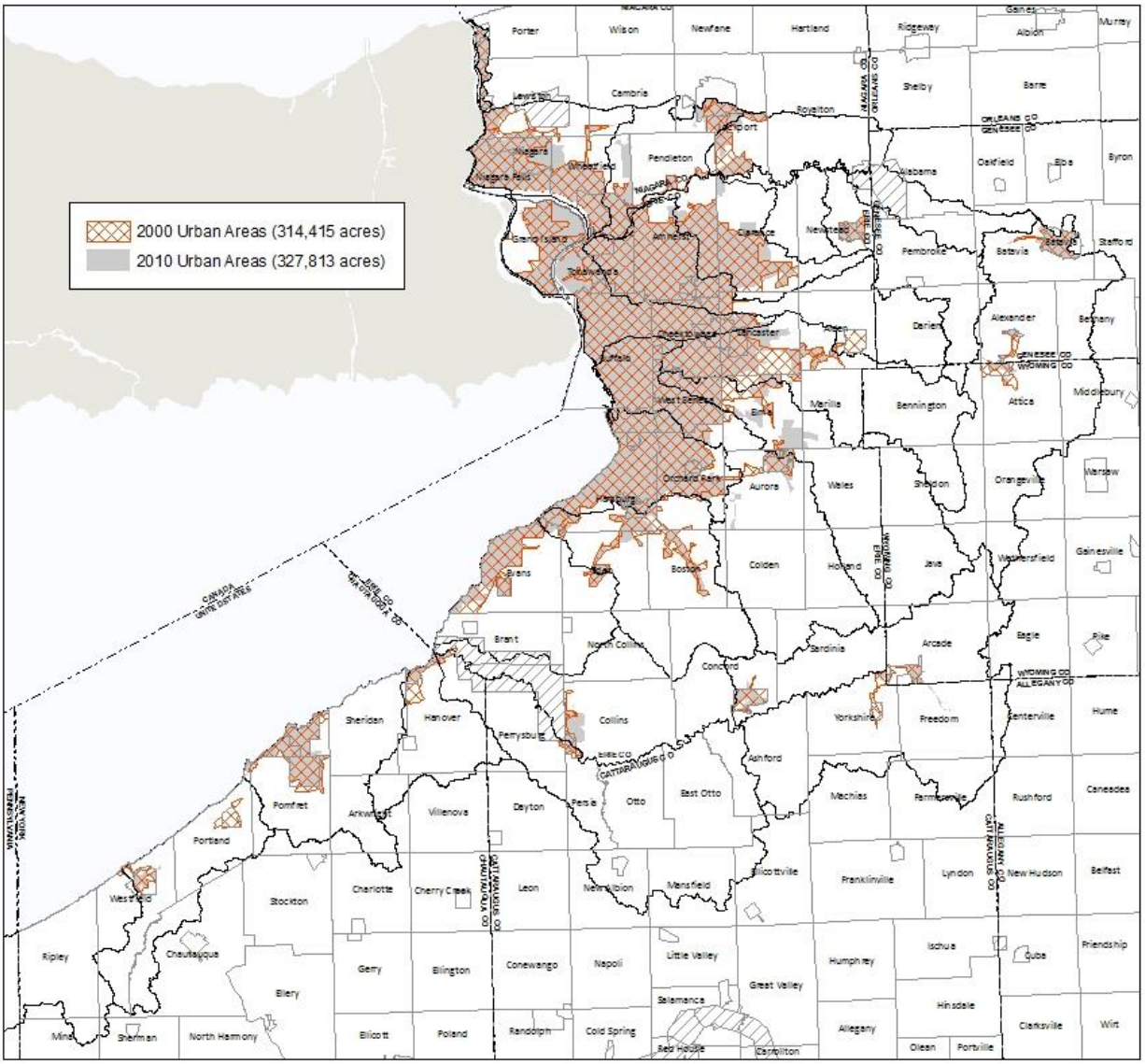
# Chapter 3: Population & Development in the Watershed

Population and land use characteristics are important indicators of current and future watershed health when assessed together. The way land is used directly affects how water moves throughout the entire watershed, influencing whether it supports water quality, quantity, and ecosystem functions or threatens them.

**Figure 3.1: Urbanized Area Change within the Niagara River/Lake Erie Watershed (2000-2010)**



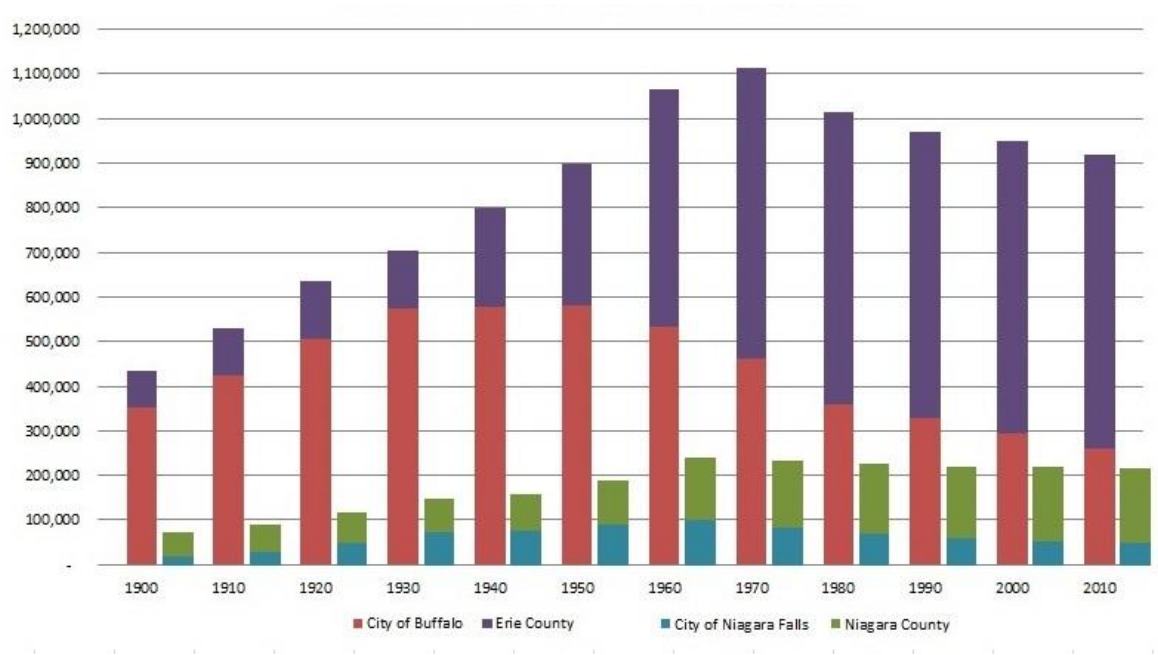
## Population Characteristics of the Watershed

In 2010, the Niagara River/Lake Erie Watershed had a total population of roughly 1,193,327 people throughout its 1,523,515 acres.[1] While the watershed is spread across eight counties (Allegany, Cattaraugus, Chautauqua, Erie, Genesee, Niagara, Orleans, and Wyoming), much of the watershed's population is concentrated along the Niagara River and eastern shoreline of Lake Erie, in and around the Cities of Buffalo, Dunkirk, and Niagara Falls as shown in Figure 3.1. There are a number of smaller populated areas in the cities of Batavia and Lockport and the villages of Akron, Arcade, Attica, Brocton, Delavan, East Aurora, Gowanda, Silver Creek, Springville, and Westfield within more rural townships. The "Urban Areas" on the map are defined by the U.S. Census Bureau and include both urbanized areas of 50,000 or more people, as well as urban clusters of 2,500 to less than 50,000 people.

## Historic & Current Population Trends

**Chart 3.1: Population Figures as part of County Totals (1900-2010)**

City of Buffalo & City of Niagara Falls, New York




From 1900-1940, the Buffalo-Niagara metropolitan area experienced a population boom where the combined population of Erie and Niagara Counties increased by 88% from 509,000 to 958,000.[2] A majority of this growth occurred within the Cities of Buffalo, Niagara Falls, and Lackawanna, the centers of industry and employment for the region. Between 1940 and 1970 the region continued to

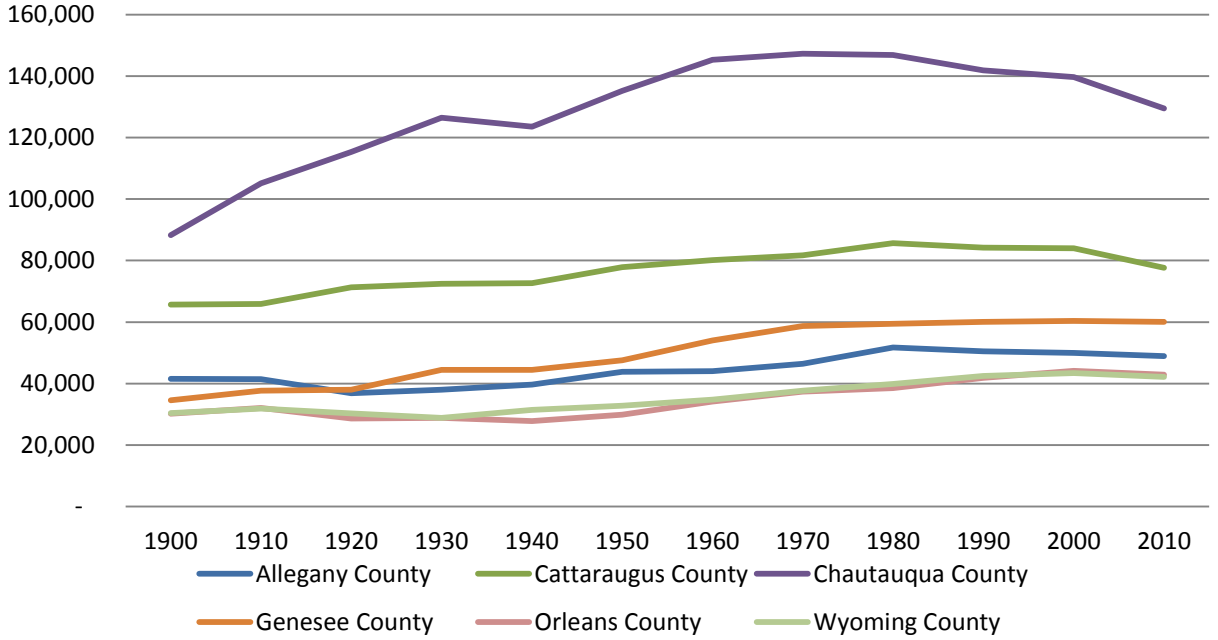
[1] Calculated based on the watershed boundary using ESRI and ArcGIS Software with US Census Data and is an estimate of the population using a uniform population assumption throughout census blocks: Census 2010 Summary File 1.
[2] Erie-Niagara Framework for Regional Growth.

