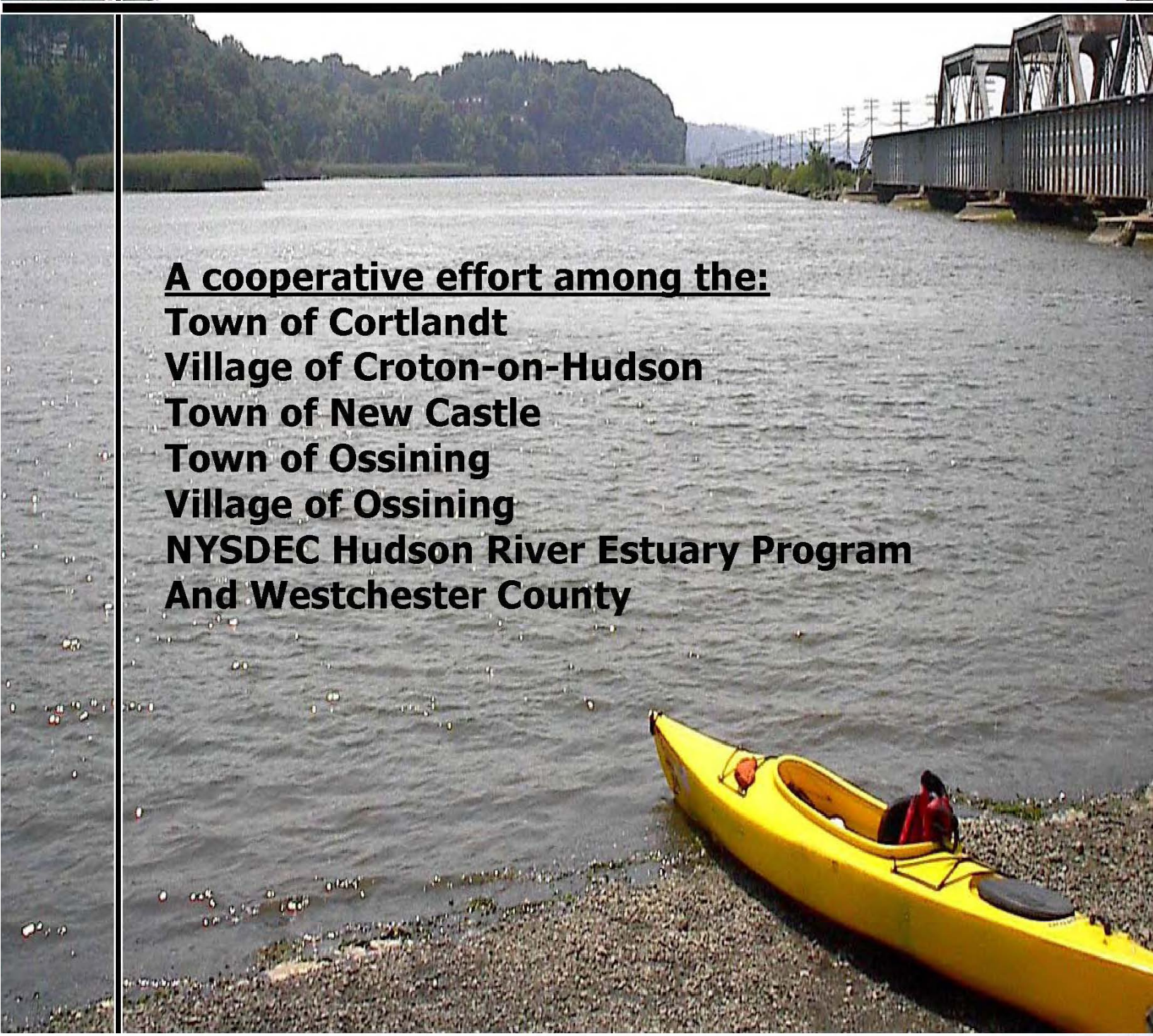
Hudson River Estuary Program

INDIAN BROOK-CROTON GORGE
WATERSHED CONSERVATION ACTION PLAN

Westchester County, New York



A cooperative effort among the:
Town of Cortlandt
Village of Croton-on-Hudson
Town of New Castle
Town of Ossining
Village of Ossining
NYSDEC Hudson River Estuary Program
And Westchester County

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Board of Legislators

WESTCHESTER COUNTY
DEPARTMENT OF PLANNING
Gerard E. Mulligan, AICP, Commissioner

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the New York State Department of Environmental Conservation
Hudson River Estuary Program

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Executive Summary

In the spring of 2003, the Westchester County Department of Planning received a grant from the New York State Department of Environmental Conservation Hudson River Estuary Program to work with the communities in the Croton Bay Watershed, which consists of the Croton Gorge and Indian Brook subwatersheds, to prepare a Watershed Conservation Action Plan. The Indian Brook-Croton Gorge Steering Committee, an inter-municipal committee consisting of representatives from the Towns of Cortlandt, Ossining, and New Castle, the Villages of Ossining and Croton-on-Hudson and Westchester County, was created. The Westchester County Department of Planning provided technical and administrative assistance to the Steering Committee in carrying out its goals related to the creation of the plan.

In order to develop a comprehensive watershed program for the Indian Brook-Croton Gorge Watershed (the watershed), each municipality, municipal representative and Westchester County had to agree to the same goals and objectives for the watershed. At the beginning of the planning process, five major goals for the plan were established relating to:

- Protecting and restoring the natural resources, most significantly the Croton River, Indian Brook Reservoir, existing wetlands and groundwater drinking sources
- Developing and implementing stormwater management practices that will improve water quality
- Promoting sustainable development through land use and environmental regulations
- Preserving and protecting fish, wildlife and significant habitat
- Educating the public

The plan details the existing conditions, or the state of the watershed, which includes information on the physical and natural resources, wildlife and habitat and land uses of the Indian Brook-Croton Gorge Watershed. Through analysis of the state of the watershed, recommendations were developed based on the above goals to improve the current water quality conditions and habitat found throughout the watershed. Implementation of the recommendations will require inter-municipal cooperation and coordination among the watershed municipalities.

Findings

The Plan generated the following major findings:

Setting

- The Indian Brook-Croton Gorge Watershed serves as an important tributary to the Hudson River.

- A total of 33% of the watershed contains steep slopes, with 23% being slopes of 15-25% and 10% being slopes greater than 25%.
- Eleven percent of the soils in the watershed are considered hydric soils, which are formed under conditions of saturation, flooding or ponding for a period long enough to develop anaerobic (low oxygen) conditions. Hydric soils can be indicative of wetlands.
- Approximately 7% (239 acres) of the watershed is wetland. Of the 239 acres, 120 acres are New York State Department of Environmental Conservation (NYSDEC) designated wetlands.
- The Indian Brook-Croton Gorge Watershed consists of 45 acres of waterbodies. The Croton River is the main river system in the watershed, flowing approximately three miles from the New Croton Dam and discharging into the Croton Bay.
- The health of the three-mile section of the Croton River between the New Croton Reservoir and the tidal Hudson River is highly influenced by management of the New Croton Reservoir.
- The Indian Brook Reservoir serves as a drinking water source for the Town and Village of Ossining.
- The Indian Brook-Croton Gorge Watershed contains a highly prolific aquifer that supplies the water source for the Village of Croton-on-Hudson water supply system.
- The Indian Brook-Croton Gorge Watershed has a diversity of plants, animals and habitats, despite a relatively small land area that has significant development.
- The Croton Bay is one of the largest shallow bay areas in the lower Hudson that is sheltered from strong currents and wind. The mouth of the Croton River is documented as a migratory fish hub used as a resting, foraging and nursery area.
- The Croton River is an important biodiversity corridor. It provides an area for wildlife to move through the watershed with minimal barriers resulting from human development. Preserving land and preventing further development along the Croton River corridor may be beneficial to the river ecosystem.

Land Use

- The watershed is almost equally residential (46%) and open space and undeveloped (38%).
- A total of 3.8% of the land in the watershed is already impervious surface.
- Approximately 27% of the watershed can be classified as open space.
- Sixteen percent of the watershed is classified as non-residential.
- Approximately 11% of the watershed consists of parcels that are undeveloped and are considered vacant land. Undeveloped land has not been preserved as open space and is open for development and can be publicly or privately owned.

Recommendations

Recommendations were developed to improve water quality protection in the watershed. The implementation of the recommendations when taken together creates a coordinated, comprehensive approach to protect natural resources within the watershed.

All five watershed municipalities are subject to Phase II regulations administered by New York State through the SPDES Program. The requirements that the municipalities must fulfill in relation to Phase II, combined with the information revealed through the planning process, reveals that each municipality, individually or in partnership, can undertake specific activities to improve and protect water quality in the watershed.

1. Protect and Restore Natural Resources

- Conduct Streamwalks in the Croton Gorge Basin
- Remediate Identified Problem Areas in the Indian Brook Basin
- Protect Indian Brook Reservoir
- Protect Wetlands at the Local Level
- Restore Degraded Wetlands
- Ensure Proper Functioning of Septic Systems
- Monitor the Croton River
- Prevent Illegal Activities that Degrade Water Quality
- Retain Tree Cover
- Maintain and Restore Forested Stream Buffers

2. Develop and Implement Stormwater Management Practices that will Improve Water Quality

- Develop and Adopt Stormwater Infrastructure Data Management Standards
- Establish Illicit Discharge Connection Program
- Develop Stormwater Infrastructure Monitoring and Maintenance Programs
- Develop Snow and Ice Operational Plan
- Participate in Household Hazardous Waste Collection
- Pretreat Stormwater Outfall Discharges and Identify Retrofit Opportunities
- Restore Eroded Streambanks

3. Promote Sustainable Development Through Land Use and Environmental Regulations

- Institute Stormwater Controls for Development

- Establish Impervious Surface Limits and Alternatives
- Establish an Indian Brook Reservoir Overlay Zone
- Develop a Croton Aquifer Overlay Zone
- Update Comprehensive Plans
- Protect Open Space
- Adopt New or Amend Current Ordinances to Reflect Model Environmental Ordinances

4. Preserve and Protect Fish, Wildlife and Significant Habitat

- Prepare a Biodiversity Plan for the Watershed
- Investigate Croton River Flow Fluctuations

5. Educate the Public

- Require Board/Committee Member Stormwater Training
- Develop an Education and Training Program for Highway Personnel
- Develop and Participate in Community Natural Resource Education Programs

Implementation Through Intermunicipal Cooperation

Many municipalities will need to work together in order to implement the above recommendations. Each community supported the grant application that was awarded to the Westchester County Department of Planning (WCDP) to create an intermunicipal agreement (IMA) to coordinate the implementation of select recommendations found within the Plan. The WCDP will be working closely with the municipalities to develop this IMA.

Section 1.0 Introduction

In the spring of 2003, the Westchester County Department of Planning received a grant from the New York State Department of Environmental Conservation Hudson River Estuary Program to work with the communities in the Croton Bay Watershed, which consists of the Croton Gorge and Indian Brook subwatersheds, to prepare a Watershed Conservation Action Plan. The Indian Brook-Croton Gorge Steering Committee, an inter-municipal committee consisting of representatives from the Towns of Cortlandt, Ossining, and New Castle, the Villages of Ossining and Croton-on-Hudson and Westchester County, was created. The Westchester County Department of Planning provided technical and administrative assistance to the Steering Committee in carrying out its goals related to the creation of the plan.

The Indian Brook-Croton Gorge Watershed Conservation Action Plan (the plan) is the first comprehensive watershed program developed along the Hudson River in Westchester County. Prior to the Indian Brook-Croton Gorge Watershed Conservation Action Plan, environmental initiatives along the Hudson River were limited or fragmented and were based on individual community/project needs and resources.

In order to develop a comprehensive watershed program for the Indian Brook-Croton Gorge Watershed (the watershed), each municipality, municipal representative and Westchester County had to agree to the same goals and objectives for the watershed. At the beginning of the planning process, five major goals for the plan were established relating to:

- Protecting and restoring the natural resources, most significantly the Croton River, Indian Brook Reservoir, existing wetlands and groundwater drinking water sources
- Developing and implementing stormwater management practices that will improve water quality
- Promoting sustainable development through land use and environmental regulations

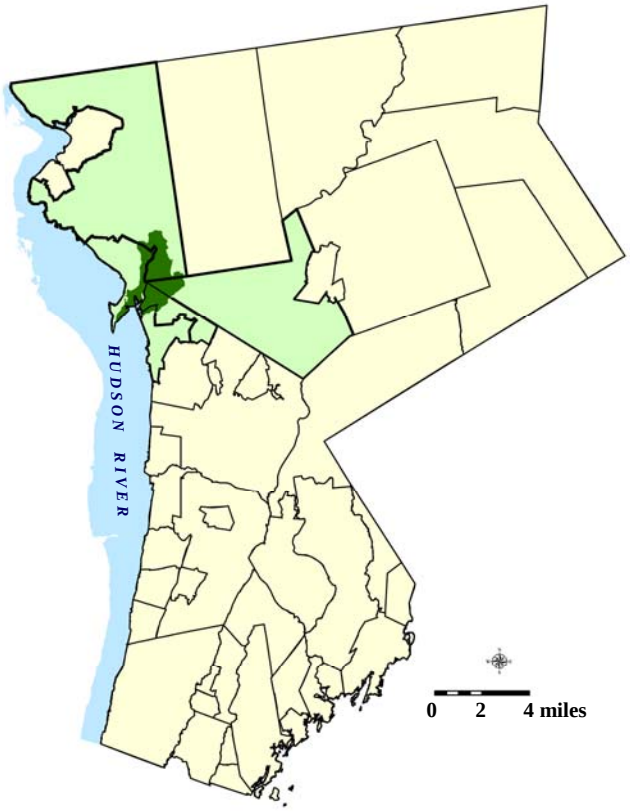


Figure 1-1. Location of Indian Brook-Croton Gorge Watershed in Westchester County

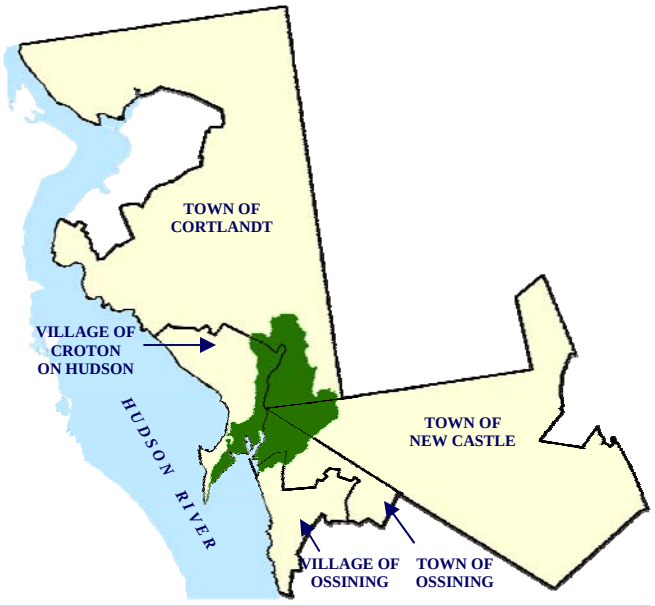


Figure 1-2. Municipalities of the Indian Brook-Croton Gorge Watershed

What is an MS4?

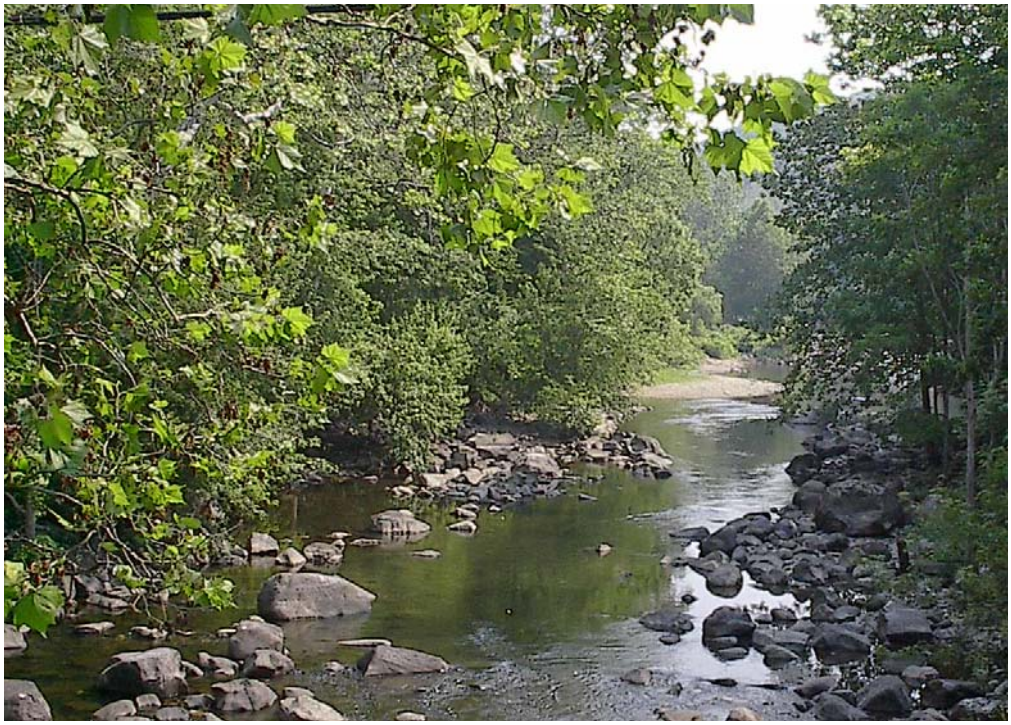
According to 40 CFR 122.26(b)(8), "municipal separate storm sewer system means a conveyance or system of conveyances (including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, man-made channels or storm drains)."

- Preserving and protecting fish, wildlife and significant habitat
- Educating the public

All five watershed municipalities are MS4s and are subject to Phase II Stormwater regulations administered by New York State through the SPDES Program. The requirements that the municipalities must fulfill in relation to Phase II, combined with the information revealed through the planning process, reveals that each municipality, individually or in partnership, can undertake specific activities to improve and protect water quality in the watershed.

The plan details the existing conditions, or the state of the watershed, which includes information on the physical and natural resources, wildlife and habitat and land uses of the watershed. Through analysis of the state of the watershed, recommendations were developed based on the above goals to improve the current water quality conditions and habitat found throughout the watershed. Implementation of the recommendations will require inter-municipal cooperation and coordination among the watershed municipalities.

Figure 1-3. The Croton River, Croton-on-Hudson
The Croton River begins where the East and West Branches of the Croton River meet downstream from the Croton Falls Reservoir. Shortly downstream, the Croton River, along with its tributary, the Muscoot River, flow into the Muscoot Reservoir, and after flowing through that, it empties into the New Croton Reservoir. The water leaves the spillway at the Croton Dam, and finally empties into the Hudson River at Croton-on-Hudson, New York.



Section 2.0 Existing Conditions

The Croton River watershed (Figure 2-1) encompasses the Croton River, its tributaries and 12 reservoirs constructed by New York City. The perimeter of the watershed extends through Putnam County and into Dutchess County on the north, into Fairfield County, Connecticut on the east and to a basin divide line that extends east/west across Westchester County (just north of Chappaqua) on the south. The natural discharge point is to the west where the Croton River flows into the Hudson River at the Village of Croton-on-Hudson.

