Appendix B: Hutchinson River Watershed Baseline Conditions Assessment

Hutchinson River Watershed
Baseline Conditions Assessment

The Hutchinson River in Mount Vernon, New York.

Prepared for:

Save the Sound

Prepared by:

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1 Introduction

This baseline conditions assessment was undertaken to develop an understanding of the Westchester County portion of the Hutchinson River watershed and to identify likely causes of water impairments. Specific tasks conducted to develop this baseline assessment included:

- Desktop Assessment – Review of existing watershed studies, reports, and mapping; identification of data gaps; and delineation of 12 subwatersheds.
- Windshield Survey – Watershed visit in December 2022 to familiarize the project team with conditions on the ground.
- Pollutant Load Modeling – Development of the Watershed Treatment Model to better understand the nonpoint source runoff contribution of nutrients, total suspended solids and bacteria from each subwatershed.
- Comparative Subwatershed Analysis – Evaluation of a series of subwatershed metrics indicating restoration potential, pollution potential and flooding potential.

This report summarizes the results of the baseline assessment.

2 The Hutchinson River Watershed – Then and Now

The Hutchinson River flows through Westchester County into the Borough of the Bronx and empties into Eastchester Bay. It is a tributary of the East River and ultimately, the Long Island Sound. The history of the region is long, robust, and an informative parameter to the Hutchinson River's current condition.

The region was originally inhabited by Native American tribes including the Siwanoy and Weckquaesgecks, both Algonquin-speaking sub bands of the Lenape (Delaware) people. They called the river "Aqueanouncke" after the red cedar trees found nearby (Lederer, 1978). Its proximity to New York City and the navigable waters surrounding it made the region heavily sought after by the colonists. By the mid-1600s, the Native American population were increasingly being pushed out of their homelands.

Anne Hutchinson was a woman from the Massachusetts Bay colony who was outspoken against the Puritan doctrine. After her exile from the colony, she and her family settled in New Netherlands near the river that now bears her name. In 1643, Hutchinson was killed during a battle between the Native Americans and white settlers in Keifts's War (Tribal History, Tribal Council of the Siwanoy Nation). She is remembered for being a proponent of religious and women's freedoms (Hutchinson River Parkway, NYC Parks).

Throughout the late seventeenth century, the Hutchinson River basin continued being developed by Europeans that settled in towns such as Pelham, Eastchester, and New Rochelle (Town of Eastchester, 2017; Davis & Kump-Leghorn, 2013). Areas surrounding these towns remained rural until the mid-nineteenth century when industrialization brought railroad lines through the region. The new transit increased the movement of goods between New York City and its surrounding areas and spurred industrial, economic, and community growth in southern Westchester County (Town of Eastchester, 2017).

In 1895, the US Army Corps of Engineers deepened and removed obstructions from the Hutchinson River in Mount Vernon, substantially improving movement through the Eastchester Canal. After its dredging, at high tide, the channel was noted to be 12 feet deep (THE WEEK, *The Iron Age*, 1895). By 1925, most of the land in the southern portion of the Hutchinson River watershed was heavily developed. Under a 1930 authorization, the portion of the Eastchester channel in Westchester County was approved to be 70 feet wide and 8 feet deep.

The rise of the car and creation of the parkway system further surged development of Westchester County in the early twentieth century. The Bronx River Parkway was the first of multiple parkways created from New York City into Westchester County to compensate for booming car traffic along the smaller roads leaving the city. The parkway system soon expanded with construction of the Hutchinson River Parkway, and eleven miles were constructed in Mount Vernon and Pelham to ease traffic. When the Hutchinson River Parkway was completed in 1941, it was one of the first major roads east of Lake Innisfree (Figure 1).

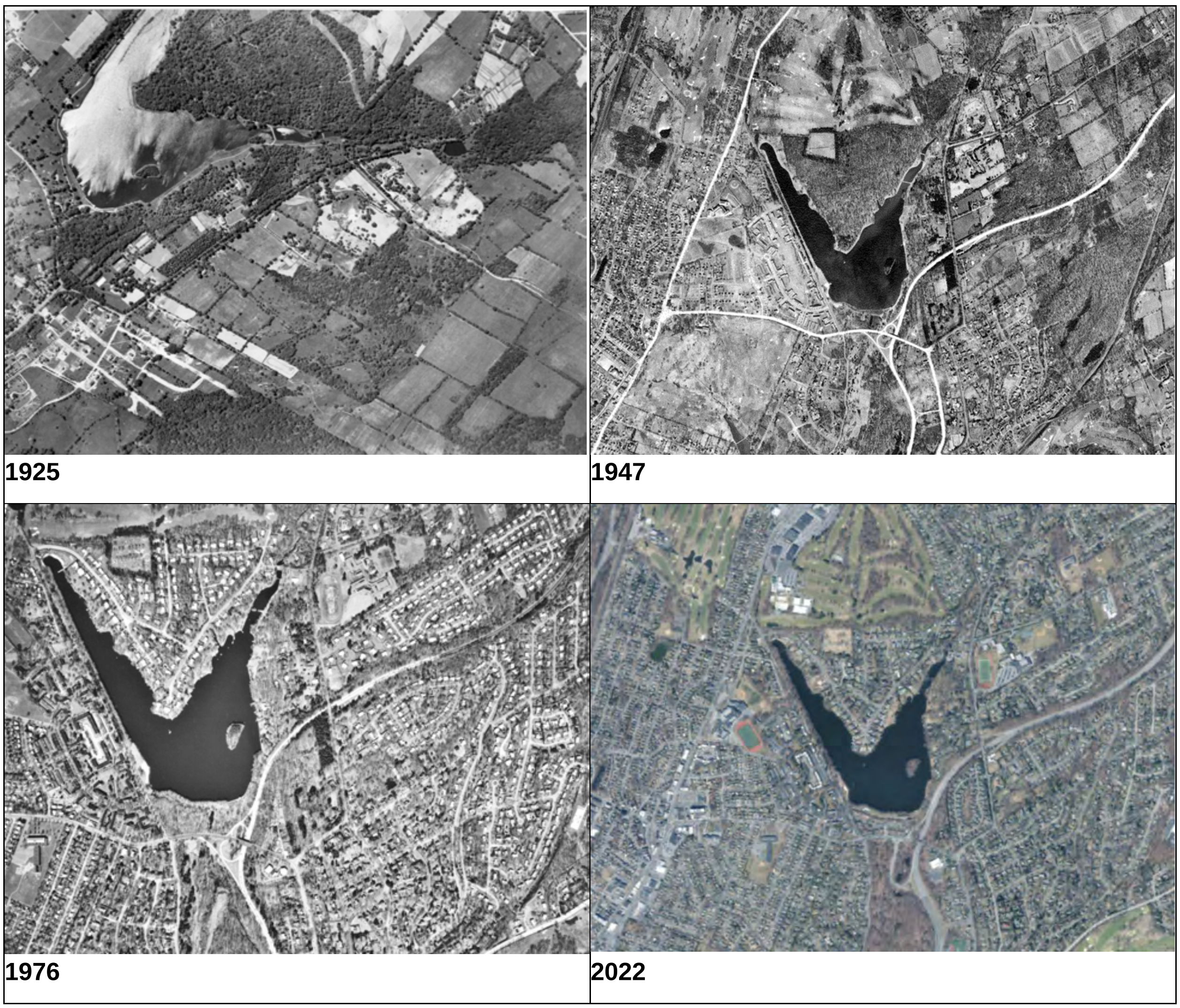

Figure 1. Aerial footage of development around Lake Innisfree before the construction of the Hutchinson River Parkway (1925) and subsequent years after (1947, 1976, 2022).

The industry and towns near the Hutchinson River were constructed before the enactment of the Clean Water Act in 1972. Today, this aged infrastructure is impacting local water quality. New York State currently faces a funding shortfall for water infrastructure and sewer lines that are operating beyond their design life, resulting in sewage overflows that pollute waterways including the Hutchinson River.

The Hutchinson River and its watershed are critical components to the region's environmental quality, health, and diversity. Not only does it provide habitat for wildlife in an urban area, but also it is a refuge for the human population from the urban environment.

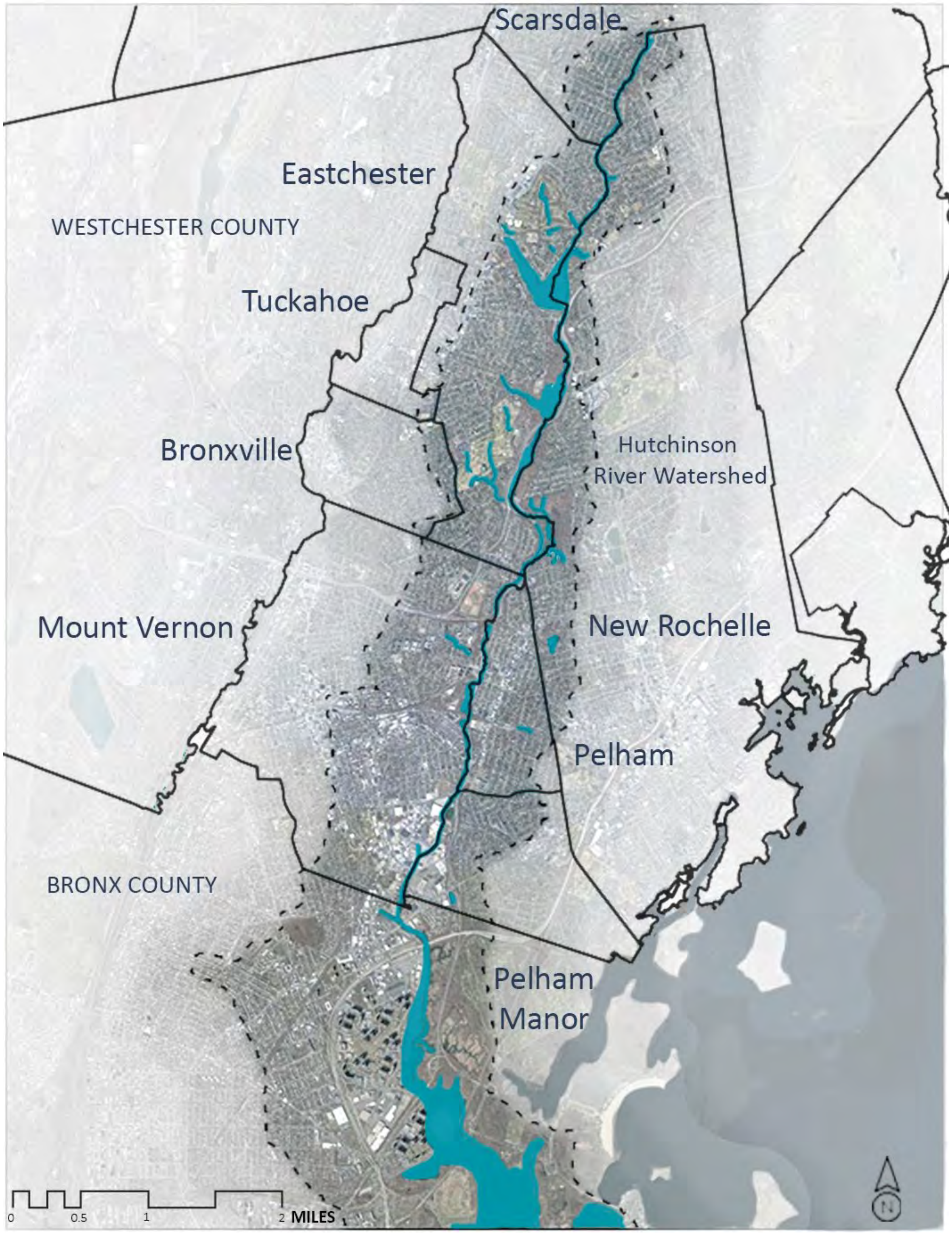

Figure 2. Map of the Hutchinson River Watershed and municipalities in Westchester County.

3 Physical Conditions

3.1 The Hutchinson River Watershed

The Hutchinson River watershed within Westchester County encompasses over 8 square miles, eight municipalities, and is home to over 200,000 people. The river itself begins at Brookline Avenue in Scarsdale and continues south, flowing through the Bronx to the Long Island Sound (Figure 2). A basic profile of the watershed is provided in Table 1.

Table 1. Basic Profile of the Hutchinson River Watershed (Westchester County only)

Area in Westchester County	— 8.2 square miles (5,234 acres)
Stream Length	— Approximately 9.5 miles
Land Use & Water Coverage	— 50% residential — 14% parks — 3.5% industrial — 21% roadways — 9% commercial — 2.5% open water
Subwatersheds	— 12 subwatersheds
Jurisdictions	— City of Mount Vernon — City of New Rochelle — Town of Eastchester — Village of Scarsdale — Village of Pelham — Village of Pelham Manor — Village of Tuckahoe — Village of Bronxville
Water Quality[1]	— Middle Branch: Class "C" — Lower Branch: Class "B"
Impoundments Leading to Timed Releases	— Lake Innisfree[2] Impoundment — Reservoir No. 3 Impoundment — Reservoir No. 2 Impoundment — Pelham Lake Impoundment
Major Transportation Routes	— I-95 — Hutchinson River Parkway — Cross Country Parkway — Metro-North Railroad
Significant Natural & Historic Features	— Twin Lakes County Park — Willson's Woods Park — Nature Study Woods — St. Paul's Church National Historic Site

[1] NYSDEC provides letter classifications to denote a water body's best use. Class B waters are primary and secondary contact recreation and fishing. Class C waters are suitable for fish, shellfish, and wildlife propagation.
[2] Lake Innisfree is also known as Reservoir 1. For this assessment the water body will be referred to as Lake Innisfree.

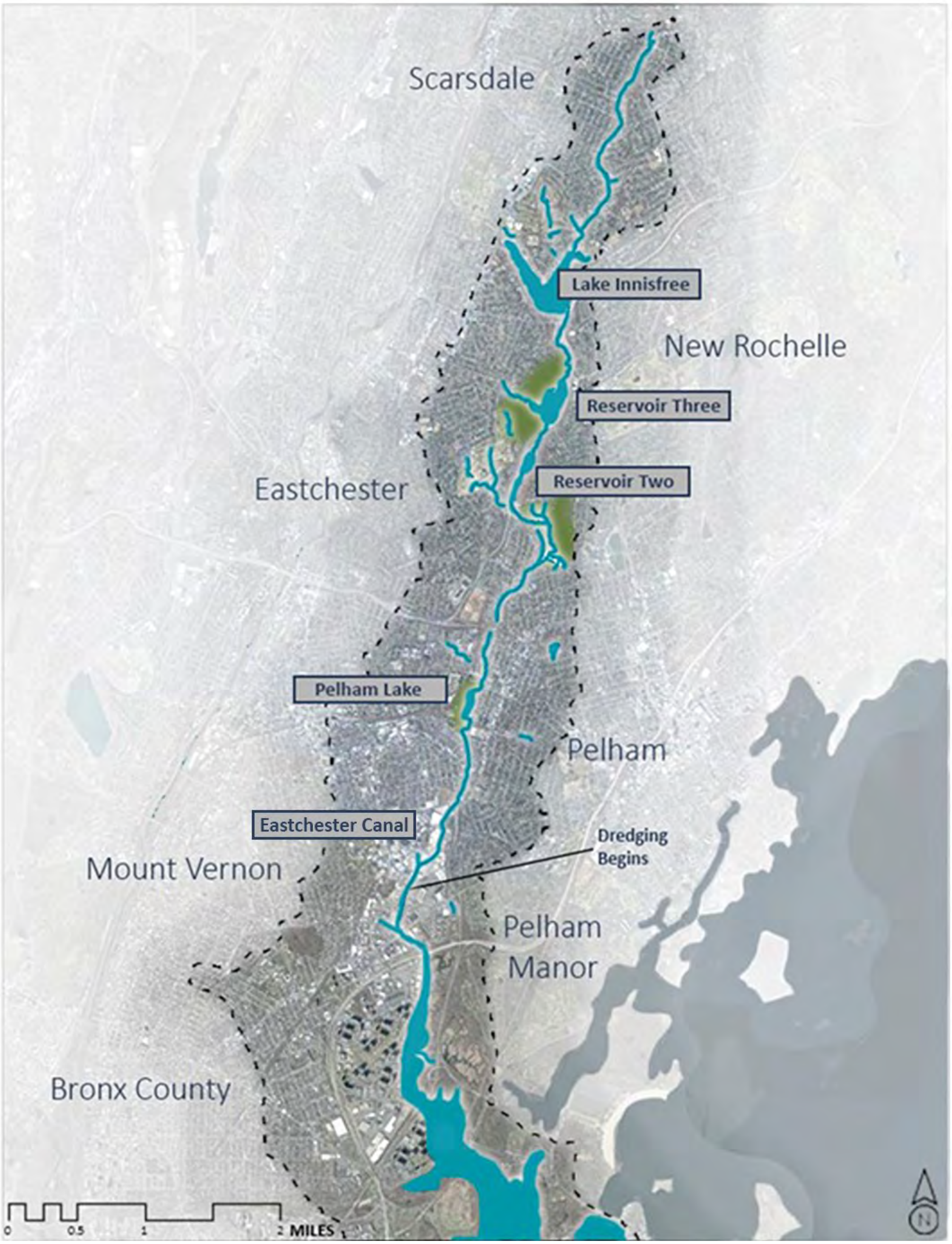

Figure 3. Map of the Hutchinson River Watershed.

The northern portion of the watershed is primarily residential with low to medium density single family homes. The area includes small parks and outdoor recreational spaces, as well as two large golf courses.

After two miles, the river reaches Lake Innisfree, the first impoundment along the Hutchinson River, in New Rochelle. This artificial lake and dam were constructed in 1894 to create a water supply for New Rochelle and Mount Vernon. The dam itself is 680 feet long and impacts the flow of the Hutchinson River. Earth dikes retain water in the reservoir which has a capacity of 1,043 acre-feet (Koch, 1979). Lake Innisfree is no longer used as a water source and now is maintained as a water body used for swimming, boating, and fishing. Homes with mowed turfgrass yards line the water's edge (Figure 3).

Figure 4. Lake Innisfree and nearby homes (left). A home on Lakeshore Drive along the Hutchinson River (right).

Less than a mile downstream from Lake Innisfree are two smaller, dammed impoundments referred to as Reservoirs No. 2 and 3 respectively. Like Lake Innisfree, these reservoirs were made by damming the Hutchinson for drinking water purposes but now are two highlighted features of Twin Lakes County Park. Reservoir No. 3 was built in 1908 by the New Rochelle Water Company. Westchester County eventually took ownership of the dam and reservoir and renovated the spillway in 1949. The reservoir is now maintained primarily for recreation (Koch, 1979). Reservoir No. 2 was constructed in 1892, originally 25 feet high and 305 feet long. The Hutchinson River Parkway was constructed along the reservoirs and the river, which led to a portion of the impoundment being filled, making the reservoirs longer and narrower with steep embankments.

The Hutchinson River continues flowing south to Pelham Lake in Willson's Woods Park, about two miles downstream of Reservoir No. 2. The area surrounding Pelham Lake is heavily developed. Approximately 98% of the usable land parcels that drain to Pelham Lake are either developed or have development planned.

Pelham Lake is currently impacted by sediment accumulation in the northern end of the lake (Figure 4). A 2020 watershed study done by Jacobs Engineering found that there is little floodplain connectivity along the river between Lake Innisfree and Pelham Lake and the river is channelized and erosion is lowering and degrading the riverbed (Jacobs, 2020).

Figure 5. 1950s north facing postcard view of Pelham Lake (left). Stream bank erosion along the Hutchinson River (right).

