GROUNDWATER STUDY AND PROTECTION PLAN

for the

GLENFORD AND WEST HURLEY AREAS
TOWN OF HURLEY
ULSTER COUNTY, NEW YORK

September 2009

Prepared for:

Town of Hurley Conservation Advisory Council

Prepared by:

Steven Winkley
New York Rural Water Association

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1.0 INTRODUCTION

1.1 Goals and Objectives

Groundwater is a valuable resource for the areas of the Town of Hurley known as Glenford and West Hurley. Here, privately-owned community water systems and individual residences and businesses rely upon wells for their source of supply. In addition, groundwater contributes a significant portion of water to local streams, wetlands, and ponds. Unfortunately, groundwater contamination has occurred in the area as a consequence of a variety of land use activities.

In order to preserve the groundwater resources of Hurley for today and the future, the following Groundwater Study and Protection Plan has been prepared by the New York Rural Water Association (NYRWA) in cooperation with the Town of Hurley Conservation Advisory Council (CAC). Funding for this initiative has been provided by a New York State Department of State Water Quality Planning and Implementation Grant for the New York City Watershed.

The objectives of this study and plan are to map the groundwater resources in detail, identify potential sources of contamination, and outline protection strategies and future work. One such approach is the development of a municipal water system for portions of the area. Accordingly, possible areas for municipal water sources have been identified as part of this report.

1.2 Scope and Methods

New York Rural Water Association has utilized a variety of published and unpublished data sources for this plan. All data were inputted into a Geographical Information System (GIS). This is a computer system that allows one to visualize, manipulate, analyze, and display geographic (spatial) data. Subsurface data was collected in digital format from the Ulster County Information Services (UCIS), the New York State Department of Environmental Conservation (NYSDEC) Water Well Program, the United States Geological Survey, and the New York State Department of Transportation. Data from a total of 201 wells and borings was compiled. In addition, data on public supply wells was collected from the New York State Department of Health.

Digital soils mapping from the Ulster County Soil Survey was utilized. Elevation data were taken from digital elevation models (DEMs). This information was then used to derive hillshading and slopes. Land use information was taken from parcel mapping from Ulster County Information Services. Other digital data including surface waters, roads, regulated facilities, aerial photography, etc. were downloaded from the New York State GIS Clearinghouse and the Cornell University Geospatial Information Repository. New York Rural Water Association also conducted on-site activities in Hurley to document the location of water supply wells, potential contaminant sources, etc. A global positioning system (GPS) device was used to capture the geospatial coordinates of such features. NYRWA also conducted geologic reconnaissance in selected areas to confirm surficial and bedrock mapping.

2.0 SETTING

2.1 Study Area

In 2006, NYRWA completed a groundwater protection plan for the Old Hurley area. The scope of this current study and plan is to cover the remainder of the Town of Hurley to the north, including the hamlets of Glenford and West Hurley. The study area is depicted in Figure 1. Due to its size, NYRWA divided the study area into four map areas (A, B, C, and D).

Hurley is situated west of the New York State Thruway and the City of Kingston in Ulster County, New York. The study area consists of the portion of Hurley located northwest of the Hurley Mountain Road (Figure 1). The area is dominated by the Ashokan Reservoir, a body of water providing drinking water for New York City.

2.2 Physiography and Drainage

The study area is located at the intersection of three distinct physiographic regions depicted on Figure 2. Within each of these regions, the geology and topography are generally similar. These physiographic regions include the Catskill Section of the Appalachian Plateaus Province to the north and northwest of the Ashokan Reservoir, the Hudson Valley Section of the Valley and Ridge Province to the northeast of the Ashokan Reservoir, and the Middle Section of the Valley and Ridge Province to the south of the Ashokan Reservoir (Figure 2).

All of the study area is located within the Esopus Creek Watershed. The Hudson Valley Section of the Valley and Ridge Province drains away from the Ashokan Reservoir to the Saw Kill and ultimately to Esopus Creek just east of the study area (Figure 2). Similarly, much of the Middle Section of the Valley and Ridge Province drains away from the Ashokan Reservoir through Stony Creek and other southerly trending streams to Esopus Creek. A small portion of this physiographic province drains towards the Ashokan Reservoir (see reservoir watershed on Figure 2).

The Catskill Section of the Appalachian Plateaus Province of the study area is located within the watershed of the Ashokan Reservoir. Water from the Ashokan Reservoir reenters the Esopus Creek via a spillway located west of the study area.

2.3 Bedrock Geology

The bedrock underlying the study area consists of Devonian shales and sandstones (see Figures 3-1 and 3-2). Figure 3-1 is a bedrock geologic map of the study area. Figure 3-2 is a stratigraphic column that shows the sequence and type of rock that underlies the region.

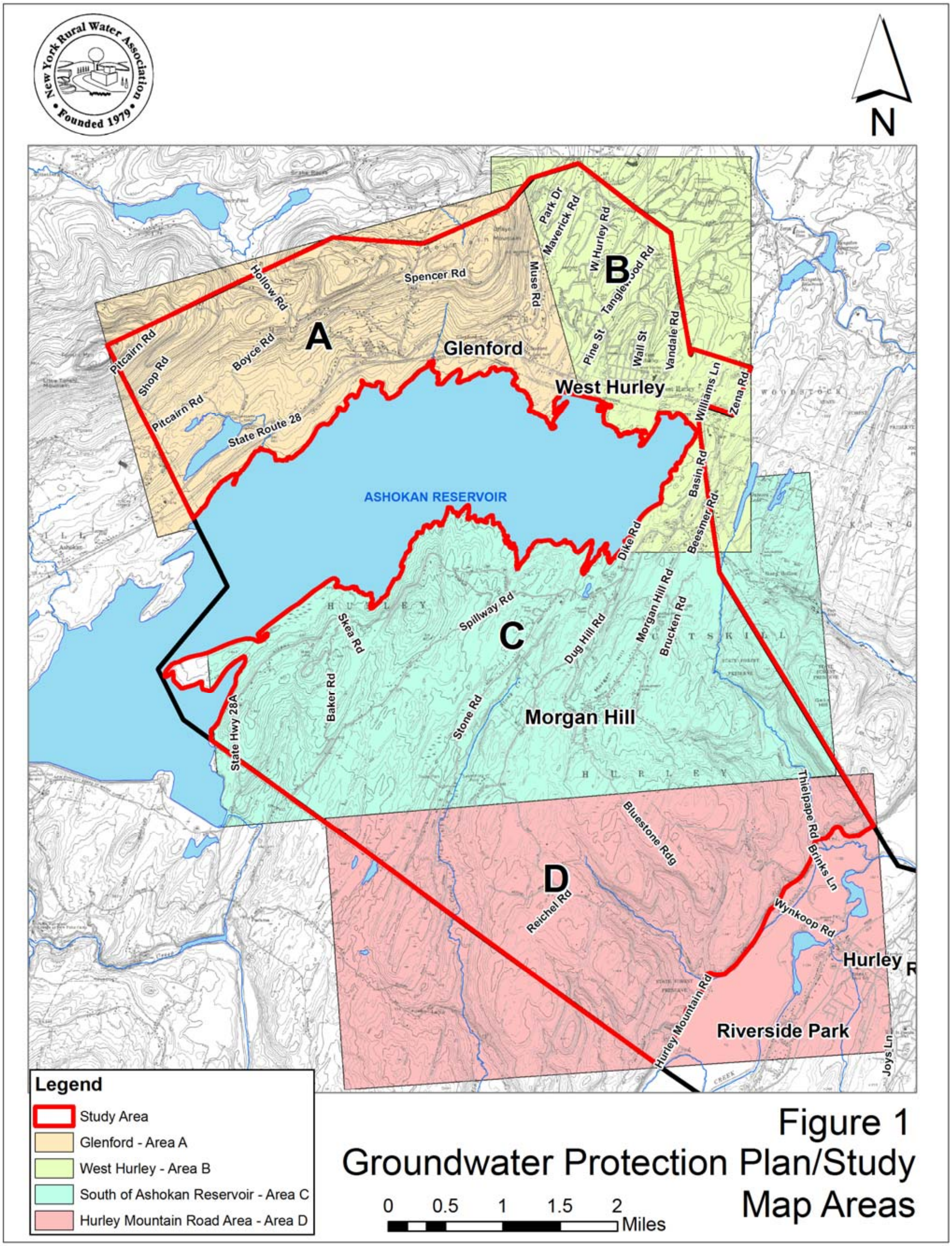

Figure 1
Groundwater Protection Plan/Study Map Areas

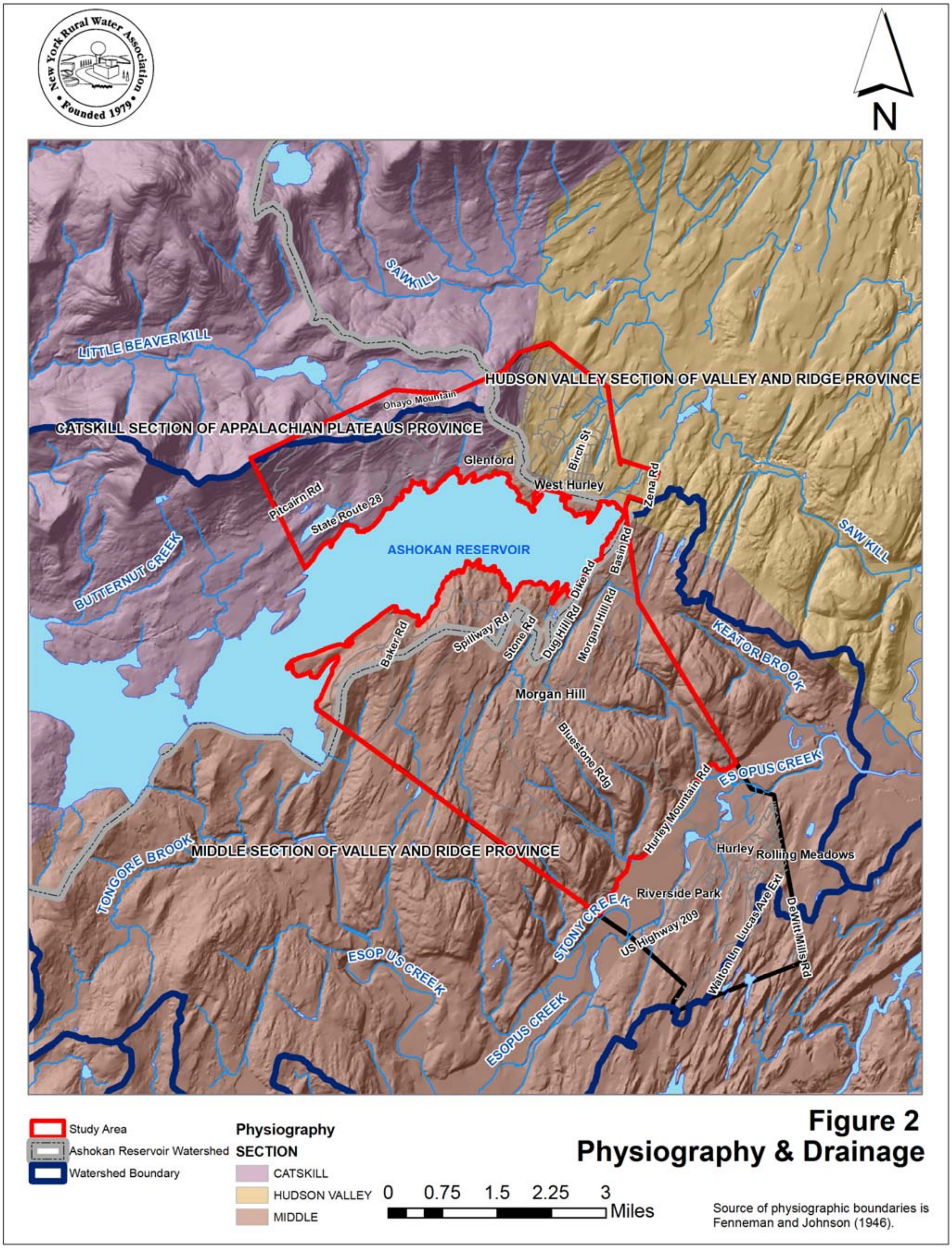

Figure 2
Physiography & Drainage

Source of physiographic boundaries is Fenneman and Johnson (1946).

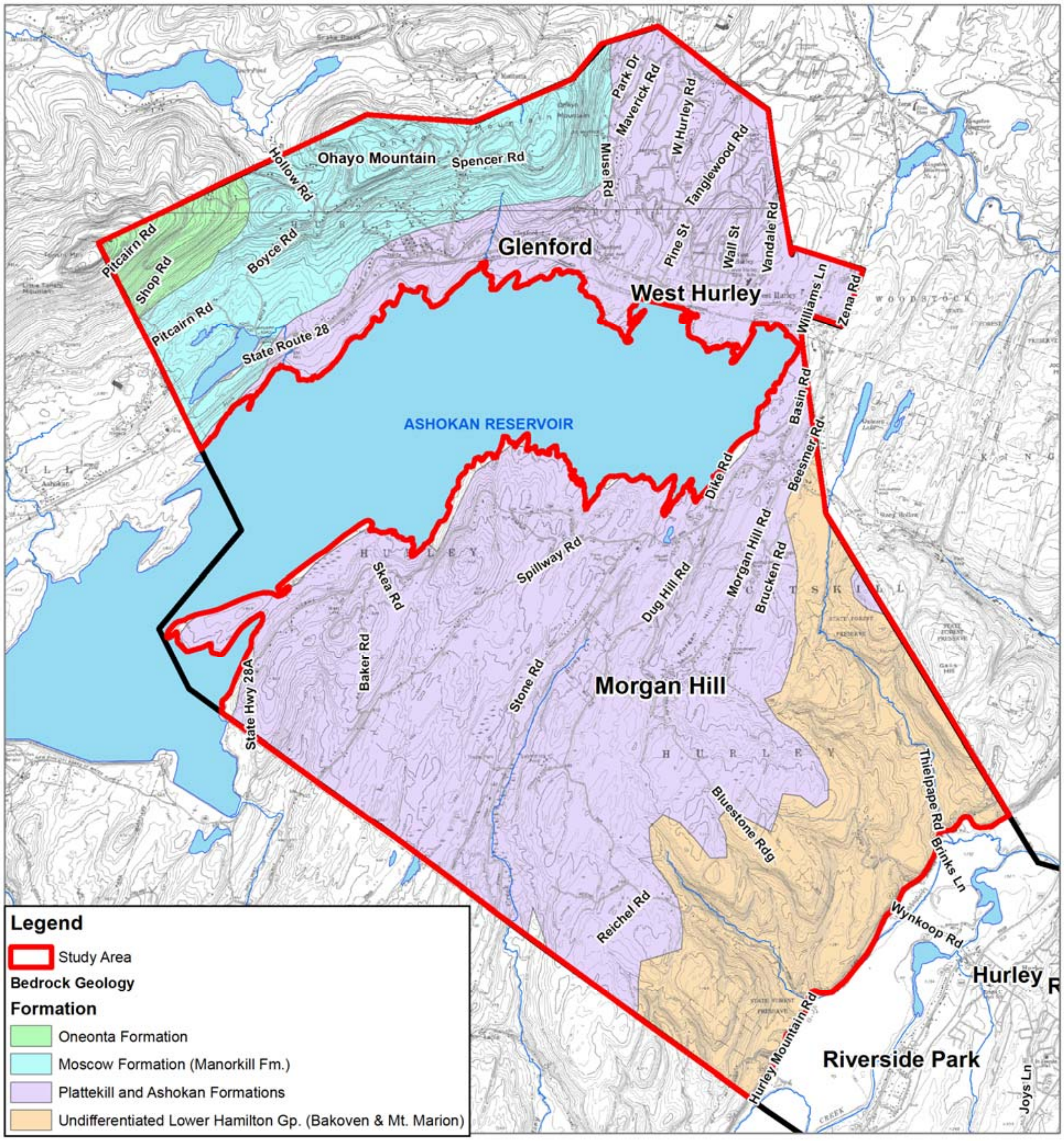

Figure 3-1
Bedrock Geology

Source of bedrock geology data is
Bedrock Geology Map of NY.

