Appendix A: Existing Conditions

A.1. Planning and Land Use Environment

Contents

Demographics

Town of Greece

The 2010 Census data shows that the Town's population is 96,095, with the highest age percentile (8.3%) between 50 to 54 years. The median age is 40.6 years. Of the three municipalities, the Town of Greece has the most people aged 65 years or older (16,011 persons, or 16.6%). About 5% of the population is under the age of 5. The Town of Greece is also the most diverse of the three municipalities, with 88.7% of the population being white, while 6% is Black or African American and 1.7% is Asian. Nearly 5% of the population identifies as Hispanic or Latino. Approximately 10% of the total population speaks a language other than English, which is also the greatest amount between the Towns of Greece and Parma and Village of Hilton.

A majority of the households are "family households" (66.2%): households with children under 18 years of age accounts for 27.5% and husband-wife family units account for 49.5%. Of the nonfamily households, householders living alone account for 28.0%. About 29% of households have individuals 65 years and over. The average household size is 2.41 persons. An estimated 7,898 individuals (8.3%) are living below the poverty level.

There are a total of 41,190 housing units in the Town of Greece, of which 39,407 are occupied. About 73% of the occupied units are owner-occupied.

Village of Hilton

The 2010 Census data shows that the Village of Hilton's population is 5,886, with the greatest amount of people between the ages of 50 to 54 years (8.3%). The median age is 38.6 years. Nearly 800 persons are aged 65 years or older (13.4%) and 358 persons are under the age of 5 (6.1%). A majority of the population is white (98.7%), while 1.5% is Black or African American and .3% is Asian. Persons who self-identify as Hispanic or Latino account for 2.3% of the population. Approximately 6% of the total population speaks a language other than English.

A majority of the households are "family households" (69.1%): households with children under 18 years of age accounts for 33.3% and husband-wife family units account for 51.3%. Householders living alone account for 21.8% of the nonfamily households. Almost 26% of households have individuals 65 years and over. The average household size is 2.50 persons. An estimated 338 individuals (5.7%) are living below the poverty level.

The Village of Hilton has a total of 2,459 housing units; 2,351 (95.6%) of those units are occupied. Of the three municipalities, the Village has the greatest percentage of renter-occupied units (34.0%).

Town of Parma

The 2010 Census data shows that the Town of Parma's population is 15,633, with the greatest amount of people between the ages of 50 to 54 years (9.5%). The median age is 41.7 years. About 2,100 persons are aged 65 years or older (13.7%) and 842 persons are under the age of 5 (5.4%). A majority of the population is white (96.6%), while 1.2% is Black or African American and .5% is Asian. Two percent of the population identifies as Hispanic or Latino. Nearly 5% of the total population speaks a language other than English.

A majority of the households are "family households" (73.6%): households with children under 18 years of age accounts for 31.5% and husband-wife family units account for 59.9%. Of the nonfamily households, 21.8% live alone. Twenty-six percent of households have individuals 65 years and over.

The average household size is 2.41 persons. An estimated 1,189 individuals (7.6%) are living below the poverty level.

Of the Town's 6,309 total housing units, 5,994 are occupied and the majority (81.0%) is owner-occupied.

Current Land Use

Land use characteristics of the three municipalities have been analyzed using New York State RPS and FIRM data in the *Community Flood Characterization* section. This section discusses TNC's Active River Area (ARA)[1] and areas identified as "floodprone."

The ARA is a visual and spatial representation of rivers that includes the channels and riparian lands necessary to accommodate the physical and ecological processes associated with river systems. "Active" is composed of the physical processes that form, disturb, and maintain different aquatic and riparian habitat components over space and time. "River Area" means the lands that contain both aquatic and riparian habitats as well as those that contain processes that interact with a river or channel. Physical processes include system-wide hydrologic connectivity, floodplain hydrology, and sediment movement along a river corridor. The ARA considers physical processes and habitats in relation to three watershed positions: upper, mid, and lower. The ARA is not the regulatory floodplain (what is known as the SFHA or 1%-annual-chance flood). For this project, they are the lands with the potential for "localized flooding problems." Local or localized flooding is smaller scale flooding that can occur anywhere in a community, which includes shallow flooding in low-lying areas after a heavy rain, flooding in small watersheds, ponding, and localized stormwater and drainage problems.

FEMA also identifies localized flooding as those areas with 0.2% probability of flooding, or the 500-year floodplain. They are depicted as shaded Zone X on the community's FIRM. Unshaded Zone X is land above the 0.2% flood elevation. Properties located in an unshaded Zone X are considered to be at low risk of flooding under the NFIP. Flood insurance is typically not required for properties located in a shaded or unshaded Zone X, as the NFIP does not require communities to take action to reduce or prevent losses in these areas. Although X Zones do not experience the type of flooding that meets NFIP criteria to be mapped as the SFHA or require flood insurance, these are the areas that usually receive

[1] M.P. Smith, R. Schiff, A. Olivero, and J.G. MacBroom, *The Active River Area: A Conservation Framework for Protecting Rivers and Streams* (The Nature Conservancy: Boston, MA, 2008).

shallow, localized flooding. Nationally, about 25% of all flood insurance claims come from properties outside the SFHA.[2]

When the definition of the flood hazard area is broadened to include both the SFHA and ARA, much more of the community becomes vulnerable to flooding: an increase of 8,715 acres in the Town of Greece; 178 acres in the Village of Hilton; and 7,011 acres in the Town of Parma (see Table 1). Residential property type is now the majority land use susceptible to localized flooding—which could be anything from stormwater and nuisance flooding to flooding on small streams, poor drainage, and ponding.

New York State Property Type Classification Code	Town of Greece	Village of Hilton	Town of Parma	No Data	Project Area
Agriculture	476.09	0	1,514.53	-	1,990.62
Commercial	642.75	37.92	224.47	-	905.14
Community Services	743.05	52.89	64.33	-	860.27
Conservation/ Public Lands	2,770.92	25.04	103.77	-	2,899.73
Industrial	31.02	0	37.51	-	68.52
Public Services	361.25	11.25	0.67	-	373.16
Recreation/Entertainment	127.82	0.16	252.73	-	380.71
Residential	4,913.24	103.69	4218.53	-	9,235.46
Vacant	1,573.27	32.89	2,198.74	-	3,804.90
No Data	-	-	-	206.00	206.00
Total Acres	**11,639.40**	**263.84**	**8,615.28**	**206.00**	**20,724.52**

Table 1: Acreage in the Active River Area.

The last component of the land use assessment utilizes interviews with the municipal representatives to delineate frequently flooded sites. These could be areas that are part of the SFHA, X Zones, or the ARA. Most of the areas delineated by the representatives from the Town of Greece and Village of Hilton with local drainage problems and flooding have commercial properties as opposed to the Town of Parma, whose representatives identified residential areas as being more floodprone than any other property type (see Table 2).

[2] "Flood Coverage Outside a Flood Zone," *New York Times*, April 17, 2005, accessed May 12, 2016, http://www.nytimes.com/2005/04/17/realestate/flood-coverage-outside-a-flood-zone.html?_r=0.

New York State Property Type Classification Code	Town of Greece	Village of Hilton	Town of Parma	Project Area
Commercial	70.89	17.89	-	88.77
Community Services	0	15.31	0.41	15.72
Conservation/Public Lands	34.82	-	-	34.82
Recreation/Entertainment	1.39	-	-	1.39
Residential	50.37	1.22	66.56	118.14
Vacant	12.96	-	-	12.96
Total	**170.42**	**34.41**	**66.98**	**271.81**

Table 2: Acreage in Floodprone Areas.

Historical Land Use

Understanding how land use in each community has changed over time is equally important as understanding current land use and its relationship to the floodplain. As floodplain filling and development in the watershed has progressed, flooding problems have likely increased.

Three sources of data were used to review changes in land use within the Towns of Greece and Parma and the Village of Hilton: the Historical Land-Use and Land-Cover Data Sets of the U.S. Geological Survey; National Land Cover Database (NLCD) 2011; and the *Land Use Report for Monroe County, New York: Major Projects Proposed, Approved and Constructed in 2013* (2013 Land Use Report). These municipal datasets can be found in Appendix A.

The historical Land Use and Land Cover (LULC) data consists of land use and land cover classification data based primarily on the manual interpretation of 1970s and 1980s National High-Altitude Photography (NHAP), usually at scales smaller than 1:60,000, with land use maps and surveys as secondary sources. The 1:250,000-scale topographic map series is generally used as the base map, sometimes referred to by the format name GIRAS (Geographic Information Retrieval and Analysis System). Anderson Level II land use codes are used to categorize this dataset:

1. Urban or Built-up Land: residential; commercial and services; industrial; transportation, communication, utilities; industrial and commercial complexes; mixed urban or built-up land; and other urban or built-up land.
2. Agricultural Land: cropland and pasture; orchards, groves, vineyards, nurseries, and ornamental horticultural; confined feeding operations; and other agricultural land.

3. Rangeland: herbaceous rangeland; shrub and brush rangeland; and mixed rangeland.
4. Forest Land: deciduous forest land; evergreen forest land; and mixed forest land.
5. Water: streams and canals; lakes; reservoirs; and bays and estuaries.
6. Wetland: forested wetland and nonforested wetland.
7. Barren Land: dry salt flats; beaches; sandy areas not beaches; bare exposed rock; strip mines, quarries, gravel pits; transitional areas; and mixed barren land.
8. Tundra: shrub and brush tundra; herbaceous tundra; bare ground; wet tundra; and mixed tundra.
9. Perennial Snow or Ice: perennial snowfields and glaciers

National Land Cover Database 2011 (NLCD 2011) is the most recent national land cover product that provides for the first time the capability to assess wall-to-wall, spatially explicit, national land cover changes and trends across the United States from 2001 to 2011. Created by the Multi-Resolution Land Characteristics (MRLC) Consortium, NLCD 2011 provides the same 16-class land cover classification scheme (additional four classes in Alaska only) as the two previous products (NLCD 2001 and 2006). It has been applied consistently across the United States at a spatial resolution of 30 meters with 2011 Landsat satellite data. Classes/values are modified from the Anderson Land Cover Classification System:

1. Water: open water and perennial ice/snow.
2. Developed: open space; low intensity; medium intensity; and high intensity.
3. Barren: barren land (rock/sand/clay).
4. Forest: deciduous forest; evergreen forest; and mixed forest.
5. Shrubland: dwarf scrub and shrub/scrub.
6. Herbaceous: grassland/herbaceous; sedge/herbaceous; lichens; and moss.
7. Planted/Cultivated: pasture/hay and cultivated crops.
8. Wetlands: woody wetlands and emergent herbaceous wetlands.

The 2013 Land Use Report provides up-to-date land use data within Monroe County using funds from the Genesee Transportation Council (GTC) Unified Planning Work Program (UPWP). The Land Use Report generally deals with permits versus actual construction. Property Type Classification Codes developed by the New York State Office of Real Property Services are used to compile data, such as the total number of parcels, or properties; property acreage; and percentages for both properties and acreage in each of nine categories:

1. Agricultural: property used for the production of crops or livestock.
2. Residential: property used for human habitation. Living accommodations such as hotels, motels, and apartments are in the commercial category.

3. Vacant Land: property that is not in use, is in temporary use, or lacks permanent improvement.
4. Commercial: property used for the sale of goods and/or services.
5. Recreation and Entertainment: property used by groups for recreation, amusement, or entertainment.
6. Community Services: property used for the well-being of the community.
7. Industrial: property used for the production and fabrication of durable and nondurable man-made goods.
8. Public Services: property used to provide services to the general public.
9. Wild, Forested, Conservation Lands and Public Parks: reforested lands, preserves, and private hunting and fishing clubs.

Due to variations in each dataset's classification system, the comparison charts below group the classes/values into four basic land uses: agricultural, developed, wild or forested land, and water. Agricultural acreage encompasses: (1) agricultural land from the historical LULC data; (2) planted/cultivated area from the NLCD 2011 data; and (3) agricultural property from the 2013 Land Use Report. Acreage of developed land includes: (1) urban or built-up land from the historical LULC data; (2) developed areas from the NLCD 2011 data; and (3) residential, vacant land, commercial, recreation and entertainment, community services, industrial, and public services property from the 2013 Land Use Report. Acreage in wild or forested land consists of: (1) rangeland, forest land, wetland, barren land, tundra, and perennial snow or ice from the historical LULC data; (2) barren, forest, shrubland, herbaceous, and wetlands from the NLCD data; and (3) wild, forested, conservation lands and public parks from the 2013 Land Use Report.

The historical LULC and NLCD 2011 both identify "water" as a land use/land cover value while the 2013 Land Use Report's property class codes do not. "No data" is also a value used in the "2013 Property Classification Summary Final by Municipality" in the 2013 Land Use Report. The historical LULC and NLCD 2011 datasets do not utilize "No data" as a value.

Town of Greece

According to the 2013 Land Use Report, the Town of Greece was second only to the Town of Penfield in proposed construction of single-family homes (92 residential building permits) and first in proposed construction of two-family homes (28 residential building permits) in Monroe County. The historical 1970-1980 data shows that the Town of Greece had about 44% of its total land use as developed land. Today, approximately 83% of the town's total land area is developed. Since the 2001 *Community*

Master Plan Update (which utilizes New York State RPS data), residential uses in the Town have increased by 2.9%, from 42.5 to 45.4%. Parcels in agricultural use decreased by 2.88%. Commercial uses comprise 7.26% of the total land area, which is an increase of 3.26%. Approximately 651 acres of land are devoted to recreational uses, with an additional 2,893 acres designated as wildlife/natural areas. Collectively, this is an increase of 5.3% (from 8%) in recreation and open space. Vacant land is potential developable land area within the Town, typically consisting of abandoned farmland and environmentally constrained areas. Vacant land had comprised approximately 29% of the total land area in 2001—in 2013, vacant land amounted to about 17%. Land devoted to community services, industrial use, and public utilities has remained relatively stable over the last thirteen years. Agricultural land has decreased by 34% over the past forty years. Wild or forested land has not decreased as significantly as agricultural land, however—from 16% in 1970-1980 to 11% in 2013 (see Table 3).

Land Use Legend Classification	Historical Land Use and Land Cover 1970-1980 (in acres)	National Land Cover Database 2011 (in acres)	2013 Land Use Report for Monroe County (in acres)
Agricultural land	11,579	7,198	1,230
Developed land	13,156	18,189	22,154
Wild or forested land	4,870	10,203	2,893
Water	1,074	1,241	NA
No Data	NA	NA	355
Total Acres	30,679	36,831	26,632
(minus water)	29,605	35,590	-

The Census TIGER/Line® Files and Shapefiles reports that the Town of Greece has a geographic area of 51.41 square miles, or 32,902 acres.

Table 3: Historical Land Use – Town of Greece.

Village of Hilton

According to the 2013 Land Use Report, the Village of Hilton issued 2 (single-family) residential building permits—ranking the village similarly with other built-up villages such the Village of Brockport (3), Village of Spencerport (3), and Village of Fairport (1). In 1970-1980, 32% of the Village's total land area was agricultural land and 65% of the land was developed. The *Village of Hilton Master Plan* (1977) describes existing land use in the village as: 22% one and two-family residential; 4% multifamily residential; 2% commercial; 2.5% industrial; 1.5% public utilities; 18% school sites; 9% public and semi-public; 23% vacant, open space, agriculture; and 18% highway and railroad right-of-way. Commercial use today is 10.29% of the total land area, compared with 2% nearly thirty-seven years ago. The largest decrease in acreage is open space and agriculture, as the Village no longer reports agricultural property and reflects 3.57% in "wild, forested, conservation lands and public parks" (although some acreage could be accounted for in the "vacant land" category). Industrial use also decreased from 2.5% to .66%. Today, the Village of Hilton does not have any agricultural land. Most of its land use is developed, which accounts for 94% of its total land area. The other 4% is composed of wild or forested land (with 2% as "no data" (see Table 4).

Land Use Legend Classification	Historical Land Use and Land Cover 1970-1980 (in acres)	National Land Cover Database 2011 (in acres)	2013 Land Use Report for Monroe County (in acres)
Agricultural land	341	50	-
Developed land	685	942	922
Wild or forested land	29	62	35
Water	-	-	NA
No Data	NA	NA	27
Total Acres	1,055	1,054	984

The Census TIGER/Line® Files and Shapefiles reports that the Village of Hilton has a geographic area of 1.78 square miles, or 1,139 acres.

Table 4: Historical Land Use – Village of Hilton.

Town of Parma

According to the 2013 Land Use Report, the Town of Parma issued 28 (single-family) residential building permits. Out of thirty municipalities in Monroe County, Parma ranked ninth along with the Town of Chili for the total number of residential building permits issued in 2013. About 8% of Parma's total land area was developed in 1970-1980—74% was devoted to agricultural use. At the time of the 1989 *Master Plan Update*, less than 15% of the Town was developed for residential, commercial, or industrial use. Farmland and cropland accounted for approximately 40% of the land area of the Town, or roughly 10,950 acres. The remaining land was either vacant or functioned as natural areas. Seventy-nine percent of the total land area of the Town is now developed, with farmland and cropland accounting for about 20% (see Table 5).

Land Use Legend Classification	Historical Land Use and Land Cover 1970-1980 (in acres)	National Land Cover Database 2011 (in acres)	2013 Land Use Report for Monroe County (in acres)
Agricultural land	19,746	13,919	4,855

Developed land	2,120	3,158	19,676
Wild or forested land	4,966	9,742	NA
Water	110	132	NA
No Data	NA	-	331
Total Acres	26,942	26,951	24,862
(minus water)	26,832	26,819	-

The Census TIGER/Line® Files and Shapefiles reports that the Town of Parma has a geographic area of 41.22 square miles, or 26,380 acres.

Table 5: Historical Land Use – Town of Parma.

Existing Laws

Reviewing local general land use regulations and environmental laws provides the basis for future regulatory and programmatic recommendations. The Towns of Greece and Parma and the Village of Hilton all have the three basic land use laws (a zoning law that incorporates site plan review and subdivision regulations). Other environmental laws such as stormwater and floodplain management regulations are discussed below.

Town of Greece

As mentioned earlier, SFHA or regulatory floodplain is delineated on a community's FIRM and corresponds to a local law for flood damage prevention that the community enforces in exchange for flood insurance and many kinds of federal disaster assistance. The local law or ordinance contains specific standards for any development in the federally mapped SFHA. The initial FIRM for the Town of Greece was identified March 3, 1980.[3] This is the initial flood identification date, or the date that flood hazards were first identified. Current effective maps are dated August 28, 2008. This is the date the new or revised flood map becomes effective for flood insurance and flood management.