The study area for Indian Brook-Croton Gorge Watershed Conservation Action Plan, (the plan), is limited to the portion of the Croton River watershed within Westchester County that is downstream of the New Croton Dam. This portion is identified as the Indian Brook-Croton Gorge Watershed and serves as an important tributary to the Hudson River.

2.1 Physical Setting

The Indian Brook-Croton Gorge Watershed, (the watershed), encompasses approximately 3,400 acres (5.3 sq. mi.) within portions of the Towns of Cortlandt (2 sq. mi.), Ossining (0.90 sq. mi.) and New Castle (0.8 sq. mi.), and the Villages of Croton-on-Hudson (1.4 sq. mi.) and Ossining (0.16 sq. mi.). The watershed is made up of two subwatershed areas: Croton Gorge and Indian Brook, see Figure 2-2. The Croton Gorge Subwatershed totals 2,040 acres (3.2 sq. mi.) and is the larger of the two subwatersheds. It lies within of the Towns of Cortlandt, Ossining and New Castle, and the Villages of Ossining and Croton-on-Hudson. The Croton Gorge Subwatershed includes the Croton-on-Hudson drinking water aquifer and the Croton River, which begins at the New Croton Dam and terminates at the Croton Bay. The Indian Brook Subwatershed totals 1,369 acres (2.1 sq. mi.) and lies within the Towns of Cortlandt, Ossining and New Castle and the Village of Ossining. The Indian Brook Subwatershed includes the Indian Brook and the Indian Brook Reservoir, a drinking water source for the Town and Village of Ossining.

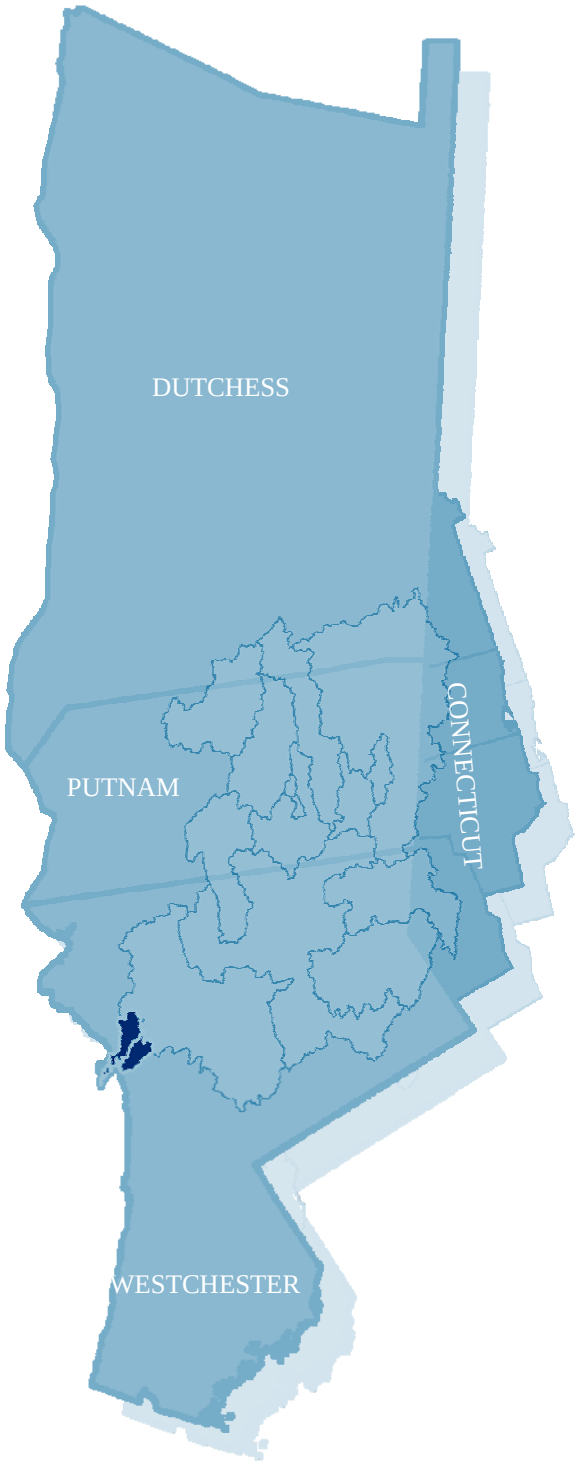
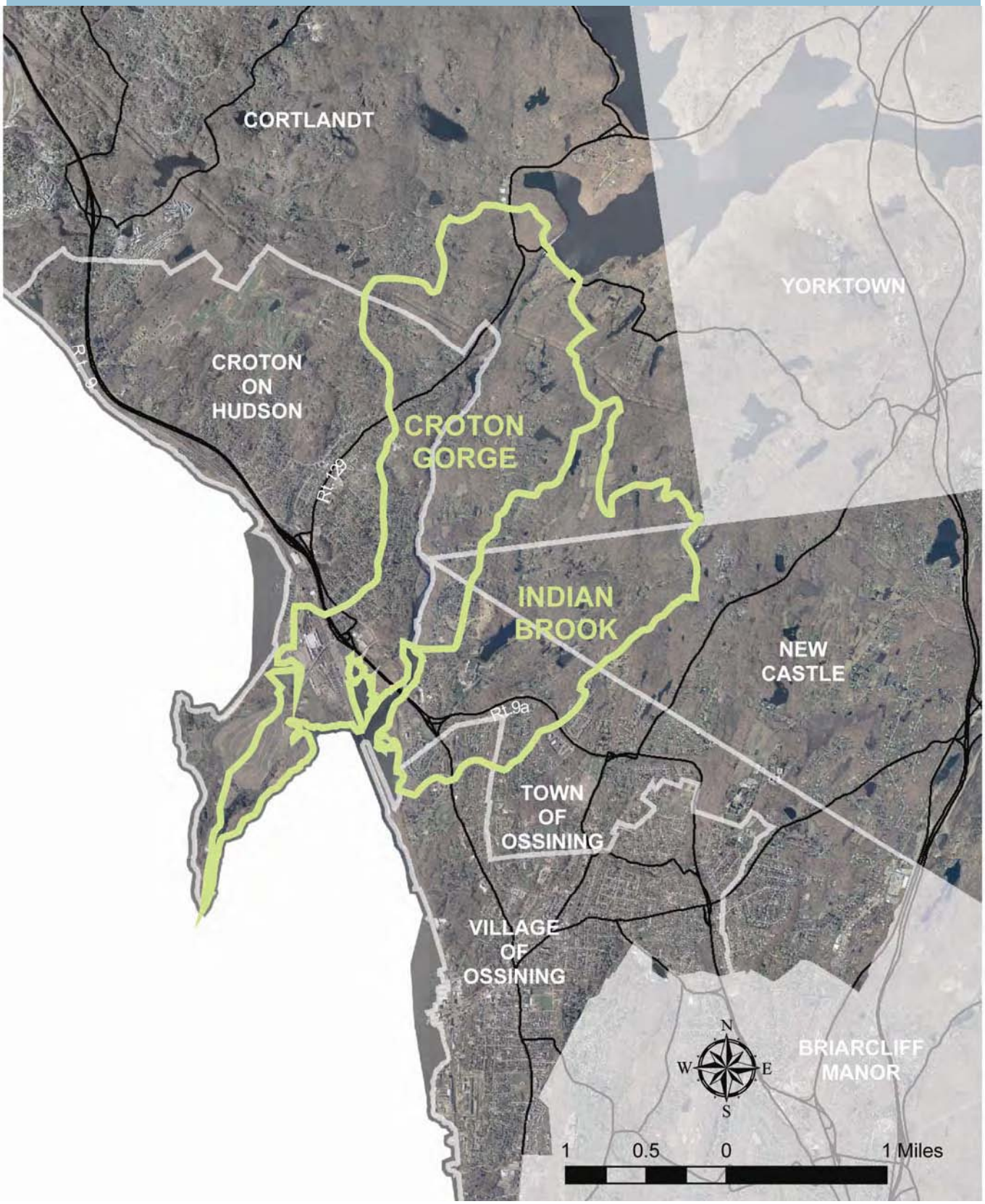


Figure 2-1. Croton River Watershed

Figure 2-2: Aerial photo and municipal boundaries of the Indian Brook-Croton Gorge Watershed



2.2 Bedrock and Surficial Geology

The topography and bedrock of the watershed are the result of complex geologic processes that began more than 1.3 billion years ago. Rocks found in Westchester County record at least three episodes of mountain building and two major periods of volcanic activity (McGuire, 1991). The bedrock found in the watershed is a result of millions of years of continual erosion of the original mountain chains by wind, water and glaciers so that only the base of these mountains now remains. The bedrock primarily consists of metamorphic (altered) rock of both sedimentary (sediments) and igneous (volcanic) origin. Croton Point Park is the only area of the watershed that does not consist of metamorphic rock. Instead, the composition consists of glacial and alluvial (river) deposits left by the most recent ice age and river system erosion.

The surficial geology in Westchester County is a result of glaciers advancing and receding from the area during the last ice age (~ 12,000 years ago) leaving various sized sediments and rocks, known as till, on top of the underlying bedrock. The surficial geology of the watershed consists mainly of glacial deposits including till and lacustrine (lake) silt and clay from proglacial lakes (lakes that existed during the last glacial period). Some areas in the watershed glacial deposits do not exist on the surface and only the underlying bedrock can be found.

The local geology of the watershed has played an important role in the economic development of the area. Inwood marble, which is found throughout Westchester County and in the watershed, was the largest source of quarried marble in the United States until about 1850. Prisoners at the Sing Sing Correctional Facility quarried the marble in the Village of Ossining. The quarry at Sing Sing also uncovered a number of interesting minerals in the marble, including graphite, pyrite, quartz, rutile, calcite, diopside (malacolite), dolomite and tremolite (McGuire, 1991).

Emery, which is a mixture of two minerals, corundum and magnetite, can be found in Cortlandt. It is an extremely hard substance and not very common in the United States. Emery was quarried in Cortlandt and one of the quarries was located near the watershed boundary on Mount Airy Road near the Village of Croton-on-Hudson (McGuire, 1991).

Clay was also excavated extensively at Croton Point Park where at one point in time there were at least five brick making factories. In addition, Croton Point was excavated for its sand and gravel to use in road building and other construction projects (McGuire, 1991).

2.3 Steep Slopes

The Indian Brook-Croton Gorge Watershed is located in the Hudson River Valley and includes the Croton River Valley, thus much of the watershed has steep slopes. Steep slopes develop in river valleys as a result of down cutting from rivers. Steep slopes in the watershed are also the result of glacier advancement and recession.

The definition of a steep slope for the purposes of the Indian Brook-Croton Gorge Watershed Conservation Action Plan includes any slope that is greater than 15% in grade. Figure 2-3 displays steep slopes located in the watershed that are between 15-25% and slopes that are greater than 25%. A total of 33% of the watershed contains steep slopes, with 23% being slopes of 15-25% and 10% being slopes greater than 25%. Unvegetated slopes have greater instability and much higher rates of erosion than vegetated slopes. The root systems of plants help maintain slope stability and reduce the amount of erosion that takes place on steep slopes. Therefore, it is very important to keep steep slopes as natural and as vegetated as possible.

2.4 Soils

Fifty-five soil types exist in the watershed. A majority of the soils found in the watershed were formed from glacial deposits. Most of the soils are loamy, which means that approximately 7-27% of the grain content is clay; 28-50% of the soil is silt and less than 52% of the grain content is sand. The soils found in the watershed are typically deep soils with a depth to bedrock of at least 6 feet and all tend to be acidic. Although the soils have similar parent material, the soils vary in permeability, depth to water table, drainage potential, runoff speed and hydrologic classification. Appendix A: Additional Resources contains a detailed map of the soils in the watershed, descriptions of the soil types, taxonomy and hydrologic classification.

Eleven percent of the soils in the watershed are considered hydric soils, which are formed under conditions of saturation, flooding or ponding for a period long enough to develop anaerobic (low oxygen) conditions. Hydric soils can be indicative of wetlands. Appendix A: Additional Resources also includes information on which soils are considered to be hydric.

2.5 Natural Resources

A. Wetlands

The Indian Brook-Croton Gorge Watershed contains both federal and state regulated tidal and freshwater wetlands. Approximately 7% (239 acres) of the watershed is wetland (refer to Figure 2-7). Of the 239 acres, 120 acres are New York State Department of Environmental Conservation (NYSDEC) designated wetlands, which are wetlands greater than 12.4 acres. NYSDEC recognizes that not all wetlands are of equal quality. In order to establish the different qualities of wetlands, the NYSDEC developed a four class regulatory system that designates a class to every NYSDEC wetland. Class I wetlands are considered to provide the most

Figure 2-3: Steep slopes in the Indian Brook-Croton Gorge Watershed

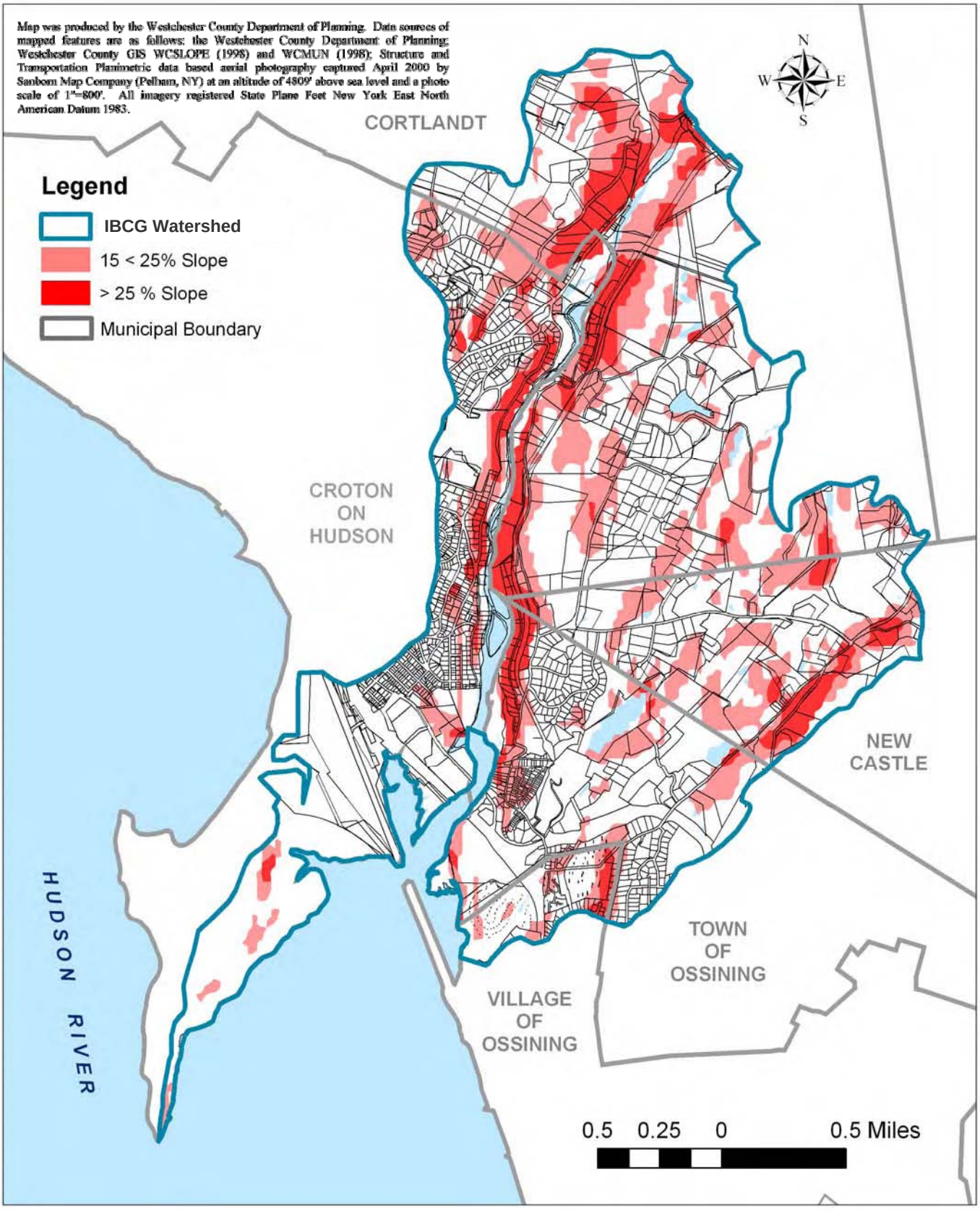


Figure 2-4. Westchester County's Croton Point Park, Croton-on-Hudson, NY

beneficial qualities in terms of ecological association, special features, hydrologic features and pollution control features. Class IV wetlands provide the least. There are 68 acres of Class I, 9 acres of Class II and 44 acres of Class III wetlands. All of the Class I and Class II designated wetlands are located in the tidal portions of the Croton Bay and the Croton River. The Class III wetland is the largest wetland in the watershed, known as the Glendale Wetland, located in the Town of New Castle. This wetland is currently designated as a nature preserve. Refer to Appendix A: Additional Resources for more information on wetlands.

Even though over 50% of the NYSDEC wetlands in the watershed are designated Class I, over the years they have become degraded due to invasive species. An invasive species is a plant that has an aggressive growth pattern that invades habitats and crowds out native species. Invasive species can also destroy biodiversity and wildlife food sources. Most of the tidal wetlands in the watershed are dominated by phragmites, a common reed, considered to be an invasive species. The table in Figure 2-5 lists the primary invasive wetland species found in New York State.

