

Hydrography

Surface Hydrology

Surface water is the water that collects on the ground, in a stream, river, lake or wetland. This water naturally increases with precipitation and is lost through evaporation, evapotranspiration, infiltration and runoff. The Niagara River/Lake Erie Watershed is primarily home to rivers, creeks, and streams, with some smaller ponds/reservoirs and the larger Lewiston Reservoir. The surface water located in the Niagara River/Lake Erie Watershed drains into Lake Erie and the Niagara River. The watershed covers an area of 1,523,515 acres drained across approximately 5,543 total miles⁵ of waterways. The general direction of surface movement is from the highlands in the southeast flowing north and west to the floodplains, lowlands, or Lake Erie.

In the uplands, streams and creeks are much more clustered due to the slopes they traverse. Tributaries to Eighteenmile Creek, Buffalo River, and Buffalo Creek follow a parallel pattern down the steep slopes into their larger streams. In the lowland areas to the north, the waterways meander and run further apart in a dendric pattern. Along the Lake Erie shoreline, most streams run parallel to each other and perpendicular to Lake Erie. In the most urban areas, waterways have been filled, covered, or diverted for development. Several of the waterways have been channelized when they flow through the industrialized areas of Niagara Falls, the Tonawandas, Buffalo, and Dunkirk.

Sub-watershed Descriptions from East to West

The **Upper Tonawanda Creek** Sub-watershed and its main tributary, Little Tonawanda, start on the Allegheny Plateau and flow northeast through steep wooded ravines as far as the village of Attica. After which both creeks meander through wetlands and farmed mucklands. Just south of the City of Batavia the two branches join on the Onondaga Escarpment and take a sharp turn left, flowing west into the Middle Tonawanda Creek Sub-watershed.

The **Middle Tonawanda Creek** Sub-watershed is located between the Lower and Upper Tonawanda Creek Sub-watersheds. The Middle portion covers Tonawanda Creek's 20 mile stretch from its confluence with Bowen Creek in the Town of Batavia west to the Town of Pendleton. In this section it travels through a broad floodplain and many wetlands which are the remaining imprint of the ancestral, 50-mile long, glacial Lake Tonawanda. Mud Creek and Beeman Creek are the major tributaries of this portion of Tonawanda Creek.

In the **Lower Tonawanda Creek** Sub-watershed the last 11.6 miles of the Tonawanda Creek was historically deep slack water but is now channelized and dredged to a width of 75 feet and a depth of 12 feet to accommodate the Erie-Barge Canal. A lock in Pendleton controls the

⁵ Based on the USGS National Hydrography Dataset.

flow, and is also where the Creek diverges from the Erie Canal. Ransom Creek, Gott Creek and Black Creek are the major tributaries running north-northwest from the Clarence and Newstead Townships to the Canal section in the Creek in Pendleton. Bull Creek is the other primary tributary running southwest from the Niagara Escarpment through low-lying hydric soils to the Canal in the Town of Wheatfield.

Most of the waterways in the **Niagara River** Sub-watershed drain directly to the upper Niagara River. Many, like Two Mile Creek, have been channelized and turned into drainage ditches receiving runoff from industries, landfills and storm sewer systems. While others, have had their historic hydrology significantly altered from urban development. Several of the tributaries located on Grand Island are the last remaining minimally-altered waterways of this sub-watershed.

Historically fifteen-mile Scajaquada Creek, a primary tributary of the Niagara River sub-watershed, rose in spring-fed wetlands in the present Town of Lancaster and flowed almost due west through the Village of Depew, Town of Cheektowaga, and City of Buffalo to its mouth on the Black Rock Canal on the Niagara River. Its course was generally level except for a small falls over the Onondaga Escarpment in present day Forest Lawn Cemetery in North Buffalo. Originally the creek was wide, shallow and meandering. Much of the creek has been channelized and tunneled underground. Portions receive overflows from the City of Buffalo's combined sewer system and Town of Cheektowaga's sanitary sewer system. Springs recharge the creek not only at its source, but also downstream in Forest Lawn Cemetery. These springs are now a major component of the base flow of lower Scajaquada Creek.