Chapter 117: Flood Damage Prevention was adopted by the Town Board on April 16, 2002. Most communities have enacted a stand-alone law or separate ordinance that includes all the NFIP regulatory requirements, usually based on a FEMA or state model. The Town of Greece enhanced the New York State Model Local Law by adding the definition of "Critical Facilities" in 2008. Critical facilities are defined as structures or facilities that use, store, and dispose of hazardous materials; hospitals and nursing homes; police and fire stations and all other emergency operations; vital public and private utility facilities; and communications infrastructure. Article VI of the Town's flood damage prevention

[3] "Community Status Book Report," Federal Emergency Management Agency, accessed 9 December 2015, https://www.fema.gov/cis/NY.html.

ordinance prevents new critical facilities from being located within the 1-percent and .2-percent annual chance floodplain. Each participating community in the state has a designated floodplain administrator. This is usually the building inspector or code enforcement official. The Building Inspector is designated as the local administrator to grant or deny floodplain development permits in the Town of Greece.
The Town of Greece has a Coastal Erosion Hazard Area (CEHA) local law, adopted as Chapter 83 by the Town Board on June 20, 1989. It requires a coastal erosion management permit for any regulated activity in an erosion hazard area as depicted on the "Coastal Erosion Hazard Area Map of the Town of Greece." The Town of Greece is one of 42 certified communities that oversee the CEHA permit application process and enforce the regulated activities within a coastal erosion hazard area. As a Certified Community, the Town is required to submit an annual assessment of their program to DEC's Coastal Erosion Management Section per 6 NYCRR Part 505.19.

Regulated activities for altering any freshwater wetland or adjacent area are also required to have a permit application filed with the Building Inspector via Chapter 120: Freshwater Wetlands. This local law is pursuant to the New York State Freshwater Wetlands Act and utilizes the DEC's "Freshwater Wetlands Map." Chapter 120: Freshwater Wetlands was adopted by the Town Board on August 31, 1976.

Cluster development, which is a form of subdivision development that concentrates buildings away from natural and environmentally sensitive areas on a site, is permitted under Chapter 211: Zoning, Article IX: Subdivision and Development Review. The land may be used for recreation, common open space, and the preservation of environmentally sensitive features such as floodplains and wetlands.

Village of Hilton

The initial FIRM was identified August 3, 1981. Current effective maps are dated August 28, 2008. Chapter 12A: Flood Damage Prevention follows the New York State Model Local Law. It was adopted by the Village Board of Trustees on May 6, 2008. The Code Enforcement Officer is designated as the local administrator to grant or deny floodplain development permits.

A Flood Hazard Protection District was recognized in the Village's Zoning Law (Local Law #1 of 1974), but was deleted on February 7, 2012 by L.L. 3, 2012 and is reserved for future use.

Town of Parma

The initial FIRM for the Town of Parma was identified August 1, 1978. Current effective maps are dated August 28, 2008. Chapter 59: Flood Damage Prevention also follows the New York State Model Local Law. It was adopted by the Town Board on July 15, 2008. The Building Department is designated as the local administrator to grant or deny floodplain development permits.

Through its zoning authority, the Town of Parma has six Environmental Protection Overlay Districts (EPODs) that are displayed on the "Town of Parma EPOD Maps" and include the Environmental Atlas maps prepared by the Monroe County Environmental Management Council (EMC). EPODs were created as part of Chapter 16: Zoning, adopted by the Town Board on March 17, 1998. The six districts are:

- EPOD (1) Large Wetland Protection District
- EPOD (2) Small Wetland Protection District
- EPOD (3) Floodplain Protection District
- EPOD (4) Stream Corridor Protection District
- EPOD (5) Woodlot Protection District
- EPOD (6) Lakefront Coastal Erosion Hazard District

EPOD (1) enforces freshwater wetlands activities regulated by the DEC for wetlands which are 12.4 acres or larger, and/or by the Army Corps of Engineers for any federally regulated wetlands. The applicant must show state and/or federally approved wetland boundaries on all preliminary and final development plans submitted for Planning Board review. EPOD (2) regulates certain activities applicable for wetlands which are between 1.0 and 12.4 acres in size. EPOD (3) doesn't impose additional regulatory control over development than is already provided in Chapter 59. However, applications for development within areas subject to flooding are referred to the Conservation Board for advisory review. EPOD (4) regulates certain activities within 50 horizontal feet from the edge of each stream, retaining a natural vegetative buffer of 25 feet. The boundaries of EPOD (5) Woodlot Protection District are delineated on the Town of Parma EPOD Maps and include all areas in the Town of Parma with five or more contiguous acres of woodlots. Activities are regulated and specific standards, such as a pre-, during- and post-protection plan for trees to be saved or moved, are in force. Lastly, the intent of EPOD (6) is "to provide notice of coastal erosion potential, direct applicants to the proper review authorities, and coordinate activities with other reviewing agencies for areas identified on Official Coastal Erosion Maps prepared by NYSDEC." The Town of Parma does not exceed the requirements of Article 34 of the

Environmental Conservation Law and therefore does not administer its own Coastal Erosion Hazard Area Program like the Town of Greece.

The Town also enforces a separate local law on freshwater wetlands, Chapter 62, which regulates certain activities and requires an application for a permit with the Clerk of the Town of Parma. Chapter 62 was adopted by the Town Board on August 30, 1976.

Stormwater Management

In New York State, the DEC administers a federal program (U.S. Environmental Protection Agency's (EPA) Stormwater Phase II Rule) to regulate stormwater runoff called the State Pollutant Discharge Elimination System (SPDES) Permit Program. There are two SPDES General Permits that govern how and when stormwater run-off is managed. The SPDES "General Permit for Construction Activity" authorizes eligible stormwater discharges from construction projects that disturb one or more acres of land. Developers must first obtain stormwater permit coverage before any activity begins.

Certain cities, towns, villages, counties and other types of public and quasi-public government units that own or operate small-scale storm sewer systems that discharge into New York State waters have been designated by DEC as Municipal Separate Storm Sewer Systems (MS4s). MS4 communities and certain covered entities wishing to discharge stormwater from their sewer systems must obtain coverage under the DEC SPDES "General Permit for Stormwater Discharges from Municipal Separate Storm Sewer Systems." They do so by submitting a Notice of Intent and indicating that they have developed and implemented a stormwater management program (SWMP). Under the General Permit, MS4 communities that have traditional land use regulations must enact a local law or ordinance requiring developers to prepare a Stormwater Pollution Prevention Plan (SWPPP). Each SWPPP is site specific and prescribes how stormwater will be managed during construction and post-construction. The *New York State Stormwater Management Design Manual* provides design standards that incorporate green infrastructure techniques to protect New York State waters from the adverse impacts of urban stormwater runoff.

Twenty-five municipalities (including the City of Rochester) are regulated as MS4s in Monroe County. The Towns of Greece and Parma and Village of Hilton are MS4s and therefore required to establish local control of stormwater impacts during and after construction and provide enforcement against illicit discharges. All three have adopted a stand-alone local law for stormwater management based on the model prepared by the Stormwater Coalition of Monroe County:

- Town of Greece, Chapter 176: Stormwater Management, adopted by the Town Board of the Town of Greece 12-18-2007 by L.L. No. 5-2007;
- Village of Hilton, Chapter 20-A: Stormwater Management, Local Law #7, 2007; and,
- Town of Parma, Chapter 128: Stormwater Management, adopted by the Town Board of the Town of Parma 4-1-2008.

Master Plans

Most successful planning efforts begin with a survey of existing conditions and a determination of the municipality's vision for the future. This process is usually referred to as comprehensive planning. A comprehensive plan should be thought of as a blueprint upon which zoning and other land use regulations are based. By reviewing each of the municipal comprehensive plans, a better sense of the community's perspective on future development and land use decisions with regard to flooding vulnerability can be assessed.

Town of Greece

The 2001 *Community Master Plan Update* (Update) is an update to the 1992 *Community Master Plan*. Many components of the Local Waterfront Revitalization Program (LWRP), which was prepared in 1999, have been integrated throughout this report. The Update is composed of six chapters: Introduction, Inventory and Analysis, Development of a Comprehensive Vision, Plan Elements and Recommendations, Alternatives, and Implementation Plan. Since the 1992 *Community Master Plan*, the Town has identified several areas of concern:

- Preservation of open spaces
- Preservation of neighborhood character
- Revitalization of commercial corridors
- Future industrial and office employment opportunities
- Prioritizing transportation and infrastructure needs
- Promotion of beautification and visual aesthetics
- Management of future growth

Water resources are discussed in Chapter II: Inventory and Analysis under the subtitle of Natural Characteristics. The Town of Greece contains several important water resources, including protected streams and waterbodies. Although Federal and New York State classified wetlands within the Town are mentioned, they are not discussed in detail. The following water resources are briefly discussed in the Update:

- Erie Canal, which runs through the southern section of the Town.
- Salmon Creek, Buttonwood Creek, and Larkin Creek are identified as protected streams.
- Protected waterbodies, such as Lake Ontario, Braddock Bay, Cranberry Pond, Long Pond, Buck Pond, Round Pond and Little Pond.

“Flooding” or “floodplains” are best identified throughout the Update grouped together with recreation, open space, and environmentally sensitive areas. In Chapter III: Development of a Comprehensive Vision, Goal B states, “Provide sufficient, well-located, active and passive recreational opportunities for town residents, while preserving environmentally-sensitive lands.” Several objectives that support sustainable floodplain management are:

- Preserve the existing environmentally sensitive natural areas remaining in the town, especially those near and adjacent to Lake Ontario.
- Develop and implement storm water management guidelines and best practices to treat stormwater runoff, protect streams, and to assure the quality of surface water that enters the town’s ponds and Lake Ontario.
- Appropriate funds for the purchase or other acquisition of land or development rights, to preserve open space.
- Identify, acquire, and preserve pristine forestland.

Recommendations for future growth in the Town over the next 10 to 15 years while preserving and enhancing the quality of life for all town residents are listed in Chapter IV: Plan Elements and Recommendations. The general recommendation for recreation, open space, and environmentally-sensitive areas is the preparation of an open space plan. The plan would identify lands to acquire in the future as open space based on the following criteria:

- Be of varying sizes
- Provide diversity of landscape
- Be environmentally sensitive

- Allow for natural habitats to occur
- Augment existing holdings of parkland

Other recommendations to protect and enhance the Town and direct future growth where sustainable floodplain management goals can be inferred are:

- Land use recommendations for Planning District#1: The Town Board should implement the recommendations of the LWRP in this area, including Critical Environmental Areas, Conservation & Passive Recreation Areas, and Parks & Active Recreation Area.
- Land use recommendations for Planning District #2: Replacement of outmoded infrastructure such as sidewalks, streets, sewers, and lighting.
- Land use recommendations for Planning District #3: Replace aging or inadequate infrastructure.
- Land use recommendations for Planning District #5: The parcels in this planning district that are used for agricultural purposes should continue in their present usage.
- Land use recommendations for Planning District #6: Several parcels should be preserved for continued agricultural use.
- Land use recommendations for Planning District #7: Develop, enhance, and protect open space and parkland within the canal corridor.
- Land use recommendations for Planning District #8: Large parcels that are used for farming should be conserved for continued agricultural use.
- Land use recommendations for Planning District #10: The parcels in this planning district that are used for agricultural purposes should continue in their present usage.
- Land use recommendations for Planning District #11: Cluster-type development would minimize the cost of sanitary sewers and other infrastructure.
- Draft and adopt a Planned Unit Development (PUD) district for the proposed Waterfront Development area of the Erie Canal, including the recommended Erie Canal Overlay District. The PUD would be a mixed-use development of office, light industrial, commercial, institutional, a limited amount of residential, and preservation of sensitive environmental features.
- Establish a new residential zoning district that requires a lower overall density. Cluster-type lots developed to this standard would provide an opportunity to preserve more open space. This district would be concentrated in parts of Planning Districts #5, #7, #10, and #11.

Lastly, Chapter VI: Implementation Plan establishes the actions that are necessary to implement the recommendations proposed in the preceding chapter. Most of the actions that relate to recreation, open space, and environmentally-sensitive areas are specific to active and passive parks and recreational facilities. Floodplain management can also be inferred under the following growth management actions:

- Adopt a Local Waterfront Revitalization District as an overlay district as part of the zoning ordinance as described in the recommendations for future land use for Planning District #1.
- Draft and adopt a Planned Unit Development District for lands in the Erie Canal Corridor Overlay District, as delineated in Planning District #7. Also, adopt an overlay district on each side of the Erie Canal for public use.
- Continue programs to conserve agricultural lands through Agricultural Districts to reduce overall housing densities and to preserve open spaces.
- Encourage the National Farm Trust and other private trusts to acquire development rights of agricultural used lands.

2001 Community Master Plan Update	Flooding/Floodplain Components	Status of Recommendation
Chapter III: Development of a Comprehensive Vision	Preserve the existing environmentally sensitive natural areas remaining in the Town, especially those near and adjacent to Lake Ontario.	450+ acres of open space acquired since the 2001 Master Plan.
	Develop and implement stormwater management guidelines and best practices to treat stormwater runoff, protect streams, and to assure the quality of surface water that enters the Town's ponds and Lake Ontario.	The Town adopted its stormwater ordinance in 2008 (Chapter 176 of Town Code); Town requires stormwater facility maintenance agreements to ensure operation of private ponds and infrastructure; landscape guidelines developed in 2004 require percentage of green space in developed sites.
	Appropriate funds for the purchase or other acquisition of land or development rights, to preserve open space.	The Town used local Recreation Trust Fund moneys, EPF grants, and Monroe County Green Space Initiative moneys to secure open space parcels.
	Identify, acquire, and preserve pristine forestland.	450+ acres of open space acquired since the 2001 Master Plan.
Chapter IV: Plan Elements and Recommendations.	The general recommendation for recreation, open space, and environmentally-sensitive areas is the preparation of an open space plan. The plan would identify lands to acquire in the future as open space based on the following criteria: • Be of varying sizes • Provide diversity of landscape • Be environmentally sensitive • Allow for natural habitats to occur • Augment existing holdings of parkland	Scoring criteria was established to determine acquisition priorities, such as site's proximity to Ontario Lake, major stream corridors, Braddock Bay Fish and Wildlife Management Area, etc.
	Land use recommendations for Planning District#1: The Town Board should implement the recommendations of the LWRP in this area, including Critical Environmental Areas, Conservation & Passive Recreation Areas, and Parks & Active Recreation Area.	The Town has implemented many recommendations of the LWRP (draft LWRP), including acquiring open space in waterfront areas and enhancing recreational opportunities. At least 15 miles of new recreational trails and trailhead facilities have been installed in the Lake Ontario waterfront area, and also the Junction Lock Trail in the Erie Canal waterfront area.

2001 Community Master Plan Update	Flooding/Floodplain Components	Status of Recommendation
	Land use recommendations for Planning District #2: Replacement of outmoded infrastructure such as sidewalks, streets, sewers, and lighting.	The Town has completed GIS mapping of all sanitary and storm sewers, a major step in eliminating cross-connections.
	Land use recommendations for Planning District #3: Replace aging or inadequate infrastructure.	The Town has completed GIS mapping of all sanitary and storm sewers, a major step in eliminating cross-connections.
	Land use recommendations for Planning District #5: The parcels in this planning district that are used for agricultural purposes should continue in their present usage.	May not be viable.
	Land use recommendations for Planning District #6: Several parcels should be preserved for continued agricultural use	May not be viable.
	Land use recommendations for Planning District #7: Develop, enhance, and protect open space and parkland within the canal corridor.	Town has purchased 116 acres from local development corporation on south side of canal for purpose of constructing a massive stormwater management facility. Recreational opportunities such as trails are anticipated to coincide with the stormwater purpose. Also the Junction Lock Trail on the north side of the canal.
	Land use recommendations for Planning District #8: Large parcels that are used for farming should be conserved for continued agricultural use.	May not be viable.
	Land use recommendations for Planning District #10: The parcels in this planning district that are used for agricultural purposes should continue in their present usage.	It may be viable in this district as it borders a more agricultural community in which farming is prevalent.
	Land use recommendations for Planning District #11: Cluster-type development would minimize the cost of sanitary sewers and other infrastructure.	In 2003, the Town adopted a new zoning ordinance which included a 1-acre lot district (R1-44). This district has the distinction that the Planning Board may actually require clustering if they determine it's in the best interest. The Board has exercised this in a number of cases, resulting in

2001 Community Master Plan Update	Flooding/Floodplain Components	Status of Recommendation
		at least 2 cluster projects which each set aside at least 25% of the original land area.
	Draft and adopt a Planned Unit Development (PUD) district for the proposed Waterfront Development area of the Erie Canal, including the recommended Erie Canal Overlay District. The PUD would be a mixed-use development of office, light industrial, commercial, institutional, a limited amount of residential, and preservation of sensitive environmental features.	The 2003 R1-44 ordinance included the Canal Corridor Overlay, and a Waterfront Development District in this area. The overlay does not apply in the Waterfront District so as to facilitate waterfront development, but it does apply to any other districts which bound the canal. It restricts structures within 200' of the high water mark and prevents clearing of vegetation within 50'.
	Establish a new residential zoning district that requires a lower overall density. Cluster-type lots developed to this standard would provide an opportunity to preserve more open space. This district would be concentrated in parts of Planning Districts #5, #7, #10, and #11.	In addition to the R1-44 District which applies to the western part of town, the Town now has a Lake Ontario Cluster District which applies to a select few parcels in the northwest part of town.
Chapter VI: Implementation Plan	Adopt a Local Waterfront Revitalization District as an overlay district as part of the zoning ordinance as described in the recommendations for future land use for Planning District #1.	In addition to the R1-44 District which applies to the western part of town, the Town now has a Lake Ontario Cluster District which applies to a select few parcels in the northwest part of town.
	Draft and adopt a Planned Unit Development District for lands in the Erie Canal Corridor Overlay District, as delineated in Planning District #7. Also, adopt an overlay district on each side of the Erie Canal for public use.	Canal Corridor Overlay District adopted in 2003.
	Continue programs to conserve agricultural lands through Agricultural Districts to reduce overall housing densities and to preserve open spaces.	The 2003 R1-44 ordinance included an Agricultural Residential District, which was cited on a volunteer basis. Several parcels have the designation and it provides flexibility for agricultural use but precludes multiple-lot

2001 Community Master Plan Update	Flooding/Floodplain Components	Status of Recommendation
		developments.
	Encourage the National Farm Trust and other private trusts to acquire development rights of agricultural used lands.	Agriculture preservation programs are likely to focus in adjoining towns where there is a critical mass of agricultural use.

Village of Hilton

The *Hilton Master Plan* (1977) updates and expands the work performed by the Monroe County Planning Council for the Village in 1968 and 1969. The Master Plan inventories land use, transportation, community facilities, and the Village's central business district. It also provides general goals and polices and specific recommendations to guide future growth. The Master Plan is composed of eleven chapters that are divided into two sections: Introduction, Land Use, Housing and Population, Transportation, and Community Facilities and Services are provided within the first section, "Planning Inventory." Community Goals and Plan Highlights, Land Use Plan, Housing Plan, Village Center Development Plan, Transportation Plan, Community Facilities and Services Plan, and Plan Implementation are contained within the second part of the document entitled, "Master Plan."

"Flooding" or "floodplains" are best identified in Chapter 4: Community Facilities and Services under Public Utilities as "Stormwater Sewer Service." Creeks and streams that flow through the Village are not discussed; however, the plan identifies a series of various sized storm sewers servicing the developed area of the Village that have not significantly changed since the completion of the Parma and Hilton *Inventory* in 1970. Runoff eventually empties into Salmon Creek at several points.