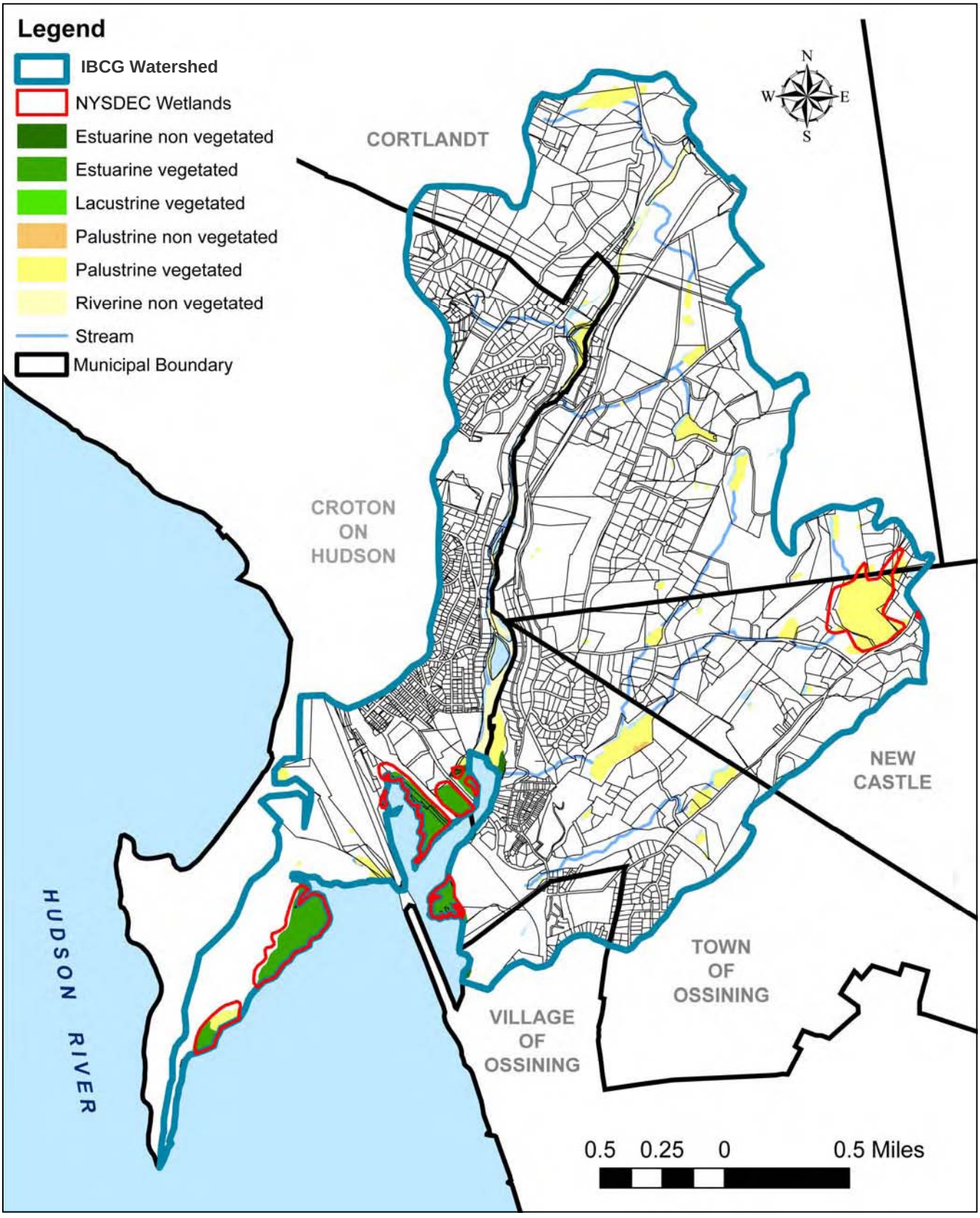
The watershed contains 73 acres of estuarine NWI wetlands, in addition to NYSDEC wetlands, that are located in the brackish tidal portions of the Croton Bay near Croton Point Park and the mouth of the Croton River. There are 128 acres of palustrine (marsh) wetlands that are found throughout the watershed. There are 38 acres of riverine wetlands; all but 2 acres are nonvegetated wetlands. Finally, the watershed contains 0.1 acres of lacustrine (lake) wetlands. Listed in Figure 2-9 are the different United States Army Corps National Wetland Inventory (NWI) wetlands that are found in the watershed.

Common Name	Latin Name
Common buckthorn	Rhamnus cathartica
Smooth buckthorn	Rhamnus frangula
Common reed	Phragmites australis
Curly pondweed	Potamogeton crispus
Eurasian water milfoil	Myriophyllum spicatum
Japanese knotweed	Polygonum cuspidatum
Japanese stilt grass	Microstegium vimineum
Multiflora rose	Rosa multiflora
Porcelain-berry	Ampelopsis brevipedunculata
Purple loosestrife	Lythrum salicaria
Water chestnut	Trapa natans

Figure 2-5. Table of common invasive plants found in New York State wetlands (Invasive Plant Council of New York)

Figure 2-6. Glendale Wetland, New Castle, NY

Figure 2-7: Wetlands in the Indian Brook-Croton Gorge Watershed



According to the NYSDEC wetland regulations, each municipality has the ability to designate wetlands of local significance. Eleven percent of the watershed contains hydric soils, a wetland indicator, and only 7% of the watershed is designated as wetland. There may be other wetlands not identified by the federal or state government that could become designated as wetlands of local significance. No municipality in the watershed to date has designated wetlands of local significance. For more information on wetlands, wetland regulations and regulatory definitions of wetlands refer to Appendix A: Additional Resources.

Figure 2-8. Phragmites dominated tidal wetlands of the Croton Bay

B. Significant Waterbodies

The Indian Brook-Croton Gorge Watershed consists of 45 acres of waterbodies (refer to Figure 2-10). The Croton River (Figure 2-11) is the main river system in the watershed, flowing approximately three miles from the New Croton Dam and discharging into the Croton Bay. Five tributaries feed into the Croton River and the most significant is the Indian Brook. The Indian Brook Reservoir, a drinking water source for the Town and Village of Ossining, is located in the watershed. Numerous ponds serve as water sources for Croton River tributaries. The Croton River empties into the Hudson River. The Hudson River runs 315 miles from its source in the Adirondacks to the New York Harbor. The lower reaches of the Hudson River, from Newburgh to the New York Harbor, are tidally influenced and contain brackish water. The Croton Bay is part of the tidally influenced portion of the Hudson River. The tidal influence continues up the Croton River past Paradise Island.

The State of New York adopted regulations (6 NYCRR §703) that identify stream use classifications and water quality standards. The standards legally set the maximum amount of pollutants allowed in a waterbody and still be considered clean. The maximum amount of pollution varies depending on the assigned stream use classification. Each stream is assigned the highest use classification that it could reach as determined by the State of New York.

The waterbodies in the watershed have different NYSDEC Surface Water Classifications. Figure 2-12 lists the surface waterbodies and their respective surface water classifications. In the watershed, the Class A surface waterbodies are all associated with the drinking water sources of either the Croton aquifer or the Indian Brook Reservoir. Class B was designated to all of the lakes and ponds not used as drinking water sources. Class C waters are tributaries of the Croton River or the Indian Brook. The tidal portion of the Croton River is designated as Class SC. Refer to Appendix A: Additional Resources for more information about NYSDEC Surface Water Classifications.

Figure 2-9. Table of U. S. Army Corps NWI of the Indian Brook-Croton Gorge Watershed

Wetland Type	Acres	Percent of Total Wetlands
Estuarine non vegetated	8	3%
Estuarine vegetated	65	27%
Palustrine non vegetated	1	<1%
Palustrine vegetated	127	53%
Riverine vegetated	2	<1%
Riverine non vegetated	36	15%
Lacustrine vegetated	<1	<1%
Total	**239**	**100%**

Croton Gorge Waterbodies

The Croton River runs three miles from the New Croton Dam and discharges into the Croton Bay on the Hudson River. Prior to the 1800's, mills were built along the riverfront and the Croton River was used as a harbor. In the early 1800's, the Croton River was dammed to create the Croton Reservoir, a drinking water source for New York City. In 1906, the existing New Croton Dam was completed. The Croton River below the dam shrunk in size, resulting in the river becoming

Figure 2-10: Waterbodies in the Indian Brook-Croton Gorge Watershed

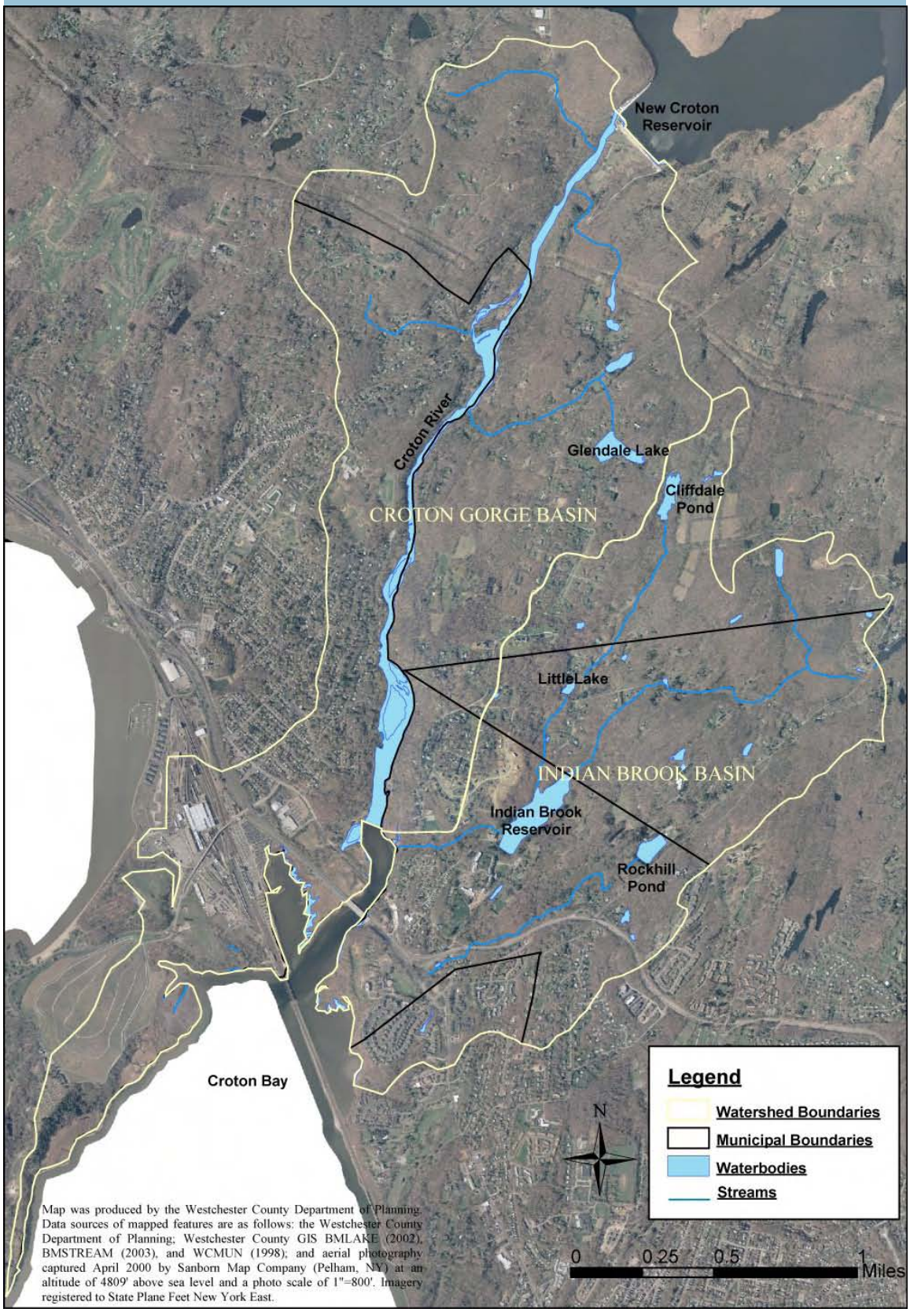


Figure 2-11. Croton River

unable to support the industries along its riverfront. Today, the Croton River primarily supports wildlife and recreational uses. Portions of the Croton River are stocked with approximately 900 rainbow trout yearlings, 100 two year old (12-15 inches) brown trout and 200 brown trout yearlings each March and April by the NYS DEC.

The Croton River receives its water flow from New Croton Reservoir water releases, dam spillway overflow, sheet flow and storm drain outfalls. New Croton dam water releases are regulated through NYC DEP's water withdrawal permit. The DEP is required to follow a specific release schedule that was enacted to maintain certain baseflow conditions in the river (see Appendix A: Additional Resources for the detailed release schedule).

Because of the NYC water supply diversion, the Croton River has much lower flow per square mile of watershed than other natural rivers. Up to 500 million gallons of water a day can be transferred out of basin from the Croton River watershed to NYC DEP drinking water customers. Maintaining river flows for wildlife and wildlife habitats downstream from water supply reservoirs is inherently complicated and requires a difficult balance between human demands and sustainable flows to conserve the ecological health of a river. The Croton River below New Croton Reservoir is no exception. During certain years, and during certain months of those years, the flow rate in the Croton River (below the reservoir) is only a fraction of what naturally would be observed under pre-dam conditions. The health of the three-mile section of the Croton River between the New Croton Reservoir and the tidal Hudson River is highly influenced by management of the New Croton Reservoir.

Figure 2-12. Table of Waterbodies and New York State Surface Water Classifications

Waterbody	NYS DEC Classification
Croton River	
New Croton Dam to Glendale Lake Tributary	A
Glendale Lake Tributary to Tidal Portion	B
Tidal Portion	SC
Indian Brook	
Indian Brook from Source to Reservoir	C
Indian Brook Reservoir	A
Indian Brook from Reservoir to Croton River	A
Other Waterbodies	
Other Croton River Tributaries	C
Cliffdale Pond	B
Glendale Lake	B
Little Lake	B
Rockhill Pond	B
Small Pond near Glendale Lake	B

Like all dammed rivers that are located in developed areas, the Croton River at times experiences fluctuations in its stream flow. Some fluctuations are normal for a river, but extreme fluctuations can cause increased erosion of the stream banks, excessive silting and drastic temperature changes. These severe changes can cause damage to fish and in-stream wildlife habitats. The current dam water release schedule can sometimes lead to highly variable fluctuations in the water temperatures. Water temperature can increase to above the maximum daily temperature for brown trout and rainbow trout. Aquatic ecosystems are sensitive to flow changes and fluctuations. An individual high, low or extreme flow event can influence the aquatic ecosystem of a river.

Data documenting ecological impacts of the New Croton

Reservoir on the Croton River are sparse. The information available on the dam release and the effects of sheet flow and storm drain discharges on Croton River baseflow is limited. However, the available data does demonstrate that the Croton River does experience fluctuations that could adversely affect the River's ecosystem. As a result, additional studies are needed to determine how flow changes actually affect wildlife in the Croton River corridor. The current flow management regime needs to be optimized to better support ecological processes downstream while still maintaining water supply needs. For more information on the New Croton Dam release please see Appendix A: Additional Resources.

Indian Brook Waterbodies

The Streamwalk Program was developed by the Natural Resources Conservation Service (NRCS) to educate citizens about streams in their communities and provide them with the tools to assess the health of these streams. In 2002, a Streamwalk was conducted by the residents of the Town of Ossining in the Indian Brook subwatershed. All sections of ponds, lakes, wetlands and streams in the subwatershed were included in the stream assessment surveys, which provided information regarding potential water quality and habitat concerns. The segment survey assessment forms were designed to act only as a preliminary identification tool to pinpoint those areas needing more in-depth investigation.

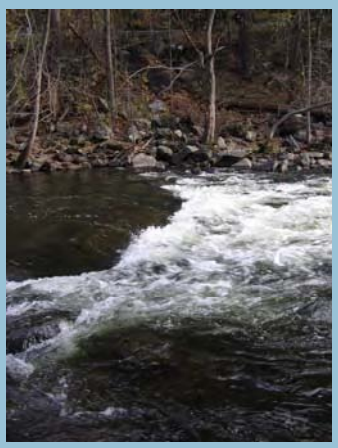
Overall, according to streamwalk surveys, the Indian Brook subwatershed contains

Croton Reservoir Release Schedule

Although flows in the Croton River can be naturally low due to climate and seasonal conditions, NYC DEP is required to maintain certain baseflow conditions in the River as part of their NYS DEC water withdrawal permit.

This New Croton Reservoir release schedule was originally designed to support seasonal use by anadromous fish species moving up the Croton River from the Hudson River Estuary and Atlantic Ocean and a stocked put and take trout fishery. The schedule can sometimes lead to fluctuations in water temperatures. More research is needed to determine how these fluctuations affect wildlife in the Croton River corridor.

For more detailed information about the release regulations, please see report entitled "A Preliminary Assessment of Croton River Hydrologic Alterations Below New Croton Reservoir" located in Appendix A: Additional Resources.



The Croton River

fair to good water quality ratings. Poor ratings were noted in the following areas:

- Barriers to Fish Movement,
- In-stream Fish Cover, and
- Pools.

Poor ratings for these parameters are typical ratings for streams that have an average depth of less than one foot. A majority of the streams in the Indian Brook Subwatershed had a stream depth of less than one foot when they were assessed. Even though the Indian Brook Subwatershed is a fairly healthy watershed, the prominent areas of concern listed as part of the Streamwalk assessment include stream bank erosion and runoff of polluted stormwater from roadways. Excessive erosion can cause increased turbidity and silting of the reservoir, streams and other ponds. Sections that are receiving runoff from roadways will have poorer water quality as a result of stormwater discharge pollutants such as nutrients, metals, sediments and petroleum products. For more details on the individual sections that were assessed as part of the Indian Brook Streamwalk please see Appendix A: Additional Resources.

The Indian Brook Reservoir (Figure 2-13) serves as a drinking water source for the Town and Village of Ossining. In 2006, the Indian Brook Plant pumped 504.6 million gallons of water for the year. The Village owned reservoir had approximately 100 million gallon capacity. The Indian Brook Reservoir is surrounded by forest. Three inlet streams to the Reservoir and one outlet stream exist and vary between 4-10 feet wide and vary between 3-8 inches deep.

Figure 2-13. Indian Brook Reservoir, Ossining, NY

The overall water quality rating based on the Indian Brook Streamwalk for the Reservoir was good. The noted areas of concern for the Reservoir included streams that were flowing directly into it. Streambank erosion was identified along the northern inlet stream. This erosion can contribute to increased turbidity and silting of the stream and the Reservoir. The eastern inlet stream of the Reservoir was reported to have poor canopy cover, which can affect the habitat quality for stream organisms. It was also noted to exhibit poor insect and invertebrate habitat, which can affect the viability of the stream ecosystem.

Portions of the Indian Brook that run parallel to Glendale Road and eventually discharge into the Reservoir might contribute stormwater pollutants to the Reservoir. Runoff discharges into the stream during storm events through outfalls or sheet flow. Two drainage pipes that discharge untreated stormwater directly into the stream were identified along the Glendale Road segment. The first discharge pipe drains runoff from Glendale Road and the second collects runoff from surrounding residences. Other segments of the Indian Brook are located in private backyards that can also receive stormwater runoff and pollutants associated with landscape management activities.

C. Groundwater

The Indian Brook-Croton Gorge Watershed contains a highly prolific aquifer that supplies the water source for the Village of Croton-on-Hudson water supply system. The natural groundwater that flows through the aquifer runs parallel to and in the same direction of flow as the Croton River. According to a 2004 report by the Chazen Companies, groundwater near the well fields is drawn towards the wells under pumping conditions. In non-pumping conditions the water table of the well fields is, generally, in equilibrium with the elevation of the river. Recharge to this system comes from a number of sources including precipitation, surface flow from the Croton River and groundwater flow from upland overburden and bedrock formations.

The extent to which the Croton River influences the water located in the aquifer is not completely known. As indicated by the 2004 Chazen Companies report, when the well fields were investigated according to NYSDOH guidance document PWS-42 (Public Water Supply 42) protocols there was no evidence that the wells should be designated as Ground Water Under the Direct Influence (GWUDI). GWUDI is a federal regulatory term that specifically refers to groundwater sources where conditions are such that pathogens are proven or have a high potential to travel from nearby surface waters into the groundwater source. The EPA left it up to the states to develop programs to make the determination of whether or not a source is GWUDI. With respect to the Croton-on-Hudson aquifer, the 2004 Chazen Companies report acknowledges that the zone of contribution from each well does include the Croton River.

Recreation in the Watershed

There are many recreational opportunities available at village, county and state parks throughout the Croton River corridor. Fishing and boating are permitted at Croton Point Park in Croton-on-Hudson. Important hiking trails include the Old Croton Aqueduct Trail and Briarcliff-Peekskill Trailway.