As the river flows south from Pelham Lake, land use is more commercial and industrial, and the Hutchinson River is more incised and channelized. Houses densely populate the west side of the river, and the Hutchinson River Parkway closely lines the east side of the river (Jacobs, 2020). In Mount Vernon, the land adjacent to the river is mainly impermeable and commercially owned.

Just south of Friendship Field on the river's east bank in Mount Vernon, the Hutchinson River was dredged to make it navigable up to the Long Island Sound. This portion of the river is now used for shipping resources including petroleum, sand and gravel, and scrap metal cargo (Figure 5). Maintenance dredging was last completed in 2010, removing 21,000 cubic yards of sediment. Slightly upstream of the Boston Road bridge, the Hutchinson River crosses from Westchester County to the Bronx. Further in the Bronx, the shipping channel widens to 150 feet (US Army Corps of Engineers, 2022). Finally, before entering the Long Island Sound, the Hutchinson River flows past Co-Op City to the west and through a series of wetlands in Pelham Bay Park.

Figure 6. Petroleum storage tanks by the Eastchester Canal in Mt. Vernon (left). Built-up of litter and the polluted Hutchinson River behind homes on Beechwood and Farrell Ave in Pelham (right).

Subwatershed Delineation

To understand the impact of land use on the river's water quality, smaller subwatersheds were delineated throughout the Hutchinson River watershed. These subwatersheds were delineated based on current topography and urban stormwater infrastructure. The delineation methodology is described in Appendix A and the results can be seen in Table 2 and Figure 6.

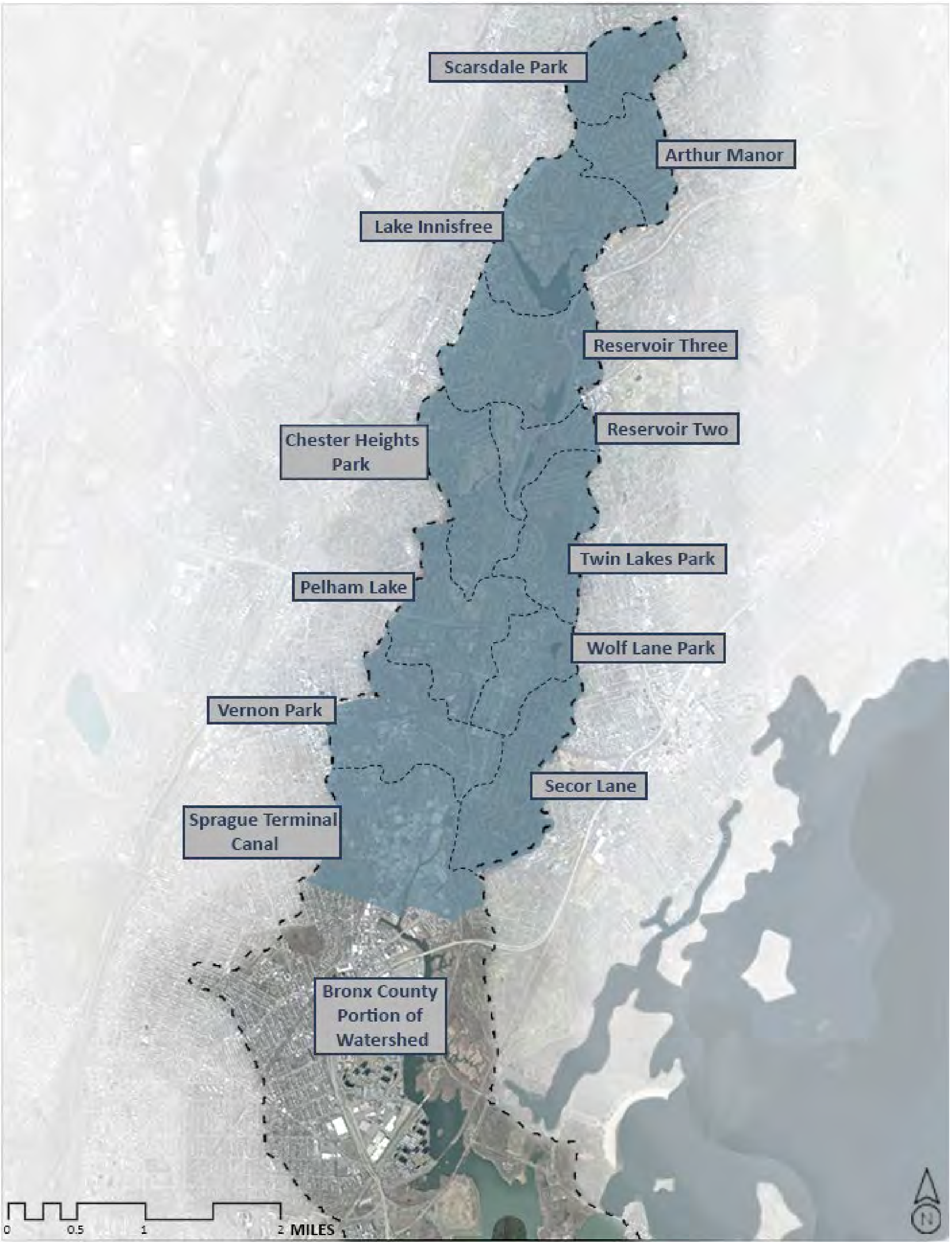

Figure 7. Subwatersheds in the Hutchinson River Watershed.

Table 2. Hutchinson River Subwatersheds in Westchester County

Subwatershed	Area (acres)	Area (square miles)
Arthur Manor	284	0.44
Chester Heights Park	441	0.69
Lake Innisfree	586	0.92
Pelham Lake	519	0.81
Reservoir Three	585	0.91
Reservoir Two	215	0.34
Scarsdale Park	298	0.47
Secor Lane	446	0.70
Sprague Terminal Canal	692	1.08
Twin Lakes Park	374	0.58
Vernon Park	518	0.81
Wolfs Lane Park	276	0.43
Total in Westchester Co.	**5,234**	**8.18**

3.2 Climate

The Hutchinson River watershed is in the temperate, humid climate of the Northeast. Historical climate information was gathered from the weather station at the Westchester County Airport in Harrison, New York. While the airport is a bit further north of the headwaters of the Hutchinson River watershed, it is the closest weather station with the most detailed data and will be used as proxy for this assessment. Precipitation is generally well distributed throughout the year with the wettest conditions in April and May and driest in February (NOAA). However, climate change is showing more frequent, intense rain events in the northeastern United States. From 1958 to 2010, New York experienced a 70% increase in "heavy precipitation," events where the amount of rain expected substantially exceeds what is normal (DEC, 2022). In Harrison, the mean annual precipitation over a 71-year period of record is 49.77 inches, and the 24-hour average temperature ranges from a high of 73.2°F in July to a low of 27.3°F in January.

3.3 Geomorphology

The Hutchinson River lies in the Hudson Valley, an area with streams and rivers shaped by glaciers. The massive ice sheets that covered the region left behind striations and exposed bedrock. Today, the bedrock in the Hutchinson River watershed may be as close to a foot of the surface (Cadwell, 1989).

Soil type influences the speed and pathways that water will take to get to a river. According to the USDA's Natural Resource Conservation Service, soils in the Hutchinson River watershed are primarily defined as urban land complexes; in these areas, the mix of urban soils with other soils are in such small areas they are not shown separately on maps. For the first foot or so, urban land can consist of cement materials, compacted soils covered by built structures, or mixed manufactured materials such as brick or concrete. These characteristics indicate that the soil likely has poor drainage and a weakened capacity to support good vegetative growth.

Prior to development, the soil around the Hutchinson River was sandy loam: soils having a good mix of large particle sizes that are optimal for drainage and retaining water. However, centuries of development combined with aging stormwater infrastructure has resulted in a degradation of the soil, resulting in flooding and drainage issues throughout the region.

3.4 Urban Geomorphology

During the twentieth century, New York City and Westchester County became economic and population hubs in the northeast. These socioeconomic changes impacted the physical conditions of the region, modifying the environment and ecosystem in the Hutchinson River Watershed.

Land Modification

Land use and land cover impact the velocity and volume of stormwater runoff. Impervious surfaces increase the speed at which water moves and restricts it from infiltrating back into the ground. This land modification impacts the amount of pollutants that enter water bodies and can result in localized flooding. This study utilizes impervious land cover data to better understand where pollutants are entering the Hutchinson River with the most ease. Land use in the Hutchinson River watershed is primarily residential land with many roadways throughout. Table 3 summarizes land use in the watershed and how much of each land use type is covered by impervious surfaces, Table 4 summarizes impervious cover in each subwatershed, and Figure 7 depicts the land use distribution in the Hutchinson River Watershed.

Table 3. Hutchinson River Watershed Land Use

Land Use	Total Area (acres)	Percent of Watershed	Percent Impervious
Residential	2,630	50%	31%
Roadways	1,105	21%	100%
Parks	716	14%	5%
Commercial	472	9%	58%
Industrial	180	3.5%	85%
Open Water	117	2.5%	0%

Table 4. Hutchinson River Subwatersheds Impervious Cover

Subwatershed	Impervious Area (acres)	Imperviousness (%)
Arthur Manor	116	41%
Chester Heights Park	169	38%
Lake Innisfree	182	31%
Pelham Lake	228	44%
Reservoir Three	235	40%
Reservoir Two	56	26%
Scarsdale Park	117	39%
Secor Lane	201	45%
Sprague Terminal Canal	473	68%

Twin Lakes Park	128	34%
Vernon Park	302	58%
Wolfs Lane Park	149	54%
Total in Westchester Co.	**2,358**	**45%**

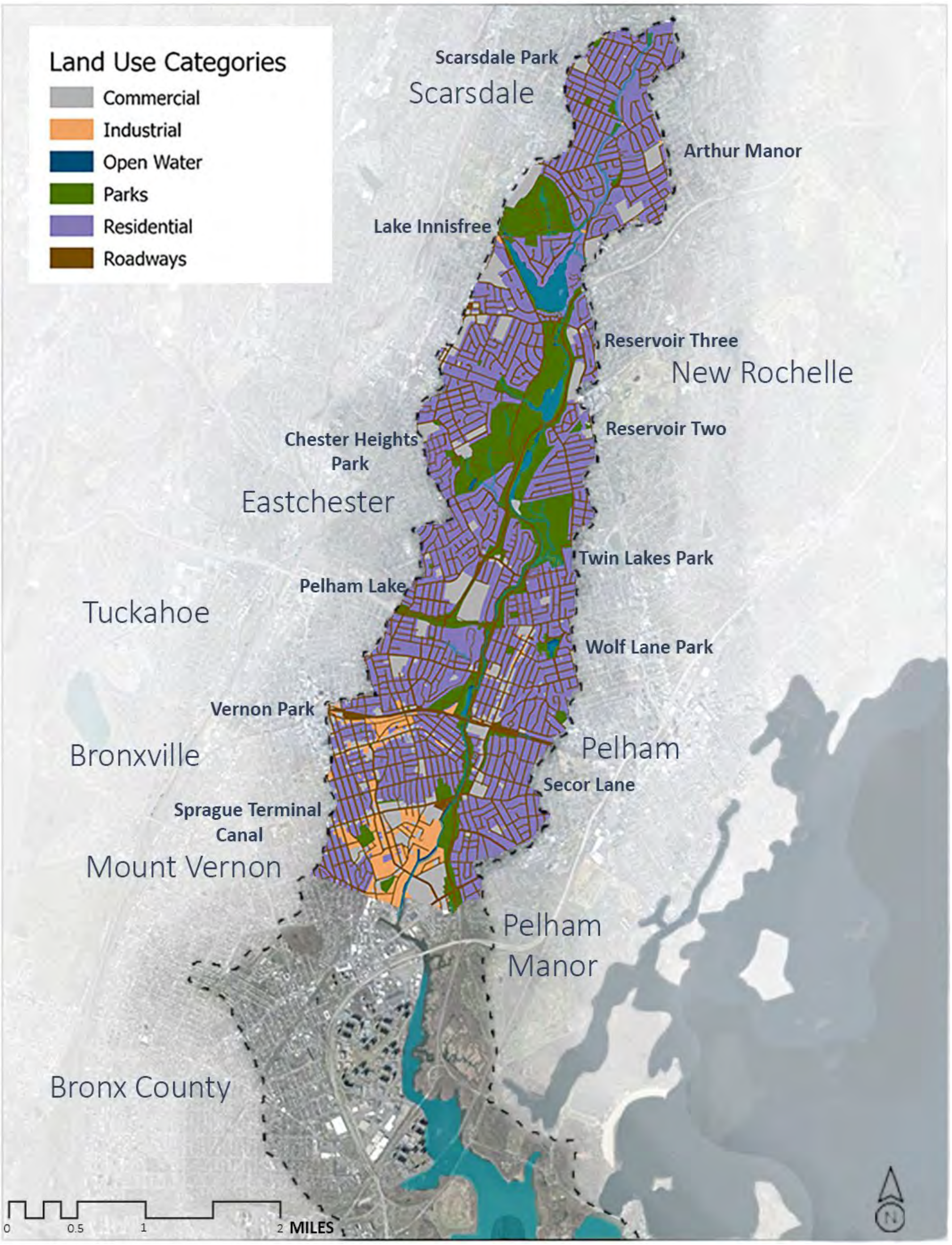

Figure 8. Land Use in the Hutchinson River Watershed.

Transportation Corridors

Transportation lines in Westchester County impacted the region's development and the river's path. Some important transportation corridors in the Hutchinson River watershed include Columbus Ave (New York State Route 22), the Cross-County Parkway, and sections of White Plains Road (Figure 8). Numerous roads cross the river as well, including Lincoln Avenue and Fulton Avenue. Additionally, the Harlem line of the Metro North Railroad system crosses the Hutchinson River just south of Pelham Lake and includes stations in Mount Vernon and Pelham.

The Hutchinson River Parkway's initial purposes included providing additional transportation out of New York City while connecting the community with parks and nature. These goals resulted in the parkway being built directly adjacent to the river, consequently restricting the floodplain and critical habitat locations. The parkway's initial construction was designed with gentle curves and a bridlepath in some parts. However, it modernized to support increased traffic volume and new development in the County. These changes resulted in some of the more aesthetic aspects of the parkway being removed (Hutchinson River Parkway, NYC Parks).

Outside of a few parks, development borders the river rather closely, generally within 50 feet across most of the watershed. This not only disconnects the river from the floodplain and reduces riparian buffers but also leaves houses and businesses at risk of flooding. Flooding events along the Hutchinson River Parkway also cause traffic issues, forcing commuters to reroute through smaller roads in the neighboring towns.

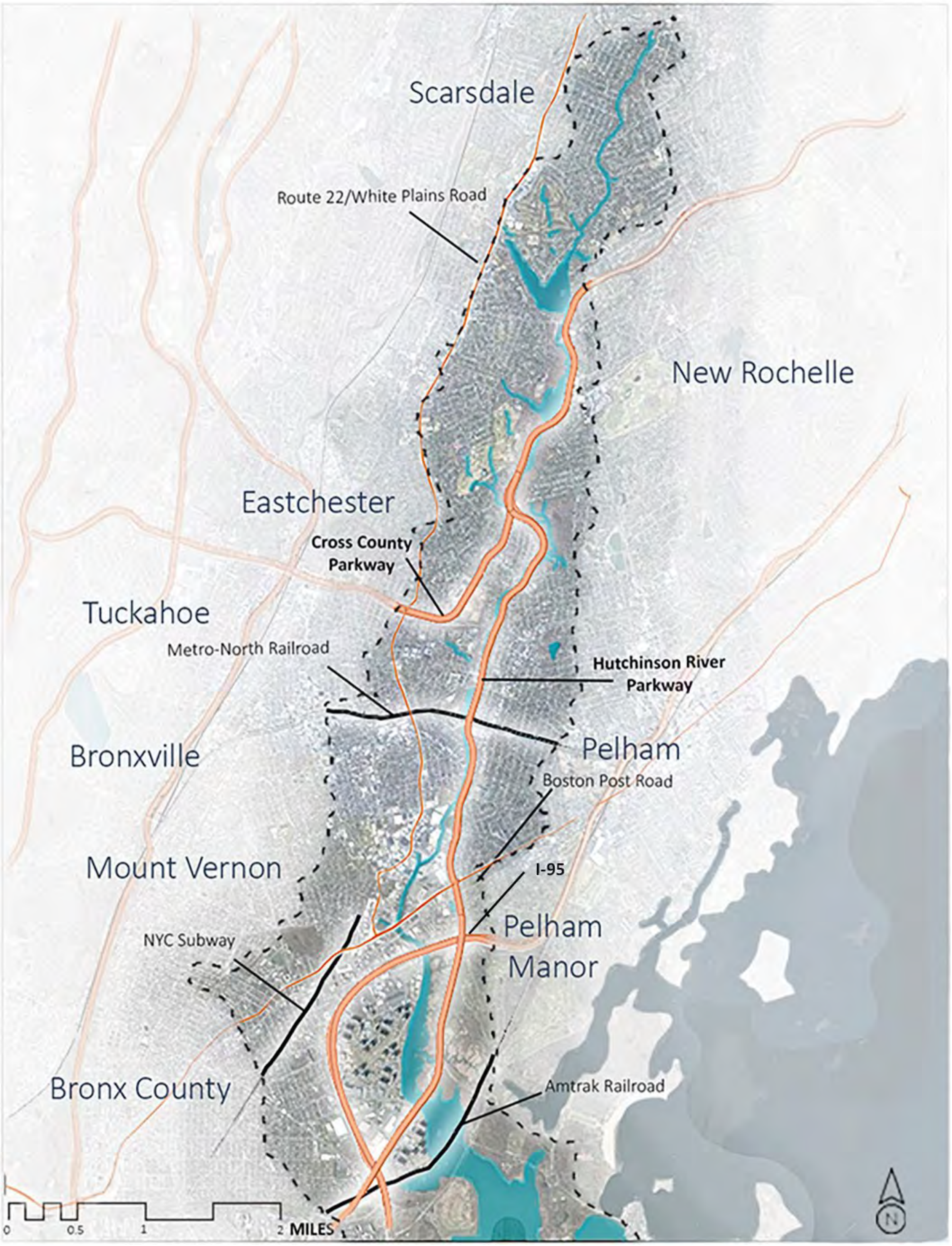

Figure 9. Transportation Corridors in the Hutchinson River Watershed.

Utilities

Westchester County and the jurisdictions within the watershed operate under a Municipal Separate Storm Sewer System (MS4) permit and maintain separate drainage systems for stormwater and wastewater. Stormwater is largely untreated before entering waterbodies such as the Hutchinson River. Any pollutants caught in runoff or sewage from leaky pipes will make its way directly to the Hutchinson River and its tributaries. For many of the jurisdictions within the watershed, it is understood that the current stormwater conveyance systems are aging and undersized for large storm events that are becoming more frequent and causing larger pollution problems for the river. To address the issue of water quality, the MS4 permittees are required to undertake minimum control measures (MCM), which include:

1. Targeted Public Education and Outreach
2. Public Involvement and Participation
3. Illicit Discharge Detection and Elimination
4. Construction Site Stormwater Runoff Control
5. Post Construction Stormwater Management
6. Stormwater Management for Municipal Operations

Each permittee is required to report on the progress of implementing these minimum control measures. Biohabitats acquired all publicly accessible 2021 MS4 reports from the municipalities in the watershed. Each of these reports detailed the types of management practices being taken to minimize pollution from entering the stormwater system where it would not be treated. The reports showed that the permittees have made progress on:

- Public outreach and education campaigns
- Mapping stormwater outfalls and drainage networks
- Detecting and eliminating illicit discharges
- Preparing Stormwater Pollution Prevention Plans (SWPPPs) for construction sites
- Implementing, inspecting, and maintaining stormwater best management practices such as filter systems, open channels, ponds, wetlands, and bioretention systems
- Sweeping streets and parking lots

Public water supply is operated by multiple sources across the watershed. Most of the water systems are maintained by the private supplier, SUEZ, with the exceptions of Mount Vernon, Pelham Village, and Scarsdale which are operated by their respective municipal governments. Electrical lines crisscross the watershed, with most of the major power transmission lines underground. The northernmost reaches are supplied by an above-ground system.