The second part of the Master Plan emphasizes the planning issues and long-range planning considerations of a traditional village, such as eliminating blight, growth of commercial activities and assessing urban services, with specific focus on the transportation network. For example, Chapter 8: Village Center Development Plan sets forth strategies for circulation, parking, and business development. Floodplain management is discussed in the Public Utilities section of Chapter 10: Community Facilities and Services Plan. In order to avoid future flooding problems, the plan recommends that the following principles be followed when developing the drainage system:

1. Natural watercourses which receive surface drainage should remain open. The village should require drainage easements across all open watercourses, so as to assure that development will not encroach on floodplain areas.
2. Adequate drainage facilities should be provided as part of all new developments and in areas which have flooding problems. Culverts, pipes and similar facilities should be designed to handle the total development of the upland drainage basin. Retention or catch basins should be required to handle runoff prior to its discharge into natural watercourses so as to minimize downstream flooding.

3. Natural features such as wetlands and wooded areas should be recognized as important elements in flood control. These features should be preserved as development occurs in the area.

The Master Plan recognizes that flooding can also be caused by drainage problems. In order to finance drainage maintenance and improvements, a drainage district was established within village limits to share costs by all property owners. The plan recommends continual assessment of the causes of flooding and that the drainage district be used to help finance any needed maintenance and improvements to the system.

Chapter 10 also recommends a passive park along the floodplain of Salmon Creek under Parks and Recreation. The development of this linear park that could link with three larger park areas along the creek infers floodplain management because of its intent to take advantage of significant natural features while meeting the future recreation need of residents.

Hilton Master Plan (1977)	Flooding/Floodplain Components	Status of Recommendation
Public Utilities section of Chapter 10: Community Facilities and Services Plan	Natural watercourses which receive surface drainage should remain open. The Village should require drainage easements across all open watercourses, so as to assure that development will not encroach on floodplain areas.	Drainage review is triggered during the building permit process or if a complaint is rendered. The Village does not have a drainage easement program. Older neighborhoods do not address drainage. About 50% of the Village has a system of catch basins and pipes that deliver runoff water to the nearest waterbody (Salmon Creek). There are some drainage easements for the subdivisions built on the Northside of the Village in the 1990s.
	Adequate drainage facilities should be provided as part of all new developments and in areas which have flooding problems. Culverts, pipes and similar facilities should be designed to handle the total development of the upland drainage basin. Retention or catch basins should be required to handle runoff prior to its discharge into natural watercourses so as to minimize downstream flooding.	Chapter 20-A of the Hilton Code, Stormwater Management Program, or Local Law #7, 2007. There are some older detention and retention ponds in the Village. The Village will soon become responsible for the maintenance of three stormwater ponds.
	Natural features such as wetlands and wooded areas should be recognized as important elements in flood control. These features should be preserved as development occurs in the area.	Most development along Salmon Creek occurred during the 1950s-60s. Salmon Creek Park was acquired in the mid-1990s.
	The Drainage District should be used to help finance any needed maintenance and improvements to the drainage system, with continual assessment of the causes of flooding.	There is currently no drainage district in the Village. Drainage and stormwater expenses come out of General Fund appropriations.

Hilton Master Plan (1977)	Flooding/Floodplain Components	Status of Recommendation
Parks and Recreation section of Chapter 10: Community Facilities and Services Plan	A passive park along the floodplain of Salmon Creek should be developed. As a conservation area, this linear park would prevent development from encroaching on the creek drainageway while providing access to the creek for fishing, hiking, and picnicking. This linear park could link with three larger park areas along the creek.	Village Park and Salmon Creek Park were acquired by the Village of Hilton.

Town of Parma

The *Master Plan Update* (1989) is the result of the Town Board's recognition that an updated Master Plan was needed in early 1987. A Master Plan Committee was formed to develop the document, composed of representatives from the Town Board, Planning Board, Zoning Board of Appeals, Conservation Board, Recreation Committee, School Board, Fire Department, the Village of Hilton and the general public. The Master Plan Update is composed of five chapters: Introduction, Community Profile, Policy Plan, Land Use Plan, and Transportation Plan.

Water resources are discussed in Chapter 2: Community Profile under the subtitle of Natural Environment. The Town of Parma contains numerous creeks, protected streams, and their associated drainageways. The Master Plan Update also references Town-wide drainage regulations and a Town drainage district, which was formed to address drainage maintenance, in addition to a comprehensive review of wetlands and floodplains. The following water resources are discussed in greater detail in the Master Plan Update:

- The 3.5-mile-long Lake Ontario shoreline is recognized by the NYS Department of Environment Conservation as a "coastal erosion hazard area" and contains Class 1 wetlands and 1% annual chance (100-year) floodplains.
- The Town's largest watershed, Salmon Creek, drains approximately 9,500 acres and contains 1% annual chance (100-year) floodplains and other large wetland areas.
- Black Creek, Northrup Creek, and their tributaries drain approximately 7,600 acres into the Long Pond watershed, located in southeastern Parma, and contain large floodplain and floodway areas.
- The Buttonwood Creek watershed is third largest Town drainage area and drains approximately 4,500 acres in the central portion of Parma.
- The Hamlin-Parma Beach watershed drains 4,000 acres of the lakefront area; East Creek is the largest water feature with associated 1% annual chance (100-year) floodplains and Class 1 wetlands.
- The Buck Pond watershed is located in southeastern Parma and is the smallest in the Town, draining approximately 400 acres.

"Flooding" or "floodplains" are best identified in the Master Plan Update in Chapter 3: Policy Plan as Environmental and Cultural Resources and Chapter 4: Land Use Plan as Conservation and Open Space. In Chapter 3: Policy Plan, the following statements provide direction for land use decision-making in regards to the protection, conservation, and preservation of environmentally-sensitive areas:

- Encourage the use of private initiative, public programs and land use controls to attain meaningful open space and recreational opportunities for the community.
- Consider the adoption of a conservation easement program pursuant to the authority of Section 247 of the Town Law.
- Encourage land developers to integrate open areas into development plans to make the open areas an attractive and functional part of the development.
- Establish overlay zoning districts for the protection of environmentally-sensitive areas. The density of development within environmental overlay areas should be reduced in order to protect sensitive environmental features.
- Enhance the functions of wetland areas by requiring appropriate permits before development is allowed in protected areas.
- Determine the essential functions and benefits of each New York State designated wetland, and ensure the maintenance of these qualities during the development review process.
- Require developers to furnish maps of designated wetlands in project areas along with certification of boundary review by the Department of Environmental Conservation.
- Allow the Department of Environmental Conservation to continue regulatory authority for designated wetlands in the Town until or unless problems arise with the administration process and the Town has adequate resources to issue permits.
- Continue to administer and enforce the minimum requirements of the National Flood Insurance Program thereby reducing the perils of flooding and enabling property owners to continue to purchase flood insurance.
- Areas of special flood hazard designated by the Federal Emergency Management Administration (FEMA) and major creeks should be considered for recreation and open space purposes.
- Require developers to certify compliance with the Town Flood Damage Prevention Law and to submit accompanying engineering and architectural reports as part of development reviews.
- Continue to acquire or obtain easements over natural and built drainage ways, including buffer and maintenance access areas within and adjacent to developments.
- Discourage stream bank disturbance and maintain natural vegetation in stream corridors.
- Monitor stream quality and habitat, and seek an upgrade of water quality classification where appropriate.
- Monitor problem flooding areas not included in the FEMA study, such as Buttonwood and Black Creeks, and request additional studies as necessary.
- Encourage the preservation of valuable trees and woodlots and encourage the planting of trees and shrubs; prepare guidelines for developers to help them identify trees that are worth preserving and make them aware that final grading plans must respect the root lines of the trees to be preserved. Encourage the planning of new trees in developments.
- Excavation operations should continue to be controlled so as to minimize conflicts with adjacent areas and to facilitate proper restoration.

- Wide scale residential development adjacent to excavation operations should be discouraged until the operation is completed.
- The Town will continue to extend their easements along Salmon Creek in order to provide an environmental protection corridor and to provide passive recreational opportunities.

Chapter 4: Land Use Plan is the central component of the Master Plan Update and basis for changes in the Town zoning ordinance. The land use plan reflects the physical and environmental capabilities of the land to support development, presented in Chapter 2, with the expression of the general goals and policies outlined in Chapter 3. The Conservation and Open Space plan recommendations include the following:

- Conservation areas include wetlands, floodplains, steep slopes, and stream channels. These areas are recommended to remain undeveloped. Low-level activity such as agriculture may be appropriate in some areas, such as floodplains.
- Conservation areas may also have limited use as passive recreation areas, as long as the natural environment is not substantially disturbed. Methods used to control development in conservation areas, short of public acquisition, include the use of conservation easements, deed restrictions and covenants, and environmental overlay zoning.
- Open space areas include significant woodlots and other features determined to be of significance and worthy of preservation. Open space areas, while important natural features, do not require the level of protection of conservation areas. It is possible that limited development could occur in these areas under strict development controls. Methods to preserve open space areas include those mentioned for conservation areas, as well as the utilization of cluster or average density developments.

The land use plan also recommends the utilization of planned development districts to allow flexibility of permitted uses and dimensional specifications primarily for industrial and commercial development. The use of planned development infers floodplain management because of its intent to preserve and enhance a site’s natural features which would otherwise not be allowed under conventional zoning.

Master Plan Update (1989)	Flooding/Floodplain Components	Status of Recommendation
Chapter 3: Policy Plan	Encourage the use of private initiative, public programs and land use controls to attain meaningful open space and recreational opportunities for the community.	The Town of Parma created the Farmland and Open Space Protection Committee in 2007. The farmland protection program is geared for protecting agriculture, but environmentally sensitive areas are determined to have extra value per ranking criteria established in the 2009 Agriculture and Farmland Protection Plan.
	Consider the adoption of a conservation easement program pursuant to the authority of Section 247 of the Town Law.	There is no formal conservation easement program. However, the Town: • Purchased an Agricultural Conservation Easement on 114-acre Martin Farm in 2010; parcel includes some wetlands and wooded area. Town co-holds the easement in partnership with Genesee Land Trust. • Helped facilitate DEC purchase of 240-acre Bennett Road addition to the Braddock Bay Fish and Wildlife Management Area. Town co-manages the parcel. • Partnered with TNC, GLT, and DEC to make grant application to NOAA for additional acquisition of Forks Park and several other environmentally sensitive areas including floodplain areas upstream from Rochester AOC (application only partially funded and ultimately landowner was not willing). • Set to pursue purchase of development rights (PDR) for farmland in 2015.
	Encourage land developers to integrate open areas into development plans to make the open areas an attractive and functional part of the development.	The Planning Board reviews development proposals, performs site plan approval and land subdivision review.
	Establish overlay zoning districts for the protection of environmentally-sensitive areas. The density of development within environmental overlay areas should be reduced in order to protect sensitive	As per Chapter 165: Zoning, Article VIII. Environmental Protection Overlay Districts (EPOD's), 1998.

Master Plan Update (1989)	Flooding/Floodplain Components	Status of Recommendation
	environmental features.	
	Enhance the functions of wetland areas by requiring appropriate permits before development is allowed in protected areas.	Chapter 165: Zoning, Article X. Regulations Applicable to all Districts, § 165-84. Filling permits.
	Determine the essential functions and benefits of each New York State designated wetland, and ensure the maintenance of these qualities during the development review process.	As per State Environmental Quality Review Act and review of development proposals. Development review as per New York State Sample Site Development Plan Review Checklist.
	Require developers to furnish maps of designated wetlands in project areas along with certification of boundary review by the Department of Environmental Conservation.	The Planning Board reviews development proposals, performs site plan approval and land subdivision review. As per Freshwater Wetlands Protection Ordinance.
	Allow the Department of Environmental Conservation to continue regulatory authority for designated wetlands in the Town until or unless problems arise with the administration process and the Town has adequate resources to issue permits.	The Planning Board reviews development proposals, performs site plan approval and land subdivision review. As per Freshwater Wetlands Protection Ordinance.
	Continue to administer and enforce the minimum requirements of the National Flood Insurance Program thereby reducing the perils of flooding and enabling property owners to continue to purchase flood insurance.	As per Chapter 59: Flood Damage Prevention, 2008.
	Areas of special flood hazard designated by the Federal Emergency Management Administration (FEMA) and major creeks should be considered for recreation and open space purposes.	As per Chapter 59: Flood Damage Prevention, 2008.
	Require developers to certify compliance with the Town Flood Damage Prevention Law and to submit accompanying engineering and architectural reports as part of development reviews.	As per Chapter 59: Flood Damage Prevention, 2008.
	Continue to acquire or obtain easements over natural	As per State Environmental Quality Review Act and review

Master Plan Update (1989)	Flooding/Floodplain Components	Status of Recommendation
	and built drainage ways, including buffer and maintenance access areas within and adjacent to developments.	of development proposals. Development review as per New York State Sample Site Development Plan Review Checklist.
	Discourage stream bank disturbance and maintain natural vegetation in stream corridors.	As per State Environmental Quality Review Act and review of development proposals. Development review as per New York State Sample Site Development Plan Review Checklist.
	Monitor stream quality and habitat, and seek an upgrade of water quality classification where appropriate.	As per State Environmental Quality Review Act and review of development proposals. Development review as per New York State Sample Site Development Plan Review Checklist.
	Monitor problem flooding areas not included in the FEMA study, such as Buttonwood and Black Creeks, and request additional studies as necessary.	NA
	Encourage the preservation of valuable trees and woodlots and encourage the planting of trees and shrubs; prepare guidelines for developers to help them identify trees that are worth preserving and make them aware that final grading plans must respect the root lines of the trees to be preserved. Encourage the planning of new trees in developments.	The Planning Board reviews development proposals, performs site plan approval and land subdivision review.
	Excavation operations should continue to be controlled so as to minimize conflicts with adjacent areas and to facilitate proper restoration.	The Planning Board reviews development proposals, performs site plan approval and land subdivision review.
	Wide scale residential development adjacent to excavation operations should be discouraged until the operation is completed.	The Planning Board reviews development proposals, performs site plan approval and land subdivision review.

Master Plan Update (1989)	Flooding/Floodplain Components	Status of Recommendation
	The Town will continue to extend their easements along Salmon Creek in order to provide an environmental protection corridor and to provide passive recreational opportunities.	NA
Chapter 4: Land Use Plan	Conservation areas include wetlands, floodplains, steep slopes, and stream channels. These areas are recommended to remain undeveloped. Low-level activity such as agriculture may be appropriate in some areas, such as floodplains.	As per Chapter 165: Zoning, Article VIII. Environmental Protection Overlay Districts (EPOD's), 1998. Established Farmland Protection Reserve Account in 2010; enacted zoning code changes to accommodate agriculture in 2011; and Right-to-Farm Law adopted in 2014.
	Conservation areas may also have limited use as passive recreation areas, as long as the natural environment is not substantially disturbed. Methods used to control development in conservation areas, short of public acquisition, include the use of conservation easements, deed restrictions and covenants, and environmental overlay zoning.	There is no formal conservation easement program. As per Chapter 165: Zoning, Article VIII. Environmental Protection Overlay Districts (EPOD's), 1998.
	Open space areas include significant woodlots and other features determined to be of significance and worthy of preservation. Open space areas, while important natural features, do not require the level of protection of conservation areas. It is possible that limited development could occur in these areas under strict development controls. Methods to preserve open space areas include those mentioned for conservation areas, as well as the utilization of cluster or average density developments.	As per Chapter 165: Zoning, Article VIII. Environmental Protection Overlay Districts (EPOD's), 1998.
	Utilization of planned development districts to allow flexibility of permitted uses and dimensional specifications primarily for industrial and commercial development. The use of planned development would	There are no planned development districts in Article VI Business and Commercial Districts or Article VII Industrial District. There is § 165-36.1. Planned Development-Senior Residential (PD-SR) District in Article V. Residential

Master Plan Update (1989)	Flooding/Floodplain Components	Status of Recommendation
	result in the preservation and enhancement of natural features on any given site.	Districts.

Appendix A: Existing Conditions

A.2. Natural Environment: Watersheds, precipitation, topography and soils, development, stream flow, and natural infrastructure

Contents

Introduction

In the fall of 2014, the *Flood Smart Communities* Study Team worked with representatives from the governments of Town of Greece, Town of Parma and Village of Hilton to complete a situation analysis[1] of flooding in their communities (**Appendix C: Flood Smart Approach**)—articulating the types of flooding they experience as well as the impacts and causes of that flooding. They also identified underlying drivers of flooding, such as dynamic hydrology, topography, soil type, existing development, and natural infrastructure. These are characteristics of the area that contribute to flooding and its impacts.

To understand how these drivers might be incorporated into a coordinated approach to floodplain management, the Project Team (the Study Team and the municipal representatives) needed a more thorough understanding of what they are, how they influence streamflow, and how they may be changing and/or how their dynamic nature needs to be accounted for. Aided with this information, recommendations could be developed that would, if implemented, lead to communities that are more resilient to flooding.

While nature may be viewed as an adversary during flood events, it can also be an ally when natural processes that mitigate flooding are embraced and maximized. When wetlands, floodplains and forests provide benefits such as flood abatement or water filtration, they are referred to as natural infrastructure. To help local governments determine how natural infrastructure can be incorporated into their flood risk management strategy, these resources have been described and characterized for the watersheds as well as the municipalities. We have mapped where they are, described the extent that lies within the jurisdiction of the local governments, and assessed how much of them are protected by federal or state regulations, or conservation ownership.

Streamflow and its Drivers

The Watersheds

The municipal boundaries of Greece, Parma and Hilton encompass 95 mi^2 and span portions of five watershed units, whose total area is more than twice the size of the municipalities at nearly 125,000 acres or 195 mi^2. Each of these watershed units have headwaters south of the beach ridge of glacial Lake Iroquois, flow in a north to northeast direction through fairly shallow valleys, and drain either directly to Lake Ontario or through a coastal pond or embayment (Fig.1). These watershed units are, in turn, comprised of one to five smaller designated drainage areas called 12-digit hydrologic units (HUC12s) by the USGS (**Error! Reference source not found.**).[2] To capture finer resolution, we have described and analyzed characteristics at this smaller drainage scale.

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[1] To develop a shared understanding of the flooding problem faced by the three communities, a situation analysis from Open Standards was modified from a primarily conservation-oriented practice to one that would fit a socio-ecological focus. On November 12, 2014, the Study Team worked with the municipal representatives to characterize the type of flooding experienced by their communities and identify the impacts and causes.

[2] To establish a base-line drainage boundary framework, USGS has divided and sub-divided the US into successively smaller hydrologic units defined by the surface water drainage area. Hydrologic units are nested within each other, from the largest geographic area (regions) to the smallest geographic area (cataloging units). Each

Many characteristics of watersheds influence the shape and size of streams and the amount of water they convey (Table 5). Groundwater, climate, geology and soils, and development are the primary influences on streamflow in the watersheds of the Town of Greece, Town of Parma, and Village of Hilton. We discuss climate, geology/soils and development in greater detail below.