To find out more information about these recreational opportunities, go to the following websites:

westchestergov.com

village.croton-on-hudson.ny.us

www.dec.ny.gov

Figure 2-14. The Croton River

The Westchester County Health Department and New York State BPWSP reviewed the GWUDI report prepared by Chazen Companies and concluded that the Croton-on-Hudson wellfield is not under the direct influence of surface water. However, the Village of Croton-on-Hudson considers the Croton River a very important part of the village water supply and will endeavor to protect its water quality. Both New Castle and Cortlandt attempt to provide groundwater quality protection in the watershed through overlay protection zones, but the current provisions do not provide adequate protection for groundwater drinking water sources.

Some of the residents in the Towns of New Castle and Cortlandt have private drinking water wells. Currently no government oversight regarding monitoring water quality of private drinking water wells exists. It is the homeowner's responsibility to monitor his/her well water.

2.6 Fish, Wildlife and Significant Habitat

The Indian Brook-Croton Gorge Watershed has a diversity of plants, animals and habitats, despite a relatively small land area that has significant development. The diversity of plants, animals and habitats (biodiversity), provides many benefits to the surrounding watershed. Natural areas are important because they provide recreational opportunities, enhance the quality of life and contribute to keeping water clean. Whether public or private, natural areas help define community identity by connecting residents to the natural landscape in which they live. Open space, pedestrian and bicycle trailways and native plant gardens are just some of the ways to connect residential areas to the surrounding natural environment. The watershed provides many recreational opportunities including hiking, boating, bird-watching, fishing and outdoor photography.

Providing habitats for biodiversity helps to preserve good water quality while providing a community connection to nature. Wetlands, stream corridors and forests all work together to clean, replenish and store water and poorly planned development can displace habitats. Suburban and urban sprawl threaten habitats on both developed and conserved lands. Poorly planned development can disrupt groundwater flow, spread invasive species and cut off essential wildlife corridors, adding more stress to already fragile ecosystems. As healthy habitats are lost, the many benefits that natural ecosystems provide may be lost as well. It is possible, however, to sustain a healthy economy and environment if community growth is prepared with nature in mind.

Croton Bay, River and Surroundings

The tidally influenced Croton Bay and River are important aquatic habitats. The bay is one of the largest shallow bay areas in the lower Hudson that is sheltered from strong currents and wind. The mouth of the Croton River is documented as a migratory fish hub used as a resting, foraging and nursery area. Currently, portions of the river are stocked each year by the NYS DEC with trout. The federally en-

dangered shortnose sturgeon has been found to use the Croton River. The NYS-DEC Hudson River Estuary Program has noted that spawning use of the Croton River by blueback herring and alewife fish species could potentially increase if minimum flow requirements were established for the Croton River.

The Croton Bay has a productive year-round habitat for resident warm-water fish, such as largemouth bass, brown bullhead, carp and panfish. It contains 120 acres of submerged aquatic vegetation (SAV) beds full of native water celery. SAV is critical to the aquatic ecosystem of the estuary, providing habitat and food for larval and adult fish, waterfowl and invertebrate species.

In New York, brackish tidal wetlands and swamps are found only in the Hudson River north of the Tappan Zee Bridge. They are a prominent shoreline feature of the mouth of the Croton River and the Croton Bay, covering nearly 100 acres. More than 90 of those acres of tidally influenced wetlands are found on the Bay's shoreline but are dominated by invasive vegetation, such as the Common Reed (Phragmites). The productive aquatic habitat of the Croton Bay is important for the migrating osprey, which is a threatened species. Eight acres of wooded swamp are found in higher areas. Trees found in the wooded swamp are primarily locust and willow, with some sycamore, ash and maple. The understory of the swamp is dominated by invasive species such as catbriar, honeysuckle, grape and false bamboo.

Figure 2-15. Great Blue Heron, (above), Pickerel frog (below) source: U.S. Fish and Wildlife Service

The tidal wetlands provide an ideal habitat for several species of invertebrates, amphibians, reptiles, fish, birds, and mammals. The salinity in the bay water and the abundance of marshes make it an ideal habitat for striped bass, perch, American eels and blue claw crabs. Croton Point Park is home to raccoons, opossums and muskrats that frequent the shoreline foraging for food. Diamondback terrapins, a species not commonly found in the Hudson Valley, have been observed in the Park. The short-eared owl (state endangered species) and Northern Harrier (state threatened species) are known to use the Park as a wintering area. Bald Eagles, another endangered species, roost at Croton Point and have been seen on the mainland in the Town and Village of Ossining. A variety of waterfowl, such as great blue herons (Figure 2-15) and cormorants also make the tidal wetlands their home at different times of the year.

Croton-to-Highlands Biodiversity Plan

The Croton-to-Highlands Biodiversity Plan was a result of a collaborative planning effort between the Towns of Yorktown, New Castle, Cortlandt and Putnam Valley, the Wildlife Conservation Society's Metropolitan Conservation Alliance (WCS/MCA), NYSDEC Hudson River Estuary Program and the Westchester Community Foundation. The eastern portions of the Indian Brook-Croton Gorge Watershed (in Cortlandt and New Castle) were described in the biodiversity plan as high quality habitats for reptiles, amphibians and breeding birds. These wildlife

corridors are displayed in Figure 2-16 (listed as Biodiversity Hubs 11-13).

The *Croton-to-Highlands Biodiversity Plan* found that the watershed is home to many different species of amphibians, reptiles and breeding birds. Significant species identified include the Eastern box turtle, Northern copperhead, Worm-eating warbler, Prairie warbler, Kentucky warbler, Canada warbler and Wood thrush. Figure 2-17 is an inventory of the common and Latin names of focal species identified in the Indian Brook-Croton Gorge watershed portion of the *Croton-to-Highlands Biodiversity Plan*. Figure 2-17 also lists if the species can be found under the NYSDEC or Westchester County Endangered Species Programs, or the Audubon Watch List. More species may exist in the watershed than those listed in Figure 2-17 but they have not been identified in the Biodiversity Plan or they may be located in areas outside of the Plan's study area.

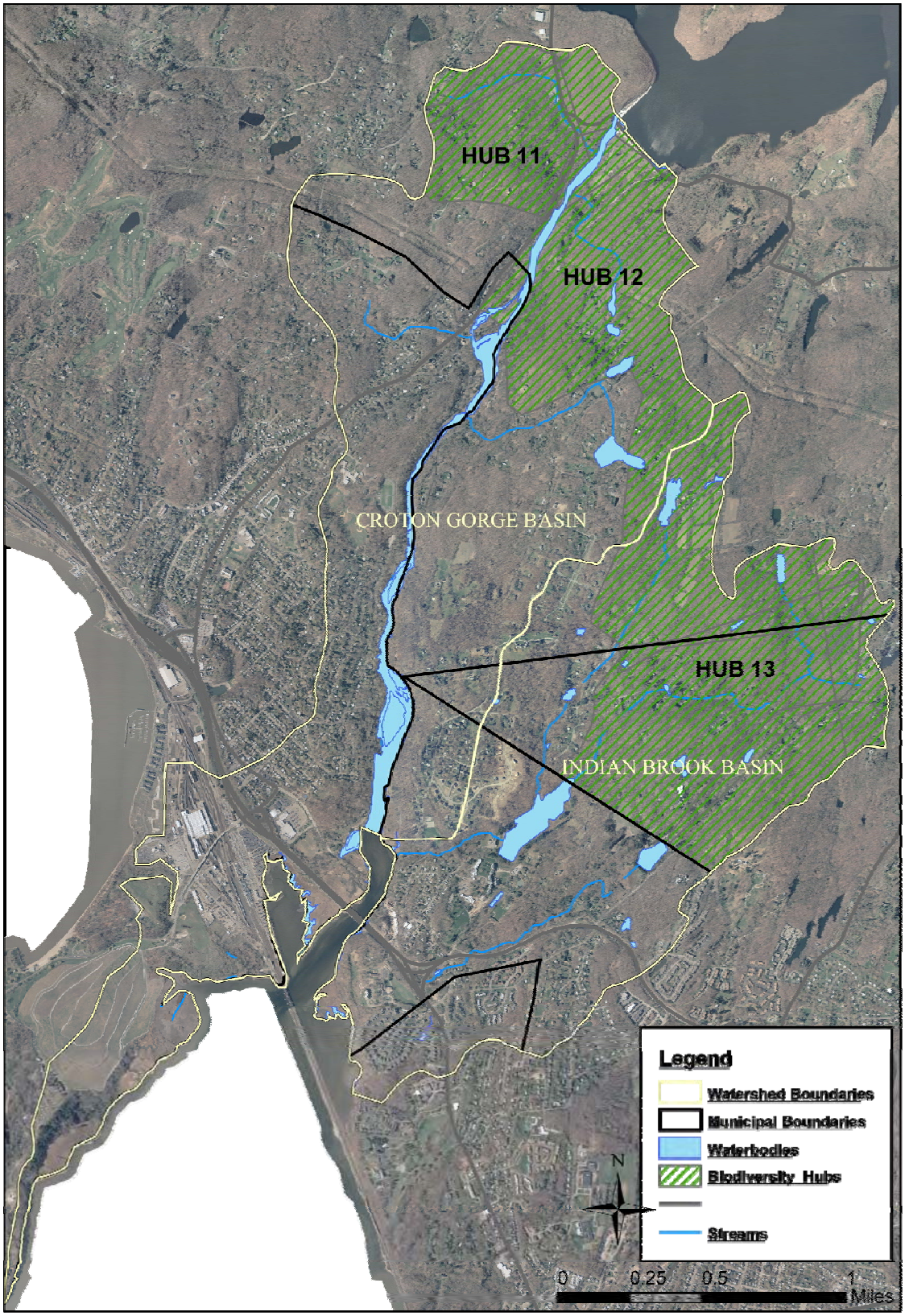
Outside the Croton River and the Bay, habitat in Croton-on-Hudson and Ossining has not been well studied. However, one area of significant wildlife habitat in the Plan ended abruptly at the municipal boundary between the Towns of New Castle and Ossining and it appears that the corridor may continue into the Town of Ossining.

The Croton River is an important biodiversity corridor, even though it is not discussed in the *Croton-to-Highlands Biodiversity Plan*. The river runs through the Town of Cortlandt, the Village of Croton-on-Hudson and along the northern border of the Town of Ossining. It provides an area for wildlife to move through the watershed with minimal barriers resulting from human development. As noted earlier, the Croton River is also home to many fish species including the endangered shortnose sturgeon. The land adjacent to the river is characterized by large-lot residential, park land and undeveloped parcels. Preserving land from further development along the Croton River corridor may be beneficial to the river ecosystem.

For more information about the *Croton-to-Highlands Biodiversity Plan* and to download a copy of the Plan, go to http://www.wcs.org/international/northamerica/mca/mcaprojects/CHBP.

Croton River

Figure 2-16. Wildlife Corridors Identified in the Indian Brook-Croton Gorge Watershed as part of the Croton-to-Highlands Biodiversity Plan



Mallard, Eastern Box Turtle, BullFrog and Northern Flicker

U.S. Fish and Wildlife Service's online digital media library

Figure 2-17. Focal Species of the Indian Brook-Croton Gorge Watershed

Common Name	Latin Name	Notes
Amphibians		
Spotted salamander	*Ambystoma maculatum*	
Northern two-lined salamander	*Eurycea bislineata*	
Four-toed salamander	*Hemidactylium scutatum*	
Redback salamander	*Plethodon cinereus*	
American toad	*Bufo americanus*	
Gray treefrog	*Hyla versicolor*	
Northern spring peeper	*Pseudacris crucifer*	
Bullfrog	*Rana catesbeiana*	
Green frog	*Rana clamitans*	
Pickerel frog	*Rana palustris*	
Wood frog	*Rana sylvatica*	
Reptiles		
Eastern box turtle	*Terrapene carolina*	A, B
Northern black racer	*Coluber c. constrictor*	
Northern ringneck snake	*Diadophis punctatus edwardsii*	
Black rat snake	*Elaphe obsoleta*	
Eastern garter snake	*Thamnophis s. sirtalis*	
Northern copperhead	*Agkistrodon contortrix mokasen*	C
Breeding Birds		
Mallard	*Anas platyrhynchos*	
Wood duck	*Aix sponsa*	
Canada goose	*Branta canadensis*	
Wild turkey	*Meleagris gallopavo*	
Mourning dove	*Zenaida macroura*	
Red-tailed hawk	*Buteo jamaicensis*	
Yellow-billed cuckoo	*Coccyzus americanus*	
Hairy woodpecker	*Picoides villosus*	
Downy woodpecker	*Picoides pubescens*	
Pileated woodpecker	*Dryocopus pileatus*	
Red-bellied woodpecker	*Melanerpes carolinus*	
Northern flicker	*Colaptes auratus*	
Eastern kingbird	*Tyrannus tyrannus*	
Great crested flycatcher	*Myiarchus crinitus*	
Eastern phoebe	*Sayornis phoebe*	
Eastern wood-pewee	*Contopus virens*	
Blue jay	*Cyanocitta cristata*	
American crow	*Corvus brachyrhynchos*	
Brown-headed cowbird	*Molothrus ater*	
Red-winged blackbird	*Agelaius phoeniceus*	
Baltimore oriole	*Icterus galbula*	
Common grackle	*Quiscalus quiscula*	
House finch	*Carpodacus mexicanus*	
American goldfinch	*Carduelis tristis*	
Chipping sparrow	*Spizella passerina*	

Focal Species of the Indian Brook-Croton Gorge Watershed, cont.

Common Name	Latin Name	Notes
Field sparrow	*Spizella pusilla*	
Song sparrow	*Melospiza melodia*	
Swamp sparrow	*Melospiza georgiana*	
Eastern towhee	*Pipilo erythrophthalmus*	
Northern cardinal	*Cardinalis cardinalis*	
Rose-breasted grosbeak	*Pheucticus ludovicianus*	
Indigo bunting	*Passerina cyanea*	
Scarlet tanager	*Piranga olivacea*	
Barn swallow	*Hirundo rustica*	
Tree swallow	*Tachycineta bicolor*	
Northern rough-winged swallow	*Stelgidopteryx serripennis*	
Cedar waxwing	*Bombycilla cedrorum*	
Red-eyed vireo	*Vireo olivaceus*	
Warbling vireo	*Vireo gilvus*	
Black-and-white warbler	*Mniotilta varia*	
Worm-eating warbler	*Helmitheros vermivorum*	C,D
Blue-winged warbler	*Vermivora pinus*	D
Yellow warbler	*Dendroica petechia*	
Black-throated green warbler	*Dendroica virens*	
Prairie warbler	*Dendroica discolor*	C,D
Ovenbird	*Seiurus aurocapilla*	
Northern waterthrush	*Seiurus noveboracensis*	
Louisiana waterthrush	*Seiurus motacilla*	
Kentucky warbler	*Oporornis formosus*	D, E
Common yellowthroat	*Geothlypis trichas*	
Canada warbler	*Wilsonia canadensis*	C, D
American redstart	*Setophaga ruticilla*	
Northern mockingbird	*Mimus polyglottos*	
Gray catbird	*Dumetella carolinensis*	
Carolina wren	*Thryothorus ludovicianus*	
House wren	*Troglodytes aedon*	
White-breasted nuthatch	*Sitta carolinensis*	
Tufted titmouse	*Baeolophus bicolor*	
Black-capped chickadee	*Poecile atricapillus*	
Blue-gray gnatcatcher	*Polioptila caerulea*	
Wood thrush	*Hylocichla mustelina*	C, D
Veery	*Catharus fuscescens*	
American robin	*Turdus migratorius*	
Eastern bluebird	*Sialia sialis*	

Notes:
A: NYS Special Concern
B: Westchester County Threatened
C: Westchester County Special Concern
D: Audubon Society Special Concern
E: Westchester County Endangered

Indigo Bunting, Cedar Waxwing, Ovenbird and Woodthrush

U.S. Fish and Wildlife Service's online digital media library

2.7 Land Use In the Watershed

Land use analysis of a watershed permits an understanding of the potential for future change through new development and land alteration. A land use analysis examines the actual use of the land (residential homes, commercial businesses, etc.). Pollutants such as metals and toxins from cars, soil from land development and earth moving practices and pesticides and fertilizers applied to lawns can end up in drinking water sources and waterbodies. Assessing the potential impacts that various land uses can have on drinking water and waterbodies is of primary importance

Figure 2-18. Indian Brook-Croton Gorge Watershed Land Use

Land Use Category	Land Use (Acres)	Percent of Watershed
Residential		
R-2A (≥2 ac.)	775	24%
R-1A (0.75-1 ac.)	217	7%
R-1/3A (0.25-0.75 ac.)	188	6%
R-1/4A (<0.25 ac.)	220	7%
R-MF (Multi-family)	55	2%
Non-Residential		
Commercial/Mixed Use	29	<2%
Institution/Religious	169	<6%
Manufacturing/Warehouse	10	<1%
Office	37	1%
Transportation General/Utility	201	9%
Open Space		
Private Recreation	71	3%
Water Supply	76	3%
Park	501	16%
Nature Preserve/Conservation	179	5%
Undeveloped		
Undeveloped	370	11%
Non-Parcel		
Right of Way	83	

when quantifying the health of a watershed and determining actions that should be taken to restore and protect drinking water sources and waterbodies.

Land use was analyzed throughout the Indian Brook-Croton Gorge Watershed. Parcels in the watershed were categorized into 15 different land uses. In order to provide an overview of land use, the 15 different land uses were placed into four general categories, Residential, Non-Residential, Open Space and Undeveloped.

Figure 2-19. Percent impervious surfaces by land use in the watershed

Land Use	Percent Impervious Surfaces
Residential	
R-2A	2%
R-1A	3%
R-1/3A	6%
R-1/4A	11%
R-MF	4%
Non-Residential	
Commercial/Mixed Use	13%
Institution/Religious	3%
Manufacturing/Warehouse	10%
Office	7%
Transportation General/Utility	5%
Open Space	
Private Recreation	<1%
Water Supply	<1%
Park	<1%
Nature Preserve/Conservation	<1%
Undeveloped	
Undeveloped	<1%

The distribution of the general land uses located in the watershed are identified in Figure 2-20. As shown in the figure, the watershed is almost equally residential (46%) and open space and undeveloped (38%).

In order to accurately assess land use in the Indian Brook-Croton Gorge Watershed a detailed land use classification was created, which combined land use categorized in both the Westchester County 1996 land use and 2004 open space GIS data coverages. The overall structure of the various land use classification system and more detailed information on the land use analysis can be found in Appendix B: Methodologies.

The land use categories that fall within each of the general land use groupings can be found in Figure 2-18. Figure 2-18 also includes the total acreage and percent coverage for each land use found in the watershed. Figure 2-21 is a land use map of the watershed.

Impervious surface was also calculated based on the 2000 Westchester County data for each land use (Figure 2-19) (for details on the calculations of impervious surfaces refer to Appendix B). A total of 3.8% of the land in the watershed is already impervious surface.