4 Ecological Conditions

The Hutchinson River was a thriving freshwater river facilitating life for plants and animals in its waters and along its banks. Historically, its freshwater marshes, wetlands, and floodplain ecosystems provided refuge for fish, migratory birds, and a diverse plethora of aquatic plants. However, development, pollution, and neglect have led to high levels of fecal coliform (bacteria) and other pollutants in the Hutchinson River, restricting public use and hurting wildlife.

The habitats along the Hutchinson River are fragmented and scattered from the region's heavy development. Yet, critical wetlands and habitats still dot the landscape and provide opportunity for ecosystem services and habitat diversity in the region. Twin Lakes County Park, Nature Study Woods, and Willson's Woods Park have all been deemed Critical Environmental Areas by Westchester County. Figure XX shows the ecological conditions in the Hutchinson River Watershed.

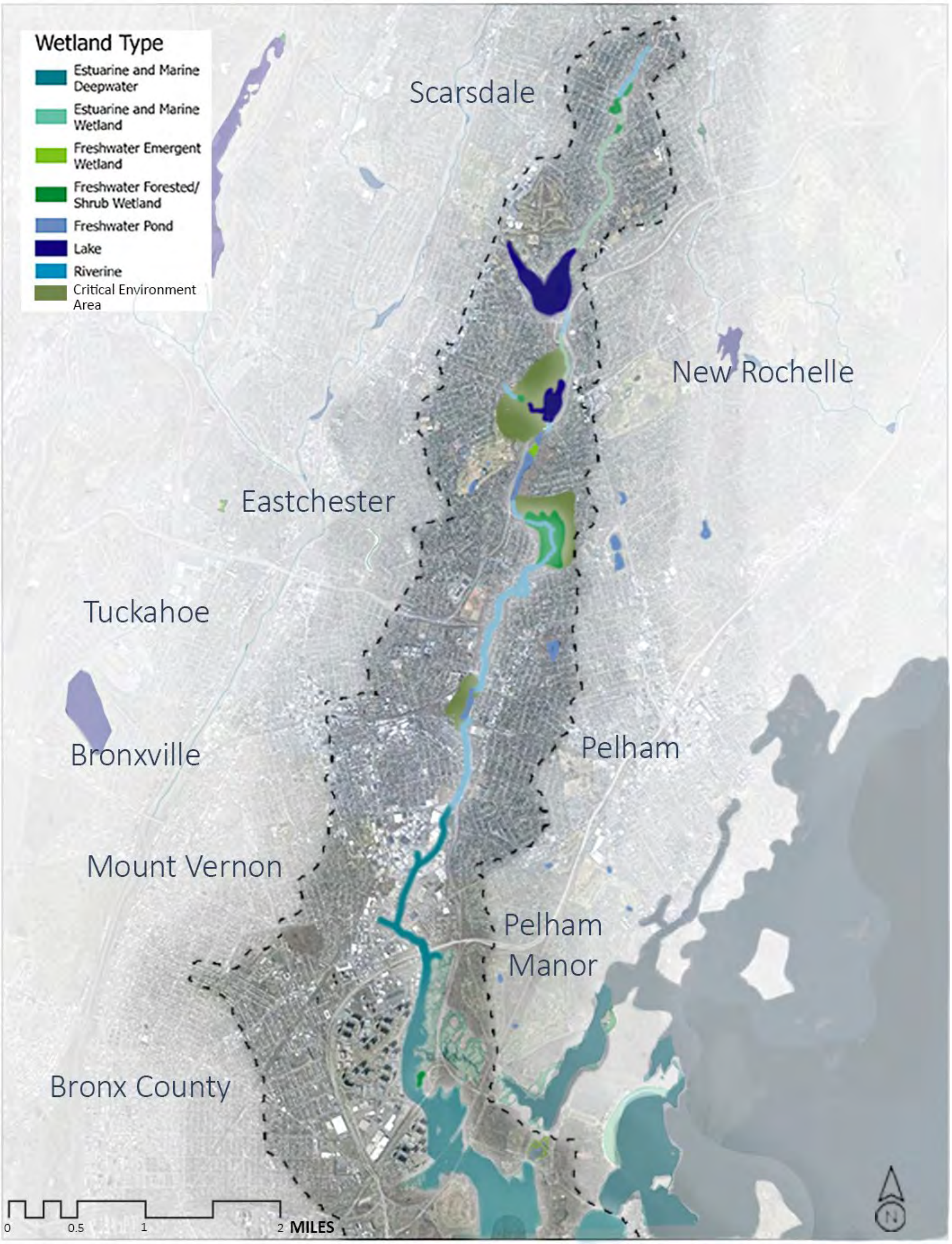

Figure 10. Ecological Conditions in the Hutchinson River Watershed.

4.1 Habitats

The Hutchinson River watershed region is an intersection of coastal, riverine, and upland habitat areas with distinct characteristics and influences on the watershed. The different habitats that are found throughout the watershed are described below.

Aquatic Habitat

From its headwaters, the Hutchinson River is a freshwater stream, becoming tidally influenced as it approaches Eastchester Bay. It is commonly used for fishing, and species that have been reported include crappies, bluegills, pumpkinseed, largemouth bass, and channel catfish. These species are all largely pollutant tolerant (iNaturalist).

Submerged aquatic vegetation (SAV) provide critical habitat for young fish and macroinvertebrates, oxygenate water, and are a food source for larger animals. However, most suitable habitat that could exist in the Hutchinson River are depleted by poor water quality that results from the dredging, shipping traffic, and development along the river.

One concern to the health of aquatic wildlife is the dams that block the river and restrict migratory fish species. In 2020, fish traps were placed below the dam to determine the presence of migratory fish and explore the feasibility of a fish passage for Pelham Lake Dam. In addition to multiple carp, an alewife was recorded in the Hutchinson for the first time since the 19th century (Long Island Sound Study, 2020). These results suggests that the river still has the capacity to support migratory fish species and possibly recover its original biodiversity.

Wetlands

Wetlands provide critical ecosystem services such as pollutant filtration, wildlife habitat, and flood control. They originally encompassed a significant amount of land in the Hutchinson River watershed and greater New York City region (National Wetlands Inventory, USFWS 2022). However, much of the land has been drained or compacted to be suitable for development. Most of the wetlands in the Hutchinson River Basin are palustrine wetlands, meaning they contain less than 0.5 ppt of ocean-derived salts, are less than 20 acres, and are typically dominated by trees, shrubs, and emergent vegetation. Hydric soil wetlands were also mapped and are scattered across the watershed. They are generally found within parklands, country clubs, and some stretches along the river. The Eastchester Canal, Pelham Lake, and Reservoirs No. 2 and 3. are all included in the National Wetlands Inventory as estuarine/marine deep water and freshwater ponds (National Wetlands Inventory, USFWS 2022). Wading birds such as great blue herons and great egrets are commonly spotted along the Hutchinson River. Painted turtles and spotted salamanders have also been sighted (iNaturalist).

The Nature Study Woods in New Rochelle is the most significant and largest wetland in the Hutchinson River watershed that is considered "forested;" its vegetation is primarily broad-leafed deciduous trees such as American beeches or red maples. It is considered a freshwater forested/shrub wetland and is regulated by New York State (National Wetlands Inventory, USFWS 2022). In the early 2000s, Westchester County completed a restoration project in the Nature Study Woods to prevent a stormwater pipe from scouring the wetland.

Although Pelham Bay Park is not within Westchester County, it is directly downstream of the Hutchinson River and significant for its great assemblage of habitats and biodiversity. It is the largest park in New York City and contains nearly 200 acres of salt marsh. The Hutchinson

River is one of three waterways that feed these marshes, creating a system of mud flats, intertidal marsh, and salt meadow near the Thomas Pell Wildlife Refuge. These marshes are dominated by native saltmarsh cordgrass, which can tolerate the brackish waters but are threatened by invasive species such as common reed that exist along the edges. Pelham Bay Park is a refuge for many plants and animals, including migratory birds, as well as an escape to nature for residents of the nation's most populous city (Pelham Bay Park- Salt Marshes in New York City Parks, NYC Parks). The health of the Hutchinson River and its own wetlands is essential for the health of Pelham Bay.

Upland Habitats

Relatively few wooded areas remain near the Hutchinson River because of its heavy urbanization. Twin Lakes County Park in Eastchester and Nature Study Woods in New Rochelle are among the largest parcels of forests and parkland in the watershed comprising of about 220 acres of forest, reservoirs, marsh, and fields.

Common plant species identified within the floodplain canopy include northern red oaks, American beeches, and flowering dogwoods. Shaded, wet areas are optimal habitats for ferns, skunk cabbage, and many native and ornamental flowers such a violets, tickseed, daffodils, and jewelweed. Invasive species commonly reported in the area include Japanese stiltgrass and porcelainberry. Since most of the land in the watershed is suburban, there are many native and ornamental trees across the neighborhoods.

Despite the development in the area, many animals have adapted to the urban and suburban landscapes. Lawns make up the most groundcover in the watershed, but still the river is closely bordered by trees in the northern reaches. White-tailed deer, coyotes, and raccoon can make the most of this patchwork of habitats and abundance of food provided by human presence. Birds typically seen in suburban neighborhoods are common such as northern cardinals and house sparrows, but also great horned and barred owls.

4.2 Ecological Challenges

Ecosystems within the Hutchinson River Watershed face many challenges to maintaining their presence and health. Industrial and commercial land use impacts water quality from point source pollution, atmospheric deposition, and heat. Development changes the landscape, altering the water flow through the system. These physical changes impact the ecological communities that once thrived along the Hutchinson River and into the Long Island Sound. Understanding the ecological challenges that the native species experience today is a critical component to providing recommendations for future restoration.

Invasive Species

Water chestnut, an invasive plant that forms large mats of vegetation on top of slow-moving bodies of water, have been observed in the Hutchinson River along Pelham Lake (iMapInvasives). Water chestnuts hinder the growth of SAVs by blocking sunlight and can contribute to eutrophication from their decay. Additionally, like much of the East Coast, the common reed (*Phragmites australis*) is outcompeting native reeds and grasses such as cattails in wetlands across the region. Phragmites grow aggressively and decrease the biodiversity of marshes and variety of habitat available for wildlife.

In the remaining forests within the watershed, Japanese stiltgrass, garlic mustard, and mugwort among others have been observed taking over the groundcover. Non-native trees such as Norwegian maples, tree of heaven, and Bradford pears are interspersed with native species. In terms of wildlife, mute swans have been sighted on the Hutchinson and spotted lanternflies and emerald ash borers exist in the area.

Although, other invasive species have not been officially recorded within the watershed, that does not necessarily mean they do not exist. Zebra mussels and Chinese mitten crabs have been a problem in the greater Hudson River basin, and Hydrilla, another invasive aquatic plant, has been identified elsewhere in Westchester County. Additionally, even if they do not currently exist, there is potential for them to occur in the future.

Ecological Harm

Numerous avian, mammal, plant, reptile, and amphibian species listed by Federal, State or County jurisdictions as threatened or endangered are known to occur in Westchester County, though their occurrence in the Hutchinson River watershed has not been confirmed. Of those, the bog turtle and bald eagle are two federally listed threatened or endangered species identified within Westchester County, whose occurrence in the Hutchinson River watershed is uncertain (USACE, 2004).

Within the Hutchinson River basin, the only endangered or threatened species listed by the U.S. Fish and Wildlife Service are the piping plover and monarch butterfly (candidate species). Both have been impacted primarily by habitat loss. Roughly 25 migratory songbirds and shorebirds pass through the area including the bald eagle, black skimmer, and wood thrush. (IPaC, USFWS).

It is important to note that while the Hutchinson River basin does not have many critical habitats as defined by the state, the interconnectivity of natural systems should not be forgotten. As mentioned, the Hutchinson River borders the salt marshes of Pelham Bay Park and feeds into the East River and Long Island Sound. Pelham Bay Park is an important stopover site for roughly 40 species of migratory birds and as mentioned is important wetland habitat for aquatic and terrestrial animals.

Non-Contiguous Habitat

The environmental makeup of the watershed is primarily ornamental lawns and grasses, and upland canopy trees with understory layers. Most of the land is built or maintained and is not ideal for plants or wildlife. The Hutchinson River that once acted as a habitat corridor is now fragmented. The river itself is blocked by four dams, cutting off the upstream reaches from the downstream and ultimately the Atlantic Ocean. On the land, the remaining forests are sparse and loosely connected. Roads crisscross the watershed, preventing safe passage for wildlife. This fragmentation not only limits the available habitat but may increase inbreeding among populations.

5 Current Pollution Conditions

Like other urban streams in the Northeast, the water quality of the Hutchinson River has been severely degraded over the last century. The New York State Department of Environmental Conservation (NYSDEC) classifies streams based on existing or expected water quality conditions to help residents and local officials understand the extent they can interact with that stream. The Westchester County portion of the Hutchinson River is categorized as a Class "B" stream: that which is "best for swimming and contact recreation, but not for drinking" (NYSDEC Division of Fish, Wildlife and Marine Resources, 2022).

In 2002, the river was placed on the New York State 303(d) List of Impaired Waters. The pollutants causing impairment are identified as oil/grease, low dissolved oxygen, and fecal coliform. An overview of current conditions relative to these pollutants is provided below.

Watershed Treatment Model

As noted in the following subsections, nutrients, total suspended solids, and fecal coliform contribute to impairment of the Hutchinson River. To estimate the annual loads of these pollutants Biohabitats used the Watershed Treatment Model (WTM), developed by the Center for Watershed Protection. The WTM is a screening level tool that is used to estimate pollutant loads under current watershed conditions and may be used to estimate the effects of proposed management practices (Caraco, 2002). The model has two components: Pollutant Sources and Treatment Options. Biohabitats used the Pollutant Sources component to estimate annual pollutant loads from primary land uses and impervious cover. The Treatment Options component of the model estimates potential reduction in loads if management measures are implemented. This analysis will be conducted during later stages of this project.

The primary land use sources are based on data from Westchester County's tax parcel data. Based on this data, Biohabitats established six land use categories as input to the WTM: Commercial, Industrial, Open Water, Parks, Residential, and Roadways. Impervious cover data was established using Westchester County's planimetric spatial data, which accurately shows bridges, buildings, driveways, parking lots, railroads, roadways, sidewalks, and transportation structures. These features were considered 100% impervious. An annual precipitation value of 49.77 inches per year was used based on data from the Westchester County Airport in Harrison, NY.

Running the WTM for the existing watershed conditions provides estimates of current annual pollutant loads for nutrients (total nitrogen and total phosphorus) and total suspended solids, which influence dissolved oxygen levels in the River as described below. The existing watershed conditions WTM also provides estimates of fecal coliform in the Westchester County portion of the Hutchinson River Watershed. The results of the WTM are presented in the following subsections. For a more detailed discussion of the WTM set up and inputs, see Appendix A.

The following should be considered when interpreting the results of the WTM for the Westchester County portion of the Hutchinson River Watershed:

- The WTM uses standard parameters and incorporates simplifying assumptions that cause the results to be specific for this study. The results should be interpreted relative to each other and not on an absolute basis.
- Due to the limited available data, Biohabitats did not incorporate Secondary Sources (e.g., septic systems, illicit connections, sanitary sewer overflows) or existing treatment measures that may be in place.

— Pollutant concentrations were taken from the WTM Manual (Caraco, 2002) and are not specific to the Westchester County portion of the Hutchinson River Watershed.

Low Dissolved Oxygen

The Hutchinson River was identified as an Impaired Water due to high Oxygen Demand in the waterbody, resulting in low dissolved oxygen (DO) levels. A primary non-point source cause for low DO in waterways is loading of nutrients, sediment, and organic matter. High levels of nutrients result in increased algal and plant growth in waterbodies. When the algae and plants die, they are decomposed by microbes which consume oxygen in the water through respiration. Similarly, when organic matter is delivered to a waterbody it results in increased rates of decomposition and consumption of oxygen, lowering the dissolved oxygen in the waterbody. Sufficient DO is important for a healthy aquatic ecosystem as fish and other aerobic organisms rely on certain levels, typically 5 mg/L, for survival. As such, nutrient and suspended solids loading may be used as a metric to evaluate impacts to DO in a waterbody. In addition to contributing to low DO, suspended solids can be detrimental to aquatic life and stream health by increasing turbidity and carrying heavy metals and other contaminants, which further emphasizes the impact of their loading.

As described above, the WTM was used to estimate the annual loading rates of total nitrogen (TN), total phosphorus (TP), and total suspended solids (TSS) for each subwatershed of the Westchester County portion of the Hutchinson River Watershed. Higher values of TN, TP, and TSS loading represent greater contribution to the low DO levels in the Hutchinson River. The WTM provides both total annual pollutant load (lb per year) and a loading rate (lb per acre per year). The loading rate is used to compare subwatersheds and identify subwatersheds that should be prioritized for nutrient or TSS management.

The results of the WTM for nutrients and TSS are shown in Figure 8, Figure 9, Figure 10 and summarized as follows:

— TN loading rates ranged from 7.5 to 16.5 lb/acre/year

— TP loading rates ranged from 1.21 to 2.59 lb/acre/year

— TSS loading rates ranged from 374 to 771 lb/acre/year

The highest loading rates are observed in the southern subwatersheds. This is due to the land uses and high levels of imperviousness in this portion of the Hutchinson River Watershed, which drive nutrient and TSS loading rates in the WTM.

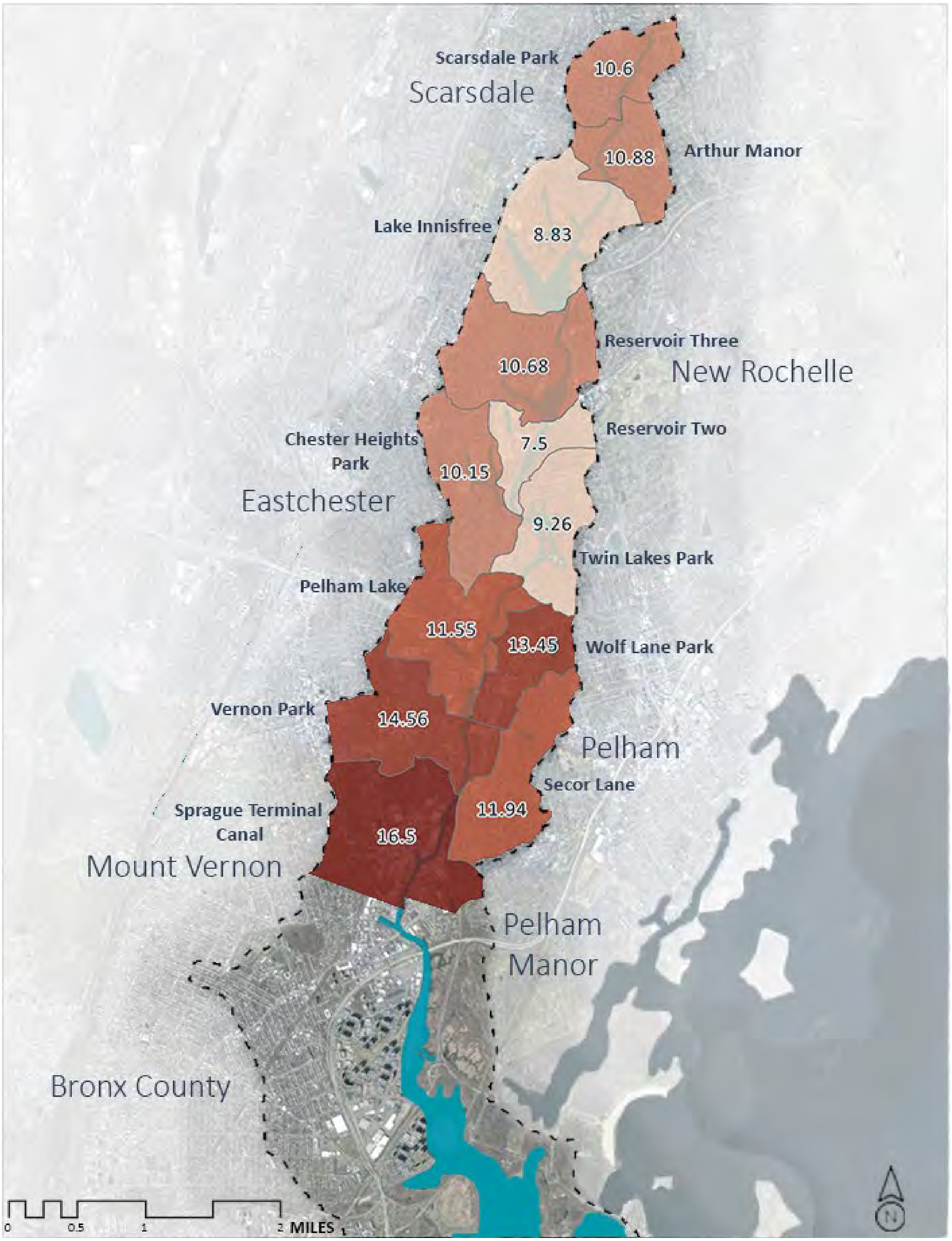

Figure 11. Total Nitrogen loading rates (lb/acre/yr) in the Hutchinson River Watershed.