Another major tributary of the Niagara River Sub-watershed, 7.6 mile long Gill Creek originates in the wetlands of the Tuscarora Nation and flows south to its mouth on the Little Niagara River approximately 1,000 feet above the upper Niagara River. The watershed is mainly flat and underlain with Lockport Dolomite covered by lake clays and silts. Today, the Lewiston reservoir occupies over half the upper watershed on Tuscarora Nation Land, with a discharge channel to Gill Creek to supplement low flows in the summer. The creek is ditched around the reservoir's southern end until it reaches the original stream bed and turns south. A dam about 1.2 miles upstream of the creek's mouth creates 30 acre Hyde Park Lake.

Murder Creek is its own sub-watershed but also the major tributary to Tonawanda Creek in the Middle Tonawanda Creek Sub-watershed. Located primarily in the southwestern portion of the Genesee County, Murder Creek also includes many low-lying areas and meanders through the Towns of Pembroke and Newstead.

Ellicott Creek, 47 miles long, flows northwest from its headwater wetlands in Genesee County through the Towns of Darien, Alden, Lancaster, and Amherst to join Tonawanda Creek about a half mile above its mouth at the Niagara River, in the Town of Tonawanda.

Many of the natural tributaries of Ellicott Creek have been channelized into stormwater conveyance systems in the urban and suburban areas of the Ellicott Creek Sub-watershed, and no longer include natural hydrologic features.

The **Cayuga Creek** Sub-watershed (in Erie County) includes Little Buffalo, Slate Bottom, and Plum Bottom creeks as tributaries. It begins in primarily farmland/wooded areas in higher elevation Wyoming County in the Towns of Sheldon and Bennington and passes through several residential areas in the Erie County Towns of Marilla, Alden, and Lancaster before its confluence with Buffalo Creek in Cheektowaga.

The 43-mile-long **Buffalo Creek** originates in the eastern portion of the watershed, in the Towns of Arcade, Java and Sheldon in Wyoming County, where higher elevations create a multitude of smaller feeder streams and tributaries, such as Plato Creek, Beaver Meadow Creek, Glade Creek, Sheldon Creek, Stoney Bottom Creek, Bender Creek, and Hunter Creek. Buffalo Creek itself flows northwest towards the City of Buffalo through Wales, Marilla, and Elma, joining Cayuga Creek 8 miles above Lake Erie in the Town of West Seneca, shortly after which Cayuga Creek flows into the Buffalo River.

The headwaters of the **Buffalo River** include the east and west branches of Cazenovia Creek and flow north-northwest to the lake plain. Cazenovia Creek joins the Buffalo River about 6 miles above Lake Erie. Its two major branches, an 18-mile long West Branch and a 24-mile long East Branch, pass through the Towns of Sardinia, Concord, Holland, Colden, Wales, and Aurora to join in the Village of East Aurora, 17 miles upstream from the confluence with the Buffalo River. At 1820 feet above sea level, the source of the East Branch is the Buffalo River Sub-watershed's highest elevation. The lower Buffalo River meanders across the flat Lake Erie Plain through Elma, West Seneca, and the City of Buffalo before draining into Lake Erie. Within the City of Buffalo, a portion of the Buffalo River is a federally-designated navigation channel and dredged to maintain a 22 foot depth. The average daily flow of the Buffalo River is about 355.5 million gallons daily.

The **Smoke(s) Creek** Sub-watershed includes several small tributaries draining directly to Lake Erie in the Town of Hamburg and City of Lackawanna. Smokes Creek, sometimes referred to as Smoke Creek or Smoke's Creek, begins in the Town of Orchard Park and flows west-northwest to its mouth on Lake Erie in the City of Lackawanna. The creek's one principal tributary is South Branch. It has the least number of waterway miles of the 18 sub-watersheds though it is not the smallest sub-watershed by area.