Figure 2-20. General land uses found in the Indian Brook-Croton Gorge Watershed

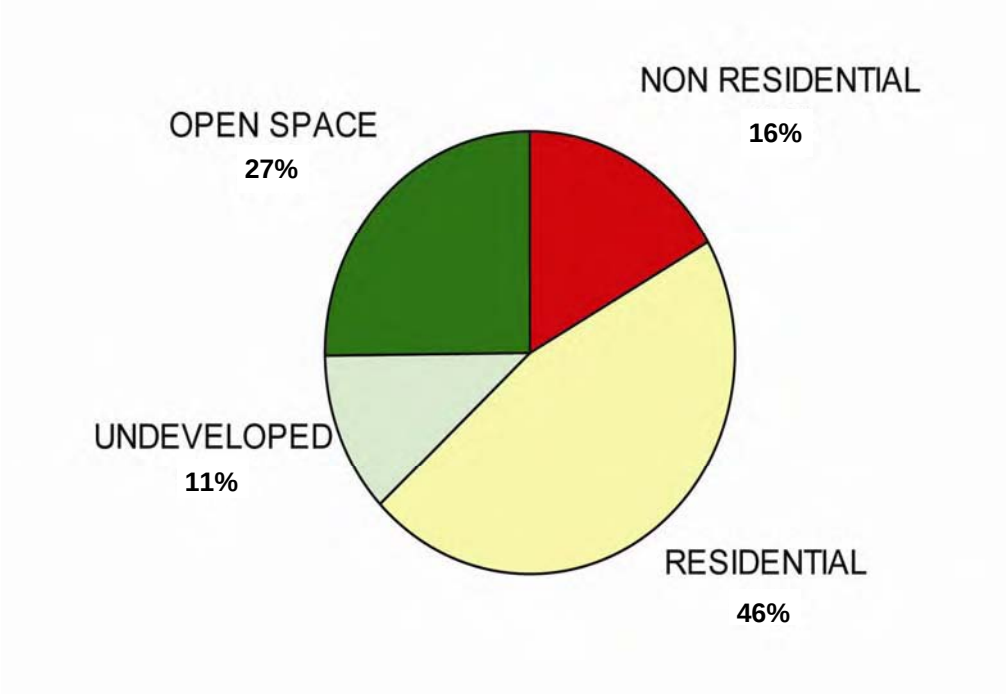
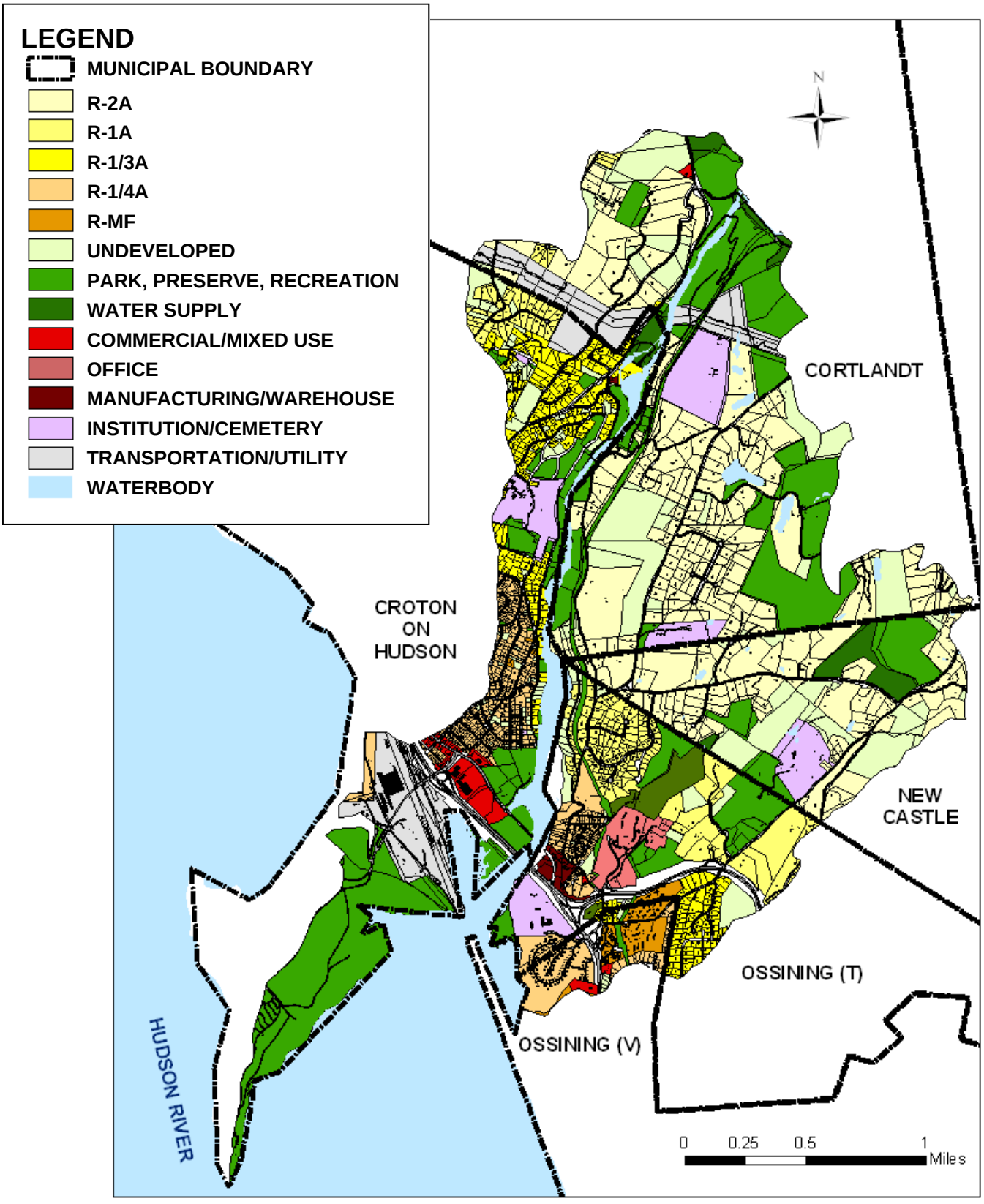


Figure 2-21. Map of general land uses found in the Indian Brook-Croton Gorge Watershed



RESIDENTIAL

Residential development is the most dominant land use throughout the watershed with 46% characterized as residential. The five residential categories were created based on acreage: R-2A, R-1A, R-1/3A, R-1/4A and R-MF (refer to Figure 2-18). Figure 2-24 illustrates the distribution of the residential land uses found in the watershed. Large homes on large properties (Figure 2-22) are common in the watershed and found mainly in unsewered areas of the watershed. Denser development is found in the sewered areas of the watershed (Figure 2-23).

Figure 2-22. Typical R-2A single family home

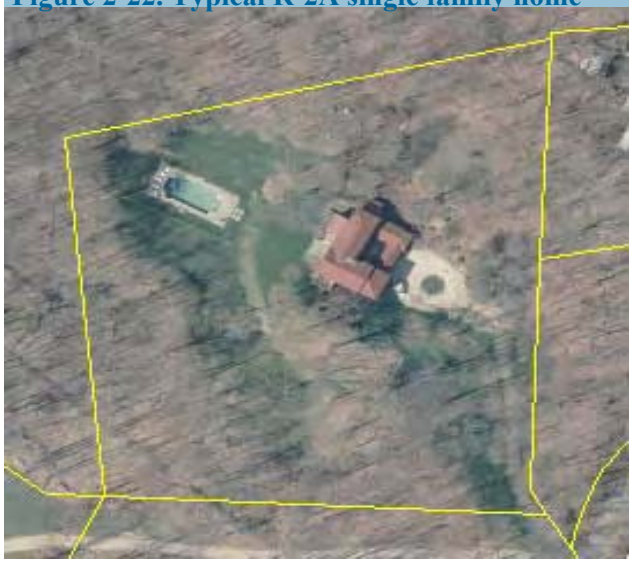


Figure 2-23. Residential housing in Ossining.

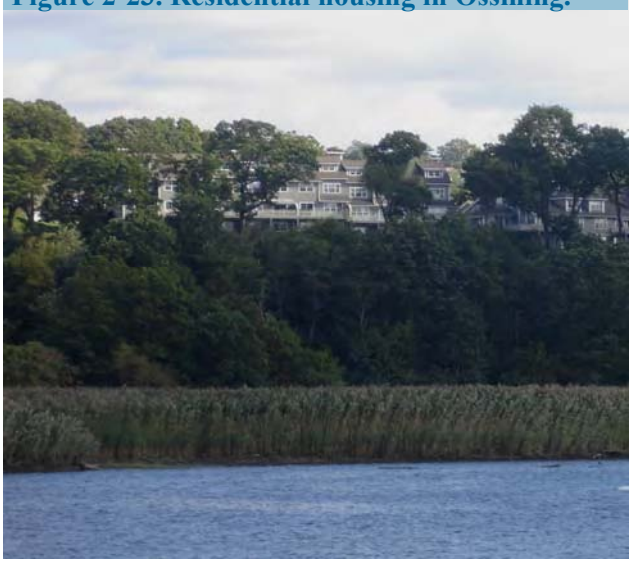
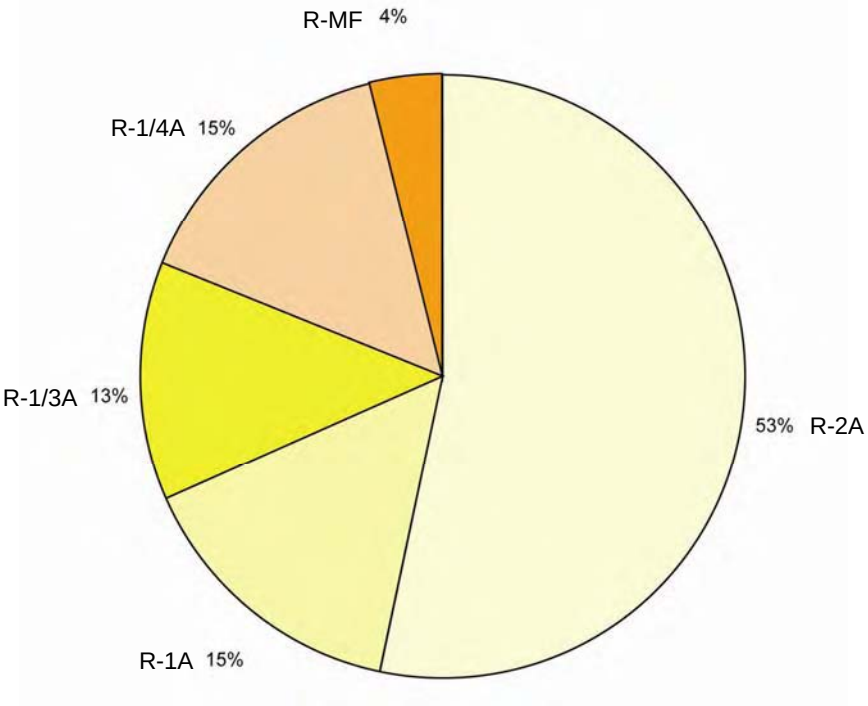


Figure 2-24. Distribution of residential land uses in the watershed



NON-RESIDENTIAL

Non-Residential is the third largest general land use found in the watershed, making up 16% of the total watershed (refer to Figure 2-20). There are five categories in the watershed under this heading that vary greatly in intensity of land use activities. Transportation and utility uses are the most prevalent non-residential land uses in the watershed due to the location of the Metro-North's Croton Harmon Station (Figure 2-27). Another common land use is general commercial as shown in Figure 2-26. Figure 2-25 displays the distribution of the non-residential land uses found in the watershed.

Figure 2-25. Distribution of non-residential land uses in the watershed

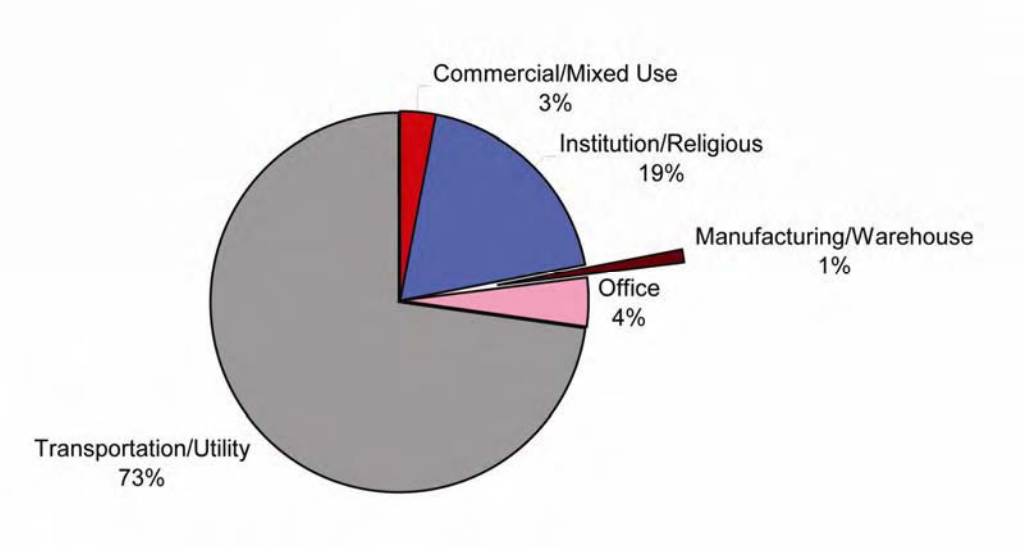


Figure 2-26. Commercial shopping center, Croton

Figure 2-27. Municipal Garage, Croton

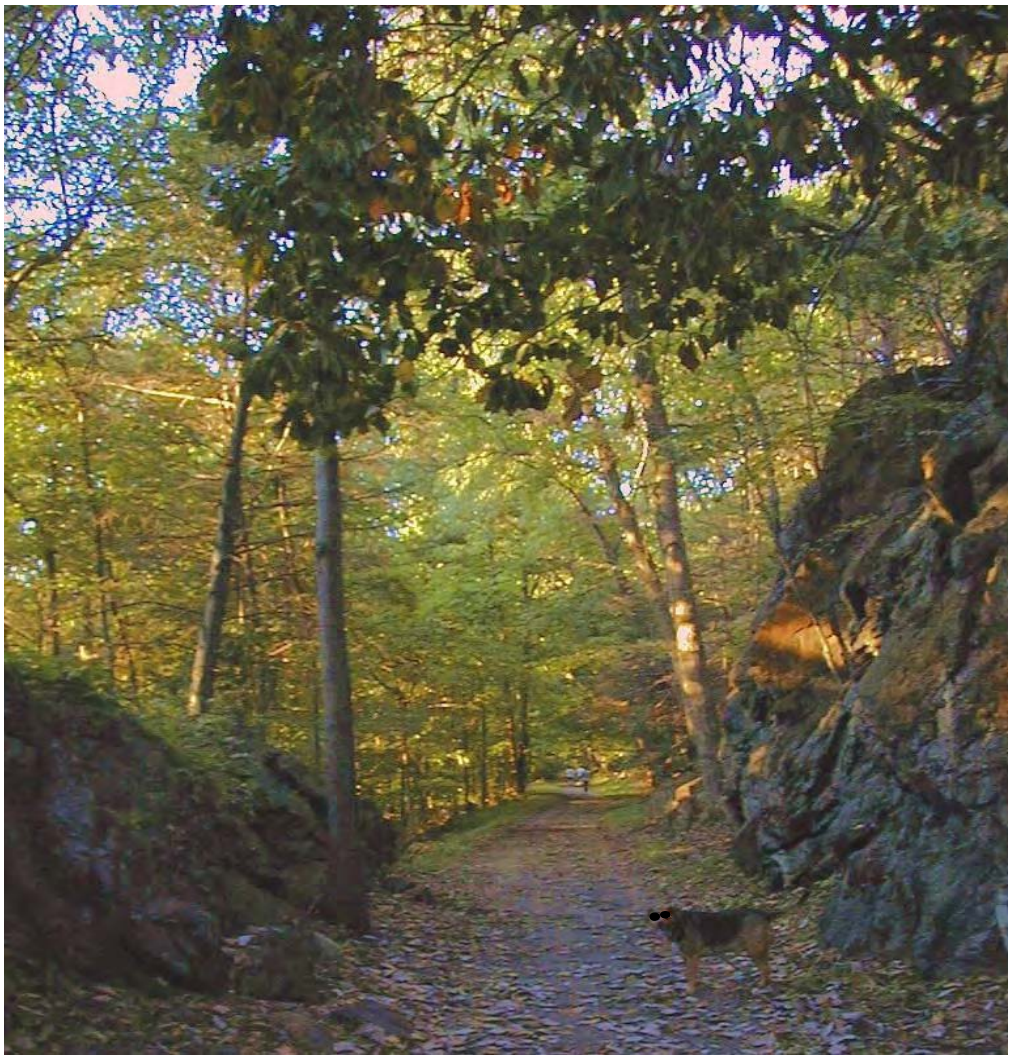
OPEN SPACE

Approximately 27% of the watershed can be classified as open space (refer to Figure 2-20). There are four categories of open space divided by the actual use of the land (refer to Table 2-18). This general land use group is the second largest land use group, after residential, in the watershed. As of 2004, there were 0.51 acres of open space for each one acre of residential use, a one to two ratio. Open space also includes a number of different land uses that are considered desirable land uses for environmental, recreational, wildlife and economic benefits.

UNDEVELOPED LAND

Approximately 11% of the watershed consists of parcels that are undeveloped and are considered vacant land (refer to Figure 2-18). Undeveloped land has not been preserved as open space and is open for development and can be publicly or privately owned.

Figure 2-28. Croton Aqueduct Trail



A. TOWN OF CORTLANDT

The Town of Cortlandt encompasses almost 35 square miles in northern Westchester. Although only 6% of the Town of Cortlandt is located in the Indian Brook-Croton Gorge Watershed, Cortlandt makes up 38% of the watershed. Cortlandt's area of the watershed is primarily large lot residential characterized by single family homes on parcels at least double the size found elsewhere in the watershed.

Forty-two percent of the watershed in Cortlandt can be classified as having steep slopes. In Cortlandt, steep slopes greater than 25% are primarily found adjacent to the Croton River where the parcels are generally residential or open space.

The Indian Brook Reservoir and its tributaries are very important environmental assets to the watershed. The Indian Brook subwatershed in Cortlandt is not fully developed. Any additional development could adversely impact water quality, especially without the utilization of stormwater best management practices. Such practices include measures such as leaf collection. Cortlandt has a leaf collection

Figure 2-29. Croton Dam Falls, Cortlandt, New York

program and currently all leaf collection is done in the fall.

In 2003, the Town of Cortlandt adopted an enhanced Steep Slope Ordinance which further protected steep slopes in excess of 15%.

Many residents in Cortlandt are on private well water and no government monitoring exists for private well supplies. It is the homeowner's responsibility to monitor his/her water quality. Cortlandt has taken steps to provide groundwater quality protection in the watershed through an entitled Aquifer Protection Zone.

Cortlandt currently has environmental regulations that could potentially help to improve and protect water quality in the watershed. These regulations are included in the ordinance review found in Appendix A: Additional Resources. The Town will be participating in Westchester County's MS4-Phase II Stormwater Education and Outreach Program funded through the NYS Environmental Protection Fund supported by the NYS DEC.