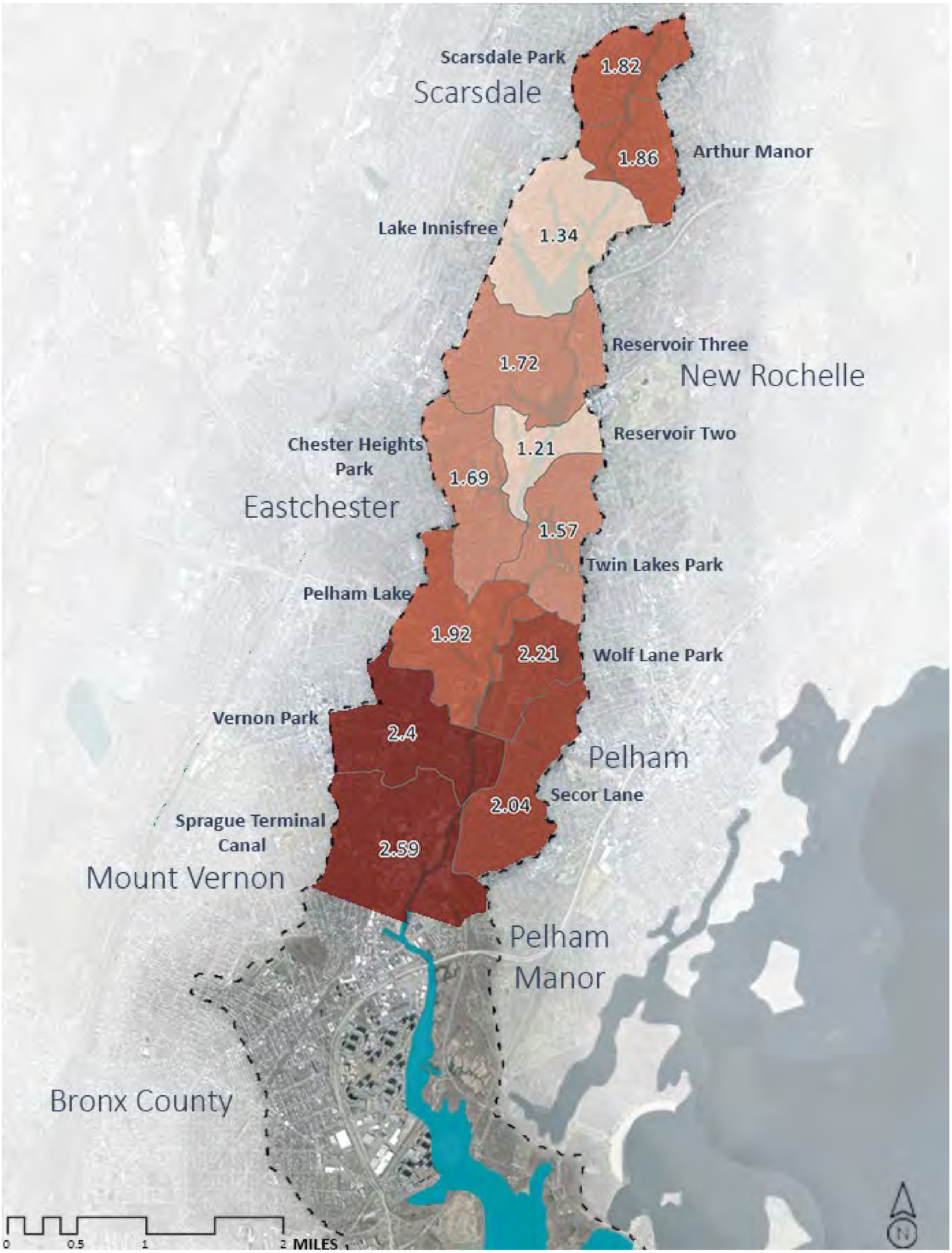

Figure 12. Total Phosphorus loading rates (lb/acre/yr) in the Hutchinson River Watershed.

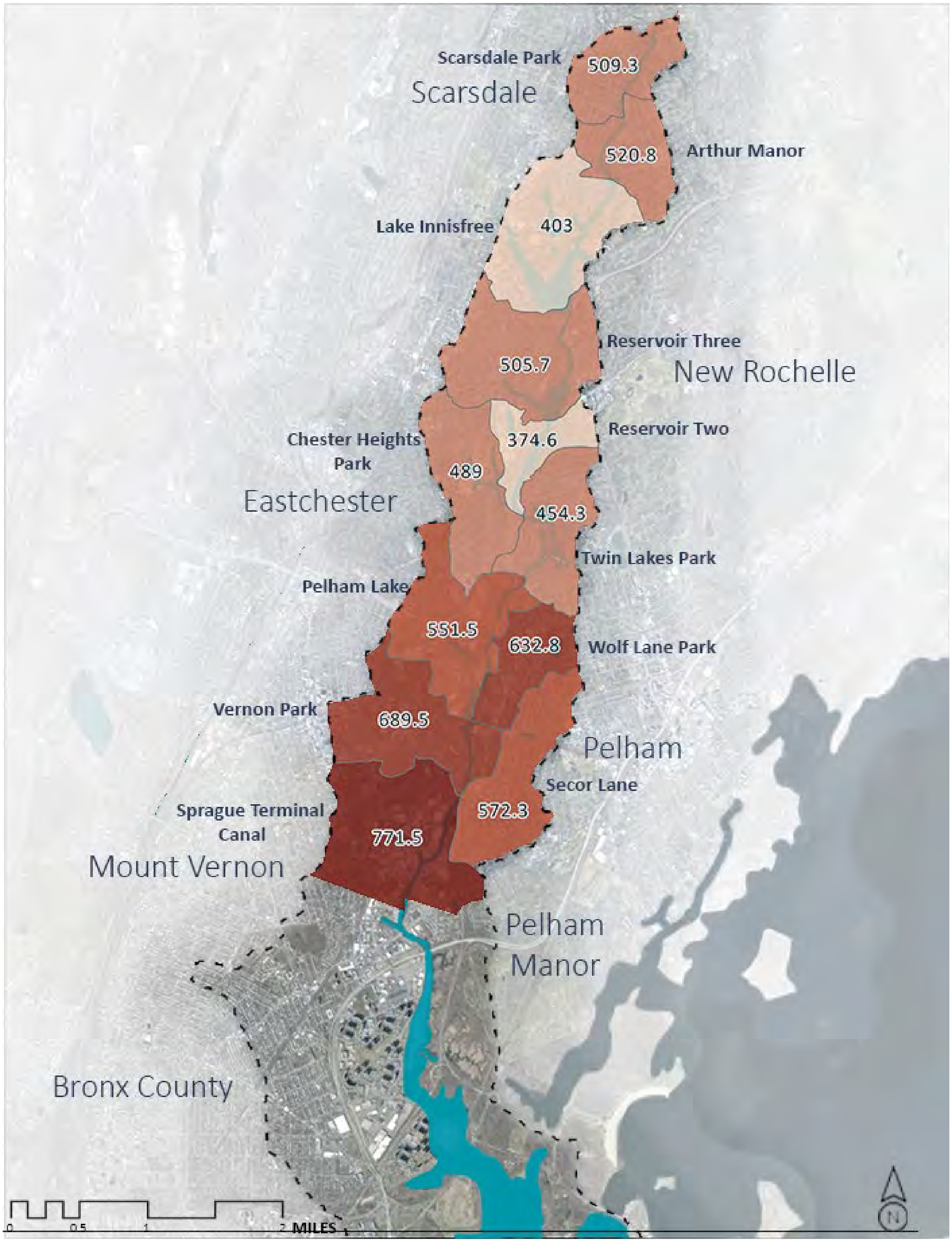

Figure 13. Total Suspended Solids loading rates (lb/acre/yr) in the Hutchinson River Watershed.

Fecal Coliform and Bacteria

As noted above, the New York State 303(d) List identifies fecal coliform as a pollutant causing impairment in the Hutchinson River.

Save the Sound monitors levels of fecal bacteria (*Enterococcus*) at four sampling locations along the Hutchinson River with a yearly monitoring program. Samples are taken weekly at set sampling locations in the lower portion of the watershed (Pelham Lake at Willson's Woods Park, upstream of Farrell and Beechwood Avenues, an outfall at the Farrell and Beechwood intersection, and Glover Field).

Since 2015, the Hutchinson River is regularly the most polluted river monitored by Save the Sound and since 2019, all samples from the sites in Mount Vernon have failed the state bacteria criteria for swimming. Oftentimes, this value is at least ten times the state threshold. Failing sewer infrastructure has been identified in most of the municipalities located within the Hutchinson River Watershed. Currently, there are efforts throughout the county to address the aging sewer shed and implement remediation efforts. In 2022, Mount Vernon was awarded $150 million in state funding to improve its sanitary sewer system.

In addition to the monitoring from Save the Sound, Biohabitats used the WTM to estimate annual fecal coliform loading from each of the subwatersheds in the Westchester County portion of the Hutchinson River Watershed. The results are presented in Figure 11 with rates ranging from 234 to 595 billions of colonies/acre/year. As noted above and in Appendix A, the WTM did not include secondary sources such as sanitary sewer overflows or illicit connections, which are major contributors to bacteria in waterbodies. Therefore, these results represent the relative contribution of bacteria to the Hutchinson River due to land use and impervious cover in each subwatershed and should be interpreted in conjunction with other available data such as Save the Sound's monitoring.

Oil and Grease

Key sources of oil and grease in an urban watershed typically include industrial areas, auto repair shops, car washes, gas stations, roadways, and restaurants.

Biohabitats conducted a desktop analysis of potential sources of oil and grease throughout the watershed, including auto body shops, car washes, manufacturing facilities, gas stations, petroleum storage facilities, trucking terminals as well as restaurants, laundromats, and commercial zones. A heat map illustrating concentrations of these potential sources is displayed in Figure 15.

Many of these sources are concentrated in the lower reaches of the watershed. The areas near Sprague Terminal Canal and Vernon Park include denser development and higher numbers of automobile repair and utility shops. These parts of Pelham, Eastchester, and Mount Vernon have historically been home to auto repair and manufacturing businesses. The higher levels of imperviousness in this portion of the watershed also means that spilled oils are more likely to drain directly to storm drains and to the Hutchinson River without treatment or separation.

The upper reaches of the watershed are more residential, and oil and grease hotspots are more spread out. However, improper handling of oils and greases from everyday activities such as cooking and car maintenance can still be an issue.

Flooding

The Hutchinson River watershed experiences disruptive flooding in low lying areas, areas where the river backs up due to silt and sediment deposits, and areas that were likely once wetlands and part of the river's original floodplain. Additionally, the increasing frequency of flash flood events due to climate change results in additional locations of flooding from inundated storm sewer systems. The abundant impervious cover throughout the watershed also decreases the water's time of concentration, resulting in high volumes of water entering the river at once. Flooding during storms impacts areas along the entire length of the river. Figure 13 shows the FEMA flood zones in the Hutchinson River watershed along with locations where flash floods have previously been reported based on hazard mitigation reports and published news articles.

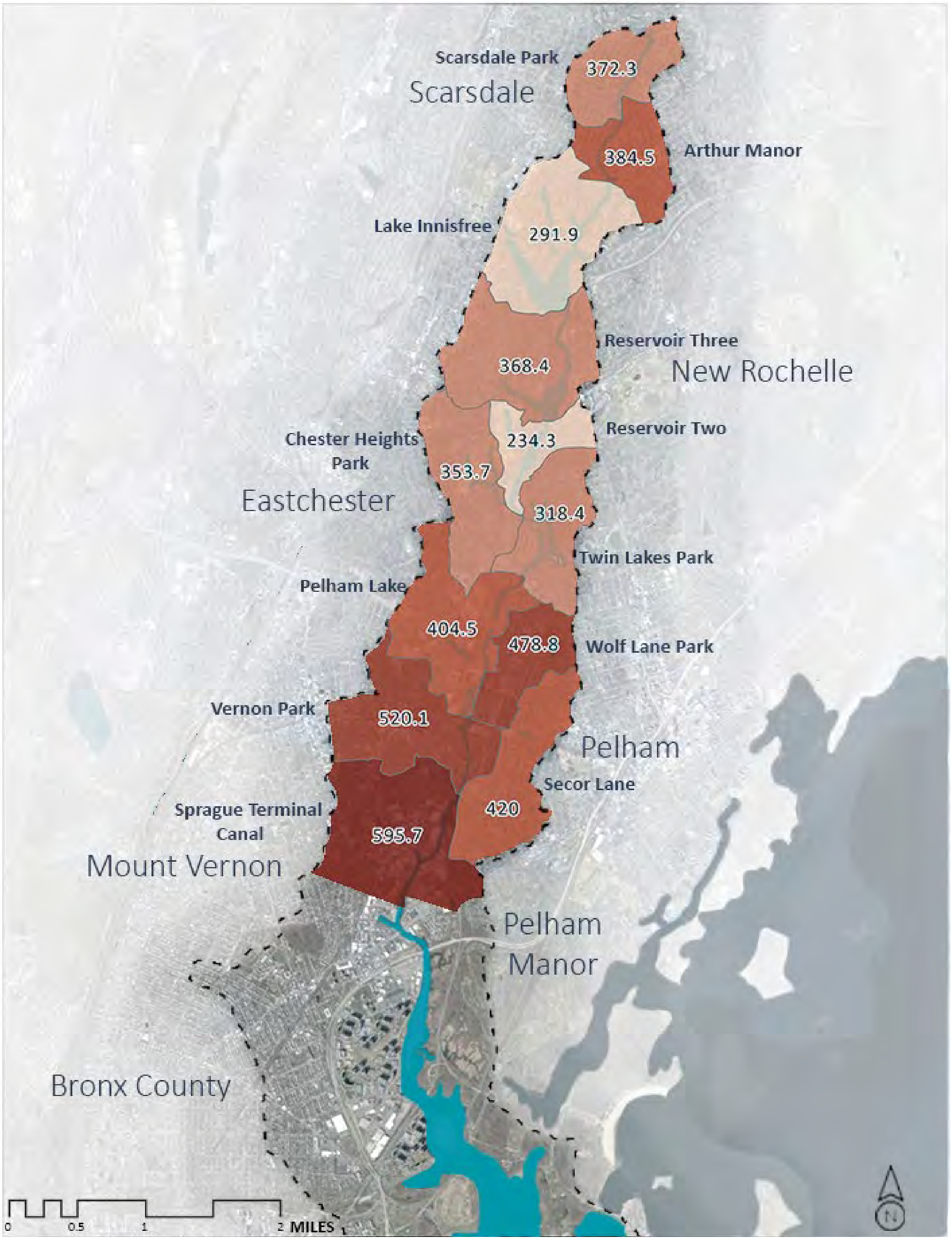

Figure 14. Bacteria loading rates (billions of colonies/yr) in the Hutchinson River Watershed.

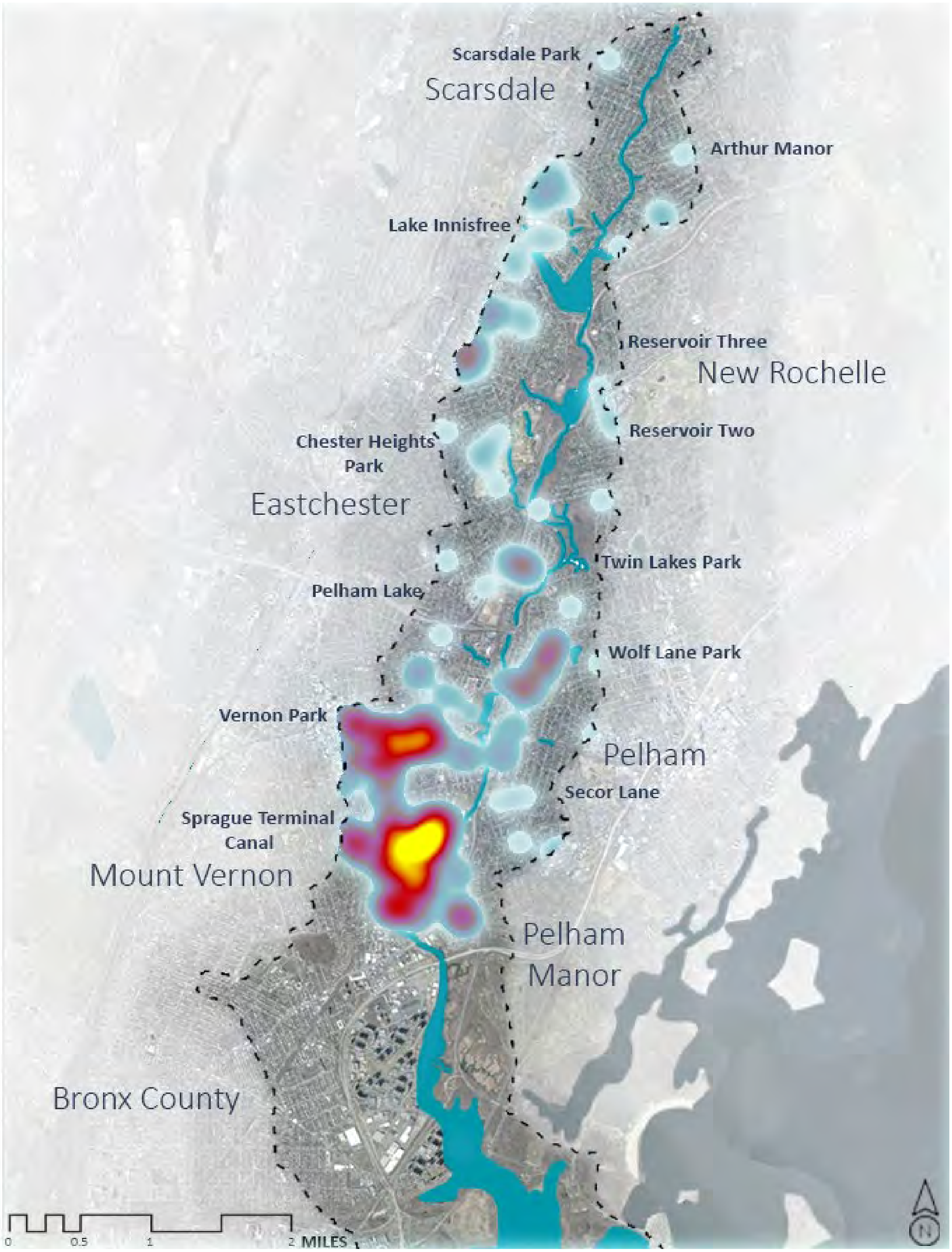

Figure 15. Oil and gas pollutant hot spots in the Hutchinson River Watershed.