Eighteen Mile Creek drains into the eastern end of Lake Erie in the Town of Evans. Its principal tributary is the South Branch. The headwaters of both of these creeks start in the Town of Colden and meander through the Towns of North Collins and Boston. Middle reaches of Eighteenmile Creek flow through steep sided gorges in the Towns of Hamburg and

Eden. At its lower end it is a large meandering stream where the lower half mile is low gradient with a broad floodplain that forms the border between the Towns of Hamburg and Evans.

Big Sister Creek Sub-watershed has sometimes been referred to as the Seven Creeks Watershed. The main tributaries to Lake Erie in this sub-watershed include Big Sister, Little Sister, Delaware, and Muddy Creeks. The headwaters in the Towns of North Collins, Brant, and Eden include steep ravines in Franklin Gulf and Hussey Gulf, while the shoreline areas include several bathing beaches such as those found at Evans Town Park, Evangola State Park, and Erie County Bennett Beach Park.

The **Headwaters Cattaraugus Creek** Sub-watershed is the second largest of the 18 sub-watersheds with many of the tributaries generally characterized by steep valley walls. This sub-watershed, along with Cattaraugus Creek Sub-watershed, has some of the highest slopes and elevations in the overall Niagara River/Lake Erie Watershed. The headwaters start in Cattaraugus, Wyoming, and Allegany counties with tributaries such as Elton Creek flowing through the Towns of Farmersville, Freedom, Yorkshire, and the Village of Delevan and eventually into Cattaraugus Creek, which heads west toward Lake Erie and forms the boundary between Cattaraugus and Erie counties. There is a Spring Brook in the headwaters in the Towns of Arcade and Eagle in Wyoming County, as well as a Spring Brook in the Town of Concord and the Village of Springville in Erie County.

The largest of the 18 sub-watersheds is **Cattaraugus Creek** Sub-watershed, which starts mainly west of Springville, NY. Cattaraugus Creek continues flowing west toward Lake Erie through Zoar Valley, a 3,014 acre Multiple-Use Area managed by NYS DEC and known for its deep gorge and dense forests. Main tributaries include South Branch Cattaraugus and Connoissarauley Creeks in Cattaraugus County and Clear Creek in Erie County and the Seneca Nation Cattaraugus Reservation.

Walnut Creek Sub-watershed is the smallest of the 18 sub-watersheds. It includes Walnut Creek, which starts in the Town of Arkwright and flows north through the Towns of Sheridan and Hanover. Silver Creek begins in the Town of Villenova and flows through the Town of Hanover to join with Walnut Creek within the Village of Silver Creek.

Canadaway Creek Sub-watershed includes the City of Dunkirk. Canadaway Creek begins in the high elevations of the Chautauqua Ridge in the Town of Charlotte before flowing through the Towns of Arkwright, Pomfret, Dunkirk, as well as the Village of Fredonia. Several other tributaries to Lake Erie, such as Crooked Brook, Hyde Creek, Beaver Creek, and Scott Creek, flow north northwest to Lake Erie through the lower elevations of the Lake Plain.

The **Chautauqua Creek** Sub-watershed’s largest tributary to Lake Erie is Chautauqua Creek. Little Chautauqua Creek joins with Chautauqua Creek in the Village of Westfield. Both of these streams’ headwaters originate in the Chautauqua Ridge area of the sub-watershed. Several other smaller tributaries to Lake Erie flow through the Lake Plain including Slippery Rock Creek through the Village of Brocton.

Sixmile Creek Sub-watershed is the only sub-watershed that includes area outside of New York State. Approximately 43,500 acres occur in New York State while approximately 125,100 acres are located in Pennsylvania. It is named after Sixmile Creek, which is located in Pennsylvania, but the largest creek in the New York State portion is Twentymile Creek, which flows west into Pennsylvania before emptying into Lake Erie.