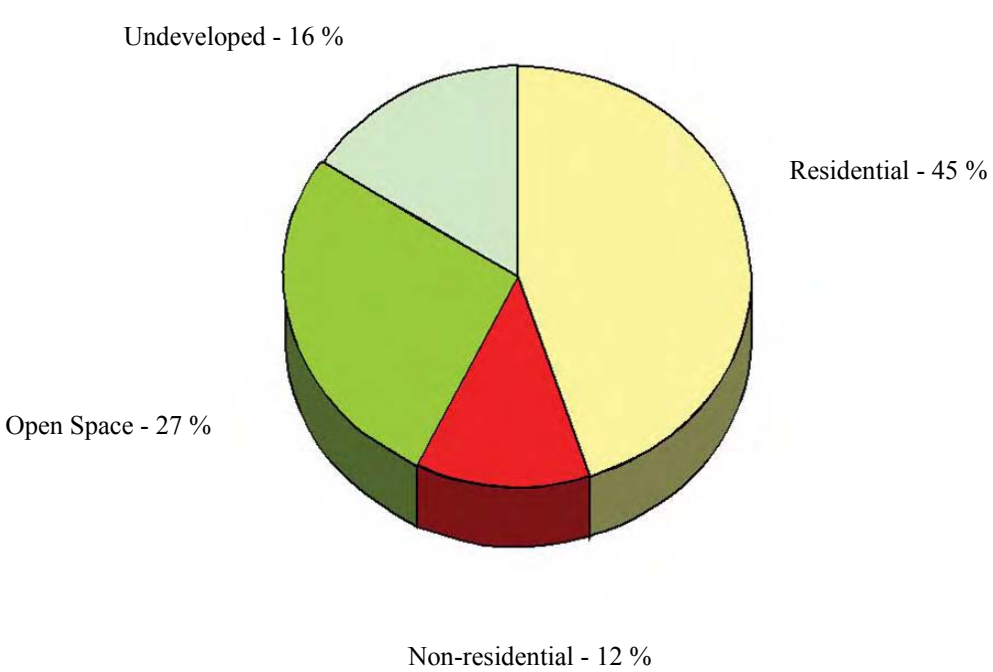
The area of Cortlandt in the watershed is not sewered and malfunctioning septic systems could be a potential source of groundwater contamination.

A majority of the road runoff in Cortlandt's share of the watershed discharges into roadside swales. Properly constructed and maintained swales can be an environmentally friendly application to direct the flow of stormwater runoff. Many roadside swales in the Town, however, are not protected by vegetation or riprap and experience a great amount of erosion. The erosion in the swales leads to structural instability of the road sides and increase in sedimentation in the receiving waterbody. In Cortlandt, the major area of concern exists along Quaker Bridge Road.

Cortlandt has recently made drainage improvements on Quaker Bridge Road.

Many outfalls in the Town discharge directly into the Croton River. Upon investi-

Figure 2-30. Town of Cortlandt Land Use in the watershed



gation, the stormwater did not appear to be pretreated. Many outfalls discharge onto steep slopes causing the slopes to erode. The high rates of destructive erosion from stormwater discharges can lead to structural instability of the slopes and increase sedimentation of the Croton River.

Land Use in Cortlandt

Land in Cortlandt's area of the watershed is typified by large lot residential and open space. No hamlet area or commercial center exists. The residential areas are characterized as being semi-rural in character. Route 129 is the only major road that goes through Cortlandt's area of the watershed. Croton Gorge Park, a County Park, is one of the largest uses of land as is the Danish Home, a retirement home for people of Danish Descent. The Danish Home practices organic gardening as a recreational activity for the residents. Figure 2-30 details the land use in Cortlandt's section of the watershed.

Undeveloped

Sixteen percent of the land area in Cortlandt is undeveloped, with the largest contiguous parcels of undeveloped in the vicinity of Quaker Bridge Road. If this land were developed, it could impact the water quality of the watershed by increasing impervious surfaces and stormwater runoff.

Nature Preserve, Parks and Conservation Land

Twenty-three percent of the land in Cortlandt consists of nature preserves, parks and conservation land. The largest park located in the Indian Brook-Croton Gorge Watershed is the Westchester County Croton Gorge Park, the site of the New Croton Dam which is National Register Landmark property.

Figure 2-31. Open Space in Cortlandt, New York

Non-residential

Institutional properties make up 5% of the total land area in Cortlandt and most parcels are underdeveloped. Seven percent of institutional lands are covered with impervious surfaces. If institutional land is developed to the fullest potential, impervious surface and the total stormwater runoff will increase.

R-2A: Lots of 2 Acres or Greater

A large portion of the R-2A district in Cortlandt does not have stormwater infrastructure. Sheet flow serves as the primary transportation method for stormwater runoff. If there is enough pervious surface for the water to infiltrate and water is not directed down steep slopes, sheet flow should not be a major concern. However, if development is to increase, flooding and pollutant loading from untreated stormwater runoff can become a major water quality issue. The primary areas of sheet flow concern are near the Croton River and waterbodies.

Figure 2-32. Typical R-2A land use in Cortlandt

B. VILLAGE OF CROTON-ON-HUDSON

The Village of Croton-on-Hudson's (Croton) area totals 3,056 acres of which 30%, 918 acres, is located in Indian Brook-Croton Gorge Watershed. Croton's portion of the watershed is only located in Croton Gorge Basin, but encompasses the second largest area, 26%, in the watershed by municipality. Figure 2-33 details Croton's land use in the watershed.

The Croton River is an important environmental asset to the watershed. The river currently receives discharges from stormwater outfalls and sheet flow. A delicate ecosystem in the river and potential interaction between the river and Croton aquifer exists. Improving and monitoring the water quality of the Croton River and determining how the flow regime affects the wildlife in Croton River corridor is important to protect the delicate balance of the river and aquifer. Additionally, it is very important that the Village of Croton-on-Hudson maintain and monitor a suffi-

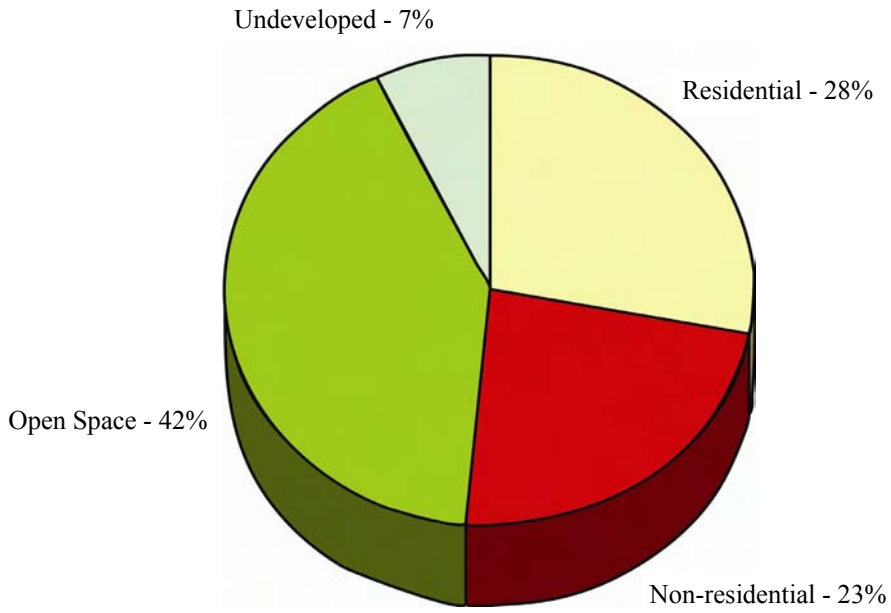
cient buffer adjacent to the Croton River to protect and improve water quality in the River and aquifer.

Wetlands in Croton have become degraded over the years as a result of invasive species. The greatest areas of concern are the tidal wetlands located along the Route 9/9A corridor. Eleven percent of watershed soils are classified as hydric, a wetland indicator, although only 7% of the entire watershed is designated as wetland. Wetlands not identified by the federal or state government could therefore have the potential to become designated wetlands of local significance and some are located in Croton in Croton Point Park and along the Croton River. Twenty-two percent of Croton contains steep slopes. Most of the steep slopes are concentrated along Croton River and in developed areas.

The Village has a stormwater public information display and stormwater newsletter inserts and will be participating in Westchester County's MS4-Phase II Stormwater Education and Outreach Program funded through the NYS Environmental Protection Fund supported by the NYS DEC. Croton currently has environmental regulations that help improve and protect water quality in the watershed. More information about Croton's ordinances can be found in the ordinance review located in Appendix A: Additional Resources.

Stormwater problem area investigations were conducted in Croton using site reconnaissance techniques. Currently, all stormwater runoff from Route 9/9A drains directly from the roadways and discharges into Croton Bay. The Shop Rite Shopping Center, located on Riverside Avenue (Figure 2-34), has a large parking lot with little pervious surface. Sediments can be found throughout the parking lot that di-

Figure 2-33. Village of Croton Land Use in the watershed



rectly drain into the catch basins during each rainstorm. Currently no stormwater practices are being conducted in this area. Dumpsters and other waste disposal containers, if not properly maintained, could also contribute to stormwater runoff pollutants. Untreated runoff from the shopping center runs underneath Route 9/9A and into Croton Bay.

Land Use in Croton

The watershed slices through the Village of Croton taking in the full spectrum of land uses found throughout the Village. Croton is the most urbanized area within the watershed.

Residential

Twenty eight percent of the total land area in Croton is zoned for residential. Residential land use contributes to a majority of the nonpoint source pollution in Croton. The nonpoint source pollution comes from common activities in residential areas such as lawn care, car washing and pet waste disposal.

Undeveloped

Seven percent of the total land area in Croton is undeveloped. Most of the undeveloped land is scattered throughout the Village, but found mostly in residential areas. Undeveloped parcels have a potential for development and if developed, may impact water quality of the watershed due to an increase in impervious surfaces and stormwater runoff.

Parks and Conservation Land

Approximately 35% percent of the total land in Croton can be classified as historic, nature preserves, parks or conservation. A majority of this land is zoned for residential uses. A concern does not really exist for residential development but the potential increase of impervious surfaces by the existing land uses such as Croton Point Park or Van Cortlandt Manor is a concern.

Figure 2-34. Shop-Rite Plaza, Croton-on-Hudson, New York

Institution

Institutional land uses, which compose 4% of the total land area in Croton, are typically underdeveloped and are about 7% impervious. A potential exists under current regulations for further development of these properties and if further developed the total impervious surface and stormwater runoff will increase.

Non-residential

Commercial and transportation uses comprise approximately 16% of Croton. Although non-residential land uses are a small percentage of the total land area in Croton, non-residential land uses typically have large areas of impervious surfaces and onsite activities that could degrade water quality. If stormwater from these parcels is not properly controlled and treated, these parcels have the potential to contribute significant pollutants into the watershed. Major areas of concern are the shopping center located east of 9/9-A, the Metro-North train station and repair yards and Route 9/9-A.

C. TOWN OF NEW CASTLE

New Castle is approximately 26 square miles and about 3% of the town is located in the watershed. It is almost entirely located in the Indian Brook subwatershed. The town comprises 15% of the watershed and similar to Cortlandt, most of town's watershed consists of single family homes on large lots.

Glendale wetland in New Castle is the largest and only upland NYS DEC designated wetland in the watershed. Steep slopes are found throughout the Town, primarily located on undeveloped and underdeveloped parcels. New Castle currently has environmental regulations to help improve and protect water quality. More information can be found in the ordinance review located in Appendix A: Additional Resources.

Some residents in the town rely on private well water for drinking water. New Castle has attempted to provide groundwater quality protection in the watershed through overlay zoning. New Castle has established an overlay zone to protect the Indian Brook Reservoir, but the restrictions are limited and pertain mostly to wetland buffers. Stormwater runoff flows as sheet flow towards the reservoir and reservoir tributaries. Any additional development may have an adverse affect on the Indian Brook Reservoir water quality, especially if certain stormwater management practices are not instituted. Land surrounding the Indian Brook Reservoir in New Castle does not contain stormwater infrastructure.

New Castle has an existing catch basin cleaning program. Most catch basins are cleaned once every year. To date, there is no official illicit discharge program in

Figure 2-35. Glendale Wetland, New Castle

place. The town currently has a street sweeping program with streets swept twice a year by mechanical sweepers. The town participates in the Westchester County Household Hazardous Waste Collection Program and informs their residents of the program through informational mailings. No town leaf collection program in place. New Castle currently has no road salt management program or policies regarding snow disposal.

New Castle has education and outreach programs concerning stormwater which includes a section in the town's newsletter called Conservation Notes. The Town will also be participating in Westchester County's EPA Phase II Stormwater Regulations Public Education and Outreach Program funded through NYS Environmental Protection Fund supported by the NYSDEC.

Land Use in New Castle

Land in New Castle's area of the watershed can be typified similarly to that in the Town of Cortlandt, by large lot residential and open space. No hamlet area or commercial center exists. The residential areas are characterized as being semi-rural character, but no major roads pass through the town. Figure 2-36 details the land use in New Castle's section of the watershed.

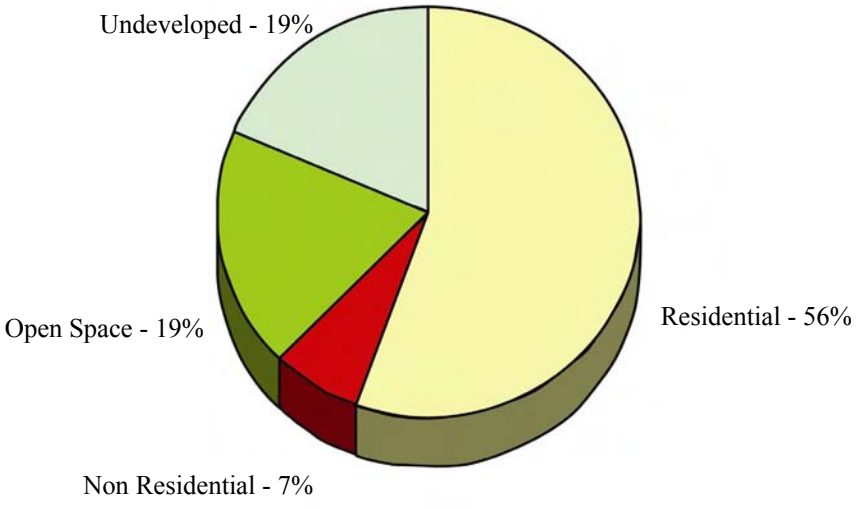
Residential

Forty-eight percent of the watershed area in New Castle is zoned R-2A, two-acre residential. Eight percent of the watershed area in the town is zoned for R-MF, multi-family housing. Residential property impervious surface is only 7%, but residential land use generates a majority of the nonpoint source pollution found in New Castle. Also, many parcels found in R-2A zoning districts are underdeveloped and have a greater potential for development. Redevelopment in areas surrounding the Indian Brook Reservoir could potentially degrade water quality.

Undeveloped

Nineteen percent of the watershed area in New Castle is undeveloped. If the unde-

Figure 2-36. Land Use in New Castle in the watershed.



veloped land becomes developed it could potentially impact water quality in the watershed due to increases in impervious surface and thus stormwater runoff. Specific areas of concern include undeveloped properties surrounding the Indian Brook Reservoir.

Open Space

Approximately 12% of the watershed area in New Castle consists of nature preserves and parks. Proper management of preserve and park land adjacent to the Glendale wetland is considered to be of great importance for water quality protection.

Non-residential

Institutional land comprises 7% of the watershed in New Castle and is also underdeveloped. Currently, institutional land uses are covered with approximately 7% of impervious surfaces. If the institutional land uses are developed to the full potential the total impervious surfaces and associated stormwater will increase. New Castle has one of the largest institutions, the Asthmatic Children's Foundation of New York (Figure 2-37), in the watershed.

D. TOWN OF OSSINING

The Town of Ossining has an area of 1,940 acres of which 29%, approximately 570 acres, is located in the watershed. The town has the third largest area in the water-

Figure 2-37. Asthmatic Children's Foundation of New York, Town of New Castle

shed and is located in both the Indian Brook and Croton Gorge Basin. Figure 2-39 is shows the distribution of land use in the watershed.

Wetlands in the Town of Ossining consist of small Federal National Wetland Inventory (NWI) wetlands and one NYS DEC tidal wetland. The Indian Brook Reservoir and its tributaries are important environmental assets to the watershed. Underdeveloped land surrounds the Indian Brook Reservoir and if certain stormwater management practices are not instituted prior to development, any additional development could potentially degrade water quality in the Indian Brook Reservoir.

Twenty-three percent of the Town of Ossining can be classified as having steep slopes. Steep slopes are found throughout the Town but tend to be concentrated along the Croton River and the Indian Brook Reservoir. Many of the steep slopes are located in areas that are already developed. If the land were to continue to be developed, increased erosion might result from an increase in stormwater runoff.

The Town of Ossining has environmental regulations that potentially can improve and protect water quality in the watershed. An ordinance review was conducted and can be found in Appendix A: Additional Resources.

The Town of Ossining has a drinking water reservoir, the Indian Brook Reservoir with a filtration plant, and it is important for the Town to maintain a buffer around

Figure 2-38. View of Croton Bay from St. Augustine's Cemetery, Town of Ossining, New York

the reservoir and provide that necessary stormwater management practices are instituted to protect water quality.

The Town currently has education and outreach programs concerning stormwater consisting of informational mailings and a booth at the Village/Town of Ossining Fair. The town will also be participating in the Westchester County's MS4-Phase II Stormwater Education and Outreach Program funded through NYS Environmental Protection Fund supported by the NYSDEC. The town participates in Westchester County's Household Hazardous Waste Collection Program and informs residents of the program by mail.

The town's current stormwater practices consist of catch basin cleaning, leaf collection and street sweeping. The Town has an existing public catch basin cleaning program and most areas are cleaned annually with known problem areas being cleaned as necessary. The Town collects leaf debris in the fall and in early winter by using a vacuum. Streets are usually swept by a Town-owned street sweeper four times per year. The Town currently does not have a road salt management program or policies regarding snow disposal but all road salt is stored in a covered building.

Stormwater problem area investigations were conducted using site reconnaissance techniques with the town. Areas of concern were identified in the field:

Outfalls to Croton Bay and River
Untreated stormwater outfalls in the Town discharge directly into the Croton Bay and often the discharge is on steep slopes causing erosion. The high rate of erosion creates both structural instability of the slopes and increased sedimentation of the bay. Stormwater outfalls of concern are located at St. Augustine's cemetery and Mystic Point condominiums.

Roadside Swales
A majority of the road runoff in the Town discharges into roadside swales not protected by vegetation or riprap. The roadside swales are experiencing significant erosion that is creating structural road side instability and increasing sedimentation into the water. A major area of concern is located along Quaker Bridge Road.

Route 9/9A
Currently, all stormwater runoff from Route 9/9A drains directly from the roadways and discharge into the Croton Bay. The stormwater is untreated and likely contributing pollutants to the Croton Bay.