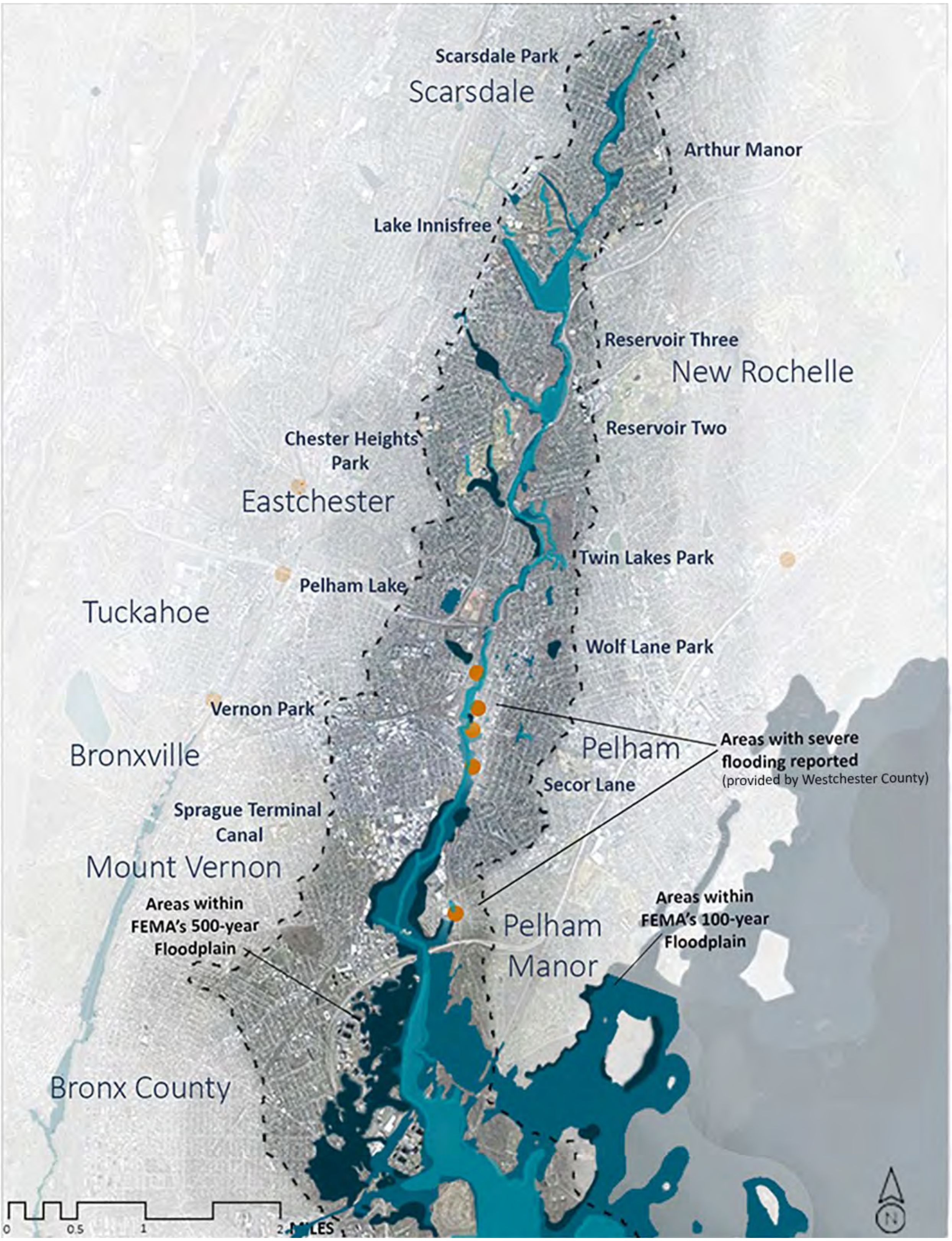

Figure 16: FEMA 100 and 500-year floodplain and reported flooding in the Hutchinson River Watershed.

6 Comparative Subwatershed Analysis

The Comparative Subwatershed Analysis (CSA) screens subwatersheds within a watershed to identify the ones with the greatest restoration potential. Subwatershed “metrics” are used to conduct this analysis. Metrics are single numeric values that characterize the relative restoration potential of a subwatershed.

The CSA involves a simple spreadsheet analysis of selected subwatershed metrics that are derived by analyzing available GIS layers and other subwatershed data sources. Subwatersheds with the highest aggregate score become priorities of subsequent field investigations for actual restoration potential. This enables watershed planners to allocate limited resources on subwatersheds where restoration has the greatest chance of success.

Many different subwatershed metrics can be used for screening purposes. The basic method to conduct a CSA consists of four general tasks:

1. Delineate subwatershed boundaries and review available metric data
2. Choose and compute metrics that best describe restoration potential
3. Develop weighting and scoring rules to assign points to each metric
4. Compute aggregate scores and develop initial subwatershed ranking

Based on a review of existing watershed data, the following metrics were identified for inclusion in the Hutchinson River Watershed CSA:

- Tree Canopy Cover
- Detached Residential Land
- Public Land
- Institutional Land
- Pervious Stream Corridor
- Current Impervious Cover
- Industrial Land
- Pollutant Hot Spot Density
- Buildings in Flood Zone
- Flood Prone Road Crossings

Upon further review and after conversations with the larger project team, it was determined that, although these metrics describe watershed characteristics related to restoration, they do not do so in the same manner. Some of these metrics represent opportunities, while some represent problems. As such, the metrics were grouped into three categories:

- Restoration Potential Metrics – indicate greater restoration potential
- Pollution Potential Metrics – indicate increased risk of pollution
- Flooding Potential Metrics – indicate greater potential for flooding

The metrics were computed for each subwatershed, and a simple scoring system was developed. Table 5 provides more detailed information on each selected metric, including:

- Metric – The metric selected to measure restoration, pollution, or flooding potential of the subwatershed.
- How Metric is Measured – Describes the units used to define the metrics.
- Higher Scoring When – Describes how this metric is used to determine restoration, pollution, or flooding potential.

Figure 14, Figure 15, Figure 16, and Figure 17 present the results of the CSA.

Table 5. Summary of Subwatershed Metrics for the Hutchinson River Watershed

Metric	Higher Score When…
Pollution Potential	
Impervious Cover	% impervious cover in subwatershed is high
Industrial Land	% of industrial land in subwatershed is high
Potential Hot Spots	Potential hot spots / acre is high
Flooding Potential	
Buildings in the Flood Zone	number of buildings in the flood zone is high
Flood Prone Road Crossings	number of flood prone road crossings is high (Westchester County, 2021)
Restoration Potential	
Tree Canopy Cover	% of existing tree canopy cover in subwatershed is low
Detached Residential Land	% of detached residential land in subwatershed is high
Publicly Owned Land	% of publicly owned land in subwatershed is high
Institutional Land	% of institutional land in subwatershed is high
Pervious Stream Corridor	% of stream corridor (100’ on either side of stream) that is pervious is high

Below provides the results from the CSA for the Hutchinson River Watershed. The coloring of these tables are based on relative gradients with darker colors signifying higher scores in the prioritization.

Subwatershed	Tree Canopy		Detached Residential Land		Publicly Owned Land		Institutional Land		Pervious Stream Corridor		Restoration Potential Score
	(%)	Score	(%)	Score	(%)	Score	(%)	Score	(%)	Score	
Arthur Manor	40%	5.0	54%	10.0	6%	2.5	4%	10.0	13%	10.0	**45.0**
Chester Heights Park	34%	7.5	41%	7.5	8%	5.0	9%	10.0	2%	5.0	**40.0**
Lake Innisfree	30%	10.0	32%	5.0	22%	7.5	5%	10.0	1%	5.0	**40.0**
Pelham Lake	34%	7.5	35%	5.0	29%	10.0	2%	5.0	2%	5.0	**40.0**
Reservoir Three	38%	5.0	34%	5.0	27%	10.0	3%	7.5	3%	10.0	**42.5**
Reservoir Two	46%	2.5	18%	2.5	44%	10.0	1%	2.5	2%	7.5	**27.5**
Scarsdale Park	48%	2.5	53%	10.0	4%	2.5	2%	7.5	2%	7.5	**35.0**
Secor Lane	43%	5.0	49%	10.0	8%	2.5	2%	7.5	0%	2.5	**35.0**
Sprague Terminal Canal	10%	10.0	17%	2.5	16%	7.5	1%	5.0	0%	2.5	**37.5**
Twin Lakes Park	54%	2.5	36%	7.5	22%	7.5	0%	2.5	6%	10.0	**32.5**
Vernon Park	19%	10.0	29%	2.5	10%	5.0	1%	2.5	2%	7.5	**37.5**
Wolfs Lane Park	30%	7.5	36%	7.5	9%	5.0	1%	5.0	0%	2.5	**37.5**

Subwatershed	Imperviousness		Industrial Land		Pollutant Hot Spots		Pollution Potential Score
	(%)	Score	(%)	Score	(#/acre)	Score	
Arthur Manor	41%	7.5	0%	2.5	0.007	2.5	**12.5**
Chester Heights Park	38%	5.0	0%	2.5	0.020	7.5	**15.0**
Lake Innisfree	31%	2.5	0%	2.5	0.020	7.5	**12.5**
Pelham Lake	44%	7.5	0%	10.0	0.019	5.0	**22.5**
Reservoir Three	40%	5.0	0%	2.5	0.027	7.5	**15.0**
Reservoir Two	26%	2.5	0%	2.5	0.014	5.0	**10.0**
Scarsdale Park	39%	5.0	0%	2.5	0.003	2.5	**10.0**
Secor Lane	45%	7.5	0%	2.5	0.013	5.0	**15.0**
Sprague Terminal Canal	68%	10.0	13%	10.0	0.273	10.0	**30.0**
Twin Lakes Park	34%	2.5	0%	2.5	0.011	2.5	**7.5**
Vernon Park	58%	10.0	5%	10.0	0.177	10.0	**30.0**
Wolfs Lane Park	54%	10.0	0%	2.5	0.087	10.0	**22.5**

Subwatershed	Buildings in Flood Zone		Flood Prone Road Crossings		Flooding Potential Score
	(#)	Score	(#)	Score	
Arthur Manor	92	10.0	2	7.5	17.5
Chester Heights Park	9	2.5	0	2.5	5.0
Lake Innisfree	45	5.0	1	2.5	7.5
Pelham Lake	54	7.5	3	10.0	17.5
Reservoir Three	101	10.0	1	2.5	12.5
Reservoir Two	1	2.5	0	2.5	5.0
Scarsdale Park	37	5.0	1	2.5	7.5
Secor Lane	77	7.5	2	7.5	15.0
Sprague Terminal Canal	129	10.0	4	10.0	20.0
Twin Lakes Park	31	2.5	2	7.5	10.0
Vernon Park	56	7.5	3	10.0	17.5
Wolfs Lane Park	42	5.0	1	2.5	7.5

Figure 17. Results of the CSA for the Hutchinson River Watershed.

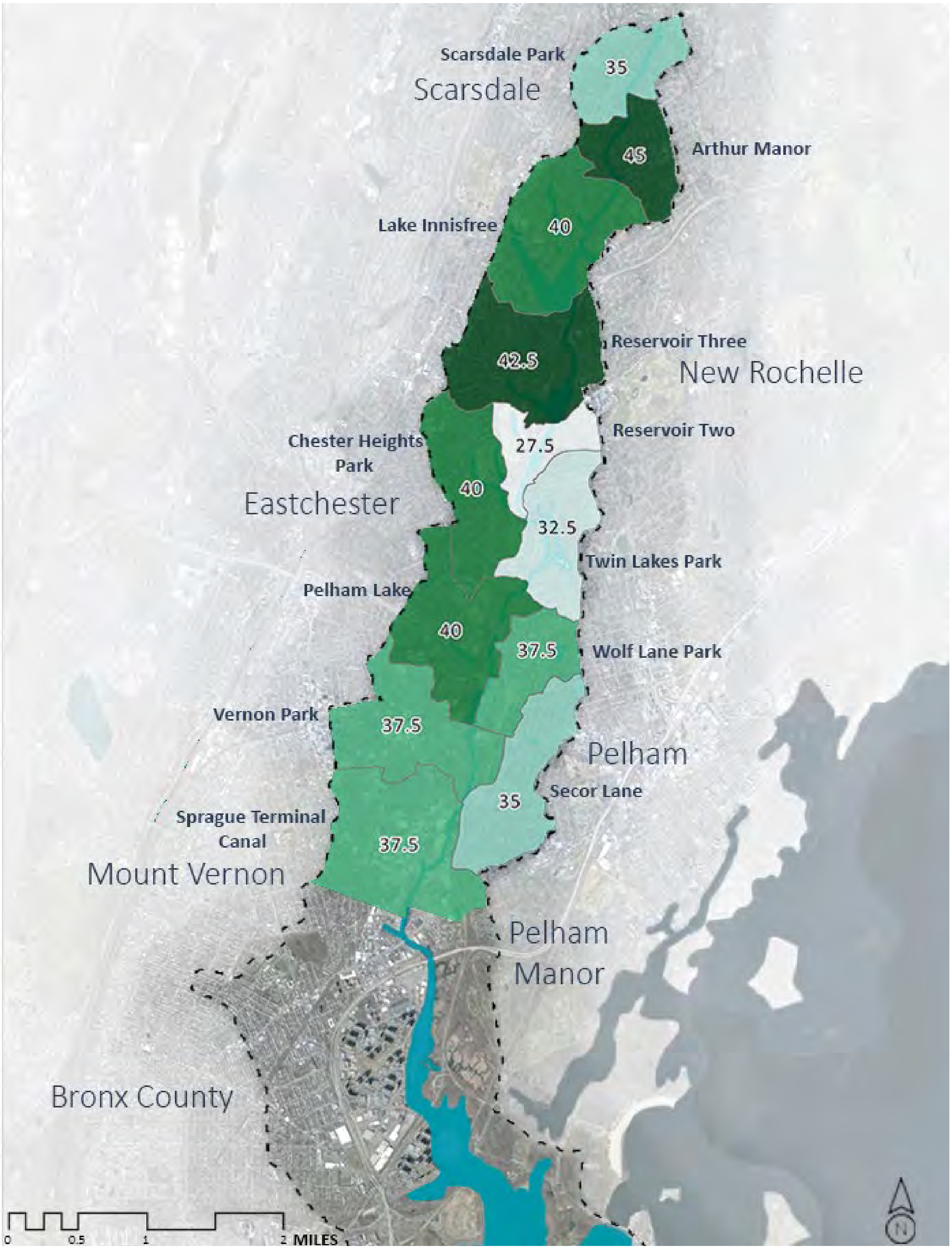

Figure 18. Restoration potential subwatershed scoring.

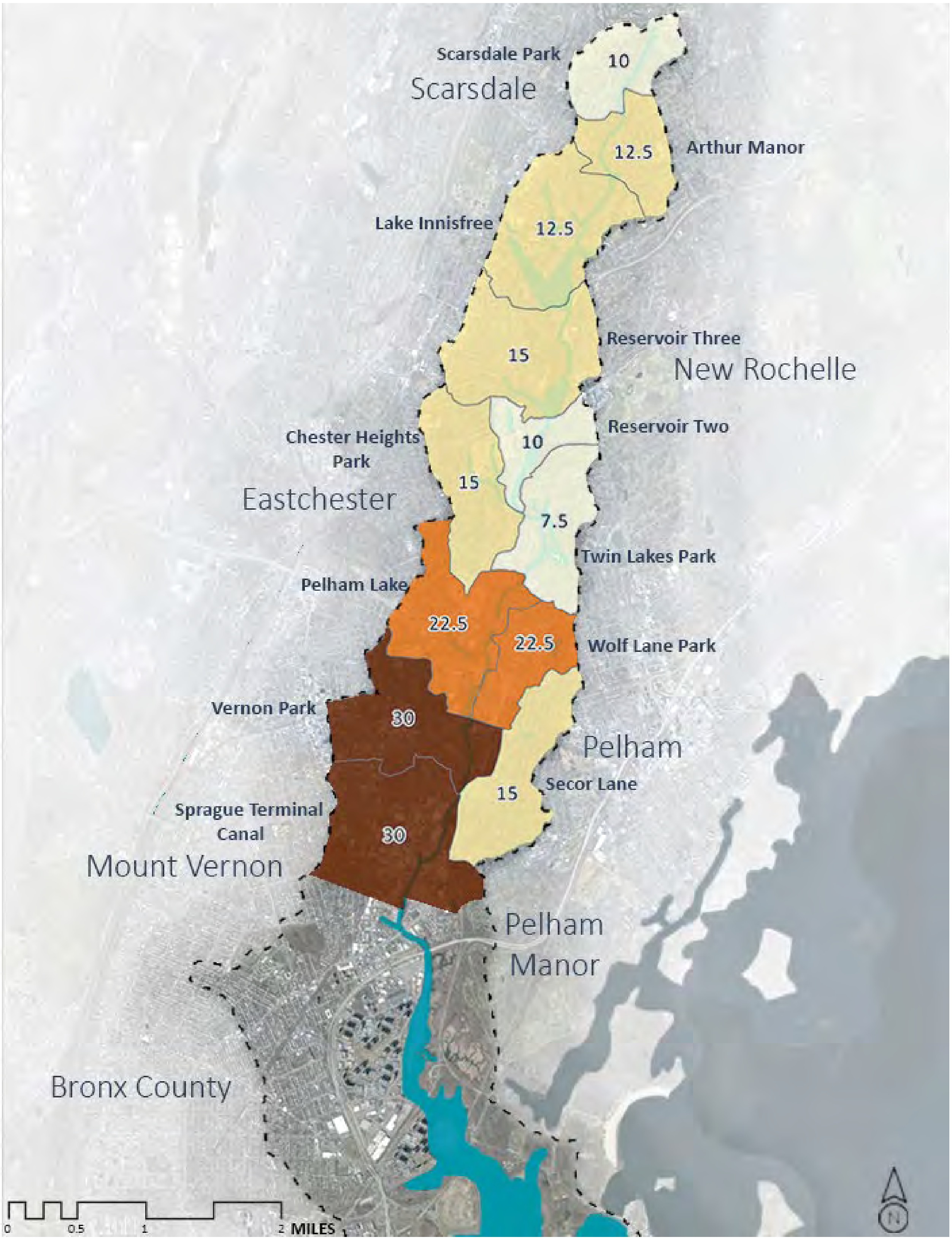

Figure 19. Pollution potential subwatershed scoring.