0 0.5 1 1.5 2 Miles

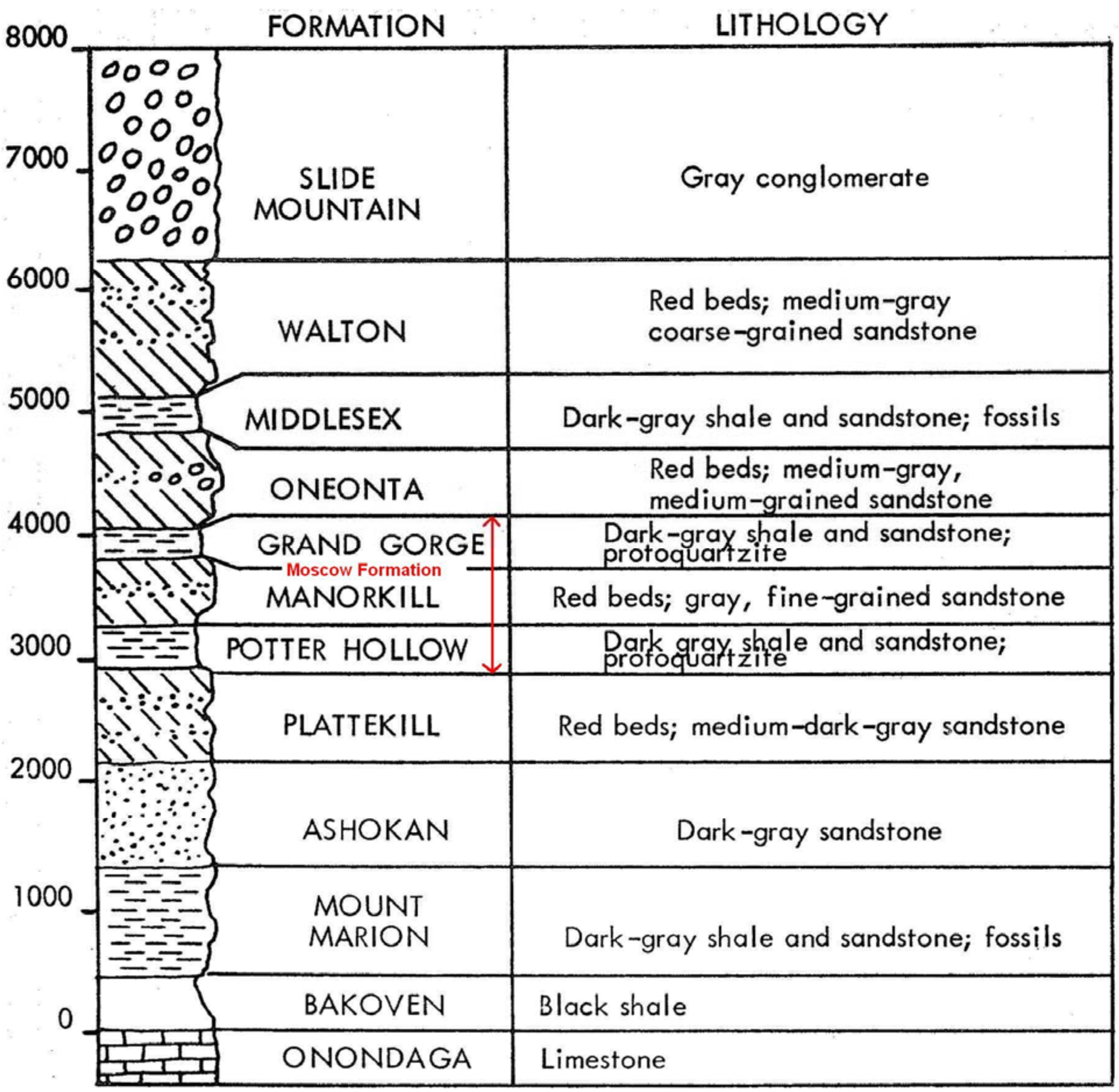

Figure 3-2. Bedrock Stratigraphy (from Fletcher, 1967)

The area immediately north of Hurley Mountain Road is underlain dark-gray shale and sandstone of the Mount Marion Formation. Due to the comparatively weaker nature of these rocks, this region is deeply dissected by steep ravines. To the north, the more resistant Ashokan Formation underlies the area around the Ashokan Reservoir. This formation consists of durable, dark-gray sandstone (bluestone) alternating with weaker very dark shale. The widely differing rates of erosion of these rocks combined with the local structural geology have resulted in the distinctive topography of the Middle Section of the Valley and Ridge Province. It is characterized by narrow, steep-sided linear valleys typically with 50-120 feet relief. The more durable sandstone layers typically form terraces separating the valleys. The valleys follow the prominent joint (crack) pattern that trends northeastward.

Exposures of the Plattekill Formation outcrop to the north of the Ashokan Reservoir. The Plattekill Formation characteristically has reddish shale beds alternating with dark-gray shale and sandstone layers. As the lower-most of the so-called Catskill red-beds, the Plattekill Formation is found at the base of the steep Catskill Front (Ohayo Mountain locally).

At successively higher elevations in the Catskills above the Plattekill Formation are the Moscow Formation and the Oneonta Formation. These formations are a continuation of the Catskill red-beds, similar in many ways to the Plattekill in having red shale beds alternating with dark-gray sandstone beds. The Plattekill Formation, the Moscow Formation, and Oneonta Formations form a distinct series of step-like cliffs.

2.4 Surficial Geology

Surficial deposits are geologic materials that are found at the land surface. Most of these are loose, unconsolidated deposits that formed as a result of continental glaciation, deglaciation, and post-glacial deposition. Using subsurface data collected from a variety of sources (Figures 4A-D), digital soils mapping, topographic expression, and field reconnaissance, NYRWA completed detailed surficial geologic maps of the study area (Figures 5A-D).

Glacial till is the oldest glacial sediment, and was deposited directly from glacial ice. Till is an unsorted dense mixture of clay, silt, sand, gravel, and boulders. Relatively thin till deposits (less than 5 feet thick) cover much of the study area. Bedrock is at or near the land surface in many remaining areas. As discussed above, the differential weathering rates and the shallow nature of the local bedrock has left a distinctive bedrock-controlled topography across most of the study area. This topography was further accentuated with glacial ice erosion.

Glaciofluvial deposits consist of sorted and stratified sand and gravel deposited from glacial meltwater streams during the deglaciation period. In contrast to most regions in New York, very few glaciofluvial deposits occur in the study area. A few scattered accumulations of such deposits occur in the West Hurley area as well as along the Hurley Mountain Road.