Town of Ossining Land Use

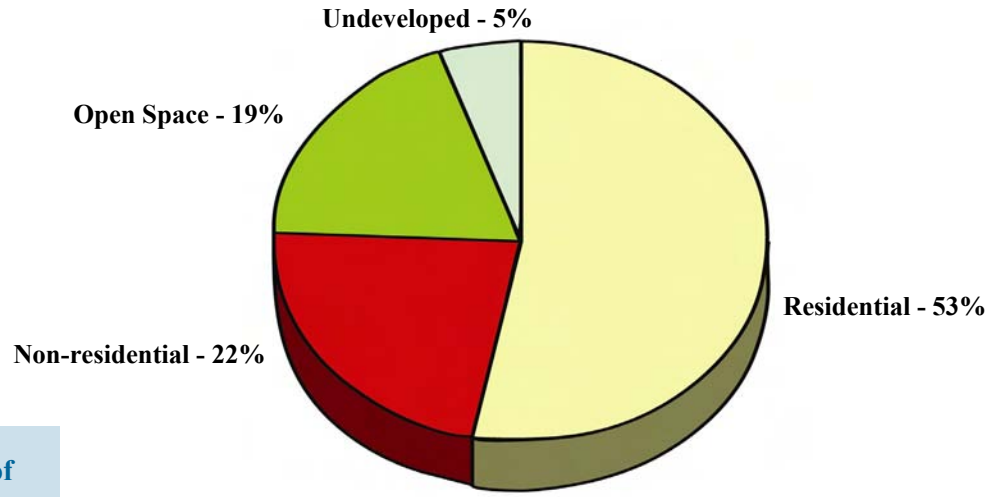
Land use in the town's area of the watershed is primarily residential with the exception of a few non-residential uses on large lots.
R-1/3A
Thirty-one percent of the Town of Ossining within the watershed is zoned for 1/3-acre lots and covered with 9% impervious surfaces. Many lots are underdeveloped with the potential for further development which could possibly lead to increase impervious surfaces and stormwater runoff. R-1/3A parcels surround the Indian Brook Reservoir in the town.

Undeveloped and Open Space
Five percent of the total land area in the Town of Ossining is undeveloped. Twelve percent of the town in the watershed consists of nature preserves and parks.

Non-residential
Office use comprises 7% of the total land area in the Town of Ossining and is also underdeveloped by current zoning standards. Currently, Office use consists only of the General Electric campus of which 16% is covered with impervious surfaces. If this parcel is developed to its fullest potential the total amount of impervious surface would potentially increase. The General Electric campus is also located adjacent to the Indian Brook Reservoir.

Approximately 11% of the Town of Ossining's land is Manufacturing or Warehouse. Although they do not make up a majority of the land area in the Town, the percentage of impervious surfaces is 15% and activities are associated with these uses that possibly generate polluted runoff.

Figure 2-39. Town of Ossining Land Use in the watershed



Cedar Lake, Town of Ossining, New York

E. VILLAGE OF OSSINING

The Village of Ossining area is 2,036 acres of which 5%, approximately 99 acres, is located in the Indian Brook-Croton Gorge Watershed. The Village of Ossining has the smallest land area of all municipalities in the watershed (3%) and is solely located in the Indian Brook subwatershed.

The Indian Brook Reservoir (Figure 2-40) provides drinking water for the Village and even though the reservoir is located in the Town of Ossining it is owned by the Village. The Village is is served by a sanitary sewer system which discharges to and is treated at the County's Ossining Waste Water treatment facility located next to Sing Sing Correctional Facility in the Village.

Thirty-three percent of the Village of Ossining is classified as steep slopes. Steep slopes are found throughout the Village. Many of the steep slopes are located in developed areas. The Village of Ossining currently has environmental regulations that help improve and protect water quality in the watershed. An ordinance review was conducted and the regulations can be found in Appendix A: Additional Resources.

The Village of Ossining currently has a street sweeping program for public streets. The Village has mapped stormwater infrastructure and will be participating in the Westchester County's MS4-Phase II Stormwater Education and Outreach Program funded through the NYS Environmental Protection Fund supported by the NYSDEC.

The Village of Ossining has stormwater outfalls that discharge directly into the Croton Bay. The stormwater is not pretreated and often discharge occurs onto steep

Figure 2-40. Indian Brook Reservoir, Town of Ossining, New York

slopes causing erosion. The high rate of erosion on the slopes cause both structural instability of the slopes and increased sedimentation of the bay.

Currently, all stormwater runoff from Route 9 drains directly from the roadways and discharges into the Croton Bay. The stormwater is untreated and is most likely contributing many different types of pollutants to the bay.

Land Use in the Village of Ossining

Ninety-four percent of the total area of the watershed in the Village of Ossining is zoned residential. Twenty-six percent of the residentially classified land in the Village of Ossining is covered with impervious surfaces and contributes a majority of the nonpoint source pollution found in the Village of Ossining. The nonpoint source pollution comes from common activities performed in residential areas such as lawn care, car washing and pet waste disposal. Four percent of the watershed in the Village is classified as Open Space and 2% is classified as Non-residential.

Figure 2-41. Mystic Pointe, Village/Town of Ossining (photo credit Ginsburg Development Corporation)

Section 3.0 Recommendations

All five watershed municipalities are subject to Phase II regulations administered by New York State through the SPDES Program. The requirements that the municipalities must fulfill in relation to Phase II, combined with the information revealed through the planning process, reveals that each municipality, individually or in partnership, can undertake specific activities to improve and protect water quality in the watershed.

Specific recommendations were developed according to the five goals of the plan. The recommendations include both activities that municipalities can undertake individually or in partnership with other municipalities in the watershed. Intermunicipal efforts have been recognized by state and federal agencies as a preferred method to address watershed-wide problems. Intermunicipal efforts are typically more efficient and effective because resources can be shared without the constraints of political boundaries.

3.1 Goal: Protect and Restore Natural Resources

The Indian Brook-Croton Gorge Watershed contains vital natural resources including wetlands, watercourses and waterbodies. All five communities rely on the reservoirs, aquifers and private wells located throughout the watershed for drinking water supplies. It is critical to protect and improve these water resources. The following recommendations relate to the preservation and restoration of natural resources in the watershed. Information found in Section 2.5, *Existing Conditions: Natural Resources*, is the foundation for the following recommendations.

Figure 3-1. Croton River Gorge, Cortlandt, New York

Recommendation 1:

Conduct Streamwalks in the Croton Gorge Basin

Streamwalk is a volunteer based stream surveying program developed by the Natural Resources Conservation Service (NRCS) that serves two purposes: natural resource assessment, and community involvement and education. Volunteers are trained to assess a stream's overall health by walking a segment of the stream and gathering information on existing physical conditions of in-stream and streamside characteristics. This information can be used later to identify resource needs and to plan conservation measures in the basin and is a first step in establishing an understanding of the condition of a watershed. Equally important as the data collected, is the educational role of the Streamwalk. Through a train-

ing program, local volunteers receive a basic course in stream ecology, morphology, water quality, non-point source pollution, and the relationship between a community and its river. The training session increases volunteers' awareness and understanding of potential impairments to the health of a river. What volunteers learn in the training session is reinforced when they conduct the survey itself. The survey brings volunteers into direct contact with a river and creates the opportunity for them to understand better the way a river system works and the relationships between their communities and the river.

Watercourses are vital components of a watershed, serving as the arteries that feed larger waterbodies. As such they are important indicators of watershed health, and degraded watercourses can be significant sources of pollution. The communities along the Croton River in the Croton Gorge subwatershed should undertake a Streamwalk. A Streamwalk was conducted for the Indian Brook subwatershed in 2002 (See Appendix A: Additional Resources), which can be easily used to develop a Streamwalk program for other watercourses in the watershed.

Figure 3-2. Water flowing in the Croton River

Recommendation 2:

Remediate Identified Problem Areas in the Indian Brook Basin

The Indian Brook Streamwalk (refer to Appendix A: Additional Resources) identified impairment areas in different stream segments. More detailed investigation of acknowledged impairments should be performed to determine the extent of impairment, ownership (public/private) and accessibility issues, and anticipated effectiveness for restoration purposes. Communities should work together in this effort and should prioritize projects, develop plans and seek funding for the remediation of impairments and the restoration of natural resources. The Westchester County Soil and Water Conservation District may be a valuable resource in such an effort.

Recommendation 3:

Protect Indian Brook Reservoir

The Indian Brook Reservoir is a drinking water source for the Town and Village of Ossining. Undeveloped and underdeveloped lands exist near the reservoir, and steps should be taken in the event these lands are developed to ensure that stormwater management practices are constructed to treat the maximum volume of runoff practical and are maintained in accordance with a practical and feasible operation and maintenance plan. Otherwise, the water quality of the reservoir may be degraded from polluted runoff. The Indian Brook Basin municipalities should also seek funding to acquire land surrounding the reservoir that would serve to increase the buffer area surrounding this important drinking water source. Potential partners might include local land trusts and state and county government. Land could be purchased outright or development rights (conservation easement) could be acquired.

Recommendation 4:

Protect Wetlands at the Local Level

State and federal agencies regulate certain activities in freshwater and tidal wetlands. However, the NYSDEC does not regulate activities in wetlands less than 12.4 acres in size unless they have been determined by the State to be wetlands of unusual local importance. The US Army Corp of Engineers (USACOE) regulates activities in wetlands that meet broader definitions, though there are exemptions for certain actions. The USACOE has a general permitting process for activities under various thresholds and has no regulation of activities within wetland buffer areas. For these and other reasons, regulations to protect all freshwater and tidal wetlands should be implemented and administered at the local level to ensure adequate protection of these fragile resources. Proposed land disturbance activities within wetlands and their associated buffer areas should be reviewed at the local level, and potential impacts should be avoided, minimized or adequately mitigated to the maximum extent practical. The Westchester County Soil and Water Conservation District's Model Ordinance for Wetland Protection should be used as a guide from which to evaluate the effectiveness of existing local wetlands ordinances. Mini-

mum area thresholds should not be included in the definition of freshwater or tidal wetlands. Minimum regulated buffer area extending 100 feet from the edge of a wetland should also be included in the ordinance. An ordinance review was conducted for each municipality and recommendations were made to ensure that local ordinances help protect wetlands. The ordinance review can be found in Appendix A: Additional Resources.

Recommendation 5:

Restore Degraded Wetlands

Many watershed wetlands have become dominated and degraded by invasive species. Funding should be sought to restore the wetlands, particularly the tidal wetlands located along the Route 9/9A corridor. Restoration of the wetlands would result in improved water quality and improved wildlife habitat, including vital fish habitat. Municipalities should utilize existing data available from the County and State as well as local data to identify and evaluate degraded wetlands. Municipalities should work in cooperation to identify and prioritize projects and seek funding to restore the wetlands. On-going monitoring should be a part of the restoration effort. The Westchester County Soil and Water Conservation District has an active aquatic habitat restoration program and can provide advice and assistance in this effort.

Figure 3-3. Tidal wetlands, Croton-on-Hudson, New York

Recommendation 6:

Ensure Proper Functioning of Septic Systems

A watershed-wide approach to ensure proper functioning of existing septic systems should be developed. Possible approaches include a requirement for inspection upon the transfer of property or when property owners apply for a building permit. The Westchester County Department of Health has approval authority over construction of new septic systems and responds to complaints of septic system failures. Neither the County, nor the watershed municipalities, has a program to track septic system maintenance or require inspections.

Recommendation 7:

Monitor the Croton River

As described in Section 2.5, *Existing Conditions: Natural Resources*, the surface water of the Croton River and Croton-on-Hudson's drinking water aquifer are potentially connected. The water quality of the Croton River must be protected in order to protect the drinking water aquifer. Monitoring for water quality parameters and other typical stormwater pollutants should be conducted regularly to ensure the good river water quality.

Recommendation 8:

Prevent Illegal Activities that Degrade Water Quality

Croton Bay municipalities should work with partners and other interested parties to monitor and control illegal activities, such as trespassing, littering, loitering and vandalism, that may degrade water quality in the watershed.

Recommendation 9:

Retain Tree Cover

Retain tree cover as forest and woodland to benefit wildlife and reduce stormwater runoff throughout the watershed.

Recommendation 10:

Maintain and Restore Forested Stream Buffers

Maintain and where possible restore forested stream buffers so as to protect wildlife and water quality.

3.2 Goal: Develop and Implement Stormwater Management Practices that Will Improve Water Quality

All municipalities in the watershed subject to Phase II MS4 regulations. Multiple stormwater management practices, all of which could contribute to the improvement of water quality in the watershed, and the ability for communities to implement Phase II MS4 stormwater requirements, should be implemented in the watershed.

Recommendation 1:

Develop and Adopt Stormwater Infrastructure Data Management Standards

Stormwater infrastructure data should be standardized throughout the watershed. Data should be collected and maintained in electronic form and geo-coded, enabling the data to be easily shared and incorporated into larger databases. Standards should be established for the data elements, scale of data, unit of measurement, frequency of collection, mapping datum and degree of accuracy. Maintenance activities, such as daily log information for road sanding and salting activities, schedules for catch basin cleaning, and general maintenance and repair work programs, should be included. A procedure to share appropriate data among towns and involved agencies should be developed so that each agency can make use of all relevant data in analyses.

Municipalities should also work to identify existing private infrastructure. Where feasible, mapping of all stormwater infrastructure, public and private, should be undertaken in conjunction with other programs or through routine maintenance of stormwater infrastructure.

Recommendation 2:

Establish Illicit Discharge Connection Program

An illicit discharge connection program should be developed to identify illegal connections. In addition, municipalities should develop a watershed-wide monitoring inspection program, including clear protocols for dealing with stormwater conveyance violations.

Recommendation 3:

Develop Stormwater Infrastructure Monitoring and Maintenance Programs

A. Develop Stormwater Infrastructure Monitoring Program

Stormwater infrastructure monitoring programs should be developed to ensure that existing stormwater infrastructure are operating effectively. The infrastructure should not contribute unnecessary pollutants into the watershed due to clogging, erosion or malfunction.

A routing schedule for inspection and maintenance should be established. Routing schedules that begin in the headwater areas of each sub-basin and progress to the discharge point within each sub-basin are most effective because they reduce the likelihood of the maintenance activity producing more work in areas that have already been maintained. Monitoring programs should include a protocol to address violations discovered during monitoring activities.

Figure 3-4. Catch Basin Cleaning Programs

- **List standard watershed-wide maintenance practices and identify those used throughout the municipality.**
- **Include a routine maintenance schedule. The cleaning schedule should coincide with street sweeping and other system maintenance efforts and where subwatershed areas cross municipal boundaries, coordination with the adjacent municipality should occur.**
- **Establish routing for catch basin cleaning, similar to other routing efforts, for water quality purposes.**

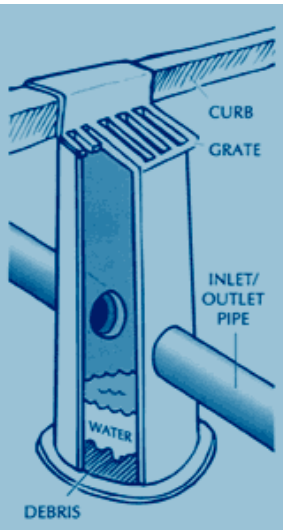


Image from: www.ci.farmington.mi.us

B. Improve Catch Basin Cleaning Program

A routine catch basin cleaning program should be developed and implemented by each watershed municipality. Development of the program should be coordinated with the stormwater infrastructure monitoring program and stormwater infrastructure mapping. Existing programs should be improved. The frequency of catch basin cleaning should be increased for water quality protection.

C. Maintenance of Private Stormwater Infrastructure

In many cases, catch basins on private property are not maintained by the municipalities. Owners of private stormwater infrastructure should be contacted and educated as to maintenance requirements of their stormwater infrastructure. Municipalities could provide private property owners with guidance documents describing how to develop stormwater infrastructure maintenance plans to address catch basin cleaning and parking lot sweeping.

D. Improve Water Quality Street Sweeping Program

Street sweeping is typically based on annual clean-up schedules, performance failures or complaints, not based on protecting water quality. Where subwatersheds are divided by municipal boundaries, street sweeping programs should be coordinated among the adjacent municipalities so as to ensure that sweeping efforts achieve the greatest benefits to water quality. The programs should utilize routing schedules as developed under the stormwater infrastructure monitoring program and be coordinated with other municipal maintenance activities such as catch basin cleaning, mowing and leaf collection.

Current street sweeping programs should be revised to protect water quality and coordinate with other stormwater control practices.

E. Develop Residential Curbside Leaf Collection Program

Municipal residential curbside leaf collection programs (either single or joint) should be developed. Leaf collection programs should consider street sweeping schedules and focus on timing beneficial to stormwater quality.

F. Create Stormwater Utility Districts

A stormwater utility district or other mechanism should be created to generate funding specifically for stormwater management. Currently under NYS law a stormwater utility district can be formed as a drainage district where property owners within the district pay a stormwater fee, and the revenue thus generated directly supports construction, maintenance and upgrade of storm drain systems.

Recommendation 4:

Develop Snow and Ice Operational Plan

Snow and ice operational plans (Figure 3-6) should be developed for each municipality. Plans should specify the type of highway deicing equipment used, the source and storage of materials and the application and calibration methods used for deicing materials.

Recommendation 5:

Participate in Household Hazardous Waste Collection

All municipalities should continue to participate and inform residents of the Westchester County Household Hazardous Waste Collection Days (Figure 3-5). The Westchester County Department of Environmental Facilities runs the program and collections occur four times a year.

Figure 3-5. Hazardous Waste Collection

Images from www.epa.gov

Recommendation 6:

Pretreat Stormwater Outfall Discharges and Identify Retrofit Opportunities

Currently untreated stormwater outfalls flow directly into streams and waterbodies of the watershed. Funding should be sought by municipalities to pretreat the stormwater prior to discharging it into the streams and waterbodies. The following problem areas have been identified for stormwater retrofits:

Figure 3-6. Snow and Ice Operational Plans

Snow and Ice Operational Plans should include:

- Make all material storage facilities permanent structures and fully enclose them.
- Mix handle and load all winter materials in covered areas.
- Install drainage and stormwater collection systems around the perimeter of storage areas to prevent salt and sediment loss to groundwater aquifers or nearby waterways.
- Wash salt trucks in designated areas designed to collect all resulting runoff.
- Remove spilled salts and excess materials remaining in trucks, yards or on roads after every storm.
- Routine calibration of spreading equipment should be conducted throughout the winter season.
- Coordination of snow and ice removal with maintenance of the stormwater conveyance system (i.e. street sweeping and stormwater/catch basin cleaning).
- Explore new technologies as made available.
- Plans should include specific procedures for handling and storing road sand and salt. Proper containment of road sand and salt is imperative for water quality protection.

Current Salt Storage Facility for the Town of Ossining, NY

Figure 3-7. Untreated outfalls leading to Croton River.