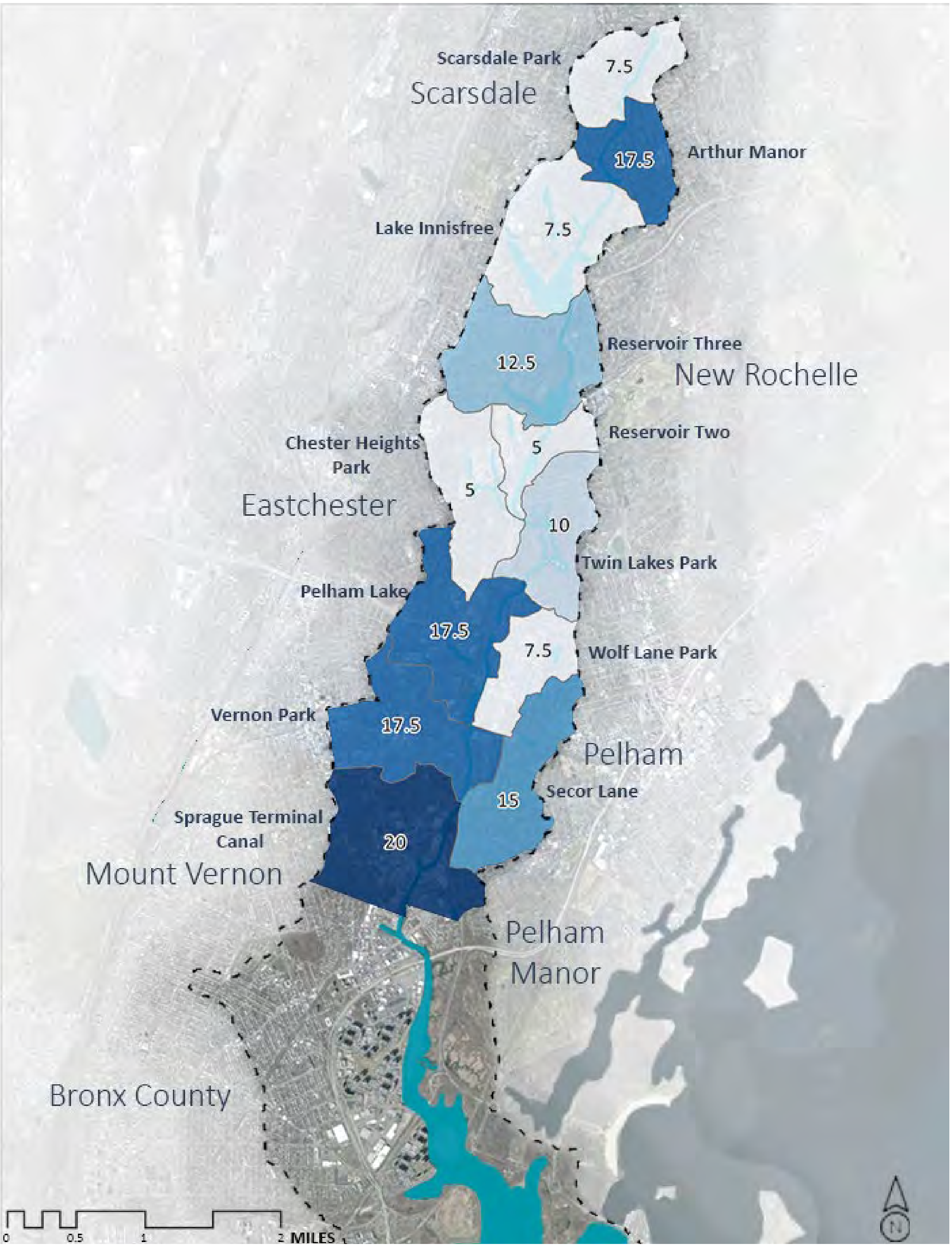

Figure 20. Flooding potential subwatershed scoring.

Subwatershed Categorization

As part of the CSA, the subwatersheds were grouped into four categories based on similar conditions (e.g., land use, development patterns, drainage patterns, etc.):

- Subwatersheds with significant water bodies and/or parkland
- Subwatersheds dominated by medium density residential areas
- Subwatersheds with steep topography and dense residential areas
- Subwatersheds in heavily industrialized areas

This categorization is displayed in Table 6. Subwatersheds with similar characteristics will also have comparable restoration strategies and recommendations. Watershed restoration is a costly and lengthy process – developing detailed restoration strategies for all 12 subwatersheds would be a costly undertaking. Instead, select subwatersheds may be studied in more detail, and subwatershed-wide recommendations can be applied to other subwatersheds in the same grouping. Subwatersheds that will be assessed during the next phase of this project will be selected in consultation with Save the Sound and Westchester County.

Table 6. Subwatershed Categorization and CSA Scoring

Subwatershed Group Characterization	Subwatershed	Restoration Potential	Pollution Potential	Flooding Potential
Subwatersheds with significant water bodies and/or parkland	Pelham Lake	40.0	22.5	17.5
	Lake Innisfree	40.0	12.5	7.5
	Reservoir Three	42.5	15.0	12.5
	Reservoir Two	27.5	10.0	5.0
	Twin Lakes Park	32.5	7.5	10.0
Subwatersheds dominated by medium density residential areas	Arthur Manor	45.0	12.5	17.5
	Chester Heights Park	40.0	15.0	5.0
	Scarsdale Park	35.0	10.0	7.5
Subwatersheds with steep topography and dense residential areas	Secor Lane	35.0	15.0	15.0
	Wolfs Lane Park	37.5	22.5	7.5
Subwatersheds in heavily industrialized areas	Sprague Terminal Canal	37.5	30.0	20.0
	Vernon Park	37.5	30.0	17.5

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Technical Assessment Methodology

Hutchinson River Watershed Plan

Overview & Objective

This appendix summarizes the methodology and results of the pollutant load model developed by Biohabitats for the Westchester County portion of the Hutchinson River watershed plan. The Watershed Treatment Model (WTM), developed by the Center for Watershed Protection, was used to estimate the annual pollutant loads to the Hutchinson River watershed as a component of the baseline watershed assessment.

Watershed Treatment Model

The WTM is a screening level tool that was used to estimate the loads of non-point source pollutants within the watershed based on local land uses and land cover under existing conditions. The model provides annual load estimates of pollutants from primary and secondary sources. Due to the limited available data, Biohabitats did not incorporate secondary sources, and the assessment focused on primary pollution sources that result from land use and impervious cover. Results provided are the annual loads of Total Nitrogen (TN), Total Phosphorus (TP), Total Suspended Solids (TSS), and Bacteria totals for the watershed and each subwatershed. The WTM may also be used to estimate load reductions associated with management measures within the watershed. Due to limited available data, Biohabitats did not incorporate existing treatment measures in the existing conditions model. Analysis of treatment measures will be conducted during later stages of this project to evaluate recommended interventions throughout the watershed.

Hutchinson River Subwatershed

Dividing watersheds into smaller drainage basins, or subwatersheds, is a common practice to better understand details about pollutant loading within a watershed. The initial boundaries for the Hutchinson River Watershed were provided by Westchester County and were used as the perimeter for the watershed delineation process. The following twelve subwatersheds were identified within the Westchester County portion of the Hutchinson River watershed:

- Arthur Manor
- Chester Heights Park
- Lake Innisfree
- Pelham Lake
- Reservoir Three
- Reservoir Two
- Scarsdale Park
- Secor Lane
- Sprague Terminal Canal
- Twin Lakes Park
- Vernon Park
- Wolfs Lane Park

To identify these twelve subwatersheds, Biohabitats used a combination of approaches:

- In general, existing waterbodies (lakes and reservoirs), primary tributaries, and secondary tributaries were identified as confluence locations in more natural areas. In more urban areas, railroad crossings, highway ramps, and large road features were used as confluence points.
- Once these confluence points were identified, traditional watershed delineation was conduction using high points throughout the watershed.
- The team used 2-foot contour data provided by Westchester County to determine surface water flows to the Hutchinson River throughout the project area.
- In more urban areas, urban stormwater systems were identified and used to delineate when available.

Table 1 summarizes the twelve subwatersheds within the Westchester County portion of the Hutchinson River Watershed and Figure 1 shows a map of the subwatersheds.

Table 1: Subwatersheds within Westchester County portion of Hutchinson River Watershed

Subwatershed	Acronym	Area (acres)	Area (square miles)
Arthur Manor	AM	284	0.44
Chester Heights Park	CHP	441	0.69
Lake Innisfree	LI	586	0.92
Pelham Lake	PL	519	0.81
Reservoir Three	R3	585	0.91
Reservoir Two	R2	215	0.34
Scarsdale Park	SP	298	0.47
Secor Lane	SL	446	0.70
Sprague Terminal Canal	STC	692	1.08
Twin Lakes Park	TLP	374	0.58
Vernon Park	VP	518	0.81
Wolfs Lane Park	WLP	276	0.43
Total in Westchester Co.	**HR**	**5,234**	**8.18**

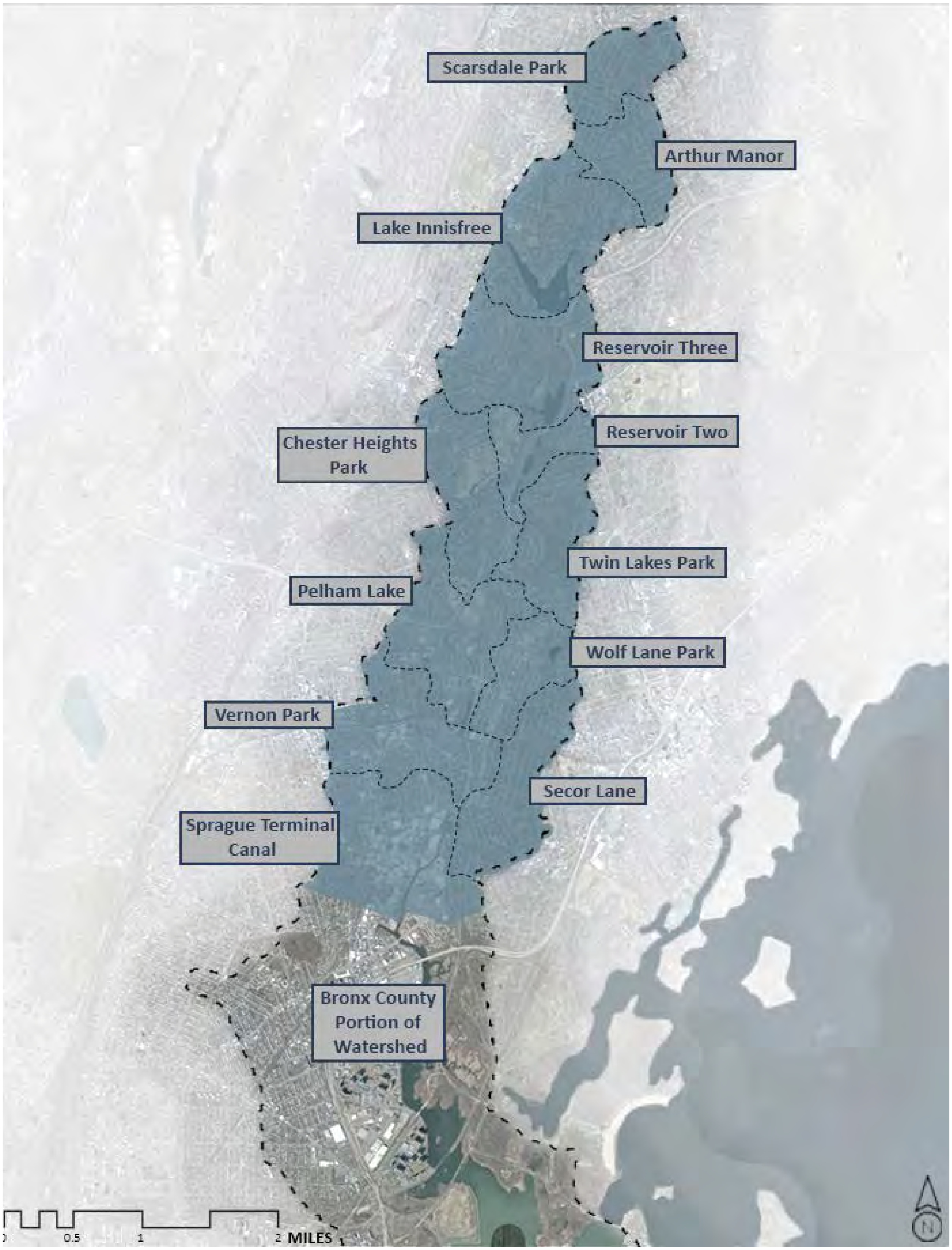

Figure 1: Subwatershed Delineation

Model Inputs

The following section identifies the different data types that were used in the watershed treatment model and any assumptions or modifications that were done to the raw data. Table 2 provides an overview of the data used for the Watershed Treatment Model:

Table 2: Data Inputs for the Watershed Treatment Model

Data Input	Usage	Source
Land Use	Use types that correlate to runoff calculations and to management recommendations.	Westchester County, 2022
Impervious Cover	Determine the land cover and how much is impervious in the watershed. Used in runoff calculations and management recommendations.	Westchester County, 2022
Precipitation	Total precipitation amounts for runoff calculations.	Cornell NRCC, 2021
Base Pollutant Concentrations	Assumptions for the different land use types and their initial concentration of primary pollutant.	Watershed Treatment Model, 2002
Runoff Calculations	Assumptions for the different land use types and their initial concentration of primary pollutant.	Watershed Treatment Model, 2002

Land Use

Initial land use data was obtained from Westchester County's tax parcel data. This dataset provides both primary land use categories and sub land use categories. Within the Hutchinson River watershed, sixteen land use categories were identified. For simplicity and relevance to the watershed assessment, only six land use categories were necessary. The following provides explanations for the creation of each land use category used as inputs to the WTM :

Commercial: This land use category combined *Commercial – Retail, Institutional and Public Assembly, Office and Research, Mixed Use,* and *Vacant/Undeveloped* land parcels identified as *Commercial Vacant*.

Industrial: All the parcels with the land use category *Manufacturing, Industrial, Warehouse* and *Vacant/Undeveloped* land parcels identified as *Industrial Vacant* were added to the Industrial Category. Additionally, the following Sub Land Use Categories from *Transportation, Communication, Utilities* were added to the Industrial Category: *Electric Power Generation – Hydro, Electric Transmission, Sewage Treatment and Water Pollution Control, Solid Wastes, Water, Water – Transportation*.

Open Water: Westchester County provided spatial data for all the lakes and reservoirs located within the watershed. Since the land use data did not identify the water bodies, the open water spatial data was overlayed onto the land use data to define these areas.

Parks: This land use category combined *Public Parks and Parkway Lands, Private Recreation,* the *Common Land Homeowners Association* parcels that were not included in open water, and the *Transportation, Communication, Utilities* with the Sub Land Use Category *Misc ROW,* *Easements*. Additionally, parcels that were identified as *Vacant* and confirmed through aerial analysis from within the *Vacant/Undeveloped* category were added to the Parks category.

Residential: This land use category included all the parcels that were defined as *Residential* and all *Vacant/Undeveloped* land parcels defined as *Residential Vacant* in the Westchester County provided data.

Roadways: Roadways included the parcels with the *Roadways* land use category along with the parcels with the sub land use categories *Parking Lots,* and *Non ceiling Railroads*.

Table 3 provides an overview of land use cover amounts within the watershed. Please see the attachments for detailed maps of each sub watershed's land use cover.

Table 3: Acreage associated with each land use in the Westchester County portion of the Hutchinson River Watershed

Land Use	Acreage in Watershed	Percent of Watershed
Commercial	472	9
Industrial	185	3.5
Open Water	117	2.25
Parks	716	13.7
Residential	2,634	50.4
Roadways	1,110	21.15
Total	**5,234**	**100**

Impervious Cover

The base understanding of impervious cover in the Hutchinson River Watershed was identified through Westchester County's planimetric spatial data. This dataset provided accurate accounts of the bridges, buildings, driveways, parking lots, railroads, roadways, sidewalks, and transportation structures throughout the county. These features were delineated as 100% impervious surfaces. The team did a detailed review of the project area and added approximately 25 structures that were not included in the GIS assessment.

Table 4 provides the percentage of impervious cover that was calculated for each Land Use Category:

Table 4: Percent Impervious Cover by Land Use Category

Land Use	Percentage Impervious
Commercial	57.6%
Industrial	84.5%
Open Water	0%
Parks	5.1%
Residential	31.1%
Roadways	100%

Because of imperfect data, there are some locations where practitioners made assumption decisions including the following:

- Roadways were assumed to be completely impervious.
- Open water was assumed to have no impervious cover.

Precipitation

To calculate annual runoff, the average annual precipitation amount was calculated from the weather station at the Westchester County Airport in Harrison, New York, as provided by the Northeast Regional Climate Center (Cornell NRCC, 2021). The airport has datasets that range from 1946 to today. All years missing more than one day of precipitation were discarded to create the most accurate depiction of precipitation. In total, 22 years of precipitation data were discarded, and the average annual rainfall amount was calculated as 49.77 inches per year. Appendix B to the Baseline Assessment provides the monthly rainfall sums that compiled into the precipitation data that was used in this assessment.

Pollutant Concentration

Pollutant concentration values were provided in the Water Treatment Model (WTM) assessment manual (Caraco, 2002). Urban and rural pollutant concentrations and how they impact run off calculations are explained below.

Urban Pollutants

The pollutant concentration values were provided for four urban land use types: *Residential, Commercial, Roadway, and Industrial* pollutant concentration values were used for the same respective land use categories. Given the characteristics of cemeteries, these land use types were also mapped to the residential land use values. Table 5 summarizes the pollutant concentrations used for each land use category.

Table 5: Land Use Category Pollutant Concentrations

Land Use Category	Total Nitrogen (mg/L)	Total Phosphorus (mg/L)	Total Suspended Solids (mg/L)	Fecal Coliforms (MPN/100 mL)
Commercial	2	0.2	75	20,000
Industrial	2.5	0.4	120	20,000
Residential	2.2	0.4	100	20,000
Roadway	3	0.5	150	20,000

Non-Urban Pollutants

Non-urban pollutant concentrations were provided through the WTM as pollutant loading rates and use a simple storm load fraction to factor in the impact of rainfall. The categories provided were *Forest* and *Rural,* assumed to be pastureland rather than row crops, to determine runoff load amounts. Because the region is primarily urban and suburban and rural calculations will incorporate high amounts of fertilizers, pesticides, and animal waste, only the forest values were used for the Parks land use category. Table 6 provides the loading rates and partitioning coefficients used for forested areas.

Table 6: Pollutant Annual Loading Rates and Partitioning Coefficients

Pollutant	Annual Loading Rate (lb/acre/yr)	Partitioning Coefficient
Total Nitrogen	2.0	0.50
Total Phosphorus	0.2	0.70
Total Suspended Solids	100	0.90
Bacteria Coliform	12 (# billion/acre/yr)	1.00

Open water loading rates were taken from atmospheric deposition rates provided by the WTM. These values were calculated by combining multiple sources and are presented in Table 7.

Table 7: Atmospheric Deposition Rates

Pollutant	Annual Loading Rate (lb/acre/yr)
Total Nitrogen	12.8
Total Phosphorus	0.5
Total Suspended Solids	155
Bacteria Coliform	---

Runoff Modeling

For urban land use areas, the WTM recommends using the Simple Method to calculate the runoff loading rates. First, the annual runoff is calculated, based on impervious cover and runoff coefficients as follows:

$R = P * P_j * Rv$ where:

R = Annual runoff

P = Annual rainfall

P_j = Fraction of annual rainfall events producing runoff (0.9)

Rv = Runoff coefficient

Where the runoff coefficient is calculated based on impervious cover as:

Rv = 0.05 + 0.9 * (Impervious fraction)

Loading rates are then calculated to convert runoff depths to pollutant concentrations as follows:

L = CF*R*C*A where:

L = loading rate (lbs/year)

CF = conversion factor

R = annual runoff

C = pollutant concentration

A = Acreage

To assure that that runoff rates are not being under predicted, the urban runoff load values were compared to the forest runoff rates and the maximum was selected for each land use. After the maximum value was selected, the annual load rate was multiplied by acreage to determine the loading rate for each land use category and subwatershed.