Table 1. Factors affecting streamflow

Groundwater and Springs	Base flow in streams is established by groundwater and is the primary contributor to streamflow when precipitation isn't falling. It is estimated that 60 to 70% of streamflow in Monroe County streams is due to base flow[3].
Precipitation	Precipitation is one of the primary factors affecting streamflow. It can result in surface water runoff and contribute to groundwater discharges to stream networks. Temperature, which affects plant water demand as well as evaporation, also affects streamflow.
Topography and Soils	Topography can influence streamflows particularly during runoff events. Very flat watersheds have relatively low energy streamflow and consequently experience pooling and ponding of flood waters rather than highly erosive flooding. Also, areas with soils that are less absorbent (or characterized as having high runoff potential) could experience higher streamflows during events because more water is running off than sinking into the ground.
Development	Impervious surfaces like pavement and rooftops reduce infiltration of precipitation to ground water which can decrease base flow and increase storm flow volumes and speeds. Stormwater drainage systems (i.e., curbs and gutters, and storm drain pipes) can also increase the efficiency with which runoff is delivered to the stream, further increasing the volume and speed of water reaching the stream network. Additionally, soils compacted by construction are capable of less infiltration. Increased development can thus put a strain on existing channels lacking sufficient width and depth to carry additional storm flows.
Water Withdrawals	The amount of water withdrawn from streams for consumption affects streamflow. Groundwater withdrawals may also affect streamflow, but neither groundwater nor surface water withdrawals have been demonstrated to have a strong influence on the streams in our project area. Creeks in the project area typically have relatively low base flows and any significant usage would be very noticeable.
Water Additions	Adding treated wastewater to a stream can contribute to streamflow particularly in low flow years. Water flushed from the Erie Canal can also impact streamflow. Neither of these have been identified as contributors to high streamflows in this project area, however.

hydrologic unit is identified by a unique hydrologic unit code (HUC) consisting of two to twelve digits based on its level of classification in the hydrologic unit system. Thus 12-digit HUCs are nested within 10-digit HUCs which are nested within 8-digit HUCs and so on. U.S. Geological Survey and U.S. Department of Agriculture, Natural Resources Conservation Service. 2012. Federal Standards and Procedures for the National Watershed Boundary Dataset (WBD) (3d ed.): U.S. Geological Survey Techniques and Methods 11–A3, 63 p.

[3] Coon, W.F. 2008. Hydrologic evidence of climate change in Monroe County, New York. US Department of the Interior, US Geological Survey, open-file report 2008-1199. Prepared in cooperation with the Monroe County Department of Health

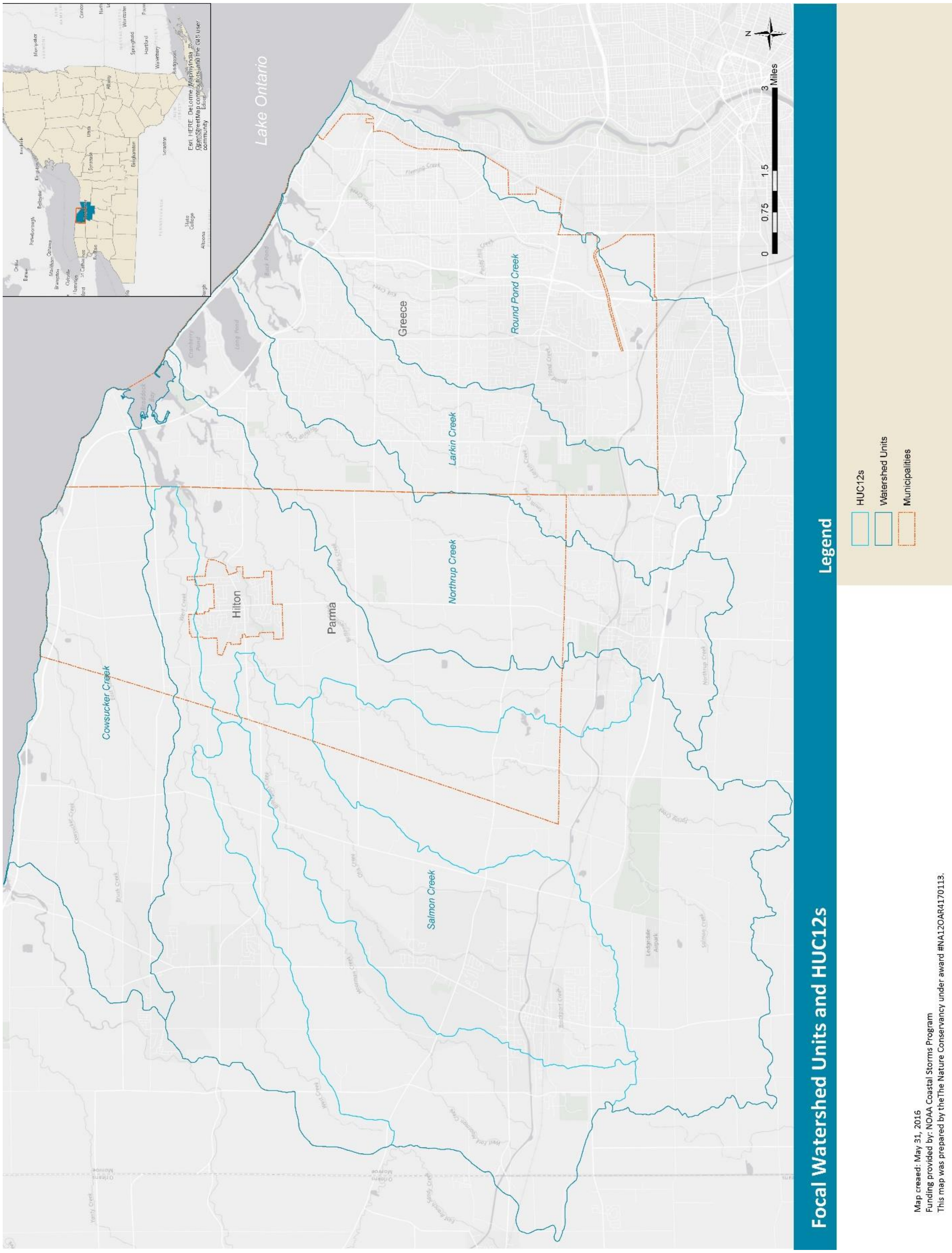

Figure 1. Focus watershed units and HUC12x.

Groundwater

Flowing water in stream channels is supported by groundwater. Streamflow generated by groundwater is called base flow and is characterized by the clear water that is flowing in streams during even long, dry periods. In Monroe County base flow accounts for 60-70 % of annual streamflow. This base flow can be obscured by streamflow's other major component, storm runoff, which results from precipitation and snowmelt that flows overland or through stormwater-drainage systems into stream channels. Storm runoff creates high water levels and turbid conditions in a stream[4].

Precipitation

The project area has a fairly humid climate with precipitation timing and patterns strongly influenced by the Great Lakes. Relatively small topographic differences across much of Monroe County result in comparatively uniform climate, so climatic data from Rochester can be applied to the project area. "Lake effect" occurs when cold air crosses the warmer lake waters and becomes saturated, creating clouds and precipitation[5]. Due in part to this "lake effect", precipitation is relatively well distributed throughout the year (32 inches of rain and 90 inches of snow across 156 days a year on average), but tends to be highest in June, August and September (**Error! Reference source not found.**).

Table 2. Average monthly precipitation for Monroe County and monthly maximums[6].

	Average Precipitation (inches)	Maximum Monthly Precipitation of Record (inches : year)
January	2.34	8.05 : 1878
February	2.04	5.40 : 1876
March	2.58	7.02 : 1873
April	2.75	6.13 : 1857
May	2.82	6.87 : 1894
June	3.36	8.53 : 1830
July	2.93	9.70 : 1947
August	3.54	7.26 : 1886
September	3.45	7.41 : 1868
October	2.60	8.67 : 1873
November	2.84	7.12 : 1927
December	2.73	6.17 : 1878
Annual	32	49.89 : 1873

Consequently, flooding for Western New York can occur at any time of year (National Weather Service). Spring and summer months can experience heavy rain due to slow moving repetitive thunderstorms. Excessive rain can also fall during summer and early fall months generated from the remains of tropical

[4] Coon, W.F. 2008. Hydrologic evidence of climate change in Monroe County, New York. US Department of the Interior, US Geological Survey, open-file report 2008-1199. Prepared in cooperation with the Monroe County Department of Health.
[5] McLaughlin, S. 2015. Rochester climate. National Weather Service, Buffalo, NY.
[6] Data from the WHAM Weather Book (04/29/10), presented in Monroe County, Office of Emergency Management. 2010. Monroe County Pre-Disaster Mitigation Plan, pp. 439.

systems. Excessive snowmelt during winter months can also lead to flooding particularly when combined with heavy spring rains.

The Federal Emergency Management Agency's (FEMA) definition of flooding was modified to apply to the types of flooding experienced by Greece, Parma and Hilton. This study defines flooding as "when a waterbody overflows its "normal" banks, potentially resulting in erosion, unusual or rapid accumulation, or water inundation that causes damage to homes, infrastructure and/or property."

Precipitation events are characterized by three components: intensity, or how much precipitation is falling per hour (in/hour); duration, or how long the precipitation falls for (hours); and frequency, or how often that combination of intensity and duration is expected based on the historic record (recurrence interval (years)). These components describe the probability that a given rainfall event will occur.

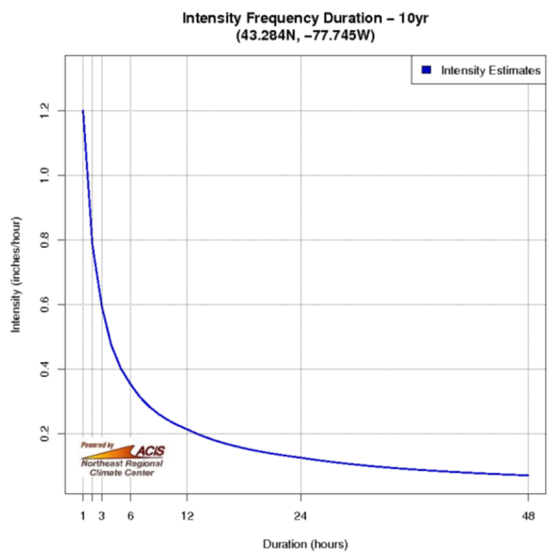

Figure 2. Example of an Intensity-Duration-Frequency curve. This curve shows that for Monroe County a precipitation event has a one in ten chance of occurring annually that will result in approximately 0.6 in of rain per hour and lasting for 3 hours.

The terms "100-year storm" or "100-year flood" are commonly used in the United States, but these terms can be confusing because they do not adequately convey that they are probabilities of a particular rain or flood event occurring. These probabilities are based on statistical methods that analyze storm or flood frequency using historical data. Rather than indicating that a particular storm event will only occur once per century, these terms mean that that storm event has a one in one-hundred (1%) chance of occurring each year--so a 100-year storm could happen two years in a row or 5 times in a century, not just once in a century. Expressed a different way, a 100-year event has a 26% chance (one in four) of occurring over the course of a 30-year mortgage[7]. Adding to the confusion is that a 100-year storm will not necessarily produce a 100-year flood, because factors like the level of the water table, soil

[7] Holmes, R.R. and K. Dinicola. 2010. 100-year flood: It's all about chance. US Department if the Interior, US Geological Survey, General Information Product 106.

saturation, and streamflow prior to the event can all influence whether a precipitation event will cause a waterbody to exceed its banks.

Table 2 provides precipitation depths in inches for varying durations (rows) and frequencies (columns)[8]. Frequencies are expressed in annual percent chance of occurrence. This table demonstrates that annually for the Greece, Parma, Hilton area, there is a 1 in 10 (or 10%) chance that a 24-hour precipitation event will produce 3.1 inches of rain. Each year there is a 1 in 100 (or 1%) chance that 4.63 inches of rain will be produced in a 24-hour event. To help understand what that much water can do, locally, over 4-inches of rain fell in the Salmon Creek watershed in September 2004 over a three-day period, and caused excess water to overload the channels and flow out onto the floodplain in the communities of Hilton, Ogden, Spencerport, and Brockport. Overbank flooding resulted with road closures, home evacuations, and impacts to small businesses. Flood damages were estimated at more than $400,000 in the Village of Hilton and $500,000 in the Village of Spencerport[9]. This was estimated to be a 25-year precipitation event that had a 4% chance of occurring annually. We don't know what the recurrence of this flood event was as there are no gages with sufficiently long-term datasets to calculate the probabilities.

[8] NOAA Atlas 14 Volume 10 was developed by the National Oceanic and Atmospheric Administration's National Weather Service and is the accepted standard for rainfall depths. NOAA has recently updated precipitation intensity-duration-frequency information for the Northeast Region.
[9] Westside News Inc. 2004. Flood clean-up, recovery continues.

Table 3. NOAA Atlas 14 Precipitation Frequency Estimates of Precipitation Depth in inches[7].

	Annual Chance of Recurrence									
Duration	100%	50%	20%	10%	4%	2%	1%	0.50%	0.20%	0.10%
5-min:	0.26	0.32	0.41	0.49	0.59	0.67	0.76	0.87	1.02	1.13
10-min:	0.37	0.45	0.58	0.69	0.84	0.95	1.07	1.23	1.44	1.6
15-min:	0.44	0.53	0.69	0.81	0.99	1.12	1.26	1.45	1.7	1.88
30-min:	0.61	0.75	0.96	1.14	1.39	1.58	1.77	2.03	2.38	2.65
60-min:	0.79	0.96	1.24	1.47	1.79	2.03	2.28	2.62	3.07	3.41
2-hr:	0.97	1.18	1.51	1.78	2.17	2.46	2.75	3.16	3.7	4.1
3-hr:	1.08	1.31	1.67	1.97	2.39	2.71	3.03	3.48	4.06	4.5
6-hr:	1.3	1.55	1.97	2.32	2.8	3.17	3.54	4.03	4.68	5.18
12-hr:	1.54	1.83	2.31	2.7	3.25	3.66	4.08	4.62	5.33	5.87
24-hr:	1.82	2.14	2.67	3.1	3.7	4.17	4.63	5.2	5.96	6.53
2-day:	2.13	2.48	3.04	3.51	4.16	4.66	5.15	5.76	6.56	7.16
3-day:	2.37	2.73	3.31	3.8	4.47	4.99	5.5	6.12	6.93	7.55
4-day:	2.56	2.94	3.54	4.05	4.74	5.28	5.81	6.44	7.26	7.89
7-day:	3.07	3.48	4.15	4.71	5.48	6.07	6.66	7.31	8.18	8.83
10-day:	3.54	3.98	4.71	5.32	6.14	6.79	7.43	8.1	9	9.67
20-day:	4.96	5.49	6.36	7.08	8.07	8.83	9.6	10.32	11.29	12.01
30-day:	6.15	6.75	7.72	8.53	9.64	10.5	11.35	12.12	13.13	13.9
45-day:	7.65	8.32	9.42	10.34	11.59	12.56	13.53	14.34	15.41	16.22
60-day:	8.92	9.65	10.86	11.85	13.23	14.29	15.34	16.2	17.32	18.18

Topography & Soils

The northwestern part of Monroe County, which includes the full extent of the three focus municipalities, is characterized as gently sloping lake plain and was formerly the lakebed of glacial Lake Iroquois. Gradients for this area are very low at around 0.5% or approximately 25 ft per mile (Fig. 3). Numerous low ridges and small circular or elliptical hills rise only 5 to 50 ft above the lake plain elevation. A beach ridge formed by the wave action of Lake Iroquois runs east-west and forms the southern boundary of the lake plain[10]. Ridge Road follows this as it runs through Greece and Parma. Within our focus watersheds, topography slopes down from this ridge to the shore of Lake Ontario, spanning a maximum elevation difference of 477 ft; there is only 327 feet of maximum elevation difference within the municipal boundaries of Greece, Parma and Hilton. Consequently, these watersheds and our target municipalities frequently experience ponding of water, and slight alterations to natural drainage patterns by construction of any sort might lead to changes in experienced ponding.

Soils can also influence the amount of rainfall that infiltrates into groundwater or runs off as surface water, because some soil types absorb water better than others (often called a soil's infiltration capability). Soil type therefore informs best practices for managing runoff to prevent and reduce flooding, drainage problems, and streambank erosion. For example, an area with a large percentage of well-drained soils could utilize infiltration-type stormwater retrofits, while areas with poorly drained soils might support wetlands.

Soils have been classified into Hydrologic Soils Groups (HSGs) based on their infiltration and water storage capacity, and depth to groundwater. HSGs are widely used as an efficient method for determining the approximate amount of direct runoff from a rainfall event in a particular area. Classes are A through D: A and B soils are well drained and absorb much of the water that drains on or over them, whereas C and D soils are more poorly drained thus contribute to surface runoff. The soils in some areas are not categorized, denoting lands that have been so altered by development that grouping a specific soil type is not feasible. Soils can be assigned a dual group where soils are wet solely due to high groundwater but could become dry if adequately drained. The first letter of this dual group applies to the drained and the second to the undrained condition.

To determine which HUC12s may have large portions of land that are producing high amounts of runoff and providing low amounts of infiltration, HSGs were summarized (Table 4). Three HUC12s in Salmon Creek's watershed standout as having poor infiltration and higher runoff potential (C and D groups): Upper Salmon Creek, Brockport and Otis Creeks, and Moorman Creek. This is true even if we assume the best case scenario/most infiltration for those areas assigned a dual HSG (Table 5). In contrast, Round Pond, Larkin, Northrup and West Creeks have a high proportion of low runoff potential soils (A and B groups). But when we assume that areas assigned dual groups are not drained and instead group them with their undrained HSG, ***all of the HUC12s have more than 65% of their land with a high runoff potential, and some HUCs change from appearing reasonably drained to very poorly drained*** (e.g. Cowsucker and West Creek change from nearly 50% of their land area producing runoff to over 90%).

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[10] US Department of Agriculture, Soil Conservation Service. 1973. Soil survey: Monroe County, NY.