- **Route 9/9A:** Currently, all stormwater runoff from Route 9/9A drains directly from the roadways into the Croton Bay. Route 9/9A is a four-lane heavily traveled highway and is the only north-south truck route along the Hudson River in Westchester County. Untreated stormwater from this road contributes to pollutants in the Croton Bay.
- **Outfalls to Croton Bay:** Located in the Town and Village of Ossining are outfalls that discharge directly into the Croton Bay. The stormwater is not pretreated and a majority of the time it is discharged onto steep slopes causing erosion. The high rate of erosion creates both structural instability of the slopes and increased sedimentation of the bay. Major areas of concern are St. Augustine's cemetery and the Mystic Point development.
- **Outfalls to Croton River:** Several outfalls (Figure 3-7) discharge directly into the Croton River and upon investigation the stormwater did not appear to be pretreated. Often times the stormwater outfalls discharged onto steeply sloped areas, causing the slopes to erode. The high rates of erosion from the stormwater discharges lead to structural instability of the slopes and increased sedimentation of the River.
- **Croton-Harmon Metro-North Railroad Station:** The Croton-Harmon Metro-North railroad station and maintenance yard contains a very large parking lot with over 2,000 parking spaces that floods during heavy rains. Presently, stormwater runoff from the southern half of the rail yard discharges into the Croton Bay through an outfall pipe located at the southern end of the site. A retrofit project is currently underway that will replace the existing 54 inch storm drain pipes with 60 inch diameter pipes and install an oil/water separator to treat the runoff prior to discharge. Only the mid to southern portions of the rail yard will benefit from the oil/water separator. All runoff from the entire area of the Croton-Harmon parking lot (Figure 3-8) should be treated.
- **Stormwater Sheet Flow:** Some residential districts in the watershed do no have stormwater infrastructure. Instead, sheet flow is the primary

Figure 3-8. Croton-Harmon Metro-North Railroad Station Parking Lot

method of stormwater conveyance. Adequate pervious surfaces must be maintained in areas of sheet flow for stormwater to properly infiltrate. Inspections should be conducted to assure that erosion is not occurring in areas where stormwater is directed with sheet flow, especially on existing roads. If upon inspection, erosion problems are discovered, action should be taken to rectify the situation with proper stormwater best management practices. Sheet flow towards the Croton River is an area of primary concern.

- **Shop Rite Shopping Center:** The Shop Rite Shopping Center located on Riverside Avenue in Croton-on-Hudson has a large parking lot that drains into catch basins during each rainstorm. Currently, onsite stormwater is not being treated in the privately owned parking lot. The existing storm drains from this shopping center run underneath Route 9/9A and discharge into the Croton Bay.

Recommendation 7:

Restore Eroded Streambanks

Tremendous erosion occurs along the streambanks of the Croton River, depositing soil and other pollutants into the Croton River and the Croton Bay. The erosion often results from unstable outfalls which discharge directly onto the steep slopes. Further studies should be conducted to find the areas of severe erosion and funding should be sought to restore these areas. Municipal highway staff should be trained in proper methods of repair that minimize erosion of drainage swales located adjacent to roads.

Figure 3-9. Eroded streambank on Quaker Bridge Road, Cortlandt

Road runoff in Cortlandt, especially along Quaker Bridge Road, commonly discharges into roadside swales. When roadside swales are poorly designed or maintained they can cause structural instability of the sides of roads and an increase in sedimentation of the receiving waterbody. Roadside swales, however, can be an effective method to control stormwater runoff flow if properly constructed and protected by vegetation or riprap.

3.3 Goal: Promote Sustainable Development Through Land Use and Environmental Regulations

Each land use in the watershed, in one way or another, contributes nonpoint source pollution to the watershed through activities occurring on the land and through the amount of impervious surfaces that exist. Forty-five percent of the watershed is currently residential. Many existing residential areas are considered underdeveloped according to local zoning. Eleven percent of the watershed is undeveloped land. The following section provides recommendations aimed at reducing the impact of existing and future land uses on water quality. Municipalities should review land development regulations and identify sections that may need amending to incorporate low-impact development standards but continue to address concerns of public health and safety. Sustainable land development can also benefit wildlife, as suggested in the Croton-to-Highlands Biodiversity corridor.

Recommendation 1:

Institute Stormwater Controls for Development

Stormwater best management practices and specific site plan requirements should

be developed and applied to building permits and site plans for new construction and redevelopment for the purpose of protecting water quality in each of the watershed municipalities.

Recommendation 2:

Establish Impervious Surface Limits and Alternatives

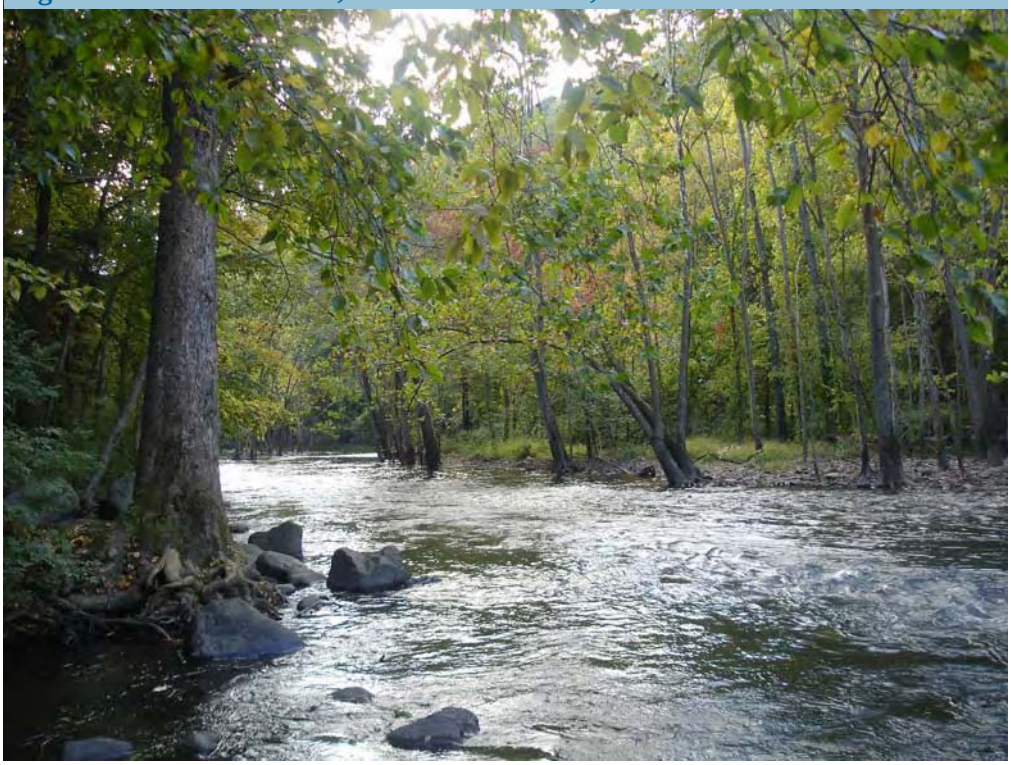
Land use regulations should be modified to set maximum limits on the amount of impervious lot coverage including all impervious surfaces such as driveways, patios and pools. Regulations should encourage alternatives to impervious surfaces such as pervious pavement, open pavers and gravel.

Recommendation 3:

Establish an Indian Brook Reservoir Overlay Zone

A majority of the land surrounding the Indian Brook Reservoir and the tributaries flowing into the reservoir is currently underdeveloped. If fully developed, the Indian Brook Reservoir could become increasingly threatened by nonpoint source pollution. Additional development could have an adverse effect on the water quality of the Reservoir, especially if certain stormwater management practices are not instituted. In an effort to protect water quality, an overlay zone should be implemented to limit impervious coverage, establish buffers, prevent steep slope development and protect environmentally sensitive areas surrounding the Reservoir. Currently, New Castle has established an overlay zone for this area to protect resources, but the restrictions are limited, pertaining mostly to wetland buffers.

Figure 3-10. Croton River, Croton-on-Hudson, NY



Recommendation 4:

Develop a Croton Aquifer Overlay Zone

The Village of Croton-on-Hudson relies on an aquifer to supply its drinking water and has a drinking water ordinance to protect this aquifer. The recharge areas for the aquifer go beyond the Village's political boundaries and management of the total aquifer recharge area is necessary. An overlay zone that follows the aquifer boundaries would further protect the recharge area of the Croton aquifer. The overlay zone should include provisions regarding impervious surface limitations and contaminants. Cortlandt and New Castle have attempted to provide some groundwater quality protection in the watershed through an overlay zone, but the current provisions do not provide adequate protection.

Recommendation 5:

Update Comprehensive Plans

Watershed municipalities should review and update their existing comprehensive plan to be consistent with the Indian Brook-Croton Gorge Watershed Plan.

Recommendation 6:

Protect Open Space

Each municipality should work to protect open space in the watershed for protection of water quality and biodiversity. Open space can be protected through acquisition, establishment of conservation easements and new zoning designations such as park and recreation zoning districts and protective overlay zones.

Open space protection plans should be prepared by each municipality in the watershed. The plans should establish criteria for evaluating the value of parcels for open space protection in terms of potential water quality impacts and preservation of community character. Environmentally sensitive areas and areas that will connect with other open space parcels should be a high priority for open space preservation to better protect the environment and biodiversity corridors. Properties should be identified for protection as permanent open space.

Preservation of undeveloped land as open space should be considered, particularly in areas with environmentally sensitive resources. Consideration should be given to purchasing land through land trusts, dedicated revenue sources and purchasing development rights.

Federal, State and local sources of funding for open space protection exist. Municipalities should seek partnerships with NYCDEP, Westchester County, New York State, land trusts and others to assist in securing grants and funding for the preservation of open space.

Recommendation 7:

Adopt New or Amend Current Ordinances to Reflect Model Environmental Ordinances

Environmental regulations may be the single most important tool available to a community to protect its natural resources and wildlife. As part of the Indian Brook-Croton Gorge Watershed Plan, an ordinance review was conducted for each municipality and recommendations were made to ensure that local ordinances help protect water quality. The watershed ordinance review can be found in Appendix A: Additional Resources.

All municipalities should seek to adopt or amend the recommendations found within the ordinance review which include recommendations for the following environmental areas:

- Drinking Water
- Wetlands and Watercourses
- Erosion and Sediment Control (including Steep Slopes)
- Stormwater
- Trees and Vegetation
- Refuse Management
- Site Design

3.4 Goal: Preserve and Protect Fish, Wildlife and Significant Habitat

Steps must be taken on a watershed level to help preserve and restore the existing habitats (Figure 3-11) thus preserving plant and animal diversity in the watershed. The following recommendations concern the preservation and restoration of biodiversity in relation to information found in Section 2.6 *Existing Conditions: Fish, Wildlife and Significant Habitat.*

Figure 3-11. Woods in Croton

Recommendation 1:

Prepare a Biodiversity Plan for the Watershed

Conduct fish, wildlife and habitat inventory for the parts of the watershed not included in the *Croton-to-Highlands Biodiversity Plan* to identify additional areas in the watershed where the existing plan's recommendations can be implemented. The study area in the *Croton-to- Highlands Biodiversity Plan* includes sections of the Indian Brook-Croton Gorge Watershed in Cortlandt and New Castle. A similar biodiversity plan inventory and study should be conducted to expand the *Croton-to-*

Highlands Biodiversity Plan study area to include the entire watershed. Sources of funding should be sought to support this expanded study. In addition, the watershed municipalities should seek funding sources and support for implementation of recommendations in the *Croton-to-Highlands Biodiversity Plan* and future recommendations that would result from other biodiversity studies in the watershed.

Recommendation 2:

Investigate Croton River Flow Fluctuations

The Croton River's complex system of flow is influenced by sheet flow, storm drain outfalls and releases from the New Croton Dam. Further investigation should be conducted to determine how the current flow affects wildlife in the river corridor and if changes could occur to help protect biodiversity in the watershed.

3.5 Goal: Educate the Public

Education and outreach is a very important component of any watershed plan. Without the support of local government, organizations and residents, the goals of any watershed plan would be difficult to accomplish. Watershed citizen education includes illustrating the connection between everyday activities and its impact on water quality. The education of local officials who create and administer regulations, permits and policies is also important. The following recommendations relate to education, outreach and public involvement programs that the watershed municipalities should undertake to protect water quality.

Recommendation 1:

Require Board/Committee Member Stormwater Training

Legislation should be adopted at the local level to set minimum annual stormwater training/education requirements for planning, zoning and conservation boards.

Recommendation 2:

Develop an Education and Training Program for Highway Personnel

An education and training program should be developed on a watershed-wide basis for highway personnel providing up-to-date information on stormwater management functions including roadside swale maintenance, winter material calibration, material handling and facility cleaning.

Recommendation 3:

Develop and Participate in Community Natural Resource Education Programs

A. Continue to Participate in the MS4-Phase II Stormwater Education and Outreach Program

Many residents are not familiar with the natural resources found in the watershed. Individual homeowners should be educated to understand the connection between the resources and the residents living in the local communities. Homeowners

should also be educated about techniques that reduce the adverse impact of house maintenance activities on water quality. House maintenance activities include snow removal and deicing, fertilizer and pesticides application, lawn mowing and fall leaf cleanup.

Watershed municipalities should continue to actively participate in Westchester County's MS4-Phase II Stormwater Education and Outreach Program funded through the NYS DEC. Over thirty other Westchester County municipalities are participating in this program.

CVMP Monitoring Program
To find out more about the CVMP or to sign up to be a volunteer, go to the program website at:

http://cvmp.westchestergov.com/cvmp

B. Participate in the Westchester County Citizens' Volunteer Monitoring Program

The Westchester County Citizens' Volunteer Monitoring Program (CVMP) involves gathering and sharing information on the health of streams and waterbodies. Volunteers attend a training session where they: 1) learn about the physical (general appearance), chemical (pH, conductivity, etc.) and biological (critters) characteristics of streams and waterbodies, 2) form a monitoring team and 3) receive equipment to begin monitoring a specific stream area. All data is entered into a centralized database. The data, along with the tools to create charts, graphs and run statistical analysis, is accessible to anyone with internet access. Each watershed municipality should have a team monitoring at least one location in their municipality.

Section 4.0 Implementation of Watershed Plan Through Intermunicipal Cooperation

Create an Intermunicipal Agreement for Plan Implementation

Water flows across tax parcels, zoning districts and political boundaries. Municipalities should coordinate decisions and activities that affect water resources as much as possible. For projects that impact one or more communities, both upstream and downstream within a shared sub-basin, a coordinated review should be required among impacted communities. Project review should be applicable to new projects and to retrofit and maintenance projects as well. Project review may require joint planning or town board meetings to discuss development projects in neighboring communities.

Figure 4-1 on the following page outlines the recommendations that each individual municipality should focus on given their geographical location and natural features. The implementation of the recommendations when taken together creates a coordinated, comprehensive approach to protect natural resources within the Indian Brook-Croton Gorge Watershed. Not all recommendations need to be implemented. Many municipalities will need to work together to obtain funding and fully implement the recommendations.

Each community supported a grant application that was awarded to the Westchester County Department of Planning (WCDP) to create an intermunicipal agreement (IMA) to coordinate the implementation of select recommendations found within this plan. The WCDP will be working closely with the municipalities to develop this IMA.

The Croton River

Figure 4-1. Indian Brook-Croton Gorge Watershed Recommendations

	Cortlandt	Croton-on-Hudson	New Castle	Ossining (T)	Ossining (V)
3.1 Goal: Protect and Restore Natural Resources					
Recommendation 1: Conduct Stream-walks in the Croton Gorge Basin	◆	◆	◆	◆	
Recommendation 2: Remediate Identi-fied Problem Areas in the Indian Brook Basin	◆		◆	◆	◆
Recommendation 3: Protect Indian Brook Reservoir	◆	◆	◆	◆	◆
Recommendation 4: Protect Wetlands at the Local Level	◆	◆	◆	◆	◆
Recommendation 5: Restore Degraded Wetlands	◆	◆	◆	◆	◆
Recommendation 6: Ensure Proper Functioning of Septic Systems	◆	◆	◆	◆	
Recommendation 7: Monitor the Croton River	◆	◆			
Recommendation 8: Prevent Illegal Activities that Degrade Water Quality	◆	◆	◆	◆	◆
Recommendation 9: Retain Tree Cover	◆	◆	◆	◆	◆
Recommendation 10: Maintain and Restore Forested Stream Buffers	◆	◆	◆	◆	◆
3.2 Goal: Develop and Implement Stormwater Management Practices that will Improve Water Quality					
Recommendation 1: Develop and Adopt Stormwater Infrastructure Data Management Standards	◆	◆	◆	◆	◆
Recommendation 2: Establish Illicit Discharge Connection Program	◆	◆	◆	◆	◆
Recommendation 3: Develop Stormwa-ter Infrastructure Monitoring and Maintenance Programs	◆	◆	◆	◆	◆
Recommendation 4: Develop Snow and Ice Operational Plan	◆	◆	◆	◆	◆
Recommendation 5: Participate in Household Hazardous waste Collection	◆	◆	◆	◆	◆
Recommendation 6: Pretreat Stormwa-ter Outfall Discharges and Identify Retrofit Opportunities	◆	◆	◆	◆	◆
Recommendation 7: Restore Eroded Streambanks	◆	◆		◆	◆

Figure 4-1. Indian Brook-Croton Gorge Watershed Recommendations, cont.

	Cortlandt	Croton-on-Hudson	New Castle	Ossining (T)	Ossining (V)
3.3 Goal: Promote Sustainable Development Through Land Use and Environmental Regulations					
Recommendation 1: Institute Stormwater Controls for Development	◆	◆	◆	◆	◆
Recommendation 2: Establish Impervious Surface Limits and Alternatives	◆	◆	◆	◆	◆
Recommendation 3: Establish Indian Brook Reservoir Overlay Zone	◆		◆	◆	◆
Recommendation 4: Develop a Croton Aquifer Overlay Zone	◆	◆			
Recommendation 5: Update Comprehensive Plans	◆	◆	◆	◆	◆
Recommendation 6: Protect Open Space	◆	◆	◆	◆	◆
Recommendation 7: Adopt New or Amend Current Ordinances to Reflect Model Environmental Ordinances	◆	◆	◆	◆	◆
3.4 Goal: Preserve and Protect Wildlife and Significant Wildlife Habitats					
Recommendation 1: Prepare a Biodiversity Plan for the Watershed	◆	◆	◆	◆	◆
Recommendation 2: Investigate Croton River Flow Fluctuations	◆	◆	◆	◆	
3.5 Goal: Educate the Public					
Recommendation 1: Require Board/ Committee Member Stormwater Training	◆	◆	◆	◆	◆
Recommendation 2: Develop an Education and Training Program for Highway Personnel	◆	◆	◆	◆	◆
Recommendation 3: Develop and Participate in Community Natural Resource Education Programs	◆	◆	◆	◆	◆

Section 5.0 Appendices

A. Additional Resources (on CD)
Contains more information on the following subjects discussed in the IBCG Plan:

- Soil Descriptions: Contains a detailed map of the soils in the IBCG Watershed, descriptions of the soil types, their soil taxonomy and hydrologic classification and if they are considered hydric soils
- Wetlands: Additional information on wetlands, wetland regulations and regulatory definitions of wetlands
- Surface Water Classifications: Information on the NYSDEC surface water classifications and their definitions
- Indian Brook Streamwalk: Contains the streamwalk report published in 2004
- IBCG Environmental Regulatory Review: Contains the ordinance review document completed in 2004
- Croton River Flow Analysis: Additional material developed by the NYSDEC Hudson River Estuary Program on the issues concerning the current flow of the Croton River
- Water Quality Analysis

B. Methodologies and Analysis (on CD)
Contains more information on the following land use and water quality analysis discussed in the IBCG Plan:

- Land Use Classification;
- Impervious Surface Calculations;
- Existing Field Conditions;
- Non-structural Stormwater Management Practices;
- Water Quality Impairment Model

C. Croton Bay Railroad Tie Removal Study (on CD)

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