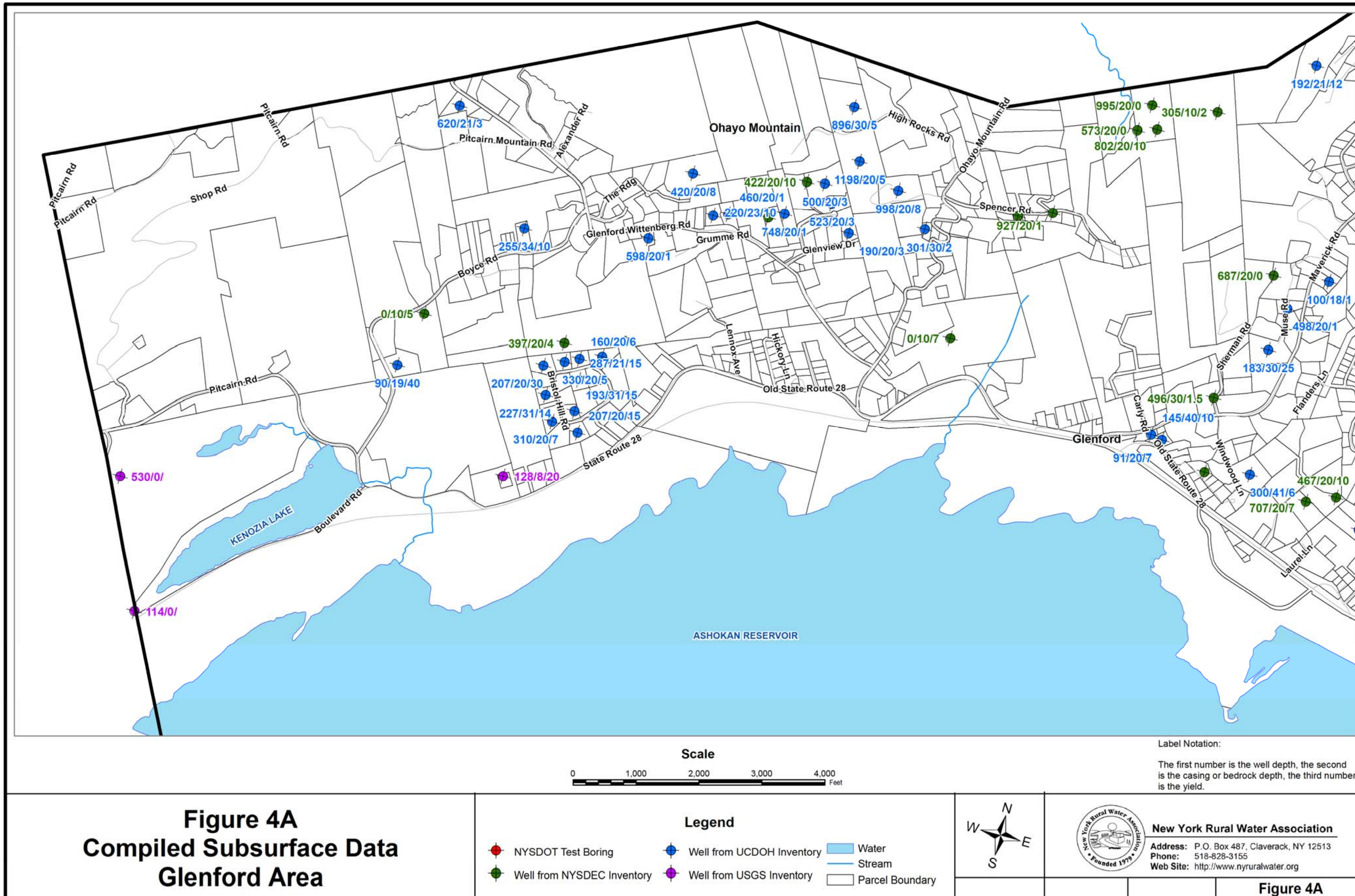

Figure 4A
Compiled Subsurface Data
Glenford Area

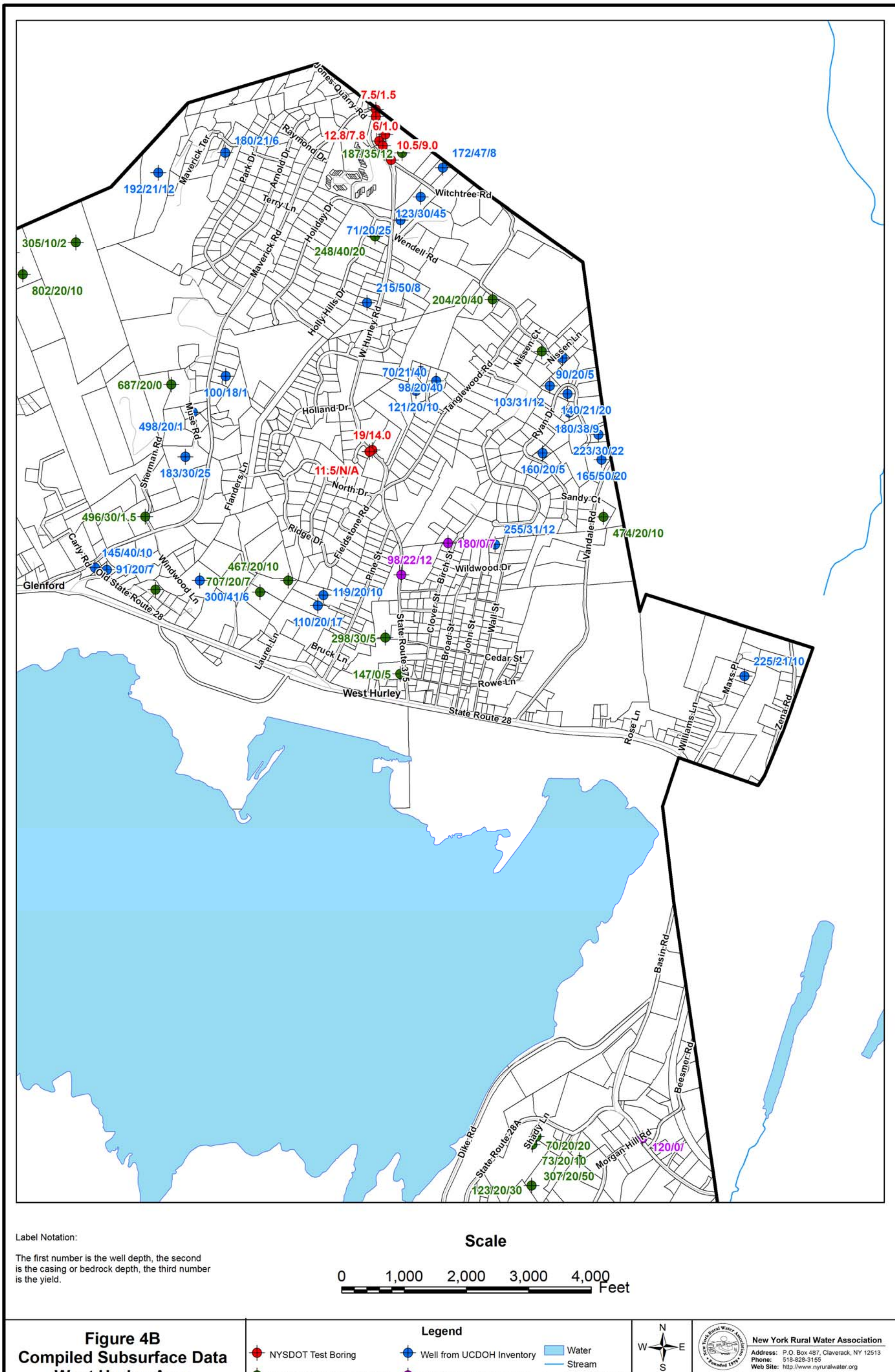

Figure 4B
Compiled Subsurface Data
West Hurley Area

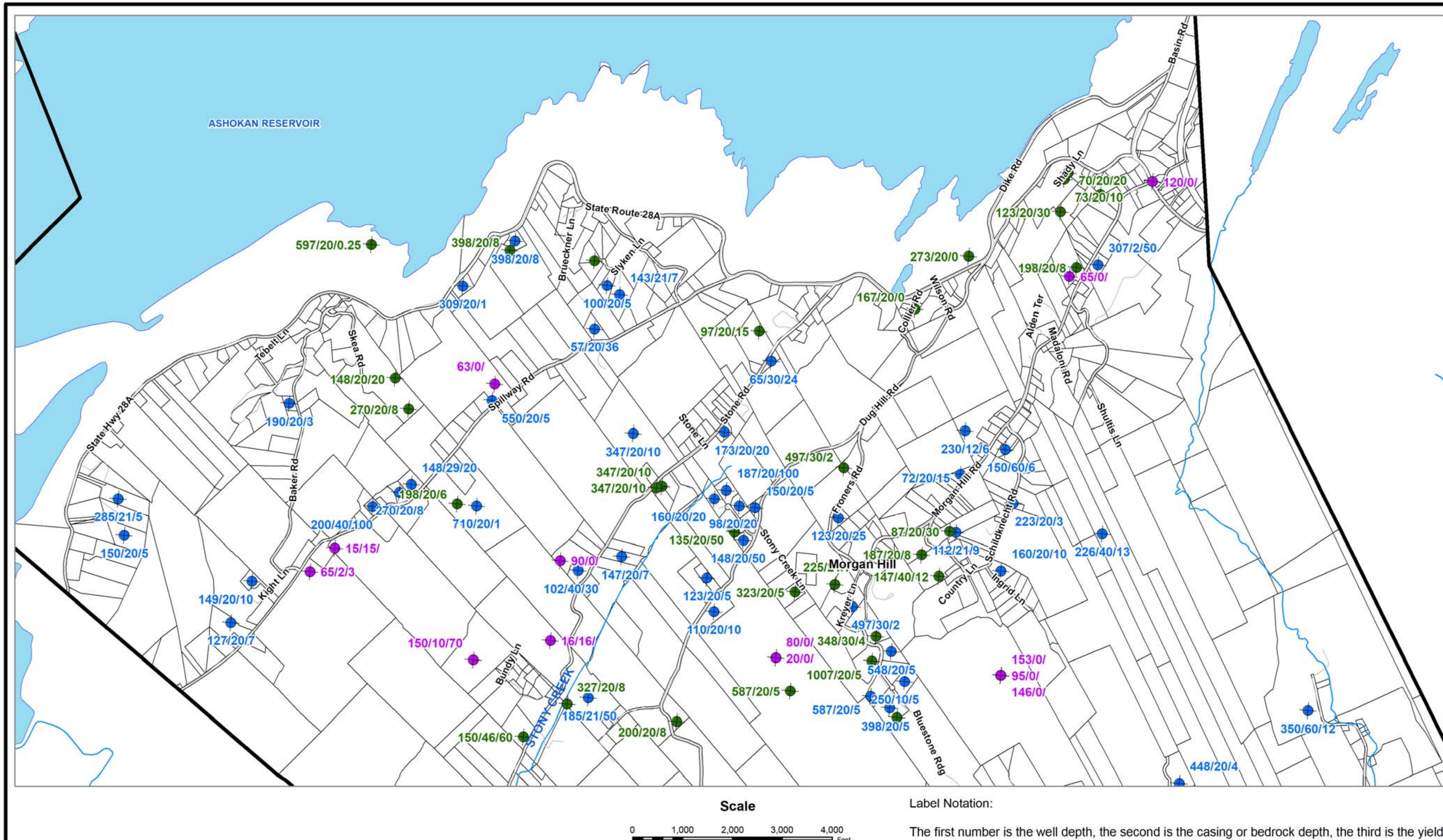

Figure 4C
Compiled Subsurface Data
Area South of Ashokan Reservoir

Legend

- NYSDOT Test Boring
- Well from NYSDEC Inventory
- Well from UCDOH Inventory
- Well from USGS Inventory
- Water
- Stream
- Parcel Boundary

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Figure 4C

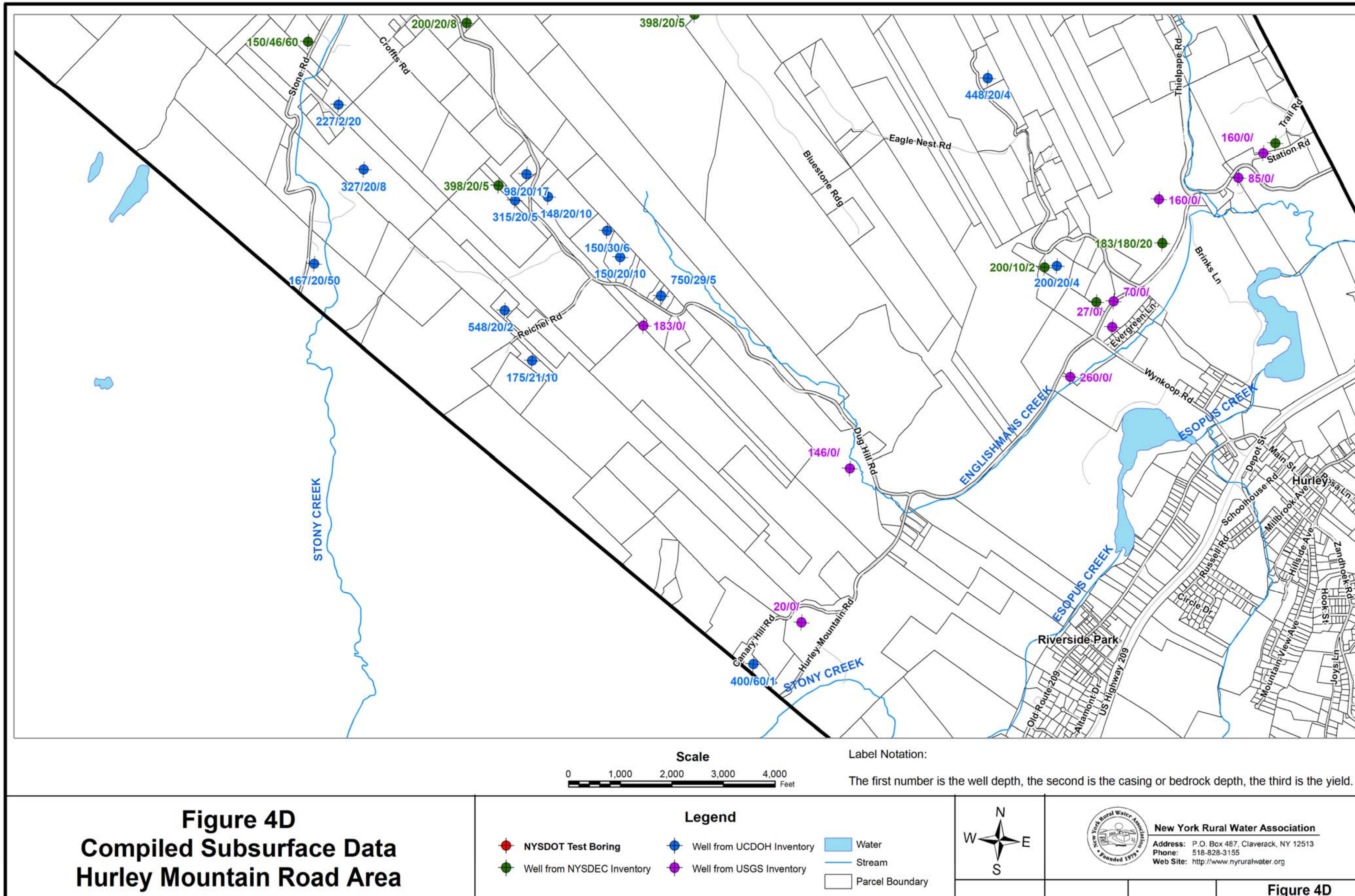


Figure 4D
Compiled Subsurface Data
Hurley Mountain Road Area

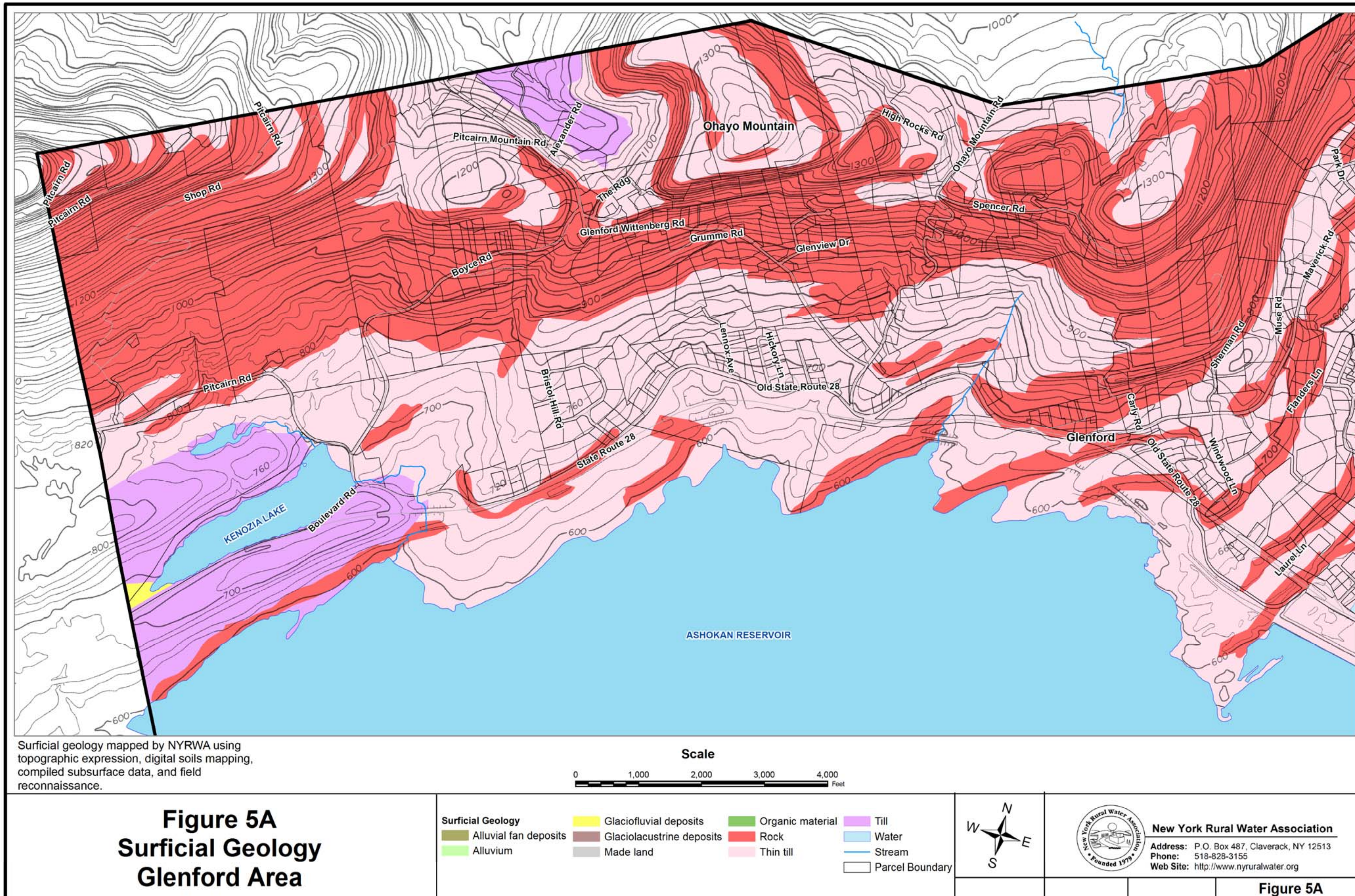
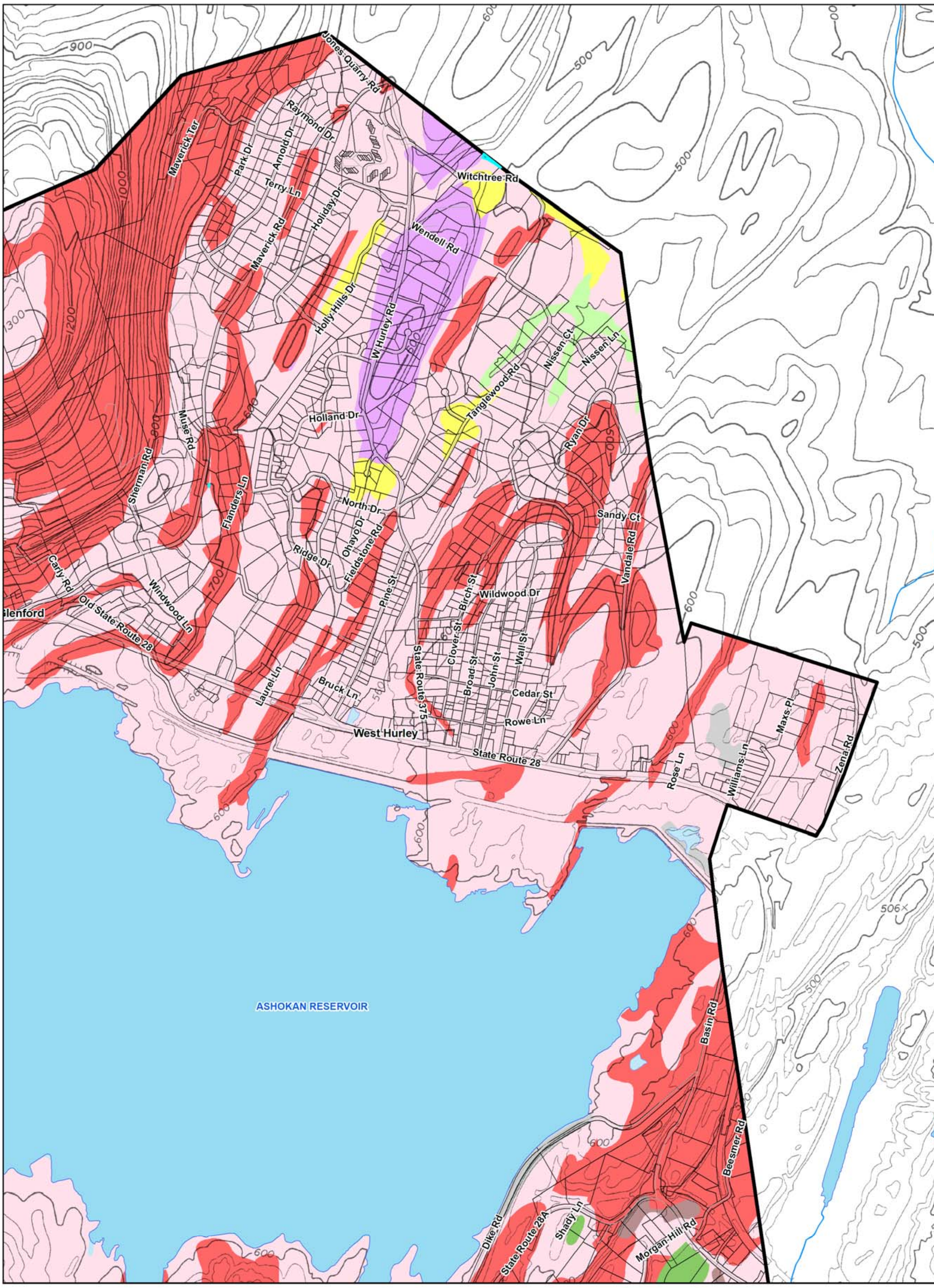