Table 2.2 shows the number miles of waterways in each sub-watershed. Cattaraugus Creek, Headwaters Cattaraugus Creek, and Upper Tonawanda Creek Sub-watersheds have the highest number of waterway miles within their limits. These are also the three largest sub-watersheds in acreage. The “% of total column” shows the percent of waterways in the entire Watershed that occur in that particular sub-watershed. Therefore, 15% of the waterways in the Niagara River/Lake Erie Watershed occur in the Cattaraugus Creek sub-watershed.

Table 2.2: Watershed Waterway Miles

Sub-watershed Name	Miles	% of Total
Big Sister Creek	186.65	3.37%
Buffalo Creek	353.72	6.38%
Buffalo River	318.02	5.74%
Canadaway Creek	187.33	3.38%
Cattaraugus Creek	837.00	15.10%
Cayuga Creek	356.19	6.43%
Chautauqua Creek	180.43	3.25%
Eighteenmile Creek	274.28	4.95%
Ellicott Creek	244.02	4.40%
Headwaters Cattaraugus Creek	615.27	11.10%
Lower Tonawanda Creek	216.63	3.91%
Middle Tonawanda Creek	331.05	5.97%
Murder Creek	222.21	4.01%
Niagara River	223.02	4.02%
Sixmile Creek	159.48	2.88%
Smoke(s) Creek	119.86	2.16%
Upper Tonawanda Creek	588.67	10.62%
Walnut Creek	129.44	2.34%
Total Watershed	5,543.28	100.00%