grow, but population and development shifted to the suburbs, which was typical for the post-WWII urban environment. It was during this outward migration that the cities began their decline, and by 1980 declining population trends were observed in the Erie-Niagara region as a whole. This population loss trend is still continuing in the twenty-first century, with the cities experiencing the most loss (Chart 3.1).[3] To illustrate the severity of population loss, the City of Buffalo's population was 261,310 in 2010, which was less than half of its 1950 peak. For Niagara Falls, the city's population peaked at 102,394 in 1960, and has since lost over 52,201 people.[4]

Historically the rural counties in the Watershed tell a different population story than their urban counterparts, one that is much more stable and consistent (Chart 3.2).[5] From 1900 through 2010, Allegany, Cattaraugus, Chautauqua, Genesee, Orleans, and Wyoming Counties have generally experienced very conservative population growth. The Southern Tier (Allegany, Cattaraugus, and Chautauqua counties) has shown population losses since the 1980s and 1990s. By the 2010 Census, however, all six counties experienced population losses ranging from 0.5% to 7.5% over the previous decade.

**Chart 3.2: Population Levels (1900-2010)**

Allegany, Cattaraugus, Chautauqua, Genesee, Orleans, and Wyoming Counties, New York




According to Cornell University's Program on Applied Demographics, population figures for Watershed counties are expected to continue their decline. Cornell's figures, which incorporate birth, death, and migration rates into their estimates, project Erie County will lose 40,965 people between

[3] US Census Bureau: 1900-2010 Decennial Census Population Figures
[4] 2010 Census.
[5] US Census Bureau: 1900-2010 Decennial Census Population Figures & County Population Projections from Cornell University's Program for Applied Demographics [online].

2010 and 2020, another 48,390 people by 2030, and 60,289 more people by 2040. The percentage of losses is expected to grow for all of the Watershed counties ranging from .3% to 4.5% population losses between 2010 and 2020, and increasing to population losses of 4.3% to 9.7% from 2030 to 2040 in each county.[6]

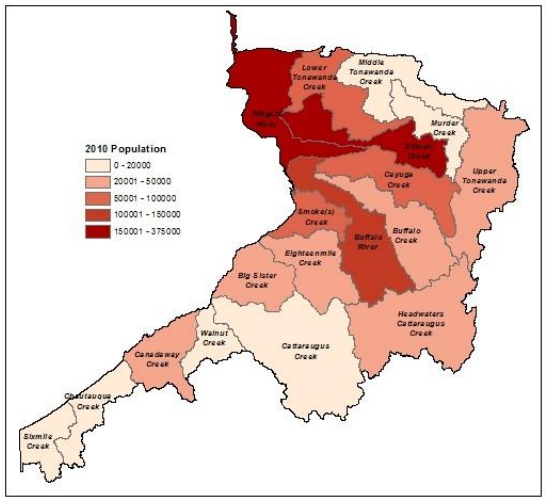



**Figure 3.2: Sub-watershed Populations**

## Population Density

On the sub-watershed level, the Niagara River Sub-watershed hosts the highest population, while the Sixmile Creek Sub-watershed (NY portion only) hosts the least (Figure 3.2). However, population density (Table 3.1) is a much better indicator of increased watershed stressors than population alone. Higher densities typically warrant a more expansive built environment, higher percentages of impervious surfaces, and additional grey infrastructure, such as water and sewer lines (sanitary & storm), utility corridors, roads and sidewalks, all of which influence the natural movement of water and directly contribute to non-point source pollution.

Ellicott Creek Sub-watershed has rather high population density considering its more suburban/rural nature (Figure 3.2). Smoke(s) Creek Sub-watershed also has a relatively high population density, but includes the City of Lackawanna and is almost entirely urbanized, whereas several other sub-watersheds that include urbanized areas also include more rural headwater areas, such as the Buffalo River Sub-watershed.

A comparison of sub-watershed population densities between 2000 and 2010 is a good indicator of which sub-watersheds are experiencing development pressures and which sub-watersheds have populations that are thinning out, sometimes despite an already established built environment. Population thinning is most prevalent in the Buffalo River and Cattaraugus Creek sub-watersheds. In the Cattaraugus Creek Sub-watershed, population losses appear to be spread throughout the area based on census block comparisons. In the Buffalo River Sub-watershed, population losses are noticeable in the City of Buffalo, as well as somewhat in the Village of East Aurora area. Please note that the Niagara River sub-watershed 2010 square miles increased (as shown in the square with a red mark in Table 3.1) because the 2010 Census Block polygons were drawn to include areas into Lake Erie and the Niagara River and likely contributed to the decrease in population density calculation.

[6] Based on County Population Projections from Cornell University's Program for Applied Demographics. https://pad.human.cornell.edu/counties/projections.cfm

**Table 3.1: 2000 & 2010 Population and Population Density Change by Sub-Watershed[7]**

| | POPULATION | | | | | | POPULATION DENSITY (PERSONS PER SQ. MILE) | |
|---|---|---|---|---|---|---|---|---|
| **Subwatershed** | **2000** | **2010** | **Population Change** | **% Change** | 2000 SQ MILES | 2010 SQ MILES | **2000** | **2010** |
| Big Sister Creek | 23,988 | 22,846 | -1,141 | -4.76% | 97 | 97 | 247 | 234 |
| Buffalo Creek | 27,249 | 26,449 | -800 | -2.94% | 146 | 146 | 187 | 182 |
| Buffalo River | 162,507 | 145,813 | -16,694 | -10.27% | 165 | 165 | 988 | 886 |
| Canadaway Creek | 31,992 | 31,524 | -468 | -1.46% | 101 | 101 | 318 | 313 |
| Cattaraugus Creek | 22,311 | 19,998 | -2,313 | -10.37% | 309 | 309 | 72 | 65 |
| Cayuga Creek | 73,593 | 73,974 | 382 | 0.52% | 127 | 127 | 579 | 582 |
| Chautauqua Creek | 10,210 | 9,250 | -960 | -9.41% | 80 | 80 | 128 | 115 |
| Eighteenmile Creek | 25,382 | 26,662 | 1,281 | 5.05% | 120 | 120 | 211 | 222 |
| Ellicott Creek | 183,907 | 184,310 | 403 | 0.22% | 120 | 120 | 1,532 | 1,535 |
| Headwaters Cattaraugus Creek | 21,773 | 21,366 | -407 | -1.87% | 251 | 251 | 87 | 85 |
| Lower Tonawanda Creek | 87,386 | 95,520 | 8,134 | 9.31% | 123 | 123 | 710 | 776 |
| Middle Tonawanda Creek | 18,107 | 19,842 | 1,736 | 9.59% | 124 | 124 | 147 | 161 |
| Murder Creek | 9,629 | 9,216 | -413 | -4.29% | 73 | 73 | 132 | 126 |
| Niagara River | 397,882 | 373,719 | -24,162 | -6.07% | 153 | 161 | 2,593 | 2,326 |
| Sixmile Creek (NYS Portion ONLY) | 3,386 | 3,137 | -249 | -7.35% | 68 | 68 | 50 | 46 |
| Smoke(s) Creek | 92,040 | 91,593 | -447 | -0.49% | 62 | 62 | 1,492 | 1,483 |
| Upper Tonawanda Creek | 30,770 | 31,686 | 916 | 2.98% | 199 | 199 | 155 | 159 |
| Walnut Creek | 6,939 | 6,420 | -519 | -7.48% | 56 | 56 | 123 | 114 |
| **Grand Total of all 18 Sub-Watersheds** | **1,229,048** | **1,193,327** | **-35,722** | **-2.91%** | **2,373** | **2,381** | **518** | **501** |

*Data Source: U.S. Census Bureau Census Block data (2000 and 2010). Methodology: Population calculated and totalled for portions of census blocks within each Sub-Watershed using ArcGIS 10.4.*

On the other hand, population densities have increased in the Lower and Middle Tonawanda Creek sub-watersheds. Areas in the Towns of Amherst, Clarence, Lockport, and Wheatfield have experienced population density increases as shown by census block data. These areas have also seen more development since 2000.

## Development Trends

With each decade of population loss documented by the U.S. Census, the Buffalo-Niagara region has also continued to develop and expand its built environment. Figure 3.1 compares the watershed's 2000 & 2010 Urbanized Areas and Clusters as identified by the U.S. Census Bureau as part of the U.S. Census Bureau's urban-rural classification system, which identifies areas with higher concentrations of population and vast human-built environments. The difference seen between the Urbanized Area Boundaries is a good indicator of the level of sprawl the watershed is experiencing. Sprawl is a common land-use planning term used to describe the outward spread of development into areas that

[7] Sub-watershed population data is estimated using U.S. Census Block Data and assumes an even population density throughout the boundaries. These numbers are only estimates.

were previously considered rural or undeveloped. Between 2000 and 2010 the Niagara River/Lake Erie Watershed counties added another 13,398 acres of urbanized areas, while at the same time losing 35,722 people.[8]

Framed in other terms, sprawl refers to the slow decentralization of human occupancy, or population redistribution. That is, communities are requiring more land and space to supply the same given population with homes, workplaces, shopping locations and recreation spaces.[9] Sprawl occurring in conjunction with extreme population loss is not sustainable, and contributes greatly to stressors on natural resources and regional ecosystems.

