In-City Water Supply Resiliency

Draft Environmental Impact Statement

CEQR No. 15DEP029Q

Prepared by New York City Department of Environmental Protection

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ACM	Asbestos-containing Materials
bgs	Below ground surface
CEA	Critical Environmental Area
CEQR	City Environmental Quality Review
CHASP	Construction Health and Safety Plan
CRIS	Cultural Resource Information System
CSO	Combined Sewer Overflow
cVOC	Carcinogenic Volatile Organic Compounds
DEIS	Draft Environmental Impact Statement
DEP	New York City Department of Environmental Protection
DPW	Department of Public Works
DSNY	New York City Department of Sanitation
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
EJ	Environmental Justice
EPA	Environmental Protection Agency
ESA	Environmental Site Assessments
GAC	Granular Activated Carbon
GHG	Greenhouse Gas
gpm	Gallons per minute
HFC	Hydrofluorocarbons
IGWMC	International Groundwater Modeling Center
IPaC	Information for Planning and Consultation
IXN	Ion Exchange (Nitrate) Vessels
IXP	Ion Exchange (Perchlorate) Vessels
JFK	John F. Kennedy International Airport
kW	Kilowatt
kWh	Kilowatt-hour
LCA	Liquid-phase Carbon Adsorption
LIPA	Long Island Power Authority
mgd	Millions gallons per day
msl	Mean sea level
MTA	Metropolitan Transportation Authority
MTBE	Methyl tertiary butyl ether
$MtCO_2e$	Metric Tons of Carbon Dioxide Equivalent
NHP	Natural Heritage Program

NOAA	National Oceanic and Atmospheric Administration
NWI	National Wetlands Inventory
NWIS	National Water Information System
NYC	New York City
NYCDOHMH	New York City Department of Health and Mental Hygiene
NYCLPC	New York City Landmarks Preservation Commission
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
OXF	Oxidation and Filtration Vessel
PAH	Polycyclic Aromatic Hydrocarbon
PCB	Polychlorinated Biphenyl
PCE	Tetrachloroethylene
PEJA	Potential Environmental Justice Area
PFC	Perfluorocarbons
PLC	Programmable Logic Controller
PLUTO	Primary Land Use Tax Lot Output
PSEG	Public Service Enterprise Group
SEQRA	State Environmental Quality Review Act
SHPO	State Historic Preservation Office
SPDES	State Pollutant Discharge Elimination System
SVE	Soil Vapor Extraction
SVOC	Semi-volatile Organic Compounds
SWMP	Solid Waste Management Plan
TCE	Trichloroethylene
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VOC	Volatile Organic Compounds
WWTP	Wastewater Treatment Plant

EXECUTIVE SUMMARY

ES-1 INTRODUCTION

The vast and complex New York City (City) water supply system (**Figure ES-1**) was originally developed through the visionary work of City planners and engineers who understood the importance of delivering an abundant and reliable supply of clean drinking water to the City. The system was designed in the early 1800s, and has been able to expand, adapt, and modernize to keep pace with a growing population. Today, the New York City Department of Environmental Protection (DEP) is responsible for supplying clean drinking water to over eight million City residents and approximately one million upstate customers in sufficient quantity to meet present water demand, and maintains the water supply system to meet future water demand. Recognizing the need to protect the long-term viability and overall resilience of the water supply system, the City continues to make systematic and sustained investments in the critical infrastructure that provides water to approximately nine million people each day. These investments include work on redundant supplies for use in the event of water supply shortages.

DEP is proposing the In-City Water Supply Resiliency project ("Proposed Project") to allow for the operation of the existing groundwater supply system in response to a water supply shortage due to drought or planned and/or unplanned infrastructure outages. The Proposed Project will not alter current water supply operations and would be employed only under the limited circumstances of a drought or water infrastructure outage. The Proposed Project includes the renewal of DEP's existing Water Supply/Water Withdrawal Permit for the groundwater system, which is up for renewal on December 31, 2017, and the potential implementation of temporary treatment systems at existing well stations. Although it is not required for the permit renewal, this Draft Environmental Impact Statement (DEIS) has been prepared voluntarily to identify and disclose any potential adverse significant environmental impacts.

As steward of the water supply for the City of New York, DEP recognizes the importance of water resources throughout the State and the region. A significant portion of this DEIS is devoted to an assessment of potential impacts on the groundwater supplies in Queens and neighboring Nassau and western Suffolk counties. In addition to the public outreach conducted during the development of this DEIS, DEP attended meetings with the New York State Department of Environmental Conservation (NYSDEC) and the U.S. Geological Survey (USGS) regarding the Long Island Water Supply Sustainability Study, which is in the early stages of data collection. DEP, NYSDEC, USGS, and neighboring water suppliers have shared historical data on groundwater wells, water levels, and water quality. This valuable data has been integrated into the New York City Groundwater Model to provide a meaningful analysis of the potential effects of the Proposed Project. The model was first developed in 2005 by DEP to evaluate the groundwater system in Kings (Brooklyn), Queens, Nassau, and western Suffolk counties and has been reviewed by the USGS. The model uses groundwater modeling software which has been applied to groundwater modeling studies in Nassau and Suffolk counties and hundreds of other studies throughout the United States. By modeling various operating scenarios for potential water withdrawal from the Queens Groundwater system, DEP has analyzed potential impacts to groundwater within the City and neighboring communities. Within the defined potential use of

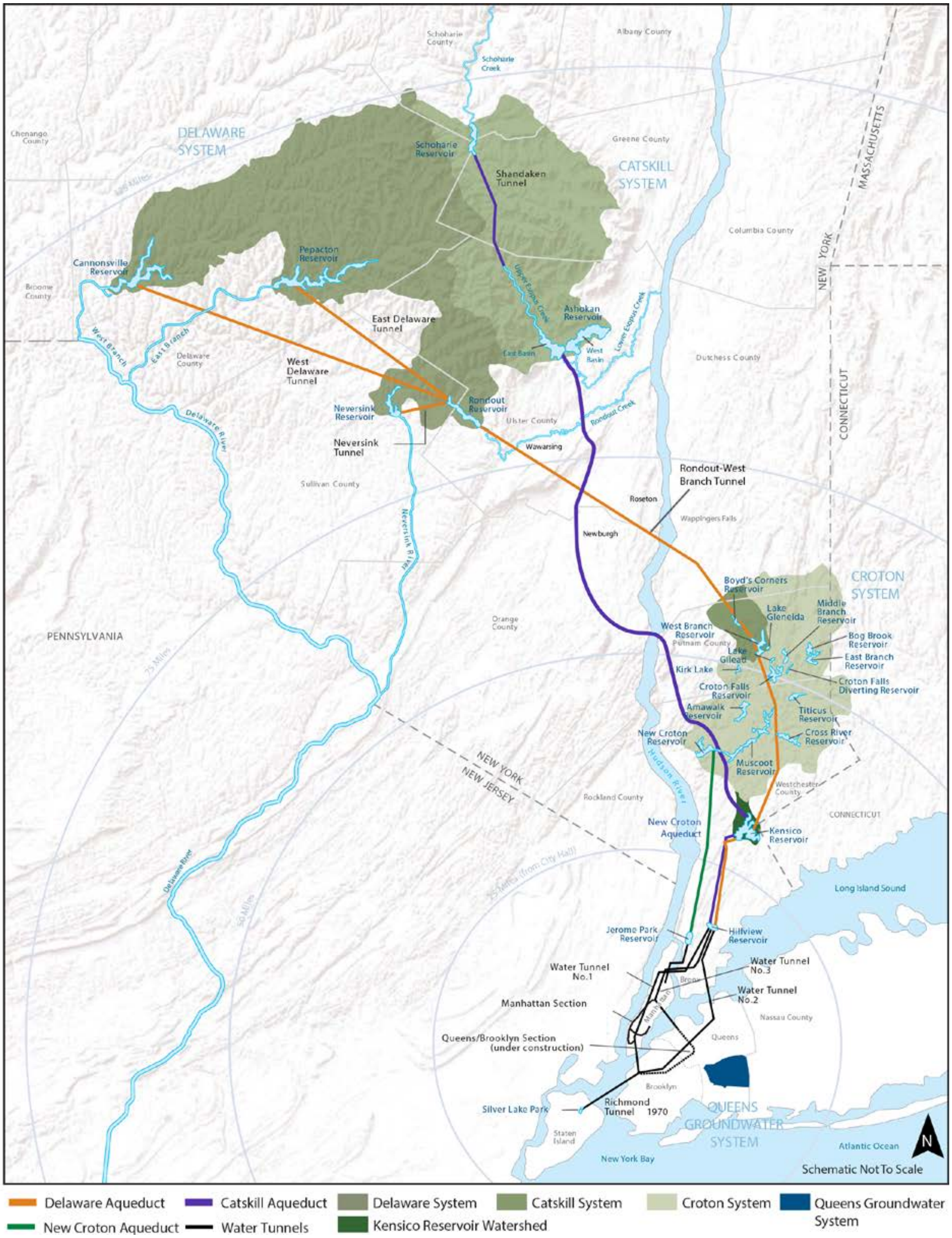

Figure ES-1: Water Supply System Map

the Proposed Project, there would be no significant impacts on neighboring communities and public water supplies. DEP welcomes continued cooperation and coordination with NYSDEC, USGS, public water suppliers, community representatives, and other stakeholders in the Long Island Sustainability Study.

Water supply and withdrawal programs should consider water conservation, demand management, and drought management alternatives. DEP has had robust programs in place since 1979 and DEP's water conservation plan has substantially reduced per capita water demand. DEP's Water Demand Management Plan describes the strategies in use to continue reduction of water consumption. The In-City Water Supply Resiliency Project is an important tool for addressing water supply shortages during drought or planned and/or unplanned infrastructure outages. As described in the City's existing Drought Management and Contingency Plan, DEP may use water from the Queens Groundwater system during a drought warning and emergency.

DEP welcomes continued collaboration with NYSDEC, USGS, and neighboring communities and water suppliers to protect and maintain our water resources. DEP remains open to discussions regarding mutual cooperation to alleviate water supply concerns, potential connections for water supply, and technical advisory assistance for water conservation, demand, and drought management.

ES-1-1 Purpose and Need

DEP is responsible for ensuring the safe and reliable delivery of drinking water to consumers in sufficient quantity to meet all present and anticipated future water demands. The purpose of the In-City Water Supply Resiliency DEIS is to support renewal of DEP's existing Water Supply/Water Withdrawal Permit for the Queens Groundwater system and potential future temporary treatment of the groundwater system to ensure its viability for meeting DEP's water supply needs as a supplement to upstate water supplies. Rehabilitating the Queens Groundwater system would improve the resiliency of the City's overall water supply system by making the groundwater system accessible in response to a water supply shortage.

The Proposed Project, which supports the permit renewal and potential use of temporary treatment systems at the existing well stations, would enable operation of the groundwater well system in southeastern Queens, New York. The DEIS includes the evaluation of impacts due to groundwater withdrawal and the future potential necessary upgrades to support temporary on-site treatment system improvements at the well stations for potable water supply to support the use of these stations in the event of a water supply shortage.

The Proposed Project is consistent with the *One New York: the Plan for a Strong and Just City (OneNYC)* initiative to protect the City's water supply and maintain reliability and resiliency of the system.

ES-2 PROJECT DESCRIPTION

The Proposed Project consists of two specific elements; renewal of DEP's existing Water Supply/Water Withdrawal Permit, most recently renewed by the NYSDEC in 2007, and the potential implementation of temporary treatment systems at groundwater wells to allow the use of Queens Groundwater system during a water supply shortage as described in more detail below.

ES-2-1 Permit Renewal

DEP holds an existing NYSDEC Water Supply Permit for the Queens Groundwater system, which is up for renewal by December 31, 2017. DEP has maintained applicable permits to operate the system since the acquisition of the Queens Groundwater system in 1996. This permit has a 10-year term and encompasses 44 well stations and a total of 68 wells. While the wells identified within the permit can produce up to 118 mgd, the permit allows DEP to withdraw up to 62 million gallons per day (mgd) (22,568 million gallons per year) of groundwater based on a five-year running average or 68 mgd (24,807 million gallons)[1] in any one year. The individual well capacities currently range from 400 gallons per minute (gpm) (0.5 mgd) to 1,800 gpm (2.5 mgd). DEP seeks to renew the permit in order to maintain the City's access to the water supply in the future and to potentially utilize the system. A renewal of DEP's existing permit for the Queens Groundwater system would allow for operation of the wells for the period from 2018 to 2028.

ES-2-2 Drought and Water Infrastructure Outage

The Proposed Project also includes the implementation of temporary treatment facilities at Queens Groundwater wells to allow DEP to utilize groundwater in the event of a water supply shortage such as a drought or planned and/or unplanned outages. Drought conditions have occurred within the City's upstate water supply system seven times over the past 75 years with the most recent drought conditions occurring in 1989, 1991, 1995, and 2002.[2] As a result, a goal of the Proposed Project is to renew DEP's existing permit and also rehabilitate the wells in the Queens Groundwater system to allow utilization of groundwater, if necessary.

DEP frequently modifies its operation of the water supply system in response to a variety of conditions. DEP has also optimized the water supply system by implementing independent programs and projects that focus on maintaining water supply during times of water supply shortage, thereby increasing system resiliency. These include an interconnection between the Catskill and Delaware aqueducts at Shaft 4 in Ulster County, New York, and the rehabilitation of the Cross River and Croton Falls pump stations to move water from the Cross River and Croton Falls reservoirs in the Croton System to the Delaware Aqueduct upstream of Kensico Reservoir in Westchester County, New York. Additional resiliency is achieved with reservoirs shared between surface water systems. The Delaware and Croton systems share the Boyd's Corners and West Branch reservoirs, while the Delaware and Catskill systems share the Kensico and Hillview reservoirs. Access to the Queens Groundwater system supports DEP's water supply system resiliency efforts, as it would provide access to another source of water, as needed. Together

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[1] All groundwater flows have been rounded to the nearest whole number mgd.
[2] http://www.nyc.gov/html/dep/html/drinking_water/droughthist.shtml

these initiatives and connections allow DEP to modify operations to meet the needs of the City and its water supply system.

As set forth within the City's existing Drought Management and Contingency Plan, DEP may use water from the Queens Groundwater system during a drought warning and emergency. In addition, the Proposed Project also supports initiatives to promote redundancy and flexibility of the City's water supply system as outlined in the *Special Initiative on Rebuilding and Resiliency* report released by the City in 2013 in the wake of Superstorm Sandy. The Proposed Project would enhance the reliability of the City's water supply and maintain flexibility during typical operations, as well as during periods when the water supply system is depleted, or when water quality in other parts of the system is affected by heavy rain or heat waves.[3]

ES-2-3 Queens Groundwater System

The Jamaica Water Supply Company operated a group of wells that served communities in southeastern Queens and portions of Nassau County from 1887 to 1996. At its peak, the Jamaica Water Supply Company provided more than 100 mgd of groundwater.

In 1996, DEP acquired the Queens portion of this system. The Queens Groundwater system is comprised of 44 well stations, which house 68 water supply wells. Well stations may consist of a single well or may have multiple wells.

DEP continued to use it in varying capacities for potable use through 2007, when water from upstate surface water supplies was provided throughout New York City. Since 2007, wells have been exercised and used for groundwater testing in accordance with DEP's Wellhead Protection Plan. DEP has retained the system in order to have a supplemental supply to the City's upstate surface water system in times of water supply shortage due to drought or planned and/or unplanned infrastructure outages.

The 44 well stations currently included within DEP's existing Water Supply/Water Withdrawal Permit vary in size from approximately 3,200 square feet to as large as two acres, with the majority less than a quarter of an acre. The well stations and wells are located within secured, DEP-owned parcels and may contain one or more small structures. Each existing well is typically associated with an existing structure or well house and supporting infrastructure and has an existing connection to the City's water distribution system and sewer system. There are no surface waters, streams, or wetlands located on any well station parcel. **Table ES-1** provides a summary of well stations and currently permitted wells.

All of the Queens well stations are located within an approximately 20 square-mile area in the southeastern section of Queens, which borders Nassau County (see **Figure ES-2**). The existing well stations are located in established areas of Queens, and have been previously developed and maintained. The stations are generally bounded by I-495 (Long Island Expressway) to the north,

[3] The *Special Initiative on Rebuilding and Resiliency* Report is available here: http://www.nyc.gov/html/sirr/html/report/report.shtml

Table ES-1: Wells and Well Stations Comprising the Proposed Project

Well No.	Station	Address (Queens, NY)	Comm. District
1	1	127-01 Metropolitan Ave.	9
3	3	109-31 120th St.	10
3A	3	109-31 120th St.	10
5	5	93-02 199th St.	12
5A	5	93-02 199th St.	12
6	6D	166-44 108th Ave.	12
6A	6	164-44 109th Ave.	12
6B	6	164-27 110th Ave.	12
6C	6	164-11 109th Dr.	12
6D	6D	166-44 108th Ave.	12
7	7	91-01 209th St./91-01 91st Ave./ 209-02 91st Ave.	13
7B	7	91-01 209th St./91-01 91st Ave./ 209-02 91st Ave.	13
8A	8	131-02 88th Ave.	9
10	10	116-32 224th St.	13
10A	10	116-32 224th St.	13
11	11	111-12 143rd St.	12
13	13	214-01 89th Ave.	13
13A	13	214-01 89th Ave.	13
14	14	116-16 144th St.	12
17	17	87-73 123rd St.	9
17A	17	87-73 123rd St.	9
18	18	84-02 164th St./84-06 164th St.	8
18A	18	84-02 164th St./84-06 164th St.	8
19	19	Highland Ave.	8
21	21	85-44 Springfield Blvd.	13
21A	21	85-44 Springfield Blvd.	13
22	22	84-76 127th St.	9
23	23	114-56 224th St.	13
23A	23	114-56 224th St.	13
26	26	113-30 Francis Lewis Blvd.	12
26A	26	113-30 Francis Lewis Blvd.	12
27	27	86-83 Dunton St.	8
29	29	216-15 102nd Ave.	13
29A	29	216-15 102nd Ave.	13
31	31	127-15 92nd Ave.	9
32	32	109-50 127th St./126-15 111th Ave.	10
33	33	160-25 108th Ave.	12
36	36	Hook Creek Blvd./244-98 129th Ave.	13
37	37	87-74 Chevy Chase St.	8
38	38	90-35 193rd St.	12
38A	38	90-35 193rd St.	12
39	39	90-42 Springfield Blvd.	13
39A	39	90-42 Springfield Blvd.	13
41	41	87th Ave.	9
42	42	197-14 Murdock Ave.	12
42A	42	197-14 Murdock Ave.	12
43	43	85-34 118th St.	9
43A	43	85-34 118th St.	9
45	45	101-19 120th St.	9
47	47	217-14 112th Rd.	13
47A	47	217-14 112th Rd.	13
48	48	109-81 Francis Lewis Blvd.	13
48A	48	109-81 Francis Lewis Blvd.	13
49	49	103-15 219th St.	13
49A	49	103-15 219th St.	13
50	50	77-09 Parsons Blvd.	8
50A	50	77-09 Parsons Blvd.	8
51	51	78-23 164th St.	8
52	52	71-52 161st St.	8
53	53	160-25 76th Rd.	8
53A	53	160-25 76th Rd.	8
54	54	227-25 Linden Blvd.	13
54A	54	227-25 Linden Blvd.	13
55	55	194-10 99th Ave.	12
56	56	134-15 222nd St.	13
58	58	180-40 Grand Central Parkway	8
59	59	132-06 Springfield Blvd.	12
60	60	231-19 128th Dr.	13

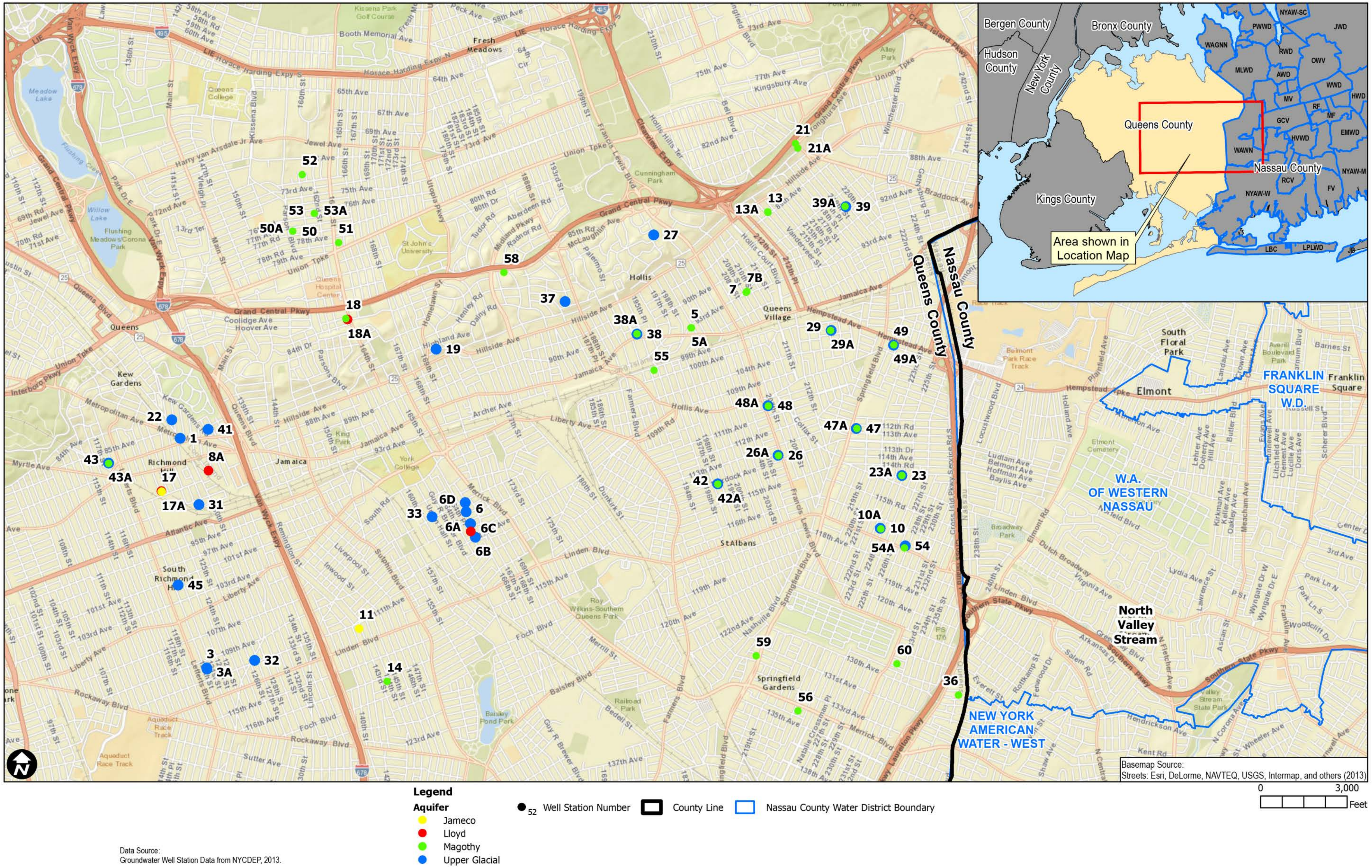

Figure ES-2: Queens Groundwater System Well Station and Well Locations

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Route 27 (Sunrise Highway) to the south, Lefferts Boulevard to the west, and the Belt/Cross Island Parkways to the east. The Proposed Project is also located within the Jamaica Bay and Bronx River-East River Watersheds, with a majority of the well stations located within the Jamaica Bay Watershed.

The sources of water for the wells in the Queens Groundwater system are the aquifers beneath the Queens section of Long Island. An aquifer is a natural underground layer of porous, water-bearing materials (e.g., sand, gravel) generally capable of yielding a large supply of water. There are four main aquifers in what is known as the Brooklyn-Queens Aquifer: the Upper Glacial and Jameco, which are the shallowest; the Magothy, which is the middle layer; and the Lloyd, which is the deepest (see **Figure ES-3**). These aquifers also extend beneath Nassau and Suffolk counties. Water for the Queens Groundwater wells is largely extracted from the Magothy and Upper Glacial aquifers, although some existing wells extract from the Jameco, and Lloyd aquifers (see **Figure ES-2** and **Figure ES-3)**.

Provided below is a brief general discussion of these aquifers.[4,5]

- **Upper Glacial Aquifer** is an unconfined aquifer located directly under the ground surface. The Upper Glacial Aquifer is the uppermost water-bearing layer, consisting of mainly glacial outwash deposits of sand and gravel. The thickness of the aquifer ranges from 0 to 300 feet and overlies the other underlying units (i.e., aquifers), and is found at ground surface throughout Queens County.

- **Jameco Aquifer** is present in buried valleys, mainly in central and southern areas of Queens County, and ranges from 0 to 250 feet thick. It consists of mostly coarse sand and gravel with small amounts of silt and clay.

- **Magothy Aquifer** is the largest of the aquifers. The Magothy Aquifer overlies the Raritan Formation clay-confining unit and ranges in thickness from 0 to 450 feet thick. The Magothy is reported to be thickest in the area of Far Rockaway, and absent in northern and northwestern Queens County and in the buried valley area trending southward from the Flushing Meadows-Corona Park area. It consists of clay lenses, clayey and silty sand, fine to coarse sand, and gravelly sand.

- **Lloyd Aquifer** is the deepest and oldest of the aquifers. The Lloyd Aquifer is the lowermost major water-bearing layer, highly confined[6] between the overlaying Raritan Formation clay and the underlying bedrock. It ranges in thickness from 0 to 300 feet, increasing southeastward. The slope of the Lloyd Aquifer mimics the underlying bedrock. The Lloyd Aquifer consists of beds of sand and gravel with beds of clay and silt.

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[4] Soren, J. 1971. *Ground-water and Geohydrologic Conditions in Queens County, Long Island, New York*. U.S. Geological Survey Water Supply Paper 2001-A.

[5] Soren, J. 1978. *Subsurface Geology and Paleogeography of Queens County, Long Island, New York*. U.S. Geological Survey, Water Resources Inv. 77-34.

[6] Confined aquifers are those in which an impermeable soil/rock layer exists that prevents water from seeping into the aquifer from the ground surface located directly above.

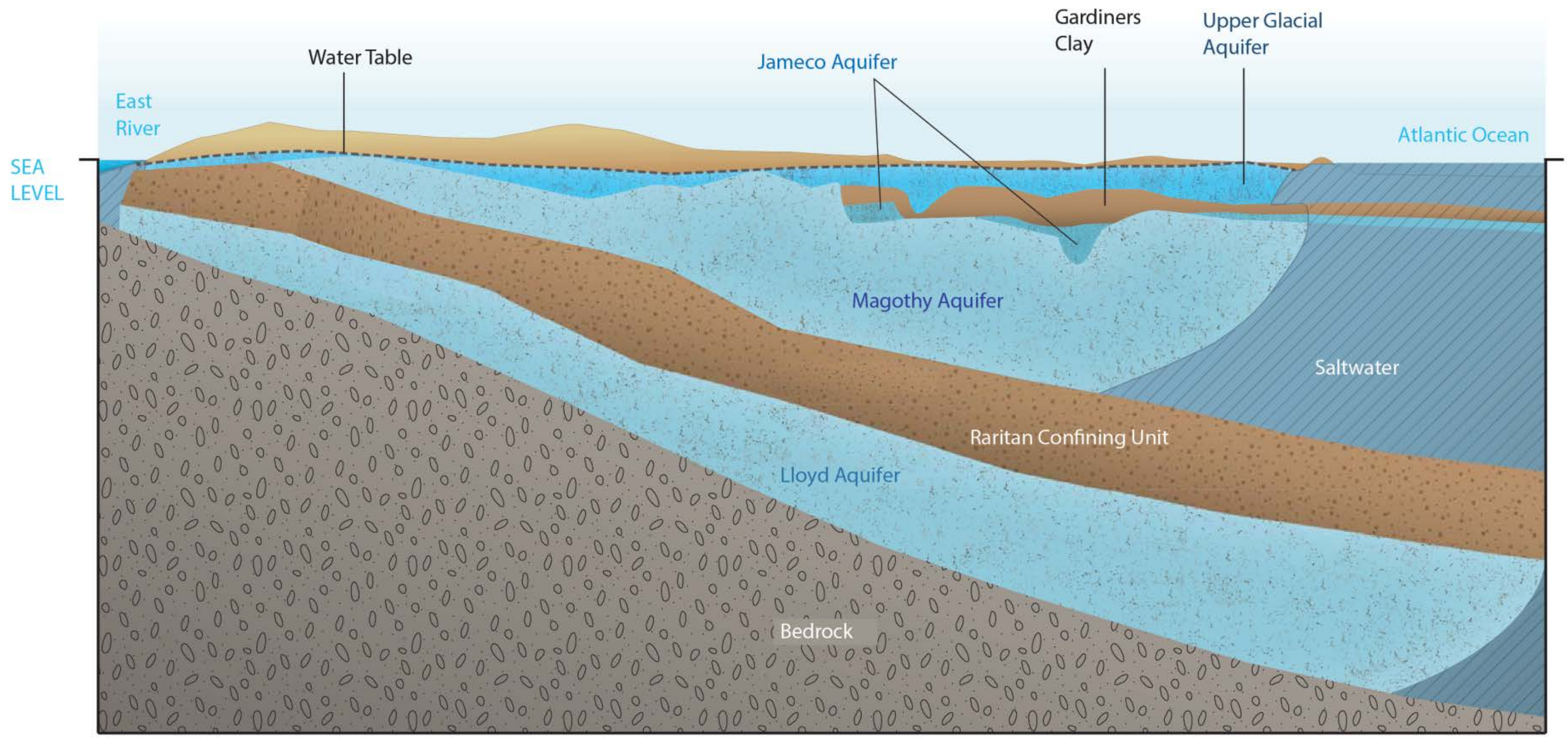

Figure ES-3: Queens Aquifers

ES-3 SCOPE OF ENVIRONMENTAL ANALYSIS

The impact analyses have been tailored to the Proposed Project and are presented in the DEIS. The environmental impact assessments included a generic individual station (see Section ES-3-1) and/or program-wide analysis (see Section ES-3-2) based upon the anticipated effects of the Proposed Project upon specific impact categories. This is discussed in additional detail in Chapter 2.0, “Analytical Framework.” As a result of the analyses conducted, impact categories that did not require additional analyses beyond an initial screening and whether a generic station-specific and/or program-wide analysis was required are identified in **Table ES-2**, and discussed in more detail within Chapter 2.0, “Analytical Framework.” For those impact categories that required additional assessment (see **Table ES-2)**, these are presented in Chapter 3.0, “Probable Impacts with the Proposed Project.”

ES-3-1 Generic Station-Specific Analysis

Operation of the Queens Groundwater wells and the potential implementation of temporary treatment systems may result in station-specific or localized impacts. Potential impacts would be expected to occur at or within close proximity to individual well stations due to the anticipated activities associated with the construction and operation of these treatment facilities at that individual location, such as potential increases in vehicular traffic, changes in land use, or air quality effects. The assessment of these station-specific impact categories are based upon the anticipated construction, operation, and layout of the generic temporary treatment system discussed in Chapter 1.0, “Project Description.”

ES-3-2 Program-Wide Analysis

As the Proposed Project involves the withdrawal of groundwater from several aquifers located beneath Queens and these aquifers extend further east of Queens and may have the potential to affect groundwater and surface water resources across a larger geographic area (Queens, Nassau, and/or western Suffolk counties), a regional or program-wide study area was considered. As an example, groundwater withdrawal in southeast Queens can result in potential effects to Nassau and western Suffolk County water suppliers or effects upon groundwater baseflows to surface waters within Queens and Nassau counties. Therefore, the DEIS also considered larger program-wide effects that may be associated with the Proposed Project.

ES-3-3 Screening

An initial screening was conducted for each impact category to initially characterize existing conditions in order to determine which impact categories warranted an impact analysis. These screenings primarily relied on desktop evaluations (e.g., review of ArcGIS data, maps, aerial imagery, online databases, existing reports, and agency consultations). Several impact categories which did not warrant further impact assessment under the *CEQR Technical Manual* are identified in **Table ES-2**.

Table ES-2: Summary of Required Impact Analyses for Proposed Project

Impact Category	Generic Station-Specific Assessments[1]	Program-Wide Assessments[1]
Land Use, Zoning, and Public Policy	✓	-
Socioeconomic Conditions	-	-
Community Facilities and Services	-	-
Open Space and Recreation	-	-
Critical Environmental Areas	-	-
Shadows	-	-
Historic and Cultural Resources	✓	-
Urban Design and Visual Resources	✓	-
Natural Resources and Water Resources	✓	✓
Hazardous Materials	✓	✓
Water and Sewer Infrastructure	✓	✓
Solid Waste and Sanitation Services	✓	-
Energy, Greenhouse Gas Emissions, and Climate Change	✓	✓
Transportation	-	-
Air Quality	-	-
Noise	-	-
Neighborhood Character	✓	-
Public Health	-	✓
Environmental Justice	-	✓
Growth Inducement	-	✓
Construction	✓	-

Note:
[1] Impact categories not identified as requiring a generic station or program-wide analysis were determined not to require a detailed analysis based upon an initial screening.

ES-3-4 Proposed Operating Scenarios

Assessment of potential impacts from the pumping of groundwater required a modified analytical approach. The current Water Supply/Water Withdrawal Permit has a 10-year duration and allows DEP to withdraw up to 62 mgd based upon a five-year running average, with a 68 mgd maximum for any single year.[7] As part of the Proposed Project, DEP is seeking a renewal of the existing permit with no change to the current pumping limits. Pumping of these wells would occur during a water supply shortage. As a result, pumping levels may vary significantly dependent upon DEP's specific needs in the future. Therefore, the DEIS assessed the following proposed operating scenarios for a range of pumping rates and durations within the limits of the existing and anticipated future permit.

[7] All groundwater flows have been rounded to the nearest whole number mgd.

- Scenario A – Groundwater pumping at current single year permitted maximum (68 mgd) for 1 year;
- Scenario B – Groundwater pumping at current single year permitted maximum (68 mgd) for 2 years;
- Scenario C – Groundwater pumping at current single year permitted maximum (68 mgd) for 3 years;
- Scenario D – Groundwater pumping at the currently permitted 5-year running average of 62 mgd for 5 years; and
- Scenario E – Groundwater pumping at the currently permitted 5-year running average of 62 mgd for 10 years.

As there were a number of uncertainties associated with predicting future conditions, a sensitivity analysis pertaining to rainfall (drought), southern Lloyd saltwater interface position, and the spatial distribution of Queens wells was also conducted.

ES-3-5 The New York City Groundwater Model

The New York City Groundwater Model was developed in 2005 by DEP to evaluate the groundwater system in Kings (Brooklyn), Queens, Nassau, and western Suffolk counties. The mathematical model has been reviewed by the U.S. Geological Survey (USGS) and utilized over the past 12 years by the City to assist with a variety of groundwater resource studies. A listing of the processes utilized in the New York City Groundwater Model include:

- Groundwater flow: Simulates piezometric heads, flow directions, and velocities at computational nodes.
- Particle tracking: Simulates the forward- or backward-in-time movement of a water particle released within the model domain based on the simulated groundwater flow field.
- Sharp saltwater interface: Simulates the interaction of freshwater and saltwater by approximating the transition between the two zones as a sharp interface. This approach is valid and favored for regional aquifer analyses.
- Variable density flow: Incorporates differences in densities that would be encountered between freshwater and saltwater.
- Wells that pump across more than one stratigraphic layer: Pumping wells with screens that span more than one stratigraphic layer add complexity to a groundwater model. The division of pumping flux between stratigraphic layers is often not known and must be approximated. In the New York City Groundwater Model, pumping fluxes are distributed vertically along the well screen based on the transmissivity of the model layer from which the well is screened.
- Surface water-groundwater interaction: Surface water-groundwater interaction includes any situation where water above the land surface interacts with groundwater below the

land surface. The New York City Groundwater Model quantifies the groundwater flux that discharges to surface waterbodies in each time step.

- The model is a regional planning tool that is designed to be used by the City to help evaluate regional groundwater supply alternatives.

While the structural underpinnings of the model (including hydrostratigraphic representations and hydraulic property values) from 2006 remain in use, the model has been updated periodically to incorporate the most up-to-date data sets.

The New York City Groundwater Model simulates historical transient groundwater flow patterns in Brooklyn, Queens, Nassau County, and the western portion of Suffolk County for the period from January 1, 1906 through December 31, 2015, using available data for that time period.

For the purposes of analyzing the Proposed Project, the historic period simulation was extended to the end of 2017 to facilitate modeling of Existing Conditions, Future without the Proposed Project, and Future with the Proposed Project. For the Future with and without the Proposed Project, the historic period was extended to simulate the proposed permit renewal period (January 2018 through December 2027).

The following assumptions were used to update the model to represent conditions of these respective time periods:

- The spatial distribution of rainfall recharge and return flow would not change between present day and December 2027;

- The last five years (2011 through 2015) of rainfall data are representative of typical conditions; and

- The last five years (2011 through 2015) of water supply pumping data are representative of typical conditions.

Based on these assumptions, monthly input values of water supply well pumping and rainfall recharge were calculated by averaging the values from 2011 through 2015. Based on the observed consistency in pumping rates, Nassau County water supply usage was not expected to increase in the near future. In addition, for the purposes of this analysis, Nassau County water supply usage was not anticipated to decrease due to the implementation of conservation measures.

All Nassau County supply wells that were pumped between January 2011 and December 2015 were considered active and incorporated into the model. Return flow, which is based on water supply pumping and sewer coverage, was applied consistent with the historic period (1906 through 2015) using these pumping data and assuming no change in sewer coverage between 2015 and December 2027.

ES-4 PROBABLE IMPACTS OF IN-CITY WATER SUPPLY RESILIENCY

Based on the analyses conducted as part of this DEIS, no significant adverse impacts due to the Proposed Project would occur, no mitigation would be required, and there are no unavoidable adverse impacts. If necessary, future station-specific environmental impact analyses would be conducted prior to required improvement and/or installation of temporary treatment facilities at specific well stations.

The assessments of the following impact categories indicated that there are no significant adverse impacts as a result of the Proposed Project.

- Land Use, Zoning, and Public Policy: No changes in the land use or zoning of any affected well station would be required as part of the Proposed Project. The Proposed Project would be consistent with the existing land use and zoning and as a temporary and short-term use would not affect long-term land use or zoning trends or result in any indirect effects to these. The Proposed Project would also be consistent with and supports the applicable *OneNYC* and *PlaNYC* policies focused on water supply, climate change, and resiliency.

- Historic and Cultural Resources: Two of the 44 well stations (Stations 41 and 43) have historic resources within 400 feet. However, no impacts to these resources are anticipated because the resources are separated from the well stations by multiple parcels and structures. Placement of temporary treatment facilities would not involve significant in-ground disturbances or vibrations that could undermine the foundation or structural integrity of these nearby resources. In addition, while 11 of the 44 well stations may be in an area that has the potential to contain archaeological resources, the anticipated activities required for the Proposed Project would occur on sites that were previously excavated and/or in areas of previous disturbance. The Proposed Project is not expected to result in any significant effects that could alter the integrity of historic and cultural resources at any well stations.

- Urban Design and Visual Resources: Proposed temporary treatment facilities would generally be consistent with the scale and use of the existing surrounding well station buildings. The temporary treatment facilities would conform with and not be out of scale with building height requirements, the well station sites would continue to include a perimeter fence, and are not expected to significantly, or more importantly permanently, alter the pedestrian view of the parcels.

- Solid Waste and Sanitation: The use of temporary treatment facilities would periodically require removal, disposal, and replacement of treatment media. The Proposed Project would not result in the generation of more than 50 tons per week of new solid or hazardous waste for all of the well stations. Expected volumes would be substantially less than this and this new waste generation would only occur when the temporary treatment facilities are in operation during a water supply shortage.

While spent media would represent the largest waste streams associated with the Proposed Project, a significant portion of this media would be regenerated and/or recycled, reducing potential impacts associated with the need for disposal. The Proposed Project would not result in any significant impact to the provision of sanitation services within the City of New York. More than sufficient collection/carting and transfer station capacity, municipal and/or commercial, is available within the City and immediately surrounding areas. No adverse impacts to sanitation services are therefore expected.

- Environmental Justice: The presence of the temporary treatment facilities would be short-term and would not reflect a permanent change to the neighborhood. The Proposed Project would be consistent with the existing land use and zoning and, as a temporary and short-term use, would not affect long-term land use or zoning trends, or result in any indirect effects. The supplemental use of the Queens Groundwater system would provide an added level of resiliency and redundancy to portions of the water supply system that serve Environmental Justice communities in Brooklyn and Queens. Finished water would meet all drinking water requirements and would be of a quality consistent or comparable with water from DEP's upstate surface water system prior to release into the distribution supply system. The Proposed Project would not result in permanent adverse impacts to surrounding Potential Environmental Justice Areas (PEJAs).

- Neighborhood Character: The Proposed Project does not have the potential to individually result in any significant adverse impacts on land use, zoning, public policy, socioeconomic conditions, open space, shadows, historic resources, urban design and visual resources, transportation, and/or noise. The Proposed Project is not anticipated to have the potential to change the pedestrian's overall experience since it would not result in significant adverse impacts on urban design, historic resources, shadows, open space, or noise. The Proposed Project is not anticipated to result in changes in prevailing businesses and economics of an area since the Proposed Project does not have the potential to result in significant adverse impacts to land use, socioeconomics, and transportation.

The analyses of those remaining impact categories that had a greater potential for significant impacts also indicated that there would be no significant adverse impacts as a result of the Proposed Project. These are discussed below.

ES-4-1 Natural Resources

Groundwater resources were assessed for the potential for the Proposed Project to result in changes in groundwater-fed surface waterbodies, potential impacts associated with construction and operation of the temporary treatment facilities at the Queens well stations and changes to groundwater-fed surface waters on federal/State Threatened, Endangered, Candidate Species, State Species of Special Concern and unlisted rare or vulnerable species, and potential changes in saltwater intrusion in groundwater was completed.

Five waterbodies (four in Queens, one in Nassau County) exhibited modeled baseflow reductions of more than 1 cubic feet per second (cfs) under certain operating scenarios. Three of the waterbodies are lakes or ponds and natural resources associated with these systems are based on the surface water levels within the waterbody. Reductions in baseflow would result in a lower hydrologic throughput in these waterbodies, but the level of the water surface should not be substantially affected. Two of the waterbodies consist of stream/creek systems and in each case the reduction in baseflow is not significant enough to substantively alter the ecosystem provided by the waterbody. The hydrology of lakes, ponds, streams, and creeks are all affected by contribution of surface runoff from rainfall within their contributing watersheds which further lessens any impact of baseflow reduction. Baseflow reductions due to the Proposed Project are not expected to represent a potential significant adverse impact to these waterbodies or the surrounding natural resources.

Six federal/State Threatened and Endangered Species have the potential to occur if suitable habitat is present within the vicinity of the Queens well stations where temporary treatment systems would be placed. Based on a desktop review, critical habitats or significant natural communities or rare plants or animals are not present. Only one species, the northern long-eared bat, was identified as having the potential to occur at the Queens well stations. Implementation of temporary treatment facilities may include limited tree removal; however, no adverse effects are anticipated, as any tree removals, if required, would occur between November 1 and March 31 when northern long-eared bats would not be utilizing summer roosting locations.

Nine federal/State Threatened and Endangered Species were noted to have the potential to occur within the vicinity of the five waterbodies that were projected to experience baseflow reductions. These reductions would not be expected to represent a potential significant adverse impact to any habitats associated with these waterbodies because any potential changes from the reduced baseflow would not have a significant impact to the overall flow. Therefore, no impacts to federal/State threatened, endangered, Candidate Species, State species of special concern and unlisted rare or vulnerable species would be anticipated at any groundwater-fed surface waterbody.

The saltwater interface is an approximation of the boundary between fresh and saline groundwater within the Long Island aquifers. Inland movement of the saltwater interface in the Upper Glacial and Magothy aquifers due to short-duration pumping (up to 10 years) of the Queens supply wells is likely to be temporary, with a subsequent rebound to historical aquifer levels. While similar movement of the assumed offshore portion of the saltwater interface in the Lloyd Aquifer is less likely to rebound after short-duration use of the Queens supply wells, the saltwater interface movement towards the Long Beach supply wells would also occur without the Proposed Project.

Analyses indicated that there would be no simulated saltwater intrusion into the capture zones for any Nassau County supply wells screened in the Upper Glacial Aquifer. There are 15 active Nassau County supply wells that have a portion of their capture zones at or south of the existing location of the saltwater interface along the south shore of Long Island in the Magothy Aquifer, although the presence of the saltwater at the bottom of the Magothy Aquifer does not imply that operations at these 15 wells are impaired since chloride concentrations at the well screens may be lower than those at the bottom of the aquifer. No new intrusion at these 15 Nassau County or western Suffolk County active supply wells in the Magothy Aquifer is anticipated to occur as a result of the project. There was also no simulated saltwater intrusion into the capture zones of any of the Queens supply wells screened in the Lloyd Aquifer or any of the active Nassau supply wells screened in the northern portion of the Lloyd Aquifer. Likewise, there would be no simulated saltwater intrusion into the capture zones of any of the active Nassau County supply wells screened in the southern portion of the Lloyd Aquifer. However, consistent pumping from the Long Beach supply wells is likely drawing the saltwater interface further inland, which could potentially be effected by pumping associated with the Proposed Project.

Therefore, as a result of the analyses conducted, no significant adverse impacts to natural resources are anticipated.

ES-4-2 Hazardous Materials

An assessment of potential impacts from the Proposed Project associated with the placement and operation of temporary treatment systems at up to 44 well stations within the Queens Groundwater system and potential impacts to existing groundwater systems serving Nassau and western Suffolk County from known sources of groundwater contamination was completed.

As part of the Proposed Project, if soil disturbance, excavation, or removal is anticipated at the Queens well stations, appropriate sampling would be conducted prior to any construction to determine the potential presence of hazardous materials. Any soil that would be removed from the sites would be tested as necessary, managed, and transported for reuse or potential disposal in accordance with applicable federal, State, and local requirements. The proposed operation of the well stations would not result in the creation of hazardous materials, but would result in the generation of spent media (e.g., GAC, nitrate selective resin) used in the removal of various contaminants associated with groundwater treatment. Periodically, this media would need to be replaced and the used media would be classified according to its degree of potential hazard, and recycled and/or disposed of in accordance with applicable regulatory requirements. Likewise, several chemicals would be required for operation of the temporary treatment at these wells. The use and storage of these chemicals would be in accordance with applicable federal, State, and local requirements for their storage and use. No impacts associated with management of waste materials from the water treatment processes or the use and storage of chemicals for water treatment would occur.

Based upon an initial assessment of potential changes in groundwater flow direction due to the Proposed Project and the geographic area associated with these changes, an assessment of potential impacts from NYSDEC-identified locations of known contamination plumes upon active Nassau County supply wells was completed. Groundwater flow pathlines were simulated from these plume sites and only one known plume site (Tres Bon Cleaners) would potentially impact one Nassau or western Suffolk County supply well with the Queens Groundwater system operating continuously for 10 years. However, further outreach to NYSDEC regarding the Tres Bon Cleaners site indicated that remediation has been completed at the plume site and reduced contamination to non-detect levels.

Therefore, no significant adverse impacts related to hazardous materials are anticipated.

ES-4-3 Water and Sewer Infrastructure

The Proposed Project involves the renewal of DEP's existing Water Supply/Water Withdrawal Permit and implementation of temporary treatment systems to allow DEP to utilize the Queens Groundwater system to supplement water supply during water supply shortages. As such, the Proposed Project would not result in any additional water demand. Likewise, raw groundwater would be treated and tested to ensure that the water is of a finished water quality that would meet or exceed all applicable drinking water quality standards at the time the treatment system is constructed and operated.

An assessment of the potential change in water table elevation greater than a change of 10 feet at water supply wells was completed. Potential impacts to these wells were grouped into one of three classifications: no action needed, well minor modifications, or well major modifications. Under operating Scenario A and B, no wells would require any modifications to maintain existing production. Under Scenario C, one well would require minor modification to upgrade its pump motor to an increased horsepower to maintain existing production. Scenario D would require minor modification to three wells consisting of an upgrade of their pump motors to an increased horsepower. Scenario E would require minor modifications to eight wells: one well would require the pump setting to be lowered to restore suction to the well, while the other seven wells would require an upgrade of their pump motor to an increased horsepower. No wells in any of the scenarios would require major well modifications. Use of the Queens Groundwater system is anticipated to more closely resemble Scenarios A, B, or C, lasting between 1 and 3 years as opposed to the longer duration scenarios analyzed (Scenario D and Scenario E). It is unlikely that any water suppliers would be required to make changes to their wells as a result of the Proposed Project and even without modifications, it is anticipated that suppliers would continue to be able to supply their customers with adequate supply using other wells in their systems.

Operation of the Proposed Project would require discharges to the sewers serving the well stations. Approvals for discharges to the DEP sewer system would be acquired, as necessary and appropriate, and would comply with applicable sewer discharge requirements. These discharges would be to sanitary sewers (separate sanitary or combined sewer overflow [CSO]) and would occur during on-site activities (i.e., startup and testing, operation, maintenance). The largest discharge flows associated with the Proposed Project would be from the initial startup and testing operations for the wells. It is anticipated that each well would be pumped to waste for eight continuous hours to demonstrate that the well and treatment systems are operating as designed. Only after successful startup and testing would DEP place the well into service and send water to the City's distribution system. As part of the design of the temporary treatment systems, DEP would evaluate the applicable or nearest sewer system to ensure that the system could adequately convey anticipated discharge flows resulting from the Proposed Project.

The Proposed Project could also result in a minimal increase in impervious areas on the well stations resulting from new concrete pads, footings, and/or temporary treatment equipment being placed on the sites during operations. However, upon the advancement of more detailed design of temporary treatment systems at one or more well stations in the future, additional station-specific analyses of specific construction and operation of temporary treatment facilities would be completed, as necessary, prior to implementation.

The Queens Groundwater system wells are located in an area served by the Jamaica and Tallman Island WWTPs. Even with conservative assumptions, the incremental increases in flow due to the Proposed Project are minimal when compared to the permitted capacity and the most recent average dry weather flows (CY2016) for each WWTP. Therefore, the Proposed Project would not represent a potential significant adverse impact to the operation of the WWTPs.

Therefore, no significant adverse impacts related to water and sewer infrastructure are anticipated.

ES-4-4 Energy, Greenhouse Gases, and Climate Change

The operation of the Queens Groundwater system including the use of temporary treatment systems would not represent a significant new energy demand based upon CEQR. No significant adverse impacts would therefore be associated with the Proposed Project and routine review and upgrade of the electrical grid by power suppliers would be able to address any potential needs. Changes in energy usage to Nassau and western Suffolk County water suppliers due to the Proposed Project would be primarily driven by a projected decrease or lowering of the water table elevation, requiring additional pumping energy to deliver the water to the supplier's distribution system. Increases in energy usage were calculated for the wells where changes in the water table elevation were greater than 10 feet. This would occur for 21 Nassau County wells. Only seven of these wells would require an upgrade of their pump motor to an increased horsepower. As described in the DEIS**,** the most conservative estimate for total additional electricity usage would be approximately 3.5 million kilowatt hours (kWh) over 10 years. The total estimated 10-year incremental increase in cost however would represents an estimated increase of approximately 0.2 percent when compared to overall operating budget for the potentially affected water suppliers. This would not represent a significant increase in electricity usage for these water suppliers. The existing electrical grid would easily accommodate the insignificant increase in energy usage for 10 years of pumping (1.6 percent) without the need for any significant upgrades.

While the Proposed Project would not require an analysis under CEQR, the anticipated increase in greenhouse gas (GHG) emissions was calculated based upon 10 years of pumping. Operation of the Queens Groundwater system would result in a minor net increase in energy demand. The incremental average annual increase over the 10-year period would only represent an approximately 0.008 percent increase in GHGs. Potential changes in the energy usage of Nassau and western Suffolk County water suppliers with the Proposed Project would result in additional GHG emissions. This incremental increase would be indiscernible.

Therefore, no significant adverse impacts related to energy, greenhouse gases, and climate change are anticipated.

ES-4-5 Public Health

As described in the relevant analyses within this DEIS, the Proposed Project would not result in significant adverse impacts in any of the technical areas (e.g., air quality, noise, hazardous materials, or water quality) related to public health.

ES-4-6 Construction

For each well station potentially utilized during a water supply shortage, the construction of temporary treatment systems would include preparation of the treatment area at the well station. In general, each well station is currently developed with a well(s), well building or vault, driveway, and associated infrastructure connections (e.g., power, water, sewer, etc.).

Construction of the temporary treatment systems would require up to 20 weeks per well station, including up to 5 weeks of site preparation and any abatement of potential hazardous materials, 12 weeks of construction and/or placement of treatment facilities, and 3 weeks for startup operations. Temporary treatment facilities would not be constructed at the same time for all well stations, but would instead be advanced on an as needed basis, depending on the nature and needs of each water supply shortage. Heavy equipment would not likely be required during the 5-week site preparation phase. Heavy equipment to be used during the remaining 12 weeks of construction would include an excavator, backhoe, cranes, and, on intermittent days, concrete trucks. Construction hours would be based on the New York City construction noise rules, which limit typical construction to weekdays between the hours of 7 AM and 6 PM. Construction vehicles would be minimal with up to a maximum of five vehicle trips per hour with a total of 26 vehicles trips per day, including autos and trucks entering and leaving a site. Once the well stations are prepared, the temporary treatment blocks would be placed at designated locations. At the conclusion of a water supply shortage, temporary treatment blocks would be removed from the site.

Due to the temporary and limited nature of construction activities, the placement of temporary treatment systems at well station locations would not be anticipated to result in significant adverse impacts.

ES-5 MITIGATION

The Proposed Project would not result in the potential for significant adverse impacts. Therefore, no mitigation is required and there are no unavoidable impacts.

ES-6 ALTERNATIVES

Under the No Action Alternative, DEP would not implement the Proposed Project and as a result would not have access to the Queens Groundwater system during a water supply shortage or localized infrastructure outage.

The City does have a Drought Management and Contingency Plan[8] to address supply shortages associated with these events. This plan establishes actions and procedures for managing water supply and demand during drought conditions. As set forth within this Plan, DEP may use water from the Queens Groundwater system during a drought warning and emergency. During the

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8 The Drought Management and Contingency Plan is available here: http://www.nyc.gov/html/dep/pdf/droughtp.pdf

watch phase of a drought, DEP would not anticipate the use of the Queens Groundwater system. Under the No Action Alternative, however, DEP would be unable to implement one component of the Drought Management and Contingency Plan, namely use of the Queens Groundwater system and therefore would have less ability to meet is water supply obligation to its customers.

The City has also proactively implemented a water conservation plan over the past 30 years. The most recent Water Demand Management Plan[9] includes six strategies aimed at reducing City water consumption. These strategies include a municipal water efficiency program; a residential water efficiency program; a non-residential water efficiency program; water distribution system optimization; a water supply shortage management strategy; and assistance to upstate wholesale customers in the development of demand management plans. Successful water conservation measures and the installation of individual water meters have resulted in a decreasing trend in water demand for many years despite an increase in population. While the implementation of a water conservation plan could support the goals of the Proposed Project through a reduction of overall water use during a water shortage or localized infrastructure outage in lieu of the Proposed Project, the City would not be able to match the additional supply provided by the Proposed Project solely through water conservation since a significant portion of these opportunities have already been achieved.

ES-7 UNAVOIDABLE ADVERSE IMPACTS

The *CEQR Technical Manual* requires that significant adverse impacts be summarized or presented when they are “unavoidable if the project is implemented regardless of the mitigation employed (or if mitigation is impossible).”

The Proposed Project would not result in significant adverse impacts that would require mitigation and as a result, there are no unavoidable adverse impacts.

[9] The Water Demand Management Plan is available here: http://www.nyc.gov/html/dep/html/ways_to_save_water/index.shtml

1.0 PROJECT DESCRIPTION

1.1 INTRODUCTION

The vast and complex New York City (City) water supply system (see **Figure 1.1-1**) was originally developed through the visionary work of City planners and engineers who understood the importance of delivering an abundant and reliable supply of clean drinking water to the City. The system was designed in the early 1800s, and has been able to expand, adapt, and modernize to keep pace with a growing population. Today, the New York City Department of Environmental Protection (DEP) is responsible for supplying clean drinking water to over eight million City residents and approximately one million upstate customers in sufficient quantity to meet present water demand, and maintains the water supply system to meet future water demand. Recognizing the need to protect the long-term viability and overall resilience of the water supply system, the City continues to make systematic and sustained investments in the critical infrastructure that provides water to approximately nine million people each day. These investments include work on redundant supplies for use in the event of water supply shortages.

DEP is proposing the In-City Water Supply Resiliency Project to allow for the operation of the existing groundwater supply system in response to a water supply shortage due to drought or planned and/or unplanned infrastructure outages. The proposed Queens Groundwater project, also referred to as In-City Water Supply Resiliency ("Proposed Project"), is the renewal of DEP's existing Water Supply/Water Withdrawal Permit for the groundwater system, which expires on December 31, 2017, and the potential implementation of temporary treatment systems at existing well stations. DEP is conducting a voluntary environmental review for the In-City Water Supply Resiliency Project.

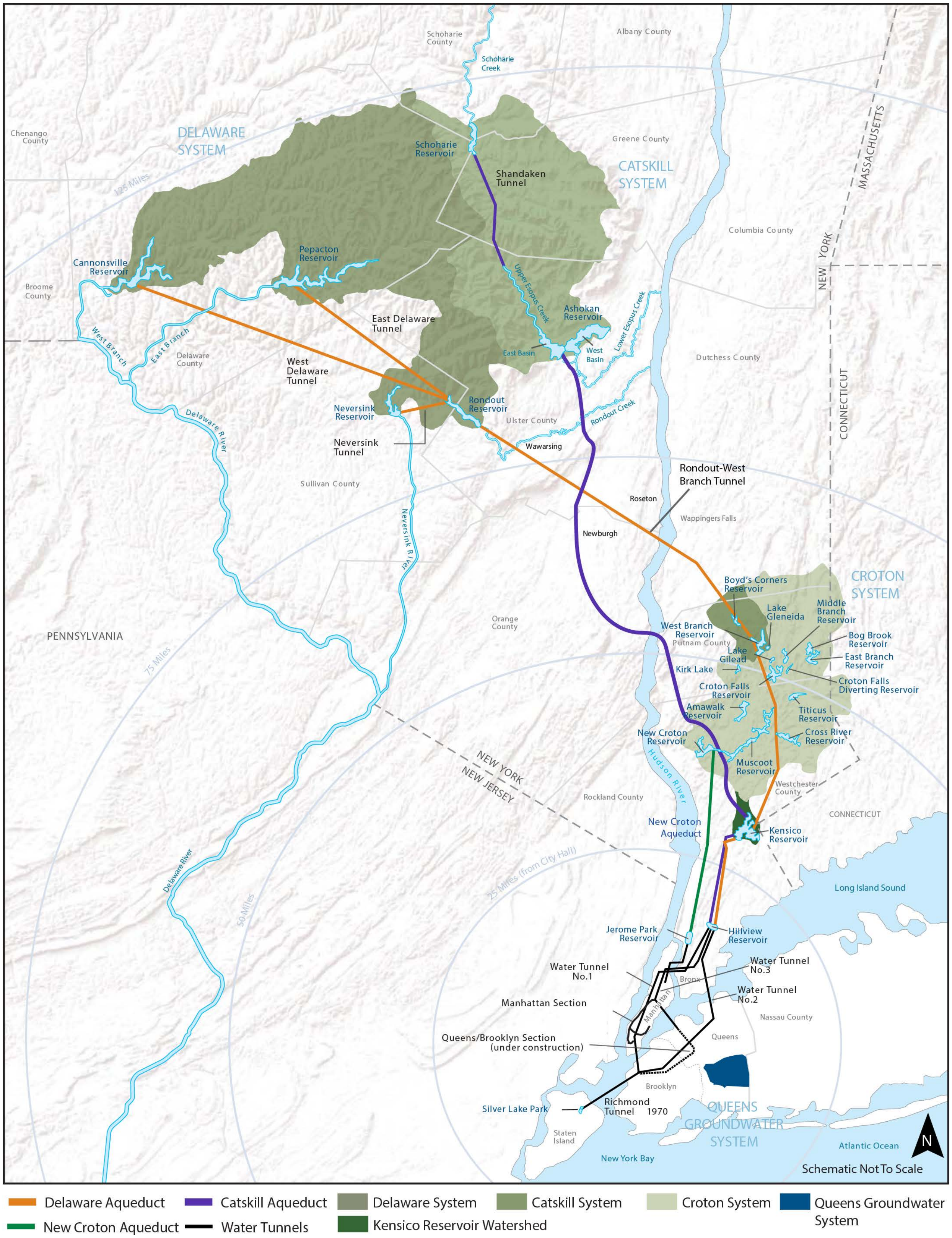

Figure 1.1-1: Water Supply System Map

1.2 BACKGROUND

The Jamaica Water Supply Company operated a group of wells that served communities in southeastern Queens and portions of Nassau County from 1887 to 1996. In 1996, DEP acquired the Queens portion of this system. The Queens Groundwater system is comprised of 44 well stations, which house a total of 68 water supply wells. These wells collectively have a permitted capacity of up to a five-year running average of 22,567.95 (22,568) million gallons per year (61.83 or 62 million gallons per day [mgd]) with a 24,806.86 (24,807) million gallon maximum in any one year (67.964 or 68 mgd).[1] DEP has owned, maintained, and operated the groundwater supply system since its acquisition. DEP continued to use it at varying capacities for potable use through 2007, when water from upstate surface water supplies was provided throughout New York City. Since 2007, wells have been exercised and used for groundwater testing in accordance with DEP's Wellhead Protection Plan.

DEP has retained the system in order to have a supplemental supply to the City's upstate surface water system in times of upstate water supply shortage due to drought or planned and/or unplanned infrastructure outages.

1.3 PURPOSE AND NEED

DEP is responsible for ensuring the safe and reliable delivery of drinking water to consumers in sufficient quantity to meet all present and anticipated future water demands. Although it is not required for the permit renewal, the purpose of the DEIS is to support the In-City Water Supply Resiliency Project which includes renewal of DEP's existing Water Supply/Water Withdrawal Permit for the Queens Groundwater system and potential future temporary treatment of the groundwater system to ensure its viability for meeting DEP's water supply needs in the event of a water supply shortage. Rehabilitating the Queens Groundwater system would improve the resiliency of the City's overall water supply system by making the groundwater system accessible in response to a water supply shortage.

DEP originally acquired the Queens Groundwater system in 1996 and has maintained and operated it as a supplemental supply to the City's upstate surface water system. DEP has maintained applicable permits to operate the system and is seeking to renew its Water Supply/Water Withdrawal Permit (NYSDEC Permit #2-6399-00005/00001) which expires on December 31, 2017, to maintain the existing permitted capacity. No new wells or modifications to the existing Water Supply/Water Withdrawal Permit would be requested and the currently permitted capacities would remain the same as provided within the existing permit. The Proposed Project, which supports the permit renewal and potential use of temporary treatment systems at the existing wells, would enable operation of the full permitted capacity of the groundwater well system in southeastern Queens, New York. As such, the EIS includes the evaluation of impacts due to groundwater withdrawal and the future necessary upgrades to support temporary on-site treatment system improvements at the well stations for potable water supply to support the use of these stations in the event of a water supply shortage.

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[1] For the purposes of the DEIS analysis, all totals have been rounded to the nearest whole number mgd or million gallons per year.

The Proposed Project is consistent with the *One New York: the Plan for a Strong and Just City (OneNYC)*[2] initiative to protect the City's water supply and maintain reliability and resiliency of the system.

1.4 IN-CITY WATER SUPPLY RESILIENCY PROJECT

As noted previously, the Proposed Project consists of two specific elements; renewal of DEP's existing Water Supply/Water Withdrawal Permit, most recently renewed by the New York State Department of Environmental Conservation (NYSDEC) in 2007, and the implementation of temporary treatment systems at groundwater wells to allow the use of Queens Groundwater system during a water supply shortage. Presented within this section is a more detailed discussion of the Proposed Project. This includes an overview of the Queens Groundwater system and the currently anticipated temporary treatment systems that would be employed at the Queens Groundwater wells.

1.4.1 PERMIT RENEWAL

DEP holds an existing NYSDEC Water Supply Permit for the Queens Groundwater system, which expires on December 31, 2017. DEP has maintained applicable permits to operate the system since the acquisition of the Queens Groundwater system in 1996. This permit has a 10-year term and encompasses 44 well stations and a total of 68 wells (some stations have more than one well). While the wells identified within the permit can produce up to 118 mgd, the permit allows DEP to withdraw up to 62 mgd (22,568 million gallons per year) of groundwater based on a five-year running average or 68 mgd (24,807 million gallons) in any one year. DEP seeks to renew the permit in order to maintain the City's access to the water supply in the future and to potentially utilize the system. A renewal of DEP's existing permit for the Queens Groundwater system would allow for operation of the wells for the period from 2018 to 2028.

1.4.2 DROUGHT AND WATER INFRASTRUCTURE OUTAGE

As noted previously, the Queens Groundwater system continued to be used at varying capacities for potable use through 2007, when water from upstate surface water supplies was provided throughout New York City. Since 2007, wells have been exercised and used for groundwater testing in accordance with DEP's Wellhead Protection Plan. In addition to DEP's renewal of their existing Water Supply/Water Withdrawal Permit, the Proposed Project would also include the implementation of temporary treatment facilities at Queens Groundwater wells to allow DEP to utilize groundwater in the event of a water supply shortage such as a drought or planned and/or unplanned outages. Drought conditions have occurred within the City's upstate water supply system seven times over the past 75 years with the most recent drought conditions occurring in 1989, 1991, 1995, and 2002.[3] As a result, a goal of the Proposed Project is to renew DEP's existing permit and also rehabilitate the wells in the Queens Groundwater system to allow utilization of groundwater, if necessary. Likewise, access to the Queens Groundwater system in the event of a planned and/or unplanned outage within the larger water supply and distribution

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2 https://onenyc.cityofnewyork.us/

3 http://www.nyc.gov/html/dep/html/drinking_water/droughthist.shtml

system would serve to provide an added level of redundancy to ensure DEP's ability to provide a reliable supply of water to its in-city customers.

DEP frequently modifies its operation of the water supply system in response to a variety of conditions. DEP has also optimized the water supply system by implementing independent programs and projects that focus on maintaining water supply during times of water supply shortage due to drought or planned and/or unplanned infrastructure outages, thereby increasing system resiliency (see **Figure 1.1-1**). These include an interconnection between the Catskill and Delaware aqueducts at Shaft 4 in Ulster County, New York, and the rehabilitation of the Cross River and Croton Falls pump stations to move water from the Cross River and Croton Falls reservoirs in the Croton System to the Delaware Aqueduct upstream of Kensico Reservoir in Westchester County. Additional resiliency is achieved with reservoirs shared between surface water systems. The Delaware and Croton systems share the Boyd's Corners and West Branch reservoirs, while the Delaware and Catskill systems share the Kensico and Hillview reservoirs. Access to the Queens Groundwater system would further support DEP's water supply system resiliency efforts, as it would provide access to another source of water, as needed. Together these initiatives and connections allow DEP to modify operations to meet the needs of the City and its water supply system.

The Proposed Project would therefore also support initiatives to promote redundancy and flexibility of the City's water supply system outlined in the *Special Initiative on Rebuilding and Resiliency* report released by the City in 2013 in the wake of Superstorm Sandy, which occurred in 2012. The Proposed Project would enhance the reliability of the City's water supply and maintain flexibility during typical operations, as well as during periods when the water supply system is depleted, or when water quality in other parts of the system is affected by heavy rain or heat waves.[4] See Section 1.6.2.1 for details on the City's Drought Management and Contingency Plan.

1.5 QUEENS GROUNDWATER SYSTEM

1.5.1 INTRODUCTION

The Jamaica Water Supply Company operated a group of wells that served communities in southeastern Queens and portions of Nassau County from 1887 to 1996. At its peak, the Jamaica Water Supply Company provided more than 100 mgd of groundwater.

In 1996, DEP acquired the Queens portion of this system. The Queens Groundwater system is comprised of 44 well stations, which house 68 water supply wells. Well stations may consist of a single well or may have multiple wells.

DEP continued to use it at varying capacities for potable use through 2007, when water from upstate surface water supplies was provided throughout New York City. Since 2007, wells have been exercised and used for groundwater testing in accordance with DEP's Wellhead Protection Plan. DEP has retained the system in order to have a supplemental supply to the City's upstate

4 The *Special Initiative on Rebuilding and Resiliency* Report is available here: http://www.nyc.gov/html/sirr/html/report/report.shtml

surface water system in times of water supply shortage due to drought or planned/unplanned infrastructure outages.

1.5.2 WATER DEMAND MANAGEMENT AND CONSERVATION

DEP has proactively developed and implemented a robust conservation plan that has substantially reduced water demand since per capita consumption peaked in 1979.

The most recent Water Demand Management Plan[5] includes six strategies aimed at reducing City water consumption. These strategies include: a municipal water efficiency program; a residential water efficiency program; non-residential water efficiency program; water distribution system optimization; a water supply shortage management strategy, and assistance to upstate wholesale customers in the development of demand management plans. Successful water conservation measures and the installation of individual water meters have resulted in a decreasing trend in water demand for many years despite an increase in population. Overall water demand has declined since the early 1990s. **Figure 1.5-1** compares the average daily demand by calendar year with the increase in New York City population for the last five decades. As illustrated on **Figure 1.5-1**, New York City has experienced various increases and decreases in both population and water demand. Some of the decreases in water demand are the result of conservation programs such as installation of low-flow plumbing fixtures since 1992 and the Automatic Meter Reading program in 2009. While the City population increased by 5 percent between 1960 and 2010, water demand decreased by 13 percent over this same period.

Water conservation efforts in Nassau and Suffolk counties, however, have not experienced the same level of conservation as that of New York City. As shown on **Figure 1.5-2** and **Figure 1.5-3**, the population of Nassau County increased by 3 percent between 1960 and 2010, and water demand increased by 68 percent. Similarly, during that same time period, the population of Suffolk County increased by 124 percent, with a 138 percent increase in water demand.

1.5.3 WELL LOCATIONS

All of the Queens well stations are located within an approximately 20 square-mile area in the southeastern section of Queens, which borders Nassau County (see **Figure 1.5-4**). The existing well stations are located in established areas of Queens, and have been previously developed and maintained. The stations are generally bounded by I-495 (Long Island Expressway) to the north, Route 27 (Sunrise Highway) to the south, Lefferts Boulevard to the west, and the Belt/Cross Island Parkways to the east. The Proposed Project is also located within the Jamaica Bay and Bronx River-East River Watersheds, with a majority of the well stations located within the Jamaica Bay Watershed.

The 44 well stations currently included within DEP's existing Water Supply/Water Withdrawal Permit vary in size from approximately 3,200 square feet to as large as two acres, with the majority less than a quarter of an acre. The well stations and wells are located within secured, DEP-owned parcels and may contain one or more small structures. Each existing well is typically associated with an existing structure or well house and supporting infrastructure and

[5] The Water Demand Management Plan is available here: http://www.nyc.gov/html/dep/html/ways_to_save_water/index.shtml

has an existing connection to the City's water distribution system and sewer system. There are no surface waters, streams, or wetlands located on any well station parcel. **Table 1.5-1** provides a summary of well stations and currently permitted wells, including address, tax parcel (block and lot), zoning district, zoning map, and community board.

1.5.4 WELL CHARACTERISTICS

1.5.4.1 Well Capacities

The capacity of a well is the permitted maximum rate at which water can be pumped from that well. The overall Queens Groundwater system has a total pumping capacity of approximately 118 mgd. However, under the existing Water Supply/Water Withdrawal Permit, water withdrawal from these wells is limited to 62 mgd (22,568 million gallons per year) based on a five-year running average or 68 mgd (24,807 million gallons per year) in any one year. The individual well capacities within the Queens Groundwater system currently range from 400 gallons per minute (gpm) (0.5 mgd) to 1,800 gpm (2.5 mgd).

Table 1.5-2 provides a summary of the current capacity and depth for each well. Wells within the Queens Groundwater system are also not all established within a single aquifer, but are instead located within one of four aquifers that are located beneath Queens and Long Island. The specific aquifer associated with each individual well is also identified within **Table 1.5-2** and additional discussion of these aquifers is provided within Section 1.5.4.2.

1.5.4.2 Aquifers

The sources of water for the wells in the Queens Groundwater system are the aquifers beneath the Queens section of Long Island. An aquifer is a natural underground layer of porous, water-bearing materials (e.g., sand, gravel) generally capable of yielding a large supply of water. There are four main aquifers in what is known as the Brooklyn-Queens Aquifer: the Upper Glacial and Jameco, which are the shallowest; the Magothy, which is the middle layer; and the Lloyd, which is the deepest (see **Figure 1.5-5**). Formed approximately 60 million years ago, the aquifers are generally separated by layers of clay and groundwater moves through the aquifer systems under the influence of pressure and gravity. Water for the Queens Groundwater wells is largely extracted from the Magothy and Upper Glacial aquifers, although some existing wells extract from the Jameco, and Lloyd aquifers (see **Figure 1.5-4**, **Figure 1.5-5**, and **Table 1.5-2)**. These aquifers also extend beneath Nassau and Suffolk counties.

Infiltration of precipitation into the ground replenishes the aquifers, but infiltrated water can also seep back into surface waterbodies (i.e., groundwater discharge). This type of natural groundwater discharge can help sustain the flow of streams, lakes, and wetlands, and can aid in the stabilization of the salinity of estuaries. For shallow aquifers, such as the Upper Glacial and Jameco, there is a greater probability of groundwater discharge to surface waterbodies. When large amounts of water are withdrawn from the ground, however, the water table is locally depressed and can reduce the amount of groundwater that discharges to streams and other surface waters.

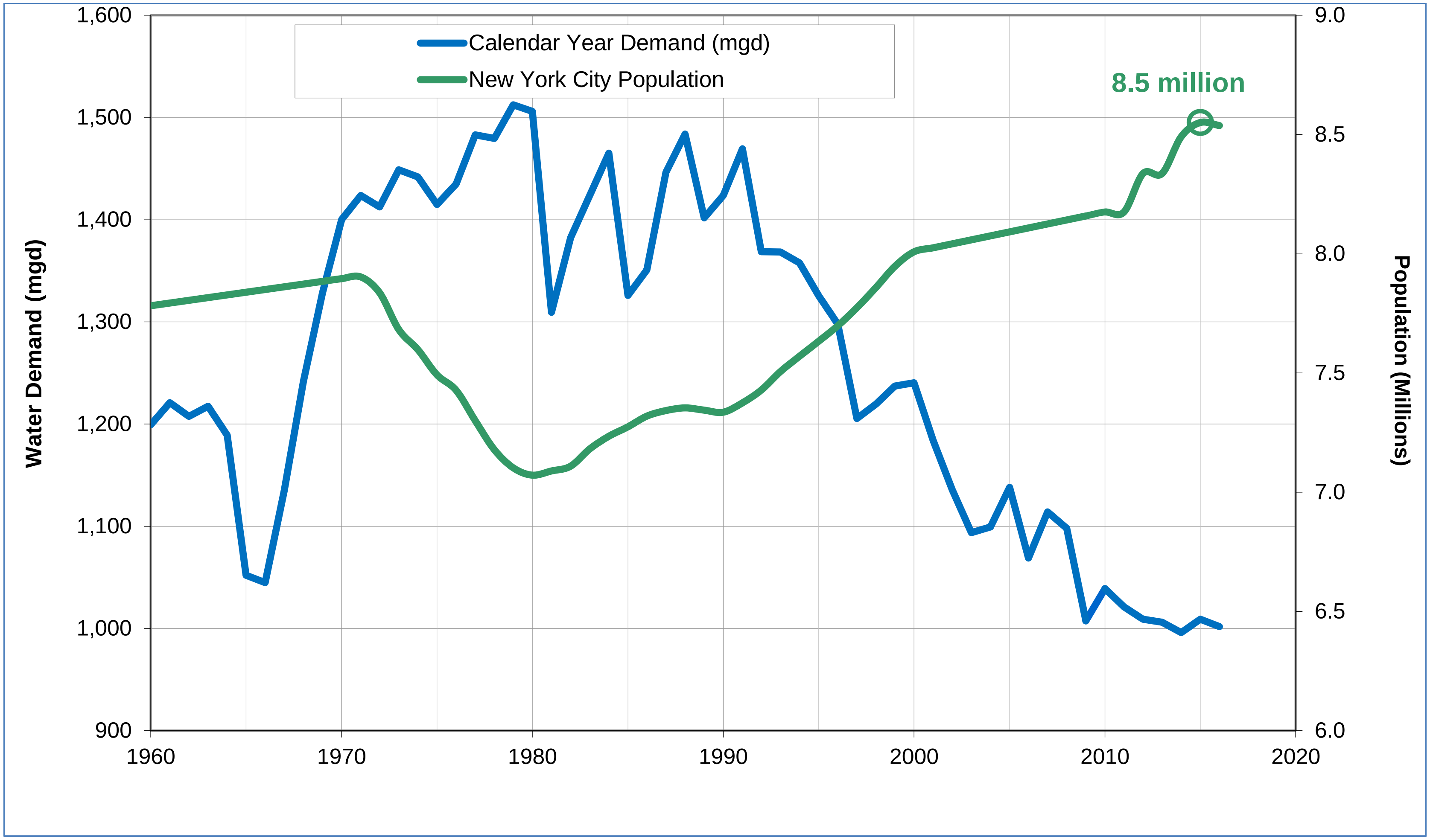

Figure 1.5-1: Comparison of Historic Changes in NYC Water Demand and Population

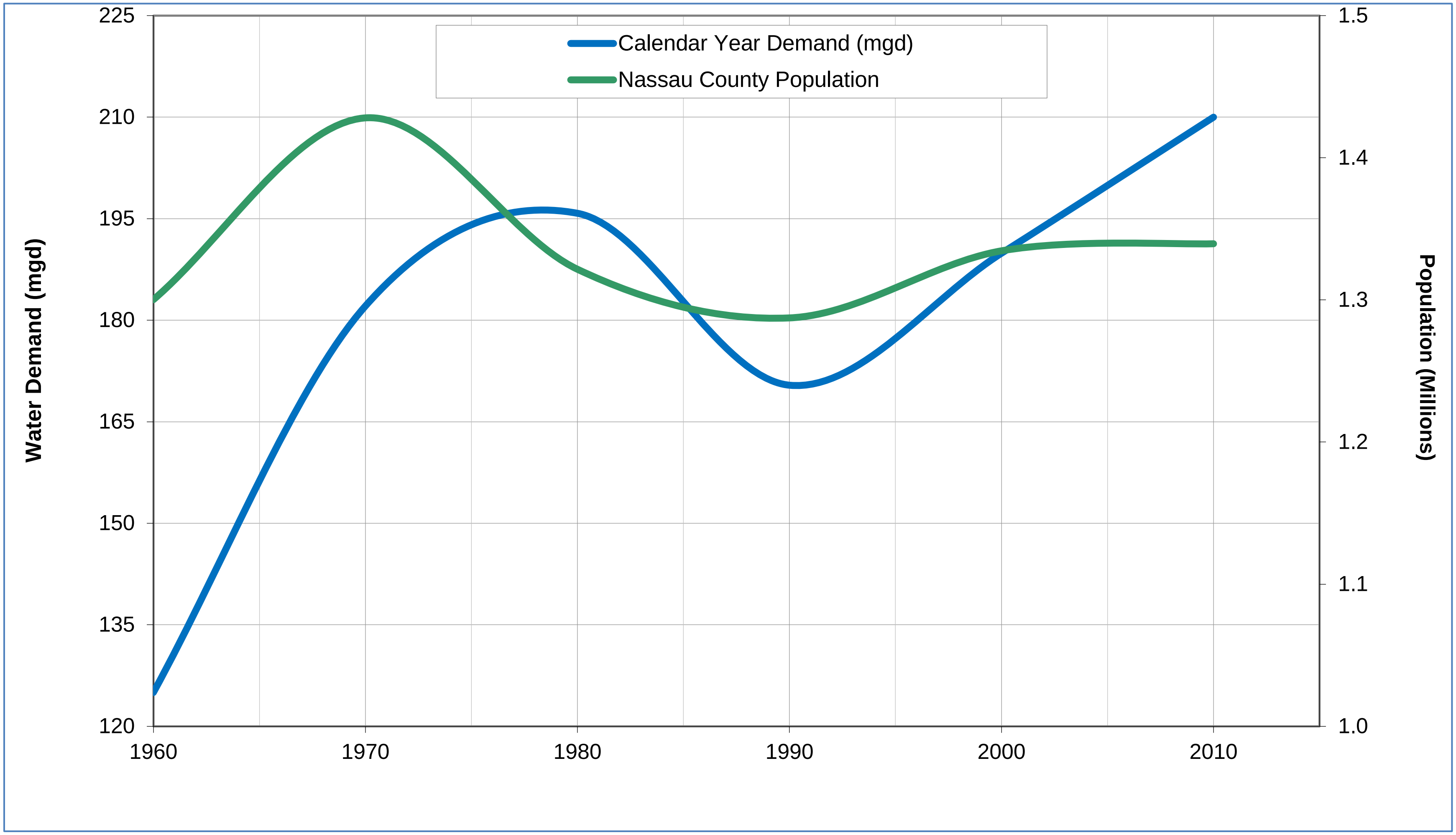

Figure 1.5-2: Comparison of Historic Changes in Nassau County Water Demand and Population

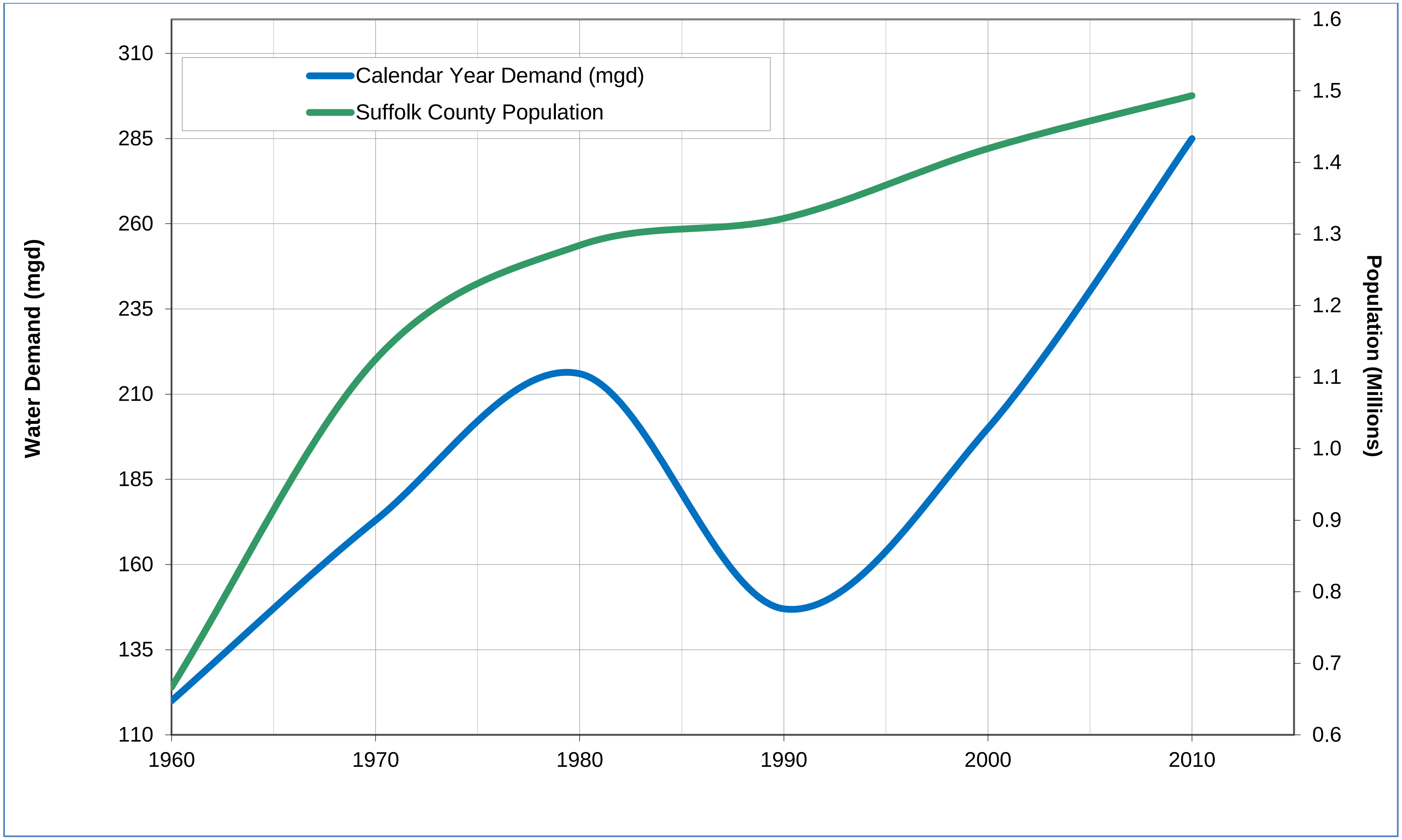

Figure 1.5-3: Comparison of Historic Changes in Suffolk County Water Demand and Population

Table 1.5-1: Wells and Well Stations Comprising the Proposed Project

Well Number	Station	Address (Queens, NY)	Block	Lot	Zoning	Zoning Map	Community Board
1	1	127-01 Metropolitan Ave.	9249	65	R6	14b	9
3	3	109-31 120th St.	11601	54	R4	18c	10
3A	3	109-31 120th St.	11601	54	R4	18c	10
5	5	93-02 199th St.	10473	19	R4	15b	12
5A	5	93-02 199th St.	10473	19	R4	15b	12
6	6D	166-44 108th Ave.	10173	48	R4-1	14d	12
6A	6	164-44 109th Ave.	10183	53	R3A	14d	12
6B	6	164-27 110th Ave.	10185	125	R3A	14d	12
6C	6	164-11 109th Dr.	10184	112	R3A	14d	12
6D	6D	166-44 108th Ave.	10173	48	R4-1	14d	12
7	7	91-01 209th St./91-01 91st Ave./209-02 91st Ave.	10560	1	R2	15a	13
7B	7	91-01 209th St./91-01 91st Ave./209-02 91st Ave.	10560	1	R2	15a	13
8A	8	131-02 88th Ave.	9338	45	M1-1	14d	9
10	10	116-32 224th St.	11324	48	R3-1	15b	13
10A	10	116-32 224th St.	11324	48	R3-1	15b	13
11	11	111-12 143rd St.	11958	6	R3A	18c	12
13	13	214-01 89th Ave.	10672	1	R2	15a	13
13A	13	214-01 89th Ave.	10672	1	R2	15a	13
14	14	116-16 144th St.	12002	11	R3A	18c	12
17	17	87-73 123rd St.	9332	47	R5	14b	9
17A	17	87-73 123rd St.	9332	47	R5	14b	9
18	18	84-02 164th St./ 84-06 164th St.	9792	73	R4B	14d	8
18A	18	84-02 164th St./ 84-06 164th St.	9792	73	R4B	14d	8
19	19	Highland Ave.	9843	15	R5	14d	8
21	21	85-44 Springfield Blvd.	10693	35	R3-2	15a	13
21A	21	85-44 Springfield Blvd.	10693	35	R3-2	15a	13
22	22	84-76 127th St.	9248	42	R4-1	14b	9
23	23	114-56 224th St.	11267	15	R2A	15d	13
23A	23	114-56 224th St.	11267	15	R2A	15d	13
26	26	113-30 Francis Lewis Blvd.	11001	1	R4B	15b	12
26A	26	113-30 Francis Lewis Blvd.	11001	1	R4B	15b	12
27	27	86-83 Dunton St.	10538	107	R1-2	15a	8
29	29	216-15 102nd Ave.	11091	1	R3-2	15b	13
29A	29	216-15 102nd Ave.	11091	1	R3-2	15b	13
31	31	127-15 92nd Ave.	9356	35	M1-1	14d	9
32	32	109-50 127th St./ 126-15 111th Ave.	11607	33	R3-2	18c	10
33	33	160-25 108th Ave.	10139	32	R4	14d	12

Table 1.5-1: Wells and Well Stations Comprising the Proposed Project

Well Number	Station	Address (Queens, NY)	Block	Lot	Zoning	Zoning Map	Community Board
36	36	Hook Creek Blvd./ 244-98 129th Ave.	12890	2	R2	19c	13
37	37	87-74 Chevy Chase St.	9962	89	R1-2	15a	8
38	38	90-35 193rd St.	10458	25	R5	15b	12
38A	38	90-35 193rd St.	10458	25	R5	15b	12
39	39	90-42 Springfield Blvd.	10718	26	R2	15a	13
39A	39	90-42 Springfield Blvd.	10718	26	R2	15a	13
41	41	87th Ave.	9621	42	R4-1	14d	9
42	42	197-14 Murdock Ave.	11014	6	R4-1	15b	12
42A	42	197-14 Murdock Ave.	11014	6	R4-1	15b	12
43	43	85-34 118th St.	9260	21	R6B	14b	9
43A	43	85-34 118th St.	9260	21	R6B	14b	9
45	45	101-19 120th St.	9488	68	R4A	18a	9
47	47	217-14 112th Rd.	11214	11	R3-2	15b	13
47A	47	217-14 112th Rd.	11214	11	R3-2	15b	13
48	48	109-81 Francis Lewis Blvd.	10947	14	R3-2	15b	13
48A	48	109-81 Francis Lewis Blvd.	10947	14	R3-2	15b	13
49	49	103-15 219th St.	11154	18	R3-2	15b	13
49A	49	103-15 219th St.	11154	18	R3-2	15b	13
50	50	77-09 Parsons Blvd.	6827	30	R3-2	14c	8
50A	50	77-09 Parsons Blvd.	6827	30	R3-2	14c	8
51	51	78-23 164th St.	6972	37	R3-2	14c	8
52	52	71-52 161st St.	6799	81	R6	14c	8
53	53	160-25 76th Rd.	6836	4	R3-2	14c	8
53A	53	160-25 76th Rd.	6836	4	R3-2	14c	8
54	54	227-25 Linden Blvd.	11328	1	R2A	15d	13
54A	54	227-25 Linden Blvd.	11328	1	R2A	15d	13
55	55	194-10 99th Ave.	10841	10	R3-2	15b	12
56	56	134-15 222nd St.	13102	1	R3A	19a	13
58	58	180-40 Grand Central Parkway	9949	60	R1-2	14c	8
59	59	132-06 Springfield Blvd.	12728	41	R2	19a	12
60	60	231-19 128th Dr.	12869	54	R2A	19c	13

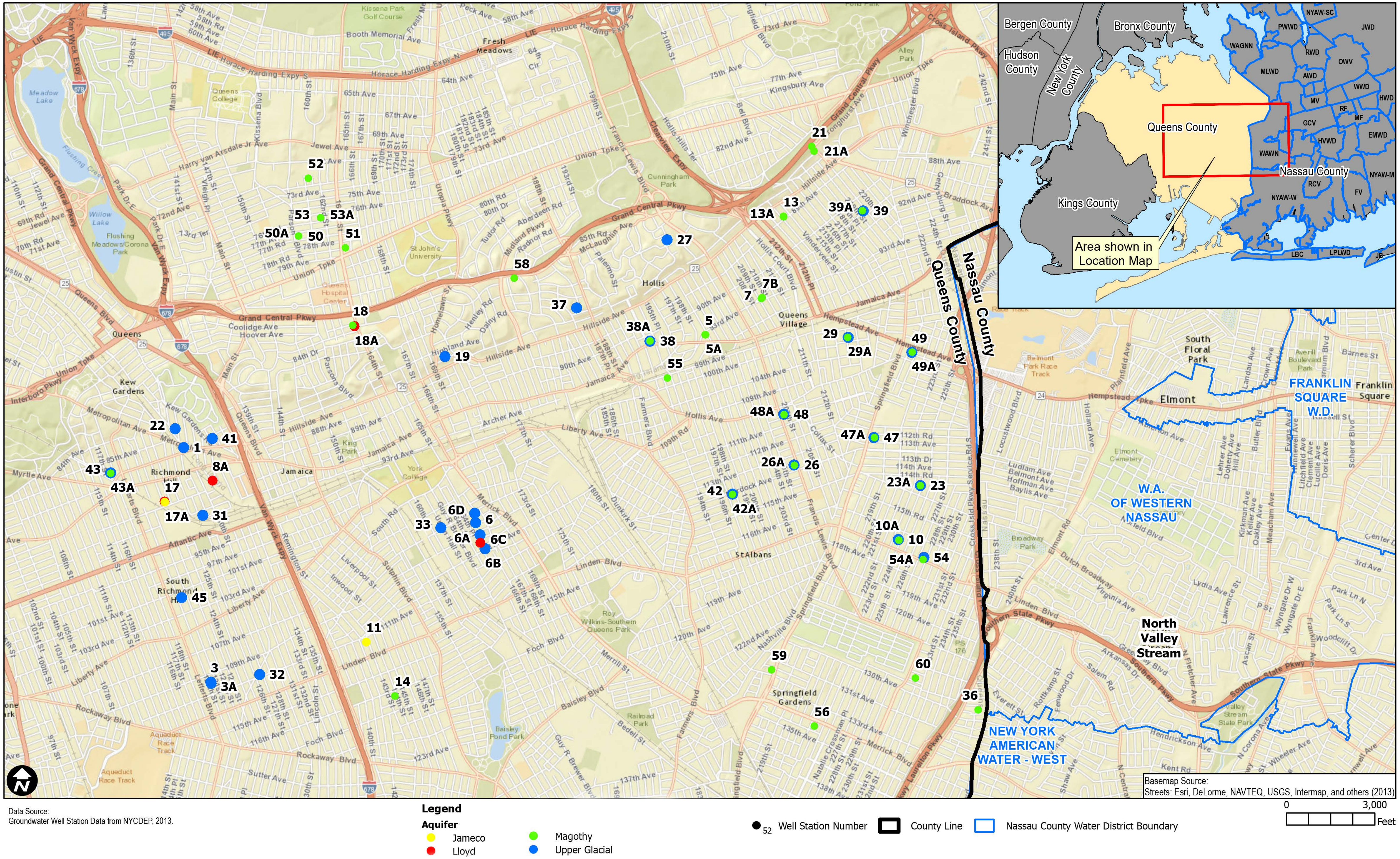

Figure 1.5-4: Queens Groundwater System Well Station and Well Locations

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Provided below is a general discussion of the various aquifers that comprise the Brooklyn-Queens Aquifer and are the source of groundwater within the Queens Groundwater system.