Figure 5A
Surficial Geology
Glenford Area



Surficial geology mapped by NYRWA using topographic expression, digital soils mapping, compiled subsurface data, and field reconnaissance.

Scale

0 | 1,200 | 2,400 | 3,600 | 4,800 Feet

Figure 5B
Surficial Geology
West Hurley Area

Surficial Geology
- Alluvial fan deposits
- Alluvium
- Glaciofluvial deposits
- Glaciolacustrine deposits
- Made land
- Organic material
- Rock
- Thin till
- Till
- Water
- Stream
- Parcel Boundary

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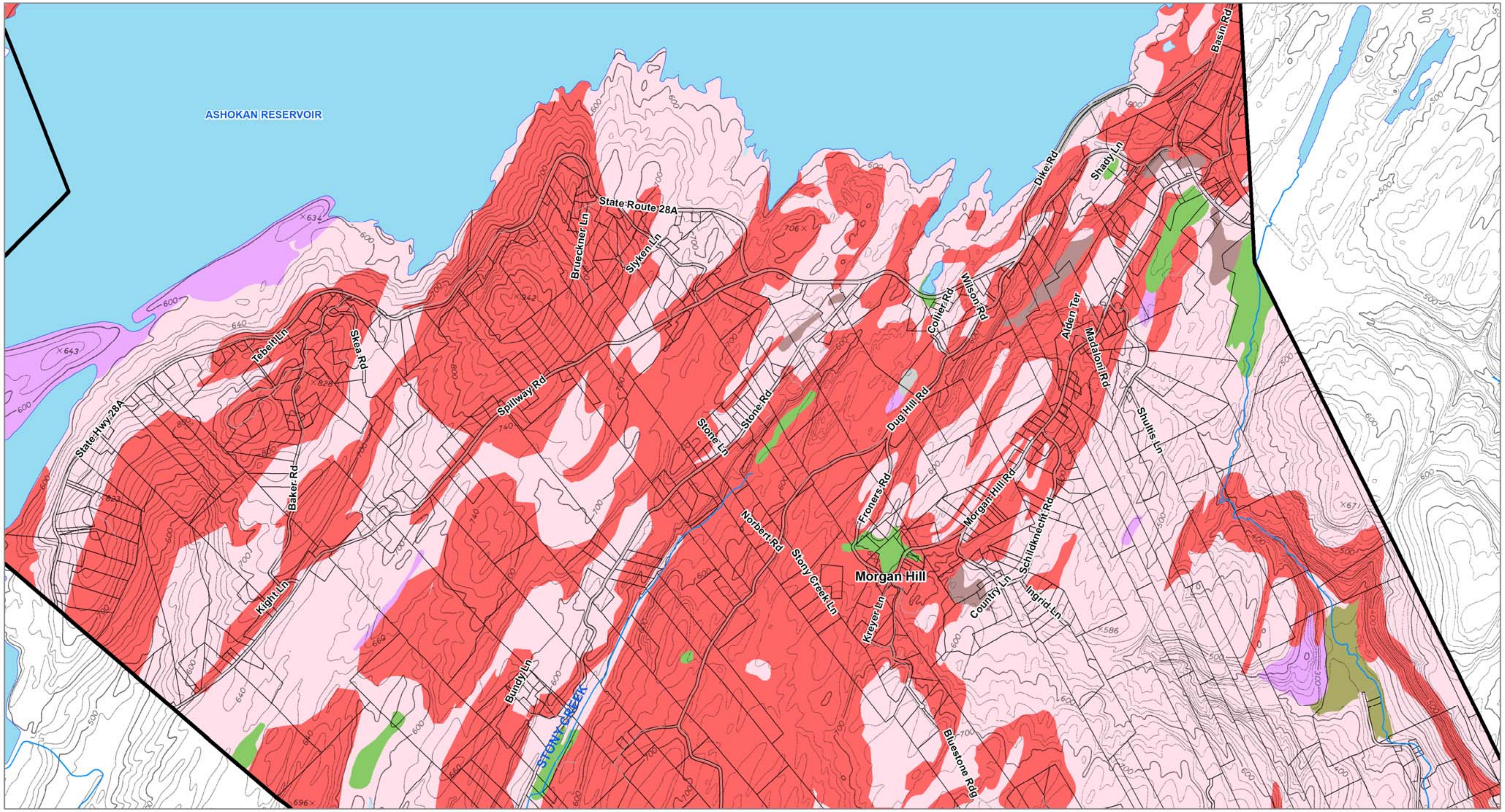
Figure 5B



Surficial geology mapped by NYRWA using topographic expression, digital soils mapping, compiled subsurface data, and field reconnaissance.

Scale

0 1,000 2,000 3,000 4,000 Feet

Figure 5C
Surficial Geology
Area South of Ashokan Reservoir

Surficial Geology
- Alluvial fan deposits
- Alluvium
- Glaciofluvial deposits
- Glaciolacustrine deposits
- Made land
- Organic material
- Rock
- Thin till
- Till
- Water
- Stream
- Parcel Boundary

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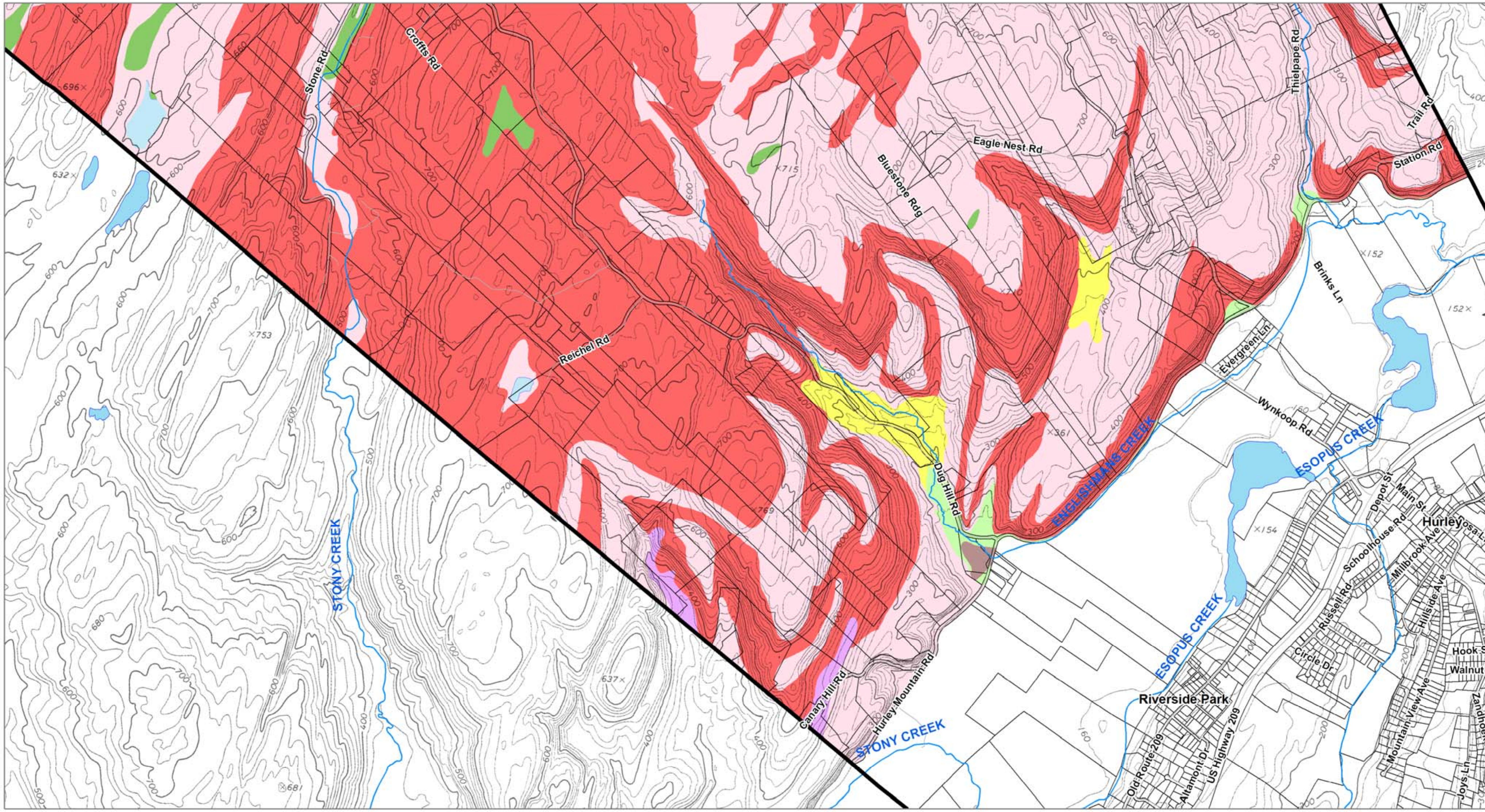
Figure 5C



Surficial geology mapped by NYRWA using topographic expression, digital soils mapping, compiled subsurface data, and field reconnaissance.

Scale
0 1,000 2,000 3,000 4,000 Feet

Figure 5D
Surficial Geology
Hurley Mountain Road Area

Surficial Geology
- Alluvial fan deposits
- Alluvium
- Glaciofluvial deposits
- Glaciolacustrine deposits
- Made land
- Organic material
- Rock
- Thin till
- Till
- Water
- Stream
- Parcel Boundary

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Figure 5D

After the glacial ice receded from the area, modern-day drainage became established. Thin layers of sand, gravel, and silt known as alluvium were deposited along floodplain areas in valleys. Organic (wetland) sediments were deposited in many depressions across the area as well.

4.0 GROUNDWATER OCCURRENCE

Groundwater is subsurface water that fills (saturates) all the voids in the rock or soil. Groundwater is found between in the pore spaces between individual grains that range in size from clay to gravel. This is referred to as primary porosity. Groundwater also occurs in cracks (fractures) found in rock. This is known as secondary porosity. Most of the water in local bedrock is found in fractures.

4.1 Unconsolidated Deposits

Due to the absence of glaciofluvial deposits, wells in the study area have not been completed in unconsolidated aquifers. The only wells reportedly completed above the bedrock in unconsolidated deposits date from before 1960, are 15-20 feet deep, and are taken from the United States Geological Survey's National Water Information System. The locations of these wells cannot be verified. They likely were completed in deeper glacial till deposits or alluvium. Such shallow wells are not advisable and are largely not completed today due to the potential for impacts from contamination and drought.

4.2 Bedrock

4.2.1 Well Depths

Bedrock is the source of groundwater for virtually all residents and businesses in the study area. In bedrock, steel casing is set through the overburden (unconsolidated deposits) and into the first few feet of sound rock. The remainder of the well is left as an open borehole in the rock. The well is generally complete once an adequate number of water-bearing fractures have been encountered and there is adequate storage volume in the well.

Although the median depth of bedrock wells in the study area is 200 feet, well depths range from 57 to 1,198 feet. The distribution of well depths is illustrated in Figure 6. Well depths geographically vary as indicated on Figures 7A-7D. The deepest wells in the area are found in the vicinity of Ohayo Mountain (High Rocks Road, Spencer Road etc.). Here, well depths routinely exceed 900 feet. Another area of relatively deep wells includes the elevated area near Morgan Hill (Figure 6C).