The most visible consequence of sprawling trends is the large-scale loss of natural forests, fields, wetlands, and other undeveloped land. However, sprawl also:

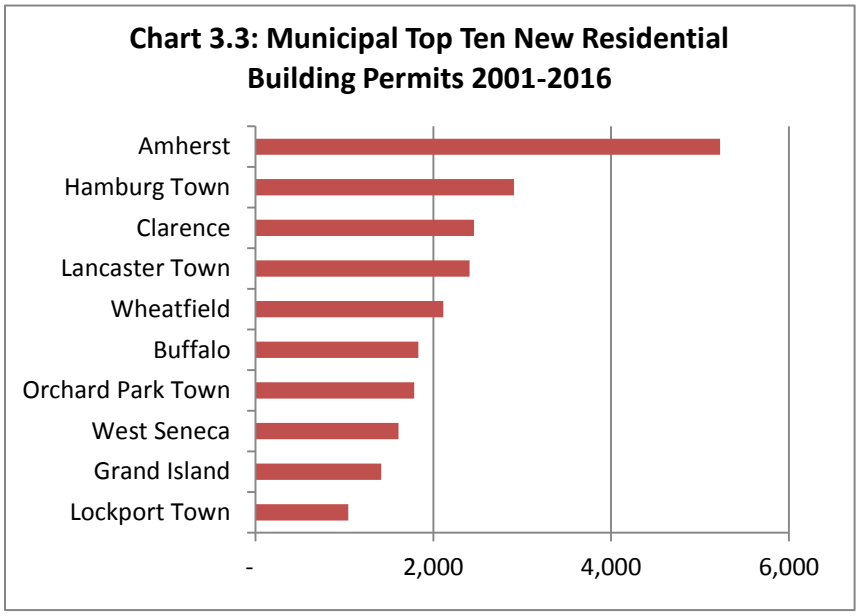
- increases non-point source pollution through the creation of new roads and increased automotive traffic;
- aggravates the effects of drought by directing stormwater runoff to drainage channels, reducing opportunities for infiltration;
- strains productive working lands, by fragmenting and isolating agriculture and forest lands;
- increases taxes and the cost of public services by extending infrastructure across a much larger geographic area; and,
- degrades and restricts wildlife habitat, and creates barriers along wildlife corridors.

Between 2005 and 2017, the watershed counties added almost 272 miles of new roads[10] and at least 25,651 new residential structures[11]. Much of this expansive development has occurred within the first and second ring suburbs of the Cities of Buffalo and Niagara Falls (Chart 3.3),[12] specifically the Towns of Amherst, Hamburg, Clarence, Lancaster and Wheatfield.

Some communities have made attempts to limit the pace of development through local laws and regulations, keeping growth in check. For example the Town of Orchard Park restricts the number of subdivisions they approve to three over a ten-year period, while the Town of Elma's lack of public water and sewer infrastructure limits both new residential and commercial development.

[8] U.S. Census Bureau Census Block Data 2000 & 2010.
[9] Cornell University, Department of Development Sociology.
[10] Derived from the streets GIS layers from the NYS Office of Cyber Security from 2005 through 2017 when methodology was consistent.
[11] https://socds.huduser.gov/permits/ from 2001 through 2016. Not all watershed municipalities were included in this data set. Only municipalities in Erie and Niagara counties were listed. Though calls to municipalities elsewhere do not indicate numbers that surpass these.
[12] See footnote 9.

In some cases, issues with existing infrastructure, such as contaminated or dried-up water wells and failing septic systems, necessitates the need to expand water and sewer service lines to existing development. While this type of development can be beneficial to water quality, it can also encourage additional development in these areas, which may be environmentally sensitive. For example, the Town of Ripley is extending water and sewer lines on Route 5, near the Lake Erie shoreline, from Shortman Road to the Pennsylvania state line. The North Chautauqua Water District has also been created to extend water service through the Towns of Sheridan, Dunkirk, Pomfret, Portland, and the Village of Brocton. This may encourage more development in the area. It is important for municipalities to plan for the possibility of additional development and encourage green infrastructure to minimize stormwater and flooding impacts from the development, as well as consider impacts on existing septic systems where there is now increased water availability. These can have large impacts on water quality.




Excessive growth is not occurring equally across the watershed either, but rather is concentrated in a few sub-watersheds, specifically the Lower Tonawanda Creek, Smoke(s) Creek, and Niagara River Sub-watersheds. Development pressures on the Niagara River Sub-watershed from residential development in Grand Island and Wheatfield are the most alarming, in that this sub-watershed already is highly urbanized with limited undeveloped or natural areas remaining. Continued loss of wetlands, farmland, and woodlands in the Niagara River Sub-watershed can further degrade water quality, reduce habitat, and limit the functional health of this sub-watershed. The same can be said for the Smoke(s) Creek Sub-watershed, which is the smallest in size and encompassed almost entirely by the Towns of Hamburg, Orchard Park, and the City of Lackawanna, the former of which is experiencing heavy residential and commercial growth. In Lower Tonawanda Creek Sub-watershed continued rural-residential development and its impacts go beyond general water quality and habitat conditions, to intensify flooding and drainage issues downstream.

Meanwhile, in Allegany, Cattaraugus, Chautauqua, Genesee, Orleans, and Wyoming counties, development is occurring at a much slower rate. As Table 3.2 shows, Erie and Niagara counties have a much higher number of residential building permits than the other counties. These numbers are for the entire counties and not just for the watershed area. As housing needs arise due to business development in areas such as Dunkirk, more residential units are expected to develop to meet the demand. While the Town of Dunkirk has had one residential building permit since 2010 and the City of Dunkirk has had 11 residential building permits in total for the years 2001-2016, as many as 30 new units could be developed in the next few years to attract new employees to the Athenex Biotech Plant nearby.[13]

**Table 3.2: Number of New Residential Building Permits by County 2001-2016**

| County | TOTAL |
|---|---|
| Allegany | 1,244 |
| Cattaraugus | 2,095 |
| Chautauqua | 3,249 |
| Erie | 25,455 |
| Genesee | 1,178 |
| Niagara | 6,204 |
| Orleans | 695 |
| Wyoming | 804 |

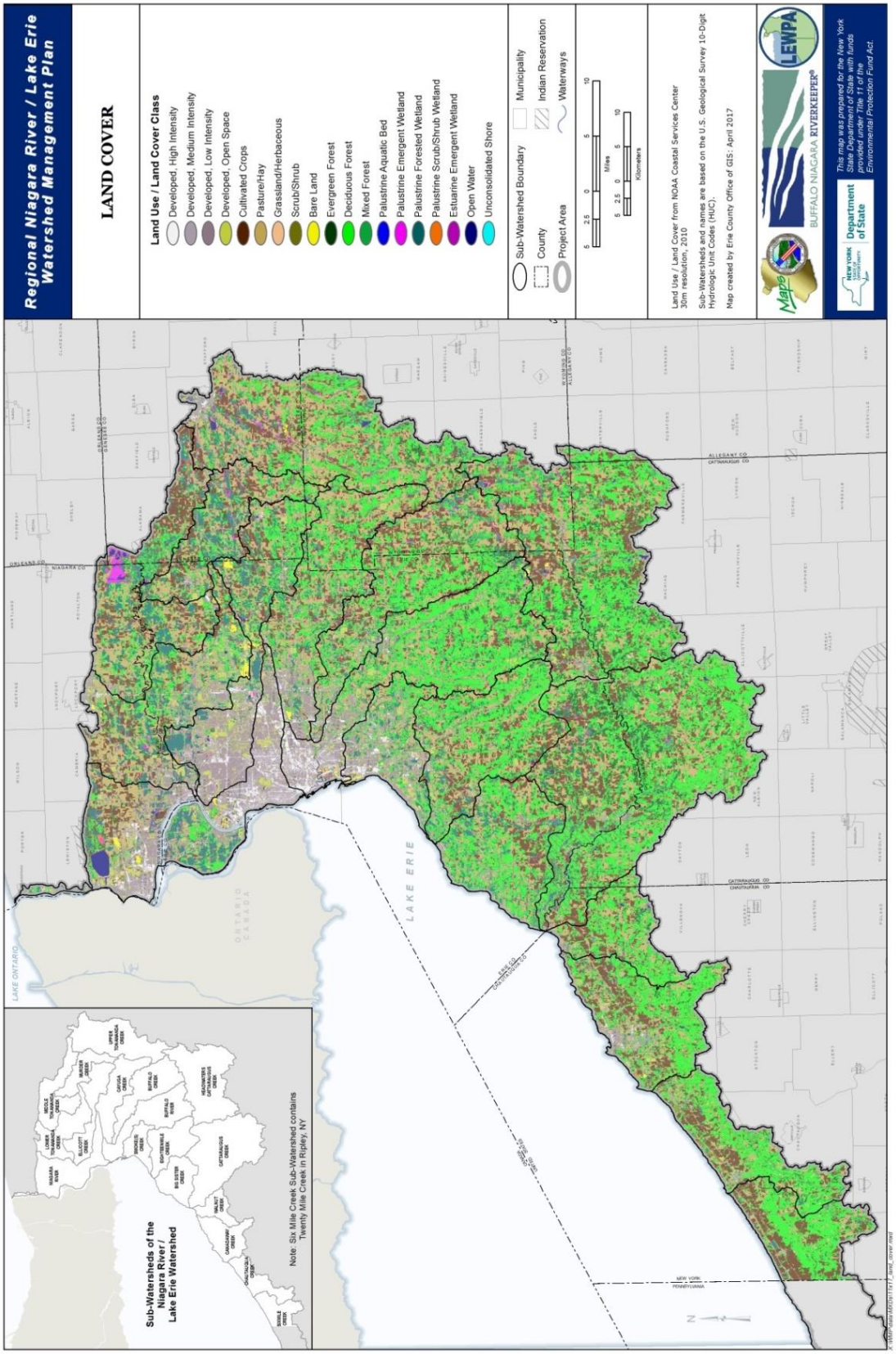
Aside from population, land cover and land uses have long been proven to directly affect watershed health; as how we use land and to what extent we build upon it directly affects the chemical, physical, and biological characteristics of our water resources.[14] Land Cover is a breakdown of both the natural features of a landscape, such as mature forest, grass land, crop land, or wetlands, as well as man-made features, such as roads, buildings, and sidewalks (Table 3.3). Table 3.3, Figure 3.3, and Figure 3.4 showcase the watershed's land cover classifications according to the National Oceanic and Atmospheric Administration (NOAA) Coastal Service Center's 2010 Land Use/Land Cover Data Set.[15] A full list of the NOAA land cover classifications and how they are defined is included in Appendix A.