Table 1.5-2: Well Capacity, Depth, and Associated Aquifer

Well Number	Station	Well Capacity (gpm)	Depth (ft)	Aquifer
1	1	800	111	Upper Glacial
3	3	1,200	105	Upper Glacial
3A	3	1,150	158	Upper Glacial
5	5	1,200	280	Magothy
5A	5	1,700	288	Magothy
6	6D	550	81	Upper Glacial
6A	6	1,200	85	Upper Glacial
6B	6	1,200	101	Upper Glacial
6C	6	1,800	607	Lloyd
6D	6D	650	100	Upper Glacial
7	7	1,400	307	Magothy
7B	7	1,200	293	Magothy
8A	8	1,000	555	Lloyd
10	10	700	108	Upper Glacial
10A	10	1,800	437	Magothy
11	11	1,380	265	Jameco
13	13	1,200	297	Magothy
13A	13	1,200	299	Magothy
14	14	1,200	305	Jameco/ Magothy
17	17	1,300	552	Lloyd
17A	17	600	286	Jameco
18	18	1,000	250	Magothy
18A	18	1,200	626	Lloyd
19	19	400	146	Upper Glacial
21	21	1,380	340	Magothy
21A	21	1,200	355	Magothy
22	22	1,020	127	Upper Glacial
23	23	1,200	103	Upper Glacial
23A	23	1,600	365	Magothy
26	26	1,000	115	Upper Glacial
26A	26	1,600	185	Magothy
27	27	1,000	268	Upper Glacial
29	29	1,200	98	Upper Glacial
29A	29	1,600	281	Magothy
31	31	1,020	144	Upper Glacial
32	32	1,194	109	Upper Glacial
33	33	1,000	85	Upper Glacial
36	36	1,600	433	Magothy
37	37	1,183	207	Upper Glacial
38	38	1,400	110	Upper Glacial
38A	38	1,800	285	Magothy
39	39	1,400	112	Upper Glacial
39A	39	1,600	165	Magothy
41	41	1,180	120	Upper Glacial
42	42	400	87	Upper Glacial
42A	42	1,700	185	Magothy
43	43	1,400	129	Upper Glacial
43A	43	1,300	247	Magothy
45	45	1,050	158	Upper Glacial
47	47	1,000	105	Upper Glacial
47A	47	1,600	342	Magothy
48	48	1,400	120	Upper Glacial
48A	48	1,600	278	Magothy
49	49	1,400	130	Upper Glacial
49A	49	1,600	235	Magothy
50	50	1,000	168	Magothy
50A	50	1,000	259	Magothy
51	51	1,000	292	Magothy
52	52	800	140	Magothy
53	53	1,000	151	Magothy
53A	53	1,000	261	Magothy
54	54	1,200	113	Upper Glacial
54A	54	1,200	365	Magothy
55	55	1,200	285	Magothy
56	56	1,400	450	Magothy
58	58	1,000	325	Magothy
59	59	1,400	422	Magothy
60	60	1,400	358	Magothy

Upper Glacial Aquifer

The Upper Glacial Aquifer is an unconfined aquifer located directly under the ground surface. An aquifer is unconfined when its upper surface (water table) is open to the atmosphere through permeable material, such as soil. The Upper Glacial Aquifer is the uppermost water-bearing layer, consisting of mainly glacial outwash deposits of sand and gravel. The thickness of the aquifer ranges from 0 to 300 feet and overlies the other underlying aquifers, and is found at ground surface throughout Queens County.[6,7]

Jameco Aquifer

The Jameco Aquifer is present in buried valleys, mainly in central and southern areas of Queens County, and ranges from 0 to 250 feet thick. It consists of mostly coarse sand and gravel with small amounts of silt and clay.[6,7]

Magothy Aquifer

The Magothy Aquifer is the largest of the aquifers. The Magothy Aquifer overlies the Raritan Formation clay-confining unit and ranges in thickness from 0 to 450 feet thick. The Magothy is reported to be thickest in the area of Far Rockaway, and absent in northern and northwestern Queens County and in the buried valley area trending southward from the Flushing Meadows-Corona Park area. It consists of clay lenses, clayey and silty sand, fine to coarse sand, and gravelly sand.[6,7]

Lloyd Aquifer

The Lloyd Aquifer is the deepest and oldest of the aquifers. The Lloyd Aquifer is the lowermost major water-bearing layer, highly confined[8] between the overlaying Raritan Formation clay and the underlying bedrock. It ranges in thickness from 0 to 300 feet, increasing southeastward. The slope of the Lloyd Aquifer mimics the underlying bedrock. The Lloyd Aquifer consists of beds of sand and gravel with beds of clay and silt.[6,7]

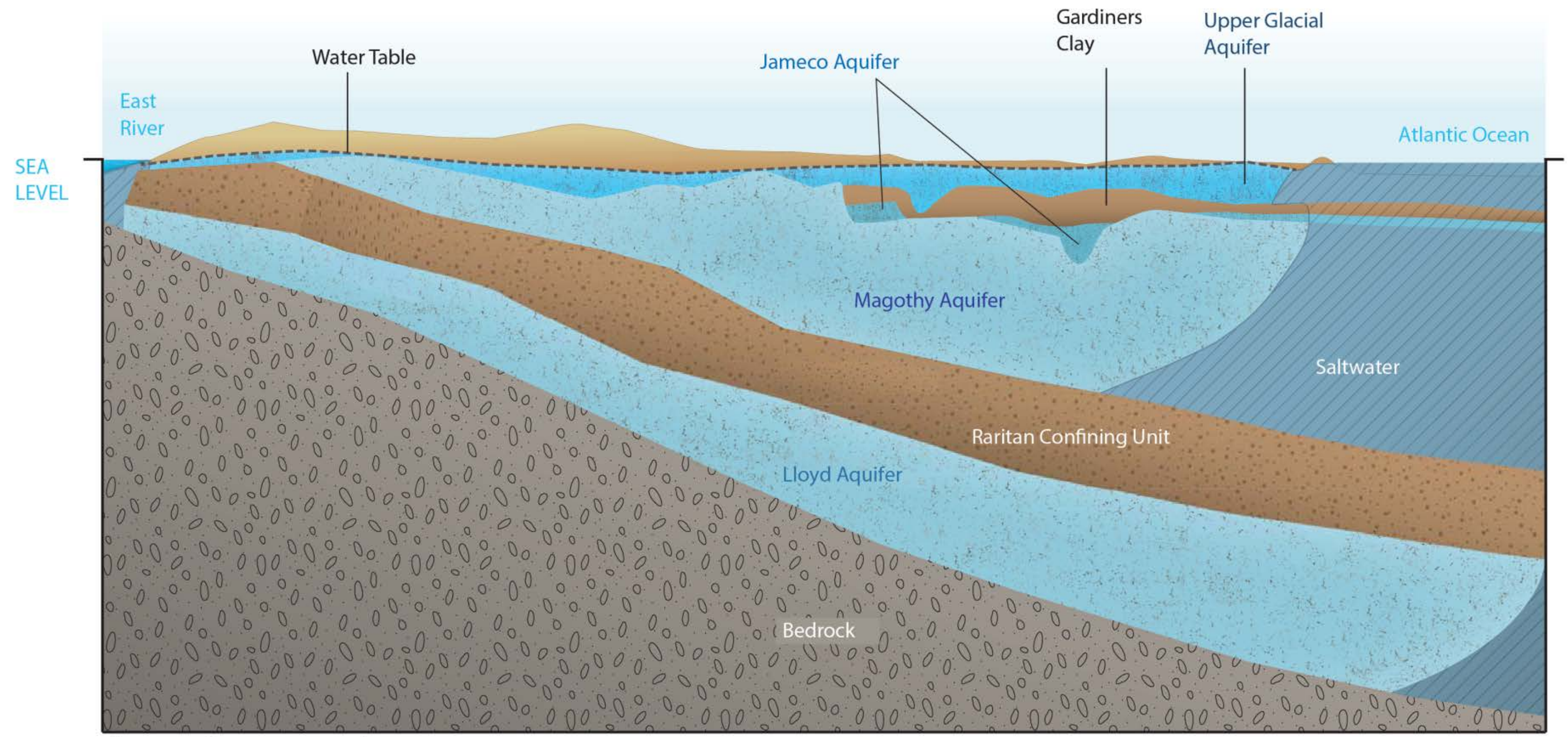
1.5.4.3 Water Quality

The historical water quality of the aquifers and the groundwater withdrawn through wells within the Queens Groundwater system is similar to other water supply wells throughout Nassau and Suffolk counties. Groundwater is impacted by both organic and inorganic contaminants including iron and manganese, volatile organic compounds (VOCs), nitrates, and perchlorate. As noted previously, the City had utilized the Queens Groundwater system as a public water supply until 2007 consistent with applicable regulatory drinking water quality requirements when access to the upstate water supply system was made available throughout the City. The City continues

[6] Soren, J. 1971. *Ground-water and Geohydrologic Conditions in Queens County, Long Island, New York.* U.S. Geological Survey, Water Supply Paper 2001-A.

[7] Soren, J. 1978. *Subsurface Geology and Paleogeography of Queens County, Long Island, New York.* U.S. Geological Survey, Water Resources Inv. 77-34.

[8] Confined aquifers are those in which an impermeable soil/rock layer exists that prevents water from seeping into the aquifer from the ground surface located directly above.



Illustrative figure, not to scale.

Figure 1.5-5: Queens Aquifers

to collect water quality samples from its Queens Groundwater system wells as part of water-quality monitoring and wellhead protection programs. Based upon these water quality samples and available historical water quality data, DEP has identified these potential contaminants (parameters of concern) as those that will most likely need to be addressed as part of any future use of the Queens Groundwater system for water supply (see Section 1.6.2.3). As these are commonly encountered parameters of concern, treatment for the removal of these is routinely implemented throughout Long Island. Representative temporary treatment options to address these contaminants are discussed in this EIS in Section 1.6.2.3.

Water quality samples, along with the complete available historical water quality for each well, would be considered prior to the implementation of any temporary treatment. Prior to activation of a specific well, DEP would conduct further water quality analysis. The selection of temporary water treatment systems discussed within this EIS are based upon the available historical water quality data, and would be subject to revision as new data becomes available.

1.6 PROPOSED ACTIONS

1.6.1 WATER SUPPLY/WATER WITHDRAWAL PERMIT RENEWAL

1.6.1.1 Current Permit

DEP originally acquired the Queens Groundwater system in 1996 and has maintained and operated it as a supplemental supply to the City's upstate surface water system. DEP has maintained applicable permits to operate the system since acquiring the system in 1996 and is seeking to renew its Water Supply/Water Withdrawal Permit (NYSDEC Permit #2-6399-00005/00001) to maintain the existing permitted capacity. The current NYSDEC Water Supply Permit from the NYSDEC was effective January 1, 2007 and requires renewal by December 31, 2017.

The existing capacity at each permitted well is listed in **Table 1.5-2**. While the overall capacity of the Queens Groundwater wells is over 118 mgd, the total system is limited to the existing permit capacity identified within the 2007 permit. The permit allows DEP to withdraw up to a five-year running average of 22,568 million gallons per year (62 mgd), with a 24,807 million gallon per year maximum for any single year (68 mgd).[9]

1.6.1.2 Proposed Permit Renewal

As noted previously, one component of the Proposed Project is the renewal of DEP's existing Water Supply/Water Withdrawal Permit. As part of this renewal, DEP is not proposing the construction of any new wells or any modifications to the existing Water Supply/Water Withdrawal Permit. The current list of well permits and their associated well capacity would remain the same. DEP is not proposing to increase any well capacity, including those currently established within the Lloyd Aquifer. The current overall permit limits on water withdrawal

[9] For the purposes of the DEIS analysis, all totals have been rounded to the nearest whole number mgd or million gallons per year.

would remain unchanged from the existing permit and no change in existing permit conditions will be requested.

1.6.2 TEMPORARY WATER TREATMENT FOR DROUGHT AND OUTAGES

While one component of the Proposed Project is to support the renewal of the Water Supply/Water Withdrawal Permit, the secondary purpose of In-City Water Supply Resiliency is to provide necessary treatment and infrastructure upgrades for the existing wells in order to support the withdrawal of potable water during a water supply shortage such as drought or planned and/or unplanned infrastructure outages within the City's surface water system. The City has encountered nine droughts within the upstate water supply system over the past 75 years and the ability to maintain the Queens Groundwater system as an element of DEP's flexibility to address these and other planned and/or unplanned infrastructure outages is an important element of DEP's water supply redundancy and resiliency to meet the demands of its in-city customers.

Presented within the following sections is an overview of the drought conditions and water supply system outages that would serve as the basis for the potential temporary use of all or a portion of the Queens Groundwater system.

1.6.2.1 Drought

Introduction

A drought is a prolonged period of abnormally low rainfall or a shortage of water resulting from low rainfall.

Surface water systems receive a majority of their water supply as direct precipitation and surface runoff from the surrounding watersheds, with lesser amounts derived from groundwater. As a result, surface water systems are more sensitive to sudden changes in precipitation levels, extended periods of elevated temperatures, and have a greater potential for evaporative loss. These can all contribute to droughts in a surface water system.

Water supply systems that rely on groundwater resources are less sensitive to these changes in precipitation levels and temperatures. As an example, infiltration into the ground and aquifers takes longer than the flow of precipitation run-off into a surface water system. As such, there is decreased probability for an overlap of drought conditions within a surface water supply system versus an aquifer-fed water supply system, such as in Nassau and Suffolk counties, as there is a lag associated with the additional time for infiltration to an aquifer. As a result, while there are years where New York City and neighboring Nassau County have both experienced drought conditions concurrently, typically these conditions would not occur at the same time.

Drought Management and Contingency Plan

Given the City's reliance on the upstate surface water supply system, the City has developed a Drought Management and Contingency Plan[10] that defines criteria to assess the probability of achieving reservoir refill in the surface water supply system using historical data, hydrologic forecasting, and a computer-modeling tool (i.e., the Operations Support Tool). This plan establishes actions and procedures for managing water supply and demand during drought conditions. Within this plan, the City has three levels of drought severity; watch, warning, and emergency. In addition, there are three stages within an emergency, with increasingly severe mandated use restrictions. The City's Drought Management and Contingency Plan provides the guidelines established to identify when a watch, warning, or emergency should be declared and the actions for each level.

- A Drought Watch is declared when there is less than a 50 percent probability that either of the two largest reservoir systems, the Delaware (Cannonsville, Neversink, Pepacton, and Rondout reservoirs) or the Catskill (Ashokan and Schoharie reservoirs), will fill by the start of the water-year (June 1).

- A Drought Warning is declared when there is less than a 33 percent probability that either of the two largest reservoir systems, the Delaware or the Catskill will fill by the start of the water-year (June 1).

- A Drought Emergency is declared when there is a reasonable probability that, without the implementation of stringent measures to reduce consumption, a protracted dry period would cause the City's reservoirs to be drained resulting in a shortage of water.

As set forth within the City's existing Drought Management and Contingency Plan, DEP may use water from the Queens Groundwater system during a drought warning and emergency. During the watch phase of a drought, DEP would not anticipate the use of the Queens Groundwater system.

Based on the actions to be implemented during a drought warning under the City's plan, DEP would also request voluntary use restrictions of its customers and coordinate with City agencies to reduce usage, such as fire hydrant flushing, fleet washing, and the limiting of water use for fountains and golf courses. A drought emergency is designated in stages, with each stage associated with increasingly stringent use restrictions based on the severity of the drought conditions. Drought rules direct and restrict water usage and increase the restriction enforcement. During a drought warning or emergency, DEP may supplement upstate water supplies with the Queens Groundwater system even with use restrictions in place.

It should be noted that historically, drought events within the City's upstate water supply system have not generally occurred concurrent with droughts on Long Island, within the aquifers. This is typically due to the increased sensitivity of the upstate system, a surface water supply, that can be more immediately impacted by significant changes in precipitation and which also routinely

[10] The Drought Management and Contingency Plan is available here: http://www.nyc.gov/html/dep/pdf/droughtp.pdf

lose additional supply through evaporative loss. The aquifer systems in Queens and Long Island do not respond as quickly to changes in precipitation patterns due to the need for recharge and infiltration over time. This serves to limit concurrent drought condition effects between these two sources of water supply.

1.6.2.2 System Outages

In addition to drought conditions, use of the Queens Groundwater system may be required during planned and/or unplanned infrastructure outages. As noted in Section 1.4.2, the Proposed Project would support initiatives to promote redundancy and flexibility of the City's water supply system as outlined in the *Special Initiative on Rebuilding and Resiliency* report released by the City in 2013.

Unplanned infrastructure outages within the water supply system cannot be predicted. Unplanned outages may include the interruption of any major, key distribution infrastructure (e.g., trunk mains, shafts). While DEP has worked to increase the redundancy and resiliency of the entire water supply system to maximize the City's flexibility to react to these unplanned outages, the Queens Groundwater system may need to be accessed on a temporary basis until the interruption or infrastructure outage has been addressed.

In addition, from time to time DEP may have planned distribution infrastructure outages. These outages may be required to maintain and repair portions of the distribution infrastructure. DEP would undertake all reasonable efforts to limit usage of the groundwater system, both in volume and duration during these planned outages. As noted in the Drought Management and Contingency Plan, DEP would engage with all stakeholders during and prior to any planned project.

1.6.2.3 Temporary Water Treatment Systems

Introduction

As part of the Proposed Project and specifically during water supply shortages due to drought or planned and/or unplanned infrastructure outages, DEP would implement temporary treatment facilities prior to the use of any of the Queens Groundwater wells. Temporary treatment facilities would be employed at all or a subset of the currently permitted wells dependent upon the DEP water supply needs that may be identified. These temporary treatment facilities would include the potential construction of concrete pad(s) or supports for the placement of container or trailer-based treatment facilities (treatment blocks), as well as necessary ancillary infrastructure (e.g., water and electrical connections, chemical storage tanks, etc.), required to treat raw water extracted from the existing wells. Raw water would be treated and tested to ensure that the water is of a finished water quality that would meet or exceed all applicable New York State Department of Health (NYSDOH), New York City Department of Health and Mental Hygiene (NYCDOHMH), or other drinking water quality standards at the time the treatment system is constructed and operated. Finished water would be of a quality consistent or comparable with water from DEP's surface water system prior to release into the water supply system.

For the purposes of this EIS, a generic discussion of a typical treatment facility that could be employed for the Queens Groundwater wells is presented, as more detailed and final designs would not be available until prior to actual implementation. As the physical layout, parameters of concern, and treatment needs for many of the Queens Groundwater wells would be similar for different sites; this typical treatment system provides a reasonable representation of the anticipated layout and operation of a system that would be utilized for many of the current wells. A general discussion of the layout of a generic treatment system at a well station and the nature of anticipated construction and operation are provided and has been used to assess the potential environmental impacts of these temporary treatment facilities. Upon the advancement of more detailed design of temporary treatment systems at one or more well stations in the future, additional site-specific analyses will be completed, if necessary, prior to implementation of the proposed treatment systems.

Parameters of Concern

Presented within this section is an overview of the anticipated temporary treatment options for the Queens Groundwater wells based on the most commonly encountered parameters of concern based upon historical water quality sampling data for the Queens Groundwater system.

The historical water quality of the aquifers and the groundwater withdrawn through wells within the Queens Groundwater system is similar to other water supply wells throughout Nassau and Suffolk counties.

Based upon the most likely parameters of concern anticipated at the Queens Groundwater wells identified from prior water quality sampling, DEP conducted a screening evaluation of possible treatment system options, comparing them in terms of their capacity to achieve finished water quality goals, operation and maintenance needs, ease of use, cost, and other factors. The parameters of concern that are anticipated to require treatment and the types of treatment systems anticipated to be required are introduced below, with the treatment system options described in more detail in Section 1.6.2.3.

For the purposes of this EIS, it is assumed that temporary treatment for a parameter of concern is needed if the contaminant is present in the well at concentrations greater than regulatory standards or treatment triggers. The current concentrations for parameters of concern, by volume, that trigger a requirement for treatment are listed in **Table 1.6-1**. In addition, many of the existing wells have historical color and turbidity sampling results in excess of current standards. For most of the wells, this can be attributed to the presence of iron or manganese, which is common in wells on Long Island and would be treated as required.

Table 1.6-1: Contaminant Treatment Triggers

Contaminant	Treatment Trigger
Iron	0.3 mg/L Sequestering[11] 0.6 mg/L Oxidation & Filtration[12]
Manganese	0.05 mg/L Sequestering 0.10 mg/L Oxidation & Filtration
Organics/VOCs	0.1 μg/L (cVOCs only) 0.5 μg/L (all other organics[VOCs])
Perchlorate	4.0 μg/L
Nitrate	9.5 mg/L
Notes: mg/L - milligrams per Liter μg/L - micrograms per liter	

Color and turbidity exceedances not attributable to iron and manganese would be expected to meet standards with continued pumpage of an existing well. As a result, temporary treatment for color and turbidity not associated with iron and manganese is not proposed, rather water would not be sent to distribution until color and turbidity are at acceptable levels. Additional information on each of the currently anticipated parameters of concern is provided below.

– *Iron and Manganese.* Groundwater in the aquifers underlying the southeastern section of Queens generally includes naturally occurring levels of iron and/or manganese, which would require treatment. Higher levels of iron and manganese in water usually result in discolored water, leading to potential discoloration in laundry and plumbing fixtures, and can affect the taste of beverages, such as coffee or tea.

– *Volatile Organic Compounds (VOCs).* VOCs are organic chemicals that include both human-made and naturally occurring chemical compounds. VOCs are widespread in the three upper aquifers of the Queens Groundwater system (i.e., Upper Glacial, Jameco, and Magothy) at varying levels and some of DEP's wells have elevated concentrations of VOCs. Commonly detected VOCs include, but are not limited to, tetrachloroethylene (PCE), methyl tertiary butyl ether (MTBE), trichloroethylene (TCE), various forms of Freon, and cis-1,2-dichloroethylene (cis,1,2-DCE). Some VOCs are classified as carcinogenic (cVOC), which when present in the raw water will trigger treatment at lower concentrations. VOCs have not been detected to date in the confined Lloyd Aquifer.

- *Perchlorate*. Perchlorate is an anion[13] that has been introduced to the environment as a contaminant in both ground and surface water from various chemical and industrial processes. Perchlorate is persistent and long lasting, and once it is introduced into the

[11] Sequestration is a means to prevent the formation of objectionable color and turbidity without actually removing the iron and manganese. It typically involves the addition of another compound that forms a complex with iron and manganese that effectively remove the ability of these metals to react to result in color or turbidity issues.

[12] Oxidation/filtration refers to precipitative processes that are designed to remove naturally occurring iron and manganese from water. The processes involve the oxidation of the soluble forms of iron and manganese to their insoluble forms that precipitate (settle out) from the treated water allowing this precipitate to be removed by filtration.

[13] An anion is an ion with net negative charge, having more electrons than protons.

environment, it migrates freely with water flow and does not easily reduce to a less oxidative state. A number of existing wells in the Queens Groundwater system contain levels of perchlorate that would require treatment.

- *Nitrate.* Nitrate is an anion that has been introduced to the environment as a contaminant from past on-site sewage disposal systems, application of fertilizers, and agricultural processes. Several existing wells in the Queens Groundwater system contain levels of nitrate that would require treatment.

Treatment System Selection

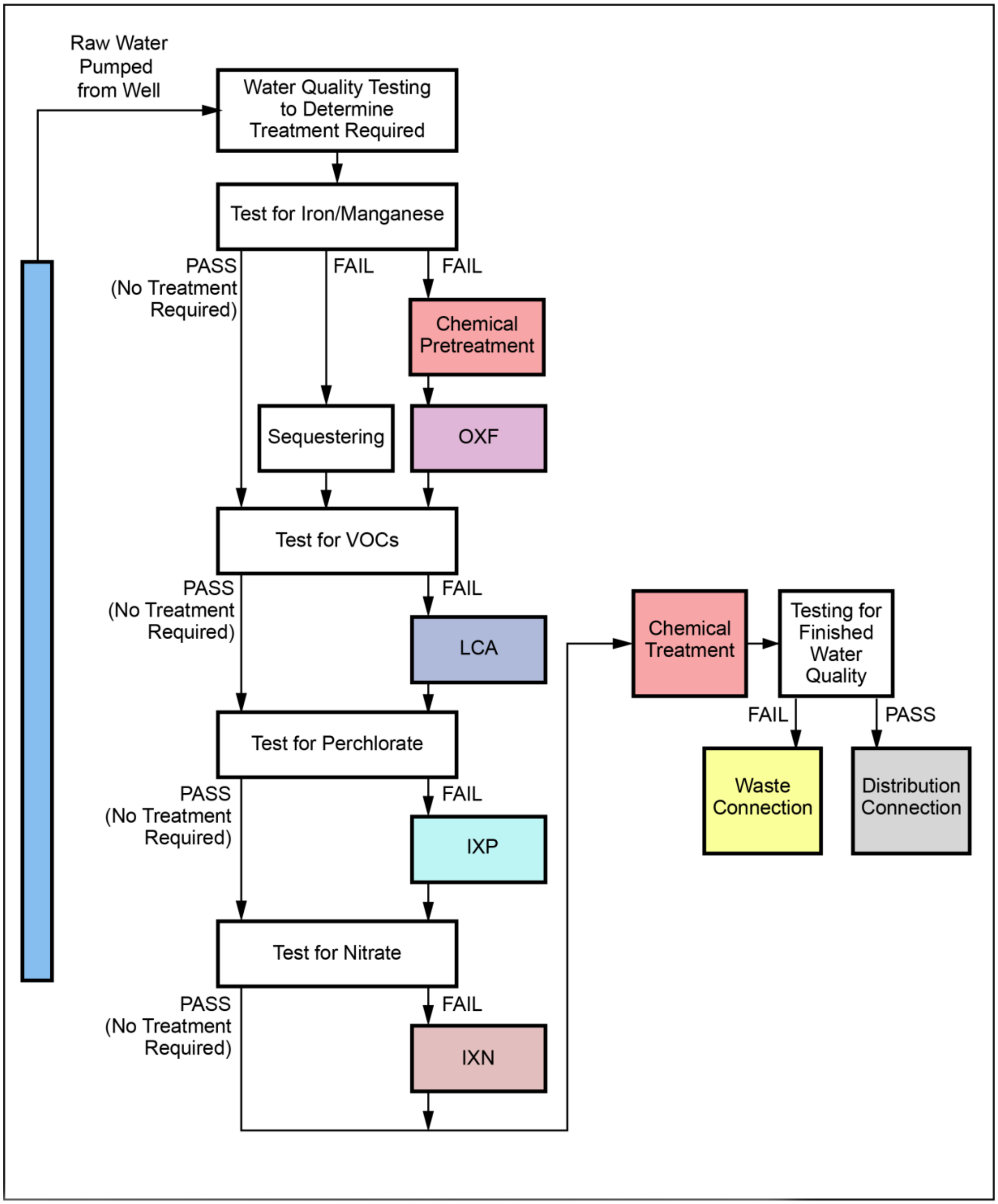
As part of the Proposed Project, DEP will have the ability to select any or all of the permitted wells for temporary treatment and use during a water supply shortage. DEP would conduct a cost-benefit analysis to prioritize which of the existing wells would be most appropriate for implementation, based on the nature of the water supply shortage. The cost-benefit analysis would take into account the well capacity and productivity, ease of treatment based on the parameters of concern listed above, operation and maintenance needs, cost, and other factors. If any particular well were determined to be problematic due to any of these factors, DEP would not prioritize activation of that particular well. DEP would however maintain the right to activate any or all of the existing permitted wells at any flow capacity within the parameters and conditions of the Water Supply/Water Withdrawal Permit.

Based on the parameters of concern and the concentrations that would trigger the need for treatment, the potential temporary treatment options are initially identified in **Table 1.6-2** and described in further detail below. Temporary treatment would be provided within discrete treatment blocks or units. Each type of treatment block would contain the equipment and/or chemicals required to address its respective parameter of concern. Different types of treatment blocks would then be provided at a specific well, based upon the parameters of concern that may be involved.

Table 1.6-2: Treatment Blocks

Parameter of Concern	Treatment Block
Inorganic: Iron, Manganese	Oxidation & Filtration Vessel (OXF) or Sequestration (Chemical)
Organic(s), VOCs	Liquid-phase Carbon Adsorption Vessels (LCA)
Inorganic: Perchlorate	Ion Exchange (Perchlorate) Vessels (IXP)
Inorganic: Nitrate	Ion Exchange (Nitrate) Vessels (IXN)

Each treatment block would be capable of accepting a maximum influent flow rate from the well. As shown in **Table 1.5-2**, well capacities range from 400 to 1,800 gpm. Treatment for any parameter of concern could be scaled up for higher flows by adding additional treatment blocks of the same type to operate in parallel. Treatment for multiple parameters of concern at a single station would be operated in a series. Soft hoses would connect the effluent of an upstream process to the influent of a downstream process in the sequence shown on **Figure 1.6-1**. If multiple treatment needs were required, treatment blocks would be installed in the following order; first OXF or Sequestration, then LCA, and then IXP/IXN. Raw water may undergo any



Note: Water may undergo any combination of OXF or Sequestration, LCA, IXP, and IXN prior to Chemical Treatment, in that order, as needed.

Figure 1.6-1: Treatment Process Flow Diagram

combination of OXF, LCA, IXP, and IXN, as needed, based on historic water quality and additional sampling that would be conducted prior to the development of design of required treatment systems.

In addition to the treatment blocks identified in **Table 1.6-2** for parameters of concern, additional chemical treatments (Chemical Treatment Container) to achieve DEP's finished water quality goals would be established to meet all applicable regulatory requirements in effect at the time that water from the Queens Groundwater system may be required. These goals would be established for chlorine residual, fluoride, orthophosphate, and pH. Target residual chlorine levels would be established to maintain adequate levels of chlorine, in order to ensure water remains safely disinfected as it travels through the distribution system and is potentially blended with water from DEP's surface water system. DEP would also add fluoride to the groundwater entering its distribution system for dental protection, in accordance with New York City's Health Code and guidance from NYSDOH and NYCDOHMH. Lastly, finished water goals would be based on the optimal water quality parameters established by NYSDOH for corrosion control treatment (such as the addition of orthophosphate) and compliance with the U.S. Environmental Protection Agency's (EPA) Lead and Copper Rule.

Typical details of the temporary treatment blocks and their characteristics and capabilities are discussed in additional detail below. If a temporary treatment block or chemical treatment (e.g., fluoride, chlorination) requires on-site storage of additional chemicals, those chemicals would be stored in compliance with any applicable federal, State, and local regulations.

Treatment Blocks

Iron and Manganese Treatment

The presence of iron and/or manganese may trigger different treatments, depending on the level of concentration of the parameters of concern, see **Table 1.6-1**.

Sequestration (Chemical)

To provide sequestration[14] for iron and/or manganese, one Chemical block, similar to the final conditioning Chemical Treatment Container discussed below (see **Figure 1.6-4**), would be required at each well. A block would be anticipated to require replacement once a week.

[14] Sequestration is a means to prevent the formation of objectionable color and turbidity without actually removing the iron and manganese. It typically involves the addition of another compound that forms a complex with iron and manganese that effectively remove the ability of these metals to react to result in color or turbidity issues.

Oxidation and Filtration Vessels (OXF)

Applicable technologies for iron and/or manganese treatment would include pH adjustment (chemical pretreatment), if necessary, followed by a combination of oxidation and filtration[15], as needed.

One OXF block would occupy a footprint of approximately 30 feet by 8 feet. A minimum of two blocks in parallel would be required to treat flows up to 1,200 gpm (three blocks for flows up to 2,400 gpm) (see **Figure 1.6-2**).

In iron and manganese treatment, a chemical oxidant, such as potassium permanganate, would be added to the untreated water, followed by passing through large vessels of filter media. A chemical oxidant converts the soluble iron and manganese in the raw water to insoluble particulates, which then can be filtered out. Each OXF block would include one dual-cell horizontal pressure vessel and face piping connections. Valves would be operated manually for filtration, backwash, and rinse operations. Soft hoses would connect influent, effluent, and backwash/waste header pipes between blocks. Backwash water would come from the distribution system. To provide oxidation prior to filtration, one pre-treatment chemical block would be required, for each well. A block would be anticipated to require replacement approximately every 12 months.

Organics and Volatile Organic Compound Treatment

Liquid-phase Carbon Adsorption Vessels (LCA)

The selected technology to treat organics and VOCs that could be present in water withdrawn from the Queens Groundwater system would be Granular Activated Carbon (GAC). GAC is effective at removing a wide range of organic contaminants and has been identified as a best available technology for VOC removal. VOC treatment technology is effective at removing a wide range of organic chemicals and has been previously installed for wellhead treatment at several DEP groundwater stations and throughout the region for similar applications. Additionally, these units typically produce little waste and require minimal operator attention.

In GAC treatment, the untreated water is passed through large vessels of GAC media known as Liquid-phase Carbon Adsorption vessels (LCA). GAC media usually comprised of organic materials with high carbon content (e.g., coconut shells, coal, etc.). GAC treats the water by adhering the contaminants onto the GAC media through a process called adsorption.[16] As the GAC pores become filled with organic compounds, removal rates decline. Therefore, the GAC must be replaced at regular intervals depending on influent contaminant concentrations, GAC type, and contact time.

[15] Oxidation/filtration refers to precipitative processes that are designed to remove naturally occurring iron and manganese from water. The processes involve the oxidation of the soluble forms of iron and manganese to their insoluble forms that precipitate (settle out) from the treated water allowing this precipitate to be removed by filtration.

[16] Adsorption is a process by which molecules or particles are bound to a surface; this is different from absorption, which involves the filling of pores in a solid. Activated carbon is an effective adsorbent because it provides substantial surface area relative to its weight and volume.

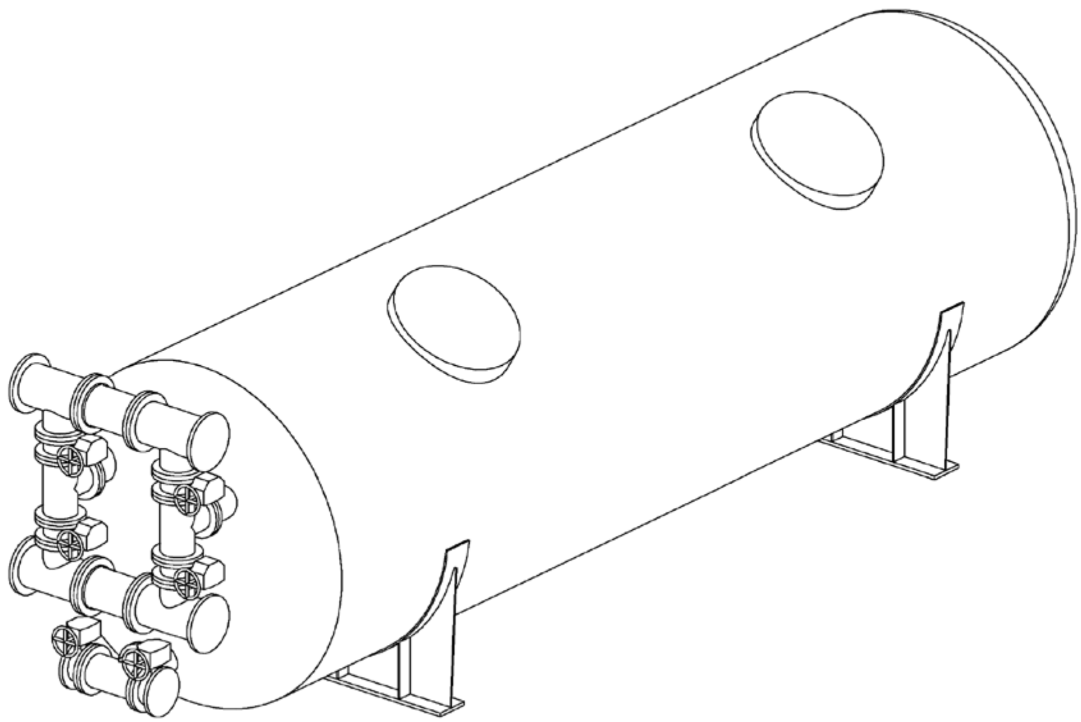


Figure 1.6-2: Sample OXF Temporary Treatment Block

One LCA block would occupy a footprint of approximately 40 feet by 8 feet. Each LCA block would include two 8-foot diameter carbon adsorption vessels and hard piping mounted on a tractor-trailer bed (see **Figure 1.6-3**). The two vessels would be configured for parallel operation. One LCA block would treat flows up to 800 gpm (two blocks would treat flows up 1,600 gpm, etc.). Vessel sidewall taps would be monitored for contaminant detections.

Before the carbon is exhausted, the GAC would be replaced, as needed. The trailer with spent carbon would be removed from site and a trailer with fresh carbon would replace it. Carbon replacement would occur off site. Spent carbon would be removed from the trailer's vessels at a central location and replaced with fresh carbon and returned to the treatment site, as needed. GAC is also an environmentally responsible product that can be reactivated through thermal oxidation and used multiple times for the same application. A block would be anticipated to require replacement every 12 months.

Perchlorate and Nitrate Treatment

Ion Exchange Vessels for Perchlorate (IXP) and Nitrate (IXN)

Ion exchange[17] is a cost-effective solution for removing perchlorate and nitrate and is the most commonly used treatment process for perchlorate and nitrate removal in potable water including for Long Island supply wells. Ion exchange is a proven technology and can be reliably operated to meet finished water quality goals.

- Ion Exchange for Perchlorate Treatment (IXP): Ion exchange is the most commonly used treatment process for perchlorate removal in potable water treatment applications. The selected perchlorate removal process is a continuous process; as the water to be treated passes through the exchange material (resin), which is placed in a packed bed, perchlorate is removed from the water in exchange for chloride. Since the typical ion exchange media used with perchlorate is single pass and regenerated off site, residual streams are limited to spent resin (media) and sample streams. Additionally, capital costs, operation, and maintenance costs, and footprint are reasonable. Single pass ion exchange is a proven technology and can be reliably operated to meet finished water quality goals. Based on experience in the operation of typical wells with perchlorate contamination within the region with similar IXP treatment blocks, a block would require replacement approximately every 12 months.

[17] Ion exchange is a water treatment method where one or more undesirable contaminants are removed from water by exchange with another non-objectionable, or less objectionable substance. One typical example of ion exchange is the process called "water softening."

Figure 1.6-3: Sample LCA/IXP/IXN Temporary Treatment Block

- Ion Exchange for Nitrate Treatment (IXN): Ion exchange is also the most common method used for nitrate removal in potable water treatment applications including for Long Island supply wells. The selected nitrate removal process is a continuous process, as the water to be treated passes through the exchange material (which is placed in a packed bed, similar to that for perchlorate removal). Nitrate is removed as groundwater flows through the resin-filled vessels and exchanges with chloride for adsorption sites on the resin. The ion exchange resin will be single pass and regenerated off site. Single pass ion exchange is a proven technology and can be reliably operated to meet finished water quality goals. Based on use of similar IXN systems for other supply wells in the region, a block would be anticipated to require replacement approximately every 12 months.

One ion exchange block (IXP, IXN) would occupy a footprint of approximately 40 feet by 8 feet. Each block would include two 8-foot diameter resin vessels and hard piping mounted on a tractor-trailer bed, similar to LCA (see **Figure 1.6-3**). The two vessels would be configured for parallel operation. One block would treat flows up to 800 gpm (two blocks would treat flows up to 1,600 gpm, etc.). Vessel sidewall taps would be monitored for contaminant detections. The resin media would be selected to remove specific ions of concern (i.e., nitrate and perchlorate).

Before the resin is exhausted, as determined by ongoing monitoring of treated water, the block would be replaced, as needed. It is anticipated that the trailer with spent resin would be removed from a site and a trailer with fresh resin would replace it. Resin replacement would occur off site. Spent resin would be removed from the trailer's vessels at a central location and replaced with fresh resin or regenerated with a brine solution.

In addition to any combination of the temporary treatment blocks discussed above, additional treatment blocks would be required at each station for operation. These include a Controls Container and Chemical Treatment Container and would be required at each activated well station regardless of the treatment technology employed for the individual well(s) on site.

Chemical Treatment Container

As discussed previously, in addition to treatment for parameters of concern, chemical treatment would be required to produce finished water. These treatment chemicals are routinely utilized in the maintenance and operation of groundwater and surface water systems throughout Long Island and the United States. Final conditioning chemical storage and feed and injection facilities would be required at each station to meet DEP's finished water quality goals and target residuals as summarized in **Table 1.6-3**.

Table 1.6-3: DEP's Finished Water Quality Goals

Type	Chemical	Finished Water Quality Goal/ Target Residual
Fluoridation	Hydrofluorosilicic Acid	Target Residual = 0.8 mg/L
pH Control	Sodium Hydroxide	Target pH = 6.8 to 7.2
Corrosion Control	Phosphoric Acid	Target Residual = 2.0 mg/L
Disinfection	Sodium Hypochlorite	Target Residual = 0.7 to 2.0 mg/L
Note: mg/L - milligrams per Liter		

Final conditioning chemicals would be injected into the treatment process at each station within one 40 feet by 8 feet container (see **Figure 1.6-4**) for each well (additional containers could be utilized if required at a specific well station). Equipment within this container would include storage tanks, feed pumps, chemical piping, and valves for the four final conditioning chemicals in **Table 1.6-3**. Large, flanged, cement-lined ductile iron process piping, flow meters, and valves would also be located within this container. Valves would regulate flow, allow distribution system water to flow into treatment blocks for backwash purposes, and allow operation to waste to a sewer connection for testing purposes. The Chemical Treatment Container(s) would receive power from a Controls Container (see below) for light, heat, and operation of the chemical injection pumps, and would provide pressure and flow measurement and safety feedback to the Controls Container. A water sampling line would originate within each Chemical Treatment Container and feed the associated continuous chemical analyzers within the Controls Container. Based on typical wells in the vicinity with similar chemical blocks, a block would be replaced once per week.

Before the chemicals are exhausted, the Chemical Treatment Container would be replaced, as needed. The trailer would be removed from site and a trailer with fresh chemicals would replace it. Chemical replacement would occur off site. The Chemical Treatment Container would be stored, refilled, and transported in compliance with any federal, State, and local regulations.

Accessory Components

Controls Container

One Controls Container would be required at each station and would include an incoming power disconnect and power distribution equipment, a programmable logic controller (PLC), and continuous chemical analyzers. The PLC would monitor the station flow (from the one or two wells at the station), pressure, operational safeties, and alarms. The analyzers would monitor finished water quality.

Distribution Connection

The Distribution Connection would provide the connection between the well and the infrastructure of the water supply system and/or the sewer system. This Distribution Connection would occupy a footprint of approximately 4 feet by 10 feet and include two isolation valves for double block and bleed (visual means to verify isolation valves are working properly), a hydrant branch off the distribution system side of the double block and bleed, and a buried pressure pipe to the City’s potable water system. After testing determines that the finished water meets or exceeds all applicable water quality standards, a soft hose from the final conditioning Chemical Treatment Container would connect to this Distribution Connection, and remain in place while the well is in service. Existing distribution system piping connections for each station would be evaluated as part of the design of temporary treatment systems and may require rehabilitation or replacement to direct treated water to the appropriate transmission main and affirm the ability to hydraulically isolate the station (distribution water does not enter or leave the station without proper valves opened). The production of water from any of the Queens Groundwater wells could be blended with other City water for distribution within the City. Separate and independent of the Proposed Project, ongoing and planned upgrades of existing water mains in Queens as part

Figure 1.6-4: Sample Chemical Treatment Block

of the City's continuous maintenance program would further support distribution of water from the Queens Groundwater system within the water supply system and make New York City's drinking water infrastructure even more resilient.

Waste Connection

A Waste Connection at each well station would also be required to allow for backwashing, flushing, and testing purposes. Rehabilitation, replacement, and/or construction of connections to the sewer system may be required at each station to direct these waste process waters off site. The Waste Connection would occupy a footprint of approximately 4 feet by 6 feet and include a precast concrete structure with a buried gravity pipe to the City's sewer system. One waste pipe would discharge above the precast structure with a minimum of a 12-inch air gap. Process wastes would be temporarily connected to the discharge pipe with a soft hose connection.

1.6.2.4 Generic Temporary Treatment System Layout

A representative generic site plan for a well station temporary treatment system is illustrated on **Figure 1.6-5.** This shows a reasonably conservative possible layout for a well station with the various treatment blocks needed to treat the maximum potential flow from two wells. This sample layout also includes the layout of temporary treatment blocks (e.g., LCA, OXF, Chemical Treatment) for the treatment of iron and manganese and VOCs. As each individual Queens Groundwater well would be unique in its physical footprint, flow capacity and parameters of concern, the treatment layout for each well station will vary, although the generic site plan maximizes the potential amount of required temporary treatment blocks for one of the smallest well stations, illustrating a reasonable conservative scenario.

As illustrated on **Figure 1.6-5**, the generic site plan illustrates the layout of temporary treatment blocks and associated facilities (as described in Section 1.6.2.3) anticipated for two wells located on a single station. The site plan indicates for this well location the treatment blocks anticipated include OXF (four treatment blocks), LCA (four treatment blocks), Chemical Treatment Containers, (four blocks), and a Controls Container, and an Emergency Shower. In addition to these facilities, the station would be connected to the water supply distribution and sewer systems through a Distribution Connection and Waste Connection, respectively.

As discussed earlier, the generic temporary treatment system site plan is used as the basis for the assessment of potential impacts. Upon the advancement of more detailed design of temporary treatment systems at one or more well stations in the future, additional site-specific analyses, if necessary, would be completed prior to implementation of the proposed treatment systems.

Construction

For each station to be utilized during a water supply shortage, the construction of the temporary treatment system would include the preparation of the treatment area at the well station. In general, each well station is currently developed with a well(s), well building or vault, driveway, and associated infrastructure connections (e.g., power, water, sewer, etc.). The area would be cleared and leveled, as necessary. As part of the design of temporary treatment systems at specific wells, DEP would conduct required sampling of groundwater in order to characterize the quality of the raw water for determining what treatment(s) may be required to meet drinking

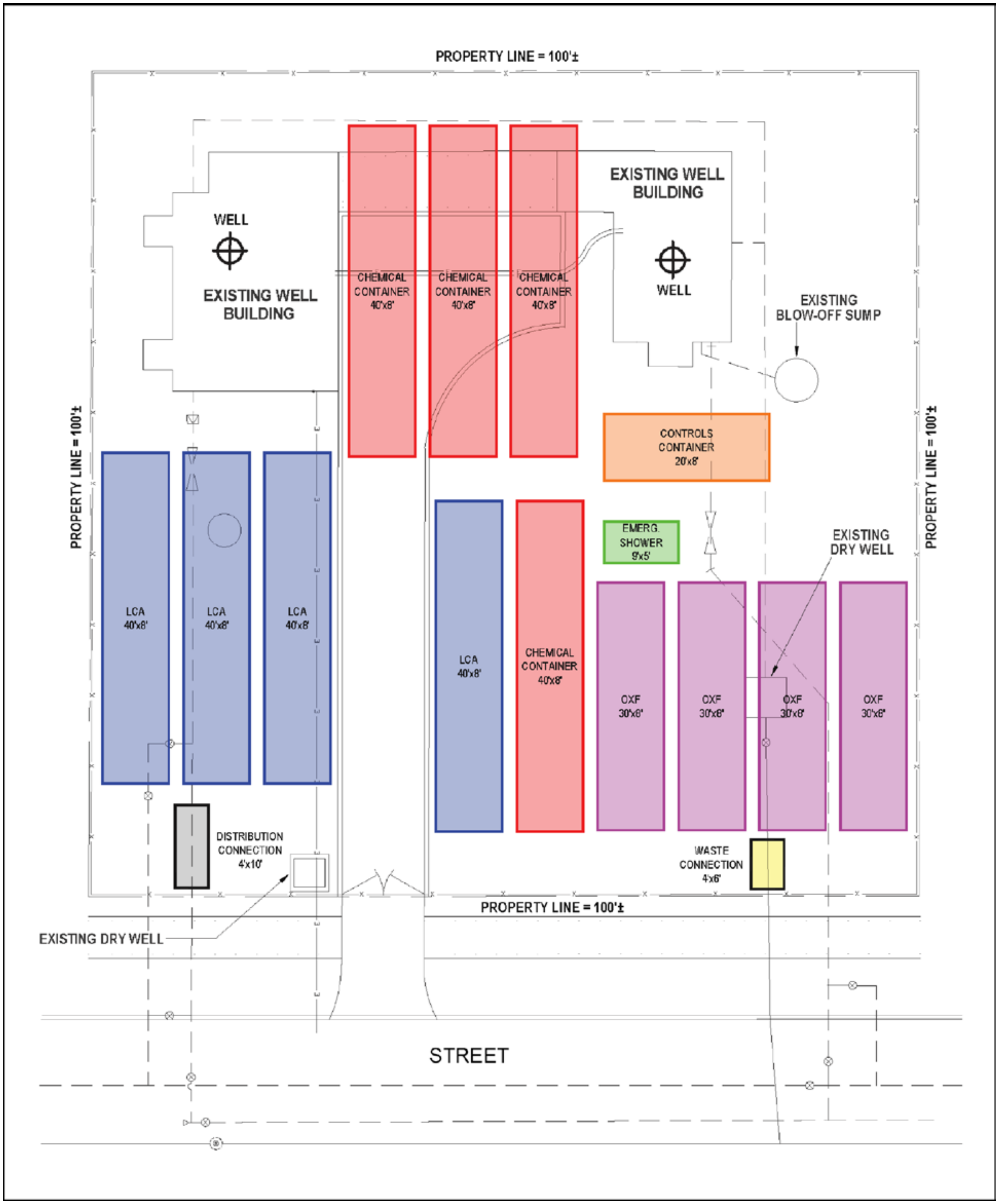


Figure 1.6-5: Generic Well Station Treatment System Site Plan

water quality standards. As part of this effort and prior to water quality sampling, a review of applicable water quality requirements would be completed, inclusive of potential new parameters of concern, in order to inform the sampling efforts and ultimately the final design of applicable treatment needs.

Construction may include the placement of treatment blocks that function within a container or are trailer-based units (see **Figure 1.6-3** as an example). Containers would be placed on site with a lift or crane, as required. Trailer-based blocks would be driven onto the site and unhitched. At the location of any treatment block that would be contained within a temporary container, construction may include the installation of temporary concrete pad(s). At the location of a trailer-based temporary treatment block, concrete support pads would be installed. The temporary treatment blocks would be delivered to the site, placed on the concrete pad or support pads, and connected to other treatment trailers, as required, with soft hoses.

The blocks not requiring periodic exchange (i.e., periodic replacement) or that would be expected to require exchanges less frequently would be placed at the back of a well station site, further removed from the gated driveway. The Distribution Connection and Waste Connection blocks would be installed close to the property line in proximity to existing or future water distribution and sewers pipes. These two blocks would then be connected to the City's below grade piping networks in the streets.

Power would be connected to the Controls Container and power sub-feeds to the Chemical Treatment Container(s). This would include the installation of a control feedback system from the Chemical Treatment Container(s) to the Controls Container. A water service line would be installed from the Distribution Connection to water sampling lines to the chemical analyzers within the Controls Container would also be installed.

Prior to operation, the system would undergo a complete system check, including startup, pressure testing, and water quality analysis. This would occur with the station discharging all water to waste (i.e., to the sewer connection), prior to release into the water distribution system. After satisfactory results for pressure and quality are achieved, and the sampling receives approval from NYSDOH and NYCDOHMH, the treatment system would be connected to the distribution system. If satisfactory results for pressure and quality at some point could not be achieved, the station may not be utilized and may be replaced by a different station.

Operation

During a water supply shortage due to drought or planned and/or unplanned infrastructure outage, DEP may supplement its upstate surface water supplies by utilizing water from the Queens Groundwater system. As noted in **Table 1.5-2**, the total potential capacity of the permitted wells is over 118 mgd, while the total system is limited to the existing permit capacity of 62 mgd for a five-year running average or 68 mgd for any single year. This would provide DEP with the flexibility to identify wells for temporary use that would meet the emergency water supply need, while also providing sufficient additional flow capacity redundancy. The temporary treatment facilities proposed at any individual well station would not include any redundancy within a station, but DEP would be able to implement treatment and use groundwater from other stations, in the event of a treatment failure or when a station may be taken offline for the exchange of treatment blocks or routine maintenance. In other words, if DEP needed to operate 10 wells to provide 10 mgd of groundwater, DEP would implement temporary treatment systems at wells beyond these 10 in order to provide DEP access to additional redundant flow capacity.

Operation of any temporary treatment system would require monitoring of the equipment function, routine water quality sampling and calibration of continuous analyzers, planned and unplanned maintenance of equipment, operation of manual valves, manual backwash of the OXFs, and replacement of LCA and IXP/IXN treatment blocks as media is exhausted.

Operation and monitoring would require a DEP employee to travel to each operating site on a daily basis. It is anticipated that one employee would be needed for each of three shifts over a 24-hour period, to provide continuous monitoring. If an issue was to be detected that required more manpower, employees could be called in to respond on a temporary basis. Exchange of pre-treatment chemical blocks and chemical blocks are initially anticipated to occur on a weekly basis. Exchange of OXF, LCA, IXP, and IXN blocks is anticipated to occur once every 12 months. During exchange of these blocks, blocks would be removed by truck either by trailering and/or through the use of a lift truck that would remove an existing or spent treatment block and would place a new block in place. It is expected that removal of an existing block and its replacement would occur on the same day.

1.7 NEW YORK CITY GROUNDWATER MODEL

1.7.1 INTRODUCTION

The New York City Groundwater Model developed in 2005 by DEP to evaluate the groundwater system in Kings (Brooklyn), Queens, Nassau and western Suffolk counties. The mathematical model has been reviewed by the U.S. Geological Survey (USGS) and utilized over the past 12 years by the City to assist with a variety of groundwater resource studies. A listing of the processes utilized in the New York City Groundwater Model includes the following:

- Groundwater flow: Simulates piezometric heads, flow directions, and velocities at computational nodes.

- Particle tracking: Simulates the forward- or backward-in-time movement of a water particle released within the model domain based on the simulated groundwater flow field.

- Sharp saltwater interface: Simulates the interaction of freshwater and saltwater by approximating the transition between the two zones as a sharp interface. This approach is valid and favored for regional aquifer analyses.

- Variable density flow: Incorporates differences in densities that would be encountered between freshwater and saltwater.

- Wells that pump across more than one stratigraphic layer: Pumping wells with screens that span more than one stratigraphic layer add complexity to a groundwater model. The division of pumping flux between stratigraphic layers is often not known and must be approximated. In the New York City Groundwater Model, pumping fluxes are distributed vertically along the well screen based on the transmissivity of the model layer from which the well is screened.

- Surface water-groundwater interaction: Surface water-groundwater interaction includes any situation where water above the land surface interacts with groundwater below the land surface. The New York City Groundwater Model quantifies the groundwater flux that discharges to surface waterbodies in each time step.

- The model is a regional planning tool that is designed to be used by the City to help evaluate regional groundwater supply alternatives.

While the structural underpinnings of the model (including hydrostratigraphic representations and hydraulic property values) from 2006 remain in use, the model has been updated periodically to incorporate the most up-to-date data sets.

1.7.2 GROUNDWATER MODELING BACKGROUND

Groundwater models have been used for decades to answer questions pertaining to the movement of groundwater flow. Recent advances in data collection methods, computing power, university programs focused on groundwater modeling training, and visualization software have led to more regular usage and acceptance of groundwater models. As water supply demands and aquifer stresses increase with time, undesirable impacts, such as saltwater intrusion and stream depletion due to groundwater extraction, have advanced the utilization of groundwater models to understand the interactions of complex hydrologic systems.

Simple mathematical models of groundwater flow were first developed at the onset of the practice of hydrogeology. Since that time, hydrogeologists and engineers have used a range of tools to represent complex groundwater systems. Groundwater models are most typically used when the level of impacts resulting from implementation of one or more groundwater-related projects is not well understood and could result in changes to the groundwater basins and connected water resources.

Groundwater models can be one-, two-, or three-dimensional in space. Three-dimensional models, like the New York City Groundwater Model, are most often used to represent groundwater flow regimes that have a higher level of complexity, often including multiple aquifer/aquitard layers, significant vertical gradients, multiple discharge locations, mechanisms (pumping well, stream discharge, etc.), and depths, and spatially varying hydraulic properties (heterogeneity).

Groundwater models are typically represented as either ‘steady-state’ or ‘transient.’ In a steady-state model, the inputs to the simulation are assumed to be constant with time. When simulated, this produces one result indicative of a solution that represents the inputs to the model. For example, the use of average groundwater pumping, average groundwater recharge, and average boundary heads (e.g., the water surface of a lake) would produce groundwater elevations representative of ‘average’ conditions.

Transient (time-varying) analyses are required if there is a significant variation between average conditions and what typically occurs during a representative time period, or, the answers sought require the understanding of the rate of change of a process (e.g., the change in heads over time corresponding to pumping), both of which are true of the Long Island aquifer system. To conduct transient modeling, a ‘time step’ is assigned to the model along with start and end times/dates. For example, the New York City Groundwater Model is run in transient mode and simulates the period of January 1, 1906 through December 31, 2015 (110 years) using monthly time steps. For this case, 1,320 flow field results are produced corresponding to the inputs provided for each time step.

Typical time-varying inputs to a transient model include pumping, groundwater recharge, boundary heads, and boundary fluxes. Most groundwater models, including the New York City Groundwater Model, assume that properties associated with the soils, such as hydraulic conductivity and ground surface elevation, are unchanged with time.

A numerical groundwater model typically involves the creation of a fixed grid or mesh (terms used interchangeably in this document) within a fixed domain. While variations between different model codes exist, the model software has the following general functionality:

- The planar area encompassed by the model domain is subdivided or “discretized” into user defined sections referred to as cells or elements. These elements can be any type of shape, depending on the software codes used. In the New York City Groundwater Model, triangles are used.

- At the intersecting points or center points of each cell (also called nodes), the equations of groundwater flow are solved for each specified time step. This nodal output is what is used to generate the head equipotential, drawdown, water table decline, and saltwater interface contours included in this document.

- Point-specific inputs, such as pumping from a well, are applied directly to the corresponding nodes while area-specific inputs, such as hydraulic properties (e.g., hydraulic conductivity) and groundwater recharge, are applied to model cells. In a transient simulation, unique values of these input parameters are included for each simulation time step.

- Along the boundary of the active domain, conditions are specified that govern flow at these extremities. For regional model analyses, such as the modeling described herein, boundaries that correspond to ‘natural’ features such as large waterbodies are utilized.

- Vertically (if it is a three-dimensional model) the model is divided up into layers, which typically have the same planar grid imposed on them and are designed to roughly correspond to the hydrostratigraphy of the system. For the New York City Groundwater Model, the tops and bottoms of each layer are referred to as levels and nodal calculations and point-specific input assignments are made at the level (as opposed to the middle of the layer).

The amount of detail required for a model is related to the detail of the available data, the natural features present, and the objectives of the project. As computations are made at each node, it is typically desirable to have more nodes (and therefore smaller grid spacing) in the areas of the model domain most important to the system and/or where steep gradients are present. These areas typically include pumping wells and waterbodies where groundwater discharges.

The amount of detail included in the assignment of hydraulic properties is dictated by the available data, the objectives of the project, and the model calibration process. When possible, the simplest approach should be prioritized. The same applies to the assignment of rainfall recharge zones.

1.7.3 MODEL SOFTWARE

DYNSYSTEM groundwater modeling software[18] was utilized in the model, including DYNFLOW/DYNCFT (single-phase groundwater flow with variable density), and DYNSWIM (dual-phase freshwater and saltwater flow). DYNFLOW/DYNCFT is a fully three-dimensional, finite element groundwater flow model code. This code has been developed, maintained, and refined over the past 40 years, is commercially available, and is in general use for large-scale basin modeling projects and site-specific remedial design investigations. It has been applied to over 200 groundwater modeling studies in the United States, including a number of Long Island studies. In 1988 and 1989, the code was used to develop the Nassau County Groundwater Model for Nassau County Department of Public Works (DPW). In 1996, DYNFLOW/DYNCFT was used to develop the Suffolk County Groundwater Model for the Suffolk County Department of Health. The code has been reviewed and tested by the International Groundwater Modeling Center (IGWMC)[19,20] and has been extensively tested and documented.

DYNSWIM is an extension of DYNFLOW especially developed for use in coastal aquifer studies where fresh groundwater interacts with saltwater. To account for the interaction of saltwater and freshwater flow systems, DYNSWIM computes the location of the interface between the two fluids, as well as the pressures and fluxes within each fluid system. DYNSWIM is fully three-dimensional, and is capable of simulating multiple transitions between freshwater and saltwater in a vertical column. This allows the distinct saltwater wedges, observed in the Lloyd, Magothy, and Upper Glacial aquifers of Long Island to be simulated simultaneously. Saltwater intrusion can be vertical (e.g., as through "holes" in aquitard layers such as the Gardiners Clay) as well as horizontal. DYNSWIM has been used in coastal aquifer studies for over 20 years, including studies of Long Island's north and south shores and the forks of eastern Long Island.

[18] http://www.dynsystem.com/

[19] International Ground Water Modeling Center, 1985. *Review of DYNFLOW and DYNTRACK Groundwater Simulation Computer Codes*. Report of Findings by Paul K.M. vab der Heijde for U.S. Environmental Protection Agency. IGWMC 85-17

[20] van der Heijde, Paul K.M., 1999. *DYNFLOW Version 5.18: Testing and Evaluation of Code Performance.*

1.7.4 MODEL STRUCTURE

The New York City Groundwater Model contains more than 20,000 elements and 10,000 nodes within each of the nine model layers. The computational grid mesh is shown on **Figure 1.7-1**. Horizontally, the model encompasses all of Kings, Queens, and Nassau counties, and extends to the natural boundaries of the Nissequogue and Connetquot Rivers in Suffolk County to the east. The northern perimeter of the model follows the Long Island's coastline and the southern perimeter extends into the Atlantic Ocean, approximately 12 miles, south of the barrier islands. Node spacing ranges from approximately 200 to 6,000 feet, selected to provide sufficient detail around boundaries, pumping wells, and other sensitive areas.

The model contains nine computational layers and ten levels. Hydrogeologic units are defined by model layers. The model levels are the top and bottom of model layers. In some cases, the model levels are contact elevations between different hydrogeologic units. An example cross section through Queens and Brooklyn (north to south) is shown on **Figure 1.7-2**.

The major hydrogeologic units of Long Island are represented in the model as follows, starting with the model base:

- Lloyd Aquifer (Layer 1): The Lloyd Aquifer overlies the saprolitic bedrock surface and is Long Island's deepest aquifer. The aquifer extends beneath most of Long Island, except along the north shore of Kings, Queens, and Nassau counties. The Lloyd Aquifer is confined in most places, except where the overlying Raritan clay has been eroded away. The typical range of thickness of the Lloyd Aquifer in the model is 150 to 450 feet.

- Raritan Clay (Layer 2): Raritan clay is the major confining unit on Long Island, ranging between 150 and 250 feet thick. Raritan clay generally overlies the Lloyd Aquifer. It extends beneath much of Long Island except for the north shore areas of Kings, Queens, and Nassau counties.

- Magothy Aquifer (Layers 3, 4, 5): The Magothy Aquifer is an upward fining sequence of the Cretaceous Age Matawan Group consisting of fine to medium grained quartz sand, silt, clay, and gravel and is up to 1,100 feet thick. The Magothy Aquifer is represented by three model layers because of the thickness of the unit and because of the variation in hydraulic properties. The base of the Magothy is very coarse, having been deposited in a high-energy environment involving stream and deltaic deposition. This high-energy deposition abruptly ended as fine sands, silts, and clays form the majority of the unit. The Magothy Aquifer is the principal water supply aquifer in Nassau and western Suffolk County.

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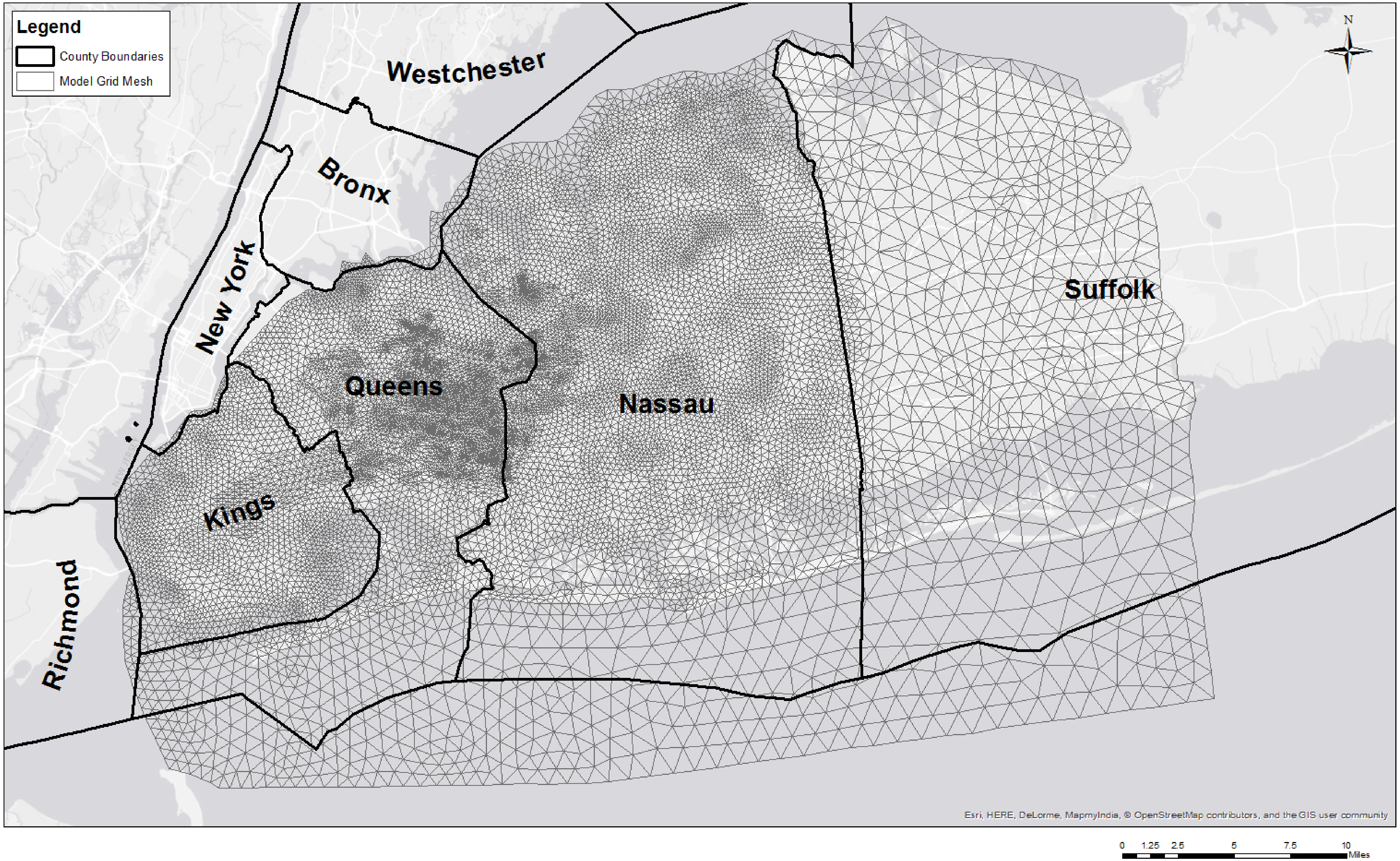

Figure 1.7-1: New York City Groundwater Model Computational Grid Mesh

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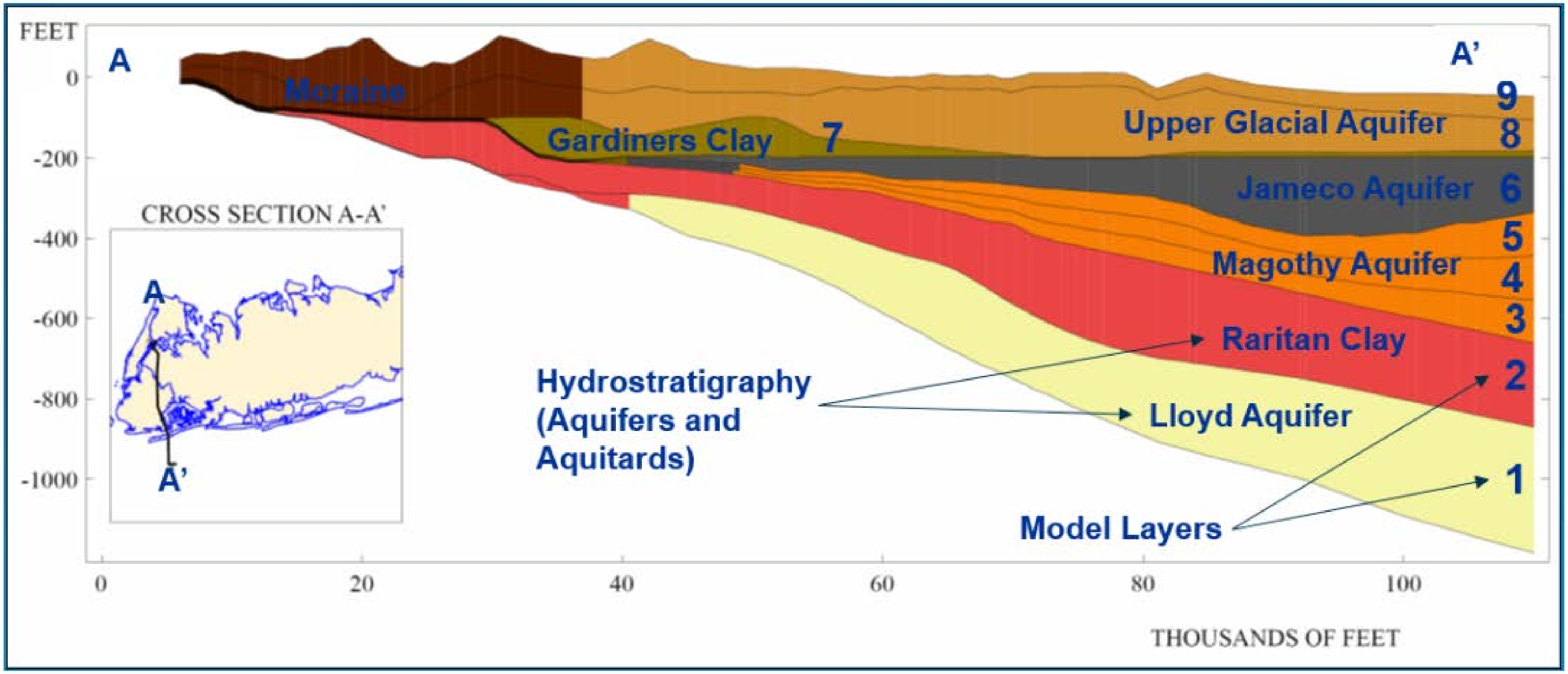


Figure 1.7-2: Cross Section with New York City Groundwater Model Stratigraphy

- Jameco Aquifer (Layer 6): The Jameco Aquifer, which overlies the Magothy Formation in Kings and Queens County, southwestern Nassau County, and southern Suffolk County, is the oldest Pleistocene Age deposit on Long Island.[21] This unit consists of very coarse sand and gravel and perhaps is the remnant of a high energy, Pleistocene Hudson River.[22] The average thickness of the Jameco Aquifer is approximately 80 feet, although ranges from 0 to 250 feet thick.

- Gardiners Clay and 20-Foot Clay (Layer 7): Gardiners Clay is a grayish green and brown clay of Pleistocene Age that overlies the Jameco Aquifer in western Long Island and extends eastward in a band along the south shore. The clay ranges in thickness from 0 feet at its northern limit to approximately 90 feet at the barrier islands. The clay has been eroded in narrow north-south trending channels along the south shore that likely correspond to glacial streams. Also, earlier investigations conducted by the USGS, identified locations south of JFK International Airport where the Gardiners Clay layer is missing.

The "20-foot" clay is a marine deposit that lies within the Pleistocene upper glacial deposits in an east-west band along southern Nassau County. The thickness of the clay ranges from 0 feet at its northern limit to 30 feet at the barrier islands. The sediments of the '20-foot' clay are similar to those of Gardiners Clay, and as with the Gardiners, are absent in north-south trending channels.

- Upper Glacial Aquifer (Layers 8, 9): The Upper Glacial Aquifer is the uppermost unit throughout the modeled area. Two model layers are used to represent the aquifer because of the thickness of the outwash deposits (up to 600 feet), and due to the variability in hydraulic properties. Along the Harbor Hill and Ronkonkoma terminal moraines and parts of the north shore, the unit is composed of till consisting of poorly sorted clay, sand, gravel, and boulders. The till is generally poorly permeable and may contain perched water. The outwash deposits that are found are mainly between, and south of, the moraines. The outwash deposits are moderately to highly permeable, consisting of gray, brown, and yellow fine to very coarse sand and gravel.

Aquifer properties are assigned to model layers to represent the hydraulic characteristics of the sediments in different stratigraphic layers. The following hydraulic properties are specified for each aquifer material defined in the model:

- Horizontal hydraulic conductivity,
- Vertical hydraulic conductivity,
- Specific storage, and
- Specific yield (applicable to the uppermost layer where the phreatic surface occurs).

[21] Smolensky, D.A. 1983. *Potentiometric Surfaces on Long Island, New York*; a Bibliography of Maps. OFR 84-070.

[22] Soren, J. 1978. *Subsurface Geology and Paleogeography of Queens County, Long Island, New York*. U.S. Geol. Survey, Water Resources Inv. 77-34.

For each material type, a range of reasonable hydraulic property values was determined based on previous studies. During calibration, aquifer properties were adjusted to achieve good comparison between measured data and simulated results.

1.7.5 MODEL INPUTS

The New York City Groundwater Model simulates historical transient groundwater flow patterns in Brooklyn, Queens, Nassau County, and the western portion of Suffolk County for the period from January 1, 1906 through December 31, 2015, using available data for that time period. Static (not varying in time) input data includes stratigraphic contact elevations, material properties, well locations and screen depths, recharge zones, and boundary conditions. Time-varying input, such as pumping and recharge data, was incorporated from multiple sources and included for every month between January 1906 and December 2015. The data included in the model are summarized below.

1.7.5.1 Groundwater Pumping

Water supply pumping, Metropolitan Transportation Authority (MTA) dewatering pumping, and industrial well pumping from a total of 1,400 wells are represented in the model. A summary of annual pumping, by county, is shown on **Figure 1.7-3**. The major data sources used to compile the groundwater pumping database are listed below:

- USGS reference papers, including:
  - USGS Water-Supply Paper 2498[23]
  - USGS Open-File Report 97-567[24]
- NYSDEC reference papers and databases, including:
  - NYSDEC report Withdrawal of Ground Water on Long Island, N.Y.[25]
  - The LIWELLS database
- MTA reference report titled Report to the New York City Transit Capital Program Management on Groundwater Pumping Systems[26]

[23] Buxton, Herbert T., Peter K. Shernoff. 1999. *Ground-Water Resources of Kings and Queens Counties, Long Island, New York.* WSP 2498.

[24] Chu, Anthony, Jack Monti, Jr., A.J. Bellitto, Jr. 1997. *Public-Supply Pumpage in Kings, Queens, and Nassau Counties, New York*, 1880-1995. OFR 97-567.

[25] Thompson, David G. and R.M. Leggette, 1930. NYS Department of Conservation Report *Withdrawal of Ground Water on Long Island, N.Y.*

[26] De Leuw. 1996. *Report to the NYCT Capital Program Management on Groundwater Pumping Systems*, June 1996.

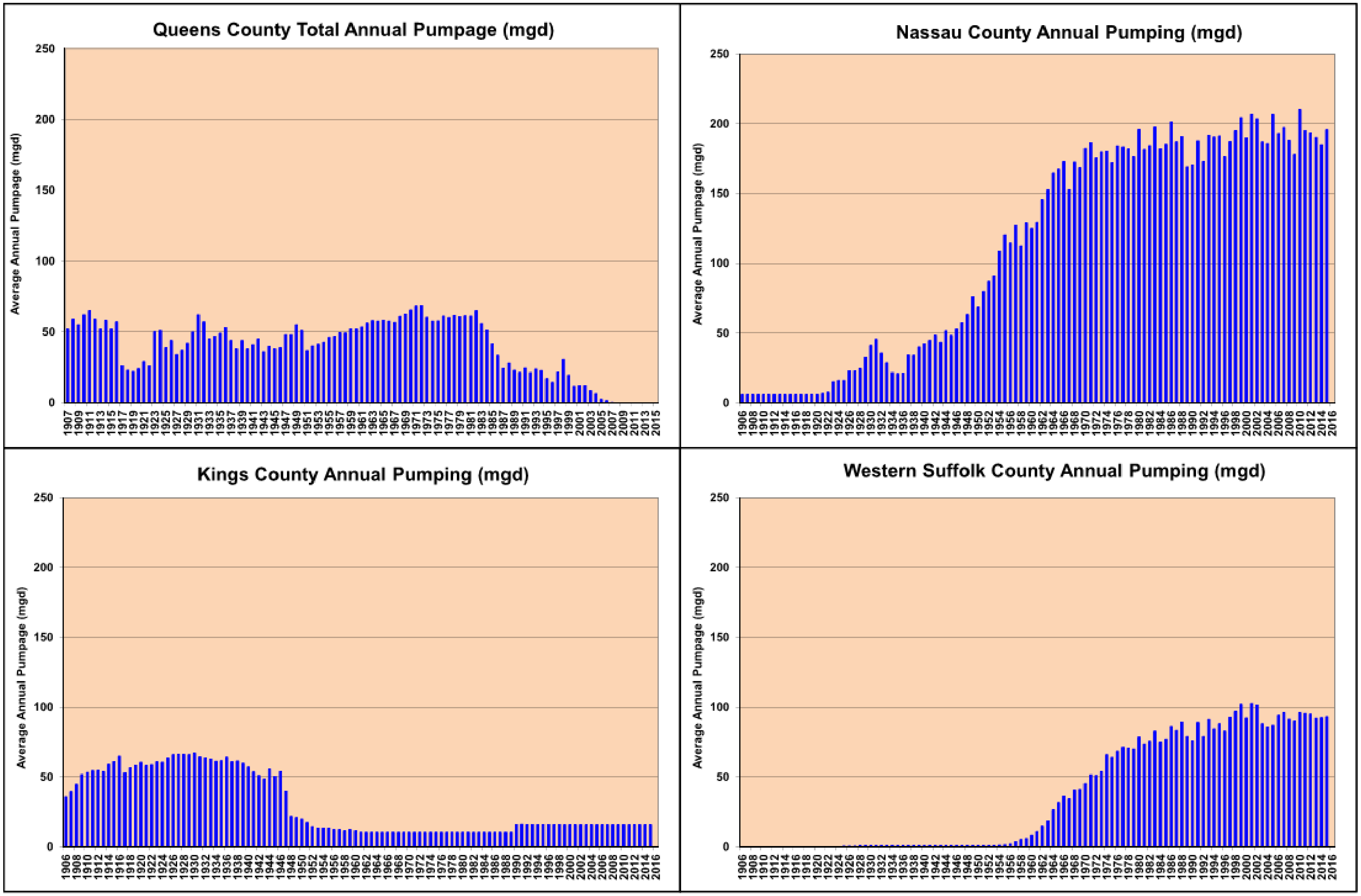


Figure 1.7-3: Simulated Annual Pumpage Summary - 1906 through 2015

- Directly accessed data from:
  - NYSDEC, Region 1
  - DEP
  - Nassau County DPW
  - Individual Nassau County water suppliers
  - Individual Suffolk County water suppliers

1.7.5.2 Groundwater Recharge from Precipitation

Groundwater recharge from precipitation is the amount of precipitation that reaches the groundwater aquifer system. Groundwater recharge from precipitation is the primary source of groundwater to the aquifer system and is a component of the hydrologic cycle, as depicted schematically on **Figure 1.7-4**, as the portion of precipitation that does not runoff to surface waterbodies, evaporate, or transpire prior to reaching the aquifer system.