Source: USGS National Hydrography Data Set

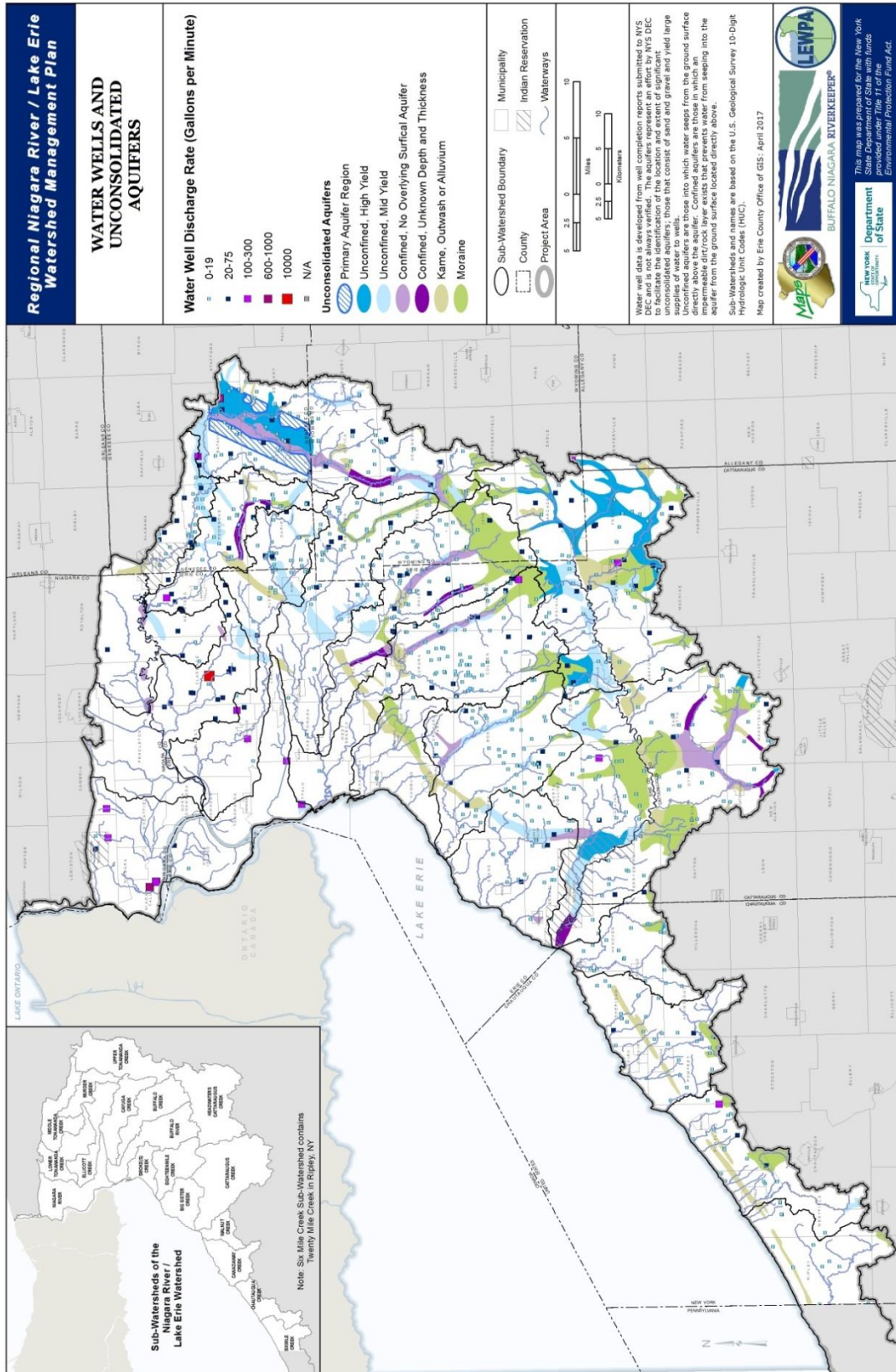
Groundwater

Groundwater is the water located beneath the ground that fills the pore or void space in soils, or fractures of rock formations. These saturated soils and rock formations that store water in the subsurface are called aquifers. Aquifers can be sand and/or gravel, glacial tills, or layers of sandstone or cavernous limestone bedrock. Water stored in these aquifers moves within the subsurface through interconnected pore space. This movement of water is generally very slow and as a result groundwater can be much older than surface water, on the order of tens of thousands of years in some cases. In some cases, groundwater can also percolate into soil and rock layers in a matter of seconds. Once there, groundwater can move through fractures in rock layers, especially shale formations, if the fractures are interconnected. As a result, aquifers need to be closely managed to prevent excessive removal of water or potential contamination. Aquifers are recharged from precipitation on the land that infiltrates the surface, seepage from stream beds, and subsurface flow through the till and bedrock. Green infrastructure, such as permeable pavement or rain gardens, can allow stormwater runoff to infiltrate the ground.

In the north and west of the Niagara River/Lake Erie Watershed, groundwater is not the primary source of potable water supply due to the subsurface geology having poorly connected pore space and the proximity to a vast amount of surface water in the Great Lakes. There are exceptions to this rule, however. For example, the towns of Clarence and Newstead have several high-yield groundwater wells that sit on top of the Onondaga Aquifer. New York State Department of Environmental Conservation has mapped and identified a limited number of aquifers throughout the Watershed with most of them being in the east and south (Figure 2.10). The uplands in the southeast sub-watersheds have large moraine aquifers. There are also several productive aquifers within the Upper Tonawanda Creek sub-basin. In the southeastern portions of the Watershed, many public and private water sources are derived from groundwater wells and springs.

Groundwater also supports many ecologically important functions. When groundwater moves upward toward the land surface it forms springs, wetlands, and supports stream flow. These springs and wetlands support both vegetation and animal habitat for some of our most valued natural resources in the region. Springs feed Spring Brook near Springville, NY in southern Erie County. It is one of a few native Brook Trout streams in the Watershed because of the cold, clear water. Groundwater discharge into streams is also an important component to stream flow during dry periods. This discharge of groundwater into streams is critical in small and large streams and has been shown to be between 41% and 45% of the total flow at stream gaging stations on Buffalo River, Cayuga Creek, and Cazenovia Creek.