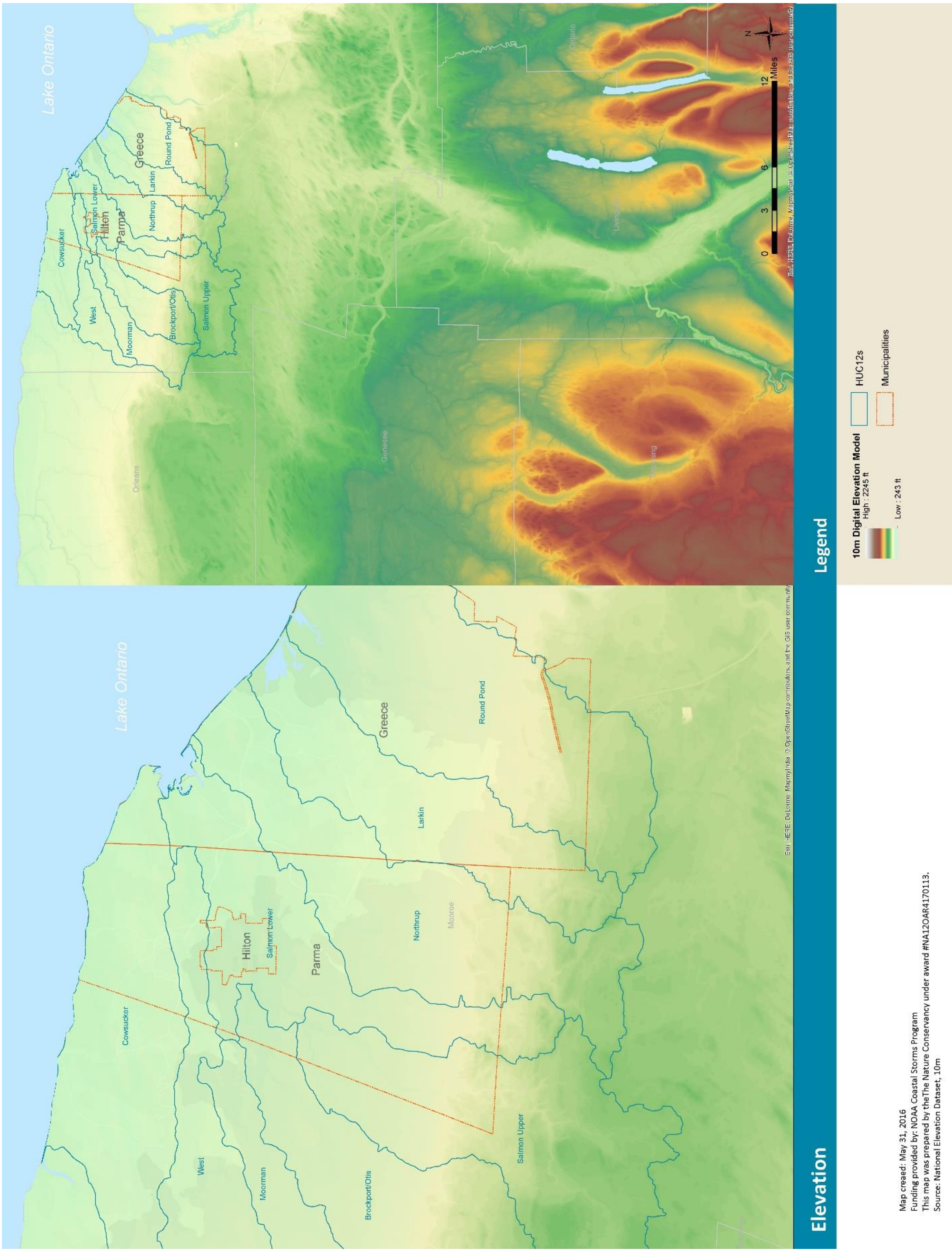

Figure 3. Elevation within the project area as well as the surrounding area.

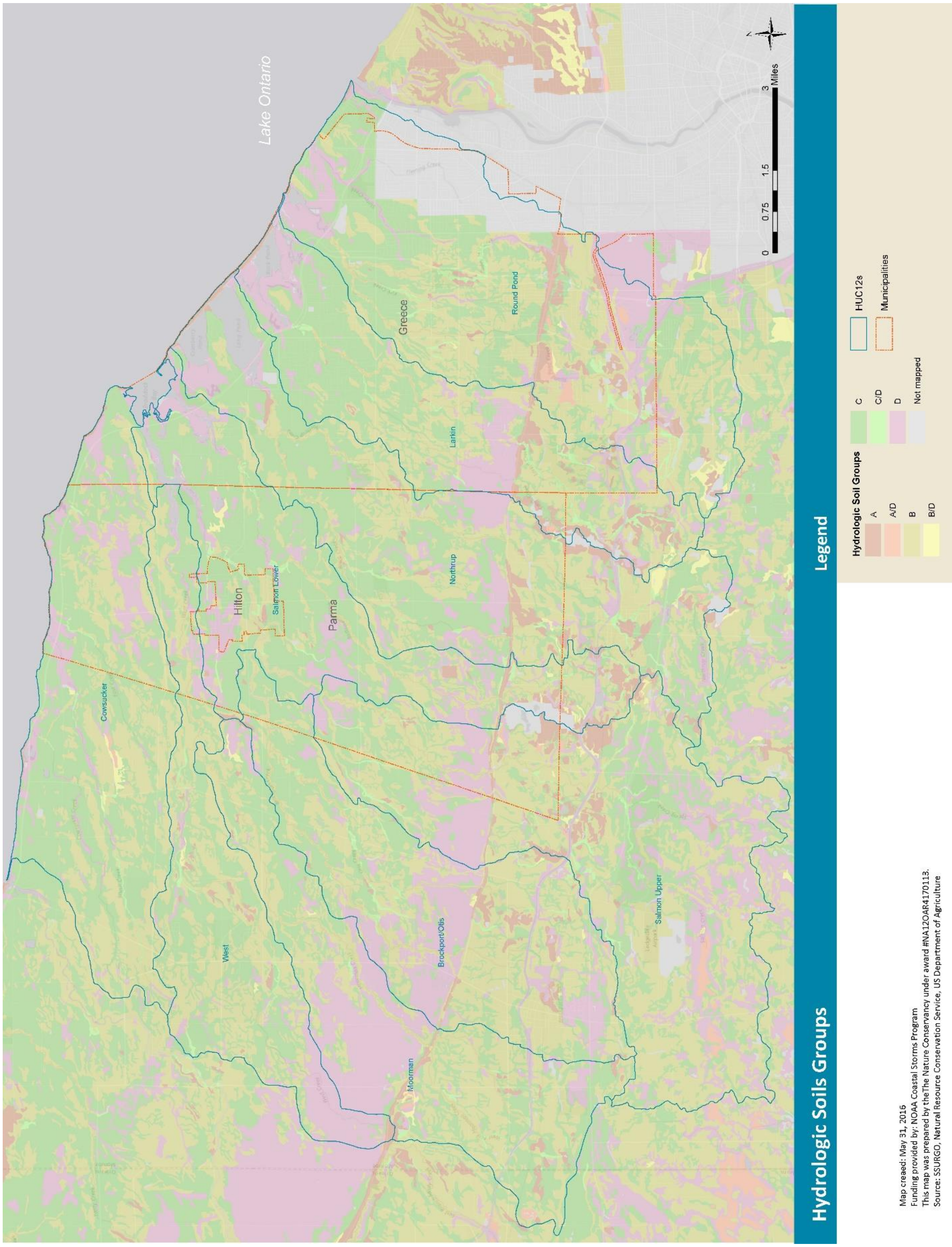

Figure 4. As part of the Soil Survey, soils have been categorized into four Hydrologic Soils Groups, A through D.

Table 4. The amount of acres in each Hydrologic Soils Group (HSG) for each HUC12 and the percent of the HUC12 each HSG occupies. Even though dual HSGs (A/D, B/D, C/D) have soil types that can infiltrate rain water, they have very high runoff potential due to high groundwater.

	Unrated		A		A/D		B		B/D		C		C/D		D		
Infiltration Rate (in/hr)			>.30				0.15-.30				0.05-0.15				0-0.05		
Runoff potential			Low[11]				Moderate				High				Very High		
	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	TOTAL
Round Pond Creek	2740	15	1227	7	2125	11	722	4	3702	20	1323	7	5907	32	789	4	18535
Larkin Creek	475	4	828	8	545	5	1120	10	2319	21	708	6	4064	37	942	9	11001
Northrup Creek	1052	7	1166	7	670	4	1502	9	2830	18	769	5	6722	43	1103	7	15813
Lower Salmon & Buttonwood Creeks	515	4	517	4	322	3	582	5	2228	19	522	4	6381	54	669	6	11736
Upper Salmon Creek	599	3	1201	6	691	3	704	4	1892	9	**3358**	**17**	**7557**	**38**	**3967**	**20**	19967
Brockport & Otis Creeks	82	1	756	6	427	3	749	6	**3105**	**24**	**2259**	**18**	**3021**	**24**	**2322**	**18**	12721
Moorman Creek	93	1	427	4	370	3	493	4	1803	16	**2530**	**22**	**3208**	**28**	**2539**	**22**	11463
West Creek	52	1	163	2	1062	11	114	1	**3358**	**35**	456	5	3513	36	938	10	9657
Cowsucker Creek	179	1	12	0	580	4	115	1	**5072**	**37**	257	2	7340	54	42	0	13598

[11] http://www.esf.edu/ere/endreny/GICalculator/SoilInstruction.html

Table 5. Best & worst case scenarios for soil absorption capacity (and inversely, runoff potential) by watershed unit. Percentages based on acres of each combination of Hydrologic Soil Groups. Best case scenario assumes soils in dual soil groups (indicated with /) have the characteristics of the most absorbent soil; worst case scenario assumes soils in dual groups have the characteristics of the least absorbent soil in the pair.

	Best Case Scenario (assume dual groups can absorb water)		Worst Case Scenario (assume dual groups cannot absorb water)	
	Low to Moderate Runoff Potential	High to Very High Runoff Potential	Low to Moderate Runoff Potential	High to Very High Runoff Potential
	A, A/D, B, B/D	C, C/D, D	A, B	all other groups
Round Pond Creek	42	43	11	75
Larkin Creek	44	52	18	78
Northrup Creek	39	54	17	76
Lower Salmon & Buttonwood Creeks	31	65	9	86
Upper Salmon Creek	22	75	10	87
Brockport & Otis Creeks	40	60	12	88
Moorman Creek	27	72	8	91
West Creek	49	51	3	97
Cowsucker Creek	42	56	1	98

Development

Development within a watershed has measurable effects on streamflow particularly peak discharge for smaller, more common storm events, due to the high degree of impervious surfaces. Primary impacts are increased runoff volume; increased peak discharge rates; increased magnitude, frequency, and duration of bankfull flows; and diminished baseflow. In the same storm event, a paved parking lot produces 15 times more runoff than a meadow. These impacts can then increase flood volumes and the spatial extent of flooding. For instance, although floods with a return period of a year or longer may not be affected by small (5% or less) amounts of impervious cover within a watershed, a flood with a return period of 100 years may be doubled in size when 30% of a watershed has impervious cover[12]. And the mean annual flood can be doubled when 20% of the watershed has been converted to impervious surfaces[13]. For a thorough review of the studied impacts of impervious cover on streamflow please see Center for Watershed Protection (2003)[14].

Percent impervious cover was calculated for each HUC12 in the study area using data from the 2011 National Land Cover Dataset's impervious surface product (Fig. 5). U.S. Geological Survey has classified nationwide land cover for 30m by 30m grid cells into 16 land cover classes that capture natural land cover, development and agriculture to form the National Land Cover Dataset (NLCD)[15]. The impervious area of each grid cell is calculated and used to create a continuous impervious surface layer. Round Pond Creek has the highest percent impervious cover at nearly 22% while Upper Salmon Creek has the lowest (Table 6). ***The degree of impervious cover in the Round Pond HUC12 is in line with percentages to have demonstrable impacts on peak discharge and reduced base flow.***

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[12] Hollis, F. 1975. The effects of urbanization on floods of different recurrence intervals. Water Resources Research 11:431- 435.

[13] Leopold, L. 1968. Hydrology for urban Land use planning – A guidebook on the hydrologic effects of urban land use. Washington, D.C. Geological Survey Circular 554.

[14] Center for Watershed Protection. 2003. Impacts of Impervious cover on Aquatic Systems. *Watershed Protection Research Monograph No. 1*.

[15] Homer, C.G., Dewitz, J.A., Yang, L., Jin, S., Danielson, P., Xian, G., Coulston, J., Herold, N.D., Wickham, J.D., and Megown, K., 2015, Completion of the 2011 National Land Cover Database for the conterminous United States-Representing a decade of land cover change information. *Photogrammetric Engineering and Remote Sensing*, v. 81, no. 5, p. 345-354.

Table 6. Percent of each HUC12 with impervious cover due to development.

HUC12	% Impervious
Round Pond Creek	21.7
Larkin Creek	9.6
Northrup Creek	4.1
Lower Salmon & Buttonwood Creeks	3.3
Upper Salmon Creek	0.9
Brockport & Otis Creeks	6.6
Moorman Creek	1.2
West Creek	1.7
Cowsucker Creek	1.0

In addition to overall percent impervious cover for each watershed, the percent impervious cover as it accumulates downstream by stream reach (Fig. 5) can be useful for identifying more specific areas where development may be impacting peak discharge and baseflow. The literature indicates 5% impervious cover may not impact streamflow but that 20% has been shown to double more frequent flood events. Therefore, it seems likely that percentages of impervious cover between 5% and 20% impact streamflow short of doubling it, but enough to cause flooding impacts. All reaches of the Round Pond Creek HUC12 have accumulated percent impervious cover over 10% with many above 20%. ***While the overall percent impervious cover for Larkin Creek's watershed is below 10%, three reaches in the lower watershed show impervious cover above 10%. Several reaches in Brockport Creek exhibit accumulated impervious cover above 10% downstream of the Village of Brockport.***

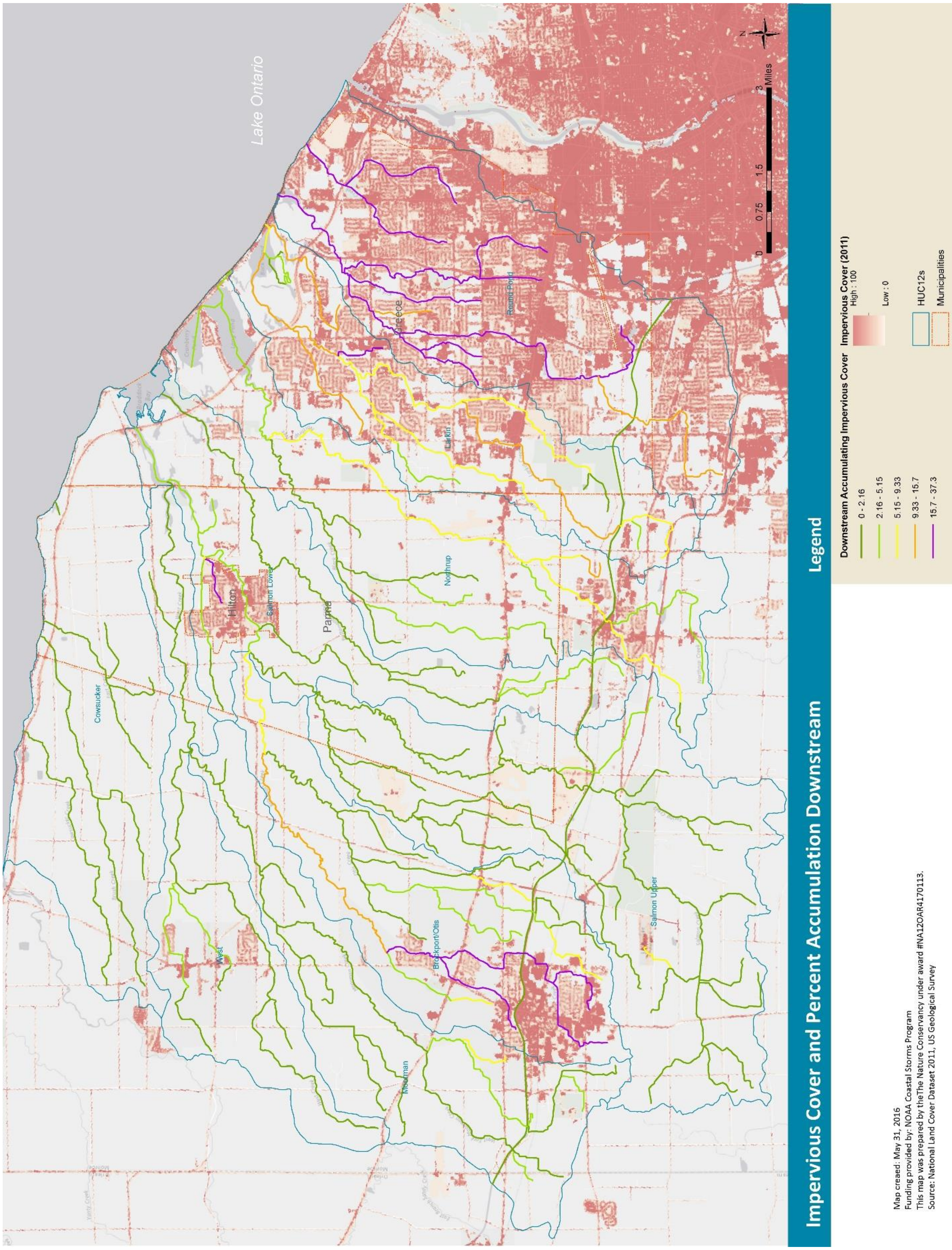

Figure 5. Downstream accumulation of impervious cover by reach for the 9 HUC12s included in the project area.

Streamflow

Streamflow refers to the amount of water flowing in a stream and measurement of it helps us understand the quantity and variability of our surface water resources. Statistics describing these measurements are useful for land use planning and development, and necessary for adequately designing infrastructure projects like bridges and culverts. They can also serve as a tool for flood forecasting and warning along rivers and streams.

Unfortunately, streamflow data within the project area are limited. Of the nine HUC12s included in the project area, only Northrup Creek has a stream gage. We used information from the Northrup Creek gage to highlight how accurate streamflow data can help with planning and regulatory requirements.

Recorded annual peak discharge (streamflow) has ranged in Northrup Creek from a low of 160 cfs in 1999 (peak for that year occurred on January 24) to a high in 2004 of 720 cfs (peak occurred on September 9, during the flood event we described earlier that caused over $1 million in damages) (Fig. 6). Flood statistics have not been calculated for this gage because USGS requires a minimum of 30 years of data in order to do so. Consequently, we do not know the annual chance of occurrence of the September 2004 event, or how it compared to the 100 year/1% annual chance of occurrence event used to delineate FEMA mapped floodplains, but it was roughly twice that of the next highest recorded annual peak discharge.

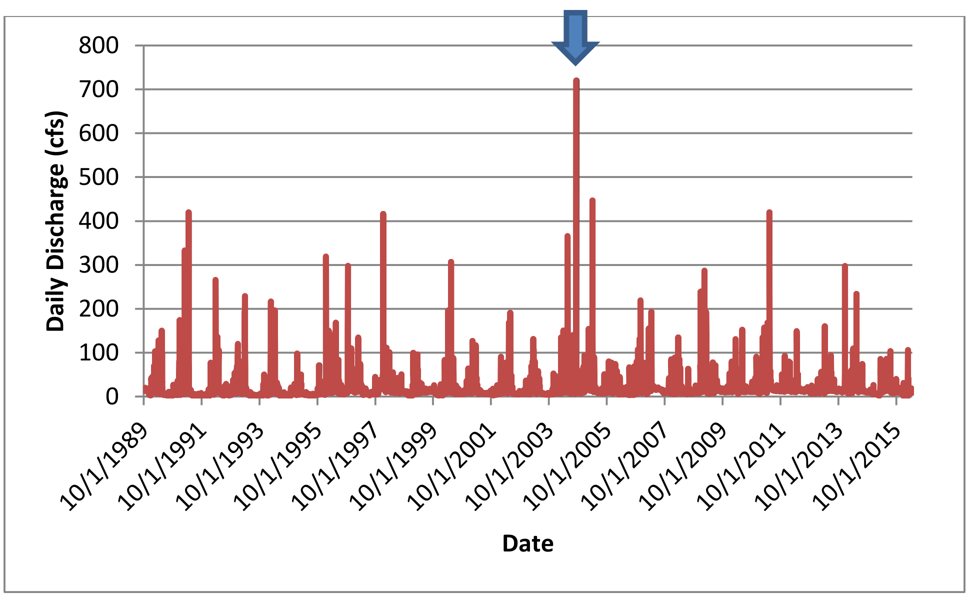

Figure 6. Daily discharge data recorded by the USGS stream gage on Northrup Creek.