Recharge from precipitation was calculated based on monthly precipitation records from the New York City Central Park weather station (1906 through 1948), the Mineola weather station (1949 through 2010), and the LaGuardia weather station (2011 through 2015). Recharge from precipitation was applied to the modeled area differently based on season and land use/land cover. Monthly recharge values were determined for each time step and applied to 17 different land use/land cover zones (i.e., pavement, buildings, vegetation, grass, etc.). Recharge in regions with less development, dominated by grass and vegetation, is higher compared with densely developed areas, and dominated by pavement and buildings.

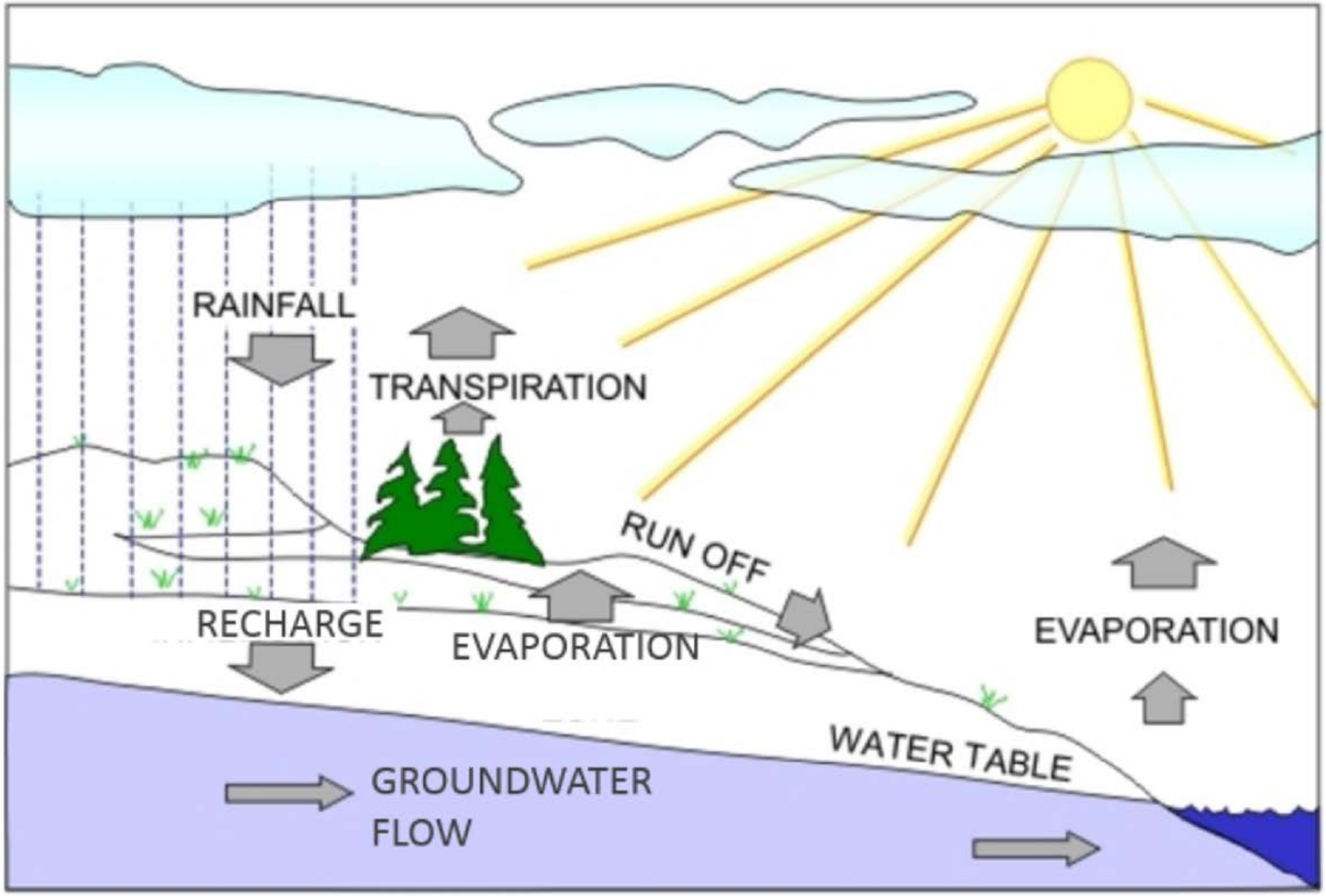
1.7.5.3 Groundwater Recharge from Return Flow

In areas served by septic tanks (e.g., unsewered areas), 85 percent of average annual water supply pumping was returned as recharge to the groundwater system. In sewered areas, 10 percent of the average annual water supply pumping was returned to the groundwater system to reflect leakage.

A historical record of percent-sewered area was compiled for each water supplier in Nassau and western Suffolk County for each year simulated. The annual records of percent-sewered area were combined with the percent-returned per district factors and the annual average district water supply pumping to calculate the annual return flow to each district. These flows were then returned on a nodal basis, as an evenly distributed source of water within the boundaries of each water supplier. Queens County was assumed to be mostly or completely sewered during the historic simulation period.

1.7.5.4 Groundwater Elevation, Streamflow, and Water Quality Data

The USGS National Water Information System (NWIS) was used to compile monitoring well details, historical records of groundwater elevation data, streamflow data, and water quality data within the model domain. This information was used to both build and calibrate the model.



Geological Survey of Ireland, 2017
http://www.gsi.ie/Education/Geology+for+Everyone/The+Water+Cycle.htm

Figure 1.7-4: Hydrologic Cycle

1.7.5.5 Saltwater Intrusion

The New York City Groundwater Model was used to simulate the regional saltwater intrusion in the Upper Glacial, Magothy, and Lloyd aquifers that was created by intensive groundwater pumping in Brooklyn and Queens. To do this, the simulated saltwater interface location for an undeveloped, no pumping condition was assigned as the initial (1906) interface location for the historic simulations in the Upper Glacial, Magothy, and Lloyd aquifers. During calibration, model simulation results were evaluated by comparing the extent of simulated saltwater intrusion with observed chloride concentrations for periods when historical saltwater encroachment occurred.

1.7.6 MODEL CALIBRATION

For any hydrologic model, calibration is an important step in the model development. The data in the model is reviewed and the model is systematically run during the simulation period to test for accuracy. For this model, the period between January 1, 1906 and December 31, 2015 is considered the "historic simulation period." Pumping and groundwater recharge data collected from these years was input to the model, groundwater elevation and chloride data collected from monitoring wells, and streamflow data collected from river gauges was used to calibrate the model to observed conditions. The model was originally calibrated to data collected through December 2005. Periodic model updates have extended the calibration through December 2015. During model calibration, model inputs were adjusted until a reasonable match with observed data was achieved.

Over the course of the historic simulation period, the following major hydrologic changes occurred:

- Large and unsustainable withdrawals in Brooklyn caused saltwater intrusion and led to the cessation of supply pumping in King County by 1950.
- Supply pumping in Queens County peaked in the 1970s and caused saltwater intrusion in southwest Queens and was subsequently phased out between 1982 and present day.
- Supply pumping in Nassau and Suffolk counties increased significantly over the middle-portion of the 20th Century and has been maintained at approximately current (county-wide) rates for the last four decades.
- Nassau County-wide sewering was implemented over the course of the 20th Century, which has reduced the amount of water available for groundwater recharge and to streams as baseflow.

The long (110-year) historic simulation period used for calibration was chosen to represent each of these instances to ensure that the model can represent the changes to the aquifer system that have occurred in the past. As such, the inclusion of, and calibration to, each of these significant instances validates the model as a tool that can be used with confidence to understand the impacts of potential future individual and cumulative stresses on the aquifer system. During calibration, model simulation results were evaluated using the following methods:

- Simulated and Observed Groundwater Elevation Time History Analysis: Time histories of simulated groundwater elevations were compared with observed data at 157 monitoring wells to evaluate the model's ability to capture the observed response of the aquifer system to changes in regional pumping. Approximately 40,000 groundwater elevation data points were utilized in this analysis. Two examples are presented below:

  Figure 1.7-5 shows time histories of simulated and measured groundwater elevations during the historic simulation period for Nassau County monitoring well N-01160. This well is situated in central (both north to south and east to west) Nassau County (in Uniondale), located at a ground surface elevation of approximately 93 feet above mean sea level (msl), and screened in the Upper Glacial Aquifer from approximately 34 to 44 feet below ground surface (bgs).

  Figure 1.7-6 shows time histories of simulated and measured piezometric heads for Q-01249, which is situated in eastern Queens County (central in the north to south direction) at a ground surface elevation of approximately 72 feet above msl, and screened in the Upper Glacial Aquifer from approximately 78 to 88 feet bgs.

  Both of these figures show a relatively good match between measured and simulated groundwater elevations. Both wells are shown on **Figure 1.7-7**. In particular, both **Figure 1.7-5** and **Figure 1.7-6** show that the model can match the timing and magnitude of changes in piezometric head that correspond to changes in stresses to the aquifer.

- Snapshot Flow Field Analysis for Specific Periods: Contours of simulated groundwater elevations were compared with observed groundwater elevation data for selected periods.

- Water Quality/Saltwater Intrusion Analysis: The extent of simulated saltwater intrusion was compared with observed chloride concentrations for periods when historical saltwater encroachment occurred and data was available.

  There were reports of saltwater intrusion near the shore in Brooklyn in the early 1900s. By the 1930s, there were reports of saltwater intrusion farther inland.[27] **Figure 1.7-8** (Upper Glacial Aquifer) and **Figure 1.7-9** (Magothy Aquifer) show simulated and measured saltwater interface data for the 1940s along the south shore. Observed maximum chloride concentrations data from the period January 1, 1940 through December 31, 1949 are shown as color-coded symbols and indicate significant inland saltwater intrusion in Brooklyn. The simulated positions of the saltwater interfaces in 1949 in the aquifers are also shown as contoured saltwater thicknesses in each aquifer. These simulated extents of saltwater intrusion produced by the model are consistent with observed groundwater chloride concentrations from the period studied. The presence of high chlorides can be correlated to the saltwater thickness in each aquifer.

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[27] Buxton, Herbert T., Peter K. Shernoff. 1999. Ground-Water Resources of Kings and Queens Counties, Long Island, New York. WSP 2498.

Figure 1.7-10 (Upper Glacial Aquifer) and **Figure 1.7-11** (Magothy Aquifer) show the simulated position of the saltwater interface in 1969 along with the observed maximum groundwater chloride concentrations for the time period January 7, 1965 through December 21, 1974. Chloride concentrations in Upper Glacial wells in the Woodhaven franchise area (southwestern Queens) increased from the 1950s to the mid-1970s due to increased pumping, almost entirely from the Upper Glacial Aquifer.[21] The simulated extent of saltwater intrusion shows saltwater intrusion into southwestern Queens County and is consistent with observed groundwater chloride concentrations and reports of saltwater intrusion in the Woodhaven franchise area of southwestern Queens.

The presence and movement of saltwater was also simulated in the Lloyd Aquifer, although south shore saltwater intrusion has not been definitively observed in the Lloyd Aquifer and there are no data available to compare simulated and measured saltwater locations there.

In Nassau County, the simulated extent of the saltwater interface is consistent with observed groundwater chloride concentrations. A cross section through southern Nassau County comparing the vertical extent of the simulated saltwater wedge in 1969 in the Magothy Aquifer to observed maximum chloride concentrations is shown on **Figure 1.7-12**. Observed chloride concentrations can vary significantly within a vertical profile due to the shape of the saltwater wedge. The simulated Magothy wedge thickness is assumed to be somewhat greater than observed, suggesting that the model may provide a conservative estimate of saltwater intrusion.

- Simulated and Observed Streamflow Time History Analysis: Data from 16 river gauges were used to evaluate simulated groundwater discharge to streams over time. Measured 7 day minimum streamflows are compared with simulated groundwater discharge to Valley Stream (one of the 16 streams included in the model calibration) in southwest Nassau County shown on **Figure 1.7-13**. Valley Stream baseflow was affected by water level declines associated with: (1) increased Queens and Nassau County water supply pumping; (2) the 1960s drought (also known as "the drought of record" for Long Island); and (3) the introduction of sanitary sewers in Nassau County, which reduced aquifer recharge that would have previously come from septic tanks. At Valley Stream, a decrease in measured streamflow correlates with sewering of the surrounding area, which occurred between 1953 and 1960. A reduction of baseflow to near zero correlates to both the increased pumping rates and the drought of record.

  The simulated results compare favorably to what was measured at the USGS stream gauge located at Valley Stream (1311500). The location of the Valley Stream gauge is shown on **Figure 1.7-7**.

The water level, streamflow, and chloride concentration data used in model calibration were obtained from the USGS NWIS online data base, as noted above.

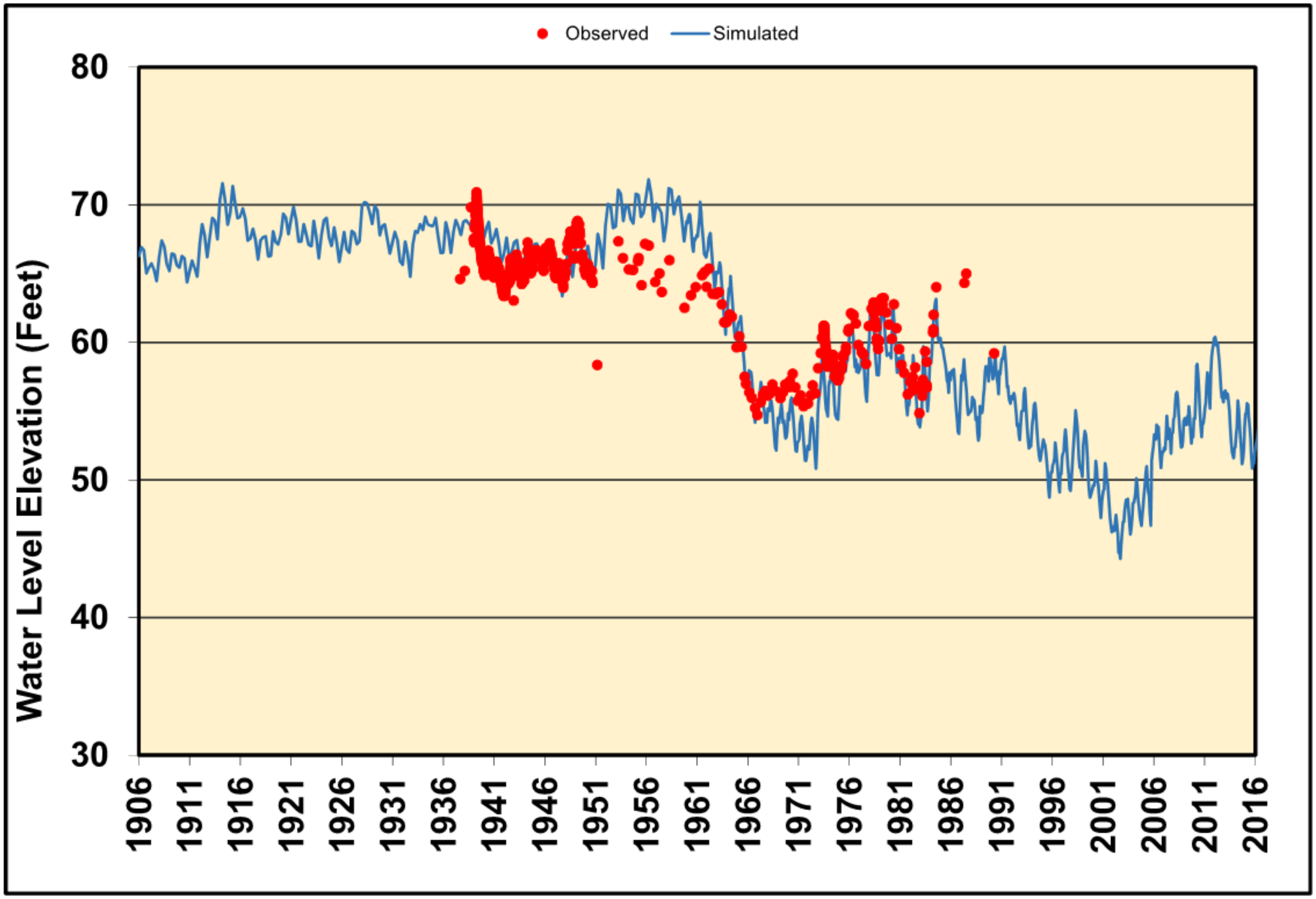

Figure 1.7-5: Time History of Well N-01160 Water Level Elevation

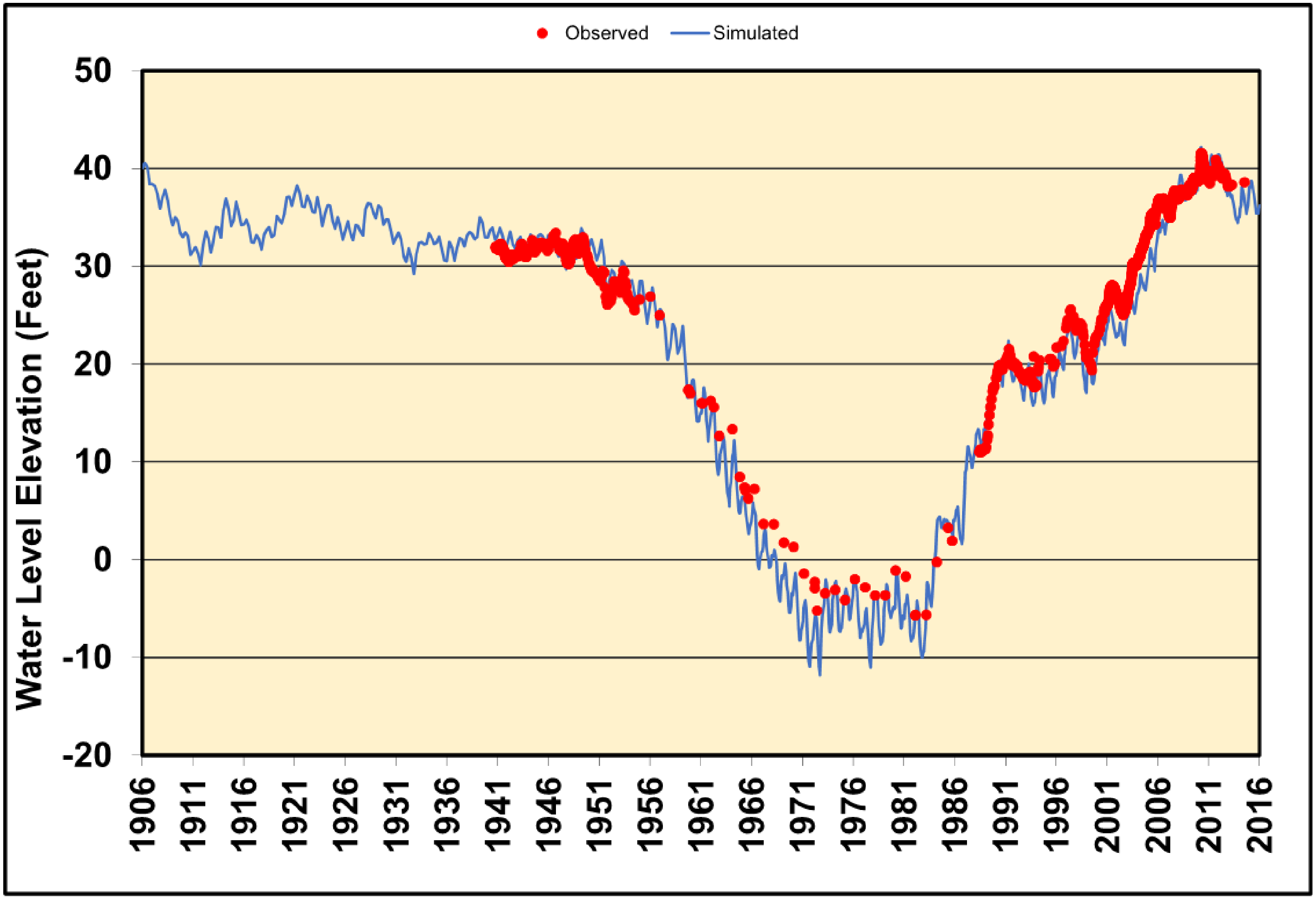

Figure 1.7-6: Time History of Well Q-01249 Water Level Elevation

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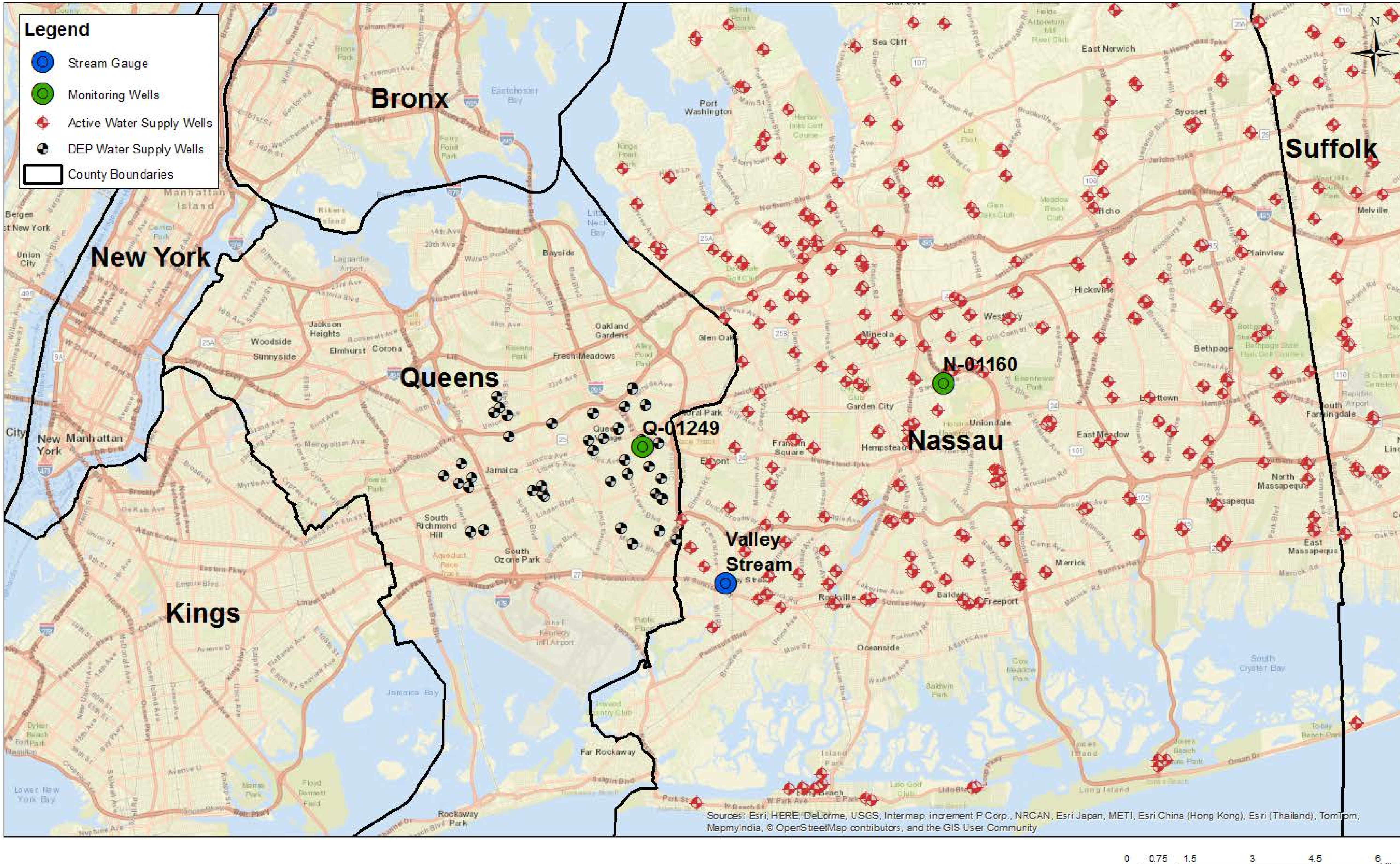

Figure 1.7-7: Select Monitoring Wells and Stream Gauge Location

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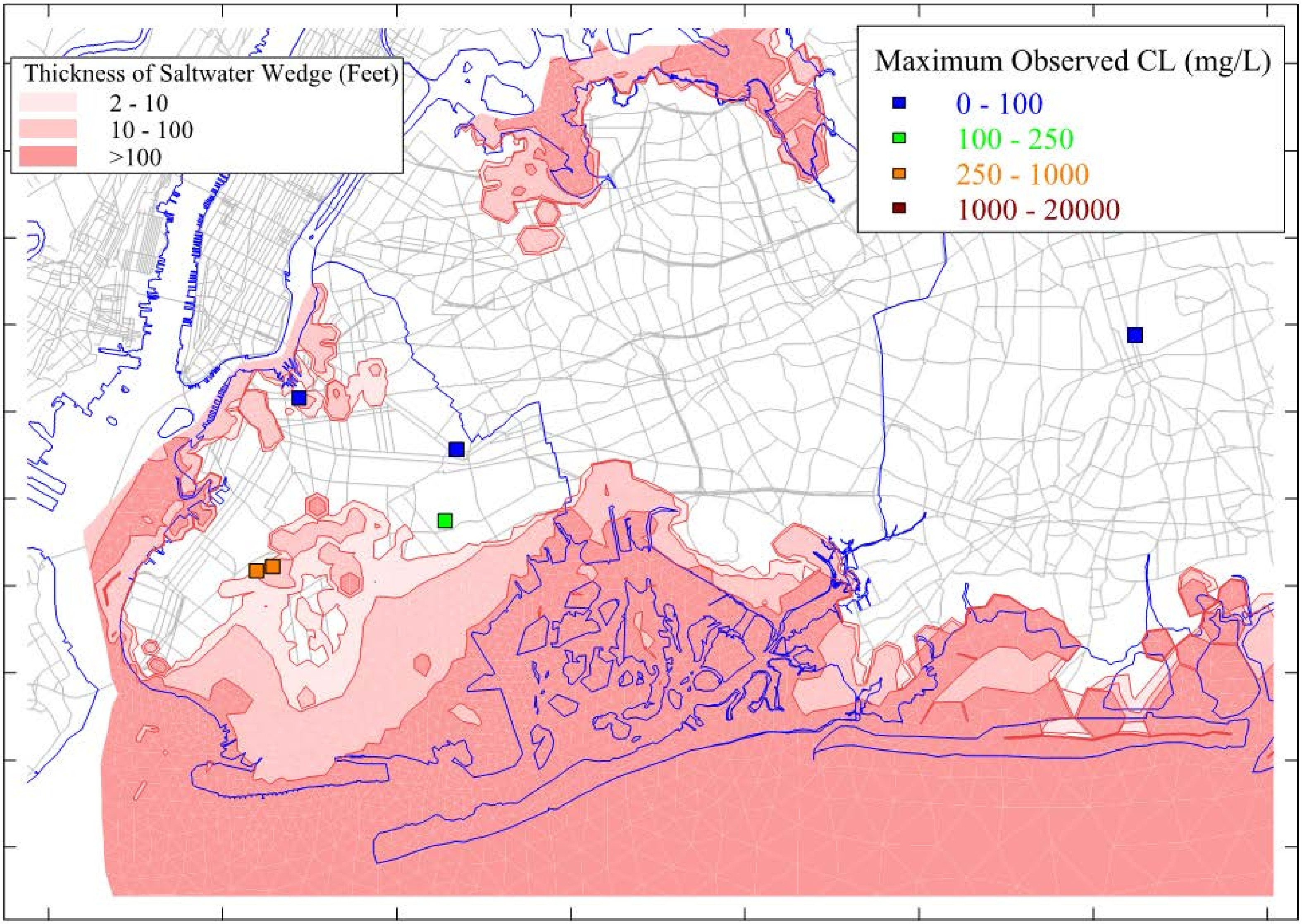

Figure 1.7-8: Saltwater Interface, Upper Glacial Aquifer - 1949

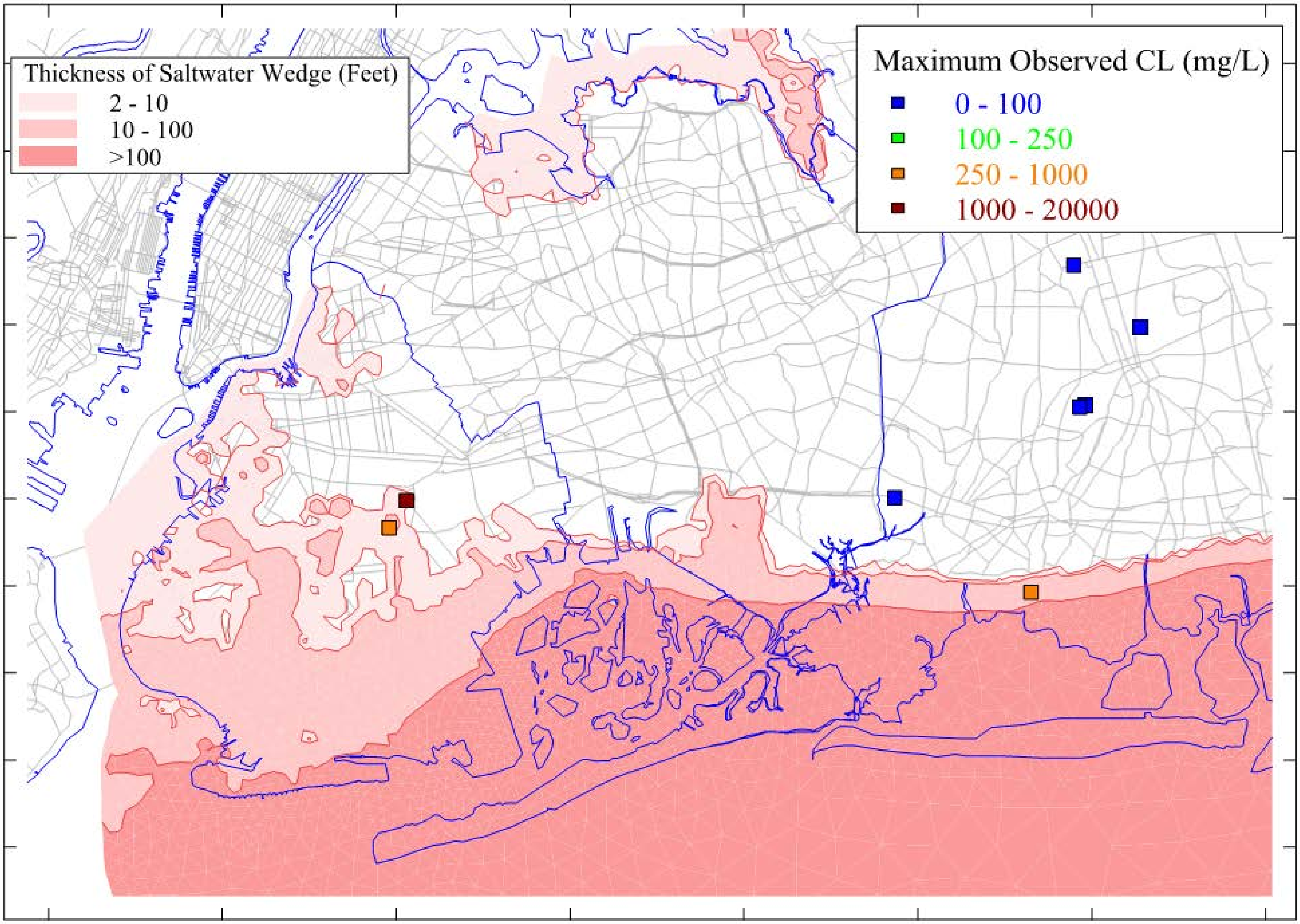

Figure 1.7-9: Saltwater Interface, Magothy Aquifer - 1949

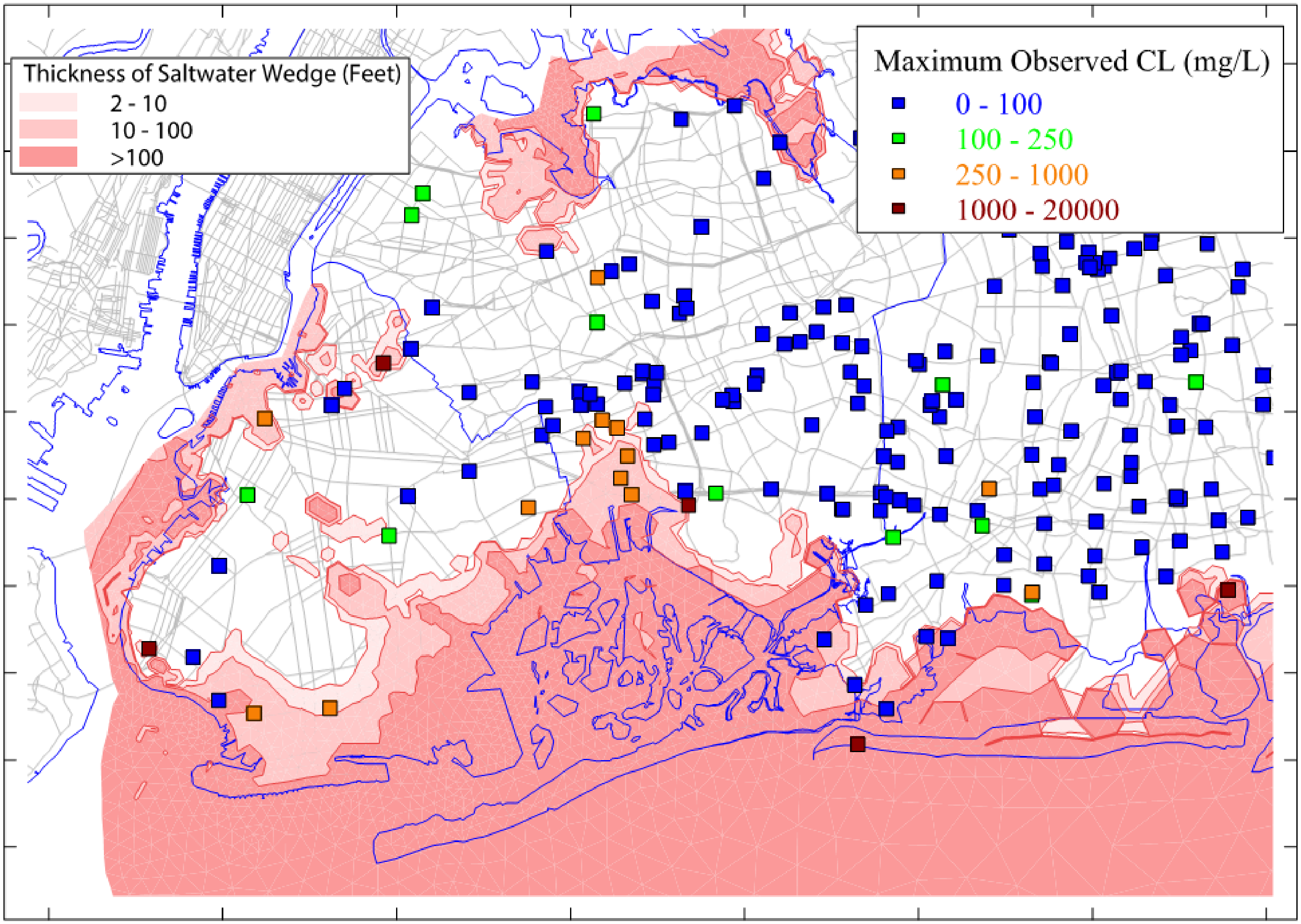

Figure 1.7-10: Saltwater Interface, Upper Glacial Aquifer - 1969

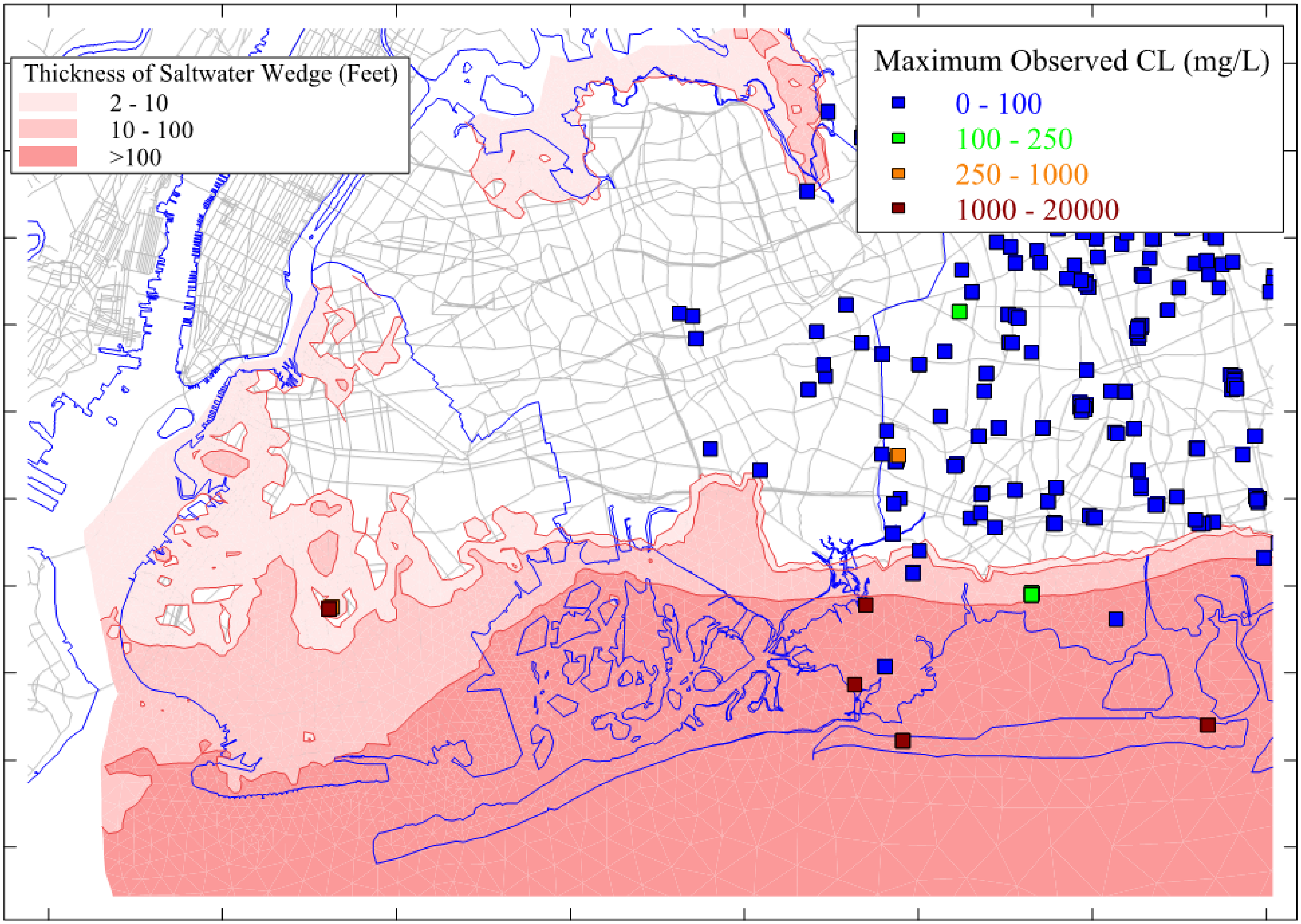

Figure 1.7-11: Saltwater Interface, Magothy Aquifer - 1969

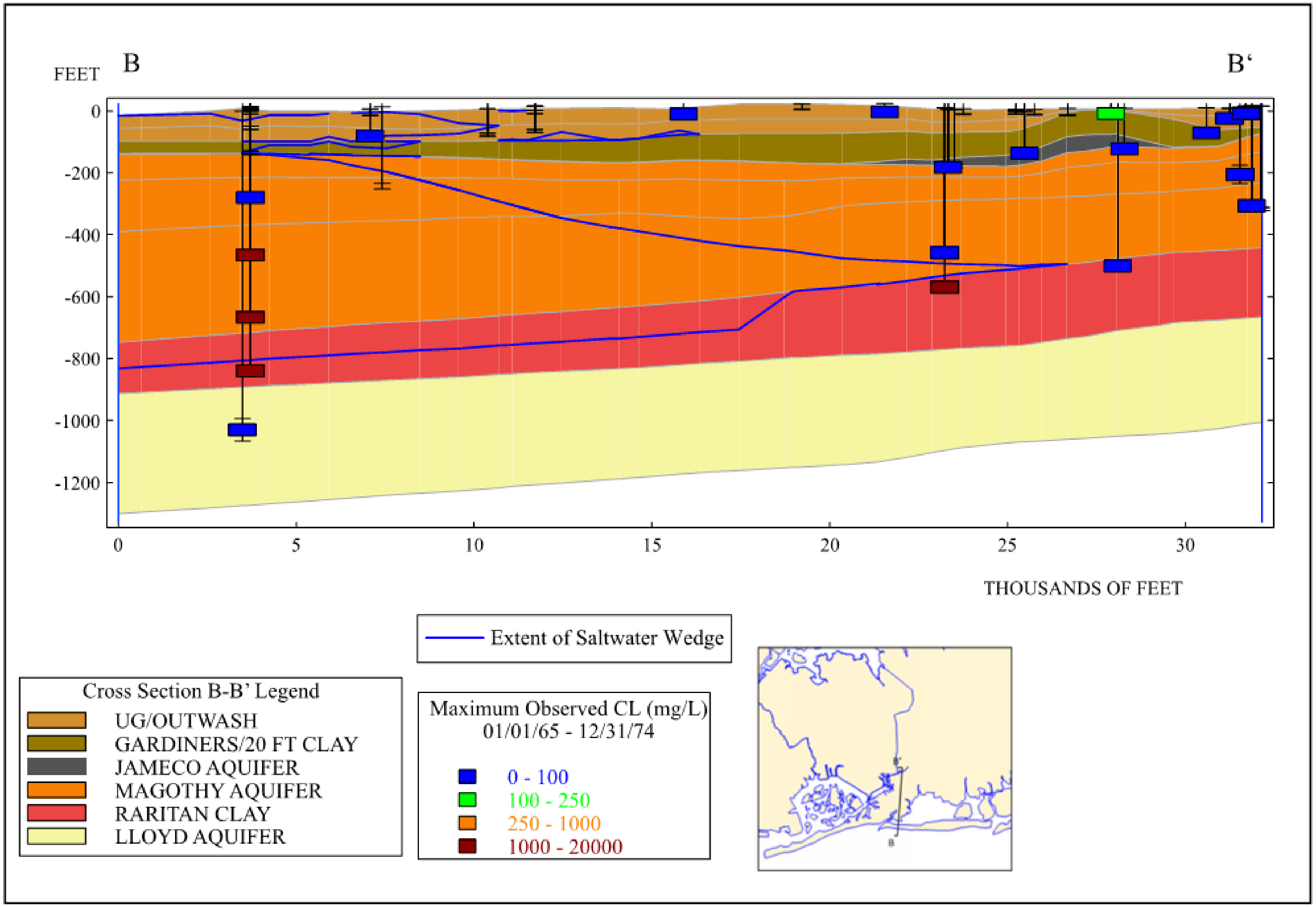

Figure 1.7-12: Cross Section, Saltwater Wedge Thickness - 1969

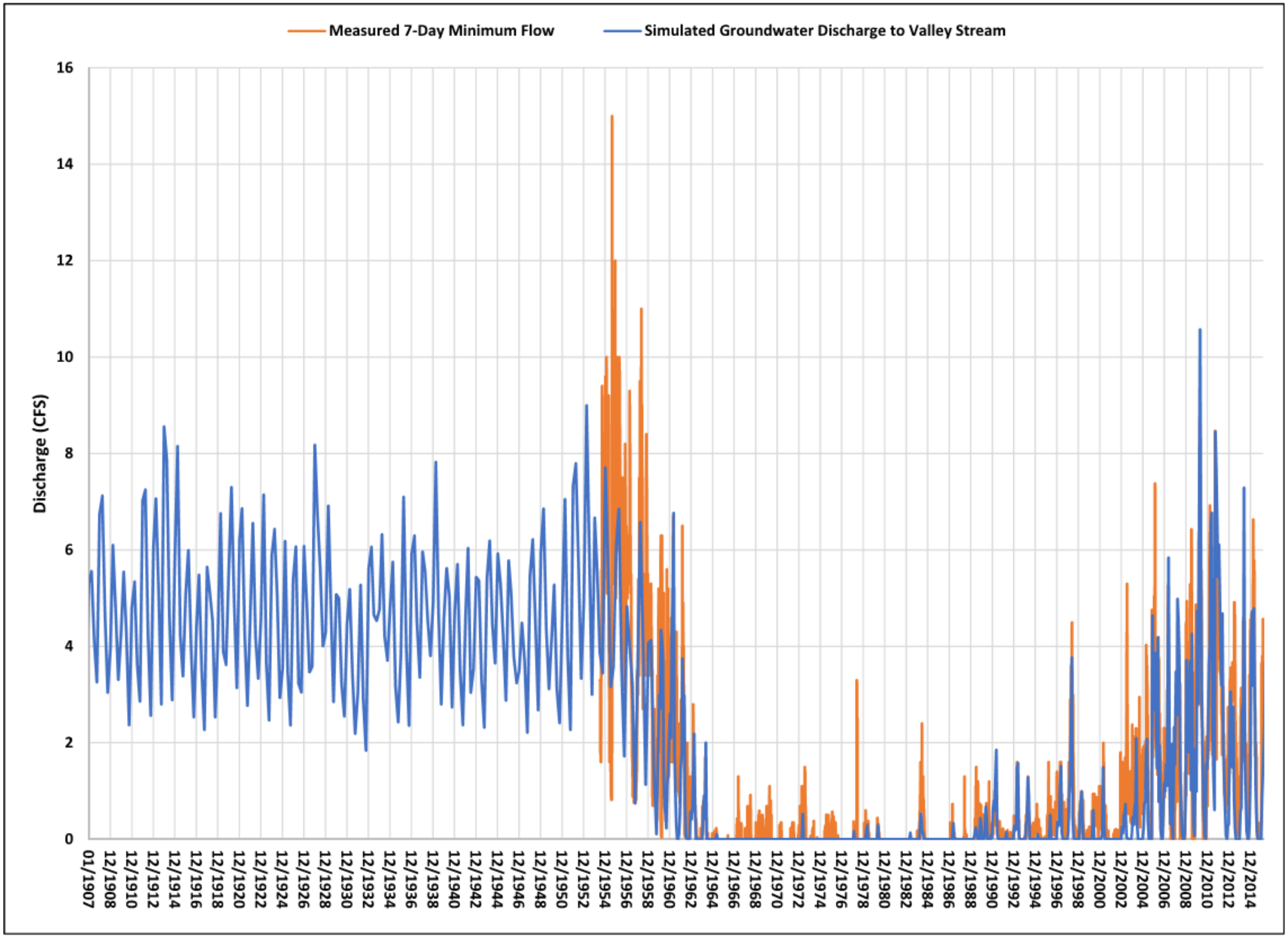

Figure 1.7-13: Measured and Simulated Groundwater Discharge to Valley Stream

1.7.7 HISTORICAL EVENTS SIMULATION

Over the course of the 20th Century, groundwater elevations, stream baseflows, and saltwater interface positions have changed as a result of the stresses applied to the aquifer system. The most significant stress is the magnitude and distribution of pumping withdrawals on Long Island. **Figure 1.7-14** shows the spatial distribution of pumping in 1930 and 2000 within the model domain from the over 1,000 wells pumped between 1905 and 2015. This figure illustrates the extreme shift from early-century western withdrawals from Kings and Queens counties to present-day withdrawals primarily from Nassau and Suffolk counties.

Figure 1.7-3 shows the annual average pumping totals in million gallons per day (mgd) for each county.[28] The nearly 150 mgd increase in water supply pumping withdrawals in Nassau County between 1930 and present day occur concurrently with reductions in groundwater elevations and stream baseflow within the county, as shown in the time series plots at N-01160 (see **Figure 1.7-5**) and Valley Stream (see **Figure 1.7-13**).

While the impacts of these stresses on measured piezometric head values are cumulative, the model can be used to disaggregate each stress component to quantify relative impacts in space and time. **Figure 1.7-5** and **Figure 1.7-6** are reproduced, respectively, as **Figure 1.7-15** and **Figure 1.7-16**, along with three additional time series of simulated groundwater elevations as follows:

- The solid black line labeled “Simulated, No Pumping” represents the simulated groundwater elevations assuming no water supply pumping occurred in Kings, Queens, Nassau, or Suffolk counties during the historic simulation period (to achieve this the model was rerun without pumping stresses from these three counties).

- The solid green line labeled “Simulated, No Nassau Pumping” represents the simulated groundwater elevations assuming no water supply pumping occurred in Nassau County during the calibration period, but with pumping occurring in Queens.

- The solid orange line labeled “Simulated, No City Pumping” represents the simulated groundwater elevations assuming no water supply pumping occurred in Kings or Queens counties during the calibration period, but with pumping occurring in Nassau County.

Comparison of the simulated historic simulation period (solid blue line labeled “Simulated”) to these three additional time series yields the observations below.

For N-01160 (see **Figure 1.7-15**), located in central Nassau County (see **Figure 1.7-7**):

- The historical impact of public supply pumping from Kings and Queens County (No City Pumping) on groundwater elevations is minimal. This is deduced by observing the minor differences, on the order of less than 1 foot, in groundwater elevations between the

[28] Suffolk County pumping is for the wells within the model domain only and not the entire county.

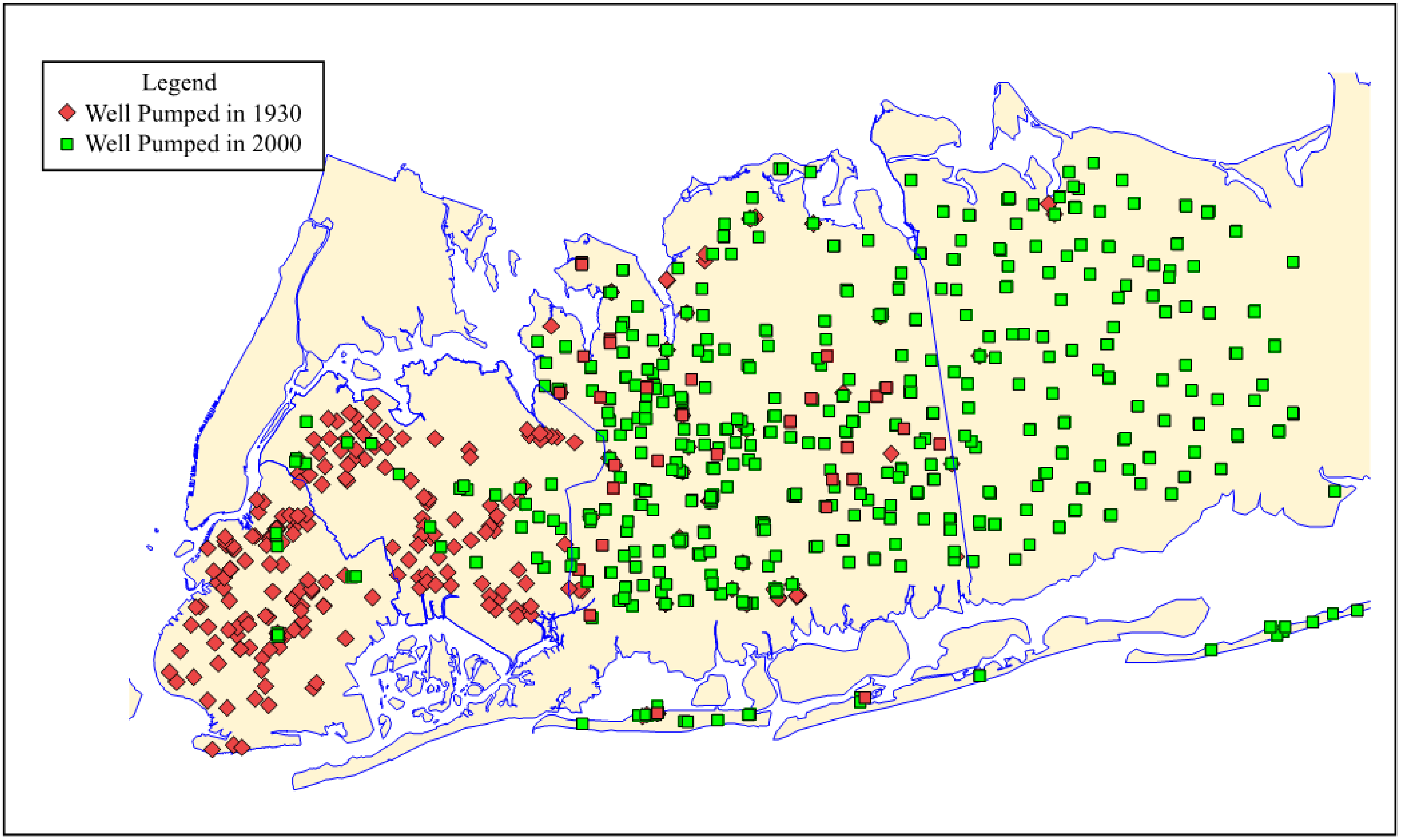

Figure 1.7-14: Distribution of Groundwater Pumping in 1930 and 2000

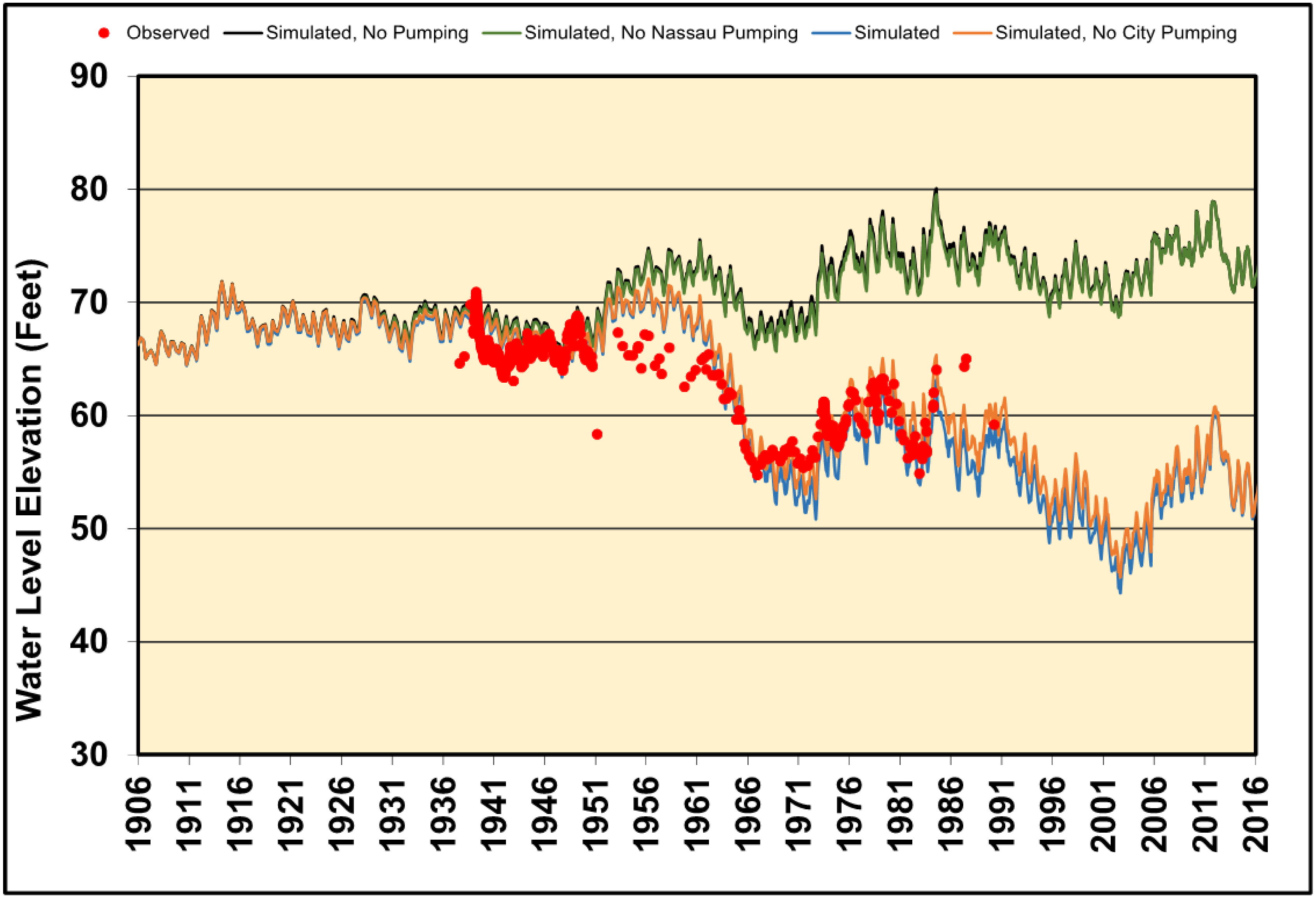

Figure 1.7-15: Expanded Time History of Well N-01160 Water Level Elevation

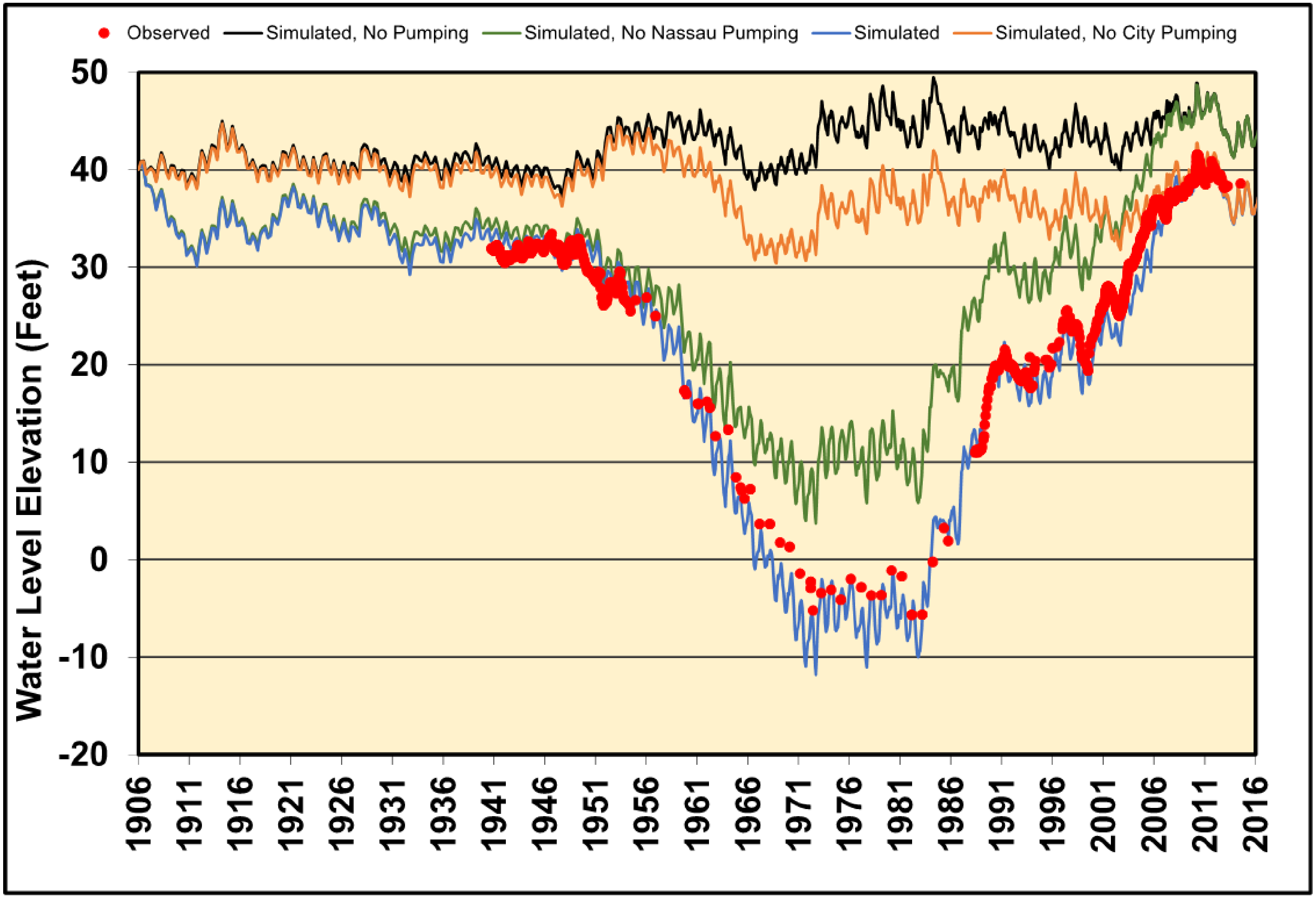

Figure 1.7-16: Expanded Time History of Well Q-01249 Water Level Elevation

- simulated historic simulation period (solid blue line) and the model run with no City pumping (solid orange line).

- In contrast, the historical impact of public supply pumping from Nassau County on groundwater elevations accounts for nearly all of the difference between the simulated conditions without water supply pumping (solid black line) and actual conditions (observed data and simulated historic simulation period shown as the solid blue line), noting that the solid green line (No Nassau pumping) and solid black line time series are nearly overlapping.

- These results show that present-day groundwater elevations in central Nassau County are approximately 20 feet lower due to Nassau County pumping than they would be if Nassau County had not pumped any water supply wells historically.

For Q-01249 (see **Figure 1.7-16**), located in eastern Queens County (see **Figure 1.7-7**):

- Much of the difference between the simulated no pumping (solid black line) and the measured data and simulated historic simulation period (solid blue line) is due to water supply pumping withdrawals from Kings and Queens counties up until their cessation in 2000. This is evident from the No Nassau Pumping (solid green line) that shows groundwater elevations to be approximately 30 feet lower than shown on the solid black line.

- However, approximately 7 to 10 feet of this difference is attributable to Nassau County pumping as shown by comparing the No City Pumping (solid orange line) and No Pumping conditions (solid black line). This shows that if Queens water supply wells had never been pumped, groundwater elevations at Q-01249 would have been depressed by nearly 10 feet from 1966 through present day due to Nassau County supply well pumping. Presently, the Queens wells are not pumping and the groundwater elevations within the vicinity of Q-01249 are depressed solely due to Nassau County pumping.

Similarly, the amount and timing of groundwater discharge to surface waterbodies is dependent on Queens and Nassau County pumping withdrawals. Relative to pre-development conditions, Valley Stream baseflow significantly declined and ultimately ceased due to drought conditions, and water supply pumping from both Queens and Nassau counties. Valley Stream saw a partial recovery in baseflow following the cessation of Queens supply pumping. However, presently, groundwater discharges to Valley Stream is below No Pumping conditions due to Nassau County pumping and sewering activities.

These simulations of groundwater elevations and stream baseflow illustrate the relative impacts of stresses on the historic simulation period and show the following:

- Water level declines and stream baseflow discharge reductions due to pumping withdrawals are spatially and temporally variable, and

- Present-day groundwater elevations and stream baseflow in both Nassau and Queens counties are lower than they would be if Nassau County wells were not pumping.

Since Nassau County supply wells are expected to continue pumping at rates similar to present-day operations, any further decreases in groundwater level or streamflow discharges caused by the resumption of Queens water supply pumping would be in addition to those already in place in Nassau County. It is therefore important to note that existing conditions, as described below, already contains these Nassau County pumping withdrawals and the aquifer changes in response to those withdrawals.

1.7.8 DEVELOPMENT OF EXISTING CONDITIONS AND FUTURE WITHOUT THE PROPOSED PROJECT

For the purposes of analyzing the Proposed Project, the historic period simulation discussed above was extended in time to facilitate modeling of Existing Conditions, Future without the Proposed Project, and Future with the Proposed Project. For Existing Conditions, the groundwater model was extended in time two years from the historic period to go through December 2017. For the Future without the Proposed Project, the historic period was extended to simulate the proposed permit renewal period (January 2018 through December 2027).

The following assumptions were used to update the model to represent conditions of these respective time periods:

- The spatial distribution of rainfall recharge and return flow would not change between present day and December 2027;
- The last five years (2011 through 2015) of rainfall data are representative of typical conditions; and
- The last five years (2011 through 2015) of water supply pumping data are representative of typical conditions.

Based on these assumptions, monthly input values of water supply well pumping and rainfall recharge were calculated by averaging the values from 2011 through 2015. The assumptions are discussed in greater detailed below:

- Water supply pumping data: Monthly water supply well pumping was calculated by averaging the values from 2011 through 2015, which results in an annual average rate of 192 mgd. This value is consistent with what has been pumped over the past three decades, as noted below:

– In Nassau County, annual average water supply pumping has ranged from 170 mgd to 210 mgd since 1990, with an average rate of 191 mgd over that period.

– Over the last 10 years of available record (2006 through 2015) the annual average was 192 mgd.

– Over the last 5 years of record (2011 through 2015), the average pumping rate was also 192 mgd, with a minimum and maximum annual rate of 185 and 196, respectively.

Based on the observed consistency in pumping rates, Nassau County water supply usage is not expected to increase in the near future. In addition, for the purposes of this analysis, Nassau County water supply usage is not anticipated to decrease due to the implementation of conservation measures.

All Nassau County supply wells that were pumped between January 2011 and December 2015 were considered active and incorporated into the Future without the Proposed Project model runs. For the portion of Suffolk County included in the model, the average annual pumping rate applied is approximately 94 mgd, consistent with recent annual averages. Return flow, which is based on water supply pumping and sewer coverage, was applied consistent with the historic period (1906 through 2015) using these pumping data and assuming no change in sewer coverage between 2015 and December 2027.

- Rainfall data: The average annual rainfall recharge used in both the Future without the Proposed Project and Future with the Proposed Project was 26.5 inches per year. This was determined by averaging annual rainfall recharge from 2011 through 2015 (5 years), during which the minimum and maximum values were 18 and 41 inches per year, respectively. The 10-year (2006 through 2015), 20-year (1996 through 2015), and 30-year (1986 through 2015) averages were 27.7, 27.1, and 26.6 inches per year, respectively. Since 1950, average annual rainfall recharge was 26.3 inches per year, with a maximum 10-year average of 30.3 inches per year and a minimum 10-year average of 21.4 inches per year. Based on these recent and historic values, the period of 2011 through 2015 can be considered representative of typical conditions and is appropriate.

- Spatial Distribution: Application of monthly recharge values varies spatially, consistent with the historic period (1906 through 2015). It was assumed that the spatial distribution of rainfall recharge and return flow would not change between present day and December 2027.

1.8 PROJECT SCHEDULE

The Proposed Project has two elements; the renewal of DEP's existing Water Supply/Water Withdrawal Permit and the future implementation of temporary treatment at the existing groundwater wells/stations.

The existing Water Supply/Water Withdrawal Permit will expire on December 31, 2017 and the permit renewal would be anticipated to have a 10-year duration, similar to the existing permit. The analysis period for the potential operation of the Queens Groundwater system is therefore conservatively based upon a 10-year permit duration (2018-2028) and the maintenance of the pumping limits allowed by the current permit.

In addition to the renewal of the current permit, the Proposed Project also involves the future construction and operation of temporary treatment systems at any or all of the Queens Groundwater wells. If treatment were put in place at all wells identified within the existing permit, it is anticipated that construction could be completed in less than two years. Operation of these wells and their associated treatment systems would be on an as needed basis and as such a defined build year was not identified. Upon the advancement of more detailed design of temporary treatment systems at one or more well stations in the future, additional site-specific analyses including the identification of a specific schedule and build year for construction and operation will be completed, if necessary, prior to implementation of the proposed treatment systems.

1.9 PROJECT APPROVALS AND COORDINATION

The Proposed Project would potentially require permits and approvals from the following State and local agencies listed below. Any required permits and approvals would be obtained prior to the installation of temporary treatment systems at the Queens Groundwater wells.

- NYS Department of Environmental Conservation
- NYS Department of Transportation
- NYS Department of Health
- NYC Office of the Mayor
- NYC Department of Health and Mental Hygiene
- NYC Department of City Planning
- NYC Department of Transportation

2.0 ANALYTICAL FRAMEWORK

2.1 INTRODUCTION

In accordance with the process described in the State Environmental Quality Review Act (SEQRA) and City Environmental Quality Review (CEQR), DEP (as Lead Agency) will examine the potential for environmental impacts that could occur as a result of the In-City Water Supply Resiliency Project. This chapter provides a description of the analytical framework that forms the basis for determination of the potential for impacts associated with In-City Water Supply Resiliency and the cumulative impacts, as applicable, as described in Chapter 4.0, "Cumulative Effects," of this Draft Environmental Impact Statement (DEIS).

Typically, the majority of a project's effects would occur upon completion of the project, once the project is constructed and operational. As discussed in Chapter 1.0, "Project Description," In-City Water Supply Resiliency is comprised of two elements or proposed actions, specifically the renewal of DEP's existing Water Supply/Water Withdrawal Permit which expires on December 31, 2017 and the implementation of temporary treatment systems at groundwater wells to allow the use of the Queens Groundwater system during a water supply shortage such as drought or planned and/or unplanned infrastructure outages. The methodology to assess potential impacts is described below for these two elements of the project.

2.2 ANALYTICAL FRAMEWORK

This DEIS was prepared in accordance with the guidelines presented in the *CEQR Technical Manual*, as applicable. For each technical area that warrants assessment, the analysis includes a description of existing conditions, an assessment of conditions in the future without the project (Future without the Proposed Project), and an assessment of future conditions with the Proposed Project (Probable Impacts of the Proposed Project).

Presented below is a description of the analytical framework used for this DEIS.

- **Analysis Year(s).** The analysis year(s) refers to the future year(s) for which a DEIS analyzes a proposed project's likely effects on its environmental setting. For the assessment of potential impact of the operation of the Queens Groundwater system upon groundwater resources, the analysis period was assumed to be the maximum 10-year duration of a renewed permit (2018 to 2028) based upon the pumping limits allowed by the current permit. For the purposes of this DEIS, construction of temporary treatment facilities would be evaluated generically with no specific assumed build year. At the time that DEP has developed a design for rehabilitation of individual well stations, further station-specific CEQR evaluations would be undertaken, as needed.

- **Existing Conditions.** Existing conditions have been evaluated in order to establish a baseline against which future conditions can be projected. In general, existing conditions will be evaluated for the impact categories most likely to be affected by the Proposed Project at the time of the publication of this DEIS.

- **Future without the Proposed Project (No Action Condition).** Using existing conditions as a baseline, conditions known to occur or expected to occur in the future, regardless of the Proposed Project, have been evaluated for the Proposed Project's analysis year(s). This is the "No Action" or "Future without the Proposed Project" and is the baseline condition against which the effects of the Proposed Project are measured.

- **Probable Impacts with the Proposed Project (Future with the Proposed Project Condition).** Potential changes within the study area resulting from the implementation of In-City Water Supply Resiliency were compared to the Future without the Proposed Project to assess the potential for significant adverse impacts. This comparison provides an understanding of the potential impacts that could result with implementation of the Proposed Project. This comparison can be found in each impact analysis as well as the cumulative analysis, as applicable.

2.3 DEFINITION OF STUDY AREAS

In-City Water Supply Resiliency is primarily focused on the renewal of DEP's existing Water Supply/Water Withdrawal Permit and the implementation of temporary treatment systems at existing Queens Groundwater wells. As the Proposed Project involves the withdrawal of groundwater from several aquifers located beneath Queens and these aquifers extend further east of Queens and may have the potential to affect groundwater resources within Nassau and western Suffolk County, a program-wide study area was considered. As such, two study areas for the Proposed Project were established: (1) typical or generic individual well stations and immediately surrounding areas, and (2) program-wide impacts from operation of the Queens Groundwater system. Dependent upon the applicable technical resource area, the DEIS therefore addresses a typical well station study area and/or a more regional or program-wide study area. This is discussed in additional detail in Section 2.4.

For each technical area in which a screening assessment was completed or impacts may occur, the applicable study area(s) are defined for analysis. This represents the geographic areas most likely to be affected by the Proposed Project for a specific technical area, or the area in which impacts of that type could potentially occur. Appropriate study areas differ depending on the type of impact being analyzed and are identified in each section of the DEIS.

2.4 SCOPE OF ENVIRONMENTAL ANALYSIS

The impact analyses have been tailored to the Proposed Project and are presented in this DEIS. For the purposes of this DEIS, the potential impacts of the Proposed Project were assessed in the following manner. An initial screening was conducted to determine what impact categories required a detailed assessment. Those impact categories that did not warrant any further assessment consistent with *CEQR Technical Manual* guidance are described in Section 2.5. If a screening threshold is exceeded and an impact analysis is warranted, a description of analysis methodology and the results of this assessment are provided within the applicable sections of Chapter 3.0, "Probable Impacts of the Proposed Project." Impact assessments are based upon the impact analysis year(s), study area(s), and *CEQR Technical Manual* criteria.

In addition, as noted in Section 2.3, the environmental impact assessments included a generic individual station and/or program-wide analysis based upon the anticipated effects of the Proposed Project upon specific impact categories. A discussion of the general need for station-specific and/or program-wide analyses is presented below.

2.4.1 GENERIC STATION-SPECIFIC ANALYSIS

Operation of the Queens Groundwater wells and the implementation of temporary treatment systems would generally result in potential station-specific or localized impacts. Potential impacts would be expected to occur at or within close proximity to individual well stations due to the anticipated activities associated with the construction and operation of these treatment facilities such as potential increases in vehicular traffic, changes in land use, or air quality effects. The assessment of these station-specific impact categories are based upon the anticipated construction, operation, and layout of the generic temporary treatment system discussed in Chapter 1.0, "Project Description."

2.4.2 PROGRAM-WIDE ANALYSIS

As the Proposed Project involves the withdrawal of groundwater from several aquifers located beneath Queens and these aquifers extend further east of Queens and may have the potential to affect groundwater and surface water resources across a larger geographic area (Queens, Nassau, and/or western Suffolk counties), a regional or program-wide study area has also been considered. As an example, groundwater withdrawal in southeast Queens can result in potential effects to Nassau and western Suffolk County water suppliers or effects upon groundwater baseflows to surface waters within Queens and Nassau counties. Therefore, the DEIS also considers larger program-wide effects that may be associated with the Proposed Project.

Table 2.4-1 provides a summary that identifies those impact categories that required additional analyses beyond an initial screening assessment and whether a generic station-specific and/or program-wide impact analysis is required. Impact categories that did not require additional analyses beyond an initial screening assessment are discussed in more detail within Section 2.5. For those impact categories that require additional assessment of potential effects, this is presented in Chapter 3.0, "Probable Impacts of the Proposed Project."

Table 2.4-1: Summary of Required Impact Analyses for Proposed Project

Impact Category	Generic Station-Specific Assessment[1]	Program-Wide Assessment[1]
Land Use, Zoning, and Public Policy	✓	-
Socioeconomic Conditions	-	-
Community Facilities and Services	-	-
Open Space and Recreation	-	-
Critical Environmental Areas	-	-
Shadows	-	-
Historic and Cultural Resources	✓	-
Urban Design and Visual Resources	✓	-
Natural Resources and Water Resources	✓	✓
Hazardous Materials	✓	✓
Water and Sewer Infrastructure	✓	✓
Solid Waste and Sanitation Services	✓	-
Energy, Greenhouse Gas Emissions, and Climate Change	✓	✓
Transportation	-	-
Air Quality	-	-
Noise	-	-
Neighborhood Character	✓	-
Public Health	-	✓
Environmental Justice	-	✓
Growth Inducement	-	✓
Construction	✓	-

Note:
[1] Impact categories not identified as requiring a generic station or program-wide analysis were determined not to require a detailed analysis based upon an initial screening.

2.4.3 PROPOSED OPERATING SCENARIOS

The Proposed Project is comprised of two proposed actions; the renewal of DEP's existing Water Supply/Water Withdrawal Permit and the implementation of temporary treatment systems at the Queens Groundwater system well stations. As previously discussed, analyses were based upon a review of the treatment components discussed in Chapter 1.0, "Project Description," and the anticipated construction and operation of a generic treatment system layout (see Chapter 1.0, "Project Description") that represented a reasonable conservative scenario. Assessment of potential impacts are described in more detailed under the specific impact sections within Chapter 3.0, "Probable Impacts of the Proposed Project," for those categories where potential impacts are possible.

Assessment of potential impacts that may result from the pumping of groundwater required a modified analytical approach. The current Water Supply/Water Withdrawal Permit has a 10-year duration and allows DEP to withdraw up to 22,568 million gallons per year (62 mgd) based upon a five-year running average, with a 24,807 million gallon per year (68 mgd) maximum for any single year.[29] As part of the Proposed Project, DEP is seeking a renewal the existing permit with no change to the current pumping limits. Pumping of these wells would occur during water supply shortages, such as upstate drought or planned and/or unplanned infrastructure outages. As a result, pumping levels may vary significantly dependent upon DEP's specific needs in the future. Therefore, the DEIS assesses several proposed operating scenarios, as summarized below, for a range of pumping rates and durations within the limits of the existing and anticipated future permit.

- Scenario A – Groundwater pumping at current single year permitted maximum (68 mgd) for 1 year;
- Scenario B – Groundwater pumping at current single year permitted maximum (68 mgd) for 2 years;
- Scenario C – Groundwater pumping at current single year permitted maximum (68 mgd) for 3 years;
- Scenario D – Groundwater pumping at the currently permitted 5-year running average of 62 mgd for 5 years; and
- Scenario E – Groundwater pumping at the currently permitted 5-year running average of 62 mgd for 10 years.

These scenarios have been developed to conservatively estimate the potential impact from operating the Queens Groundwater system taking into account a range of pumping rates and durations. As there are a number of uncertainties associated with predicting future conditions, a sensitivity analysis pertaining to rainfall (drought), southern Lloyd saltwater interface position, and the spatial distribution of Queens wells will be conducted.

2.5 SCREENING

As noted in the DEIS Final Scope of Work, an initial screening was conducted for each impact category in order to form an initial characterization of Existing Conditions to determine which impact categories warranted an impact analysis. These screenings primarily relied on desktop evaluations (e.g., review of ArcGIS data, maps, aerial imagery, online databases, existing reports, and agency consultations). Several impact categories did not warrant further impact assessment under the *CEQR Technical Manual*, and these are described below.

- Socioeconomics: The Proposed Project supports the renewal of an existing Water Supply/Water Withdrawal Permit and the potential implementation of temporary treatment facilities at up to 44 well stations during periods of water supply shortage. It does not involve direct or indirect displacement of residential or business uses or effects to a specific industry. As a result, no further analysis is warranted.

[29] All groundwater flows have been rounded to the nearest whole number mgd.

- Community Facilities and Services: The Proposed Project would not physically and permanently alter an existing facility and does not involve the addition of new populations that require changes to community facilities and services.

- Open Space and Recreation: As the Proposed Project does not involve the loss or limitation of public open space, change in the use of any open space, or increased noise or air emissions. The Proposed Project would not add population or demand on the use of open space. A detailed analysis is not required.

- Critical Environmental Areas: There is one Critical Environmental Area (CEA) located in the vicinity of one station site: the Jamaica Bay CEA. This CEA is located approximately ¼-mile from Station 36. There is no potential for the Proposed Project to affect or be affected by the environmental characteristics of this CEA. As a result, no further assessment is necessary.

- Shadows: The Proposed Project would not include any permanent structures over 50 feet in height or a proposed component that could cast new shadows or substantially increase existing shadows on a publicly-accessible open space or park, historic landscape or resource, or important natural feature.

- Natural Resources: Several natural resource areas did not warrant a detailed assessment at the individual well stations of the Queens Groundwater system under *CEQR Technical Manual* guidance.

  - There would be no substantive disturbance to geology and soils, and no disturbance to aquatic/benthic resources, wildlife, terrestrial/upland resources, wetlands, floodplains, drainage, and built resources associated with the implementation of the Proposed Project at any of the well stations.
  - There are no surface waters, streams, wetlands, floodplains, dunes and beaches, grasslands, or woodland located on or adjacent any well station.
  - No significant natural communities, as classified by the NYSDEC Natural Heritage Program (NHP) for rare or high-quality wetlands, forests, grasslands, ponds, streams, and other types of habitats, ecosystems, and ecological areas are located at or in close proximity to the existing well stations.
  - There are also no built resources, such as piers, waterfront structures, and ruins that provide habitat for marine species and nesting and foraging areas for birds, or other structures offering significant habitat at any of the well stations.
  - The Proposed Project is located within the Jamaica Bay Watershed, with a majority of the well stations located within the watershed. No significant adverse direct or indirect impacts to the watershed due to the Proposed Project are anticipated as the implementation of temporary treatment facilities would be localized on sites with existing development, with no impact to the Bay.

- Natural Resources: Several natural resource areas did not warrant a detailed assessment due to groundwater pumping of the Queens Groundwater system within Queens, Nassau, and western Suffolk counties under *CEQR Technical Manual* guidance.

  – While pumping of the Queens Groundwater wells for water supply may potentially impact groundwater resources and surface baseflow within Queens, Nassau, and western Suffolk counties, it would not include impacts to geology and soils, floodplains, drainage, and built resources, therefore, no further analysis of these areas is warranted.

- Transportation: Operation of temporary treatment facilities at the Queens Groundwater stations would not result in any significant impacts to pedestrian, transit, or parking. New traffic associated with the operation of the temporary treatment facilities would be limited and primarily related to periodic removal and replacement of treatment blocks, delivery of chemicals required for groundwater treatment, and limited on-site workers who would be responsible for operation of the temporary treatment facilities. This is expected to involve no more than a few trucks per week per site and limited personal vehicle trips on a daily basis. The Proposed Project would not be anticipated to generate more than 50 PCEs per hour at any well station. Therefore, a detailed transportation analysis is not warranted.

- Air Quality: The Proposed Project would not involve the addition of any new emission sources related to proposed treatment technologies, heat and hot water systems, and would not have any on-site emergency generators. In addition, operation of the Proposed Project is not expected to significantly alter traffic conditions.

- Noise: The Proposed Project is not anticipated to generate a significant increase in noise levels at the property boundary and the nearest noise-sensitive receptors due to on-site activities. If, upon further design of the temporary treatment facilities, noise levels were determined to potentially not be in compliance with the *CEQR Technical Manual* or other applicable impact thresholds, DEP would review potential measures, as necessary. The Proposed Project is not expected to significantly alter existing traffic conditions, thereby affecting mobile sources of noise.

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3.0 PROBABLE IMPACTS OF THE PROPOSED PROJECT

3.1 LAND USE, ZONING, AND PUBLIC POLICY

In accordance with the *CEQR Technical Manual*, this section considers the Proposed Project's consistency with land use, zoning, and public policies. The Proposed Project includes the potential placement and operation of temporary treatment facilities at the existing Queens well stations.

3.1.1 METHODOLOGY

The impact analysis consisted of: (1) establishing and describing an overview of existing conditions at the well stations by identifying existing land uses, zoning districts, and relevant public policies, including adopted State, City, neighborhood, and community plans; (2) establishing future conditions without the Proposed Project by identifying potential anticipated updates to land use, zoning, and public policies planned and programmed for implementation of the Proposed Project; (3) establishing future conditions with the Proposed Project based on the potential implementation of the temporary treatment facilities at the well stations; and (4) analyzing the potential for impacts from the Proposed Project by evaluating whether the Proposed Project would result in direct or indirect displacement or alteration of land uses or zoning districts, would preclude future development of the land, or potentially be non-compatible with applicable public policies.

3.1.2 EXISTING CONDITIONS

All of the well stations that are part of the Proposed Project are currently located within mapped transportation and utility land use areas according to a review of the City's Primary Land Use Tax Lot Output (PLUTO) Map (see **Figure 3.1-1**). The well stations vary in size from approximately 3,200 square feet to as large as 2 acres, with the majority less than a quarter of an acre. A typical well station contains a driveway, one or more one-story brick well station buildings, a maintained lawn surrounded by perimeter fencing. Additional on-site structures may also be present. Land uses surrounding the well stations are predominately residential areas. Limited areas of mixed commercial/residential, industrial/manufacturing, transportation/utility, parking, vacant, and public facility/institutional uses are located within the 400 feet surrounding many of the well stations. Generally the areas surrounding the well stations are typically low- to medium-density residential uses, ranging from one-family to multi-family residences. Well stations included as part of the Proposed Project have, in many cases, existed for over 100 years within these communities of Queens. These sites have been used for water supply purposes originally by the Jamaica Water Supply Company until 1996 when DEP assumed ownership and operation.