Figure 2.10: Water Wells and Unconsolidated Aquifers



Lake Seiches

Lake Erie experiences more large seiches (standing waves) than the four other Great Lakes due to how shallow it is and the fact that it is lined up with the typical prevailing wind direction. These large waves result in a sudden rise in water due to strong winds and rapid atmospheric pressure changes causing the water to be pushed from one end of the Lake to the other. These typically occur when the winds blow from southwest to northeast. In 1844, a 22-foot high seiche killed 78 people and dammed ice in the Niagara River, cutting off flow temporarily to Niagara Falls.⁶ Seiches can cause intense flooding and erosion, as experienced in 2008 when 12-16 foot waves flooded the west side of Buffalo. As the winds die down, seiche waters can “slosh” back and forth across the Lake until water levels equilibrate. This water movement is so forceful that it can cause severe damage to shorelines.

Wetlands

Wetlands occur where land and water meet for extended periods of time. They generally occur along water bodies, lakes, rivers, streams, etc., in low lying areas where water ponds, and even on hillsides where groundwater seeps to the surface. They provide natural open space and help to provide food and homes to fish, amphibians, shellfish, insects, birds, and other animals. Wetlands also clean our water by filtering pollution and recharging aquifers. They maintain dry season stream flows and stabilize shorelines from erosion.

Figure 2.11: Tifft Nature Preserve Wetland



Wetlands are particularly important for flood protection. They act as natural sponges that trap and slowly release surface water, rain, snowmelt, groundwater, and flood waters. The holding capacity of wetlands helps to control floods and prevent water logging of crops. Trees, root mats, and other wetland vegetation also slow the speed of flood waters and distributes them more slowly over the floodplain, reducing flash flooding and downstream inundation. This combined water storage and braking action lowers flood heights and reduces erosion. Wetlands within and downstream of urban areas are particularly valuable, counteracting the greatly increased rate and volume of surface water runoff from pavement and buildings (impervious cover). Figure 2.11 shows an example of a wetland in the Watershed.

⁶ NOAA <https://oceanservice.noaa.gov/facts/seiche.html>

Wetlands are characterized as having a water table that stands at or near the land surface for a long enough period of time each year to support aquatic plants. These lands have hydric soils that are often saturated with water permanently or for part of the year. Most importantly they have plants and animals that can withstand this flooding.

The amount and the character of wetlands in the Niagara River/Lake Erie Watershed changes as you transit from the south to the north. Figure 2.12 shows that the headwater areas, which have steeper slopes, better drainage, and deeper riverbeds contain only small pockets of wetlands. The floodplains are very narrow in this area as well. As you pass north over the Portage escarpment the waterways start to meander more and the amount of wetlands increases.