Results

The Watershed Treatment Model provided the team with estimates of pollution loads in pounds per year and bacteria loads in billions of colonies per year to better understand the impacts that land cover has on the pollution in the watershed. The results can be seen in Appendix C.

Monthly Total Precipitation for WESTCHESTER CO AP, NY

Each column contains monthly value and monthly number of missing days

Year	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec		Annual
1946	M	-	M	-	M	-	1.48	0	9.89	0	3.95	0	3.95	1	M	15	M	8	2.18	0	2.03	0	M	5	M
1947	M	2	3.23	0	3.81	0	5.08	0	M	2	3.66	0	3.54	1	1.35	0	3.42	0	1.90	0	6.04	0	3.66	0	M
1948	4.75	1	M	23	2.21	1	3.99	0	6.50	0	4.54	0	4.60	0	3.09	0	1.13	0	2.65	0	5.09	0	5.06	0	M
1949	5.36	0	3.77	0	2.71	0	4.58	0	5.33	0	0.06	0	3.93	0	4.99	0	4.55	0	1.95	0	0.84	0	3.55	0	41.62
1950	3.63	0	5.52	0	4.15	0	2.85	0	5.14	0	2.72	0	4.29	0	5.24	0	1.57	0	1.63	0	7.03	0	5.58	0	49.35
1951	4.10	0	5.25	0	8.69	0	2.46	0	5.36	0	3.70	0	4.42	0	6.47	0	1.94	0	5.44	0	7.25	0	5.96	0	61.04
1952	5.88	0	2.32	0	5.71	0	9.43	0	8.36	0	4.00	0	4.12	0	8.14	0	2.71	0	0.49	0	3.69	0	5.39	0	60.24
1953	5.92	0	2.56	0	11.44	0	6.53	0	4.31	0	1.65	0	3.86	0	2.31	0	1.80	0	4.17	0	2.89	0	5.15	0	52.59
1954	1.76	0	2.28	0	4.25	0	3.62	0	4.24	0	1.27	0	1.18	0	8.45	0	8.12	0	1.64	0	7.26	1	4.69	0	48.76
1955	0.44	0	3.79	0	M	31	4.26	0	1.57	0	3.42	0	4.10	0	13.13	0	3.16	0	13.85	0	6.87	0	0.49	0	M
1956	2.55	0	M	29	4.54	0	4.63	0	3.07	0	3.19	0	5.67	0	1.71	0	4.51	0	6.07	0	3.29	0	4.66	0	M
1957	2.02	1	2.40	0	3.43	0	4.79	0	2.97	0	1.29	0	2.92	0	3.52	0	3.50	0	3.99	0	6.07	0	7.34	0	44.24
1958	8.05	0	4.85	0	4.64	0	8.08	0	5.45	0	2.61	0	3.37	1	5.24	0	M	3	5.83	0	3.61	0	1.31	0	M
1959	2.71	0	2.30	0	5.40	0	2.97	0	1.73	0	5.39	0	2.20	0	3.87	0	2.16	0	6.99	0	5.44	0	6.02	0	47.18
1960	3.16	0	5.01	0	4.16	0	2.81	0	3.53	0	1.19	0	7.38	0	4.02	0	6.53	0	2.77	0	2.90	0	3.84	0	47.30
1961	3.52	0	5.93	1	3.46	0	7.86	0	3.91	1	2.78	0	3.91	0	5.71	0	2.35	0	2.49	0	3.76	0	4.02	0	M
1962	2.95	0	5.75	0	3.64	0	3.26	0	1.18	0	4.86	0	2.36	0	7.43	0	4.07	0	4.28	0	5.89	0	2.96	0	48.63
1963	3.42	0	2.91	0	4.21	0	2.23	0	2.77	0	2.21	0	3.85	0	1.32	0	4.28	0	0.19	0	8.45	0	1.99	0	37.83
1964	4.86	0	3.23	0	2.53	0	5.62	0	1.80	0	2.73	0	5.04	0	0.52	0	1.37	0	1.53	0	1.69	0	4.86	0	35.78
1965	3.50	0	3.53	0	2.27	0	2.89	0	1.55	0	0.97	0	4.26	0	3.00	0	2.06	0	2.52	0	2.09	0	2.52	0	31.16
1966	3.22	0	4.76	0	1.86	0	3.04	0	4.14	0	1.36	0	1.48	0	1.46	0	7.04	0	4.54	0	2.93	0	3.98	0	39.81
1967	2.39	0	3.13	0	7.67	0	3.16	0	4.65	0	2.54	0	4.86	0	4.66	0	1.49	0	3.83	0	3.42	0	8.23	0	50.03
1968	1.82	0	1.23	0	4.88	0	3.20	0	7.08	0	5.70	0	0.57	0	3.57	0	3.44	0	2.00	0	5.49	0	5.58	0	44.56
1969	1.78	0	3.70	0	3.86	0	5.16	0	2.73	0	4.52	0	7.31	0	2.97	0	4.34	0	1.67	0	4.72	0	6.63	0	49.39
1970	0.53	0	4.81	0	3.32	0	1.17	1	2.72	0	3.10	0	2.90	0	2.33	0	1.69	0	2.11	0	4.57	0	3.03	0	32.28
1971	2.49	0	5.32	0	4.24	0	2.51	0	3.51	0	0.75	0	5.39	0	7.35	0	7.71	0	3.83	0	4.49	0	2.08	0	49.67
1972	1.57	0	5.21	0	5.00	0	3.84	0	7.44	0	14.29	0	3.62	0	1.57	0	1.48	0	4.86	0	9.24	0	5.55	0	63.67
1973	4.85	0	3.90	0	3.14	0	8.08	0	5.56	0	4.74	0	5.42	0	2.06	0	2.60	0	2.67	0	2.15	0	9.38	0	54.55
1974	4.46	0	1.99	0	5.70	0	4.05	0	4.74	0	2.69	0	1.07	0	3.76	0	11.07	0	2.50	0	2.74	0	5.57	0	50.34
1975	5.01	0	3.26	0	4.01	0	3.19	0	3.00	0	5.38	0	7.26	0	2.53	0	12.84	0	5.10	0	4.16	0	4.52	0	60.26
1976	5.94	0	3.37	0	2.63	0	3.59	0	4.96	0	6.39	0	2.55	0	6.96	0	2.87	0	5.68	0	0.26	0	2.52	0	47.72
1977	2.27	0	3.81	0	7.75	0	4.72	0	1.73	0	4.79	0	1.63	1	4.37	0	7.74	0	5.68	0	8.89	0	5.13	0	58.51
1978	8.17	0	2.07	0	4.59	0	2.19	0	8.18	0	1.69	0	4.51	0	5.32	0	2.52	0	1.98	0	4.66	0	4.98	0	50.86
1979	11.17	0	4.76	0	4.47	0	5.12	0	4.70	0	1.07	0	1.20	0	4.55	0	5.73	0	4.30	0	4.62	0	3.42	0	55.11
1980	2.01	0	1.12	0	11.34	0	7.46	0	2.93	0	4.47	0	4.57	0	1.10	0	1.91	0	3.84	0	4.55	0	0.56	0	45.86
1981	1.19	0	7.25	0	0.94	0	3.59	0	5.02	0	2.19	0	4.22	0	0.74	0	5.22	0	4.82	0	2.78	0	4.84	0	42.80
1982	6.08	0	2.58	0	M	13	6.72	0	2.55	0	6.85	0	3.39	0	2.54	0	2.13	0	1.91	0	4.24	0	1.18	0	M
1983	7.60	0	3.50	1	11.10	0	12.11	0	4.35	0	2.40	0	1.84	0	3.54	0	2.07	0	10.20	0	5.35	0	10.09	0	74.15
1984	2.35	0	4.16	0	6.77	0	8.37	0	11.22	0	5.14	0	8.83	0	1.43	0	1.86	0	4.58	0	3.31	0	3.27	0	61.29
1985	1.34	0	2.84	0	1.93	0	0.96	0	4.88	0	4.39	0	3.34	0	5.37	0	M	21	1.43	0	8.95	0	2.50	0	M
1986	5.51	0	4.06	0	2.36	0	3.17	0	0.48	0	3.99	0	3.63	0	4.61	0	1.15	0	1.79	0	5.45	0	6.41	0	42.61
1987	5.43	0	0.45	0	5.31	0	6.11	0	1.59	0	3.25	0	2.56	0	6.10	0	5.14	0	3.63	0	3.58	0	2.62	0	45.77
1988	4.07	0	3.96	0	2.26	1	1.75	0	4.90	0	0.64	0	5.36	0	2.14	0	3.87	0	2.39	0	6.68	0	1.00	0	39.02
1989	3.63	0	3.39	0	4.84	0	3.30	0	13.20	0	4.32	0	2.50	0	5.40	0	4.23	0	9.81	0	3.13	0	1.12	0	58.87
1990	3.88	0	2.81	0	4.29	0	5.79	0	6.46	0	3.15	0	1.46	0	10.46	0	1.23	0	7.15	0	4.17	1	6.86	0	57.71
Mean	3.53		3.19		4.24		4.40		4.27		3.84		3.87		4.10		4.39		4.09		4.18		4.25		49.77
Max	11.17 1979		7.25 1981		11.44 1953		12.78 2007		13.20 1989		14.29 1972		8.83 1984		13.97 2011		12.84 1975		15.66 2005		9.24 1972		10.09 1983		74.15 1983
Min	0.44 1955		0.32 2009		0.49 2009		0.96 1985		0.48 1986		0.06 1949		0.44 1999		0.37 1995		0.60 2009		0.19 1963		0.26 1976		0.49 1955		27.10 2009

Appendix B

Year	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec		Annual
1991	4.74	0	2.27	0	4.89	0	3.63	0	3.51	0	1.86	0	3.07	0	7.57	0	3.99	0	1.99	0	2.87	0	4.43	0	44.82
1992	1.59	0	1.80	0	3.99	0	2.11	0	4.20	0	6.21	0	4.17	0	5.03	0	6.15	0	1.83	0	6.47	0	6.03	0	49.58
1993	3.40	0	3.86	0	5.27	0	4.45	0	0.48	1	2.45	0	1.61	0	2.87	1	4.92	0	3.84	0	1.96	0	4.52	1	M
1994	2.99	1	3.35	0	5.84	1	2.35	1	3.41	0	1.74	0	5.50	0	4.49	0	2.19	0	0.85	0	5.12	0	M	31	M
1995	4.17	0	2.21	0	1.24	0	2.18	0	2.34	0	M	30	4.50	0	0.37	0	5.93	0	8.27	0	4.33	1	2.99	0	M
1996	4.28	0	1.48	0	4.61	0	7.64	0	3.39	0	4.72	0	6.11	0	2.26	0	8.42	0	8.12	0	3.29	0	7.51	0	61.83
1997	4.90	0	2.54	0	4.08	0	4.25	0	4.09	0	4.85	0	M	2	4.18	1	2.77	0	2.21	0	5.88	0	4.42	0	M
1998	4.84	0	4.47	0	5.64	0	4.73	0	5.56	0	5.53	0	2.04	0	2.30	0	2.11	0	3.23	0	2.04	0	1.32	0	43.81
1999	5.97	0	3.84	0	6.04	0	1.67	0	4.53	0	1.35	0	0.44	0	3.35	0	10.29	0	3.18	0	2.42	0	3.93	0	47.01
2000	3.26	0	1.46	0	4.06	0	3.69	0	4.19	0	4.28	0	6.61	0	4.32	0	6.02	0	0.64	0	4.88	0	4.48	0	47.89
2001	3.20	0	1.77	1	6.28	0	1.81	0	2.71	0	6.13	0	3.05	0	5.75	0	5.19	0	0.93	0	1.23	0	2.51	0	40.56
2002	1.91	0	1.02	0	4.74	0	4.41	0	6.27	0	6.82	0	1.19	0	5.01	0	7.16	0	5.91	0	5.46	0	3.68	0	53.58
2003	2.12	0	2.71	0	3.97	0	3.04	0	4.57	0	8.16	0	1.89	0	5.09	0	7.25	0	4.36	0	4.16	0	5.50	0	52.82
2004	1.83	0	2.62	0	3.88	0	5.97	0	4.50	0	4.65	0	7.09	0	3.70	0	12.56	0	1.36	0	3.87	0	3.87	0	55.90
2005	4.09	0	2.94	0	3.67	0	5.06	0	1.36	0	4.65	0	4.79	0	1.98	0	1.62	1	15.66	0	4.47	0	5.29	0	55.58
2006	4.57	0	1.81	0	0.64	0	6.46	0	5.95	0	6.19	0	4.46	0	6.18	0	4.69	0	7.90	0	6.72	0	2.53	0	58.10
2007	4.00	0	1.44	0	5.90	0	12.78	0	1.20	0	5.16	0	3.25	0	1.58	1	2.46	0	5.38	0	2.24	0	4.87	0	50.26
2008	2.02	0	6.51	0	4.17	0	2.60	0	3.55	0	4.65	0	3.15	0	3.05	0	6.72	0	2.43	0	2.01	0	3.67	0	44.53
2009	1.06	0	0.32	0	0.49	0	2.06	0	2.55	0	6.40	0	1.63	0	4.64	0	0.60	0	2.42	0	0.61	0	4.32	0	27.10
2010	1.03	0	0.74	0	2.77	1	M	7	2.66	0	2.35	0	3.42	0	4.17	0	4.41	0	4.70	0	2.75	0	3.54	0	M
2011	2.17	0	3.73	0	7.40	0	7.10	0	6.73	0	5.95	0	2.59	0	13.97	1	11.38	0	4.90	0	2.99	0	4.38	0	73.29
2012	2.86	0	1.38	1	1.00	0	2.93	0	5.64	0	3.93	0	1.64	1	2.68	0	6.06	0	4.61	0	1.01	0	4.99	0	M
2013	2.59	0	1.90	1	1.58	0	1.28	0	4.92	0	8.19	0	5.98	0	2.98	0	1.38	0	0.86	0	4.52	0	3.36	0	39.54
2014	2.35	0	3.41	0	3.70	0	6.45	0	3.44	0	3.65	1	6.39	1	2.25	0	M	2	5.31	0	4.29	0	5.70	1	M
2015	4.02	0	1.51	0	4.10	0	3.14	0	3.86	0	4.64	1	4.06	1	2.25	0	4.99	0	4.07	0	2.87	0	4.81	0	M
2016	1.99	0	5.00	0	1.24	0	3.39	0	2.94	0	2.41	1	6.59	1	1.14	0	1.76	0	3.47	1	4.74	0	2.72	0	M
2017	3.08	0	1.52	0	3.75	0	3.95	0	M	2	2.75	0	3.48	0	2.64	0	2.19	0	4.99	0	M	2	1.45	1	M
2018	1.46	0	5.35	0	2.55	0	4.94	0	3.32	0	3.53	0	4.21	0	7.93	0	9.11	0	4.50	0	6.16	0	6.43	0	59.49
2019	4.42	0	2.54	0	2.83	0	4.76	0	6.94	0	2.77	0	7.56	0	2.71	1	0.72	0	8.28	0	1.96	0	5.70	0	51.19
2020	2.01	0	2.45	0	3.04	0	5.22	0	1.93	0	1.81	0	5.68	1	3.30	0	3.49	0	4.15	0	4.45	0	M	2	M
2021	1.62	0	M	4	2.56	1	2.97	0	4.96	0	3.98	0	M	6	4.54	1	8.54	0	5.99	0	1.11	0	1.11	0	M
2022	2.60	1	2.58	0	2.09	0	5.91	0	3.40	0	3.72	0	3.50	0	1.03	1	4.46	0	M	12	M	30	M	31	M
Mean	3.53		3.19		4.24		4.40		4.27		3.84		3.87		4.10		4.39		4.09		4.18		4.25		49.77
Max	11.17 1979		7.25 1981		11.44 1953		12.78 2007		13.20 1989		14.29 1972		8.83 1984		13.97 2011		12.84 1975		15.66 2005		9.24 1972		10.09 1983		74.15 1983
Min	0.44 1955		0.32 2009		0.49 2009		0.96 1985		0.48 1986		0.06 1949		0.44 1999		0.37 1995		0.60 2009		0.19 1963		0.26 1976		0.49 1955		27.10 2009

Annual Total Nitrogen Loading Rate (lb/yr)						
Subwatershed	Commercial	Industrial	Open Water	Parks	Residential	Roadways
Arthur Manor	84.3	23.1	0.3	5.1	1,262.6	1,714.5
Chester Heights Park	330.8	-	10.9	76.8	1,512.1	2,553.8
Lake Innisfree	736.6	11.8	390.1	117.3	1,482.6	2,366.6
Pelham Lake	414.9	13.7	39.2	63.6	2,098.3	3,252.9
Reservoir Three	666.1	-	137.9	113.4	1,956.0	3,337.0
Reservoir Two	75.4	-	62.2	108.1	372.5	991.5
Scarsdale Park	52.8	-	-	8.9	1,287.7	1,791.1
Secor Lane	166.3	-	0.0	13.4	2,088.3	3,030.5
Sprague Terminal Canal	1,752.1	2,897.3	62.0	61.7	2,148.0	4,421.3
Twin Lakes Park	91.4	-	8.0	107.3	1,341.1	1,936.4
Vernon Park	665.1	692.3	9.1	26.8	2,453.6	3,760.6
Wolfs Lane Park	397.9	65.2	28.7	14.0	1,320.8	1,996.8

Annual Total Phosphorus Loading Rate (lb/yr)						
Subwatershed	**Commercia**	**Industrial**	**Open Water**	**Parks**	**Residential**	**Roadways**
Arthur Manor	8.4	3.7	0.0	0.7	229.6	285.8
Chester Heights Park	33.1	-	0.6	10.8	274.9	425.6
Lake Innisfree	73.7	1.9	21.3	16.4	269.6	394.4
Pelham Lake	41.5	2.2	2.1	8.9	381.5	542.1
Reservoir Three	66.6	-	7.5	15.9	355.6	556.2
Reservoir Two	7.5	-	3.4	15.1	67.7	165.3
Scarsdale Park	5.3	-	-	1.2	234.1	298.5
Secor Lane	16.6	-	0.0	1.9	379.7	505.1
Sprague Terminal Canal	175.2	463.6	3.4	8.6	390.5	736.9
Twin Lakes Park	9.1	-	0.4	15.0	243.8	322.7
Vernon Park	66.5	110.8	0.5	3.7	446.1	626.8
Wolfs Lane Park	39.8	10.4	1.6	2.0	240.1	332.8

Annual Total Suspended Solids Loading Rates (lb/yr)						
Subwatershed	Commercial	Industrial	Open Water	Parks	Residential	Roadways
Arthur Manor	3,161.8	1,107.6	7.3	462.7	57,391.7	85,725.6
Chester Heights Park	12,405.5	-	238.1	6,916.4	68,730.5	127,690.8
Lake Innisfree	27,621.6	568.0	8,502.4	10,560.7	67,390.3	118,327.9
Pelham Lake	15,557.5	658.7	855.5	5,720.8	95,378.0	162,644.3
Reservoir Three	24,980.4	-	3,005.0	10,202.2	88,910.1	166,852.4
Reservoir Two	2,827.1	-	1,355.0	9,727.6	16,932.4	49,575.5
Scarsdale Park	1,979.2	-	-	797.6	58,532.3	89,556.8
Secor Lane	6,236.0	-	0.0	1,209.1	94,920.9	151,524.0
Sprague Terminal Canal	65,703.2	139,071.3	1,351.6	5,552.1	97,635.5	221,064.6
Twin Lakes Park	3,425.9	-	175.4	9,659.8	60,958.5	96,818.4
Vernon Park	24,941.7	33,231.1	198.8	2,410.0	111,526.1	188,030.3
Wolfs Lane Park	14,920.2	3,130.8	625.5	1,257.1	60,035.1	99,841.6