Residential zoning is predominately mapped in proximity to the well stations, ranging from lower-density (R-1 to R-5) to medium-density (R-6) residential districts (see **Table 3.1-1**). Special uses, such as "water or sewage pumping stations" are allowed by Special Permit under the City's Zoning Resolution within residential zoning. Lower-density residential zoning includes detached, single-family homes with low building heights (R-1), to semi-detached (R-3); to attached row house style (R-5) residential districts. R1 and R2 districts allow only detached single-family residences. R3A, R3X, R4A, and R5A districts allow only detached single- and two-family residences. R3-1 and R4-1 districts permit both detached and semi-detached one- and two-family houses. R4B districts also permit attached row houses limited to one- and two-family residences. Zero lot line buildings are permitted in R3A, R4-1, R4B, R5B, and R5D districts. R5 districts allow a variety of housing at a higher density than permitted in R3-2 and R4 districts and are permitted to height of 40 feet. R6 zoning districts are widely mapped in built-up, medium-density areas with a diverse mix of building types and heights to large-scale "tower in the park" developments. Typical height of R6 zoning districts are 13 stories. A few of the well stations are located within Manufacturing District (M1-1) zoning. M1 districts allow for light manufacturing uses characterized by one- or two-story warehouse buildings typically with loading bays areas on the same lot.

Applicable public policies of New York City, the Borough of Queens, and the various Community Board Districts were reviewed in relation to the Proposed Project. The Proposed Project is not located within the City's Waterfront Revitalization Program boundaries. Two New York City initiatives were applicable to the Proposed Project:

- *PlaNYC: A Greener, Greater New York (2011)* – As the *CEQR Technical Manual* has not been updated to address the more recent *OneNYC* plan (see below); a discussion of consistency with *PlaNYC* is therefore provided. *PlaNYC* establishes sustainability planning policies to address three key challenges that the City faces over the next 20 years: population growth; aging infrastructure; and global climate change. Key elements of the plan include housing and neighborhoods, parks and public space, brownfields, waterways, water supply, transportation, energy, air quality, solid waste, and climate change.

- *One New York: The Plan for a Strong and Just City (OneNYC) (2015)* – Released by the Mayor's Office of Sustainability, *OneNYC* is a comprehensive plan for growth, sustainability, and resiliency, while economic equity is used as a guiding principle throughout the plan.

3.1.3 FUTURE WITHOUT THE PROPOSED PROJECT

Based on planned developments in the project area, it is DEP's understanding that no substantive or significant changes in existing land uses or zoning designations would occur within the project timeframe. No changes in the land use or zoning at the individual well stations are expected. Under the Future without the Proposed Project, DEP would continue to undertake required maintenance and monitoring activities at the well stations, as necessary. Therefore, in the Future without the Proposed Project, it is assumed that land uses and zoning designations within the project area would remain unchanged from Existing Conditions.

No changes to the well stations or their current operation would occur and consistency with applicable public policy would remain the same as under Existing Conditions.

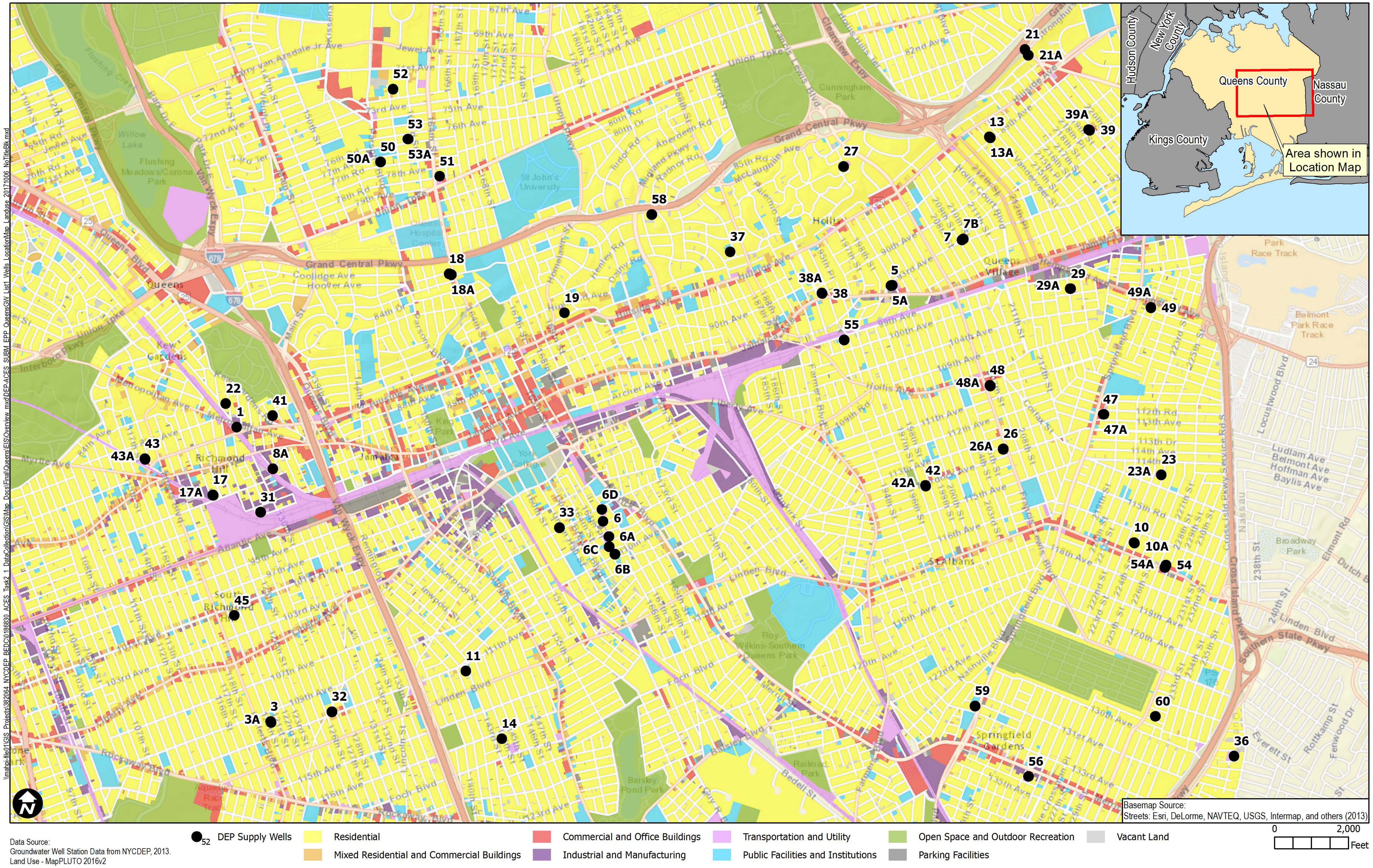

Figure 3.1-1: Existing Land Use

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Table 3.1-1: Summary of Well Station, Zoning, and Community Boards

Well Number	Station	Zoning	Community Board
1	1	R6	9
3	3	R4	10
3A	3	R4	10
5	5	R4	12
5A	5	R4	12
6	6	R4-1	12
6A	6	R3A	12
6B	6	R3A	12
6C	6	R3A	12
6D	6	R4-1	12
7	7	R2	13
7B	7	R2	13
8A	8	M1-1	9
10	10	R3-1	13
10A	10	R3-1	13
11	11	R3A	12
13	13	R2	13
13A	13	R2	13
14	14	R3A	12
17	17	R5	9
17A	17	R5	9
18	18	R4B	8
18A	18	R4B	8
19	19	R5	8
21	21	R3-2	13
21A	21	R3-2	13
22	22	R4-1	9
23	23	R2A	13
23A	23	R2A	13
26	26	R4B	12
26A	26	R4B	12
27	27	R1-2	8
29	29	R3-2	13
29A	29	R3-2	13
31	31	M1-1	9

Well Number	Station	Zoning	Community Board
32	32	R3-2	10
33	33	R4	12
36	36	R2	13
37	37	R1-2	8
38	38	R5	12
38A	38	R5	12
39	39	R2	13
39A	39	R2	13
41	41	R4-1	9
42	42	R4-1	12
42A	42	R4-1	12
43	43	R6B	9
43A	43	R6B	9
45	45	R4A	9
47	47	R3-2	13
47A	47	R3-2	13
48	48	R3-2	13
48A	48	R3-2	13
49	49	R3-2	13
49A	49	R3-2	13
50	50	R3-2	8
50A	50	R3-2	8
51	51	R3-2	8
52	52	R6	8
53	53	R3-2	8
53A	53	R3-2	8
54	54	R2A	13
54A	54	R2A	13
55	55	R3-2	12
56	56	R3A	13
58	58	R1-2	8
59	59	R2	12
60	60	R2A	13

3.1.4 FUTURE WITH THE PROPOSED PROJECT

No changes in the land use or zoning of any affected well station would be required as part of the Proposed Project. In the Future with the Proposed Project, temporary treatment facilities may be installed at up to 68 wells located at 44 well stations. These facilities would be temporary and consistent with existing uses at the sites (e.g., transportation and utility land uses) and existing zoning designations. During a water supply shortage, temporary treatment system(s) may be installed, consisting of container or trailer-based treatment facilities, chemical addition equipment, and infrastructure connections or improvements that would be completed in order to provide electrical service, and connection to the water distribution and wastewater collection systems (see Chapter 1.0, “Project Description”). Operation of these systems would require monitoring, routine water quality sampling, maintenance, and exchange of treatment blocks, as required. After a water supply shortage event passes, the temporary treatment facilities would be removed, although concrete pads that may potentially be installed to support temporary treatment facilities (i.e., blocks) would remain for potential use during future water supply shortages.

In the Future with the Proposed Project, the presence of temporary treatment facilities would be short term and would not reflect a permanent change to the neighborhood. The existing well stations have existed at these locations in many cases for more than 100 years. The Proposed Project would be consistent with the existing land use and zoning and as a temporary and short-term use would not affect long-term land use or zoning trends or result in any indirect effects to these.

The Proposed Project would also be consistent with and supports the applicable *PlaNYC* policies focused on water supply, climate change, and resiliency as noted below:

- *Water Supply: Ensure the high quality and reliability of our water supply system.*
  - *Maintain and enhance the infrastructure that delivers water to New York City*

    The City’s upstate surface water supply system currently serves New York City and the study area of the Proposed Project. As an enhancement, the Proposed Project would allow DEP to supplement the upstate surface water system by utilizing the Queens Groundwater system to provide an additional level of redundancy and reinforcing DEP’s ability to meet water supply needs in the event of a water supply shortage.

  - *Modernize in-city distribution*

    Implementation of proposed temporary treatment of the Queens Groundwater system would include on-site and off-site improvements to infrastructure at the affected well stations. This would potentially include improvements to existing electrical service and potential upgrades related to water distribution and wastewater collection connections.

– *Improve the efficiency of the water supply system*

  The Proposed Project would improve the resiliency and efficiency of the City's overall water supply system by making a portion of the groundwater system accessible during a water supply shortage.

- *Climate Change: Increase the resilience of our communities, natural systems, and infrastructure to climate risks*

  As global climate change continues, there is a greater potential for drought conditions and variations in precipitation levels, which can severely affect the City's water supply. By utilizing the Queens Groundwater system, DEP would enhance infrastructure resilience of the water supply system to meet City community needs during periods of water supply shortage that may be associated with climate change-derived changes.

The Proposed Project is therefore consistent with the policies set forth in *PlaNYC*.

The Proposed Project would also be consistent with and supports the two applicable policies focused on growth, sustainability, and resiliency under *OneNYC*:

- *A Growing, Thriving City by fostering industry expansion and cultivation, promoting job growth, creating and preserving affordable housing, supporting the development of vibrant neighborhoods, increasing investment in job training, expanding high-speed wireless networks, and investing in infrastructure.*

  The Proposed Project would reflect an investment in the reliability and resiliency of the City's water supply system by providing more ready access to the Queens Groundwater system. By having a resilient water supply, DEP's Queens Groundwater system would continue the City's long-term investment in its infrastructure in order to provide a high level of reliability and redundancy with the City's water supply system.

- *A Resilient City by making buildings more energy efficient, making infrastructure more adaptable and resilient, and strengthening coastal defenses.*

  The utilization of the Queens Groundwater system would provide an additional opportunity to make DEP's water supply system more robust, resilient, and adaptable by making a portion of the groundwater system accessible during water supply shortages. Therefore, the Proposed Project would be consistent with this policy of *OneNYC*.

The Proposed Project is therefore consistent with and supports the policies set forth in *OneNYC*.

In addition, economic equity also represents a guiding principle throughout the *OneNYC* plan. The Proposed Project would provide more robust resiliency to portions of the water supply system that serve Environmental Justice communities in Brooklyn and Queens. The Proposed Project would provide DEP with the ability to place Queens Groundwater into the distribution systems within these two boroughs in the event of a water supply shortage; thereby increasing DEP's ability to provide water supply in times of shortage.

The Proposed Project would therefore not result in any significant adverse impacts to land use, zoning, or applicable public policies within the project area.

3.2 HISTORIC AND CULTURAL RESOURCES

In accordance with the *CEQR Technical Manual*, an historic and cultural resources assessment is required for projects that would have any ground disturbance affecting archaeological resources or if the project would result in a new or alteration to a historically important building, structure, or object. Architectural resources generally include historically important buildings, structures, objects, sites, and districts. Archaeological resources are physical remains, usually subsurface, of the prehistoric, Native American, and historic periods, such as burials, foundations, artifacts, wells, and privies. The Proposed Project would not affect historically important buildings, structures, or objects, but may involve ground disturbance. This section analyzes the potential for the Proposed Project to affect historic and cultural resources.

3.2.1 METHODOLOGY

The impact analysis consisted of: (1) describing existing historic resources; (2) establishing future conditions without the Proposed Project by identifying whether any changes to existing historic or potential historic resources are likely to occur; (3) establishing future conditions with the Proposed Project based on the anticipated operation of the Queens Groundwater system and potential implementation of temporary treatment facilities; and (4) analyzing the potential for impacts on historic resources by evaluating if the Proposed Project would potentially disturb or alter the integrity of historic and cultural resources.

3.2.2 EXISTING CONDITIONS

All of the Queens Groundwater well stations were originally established prior to acquisition of the well system by DEP in 1996 with many originally established in the late 19th or 20th century. The existing well stations that are part of the Proposed Project and locations immediately adjacent to these do not contain any historical resources or New York City Landmarks based upon a review of the New York State Historic Preservation Office's (SHPO) Cultural Resource Information System (CRIS) and the New York City Landmarks Preservation Commission's (NYCLPC) online maps. Two of the 44 well stations have historic resources within 400 feet of a well station; however, these resources are not located on parcels adjacent to the well stations. Maple Grove Cemetery is located approximately 250 feet north of Station 41. Station 43 has two resources within 400 feet, the Church of the Resurrection located approximately 130 feet north and the RKO Keith's Theatre located approximately 250 feet south of Station 43, respectively. Eleven of the well stations may be in an area that has the potential to contain archaeological resources. These include Stations 5, 6, 6D, 7, 11, 18, 19, 27, 38, 55, and 58, although, as noted, the sites have been previously disturbed.

3.2.3 FUTURE WITHOUT THE PROPOSED PROJECT

In the Future without the Proposed Project, it is assumed that historic and cultural resources within the study area would remain the same as under Existing Conditions. Under the Future without the Proposed Project, DEP would continue to undertake required maintenance and monitoring activities at the well stations, as necessary. Therefore, in the Future without the Proposed Project, no impacts to historic and cultural resources are anticipated at any well station within the timeframe of the impact analysis.

3.2.4 FUTURE WITH THE PROPOSED PROJECT

Two of the 44 well stations (Stations 41 and 43) have historic resources within 400 feet; this includes the Maple Grove Cemetery, the Church of the Resurrection, and RKO Keith's Theatre. However, no impacts to these resources are anticipated because the resources are separated from the well stations by multiple parcels and structures. Placement of temporary treatment facilities would not involve significant in-ground disturbances or vibrations that could undermine the foundation or structural integrity of these nearby resources.

While 11 of the 44 well stations may be in an area that has the potential to contain archaeological resources, the anticipated activities required for the implementation of the Proposed Project, however, would occur on sites that were previously excavated and/or would occur in areas of previous disturbance. Currently anticipated excavation would be limited consisting of the potential placement of new concrete pads for placement of temporary treatment facilities, new or improvements to utility interconnections at the sites (e.g., electric, sewer and water supply); and placement of treatment facilities (see Chapter 1.0, "Project Description") that would be placed temporarily at existing well stations with little or no need for excavation.

As a result, the Proposed Project is not expected to result in any significant effects that could alter the integrity of historic and cultural resources at any well stations. If necessary, future station-specific analyses would be conducted prior to required improvement and/or installation of temporary treatment facilities at specific well stations.

3.3 URBAN DESIGN AND VISUAL RESOURCES

An urban design assessment under CEQR considers how a project may change the experience of a pedestrian in the project area. In general, an urban design assessment is required when the project may have effects on one or more of the elements contributing to the pedestrian experience. As the Proposed Project may introduce multiple temporary treatment facilities (i.e., treatment blocks) on up to 44 well stations, a potential change to the pedestrian experience may occur. A visual resources analysis is required if a project would partially or totally block a view corridor or a defining visual resource of the neighborhood.

3.3.1 METHODOLOGY

The impact analysis consisted of: (1) establishing and describing existing conditions by determining existing aesthetic and visual resources, including a characterization of existing public view corridors; (2) establishing future conditions without the Proposed Project by identifying proposed projects that would potentially alter views ; (3) establishing future conditions with the Proposed Project based on the implementation of temporary treatment facilities at the well stations; and (4) analyzing the potential for impacts from the Proposed Project on visual resources through a qualitative determination of the effect to these view corridors from the Proposed Project and the magnitude of potential change for the project to eliminate or substantially limit views which are deemed to have aesthetic value.

3.3.2 EXISTING CONDITIONS

Pedestrians walking by a typical well station site may currently have a view of a 1-story brick well station building(s) with a driveway, surrounded by a maintained lawn and perimeter fencing. The residential areas neighboring many of the Proposed Project sites are typically low to medium-density residential areas, ranging from one-family to multi-family attached residences, up to 40 feet in height. A small number of well stations are adjacent to residential apartment buildings up to 13 stories, and one- to two-story commercial buildings and/or warehouses. The existing well stations have existed in many cases for more than 100 years within these communities of Queens.

As noted, while there are historic resources within 400 feet of two of the well stations (see Section 3.2), there are no parks, open spaces, cemeteries, historic buildings or structures, churches or other defining visual resources adjacent to the well stations.

3.3.3 FUTURE WITHOUT THE PROPOSED PROJECT

As described in Section 3.1, "Land Use, Zoning, and Public Policy," no major development projects are anticipated in the project area in the Future without the Proposed Project. There are no neighborhood defining visual resources on or adjacent to any of the well stations. Under the Future without the Proposed Project, DEP would continue current maintenance operations of the existing facilities at the well stations. Conditions at the well stations and the surrounding pedestrian experience are expected to remain largely unchanged from Existing Conditions with the exception of the removal of several existing water tanks (CEQR No. 15DEP008Q), originally constructed between 1905 and 1932, at Stations 1, 19, 21, 22, and 39. This would be completed in 2018 or 2019. Ongoing improvements related to the $1.7 billion build out of the sewer system in southeastern Queens would continue but would have no impact to existing urban design and visual character in the study area. In addition, DEP would also close-out and remove several chemical bulk chemical storage tanks at Stations 10, 23, 36, 39, 56, and 59 in the Future without the Proposed Project.

The urban design and visual character of the well stations and their surrounding communities is largely anticipated to remain substantially the same as under Existing Conditions.

3.3.4 FUTURE WITH THE PROPOSED PROJECT

Under the Future with the Proposed Project, temporary treatment facilities could be placed at up to 44 well stations. As described in Section 1.6.2.3, the temporary treatment facilities would consist of several treatment blocks. Proposed temporary treatment facilities would generally be consistent with the scale and use of the existing surrounding well station buildings consisting of Conex boxes (similar in size to shipping container boxes) or trailer-mounted units. The temporary treatment facilities would conform with, and not be out of scale with, building height requirements, the well station sites would continue to include a perimeter fence, and are not expected to significantly, or more importantly permanently, alter the pedestrian view of the parcels. As the proposed treatment blocks are approximately 8 feet in height (see **Figure 1.6-2** and **Figure 1.6-3**), the implementation of the temporary treatment facilities would be of a massing and height consistent with the existing urban design of the areas, which may include much larger buildings of varying footprints and heights. The anticipated change in view from the pedestrian's point of view would be the density of the treatment blocks within the existing perimeter fencing. However, the treatment facilities would be temporary and would be removed at the conclusion of the water supply shortage. It should also be noted that the existing well stations are generally not aligned with view corridors of defining visual resources of their surrounding neighborhood, such as parks, churches, or historic buildings, and as such are not anticipated to have any significant adverse impacts to urban design and visual resources.

Under the Proposed Project, DEP's groundwater well stations would remain at the same sites and in the same neighborhoods as they have in many instances for more than 100 years. Prior to the installation of individual temporary treatment facilities, station-specific assessments, if required, would be prepared to further assess potential impacts from the pedestrian perspective. As the Proposed Project would be temporary and treatment facilities would be removed from each station after a water shortage event, the Proposed Project would have a limited effect and no significant impacts to urban design or visual resource are anticipated.

3.4 SOLID WASTE AND SANITATION

A solid waste assessment determines whether a proposed project would cause a substantial increase in solid waste production that would overburden available waste management capacity or otherwise be inconsistent with the City's approved solid waste management plan (SWMP) or with State policy related to the City's integrated solid waste management system. According to the *CEQR Technical Manual*, if a proposed project may lead to substantial new development resulting in at least 50 tons (100,000 pounds) of solid waste generated per week, a detailed solid waste and sanitation services analysis is warranted in order to assess the impacts of the project on the City's waste management capacity.

3.4.1 METHODOLOGY

This section provides a general overview of solid waste disposal practices in New York City and then provides a qualitative discussion of current solid waste generation and anticipated future waste generation due to the Proposed Project. The potential impact of the Proposed Project's solid waste generation on the City's collection needs and disposal capacity is discussed qualitatively including an assessment of whether the Proposed Project would represent an impact to solid waste and sanitation including the adequacy or need for additional sanitation services due to the Proposed Project.

3.4.2 EXISTING CONDITIONS

Within the City of New York, waste and recyclables generated by residences, some non-profit institutions, tax-exempt properties, and federal, State, and City agencies are collected by the Department of Sanitation (DSNY). Commercial establishments (restaurants, retail establishments, offices, industries, etc.) in the City contract with private waste carters for waste and recyclables collection and disposal. Depending on the source, volume, and the collection route, private carters use either manual or containerized collection. Private carters typically deliver commercial waste to solid waste management facilities located both inside and outside of the City.

The majority of solid waste collected in the City may initially be managed within the City, but is then transported primarily by long haul trucks or train to waste management facilities in New York or other states. Some waste collected by DSNY is transferred to existing marine-based transfer stations for transport by barge to recycling or intermodal facilities where containerized waste is loaded onto trains for transport to out-of-City waste management facilities.

Operation of the existing Queens Groundwater well stations is currently very limited. As a result minimal solid waste is currently generated at these sites and this waste, as applicable, is collected and transported to transfer stations or other waste management facilities. Wastes associated with some Queens well stations that currently have treatment systems in place are removed and recycled (e.g., GAC-based treatment systems) or appropriately managed at licensed waste management facilities.

Waste generation from the existing well stations does not represent a significant source of waste in comparison to the City's overall municipal and private waste management infrastructure.

3.4.3 FUTURE WITHOUT THE PROPOSED PROJECT

Under the Future without the Proposed Project, DEP would continue to maintain and operate the Queens Groundwater system consistent with current usage. No substantive change in the operation of the well stations would be anticipated and no significant change in the generation of solid waste or the need for new or expanded sanitation services would be anticipated.

DEP would advance removal of several existing water tanks (CEQR No. 15DEP008Q), originally constructed between 1905 and 1932, at Stations 1, 19, 21, 22, and 39. This would be completed in 2018 or 2019. DEP also intends to close-out and remove several chemical bulk chemical storage tanks at Stations 10, 23, 36, 39, 56, and 59. These projects would result in solid waste, but much of these materials would be recycled. The removal of all of these tanks would also be a one-time occurrence and no significant and long-term change related to solid waste and sanitation in the Future without the Proposed Project would be anticipated.

Likewise no significant, large-scale developments within the study area are anticipated that would result in a significant impact, change, or substantive increase in solid waste generation or the need for sanitation services.

3.4.4 FUTURE WITH THE PROPOSED PROJECT

Under the Proposed Project, temporary treatment facilities may be placed at up to 44 well stations. These temporary treatment facilities would be consistent with the generic temporary treatment system described in Chapter 1.0, "Project Description." The systems would consist of temporary treatment blocks that would contain media which would periodically require removal, disposal, and replacement. These treatment blocks, which would differ based upon the needs at individual well stations, may include Liquid-phase Carbon Absorption vessels (LCA) with Granular Activated Carbon (GAC) media, ion exchange with resin media (IXP/IXN), and oxidation and filtration vessels (OXF) with manganese dioxide-coated greensand, anthracite, and gravel media.

The GAC media associated with LCAs would be regularly monitored until it is no longer effective for the removal of target organic compounds (e.g., VOCs). At that time, the complete LCA block (i.e., trailer) with media inside will be removed from a well station and brought to a central location for GAC replacement. A sample of the spent GAC media would be sent to a laboratory and tested to determine the carbon profile and identify the elements and other potential contaminants adsorbed to the GAC during its use for groundwater treatment. Depending on the profile results, the GAC may be reactivated off site by the manufacturer for reuse, or disposed of in a landfill, if necessary, in accordance with all applicable regulations. GAC would be transported by trucks in accordance with applicable federal, State and/or local Department of Transportation regulations. Reactivation and/or recycling of GAC media is a routine process and as a result a limited amount of this media is expected to require disposal.

Similar to GAC, the resin media within the ion exchange vessels would also require regular monitoring to determine when it is no longer effective for the removal of the target contaminants (e.g., nitrates and perchlorate). At that time, the complete ion exchange block (i.e., trailer) with media inside would be removed from the well station and brought to a central location for resin removal, possible regeneration, and/or replacement. A sample of spent resin would be sent to a laboratory for analysis to determine if the resin can be safely regenerated or requires disposal. If the resin needs to be disposed, the laboratory analysis results would be sent to an approved waste disposal facility for confirmation that they would accept the spent resin. Depending on the profile results, the resin may be disposed of in a landfill or at a waste-to-energy facility.

The manganese dioxide-coated greensand, anthracite, and gravel media within the OXFs would be routinely backwashed to remove accumulated inorganic material such as manganese and iron. Backwash waters would be discharged to the City's sewer system, in accordance with applicable requirements, as described in Section 3.7, "Water and Sewer Infrastructure." At the end of the media's useful life, sample cores would be extracted from the vessels and tested in a laboratory to determine the composition and presence of potentially known hazardous contaminants. If hazardous contaminants are not present, the media would be removed from the vessels with vacuum trucks and disposed of in a landfill. If hazardous materials are detected in the media sample cores, the material would be transported and disposed in accordance with applicable federal, State, and local requirements for the management and disposal of hazardous materials.

In addition to spent media, the Proposed Project would also result in other associated waste generation during operation of the temporary treatment facilities. This would consist of routine solid waste associated with on-site personnel, deliveries of materials, spent storage containers for chemicals, and other materials. The overall volume of this material would be expected to be minimal and would not represent an impact to solid waste and sanitation services.

Overall the Proposed Project would not result in the generation of more than 50 tons per week of new solid or hazardous waste for all of the well stations. As a result, a detailed assessment is not warranted. Expected volumes would be substantially less than this and this new waste generation would only be expected to occur when the temporary treatment facilities are in operation during a water supply shortage. At the conclusion of a water supply shortage, the temporary treatment facilities would be removed, remaining waste materials would be recycled or disposed of, and waste generation would return to levels comparable with Existing Conditions. In addition, spent media would be expected to represent the largest waste streams associated with the Proposed

Project, but a significant portion of this media would be regenerated and/or recycled as is common practice for the use of these materials, thereby further reducing potential impacts associated with the need for disposal of materials.

The Proposed Project would also not result in any significant impact to the provision of sanitation services within the City of New York. More than sufficient collection or carting capacity, municipal and/or commercial, is available within the City and immediately surrounding areas (Nassau and Westchester Counties and New Jersey). Sufficient transfer station capacity is also likewise available. No adverse impacts to sanitation services are therefore expected.

The Proposed Project would therefore not result in an adverse significant impact to solid waste and sanitation services.

3.5 NATURAL RESOURCES

3.5.1 INTRODUCTION

This section considers the potential for impacts from the implementation and operation of the Proposed Project on natural resources. As noted in Chapter 2.0, "Analytical Framework," several natural resource areas did not warrant a detailed assessment at the individual Queens well stations under *CEQR Technical Manual* guidance. These include geology and soils, aquatic/benthic resources, wildlife, terrestrial/upland resources, wetlands, floodplains, drainage, and built resources. No significant natural communities, as classified by the NYSDEC Natural Heritage Program (NHP) for rare or high-quality wetlands, forests, grasslands, ponds, streams, and other types of habitats, ecosystems, and ecological areas are located at or in close proximity to the existing Queens well stations.

This section includes an assessment of groundwater resources and the potential to change groundwater-fed surface water baseflow. The assessment includes an assessment of a range of potential operating scenarios, as described in Chapter 2.0, "Analytical Framework." The primary tool utilized for this assessment is the New York City Groundwater Model, as discussed in Chapter 1.0, "Project Description," which was developed for use in analyzing the groundwater system. In addition, this section includes an assessment of the potential impacts associated with the construction and operation of the temporary treatment facilities at the Queens well stations on federal/State Threatened, Endangered, Candidate Species, State Species of Special Concern and unlisted rare or vulnerable species. While pumping of the Queens Groundwater wells for water supply may potentially impact groundwater resources and surface baseflow, it would not include impacts to geology and soils, floodplains, drainage, and built resources, therefore, no further analysis of these areas is warranted.

3.5.2 METHODOLOGY

3.5.2.1 Surface Water

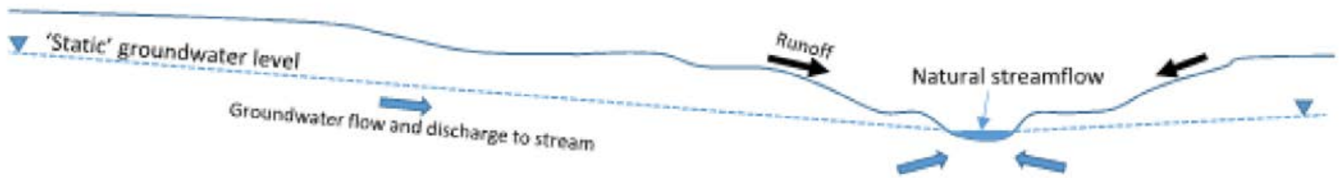
The Proposed Project's utilization of groundwater resources pumped from the aquifer network underlying Kings, Queens, Nassau, and Suffolk counties has the potential to change the groundwater-fed baseflow over the range of potential operating scenarios and durations discussed in Section 2.4.3, “Proposed Operating Scenarios.” Baseflow is the portion of water in a surface waterbody that comes from groundwater seepage through the natural bottom sediments of a lake, pond, or river and therefore represents a portion of the overall water contribution to a specific surface water. As depicted schematically on **Figure 3.5-1**, baseflow and surface runoff (including discharge from drainage pipes) are the components of water inputs to a surface waterbody. Depending on the characteristics of the surface waterbody, the portion of overall inflow that is baseflow can vary. Some waterbodies are completely disconnected from a groundwater aquifer and receive only inputs from runoff.

Figure 3.5-1 shows schematically how groundwater discharge to a surface waterbody can be reduced or eliminated as a result of nearby aquifer pumping.

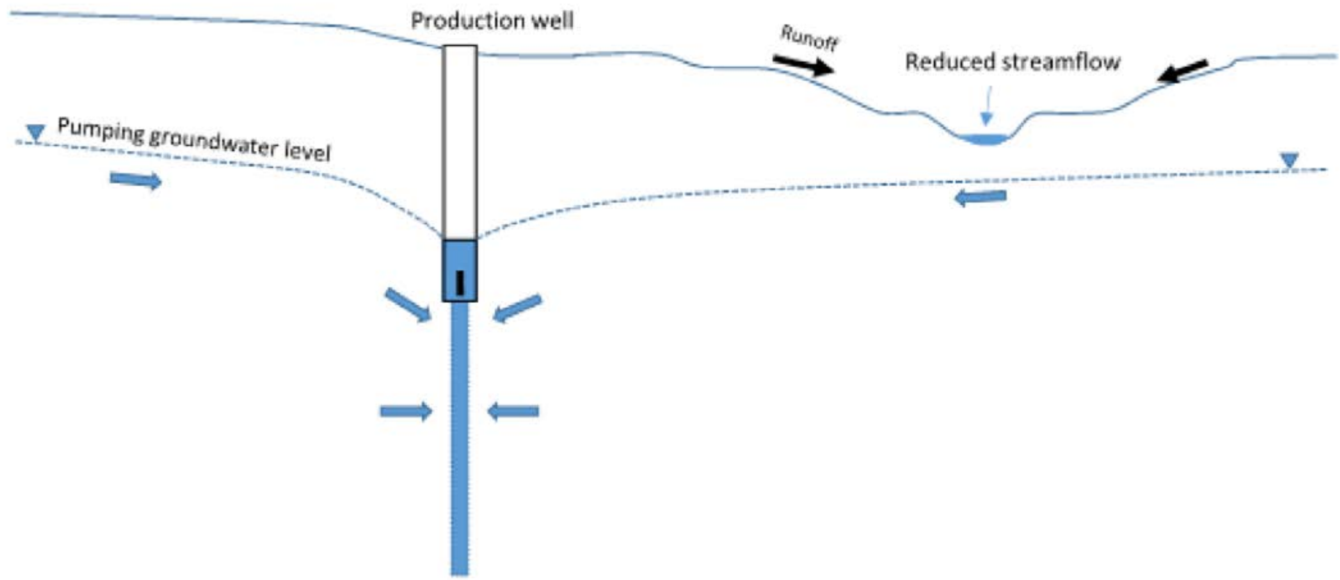
The New York City Groundwater Model, described in Chapter 1.0, “Project Description,” was the primary tool utilized to analyze potential baseflow changes to surface water for the Proposed Project. A more detailed description of the model is provided in Section 1.7, including, but not limited to, a description of the overall model, its background, development, calibration, and its capabilities as a predictive tool.

In order to assess surface waters, the New York City Groundwater Model was used to examine the potential effects of these scenarios and the potential changes in simulated groundwater-fed surface water baseflow relative to Existing Conditions, Future without the Proposed Project, and Future with the Proposed Project. Potential changes in groundwater-fed surface water baseflow were quantified and the potential impacts to associated natural resources (e.g., wetlands, aquatic biota) are described qualitatively. Potential impacts to streams were assessed further when the simulated baseflow for a scenario changed by more than 1.0 cubic foot per second (cfs), relative to the Future without the Proposed Project conditions. This threshold for further evaluation is considered conservative given the recording accuracy of the stream gauging stations, and the seasonal variation encountered in streams which is approximately 1.0 to 4.0 cfs based on Valley Stream at Valley Stream, New York gauging station (USGS 01311500), and is considered representative for the waterbodies evaluated. While the groundwater model provides a representation of changes in baseflow, it does not simulate the flows into waterbodies associated with direct rainfall runoff or discharged through drainage pipes or losses associated with evaporation or direct extraction from surface waterbodies. If significant adverse impacts are identified, potential measures that may be implemented to limit these are discussed.

A literature review was conducted to gather existing information on current conditions within the waterbodies of concern, including existing baseflow and surface water inputs. This information was used to assess the relative magnitude of potential effects of the Proposed Project and its interaction with these heavily-modified hydrologic features in the urbanized environment of Queens and Long Island. Data available for each waterbody varies; the best sources of information were utilized and where necessary reasonable assumptions were made such as whether available data applied to only a certain portion of a stream or whether anecdotal historic information were relevant to current conditions. It is likely, when considering reasonable values of recharge, that baseflow contributions to all the waterbodies discussed have diminished over time due to the expansion of sewering activities, increases in existing groundwater pumping and other factors.



(a) Non-pumping condition – groundwater and stream are hydraulically connected



(b) Potential present-day or future scenario condition –
groundwater table is lowered and section of stream may become hydraulically separated

Figure 3.5-1: Schematic of Baseflow to Streams

As shown on **Figure 3.5-2**, 19 waterbodies were assessed for potential environmental impacts. This included Willow Lake, Meadow Pond, Baisley Pond, Alley Creek, Kissena Lake, and Conselyeas Pond Tributary in Queens and Valley Stream, Pines Brook, East Meadow Brook, Bellmore Creek, Seaford Creek, Massapequa Creek, Glen Cove Creek, Cold Spring Creek, Santapogue Creek, Carls River, Sampawams Creek, Penataquit Creek, and Champlin Creek in Nassau and western Suffolk counties.

Based on an initial assessment, Kissena Lake, being concrete lined, is not influenced by groundwater-fed baseflow. East Meadow Brook, Bellmore Creek, Seaford Creek, Massapequa Creek, Glen Cove Creek, Cold Spring Creek, Santapogue Creek, Carls River, Sampawams Creek, Penataquit Creek, and Champlin Creek would not experience a reduction in baseflow of more than the 1.0 cfs threshold. Additionally, while Conselyeas Pond Tributary and Pines Brook have an average daily flow of less than 1 cfs, a review of USGS stream gauge data for both determined that a majority of their flow is derived from surface runoff or precipitation. Baseflow reductions less than 1 cfs on these waterbodies would be inconsequential. Therefore, no further assessment is required.

3.5.2.2 Federal/State Threatened, Endangered, Candidate Species, State Species of Special Concern and Unlisted Rare or Vulnerable Species

An analysis was completed to determine the potential for the Proposed Project to affect federal/State Threatened, Endangered, and Candidate Species, State Species of Special Concern, and unlisted rare or vulnerable species or their habitat due to implementation of temporary treatment systems at the Queens well stations or potential changes to groundwater-fed baseflow of surface waters. A desktop review was conducted of the following: U.S. Fish and Wildlife Service (USFWS) and NYSDEC NHP databases, National Oceanic and Atmospheric Administration (NOAA) Essential Fish Habitat (EFH) Mapper, and NYSDEC's Environmental Resource Mapper.

The assessment of the federal and State listed species included the identification of species potentially occurring and consisted of estimating any temporary, indirect, or direct effects to the habitat or natural history (e.g., life cycle) of these species based on anticipated conditions at the well stations or potential changes in groundwater-fed baseflow on surface waters.

Where applicable, based on anticipated construction and/or operations at the well stations or predicted changes in baseflow to surface waters, the impact analysis consisted of: (1) describing existing conditions of potential habitat for significant natural communities based on ArcGIS data; (2) establishing future conditions without the Proposed Project; (3) establishing future conditions with the Proposed Project based on construction or operation activities and/or potential changes in groundwater-fed baseflow; and (4) analyzing the potential for impacts from the Proposed Project to identified species.

While the waterbodies of concern are located in an EFH managed area, there are no potential impacts to EFH-listed species or their life stages. It is also noted that none of the EFH-listed species are threatened or endangered. No further assessment is required.

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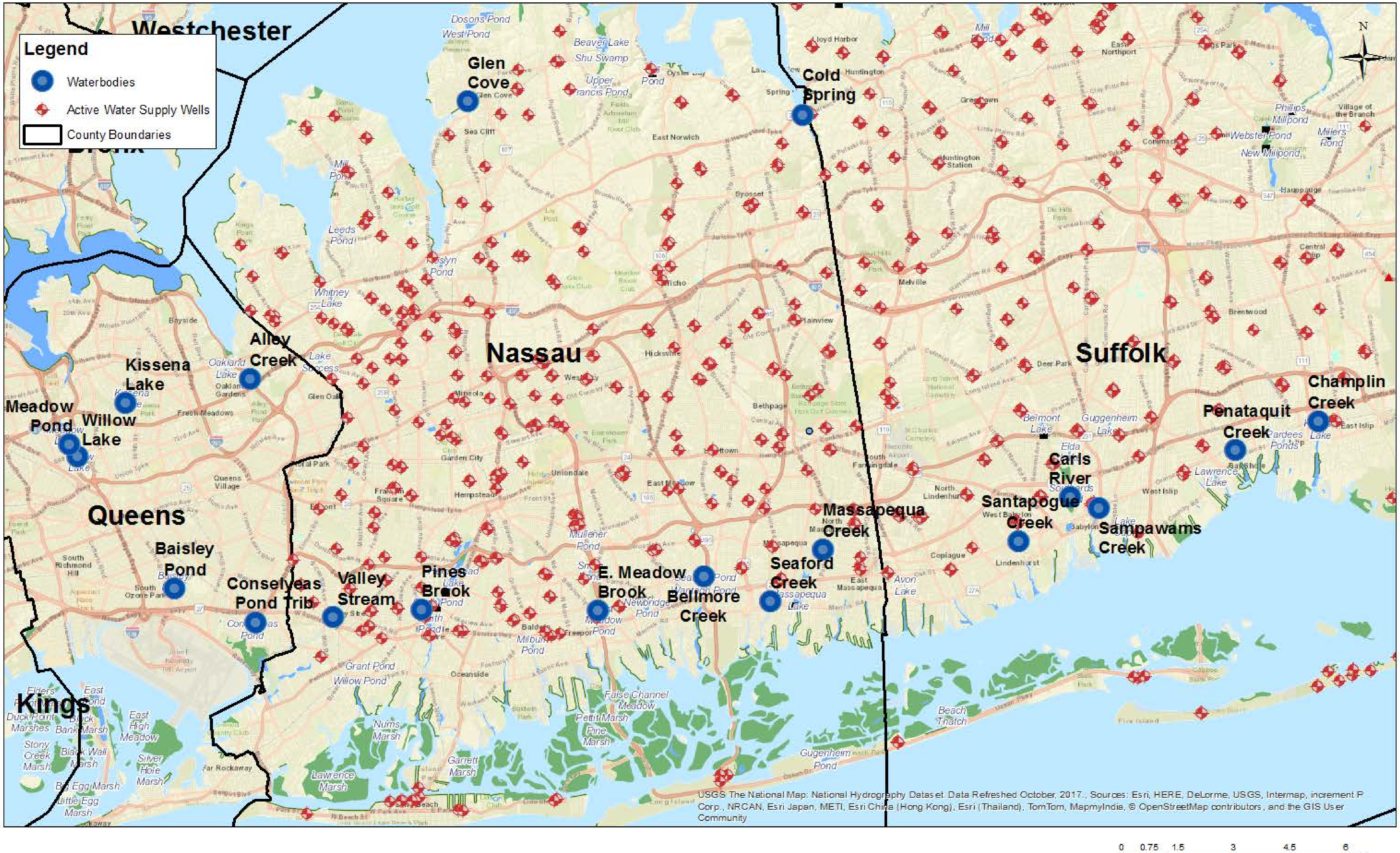

Figure 3.5-2: Waterbodies Assessed for the Proposed Project

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3.5.2.3 Saltwater Interface

The Proposed Project's utilization of groundwater resources also has the potential to result in changes in groundwater flow. The New York City Groundwater Model was therefore also used to examine potential effects due to the Proposed Project and how these potential changes could impact the simulated movement of saltwater (i.e., saltwater intrusion) relative to Existing Conditions, Future without the Proposed Project, and Future with the Proposed Project. Potential changes in saltwater intrusion in the groundwater due to the Proposed Project were evaluated by comparing the locations of the modeled saltwater interfaces for each scenario to the Future without the Proposed Project interface location. Areas that show inland movement relative to the Future without the Proposed Project were compared to the hydraulic zones of capture for supply wells as a measure of potential impact to drinking water quality.

3.5.3 EXISTING CONDITIONS

3.5.3.1 Surface Water

Surface water features within the study area generally fall into two categories, lakes and ponds or creeks and streams, and share some common characteristics. As noted in Chapter 2.0, "Analytical Framework," there are no surface waters, floodplains, or wetlands located on any of the 44 well station parcels, therefore, there is no potential for impacts to surface water resources at these sites due to the implementation of the Proposed Project. However, potential impacts associated with groundwater-fed baseflow to off-site surface waterbodies within Queens, Nassau and western Suffolk counties was possible and an additional review of these was required. The lakes and ponds in the study area are all man-made or have been modified to some degree from their original natural conditions. A common trait of these waterbodies is that they do not have a large component of groundwater-fed baseflow (i.e., input from groundwater discharge to a waterbody), and most of them receive discharges from other sources (i.e., stormwater outfalls, direct runoff, etc.) and function as a component of the urban stormwater system. Therefore, the amount of baseflow volume is much smaller than the volume of surface water inputs from other sources that are contributed from highly impervious urban drainage areas.

Creeks and streams, such as Alley Creek and Valley Stream, may be subject to groundwater-fed baseflow along their entire length. The studied streams have low average flows, but during and immediately following storm events, their flow is dominated by surface water runoff. In a small watershed such as Alley Creek, the peak flow associated with runoff would come and go quickly creating a so-called "flashy" stream.

As shown on **Figure 3.5-2**, 19 waterbodies were considered for potential environmental impacts. As noted in Section 3.5.2.1, the following waterbodies were determined to not be influenced by groundwater-fed baseflow or would not experience a change in baseflow more than the 1.0 cfs threshold or have minimal baseflow, as their flow is derived from surface runoff or precipitation and baseflow reductions less than 1 cfs would be inconsequential.: Kissena Lake and Conselyeas Pond Tributary in Queens and Pines Brook, East Meadow Brook, Bellmore Creek, Seaford Creek, Massapequa Creek, Glen Cove Creek, Cold Spring Creek, Santapogue Creek, Carls River, Sampawams Creek, Penataquit Creek, and Champlin Creek in Nassau and western Suffolk counties.

A discussion of Existing Conditions for the remaining waterbodies that would experience a potential baseflow reduction greater than 1.0 cfs due to the Proposed Project is provided below.

Willow Lake and Meadow Pond

General Description

Willow Lake is located in Queens between I-678 (Van Wyck Expressway) and the Grand Central Parkway, and drains to the north into Meadow Pond (also known as Meadow Lake) in Flushing Meadows-Corona Park. Meadow Pond then drains to Flushing Creek, which empties into Flushing Bay at Willet's Point.

Meadow Pond covers 95 acres, is brackish, and is tidally-influenced via Flushing Creek. It is very shallow, averaging only 4 feet in depth throughout. Meadow Pond was originally created for recreational use during the 1939 World's Fair. Willow Lake was designed as a nature refuge and remained one throughout the 1939 and then the 1964 World's Fairs. After the 1964 World's Fair, the Willow Lake area was enhanced with diverse plant and wildlife habitats.

Hydrology and Groundwater

Meadow Pond is hydraulically connected to the tidally-influenced Flushing Creek. Willow Lake is connected through a single outlet to Meadow Pond, but generally is considered freshwater and supports freshwater species. The watershed drainage area for these two waterbodies is over 500 acres. The watershed area is highly urbanized, receiving runoff from Flushing Meadows-Corona Park, highways and northern Queens. According to the DEP Flushing Bay Facility Plan Report[30] from 2011, the Meadow Pond and Willow Lake system is dominated by urbanized runoff and stormwater influxes. The downstream end of this double-lake system is controlled by a tidal control structure (i.e., tide gate). This operational structure keeps saltwater from migrating into Meadow Pond, and artificially regulates the water levels in both waterbodies. The total estimated discharge from the ponds at the head of Flushing Creek into Flushing Bay is 6.2 cfs (average daily flow).

Wetlands

Meadow Pond is a man-made 95-acre freshwater lake which, according to the NYSDEC Environmental Resource Mapper, is not regulated by the State. The National Wetlands Inventory (NWI) classification for Meadow Pond is L1UBH. This is defined as a large lacustrine system (open water) that has an unconsolidated bottom that is permanently flooded (i.e., covers the surface the entire year in all years).

Willow Lake is an approximately 81.8-acre NYSDEC regulated Class I freshwater wetland (NYSDEC identification number JA-1) (see **Figure 3.5-3**). It is connected to Meadow Pond to the north via Flushing Creek which runs north to south underneath 69th Road and Jewel Avenue and parallel to the Van Wyck Expressway. Willow Lake consists of multiple wetland habitat

[30] http://www.nyc.gov/html/dep/pdf/cso_long_term_control_plan/ltcp-flushing-bay-cso.pdf

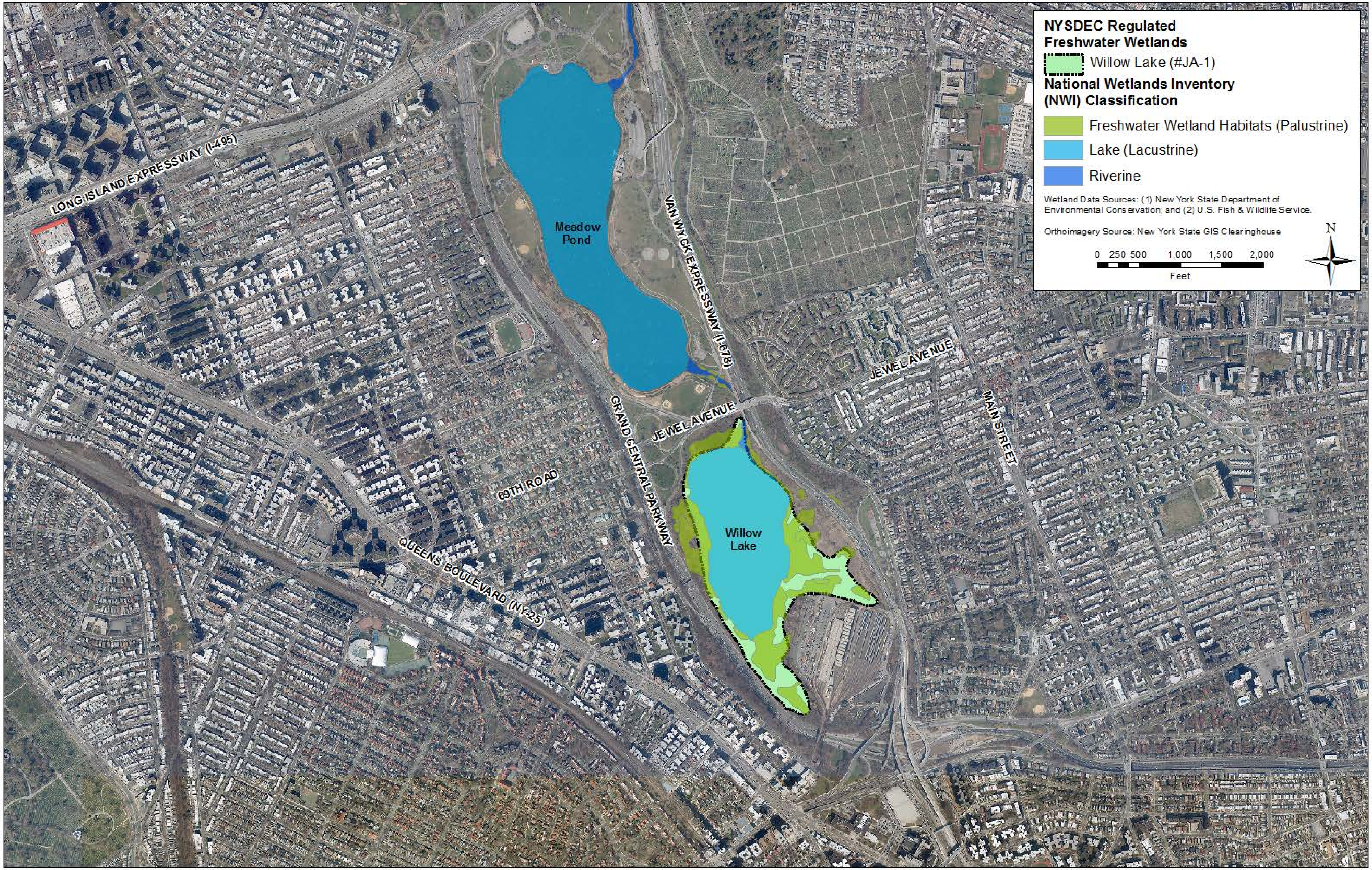

Figure 3.5-3: Willow Lake and Meadow Pond - Existing Conditions

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types including a lacustrine/lake system, emergent marshes, and scrub-shrub swamps. NWI has several habitat types listed for Willow Lake within the following classifications:

- L1UBH – Large lacustrine habitats that have an unconsolidated bottom that is permanently flooded.
- PEM1C – Palustrine non-tidal or tidal habitat with salinity below 0.5 parts per thousand wetland habitat dominated by emergent, persistent vegetation, which is seasonally flooded during the growing season.
- PEM1A - Palustrine wetland habitat dominated by emergent, persistent vegetation, which is temporarily flooded during the growing season.
- PSS1C – Palustrine wetland habitat dominated by broad-leaved deciduous woody vegetation smaller than 20 feet tall, which is seasonally flooded.

Vegetation and Wildlife

The Willow Lake area is home to a wide variety of willows, including white willow, weeping willow, goat willow, and pussy willow, hence the name Willow Lake. The lake and shores support a diverse variety of trees, flowers, and aquatic plants. When the Willow Lake habitats were previously enhanced, berry-bearing shrubs and trees were planted to attract local and migratory birds. Meadow Pond does not host as diverse a variety of plant life, but shares some aquatic vegetation and an extensive growth of invasive plants (i.e., *Phragmites*) in common with Willow Lake.

Flushing Meadows-Corona Park, Meadow Pond, and Willow Lake also provide habitat for a wide variety of birds, some migratory, as well as aquatic life such as turtles, muskrats, fish, eels, and killifish. However, no significant natural communities, as classified by the NYSDEC NHP for rare or high-quality wetlands, forests, grasslands, ponds, streams, and other types of habitats, ecosystems, and ecological areas are located at or in close proximity Willow Lake and Meadow Pond.

Baisley Pond

General Description

Baisley Pond is located within Baisley Pond Park, which is north of the Belt Parkway and east of the Van Wyck Expressway in southeast Queens. The pond is not entirely natural since it was created in the 1700s when local farmers dammed three streams as part of their grain milling operation. Today, the pond has more than 20 stormwater inflows, and one outflow located at its southern end that connects to the City's stormwater system.[31]

[31] *Baisley Pond Park Environmental Site Analysis* Report by Great Ecology & Environments, Inc. 2008.

Hydrology and Groundwater

Baisley Pond is about 30 acres in area with an approximately 105-acre drainage area. The exchange between groundwater and the pond is difficult to quantify without any recorded gauge data. However, records from a historic publication on underground water resources provide average (mean) monthly discharge measurements from Baisley Pond during 1852. These values range from approximately 9.7 cfs to 12.5 cfs, with an average of 9.4 cfs over the course of the year.[32]

To conservatively estimate existing discharge (average daily flow) conditions for use in the assessment of potential changes resulting from the Proposed Project, a comparison of historical and existing groundwater recharge rates was made. As the rural character of Baisley Pond and southeast Queens in the 1850s would be similar to the less developed regions of modern-day Long Island (e.g., portions of eastern Suffolk County), the recharge rate was estimated at 50 percent in 1852.[33] The increased urbanization and impervious land cover that exists today around Baisley Pond has resulted in a recharge rate of approximately 30 percent, and was modeled as such in the New York City Groundwater Model. Using the average daily flow of 9.4 cfs from 1852, in conjunction with an assumed recharge rate of 50 percent, the estimated existing average daily flow with a recharge rate of 30 percent would be reduced to 5.6 cfs. Furthermore, this value assumes that the average daily flow reduction is entirely dependent on the recharge, which ultimately contributes to the baseflow of the pond. The current and substantial stormwater runoff inputs are not considered, thus making this average daily flow calculation very conservative.

Wetlands

Baisley Pond includes a 28.7-acre NYSDEC regulated Class 1 Freshwater Wetland (NYSDEC identification number JA-3) (see **Figure 3.5-4**). Baisley Pond is classified by NWI as L1UBH, a large lacustrine habitat that has an unconsolidated bottom that is permanently flooded.

Vegetation and Wildlife

Baisley Pond Park is a natural habitat for many species of plant and animal life. It has lily pads, turtles, and bullfrogs. Eight different varieties of dragonflies and a variety of birds thrive here as well. In winter, Canadian Geese, Mallards, Shovelers, Coots, Grebes, and Gulls utilize the habitat. In summer, Blackbirds, Cormorants, Herons, Egrets, Doves, Mockingbirds, Robins, Starlings, Warblers, Cardinals, and Sparrows forage and breed in the area.[34] However, no significant natural communities, as classified by the NYSDEC NHP are located at or in close proximity Baisley Pond.

32 *Underground Water Resources of Long Island, New York*, USGS Professional Paper No. 44, 1906
33 *Ground-Water-Recharge Rates in Nassau and Suffolk Counties, New York*, USGS WRIR 86-4181
34 https://www.nycgovparks.org/parks/baisley-pond-park/history

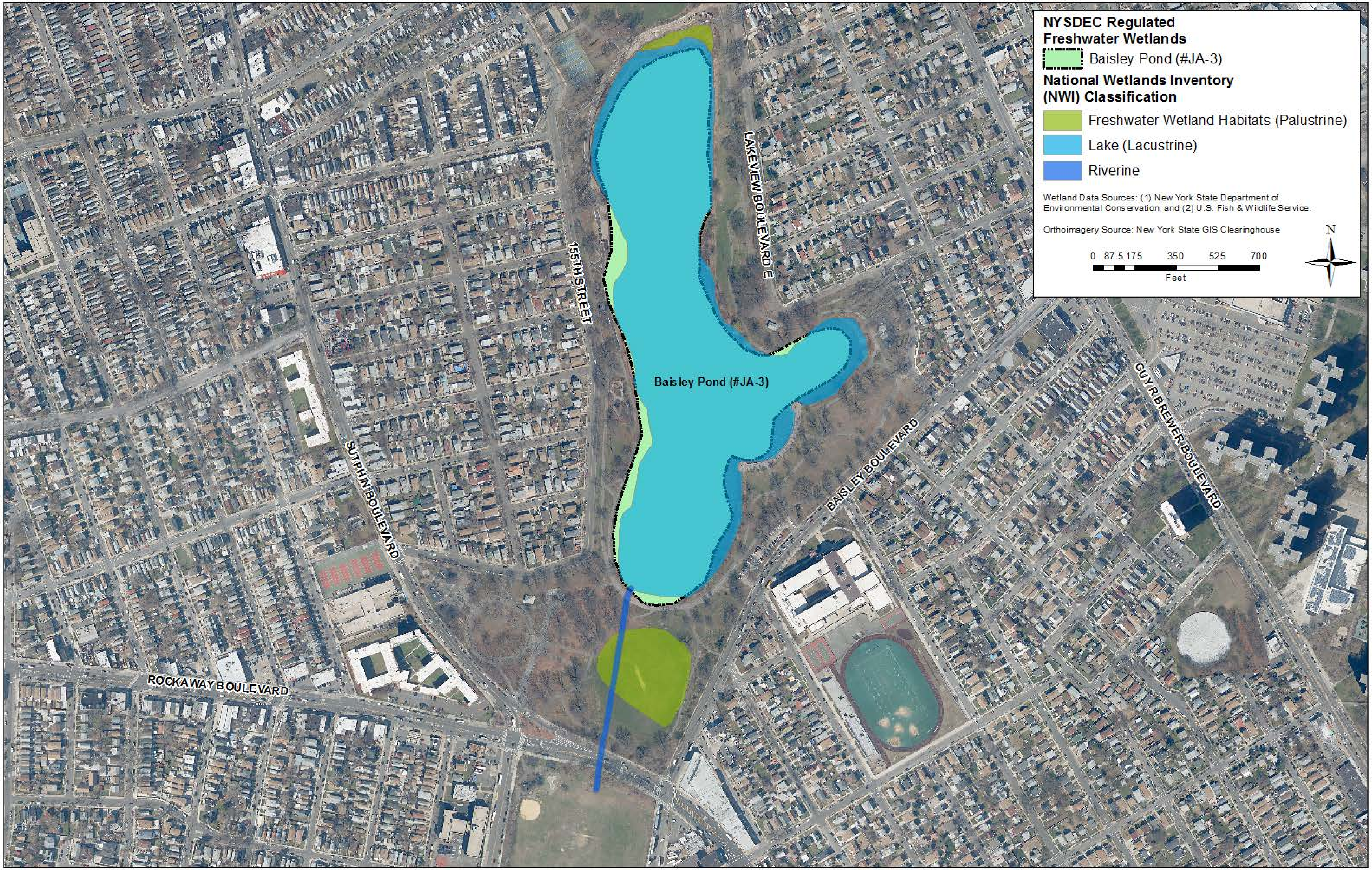

Figure 3.5-4: Baisley Pond - Existing Conditions

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Alley Creek

General Description

Alley Creek is located in northeastern Queens, within the 624-acre Alley Pond Park which is located north and south of the Long Island Expressway (I-495) and east of the Cross Island Parkway. The drainage area for Alley Creek is 435 acres. There is a USGS gauge station located near the west bank of the creek, just upstream from the Cross Island Parkway entrance ramp from the Long Island Expressway, at the upstream side of the culvert in Alley Pond Park.

Hydrology and Groundwater

A plot of all available daily discharge data recorded at the USGS gauge station is shown on **Figure 3.5-5**. The average daily discharge recorded at this gauge station is 3.3 cfs over the 10 years of record (2007 through 2016), which is representative of Existing Conditions since the cessation of the regular pumping of the Queens wells.[35]

Downstream of the USGS gauge station and towards Little Neck Bay, there are numerous stormwater and CSO outfalls that provide input to the creek, the nearest of which is TI-024. This outfall alone discharges approximately 122.4 million gallons per year to the creek.[36] Since the USGS gauge station is located upstream of most of the stormwater and CSO outfalls, their input to the creek between the Long Island Expressway through the creek's terminus at Little Neck Bay would not be registered at this gauge station.

Wetlands

Alley Creek consists of and is surrounded by both tidal and freshwater wetlands. It is a tributary of Little Neck Bay, which is classified as an SB[37] water by NYSDEC. The surrounding habitat consists of tidally influenced (sub-tidal/intertidal) NYSDEC regulated Class 1 freshwater wetlands (NYSDEC identification number SE-1, SE-3, FL-1, and FL-4) (see **Figure 3.5-6**). These wetlands are considered both tidal and freshwater wetlands as they are influenced by daily tidal pulses and the salinity is low enough to be considered freshwater tidal fluxes. The NWI classifies Alley Creek as E1UBL, an estuarine (deep water tidal habitat or adjacent tidal wetlands) sub-tidal wetland with an unconsolidated bottom that is permanently flooded with tidal water. The surrounding freshwater wetlands which are part of the Alley Creek system have the following NWI classifications:

- E2EM1N – Estuarine adjacent intertidal wetland which is dominated by persistent, emergent vegetation and is regularly flooded with tidal water at least once daily.

- E2EM1P - Estuarine adjacent intertidal wetland which is dominated by persistent, emergent vegetation and is irregularly flooded with tidal water less often than once a day.

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35 https://waterdata.usgs.gov
36 http://www.nyc.gov/html/dep/pdf/cso_long_term_control_plan/alley-creek-ltcp-resubmission-20140630.pdf
37 NYSDEC Class SB surface waters are marine waters with a best usage for swimming, fishing, and other recreation.

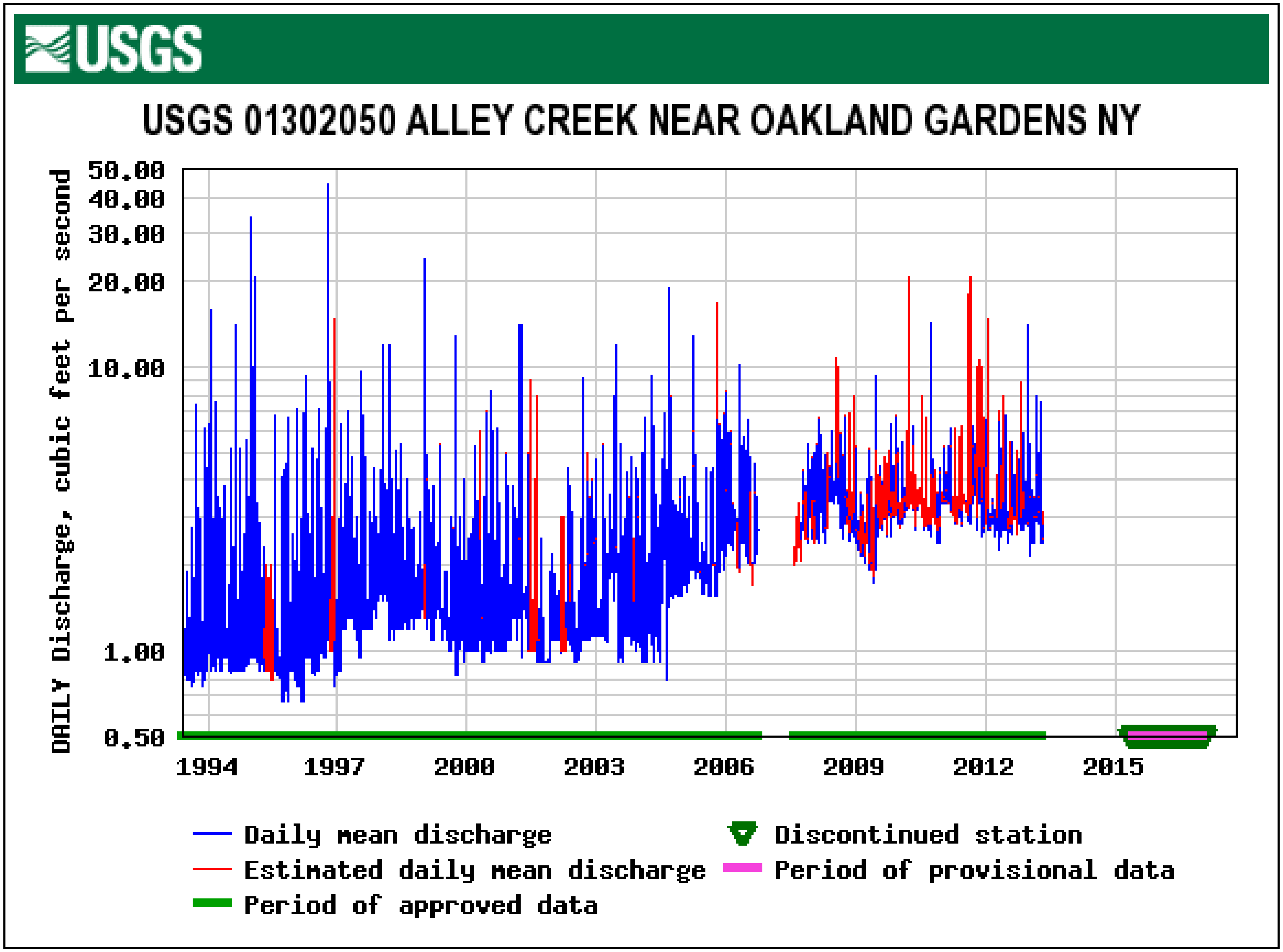

Figure 3.5-5: Alley Creek USGS Gauge Station Data

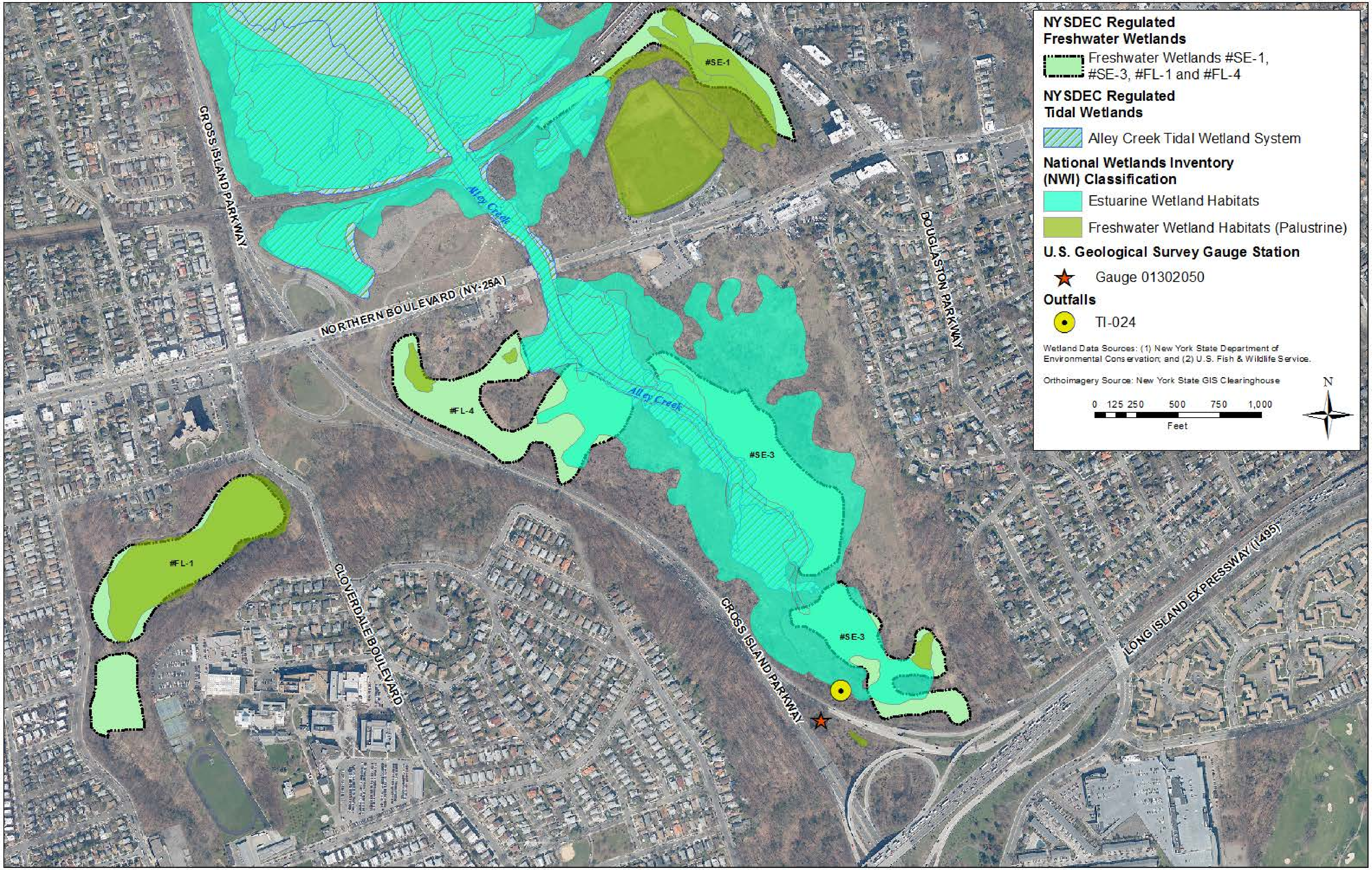

Figure 3.5-6: Alley Creek - Existing Conditions

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- E2SS1P **–** Estuarine adjacent intertidal wetland which is dominated by broad-leaved deciduous woody shrub species and is irregularly flooded with tidal water less often than once a day.

Vegetation and Wildlife

Alley Pond Park, which surrounds the creek, is a large and diverse habitat, with 440 acres of upland forest, 90 acres of freshwater wetlands, 40 acres of grassland meadows, 15 acres of riparian forest and freshwater wetlands, 3 acres of spring fed aquatic systems, 50 acres of salt marsh, 3 miles of public shoreline, and 1,400 acres of open water and marine habitat.[38] The park and Alley Creek watershed exist within a heavily urbanized area of Queens, where development, paving, and diversion of stormwater runoff flow into combined and storm sewers have resulted in loss of habitat value and an increase of pollutants in the creek. Urban runoff has resulted in a stream system characterized by low diversity and pollution tolerant biota.

Alley Pond Park is known to contain more than 300 species of wildlife, dominated by a diverse native bird population including scarlet tanager and wood thrush. Spotted salamander, wood frog and many other freshwater wetland species are found in Alley Pond Park. However, no significant natural communities, as classified by the NYSDEC NHP are located at or in close proximity Alley Creek.

Valley Stream

General Description

Valley Stream extends from Valley Stream State Park (south of the Southern State Parkway) southward to Edward W. Cahill Memorial Park (south of Sunrise Highway). The channel traverses through highly urban/suburban areas, in some places disappearing as a surface feature. It is also artificially ponded in some areas.[39] The drainage area of Valley Stream is over 2,400 acres. There is a USGS gauge station located north of Sunrise Highway in Village Green Park.

Hydrology and Groundwater

A plot of the available daily discharge data recorded at the USGS gauge station (from the mid-1950s through 2016) is shown on **Figure 3.5-7**. The average daily discharge recorded at this gauge station is 3.9 cfs over the 10 years of record (2007 to 2016), which is representative of Existing Conditions since the cessation of the regular pumping (i.e., 2007) of the Queens wells.[40]

Valley Stream is a system primarily fed by stormwater runoff. At any given time, there is little water flowing within the stream, however, it experiences surges as it receives surface water runoff during storm events. The spikes in daily discharge shown on **Figure 3.5-7** indicate that the stream flow goes from nearly zero to much higher flow rates resulting from stormwater

[38] https://www.nycgovparks.org/download/nycdpr-exec-summary-alley-creek-plan-2015.pdf
[39] https://parks.ny.gov/parks/159/
[40] https://waterdata.usgs.gov

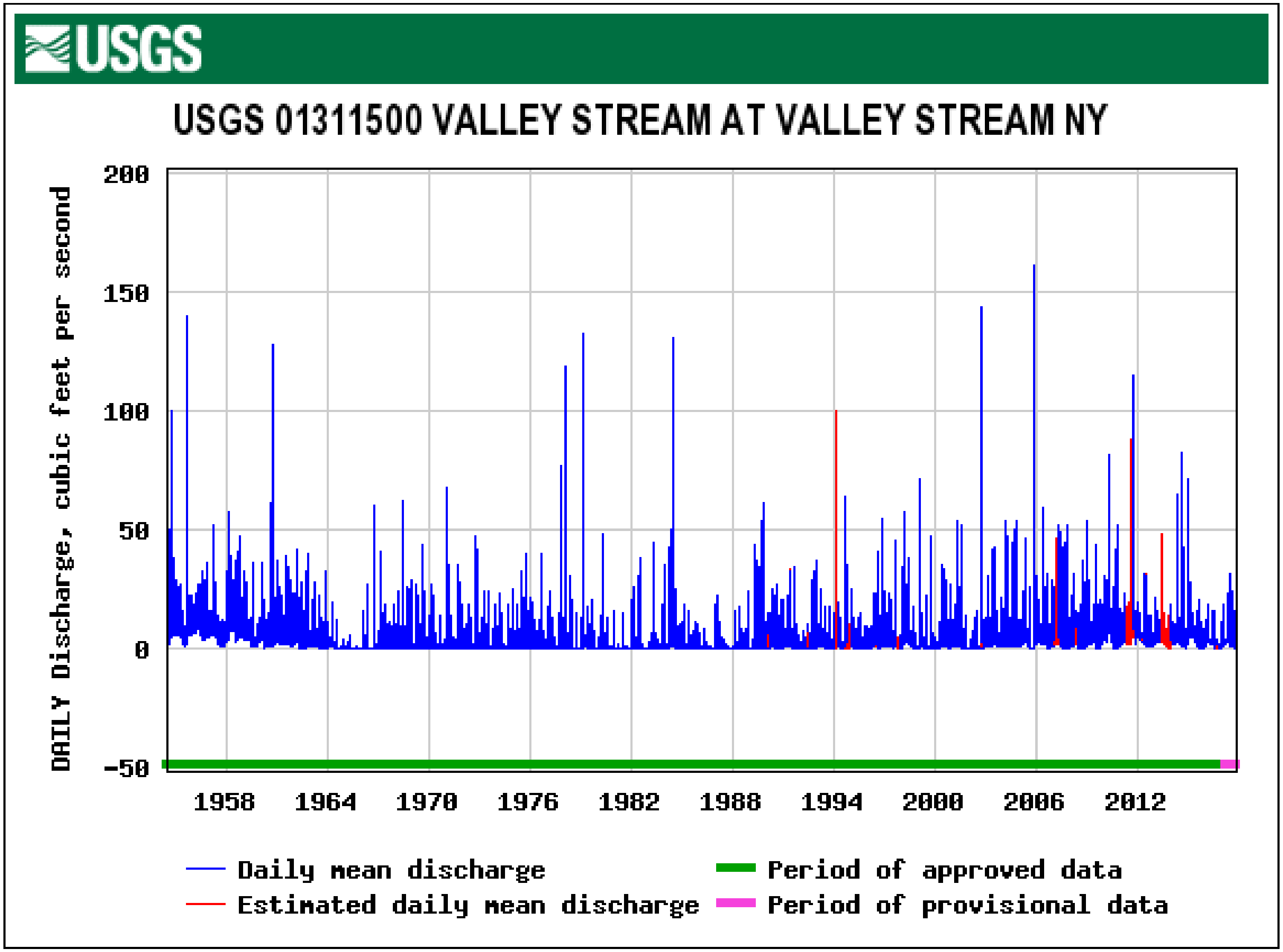

Figure 3.5-7: Valley Stream USGS Gauge Station Data

runoff, whether over land or through engineered drainage features. The flows from these storm events are short lived and not representative of typical flow conditions for Valley Stream.

Wetlands

Only the segment of Valley Stream in Valley Stream State Park, north of Hendrickson Avenue, is a NYSDEC regulated Class 2 freshwater wetland(NYSDEC identification number L-4) (see **Figure 3.5-8**). This 33.5-acre segment of the wetland consists of the following NWI habitat types

- PFO1C – Palustrine forested swamp dominated by broad-leaved deciduous trees which is seasonally flooded during the growing season.
- PFO1A – Palustrine forested swamp dominated by broad-leaved deciduous trees which is temporarily flooded during the growing season.
- R2UBH – A riverine system which is not tidally influenced and, in most years, has water flow during the entire year. The substrate consists of mainly sand and mud and is loosely consolidated.

The remainder of the wetland network south of Valley Stream State Park and Hendrickson Avenue is classified by the NWI and consists of the following habitats:

- PUBHx – Palustrine wetland habitat with an unconsolidated bottom that is permanently flooded which was previously excavated via artificial means.
- R5UBH – A riverine system which is non-tidal with a classification as "Unknown Perennial" with no specific distinction and has an unconsolidated bottom which is permanently flooded.
- R4SBC – A riverine system which is non-tidal and contains flowing water only during a portion of the year and is considered an intermittent subsystem of the overall Riverine System (Valley Stream).
- R2UBH - A riverine system which is not tidally influenced and, in most years, has water flow during the entire year. The substrate consists of mainly sand and mud and is loosely consolidated.

Vegetation and Wildlife

The vegetation near Valley Stream, in areas where the land is not completely urbanized, consists of trees and shrubs, with grassed open areas. Valley Stream State Park, Arthur J. Hendrickson Park, and Edward W. Cahill Memorial Park are among the open spaces along the stream. Abundant birdlife frequents the Valley Stream corridor seasonally and includes both shore and

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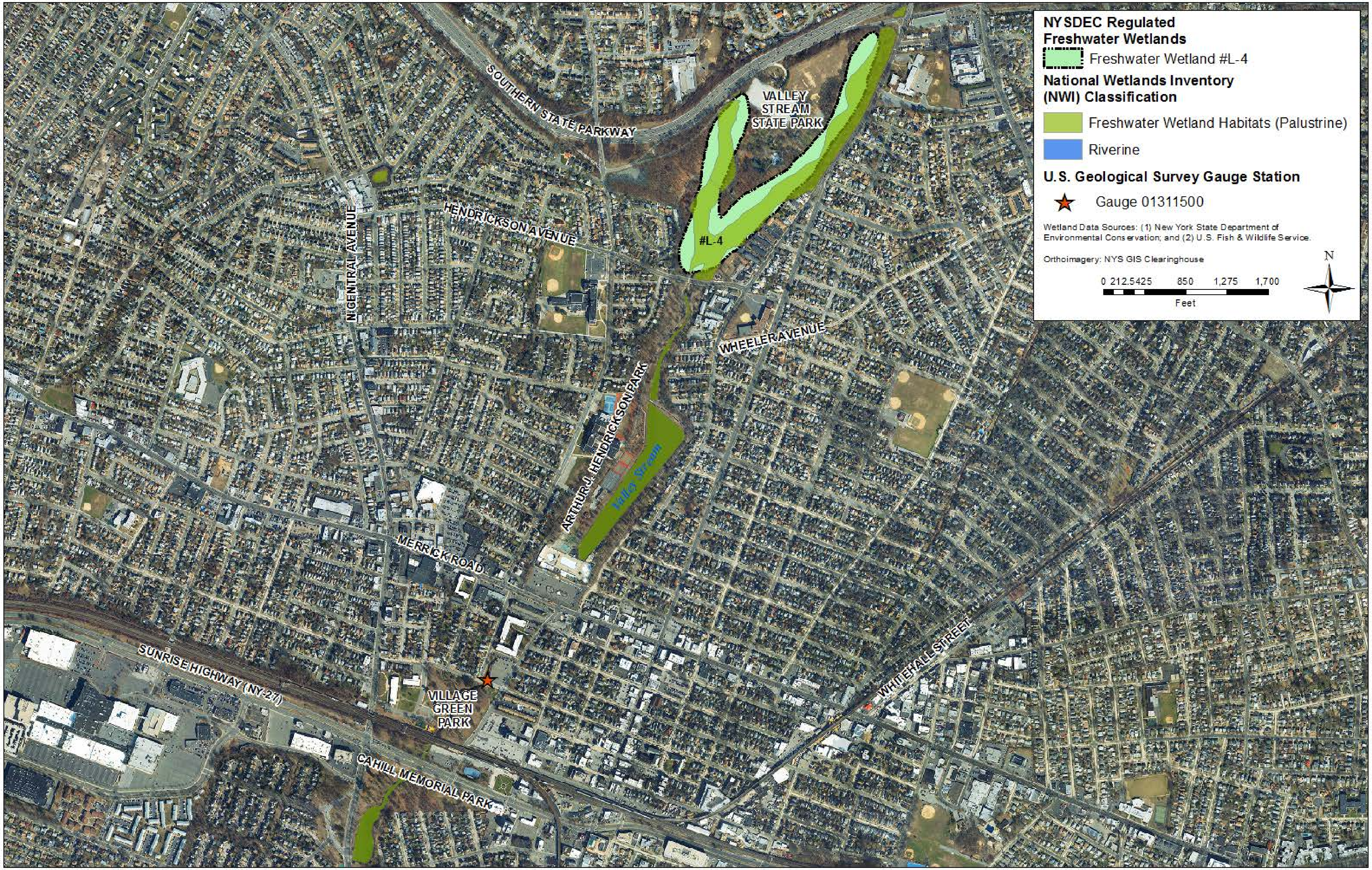

Figure 3.5-8: Valley Stream - Existing Conditions

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woodland species.[41] However, no significant natural communities, as classified by the NYSDEC NHP are located at or in close proximity Valley Stream.

3.5.3.2 Federal/State Threatened, Endangered, Candidate Species, State Species of Special Concern and Unlisted Rare or Vulnerable Species

Queens Groundwater Well Stations

Six federal/State Threatened and Endangered Species have the potential to occur if suitable habitat is present within the vicinity of the Queens well stations where implementation of temporary treatment systems would occur (see **Table 3.5-1**).

Table 3.5-1: Federal/State Threatened and Endangered Species and State Species of Special Concern and Habitats - Queens Groundwater Well Stations

Common Name	Scientific Name	Federal Listing	State Listing	Potential Habitat
Birds				
Piping Plover	*Charardrius melodus*	Threatened	Endangered	No
Red Knot	*Calidris canutus*	Threatened	Unlisted	No
Roseate Tern	*Sterna dougallii dougallii*	Endangered	Endangered	No
Mammals				
Northern Long-eared Bat	*Myotis septentrionalis*	Threatened	Threatened	Yes
Plants				
Sandplain Gerardia	*Agalinis acuta*	Endangered	Unlisted	No
Seabeach Amaranth	*Amaranthus pumilus*	Threatened	Unlisted	No

Based on a desktop review and Existing Conditions at the Queens well stations and immediately adjacent areas, critical habitats or significant natural communities or rare plants or animals are not present. Only one species, the northern long-eared bat, was identified as having the potential to occur at the Queens well stations.

The northern long-eared bat was listed as a federal and State Threatened Species under the Endangered Species Act by USFWS on April 2, 2015. A final 4(d) rule, which specifically defines “take” prohibitions, was published in the Federal Register on January 14, 2016. The northern long-eared bat roosts in trees with exfoliating bark or suitable cracks and crevices. However, the northern long-eared bat is also known to roost in smaller trees and in man-made structures, such as buildings, barns, bridges, and bat houses.[42] Tree cutting from November 1 through March 31, when northern long-eared bats are hibernating or concentrated near their hibernacula (winter shelters), is permissible for trees that provide suitable northern long-eared bat summer roosting habitat.[43]

41 https://parks.ny.gov/parks/159/
42 U.S. Fish and Wildlife Service. 2015. Northern Long-Eared Bat Fact Sheet. Retrieved from: https://www.fws.gov/midwest/endangered/mammals/nleb/nlebFactSheet.html
43 http://www.dec.ny.gov/animals/106090.html

Review of the USFWS Information for Planning and Consultation (IPaC) report44 identified the potential for northern long-eared bat habitat to occur within or adjacent to 13 of the 44 well stations. A habitat assessment of the 13 well stations with potential for occurrence was conducted on May 6 through 8, 2014, and no bats or bat uses (urine stains and guano) were observed.

Based on these conclusions, a detailed natural resources impact analysis related to northern long-eared bats and their habitat is not warranted.

Surface Water

While no impacts to surface waters at the Queens well stations would occur, as described in Section 3.5.3.1, five waterbodies have the potential to be affected by a reduction in groundwater-fed baseflow due to the Proposed Project. Nine federal/State Threatened and Endangered Species have the potential to occur within the vicinity of the five waterbodies (see **Table 3.5-2**).

[44] U.S. Fish and Wildlife Service. WS. 2017. IPaC Trust Resources Report. Generated August 14, 2017.