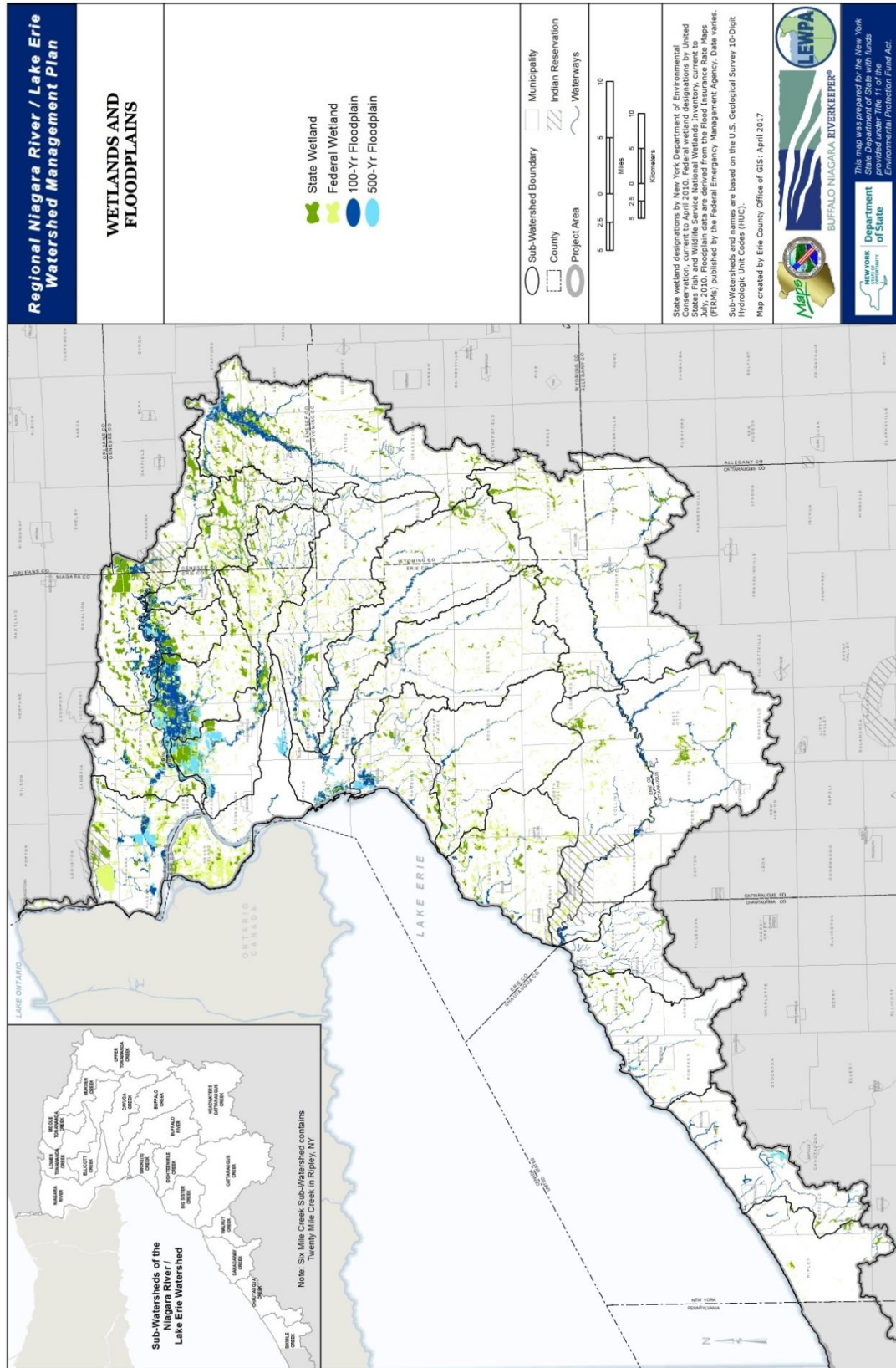
Table 2.3 outlines the acreage of wetlands as determined by the National Wetlands Inventory (NWI) and New York State Department of Environmental Conservation (NYS DEC) located within each sub-watershed. NWI and NYS DEC wetlands often overlap, which is why the “All Wetland Acres” category is not simply an addition of the two NWI and NYS DEC columns.