While only one of the focus HUC12s has gage data, a tool developed by USGS called StreamStats can be used to estimate streamflow statistics for ungaged streams. StreamStats[16] is a Web-based Geographic Information Systems (GIS) application that provides users with access to an assortment of analytical tools that are useful for a variety of water-resources planning and management purposes as well as

[16] Ries III, K.G, J.D. Guthrie, A.H. Rea, P.A. Steeves, and D.W. Stewart. 2008. StreamStats: A water resources web application. US Geological Survey Fact Sheet FS 2008–3067.

engineering and design purposes. Users can select any location along a stream and obtain the drainage-basin boundary, basin characteristics, and estimates of streamflow statistics for the location. Estimates obtained for ungaged sites assume natural flow conditions at the site (i.e. less than 15% developed area within the watershed and minimal water storage).

The gage location on Northrup Creek was used in StreamStats to get a sense of the recurrence intervals for a range of streamflows. StreamStats estimates of discharge for recurrence intervals seem to be in line with daily discharge measurements collected by the gage. Approximately every 10 years, a streamflow event has been recorded just slightly above 400 cfs. Annual events seem to range from approximately 70 to 150 cfs. Therefore, it might be reasonable to use StreamStats outputs as guidance for considering current recurrence intervals for Northrup Creek.

Table 7. Discharge in cubic feet per second generated by StreamStats for a range of recurrence intervals using the location of the USGS stream gage on Northrup Creek. The tool characterized the basin area upstream of the gage as 10.2 mi^2 with a ratio of main channel slope to basin slope[17] of 0.24. The percentage of storage (lakes, ponds, reservoirs, and wetlands) within the drainage area is only 0.5% with 23.7% developed land use (from the NLCD 2011).

Recurrence Interval (yrs)	StreamStats Discharge (cfs)
1.25	161
1.5	196
2	238
5	346
10	417
25	505
50	570
100	632
200	697
500	777

As precipitation and streamflow datasets cover longer periods of time and capture more extreme events, a more complete picture can be generated of dynamic climatic and hydrologic cycles. The Northeast Regional Climate Center has modeled projections of future extreme precipitation events[18] and estimates that by the mid-21st century, rain events with a 1% and 10% annual chance of recurrence will produce approximately 15% more rain in a 24-hour period. The probability of occurrence will double for what are *currently* considered 100-year (1% annual chance) and 10-year (10% annual chance) rainfall events.

[17] as defined in SIR 2006-5112
[18] Get citation for NRCC modeling

USGS has developed a supplemental tool to StreamStats that estimates how streamflows might change given increased precipitation. This future flows tool[19] was developed in cooperation with New York State Department of Transportation. It allows users to apply a set of regression equations to estimate the magnitude of future floods for any stream or river in New York State (exclusive of Long Island) and the Lake Champlain Basin in Vermont.

With this tool, changes in streamflows were estimated for Northrup Creek at the USGS stream gage and for Salmon Creek just upstream of the Village of Hilton. For both creeks, changes were most profound in more frequent flood events ranging from the 1.25-year event (80% annual chance of occurrence) to the 10-year event (10% annual chance of occurrence). For these events, estimated increases in flow ranged from 10% to nearly 20% depending on the degree of change in precipitation and the future time period. For larger and less frequent events (4% to 0.2% annual chance of occurrence), increases in streamflow ranged from 7% to 15%.

The lack of confidence in these models largely comes from not having a full 100 years of data. Experts believe that with longer-term datasets, the Intensity-Duration-Frequency curves would be higher. Therefore, ***it is recommended that the upper end of the range be used for design purposes particularly for development that is expected to last more than 50 years***.

[19] This application uses regression equations that were developed in previous investigations by the U.S. Geological Survey (USGS) and are the basis for StreamStats. These regression equations include several fixed landscape metrics that quantify aspects of watershed geomorphology, basin size, and land cover as well as a climate variable—either annual precipitation or annual runoff. The application uses predictions of future annual precipitation and provides results that are averaged over three future periods—2025 to 2049, 2050 to 2074, and 2075 to 2099. It is intended to be used only as an exploratory tool because the regression equations on which the application is based have not been adequately tested outside the range of current precipitation and due to the high degree of uncertainty. A discussion of the assumptions, uncertainties, and appropriate use of this exploratory application is available in the cited report.Burns, D.A., M.J. Smith, and D.A. Freehafer. 2015. Development of flood regressions and climate change scenarios to explore estimates of future peak flows: U.S. Geological Survey Open-File Report 2015–1235, 11 p.

Natural Infrastructure

Natural ecosystems like floodplains, wetlands, and forests provide essential services to water utilities, businesses, and communities such as streamflow regulation, flood abatement, and water purification. To ensure these ecosystem functions and associated benefits continue, networks of natural lands and other open spaces can be secured as “natural infrastructure.” While concrete-and-steel built infrastructure or “gray infrastructure” has its place in our communities and its own benefits, investing in natural infrastructure can reduce or avoid costs and enhance water services as part of an integrated system to cost-effectively mitigate flood risk and improve water quality[20].

Forests: The canopy cover of forests catches and disperses rain drops before they hit the land surface, increasing the time it takes water to reach the ground and ultimately reducing the amount of rain that turns into surface flow. This leads to water levels that rise and fall less rapidly therefore helping to regulate streamflow and reduce flood flows.

The benefits of natural infrastructure can be characterized as ecosystem services – products and processes generated by functioning ecosystems that economically benefit society (Brauman, Daily et al. 2007)[17]. In their review of the value of the world’s ecosystem services, Costanza et al. (1997) found that floodplains were the second ranked ecosystem type, behind only estuaries, in terms of their per-hectare value to society. Despite representing <2% of Earth’s terrestrial land surface area, floodplains provided approximately 25% of all ‘‘terrestrial’’ (i.e., non-marine) eco-system service benefits. Sheaffer et al. (2002) estimated that replacing the services provided by functioning floodplains (e.g. through constructed features) would cost approximately $150,000 per hectare.

Greece, Parma and Hilton and the watersheds that they are a part of have many natural resources that are likely serving as natural infrastructure and providing flood attenuation and water quality benefits to their communities. We describe them at a watershed scale because they provide benefits through and along the path of flowing water, and management decisions made upstream can impact those communities located downstream. Since municipal boundaries are operationally relevant, and the scale at which resources are managed and decisions made, we also summarize them within each municipality.

Floodplains

What are floodplains?

Flood flows are generated by heavy rainfall, snowmelt or a combination of these sources of runoff. Runoff is collected by the channel network from all of the land that drains to it. The channel network also transports sediment that erodes from the land, wood and other biological material. **While most people view the river as “water” and the floodplain as “land,” in reality the river and floodplain are one integrated system for conveying water and sediment downstream, with the floodplain being the component that only carries water during floods[21].** In fact, floodplains tend to be flat and fertile

[20] Gartner, T., J. Mulligan, R. Schmidt, and J. Gunn. 2013. Natural Infrastructure: Investing in Forested Landscapes for Source Water Protection in the United States. World Resources Institute, Washington.
[21] Opperman, J.J. 2014. A Flood of Benefits: Using Green Infrastructure to Reduce Flood Risks. The Nature Conservancy, Arlington, Virginia.

precisely because they are built up over time as centuries of floods deposit sequential layers of soil. So, during floods, the floodplain carries water from the river and the river "builds" land on the floodplain.

What services do they provide?

Floodplains convey water when floods exceed the ability of the river channel to transport the flood between its banks. During floods, floodplains essentially increase the ability of a river to move or convey floodwaters. Initially during a flood, the flood height rises with increasing flood volume. When the flood exceeds the channel capacity and spills out onto the floodplain, flood height increases much more slowly with flood volume because the additional volume of water moves out onto the floodplain. Floodwaters move much more slowly on floodplains, because they tend to be flat and vegetated, and so very extensive floodplains can act something like a reservoir that temporarily stores water, slowly releasing it back to the river as the flood recedes[23]. Slow moving water also allows sediment and nutrients to drop out on the floodplain, where they can be utilized by plants.

Where are our floodplains?

Floodplains are not particularly well mapped. At the federal level, FEMA floodplains are delineated to determine rates for flood insurance. They represent the inundation footprint or area of land that would be covered with water given a stream discharge with a recurrence interval of 100 years (1% annual chance of occurrence) and 500 years (0.2% annual chance of occurrence). **While these maps can be useful for thinking about flood risk, they are insufficient for fully planning for and addressing flooding within communities because:**

- they do not cover all streams,
- they do not account for qualities or characteristics of floodplains that provide flood abatement, water quality and habitat benefits, and
- flooding regularly occurs outside of their boundaries (nationwide one-third of all flooding occurs outside of FEMA mapped floodplains and in Vermont that number has been shown to be closer to two-thirds).

There are no local resources to augment the incomplete FEMA mapping efforts: New York State has not mapped floodplains nor have any other federal agencies with the exception of some inundation mapping completed for limited geographies by USGS and the Susquehanna River Basin Commission. Consequently, floodplains are difficult to represent geospatially and difficult to assess for condition, ecosystem function, or the flood abatement or water quality services they provide. For these reasons, we have used other datasets to consider the condition of floodplains in our focus area and the flood abatement, water quality, and habitat benefits they may be providing.

In 2008 The Nature Conservancy and partners developed a modeling tool and outputs for the Northeast Region called the Active River Area (ARA). The ARA framework is based upon dominant processes and disturbance regimes to identify areas within which important physical and ecological processes of the river or stream occur. The framework identifies five key subcomponents of the active river area: 1) material contribution zones, 2) meander belts, 3) riparian wetlands, 4) floodplains, and 5) terraces. The framework provides a spatially explicit manner for accommodating the natural ranges of variability to system hydrology, sediment transport, processing and transport of organic materials, and key biotic interactions. The Active River Area essentially represents the places on the land that are the most intimately connected to the function of streams.

The ARA is *not* the regulatory floodplain nor is it an inundation map; for this project, it indicates areas of land that interact with water to varying degrees and much more directly influence the amount of water flowing in a stream channel and the way it moves across the land. In places where the ARA has been developed, for example, less land is available to slow, store, and filter water so flood abatement and water quality services are likely reduced too.

The ARA within the project areas is much more inclusive than the FEMA floodplains and is greatly influenced by the flat topography of the lake plain and in some places by development (Fig. 7). The ARA is quite wide in most of the HUC12s particularly north of Ridge Road and along the shore of Lake Ontario indicating places that are connected elevationally to some degree to the stream channel. These are also places where water may pool and pond, and saturate soils. In the more developed HUC12s like Round Pond and Larkin, it is quite likely that prior to development the ARA more closely resembled the ARA in less developed watersheds like Northrup and Upper Salmon. Development has constrained the ARA which has removed the intimate connection between water and land, almost certainly impacting streamflow.

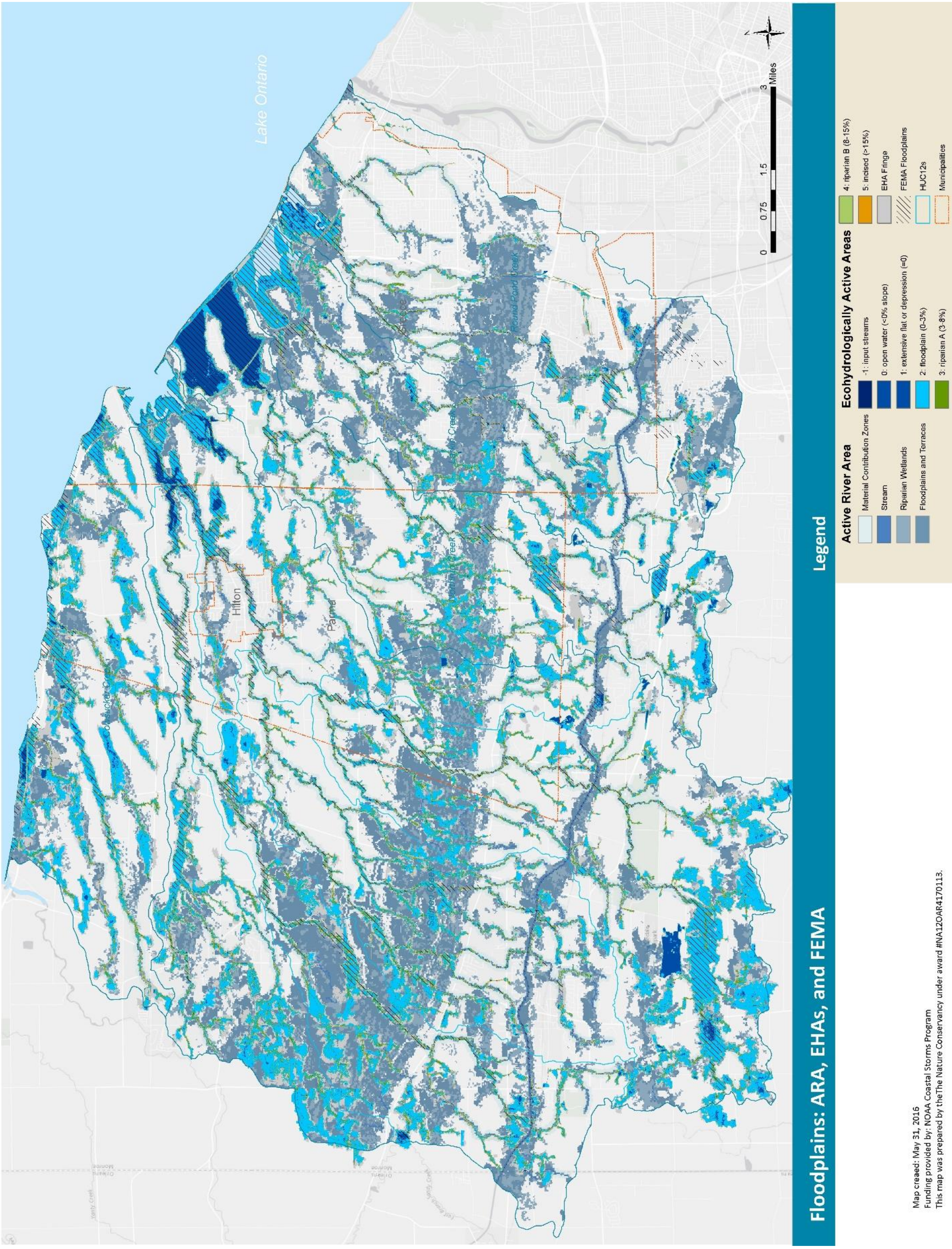

Figure 7. Floodplains as represented by FEMA, the Active River Area (ARA) and Ecohydrologically Active Areas (EHAs).

While the ARA is useful for thinking about broad influences of land use on streamflow, another Nature Conservancy tool identifies areas that are ecohydrologically active (EHAs) [22], places where groundwater is close enough to the surface that vegetation can interact with it. This interaction can lead to open water, headwater wetlands, floodplains, and riparian buffers---**all of which are areas that could be providing flood abatement and water quality benefits.** The tool identifies these areas based on the geomorphology of the stream corridor and the surrounding landscape. First, it uses a high resolution digital elevation model (LiDAR) to delineate land within 1.5 meters elevation of ground water. It then determines the relative slope of lands within this area. The slope of the land surface across these wetter areas indicates whether an area is likely inundated, driven by surface water input, saturated (but not flooded) and likely driven by groundwater inputs, or incised. **The model has an advantage over traditional digital wetland sources (National Wetlands inventory or SSURGO hydric soils) in that the analysis of the land surface can identify prior converted wetlands or other unmapped wetland features.**

Much of the EHA within the nine HUC12s is out of the jurisdiction of Greece, Parma and Hilton. Of the 32,503 acres of EHAs in the focus watersheds, nearly half lie within the jurisdictional boundaries of the three municipalities. The proportion varies greatly by HUC12 and is reflective of the amount of the overall HUC12 that lies within the municipal bounds. For Larkin, Northrup, Round Pond and Salmon Lower, the three municipalities have jurisdiction over large portions of the HUC12s and the EHA within. However, all or nearly all of the EHAs in Brockport/Otis and Moorman are out of their jurisdiction.

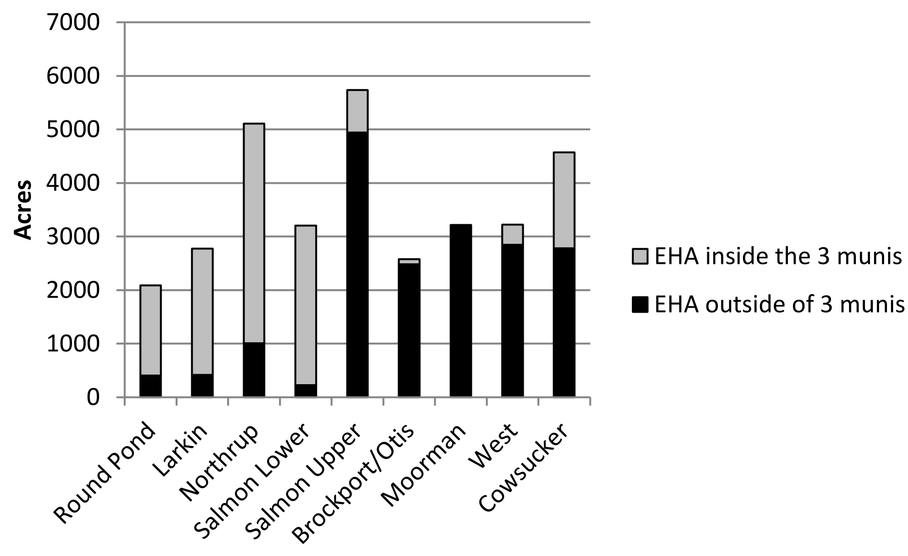

Figure 8. Total acres of EcoHydrologically Active Areas (EHA) within each HUC12 as well as the proportion of the total EHA for the HUC12 that lies within the municipal boundaries of Greece, Parma and Hilton.

[22] Boomer et al, *in prep*

What condition are our floodplains in?

Floodplains can best provide the services of flood attenuation and water quality protection when they are connected to the stream; large, flat, and vegetated; and have unsaturated soils and topographic depressions. Natural floodplains tend to exhibit these characteristics and are generally the most effective at providing services. While crops and pasture lands remain permeable to water and have plant cover at some times of year, they represent an economic investment and an important component of the local economy so are not ideal for flooding. Often the way that water flows across farmland has been altered by ditching or tile drainage. Development is the least desirable land use in floodplains as it most severely alters the natural processes that provide ecosystem services, and puts people and assets at risk.

To assess the condition of floodplains within the study area, we analyzed land cover within the EHAs using the NLCD 2011. We selected EHAs as the best area to represent floodplain services because the cover all streams (not just those that have been mapped by FEMA) and because the method to create them takes into account 1) interactions between vegetation and groundwater for water quality benefits and 2) the elevation of areas adjacent to the stream channel. Northrup and Moorman have the highest proportion of natural land within the EHA. We might expect these watersheds to have the least altered hydrology, more floodplain area available for flood attenuation, and better water filtration due to more water contact with filtering vegetation. Areas downstream will benefit most from these services.