4.2.2 Well Yields

Compiled well yields in the study area range from 0.25 gallons per minute (gpm) to 100 gpm. The median well yield is 8 gpm. As the distribution of yields on Figure 8 indicates, 18.2 percent of wells in the area yield less than the 5 gpm required by Federal Housing Administration (FHA) insured loans for new home loans. Just seven percent of drilled wells in the area yield 1 gpm or

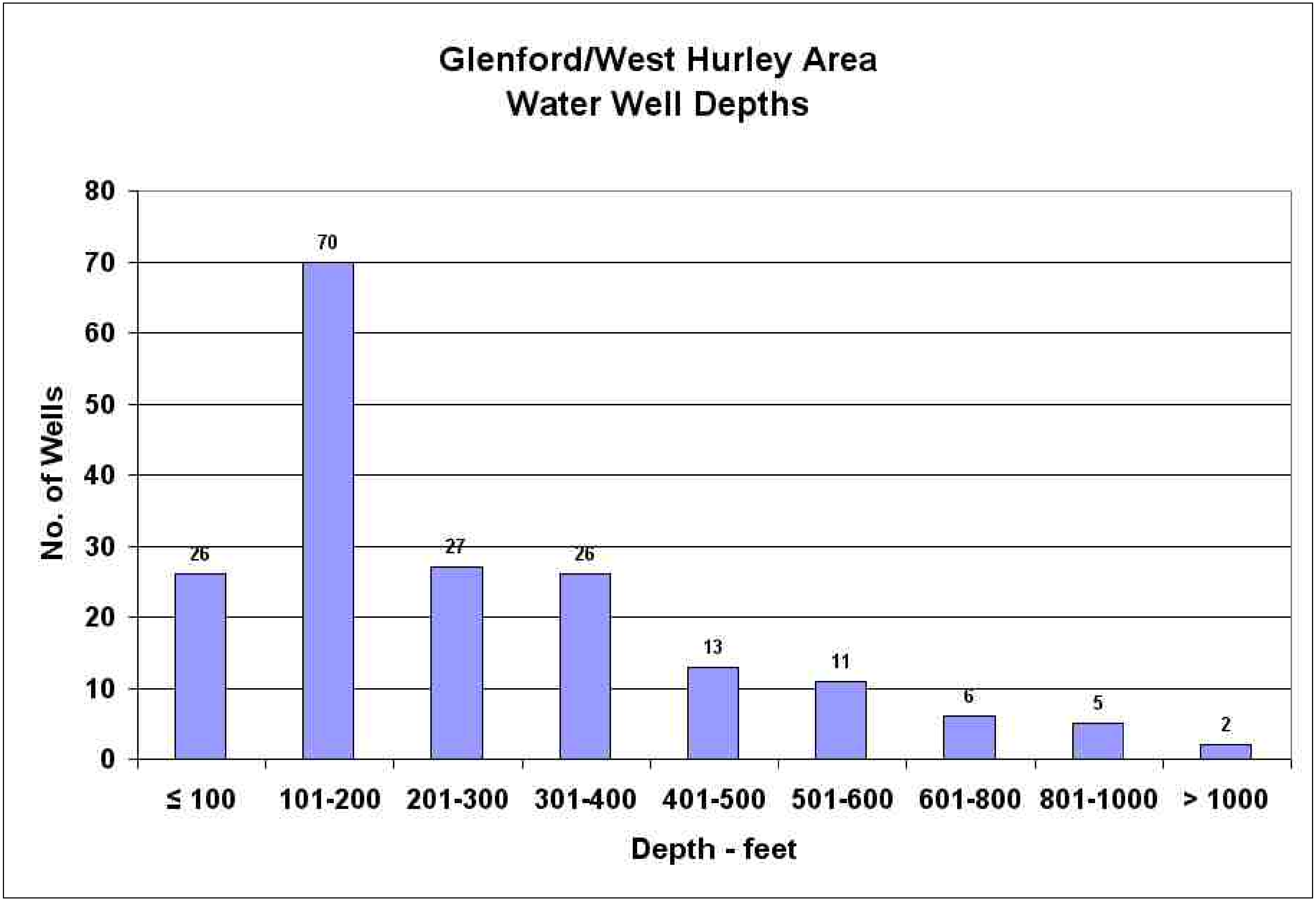


Figure 6. Distribution of Water Well Depths.

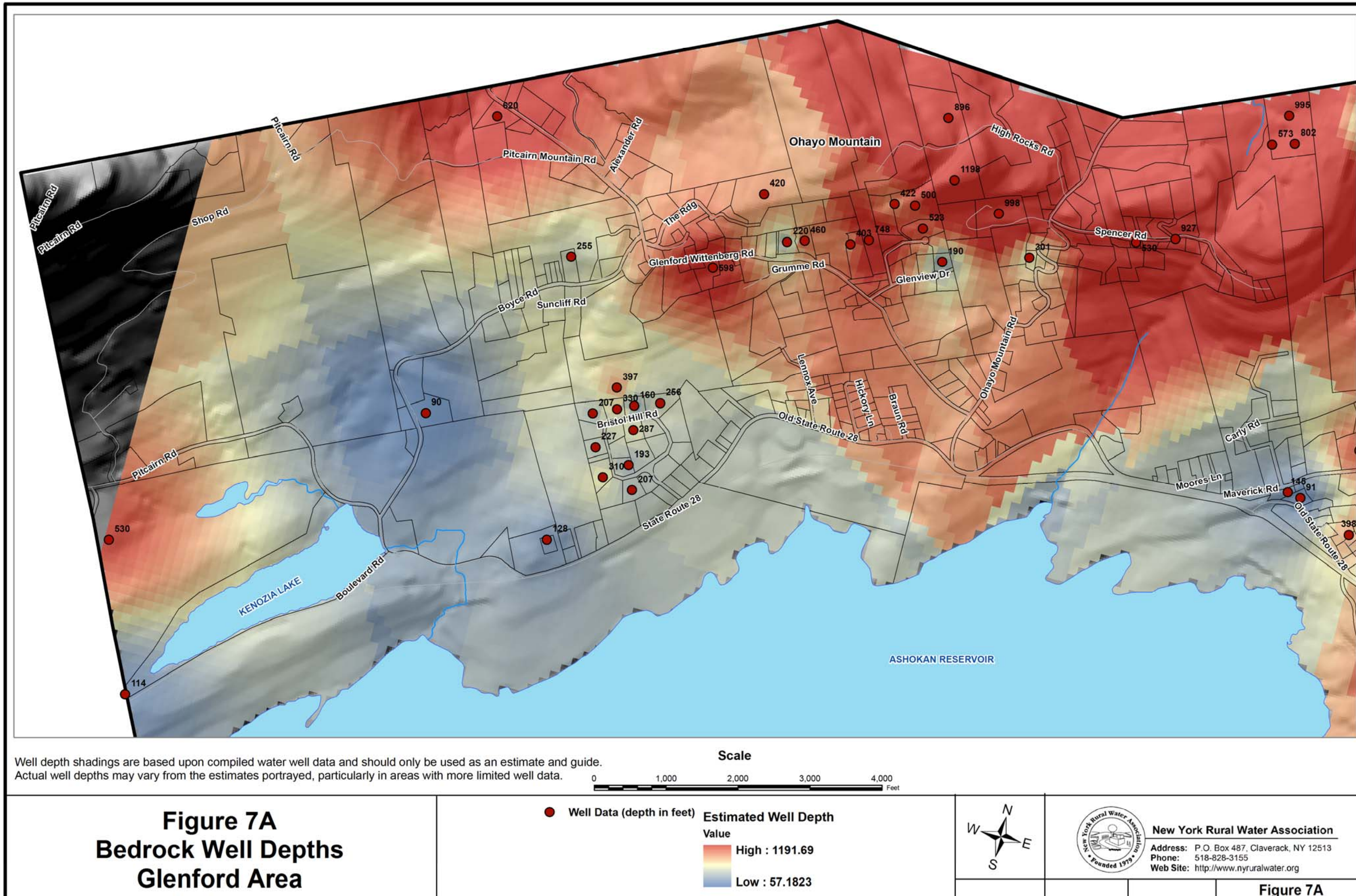
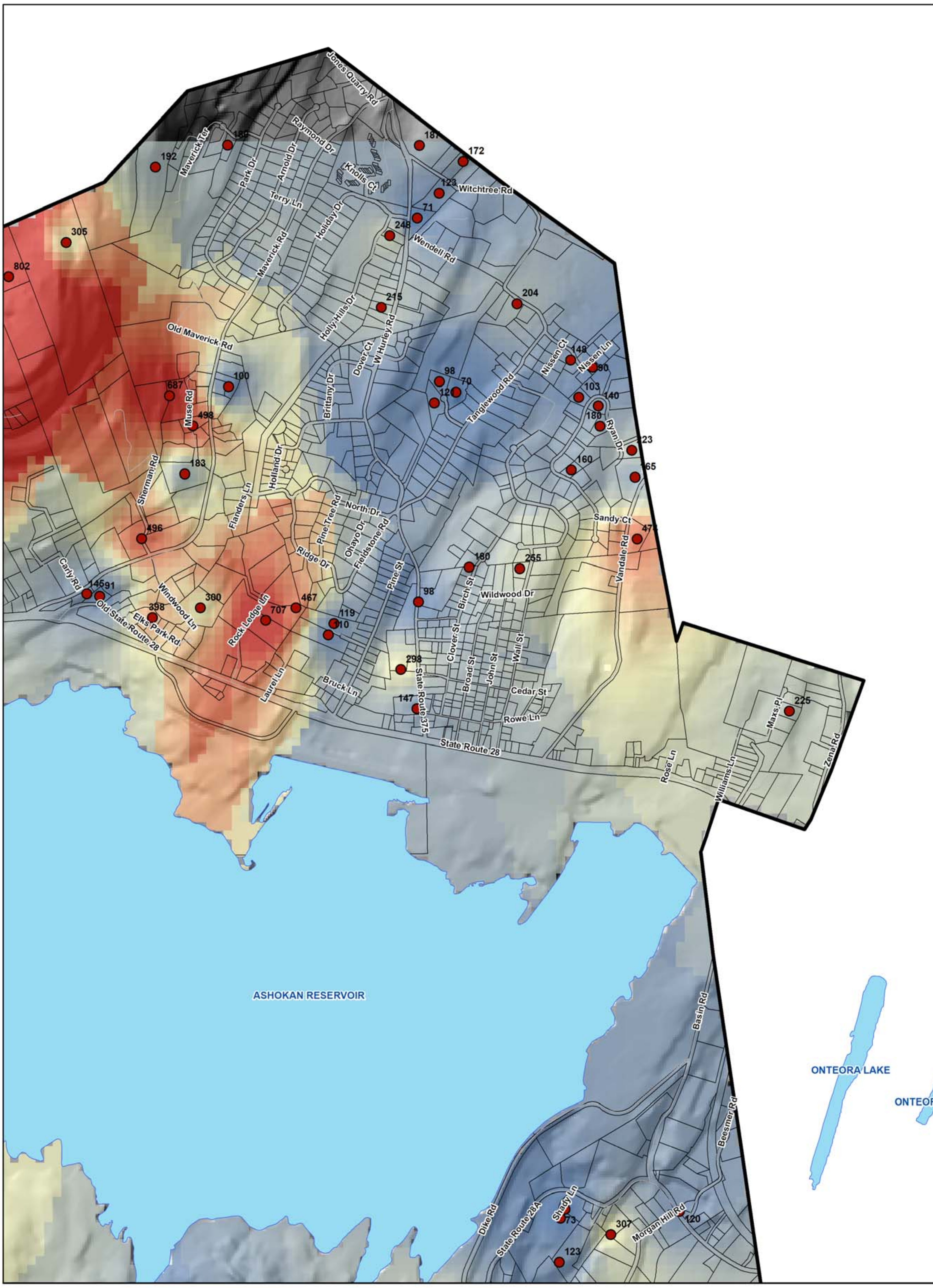


Figure 7A
Bedrock Well Depths
Glenford Area



Well depth shadings are based upon compiled water well data and should only be used as an estimate and guide.
Actual well depths may vary from the estimates portrayed, particularly in areas with more limited well data.

Scale

0 1,500 3,000 4,500 6,000 Feet

● Well Data (depth in feet)

Estimated Well Depth

Value

High : 1191.69

Low : 57.1823

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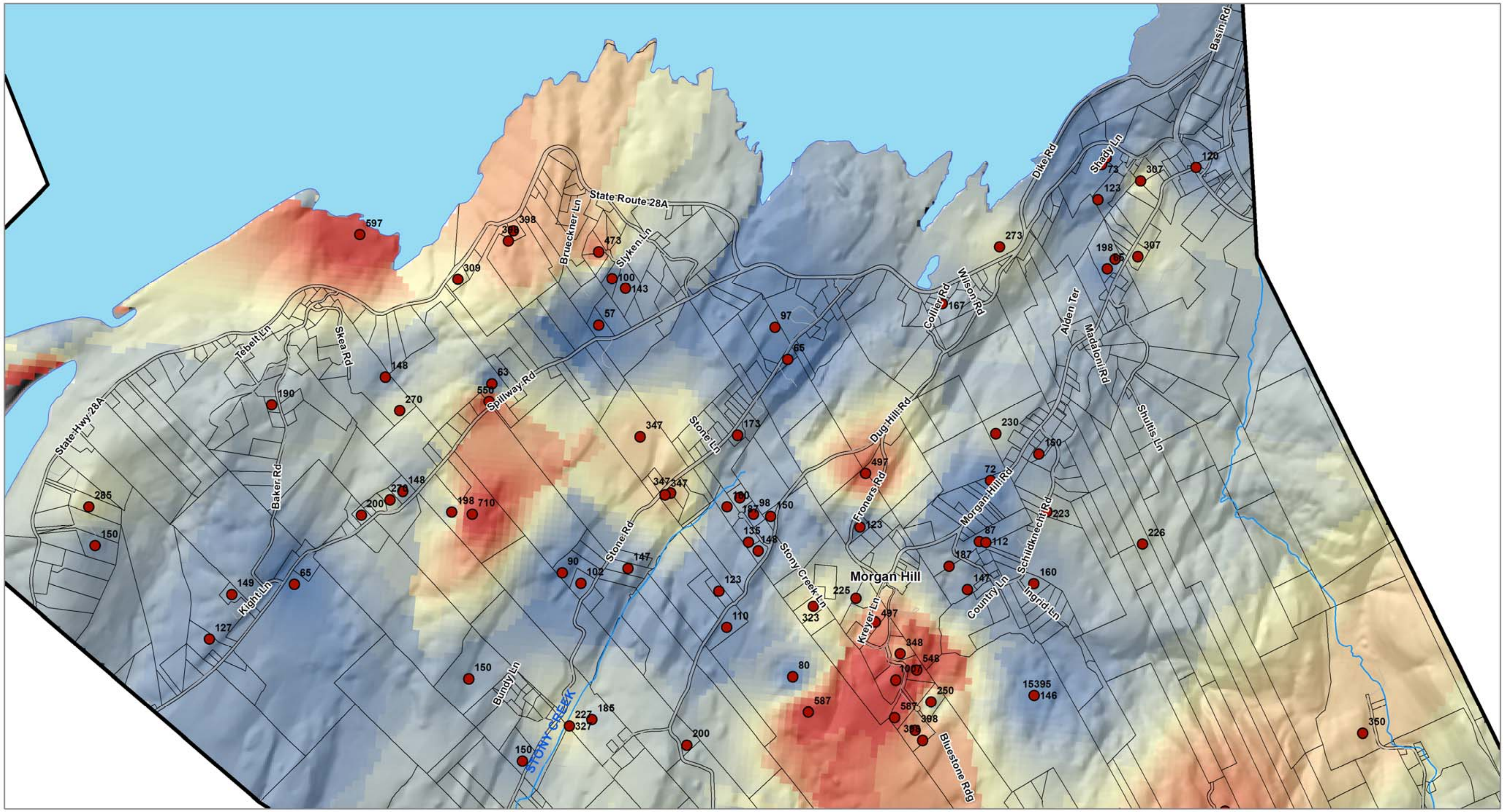
Figure 7B
Bedrock Well Depths
West Hurley Area

Figure 7B



Well depth shadings are based upon compiled water well data and should only be used as an estimate and guide. Actual well depths may vary from the estimates portrayed, particularly in areas with more limited well data.