[13] From conversation with Edward Hayes, Deputy Director of Planning and Development, City of Dunkirk and http://www.observertoday.com/news/page-one/2017/05/zoning-board-approves-battery-point-housing-development

[14] Snyder, M. N., Goetz, S. J. and Wright, R. K. (2005), STREAM HEALTH RANKINGS PREDICTED BY SATELLITE DERIVED LAND COVER METRICS. JAWRA Journal of the American Water Resources Association, 41: 659–677. doi: 10.1111/j.1752-1688.2005.tb03762.x

[15] Please note that the classifications are based upon pixels representing 30m x 30m areas with the dominant land cover for that 900$m^2$ area categorized. These pixels have then been transferred to acres, which accounts for the discrepancy in total acreage due to rounding.

**Figure 3.3: Land Cover of the Niagara River/ Lake Erie Watershed**



## Watershed Land Cover

The top four land cover classifications have been highlighted in Table 3.3. When the land cover classifications are grouped together, forested areas (deciduous, evergreen, and mixed) make up 37.8% of the watershed while working agricultural lands (pasture/hay and cultivated crops) make up 36% of the watershed. These are the most prevalent land cover classifications within the Niagara River/Lake Erie Watershed. Wetlands only make up 8.6% of the watershed. Developed land makes up 13.5% of the watershed, with most developed lands located in and around the cities of Niagara Falls, Lockport, Batavia, North Tonawanda, Tonawanda, Buffalo, Lackawanna, and Dunkirk, as well as some developed clusters in village centers.

**Table 3.3: Watershed Land Cover/Land Use Breakdown**

| Land Cover Classification | Acres | Percentage |
|---|---|---|
| Developed, High Intensity | 19,067 | 1.24% |
| Developed, Medium Intensity | 36,239 | 2.36% |
| Developed, Low Intensity | 109,074 | 7.12% |
| Developed, Open Space | 43,410 | 2.83% |
| Cultivated Crops | 256,147 | 16.71% |
| Pasture/Hay | 295,635 | 19.29% |
| Grassland/Herbaceous | 12,097 | 0.79% |
| Deciduous Forest | 473,013 | 30.86% |
| Evergreen Forest | 52,880 | 3.45% |
| Mixed Forest | 53,859 | 3.51% |
| Scrub/Shrub | 29,240 | 1.91% |
| Palustrine Forested Wetland | 107,100 | 6.99% |
| Palustrine Scrub/Shrub Wetland | 7,442 | 0.49% |
| Palustrine Emergent Wetland | 17,677 | 1.15% |
| Estuarine Emergent Wetland | 2 | 0.00% |
| Unconsolidated Shore | 425 | 0.03% |
| Bare Land | 5,550 | 0.36% |
| Open Water | 13,674 | 0.89% |
| Palustrine Aquatic Bed | 69 | 0.00% |
| TOTALS | 1,532,598 | 100.00% |

Based on the concentration of built environment, much of the land cover classified as "developed" in the watershed is considered low-intensity, defined as, "suburban-rural in nature and consisting of 21-49% constructed materials as well as substantial amounts of vegetation." While this type of land-use can have a lower impact on water quality than heavily developed (downtown core) urban areas, low-density sprawl also expands the amount of land consumed by development than otherwise would be for the current population. Moving populations back to the core developed areas and "inner-ring" suburbs will leave more land for conservation, habitat, nutrient filtering, flood management, and more in the headwater areas.

## Land Cover by Sub-watershed

A land cover assessment at the sub-watershed level (Figure 3.3) is useful in identifying the primary stressors for each individual sub-watershed and can assist in pinpointing specific management actions. For example, the Buffalo River, Ellicott Creek, Lower Tonawanda Creek, Niagara River, and Smoke(s) Creek Sub-watersheds are more highly urbanized and will face more stressors associated with urbanization, such as limited water infiltration, increased roadway run-off pollution, higher

bacteria levels from combined sewer overflows, and legacy contamination from industrial land uses, than other sub-watersheds.

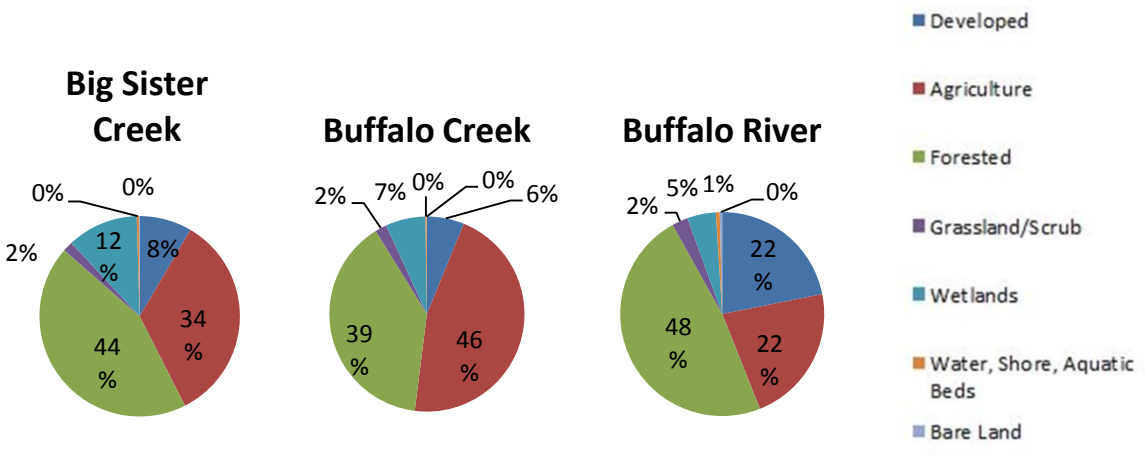
The assessment also highlights which sub-watersheds have significant concentrations of land cover features important in maintaining water quality, such as wetlands and forested areas. Ellicott Creek, Lower and Middle Tonawanda Creeks, and Murder Creek Sub-watersheds all have over 15% of the land cover within the sub-watersheds as wetlands; while existing wetlands are 5% or less of land cover in the Buffalo River, Buffalo Creek, Canadaway Creek, Cattaraugus Creek, Chautauqua Creek, Eighteenmile Creek, Headwaters Cattaraugus Creek, Sixmile Creek, and Walnut Creek Sub-watersheds. In the case of the southernmost sub-watersheds, the steep terrain may impact the existence of wetlands. This makes maintaining those limited wetlands very important for their many benefits.

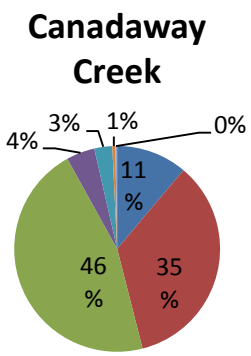
Nine of the eighteen sub-watersheds have developed land plus agricultural land as the majority of land use:

- Buffalo Creek
- Cayuga Creek
- Ellicott Creek
- Lower Tonawanda Creek
- Middle Tonawanda Creek
- Murder Creek
- Niagara River
- Smoke(s) Creek
- Upper Tonawanda Creek

The other nine sub-watersheds have more unaltered land uses making up a majority of the overall land use percentage.