High proportions of development greatly reduce or eliminate the ability of floodplains to provide flood attenuation and water quality benefits. In the HUC12s of Round Pond and Larkin Creeks, the EHA has been constrained by the filling of floodplains and straightening of stream channels so that they more closely resemble ditches. Not only does removing the floodplain connection reduce or eliminate flood attenuation but it can also make downstream flooding worse. Ditching of stream channels restricts flood flows to a smaller cross section which makes it more likely that stream banks and road stream crossings will be overwhelmed in storm events, and that erosion of stream banks will occur. While a high percentage of Round Pond's EHAs are in natural land cover, they have been so constrained that it is unlikely those natural areas are fully providing benefits.

Watersheds with more agriculture, like Cowsucker, have less altered hydrology than developed watersheds, but agricultural practices may have ditching and tile drainage. These practices tend to focus flows with the intention of getting water off the land quickly rather than allowing it to spread out, slow down and infiltrate into the soils. On the other hand, these techniques may also leave soils drier so that they are available to store water in rain events. Cowsucker's HUC12 has the highest proportion of agriculture within the EHA (57%). This could mean that farmers struggle with drainage issues on more of their farmland than in other watersheds.

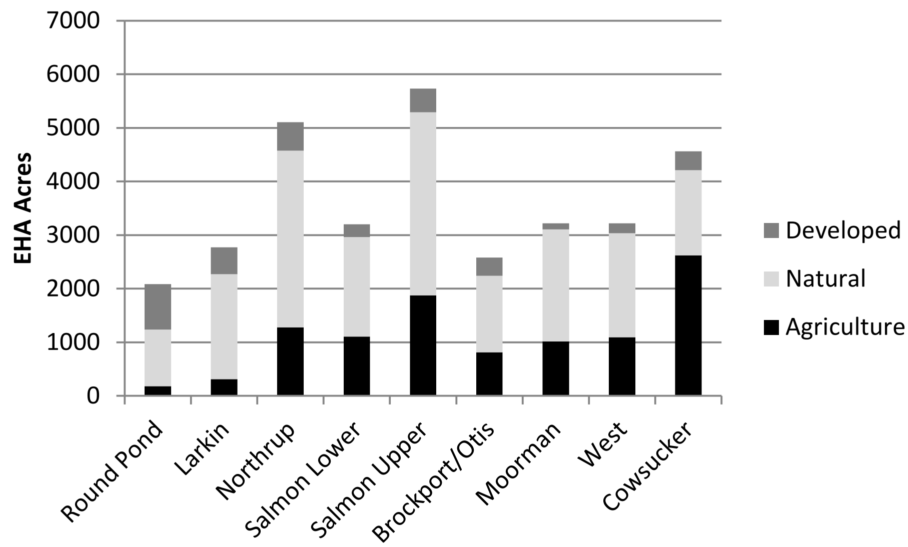

Figure 9. Land cover within the EcoHydrologically Active Areas (EHAs)

How protected are our floodplains?

Federal regulation of activities in floodplains is limited to two primary agencies, FEMA through the National Flood Insurance Program (NFIP), and United States Environmental Protection Agency (USEPA) and Army Corps of Engineers (ACOE) jointly through Section 404 of the Clean Water Act. Once FEMA provides a community with the flood hazard information upon which floodplain management regulations are based, the community is required to adopt a floodplain management ordinance that meets or exceeds the minimum NFIP requirements. FEMA's flood maps determine the regulatory boundary. The overriding purpose of floodplain management regulations is to ensure that participating communities take into account flood hazards, to the extent that they are known, in all official actions relating to land management and use. Enforcement of compliance is the responsibility of the community. As described in the wetland section below, Section 404 regulates dredging of material or filling of certain waterbodies which can include floodplains. The basic premise of the program is that no discharge of dredged or fill material may be permitted if: (1) a practicable alternative exists that is less damaging to the aquatic environment or (2) the nation's waters would be significantly degraded. In other words, a permit applicant must demonstrate that steps have been taken to avoid impacts to wetlands, streams and other aquatic resources, that potential impacts have been minimized, and that compensation will be provided for all remaining unavoidable impacts.

Of the 32,503 acres of EHA within the nine HUC12s, 34% receive some sort of protection either because they have been mapped as wetlands by NYSDEC, they are regulated to meet NFIP standards, or they are in conservation ownership. Within the nine HUC12s, only 26% of EHA acres fall within the regulatory boundary of FEMA and are regulated to meet NFIP standards, likely because so many stream reaches have not been mapped for these purposes and because the EHA is capturing more than the land surface that would be inundated by a 1% or 0.2% chance flood. Only 7% fall within conservation ownership.

While floodplains in the project area, as in the rest of New York, have been altered dramatically by straightening and channelizing stream channels and filling floodplains and wetlands, many areas are still functioning and providing flood abatement and water quality benefits. ***These floodplain areas should be targeted for protection by either fee title or easement acquisition or through local land use regulation.*** Prioritizing areas for protection will help ensure that limited resources are allocated to get the most benefit for the cost.

Table 8. Acres and proportions of lands protected by regulation (NFIP, DEC) or conservation ownership.

HUC12	EHA Acres in HUC12s	DEC Mapped Wetlands		FEMA Mapped Floodplains		Lands in Conservation Ownership		Total with some form of protection		EHA Acres in Munis	Protected in Munis		
		Acres	%	Acres	%	Acres	%	Acres	%		Acres	% of Total	% in Munis
Round Pond	2087	511	24%	847	41%	60	3%	940	45%	1679	822	39%	49%
Larkin	2773	925	33%	1166	42%	829	30%	1345	48%	2356	1196	43%	51%
Northrup	5107	897	18%	1696	33%	700	14%	1999	39%	4096	1668	33%	41%
Salmon Lower	3208	1021	32%	1152	36%	544	17%	1359	42%	2981	1326	41%	44%
Salmon Upper	5734	1271	22%	1109	19%	20	0%	1775	31%	793	237	4%	30%
Brockport/Otis	2581	143	6%	536	21%	8	0%	638	25%	101	57	2%	57%
Moorman	3219	367	11%	589	18%	9	0%	906	28%	0	0	0%	0%
West	3224	545	17%	599	19%	36	1%	950	29%	380	340	11%	89%
Cowsucker	4570	655	14%	861	19%	136	3%	1023	22%	1790	547	12%	31%
Total	32503	6335	19%	8555	26%	2342	7%	10935	34%	14176	6192	19%	44%

Wetlands

What are wetlands?

Wetlands lie at the transition from land to deeper water in streams, lakes and oceans. They are characterized by the soils, topography and hydrology that support them. They store flood waters that overflow riverbanks and surface water that collects in topographic depressions depending on the size of the area, type and condition of vegetation, slope, location of the wetland in the flood path and the saturation of wetland soils before flooding.

New York has an estimated 2.5 million acres of freshwater wetlands and 25,000 acres of tidal wetlands. They encompass about nine percent of the land mass of New York. **The U.S. Fish and Wildlife Service estimates that over half of New York's wetlands have been lost since colonization due to development and agriculture.**

What services do they provide?

Wetlands can act as sponges that soak up storm water, storing high flows and releasing the water slowly to the stream or groundwater system. A one-acre wetland can typically store about three-acre feet of water, or one million gallons[23]. Wetlands often overlap with floodplains. Floodplain or riparian wetlands maintain saturated soils generally due to groundwater while other parts of the floodplain are only wet when inundated by flood flows. Wetlands can also be isolated from floodplains but continue to provide a flood abatement service by storing water until it can infiltrate to ground water or by intercepting surface water runoff before it reaches a stream network. Wetlands also filter water by slowing flows and allowing sediment and nutrients to drop out. Bio-geochemical processes within wetlands, such as denitrification, can reduce nitrogen loads. Because of the ecosystem services wetlands provide, their restoration and protection is an important part of flood risk management.

[23] US Environmental Protection Agency. 2006. Wetlands: Protecting life and property from flooding. US EPA, Office of Water, EPA843-F-06-001.

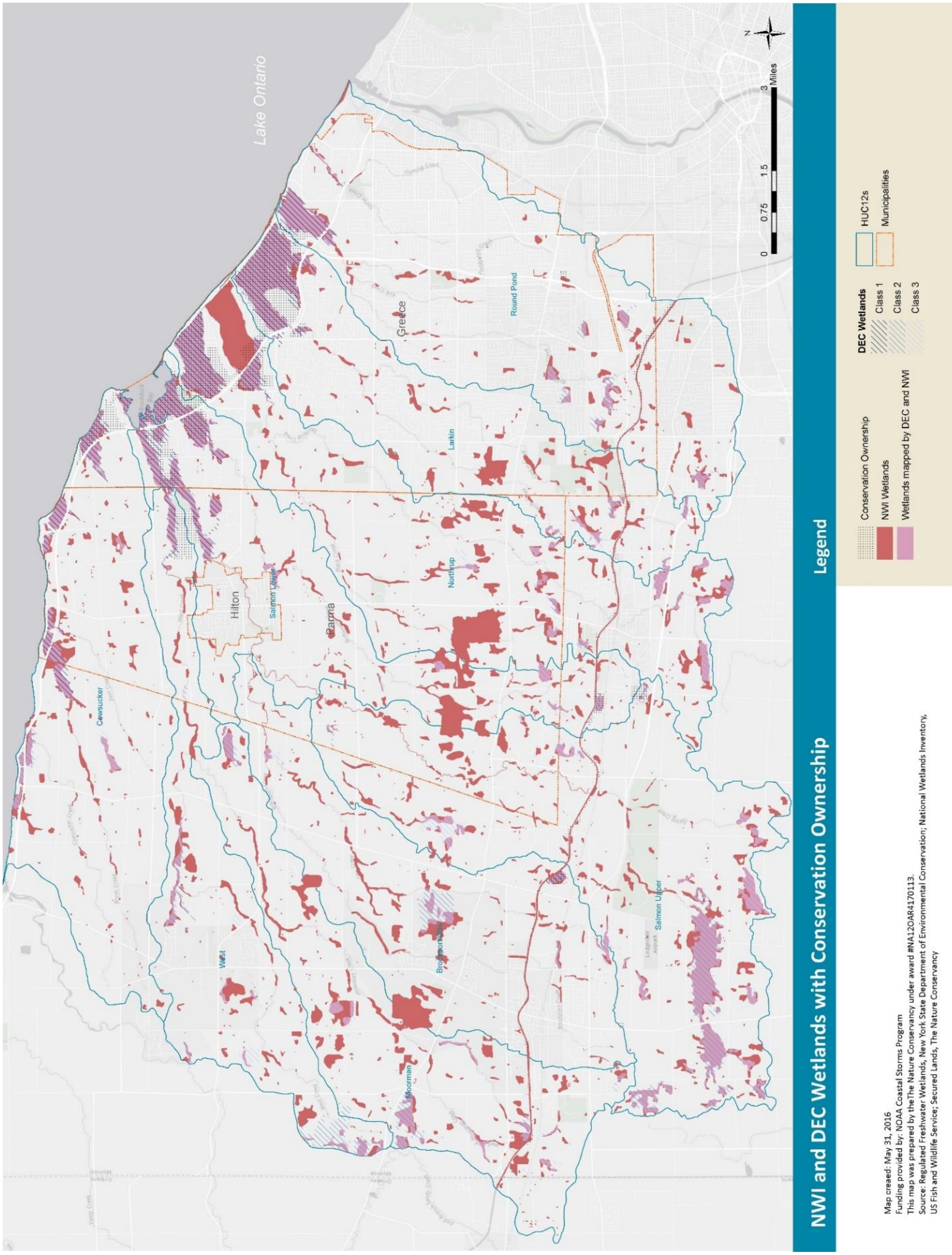

Figure 10. Wetlands mapped by the National Wetlands Inventory (NWI) and New York State Department of Environmental Conservation (DEC). Lands in conservation ownership are also shown.

Where are our wetlands?

Two datasets have been developed to identify wetlands in New York State. The first is the National Wetlands Inventory (NWI) developed by the US Fish and Wildlife Service (USFWS)[24] and the second is Regulatory Freshwater Wetlands by New York State Department of Environmental Conservation[25](Fig. 9). These two efforts use different methods in part due to their different regulatory impetus, and consequently do not entirely overlap. They also do not identify all wetlands and should not be relied on as a sole source of wetland location information.

Roughly one-third of floodplains, as represented by the EHAs, overlap with wetlands that have been mapped by either USFWS, NYSDEC or both.

For the nine HUC12 watersheds included in the project, 15,329 acres have been mapped as wetlands by USFWS, NYSDEC or both (Figure X). These wetlands cover approximately 12% of the total watershed area (Table 1). Northrup Creek has both the highest number of mapped wetland acres and the highest proportion of its watershed in wetlands. Round Pond Creek has the least proportion of land cover in wetlands at only 6.3%.

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[24] The NWI was established by USFWS to conduct a nationwide inventory of U.S. wetlands to provide biologists and others with information on the distribution and type of wetlands to aid in conservation efforts. To do this, the NWI developed a wetland classification system that is now the official USFWS wetland classification system and the Federal standard for wetland classification. The NWI relies on trained image analysts to identify and classify wetlands and deepwater habitats from aerial imagery. Large-scale (1:24K scale) maps are produced digitally and distributed online. Tiner, R.W. (editor). 2009. Status Report for the National Wetlands Inventory Program: 2009. U.S. Fish and Wildlife Service, Division of Habitat and Resource Conservation, Branch of Resource and Mapping Support, Arlington, VA. 48 pp.

[25] New York State began regulating wetlands in 1975 when the State Legislature passed The Freshwater Wetlands Act. The intent was to preserve, protect and conserve freshwater wetlands and their benefits, consistent with the general welfare and beneficial economic, social and agricultural development of the state. The Freshwater Wetlands Act protects wetlands 12.4 acres (5 hectares) or larger. Wetlands smaller than this may be protected if they are considered to have unusual local importance. Around every wetland is an 'adjacent area' of 100 ft that is also regulated to provide protection for the wetland. A permit is required to conduct any regulated activity in a protected wetland or its adjacent area. Jurisdiction over wetlands that are less than 12.4 acres in size and not of "unusual importance" is up to the discretion of local governments. Different wetlands provide different functions and benefits and in varying degrees. The Act requires DEC to rank wetlands in classes based on the benefits and values provided by each wetland. The wetland class helps to determine the best uses for each wetland. Higher class wetlands provide the greatest level of benefits and are afforded a higher level of protection. Lower class wetlands still provide important functions and benefits, but typically require less protection to continue to provide these functions. New York State Department of Environmental Conservation. 1997. Article 24, Freshwater Wetlands, Title 23 of Article 71 of the Environmental Conservation Law.

Table 9. Mapped NWI and DEC wetlands in the nine HUC12s that were included in the project area. Percentages are the number of mapped acres from each agency as a proportion of the total HUC12 acres. The highlighted column depicts the total amount of mapped wetlands by either agency or both.

HUC12	HUC12 Total Acres	NWI		DEC		Acres as both NWI/DEC	**NWI/DEC Combined**	
		Acres	%	Acres	%		**Acres**	**%**
Round Pond	18535	994	5.4%	604	3.3%	432	**1166**	**6.3%**
Larkin	11001	1505	13.7%	1001	9.1%	825	**1681**	**15.3%**
Northrup	15812	2622	16.6%	977	6.2%	821	**2778**	**17.6%**
Salmon Lower	11736	1545	13.2%	1092	9.3%	816	**1821**	**15.5%**
Salmon Upper	19967	2340	11.7%	1543	7.7%	1138	**2745**	**13.7%**
Brockport/Otis	12720	948	7.5%	339	2.7%	136	**1151**	**9.0%**
Moorman	11462	1286	11.2%	499	4.4%	303	**1482**	**12.9%**
West	9657	814	8.4%	703	7.3%	266	**1251**	**13.0%**
Cowsucker	13602	1097	8.1%	699	5.1%	542	**1254**	**9.2%**
Total	124492	13151	10.6%	7457	6.0%	5279	**15329**	**12.3%**

Greece, Parma and Hilton are at the downstream end of the nine HUC12s (Fig. 9) and include approximately 50% of the watershed area that drains to and through their communities (they include none of Moorman Creek). High proportions of Round Pond (79.3%), Larkin (83.8%), Northrup (74.5%), and Lower Salmon and Buttonwood Creeks (89.9%) lie within their municipal boundaries. However, only 11.5% of the upper portions of Salmon Creek's watershed are within their jurisdiction.

Consequently, the majority of wetlands that could be providing flood attenuation and water quality benefits to Greece, Parma and Hilton are located upstream and outside of their jurisdiction. For the eastern-most coastal HUC12s (Round Pond, Larkin, Northrup, and Lower Salmon and Buttonwood), between 82 and 93% of the total mapped wetlands lie within the jurisdiction of the three municipalities. For the watersheds that lie upstream of these communities, however, only 0 to 19% of mapped wetlands are within their jurisdiction.

Table 10. Mapped NWI and DEC wetlands in the portions of the nine HUC12s that lie within the Towns of Greece and Parma and the Village of Hilton. The percentages represent the number of mapped wetland acres that lie within the municipal boundaries compared to the total number of mapped acres.

HUC12	HUC12 Total Acres	HUC12 within Munis		NWI		DEC		Acres as both NWI/DEC	NWI/DEC Combined	
		Acres	%	Acres	%	Acres	%		Acres	%
Round Pond	18535	14697	79.3%	811	81.6%	564	93.4%	400	975	83.6%
Larkin	11001	9221	83.8%	1292	85.8%	869	86.8%	748	1413	84.1%
Northrup	15812	11783	74.5%	2152	82.1%	753	77.1%	635	2270	81.7%
Salmon Lower	11736	10554	89.9%	1445	93.5%	1040	95.2%	790	1695	93.1%
Salmon Upper	19967	3722	**18.6%**	354	15.1%	27	1.7%	9	372	13.6%
Brockport/Otis	12720	692	**5.4%**	23	2.4%	0	0.0%	0	23	2.0%
Moorman	11462	0	**0.0%**	0	0.0%	0	0.0%	0	0	0.0%
West	9657	1767	**18.3%**	151	18.6%	140	19.9%	84	207	16.5%
Cowsucker	13602	5202	38.2%	635	57.9%	438	62.7%	360	713	56.9%
Total	124492	57638		6863	52.2%	3831	51.4%	3026	7668	50.0%

What condition are our wetlands in?

Land cover within NWI and DEC wetlands was calculated using the NLCD 2011. For each of the nine HUC12s, 82-94% of NWI wetlands and 82-97% of DEC wetlands have natural land cover (Fig. 5). This indicates that a large proportion of mapped wetlands are providing the ecosystem services of flood abatement and water filtration. It also implies that the regulatory agencies and local municipalities are doing a reasonable job of enforcing wetland protections. Round Pond, where development pressure may be the most intensive, has the highest number of acres and highest proportion of mapped wetlands in developed land cover for both NWI and DEC wetlands. Salmon Upper has the highest number of NWI wetland acres in agriculture while Cowsucker has the highest percentage. For DEC wetlands, Salmon Lower, which includes Buttonwood Creek, has the highest number of acres in agriculture while Moorman has the highest percent.

