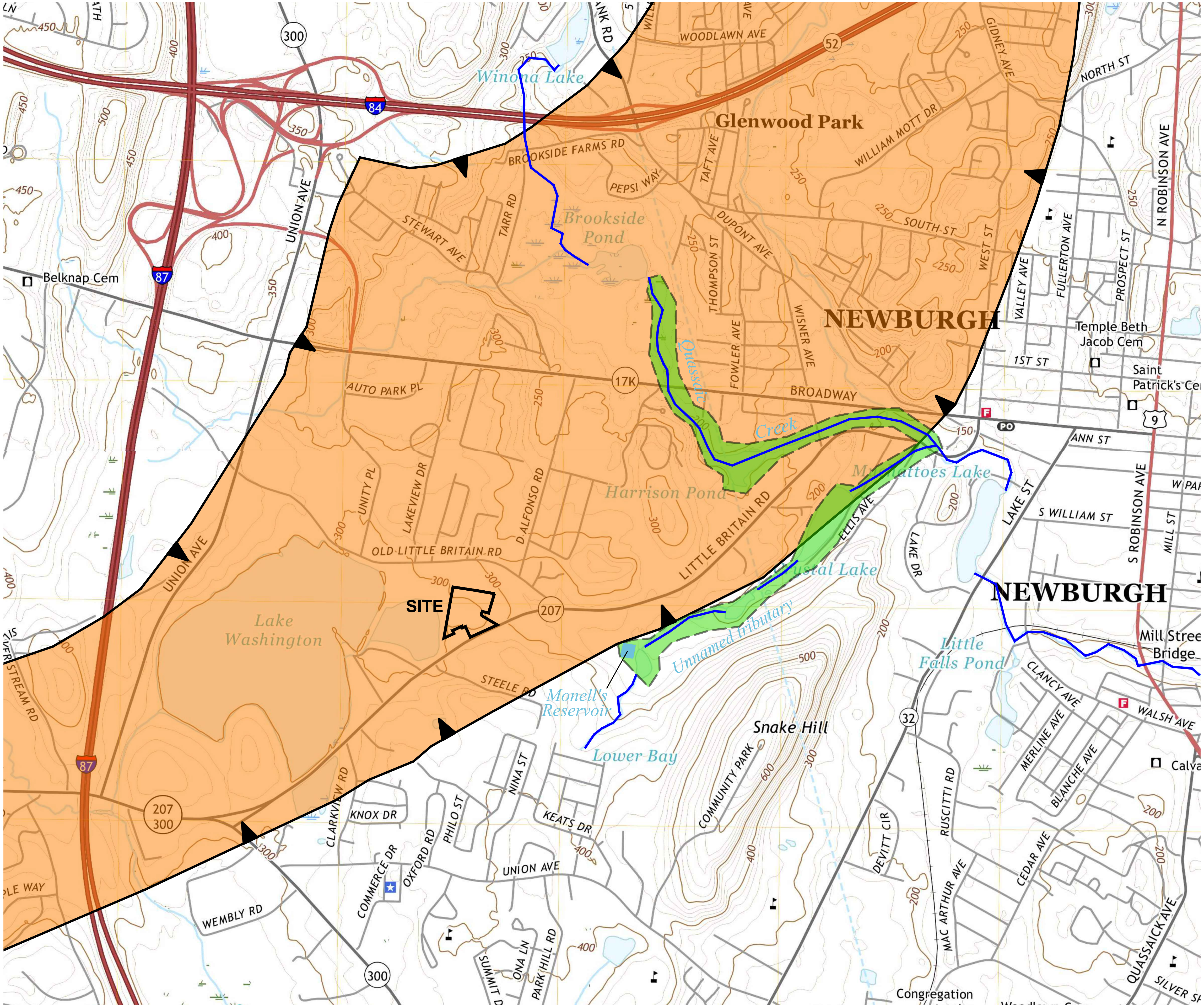
NY_Newburgh_20190923_TM_geo.tif



LEGEND:

- WAPPINGER GROUP DOLOSTONE
- STREAM REACHES THAT MAY CONTAIN SPRINGS DRAINING SITE BEDROCK GROUNDWATER
- THRUST OR REVERSE FAULT; SAW TEETH ON OVERTHRUST BLOCK

NOTES:

1. BASE MAP USGS 7.5. MIN. TOPO. QUAD., CORNWALL-ON-HUDSON, NY, 2019 AND NEWBURGH, 2019, NY.
2. LIMITS OF WAPPINGER GROUP INFERRED FROM FISHER ET AL. (1970).

0 1500' 3000'

GRAPHIC SCALE

CENTRAL HUDSON GAS & ELECTRIC CORPORATION
LITTLE BRITAIN ROAD SERVICE CENTER
NEW WINDSOR, NEW YORK

TRACER STUDY RECONNAISSANCE WORK PLAN

POTENTIAL DISCHARGE LOCATIONS FOR SITE GROUNDWATER

ARCADIS

FIGURE
2

Appendix A

Characterization Log

ARCADIS

SPRING CHARACTERIZATION LOG

Site:	Feature ID:
Personnel:	
Date: Time:	Stream ID:
Weather:	GPS Point ID: ☐ Same as feature ID

1. Nature of Feature

☐ **Spring**
- ☐ Single point OR
- ☐ Complex
- ☐ Rock orifice
- ☐ Soil tube
- ☐ Boil
- ☐ Discharge obscured

☐ **Seep**
- ☐ Single point OR
- ☐ Complex
- ☐ Rock (fracture)
- ☐ Rock (matrix)
- ☐ Soil
- ☐ Discharge obscured

☐ **Stream Resurgence OR**
☐ **Sinking Reach**
(if discharge is not clearly a spring or seep)
- ☐ Bedrock streambed
- ☐ Cobble/gravel /sand streambed
- ☐ Soft sediment streambed
- ☐ Resurgence or sink is in a marsh

☐ **Other**
- ☐ Pipe outfall
- ☐ Tributary outlet
- ☐ Dam
- ☐ ____________

2. Relation to Stream Channel

Feature joins stream from:
- ☐ Left bank
- ☐ In-channel
- ☐ Right bank

looking downstream

- ☐ Feature is headwater of stream

Feature connects to stream via:
- ☐ Streambed
- ☐ Stream bank
- ☐ Channel embayment
- ☐ Spring run
- ☐ Marsh

Is there a spring pool or pond: ☐ Yes ☐ No

Sketch (if needed)

3. Approximate Dimensions

Distance of feature from channel (ft):

Elevation above to channel stage (ft):

Length of discharge (or sink) area (ft):

4. Other Observations

Note if present:	***Yes***	***No***	***Explanation***
Bacterial growth	☐	☐	
Indicator vegetation	☐	☐	
Sediment accumulation	☐	☐	
Man-made modifications	☐	☐	

5. Field Parameters

PARAMETER	Spring or seep discharge	Upstream of discharge
pH		
Temp. (°C)		
Conductivity (µS/cm)		

6. Estimate of Discharge Rate

Spring or seep discharge:
Estimation method:

7. Notes

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