**Figure 3.4: Land Cover Breakdown by Sub-watershed**




Canadaway Creek
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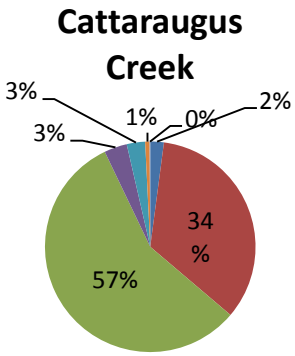
46 %
35 %


Cattaraugus Creek
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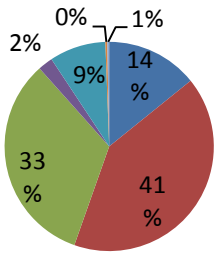
2%
34 %
57%


Cayuga Creek
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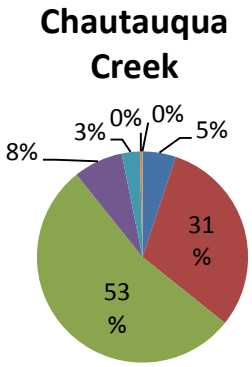
Chautauqua Creek
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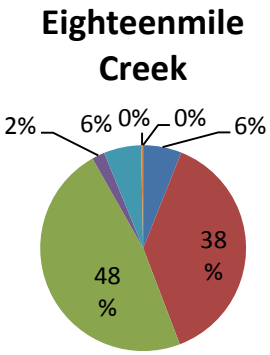
Eighteenmile Creek
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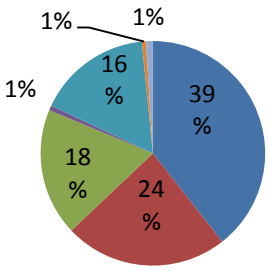
6%
38 %
48 %


Ellicott Creek
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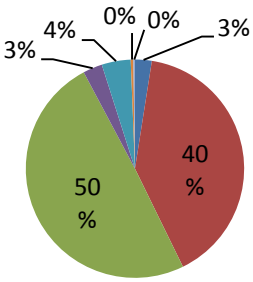
Headwaters Cattaraugus Creek
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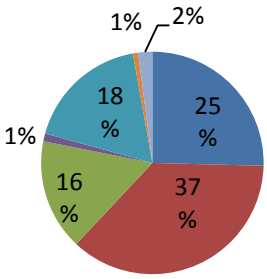
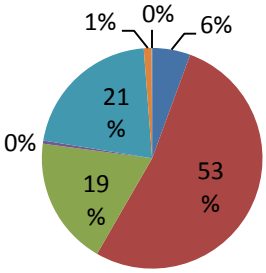
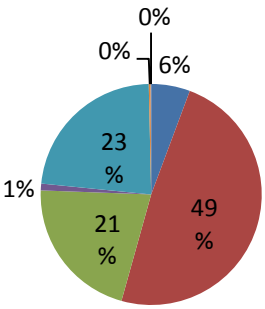
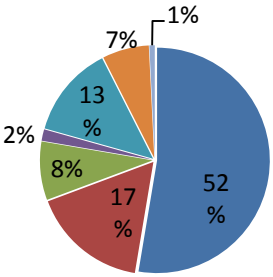
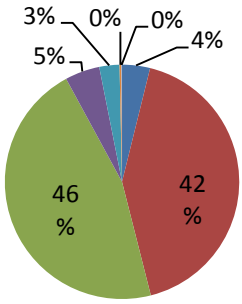

Lower Tonawanda Creek
1%
2%
1%
18 %
25 %
16 %
37 %


Middle Tonawanda Creek
1%
0%
6%
0%
21 %
19 %
53 %


Murder Creek
0%
0%
6%
1%
23 %
21 %
49 %


Niagara River
7%
1%
2%
13 %
8%
17 %
52 %


Sixmile Creek
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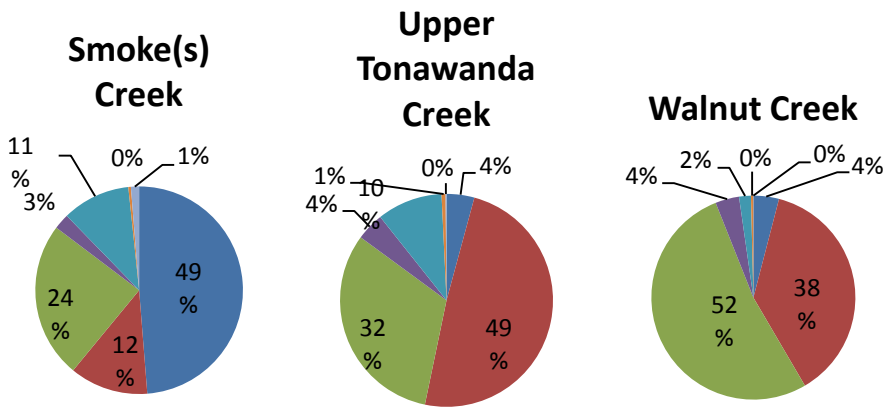
42 %




## Impervious Cover

According to the U.S. Environmental Protection Agency, water quality can begin to degrade at 10% impervious cover, while higher percentages generally equal a completely altered watershed environment, changing pre-development infiltration, evaporation, and runoff rates.[16] These are discussed in Table 3.4.

To determine the impervious cover existing within the watershed, land cover and population density data were incorporated into NOAA Coastal Services Center's *Impervious Surface Analysis Tool* to establish the average percentage (i.e. coefficient) of impervious cover for each land cover classification. The coefficients were then used to calculate the actual acreage of impervious cover within each sub-watershed based on their land cover. The analysis followed a similar methodology outlined by the Center for Watershed Protection's *A User's Guide to Watershed Planning in*

**Table 3.4: Sub-watershed Impervious Cover (IC) Thresholds & Corresponding Conditions**

| Category | IC% | Conditions |
|---|---|---|
| Sensitive | <10% | Streams are of high-quality and are typified by stable channels, excellent habitat structure, good to excellent water quality, and diverse communities of both fish and aquatic insects. |
| Impacted | 10-25% | Streams show clear signs of degradation due to watershed urbanization; greater storm flows have begun to alter the stream geometry; both erosion and channel widening are evident. Stream banks become unstable, and physical habitat in the stream declines noticeably. Stream biodiversity declines to fair levels, with the most sensitive fish and aquatic insects disappearing from the stream. |

[16] https://www3.epa.gov/npdes/pubs/nps_urban-facts_final.pdf

| | | |
|---|---|---|
| Non-Supporting | 26-60% | Streams essentially become a conduit for conveying stormwater flows, and can no longer support a diverse stream community. Channel becomes highly unstable, and many stream reaches experience severe widening, down-cutting and stream bank erosion. The water and biological quality is considered poor, and dominated by pollution tolerant insects and fish. |
| Urban Drainage | >60% | In the highly developed sub-watersheds, streams are often piped underground, or consist of concrete channels that do not support any aquatic life and serve only to convey flows. |

Source: Center for Watershed Protection. http://fosc.org/PDF/mncppc2.pdf

*Maryland*, and takes into account unbuildable lands and transportation infrastructure.[17] Tables 3.5 and 3.6 outline the percentages of impervious cover for the entire Niagara River/Lake Erie Watershed and each sub-watershed.

**Table 3.5: Impervious Cover for the Niagara River/Lake Erie Watershed by Land Cover Classification[18]**

| Land Cover Classification | Total Acreage | Total Percentage | Impervious Cover Coefficient | Impervious Cover Acreage | % Watershed Impervious Cover |
|---|---|---|---|---|---|
| Developed, Low Intensity | 109,074.07 | 7.12% | 0.31 | 33,812.96 | 2.21% |
| Developed, Medium Intensity | 36,239.27 | 2.36% | 0.63 | 22,830.74 | 1.49% |
| Developed, High Intensity | 19,067.04 | 1.24% | 0.86 | 16,397.65 | 1.07% |
| Cultivated Crops | 256,147.00 | 16.71% | 0.03 | 7,684.41 | 0.50% |
| Pasture/Hay | 295,634.57 | 19.29% | 0.02 | 5,912.69 | 0.39% |
| Deciduous Forest | 473,013.48 | 30.86% | 0.01 | 4,730.13 | 0.31% |
| Developed, Open Space | 43,409.95 | 2.83% | 0.1 | 4,340.99 | 0.28% |
| Evergreen Forest | 52,879.97 | 3.45% | 0.06 | 3,172.80 | 0.21% |
| Mixed Forest | 53,858.73 | 3.51% | 0.03 | 1,615.76 | 0.11% |
| Palustrine Forested Wetland | 107,100.32 | 6.99% | 0.01 | 1,071.00 | 0.07% |
| Palustrine Emergent Wetland | 17,676.84 | 1.15% | 0.06 | 1,060.61 | 0.07% |
| Bare Land | 5,549.64 | 0.36% | 0.16 | 887.94 | 0.06% |
| Scrub/Shrub | 29,239.61 | 1.91% | 0.02 | 584.79 | 0.04% |
| Grassland/Herbaceous | 12,096.51 | 0.79% | 0.03 | 362.90 | 0.02% |
| Palustrine Scrub/Shrub Wetland | 7,442.00 | 0.49% | 0.04 | 297.68 | 0.02% |
| Open Water | 13,673.51 | 0.89% | 0.01 | 136.74 | 0.01% |
| Unconsolidated Shore | 424.77 | 0.03% | 0.28 | 118.94 | 0.01% |
| Palustrine Aquatic Bed | 69.16 | 0.00% | 0.09 | 6.22 | 0.00% |
| **TOTALS** | **1,532,596.45** | **100.00%** | | **105,024.96** | **6.85%** |

[17] For a full outline of the methodology used, see Appendix B. The same procedure was used for Phase 2 with updated information on new sub-watersheds.

[18] Estuarine Emergent wetland comprises 2 acres in the Buffalo River Sub-watershed and is not accounted for in this table.

The Niagara River/Lake Erie Watershed consists of an estimated 105,025 acres of impervious cover or approximately 6.85%. Based on the impervious cover thresholds for sub-watersheds (Table 3.6), the Niagara River, Smoke(s) Creek, Ellicott Creek, and Buffalo River Sub-watersheds fall within the "Impacted" range. All the remaining sub-watersheds are considered "Sensitive", ranging from 2.8-9.39%, with Lower Tonawanda Creek Sub-watershed nearing the 10% threshold to be considered Impacted in the future (Table 3.6).