Scale

0 1,000 2,000 3,000 4,000 Feet

Figure 7C
Bedrock Well Depths
Area South of Ashokan Reservoir

● Well Data (depth in feet)

Estimated Well Depth

Value

High : 1191.69

Low : 57.1823

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Figure 7C

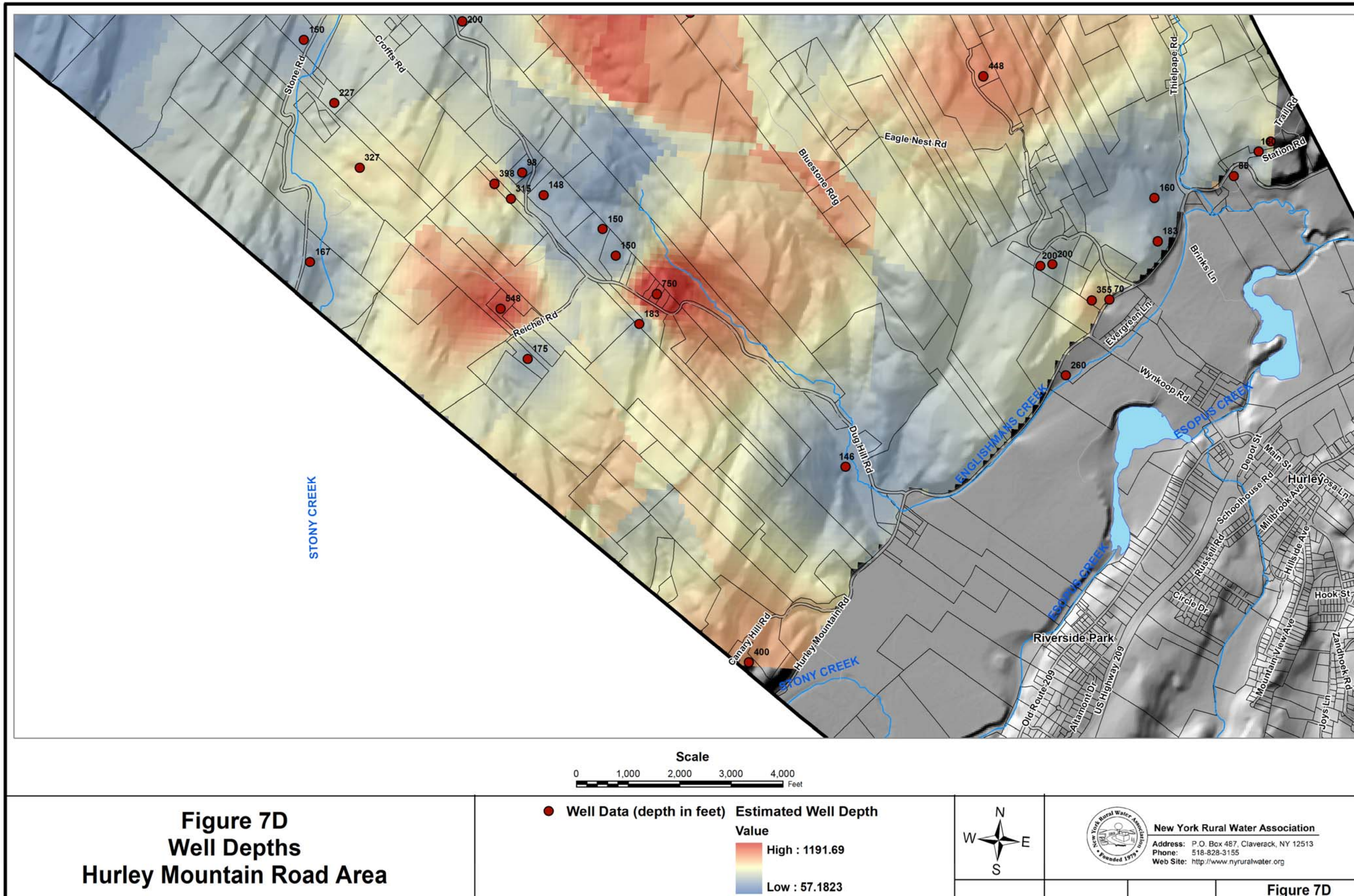


Figure 7D
Well Depths
Hurley Mountain Road Area

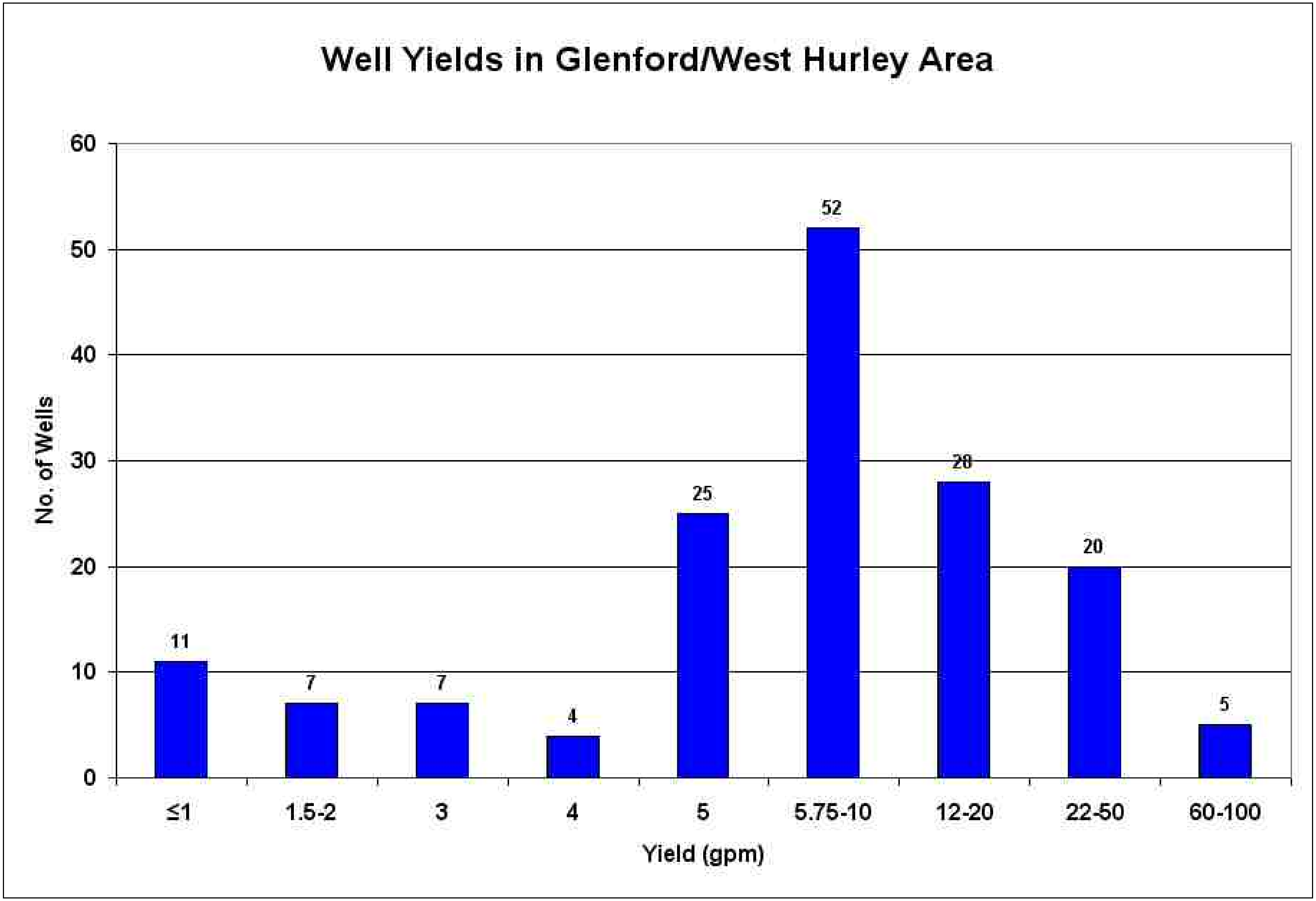


Figure 8. Distribution of Water Well Yields.

less. NYSDOH does not recommend the use of wells with yields of 1 gallon per minute or less for any homes with four or more bedrooms.

There are several factors that control bedrock well yield. Higher yielding wells are generally found in more permeable bedrock formations that have more intense rock fracturing, are more often in topographic lows, and frequently are situated near linear features found on topographic maps or aerial photographs. Conversely, low yielding wells are often found in poorly permeable formations (shale), and are usually situated on steep slopes at higher elevations or hilltops.

A major control on bedrock well yield is the formation. Wells completed in the area underlain by the Plattekill and Ashokan Formations (Figure 3-1) have a median yield of 9 gallons per minute (gpm). This is in contrast to median yields of 5 gpm and 5.75 gpm for the areas underlain by the Undifferentiated Lower Hamilton Group and Moscow Formation respectively (see Figure 3-1).

The largest control on well yield in the study area is the relative number of fractures in the local rock intersected by the wellbore. These fractures are often concentrated in zones that are marked by linear features visible on aerial photography and topographic maps. Using digital elevation models and aerial photography, NYRWA mapped these individual linear features and clusters of such features on Figures 9A-9D. Clusters of mapped linear features are indicated on these maps as *Possible Concentration of Bedrock Fractures*. The number of high-yield wells in each area is noted as well. High-yield wells are considered those above the median value (8 gpm).

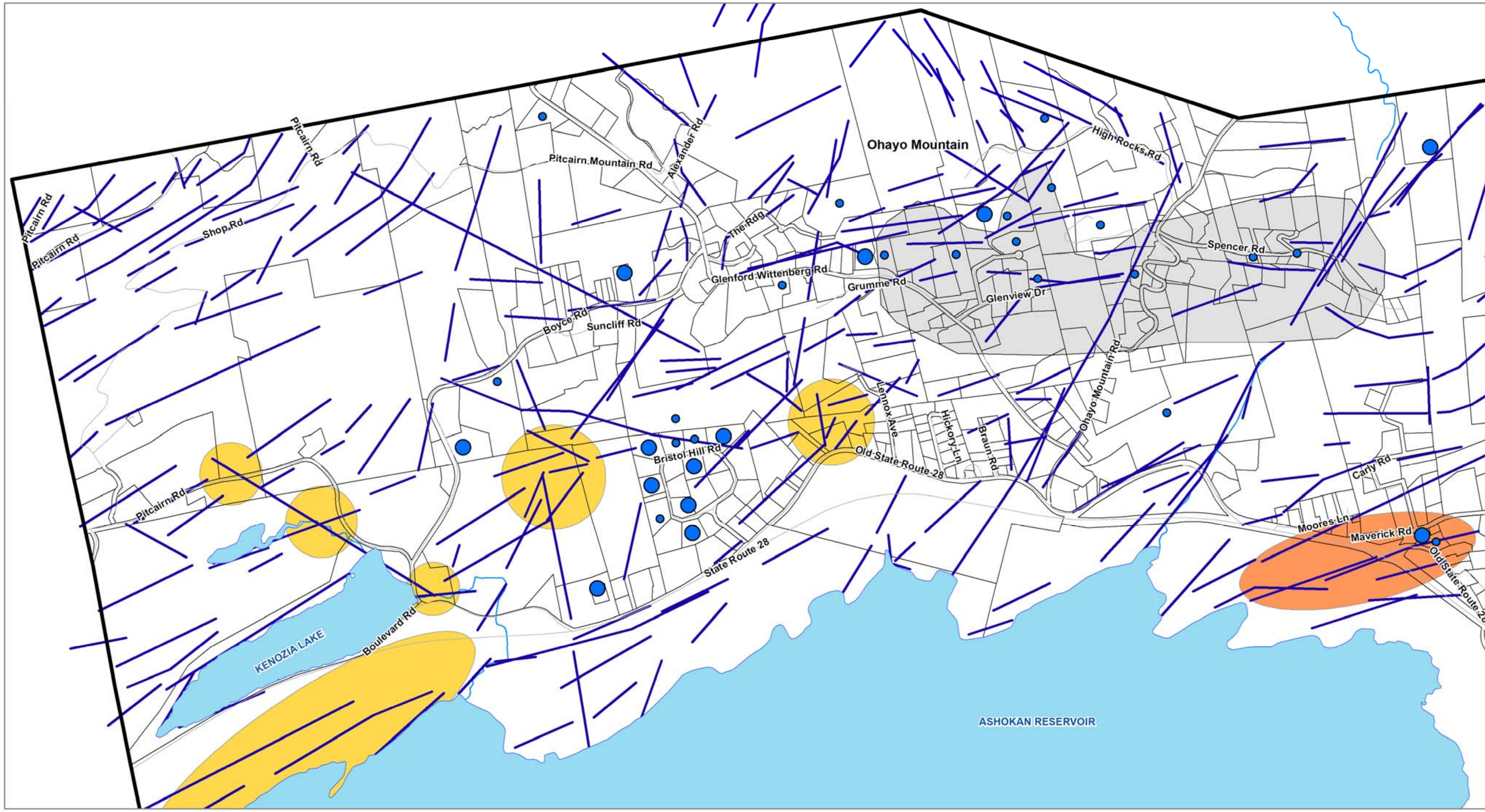
The areas marked as *Possible Concentration of Bedrock Fractures* generally trend northeasterly, coincident with the master joint (fracture) set in the region. Such areas typically present themselves as topographic lows. Areas of concentrated linear features are especially noteworthy south of the Ashokan Reservoir. Here, such features are traceable for up to four miles in length.

A very strong correlation exists between well yield and these concentrations of linear features. For such areas with existing well data, the median well yield is 20 gpm versus 5 gpm for wells not located in such zones.

In addition to the areas with higher yields, NYRWA identified two areas where well yields are consistently lower than average. Not coincidentally, these areas also correspond to those areas with deeper than average wells: the vicinity of Ohayo Mountain and Morgan Hill (see Figures 9A and 9C respectively). In addition to higher topographic settings, these areas are marked by an absence of concentrations of linear features.

4.2.3 Water Quality

Unfortunately, well water quality data is not widely available for wells. Therefore, NYRWA conducted an online survey of local residents to determine if there were water quality concerns in the area. The online survey was posted to the Town of Hurley's



Linear features possibly reflective of underlying fractures zones mapped by NYRWA from tonal variations and topographic expression.

