Section 1
Watauga River Basin
Geography, Population, Land Cover, Nonpoint Source Pollution, Stream Flow and Impoundments

Basinwide planning is a watershed-based approach to identify areas across the state where water resource concerns should be addressed. The planning process also identifies areas that need additional protection, restoration or preservation to ensure waters of the state are meeting their designated use. Basinwide plans are required under General Statute 143-215.8B and are approved by the Environmental Management Commission (EMC) every 10 years[1]. Updates are provided throughout the 10-year period to address changes in water quality and modeling methodology, to report changes to wastewater permits, and to share advances in scientific knowledge. The basinwide plans are not a rule; however, any "water quality standard or classification and any requirement or limitation of general applicability that implements a basinwide water quality management plan" is considered a rule and must be adopted under protocols defined in the Administrative Procedures Act, Article 2A of Chapter 150B of the General Statutes.[2]

Information presented in Section 1 includes geographic and ecoregion characteristics found in the Watauga River basin, population and land use numbers, nonpoint source pollution related to agriculture, forestry and stormwater, and a general discussion about stream flow, climatic events, and impoundments.

1.1 Geography and Ecoregion Characteristics

The Watauga River basin is situated in the far northwest corner of the state between the French Broad and Catawba River basins to the south and the New River basin to the north. The entire watershed drains northwest into Tennessee where it flows into the Watauga River Reservoir. The Watauga River itself is a major tributary to the Holston River, which eventually flows to the Tennessee River. The Watauga River Gorge, where the river drops sharply as it enters Tennessee, is one of the most beautiful stretches of river in the basin. Parts of the basin are traversed by the scenic Blue Ridge Parkway and contained within the Pisgah National Forest. The basin is the second smallest in the state, containing nearly 280 classified stream miles and encompassing only 205 square miles. The Watauga River basin contains one 8-digit hydrologic unit code (HUC).

The North Carolina portion of the Watauga River basin is located entirely in the Blue Ridge Province of the Appalachian Mountains. Major tributaries to the Watauga River include Boone Fork, Cove Creek, Beech Creek, Beaverdam Creek, and the Elk River. Most of the watersheds are made up of high-gradient, cool water streams that can support a variety of habitats (terrestrial and aquatic) and a wide range of biodiversity including the freshwater mussel, Green Floater (*Lagmigona subviridis*), and the Hellbender (*Cryptobranchus alleganiensis*). Portions of two North Carolina counties (Avery and Watauga) are in the basin along with the municipalities of Banner Elk, Beech Mountain, Elk Park, Seven Devils and Sugar Mountain. The western outskirts of the Town of Boone are also located in the basin.

[1] Session Law 2012-200
[2] G.S. 143-215.8B(e)

1.2 Population and Land Cover

1.2.1 Population Projections

Information on population density is useful in determining what watersheds are likely to have the most impacts as a result of population growth. Information on population densities can also identify where there may be opportunities for preservation or restoration activities. Population information is intended to present an estimate of expected population growth in the counties and municipalities located wholly or partially in the Watauga River basin. County populations were obtained from the North Carolina Office of State Budget and Management (OSBM) (2014) and can be projected out to 2030. Population projections for public water supply (PWS) systems are projected out to 2060 and are required as part of the local water supply plan (LWSP). According to data available through OSBM, population in Avery and Watauga County is projected to grow by 2 and 18 percent, respectively, between 2010 and 2030 (Table 1.1). Proper land use planning can assist local leaders in establishing long-range goals, help control the rate of development and growth patterns, and ensure open space is conserved throughout the basin.

Table 1.1: Population Growth and Projections – County (OSBM, 2014)

County	Population 2000	Population 2010	Population Projection 2020	Population Projection 2030	Percent Growth 2000-2010	Percent Growth 2010-2020	Percent Growth 2010-2030
Avery	17,167	17,745	17,912	18,102	3.3	0.9	2.0
Watauga	42,693	50,981	56,744	62,757	12.1	10.2	18.8
Totals	59,860	68,726	74,656	80,859	14.8	7.9	15.0