**Table 3.6: Impervious Cover by Sub-Watershed[19]**

| Sub-watershed | Total Acreage | Impervious Cover Acreage | % Sub-watershed Impervious Cover |
|---|---|---|---|
| Niagara River | 102,830.11 | 24,480.59 | 23.81% |
| Smoke(s) Creek | 39,521.59 | 7,314.05 | 18.51% |
| Ellicott Creek | 76,835.25 | 11,761.62 | 15.31% |
| Buffalo River | 105,387.21 | 12,301.73 | 11.67% |
| Lower Tonawanda Creek | 78,795.22 | 7,401.33 | 9.39% |
| Cayuga Creek | 81,372.55 | 5,465.74 | 6.72% |
| Canadaway Creek | 64,541.03 | 3,521.45 | 5.46% |
| Big Sister Creek | 62,365.12 | 2,569.65 | 4.12% |
| Buffalo Creek | 93,161.49 | 3,714.19 | 3.99% |
| Middle Tonawanda Creek | 79,096.34 | 2,941.00 | 3.72% |
| Eighteenmile Creek | 76,842.37 | 2,750.99 | 3.58% |
| Murder Creek | 46,676.48 | 1,669.20 | 3.58% |
| Upper Tonawanda Creek | 127,246.64 | 4,464.10 | 3.51% |
| Chautauqua Creek | 51,274.95 | 1,689.63 | 3.30% |
| Sixmile Creek | 52,450.53 | 1,651.38 | 3.15% |
| Walnut Creek | 36,027.77 | 1,107.29 | 3.07% |
| Headwaters Cattaraugus Creek | 160,625.23 | 4,689.89 | 2.92% |
| Cattaraugus Creek | 197,546.58 | 5,531.13 | 2.80% |
| **TOTAL** | **1,532,596.45** | **105,024.96** | **6.85%** |

The excessive spreading of low-intensity development in the Western New York region is reflective in the findings of the Impervious Cover Analysis as well. Low-intensity development is the largest contributor to impervious cover within the overall watershed. This is also generally true on the sub-watershed level. Exceptions include the Buffalo and Niagara River Sub-watersheds, where medium and high-intensity development patterns surpass impervious cover attributed to low-intensity development. As we move south in the watershed, Headwaters Cattaraugus Creek and Sixmile Creek sub-watersheds have the largest impervious cover due to cultivated crops, while the Cattaraugus Creek sub-watershed has impervious cover from cultivated crops, evergreen forest, and mixed forest surpassing impervious cover from low-intensity development.

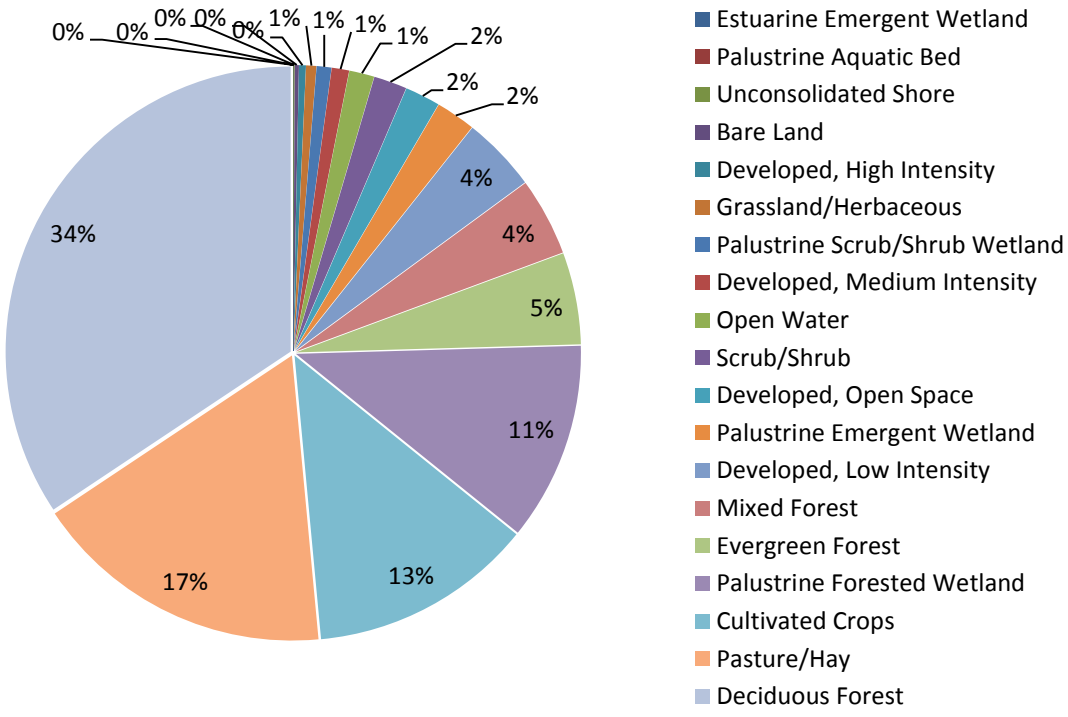
[19] Estuarine Emergent wetland comprises 2 acres in the Buffalo River sub-watershed and is not accounted for in this table.

## Riparian Lands Assessment

Having connected green space is critical for maintaining wildlife habitat, but having connected green space along riparian corridors can also have the added benefit of flood control and resiliency benefits, as well as pollution reduction. Trees and shrubs absorb nutrients and other potential pollutants, trap sediment and water, and can reduce erosion along waterways.

Through geo-spatial analyses, the 2010 NOAA Land Cover/Land Use data set was also used to evaluate the current composition of riparian lands within the watershed. Chart 3.4 depicts the breakdown of land cover for all lands within 100 meters of waterways in the entire watershed, accounting for over 410,000 acres. Overall findings indicate that forested (44%), agricultural lands (30%), and wetlands (14%) constitute the greatest share of riparian land cover overall. This indicates the importance of installing riparian buffers on cropland and pastureland to reduce non-point source

**Chart 3.4: Land Cover within 100 meters of Water Features**




pollution to waterways from agricultural land. While developed areas (8%) can benefit from riparian buffers, the 30% of the riparian land in the Niagara River/Lake Erie Watershed that is pasture, hay, or cultivated crops is a good place to focus efforts. Organizations such as the National Resource Conservation Service and county Soil and Water Conservation Districts have programs to assist agricultural land owners with installing buffers. Other programs, such as the NYSDEC Trees for Tribs

**Table 3.7 Riparian Woodland Tracts in the Niagara River Watershed (50+ Acres)**

| Subwatershed | # of Tracts | Total Acreage |
|---|---|---|
| Buffalo Creek | 44 | 24,371.7 |
| Buffalo River | 31 | 38,622.4 |
| Cayuga Creek | 42 | 20,757.5 |
| Eighteenmile Creek | 28 | 20,531.2 |
| Ellicott Creek | 26 | 14,362.8 |
| Lower Tonawanda Creek | 24 | 8,274.4 |
| Middle Tonawanda Creek | 31 | 14,490.2 |
| Murder Creek | 25 | 11,631.0 |
| Niagara River | 15 | 9,249.1 |
| Smokes Creek | 22 | 3,912.0 |
| Upper Tonawanda Creek | 66 | 29,762.5 |
| **Total** | **354** | **195,964.8** |

Source: Niagara River Regional Habitat Conservation Strategy

or "Buffer in a Bag" programs and the Lake Erie Watershed Protection Alliance riparian buffer program can assist additional types of land owners as well.

Upon further evaluation, the *Niagara River Regional Habitat Conservation Strategy* (2014) pinpointed large tracts (over 50 contiguous acres) of forested cover within 100 meters of water courses within the Niagara River Watershed only. The Habitat Conservation Strategy utilized this data to identify contiguous forested parcels for future conservation efforts and found that over 354 large contiguous tracts exist in the Niagara River Watershed unprotected, accounting for over 195,960 acres.

From the assessment findings and land cover transition trends, it seems large riparian forest tracts are most rare and vulnerable within the Niagara River, Smoke(s) Creek, and Lower Tonawanda Creek Sub-watersheds. While the greatest number of opportunities for protection of forested riparian buffers exist in the headwaters of the Tonawanda Creek (Upper Tonawanda Creek Sub-watershed). This assessment was not expanded for the new territory added to complete the Niagara River/Lake Erie Watershed due to a lack of resources.

## Watershed Land Uses/ Property Classes

Land Use data differs from Land Cover data in that it assigns a single, primary use to each property such as residential, agriculture, industrial, or commercial activities. Each land use type (and the concentration of those land use types) can have varying effects on neighboring water resources. For example, in predominantly agricultural areas there's a greater potential for non-point source pollution with high concentrations of nutrients from fertilizers, pathogens from untreated animal wastes, and chemicals from pesticides. While in high-density commercial and residential areas, non-point source pollution generally has higher concentrations of road-way contaminants, nutrients from lawn fertilizers, debris, and garbage.

Land use classifications are established by the New York State Office of Real Property Services' Property Type Classification Codes, which assign a primary use to parcels during municipal tax assessments. According to NYS's Office of Real Property Service, the Niagara River/Lake Erie Watershed has land uses that fall within nine main categories (Table 3.8).

**Table 3.8 Land Use Classifications**[20]

| | |
|---|---|
| Agriculture | Property used for the production of crops or livestock. Includes dairy farms, orchards, poultry farms, field crops, nurseries, fish & game preserves, etc. |
| Residential | Property used for human habitation. Includes single-family, two-family, and multi-family residences, mobile home parks, and seasonal residences, etc. |
| Vacant Land | Property that is not in use, is in temporary use, or lacks permanent improvement. Includes vacant industrial, residential, commercial, rural or public utility lands, etc. |
| Commercial | Property used for the sale of goods and/or services. Includes hotels, restaurants, bars, auto service centers, storage facilities, gas stations, retail shopping, banks, junkyards, etc. |
| Recreation & Entertainment | Property used for groups for recreation, amusement, or entertainment. Includes fairgrounds, amusement parks, social clubs, camp grounds, stadiums, gyms, golf courses, ski resorts, beaches, marinas, etc. |
| Community Services | Property used for the well-being of the community. Includes libraries, schools, colleges, hospitals, civic buildings, museums, cemeteries, etc. |
| Industrial | Property used for the production and fabrication of durable and non-durable man-made goods. Includes manufacturing, mining, wells, etc. |
| Public Services | Property used to provide services to the general public. Includes, water treatment, telecommunications, roads, railroads, airports, bridges, landfills, waste-water treatment, utilities, transmission, etc. |
| Wild, Forested, Conservation Lands & Public Parks | Reforested lands, preserves, and private hunting and fishing clubs. Includes forest land, state owned land, wetlands, conservation easements, and special taxing districts for environmental purposes. |

Table 3.9 on the following page illustrates the land uses for the entire Niagara River/ Lake Erie Watershed, according to these land use classifications. New York State parcel centroid point data from November 2017 was used to determine the property class of each parcel and the parcel acreage was used to calculate the overall acreage of each property land use classification in the watershed. Note: the center of the parcel determined in which sub-watershed the parcel was placed. Parcels were not split along watershed or sub-watershed boundaries.