Table 3.5-2: Federal/State Threatened and Endangered Species and State Species of Special Concern and Habitats within Waterbodies of the Proposed Project

Common Name	Scientific Name	Location	Federal Listing	State Listing	Potential Habitat
Birds					
Piping Plover	*Charardrius melodus*	Meadow Pond, Willow Lake, Baisley Pond, Alley Creek, Valley Stream	Threatened	Endangered	Yes
Red Knot	*Calidris canutus*	Meadow Pond, Willow Lake, Baisley Pond, Alley Creek, Valley Stream	Threatened	Unlisted	Yes
Roseate Tern	*Sterna dougallii dougallii*	Meadow Pond, Willow Lake, Baisley Pond, Alley Creek, Valley Stream	Endangered	Endangered	Yes
Mammals					
Northern Long-eared Bat	*Myotis septentrionalis*	Valley Stream	Threatened	Threatened	Yes
Plants					
Brown Bog Sedge	*Carex buxbaumii*	Alley Creek	-	Threatened	Yes
Pale Duckweed	*Lemna valdiviana*	Alley Creek	-	Endangered	Yes
Seabeach Amaranth	*Amaranthus pumilus*	Meadow Pond, Willow Lake, Baisley Pond, Alley Creek, Valley Stream	Threatened	Unlisted	Yes
Persimmon	*Diospyros virginiana*	Valley Stream	-	Threatened	Yes
Yellow Giant Hyssop	*Agastache nepetoides*	Alley Creek	-	Threatened	Yes

3.5.3.3 Saltwater Interface

The saltwater interface is an approximation of the boundary between fresh and saline groundwater within the Long Island aquifers. The saltwater interface position and thickness within each aquifer varies spatially and temporally, based on the historic and present-day stresses applied to the system. The development of and calibration to the saltwater interfaces within the New York City Groundwater Model domain is described in Section 1.7. **Figure 3.5-9** through **Figure 3.5-12** are examples that illustrate the simulated saltwater interfaces under Existing Conditions for the Upper Glacial, Magothy, northern Lloyd, and southern Lloyd aquifers, respectively.

The contour lines depicted on the figures represent the location where the thickness of saltwater within the aquifer is 1 foot. While the saltwater wedge thickness varies, and in some locations is less than 1 foot thick, viewing the 1-foot thickness contours yields a good understanding of the relative movement of the saltwater interface due to aquifer stresses. Active Nassau County and Queens water supply wells are shown in red and black symbols, respectively. Only wells screened in (i.e., withdraw water from) the corresponding aquifers (Upper Glacial, Magothy, or Lloyd) are included on each figure. Of the 345 Nassau County active water supply wells included in the model simulations, 12 are screened in the Upper Glacial Aquifer, 299 are screened in the Magothy Aquifer, and 34 are screened in the Lloyd Aquifer.

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Figure 3.5-9: Saltwater Interface Location, Upper Glacial Aquifer - Existing Conditions

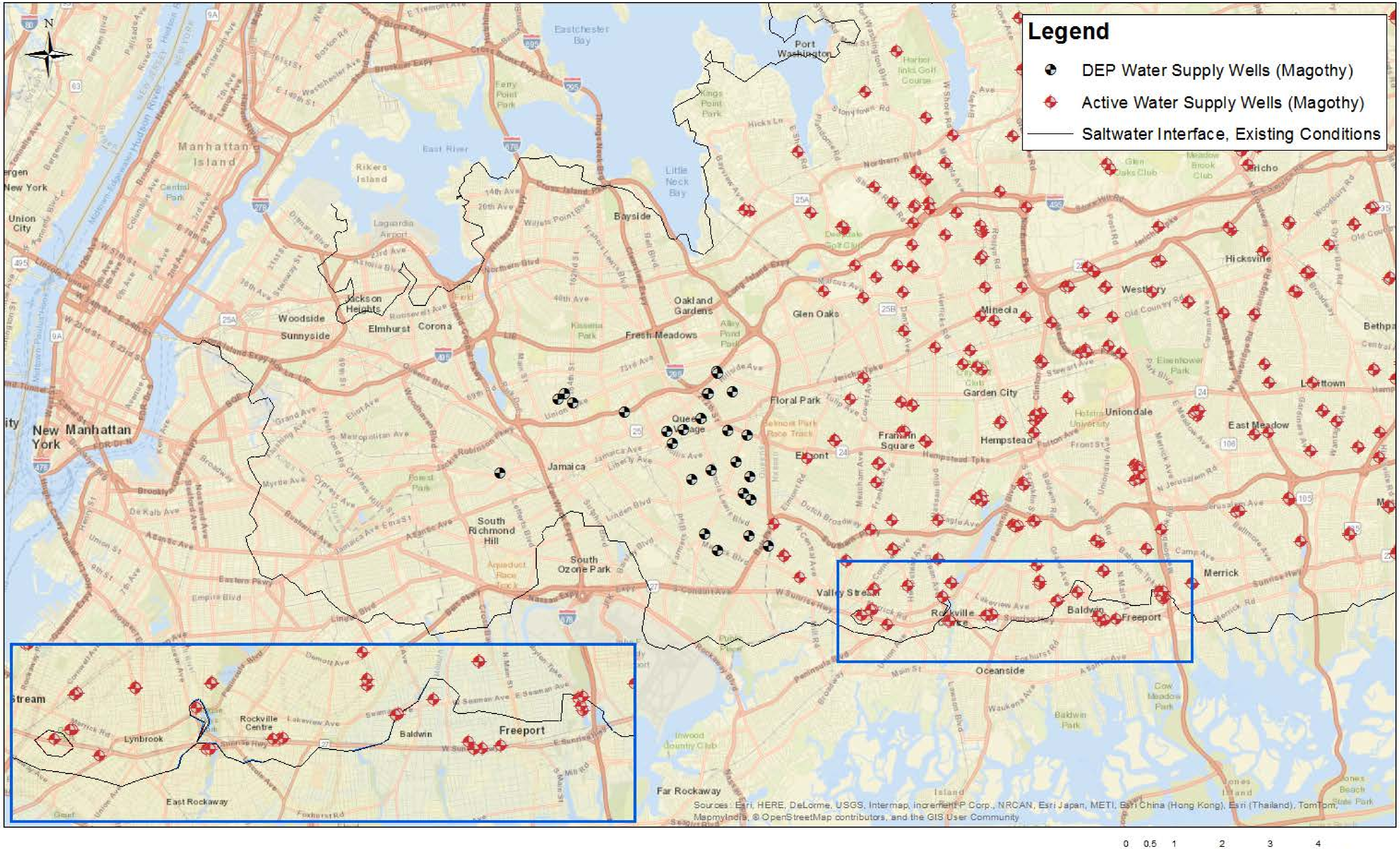

Figure 3.5-10: Saltwater Interface Location, Magothy Aquifer - Existing Conditions

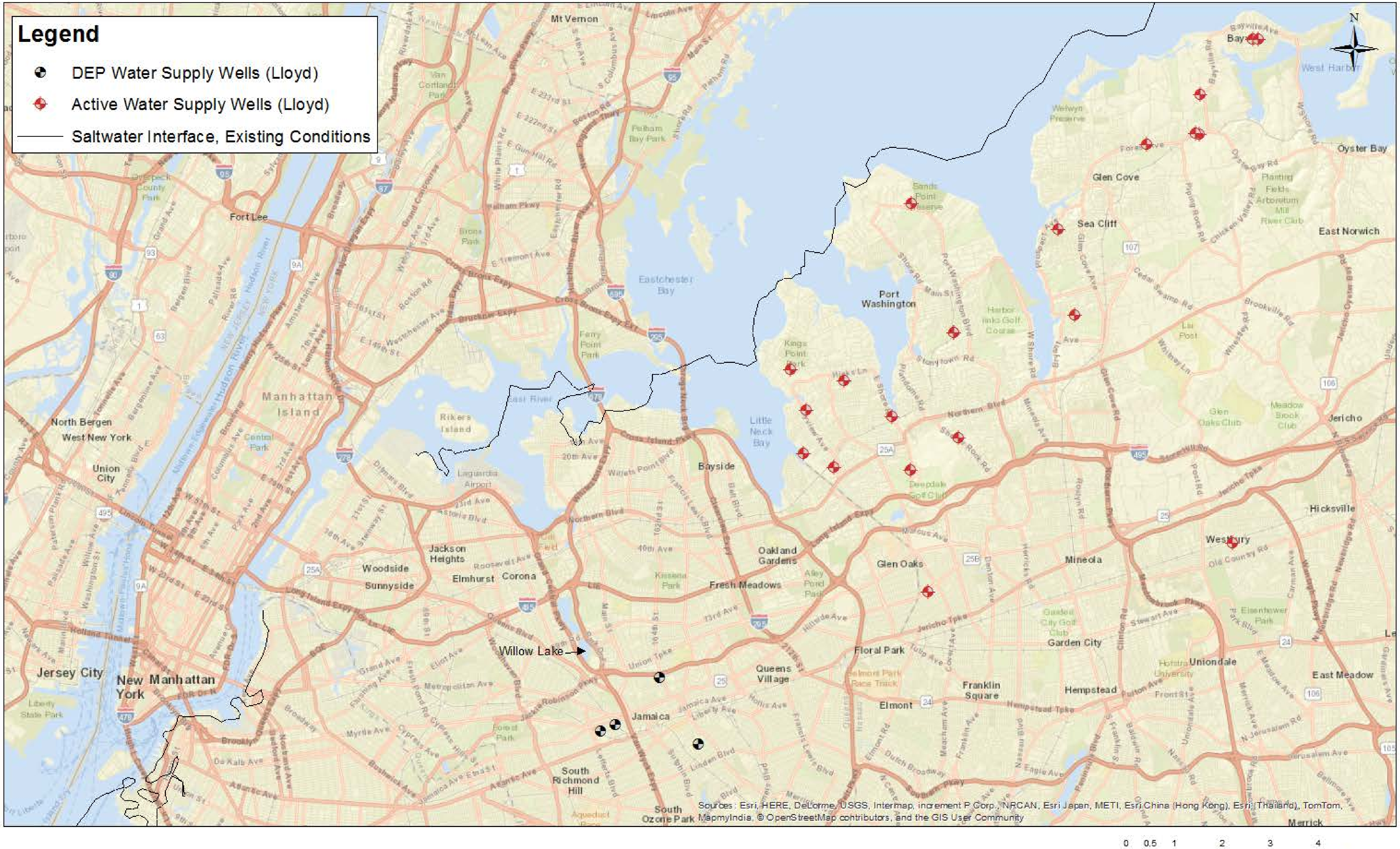

Figure 3.5-11: Saltwater Interface Location, Lloyd Aquifer (North Shore) - Existing Conditions

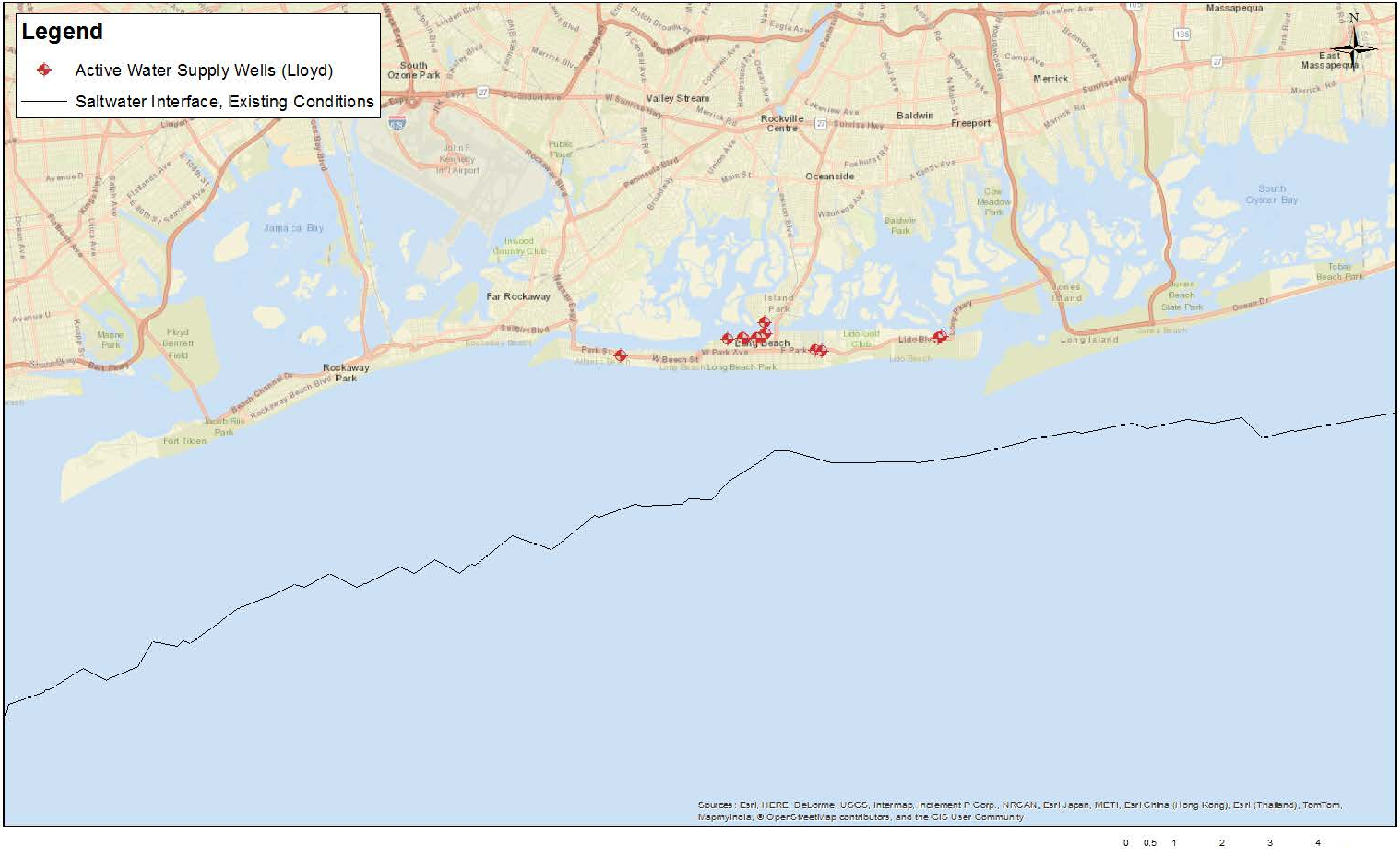

Figure 3.5-12: Saltwater Interface Location, Lloyd Aquifer (South Shore) - Existing Conditions

Figure 3.5-10 shows that the spatial location of 15 active Nassau County supply wells screened in the Magothy Aquifer are currently located on the seawater side of the existing saltwater interface. Not all of the 15 wells can be seen on the figure due to their close proximity to each other and the scale of the figure. As shown on **Figure 1.7-12**, the saltwater interface is a three-dimensional "wedge" that lies along the bottom of the approximately 200-foot thick Magothy Aquifer, due to the higher density of saltwater relative to the density of freshwater. The presence of the saltwater at the bottom of the Magothy Aquifer does not imply that operations at these 15 wells are impaired since chloride concentrations (i.e., salinity or saltwater concentrations) at the well screens may be lower than those at the bottom of the aquifer.

3.5.4 FUTURE WITHOUT THE PROPOSED PROJECT

3.5.4.1 Surface Water

Under the Future without the Proposed Project, surface water conditions would largely remain the same with average recharge and pumping consistent with Existing Conditions as described above. For these reasons, no substantive changes in stream baseflow are expected or simulated during the Future without the Proposed Project.

3.5.4.2 Federal/State Threatened, Endangered, Candidate Species, State Species of Special Concern and Unlisted Rare or Vulnerable Species

Queens Groundwater Well Stations

Under the Future without the Proposed Project, the Queens Groundwater well stations would remain as they currently exist, with operations remaining similar to those under Existing Conditions.

Surface Water

Under the Future without the Proposed Project, surface water conditions would be expected to largely remain the same as Existing Conditions, as noted in Section 3.5.3.1. No changes in stream baseflows are expected or were simulated for the Future without the Proposed Project conditions.

3.5.4.3 Saltwater Interface

The New York City Groundwater Model simulates the positions and movements of the interfaces between fresh and saltwater in each aquifer. The positions of the saltwater interfaces in the Upper Glacial, Magothy, and Lloyd aquifers were examined for the Future without the Proposed Project and compared to the Existing Conditions. In order to reflect the potential location of the saltwater interface consistent with the pumping durations associated with Scenario A through E (i.e., 1, 2, 3, 5, and 10 years, respectively), the New York City Groundwater Model was used to simulate potential movement of the interface location for each of these for the Future without the Proposed Project.

The Future without the Proposed Project is illustrated on **Figure 3.5-15** through **Figure 3.5-39** for each of the aquifers and scenarios. Contours representing the location of the saltwater interfaces under the Future without the Proposed Project are shown in blue. In addition, the figures also display the Existing Conditions (black lines), as well as the Future with the Proposed Project (red lines) saltwater interface locations.

In the Upper Glacial Aquifer, the saltwater interface position the Existing Conditions and Future without the Proposed Project conditions for Scenario A through E, respectively, are virtually identical and the contour lines are barely distinguishable from each other for the majority of the study area. In locations where no movement of the saltwater interface occurs under the Future without the Proposed Project, only the black contour line representing Existing Conditions is discernible (see **Figure 3.5-15** through **Figure 3.5-19**).

In the Magothy Aquifer, the saltwater interface position for Existing Conditions and the Future without the Proposed Project for Scenario A through E, respectively, shows no discernible difference between the Future without the Proposed Project and Existing Conditions (see **Figure 3.5-20** through **Figure 3.5-24**).

In the Lloyd Aquifer along the north shore of Long Island, the saltwater interface position for Existing Conditions and Future without the Proposed Project for Scenario A through E, respectively, shows no discernible difference between the Future without the Proposed Project and Existing Conditions (see **Figure 3.5-25** through **Figure 3.5-29**).

In the Lloyd Aquifer along the south shore of Long Island, the saltwater interface position for Existing Conditions and Future without the Proposed Project shows no discernible difference between the Future without the Proposed Project and Existing Conditions for Scenario A through C, respectively. For the 5 and 10 year durations associated with Scenario D and E, there is a discernible difference between Existing Conditions and the Future without the Proposed Project (see **Figure 3.5-30** through **Figure 3.5-34**). In order to display effects within the Lloyd Aquifer in more detail, a closer examination of potential movement of the saltwater interface south of Long Beach was prepared (see **Figure 3.5-35** through **Figure 3.5-39)**. The Lloyd Aquifer is the sole source of drinking water for Long Beach, which is supplied via 13 active supply wells. These wells pump an average annual combined rate of approximately 4.5 mgd (3,125 gpm). The results of model simulation indicate that under the Future without the Proposed Project conditions, the portion of the Lloyd Aquifer saltwater interface upgradient of Long Beach would move inland approximately 450 to 725 feet over 10 years, relative to Existing Conditions.

3.5.5 FUTURE WITH THE PROPOSED PROJECT

Five scenarios were simulated through the use of the New York City Groundwater Model to assess a range of water supply operations that could be undertaken by the City during the duration of a renewed permit under the Proposed Project. These scenarios represent a range of potential pumping and durations of usage for the Queens water supply wells and were added to the model along with the same dataset used for the assessment of the Future without the Proposed Project simulation described above. Each of the five scenarios included the maximum permitted flow rate for the system over a prescribed period of time as described below. The model was run using 1 month time steps for the duration specified for each scenario to incorporate seasonal variability in pumping and recharge.

- Scenario A – Groundwater pumping at current single year permitted maximum (68 mgd[45]) for 1 year;
- Scenario B – Groundwater pumping at current single year permitted maximum (68 mgd) for 2 years;
- Scenario C – Groundwater pumping at current single year permitted maximum (68 mgd) for 3 years;
- Scenario D – Groundwater pumping at the currently permitted 5-year running average of 62 mgd for 5 years; and
- Scenario E – Groundwater pumping at the currently permitted 5-year running average of 62 mgd for 10 years.

Scenario A, B, and C, and then Scenario D and E utilize the same respective sets of pumping wells and rates. The locations of the wells assumed for pumping in Scenario A, B, and C are shown on **Figure 3.5-13**. Well by well pumping rates for these three scenarios are shown in both mgd and gpm in **Table 3.5-3**. The locations of the wells assumed for pumping in Scenario D and E are shown on **Figure 3.5-14**, with well by well pumping rates for these two scenarios also shown in **Table 3.5-3**. While the 68 wells of the Queens Groundwater system could produce up to 118 mgd, the maximum limits for pumping are included within the Water Supply/Water Withdrawal Permit, as discussed in Chapter 1.0, "Project Description." The wells selected for use in the five operating scenarios were based upon a current analysis of multiple criteria, including, but not limited to historic water quality, anticipated treatment needs, existing available treatment technologies, well station property size, and anticipated capital and operating costs. Future conditions may determine that wells currently not selected to be part of the operating scenarios for this analysis would become favorable for use. The ultimate selection of wells to be used would be based on an assessment of benefits and costs to be made at the time of the water supply shortage. The assessment would be based on potential yield, water quality, and treatment requirements at the time of well usage.

[45] All groundwater flows have been rounded to the nearest whole number mgd.

Table 3.5-3: Pumping Rates for the Queens Groundwater System, Future with the Proposed Project - All Scenarios

Well	DEC ID	Aquifer	Pumping Rate											
			Capacity		Scenario A		Scenario B		Scenario C		Scenario D		Scenario E	
			(mgd)	(gpm)	(mgd)	(gpm)	(mgd)	(gpm)	(mgd)	(gpm)	(mgd)	(gpm)	(mgd)	(gpm)
1	Q-00301	Upper Glacial	1.15	800										
3	Q-00303	Upper Glacial	1.73	1,200	1.73	1,200	1.73	1,200	1.73	1,200	1.73	1,200	1.73	1,200
3A	Q-00558	Upper Glacial	1.66	1,150	1.66	1,150	1.66	1,150	1.66	1,150	1.66	1,150	1.66	1,150
5	Q-00305	Magothy	1.73	1,200	1.73	1,200	1.73	1,200	1.73	1,200	1.73	1,200	1.73	1,200
5A	Q-01957	Magothy	2.45	1,700	2.45	1,700	2.45	1,700	2.45	1,700	2.45	1,700	2.45	1,700
6	Q-00306	Upper Glacial	0.79	550										
6A	Q-00560	Upper Glacial	1.73	1,200										
6B	Q-00561	Upper Glacial	1.73	1,200										
6C	Q-00562	Lloyd	2.59	1,800	2.59	1,800	2.59	1,800	2.59	1,800	2.59	1,800	2.59	1,800
6D	Q-01839	Upper Glacial	0.94	650										
7	Q-00307	Magothy	2.02	1,400	1.44	1,000	1.44	1,000	1.44	1,000	1.44	1,000	1.44	1,000
7B	Q-00564	Magothy	1.73	1,200	1.44	1,000	1.44	1,000	1.44	1,000	1.44	1,000	1.44	1,000
8A	Q-03069	Lloyd	1.44	1,000	1.44	1,000	1.44	1,000	1.44	1,000	1.44	1,000	1.44	1,000
10	Q-00310	Upper Glacial	1.01	700										
10A	Q-01958	Magothy	2.59	1,800	2.59	1,800	2.59	1,800	2.59	1,800	2.59	1,800	2.59	1,800
11	Q-03157	Jameco	1.99	1,380										
13	Q-00313	Magothy	1.73	1,200	1.73	1,200	1.73	1,200	1.73	1,200	1.73	1,200	1.73	1,200
13A	Q-01600	Magothy	1.73	1,200	1.15	800	1.15	800	1.15	800	1.15	800	1.15	800
14	Q-03156	Jameco	1.73	1,200										
17	Q-00317	Lloyd	1.87	1,300	1.56	1,083	1.56	1,083	1.56	1,083	1.56	1,083	1.56	1,083
17A	Q-00566	Magothy	0.86	600	0.86	600	0.86	600	0.86	600	0.86	600	0.86	600
18	Q-02137	Magothy	1.44	1,000	1.44	1,000	1.44	1,000	1.44	1,000	1.44	1,000	1.44	1,000
18A	Q-00567	Lloyd	1.73	1,200	1.73	1,200	1.73	1,200	1.73	1,200	1.73	1,200	1.73	1,200
19	Q-00319	Upper Glacial	0.58	400										
21	Q-00321	Magothy	1.99	1,380										
21A	Q-02435	Magothy	1.73	1,200										

Table 3.5-3: Pumping Rates for the Queens Groundwater System, Future with the Proposed Project - All Scenarios

Well	DEC ID	Aquifer	Pumping Rate											
			Capacity		Scenario A		Scenario B		Scenario C		Scenario D		Scenario E	
			(mgd)	(gpm)	(mgd)	(gpm)	(mgd)	(gpm)	(mgd)	(gpm)	(mgd)	(gpm)	(mgd)	(gpm)
22	Q-00322	Upper Glacial	1.47	1,020	1.47	1,020	1.47	1,020	1.47	1,020				
23	Q-00323	Upper Glacial	1.73	1,200										
23A	Q-00568	Magothy	2.30	1,600										
26	Q-01450	Upper Glacial	1.44	1,000										
26A	Q-01815	Magothy	2.30	1,600	2.30	1,600	2.30	1,600	2.30	1,600	2.30	1,600	2.30	1,600
27	Q-01747	Upper Glacial	1.44	1,000										
29	Q-01534	Upper Glacial	1.73	1,200	1.44	1,000	1.44	1,000	1.44	1,000	1.44	1,000	1.44	1,000
29A	Q-01629	Magothy	2.30	1,600	2.30	1,600	2.30	1,600	2.30	1,600	2.30	1,600	2.30	1,600
31	Q-01811	Upper Glacial	1.47	1,020										
32	Q-01840	Upper Glacial	1.72	1,194	1.72	1,194	1.72	1,194	1.72	1,194				
33	Q-01843	Upper Glacial	1.44	1,000	1.44	1,000	1.44	1,000	1.44	1,000	1.44	1,000	1.44	1,000
36	Q-02026	Magothy	2.30	1,600	2.30	1,600	2.30	1,600	2.30	1,600	2.30	1,600	2.30	1,600
37	Q-02001	Upper Glacial	1.70	1,183										
38	Q-01997	Upper Glacial	2.02	1,400										
38A	Q-02432	Magothy	2.59	1,800							2.59	1,800	2.59	1,800
39	Q-02000	Upper Glacial	2.02	1,400	2.02	1,400	2.02	1,400	2.02	1,400	2.02	1,400	2.02	1,400
39A	Q-02188	Magothy	2.30	1,600	2.30	1,600	2.30	1,600	2.30	1,600	2.30	1,600	2.30	1,600
41	Q-02006	Upper Glacial	1.70	1,180										
42	Q-02027	Upper Glacial	0.58	400							0.58	400	0.58	400
42A	Q-02028	Magothy	2.45	1,700										
43	Q-02138	Upper Glacial	2.02	1,400	1.44	1,000	1.44	1,000	1.44	1,000				
43A	Q-02332	Magothy	1.87	1,300	1.44	1,000	1.44	1,000	1.44	1,000	1.44	1,000	1.44	1,000
45	Q-02189	Upper Glacial	1.51	1,050	0.37	257	0.37	257	0.37	257				
47	Q-02275	Upper Glacial	1.44	1,000							1.44	1,000	1.44	1,000
47A	Q-02276	Magothy	2.30	1,600	2.30	1,600	2.30	1,600	2.30	1,600	2.30	1,600	2.30	1,600
48	Q-02299	Upper Glacial	2.02	1,400										

Table 3.5-3: Pumping Rates for the Queens Groundwater System, Future with the Proposed Project - All Scenarios

Well	DEC ID	Aquifer	Pumping Rate											
			Capacity		Scenario A		Scenario B		Scenario C		Scenario D		Scenario E	
			(mgd)	(gpm)	(mgd)	(gpm)	(mgd)	(gpm)	(mgd)	(gpm)	(mgd)	(gpm)	(mgd)	(gpm)
48A	Q-02300	Magothy	2.30	1,600										
49	Q-02321	Upper Glacial	2.02	1,400										
49A	Q-02343	Magothy	2.30	1,600										
50	Q-02373	Upper Glacial	1.44	1,000	1.44	1,000	1.44	1,000	1.44	1,000				
50A	Q-02374	Magothy	1.44	1,000	1.44	1,000	1.44	1,000	1.44	1,000				
51	Q-02362	Magothy	1.44	1,000	1.44	1,000	1.44	1,000	1.44	1,000	1.44	1,000	1.44	1,000
52	Q-02363	Upper Glacial	1.15	800	1.15	800	1.15	800	1.15	800	1.15	800	1.15	800
53	Q-02408	Upper Glacial	1.44	1,000	1.44	1,000	1.44	1,000	1.44	1,000				
53A	Q-02409	Magothy	1.44	1,000	1.44	1,000	1.44	1,000	1.44	1,000				
54	Q-02442	Upper Glacial	1.73	1,200	1.73	1,200	1.73	1,200	1.73	1,200	1.73	1,200	1.73	1,200
54A	Q-02443	Magothy	1.73	1,200	1.73	1,200	1.73	1,200	1.73	1,200	1.73	1,200	1.73	1,200
55	Q-03034	Magothy	1.73	1,200	1.73	1,200	1.73	1,200	1.73	1,200	1.73	1,200	1.73	1,200
56	Q-02955	Magothy	2.02	1,400	2.02	1,400	2.02	1,400	2.02	1,400	2.02	1,400	2.02	1,400
58	Q-03014	Magothy	1.44	1,000										
59	Q-03029	Magothy	2.02	1,400	2.02	1,400	2.02	1,400	2.02	1,400	2.02	1,400	2.02	1,400
60	Q-03083	Magothy	2.02	1,400	2.02	1,400	2.02	1,400	2.02	1,400	2.02	1,400	2.02	1,400
		Total[1]	**118**	**82,257**	**68**	**47,204**	**68**	**47,204**	**68**	**47,204**	**62**	**42,933**	**62**	**42,933**

Note:
[1] Total mgd has been rounded to the nearest million.

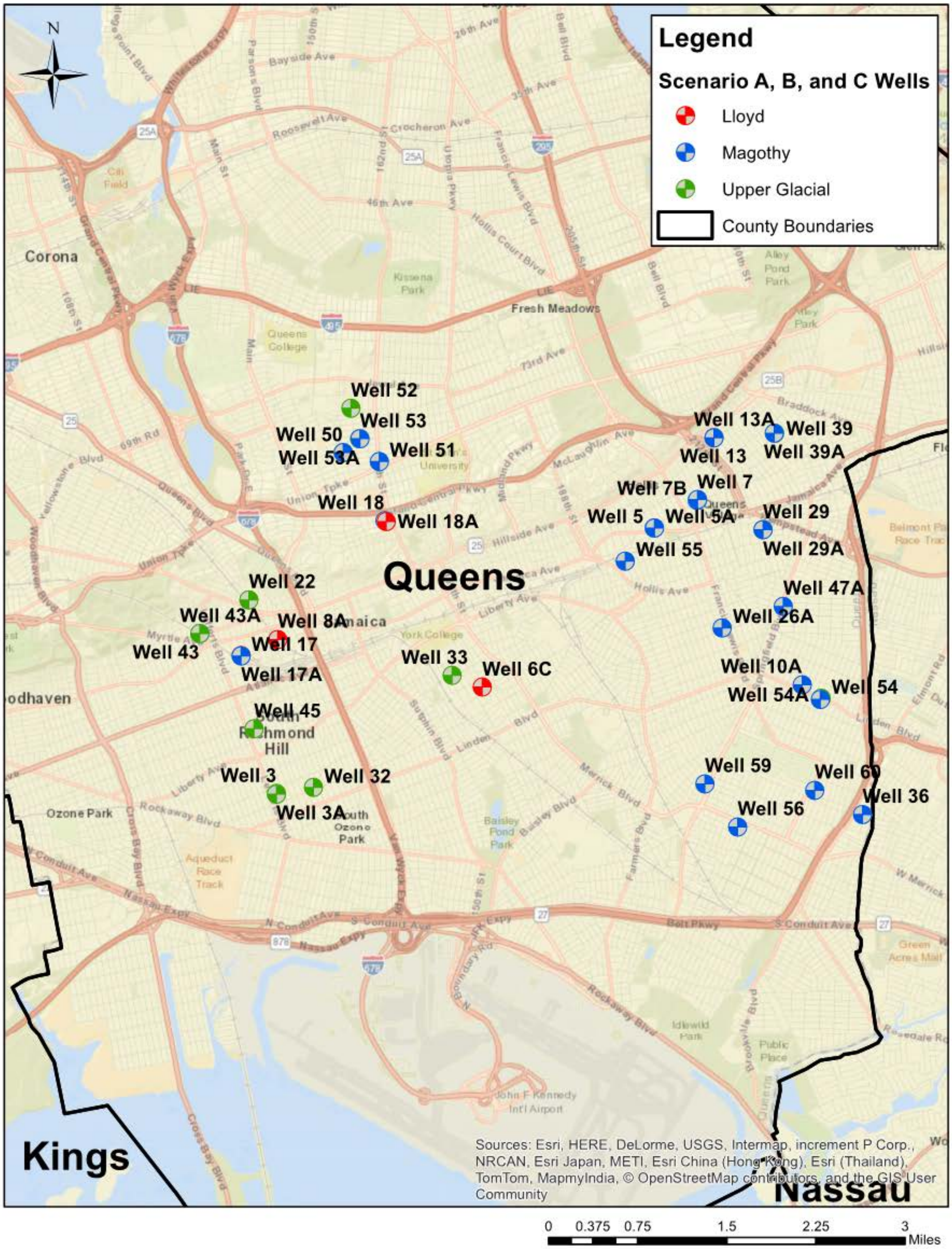

Figure 3.5-13: Queens Groundwater System Wells - Scenario A, B, and C

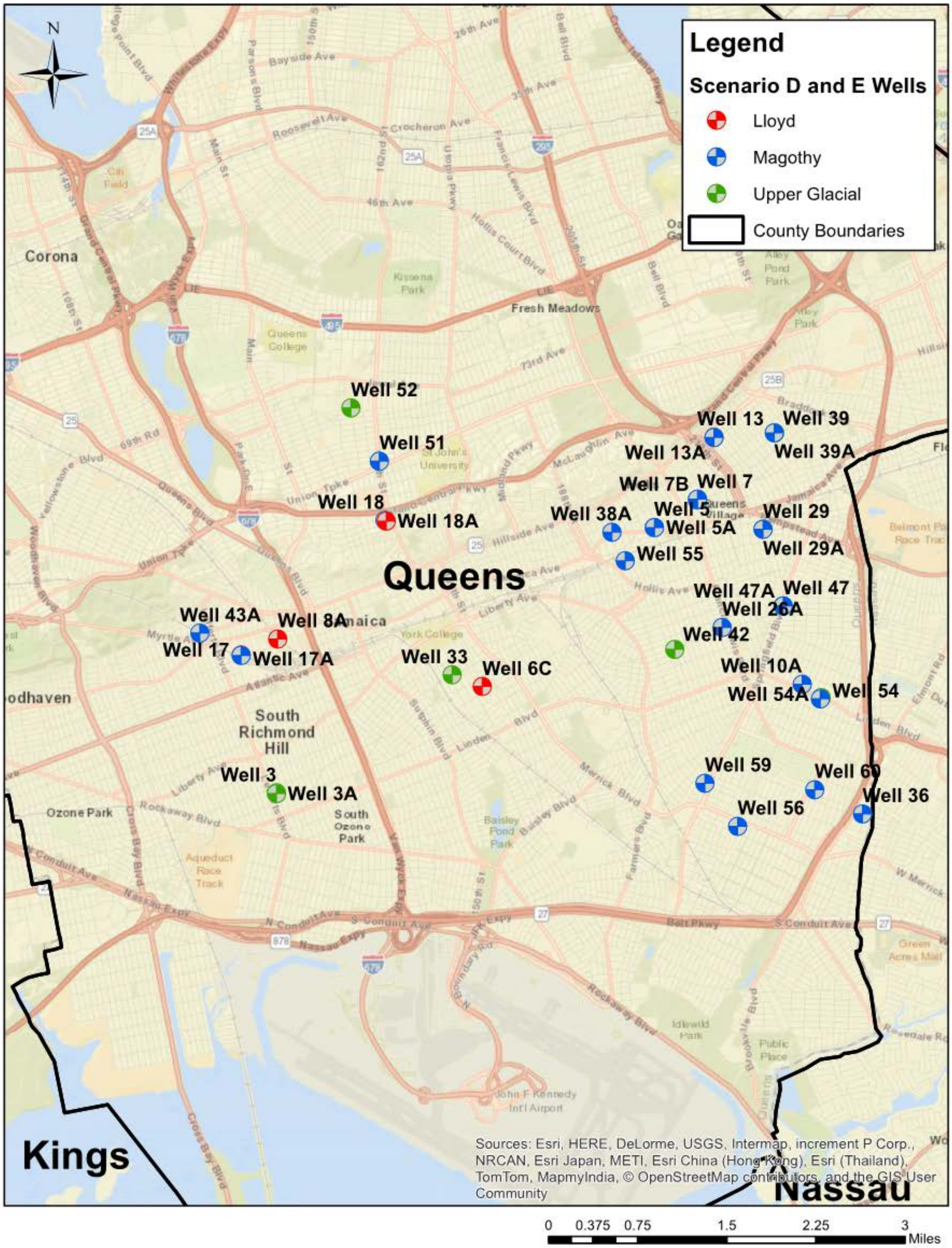

Figure 3.5-14: Queens Groundwater System Wells - Scenario D and E

3.5.5.1 Surface Water

Groundwater discharge to surface waterbodies (baseflow) was simulated for the Future with the Proposed Project conditions at the 19 locations shown on **Figure 3.5-2**. The differences between the simulated baseflow for the Future with the Proposed Project and the simulated baseflow for the Future without the Proposed Project represents the potential reduction in baseflow associated with each of the Queens Groundwater system operating scenarios (A through E). The modeled declines in baseflow to each of these waterbodies for the five scenarios are shown in **Table 3.5-4.** Scenarios where baseflow reductions are greater than 1 cfs are shown in bold.

Table 3.5-4: Simulated Reduction in Baseflow to Surface Waterbodies due to the Future with the Proposed Project - All Scenarios

Surface Water Body	County	Simulated Reduction of Baseflow to Surface Water (cfs)				
		Scenario A	Scenario B	Scenario C	Scenario D	Scenario E
Willow Lake	Queens	**1.29**	**2.45**	**3.01**	**2.36**	**2.78**
Meadow Pond	Queens	0.95	**1.86**	**2.33**	**1.88**	**2.25**
Baisley Pond	Queens	0.34	**1.03**	**1.55**	**1.95**	**2.23**
Alley Creek	Queens	0.25	0.81	**1.23**	**1.81**	**2.40**
Conselyeas Pond Tributary	Queens	0.05	0.10	0.15	0.23	0.34
Kissena Lake	Queens	n/a	n/a	n/a	n/a	n/a
Valley Stream	Nassau	0.49	**1.29**	**1.74**	**1.96**	**2.02**
East Meadow Brook	Nassau	0.01	0.06	0.12	0.30	0.72
Pines Brook	Nassau	0.04	0.12	0.19	0.32	0.45
Bellmore Creek	Nassau	0.00	0.02	0.03	0.06	0.19
Glen Cove Creek	Nassau	0.00	0.01	0.02	0.04	0.12
Massapequa Creek	Nassau	0.00	0.01	0.02	0.02	0.07
Seaford Creek	Nassau	0.00	0.01	0.01	0.01	0.04
Cold Spring Creek	Nassau	0.00	0.00	0.00	0.00	0.00
Champlin Creek	Suffolk	0.00	0.00	0.00	0.00	0.00
Penataquit Creek	Suffolk	0.00	0.00	0.00	0.00	0.00
Sampawams Creek	Suffolk	0.00	0.00	0.00	0.00	0.00
Carls River	Suffolk	0.00	0.00	0.00	0.00	0.00
Santapogue Creek	Suffolk	0.00	0.00	0.00	0.00	0.00

Note:
n/a – Not applicable as Kissena Lake is concrete lined

As shown in **Table 3.5-4**, under Scenario A, there is only one surface waterbody (Willow Lake) that exhibits baseflow reductions greater than 1.0 cfs. Under Scenario B, there are four surface waterbodies (Willow Lake, Meadow Pond, Baisley Pond, and Valley Stream) that exhibit baseflow reductions of greater than 1.0 cfs. Under Scenario C through E, there are five surface waterbodies (Willow Lake, Meadow Pond, Baisley Pond, Alley Creek, and Valley Stream) that exhibit baseflow reductions greater than 1.0 cfs. Each of these waterbodies are examined in more detail below.

A total of five waterbodies (four in Queens, one in Nassau County) exhibit modeled baseflow reductions of greater than 1.0 cfs in at least one of the five scenarios. These waterbodies are presented in **Table 3.5-5** along with Existing Conditions data and simulated baseflow reduction.

Table 3.5-5: Simulated Reduction in Baseflow for the Future with the Proposed Project - All Scenarios

Waterbody	Existing Conditions			Simulated Reduction in Baseflow by Scenario (cfs)				
	Average Daily Flow (cfs)	Drainage Area (acres)	Waterbody Area (acres)	A	B	C	D	E
Willow Lake	6.2	250	46.7	1.29	2.45	3.01	2.36	2.78
Meadow Pond	6.2	250	90.8	0.95	1.86	2.33	1.88	2.25
Baisley Pond	5.6	105	30.0	0.34	1.03	1.55	1.95	2.23
Alley Creek	3.3	435	n/a	0.25	0.81	1.23	1.81	2.40
Valley Stream	3.9	2,413	n/a	0.49	1.29	1.74	1.96	2.02

Note:
n/a - Not applicable

Willow Lake and Meadow Pond

Natural resources associated with these waterbodies include wetlands, vegetation, and wildlife that are dependent on the presence of surface water. The surface waters in Willow Lake and Meadow Pond are fed by inputs that include both groundwater baseflow and surface runoff from rainfall events. While groundwater-fed baseflow is relatively constant, surface runoff from rainfall is variable and is dependent on weather patterns, storm events, and seasonal variations. The tidal control structure (i.e., tide gate) at the downstream end of Meadow Pond also exerts a significant influence on water surface elevations.

As shown in **Table 3.5-5**, the reduction in baseflow to both Willow Lake and Meadow Pond would exceed the 1.0 cfs threshold in each scenario, except Scenario A for Meadow Pond. Because of their proximity to one another and their hydraulic connectivity, changes to these waterbodies under the Future with the Proposed Project are related. Under the Future with the Proposed Project, the average daily flow value (6.2 cfs) would be lowered by the amount of the simulated baseflow reduction for each scenario. Under all scenarios, Willow Lake and Meadow Pond would retain a flow of water through their systems.

While the reductions in baseflow into these ponds would reduce the hydrologic throughput in these systems, they are unlikely to cause substantive changes in surface water elevations upon which the natural resources are dependent. The surface water elevations in these waterbodies would continue to be controlled by outfall structures (e.g., dam, weir). Therefore, surface water elevations are not anticipated to change due to changes in baseflow through Willow Lake and Meadow Pond. Fluctuations in surface water elevations are more greatly influenced by surface runoff. The conclusion that surface water elevations are relatively static outside of large rainfall event is also affirmed by historic aerial photographs of Willow Lake and Meadow Pond which depict relatively consistent water surface area, even throughout the peak pumping periods of the Queens wells during the 1960s and 1970s.

Since surface water elevations in these waterbodies are not anticipated to be significantly affected by the Proposed Project and since natural resources in these waterbodies are dependent on surface waters, baseflow reductions under the Future with the Proposed Project are not expected to represent a potential significant adverse impact to these waterbodies or the surrounding natural resources. Therefore, no potential significant adverse impacts to the natural resources of Willow Lake or Meadow Pond are anticipated.

Baisley Pond

As shown in **Table 3.5-5**, the reduction in baseflow to Baisley Pond would exceed the 1.0 cfs criteria under each scenario with the exception of Scenario A. Under all scenarios, there is still average daily flow in this waterbody.

Consistent with other surface waterbodies studied in Queens, the water input to Baisley Pond is dominated by stormwater runoff. With stormwater as the dominant input to the pond, the simulated baseflow reductions in **Table 3.5-5** would be minor when compared to the overall hydrologic inputs to the pond and to the storage volume of the pond.

Even with the modest reduction in baseflow contributions under the Future with the Proposed Project scenarios, it is expected that the remaining average daily flow would prevent substantive changes to this waterbody and surface water elevations would remain relatively unchanged. Seasonal fluctuations and storm events would exert a much greater influence on variations in water surface elevation than changes in baseflow. Likewise, a review of historic aerial photographs of Baisley Pond depict relatively consistent water surface areas, even throughout the peak pumping periods of the Queens wells during the 1960s and 1970s. Therefore, surrounding wetlands, vegetation and wildlife are also not expected to experience significant adverse impacts due to the Proposed Project.

Alley Creek

As shown in **Table 3.5-5**, the reduction in baseflow to Alley Creek would exceed the 1.0 cfs criteria under Scenario C, D, and E. The existing average daily flow at the USGS gauge station, which is located at the southern end, in the upstream portion of Alley Creek, is 3.3 cfs. Since the baseflow contribution to the flow in Alley Creek takes place both upstream and downstream of the gauge location, the flow at the gauge station reflects only part of the full baseflow contribution. However, to conservatively estimate the impact of the baseflow reduction on Alley Creek, the baseflow reduction was applied to the flow measured at the gauge. This approach would yield the remaining average flow for each simulated baseflow reduction under each pumping scenario. Actual reductions in baseflow would likely be less than shown. In addition, any potential changes from the reduced baseflow would not be pronounced because the system is dominated by surface runoff inputs and subject to the tidal influence of Little Neck Bay. As a result, the wetlands, vegetation, and wildlife at and in proximity to Alley Creek would not be expected to experience potential significant adverse impacts as a result of the Proposed Project.

Valley Stream

The reduction in baseflow to Valley Stream would exceed the 1.0 cfs criteria under all scenarios with the exception of Scenario A as shown in **Table 3.5-5**. Under all scenarios, there would still be flow in the stream.

Any potential changes from the reduced baseflow would not be pronounced because the system is dominated by surface runoff inputs. As shown by a review of USGS gauge data on **Figure 3.5-7,** Valley Stream experiences periods where there is little to no water flowing. However, the stream experiences surges in flow as it receives surface water runoff during storm events. The USGS gauge data collected throughout the peak pumping periods of the Queens wells during the 1960s and 1970s indicates an average discharge of 1.6 cfs during these two decades. The average discharge of 1.6 cfs includes a reduction of baseflow due to the installation of storm sewers in Nassau County in the 1950s, as well as increasing pumping in Nassau County. Therefore, the potential reduced baseflow resulting from the Proposed Project would not have a significant impact to the overall flow in the Valley Stream system. Existing wetlands, vegetation, and wildlife in proximity to Valley Stream would therefore not be expected to experience potential significant adverse impacts as a result of the Proposed Project.

3.5.5.2 Federal/State Threatened, Endangered, Candidate Species, State Species of Special Concern and Unlisted Rare or Vulnerable Species

Queens Groundwater Well Stations

The implementation of temporary treatment facilities as part of the Proposed Project may include limited tree removal; however, no adverse effects to northern long-eared bats are anticipated. Any tree removals, if required, would occur between November 1 and March 31 when northern long-eared bats would not be utilizing summer roosting locations. Therefore, in the Future with the Proposed Project, no impacts to federal and State species are anticipated at any well station due to the implementation of temporary treatment systems as part of the Proposed Project.

Surface Water

As noted in Section 3.5.5.1, under Scenario A, there would only be one surface waterbody (Willow Lake) that would exhibit baseflow reductions greater than 1.0 cfs. Under Scenario B, there are four surface waterbodies (Willow Lake, Meadow Pond, Baisley Pond, and Valley Stream) that would exhibit baseflow reductions greater than 1.0 cfs. Under Scenario C through E, there would be five surface waterbodies (Willow Lake, Meadow Pond, Baisley Pond, Alley Creek, and Valley Stream) that would exhibit baseflow reductions greater than 1.0 cfs. Baseflow reductions under the Future with the Proposed Project, however, as discussed previously within Section 3.5.5.1, “Surface Water,” would not be expected to represent a potential significant adverse impact to any habitats associated with these waterbodies. Therefore, in the Future with the Proposed Project, no impacts to federal/State threatened, endangered, Candidate Species, State species of special concern and unlisted rare or vulnerable species would be anticipated at any groundwater-fed surface waterbody.

3.5.5.3 Saltwater Interface

The positions of the saltwater interfaces in the Upper Glacial, Magothy, and Lloyd aquifers were examined for each of the operating scenarios under the Future with the Proposed Project and then compared to the simulated saltwater interface locations for the Future without the Proposed Project. Contours representing the saltwater interfaces are shown on **Figure 3.5-15** through **Figure 3.5-39** as black lines for Existing Conditions, blue for Future without the Proposed Project, and red lines for the Future with the Proposed Project conditions. Inland movement of the saltwater interface in the Upper Glacial and Magothy aquifers due to short-duration pumping of the Queens supply wells is likely to be temporary (up to 10 years), with a subsequent rebound back to Existing Conditions, similar to what has been observed in these aquifers historically in Brooklyn and southern Queens. Similar movement of the assumed offshore portion of the saltwater interface in the Lloyd Aquifer is less likely to rebound after short-duration use of the Queens supply wells.

Figure 3.5-15 through **Figure 3.5-19** show the saltwater interface position in the Upper Glacial Aquifer for Existing Conditions, Future without the Proposed Project, and Future with the Proposed Project for Scenario A through E. In each figure, the existing, Future without the Proposed Project, and Future with the Proposed Project conditions are virtually identical and the contour lines for each are barely distinguishable from each other for the majority of the study area (as the contour lines for each condition in many instances overlap one another). In locations where no movement of the saltwater interface would occur under the Future without the Proposed Project and Future with the Proposed Project, only the black contour line representing Existing Conditions is discernible.

There would be no simulated saltwater intrusion into the capture zones (the area from which water is pumped over the duration of the simulation) for any Nassau County supply wells screened in the Upper Glacial Aquifer. Well 3A of the Queens Groundwater system, which is screened at the base of the Upper Glacial Aquifer, would have saltwater in it under all conditions simulated, as it currently exists today, and the intrusion zone around this well would increase noticeably under Scenario C, D, and E. Aside from Well 3A, the analysis showed no simulated saltwater intrusion into the capture zones of any of the other Queens supply wells screened in the Upper Glacial Aquifer.

Figure 3.5-20 through **Figure 3.5-24** show the saltwater interface position in the Magothy Aquifer for the existing, Future without the Proposed Project, and Future with the Proposed Project conditions for Scenario A through E. The greatest change in the inland extent of the saltwater interface location in the Magothy Aquifer would be approximately 1,200 feet when comparing the Future without and Future with the Proposed Project conditions under Scenario E (see **Figure 3.5-24**). However, no simulated saltwater intrusion into the capture zones of any of the Queens supply wells screened in the Magothy Aquifer would occur. As discussed above in Section 3.5.5.3., "Saltwater Interface," there are 15 active Nassau County supply wells that have a portion of their capture zones at or south of the existing location of the saltwater interface along the south shore of Long Island, although the presence of the saltwater at the bottom of the Magothy Aquifer does not imply that operations at these 15 wells are impaired since chloride concentrations at the well screens may be lower than those at the bottom of the aquifer. While Scenario E would result in the greatest movement in the interface for this aquifer in Nassau

County, no new intrusion (at the 15 wells noted above or any other active supply wells) was simulated at Nassau County or western Suffolk County active supply wells in the Magothy Aquifer.

Figure 3.5-25 through **Figure 3.5-29** show the saltwater interface position in the northern portion of the Lloyd Aquifer for Existing Conditions, Future without the Proposed Project, and Future with the Proposed Project for Scenario A through E. The model simulates downward movement of the saltwater interface from the Upper Glacial Aquifer into the Lloyd in the area of the red contour around Willow Lake, where the Upper Glacial Aquifer and the Lloyd Aquifer are believed to be hydraulically connected (i.e., not separated by the Raritan Clay aquitard). However, there is no simulated saltwater intrusion into the capture zones of any of the Queens supply wells screened in the Lloyd Aquifer, and there is no simulated saltwater intrusion into the capture zones of any of the active Nassau supply wells screened in the northern portion of the Lloyd Aquifer. With the exception of the area around Willow Lake noted above, differences between the three conditions shown are barely discernible.

Figure 3.5-30 through **Figure 3.5-34** show the saltwater interface position in the southern portion of the Lloyd Aquifer for the existing, Future without the Proposed Project, and Future with the Proposed Project conditions for Scenario A through E. There would be no simulated saltwater intrusion into the capture zones of any of the Queens supply wells screened in the Lloyd Aquifer. In addition, there would be no simulated saltwater intrusion into the capture zones of any of the active Nassau County supply wells screened in the southern portion of the Lloyd Aquifer. However, consistent pumping from the Long Beach supply wells is likely drawing the saltwater interface further inland, which could be potentially effected by the Proposed Project pumping. To more fully understand the extent of this movement, a closer examination of the interface south of Long Beach was conducted.

Figure 3.5-35 through **Figure 3.5-39** shows the location of the saltwater interfaces under Existing Conditions, Future without the Proposed Project, and Future with the Proposed Project in the vicinity of Long Beach. The Lloyd Aquifer is the sole source of drinking water to Long Beach, which has its water supplied via 13 active wells. These wells pump at an average annual combined rate of approximately 4.5 mgd (3,125 gpm). The maximum additional inland movement of the saltwater interface under the Future without the Proposed Project ranges from approximately 450 to 725 feet. Under the Future with the Proposed Project, specifically Scenario E (62 mgd for 10 consecutive years), there is approximately 220 to 280 feet of additional inland movement.

Figure 3.5-15: Saltwater Interface Location, Upper Glacial Aquifer - Scenario A (68 mgd for 1 Year)

Figure 3.5-16: Saltwater Interface Location, Upper Glacial Aquifer - Scenario B (68 mgd for 2 Years)

Figure 3.5-17: Saltwater Interface Location, Upper Glacial Aquifer - Scenario C (68 mgd for 3 Years)

Figure 3.5-18: Saltwater Interface Location, Upper Glacial Aquifer - Scenario D (62 mgd for 5 Years)

Figure 3.5-19: Saltwater Interface Location, Upper Glacial Aquifer - Scenario E (62 mgd for 10 Years)

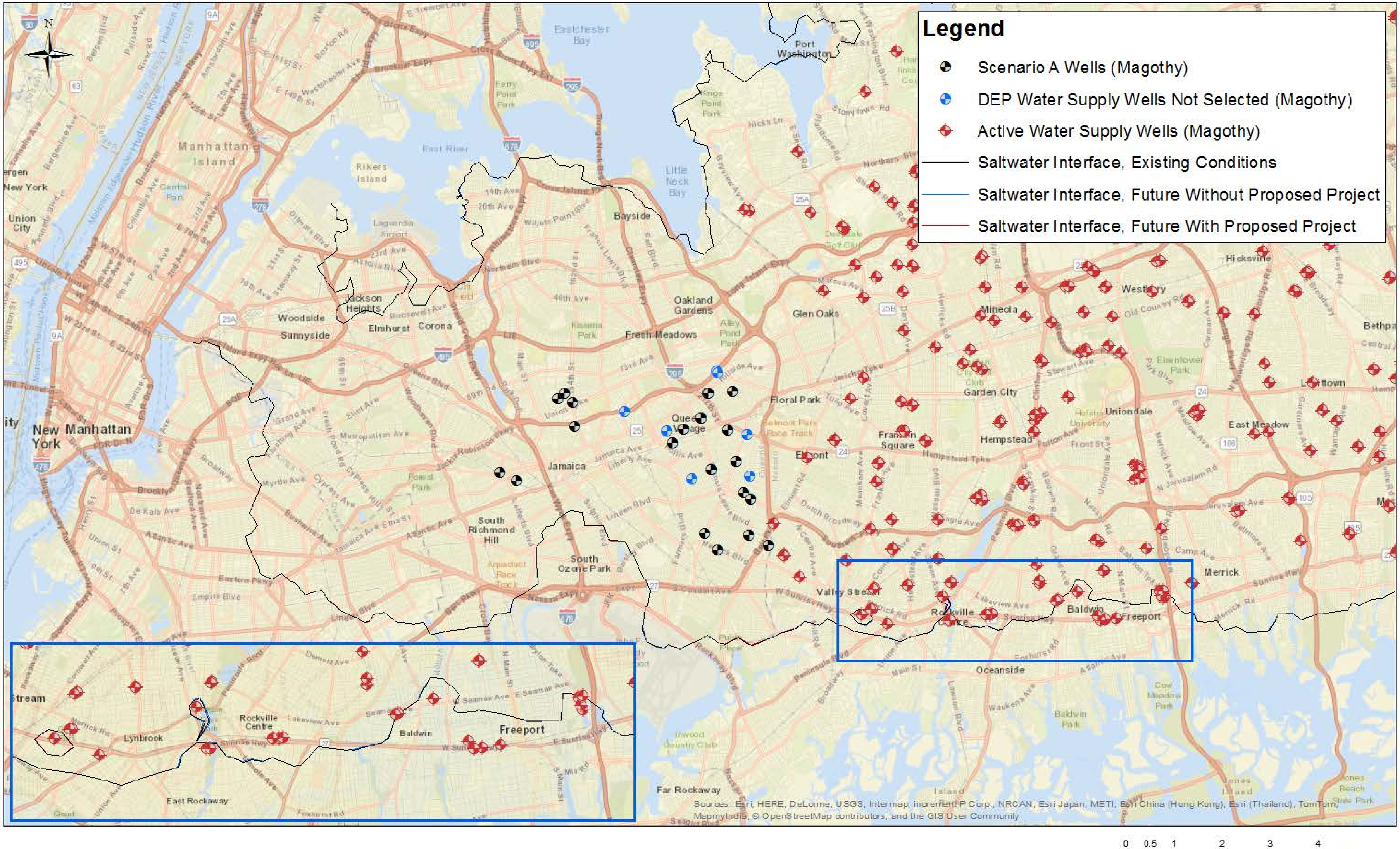

Figure 3.5-20: Saltwater Interface Location, Magothy Aquifer - Scenario A (68 mgd for 1 Year)

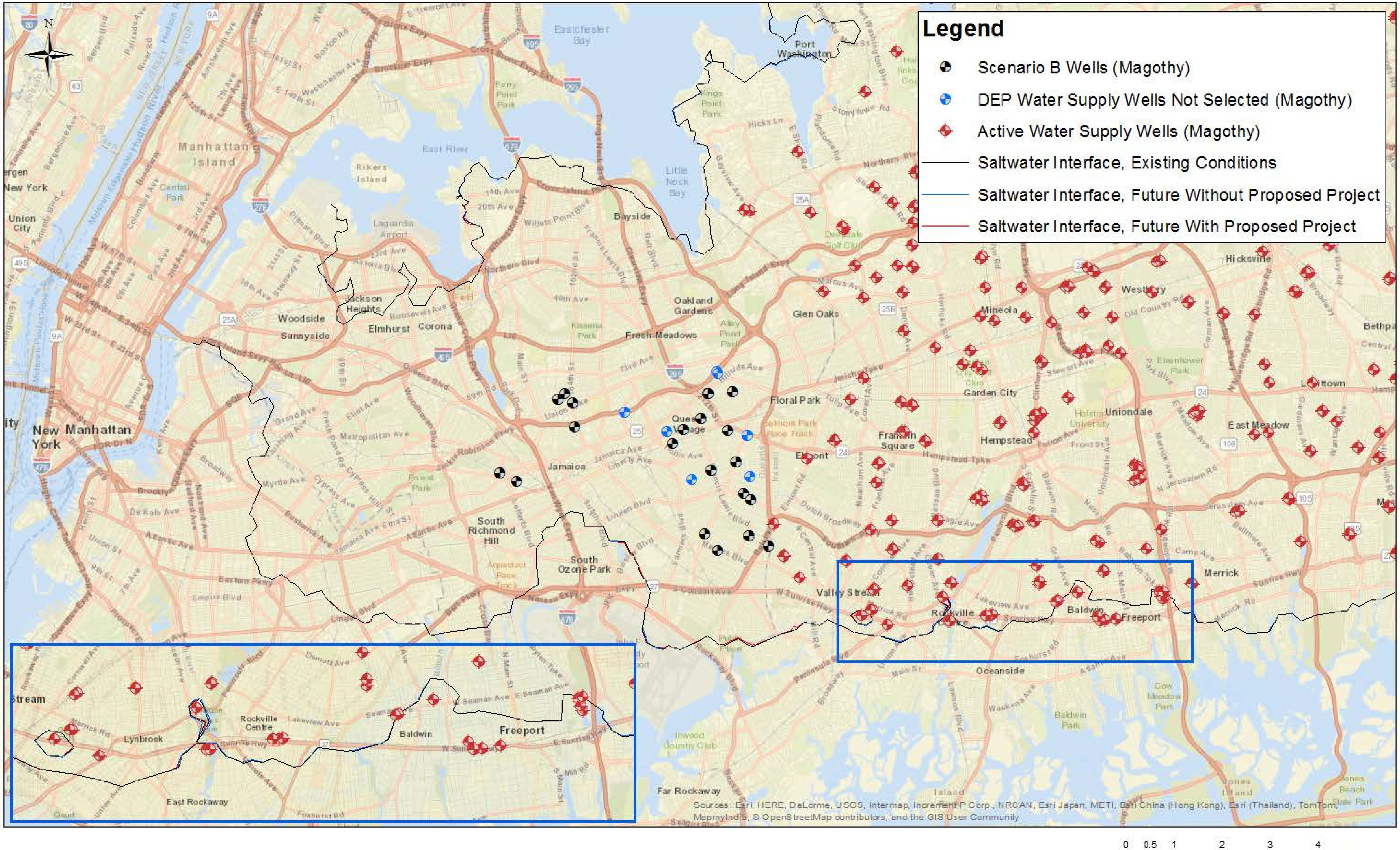

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Figure 3.5-21: Saltwater Interface Location, Magothy Aquifer - Scenario B (68 mgd for 2 Years)

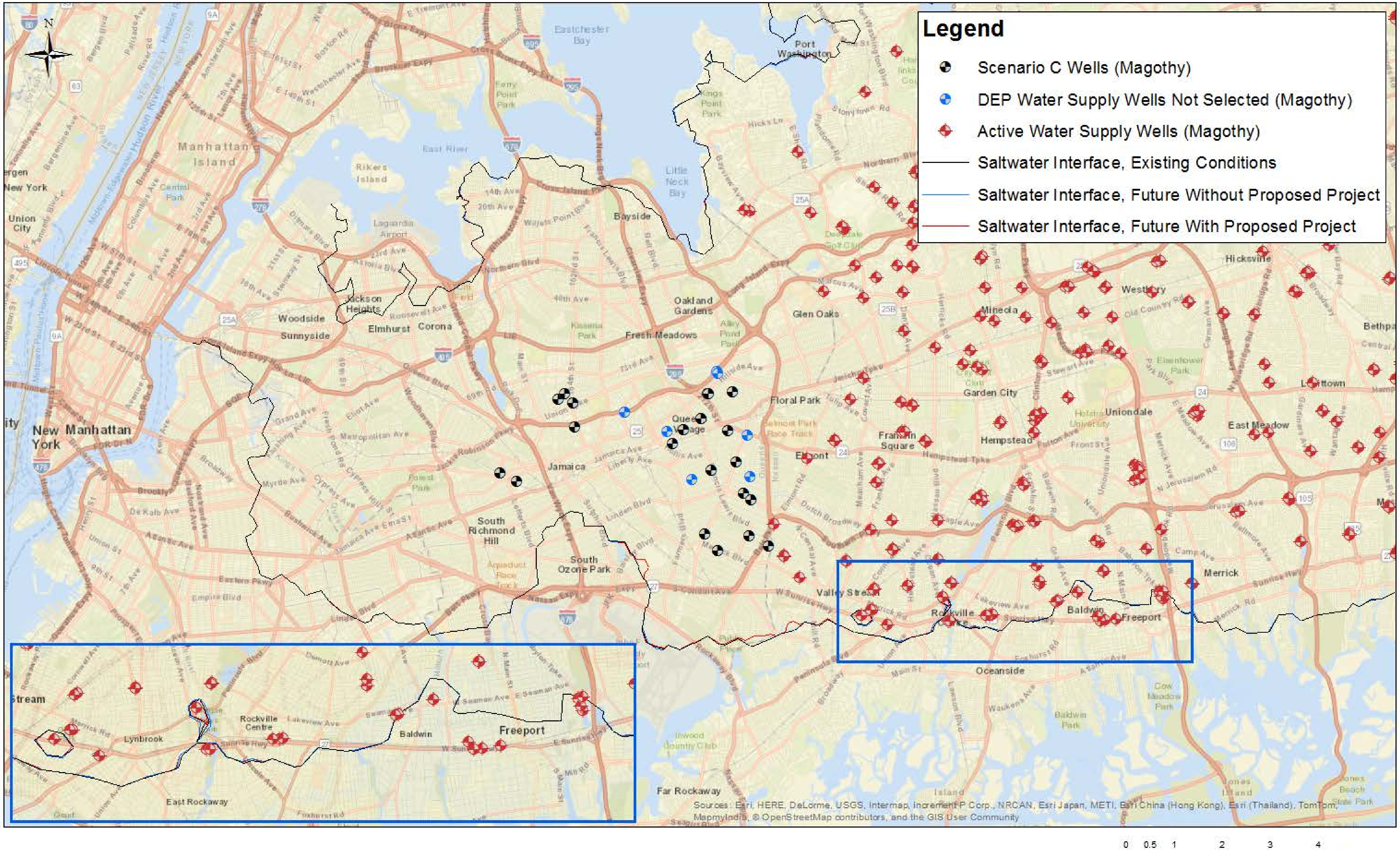

Figure 3.5-22: Saltwater Interface Location, Magothy Aquifer - Scenario C (68 mgd for 3 Years)

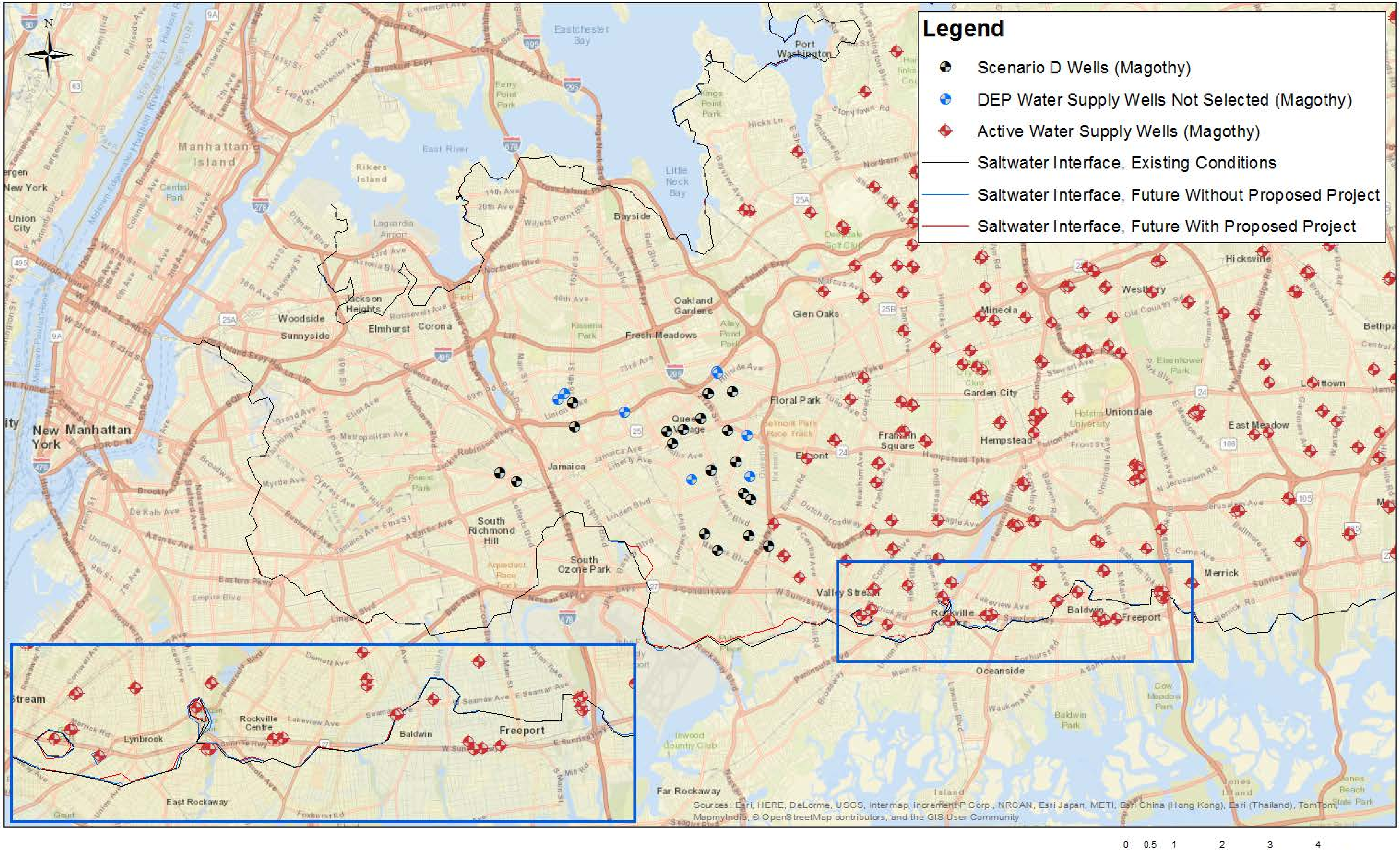

Figure 3.5-23: Saltwater Interface Location, Magothy Aquifer - Scenario D (62 mgd for 5 Years)

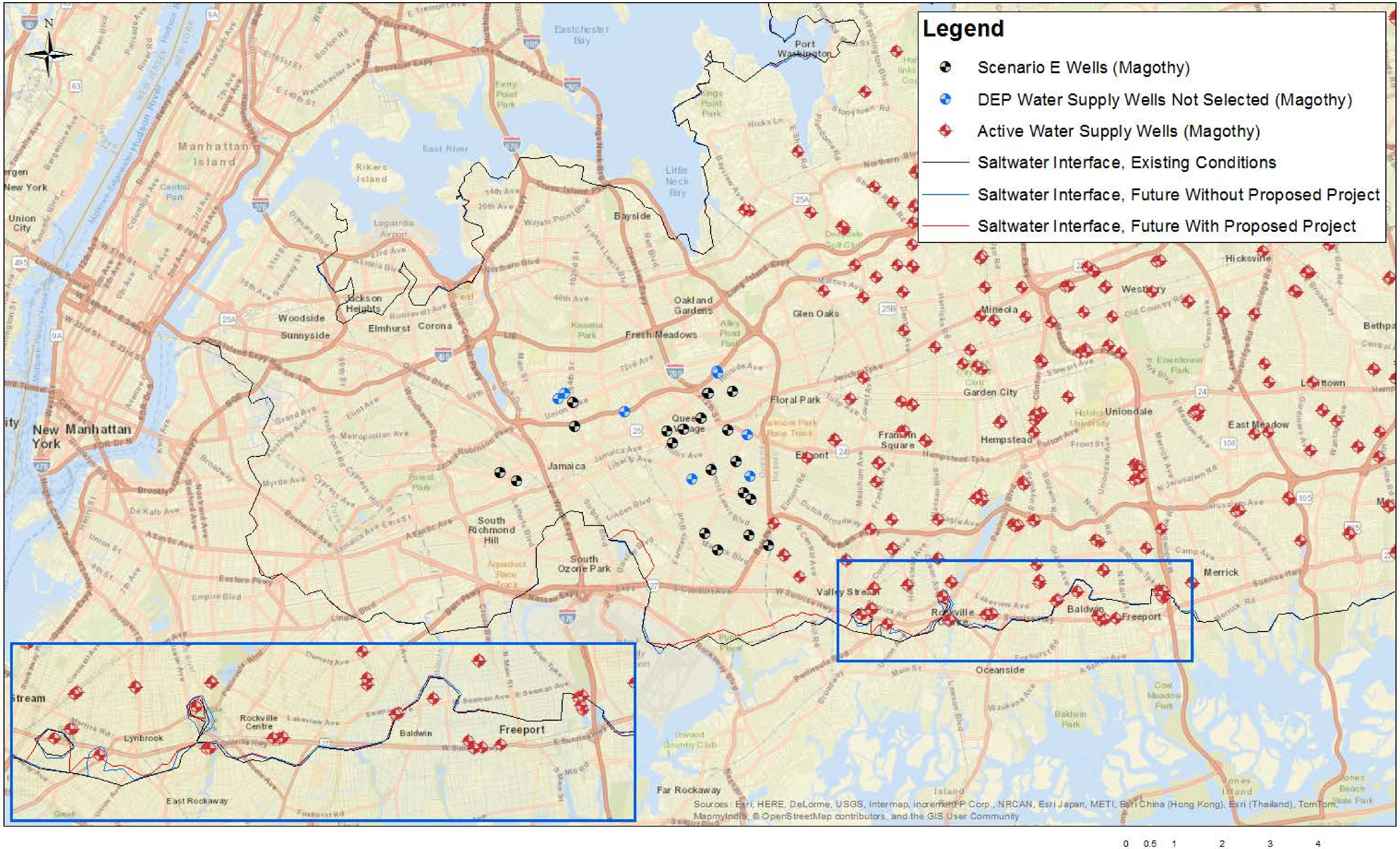

Figure 3.5-24: Saltwater Interface Location, Magothy Aquifer - Scenario E (62 mgd for 10 Years)

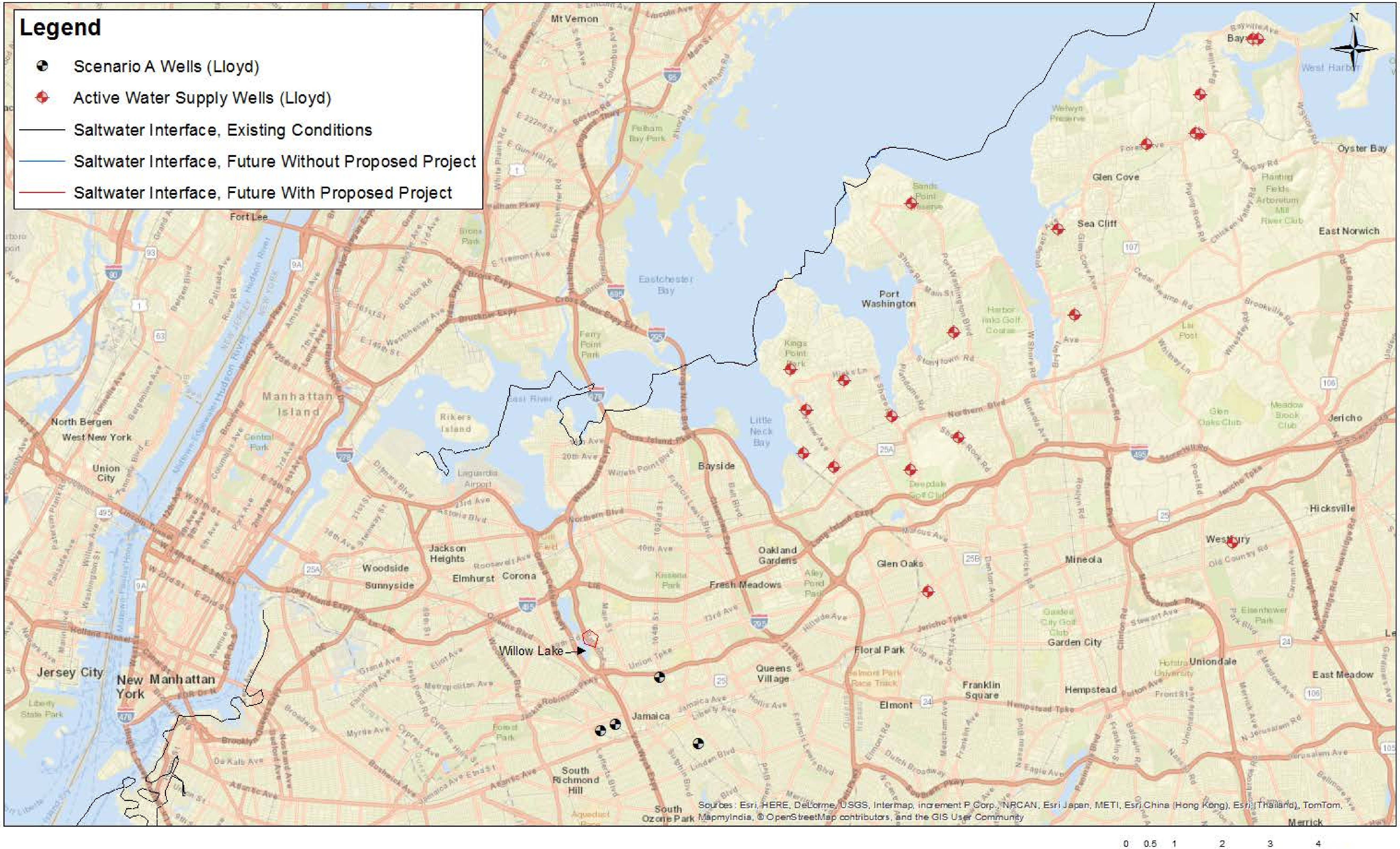

Figure 3.5-25: Saltwater Interface Location, Lloyd Aquifer (North Shore) - Scenario A (68 mgd for 1 Year)

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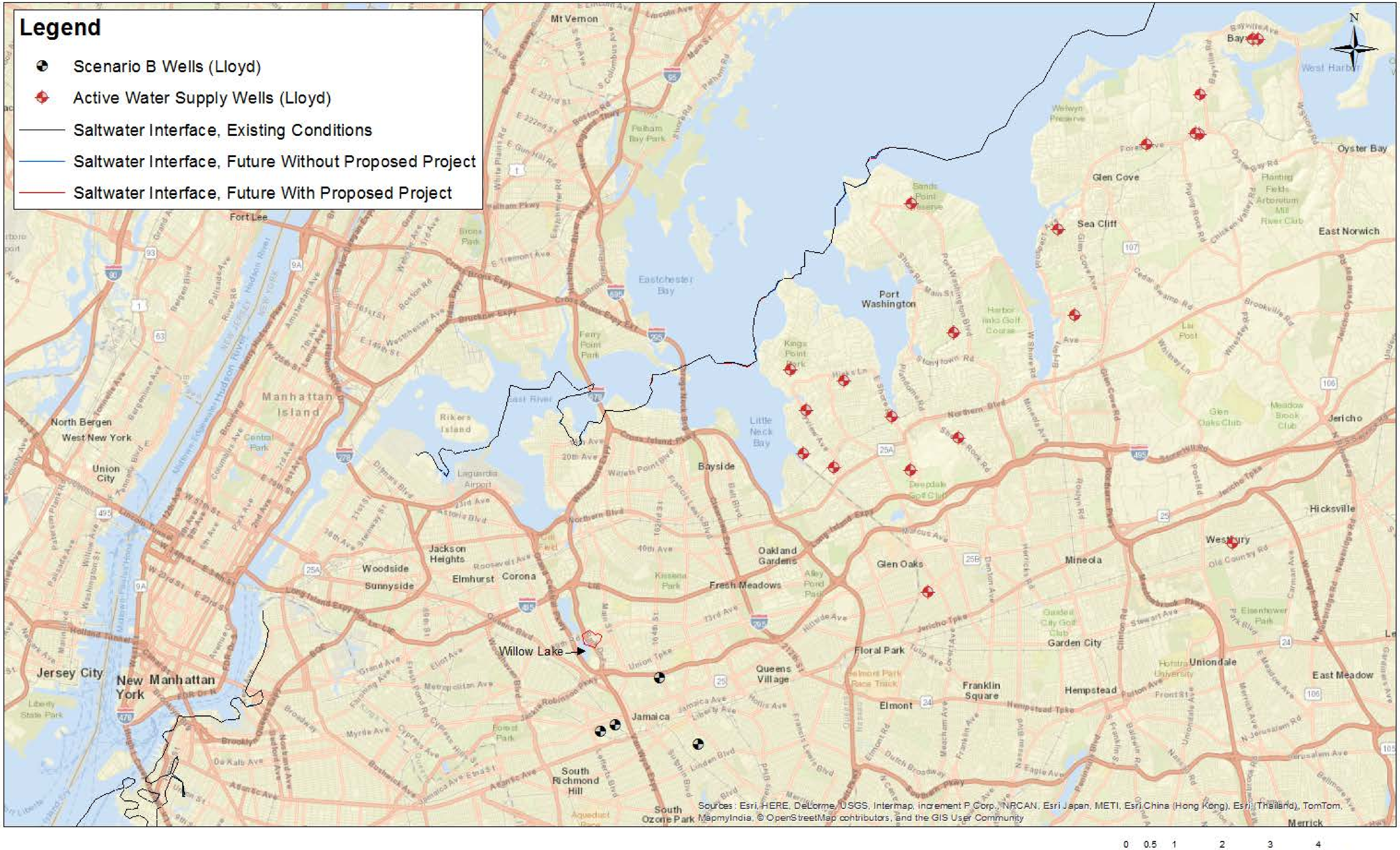

Figure 3.5-26: Saltwater Interface Location, Lloyd Aquifer (North Shore) - Scenario B (68 mgd for 2 Years)

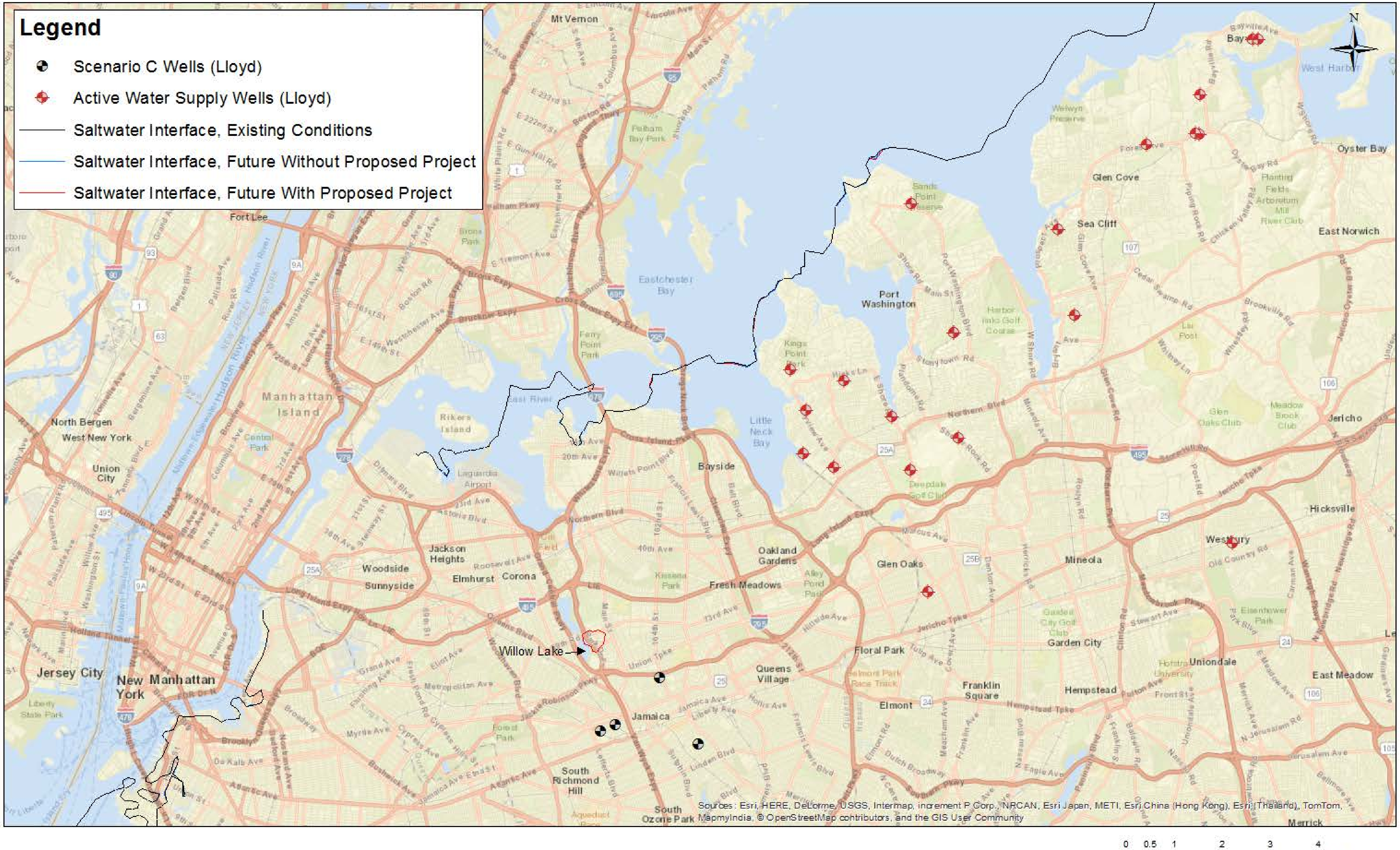

Figure 3.5-27: Saltwater Interface Location, Lloyd Aquifer (North Shore) - Scenario C (68 mgd for 3 Years)

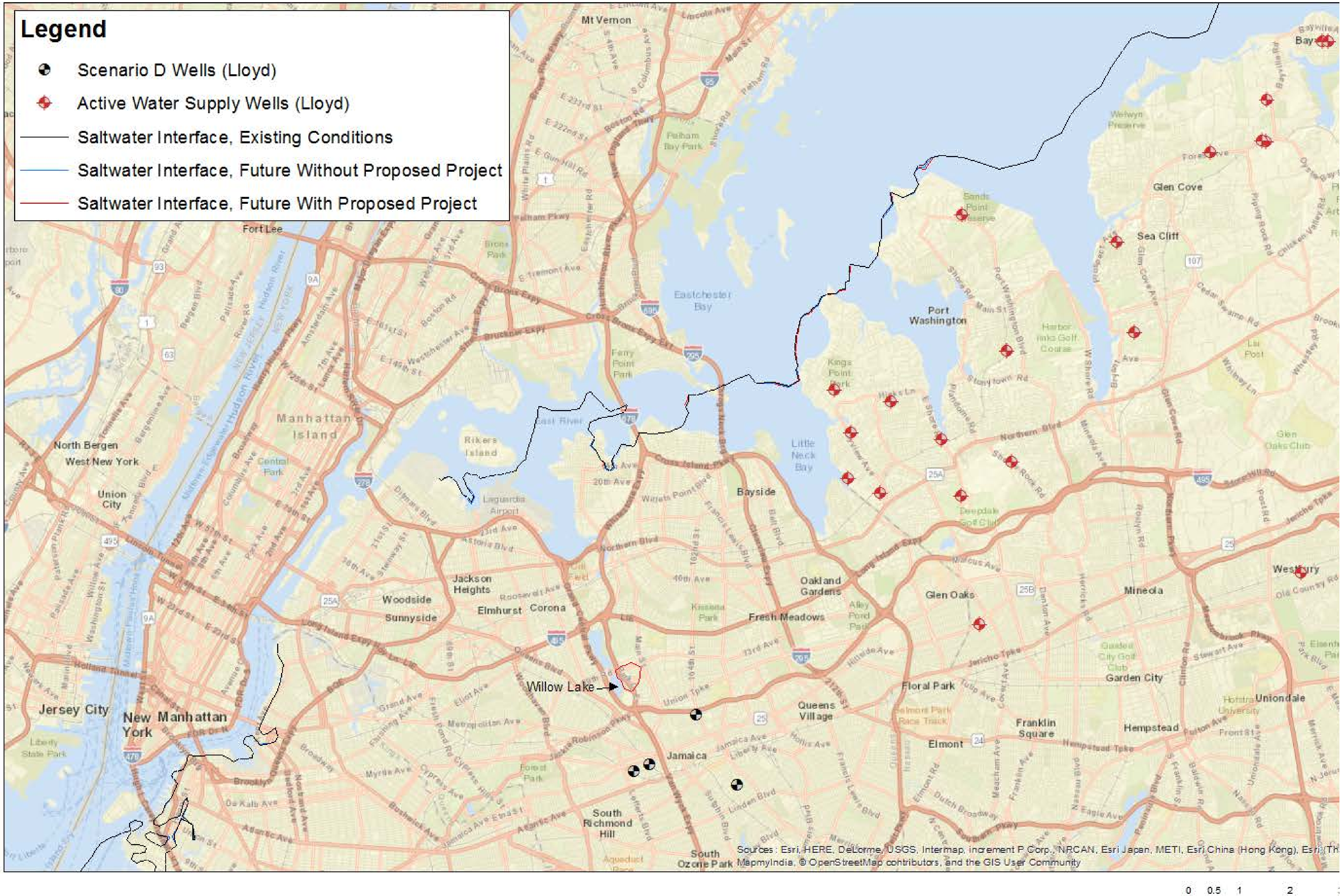

Figure 3.5-28: Saltwater Interface Location, Lloyd Aquifer (North Shore) - Scenario D (62 mgd for 5 Years)