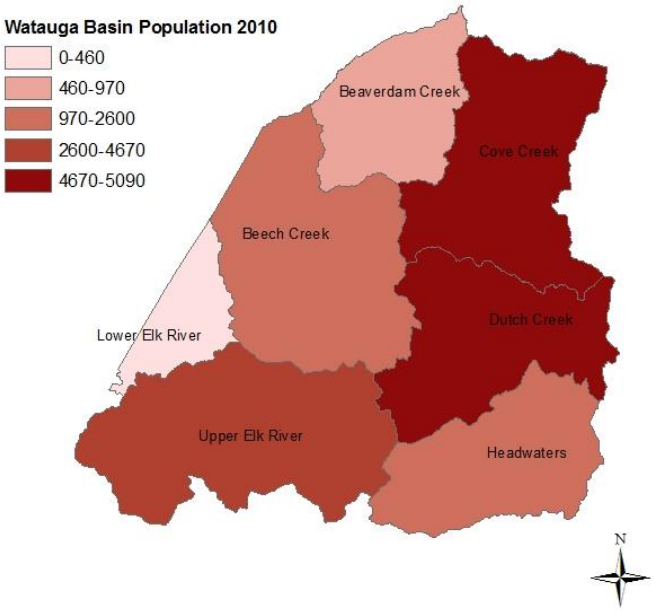
Note: The numbers reported here reflect county population. The county is not entirely within the basin. The intent is to demonstrate growth for counties located wholly or partially in the basin.

Using county projections from OSBM, land use and parcel datasets, population can be estimated for each HUC 12 in the Watauga River basin. Cove Creek and Dutch Creek are the most populated watersheds. Lower Elk River is the least populated. It also has the least land area (Table 1.2; Figure 1.1).

Table 1.2: Estimate Population Projections – HUC 12 (OSBM, 2014)

HUC Name	HUC 12	Total Land Area (Square Miles)	Population 2010	Population Projection 2020	Population Projection 2030
Headwaters Watauga River	60101030301	26.3	2,599	2,553	2,623
Cove Creek	60101030302	34.8	5,089	4,926	5,068
Dutch Creek	60101030303	29.9	4,960	4,008	4,124
Beaverdam Creek	60101030304	20.5	969	1,039	1,070
Beech Creek	60101030305	40.3	2,475	2,619	2,681
Upper Elk River	60101030201	41.9	4,669	4,860	4,885
Lower Elk River	60101030202	10.2	461	451	454
Totals		**203.9**	**21,222**	**20,456**	**20,906**

Figure 1.1: HUC 12 Estimated Population 2010 (OSMB, 2014)



A PWS system often crosses county lines and provides water to people in any number of counties and municipalities. Population projections are included in the LWSP to ensure the PWS system has enough water available to meet its customer's demands. Portions of Beech Mountain, Seven Devils and Sugar Mountain are located in both Avery and Watauga County. Banner Elk and Elk Park are located entirely in Avery County.

Three PWS systems report year-round populations as well as seasonal populations. Sugar Mountain has become a year-round destination and includes the seasonal population with the total population projections in their LWSP. Banner Elk, Beech Mountain and Seven Devils, however, report seasonal population separately. Table 1.3 includes year-round and seasonal population projections. Total population (year-round and seasonal) is used for projecting future water use and demand.

1.2.2 Land Use – National Land Cover Data

Land cover information can assist local, state and federal managers and officials assess ecosystem status and health. Land cover can also assist with modeling nutrient and pesticide runoff, understanding spatial patterns in biodiversity, developing land use management policies, and evaluating the effects of land use changes on water quality (NLCD, 2011). North Carolina uses land cover datasets available from the National Land Cover Database (NLCD). Land cover types, number of acres and percent coverage are included in Table 1.4. Spatial distribution is shown in Figure 1.3.

Table 1.3: Population Projections by Public Water Supply System (PWSS) (LWSP, 2015)

PWSS Name	PWS ID	2010	2015	2020	2030	2040	2050	2060
Banner Elk	01-06-015	850	1,075	1,082	1,121	1,160	1,202	1,244
Elk Park	01-06-025	480	495	505	525	546	568	591
Sugar Mountain	01-06-107	3,054	2,953	3,075	3,257	3,439	3,621	3,803
Beech Mountain**	01-95-104	360	340	402	505	608	711	815
Seven Devils*	01-95-118	225	192	202	230	250	272	296
Total Year-Round Residents		**4,969**	**5,055**	**5,266**	**5,638**	**6,003**	**6,374**	**6,749**
Banner Elk	01-06-015	0	1,575	1,594	1,652	1,712	1,774	1,836
Beech Mountain	01-95-104	2,500	5,122	6,036	7,559	9,082	10,605	12,129
Seven Devils*	01-95-118	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Total Seasonal Population		**3,500**	**7,697**	**8,630**	**10,211**	**11,794**	**13,379**	**14,965**
Total Population		**8,469**	**12,752**	**13,896**	**15,849**	**17,797**	**19,753**	**21,714**

*Seven Devils population projection based on the 2014 LWSP.