Scale

0 780 1,560 2,340 3,120 Feet

Figure 9A
Bedrock Well Yields
Glenford Area

Reported Water Well Yield

Yield

- < 10 gpm
- >= 10 gpm
- Linear Feature

Possible Concentration of Bedrock Fractures

No. of Higher Yield Wells

- 0
- 1
- 2
- 3 - 4
- 5 - 6

Area of Well Yields <= 5 gpm

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Figure 9A

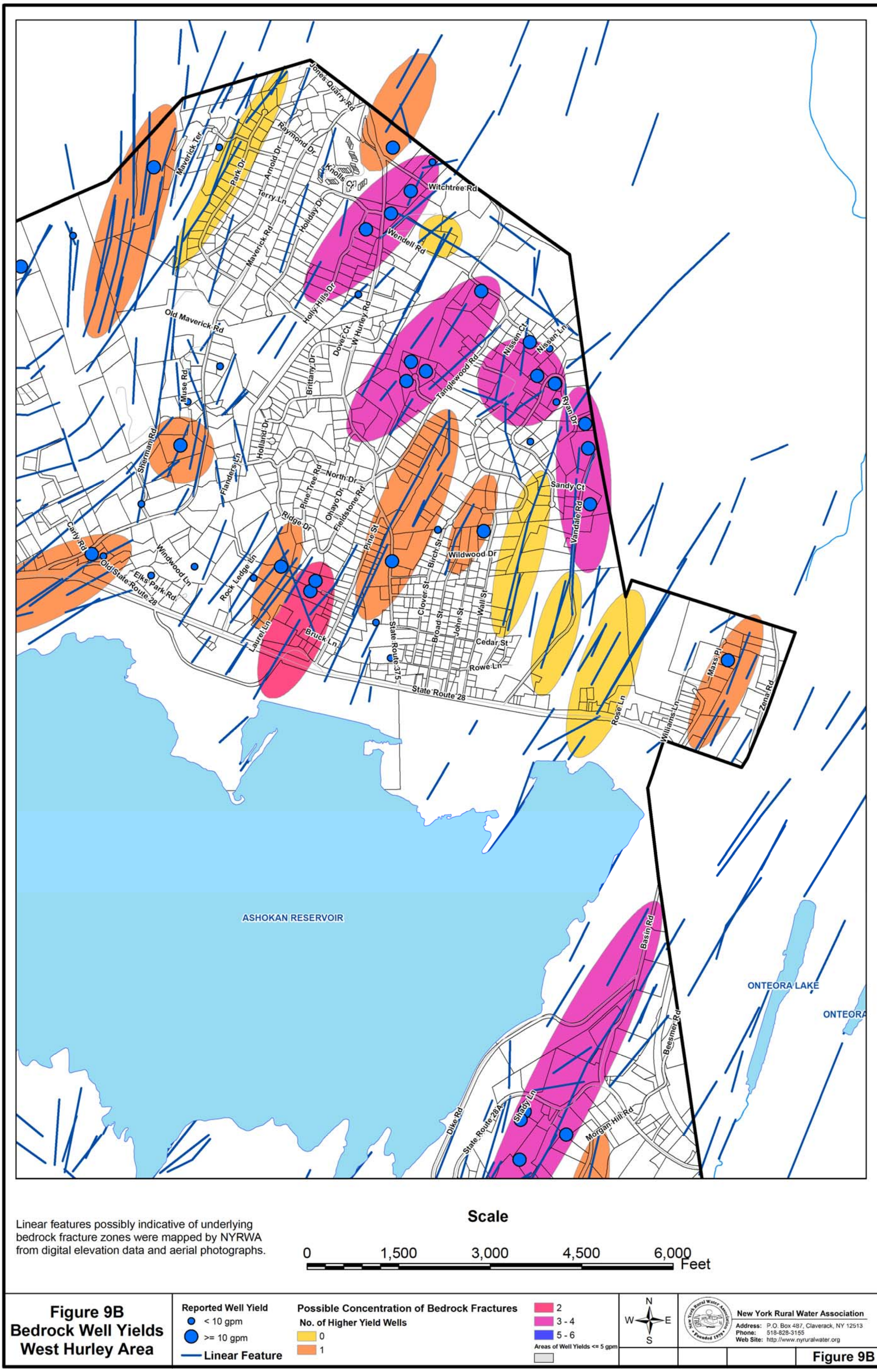
Jones Quarry Rd
Maverick Ter
Park Dr
Raymond Dr
Arnold Dr
Knolls Ct
Terry Ln
Holiday Dr
Witchtree Rd
Wendell Rd
Maverick Rd
Holly Hills Dr
W Hurley Rd
Old Maverick Rd
Dover Ct
Brittany Dr
Nissen Ct
Nissen Ln
Tanglewood Rd
Muse Rd
Ryan Dr
Holland Dr
Sherman Rd
Flanders Ln
North Dr
Pine Tree Rd
Ohayo Dr
Fieldstone Rd
Sandy Ct
Vandale Rd
Ridge Dr
Cary Rd
Pine St
Birch St
Wildwood Dr
Windwood Ln
Old State Route 28
Elks Park Rd
Rock Ledge Ln
Clover St
Broad St
John St
Wall St
Laurel Ln
Bruck Ln
State Route 375
Cedar St
Rowe Ln
State Route 28
Rose Ln
Williams Ln
Maxs Pl
Zena Rd
ASHOKAN RESERVOIR
ONTEORA LAKE
ONTEORA
Basin Rd
Beesmer Rd
Dike Rd
Shady Ln
State Route 28A
Morgan Hill Rd
Linear features possibly indicative of underlying bedrock fracture zones were mapped by NYRWA from digital elevation data and aerial photographs.
Scale
0
1,500
3,000
4,500
6,000
Feet
Figure 9B
Bedrock Well Yields
West Hurley Area
Reported Well Yield
< 10 gpm
>= 10 gpm
Linear Feature
Possible Concentration of Bedrock Fractures
No. of Higher Yield Wells
0
1
2
3 - 4
5 - 6
Areas of Well Yields <= 5 gpm
N
W
E
S
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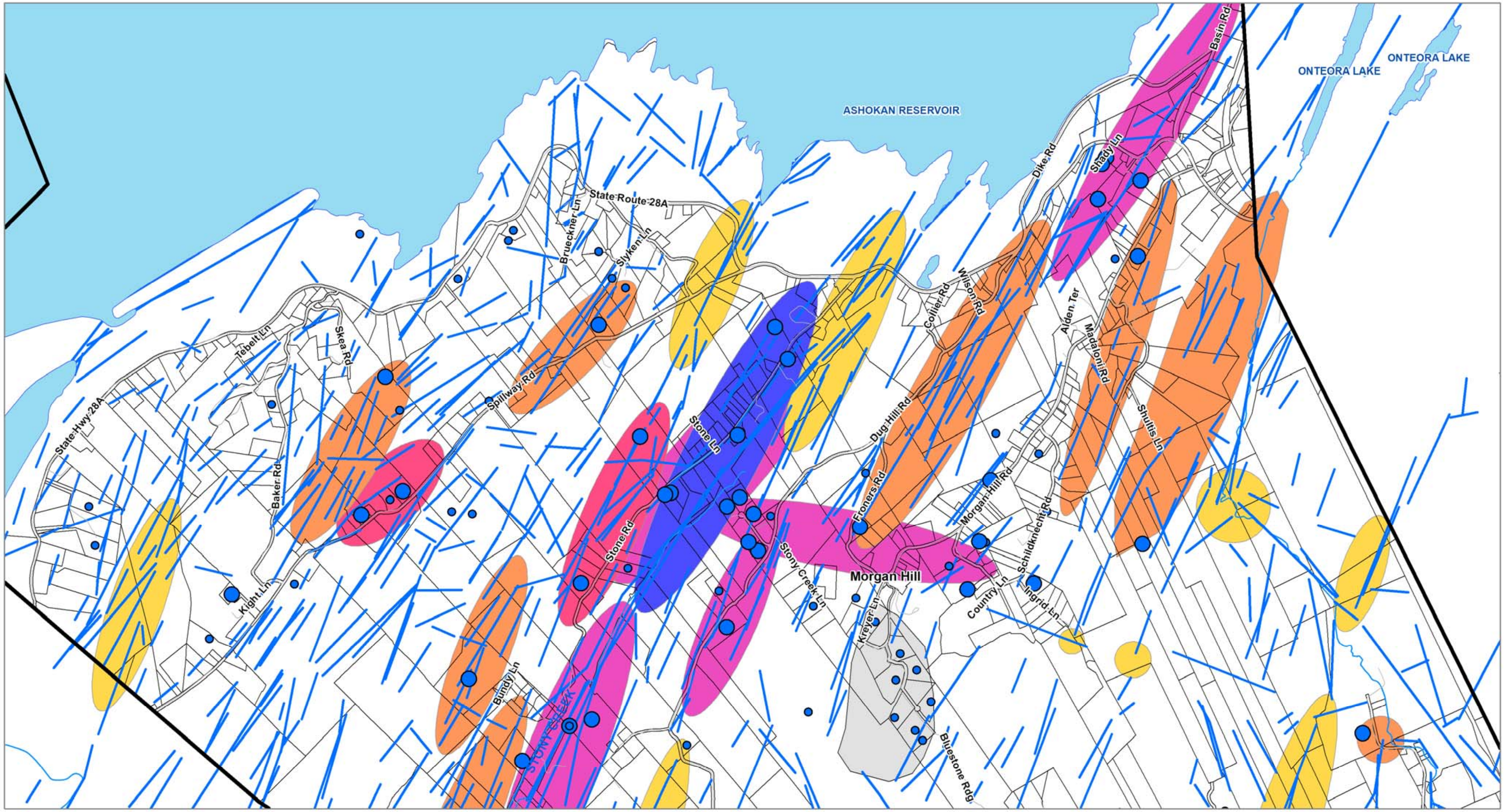
Figure 9B



Linear features possibly indicative of underlying bedrock fracture zones were mapped by NYRWA from digital elevation data and aerial photographs.

Scale

0 1,000 2,000 3,000 4,000 Feet

Figure 9C
Bedrock Well Yields
Area South of Ashokan Reservoir

Reported Water Well Yield

Yield
- < 10 gpm
- >= 10 gpm
- Linear Feature

Possible Concentration of Bedrock Fractures

No. of Higher Yield Wells
- 0
- 1
- 2
- 3 - 4
- 5 - 6
- Area of Yields <= 5 gpm

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Figure 9C

Surficial geology mapped by NYRWA using topographic expression, digital soils mapping, compiled subsurface data, and field reconnaissance.

Scale

0 1,000 2,000 3,000 4,000 Feet

Figure 9D
Bedrock Well Yields
Hurley Mountain Road Area

Reported Water Well Yield

Yield

- < 10 gpm
- >= 10 gpm
- Linear Feature

Possible Concentration of Bedrock Fractures

No. of Higher Yield Wells

- 0
- 1
- 2
- 3 - 4
- 5 - 6

Area of Yields <= 5 gpm

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Figure 9D

website in April, 2009. From April, 2009 to August, 2009 six residents responded to the survey.

One-third of respondents indicated that they had experienced no problems with their wells. Reddish and black staining indicative of excess iron and manganese, rotten-egg odor caused by hydrogen sulfide, and green staining caused by low pH were reported. One resident reported that E. coli bacteria were found after a septic system had been built on a neighboring lot. In addition, one resident on the Glenford Wittenberg Road indicated problems with not having enough water. This is consistent with the results detailed in section 4.2.2 above.

5.0 HYDROGEOLOGIC ANALYSES

5.1 Inventory of Existing and Potential Contaminant Sources

Groundwater resources are susceptible to contamination from a variety of manmade sources. These include various so-called high-risk industrial, commercial, residential, and agricultural uses and activities. Once contaminated, groundwater can be difficult and costly to cleanup. The West Hurley area contains a large concentration of existing and potential sources of contamination. These have been investigated and mapped on Figure 10 as part of this study.

A number of petroleum spills have been investigated in the area by the NYSDEC Spill Response Unit. Many of these spills were found to not be of serious concern and their cases were closed. However, some of these spills were investigated further and cleanup activities were undertaken. Some of these spills have not been closed in the area (see Figure 10). These spills are either still being investigated or have not met cleanup standards.

Some of the sites mapped on Figure 10 represent facilities regulated by the NYSDEC and/or USEPA. These include petroleum bulk storage facilities (combined storage ≥ 1,100 gallons), SPDES dischargers (wastewater discharges ≥ 1,000 gallons/day), RCRA waste facilities, and hazardous waste sites. Two hazardous waste sites are mapped in the West Hurley area. One is the so-called Rotron-Woodstock site located just to the north in the Town of Woodstock, Ulster County (Figure 10). A groundwater extraction and treatment system and soil-vapor extraction system were installed here and continue to operate. The Numrich Arms Gun Parts Corporation off Williams Lane was once listed as a Superfund site in the 1990's. It is no longer on the current Superfund list and is now listed as a USEPA RCRA waste handler.

NYRWA used property classification codes from Ulster County real property data to identify higher risk land uses within the study area. This land uses have not necessarily caused groundwater contamination, but have greater risk to do so. Such land uses in the West Hurley area include: bus garages, gas stations, manufacturing facilities, vehicle repair garage(s), and waste handling facilities (see Figure 10).