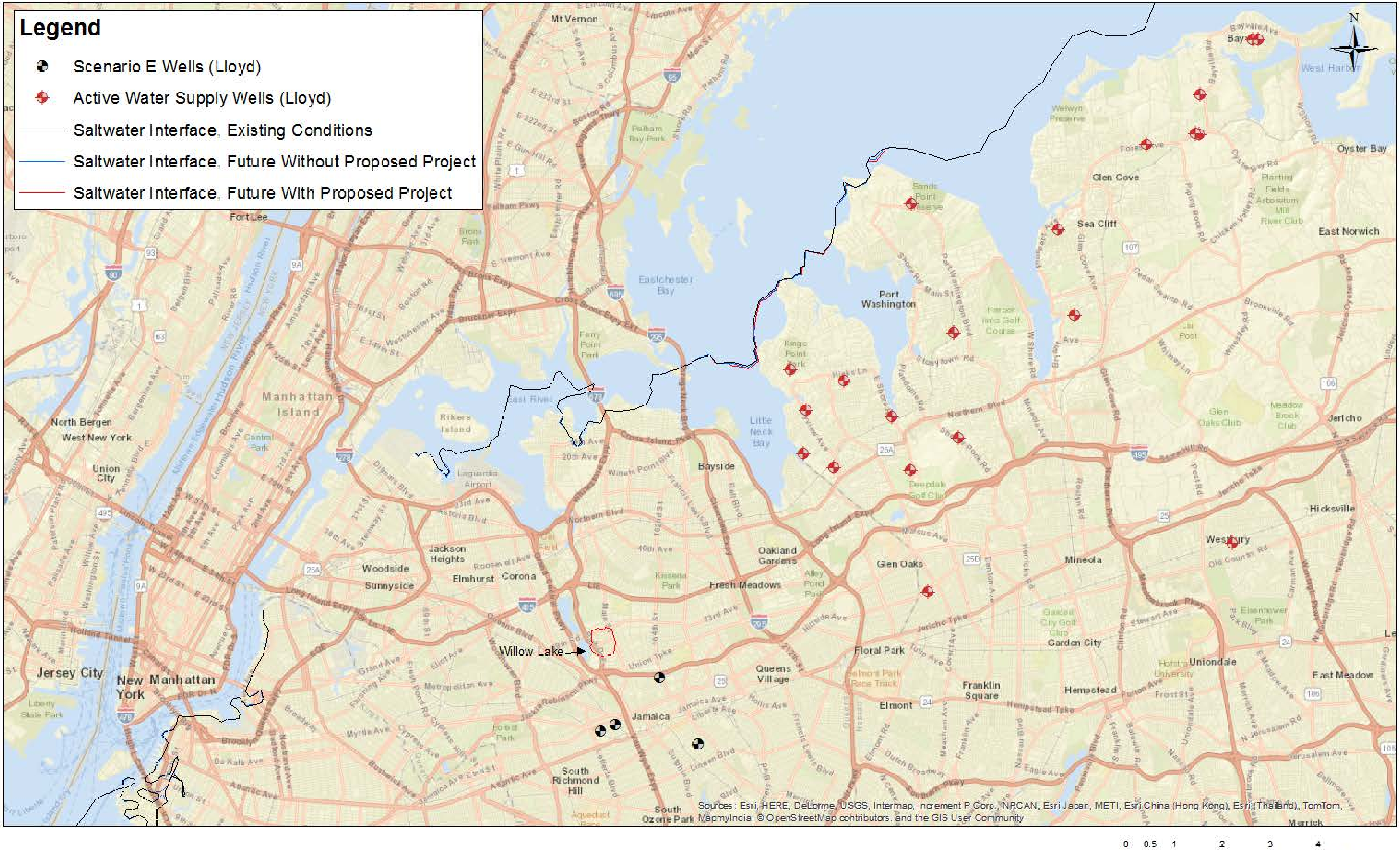

Figure 3.5-29: Saltwater Interface Location, Lloyd Aquifer (North Shore) - Scenario E (62 mgd for 10 Years)

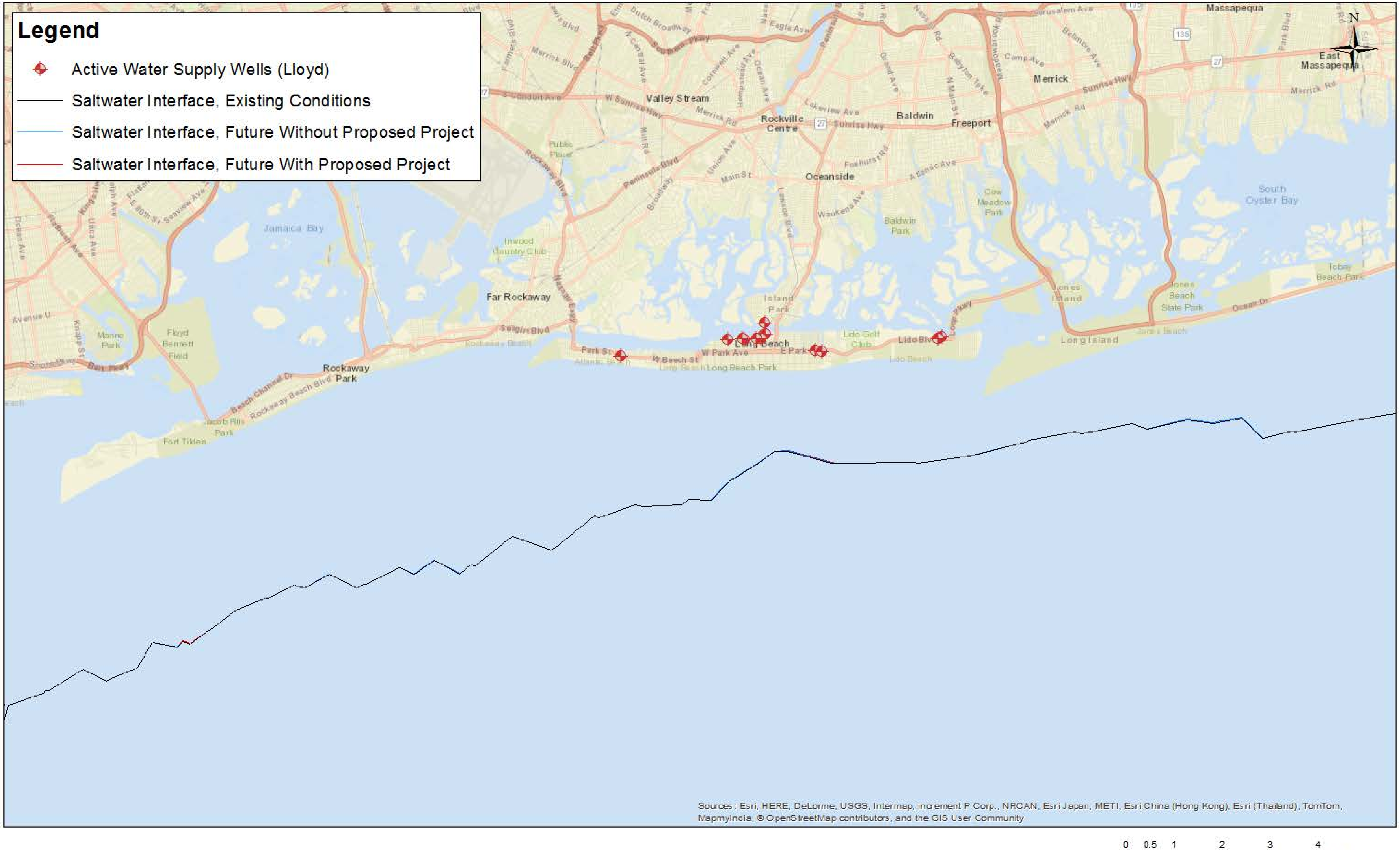

Figure 3.5-30: Saltwater Interface Location, Lloyd Aquifer (South Shore) - Scenario A (68 mgd for 1 Year)

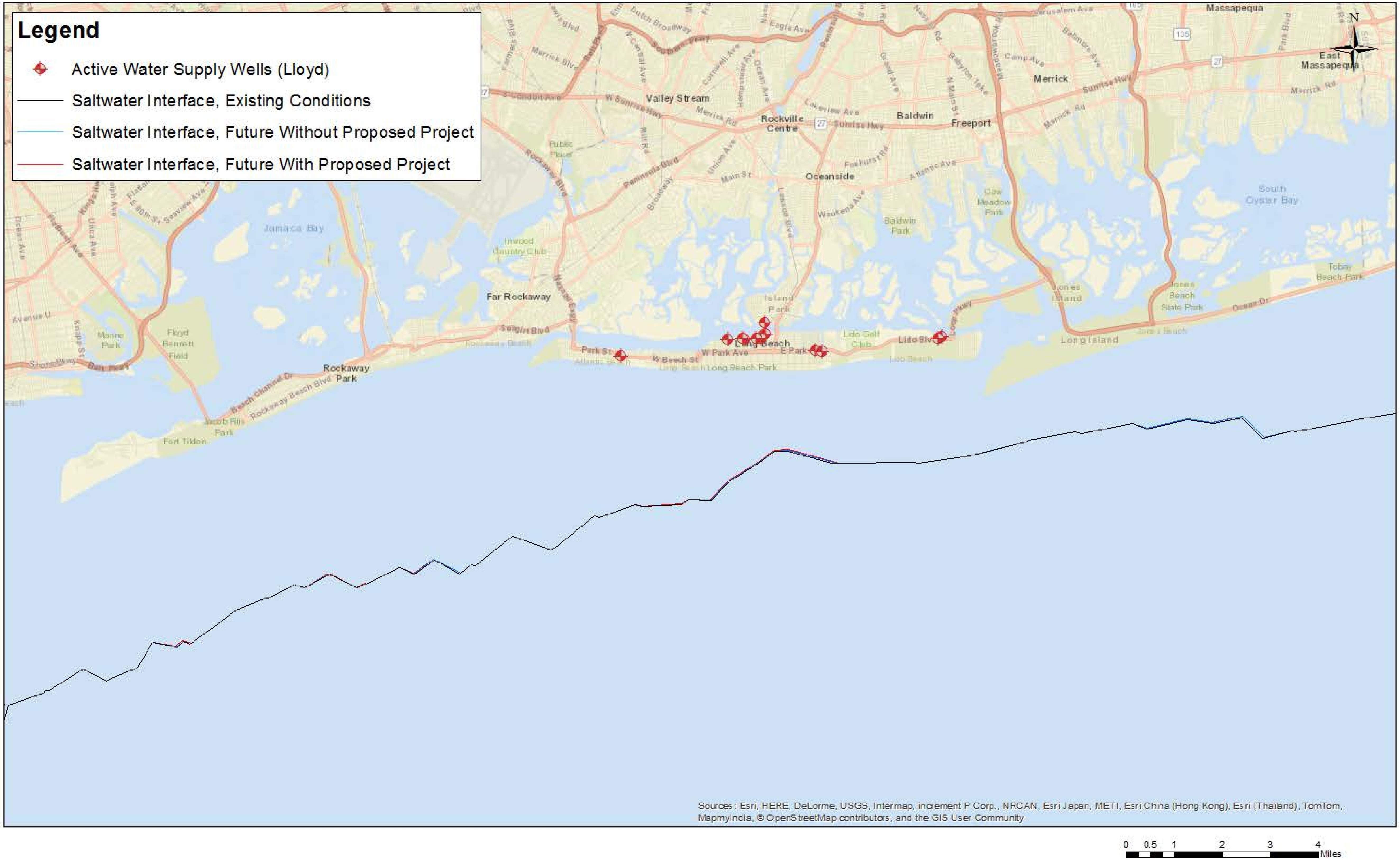

Figure 3.5-31: Saltwater Interface Location, Lloyd Aquifer (South Shore) - Scenario B (68 mgd for 2 Years)

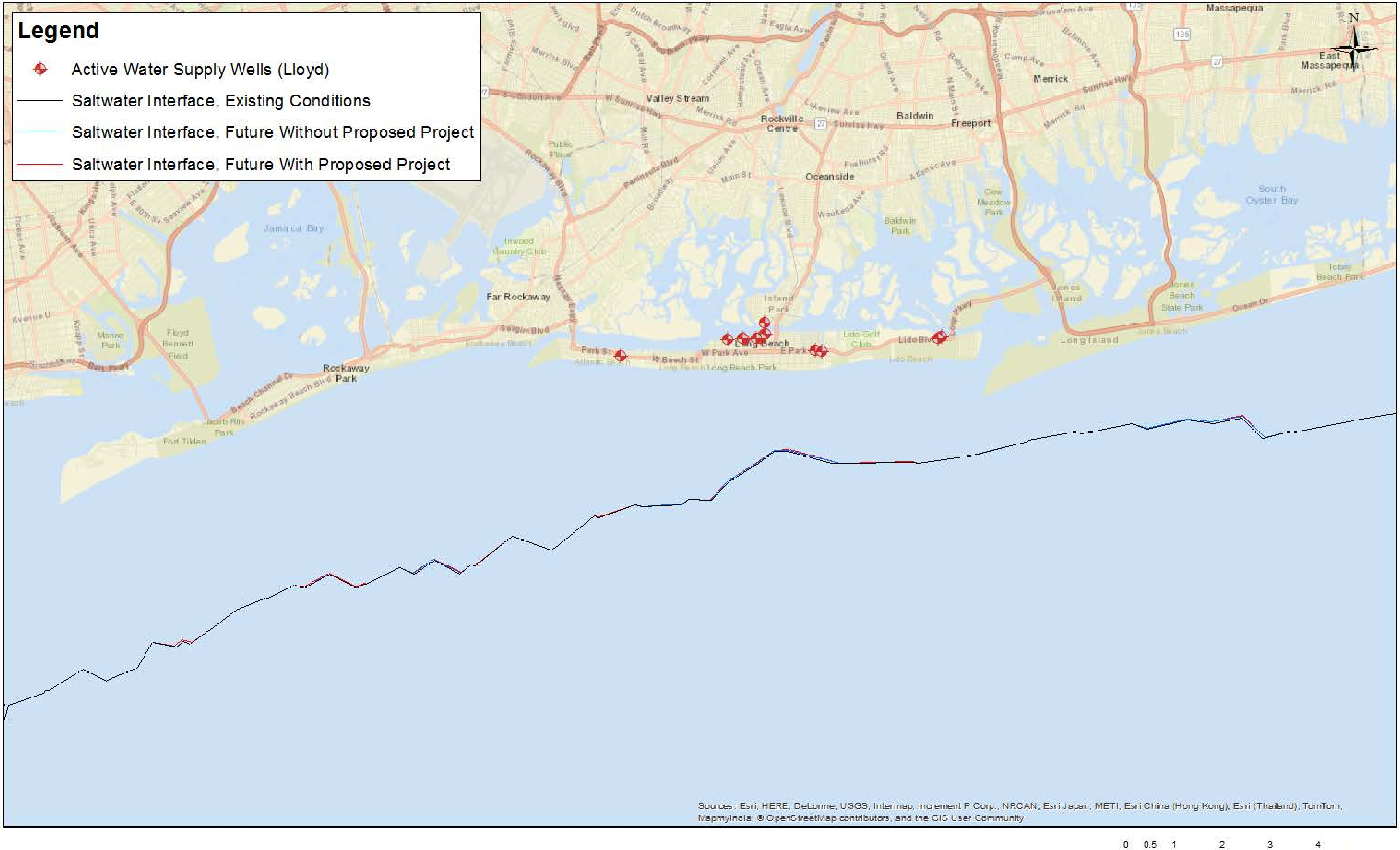

Figure 3.5-32: Saltwater Interface Location, Lloyd Aquifer (South Shore) - Scenario C (68 mgd for 3 Years)

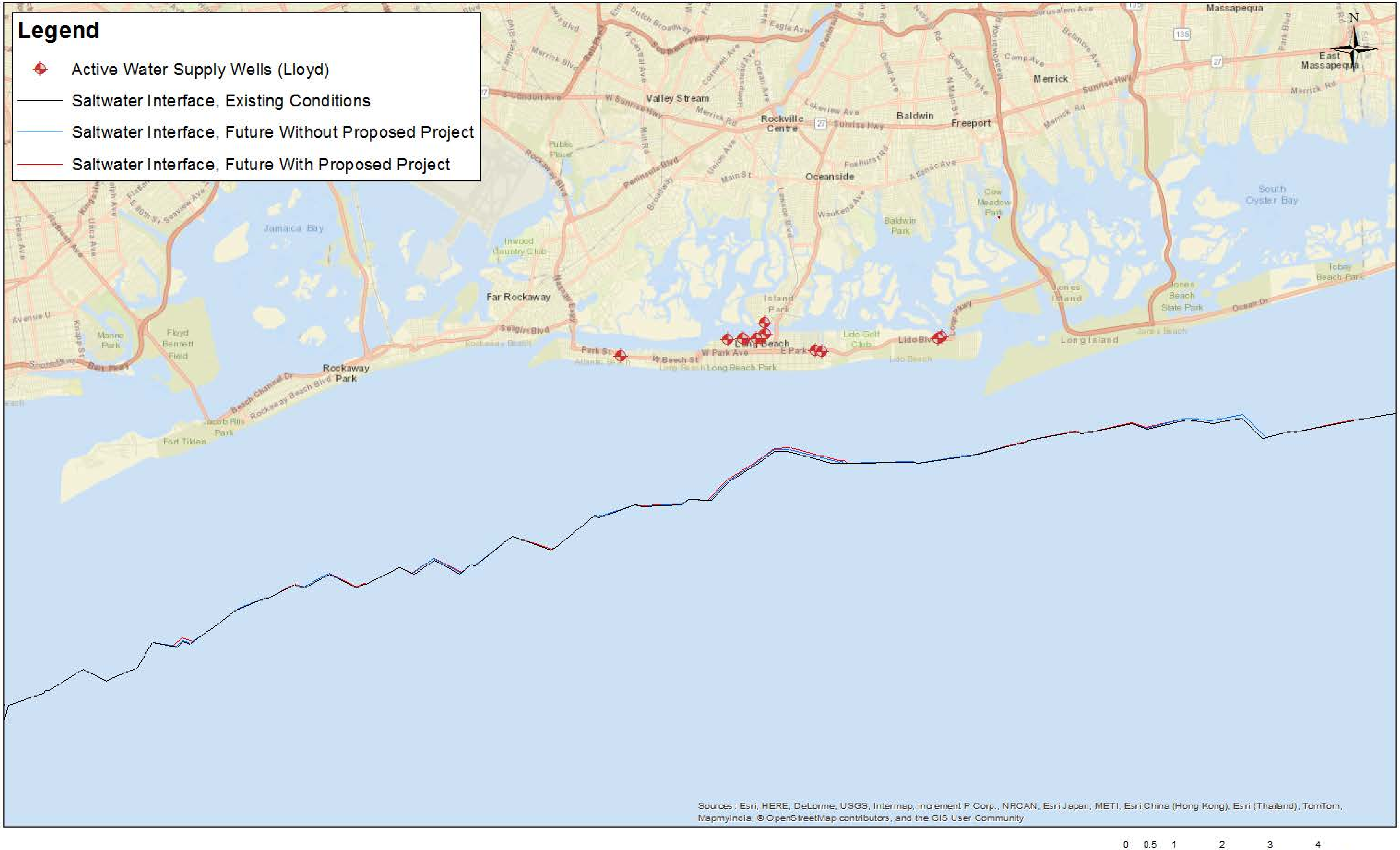

Figure 3.5-33: Saltwater Interface Location, Lloyd Aquifer (South Shore) - Scenario D (62 mgd for 5 Years)

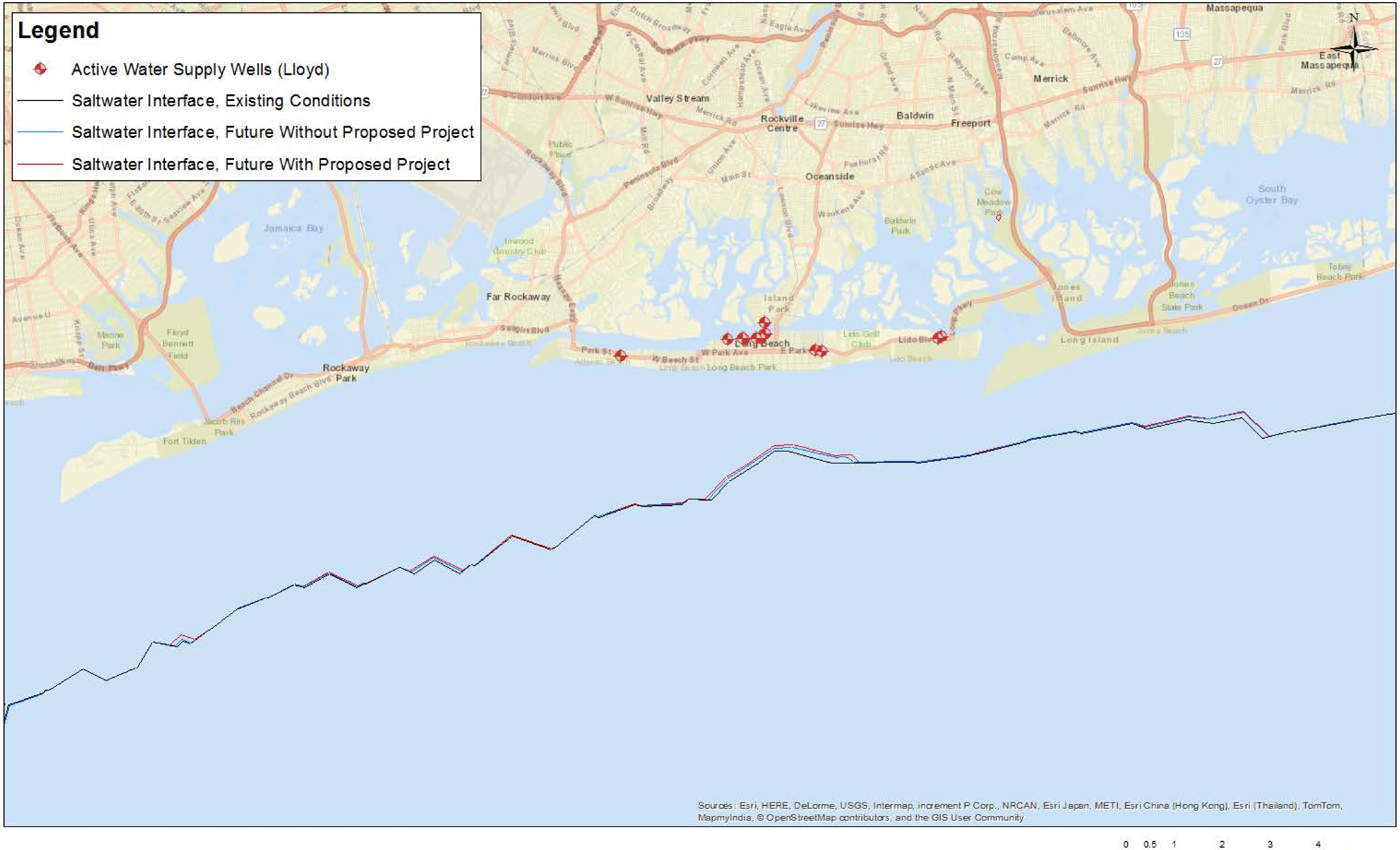

Figure 3.5-34: Saltwater Interface Location, Lloyd Aquifer (South Shore) - Scenario E (62 mgd for 10 Years)

Figure 3.5-35: Saltwater Interface Location, Lloyd Aquifer (South Shore Near Long Beach) - Scenario A (68 mgd for 1 Year)

Figure 3.5-36: Saltwater Interface Location, Lloyd Aquifer (South Shore Near Long Beach) - Scenario B (68 mgd for 2 Years)

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Figure 3.5-37: Saltwater Interface Location, Lloyd Aquifer (South Shore Near Long Beach) - Scenario C (68 mgd for 3 Years)

Figure 3.5-38: Saltwater Interface Location, Lloyd Aquifer (South Shore Near Long Beach) - Scenario D (62 mgd for 5 Years)

Figure 3.5-39: Saltwater Interface Location, Lloyd Aquifer (South Shore Near Long Beach) - Scenario E (62 mgd for 10 Years)

The range of simulated interface movements shown in these figures are summarized in **Table 3.5-6.**

Table 3.5-6: Saltwater Interface Movement in the Lloyd Aquifer near Long Beach, Nassau County

Scenario	Maximum Saltwater Interface Movement - Future Without Proposed Project Pumping (Feet)	Additional Maximum Saltwater Interface Movement due only to Future With Proposed Project Scenario Pumping (Feet)	Total Maximum Saltwater Interface Movement - Future With Proposed Project Scenario Pumping (Feet)
Scenario A	90	< 10	< 100
Scenario B	160	50	210
Scenario C	225	105	330
Scenario D	375	180	555
Scenario E	725	280	1,005

The following factors create uncertainties associated with the modeled position of the saltwater interface in the Lloyd Aquifer along the south coast of Long Island:

- This portion of the saltwater interface is believed to reside offshore where data collection is challenging and requires expensive offshore wells to be drilled and installed. To date, no offshore data are available.

- The thickness of the saltwater wedge (the portion of saltwater present at the bottom of the Lloyd Aquifer) can vary significantly over distance. Therefore, there is the potential for very thin (less than 1 foot) lenses of saltwater to be present, but undetected onshore with thicker portions of the wedge (1 foot or greater) still offshore.

- The movement of the saltwater interface is spatially variable and dependent on both the hydraulic gradients and the slope of the contact between the bottom of the Lloyd Aquifer and the underlying bedrock. Due to the limitations in offshore data noted above, the contact elevations (and slope) between the Lloyd Aquifer and the bedrock are estimated based on the onshore data and regional geologic interpretations.

- The Magothy Aquifer saltwater interface position onshore is north of the Long Beach pumping wells, indicating the presence of saltwater above the Lloyd Aquifer on Long Beach. This creates the potential for downward leakage of saltwater through well casings or less competent portions of the Raritan clay and ultimately into the Lloyd Aquifer and the Long Beach monitoring and supply wells.

- Chloride concentrations from water quality samples taken at Long Beach monitoring and supply wells have shown variability over the years. As noted above, the source of these chlorides could be from vertical leakage or horizontal intrusion.

As a result, and in order to provide an even more conservative assessment of the results presented above, the starting location of the Lloyd Aquifer saltwater interface along the south shore was moved approximately 1 mile inward towards the shoreline. The model was then rerun for Existing Conditions, Future without the Proposed Project and Future with the Proposed Project Scenario E conditions. The results of this more conservative assessment are shown on **Figure 3.5-40** and **Table 3.5-7**. The simulations indicate that under the Future without the Proposed Project condition the saltwater interface would move approximately 100 to 450 feet inland over 10 years, relative to a more conservative initial location of the saltwater interface. The additional inland movement under the Future with the Proposed Project associated with Scenario E would be minimal in some areas and ranges up to an additional approximately 150 feet in other areas. These saltwater interface movements would be less than what was simulated under the base model (without adjustments to the location of the saltwater interface). The lower overall movement of the interface would be due to the steeper contact slope between the Lloyd Aquifer and the underlying bedrock at this location which would slow the landward movement of the saltwater interface.

As noted above, there are uncertainties about these contact elevations (and slopes), as well as the starting interface locations. However, as shown on **Figure 3.5-40**, the relative movement of the interface under the Future without the Proposed Project and Scenario E in the Future with the Proposed Project would remain consistent between the base model runs and the more conservative model runs. In both cases, the most significant interface movement is expected to continue to result from ongoing Long Beach withdrawals and not from future Queens supply well pumping. This would be expected to be the case for any starting interface position simulated and for any interpretation of Lloyd Aquifer bottom elevations (and slopes) used in the model.

Table 3.5-7: Saltwater Interface Movement in the Lloyd Aquifer near Long Beach, Nassau County, Sensitivity

Scenario	Maximum Saltwater Interface Movement - Future Without Proposed Project Pumping (Feet)	Additional Maximum Saltwater Interface Movement due only to Future With Proposed Project Scenario Pumping (Feet)	Total Maximum Saltwater Interface Movement - Future With Proposed Project Scenario Pumping (Feet)
Scenario E, Sensitivity[1]	450	150	600

Note:
[1] Over 10 year duration.

As the Proposed Project would not result in significant saltwater intrusion to the aquifer network studied, no potential significant adverse impacts to groundwater would occur.

Additional analyses were also conducted to better understand and disclose the potential pathways for the saltwater interface within the Lloyd Aquifer to advance towards the Long Beach supply wells. As noted above, the primary driver for saltwater interface movement towards the Long Beach supply wells is the groundwater movement in the area where supply wells in Long Beach wells are pumped. As the well pull water from all directions, the more groundwater that is pumped, the more water comes from offshore, therefore advancing the saltwater interface towards the wells. **Figure 3.5-41** shows the simulated groundwater level contours (2-foot intervals) in the Lloyd Aquifer near Long Beach associated with Future without the Proposed

Project conditions. Examination of these contours show the contours converging on the Long Beach pumping wells, which indicates that water is being removed faster from the aquifer at the wells. **Figure 3.5-42** shows the analogous contours associated with Scenario E, where the contours are at lower elevations and closer together (water moving faster) due to the Proposed Project pumping. In both instances, the groundwater flow directions, which are perpendicular to the contours, are similar, with flow converging on the Long Beach supply wells.

An additional simulation was likewise generated with Scenario E pumping condition, but without pumping from the Long Beach supply wells. The groundwater level contours associated with these conditions are shown on **Figure 3.5-43**. Under these conditions, groundwater flow does not converge on the Long Beach supply wells and is in fact nearly perpendicular to Long Beach, limiting further intrusion of the saltwater interface. Conclusions drawn from these three figures indicate that the saltwater interface movement in the vicinity of Long Beach would only be accelerated by Proposed Project pumping when coupled with Long Beach supply pumping.

Therefore, as a result of the analyses conducted, the Proposed Project is not anticipated to result in any significant adverse impacts to natural resources.

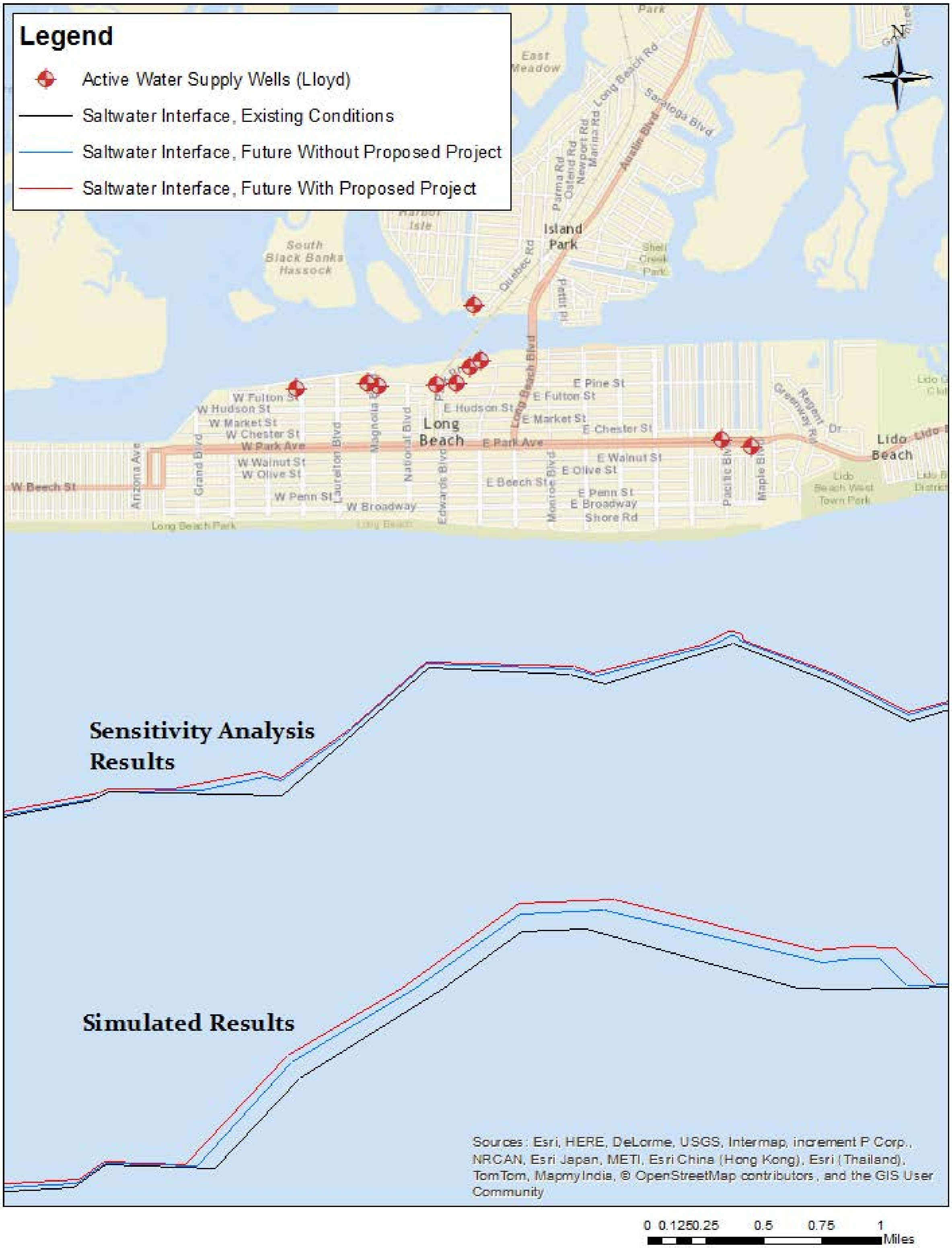


Figure 3.5-40: Saltwater Interface, Lloyd Aquifer (South Shore Near Long Beach) Scenario E (62 mgd for 10 Years), One Mile Inland

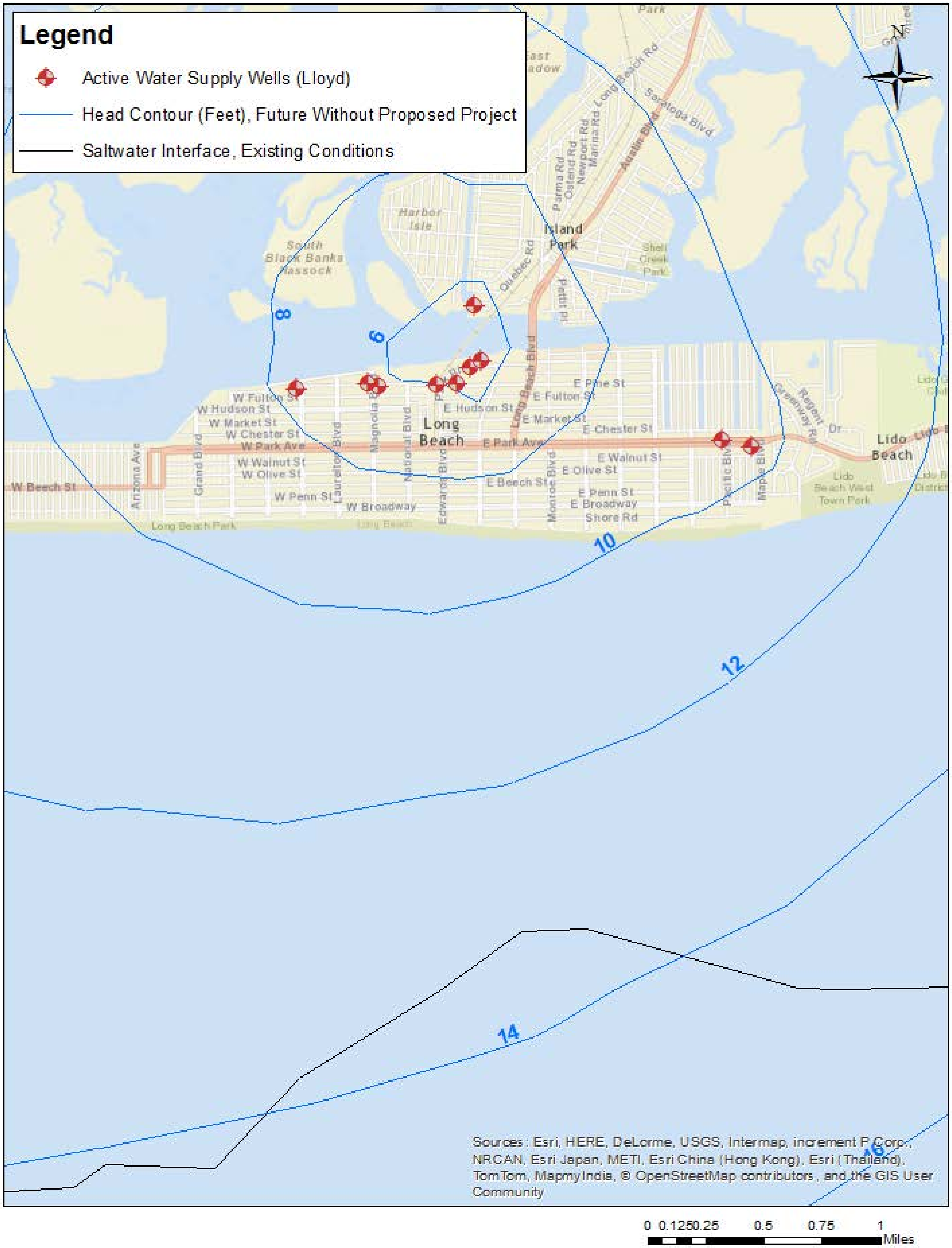


Figure 3.5-41: Groundwater Contours, Lloyd Aquifer (near Long Beach) – Future without the Proposed Project

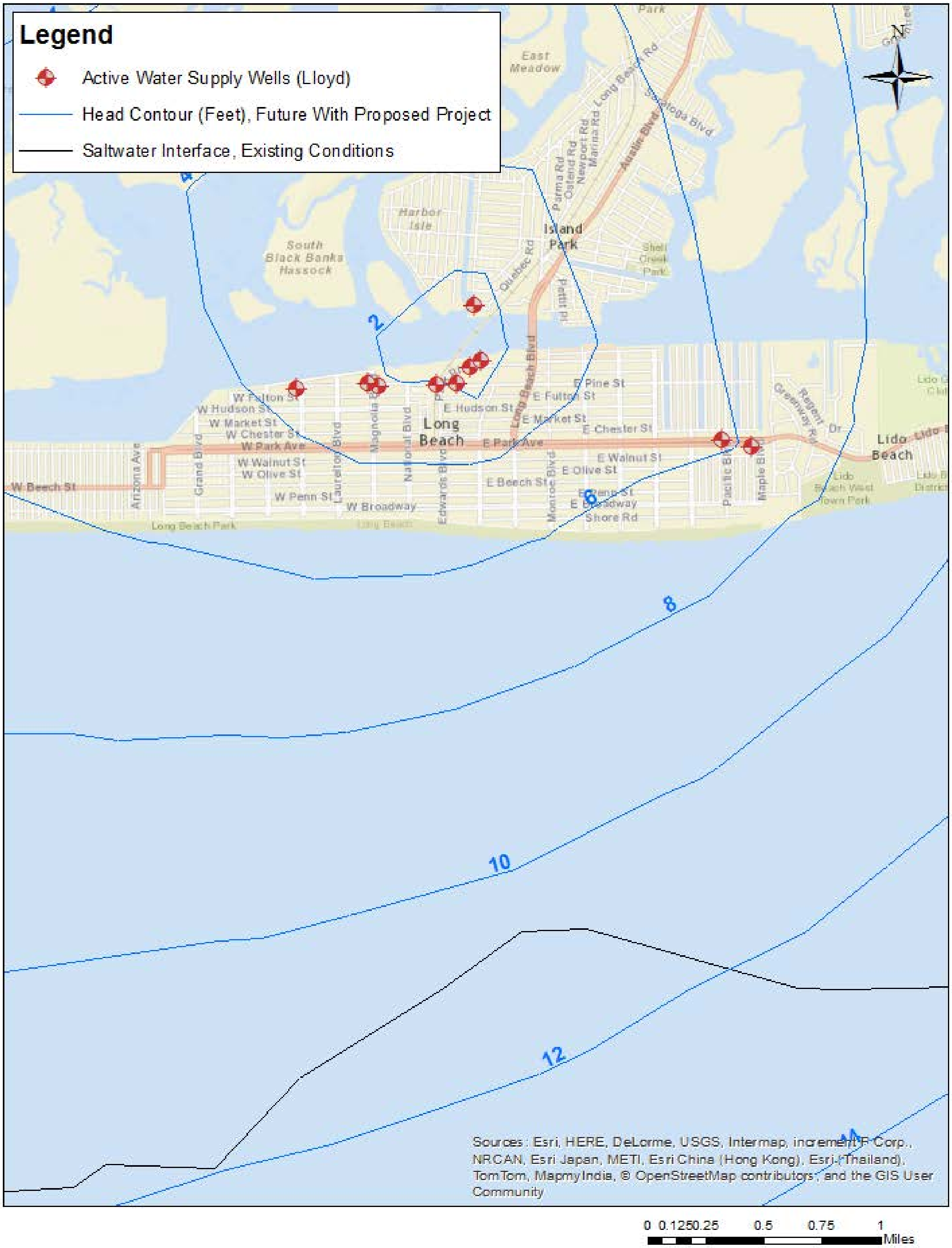


Figure 3.5-42: Groundwater Contours, Lloyd Aquifer (near Long Beach) – Future with the Proposed Project – Scenario E (62 mgd for 10 Years)

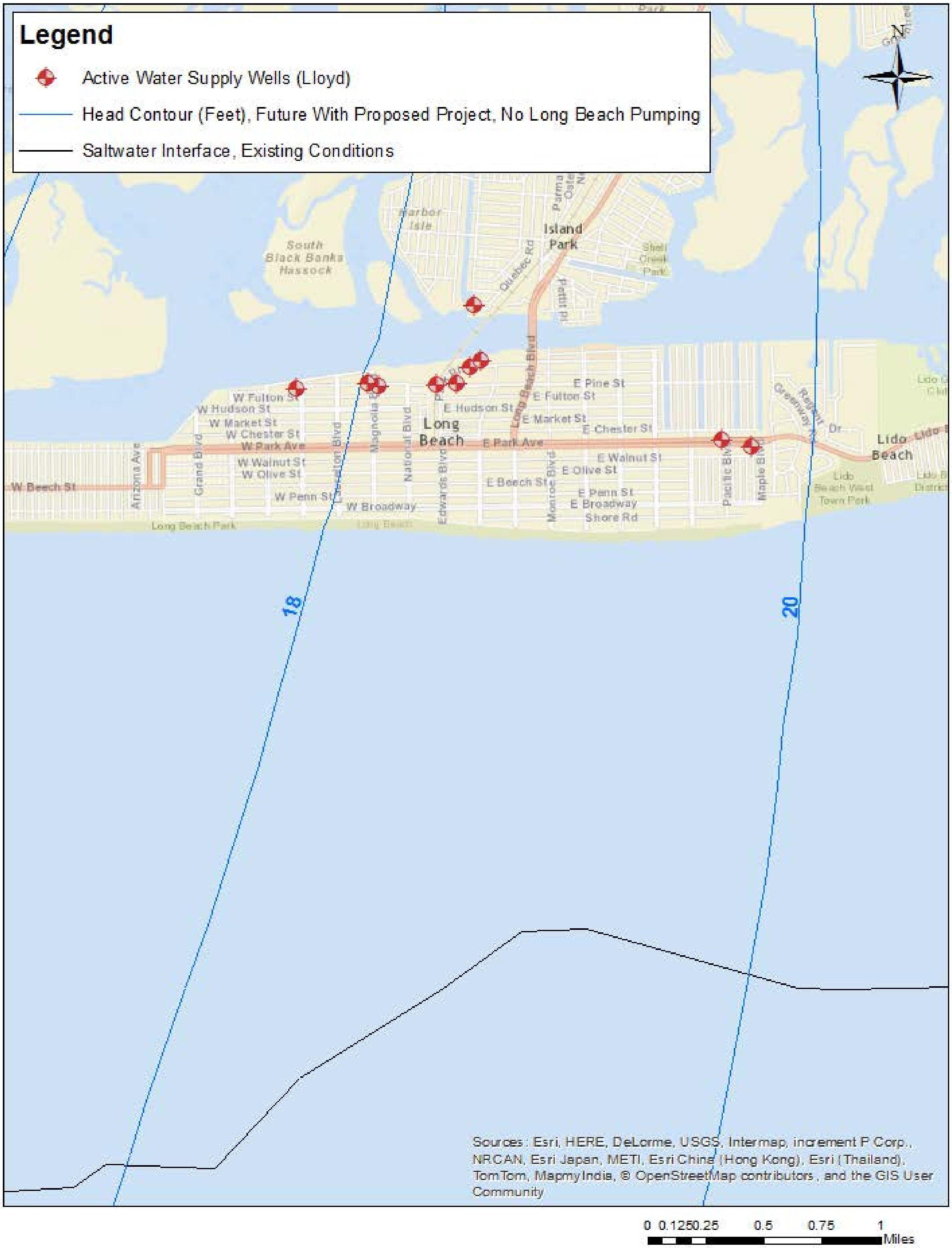


Figure 3.5-43: Groundwater Contours, Lloyd Aquifer (near Long Beach) – Scenario E (62 mgd for 10 Years) without Long Beach Pumping

3.6 HAZARDOUS MATERIALS

This section assesses the potential for impacts due to the Proposed Project on hazardous materials. This includes an assessment of potential impacts associated with the placement and operation of temporary treatment systems at up to 44 well stations within the Queens Groundwater system. In addition, this section also evaluates the potential impacts to existing groundwater systems serving Nassau and western Suffolk County that may be associated with the operation of the Queens Groundwater system and its potential effect upon known sources of groundwater contamination.

3.6.1 METHODOLOGY

3.6.1.1 Introduction

According to the *CEQR Technical Manual*, an analysis of hazardous materials focuses on whether a proposed project may increase the exposure of people or the environment to hazardous materials, and if this increased exposure would result in a potential significant public health or environmental impact.

The Proposed Project would not specifically generate hazardous materials, but does have the potential to affect existing hazardous materials that may be located at the Queens Groundwater stations during proposed construction of temporary treatment facilities. In addition, operation of the Queens Groundwater system may result in the movement of existing sources of hazardous or contaminated materials that are present today within soils and groundwater not located at the Queens well stations. The aquifers from which the Queens Groundwater system and Nassau and western Suffolk County water suppliers source water are impacted by multiple types of contamination including, but not limited to VOCs, nitrates, and perchlorate due to human activities. Contamination of the aquifers is widespread, with numerous plumes of contamination, some of which are well documented by federal and/or State agencies, and other plumes that are not clearly defined or even known.

Groundwater plumes are areas where a contaminant was released to the subsurface (such as through a leak in an underground storage tank), migrated to the aquifer, and has then moved with the groundwater. These plumes can move at the same speed as the groundwater or be slowed, transformed, or destroyed due to physical and/or chemical reactions within the aquifer. Regardless of these reactions, a plume of dissolved contaminants will always move in the same direction as the groundwater. If a plume is located within the capture zone (i.e., the area from which water is pumped) of a pumped well, the dissolved contaminants would be extracted by the well along with the flowing groundwater.

3.6.1.2 Queens Groundwater Well Stations

Well Stations

As the Proposed Project would potentially result in soil disturbance at the Queens well stations due to the placement of temporary treatment systems, an assessment of potential impacts associated with hazardous materials is presented based upon historic reports. Phase I Environmental Site Assessments (ESA) were previously completed by DEP and included findings of site visits to the proposed Queens Groundwater well stations, an evaluation of readily available historical information, and a search of selected environmental databases and electronic records in accordance with American Society for Testing and Materials (ASTM) E1607. In addition, Phase II ESAs were also previously performed at all well stations to identify any environmental liabilities associated with the former Jamaica Water Supply Company properties (i.e., DEP's Queens Groundwater system).

As part of the 1996 Phase I ESAs at the well station properties, the entire sites were traversed to observe environmental conditions and identify any obvious environmental concerns. Accessible areas of each station were visited to observe the potential presence of hazardous substances, hazardous wastes, or inappropriate material handling practices. The number of buildings, chemicals stored on-site, station history, and surrounding station history were included in the assessment. The subsequent 1998 Phase II ESA investigations involved the identification and quantification of any lead-based paint surfaces, asbestos-containing materials (ACM), and soil and groundwater sampling.

Based upon a review of these prior investigations, a summary of conditions noted at the well stations related to hazardous materials is presented. Potential measures that would be implemented as part of the potential implementation and operation of the temporary treatment systems is provided.

Groundwater Supply

The Proposed Project may involve the use of up to 44 well stations in southeast Queens as a source of potable water supply during periods of water supply shortage. Operation of these wells would therefore have the potential to impact existing groundwater quality due to existing contamination within the aquifers and/or additional off-site sources of groundwater contamination.

The New York City Groundwater Model, as discussed in Section 3.5, "Natural Resources," is a regional planning tool and is not currently calibrated to accurately predict potential plume migration between and within the specific capture zones of each of the wells within the Queens Groundwater system. Therefore, the analysis of potential impacts to Queens Groundwater is assessed through an overall qualitative summary of existing groundwater quality based upon historic sampling. Potential impacts to groundwater are then discussed qualitatively and a more detailed discussion of the initial sampling that would be instituted as part of the Proposed Project is discussed and the use of this data to ensure that the temporary treatment systems are adequate to meet water quality standards for groundwater pumped from the aquifer, while also providing flexibility to modify treatment or consider operating different wells. A general discussion of the water quality monitoring program that would be required during operation of the Queens Groundwater system under applicable federal, State, and local regulations is also provided. Existing programs, such as DEP's Wellhead Protection Program are also discussed.

3.6.1.3 Nassau and Western Suffolk County

An assessment of the potential impact of the Proposed Project on aquifers located beneath Nassau and western Suffolk County is less dependent on the specifics of which wells would be operated within the Queens Groundwater system and more dependent on the overall pumping rates and durations. The New York City Groundwater Model, discussed in more detail in Section 3.5, "Natural Resources," as a regional planning tool is appropriate to evaluate the potential impacts to supply wells in Nassau and western Suffolk County due to hazardous materials associated with contaminant plumes within the groundwater.

The New York City Groundwater Model simulates the flow velocity and direction at all computational nodes within the model domain (see Section 3.5, "Natural Resources"). Comparisons of groundwater flow directions simulated during Future without the Proposed Project to those simulated during the Future with the Proposed Project operating scenarios were used to identify where directions of flow would be expected to change. These changes in directions of flow were then used to identify known plumes sites that had the potential to be influenced by the Proposed Project.

NYSDEC identified known groundwater plume sites of concern for consideration in this analysis. Groundwater plumes to the east of the Meadowbrook Parkway were not examined further because the groundwater flow directions are not expected to change substantively in those areas due to the Proposed Project. The list of plume sites provided by NYSDEC are listed in **Table 3.6-1** and shown on **Figure 3.6-1**. If a plume was identified as having the potential to change flow direction due to the Proposed Project, it was further analyzed to determine if a water supply well would potentially be impacted by the contamination associated with the plume. The analysis utilized simulated flow pathlines to model the movement of a water particle from a known plume location in the future under the operating scenarios that were identified in Chapter 2.0, "Analytical Framework," (i.e., Scenario A to E) for the Proposed Project. A flow pathline comparison of Future without the Proposed Project groundwater flows with the Future with the Proposed Project was conducted and a discussion of any substantive changes to the potential plume path(s) is discussed.

Table 3.6-1: Plume Sites of Concern and Primary Contaminants Identified by NYSDEC[46]

Site Name	Address	Primary Type of Contaminant
150 Community Drive	150 Community Drive, Great Neck	VOC
400 Lakeville Road	400 Lakeville Road, New Hyde Park	cVOC
Unisys Corporation	1111 Marcus Avenue, Lake Success	cVOC
Zoe Chemical Co	1801 Falmouth Avenue, New Hyde Park	cVOC
Tres Bon Cleaners	197 Franklin Avenue, Franklin Square	cVOC
Peninsula Boulevard	Peninsula Boulevard, Hewlett	cVOC
Former Darby Drugs	80-100 Banks Avenue, Rockville Centre	cVOC
Fulton Avenue	150 Fulton Avenue, Garden City Park	cVOC
Imperial Cleaners	218 Lakeville Road, Lake Success	cVOC
Former Shell Service Station	650 Hillside Avenue, New Hyde Park	VOC

Notes:
VOC: volatile organic compounds
cVOC: carcinogenic volatile organic compounds

[46] Based on correspondence received from NYSDEC Region 1 on August 11, 2017.

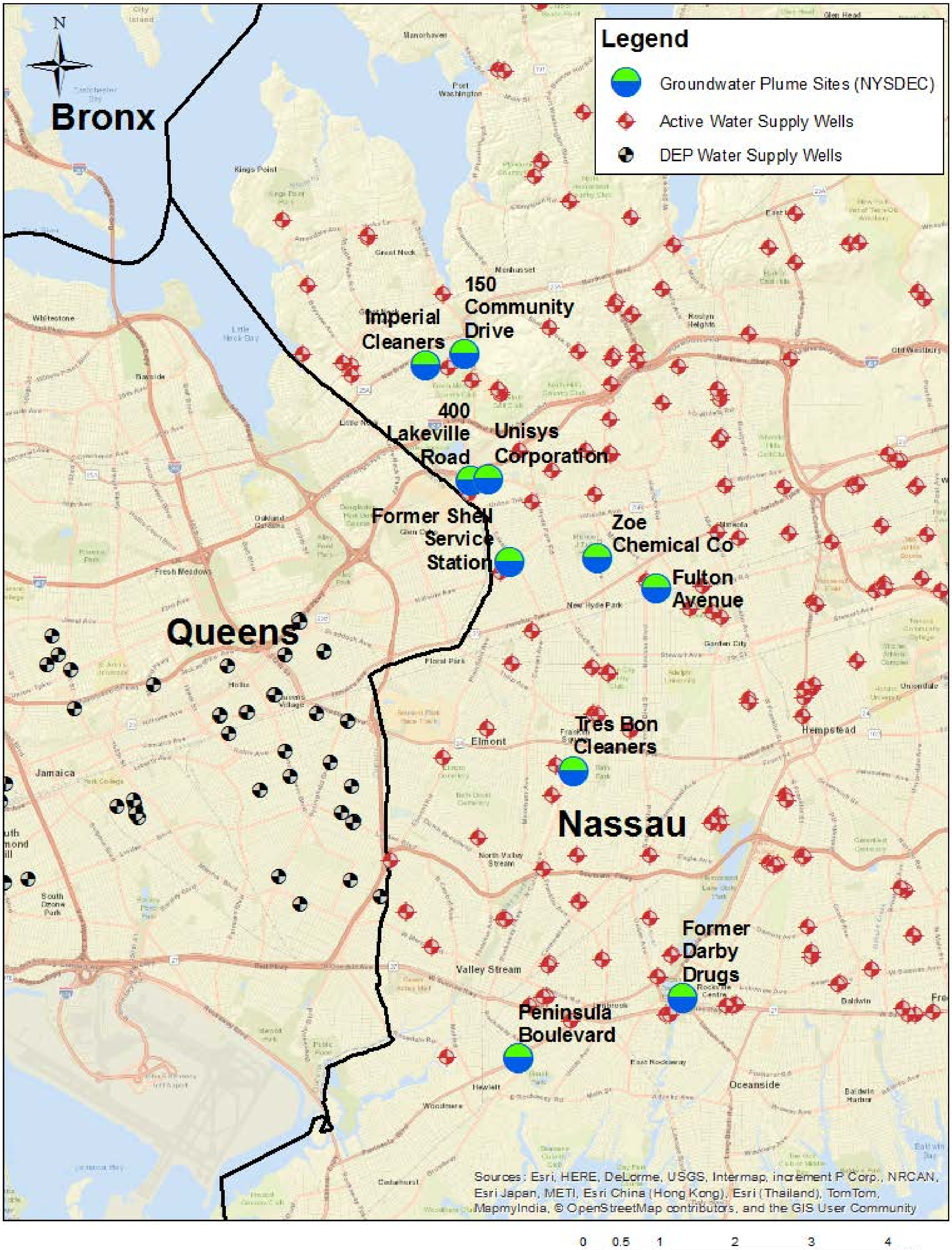


Figure 3.6-1: NYSDEC Identified Plume Sites of Concern

3.6.2 EXISTING CONDITIONS

3.6.2.1 Queens Groundwater Well Stations

Well Stations

The Queens Groundwater well stations typically contain one, single-story or subgrade brick building with at least one water supply pumping well. The station properties are surrounded by a perimeter fence and typically contain one dry well and a driveway for access. For those stations that are known to contain VOCs in the groundwater, a treatment building may be present in addition to the brick well building. Several stations contain more than one well or wells that were previously closed due to groundwater contamination.

Phase I ESAs were completed by DEP in 1996 as part the City’s acquisition of those elements of the former Jamaica Water Supply Company in Queens. These Phase I ESAs included the results of site visits for each well station, a summary of readily available historical information, and information from selected environmental databases and electronic records. Based on the 1996 Phase I and 1998 Phase II ESA reports, the majority of well stations at that time were noted to have mercury-contaminated materials beneath on-site mercury traps; ACM was present; and lead-based paint was noted on building surfaces. Chemicals stored on-site during these prior ESAs were inventoried and typically consisted of plastic 100-gallon tanks containing fluoride, bleach, or other water quality treatment chemicals.

The Phase II ESAs, conducted in 1998, were performed to identify any environmental liabilities associated with the former Jamaica Water Supply Company properties. Dependent on the well station conditions and what was reported during the Phase I ESAs, mercury, soil, and groundwater were sampled to assess potential levels of contamination. During the Phase II ESA investigations, sludge, sediment, and other materials in building drains and sumps were sampled to determine whether the material had been contaminated by leaks and spills of mercury used in gauges and other on-site apparatus. Lead-based paint and ACM were identified or assumed at all of the well stations due to their age. When a soil boring program was completed, soils were sampled for semi-volatile organic compounds (SVOCs), metals, pesticides, and polychlorinated biphenyls (PCBs). If a groundwater monitoring well was installed, groundwater was sampled for VOCs, SVOCs, PCBs, and metals.

Table 3.6-2 provides a summary of those well stations that were noted to have elevated levels of contaminants within groundwater and soils at that time. Contaminants of concern by well station are also provided in **Table 3.6-2**.

Based upon the previously completed Phase I and II ESAs, mercury contamination from gauges was identified and ACM and lead-based paint were present at all well station buildings. Many of the well stations presented in **Table 3.6-2** experienced elevated levels of VOCs and iron in the groundwater. Sixteen of the 44 well stations also had elevated levels of contaminants in shallow surface soils. Several of these shallow surface samples were taken near elevated water storage tanks. Station 49, as part of these prior studies, had a groundwater sample that contained 6,600 parts per billion of benzene compared with a New York State Class GA groundwater standard of one part per billion.

Table 3.6-2: Well Stations with Groundwater and Soil Contamination Based upon Historic Phase I and II Environmental Site Assessments

Well Number	Station	Contaminants of Concern
1	1	Historic high levels of VOCs in groundwater
3	3/3A	Elevated levels of VOCs in groundwater
5	5/5A	Elevated levels of VOCs in groundwater (removed by VOC treatment building) Elevated levels of zinc in soils
6	6/6A/6B 6C/6D	High iron concentrations in groundwater Elevated levels of VOCs in groundwater Elevated levels of lead and zinc in soils
8	8A	Slightly elevated levels of SVOCs in soils
11	11	Elevated iron levels in groundwater Slightly elevated levels of SVOCs in soils
14	14	Elevated iron levels in groundwater
18	18/18A	Elevated levels of chromium, lead, and zinc in soil surrounding elevated tank
21	21/21A	Elevated levels of chromium, lead, and zinc in soils
22	22	Elevated levels of VOCs in groundwater Elevated levels of lead and zinc in soils
23	23/23A	Elevated levels of chromium, lead, and zinc in soils
26	26/26A	Elevated levels of VOCs in groundwater
27	27	Elevated levels of lead and zinc in soils
29	29/29A	High organic concentrations in groundwater
33	33	Elevated levels of antimony in groundwater Elevated levels of SVOCs and metals in the soil
36	36	Elevated levels of chromium, lead, and zinc in soil surrounding elevated tank
37	37	Elevated levels of iron in groundwater
38	38/38A	Elevated levels of VOCs in groundwater Elevated levels of antimony and sodium in groundwater Elevated levels of SVOCs and metals in soil
39	39/39A	Elevated levels of organics in groundwater Elevated levels of tetrachloroethene, alpha-chlordane, antimony, and sodium in groundwater Elevated levels of SVOCs and metals in soils
41	41	Elevated levels of organics in groundwater
42	42/42A	Elevated levels of iron in groundwater
43	43/43A	Elevated levels of VOCs in groundwater
47	47/47A	Elevated levels of antimony and sodium in groundwater
48	48/48A	Elevated levels of VOCs in groundwater Elevated levels of lead and zinc in soils
49	49/49A	Elevated levels of VOCs in groundwater Gasoline contamination in groundwater (benzene, MTBE, tetrachloroethene)
50	50/50A	Elevated levels of VOCs in groundwater (removed by VOC treatment building)
51	51	Elevated levels of VOCs in groundwater Elevated levels of PAHs in surface soils
53	53/53A	Elevated levels of VOCs in groundwater (removed by VOC treatment building)
54	54/54A	Elevated levels of VOCs in groundwater
56	56	Elevated iron levels in groundwater Elevated levels of lead and zinc in surface soils
58	58	Elevated VOCs in groundwater (removed by VOC treatment building)
60	60	Elevated levels of iron in groundwater

Groundwater Supply

Results of previous Phase I and II ESAs conducted for the Queens Groundwater system have shown the presence of numerous potential sources of groundwater contamination within this portion of Queens. This is based predominately on a review of federal and State databases of known releases and potential sources. Similarly, while these reports do not include unknown or undocumented sources, water suppliers often cannot identify the source of contamination impacting their wells, suggesting that unknown plumes exist within the aquifers.

Historical water quality of the Queens Groundwater wells confirms that plumes of VOCs and other contaminants are prevalent throughout most of the aquifers in Queens, with exception of the Lloyd, and currently impacts wells comprising the Queens Groundwater system. Commonly detected VOCs include, but are not limited to, tetrachloroethylene (PCE), methyl tertiary butyl ether (MTBE), trichloroethylene (TCE), various forms of Freon, and cis-1,2-dichloroethylene (cis,1,2-DCE). In addition to VOCs, existing groundwater quality within the Queens Groundwater system indicates the presence of a variety of naturally occurring inorganic contaminants (e.g., iron and manganese), as well as a number of other inorganic contaminants more indicative of soil and/or groundwater contamination from historic industrial uses, agriculture, and other sources (e.g., nitrate and perchlorate).

3.6.2.2 Nassau and Western Suffolk County

Historically, the general water quality found in the aquifers on Long Island has been exceptionally good. However, since the 1970s, water quality has deteriorated in many areas throughout Nassau and western Suffolk County[47]. This deterioration is primarily due to large increases in industrial chemical usage, lack of sewers in certain densely populated areas, the continued application of fertilizers, the application of increasing amounts of pesticides and herbicides, leaking underground fuel storage tanks, and unlined landfills. In addition, within the past 30 years, there has been a dramatic improvement in the ability to test for even more minute concentrations of contaminants. From the 1940s through the 1960s, the water quality issues in Nassau and western Suffolk County were related to parameters such as pH, hardness, iron, dissolved solids, chlorides, nitrates, and bacteria. The continuing improvement of analytical equipment, combined with ongoing research of hazardous drinking water contaminants, has resulted in the incorporation of organic compounds, inorganic compounds, radioactive compounds, and various other compounds represented in current drinking water standards. The Nassau and western Suffolk County water supply facilities are similar in nature to the Queens Groundwater system, impacted by point and non-point sources of contamination existing around the various well capture zones.

More recent typical contaminants of concern that are routinely encountered in Nassau and Suffolk County groundwater include the historic contaminants of iron, manganese, and nitrates, and newer contaminants that have been identified since the 1970s including, but not limited to, VOCs such as PCE, MTBE, and TCE, and inorganic contaminants such as perchlorate.

[47] State of the Aquifer 2016, Long Island Commission for Aquifer Protection at http://www.liaquifercommission.com/images/LICAP_State_of_the_Aquifer_2016.pdf

3.6.3 FUTURE WITHOUT THE PROPOSED PROJECT

3.6.3.1 Queens Groundwater Well Stations

Well Stations

Under the Future without the Proposed Project, the Queens Groundwater well stations would remain as they currently exist, with operations remaining similar to those under Existing Conditions. Elevated levels of contaminants in soils, as listed in **Table 3.6-2**, are residual contaminants which would not be an issue of concern unless the materials are disturbed. No specific hazardous materials conditions requiring action would be anticipated and no significant change in Existing Conditions related to potential hazardous materials at these locations would be anticipated.

As part of an independent project (CEQR No: 15DEP008Q), existing water tanks originally constructed between 1905 and 1932, at Stations 1, 19, 21, 22, and 39 would be removed in 2018 or 2019. Prior Phase 1 and II ESAs had indicated the location of elevated levels of contamination in surface soils in proximity to some tanks. In addition, DEP would also close-out and remove chemical bulk chemical storage tanks at Stations 10, 23, 36, 39, 56, and 59 in the Future without the Proposed Project.

Groundwater Supply

In the Future without the Proposed Project, no substantive change in the existing operation of the Queens Groundwater system would occur. Known and unknown plumes in Queens would continue to migrate within the aquifers as they do today with little or no impact upon this movement due to the ongoing maintenance and limited operation of the Queens Groundwater system. Simulated groundwater flow direction in the Upper Glacial Aquifer in the Future without the Proposed Project would be as shown on **Figure 3.6-2**. Groundwater flow velocity is not shown as part of this figure. Direction of groundwater flow would generally be towards the north and south shores of Long Island, with a groundwater divide located roughly along the Route 25/Northern State Parkway corridor in eastern Queens and Nassau County. The only location where groundwater may flow from Queens into Nassau County would be along the west to east section of Route 25 between the Cross Island Parkway and Little Neck Parkway. Along this stretch, flow would be north to south from Queens into Nassau County. Along the rest of the Queens/Nassau border, flow would either be from Nassau County into Queens, or would be roughly parallel to the county line. No substantive change in groundwater flows would occur under the Future without Proposed Project condition.

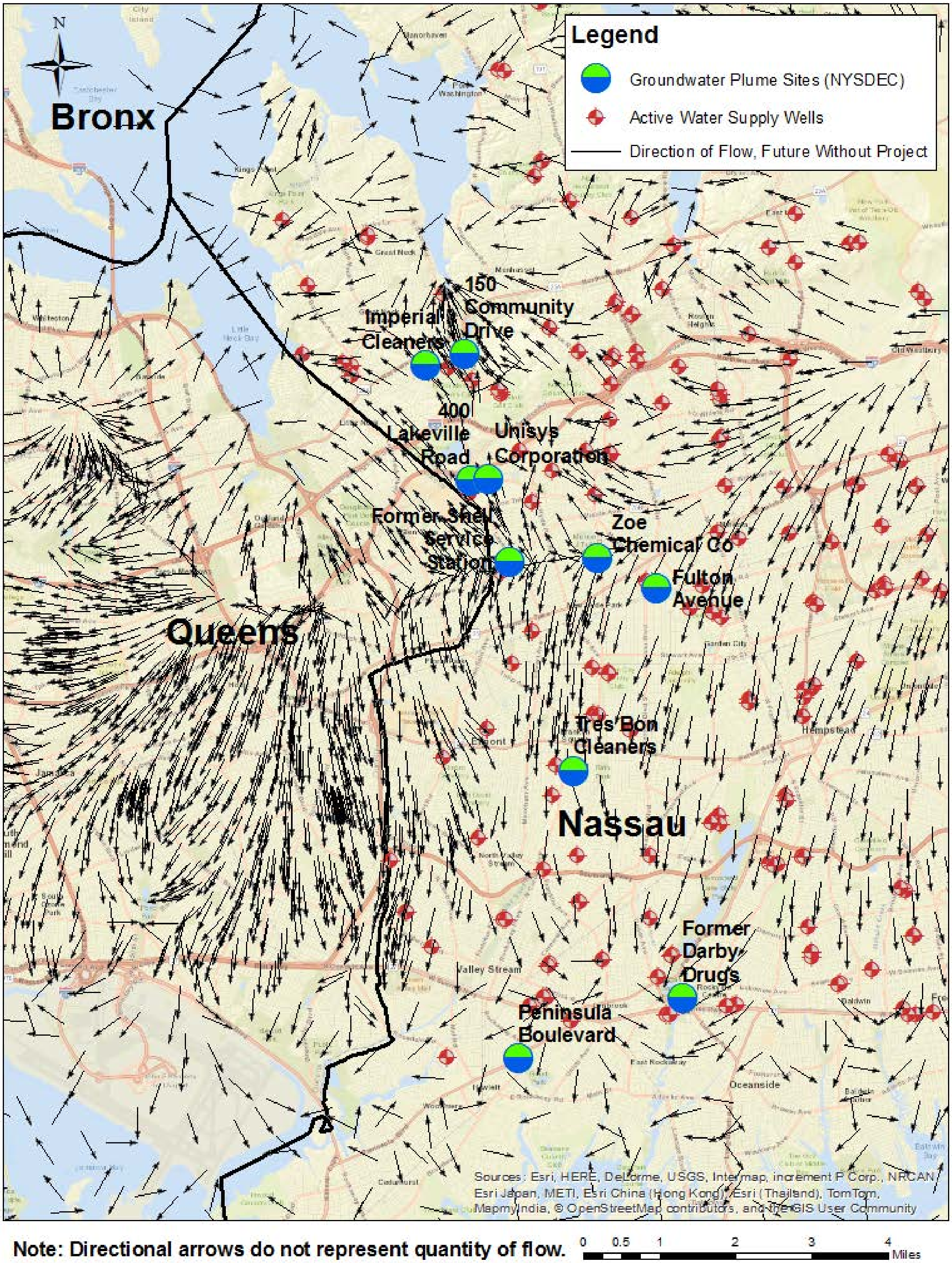


Figure 3.6-2: Simulated Groundwater Flow Direction – Future without the Proposed Project (Upper Glacial Aquifer)

3.6.3.2 Nassau and Western Suffolk County

In the Future without the Proposed Project, DEP would continue to maintain the Queens Groundwater system consistent with its current limited operations. No substantive change or impacts to groundwater flow direction in the Upper Glacial Aquifer (see **Figure 3.6-2**) or related known and unknown contaminant plumes within the Nassau and western Suffolk County aquifers due to the existing usage of the Queens Groundwater system would occur. Similarly, in general, no substantive changes in the nature of existing NYSDEC identified plumes of concern would occur in the Future without the Proposed Project. Under the Future without the Proposed Project, the Former Shell Service Station plume would continue to migrate towards and potentially impact Well N-01958.

No substantive change or impacts to Nassau and Suffolk County water suppliers or the quality of their current supplies associated with the continuing maintenance of the Queens Groundwater system would occur.

3.6.4 FUTURE WITH THE PROPOSED PROJECT

3.6.4.1 Queens Groundwater Well Stations

Well Stations

The Proposed Project may entail the construction of a temporary concrete pad, placement of trailer-based facilities, and/or the interconnection of new or improvement of existing utility connections (e.g., electric, wastewater collection and water supply distribution) on the well stations. This may require limited tree removal, clearing, and shallow excavation to accommodate concrete pads and utility connections.

As part of the Proposed Project, if soil disturbance, excavation or removal is anticipated, appropriate sampling would be conducted prior to any construction to determine the potential presence of hazardous materials. Any soil that would be removed from the site would be tested as necessary, managed, and transported for reuse or potential disposal in accordance with applicable federal, State, and local requirements. Proper soil erosion and stormwater controls, as applicable, during construction would be implemented in accordance with NYSDEC and DEP requirements. As necessary, a site-specific construction health and safety plan (CHASP) would be prepared prior to the start of construction. The CHASP would be implemented during construction activities to minimize any potential exposure to contractors, construction workers or the public.

The proposed operation of the well stations would not result in the creation of hazardous materials, but would result in the generation of spent media (e.g., GAC, nitrate selective resin) used in the removal of various contaminants associated with groundwater treatment. Periodically, this media would need to be replaced and the used media would be classified according to its degree of potential hazard, and recycled and/or disposed of in accordance with applicable regulatory requirements. Likewise several chemicals would be required for operation of the temporary treatment at these wells. The use and storage use of these chemicals would be in accordance with applicable federal, State and local requirements for their storage and use. No impacts associated with management of waste materials from the water treatment processes or the use and storage of chemicals for water treatment would occur.

Placement and operation of temporary treatment systems as part of the Proposed Project would therefore not result in any significant adverse impacts related to hazardous materials.

Groundwater Supply

Under the Future with the Proposed Project, the DEP may utilize groundwater from up to 44 well stations and 68 wells for production of potable drinking water during a water supply shortage. As part of the Proposed Project, DEP would potentially implement temporary treatment systems at these wells in advance of the use of groundwater for public supply. Anticipated initial treatment would include, but not be limited to, oxidation and filtration vessels (OXF), Liquid-phase Carbon Absorption vessels (LCA) with GAC media, ion exchange with resin media (IXP/IXN), and chemical treatment to meet finished water quality requirements. Prior to implementation of temporary treatment systems, DEP would conduct water quality sampling of those wells to be used to confirm groundwater quality characteristics. If the wells selected for operation have detectable levels of contamination in the raw water, appropriate treatment would be deployed as necessary.

To ensure ongoing compliance with federal, State, and local drinking water standards, DEP would institute required regular monitoring of the untreated and treated well water quality for the duration of the water supply shortage. This monitoring would allow DEP to understand the type(s) and levels of treatment necessary to meet the water quality standards in effect at the time of the well use. This monitoring would also assist in the ultimate selection of the various wells needed to meet anticipated production demands associated with a specific water supply shortage. In addition, DEP would regularly monitor for the presence of unregulated and emerging contaminants as required by applicable federal (e.g., EPA), State and/or local agencies, as the presence of these contaminants would have the potential to modify DEP's selection of wells for operation under future water supply shortages. DEP would also continue to institute its ongoing wellhead protection program to limit potential contamination. Through these efforts, DEP would be able to proactively identify and address potential changes in or new contamination in groundwater wells that may be encountered during operation of the Proposed Project.

No potential significant adverse impacts due to hazardous materials are anticipated at the Queens well stations under the Proposed Project.

3.6.4.2 Nassau and Western Suffolk County

As part of the assessment of potential impact to water supply wells in Nassau and western Suffolk County due to the Proposed Project, the New York City Groundwater Model was used to identify those wells that were projected to experience a water table decline greater than 10 feet. These wells are summarized in **Table 3.6-3** for each operating scenario assessed.

Table 3.6-3: Water Supply Wells Exhibiting a Change in Water Table Elevation Greater Than 10 Feet Due to the Proposed Project

Well ID	Water District	Screened Aquifer	Scenario A Maximum Water Table Decline (Feet)	Scenario B Maximum Water Table Decline (Feet)	Scenario C Maximum Water Table Decline (Feet)	Scenario D Maximum Water Table Decline (Feet)	Scenario E Maximum Water Table Decline (Feet)
N-07482	Water Authority of Western Nassau County	Magothy	10.12	15.23	18.63	24.41	29.19
N-11037	Water Authority of Western Nassau County	Magothy		11.14	14.65	20.71	26.12
N-06744	Water Authority of Western Nassau County	Upper Glacial			10.45	15.9	21.38
N-06745	Water Authority of Western Nassau County	Magothy			10.43	15.88	21.36
N-05155	Water Authority of Western Nassau County	Upper Glacial			10.44	15.9	21.36
N-05156	Water Authority of Western Nassau County	Magothy			10.41	15.86	21.33
N-05145	New York American Water	Magothy			12.37	16.56	20.32
N-09613	New York American Water	Magothy			12.20	16.34	20.08
N-02414	Water Authority of Western Nassau County	Upper Glacial				14.08	18.39
N-04298	Water Authority of Western Nassau County	Magothy				11.44	16.48
N-07650	Water Authority of Western Nassau County	Magothy					13.54
N-07649	Water Authority of Western Nassau County	Magothy					13.52
N-08818	Franklin Square Water District	Magothy					13.43
N-07117	Franklin Square Water District	Magothy					13.42
N-01958	Water Authority of Western Nassau County	Lloyd					12.69
N-03605	Franklin Square Water District	Magothy					12.67
N-07548	New York American Water	Magothy					11.20
N-03603	Franklin Square Water District	Magothy					11.15
N-03604	Franklin Square Water District	Magothy					10.87
N-03881	Garden City Village	Magothy					10.60
N-13749	Manhasset-Lakeville Water District	Lloyd					10.46

Notes:
Scenario A: 68 mgd for 1 Year
Scenario B: 68 mgd for 2 Consecutive Years
Scenario C: 68 mgd for 3 Consecutive Years
Scenario D: 62 mgd for 5 Consecutive Years
Scenario E: 62 mgd for 10 Consecutive Years

Projected changes in direction of groundwater flow associated with Scenario A (green colored arrows) were superimposed on top of the Future without the Proposed Project flow direction (Future without the Proposed Project; black colored arrows) and are shown on **Figure 3.6-3**. The one active supply well (N-07482) with a water table decline greater than 10 feet is shown as a blue circle. Visual inspection of the arrows indicates that there are no appreciable changes in flow direction in the vicinity of the groundwater plume sites identified by NYSDEC and illustrated on **Figure 3.6-3**. **Figure 3.6-4** through **Figure 3.6-7** depict flow direction arrows for Scenario B through E, respectively, in comparison to the flow direction under the Future without the Proposed Project. In all five scenarios, changes in flow direction around active Nassau County supply wells are correlated to instances of simulated water declines of greater than 10 feet. Likewise, in each scenario, flows along the Queens-Nassau County boundary are from Nassau into Queens, reflecting the increase in pumping stresses applied due to operation of the Queens Groundwater system.

Based upon this initial assessment of flow direction changes and as previously mentioned, the geographic area defined by potential changes in flow direction became the basis for a request to NYSDEC for locations of known plumes. Specifically, a request was made for known plume sites west of the Meadowbrook Parkway. These are summarized in **Table 3.6-1** and their locations are shown on **Figure 3.6-1**. It should be noted that the area of interest did not include several well-publicized Long Island plumes, including the Northrop Grumman plume in Bethpage and the Hooker Chemical plume in Hicksville, as the model results indicate that groundwater flow direction at these plumes would not be influenced by the use of the Queens Groundwater system under the five operating scenarios evaluated. Under the most extreme operating condition (Scenario E), which would not be typical of DEP's anticipated temporary use of the Queens Groundwater system, potentially substantive flow direction changes are observed at the Tres Bon Cleaners, Former Shell Service Station, 400 Lakeville Road, and Unisys Corporation plume sites, with the most pronounced changes occurring at Tres Bon Cleaners (see **Figure 3.6-7**).

To further examine the potential impacts on active Nassau County supply wells, groundwater flow pathlines were simulated from the NYSDEC identified groundwater plume sites through a comparison between the Future without the Proposed Project and Scenario E conditions. These simulated pathlines trace the potential movement of a particle of water over time, starting from each plume site in January 2018 (the start of the scenario simulation period) and running through end of the simulation period, December 2027 (a period of 10 years). These simulations assume that the plume (as represented by the pathlines) would move at the velocity of the groundwater, with no physical or chemical reactions to slow it down (a conservative approach). In addition, remediation activities, such as pumping to extract contaminated water or source removal via soil removal or chemical augmentation, has not been included in this analysis, which is also conservative with respect to future plume movement and levels of contamination. **Figure 3.6-8** shows two sets of flow pathlines to allow a comparison of the differences in spatial movement over the 10-year simulation period. The Future without the Proposed Project conditions are displayed in blue and the Scenario E (Future with the Proposed Project) pathlines are shown in red, All but two of the plume sites generate pathline-pairs that are either similar to one another and/or are not near an active groundwater supply well. The exceptions are the Former Shell Service Station and Tres Bon Cleaners plume sites.

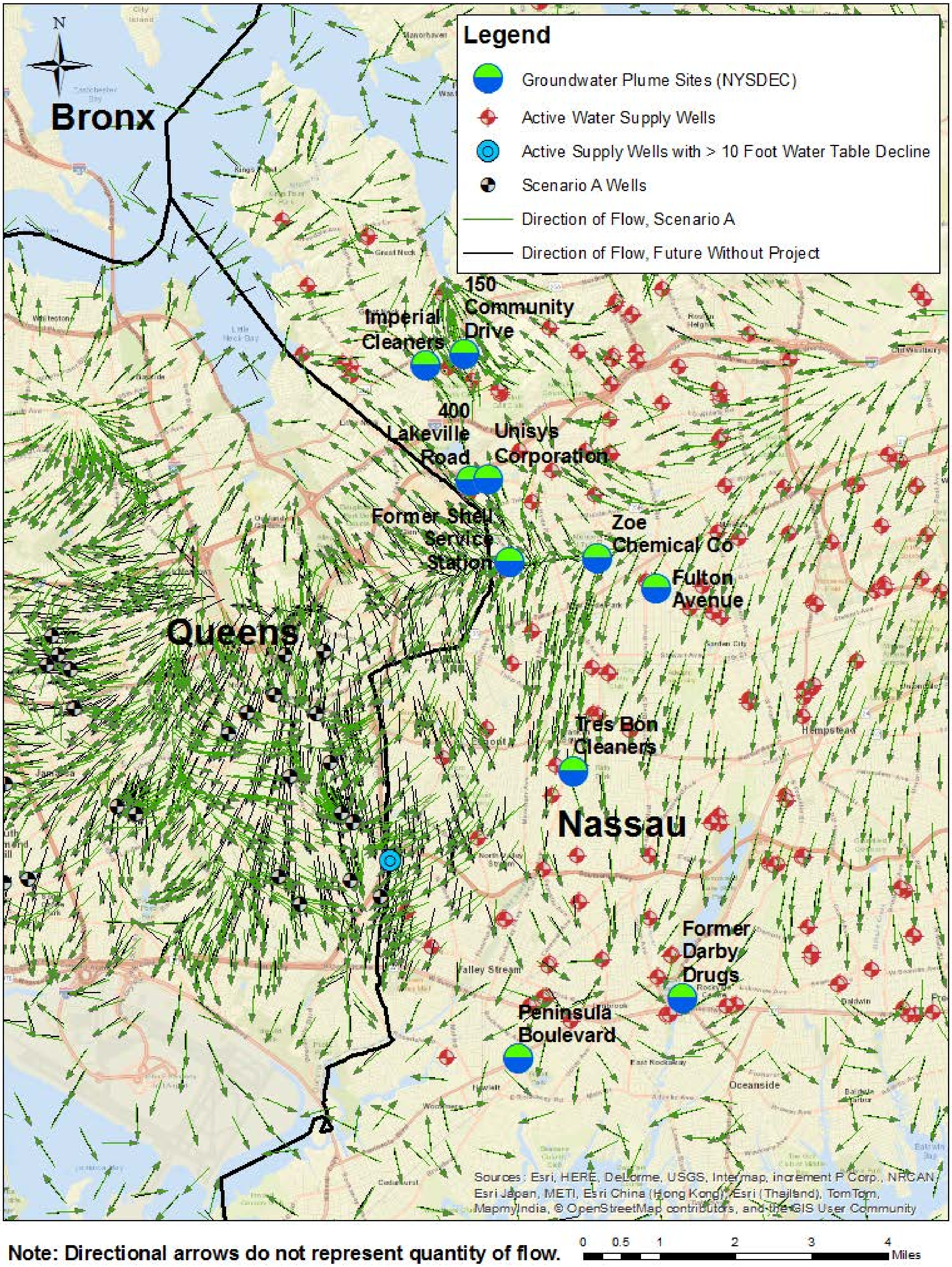
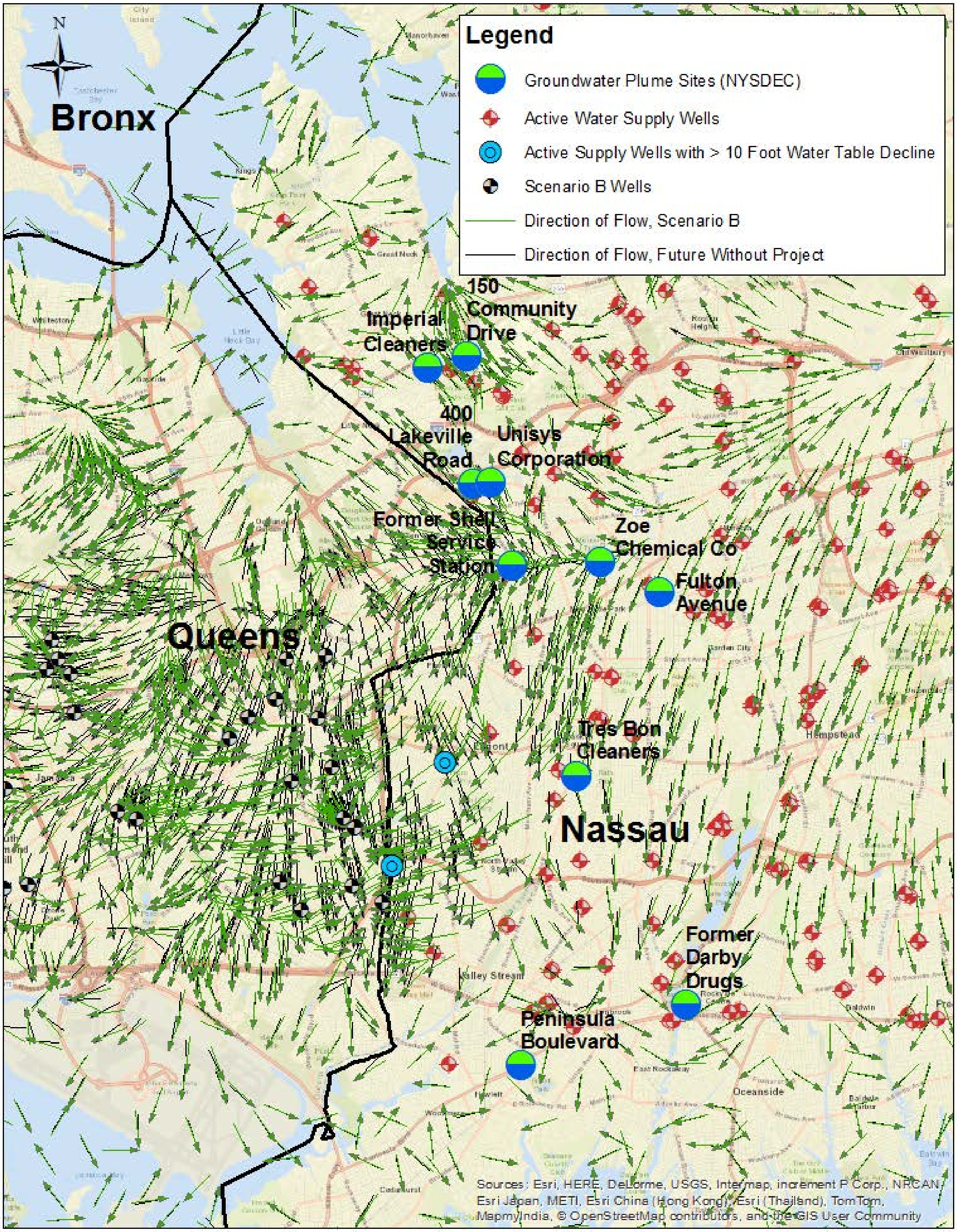


Figure 3.6-3: Simulated Groundwater Flow Direction - Scenario A (68 mgd for 1 Year)



Note: Directional arrows do not represent quantity of flow.