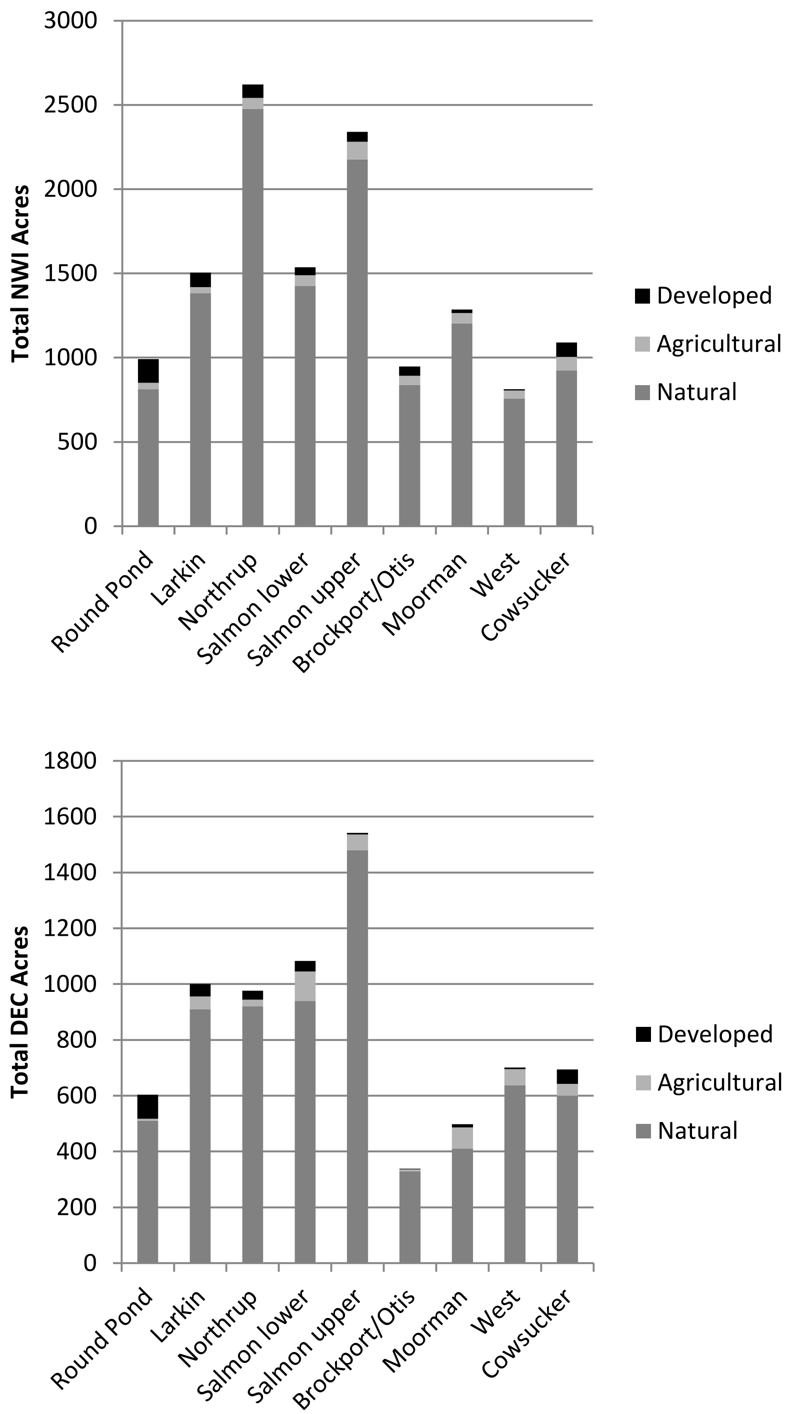

Figure 11. Proportion of wetlands in developed, agricultural and natural land cover (top: National Wetlands Inventory, bottom: Department of Environmental Conservation Freshwater Wetlands).

How well are our wetlands protected?

Only about one-half of all mapped wetlands in our nine HUC12s are protected to some degree by the State and only one-fifth to one-quarter receive the highest level of State protection. Federal regulation provides some protection but its jurisdiction is not delineated geospatially so it is difficult to estimate the proportion of wetlands that receive the benefit of that protection.

- NYSDEC regulatory wetlands are classified as Class I through IV based on the benefits they provide and the protection level presumed required to maintain those benefits, with Class I receiving the highest degree of regulatory protection which prohibits alteration. Only 45% of DEC mapped wetlands receive this highest degree of protection, while 34% receive Class II and 21% receive Class III protections which allow for possible alteration as long as every attempt has been made to avoid, minimize and mitigate impacts. There are no Class IV wetlands.
- NWI wetlands receive no official regulatory protection. They are typically used only as a coarse screen by the Army Corps of Engineers as part of its review under Section 404 of the Clean Water Act[26]. They *may* be used by NYSDEC as part of their review under Section 401 of the Clean Water Act.

A large proportion of wetlands that might be providing flood abatement benefits to Greece, Parma and Hilton is not protected by State regulations and are out of the regulatory jurisdiction of the local governments. The majority of mapped wetlands that are in their jurisdiction are at the downstream-most ends of these watersheds and while they are likely providing water quality benefits to Lake Ontario they are not ideally situated to provide flood abatement benefits to Greece, Parma and Hilton.

An additional form of protection for wetlands aside from regulation, would be to hold them in conservation ownership. Wetlands in the area with this form of protection overlap greatly with those mapped and protected by NYSDEC, and largely lie at the downstream most end of the watersheds in the Braddock Bay WMA. Consequently, while conservation lands are likely providing benefit to the water quality of Lake Ontario and habitat for a diversity of aquatic and terrestrial species, they are not located higher in the watershed or upstream of population centers where they might provide water filtration and flood abatement benefits.

The Nature Conservancy maintains a database of protected lands, including public land ownership or voluntarily provided private conservation lands that offer a degree of permanent protection and are managed, at least in part, to preserve biological diversity and to other natural, recreational and cultural

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[26] Floodplains and wetlands are afforded some protection under Section 404 of the Clean Water Act. Water quality evaluations must be prepared for all projects in which dredged or fill material will be discharged into waters of the United States. The term “waters of the United States” is defined in the Environmental Protection Agency Guidelines for Specification of Disposal Sites for Dredged or Fill Material, Federal Register, December 24, 1980. The definition is complex and can be difficult to apply.

uses. This database was used to determine the amount of mapped wetlands that have protected status through conservation ownership within the nine HUC12s.

Larkin Creek's HUC12 has by far more wetlands in conservation ownership (49%) than any other HUC12. The majority of these protected lands lie at the downstream-most end of this watershed within the Braddock Bay Wildlife Management Area. Lower Salmon and Buttonwood Creeks' HUC12 and Northrup Creek's HUC12 also have a high proportion of mapped wetlands in conservation ownership at 29% and 24% respectively, largely due to the Braddock Bay Wildlife Management Area as well. The two remaining coastal watersheds, Round Pond and Cowsucker, have just 6% and 10% respectively of mapped wetlands protected. The upstream watersheds of Salmon, Brockport/Otis, Moorman and West Creeks have a very small amount of mapped wetlands in conservation ownership ranging from just 0.6% to a maximum of 3.6%.

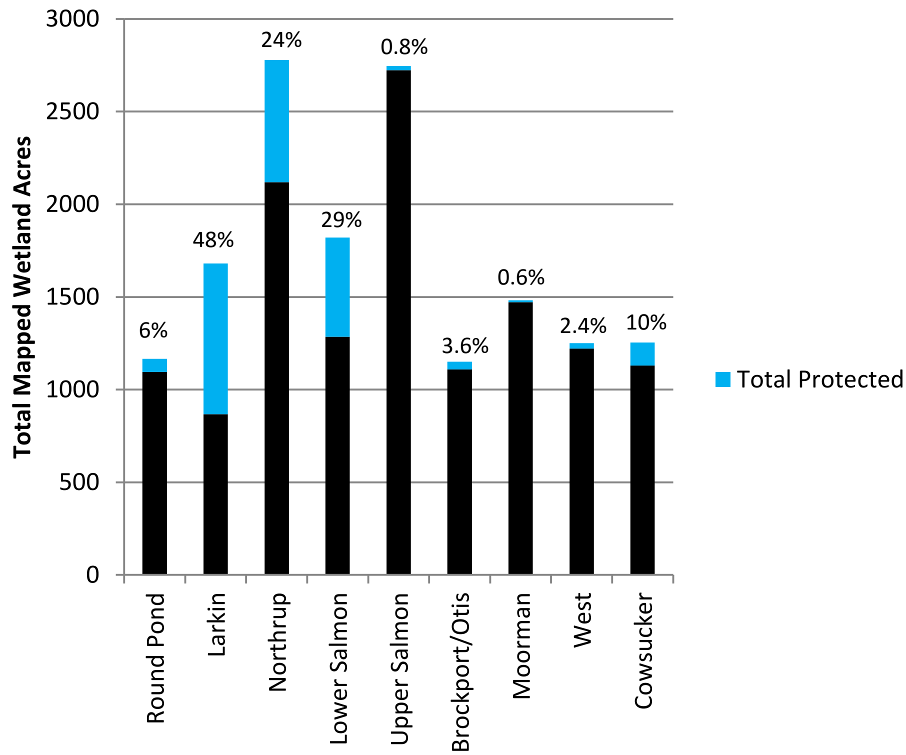

Figure 12. Total mapped wetland acres (NWI & DEC combined) for each HUC12 with the proportion of those wetlands in conservation ownership.

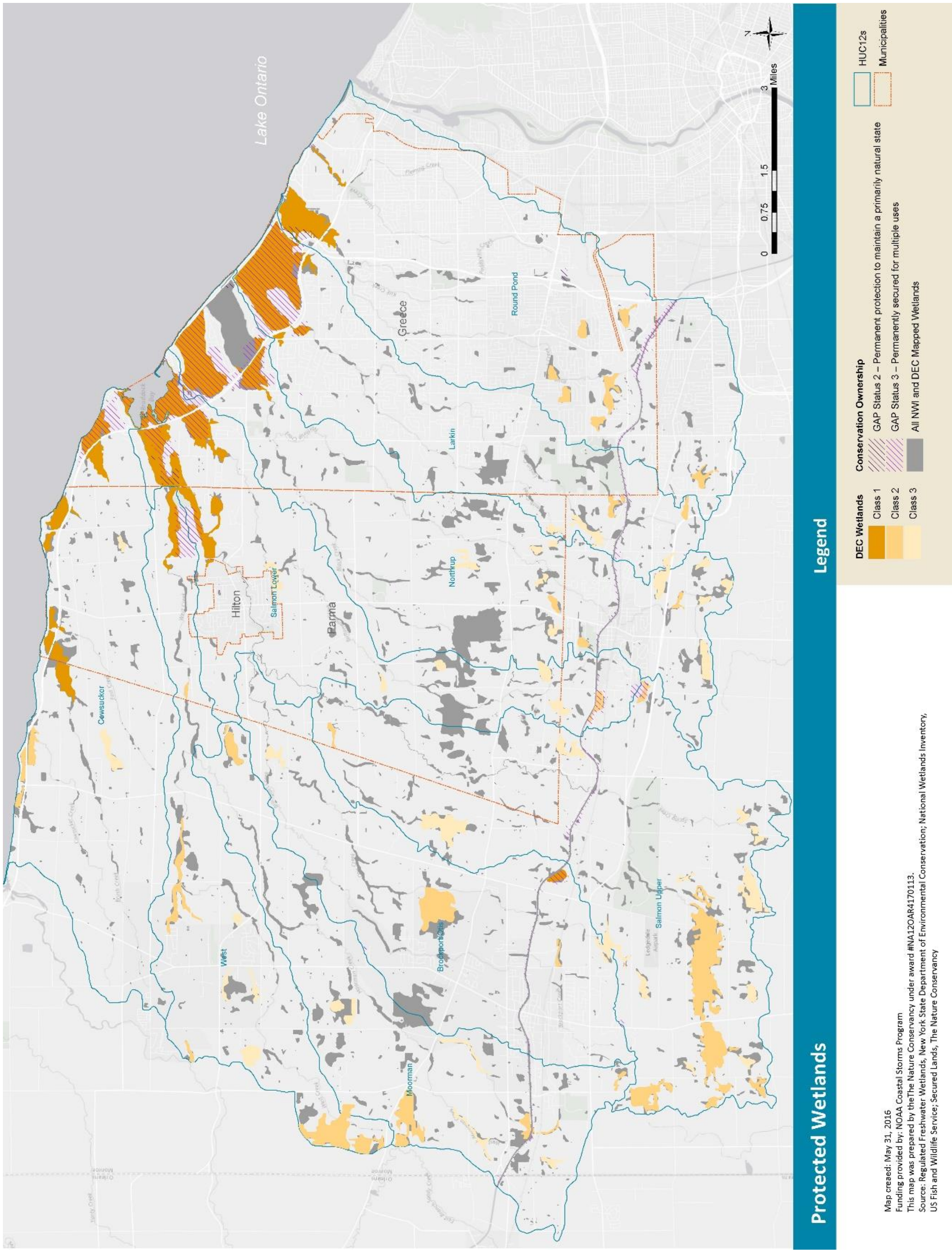

Figure 13. Mapped wetlands that are protected by New York State Department of Environmental Conservation or by conservation ownership. The Nature Conservancy maintains a database of protected lands, including public land ownership or voluntarily provided private conservation lands that offer a degree of permanent protection and are managed, at least in part, to preserve biological diversity and to other natural, recreational and cultural uses. Each area is assigned a GAP status based on the degree of permanent protection and management for conservation benefit]. In our project area there are no GAP 1 or GAP 4 lands

Conclusions

The four upper HUC12s of Salmon Creek's watershed, Upper Salmon Creek, Brockport/Otis Creeks, Moorman Creek, and West Creek, have a high proportion of soils with high runoff potential, low amounts of floodplain that receive some sort of federal or state protection, very low percentages of mapped wetlands with some sort of protection, and the majority of their land surface lies outside of the jurisdiction of Greece, Parma and Hilton. These three municipalities should work with each other and the other municipalities in these watersheds to devise a well-balanced flood risk management plan that includes protection of existing natural infrastructure. Greece, Parma and Hilton could also work with local land trusts to look for areas where habitat benefits overlap with flood abatement benefits and help with funding protection of those areas. While some characteristics of these HUC12s highlight the need for watershed wide flood risk planning and management, other characteristics indicate that efforts are not too late. All of these HUC12s with the exception of Brockport/Otis have had more than 10% of their area mapped as wetlands, and have a high proportion of floodplains in natural and agricultural land cover (almost all over 90%). It would be very beneficial to all communities in these watersheds to take action to protect mapped wetlands and maintain less risky land use within floodplains.

The more developed HUC12s, Round Pond Creek and Larkin Creek, have high proportions of land area as impervious surfaces and high amounts of developed Active River Area indicating that the hydrology in these watersheds is highly altered. Stream channels in these areas have likely been modified to have greater depths and widths, but have disconnected flows from their floodplains to maximize space for development. While these channels may be successfully carrying smaller, more frequent flow events, it is quite likely that capacity will be reached for larger events and that stormwater systems that were installed at the early stages of development will likely be overwhelmed frequently. Greece and portions of Parma should continue to utilize local land use authority to maintain natural land cover within existing wetlands and floodplains, and work with older areas of development to update stormwater systems, minimize impervious surfaces and utilize green infrastructure to reduce inputs to stormwater systems and streams. While only small portions of these HUC12s are outside of the jurisdiction of Greece and Parma, those portions lie upstream of their communities. Thus it is important for Greece to work with upstream municipalities to ensure that flood risk management strategies are employed. While high proportions of the Active River Area have been developed, much less of the more active areas of the floodplain have been developed indicating that the amount of development at risk is not as great as one might assume.

Northrup Creek's HUC12 has moderate levels of development within floodplains, more than 10% of its area as mapped wetlands with a fairly high proportion that receive some level of protection, and a moderately high proportion of protected floodplains. As with the other coastal watersheds though, the majority of wetlands and the majority of those with protection lie at the downstream end of the watershed. Greece and Parma should work together and with upstream municipalities to ensure that wetlands and floodplains throughout the watershed are protected.

The Cowsucker HUC12 encompasses the watersheds of three separate coastal streams. While the shore of Lake Ontario has been densely developed, many of the coastal wetlands within the HUC12 have been protected. Nearly 10% of its total area has been mapped as wetlands, but as with the other watershed units, a high proportion of those wetlands are coastal and therefore likely not providing flood abatement benefits for developed areas. There may be some exceptions to this in areas where flooding comes from the tributaries instead of or in addition to Lake Ontario. The highest proportion of Cowsucker's floodplains are agricultural (57%) which puts those lands at risk. Given that they are an important component of the local economy; farm land may not be the ideal land use in flood prone areas. Local municipalities should work with agricultural interests to identify marginal farm lands that could be restored to natural land cover.

Lands that lie north of Ridge Road tend to be very flat, have water tables that are close to or at the surface, and soils that do not drain well. These areas are likely providing flood abatement benefits that should be studied more closely before the natural lands that remain are developed. Draining these lands to convert them could greatly alter downstream hydrology and add to flooding issues.

The Town of Greece doesn't have a lot of natural infrastructure left except what's in the Braddock Bay Wildlife Management Area. However, it has done a good job of protecting FEMA floodplains since they were mapped. The Town of Parma has natural infrastructure left that's distributed throughout the community, and is in a good place to protect it before development intensifies. EPODs are a good way to protect these lands, but enforceability needs to be strengthened. The Village of Hilton is fully developed and is small geographically so that it is limited in how much benefit it can provide within its municipal boundaries. Consequently, this community is largely at the mercy of upstream communities. To keep flooding away from people and people away from flooding, all three communities should use local land use authority to limit development in areas not mapped by FEMA and enforce NFIP standards in areas that have been mapped.

Because it is the only gage in the nine HUC12s, it is important to maintain the Northrup Creek gage and ideally provide additional gages in Salmon Creek's watershed because it is the largest of these coastal watersheds and experiences regular flooding problems, and in Round Pond Creek's watershed because it is so heavily developed.

While floodplains in the project area, as in the rest of New York, have been altered dramatically by straightening and channelizing stream channels and filling floodplains and wetlands, many areas are still functioning and providing flood abatement and water quality benefits. These areas should be targeted for protection by either fee title or easement acquisition or through local land use regulation. Prioritizing areas for protection will help ensure that limited resources are allocated to get the most benefit for the cost.

Wetland coverage prior to colonization of the area is not well documented so that we might know how many acres of wetlands originally covered these watersheds. Therefore, we do not know how many acres have already been lost. It might be safe to say that the wetlands that remain are providing important benefits to the communities by attenuating flood flows, filtering nutrients and sediment from water, and providing habitat for both aquatic and terrestrial species for which these communities would have to pay for engineered alternatives if the remaining wetlands were reduced or lost altogether.

Therefore, Greece, Parma and Hilton should work with upstream communities to protect existing wetlands.