Table 2.3: Wetlands by Sub-watershed

Sub-Watershed Name	All Wetland Acres*	NWI Acres	NYS DEC Acres	% of Sub-watershed Acreage as Wetlands	% of Wetlands Protected by NYS DEC
Sixmile Creek	947	750	392	2.18%	41.42%
Walnut Creek	902	630	505	2.50%	55.93%
Chautauqua Creek	1,340	1,089	559	2.61%	41.73%
Canadaway Creek	1,852	1,529	611	2.87%	33.02%
Cattaraugus Creek	8,960	7,993	2,307	4.54%	25.75%
Buffalo River	5,366	4,894	1,041	5.09%	19.40%
Headwaters Cattaraugus Creek	9,166	8,118	3,438	5.71%	37.51%
Eighteenmile Creek	4,497	4,199	987	5.85%	21.96%
Buffalo Creek	6,218	5,432	1,967	6.67%	31.64%
Cayuga Creek	6,629	6,101	1,318	8.15%	19.88%
Smoke(s) Creek	3,876	3,491	1,059	9.81%	27.32%
Big Sister Creek	6,650	5,834	1,641	10.66%	24.68%
Upper Tonawanda Creek	13,662	11,748	5,763	10.74%	42.18%
Ellicott Creek	12,657	11,888	4,104	16.48%	32.42%
Lower Tonawanda Creek	14,356	13,145	5,452	18.22%	37.98%
Niagara River	20,865	20,463	3,308	20.29%	15.85%
Middle Tonawanda Creek	17,053	15,188	8,760	21.56%	51.37%
Murder Creek	10,680	9,203	5,252	22.89%	49.18%
Niagara River/Lake Erie Watershed	145,675	131,696	48,466	9.56%	33.27%

* Includes both State listed (Department of Environmental Conservation) and Federally listed (National Wetlands Inventory).

Figure 2.12: Wetlands and Floodplains



The table illustrates that the sub-watersheds in the northern portion of the Niagara River/Lake Erie Watershed, such as Tonawanda Creek and its tributaries, have the largest percentage of their total acreage as wetlands. The four sub-watersheds north of the Onondaga Escarpment (Lower & Middle Tonawanda, Ellicott Creek and Niagara River Sub-watersheds) have a significant amount of wetland habitat, hydric soils, and connection with underlying aquifers including the Onondaga Aquifer (See Figures 2.7, 2.10, and 2.12). Wetlands constitute an average of 18% of sub-watershed habitat within the three sub-watersheds of Tonawanda Creek, Murder Creek, Ellicott Creek, and the Niagara River sub-watersheds. Tonawanda Creek flows through the former lake bed of the prehistoric Glacial Lake Tonawanda, and many of the wetlands are remnants of that earlier time. On the northeastern edge of the Watershed, halfway between Lockport and Batavia, the Tonawanda Wetland Area is located in the Middle Tonawanda Creek Sub-watershed. It is a 5,600-acre wetland tract. From there, a broad floodplain sprinkled with wetlands, extends westward across the watershed until it meets and is stopped by the urban development in the City of Buffalo and the Tonawandas.

The amount of wetlands decreases generally as you move south through the Watershed. Sixmile Creek Sub-watershed has the least percentage of delineated wetlands within the New York state boundaries making up only 2.18% of the acreage of the sub-watershed. The 12 southern sub-watersheds not mentioned in the paragraph above average only 5.5% of their habitat as wetlands.

The final column of Table 2.3 shows the percent of all wetlands that are protected by the NYS DEC. It ranges from 15% to 55% of the wetlands within each sub-watershed. The amount of wetland acreage protected by the NYS DEC is much higher in the northern portion of the Watershed.

Floodplains

The Niagara River/Lake Erie Watershed has approximately 107,818 acres of designated floodplain as depicted in Figure 2.12. These include both 100-year floodplains, which have a 1% chance of a flood occurring in any given year, and 500-year floodplains, which have a .02% chance of a flood occurring in a given year.

Presently the northern low-lying areas of the watershed host the largest acreage of floodplain (Table 2.4). Former Lake Tonawanda's boundary can be seen from Figure 2.12, spanning the large 100-year and 500-year floodplain complex sprawled across Tonawanda Creek from northern Amherst to the Tuscarora Reservation. The development in and around this floodplain complex has seen increased high-water flooding events in the downstream cities of Tonawanda and North Tonawanda. The other large floodplain complex existing along Tonawanda Creek in the Upper Tonawanda Creek Sub-watershed is located just south of the City of Batavia in Genesee County, where several tributaries converge.

The middle of the Niagara River Sub-watershed shows an area of 500-year floodplain just west of the Village of Depew in the Town of Cheektowaga. This area coincides with extensive commercial and