[20] *NYS Office of Real Property Services' Assessor's Manual: Data Collection and Maintenance of Property Inventories –RFV. Property Type Classification and Ownership Codes (September 2006).*

Upon comparing land use or property class to land cover characterization for the watershed, it's apparent a much larger percentage of land is currently in residential use than is considered developed (Table 3.9). While only 164,380 acres of land are classified as developed under land cover classifications, 541,220 acres, or over a third of the Niagara River/Lake Erie Watershed, are classified as residential in land use classifications. While it is true that some of the residential parcels in more rural areas may be characterized as forested, open space, or another land cover classification, the long-term viability of forested or agricultural land is hindered when encroaching residential development isolates these parcels making the land more likely to be converted to other uses, such as adding residential units, in the future. Community programs and policies should focus on mitigating sprawling development patterns and low-intensity residential development by addressing how land is converted to residential uses (i.e. conservation, subdivision, site design regulations) and protecting natural lands.

**Table 3.9: Acreage of Land Use Classifications**

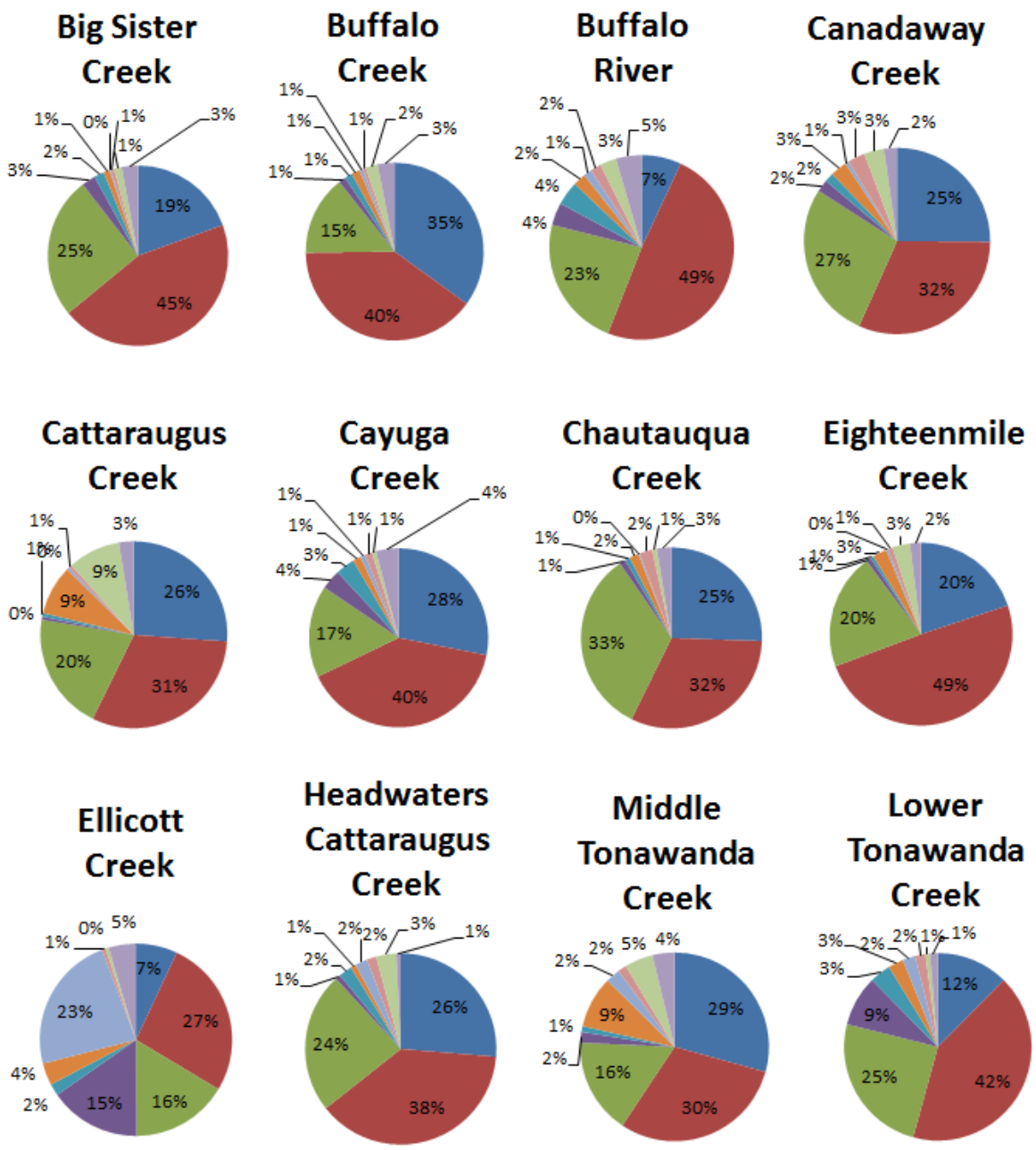
| Land Use Classification | Acreage Totals | Percentage of Watershed |
|---|---|---|
| Agriculture | 340,741 | 23% |
| Residential | 541,220 | 36% |
| Vacant Land | 311,120 | 21% |
| Commercial | 53,109 | 4% |
| Recreation & Entertainment | 27,300 | 2% |
| Community Services | 57,504 | 4% |
| Industrial | 53,542 | 4% |
| Public Services | 25,891 | 2% |
| Wild, Forested, Conservation Lands & Public Parks | 48,230 | 3% |
| Undefined | 49,419 | 3% |
| **Total** | **1,508,077** | **100%** |

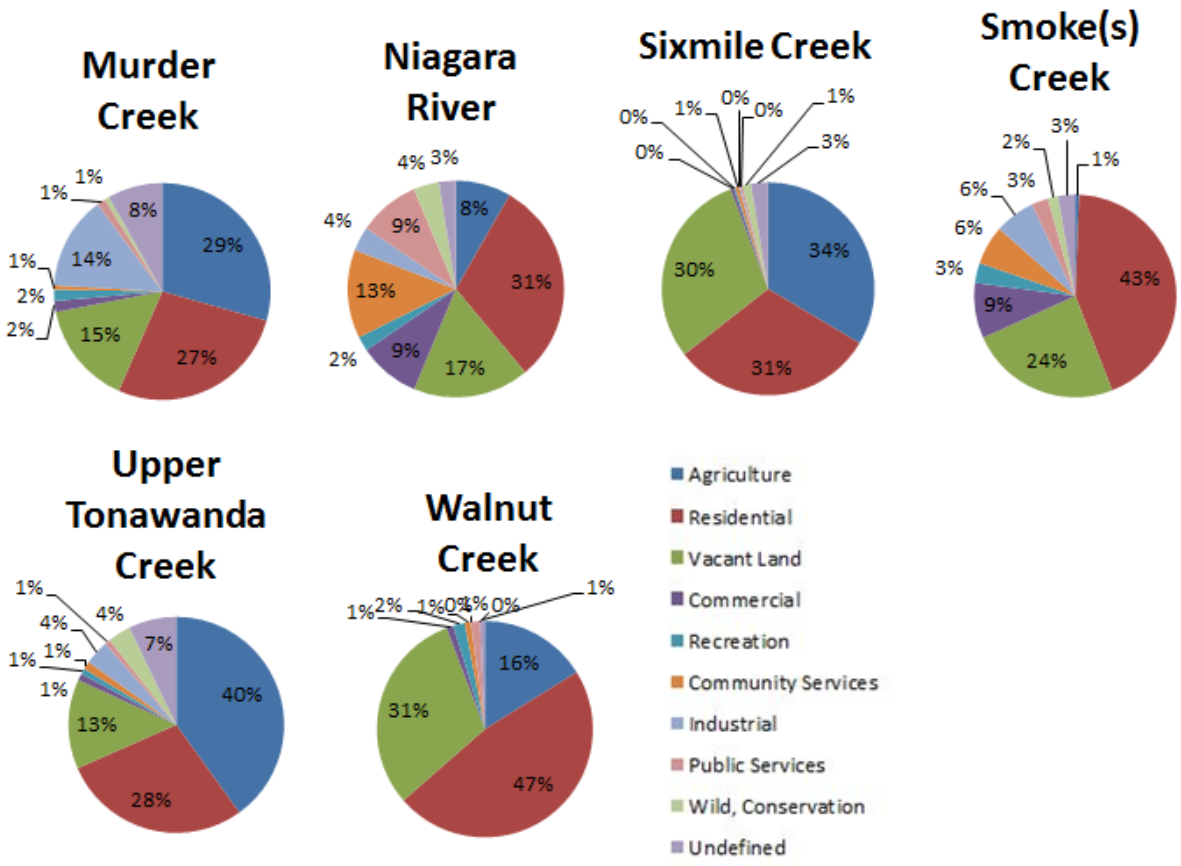
While vacant lands do constitute a large percentage of the watershed's overall property classification, this is misleading since nearly 80% of these lands are considered vacant-residential properties, meaning they are either located within primarily residential areas or have minor residential improvements upon them (garages). Vacant land and former industrial and commercial properties do offer opportunities to improve watershed protections by re-establishing wetlands, floodplains and riparian buffers, or implementing green infrastructure during future redevelopment or conservation efforts.