0 0.5 1 2 3 4 Miles

Figure 3.6-4: Simulated Groundwater Flow Direction - Scenario B (68 mgd for 2 Years)

NYC Environmental Protection

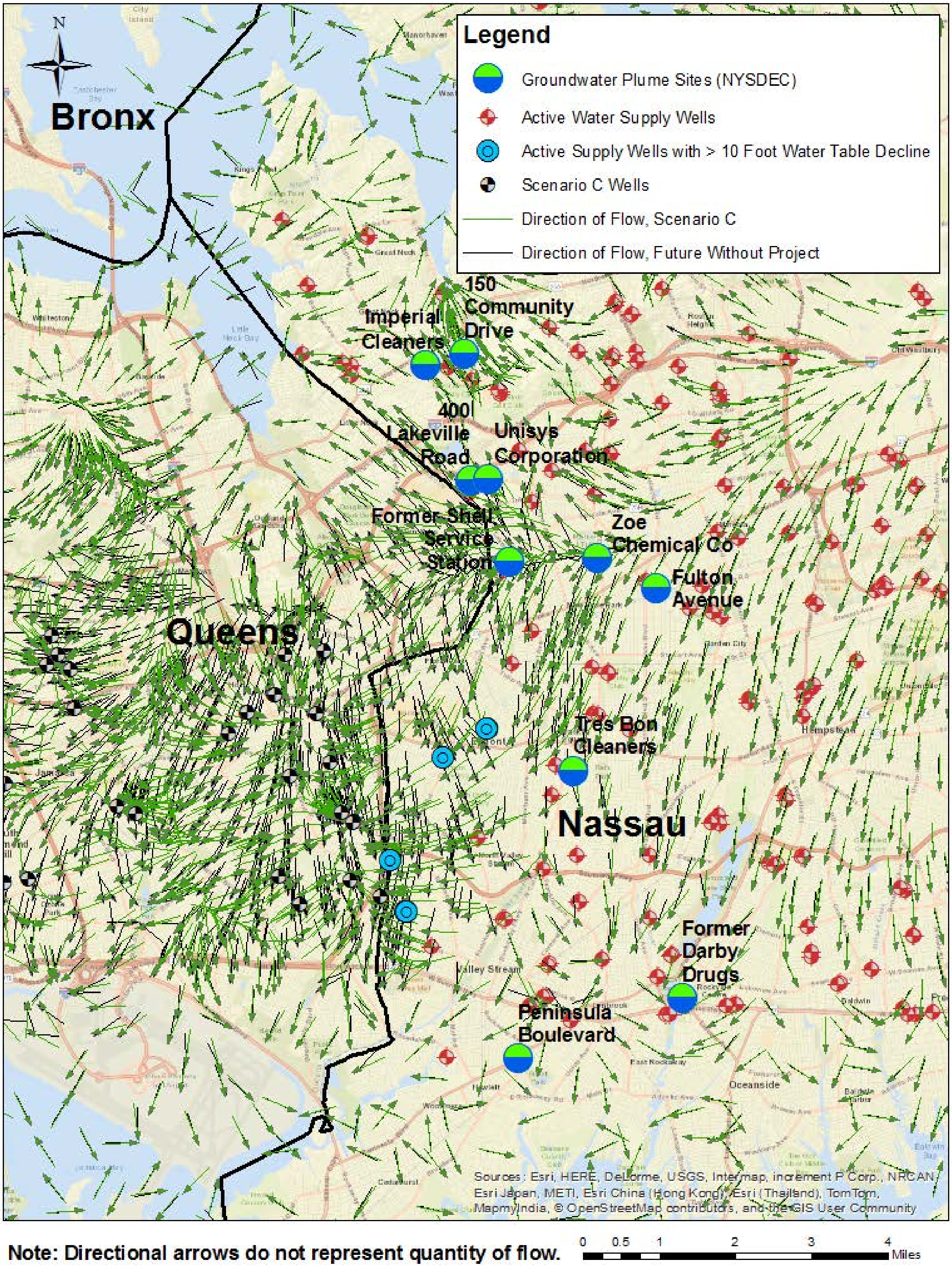


Figure 3.6-5: Simulated Groundwater Flow Direction – Scenario C (68 mgd for 3 Years)

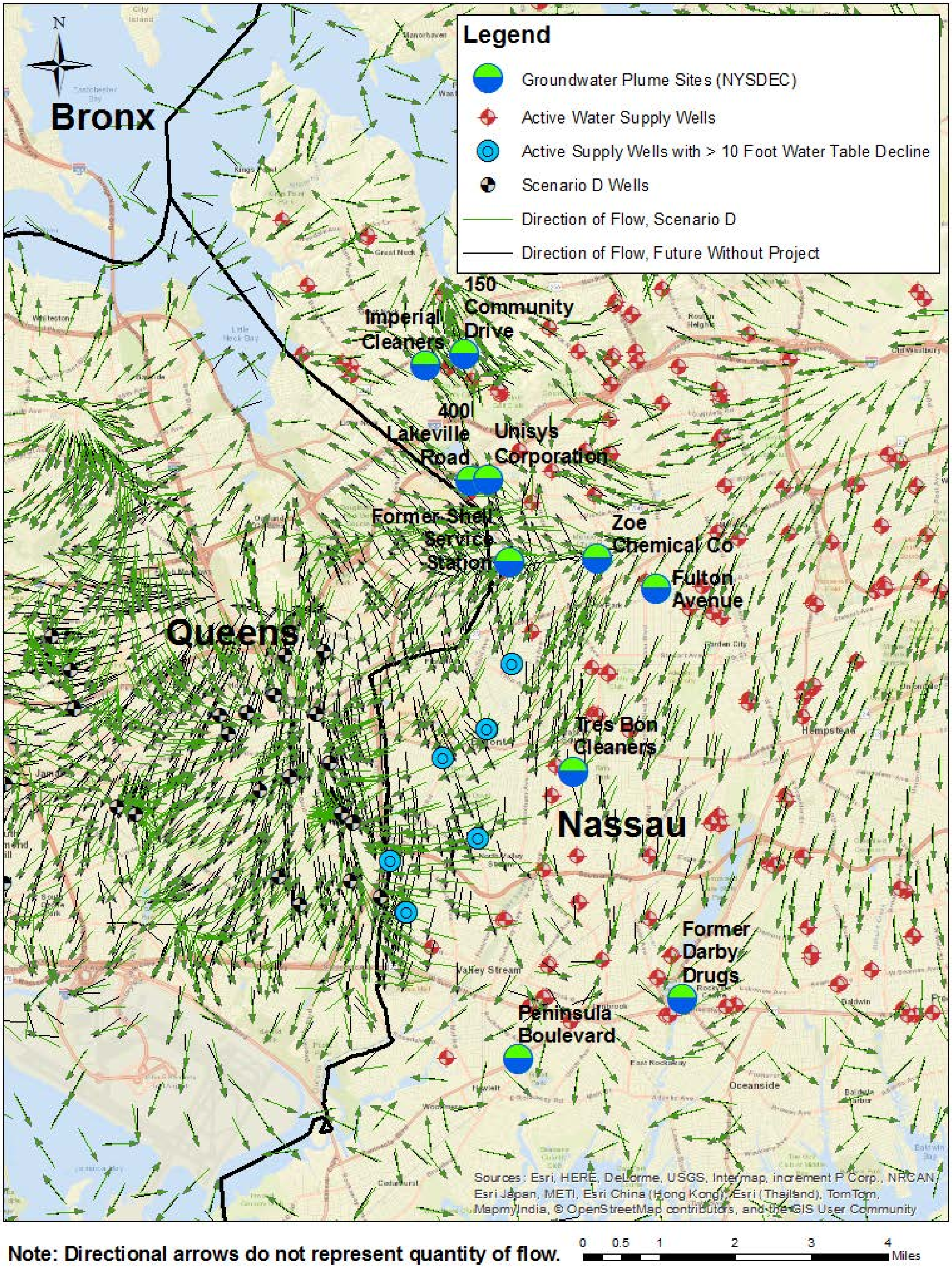
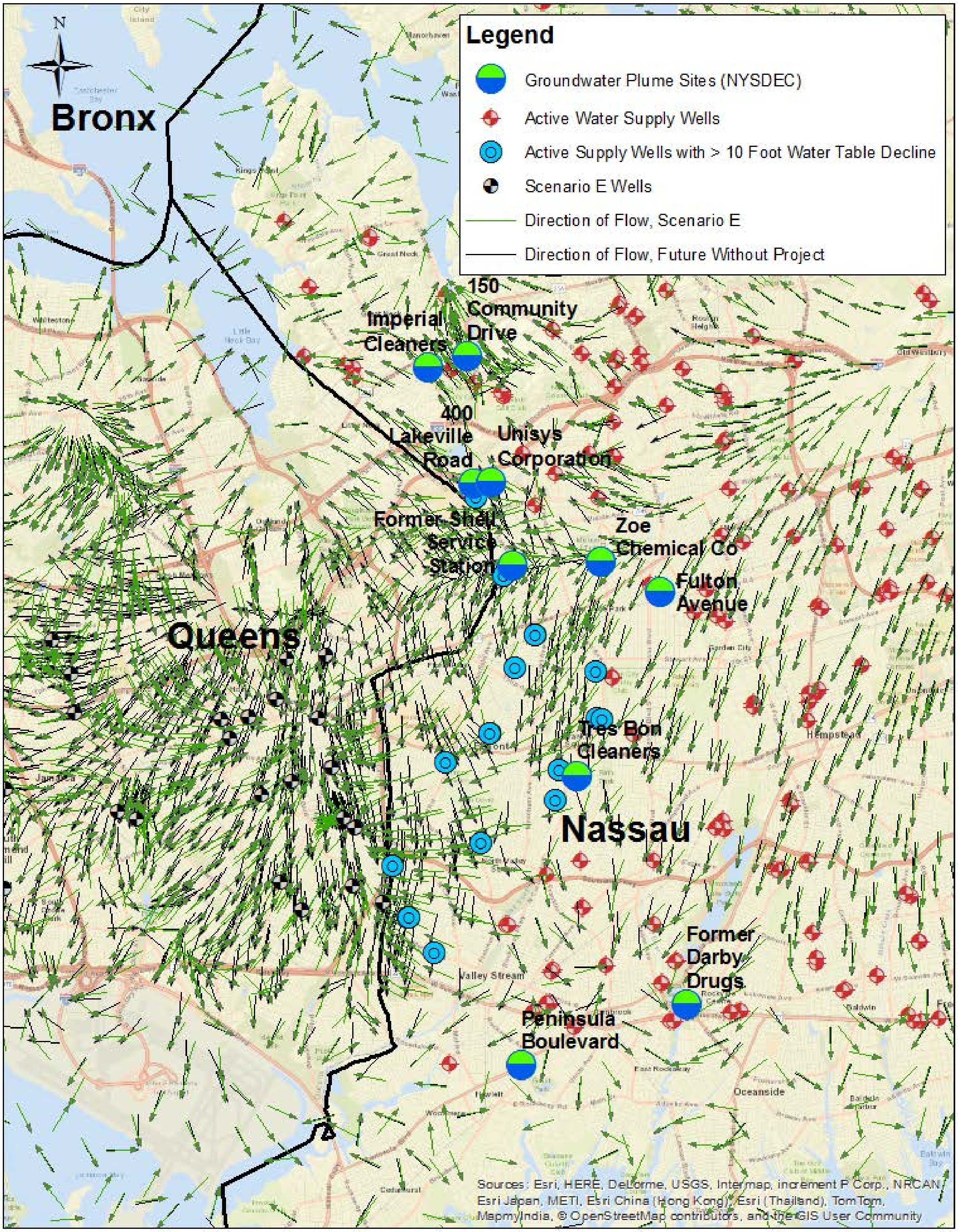


Figure 3.6-6: Simulated Groundwater Flow Direction - Scenario D (62 mgd for 5 Years)



Note: Directional arrows do not represent quantity of flow.

Figure 3.6-7: Simulated Groundwater Flow Direction – Scenario E (62 mgd for 10 Years)

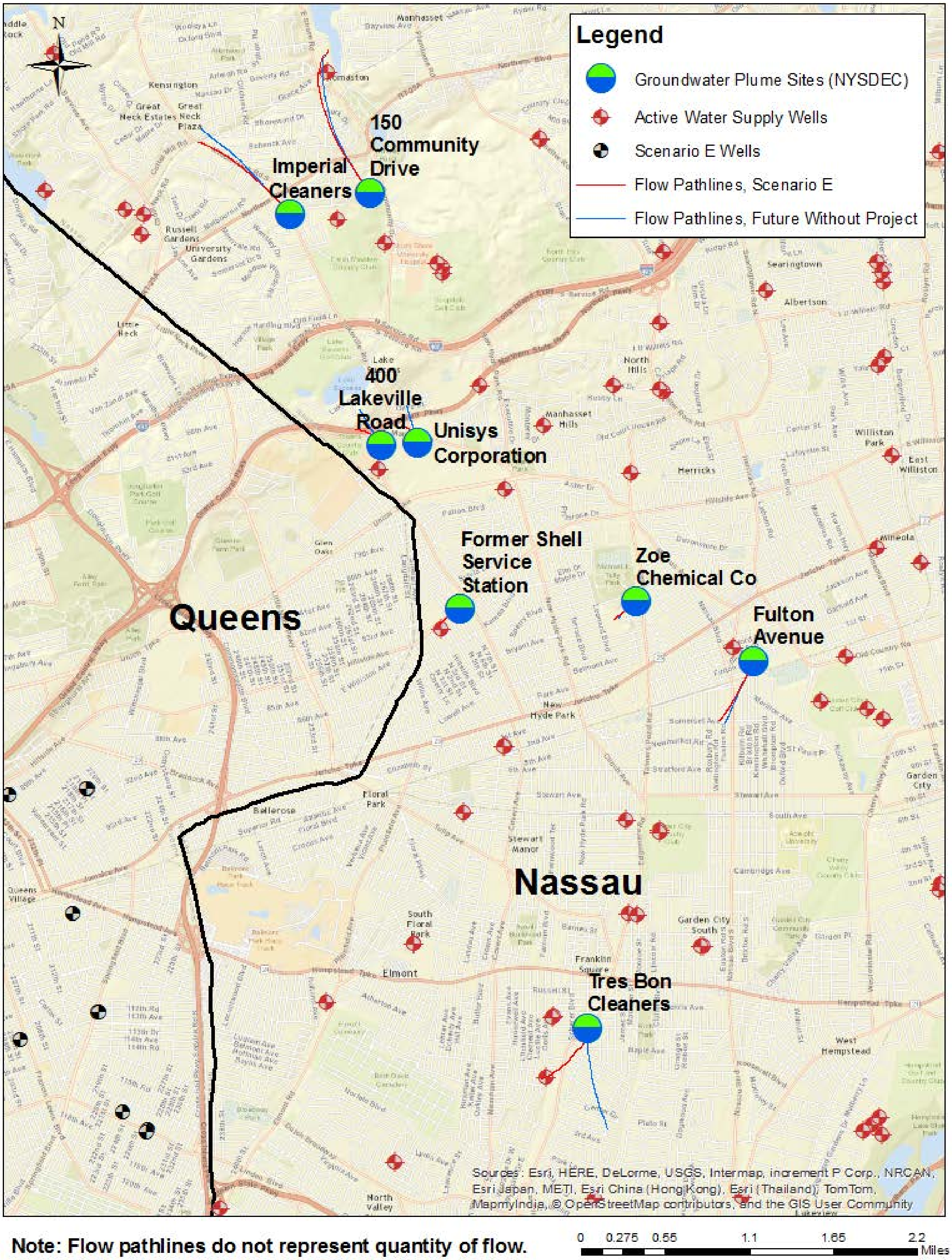


Figure 3.6-8: Simulated Pathlines of Groundwater Plumes - Scenario E (62 mgd for 10 Years)

Flow pathlines from the Former Shell Service Station appear to move directly towards Well N-01958. However, this well is screened in the Lloyd Aquifer and is hydraulically separated from the Upper Glacial Aquifer. For this reason, the implementation of any operating scenario would have limited new impacts on plume movement from this site, or the water quality at Well N-01958. The Former Shell Service Station plume will track towards Well N-01958 with or without the Proposed Project.

Projected flow pathlines from the Tres Bon Cleaners plume site would differ between the Future without the Proposed Project and Scenario E conditions. Under the Future without the Proposed Project, flow would be to the south and towards Well N-03720 (see **Figure 3.6-8**). However, under Scenario E that would involve pumping over a full 10 year period, the flow pathline is projected to be pulled into Well N-03605 (see **Figure 3.6-8**). A similar assessment of Scenario A through D indicate that while groundwater flow (and plume movement) in the vicinity of Tres Bon Cleaners and N-03605 would deviate from Future without Proposed Project conditions, the durations are not long enough to move the groundwater water from the source to the vicinity of N-03605, as occurs under Scenario E conditions.

Further outreach to NYSDEC indicated that remediation efforts have occurred at the Tres Bon Cleaners site. Remediation included groundwater extraction and treatment and soil vapor extraction (SVE) and treatment which began in 1993. Subsequent trends in groundwater sampling have shown a marked decrease in the concentration of contaminants. Remediation was completed in 2003. Groundwater investigation results indicated some residual low levels of PCE in groundwater at the water table in proximity to the original source area (which has been remediated via soil excavation, groundwater extraction and treatment, and SVE). Groundwater concentrations drop to non-detect one block to the south.

If any residual contamination remains in the groundwater, a plan may be required to install treatment at Well N-03605. However, even with the potential affects to this well under a 10 year pumping scenario (Scenario E) which would be very unlikely, the Franklin Square Water District would still be able to provide a continued supply of water to its customer from its other supply wells. In summary, only one known plume site (Tres Bon Cleaners) may potentially impact a Nassau or western Suffolk County supply well with the Queens Groundwater system operating. While Scenario E represents a conservative analysis scenario, it is expected that any future use of the Queens Groundwater system due to a water supply shortage would more closely resemble Scenario A, B, or C lasting between 1 and 3 years. Under these scenarios and as discussed above, potential impacts to the use and quality of Well N-03605 or the Franklin Square Water District related to meeting district water supply needs would not be anticipated. Likewise, as noted above, remediation at the site has reduced contamination to non-detect levels. Therefore, no significant adverse impacts related to hazardous materials are anticipated.

3.7 WATER AND SEWER INFRASTRUCTURE

3.7.1 INTRODUCTION

This section evaluates the potential for the Proposed Project to result in significant adverse impacts on the City's water supply, and its wastewater and stormwater collection systems, and wastewater treatment infrastructure. In addition, it also evaluates the potential for significant adverse impacts on water supplies in Nassau and western Suffolk counties who depend upon groundwater from the same aquifer network as their sole source of drinking water. Assessment of potential impacts to groundwater quality from saltwater intrusion or other contaminants are provided in Section 3.6, "Hazardous Materials," and Section 3.5, "Natural Resources."

3.7.2 METHODOLOGY

3.7.2.1 Water Supply Infrastructure

New York City Water Supply

The *CEQR Technical Manual* indicates a preliminary water supply analysis is needed for a proposed project if it would result in an exceptionally large demand for water or is located in an area of the City's water distribution system that experiences low water pressure.

The Proposed Project would not meet the CEQR criteria requiring the need for a preliminary analysis. Specifically, the Proposed Project would not result in an increase in water demand within the City or impact water consumption patterns. The Proposed Project supports the renewal of DEP's existing Water Supply/Water Withdrawal Permit and involves the potential implementation of temporary treatment systems at wells, as needed, to respond to a water supply shortage. Further, the Proposed Project is not located in an area that experiences low water pressure issues. Accordingly, no further analysis of the potential impacts to the City's water supply system is warranted.

Nassau and Western Suffolk County Water Supply

The Proposed Project would represent a temporary increase in water demand from current conditions on the aquifer system underlying much of Long Island, the same system that serves as a sole source of drinking water supply to Nassau and Suffolk counties. Prior to 1996, the wells currently part of the Queens Groundwater system were owned and operated by the Jamaica Water Supply Company and they were pumped to meet the water demands of southeast Queens. Most of the wells in Nassau and western Suffolk County that exist today were also in existence prior to 1996 and were constructed to operate within an aquifer system shared with actively pumped Queens wells (see **Figure 3.7-1**). Since DEP's acquisition of the Jamaica Water Supply Company wells, DEP continued to use the wells at varying capacities for potable use through 2007. Since 2007, wells have been exercised and used for groundwater testing in accordance with DEP's Wellhead Protection Plan. Pumping has been limited since 2007, which has contributed to the rise of the water table during the last two decades. It is anticipated that any temporary regular pumping of these wells as part of the Proposed Project would result in a temporary drops in the water table. An analysis of the potential impact of the Proposed Project on water supplies and their operations in Nassau and western Suffolk counties was completed. This analysis first involved the identification of supply wells where typical water table elevations could experience changes greater than 10 feet due to the Proposed Project. This was accomplished through the application of the New York City Groundwater Model, described in more detail within Section 3.5, "Natural Resources," for a range of potential operating scenarios and durations. The threshold of greater than 10 feet was chosen because pump settings are typically set to be a minimum of 20 feet below the pumping water level to accommodate temporary/seasonal variations. Therefore, identification of water table changes at specific wells that were in excess of 10 feet was initially identified, and a more detailed analysis of potential impacts at these locations was conducted. For those wells that have a change of 10 feet or more, additional analysis was conducted to determine if there would be operational impacts to these wells due to the water table location with respect to the existing well screen location, pump setting, and pump motor.

While actual well selection would be based on well capacity and productivity, ease of treatment, operation and maintenance needs, cost, and other factors, additional simulations were generated to identify the potential effects associated with different geographic distributions of the 68 Queens supply wells may be pumped in the future. The assessment evaluates two conservative conditions; one with the easternmost wells (see **Figure 3.7-2**) assumed to be used and one with the westernmost wells (see **Figure 3.7-3**), respectively. The pumping rates used for the wells are shown in **Table 3.7-1**.

In addition, a sensitivity analysis consisting of additional simulations were generated to identify the potential effects of an extreme drought on Long Island with the Queens Groundwater wells in operation. Potential rainfall and subsequent recharge during a Long Island drought that may occur during future pumping scenarios was examined. This was accomplished by using the lowest contiguous rainfall years on record since 1950 for the length of each scenario as part of the model simulation, instead of the average rainfall/recharge values summarized in Section 1.7.5, thereby simulating drought conditions.

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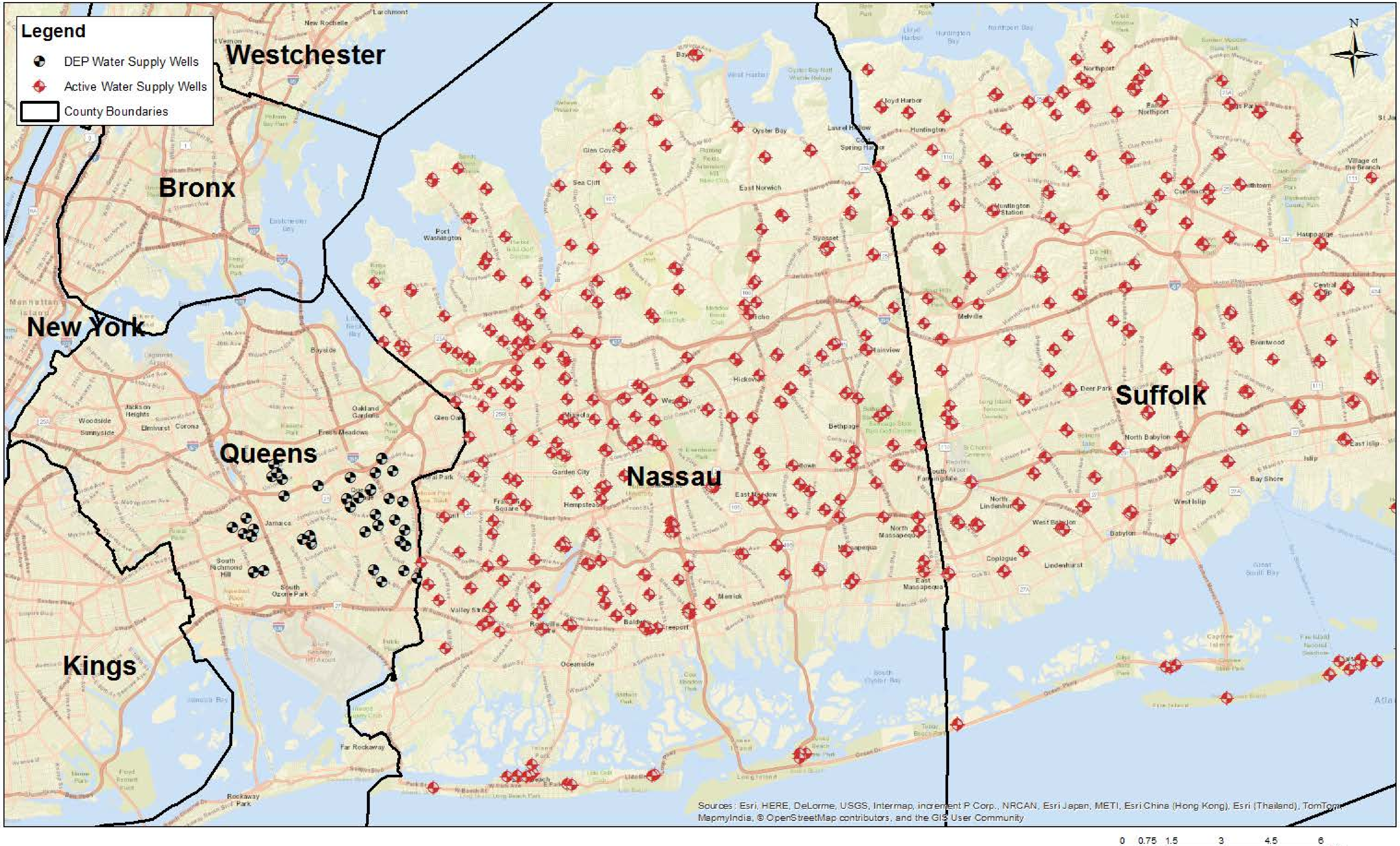

Figure 3.7-1: Water Supply Wells

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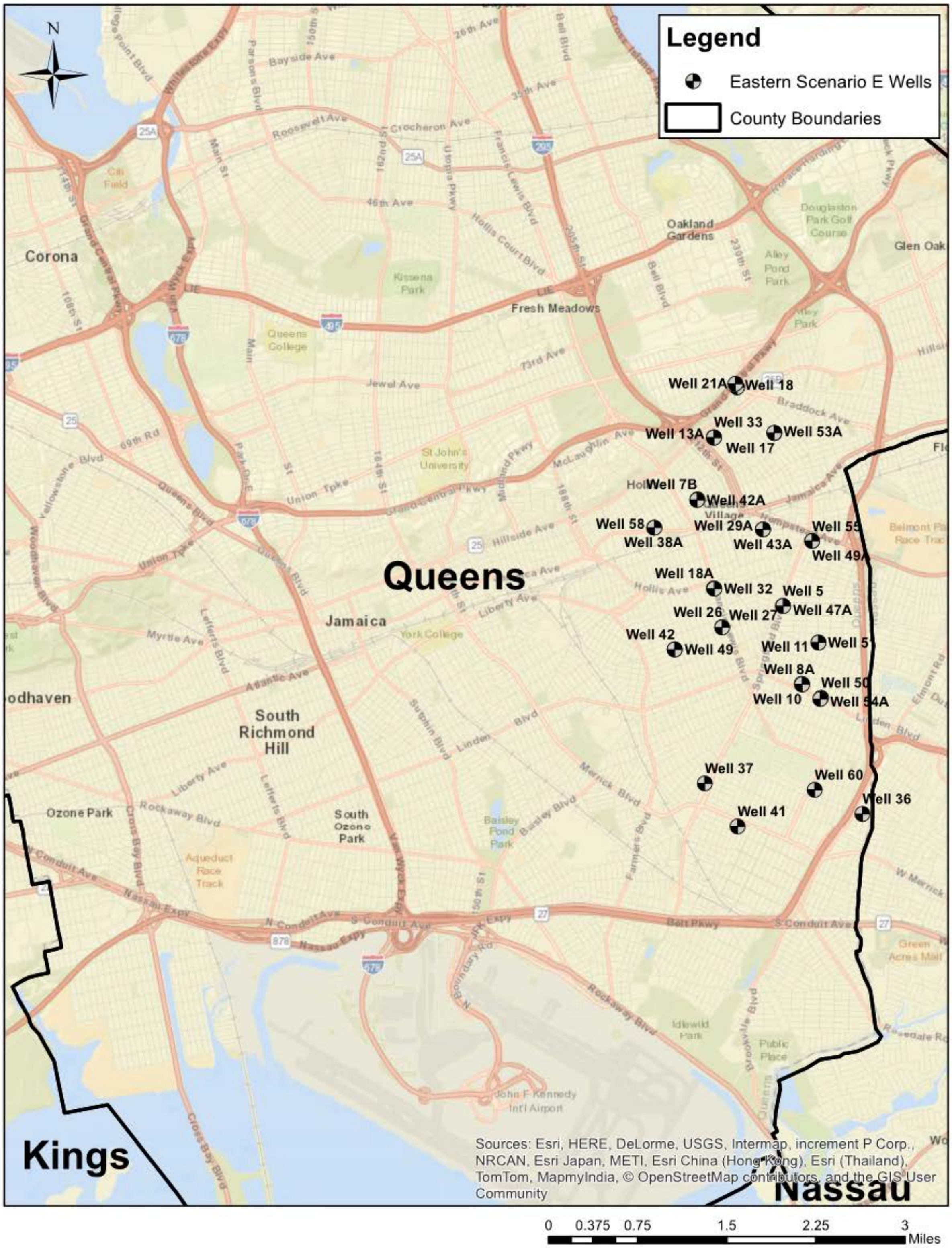

Figure 3.7-2: Queens Groundwater Supply Wells – Easternmost Wells

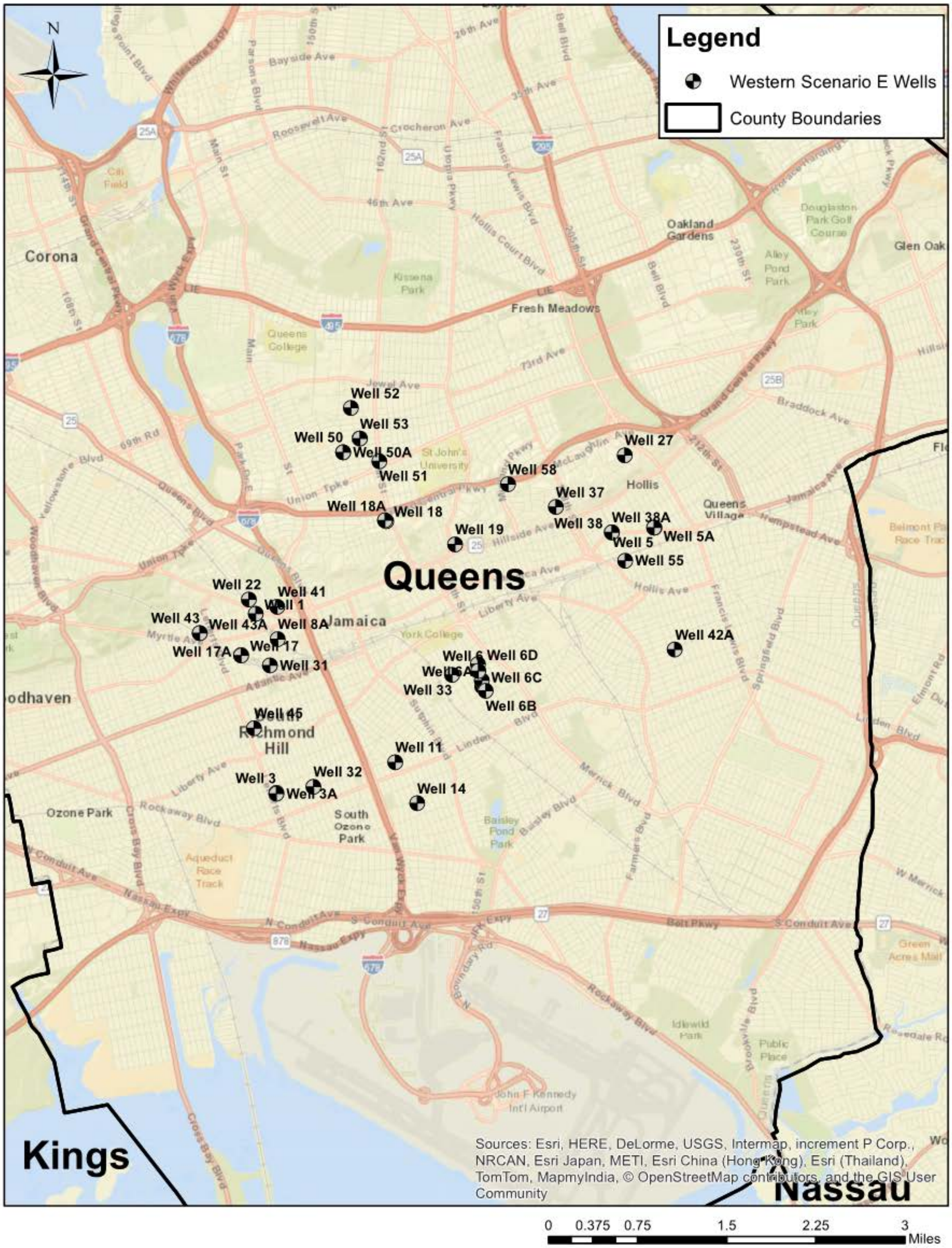

Figure 3.7-3: Queens Groundwater Supply Wells – Westernmost Wells

Table 3.7-1: Queens Groundwater Supply Wells - Easternmost and Westernmost Pumping Rates

Well	DEC ID	Aquifer	Pumping Rate					
			Capacity		Scenario E East		Scenario E West	
			(mgd)	(gpm)	(mgd)	(gpm)	(mgd)	(gpm)
1	Q-00301	Upper Glacial	1.15	800			1.15	800
3	Q-00303	Upper Glacial	1.73	1,200			1.73	1,200
3A	Q-00558	Upper Glacial	1.66	1,150			1.66	1,150
5	Q-00305	Magothy	1.73	1,200	1.73	1,200	1.73	1,200
5A	Q-01957	Magothy	2.45	1,700	2.45	1,700	2.45	1,700
6	Q-00306	Upper Glacial	0.79	550			0.79	550
6A	Q-00560	Upper Glacial	1.73	1,200			1.73	1,200
6B	Q-00561	Upper Glacial	1.73	1,200			1.73	1,200
6C	Q-00562	Lloyd	2.59	1,800			2.59	1,800
6D	Q-01839	Upper Glacial	0.94	650			0.94	650
7	Q-00307	Magothy	2.02	1,400	2.02	1,400		
7B	Q-00564	Magothy	1.73	1,200	1.73	1,200		
8A	Q-03069	Lloyd	1.44	1,000			1.44	1,000
10	Q-00310	Upper Glacial	1.01	700	1.01	700		
10A	Q-01958	Magothy	2.59	1,800	2.59	1,800		
11	Q-03157	Jameco	1.99	1,380			1.99	1,380
13	Q-00313	Magothy	1.73	1,200	1.73	1,200		
13A	Q-01600	Magothy	1.73	1,200	1.73	1,200		
14	Q-03156	Jameco	1.73	1,200			1.73	1,200
17	Q-00317	Lloyd	1.87	1,300			1.87	1,300
17A	Q-00566	Magothy	0.86	600			0.86	600
18	Q-02137	Magothy	1.44	1,000			1.44	1,000
18A	Q-00567	Lloyd	1.73	1,200			1.73	1,200
19	Q-00319	Upper Glacial	0.58	400			0.58	400
21	Q-00321	Magothy	1.99	1,380	1.99	1,380		
21A	Q-02435	Magothy	1.73	1,200	1.73	1,200		
22	Q-00322	Upper Glacial	1.47	1,020			1.47	1,020
23	Q-00323	Upper Glacial	1.73	1,200	1.73	1,200		
23A	Q-00568	Magothy	2.30	1,600	2.30	1,600		
26	Q-01450	Upper Glacial	1.44	1,000	1.44	1,000		
26A	Q-01815	Magothy	2.30	1,600	2.30	1,600		
27	Q-01747	Upper Glacial	1.44	1,000			1.44	1,000
29	Q-01534	Upper Glacial	1.73	1,200	1.73	1,200		
29A	Q-01629	Magothy	2.30	1,600	2.30	1,600		
31	Q-01811	Upper Glacial	1.47	1,020			1.47	1,020
32	Q-01840	Upper Glacial	1.72	1,194			1.72	1,194
33	Q-01843	Upper Glacial	1.44	1,000			1.44	1,000

Table 3.7-1: Queens Groundwater Supply Wells - Easternmost and Westernmost Pumping Rates

Well	DEC ID	Aquifer	Pumping Rate					
			Capacity		Scenario E East		Scenario E West	
			(mgd)	(gpm)	(mgd)	(gpm)	(mgd)	(gpm)
36	Q-02026	Magothy	2.30	1,600	2.30	1,600		
37	Q-02001	Upper Glacial	1.70	1,183			1.70	1,183
38	Q-01997	Upper Glacial	2.02	1,400			2.02	1,400
38A	Q-02432	Magothy	2.59	1,800			2.59	1,800
39	Q-02000	Upper Glacial	2.02	1,400	2.02	1,400		
39A	Q-02188	Magothy	2.30	1,600	2.30	1,600		
41	Q-02006	Upper Glacial	1.70	1,180			1.70	1,180
42	Q-02027	Upper Glacial	0.58	400	0.58	400		
42A	Q-02028	Magothy	2.45	1,700	2.45	1,700	1.45	1,007
43	Q-02138	Upper Glacial	2.02	1,400			2.02	1,400
43A	Q-02332	Magothy	1.87	1,300			1.87	1,300
45	Q-02189	Upper Glacial	1.51	1,050			1.51	1,050
47	Q-02275	Upper Glacial	1.44	1,000	1.44	1,000		
47A	Q-02276	Magothy	2.30	1,600	2.30	1,600		
48	Q-02299	Upper Glacial	2.02	1,400	2.02	1,400		
48A	Q-02300	Magothy	2.30	1,600	2.30	1,600		
49	Q-02321	Upper Glacial	2.02	1,400	2.02	1,400		
49A	Q-02343	Magothy	2.30	1,600	2.30	1,600		
50	Q-02373	Upper Glacial	1.44	1,000			1.44	1,000
50A	Q-02374	Magothy	1.44	1,000			1.44	1,000
51	Q-02362	Magothy	1.44	1,000			1.44	1,000
52	Q-02363	Upper Glacial	1.15	800			1.15	800
53	Q-02408	Upper Glacial	1.44	1,000			1.44	1,000
53A	Q-02409	Magothy	1.44	1,000			1.44	1,000
54	Q-02442	Upper Glacial	1.73	1,200	1.73	1,200		
54A	Q-02443	Magothy	1.73	1,200	1.73	1,200		
55	Q-03034	Magothy	1.73	1,200			1.73	1,200
56	Q-02955	Magothy	2.02	1,400	2.02	1,400		
58	Q-03014	Magothy	1.44	1,000			1.44	1,000
59	Q-03029	Magothy	2.02	1,400	2.02	1,400		
60	Q-03083	Magothy	2.02	1,400	2.02	1,400		
		Total[1]	**118**	**82,257**	**62**	**43,080**	**62**	**43,084**

Note:
[1] Total mgd has been rounded to the nearest million.

3.7.2.2 Wastewater and Stormwater Infrastructure

Collection System

The *CEQR Technical Manual* indicates that a preliminary sewer infrastructure analysis may be necessary in several cases. Two triggers for further analysis potentially apply to the Proposed Project. These include location in an area that is partially sewered or currently unsewered and development on sites one acre or larger which would increase impervious surfaces located in the Jamaica Bay Watershed.

The Proposed Project is located in an area of southeastern Queens that does not have a fully built out storm sewer system. This section will therefore discuss the Proposed Project's potential impacts to the collection system. Processes that would be implemented as part of the Proposed Project to ensure that no potential significant adverse impacts occur to the system will be described. Stormwater management techniques that would be employed to manage new impervious surfaces will also be discussed.

As the Proposed Project would not impact collection system infrastructure outside the City within Nassau and Suffolk counties, no further analysis was required for these areas.

Wastewater Treatment

Wastewater within the limits of the Queens Groundwater system drains to one of two existing wastewater treatment plants (WWTP) and an assessment of current WWTP flows and their respective flow limits is provided within this section. An identification of anticipated wastewater streams associated with the operation of the Queens Groundwater wells and the implementation of temporary treatment is discussed. Existing wastewater flows are discussed; and estimated wastewater flows associated with the Proposed Project were calculated and compared to flows with and without the Proposed Project in order to assess the ability of the City's wastewater infrastructure to handle wastewater generation associated with the Proposed Project. This chapter compares the incremental increase due to the Proposed Project to the Future without the Proposed Project consistent with the *CEQR Technical Manual*. In addition, potential pollutants from the Proposed Project are discussed and a qualitative discussion of how the City's standards for discharges into its sewer system would be met is provided.

Implementation of the Proposed Project would not impact wastewater treatment systems within Nassau and Suffolk counties, therefore no further analysis of potential impacts outside the City was required.

3.7.3 EXISTING CONDITIONS

3.7.3.1 Water Supply System

New York City Water Supply

The New York City surface water supply system is comprised of 19 reservoirs and three controlled lakes located in three upstate watersheds, the Croton, Catskill, and Delaware. Together, they deliver more than 1 billion gallons per day (gpd) of fresh, clean water to the City and several upstate outside communities. The upstate watershed extends more than 125 miles from the City and serves nine million customers within the City and upstate New York. From these watersheds, water is transported to and within the City through a system of deep aqueducts and tunnels. Within the City, a grid of more than 6,800 miles of water pipes distributes water throughout the City and private water service connections bring water into homes and businesses.

In addition to its upstate water supply system, the DEP also maintains the Queens Groundwater system, described in more detail within Chapter 1.0, “Project Description.” This system is comprised of 44 well stations and 68 groundwater supply wells that source water from several aquifers located beneath southeastern Queens including the Upper Glacial, Jameco, Magothy, and Lloyd aquifers (see Chapter 1.0, “Project Description,” and Section 3.5, “Natural Resources”). The City purchased the water supply wells from the Jamaica Water Supply Company in 1996, which had operated these and other wells located within portions of Nassau County for more than 100 years. The City has maintained a Water Supply Permit since the acquisition of these wells in 1996 and had distributed water to customers until 2007. The City has not used the wells to supply large-scale drinking water since 2007, but wells have been exercised and used for groundwater testing in accordance with DEP’s Wellhead Protection Plan. The City has maintained its Water Supply Permit for use of the wells to supplement water supplies during a water supply shortage.

Nassau and Western Suffolk County Water Supply

All water used by Nassau and Suffolk counties comes from the supply wells that draw from the aquifers beneath Long Island. Since this aquifer system is the only source of drinking water for these counties, it is designated as a “sole source aquifer” by EPA. There are approximately 1,200 community public supply wells in Nassau and Suffolk counties, owned and operated by cities, towns, villages, special districts, and private purveyors. An estimated 450 to 500 million gallons per day (mgd) is pumped, with more than 75 percent of withdrawals from the Magothy Aquifer. **Figure 3.7-1** shows the locations of the active public supply wells in Nassau and western Suffolk County, in addition to the Queens Groundwater wells.

3.7.3.2 Wastewater and Stormwater Collection Systems

The New York City sewer system is comprised of approximately 7,500 miles of pipes installed beneath City streets and 148,000 catch basins that capture stormwater at street level and convey it underground. Approximately 60 percent of the sewer system is a combined system; meaning that sanitary flows from homes and business and stormwater flows are collected in the same sewer pipes and conveyed together to WWTPs for treatment. During wet weather, the sewer system is designed to release flows that exceed the capacity of the WWTPs into surface water within the City as combined sewer overflow (CSO). This process prevents damage to the WWTPs from excessive flows.

The remaining 40 percent of the sewer system is separated. In separated systems, sanitary sewers carry sewage directly to the WWTP for treatment and storm sewers carry storm runoff in a separate, often parallel pipe, directly to a local waterbody.

The Queens Groundwater system is located in an area of the City served by both combined and separate systems. The storm sewer system in this region is not completely built out, and this has contributed to the historical street flooding experienced in some neighborhoods. Historically, sewer backups have also been high in this area. Over the past several years, DEP has invested considerable resources in a data-driven approach to sewer maintenance and this has resulted in significantly enhanced resource allocations for sewer maintenance in areas of the City that would benefit from it most. Throughout Queens over the past five years, the number of street segments with recurring confirmed sewer backups has decreased by 37 percent. The number of street segments with recurring confirmed dry weather sewer backups has decreased by 34 percent.[48] Many of these improvements have occurred within southeastern Queens and DEP continues to invest in sewer maintenance and upgrades in the area (see Section 3.7.4.2 for details).

Based upon a review of the wells included within the existing Water Supply/Water Withdrawal Permit, and DEP records, 33 wells are located within a combined sewer area, 35 are located within a separately sewered area.

3.7.3.3 Wastewater Treatment System

New York City's wastewater is treated at 14 WWTPs located throughout the City with each plant accepting flows from a different geographic area of the City; called its drainage area. Each plant has a NYSDEC State Pollutant Discharge Elimination System (SPDES) permit that sets flow and effluent discharge limits for selected pollutants for each WWTP.

The Proposed Project is located within drainage areas served by these two WWTPs; the Jamaica and Tallman Island WWTPs. Of the 68 wells identified within DEP’s existing Water Supply Permit, 58 wells are located within the Jamaica WWTP drainage area and 10 wells are located within the Tallman Island WWTP drainage area.

Provided within **Table 3.7-2** is a summary of existing permitted flows for two WWTPs and the most recent average daily dry weather flow for calendar year 2016. The two WWTPs currently operate significantly below their permitted flow limits.

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[48] http://www.nyc.gov/html/dep/pdf/reports/state-of-the-sewers-2016.pdf “State of the Sewers 2016- Performance Metrics” Fiscal Year 2016 (July 1, 2015 through June 30, 2016).

Table 3.7-2: WWTP Permitted and Current Flows

WWTP	Permitted Daily Dry Weather Flow (mgd)	Current Actual Daily Dry Weather Flow - CY 2016 (mgd)
Jamaica	100.0	72.6
Tallman Island	80.0	52.1

3.7.4 FUTURE WITHOUT THE PROPOSED PROJECT

3.7.4.1 Water Supply System

New York City Water Supply

In the Future without the Proposed Project, no substantive changes to the Queens Groundwater system would occur. DEP has previously proposed the removal of certain existing water tanks (CEQR No. 15DEP008Q), originally constructed between 1905 and 1932, at Stations 1, 19, 21, 22, and 39. This would be completed in 2018 or 2019. In addition, DEP also anticipates the close-out and removal of chemical bulk storage tanks at Stations 10, 23, 36, 39, 56, and 59 which would also occur in the Future without the Proposed Project.

Several ongoing and future water supply projects, largely focused upon distribution system infrastructure, would be implemented in the project area in the Future without the Proposed Project. This includes new water main installations associated with the ongoing build out of the southeast Queens drainage plan, which would serve to further increase the reliability of the water supply system.

Nassau and Western Suffolk County Water Supply

In the Future without the Proposed Project, water purveyors in Nassau and Suffolk counties would continue to maintain, upgrade, and expand their systems as necessary to meet the demands of their consumers.

3.7.4.2 Wastewater and Stormwater Collection Systems

In the Future without the Proposed Project, DEP would continue its plans to implement the southeastern Queens sewer build out program. This program targets areas in southeast Queens that are most in need of collection system upgrades. This currently encompasses an initial, 10-year, $1.7 billion capital commitment. This funding would implement new stormwater systems and replace or upgrade, as needed, existing sanitary sewers.

In addition, on July 21, 2017, Mayor Bill de Blasio announced a new feasibility study for a groundwater drainage project aimed to address basement flooding in southeast Queens. The Groundwater Radial Collection Feasibility Study (“Drainage Project”) will measure how high the groundwater table has risen, how much it must be lowered in order to address basement flooding, and the feasibility of a radial collection plan. It is anticipated that this study would be completed in 2018.

3.7.4.3 Wastewater Treatment System

In the Future without the Proposed Project, DEP would continue the implementation of ongoing and/or required capital investments to maintain and upgrade its WWTPs, as necessary and required.

3.7.5 FUTURE WITH THE PROPOSED PROJECT

3.7.5.1 Water Supply System

New York City Water Supply

The Proposed Project involves the renewal of DEP's existing Water Supply/Water Withdrawal Permit and implementation of temporary treatment systems to allow DEP to utilize the Queens Groundwater system to supplement water supply during water supply shortages such as drought or planned and/or unplanned infrastructure outages. As such, the Proposed Project would not result in any additional water demand.

During temporary operation of the well system during water supply shortages, treated water from the Queens Groundwater system would be integrated into the water supply distribution system and could be blended with water from other City water supply sources. The treated water would be added to the system under pressure sufficient to deliver it anywhere in Brooklyn and Queens as needed. No outages of supply, pressure problems, or other service interruptions associated with the startup or addition of the groundwater to the distribution network are anticipated. No potential significant adverse impacts to the quantity of water supply in the City are anticipated. For a discussion on water quality, see Section 3.11, "Public Health."

Nassau and Western Suffolk County Water Supply

Potential Impacts of the Proposed Project

As part of the analysis of potential impact, the New York City Groundwater Model was used to evaluate the potential impacts associated with the operation of the Queens Groundwater system under several different operating scenarios and durations. **Table 3.7-3** presents a summary of those wells that would show a change of greater than 10 feet under each of the five potential operating scenarios. The change in water table elevation at the wells is calculated as the difference in water table elevation between the Future without the Proposed Project and Future with the Proposed Project conditions. For example, the first well in the table, N-07482, has a simulated water table elevation that is approximately 29 feet greater under the Future without the Proposed Project, when compared with the Future with the Proposed Project at the end of Scenario E. A schematic showing the relative water table elevation at an active supply well under a range of conditions is shown on **Figure 3.7-4**. As shown in **Table 3.7-3,** for the various scenarios, there were different levels of effect, with a total of 21 wells in Scenario E. All wells that could experience a maximum water table decline in excess of 10 feet were located within the western portion of Nassau County.

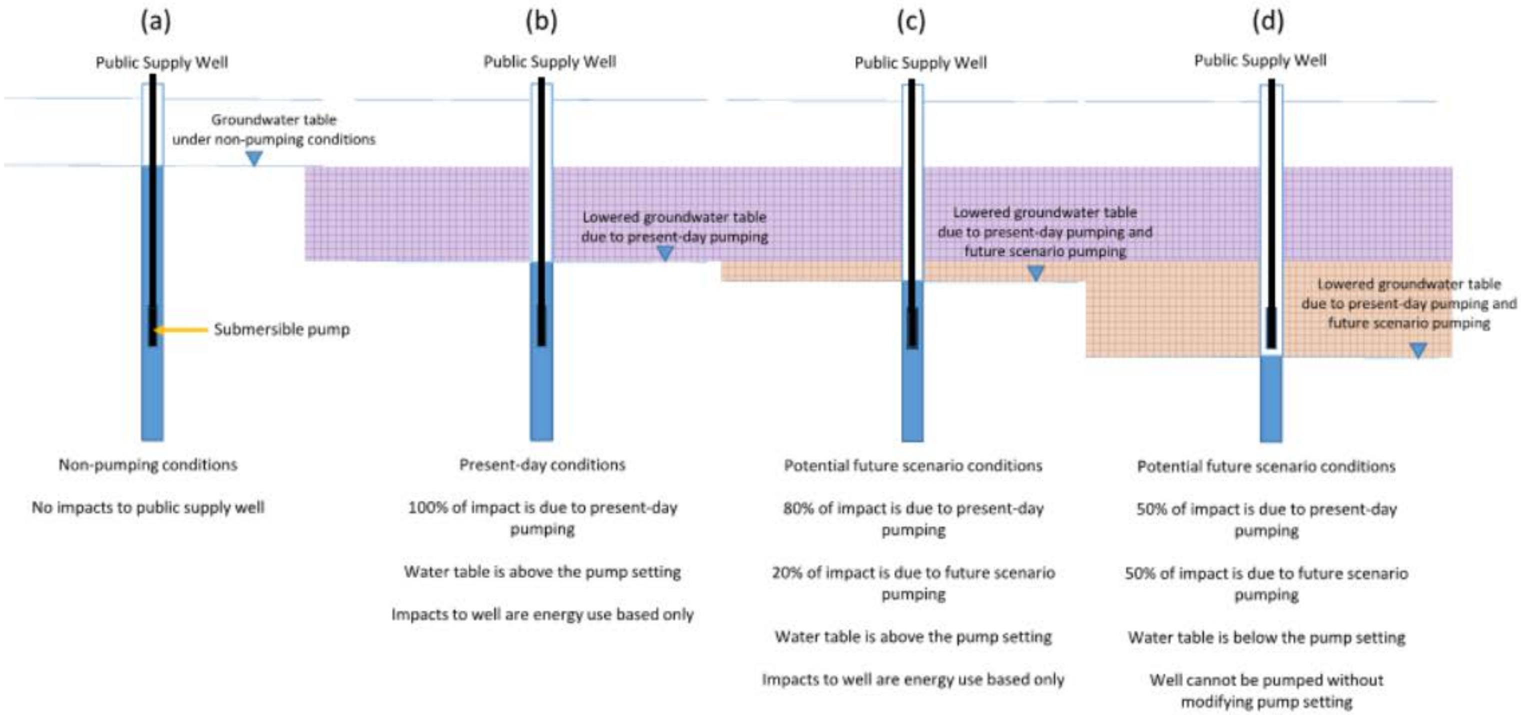

Figure 3.7-4: Water Table Decline Schematic

Simulated water table decline contours are shown for Scenario A through E on **Figure 3.7-5** through **Figure 3.7-9**, respectively. Each figure shows the extent of water table decline, along with the locations of scenario-specific Queens supply wells and the active water supply wells in Nassau and western Suffolk counties. Water table declines are largest in Queens, around the Queens Groundwater system. The extent of the 10-foot decline contour extends eastward into Nassau County over time, with the maximum eastward extent occurring at the end of the 10-year simulation period associated with Scenario E.

Based upon the results of the initial analysis, an additional assessment of the wells identified in **Table 3.7-3** was completed. A review of NYSDEC records concerning the existing screen location, pump setting, and pump motor for these wells was conducted. The well screen is the area of the well casing below ground in which water from the aquifer is collected. The screen location must be submersed (located below the water table) for a well to pump water. The pump setting refers to the location of the pump in the well casing. As with the screen, the pump must also be submersed in the water table for the well to yield water. The pump motor is the “engine” that delivers the power required to operate the pump. The size of the motor (i.e., horsepower) is determined by several factors, including desired well capacity and water table levels. Based upon a review of the records, it was determined that the potential impacts to these wells can be grouped into one of three classifications:

- No Action Needed – No modifications to well screen location, pump setting, or pump motor required to maintain existing well production.
- Well Minor Modifications – Changes to pump setting and/or pump motor required to maintain well production.
- Well Major Modifications – Deepening well, screen location, or drilling a new well.

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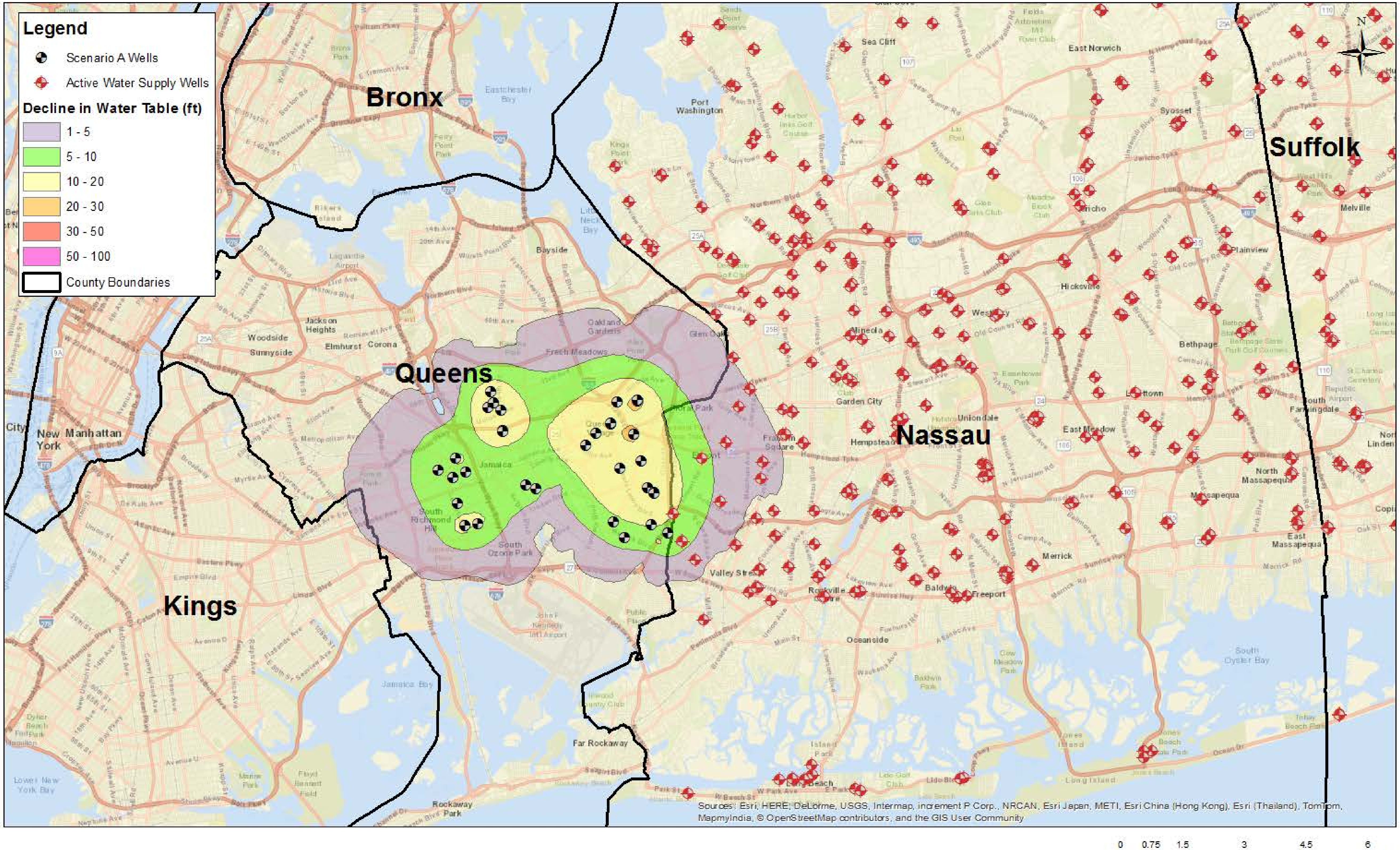

Figure 3.7-5: Simulated Decline in Water Table – Scenario A (68 mgd for 1 Year)

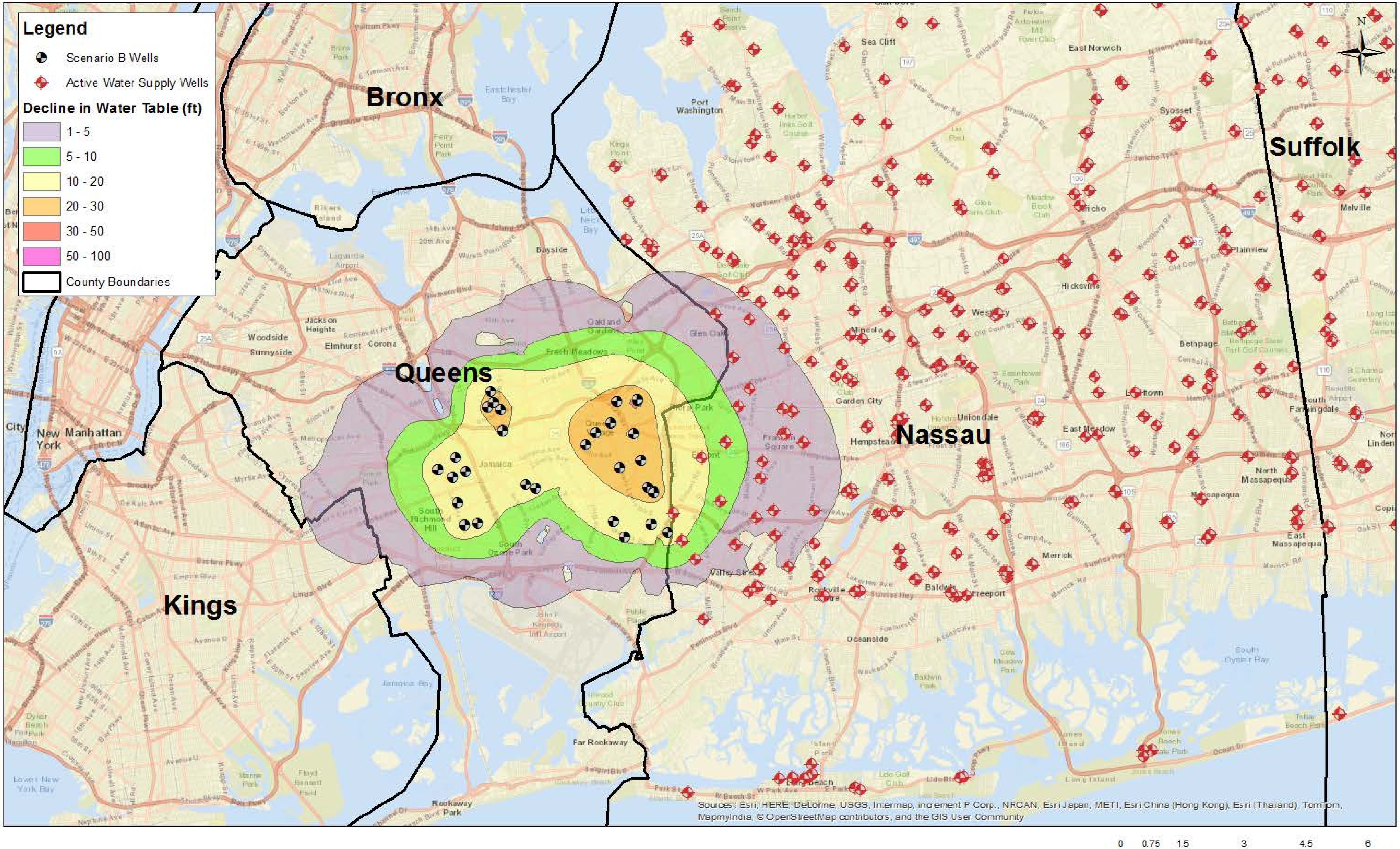

Figure 3.7-6: Simulated Decline in Water Table – Scenario B (68 mgd for 2 Years)

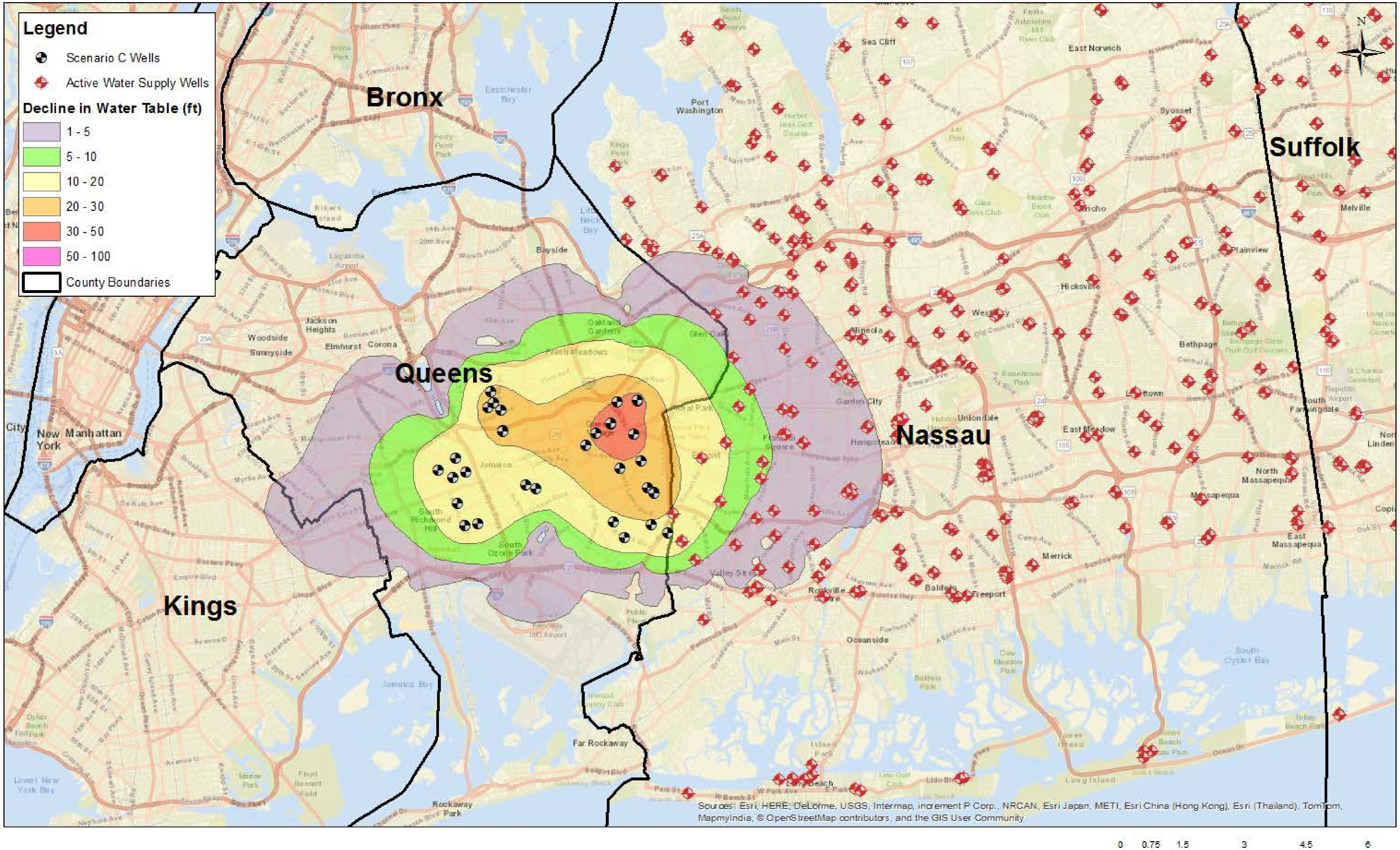

Figure 3.7-7: Simulated Decline in Water Table – Scenario C (68 mgd for 3 Years)

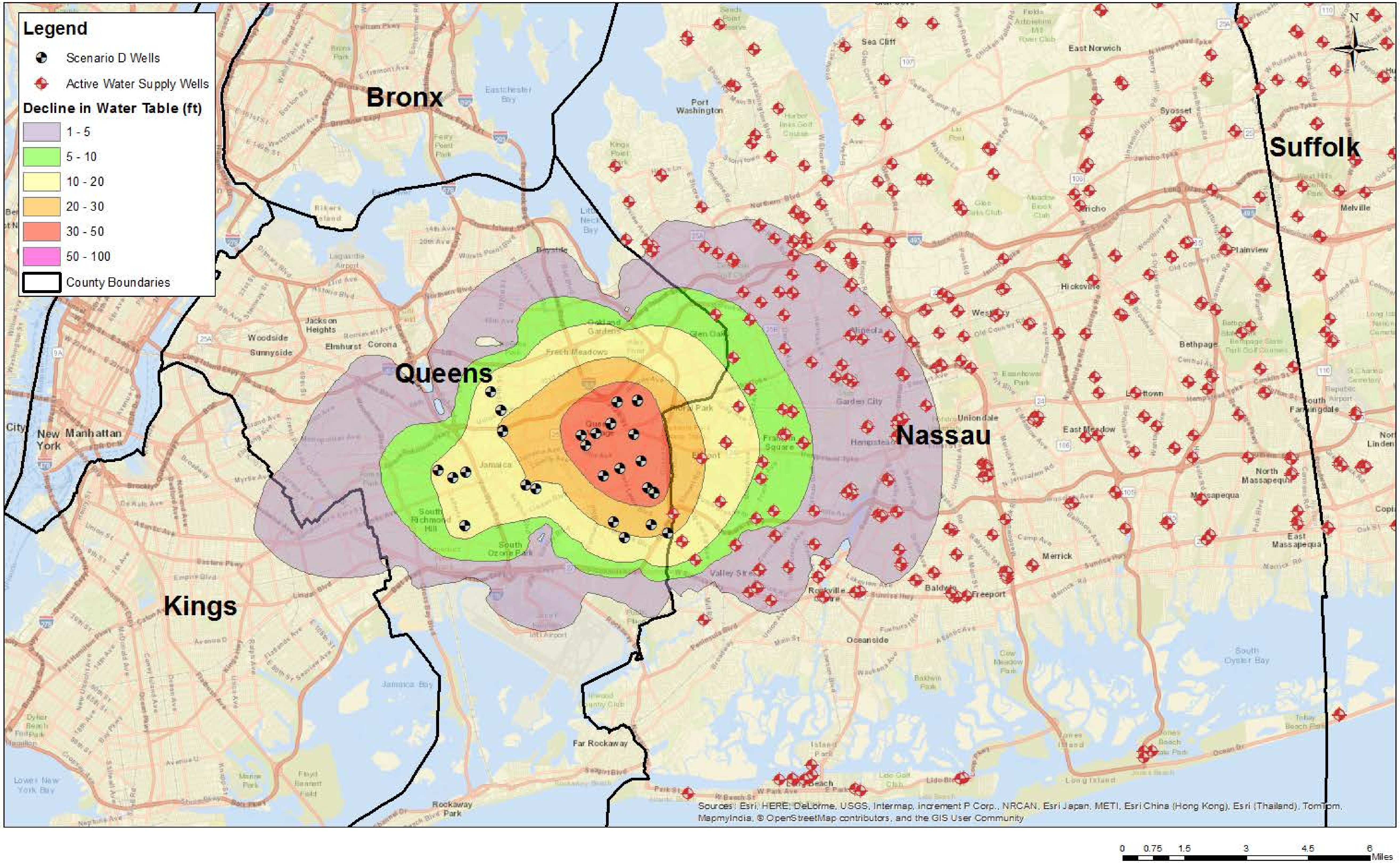

Figure 3.7-8: Simulated Decline in Water Table – Scenario D (62 mgd for 5 Years)

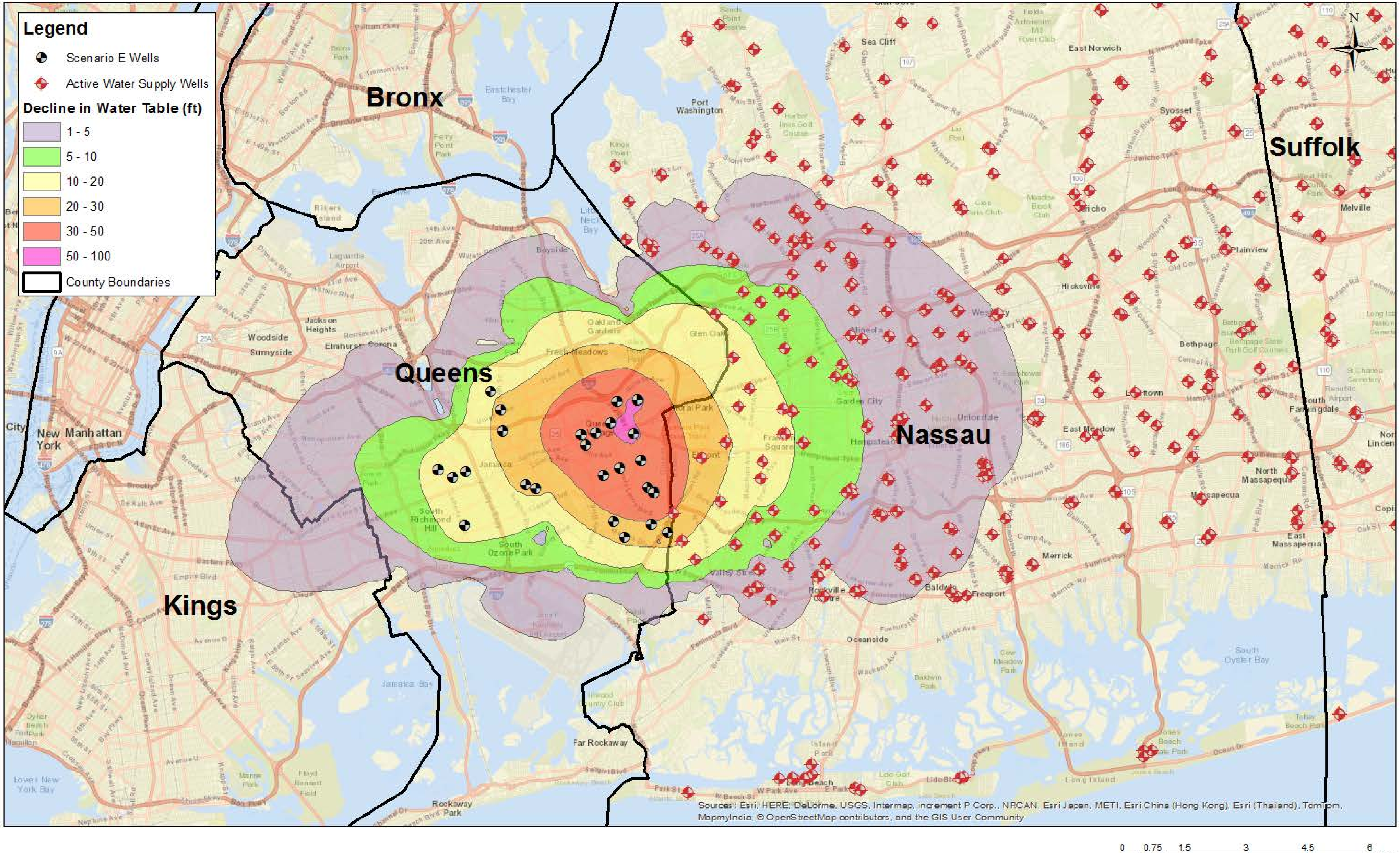

Figure 3.7-9: Simulated Decline in Water Table – Scenario E (62 mgd for 10 Years)

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Table 3.7-3: Water Supply Wells Exhibiting a Change in Water Table Elevation Greater Than 10 Feet Due to the Proposed Project

Well ID	Water Suppliers	Screened Aquifer	Scenario A Maximum Water Table Decline (Feet)	Scenario B Maximum Water Table Decline (Feet)	Scenario C Maximum Water Table Decline (Feet)	Scenario D Maximum Water Table Decline (Feet)	Scenario E Maximum Water Table Decline (Feet)
N-07482	Water Authority of Western Nassau County	Magothy	10.12	15.23	18.63	24.41	29.19
N-11037	Water Authority of Western Nassau County	Magothy		11.14	14.65	20.71	26.12
N-06744	Water Authority of Western Nassau County	Upper Glacial			10.45	15.9	21.38
N-06745	Water Authority of Western Nassau County	Magothy			10.43	15.88	21.36
N-05155	Water Authority of Western Nassau County	Upper Glacial			10.44	15.9	21.36
N-05156	Water Authority of Western Nassau County	Magothy			10.41	15.86	21.33
N-05145	New York American Water	Magothy			12.37	16.56	20.32
N-09613	New York American Water	Magothy			12.20	16.34	20.08
N-02414	Water Authority of Western Nassau County	Upper Glacial				14.08	18.39
N-04298	Water Authority of Western Nassau County	Magothy				11.44	16.48
N-07650	Water Authority of Western Nassau County	Magothy					13.54
N-07649	Water Authority of Western Nassau County	Magothy					13.52
N-08818	Franklin Square Water District	Magothy					13.43
N-07117	Franklin Square Water District	Magothy					13.42
N-01958	Water Authority of Western Nassau County	Lloyd					12.69
N-03605	Franklin Square Water District	Magothy					12.67
N-07548	New York American Water	Magothy					11.20
N-03603	Franklin Square Water District	Magothy					11.15
N-03604	Franklin Square Water District	Magothy					10.87
N-03881	Garden City Village	Magothy					10.60
N-13749	Manhasset-Lakeville Water District	Lloyd					10.46

Notes:
Scenario A: 68 mgd for 1 Year
Scenario B: 68 mgd for 2 Consecutive Years
Scenario C: 68 mgd for 3 Consecutive Years
Scenario D: 62 mgd for 5 Consecutive Years
Scenario E: 62 mgd for 10 Consecutive Years

Table 3.7-4 summarizes the potential action levels for these wells. Under operating Scenario A and B, no wells would require any modifications to maintain existing production. Operating Scenario C would require one well to upgrade its pump motor to an increased horsepower to maintain existing production. Operating Scenario D would require changes to three wells consisting of an upgrade of their pump motors to an increased horsepower. Operating Scenario E would require changes to eight wells: N-05155 would require the pump setting to be lowered to restore suction to the well, while the other seven wells would require an upgrade of their pump motor to an increased horsepower. No wells in any of the scenarios would require major well modifications. Additional information on the potential energy impacts of these are discussed in Section 3.8, "Energy, Greenhouse Gas Emissions, and Climate Change."

Table 3.7-4: Potential Action Classification of Water Supply Wells

Operating Scenario	No Action Needed	Well Minor Modifications	Well Major Modifications
Scenario A	N-07482		
Scenario B	N-07482 N-11037		
Scenario C	N-07482 N-11037 N-06744 N-06745 N-05155 N-05156 N-05145	N-09613	
Scenario D	N-07482 N-11037 N-06744 N-06745 N-05155 N-05156 N-02414	N-05145 N-09613 N-04298	
Scenario E	N-07482 N-11037 N-06744 N-06745 N-05156 N-02414 N-07650 N-08818 N-01958 N-07548 N-03603 N-03604 N-13749	N-05155 N-05145 N-09613 N-04298 N-07649 N-07117 N-03605 N-03881	

It should be noted that any future planned and/or unplanned events that require DEP to operate the Queens Groundwater system would more closely resemble Scenario A, B, or C, lasting between 1 and 3 years as opposed to the longer duration scenarios analyzed (Scenario D at 62 mgd for 5 years and Scenario E at 62 mgd for 10 years). As such, it is highly unlikely that any neighboring water suppliers would be required to make changes to their wells as a result of DEP pumping operations. The wells requiring minor modifications under Scenario D are operated by two water suppliers (Water Authority of Western Nassau and New York American Water). The wells requiring minor modifications under Scenario E are operated by four water suppliers (Water Authority of Western Nassau, New York American Water, Franklin Square Water District, and Garden City Village). All of these suppliers operate additional wells that would not be impacted by the Proposed Project. The redundancy provided by these additional wells would allow these water suppliers to continue providing uninterrupted service to their customers. In the unlikely event that the Queens Groundwater system is operated for 5 or 10 years (Scenario D and E, respectively), DEP would coordinate with the water suppliers. In addition, implementation of conservation measures by Nassau and Suffolk counties could further reduce potential effects.

Sensitivity Analyses

Introduction

In addition to standard operation of the Queens Groundwater system under the Proposed Project, sensitivity analyses were also conducted. This consisted of additional simulations that were generated to identify the potential effects associated with which of the 68 Queens supply wells may be pumped in the future and to discuss more conservative simulated hydrologic conditions Long Island with the Queens Groundwater wells in operation.

Queens Groundwater Well Selection

Actual well selection would be based on well capacity and productivity, ease of treatment, operation and maintenance needs, cost, and other factors which would be more reflective of the actual wells that would be selected and used and that were ultimately analyzed as part of Scenario E, as discussed above. However, to better understand the range of uncertainty with respect to potential effects, pumping volumes, and durations associated with Scenario E, DEP simulated two conservative well distributions: one pumping the easternmost wells and one pumping the westernmost wells. Simulated water table decline contours are shown for each of these two conditions shown on **Figure 3.7-10** and **Figure 3.7-11**, respectively. The selection of the easternmost Queens Groundwater wells could increase the number of active Nassau County water supply wells that exhibit more than 10 feet of water table decline from 21 to 37 wells. The selection of the westernmost Queens water supply wells could decrease the number of active Nassau County water supply wells that exhibit more than 10 feet of water table decline from 21 to 2 wells. These results are summarized in **Table 3.7-5**.