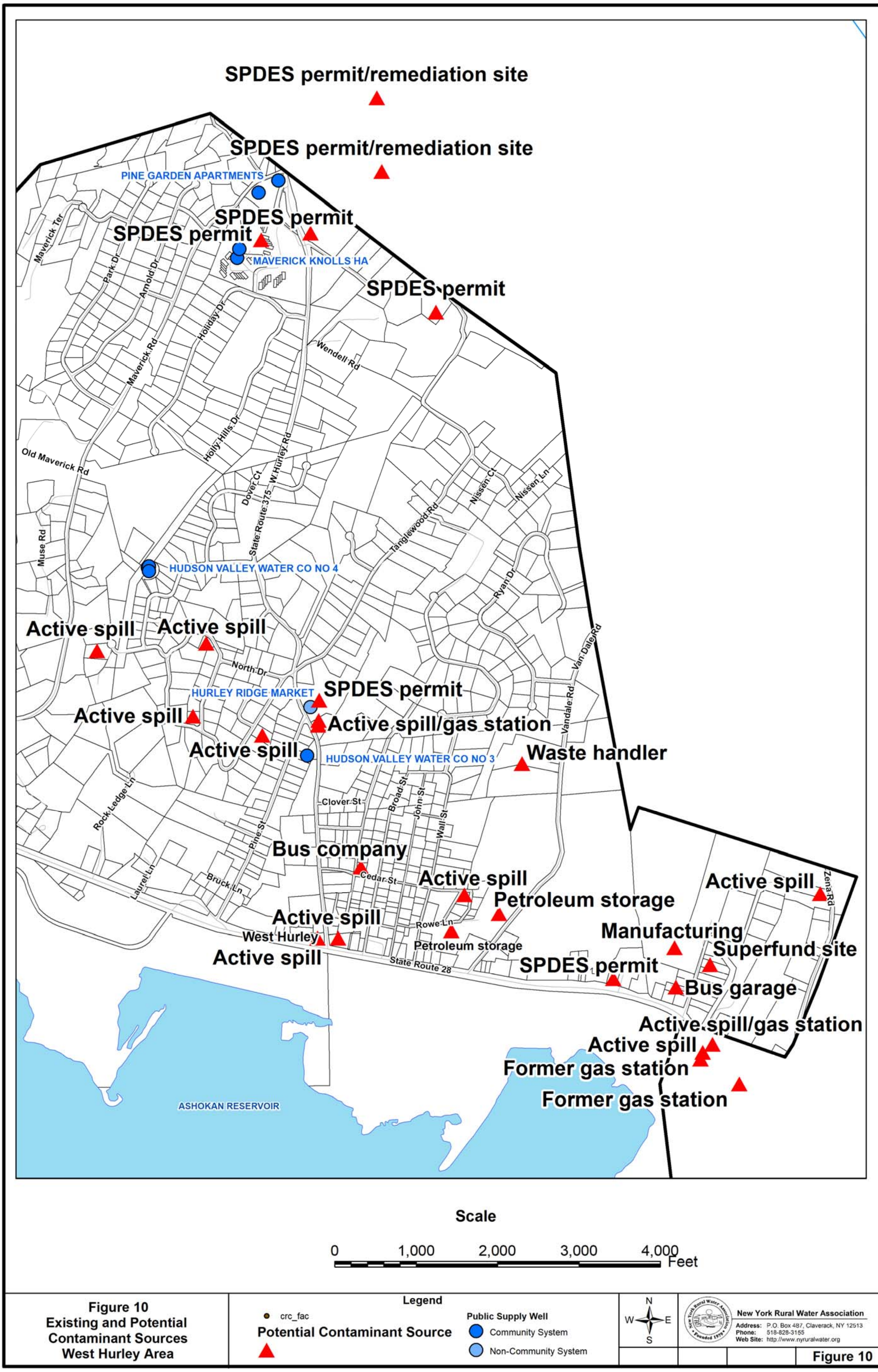

Figure 10
Existing and Potential Contaminant Sources
West Hurley Area

5.2 Hydrogeologic Sensitivity

Vulnerability to groundwater contamination depends in large part on the hydrogeologic setting. Sensitive hydrogeologic settings are those aquifer types that have large interconnected openings (voids) that allow groundwater to move at relatively high velocities with little or no reduction of contamination. The USEPA (2000) has identified three types of sensitive aquifers types: (1) karst aquifers, (2) fractured bedrock aquifers, and (3) gravel aquifers. These types of aquifers are highly vulnerable to contamination unless a hydrogeologic barrier exists. Hydrogeologic barriers are physical, chemical, and biological factors that prevent the movement of contaminants to a supply well.

In this report, the *hydrogeologic sensitivity* of a location is a relative measure of the ease and speed with which a contaminant could migrate into and within the upper-most water-bearing unit. High to very high hydrogeologic sensitivity ratings indicate that, in general, groundwater could be easily and quickly impacted by surface activities.

The two factors controlling the hydrogeologic sensitivity are the site's geologic materials (the hydraulic characteristics of the uppermost water-bearing unit and the overlying soils) and the site's topographic position (the topographic factors influencing the vertical migration of groundwater). Using GIS, NYRWA was able to identify those areas with geologic materials and topography that would result in higher hydrogeologic sensitivity. These areas have been mapped on Figure 11. In general, such settings are underlain by coarse-grained soils or thin-soils where topography would promote groundwater recharge. These include topographic highs with relatively low slopes.

Sensitive hydrogeologic areas on Figure 11 have been subdivided as to their land use based upon property classification codes from Ulster County real property data For example, sensitive areas owned by New York State or New York City are classified as protected sensitive areas. Most of the area classified as vacant or undeveloped sensitive is located in the area between the Ashokan Reservoir and Hurley Mountain Road.

5.3 Municipal Water Supply Planning

In April 2007, C.T. Male Associates, P.C. completed a report entitled ***Water Service Feasibility Study***. The intent of this study was principally to layout a possible West Hurley municipal water district and system schematic, to provide a cost estimate for the infrastructure, and determine potential user costs. The proposed water district from this study is shown on Figure 12.

In order to locate a suitable site for a public water supply well for a municipal water district in West Hurley, several factors must be considered. An ideal well site would be:

a. within or contiguous to the proposed water district;
b. located away from potential sources of contamination (> 500 feet);
c. less vulnerable to the direct influence of surface water (>200 feet from water);

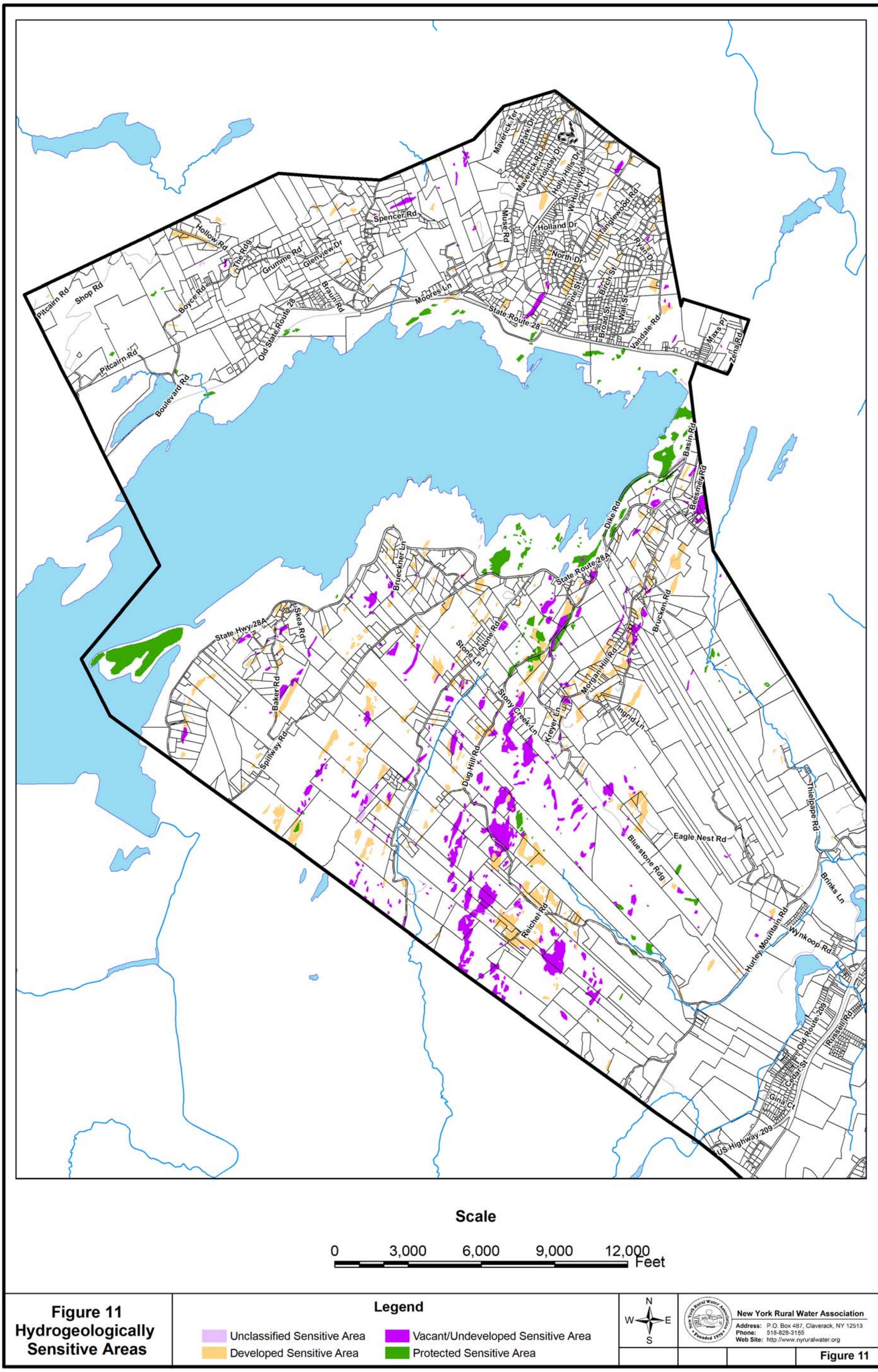

Figure 11 Hydrogeologically Sensitive Areas

Scale

0 600 1,200 1,800 2,400 Feet

Figure 12 Public Supply Well Planning

- Public Supply Well
- Potential Contaminant Source
- Proposed Water District Boundary
- Linear Feature
- Potential Supply Well Location

N W E S

New York Rural Water Association
Address: P.O. Box 487, Claverack, NY 12513
Phone: 518-828-3155
Web Site: http://www.nyruralwater.org

Figure 12

d. capable of meeting requirements for land ownership/control (at least 200 feet);
e. located in a potentially productive well yield area; and
f. accessible for drilling, etc.

Using these criteria, seven (7) possible sites for a new water supply well have been identified by NYRWA (see Figure 12). The characteristics of each potential well site are indicated in Table 1. Three of these sites are located on property owned by the Onteora Central School District (West Hurley Elementary School).

Another option that should be investigated are existing public supply wells in the area, particularly those that are already meeting NYSDOH standards for community public water systems. Once such well is that utilized by the Hudson Valley Water Company No. 3. Yield information was not obtained by NYRWA for this well, but it is located along a prominent fracture trace (Figure 12).

5.0 GROUNDWATER PROTECTION STRATEGIES

It is important to develop and implement effective groundwater protection measures in order to protect water resources and encourage future development where it is best suited. There are number of groundwater protection measures that can be chosen. Some of these are regulatory in nature. Others are non-regulatory. The Town of Hurley must determine which measures are acceptable given local socioeconomic and political conditions.

5.1 Open Space Planning

NYRWA recommends that the Hurley Open Space Preservation Plan be amended to include those sensitive areas identified in Figure 11. Protection of these vulnerable open space areas is critical to groundwater resource protection in the area.

5.2 Land Use Regulations

Subdivision regulations relate to how land is to be divided into lots and what improvements such as streets, lighting, fire protection, utilities, drainage, and parks are made to service the lots. In Hurley, the Town has Land Subdivision Regulations. Subdivisions are to be approved by the Planning Board. One recommendation relevant to the study area is that local subdivision regulations could be rewritten to require more hydrogeologic documentation in sensitive hydrogeologic settings or in areas with poor well yields. Such studies should not only demonstrate that there are adequate groundwater resources to support the planned development, but that the development does not adversely impact upon other existing public or private groundwater supplies or the quantity/quality of surface water.

Perhaps the most widely accepted zoning technique for water resource protection involves overlay zoning. Overlay zoning creates a set of regulations for a given area that are in addition to the regulations in the standard "underlying" zoning districts. In 2006,

Site Name	No. of Parcels	Parcel ID No.	Property Use Classification	Parcel Acres	Acres Located In Site	% of Parcel In Site
A	3	38.10-8-24.2	Rural Vacant Lots of 10 Acres or Less	8.43	6.28	74.4%
		38.1-3-34.14	Rural Vacant Lots of 10 Acres or Less	5.08	0.35	7.0%
		38.1-3-34.15	Rural Vacant Lots of 10 Acres or Less	4.44	2.26	50.8%
B	2	38.10-3-31	Residential Vacant Land	5.13	0.36	7.0%
		38.10-3-5	Schools	16.06	1.15	7.2%
C	1	38.10-3-5	Schools	16.06	1.47	9.2%
D	2	38.10-6-1.2	Rural Vacant Lots of 10 Acres or Less	5.07	1.41	27.8%
		38.10-2-60	Residential Vacant Land Over 10 Acres	13.54	0.13	0.9%
E	1	38.10-2-60	Residential Vacant Land Over 10 Acres	13.54	4.55	33.6%
F	1	38.6-4-20	Rural Vacant Lots of 10 Acres or Less	7.30	6.64	91.1%
G	1	38.10-3-5	Schools	16.06	2.36	14.7%

Table 1. Potential Water District Supply Sites.

NYRWA recommended that the Town of Hurley develop and implement an aquifer protection overlay district for the Old Hurley area. The aquifer in this area consists of sand and gravel and underlying karst (limestone/dolostone) bedrock. An aquifer overlay district would be difficult to implement for Glenford and West Hurley areas due to the nature of the groundwater resources here. It would be more practical to develop wellhead protection overlay zones around public water supply well sources. Adequate data would presumably exist from the development a new supply well to identify the recharge area of such supply well(s).

5.3 Future Water System Work

The engineering feasibility and landowner willingness should be investigated for all seven of the sites identified on Figure 12. If acceptable, future work on a municipal water district for West Hurley could commence with a detailed analysis of the West Hurley Elementary School property as a potential water supply source. This property has three sites identified by NYRWA as potentially suitable for a public water supply site (Sites B, C, and G).

NYSDEC data indicated two underground petroleum storage tanks exist on the school property: a 10,000 gallon fuel oil tank installed in 1990 and a 2,000 gallon fuel oil tank installed in 1987. Locations of these tanks should be documented as part of an environmental assessment of the property. Another potential contaminant source(s) on the property are subsurface wastewater disposal field(s). In addition, a spill of petroleum was reported in 2000 at 76 Cedar Street. This property is less than 500 feet from the school. The spill impacted groundwater and the case remains open as of the writing of this report.

After the research described above is conducted, 2-3 sites should be identified for further investigation. A survey employing surface geophysical techniques such as electrical resistivity profiling or VLF can be completed in a relatively short period of time in order to pinpoint test drilling locations. Although this step may be considered optional, it can improve the odds of finding a high-yielding well and can reduce drilling costs.

Test drilling should be accomplished using a drilling contractor registered with the New York State Department of Environmental Conservation. Such a contractor should be experienced with local conditions and with constructing wells in accordance with NYSDOH regulations (Ten States Standards) for public water supply wells. A qualified hydrogeologist should supervise the test drilling program.

With the history and potential for groundwater contamination in the area, water quality should be assessed early in the test drilling phase. Samples should be analyzed for petroleum compounds and other potential contaminants.