## Land Use by Sub-watershed

The pie charts in Figure 3.5 portray the land use breakdown within each sub-watershed, based on the percentage of land uses defined by 2017 New York State parcel centroid point data. Two of the most

**Figure 3.5: Land Use Breakdown by Sub-watershed**






striking things found in this data are the extreme lack of land currently classified as "Wild, Conservation, or Public Parks" as a whole across the watershed, and the large percentage of land classified as "Vacant" in each sub-watershed. In every sub-watershed "Wild, Conservation or Public Parks" make up 5% or less of the total land use acreage, which is grossly inadequate for long-term protection of water resources and important aquatic habitats. Buffalo Niagara Riverkeeper's *Niagara River Regional Habitat Conservation Strategy* (2014) identified 30 sites prioritized for future protection/conservation based on what would be most beneficial for sub-watershed and habitat health.

Vacant land uses are substantial in the overall watershed and range between 13-33% within each sub-watershed. These properties may be considered vacant residential or vacant commercial and offer an opportunity for redevelopment. Vacant land reuse should aim to remedy poor site design elements to preserve and improve natural features that support watershed health however.

It is also important to note that parcel data may list properties as residential, but they may have agriculture or other uses on the premises as well. Only one land use is listed per parcel.

## Other Adverse Land Uses, Sites or Facilities

The Niagara River/Lake Erie Watershed Atlas and Bibliography associated with this plan also includes a number of mapped Geographic Information System data sets that assist in identifying potential threats from other adverse land uses not necessarily reflected in parcel data.[21] This information includes:

- State Inventory of Dams
- Highway and Railway Bridges
- State Permits for Large and Medium Concentrated Animal Feeding Operations (CAFOs)
- State Regulated Oil, Brine & Storage Wells
- State Regulated Gas Wells
- State Pollution Discharge Elimination System (SPDES) permitted facilities
- State Regulated Remediation Sites (i.e. Brownfields)
- Resource Conservation and Recovery Act (RCRA) Transporters & RCRA Hazardous Waste permitted facilities
- Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Superfund Sites
- EPA Regulated Treatment, Storage & Disposal Facilities
- EPA National Priorities List Sites (NPL)
- EPA Toxic Release Inventory (TRI) Sites
- National Pollution Discharge Elimination System (NPDES) permitted facilities
- Combined Sewer Overflows (CSOs)
- EPA Regulated Large & Small Quantity Generators

Because many of the issues and potential threats associated with these land uses, sites and facilities are outlined in other chapters of this plan, Table 3.10 offers a brief summary of the sub-watersheds with the highest concentrations[22] of these facilities. Sub-watersheds not listed did not show high concentrations of these facilities. Many of these land uses and facilities are located in the most urbanized sub-watersheds, Niagara River, Buffalo River, and Ellicott Creek, where industry and infrastructure are most concentrated. The Cattaraugus Creek sub-watershed also shows high concentrations of these facilities, though due to the number of state regulated wells and dams.

[21] http://www2.erie.gov/environment/sites/www2.erie.gov.environment/files/uploads/pdfs/ECS_June%202017%20Final%20Draft%20Atlas%20and%20Bibliography%20compressed.pdf

[22] Sub-watersheds with the number of each type of facility over the 75th percentile for that type in the watershed were considered highest concentrations.

**Table 3.10 High Concentrations of Land-uses, Sites, and Facilities with Potential Impacts to Water Quality by Sub-watershed**

| Sub-watershed | Facilities of High Concentration |
|---|---|
| Niagara River | State & National Pollution Discharge Elimination System (S/NPDES) permitted facilities, State Regulated Remediation Sites, Bridges, National Priority List (NPL) Sites, Permit Compliance System Sites, Superfund Sites, Combined Sewer Overflows (CSOs), U.S. EPA Small & Large Quantity Generators, Toxic Release Inventory Sites, Resource Conservation and Recovery Act (RCRA) Transporters & Hazardous Waste Facilities, and Treatment, Storage, and/or Disposal Facilities. |
| Buffalo River | State Regulated Storage & Unlisted Wells, State Regulated Remediation Sites, Dams, Bridges, Superfund Sites, RCRA Hazardous Waste Facilities, Toxic Release Inventory Sites, U.S. EPA Small & Large Quantity Generators, S/NPDES permitted facilities, and Permit Compliance System Sites. |
| Ellicott Creek | State Regulated Gas Wells, Bridges, U.S. EPA Large & Small Quantity Generators, RCRA Hazardous Waste Facilities, S/NPDES permitted facilities, State Regulated Remediation Sites, and Permit Compliance System Sites. |
| Cattaraugus Creek | State Regulated Gas, Oil, Storage, & Unlisted Wells, National Priority List Sites, and Dams. |
| Smokes Creek | U.S. EPA Large & Small Quantity Generators, CSOs, State Regulated Remediation Sites, RCRA Hazardous Waste Facilities, Permit Compliance System Sites, and Toxic Release Inventory Sites. |
| Upper Tonawanda Creek | Dams, Concentrated Animal Feeding Operations (CAFOs), and State Regulated Brine Wells. |
| Buffalo Creek | CAFOs and State Regulated Unlisted Wells. |
| Canadaway Creek | State Regulated Gas & Unlisted Wells. |
| Headwaters Cattaraugus Creek | CAFOs and Dams. |
| Cayuga Creek | CSOs. |
| Chautauqua Creek | State Regulated Gas Wells. |
| Eighteenmile Creek | State Regulated Unlisted Wells. |
| Lower Tonawanda Creek | Bridges. |

## Lands Protected from Development

Land conservation has been identified in a number of studies as a primary tool in preserving water quality, reducing public-water supply treatment costs, and managing stormwater. Protecting certain areas can have an even larger impact on water quality. For instance, protecting wetlands provides for increased water filtration to occur. Wetlands act as the natural filters of the watershed and can have tremendous beneficial impact on downstream water quality. Protecting native vegetated areas with deep root systems can also absorb large amounts water and avoid stormwater runoff to waterways. This not only allows for the water to be filtered before reaching water sources, but also reduces the erosion of stream banks, which in turn reduces the amount of sediment and nutrient pollution to waterways.

Additional land protection benefits include conserved fish and wildlife habitat for increased biodiversity, improved recreational opportunities, reduced air pollution, carbon storage to offset climate change, and increased flood resiliency through protected floodplains.

**Table 3.11: Total Acres Protected from Development by Sub-watershed**

| Sub-Watershed | Total Protected Acres | Percent of Sub-watershed Acres Protected |
|---|---|---|
| Big Sister Creek | 10,544.20 | 16.91% |
| Buffalo Creek | 7,301.80 | 7.84% |
| Buffalo River | 8,294.70 | 7.87% |
| Canadaway Creek | 3,963.60 | 6.14% |
| Cattaraugus Creek | 31,829.50 | 16.11% |
| Cayuga Creek | 4,995.70 | 6.14% |
| Chautauqua Creek | 2,215.90 | 4.32% |
| Eighteenmile Creek | 3,625.00 | 4.72% |
| Ellicott Creek | 10,211.20 | 13.29% |
| Headwaters Cattaraugus Creek | 11,605.90 | 7.23% |
| Lower Tonawanda Creek | 14,712.00 | 18.67% |
| Middle Tonawanda Creek | 23,299.80 | 29.46% |
| Murder Creek | 11,324.10 | 24.27% |
| Niagara River | 12,780.60 | 12.43% |
| Sixmile Creek | 1,534.40 | 3.52% |
| Smoke(s) Creek | 4,344.10 | 10.99% |
| Upper Tonawanda Creek | 19,980.30 | 15.70% |
| Walnut Creek | 1,158.70 | 3.22% |
| **Total** | **183,721.50** | |

Source: http://www.nypad.org, as well as state and federal wetlands.

At this time approximately 12% of the 1,523,515 acres in the Niagara River/ Lake Erie Watershed is considered protected through a variety of mechanisms, including conservation easements, fee title acquisition, regulatory protections on environmental features (i.e. wetlands), reservations, and land under governmental jurisdiction (parks, forests, trails, canals) according to the 2014 NYS Natural Heritage Program.

Figure 3.6 illustrates how scattered and limited the watershed's protected lands are as of 2010, especially within the southern portion of the watershed. Presently, Middle Tonawanda Creek Sub-watershed hosts the largest percentage of protected lands at approximately 29.5% of its total acreage, while Walnut Creek Sub-watershed hosts the least at 3.2% of its total acreage. There are a few large tracts of protected land throughout the watershed such as the Iroquois National Wildlife Refuge and the Carlton Hill State Forest. While the Cattaraugus, Tonawanda, and Tuscarora reservations are listed, they are considered to have no known public/private institutional mandates or legally recognized easements.

It is interesting to note that many of the sub-watersheds with the least percentage of protected land also have the least percentage of impervious cover as shown by comparing Table 3.6 to Table 3.11. These areas also tend to have lower population density and fewer urban stressors. It is important to note is that should sprawl pressures increase in these areas, large parcels may be subdivided for residential or commercial use as there are few formal protections in place.

In order to offer the most benefits for watershed function, the Center for Watershed Protection recommends land conservation focus on protecting:

- critical habitat for plants and wildlife;
- aquatic corridors where land and water meet;
- hydrological reserves (undeveloped areas, such as forests and agricultural lands, that sustain the hydrological responsiveness of the watershed); and,
- features of land that could contribute pollutants to natural waters (if developed).

By preserving the features listed above and employing effective land use and floodplain regulations throughout the watershed, an integrated network of Living Infrastructure[23] can be established.

[23] Living Infrastructure refers to an interconnected network of green space and natural systems (waterways, wetlands, forests, meadows, and other natural areas) that support native species, maintain natural ecological processes, sustain air and water resources, and contribute to the health and quality-of-life for communities.

**Figure 3.6: Protected Land of the Niagara River/ Lake Erie Watershed**