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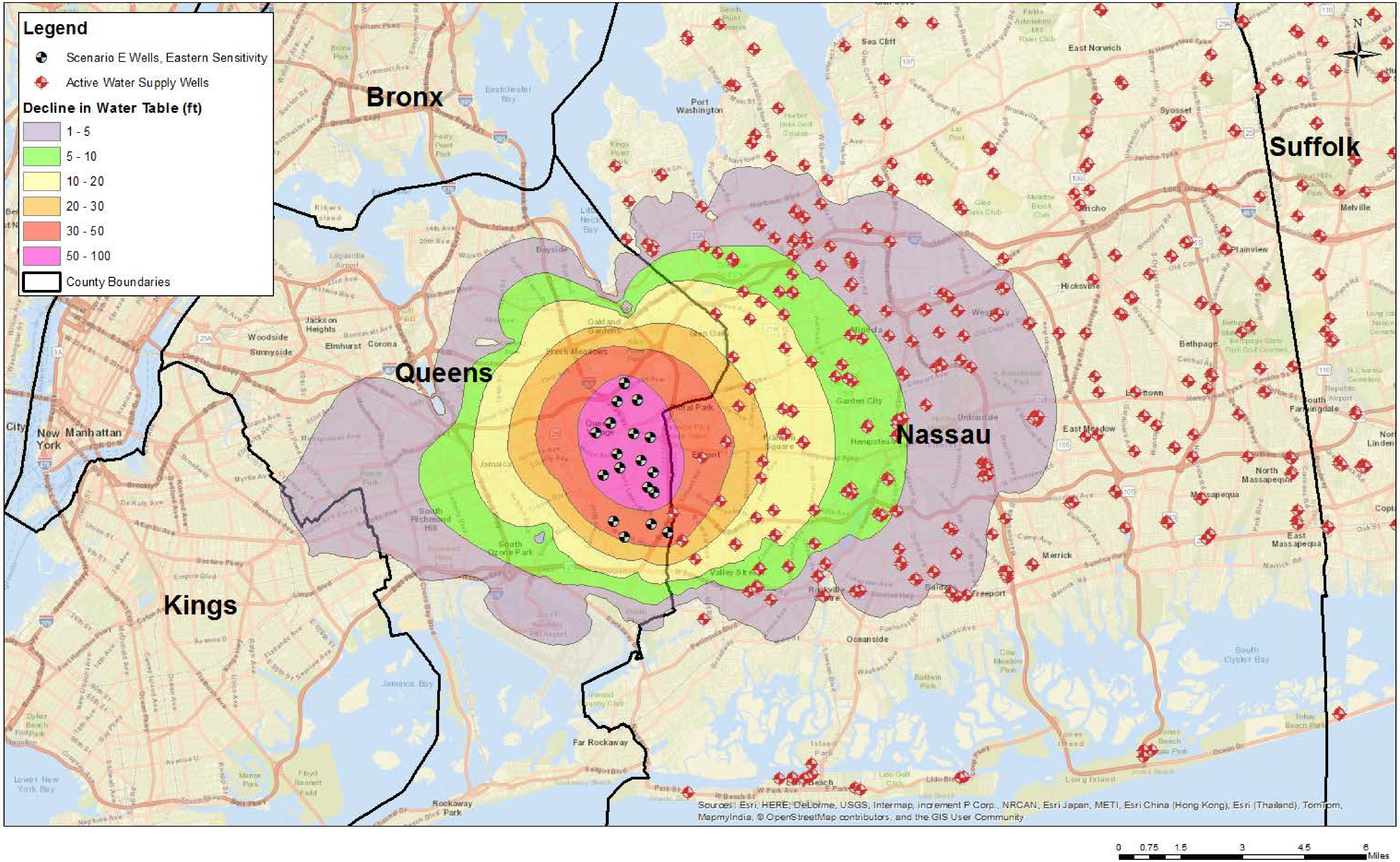

Figure 3.7-10: Simulated Decline in Water Table - Easternmost Wells

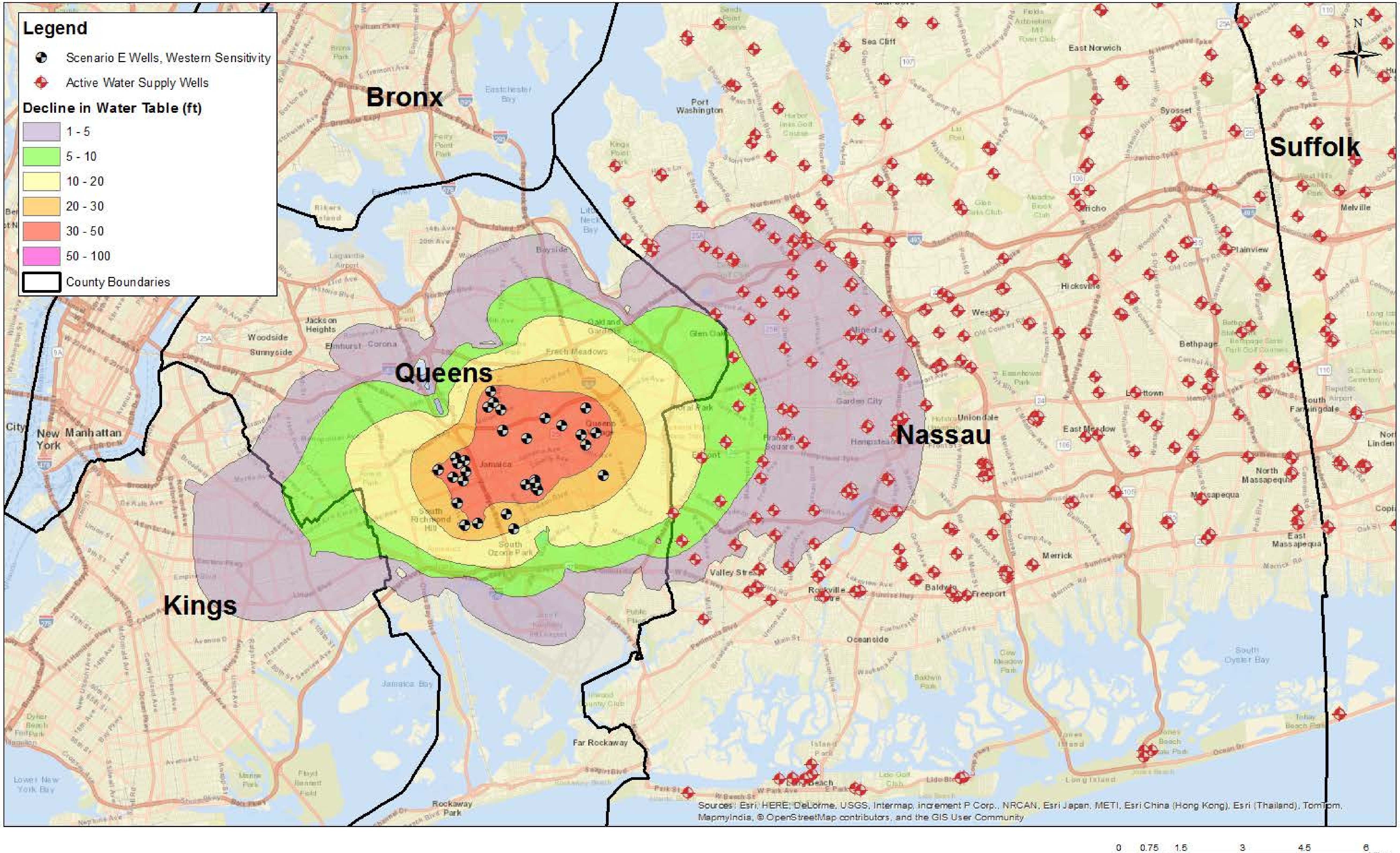

Figure 3.7-11: Simulated Decline in Water Table - Westernmost Wells

Table 3.7-5: Water Supply Wells Exhibiting a Change in Water Table Elevation Greater Than 10 Feet, Scenario E (62 mgd for 10 Years) – Easternmost and Westernmost Well Selection

Well ID	Water Suppliers	Screened Aquifer	Scenario E Maximum Water Table Decline (Feet)	Scenario E - East Pumping Maximum Water Table Decline (Feet)	Scenario E - West Pumping Maximum Water Table Decline (Feet)
N-07482	Water Authority of Western Nassau County	Magothy	29.19	43.88	10.14
N-11037	Water Authority of Western Nassau County	Magothy	26.12	40.60	10.10
N-06744	Water Authority of Western Nassau County	Upper Glacial	21.38	33.11	
N-06745	Water Authority of Western Nassau County	Magothy	21.36	33.08	
N-05155	Water Authority of Western Nassau County	Upper Glacial	21.36	33.08	
N-05156	Water Authority of Western Nassau County	Magothy	21.33	33.03	
N-05145	New York American Water	Magothy	20.32	30.12	
N-09613	New York American Water	Magothy	20.08	29.77	
N-02414	Water Authority of Western Nassau County	Upper Glacial	18.39	28.12	
N-04298	Water Authority of Western Nassau County	Magothy	16.48	24.82	
N-07650	Water Authority of Western Nassau County	Magothy	13.54	20.17	
N-07649	Water Authority of Western Nassau County	Magothy	13.52	20.13	
N-08818	Franklin Square Water District	Magothy	13.43	20.51	
N-07117	Franklin Square Water District	Magothy	13.42	20.50	
N-01958	Water Authority of Western Nassau County	Lloyd	12.69	18.62	
N-03605	Franklin Square Water District	Magothy	12.67	19.41	
N-07548	New York American Water	Magothy	11.20	17.18	
N-03603	Franklin Square Water District	Magothy	11.15	16.82	
N-03604	Franklin Square Water District	Magothy	10.87	16.41	
N-03881	Garden City Village	Magothy	10.60	15.85	
N-13749	Manhasset-Lakeville Water District	Lloyd	10.46	15.37	
N-04512	Water Authority of Western Nassau County	Magothy		14.80	
N-08420	New York American Water	Magothy		13.17	
N-03720	Water Authority of Western Nassau County	Magothy		14.85	
N-10286	New York American Water	Magothy		12.99	
N-07855	New York American Water	Magothy		11.67	
N-08339	Garden City Village	Magothy		14.68	
N-07058	Garden City Village	Magothy		14.66	

Table 3.7-5: Water Supply Wells Exhibiting a Change in Water Table Elevation Greater Than 10 Feet, Scenario E (62 mgd for 10 Years) – Easternmost and Westernmost Well Selection

Well ID	Water Suppliers	Screened Aquifer	Scenario E Maximum Water Table Decline (Feet)	Scenario E - East Pumping Maximum Water Table Decline (Feet)	Scenario E - West Pumping Maximum Water Table Decline (Feet)
N-10103	New York American Water	Magothy		11.57	
N-13597	West Hempstead Water District	Magothy		13.83	
N-07720	West Hempstead Water District	Magothy		13.73	
N-07445	Water Authority of Western Nassau County	Magothy		13.16	
N-01603	New York American Water	Magothy		10.10	
N-00017	Water Authority of Western Nassau County	Magothy		11.50	
N-07512	Garden City Park Water District	Magothy		10.68	
N-13704	Manhasset-Lakeville Water District	Magothy		10.06	

Hydrologic Sensitivity Analysis

An assessment of potential effects of Scenario A through E, as discussed in Section 3.7.5.1, "Potential Impacts of the Proposed Project," above, was conducted to assess the use of the Queens supply wells during a water supply shortage including a drought in the upstate surface water system. With the uncertainty regarding potential rainfall and subsequent recharge for the Long Island aquifers, Scenario A through E were also simulated using the lowest contiguous rainfall years for Long Island for the length of each scenario (for example, for the 1 year duration of Scenario A, the lowest 1 year was used, for the 5 year duration of Scenario D, the lowest 5 years was used) on record since 1950, instead of the average rainfall/recharge values for Long Island as discussed in Section 3.5, "Natural Resources." Water table decline contours for these more conservative simulated hydrologic conditions are shown on **Figure 3.7-12** through **Figure 3.7-16** for Scenario A through E, respectively. Water table declines are included in **Table 3.7-6**, with results summarized below.

- Lowest 1 year of rainfall: same number of wells affected as Scenario A
- Lowest 2 consecutive years of rainfall: 2 more wells affected than in Scenario B
- Lowest 3 consecutive years of rainfall: 1 more well affected than in Scenario C
- Lowest 5 consecutive years of rainfall: 4 more wells affected than in Scenario D
- Lowest 10 consecutive years of rainfall: 11 more wells affected than in Scenario E

These hydrologic conditions, which assume use of the Queens Groundwater system concurrent with extreme drought conditions on Long Island, should be viewed as a representation of a condition that would not be anticipated. As an example, the sensitivity analysis completed for Scenario E with the lowest 10 consecutive years of rainfall would not represent a reasonable analysis condition. Typical drought durations would be more consistent with Scenario A through C (68 mgd for 1 to 3 consecutive years). Therefore, the results of the sensitivity analyses illustrate that the Proposed Project's scenarios represent a reasonable conservative analysis.

Table 3.7-6: Water Supply Wells Exhibiting a Change in Water Table Elevation Greater Than 10 Feet, Hydrologic Sensitivity Analysis

Well ID	Water Suppliers	Screened Aquifer	Scenario A Sensitivity Maximum Water Table Decline (Feet)	Scenario B Sensitivity Maximum Water Table Decline (Feet)	Scenario C Sensitivity Maximum Water Table Decline (Feet)	Scenario D Sensitivity Maximum Water Table Decline (Feet)	Scenario E Sensitivity Maximum Water Table Decline (Feet)
N-07482	Water Authority of Western Nassau County	Magothy	10.61	16.67	20.76	27.82	34.48
N-11037	Water Authority of Western Nassau County	Magothy		11.76	15.90	23.13	30.46
N-06744	Water Authority of Western Nassau County	Upper Glacial			11.59	18.17	25.88
N-06745	Water Authority of Western Nassau County	Magothy			11.57	18.15	25.88
N-05155	Water Authority of Western Nassau County	Upper Glacial			11.58	18.16	25.86
N-05156	Water Authority of Western Nassau County	Magothy			11.55	18.12	25.83
N-05145	New York American Water	Magothy		11.48	14.62	19.97	25.52
N-09613	New York American Water	Magothy		11.31	14.43	19.74	25.25
N-02414	Water Authority of Western Nassau County	Upper Glacial			11.38	17.05	23.23
N-04298	Water Authority of Western Nassau County	Magothy				12.62	19.43
N-08818	Franklin Square Water District	Magothy				11.04	16.85
N-07117	Franklin Square Water District	Magothy				11.05	16.84
N-03605	Franklin Square Water District	Magothy				10.82	16.35
N-07548	New York American Water	Magothy				11.79	16.00
N-07650	Water Authority of Western Nassau County	Magothy					15.86
N-07649	Water Authority of Western Nassau County	Magothy					15.83
N-04512	Water Authority of Western Nassau County	Magothy					14.65
N-01958	Water Authority of Western Nassau County	Lloyd					14.23
N-08420	New York American Water	Magothy					13.74
N-03603	Franklin Square Water District	Magothy					13.66
N-03720	Water Authority of Western Nassau County	Magothy					13.66
N-10286	New York American Water	Magothy					13.64
N-03604	Franklin Square Water District	Magothy					13.35

Table 3.7-6: Water Supply Wells Exhibiting a Change in Water Table Elevation Greater Than 10 Feet, Hydrologic Sensitivity Analysis

Well ID	Water Suppliers	Screened Aquifer	Scenario A Sensitivity Maximum Water Table Decline (Feet)	Scenario B Sensitivity Maximum Water Table Decline (Feet)	Scenario C Sensitivity Maximum Water Table Decline (Feet)	Scenario D Sensitivity Maximum Water Table Decline (Feet)	Scenario E Sensitivity Maximum Water Table Decline (Feet)
N-03881	Garden City Village	Magothy					12.76
N-07855	New York American Water	Magothy					11.93
N-08339	Garden City Village	Magothy					11.89
N-07058	Garden City Village	Magothy					11.87
N-10103	New York American Water	Magothy					11.83
N-13749	Manhasset-Lakeville Water District	Lloyd					11.75
N-13597	West Hempstead Water District	Magothy					11.47
N-07720	West Hempstead Water District	Magothy					11.40
N-07445	Water Authority of Western Nassau County	Magothy					10.13

Notes:
Scenario A Sensitivity: Lowest 1 year of rainfall
Scenario B Sensitivity: Lowest 2 consecutive years of rainfall
Scenario C Sensitivity: Lowest 3 consecutive years of rainfall
Scenario D Sensitivity: Lowest 5 consecutive years of rainfall
Scenario E Sensitivity: Lowest 10 consecutive years of rainfall

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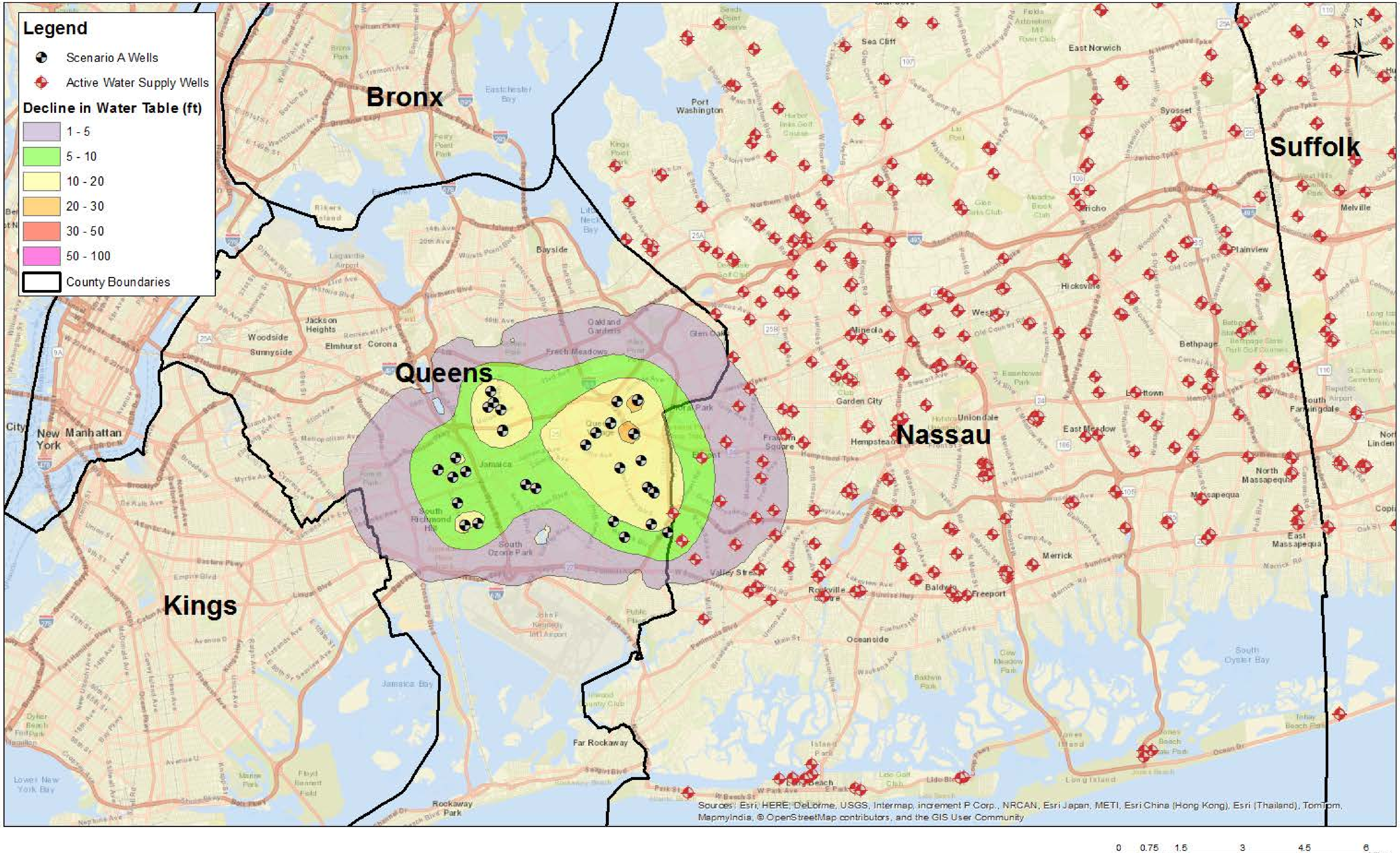

Figure 3.7-12: Simulated Decline in Water Table, Hydrology Sensitivity Analysis – Scenario A (68 mgd for 1 Year) Lowest 1 Year of Rainfall

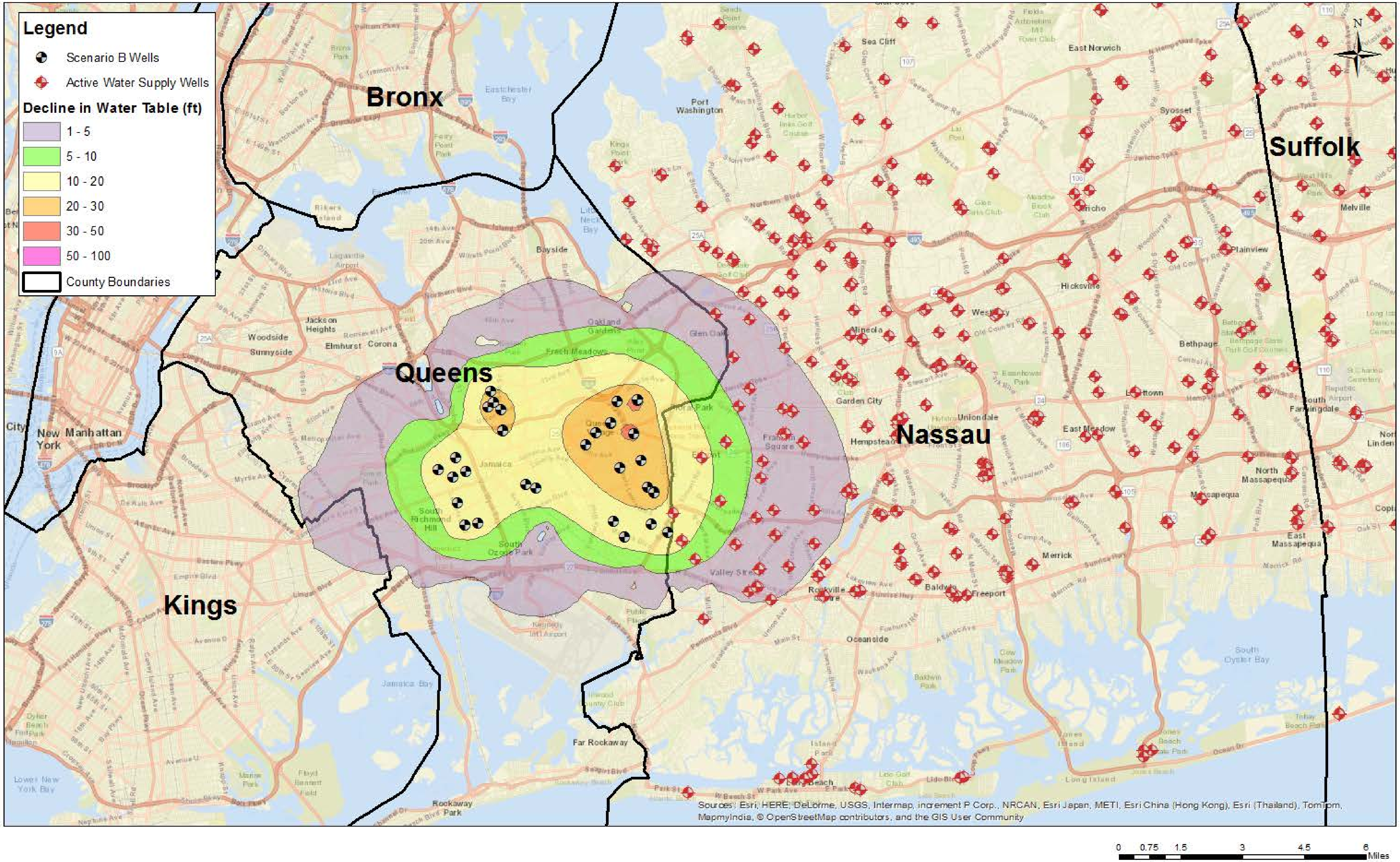

Figure 3.7-13: Simulated Decline in Water Table, Hydrology Sensitivity Analysis – Scenario B (68 mgd for 2 Years) Lowest 2 Consecutive Years of Rainfall

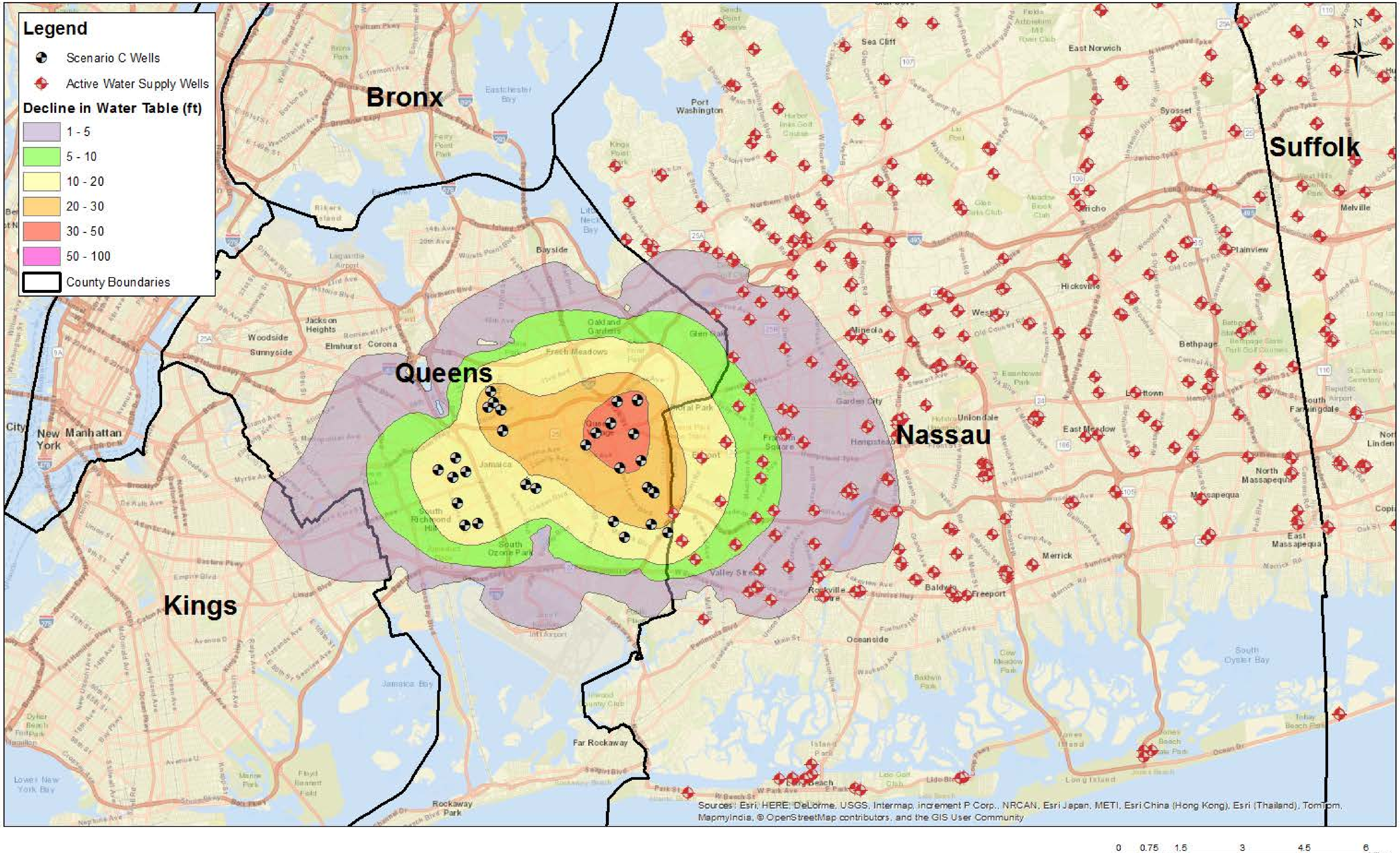

Figure 3.7-14: Simulated Decline in Water Table, Hydrology Sensitivity Analysis – Scenario C (68 mgd for 3 Years) Lowest 3 Consecutive Years of Rainfall

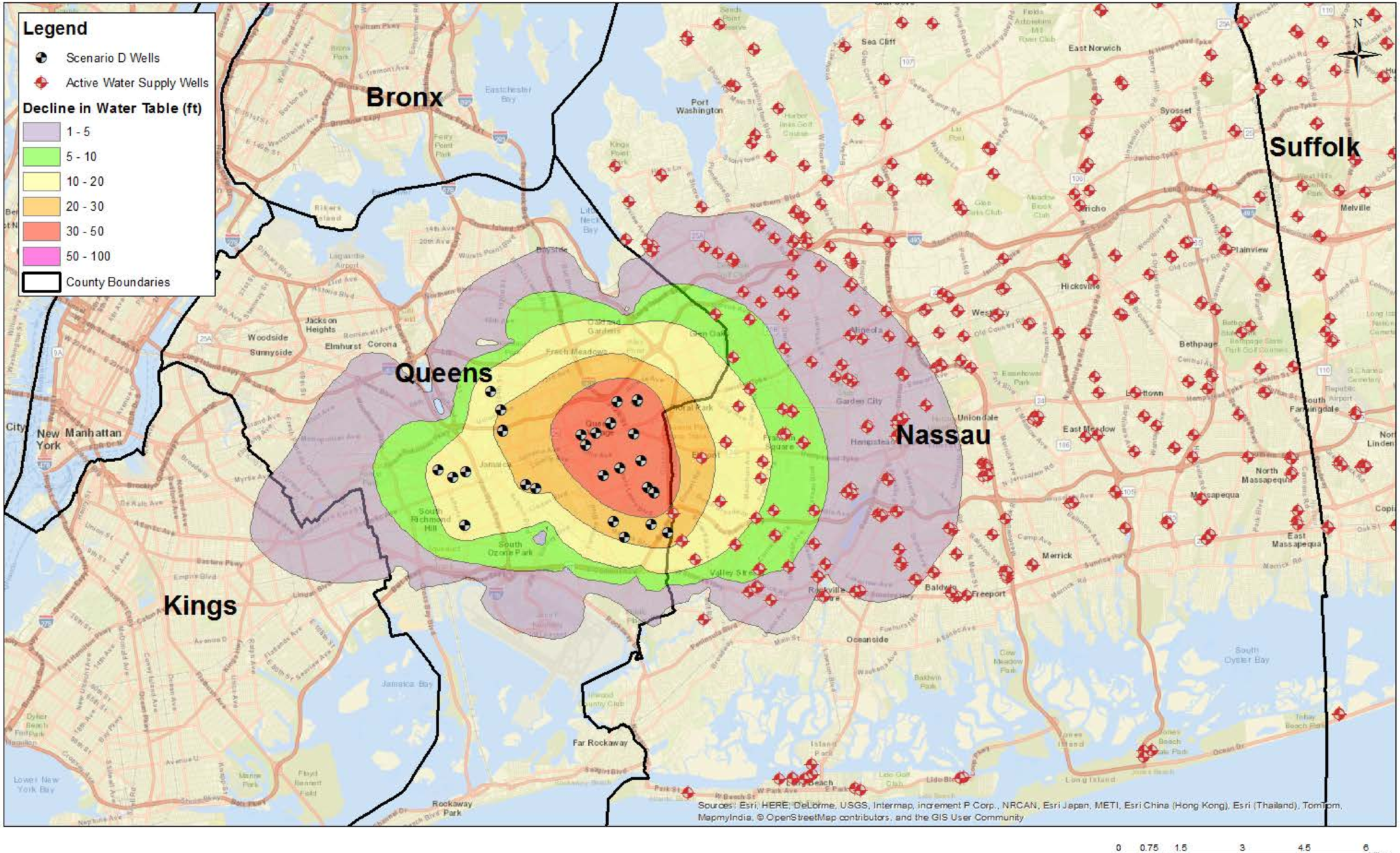

Figure 3.7-15: Simulated Decline in Water Table, Hydrology Sensitivity Analysis – Scenario D (62 mgd for 5 Years) Lowest 5 Consecutive Years of Rainfall

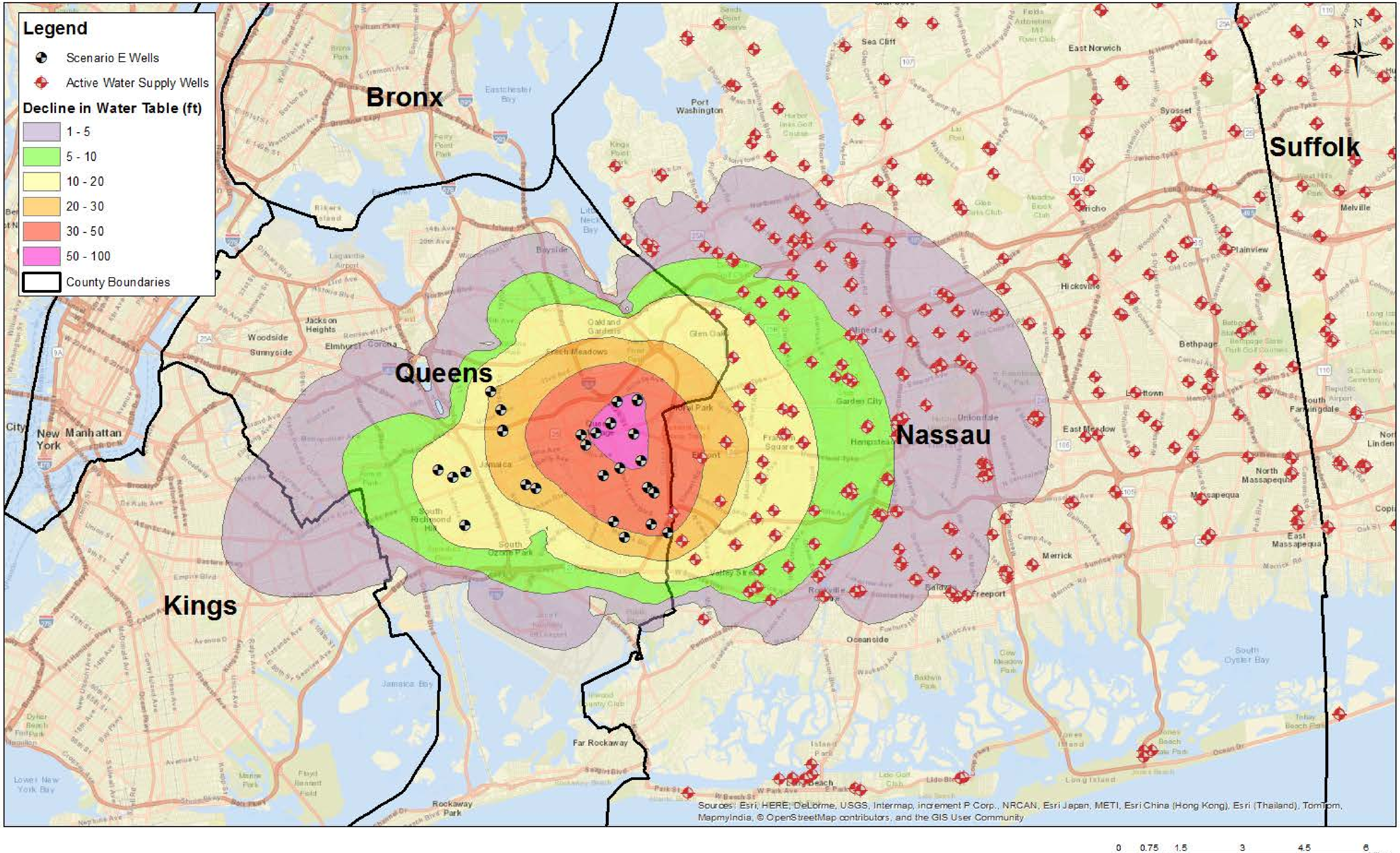

Figure 3.7-16: Simulated Decline in Water Table, Hydrology Sensitivity Analysis – Scenario E (62 mgd for 10 Years) Lowest 10 Consecutive Years of Rainfall

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3.7.5.2 Wastewater and Stormwater Collection Systems

As part of the Proposed Project, temporary treatment systems would be put in place in order to allow DEP to use the Queens Groundwater system as a supplemental water supply during water supply shortages such as drought and planned and/or unplanned infrastructure outages. Operation of the Proposed Project would require discharges to the sewers serving the well stations. Approvals for discharges to the municipal sewer system would be acquired, as necessary and appropriate, and would comply with applicable sewer discharge requirements. These discharges would be to sanitary sewers (separate sanitary or CSO) and would occur during the following on-site activities:

- Startup and Testing: During startup and testing of the well and temporary treatment systems, discharges including blow off of the well and representative finished flows are necessary to demonstrate system performance to DEP operational standards and NYCDOHMH acceptance requirements.

- Operation: Routine discharges including well blow off and backwashing (vessel flushing) of the liquid-phase carbon adsorption vessels (LCA), oxidation and filtration vessels (OXF), ion exchange perchlorate vessels (IXP), and ion exchange nitrate vessels (IXN) would be required. For each of these processes, it is necessary to flow well water through the process (i.e., treatment) media to remove particulates and prepare the treatment vessel or unit for its treatment role. This water is considered spent and must be discharged.

- Maintenance: Discharges including well and pump capacity testing, winterization of treatment blocks, and draining for demobilization.

The largest discharge flows associated with the Proposed Project would be from the initial startup and testing operations for the wells. It is anticipated that each well would be pumped to a sewer connection for eight continuous hours to demonstrate that the well and treatment systems are operating as designed. Only after a successful startup and testing would DEP place the well into service and send water to the City’s distribution system. Once a well is placed into service, operation would vary depending on the supply needs of the City. Each time a well is turned on, a small quality of water would be pumped to a sewer connection (blow off) before water is sent to the distribution system. Well blow off typically would last for five minutes, allowing for any stagnant water in the well and site piping to be sent to the wastewater system and operators to confirm everything is operating as expected. Backwashing of the process equipment and maintenance activities are expected to be infrequent and generate minimal wastewater.

Due to operational constraints, it is anticipated that the wells at only one station would undergo initial startup and testing in any given 24-hour period. To conservatively assess the potential for waste discharges from the initial startup and testing operations, the station with the largest total capacity (Station 6, with Wells 6A, 6B, and 6C) was evaluated. Consecutively pumping each of these wells to a sewer connection for eight continuous hours (24 hours total) would generate 2.02 mgd. Furthermore, assuming all the other wells that share the Jamaica WWTP drainage area with Station 6 are already in service and each experience a 5-minute blow off within this 24-hour period, an additional 0.34 mgd of wastewater would be generated, for a total of 2.36 mgd.

Table 3.7-7 below illustrates that this waste contribution to the Jamaica WWTP can readily be accepted. Similarly, Station 18, with Wells 18 and 18A, would generate the largest waste discharges within the Tallman Island drainage area. Coupled with all other wells experiencing a normal blow off while Station 18 undergoes initial startup and testing, a total of 1.10 mgd would be sent to the Tallman Island WWTP. As previously stated, once a well is placed into service, discharges from blow off operations, and minimal contributions from backwashing and maintenance, are the only waste flows expected.

As part of the design of the temporary treatment systems, DEP would evaluate the applicable or nearest sewer system to ensure that the system could adequately convey anticipated discharge flows resulting from the Proposed Project. This analysis would take into account the potential for multiple stations to discharge to the same sewer line and ensure that sufficient sewer capacity exists to safely convey flows. If the flows from the Proposed Project were not consistent with existing sewer capacity, this would trigger implementation of actions to ensure no negative effect to the sewer system performance occurs. Specifically, operational rules would be implemented such as modification of flow rates, restrictions on operations of wells that may be within the same sewer pipe network, and timing of operations (e.g., operations only during overnight hours when sewer flows are less) to reduce the amount of flow sent to the sewer system at one time. Sewer system upgrades or other actions to provide additional capacity would also be pursued if warranted based on the Proposed Project flows, duration of operations anticipated at a well station(s) and condition of the system. DEP routinely has the ability to review and prioritize infrastructure improvements as necessary to address changes in needs.

It is currently anticipated that the Proposed Project would discharge to sanitary sewers only, however, in the event it was necessary to connect to a combined sewer, the procedures described above would be followed and enhanced to ensure no tipping events occur as a result of groundwater system operation. Specifically, if combined sewers were utilized, operational rules would include restrictions on operations during and within specified time periods after rain events and would also include additional restrictions to prohibit well station operations within the same regulator drainage area. With these operational protocols in place, no potential substantive increase in CSO volumes would occur, thereby not causing any WWTP to violate their SPDES permit.

The Proposed Project could result in minimal increases in impervious areas on the well stations resulting from new concrete pads, footings, and/or temporary treatment equipment being placed on the sites during operations. However, upon the advancement of more detailed design of temporary treatment systems at one or more well stations in the future, additional station-specific analyses of specific construction and operation of temporary treatment facilities would be completed, as necessary, prior to implementation.

Importantly, the Proposed Project is located in an area of southeast Queens that is scheduled for significant investments in sewer infrastructure. As previously described, in the Future without the Proposed Project, DEP has already committed to invest $1.7 billion dollars to build out storm sewers and reconstruct and upgrade sanitary sewers. DEP is targeting early spending of this funding to areas most in need of sewer upgrades and should areas serving the well sites warrant investment, DEP can prioritize these resources accordingly.

No potential significant adverse impacts to the operations of the sewer collection system would therefore be anticipated as a result of the Proposed Project.

3.7.5.3 Wastewater Treatment

The Queens Groundwater system wells are located in an area served by two existing WWTPs. As previously stated, the estimated maximum calculated daily discharge flow from any one station would be from the initial startup and testing operations at Station 6 within the Jamaica WWTP drainage area, and Station 18, within the Tallman Island WWTP drainage area. Accounting for normal well blow off for all other wells within each drainage area, the conservative estimated maximum daily increase in flows are shown in **Table 3.7-7**. The calculation of potential increased flow is extremely conservative, as not every well would be anticipated to be operating on a daily basis. Even with these conservative assumptions, the incremental increase in flow under this scenario are minimal when compared to the permitted capacity of each WWTP and the most recent average dry weather flows (CY2016) for each WWTP. Therefore, the Proposed Project would not represent a potential significant adverse impact to the operation of the WWTPs.

Table 3.7-7: Incremental Flow Increases to WWTPs from Proposed Project Operations

WWTP	Maximum Daily Flow Increment from Proposed Project (mgd)	Current Actual Daily WWTP Dry Weather Flow (DWF) - CY 2016 (mgd)	Projected Average Daily WWTP DWF with Proposed Project (mgd)	WWTP Permitted DWF (mgd)
Jamaica	2.36	72.6	74.96	100.0
Tallman Island	1.10	52.1	53.2	80.0

All wastewater discharged from the Proposed Project to the sewer system would be pretreated to ensure compliance with applicable standards including DEP's Wastewater Quality Control Application and Industrial Pre-Treatment Program requirements. No potential significant adverse impacts to WWTP operations, the ability of the WWTPs to comply with their existing permits, or receiving waterbodies would occur.

Therefore, the Proposed Project is not anticipated to result in any significant adverse impacts to water and sewer infrastructure.

3.8 ENERGY, GREENHOUSE GAS EMISSIONS, AND CLIMATE CHANGE

3.8.1 INTRODUCTION

This section evaluates the potential for the Proposed Project to result in significant adverse impacts on energy demand within Queens and the potential for increased energy usage for water suppliers in Nassau and western Suffolk County. This section also addresses the greenhouse gas (GHG) emissions that may be generated by the Proposed Project.

3.8.2 METHODOLOGY

According to the *CEQR Technical Manual*, an analysis of energy focuses on a project's consumption of energy and, where relevant, potential effects on the transmission of energy that may result from a proposed project. Disclosing the potential energy consumed by a proposed project begins with an analysis of operational energy, or the amount of energy that would be consumed annually after a project is operational. This calculation encompasses the energy usage from different operational elements of a proposed project including a building's heating, cooling, lighting, and other energy utilizing features such as electric-powered equipment.

The Proposed Project would utilize energy for well pumping, water treatment, and facility operations. Presented within the following sections is additional detail on how these energy demands were calculated and evaluated. Calculations of potential energy usage are presented for each of the operating scenarios (Scenario A through E), which are described in Chapter 2.0, "Analytical Framework."

The energy assessment utilizes different methods to assess energy changes in Queens and Nassau and western Suffolk County, respectively. As described below, the two methods were chosen for its suitability in assessing the relevant aspects of the Proposed Project and its potential for impacts in the different geographic settings.

- Kilowatts (kW): In Queens, the energy demand is represented as the power, in kW, that each operating scenario would require from the electric utility's distribution grid. It is the instantaneous power that would need to be available to operate the Queens Groundwater system under each operating scenario. This allows an assessment of the existing electrical grid's ability to meet this demand and is an appropriate method for assessing potential impacts.

- Kilowatt-hour (kWh): In Nassau and western Suffolk County, the energy is represented in kWh, which is the additional energy that potentially impacted water suppliers would consume due to the effects of the operation of the Queens Groundwater system for the duration of each scenario. This method allows a comparison between existing usage and the future additional energy usage for the affected Nassau and western Suffolk County water wells.

3.8.2.1 Queens Groundwater Well Stations

Energy demand for operating the Queens Groundwater system under operating Scenario A through E was estimated by calculating the energy demand associated with well pumping and facility operation needs for each utilized well. These inputs are described in more detail below:

- Pumping: The pumping energy is the energy required to produce the respective groundwater flow from each well, pumping it from the groundwater table (water table) elevation, through applicable treatment system(s), and up to an elevation sufficient to allow the DEP to transport the flow into the City's water distribution system. Projected water table elevations for each well utilized under the different operating scenarios are provided by the New York City Groundwater Model, described in more detail within

Section 3.5, "Natural Resources." The calculation of pumping energy includes the energy to pump groundwater from the water table elevations estimated in the New York City Groundwater Model, through a representative treatment system that includes up to three treatment processes (OXF, LCA, and IXP/IXN), and to the distribution system. Use of a three treatment process arrangement represents a conservative calculation, as all three treatment processes are not expected to be required for all wells and most wells would likely only require one treatment process. The calculated pumping energy for this operation would therefore represent the largest anticipated energy usage at the well stations which represents a reasonable conservative analysis.

- Chemical Treatment and Facility Operation: Energy is also needed to support the limited and applicable environmental systems on site for facility heating, cooling, lighting, control systems, and the chemical treatment (i.e., Chemical Treatment Container; see Chapter 1.0, "Project Description") necessary to produce finished water. To conservatively estimate this energy demand, an additional energy need of five percent was added to the calculated pumping energy, to represent the total energy demand at each well station. For a typical well station, the collective energy demand in kilowatts (kW) to meet the chemical treatment and facility operation needs would not be expected to exceed five percent of the projected pumping energy, as these systems are much smaller when compared with the well pump motors.

The potential energy demand for each well that would be utilized in a specific operating scenario was then calculated by adding the pumping, chemical treatment and facility operation demands, and then the energy demand for all wells within a specific scenario were summed to provide an estimate of the total energy demand by scenario. The energy demand is represented as the power, in kW, that the operating scenario would require from the electric utility's distribution grid. It is the instantaneous power that would need to be available to use the Queens Groundwater system under an operating scenario.

3.8.2.2 Nassau and Western Suffolk County

Potential changes in energy usage for Nassau and western Suffolk County wells under operating Scenario A through E have been estimated by calculating the needed increase in pumping energy resulting from the water table decline at those wells which exceeded a 10-foot threshold, as discussed in Section 3.7, "Water and Sewer Infrastructure." The energy calculation includes the additional pumping energy required due to the decreased modeled water table elevation. The methodology used assesses the additional energy required by a water supplier to continue to pump, treat, and distribute water in a manner consistent with its current operation.

After determining the potential energy usage increase for the impacted wells in each of the operating scenarios, these were then summed to provide an estimate of the total additional energy usage by scenario. The additional energy usage, in kilowatt-hours (kWh), is the additional energy that the impacted wells would consume due to the Proposed Project. While the evaluation of total instantaneous energy demand (power in kW) was appropriate for the Queens Groundwater well stations to verify that the grid could handle the increase, focusing on the potential additional energy usage over the duration of the scenarios (kWh) was more appropriate for affected Nassau and western Suffolk County water wells.

3.8.2.3 Greenhouse Gas Emissions and Climate Change

There are six internationally-recognized greenhouse gases regulated under the Kyoto Protocol, an international agreement adopted in 1997 that is linked to the United Nations Framework Convention on Climate Change. These include carbon dioxide (CO_2), nitrous oxide (N_2O), methane (CH_4), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6).

Generally, an assessment of GHG emissions is typically conducted only for larger projects. The temporary operation of the Queens Groundwater well stations and implementation of temporary treatment facilities would be located on small sites.

In accordance with the *CEQR Technical Manual*, a project that proposes either of the following may warrant assessment:

- Power generation (not including emergency backup power, renewable power, or small-scale cogeneration); or
- Regulations and other actions that fundamentally change the City's solid waste management system by changing solid waste transport mode, distances, or disposal technologies.

The Proposed Project does not involve a power generation plant. Likewise, the Proposed Project would not fundamentally change the City's solid waste management system or result in the development of 350,000 square feet or more. Therefore, the Proposed Project would not result in any significant adverse impact on greenhouse gas emissions and no further analysis is warranted. However, for the purposes of disclosure, a calculation of estimated GHG emissions due to the Proposed Project is provided below. This calculation is based upon the estimated increase in energy use at the Queens Groundwater well stations and for Nassau and western Suffolk County water suppliers.

3.8.3 EXISTING CONDITIONS

3.8.3.1 Queens Groundwater Well Stations

The Queens Groundwater system consists of 44 well stations, which house a total of 68 water supply wells throughout southeast Queens. Some of these well stations have multiple wells located on the same station.

As discussed in Chapter 1.0, "Project Description," DEP previously used the Queens Groundwater system as a source of water supply until 2007 when access to upstate water supplies was made available throughout the City. As a result, each of the existing well stations is still connected to Consolidated Edison, Incorporated's (Con Edison) distribution grid for electric supply. Many of the stations are fed by existing transformers that are located in below-grade vaults in front of the well stations or on concrete utility pads fronting the well stations.

Current energy use within the Queens Groundwater system is small, associated with routine facility maintenance activities and the infrequent use of the facilities and wells for water quality testing.

3.8.3.2 Nassau and Western Suffolk County

The Nassau and western Suffolk County wells are located throughout the various service areas of the water suppliers. Many of the wells are located on separate sites, with few groupings of greater than two wells.

Energy demands at these sites are primarily met with electricity, but a few suppliers utilize direct drive natural gas and/or diesel engines. Utility providers, including Public Service Enterprise Group (PSEG), Long Island Power Authority (LIPA), National Grid, and in a few cases the local municipality, deliver electric and natural gas to the sites. Sufficient resources are currently available from these providers to meet current energy demands at these wells. Many sites are also equipped with natural gas or diesel-powered generators, for use as a secondary power supply during emergencies.

Current energy usage at these facilities is typically due to well pumping, treatment, and facility operation. However, the primary energy demands associated with these facilities are from the electric motors used to operate the well pumps. The addition of advanced treatment processes at some locations has also added energy demands in the form of air blowers, compressors, and intermediate pumps.

3.8.3.3 Greenhouse Gas Emissions and Climate Change

New York City consumes a substantial amount of energy on an annual basis. As a byproduct of the creation of the energy needed to supply the City, GHG emissions are produced. Based upon the City’s 2015 energy consumption, GHG emissions were estimated at a total 52.0 million metric tons of carbon dioxide equivalent ($MtCO_2e$).[49] The majority of the emissions are a result of the generation of electricity. The remainder of the emissions are attributed to solid waste and waste management.

3.8.4 FUTURE WITHOUT THE PROPOSED PROJECT

3.8.4.1 Queens Groundwater Well Stations

In the Future without the Proposed Project, DEP would continue to maintain the existing facilities. Upgrades to on-site electrical equipment by DEP would be undertaken as needed and in accordance with operational priorities. Con Edison would continue to monitor and maintain electrical service within southeastern Queens as necessary and required. No significant change in existing energy usage at the Queens Groundwater wells is expected.

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[49] http://www.dec.ny.gov/docs/administration_pdf/nycghg.pdf

3.8.4.2 Nassau and Western Suffolk County

In the Future without the Proposed Project, water suppliers in Nassau and western Suffolk County are expected to upgrade and improve electrical facilities and energy transmission capacity as necessary or required at to allow ongoing operation of their facilities. Upgrades to the regional electrical grid would be completed as required by local utilities. No significant change in energy usage at these facilities is anticipated in the Future without the Proposed Project.

3.8.4.3 Greenhouse Gas Emissions and Climate Change

In the Future without the Proposed Project, DEP would continue to maintain the existing facilities and no substantive change in GHGs would be anticipated. Con Edison would continue to generate and maintain electrical service within southeastern Queens and would conduct required upgrades as necessary and required. As noted in the New York City's Roadmap to 80 x 50[50], policies and programs already implemented by the City to reduce GHG emissions would continue to be implemented to reduce GHG emissions.

3.8.5 FUTURE WITH THE PROPOSED PROJECT

3.8.5.1 Queens Groundwater Well Stations

The following section describes the potential energy demand of the Queens Groundwater system with the Proposed Project in place, and is presented for each modeled operating condition (i.e., Scenario A through E).

Improvements to or replacement of existing electrical facilities at the well stations would therefore be required, as part of the Proposed Project, to allow for the temporary treatment and use of groundwater for water supply during an emergency such as drought and planned and/or unplanned infrastructure outages. Representative electrical system improvements would require new or increased energy use above Existing Conditions and Future without the Proposed Project. These improvements would include, but not be limited to, the following: motor control centers, variable frequency drives, well pump motors, chemical metering pumps, water quality analyzers, and electric unit heaters. As current use of these well sites is limited, and therefore, typical existing electrical demand is low, the Proposed Project would represent an increase in energy demand over Existing Conditions. Where feasible, energy-efficient equipment would be used and in many cases, such as the replacement or upgrade of on-site pumps, new equipment may represent an improvement (e.g., energy efficiency) over previously available equipment.

As discussed above, the energy demand for each well station is the sum of the pumping, chemical treatment, and facility maintenance demands. **Table 3.8-1** has been prepared utilizing this approach to calculate the total energy demand for those wells within the Queens Groundwater system required for each of the proposed operating scenarios.

[50] https://www1.nyc.gov/assets/sustainability/downloads/pdf/publications/New%20York%20City's%20Roadmap%20to%2080%20x%2050_Final.pdf

Table 3.8-1: Total Estimated Queens Energy Demand for Operating Scenarios under the Proposed Project

Scenario	Power (kW)
A	4,060
B	4,121
C	4,160
D	3,845
E	3,893
Note: kW – kilowatts	

As indicated in **Table 3.8-1**, Scenario C (68 mgd for 3 consecutive years) would require an additional 4,160 kW, the highest total energy demand of the five operating scenarios. For comparison, Con Edison's existing electric grid handles peak demands in excess 11,000,000 kW[51]. The energy demand associated with Scenario C would represent less than 0.04 percent of what the existing electric grid can deliver. Additionally, under operating Scenario C, 40 wells would be pumped to achieve the 68 mgd. Dividing the 4,160 kW across these 40 wells results in an average of 104 kW per well. As they currently exist today, the well stations are already rated for an electric service in excess of this amount, even when accounting for multiple wells at the same station. To reliably service each site in the future, existing infrastructure at each station may need to be upgraded to more energy-efficient equipment including transformers, feeders, and potentially local transmissions lines. The anticipated energy demands at the well stations is negligible and Con Edison regularly upgrades the existing electrical grid and associated infrastructure, as necessary, and therefore no potential significant adverse impacts to energy are anticipated due to the potential temporary use of the Queens Groundwater system.

3.8.5.2 Nassau and Western Suffolk County

Potential changes in energy usage to Nassau and western Suffolk County water suppliers with the Proposed Project for each operating condition (Scenario A through E) are presented below. Changes in energy usage would be primarily driven by a projected decrease or lowering of the water table elevation, requiring additional pumping energy to deliver the water to the supplier's distribution system. **Table 3.8-2** summarizes the calculated additional energy usage for potentially affected wells for each operating scenario.

As indicated in **Table 3.8-2**, under Scenario E (62 mgd for 10 consecutive years) a total of 21 wells in Nassau County would have a water table elevation decline greater than the 10-foot threshold. These water table elevation changes would result in a total estimated increase in energy usage of 3,490,976 kWh, the highest of the five scenarios. To be conservative, the water table level declines observed at the completion of the 10 consecutive years of pumping under Scenario E were used to calculate the additional energy usage for the entire duration. In a real operating condition, the additional energy usage for the first year would be less than that for the

[51] PlaNYC "A Stronger, More Resilient New York" available at: http://www.nyc.gov/html/sirr/downloads/pdf/final_report/001SIRR_cover_for_DoITT.pdf

tenth year, as the water table decline would gradually increase with each passing year. While Scenario E represents a conservative analysis, it is expected that any future use of the Queens Groundwater system due to a water supply shortage such as drought or planned and/or unplanned infrastructure outages would more closely resemble Scenario A, B, or C (estimated increased energy usage ranging between 7,044 and 339,177 kWh), lasting between 1 and 3 years.

As discussed in **Table 3.8-2** and Section 3.7, "Water and Sewer Infrastructure," there are 21 Nassau County wells that would be expected to see an increase in pumping under Scenario E. Only seven of these wells (N-05145, N-09613, N-04298, N-07649, N-07117, N-03605, and N-03881) would require an upgrade of their pump motor to an increased horsepower. The remaining wells have adequate horsepower to meet the increased pumping. In each case, upgrading the motor by approximately 25 horsepower (e.g., 100 to 125 horsepower) would be more than adequate to maintain existing well production. As they exist today, the sites of these impacted wells are currently rated for an electric service that can accommodate an additional load of 25 horsepower (19 kW). In addition, it is anticipated that this increase would not significantly impact the water supplier's ability to use any existing secondary power supply sources, such as natural gas or diesel-powered generators, during an emergency.

As indicated in **Table 3.8-2,** the most conservative estimated, Scenario E, for total additional electricity usage would be approximately 3.5 million kWh over 10 years. This does not represent a significant increase in electricity usage for these water suppliers. As an example, based on an estimate of current usage for the affected water suppliers, the additional energy usage would only represent an increase in electrical consumption of approximately 1.6 percent over current usage. Comparing the estimated cost of this additional energy use at a conservative rate of $0.181 per kWh[52] (residential rates were used as a conservative estimate, as these are typically higher than commercial utility rates) to the overall operating budgets for potentially affected water suppliers, the total 10-year incremental cost would represent an estimated increase of approximately 0.2 percent. This total estimated potential increase in energy usage also represents a reasonable conservative scenario, as actual anticipated temporary use of the Queens Groundwater system would likely be more consistent with Scenario A through C, which would represent a conservatively estimated increase in energy usage of 0.03 percent to 0.5 percent (7,044 kWh for 1 year to 339,177 kWh for 3 years). The overall impact on water supplier operating budgets under these three scenarios is estimated to be on the order of 0.005 percent to 0.07 percent, respectively.

The insignificant increase in energy usage for Scenario E (1.6 percent) would be easily accommodated by the existing electrical grid without the need for any significant upgrades.

[52] http://data.newsday.com/long-island/data/politics/where-lipa-ranks-in-cost/

Table 3.8-2: Estimated Additional Energy Usage for Nassau County Wells Affected by Proposed Project under Various Operating Scenarios

Well ID	Water Supplier	Screened Aquifer	Average Annual Pumping Rate (gpm)[1]	Scenario A[2]		Scenario B[3]		Scenario C[4]		Scenario D[5]		Scenario E[6]	
				Water Table Decline (Feet)	Additional Energy (kWh)[7]	Water Table Decline (Feet)	Additional Energy (kWh)[7]	Water Table Decline (Feet)	Additional Energy (kWh)[7]	Water Table Decline (Feet)	Additional Energy (kWh)[7]	Water Table Decline (Feet)	Additional Energy (kWh)[7]
N-07482	Water Authority of Western Nassau County	Magothy	346	10.12	7,044	15.23	21,201	18.63	38,902	24.41	84,952	29.19	203,175
N-11037	Water Authority of Western Nassau County	Magothy	673			11.14	30,164	14.65	59,502	20.71	140,192	26.12	353,629
N-06744	Water Authority of Western Nassau County	Upper Glacial	62					10.45	3,910	15.9	9,916	21.38	26,666
N-06745	Water Authority of Western Nassau County	Magothy	331					10.43	20,835	15.88	52,870	21.36	142,229
N-05155	Water Authority of Western Nassau County	Upper Glacial	364					10.44	22,934	15.9	58,214	21.36	156,409
N-05156	Water Authority of Western Nassau County	Magothy	1,341					10.41	84,248	15.86	213,925	21.33	575,412
N-05145	New York American Water	Magothy	885					12.37	66,068	16.56	147,412	20.32	361,765
N-09613	New York American Water	Magothy	581					12.20	42,778	16.34	95,490	20.08	234,692
N-02414	Water Authority of Western Nassau County	Upper Glacial	330							14.08	46,735	18.39	122,083
N-04298	Water Authority of Western Nassau County	Magothy	1,060							11.44	121,972	16.48	351,417
N-07650	Water Authority of Western Nassau County	Magothy	442									13.54	120,393
N-07649	Water Authority of Western Nassau County	Magothy	720									13.52	195,825
N-08818	Franklin Square Water District	Magothy	183									13.43	49,441
N-07117	Franklin Square Water District	Magothy	572									13.42	154,421
N-01958	Water Authority of Western Nassau County	Lloyd	481									12.69	122,791
N-03605	Franklin Square Water District	Magothy	11									12.67	2,804
N-07548	New York American Water	Magothy	446									11.20	100,488
N-03603	Franklin Square Water District	Magothy	352									11.15	78,954
N-03604	Franklin Square Water District	Magothy	347									10.87	75,878
N-03881	Garden City Village	Magothy	153									10.60	32,625
N-13749	Manhasset-Lakeville Water District	Lloyd	142									10.46	29,880
			Total kWh		**7,044**		**51,365**		**339,177**		**971,678**		**3,490,976**

Notes:

1 Annual Average Pumping Rate based on historical monthly pumpage records. See Table 3.7-3 of Section 3.7, "Water and Sewer Infrastructure."
2 Scenario A: 68 mgd for 1 Year
3 Scenario B: 68 mgd for 2 Consecutive Years
4 Scenario C: 68 mgd for 3 Consecutive Years
5 Scenario D: 62 mgd for 5 Consecutive Years
6 Scenario E: 62 mgd for 10 Consecutive Years
7 kWh: kilowatt-hours

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Likewise, the additional energy usage associated with increased pumping would also not represent a significant impact. With no upgrades required to the electric grid or local service carrying utility equipment at the sites and the insignificant impact of increased energy usage to water suppliers, there are no potential significant adverse impacts to energy anticipated.

3.8.5.3 Greenhouse Gas Emissions and Climate Change

As noted previously, the temporary operation of the Queens Groundwater well stations and implementation of temporary treatment facilities would be located on small sites and would not require an analysis of GHG emissions under CEQR. However, for the purposes of disclosure, a calculation of estimated GHG emissions due to the Proposed Project was completed and is discussed below.

In the Future with the Proposed Project, the City would continue to implement strategies to reduce GHG emissions from the generation of energy. For the purposes of this analysis, it was assumed that the 2014 GHG emissions noted in Section 3.8.3.3 would remain consistent throughout the duration of Proposed Project.

Potential changes in the energy usage of Nassau and western Suffolk County water suppliers with the Proposed Project would result in additional GHG emissions over Existing Conditions and the Future without the Proposed Project. The estimated emissions are shown in **Table 3.8-3.**

Table 3.8-3: Estimated GHG Emissions from Nassau and Western Suffolk County Water Suppliers due to the Proposed Project

Scenario (Duration)	kWh	GHG Emissions	
		kg CO_2e	mtCO_2e
Scenario A (1 year)	7,044	862	1
Scenario B (2 years)	51,365	6,287	6
Scenario C (3 years)	339,177	41,518	42
Scenario D (5 years)	971,678	118,941	119
Scenario E (10 years)	3,490,976	427,324	427

Notes:
kWh – kilowatt-hours
kg – kilograms
CO_2e – carbon dioxide equivalent
mtCO_2e – metric tons of carbon dioxide equivalent

A total increase of 427 mtCO_2e over 10 years would only represent an approximately 0.0008 percent increase when compared to the City's 52.0 million mtCO_2e annual GHG emissions. This incremental increase would therefore be indiscernible.

In addition, operation of the Queens Groundwater system would also result in an increase in energy demand over Existing Conditions and the Future without the Proposed Project. These emissions are shown in **Table 3.8-4.**

Table 3.8-4: Estimated GHG Emissions from Operation of Queens Groundwater Wells under the Proposed Project

Scenario (Duration)	kW	kWh	GHG Emissions	
			kg CO_2e	mtCO_2e
Scenario A (1 year)	4,060	35,565,600	4,353,523	4,354
Scenario B (2 years)	4,121	72,199,920	8,837,866	8,838
Scenario C (3 years)	4,160	109,324,800	13,382,258	13,382
Scenario D (5 years)	3,845	168,411,000	20,614,896	20,615
Scenario E (10 years)	3,893	341,026,800	41,744,494	41,744

Notes:
kWh – kilowatt-hours
kg – kilograms
CO_2e – carbon dioxide equivalent
mtCO_2e – metric tons of carbon dioxide equivalent

While there would be a total increase of approximately 41,744 mtCO_2e over a 10 year period, this total would only represent an increase of approximately 0.08 percent for one year when compared to the City's 52.0 million mtCO_2e annual GHG emissions. Likewise, the incremental average annual increase over the 10 year period of Scenario E (i.e., 4,174 mtCO_2e per year) would be approximately 0.008 percent.

While the Proposed Project would not require an analysis under CEQR, the anticipated increase in GHG emissions were calculated and based upon Scenario E (10 years) would not represent a significant adverse impact on GHG emissions and actual operation of the Queens Groundwater system during a water shortage would be more comparable with Scenario A through C (1 to 3 years) and the incremental increase in GHG emissions would therefore be even smaller.

Therefore, the Proposed Project is not anticipated to result in any significant adverse impacts to energy, greenhouse gases, and climate change.

3.9 ENVIRONMENTAL JUSTICE

3.9.1 INTRODUCTION

This section evaluates the potential for the Proposed Project to result in significant adverse impacts to Environmental Justice communities from the operation of the Proposed Project.

In accordance with guidance provided within NYSDEC Commissioner Policy (CP) 29, Environmental Justice and Permitting (CP-29), the NYSDEC incorporates an Environmental Justice (EJ) review into several environmental permit application processes (e.g., SPDES, solid waste management facility, and air permits). While not required by CP-29 (see CP-29 Section V.A.2), an EJ assessment has been prepared for DEP's renewal of a NYSDEC Water Supply/Water Withdrawal Permit for the Proposed Project. An EJ assessment is required to identify whether a proposed project is within Potential Environmental Justice Areas (PEJAs), determine whether potential adverse environmental impacts within the PEJAs would be significant, and identify mitigation for any significant adverse impacts to PEJAs, as necessary. CP-29 defines PEJA as meeting one of the following parameters:

- At least 51.1 percent of the population in an urban area are minority groups; or
- At least 33.8 percent of the population in a rural area are minority groups; or
- At least 23.59 percent of the population in an urban or rural area had household incomes below the federal poverty level.

3.9.2 METHODOLOGY

The EJ assessment follows the guidance set forth in CP-29. The EJ assessment involves the following steps:

- Identify PEJAs within the Proposed Project area using the NYSDEC County Maps showing PEJAs;
- Describe the existing conditions of the PEJAs;
- Identify potential adverse impacts from the Future with the Proposed Project within the mapped PEJAs;
- Evaluate potential adverse impacts to determine whether the Proposed Project would result in any significant effects on the PEJAs; and
- For projects that would result in significant adverse effects on PEJAs, determine appropriate mitigation measures to avoid or reduce the significant adverse impacts.

3.9.3 EXISTING CONDITIONS

Using NYSDEC's database for PEJAs, an Environmental Justice screening and mapping tool, it was determined that several PEJAs are located within the study area of the Proposed Project (see **Figure 3.9-1**). As shown on **Figure 3.9-1**, PEJAs are present within the majority of the study area of the Proposed Project, which was defined as the City's water distribution system in Queens and Brooklyn. Under Existing Conditions, the water supply network serving the PEJAs is supplied from the City's upstate surface water system, which DEP monitors to ensure continuous, high quality potable water supply service to its customers.

3.9.4 FUTURE WITHOUT THE PROPOSED PROJECT

In the Future without the Proposed Project, DEP's Queens Groundwater system would not be utilized for distribution into the water supply network during water supply shortages. DEP would however continue to maintain and operate the Queens Groundwater system at current levels for completion of periodic sampling and other maintenance activities. In the event of a water supply shortage, the PEJAs in the vicinity of the Proposed Project would continue to receive their water supply from the upstate surface water system. Therefore, in the Future without the Proposed Project, domestic water service needs would continue to be continuously met and no environmental burdens resulting from the continued maintenance of the Queens Groundwater system would result in impacts to the surrounding PEJA communities.

3.9.5 FUTURE WITH THE PROPOSED PROJECT

In the Future with the Proposed Project, temporary treatment facilities at up to 44 well stations may be installed. Prior to the installation of temporary treatment facilities, a station-specific environmental assessment would be completed, as required, to identify any potential environmental impacts. Under the Proposed Project, the presence of the temporary treatment facilities would be short-term and would not reflect a permanent change to the neighborhood. The existing well stations have existed at these locations in many cases for more than 100 years. The Proposed Project would be consistent with the existing land use and zoning and, as a temporary and short-term use, would not affect long-term land use or zoning trends or result in any indirect effects.

As a benefit to PEJA communities, the supplemental use of the Queens Groundwater system would provide an added level of resiliency and redundancy to portions of the water supply system that serve Environmental Justice communities in Brooklyn and Queens. The Proposed Project would increase DEP’s ability to provide water supply in times of shortage due to drought or planned and/or unplanned system outages by adding Queens Groundwater into the distribution system. Production of water from any of the Queens wells, dependent upon the cause of the water shortage, would enter the distribution system and/or could be blended with water from the upstate surface water system for distribution within Brooklyn and Queens. Prior to distribution, raw water would be treated and tested to ensure that the water is of a finished water quality that would meet or exceed all applicable NYSDOH, NYCDOHMH, or other drinking water quality standards at the time the treatment system is constructed and operated. Finished water would be of a quality consistent or comparable with water from DEP’s upstate surface water system prior to release into the distribution supply system. The Proposed Project would not result in permanent adverse impacts to the surrounding PEJAs.

During implementation of the Proposed Project, any short-term construction-related impacts would be minimized with best management practices. No significant adverse environmental or social impacts would occur from the implementation or operation of the Proposed Project and at the conclusion of a water supply shortage, the temporary treatment facilities would be largely removed from the well stations with the possible exception of concrete pads that are constructed to allow placement of the temporary treatment systems. Domestic water service needs would be continuously met and no additional burden associated with any significant adverse environmental impact to PEJAs would occur from the Proposed Project, and no further EJ assessment would be necessary.

In accordance with the public outreach guidelines of CP-29, public outreach has been conducted for the Proposed Project. DEP held two public scoping hearings and would continue public outreach through the environmental review process and could do additional public information meetings as determined necessary.

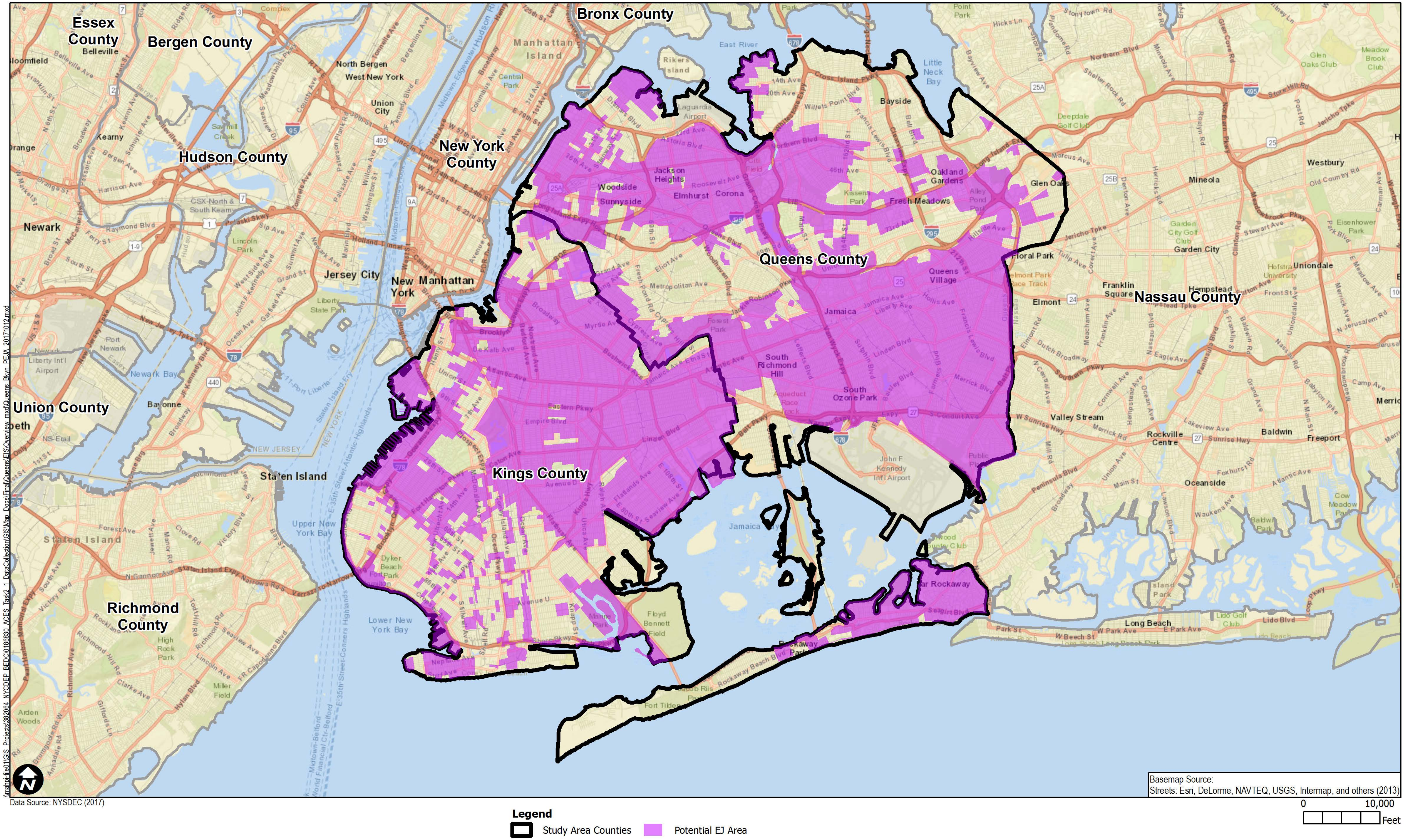

Figure 3.9-1: NYSDEC Potential Environmental Justice Area Communities

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3.10 NEIGHBORHOOD CHARACTER

An assessment of neighborhood character is generally needed when a proposed project has the potential to result in significant adverse impacts in any of the technical areas noted below, or when a project may have moderate effects on several of the elements that define a neighborhood's character. According to the *CEQR Technical Manual*, neighborhood character is a combination of various elements that give neighborhoods a distinct "personality." These elements may include a neighborhood's land use, zoning, public policy, socioeconomic conditions, open space, shadows, historic resources, urban design and visual resources, transportation, and/or noise. Not all of these elements affect neighborhood character in all cases; a neighborhood usually draws its distinctive character from a few of these defining elements.

According to the *CEQR Technical Manual*, neighborhood character impacts are rare. Only under unusual circumstances would a combination of moderate effects to the neighborhood result in an impact to neighborhood character, in the absence of an impact in any of the relevant technical areas. Moreover, a significant impact identified in one of the technical areas that contribute to a neighborhood's character is not automatically equivalent to a significant impact on neighborhood character. Rather, it serves as an indication that neighborhood character should be examined. The examination focuses on whether a defining feature of the neighborhood's character may be significantly affected.

The Proposed Project may involve the temporary placement and operation of treatment facilities at up to 44 existing well stations during a water supply shortage and these facilities would be removed at the conclusion of the shortage. The Proposed Project does not have the potential to individually result in any significant adverse impacts on land use, zoning, public policy, socioeconomic conditions, open space, shadows, historic resources, urban design and visual resources, transportation, and/or noise. Also, the Proposed Project is not anticipated to have the potential to change the pedestrian's overall experience since the Proposed Project does not have the potential to result in significant adverse impacts on urban design, historic resources, shadows, open space, or noise. The Proposed Project is not anticipated to result in changes in prevailing businesses and economics of an area since the Proposed Project does not have the potential to result in significant adverse impacts to land use, socioeconomics, and transportation. Therefore, no further analysis of neighborhood character is required.

3.11 PUBLIC HEALTH

The *CEQR Technical Manual* defines as its goal with respect to public health "to determine whether adverse impacts on public health may occur as a result of a proposed project, and if so, to identify measures to mitigate such effects." According to the *CEQR Technical Manual*, for most proposed projects, a public health analysis is not necessary where no significant unmitigated adverse impact is found in other CEQR analysis areas, such as air quality, water quality, hazardous materials, or noise. If an unmitigated significant adverse impact is identified in one or more of these analysis areas, a public health assessment is warranted for that specific technical area(s).

The Proposed Project supports the renewal of an existing Water Supply/Water Withdrawal Permit and the potential implementation of temporary treatment systems at DEP's Queens Groundwater wells to allow for the operation of the existing groundwater supply system in response to a water supply shortage. As described in the relevant analyses within this EIS, the Proposed Project would not result in significant adverse impacts in any of the technical areas (e.g., air quality, noise, hazardous materials, or water quality) related to public health.

3.11.1 HAZARDOUS MATERIALS

As described in Section 3.11.1, "Hazardous Materials," contamination may exist as noted within the historic Phase I and II ESAs completed for the Queens well stations. Potential soil excavation and/or grading at the site would however be limited and DEP would complete additional investigations, if required, prior to implementation of temporary treatment. The procedures discussed in Section 3.9.4 would be put in place and/or followed prior to, during, and/or after construction, as applicable and appropriate, in order to avoid the potential for impacts.

3.11.2 WATER QUALITY

During a water supply shortage, raw water from the Queens Groundwater system would potentially be put into distribution system for potable supply in Brooklyn and Queens. As discussed in Section 1.6.2.3 and Section 3.11.1, groundwater associated with the Queens wells has varying levels of naturally occurring and synthetic contaminants typical of groundwater supply throughout Long Island. As part of the Proposed Project and as discussed in more detail within Section 1.6.2.3, DEP would conduct required sampling in advance of the use of Queens Groundwater wells to characterize the quality of the raw water for determining what treatment(s) may be required to meet current drinking water quality standards. Raw groundwater would be treated and tested to ensure that the water is of a finished water quality that would meet or exceed all applicable NYSDOH, NYCDOHMH, or other drinking water quality standards at the time the treatment system is constructed and operated. Finished water would be of a quality consistent or comparable with water from DEP's surface water system.

Likewise, discharge of wastewaters (e.g., water to waste, backwash waters, etc.) from individual well stations associated with the startup, maintenance, and operation of the Queens Groundwater system during a water supply shortage would meet all applicable federal, State, and/or local requirements for discharge to the municipal sewer system as discussed in Section 3.7.5.3.

3.12 CONSTRUCTION

Construction activities were qualitatively evaluated consistent with the *CEQR Technical Manual* based on the magnitude, impacted area, and anticipated construction duration in order to determine if potential impacts would be considered significant.

For each well station that would potentially be utilized during a water supply shortage, the construction of the temporary treatment system would include the preparation of the treatment area at the well station. In general, each well station is currently developed with a well(s), well building or vault, driveway, and associated infrastructure connections (e.g., power, water, sewer, etc.). As part of the Proposed Project, each well station would be cleared and leveled, as necessary.

Construction may include the placement of treatment blocks (see Section 1.6.2.3 that would be physically located within a container (e.g., Conex box) or would consist of trailer-based units. Containers (see **Figure 1.6-4** as an example) would be placed on site with a lift or crane, as required. Placement of container-based treatment blocks at a well station may involve the construction of a concrete pad(s). Trailer-based treatment blocks (see **Figure 1.6-3** as an example) would be driven to a site and unhitched. Trailer-based temporary treatment blocks could require the installation of concrete support pads. All temporary treatment blocks would be delivered to a site, placed on the concrete pad or support pads, if necessary, and then interconnected to other treatment blocks, as required, with soft hoses. As potential treatment needs would vary by site, more than one treatment block could be needed thereby requiring the placement of more than one treatment block.

Treatment blocks that would not require, or may require less frequent, periodic exchange (e.g., replenishment or replacement of filter media) would typically be placed at the back of a well station, further removed from the gated driveway. The Distribution Connection and Waste Connection blocks would be installed close to the property line in proximity to existing or future water distribution and sewers pipes. These two blocks would then be connected to the City's below grade piping networks in the streets. Construction and interconnection of the Distribution and Waste Connection blocks would require limited excavation.

Electrical power would be provided at each well station from existing electrical interconnections, through improvements to, or construction of new connections to the electrical grid. Power would then be connected to the Controls Container and power sub-feeds to the Chemical Treatment Container(s). This would include the installation of a control feedback system from the Chemical Treatment Container(s) to the Controls Container. A water service line would be installed from the Distribution Connection to the water sampling lines to the chemical analyzers within the Controls Container.

Construction duration for the temporary treatment systems would require up to 20 weeks per well station, including up to 5 weeks of site preparation and any abatement of hazardous materials, 12 weeks of construction and/or placement of treatment facilities, and 3 weeks for startup operations. Well stations requiring fewer treatment facilities/blocks or less site preparation would require less construction and a shorter timeline. Temporary treatment facilities would not be constructed at the same time for all well stations, but would instead be advanced on an as needed basis, depending on the nature and needs associated with a water supply shortage. Heavy equipment would not likely be required during the 5 week site preparation phase. Heavy equipment to be used during the remaining 12 weeks of construction (after site preparation and prior to startup operations) would include an excavator, backhoe, cranes, and, on intermittent days, concrete trucks. Construction hours would be based on the New York City construction noise rules, which limit typical construction to weekdays between the hours of 7 AM and 6 PM. Construction vehicles would be minimal with up to a maximum of five vehicle trips per hour with a total of 26 vehicles trips per day, including autos and trucks entering and leaving a site. A compressor would be used on site during the startup operations phase for loading GAC media into the temporary treatment vessels for up to 3 weeks. All construction would be conducted in compliance with applicable federal, State, and/or local requirements governing these activities.

Once the well stations are prepared, the temporary treatment blocks would be placed at designated locations. Prior to operation, the system would undergo a complete system check, including startup, pressure testing, and water quality analysis. This would occur with each station discharging all water to a sewer connection. At the conclusion of a water supply shortage, temporary treatment blocks would be removed from the site. If an additional water supply shortage were to occur, temporary treatment blocks would be placed on the concrete pad(s) or support pads that were installed during initial construction activities at a well station (i.e., concrete pads and support pads would only be constructed once at a given well station).

Due to the temporary and limited nature of construction activities, the placement of temporary treatment systems at well station locations would not be anticipated to result in significant adverse impacts.

4.0 CUMULATIVE EFFECTS

The *CEQR Technical Manual* defines cumulative effects as “two or more individual effects on the environment that, when taken together, compound or increase each other.” Based on the assessment of the anticipated construction and operation of the temporary treatment facilities, none of which individually resulted in a significant adverse impact, no two or more individual effects on the environment would occur that, when taken together, compound or increase each other. As discussed above, construction of the Proposed Project would be short-term, temporary, and applicable protective measures would be employed, as required, to protect any resources that have the potential for a significant impact. In addition, operation of the temporary treatment facilities would not involve significant disturbances or impacts to resources within area of the Proposed Project would be consistent with Existing Conditions, and facilities would be removed at the conclusion of a water supply shortage. Therefore, no cumulative effects would occur from the Proposed Project.

5.0 GROWTH-INDUCING ASPECTS OF THE PROPOSED PROJECT

The term “growth-inducing aspects” generally refers to the potential for a proposed project to trigger additional development in areas outside the project site that would otherwise not experience such development without the proposed project. The *CEQR Technical Manual* indicates that an analysis of the growth-inducing aspects of a proposed project is appropriate when a project:

- Adds substantial new land use, new residents, or new employment that could induce additional development of a similar kind or of support uses, such as retail establishments to serve new residential uses; and/or

- Introduces or greatly expands infrastructure capacity.

The potential implementation and operation of the Proposed Project would provide a supplemental source of water supply to Queens and Brooklyn during water supply shortages, thereby making the City’s drinking water infrastructure more resilient and provide an additional level of redundancy. While the Proposed Project would provide access to additional water supply within Brooklyn and Queens, it would not result in a permanent increase in water supply capacity as the use of this supply would only be during periods of water shortage and at the conclusion of a water shortage, the temporary treatment facilities would be removed. As a result, the Proposed Project would not provide an opportunity to support long-term additional development in the area.

In addition, the Proposed Project would not add any new land uses, new residents, significant new employment, or any other substantive change in existing infrastructure (e.g., electric, water supply and distribution, wastewater collection and treatment) that could induce new development within the study area. Therefore, no growth-inducing impacts as a result of the Proposed Project would occur.

6.0 MITIGATION

As presented within the technical assessments completed as part of this EIS, the Proposed Project would not result in the potential for significant adverse impacts. Therefore, no mitigation is proposed and there are no unavoidable impacts.

7.0 ALTERNATIVES

7.1 INTRODUCTION

The purpose of an alternatives analysis is to identify and examine reasonable and practicable options to a proposed project that avoid or reduce project-related significant adverse impacts and still achieve the stated goals and objectives of the project. Based on the assessments conducted in this EIS, the Proposed Project would not result in potential significant adverse impacts.

7.2 NO ACTION ALTERNATIVE

Under the No Action Alternative, DEP would not implement the Proposed Project and as a result would not have access to the Queens Groundwater system during a water supply shortage or localized infrastructure outage.

The City does have a Drought Management and Contingency Plan[53] to address supply shortages associated with these events. This plan establishes actions and procedures for managing water supply and demand during drought conditions. As set forth within this Plan, DEP may use water from the Queens Groundwater system during a drought warning and emergency. During the watch phase of a drought, DEP would not anticipate the use of the Queens Groundwater system. Under the No Action Alternative, however, DEP would be unable to implement one component of the Drought Management and Contingency Plan, namely use of the Queens Groundwater system and therefore would have less ability to meet is water supply obligation to its customers. Thus, DEP is undertaking the Proposed Project to meet the actions of the Drought Management and Contingency Plan.

The City has also proactively implemented a water conservation plan over the past 30 years. The most recent Water Demand Management Plan[54] includes six strategies aimed at reducing City water consumption. These strategies include a municipal water efficiency program; a residential water efficiency program; a non-residential water efficiency program; water distribution system optimization; a water supply shortage management strategy; and assistance to upstate wholesale customers in the development of demand management plans. Successful water conservation measures and the installation of individual water meters have resulted in a decreasing trend in water demand for many years despite an increase in population (see Section 1.5.2). While the implementation of a water conservation plan could support the goals of the Proposed Project through a reduction of overall water use during a water shortage or localized infrastructure outage in lieu of the Proposed Project, the City would not be able to match the additional supply provided by the Proposed Project solely through water conservation since a significant portion of these opportunities have already been achieved.

[53] The Drought Management and Contingency Plan is available here: http://www.nyc.gov/html/dep/pdf/droughtp.pdf

[54] The Water Demand Management Plan is available here: http://www.nyc.gov/html/dep/html/ways_to_save_water/index.shtml

The Proposed Project, including the renewal of the Water Supply/Water Withdrawal Permit and operation of the Queens Groundwater system, is a part of the existing Drought Management and Contingency Plan to supplement the upstate water supply during a water supply shortage, and therefore, is not considered an alternative to the Proposed Project.

8.0 UNAVOIDABLE ADVERSE IMPACTS

Unavoidable significant adverse impacts are defined as those that meet the following two criteria:

- There are no reasonably practicable mitigation measures to eliminate the impacts; and
- There are no reasonable alternatives to the proposed project that would meet the purpose and need of the action and eliminate the impact.

As described in Chapter 6.0, “Mitigation”, “there are no potential significant adverse impacts identified for the proposed In-City Water Supply Resiliency. The Proposed Project would not result in significant adverse impacts that would require mitigation and as a result there are no unavoidable adverse impacts.

9.0 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

As required in the *CEQR Technical Manual*, this section summarizes the Proposed Project and its impacts to environmental resources, both man-made and natural resources. The potential construction and operation of the Proposed Project would involve the use of various construction vehicles, materials for construction, operation, and maintenance, fuels, and energy for construction and operation. Some of the materials that would be used for the Proposed Project are nonrenewable resources, and are considered irretrievably and irreversibly committed, because reuse is not possible or is highly unlikely. However, the use of these materials would not be significant in volume or duration that would result in a significant commitment of resources.

The Proposed Project would not result in a significant loss of environmental resources, both in the immediate future or long term. The construction of temporary treatment facilities would occur within existing and previously developed well stations, thereby not resulting in the commitment of new land resources. Minor ground disturbances due to the Proposed Project would be expected to similar to Existing Conditions after the temporary facilities are removed.

These commitments of resources and materials are weighed against the benefits of the Proposed Project. The Proposed Project would provide additional resiliency and redundancy of the water supply system during a water supply shortage to allow DEP to continue to meet all current and future water demands. Therefore, the Proposed Project would not result in an irreversible or irretrievable impact to resources.