Annual Bacteria Loading Rate (billion/yr)						
Subwatershed	**Commercial**	**Industrial**	**Open Water**	**Parks**	**Residential**	**Roadways**
Arthur Manor	3,842.7	841.3	-	61.7	52,312.8	52,092.9
Chester Heights Park	15,076.9	-	-	922.2	62,648.1	77,593.8
Lake Innisfree	33,569.6	431.5	-	1,408.1	61,426.5	71,904.3
Pelham Lake	18,907.6	500.4	-	762.8	86,937.5	98,834.0
Reservoir Three	30,359.7	-	-	1,360.3	81,042.0	101,391.1
Reservoir Two	3,435.9	-	-	1,297.0	15,433.9	30,125.5
Scarsdale Park	2,405.4	-	-	106.4	53,352.5	54,421.0
Secor Lane	7,578.9	-	-	161.2	86,520.8	92,076.5
Sprague Terminal Canal	79,851.7	105,636.7	-	740.3	88,995.2	134,334.2
Twin Lakes Park	4,163.7	-	-	1,288.0	55,564.0	58,833.6
Vernon Park	30,312.6	25,241.9	-	321.3	101,656.6	114,260.3
Wolfs Lane Park	18,133.1	2,378.1	-	167.6	54,722.2	60,670.7

Baseline Conditions Assessment Data Sources

Index	Type	Name	Description	Author	Source (agency)	Unit	Quality	Representativeness of data (number of samples)	Year Created
1	Tabular	Northeast RCC Climod 2	Precipitation Data	NOAA Regional Climate Center	Cornell University	Inches	Accredited weather data	Daily data	2022
2	Tabular	Bacteria Monitoring Data	Fecal bacteria data	Save the Sound	Save the Sound	MPN/100 mL	Samples taken yearly since 2019	Weekly samples	2022
3	Existing report	2021 Westchester County Hazard Mitigation Plan	Hazard Mitigation Plan	Westchester County	Westchester County Office of Emergency Management	N/A	Government report	N/A	2021
4	Existing report	Pelham Lake Rehabilitation - Sediment Loading Analysis	Watershed Assessment	Jacobs Civil Consultants Inc.	Westchester County Department of Public Works and Transportation	N/A	Most recent/<10 yrs	N/A	2020
5	Existing report	2022 Westchester County MS4 Report	MS4 Report	Westchester County	Westchester County	N/A	Government report	N/A	2022
6	Existing report	2021 New Rochelle MS4 Report	MS4 Report	City of New Rochelle	City of New Rochelle	N/A	Government report	N/A	2021
7	Existing report	2021 Eastchester MS4 Report	MS4 Report	Town of Eastchester	Town of Eastchester	N/A	Government report	N/A	2021
8	Existing report	2021 Pelham Manor MS4 Report	MS4 Report	Village of Pelham Manor	Village of Pelham Manor	N/A	Government report	N/A	2021
9	Existing report	2021 Scarsdale MS4 Report	MS4 Report	Village of Scarsdale	Village of Scarsdale	N/A	Government report	N/A	2021
10	Existing report	USACE Eastchester Creek Maintenance Fact Sheet	Website/Fact Sheet	USACE, New York Division	United States Army Corps of Engineers	N/A	Government report	N/A	2022
11	Existing report	National Dam Safety Program. New Rochelle Reservoir Number 1 Dam (Inventory Number NY 20), Hutchinson River Basin, Westchester County, New York. Phase I Inspection Report.	Dam inspection report	Koch, George	New York State Dept of Environmental Conservation	N/A	Government report	N/A	1979
12	Existing report	National Dam Safety Program. New Rochelle Reservoir Number 3 Dam, Hutchinson River Basin, Westchester County, New York. Phase 1 Inspection Report	Dam inspection report	Koch, George	New York State Dept of Environmental Conservation	N/A	Government report	N/A	1979
13	Existing report	Case Number 18. Civ. 5845	Mount Vernon Clean Water Act Court Order	U.S. District Court Southern District of New York	U.S. District Court Southern District of New York	N/A	Government report	N/A	2020
14	Anecdotal	The Historical Aerial Photograph Collection of Westchester County	1925 Aerial Survey	Underwood and Underwood	Westchester County, Department of Planning	Image	Government data	N/A	1925
15	Anecdotal	The Historical Aerial Photograph Collection of Westchester County	1926 Aerial Survey	Airmap Corp. of America	Westchester County, Department of Planning	Image	Government data	N/A	1926
16	Anecdotal	The Historical Aerial Photograph Collection of Westchester County	1940 Aerial Survey	Aero Service Corp.	Westchester County, Department of Planning	Image	Government data	N/A	1940
17	Anecdotal	The Historical Aerial Photograph Collection of Westchester County	1947 Aerial Survey	Fairchild Aerial Surveys, Inc.	Westchester County, Department of Planning	Image	Government data	N/A	1947
18	Anecdotal	The Historical Aerial Photograph Collection of Westchester County	1954 Aerial Survey	Photogrammetic Engineers, Inc.	Westchester County, Department of Planning	Image	Government data	N/A	1954
19	Anecdotal	The Historical Aerial Photograph Collection of Westchester County	1960 Aerial Survey	American Air Surveys, Inc.	Westchester County, Department of Planning	Image	Government data	N/A	1960
20	Anecdotal	The Historical Aerial Photograph Collection of Westchester County	1965 Aerial Survey	N/A	Westchester County, Department of Planning	Image	Government data	N/A	1965

Baseline Conditions Assessment Data Sources

Index	Type	Name	Description	Author	Source (agency)	Unit	Quality	Representativeness of data (number of samples)	Year Created
21	Anecdotal	The Historical Aerial Photograph Collection of Westchester County	1970 Aerial Survey	Raytheon Co.	Westchester County, Department of Planning	Image	Government data	N/A	1970
22	Anecdotal	The Historical Aerial Photograph Collection of Westchester County	1976 Aerial Survey	Aerial Data Reduction Services, Inc.	Westchester County, Department of Planning	Image	Government data	N/A	1976
23	Anecdotal	The Historical Aerial Photograph Collection of Westchester County	1980 Aerial Survey	Keystone Aerial Surveys, Inc.	Westchester County, Department of Planning	Image	Government data	N/A	1980
24	Anecdotal	The Historical Aerial Photograph Collection of Westchester County	1986 Aerial Survey	Keystone Aerial Surveys, Inc.	Westchester County, Department of Planning	Image	Government data	N/A	1986
25	Anecdotal	The Historical Aerial Photograph Collection of Westchester County	1990 Aerial Survey	Keystone Aerial Surveys, Inc.	Westchester County, Department of Planning	Image	Government data	N/A	1990
26	Anecdotal	The Historical Aerial Photograph Collection of Westchester County	1995 Aerial Survey	Photo Science, Inc.	Westchester County, Department of Planning	Image	Government data	N/A	1995
27	Anecdotal	THE WEEK, The Iron Age, Oct. 10, 1895, p. 745	Historical Record	Williams, David	Historic Pelham Blog	N/A	Curated by official town historian	N/A	1895
28	Anecdotal	The Place Names of Westchester County, New York	Book, history	Lederer Jr., Richard M.	N/A	N/A	Historical resource	N/A	1978
29	Anecdotal	Surficial Geologic Map of New York	Bedrock depth map	Caldwell, Donald H.	New York State Museum	Meters	Government resource	N/A	1989
30	Anecdotal	First Alewife Spotted on the Hutchinson River Since the 19th Century	Article	Long Island Sound Study	Long Island Sound Study	N/A	Government resource	N/A	2020
31	Anecdotal	Pelham Bay Park - Salt Marshes in New York City Parks	Article	NYC Parks	New York City Department of Parks & Recreation	N/A	Government resource	N/A	Past 10 yrs
32	Anecdotal	Hutchinson River Parkway	Article	NYC Parks	New York City Department of Parks & Recreation	N/A	Government resource	N/A	Past 10 yrs
33	Anecdotal	Tribal History	Article- tribal history	Tribal Council of the Siwanoy Nation	Tribal Council of the Siwanoy Nation	N/A	Tribal resource	N/A	Past 10 yrs
34	Anecdotal	Our History	History exhibit	Davis, Barbara; Kump-Leghorn, Theresa	City of New Rochelle	N/A	Government resource	N/A	2013
35	Anecdotal	Local History- Interesting Facts, Famous Names & Places	Website- town history	Town of Eastchester	Town of Eastchester	N/A	Government resource	N/A	Past 10 yrs
36	Anecdotal	Historic NY Funding to Tackle Mount Vernon Sewage Crisis	Article	Rao, Sahana	NRDC	N/A	Government resource	N/A	2022
37	Anecdotal	New York iMapInvasives	Public invasive species map	New York Natural Heritage Program	New York Natural Heritage Program	Points	Government resource	N/A	2022
38	Anecdotal	Information for Planning and Consultation (IPaC)	Endangered Species map	USFWS	U.S. Fish and Wildlife Service	N/A	Government resource	N/A	2022
39	GIS	Hydric Soils	Hydrologic Soil Groups	Westchester County	Westchester County GIS	Type/%/Acres	Government data	spatial data	2020
40	GIS	Municipal Boundaries	Municipal Boundaries	Westchester County	Westchester County GIS	Polygons	Government data	spatial data	2019
41	GIS	Septic Pump Out 2021	Septic Systems	Westchester County	Westchester County GIS	Points	Government data	spatial data	2022
42	GIS	Combined Sewer Overflows (CSOs): Beginning 2013	CSO Overflows since 2013	New York State Department of Environmental Conservation	State of New York	Points	Government data	spatial data	2020

Baseline Conditions Assessment Data Sources									
Index	Type	Name	Description	Author	Source (agency)	Unit	Quality	Representativeness of data (number of samples)	Year Created
43	GIS	Wetlands Mapper (National Wetlands Inventory)	Wetlands	USFWS	U.S. Fish and Wildlife Service	Polygons	Government data	spatial data	2021
44	GIS	Municipal Sewer Mains	Sewer Infrastructure	Westchester County	Westchester County GIS	Lines	Government data	spatial data	2019
45	GIS	Westchester County Storm Pipes	Stormwater Infrastructure	Dolph Rotfeld Engineering and Stellar Services	Westchester County GIS	Lines	Government data	spatial data	2020
46	GIS	Westchester County MS4 Drainage Structure	Stormwater Infrastructure	Dolph Rotfeld Engineering and Stellar Services	Westchester County GIS	Points	Government data	spatial data	2020
47	GIS	Web Soil Survey	Soils	Natural Cooperative Soil Survey	USDA- Natural Resources Conservation Service	Polygons	Government data	spatial data	2019
48	GIS	Westchester County Tax Parcel Centroid Points	Tax Parcels w/ owner info	NYS GIS	New York State GIS	Points	Government data	spatial data	2022
49	GIS	Tax Parcels	Tax Parcels	Westchester County	Westchester County, Department of Planning	Polygons	Government data	spatial data	2022
50	GIS	Westchester County Planimetrics Data	Impervious Cover	Westchester County	Westchester County GIS	Polygons	Government data	spatial data	2022
51	GIS	Contours	2 foot contours	Westchester County GIS	Westchester County GIS	Elevation (ft or meters)	Government data	spatial data	2004
52	GIS	Land Use	Land Use	Westchester County GIS	Westchester County GIS	Type/Acres	Government data	spatial data	2022
53	GIS	NYS 12 Digit HUC Watershed	Watershed Boundaries	NYS DEC	New York State Department of Enviromental Conservation	Polygons	Government data	spatial data	2019
54	GIS	National Flood Hazard Layer	Flood Hazard Maps	FEMA	FEMA	Polygons	Government data	spatial data	2007
55	GIS	NLCD 2016 USFS Tree Canopy Cover (CONUS)	Tree Canopy	U.S. Forest Service	Multi-Resolution Land Characteristics Consortium (MRCC)	30 m Raster	Accredited data	spatial data	2016
56	GIS	Total Nitrogen	Watershed Treatment Model for Total Nitrogen	Caraco, Deb (Center for Watershed Protection)	Center for Watershed Protection	mg/L	Reputable source	spatial data	2009
57	GIS	Total Phosphorus	Watershed Treatment Model for Total Phosphorus	Caraco, Deb (Center for Watershed Protection)	Center for Watershed Protection	mg/L	Reputable source	spatial data	2009
58	GIS	Fecal Indicator Bacteria	Watershed Treatment Model for Bacteria	Caraco, Deb (Center for Watershed Protection)	Center for Watershed Protection	CFU	Reputable source	spatial data	2009
59	GIS	Buildings	Building parcels	Westchester County	Westchester County GIS	Polygons	Government data	spatial data	2020

Hutchinson River Watershed Comparative Subwatershed Analysis Results

Subwatershed	Total Area (acres)	Tree Canopy (acres)	Tree Canopy (%)	Tree Canopy Score	Detached Residential Land (acres)	Detached Residential Land (%)	Detached Residential Land Score	Public Parcels (acres)	Public Parcels %	Public Parcel Score	Institutional Land (acres)	Institutional Land (%)	Institutional Land Score	Pervious Stream Corridor (acres)	Total Stream Corridor (acres)	Pervious Stream Corridor (%)	Pervious Stream Corridor Score	RESTORATION POTENTIAL
Arthur Manor	283.7	113.4	40%	5.0	153.0	54%	10.0	17.6	6%	2.5	10.8	4%	10.0	1.9	14.3	13%	10.0	45.0
Chester Heights Park	441.5	150.9	34%	7.5	179.2	41%	7.5	36.1	8%	5.0	40.1	9%	10.0	7.2	16.9	2%	5.0	40.0
Lake Innisfree	586.1	176.1	30%	10.0	185.3	32%	5.0	130.6	22%	7.5	31.9	5%	10.0	4.0	26.2	1%	5.0	40.0
Pelham Lake	519.2	175.9	34%	7.5	183.8	35%	5.0	148.3	29%	10.0	9.0	2%	5.0	8.5	29.1	2%	5.0	40.0
Reservoir Three	585.0	220.2	38%	5.0	199.9	34%	5.0	155.7	27%	10.0	16.9	3%	7.5	15.7	25.1	3%	10.0	42.5
Reservoir Two	214.6	98.3	46%	2.5	38.7	18%	2.5	93.6	44%	10.0	2.4	1%	2.5	4.0	11.5	2%	7.5	27.5
Scarsdale Park	297.6	143.1	48%	2.5	159.0	53%	10.0	13.1	4%	2.5	5.5	2%	7.5	6.0	20.5	2%	7.5	35.0
Secor Lane	445.8	191.6	43%	5.0	216.6	49%	10.0	33.5	8%	2.5	10.3	2%	7.5	0.0	0.3	0%	2.5	35.0
Sprague Terminal Canal	692.5	67.7	10%	10.0	117.9	17%	2.5	112.7	16%	7.5	7.8	1%	5.0	1.2	24.8	0%	2.5	37.5
Twin Lakes Park	374.3	200.4	54%	2.5	135.2	36%	7.5	82.3	22%	7.5	0.0	0%	2.5	21.7	27.6	6%	10.0	32.5
Vernon Park	518.3	100.8	19%	10.0	150.6	29%	2.5	50.5	10%	5.0	3.2	1%	2.5	8.9	15.6	2%	7.5	37.5
Wolfs Lane Park	275.6	83.4	30%	7.5	100.4	36%	7.5	25.7	9%	5.0	3.3	1%	5.0	0.7	1.3	0%	2.5	37.5

lower canopy cover = higher restoration potential		**10.00**	**higher detached residential = higher restoration potential**		**10.00**	**higher public land = higher restoration potential**		**10.00**	**higher institutional land = higher potential**		**10.00**	**higher pervious = higher restoration potential**			**10.00**	**60.00**
Quartile	**Break**	**Score**	**Quartile**	**Break**	**Score**	**Quartile**	**Break**	**Score**	**Quartile**	**Break**	**Score**	**Quartile**		**Break**	**Score**	
1	30%	10.0	1	31%	2.5	1	8%	2.5	1	1%	2.5	1		1%	2.5	
2	36%	7.5	2	36%	5.0	2	13%	5.0	2	2%	5.0	2		2%	5.0	
3	44%	5.0	3	43%	7.5	3	23%	7.5	3	3%	7.5	3		2%	7.5	
4	54%	2.5	4	54%	10.0	4	44%	10.0	4	9%	10.0	4		13%	10.0	

Subwatershed	Total Area (acres)	Impervious Area (acres)	Imperviousness (%)	Imperviousness Score	Industrial Land (acres)	Industrial Land (%)	Industrial Land Score	Pollutant Hot Spots (#)	Pollutant Hot Spots (#/acre)	Pollutant Hot Spot Score	POLLUTION POTENTIAL	Buildings in Flood Zone (#)	Buildings in Flood Zone Score	Flood Prone Road Crossings (#)	Flood Prone Road Crossings Score	FLOODING POTENTIAL
Arthur Manor	283.7	115.9	41%	7.5	0.0	0%	2.5	2	0.007	2.5	12.5	92	10.0	2	7.5	17.5
Chester Heights Park	441.5	169.1	38%	5.0	0.0	0%	2.5	9	0.020	7.5	15.0	9	2.5	0	2.5	5.0
Lake Innisfree	586.1	182.1	31%	2.5	0.0	0%	2.5	12	0.020	7.5	12.5	45	5.0	1	2.5	7.5
Pelham Lake	519.2	227.9	44%	7.5	2.2	0%	10.0	10	0.019	5.0	22.5	54	7.5	3	10.0	17.5
Reservoir Three	585.0	235.4	40%	5.0	0.0	0%	2.5	16	0.027	7.5	15.0	101	10.0	1	2.5	12.5
Reservoir Two	214.6	55.7	26%	2.5	0.0	0%	2.5	3	0.014	5.0	10.0	1	2.5	0	2.5	5.0
Scarsdale Park	297.6	116.9	39%	5.0	0.0	0%	2.5	1	0.003	2.5	10.0	37	5.0	1	2.5	7.5
Secor Lane	445.8	201.5	45%	7.5	0.0	0%	2.5	6	0.013	5.0	15.0	77	7.5	2	7.5	15.0
Sprague Terminal Canal	692.5	473.4	68%	10.0	90.5	13%	10.0	189	0.273	10.0	30.0	129	10.0	4	10.0	20.0
Twin Lakes Park	374.3	128.3	34%	2.5	0.0	0%	2.5	4	0.011	2.5	7.5	31	2.5	2	7.5	10.0
Vernon Park	518.3	302.3	58%	10.0	24.3	5%	10.0	92	0.177	10.0	30.0	56	7.5	3	10.0	17.5
Wolfs Lane Park	275.6	149.2	54%	10.0	0.0	0%	2.5	24	0.087	10.0	22.5	42	5.0	1	2.5	7.5

higher imperviousness = higher pollution concern		**10.0**	**more industrial land = higher pollution concern**		**10.00**	**more hotspots = higher pollution concern**		**10.00**	**20.00**	**more buildings in flood plain = higher flood potential**	**10.0**	**more road crossings = higher flood potential**	**10.0**	**20.0**
Quartile	**Break**	**Score**	**Quartile**	**Break**	**Score**	**Quartile**	**Break**	**Score**		**Break**	**Score**	**Break**	**Score**	
1	37%	2.5	1	0%	2.5	1	0.013	2.5		36	2.5	1	2.5	
2	41%	5.0	2	0%	5.0	2	0.020	5.0		50	5.0	2	5.0	
3	47%	7.5	3	0%	7.5	3	0.042	7.5		81	7.5	2	7.5	
4	68%	10.0	4	13%	10.0	4	0.273	10.0		129	10.0	4	10.0	