**Sugar Mountain includes seasonal population projections with year-round population projections.

Figure 1.2: Population Projections – PWSS (LWSP, 2015)

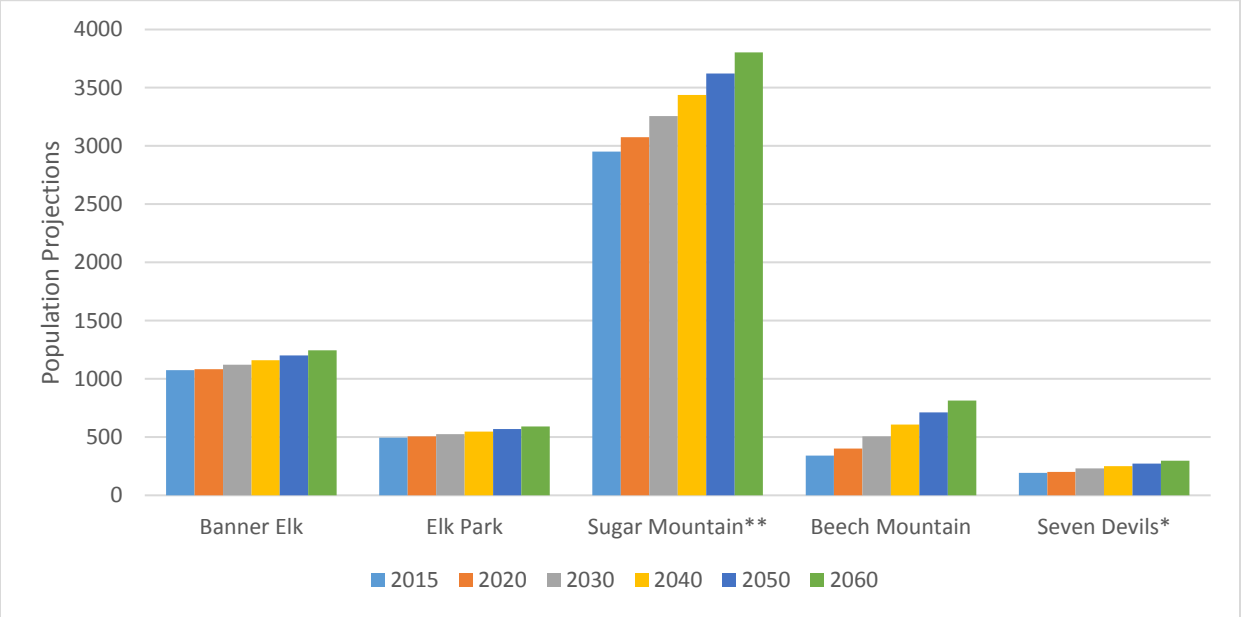
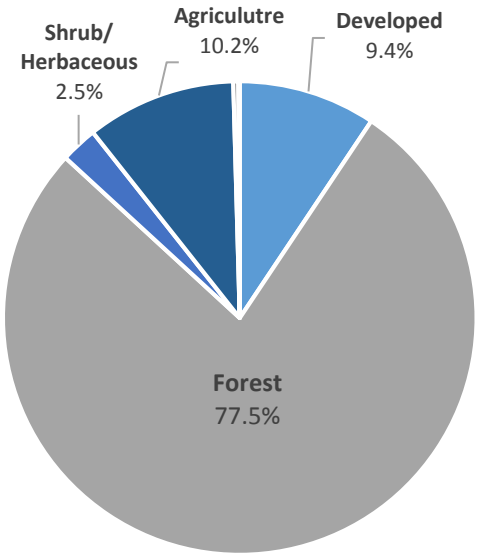


Table 1.4: Land Cover – Watauga HUC 06010101

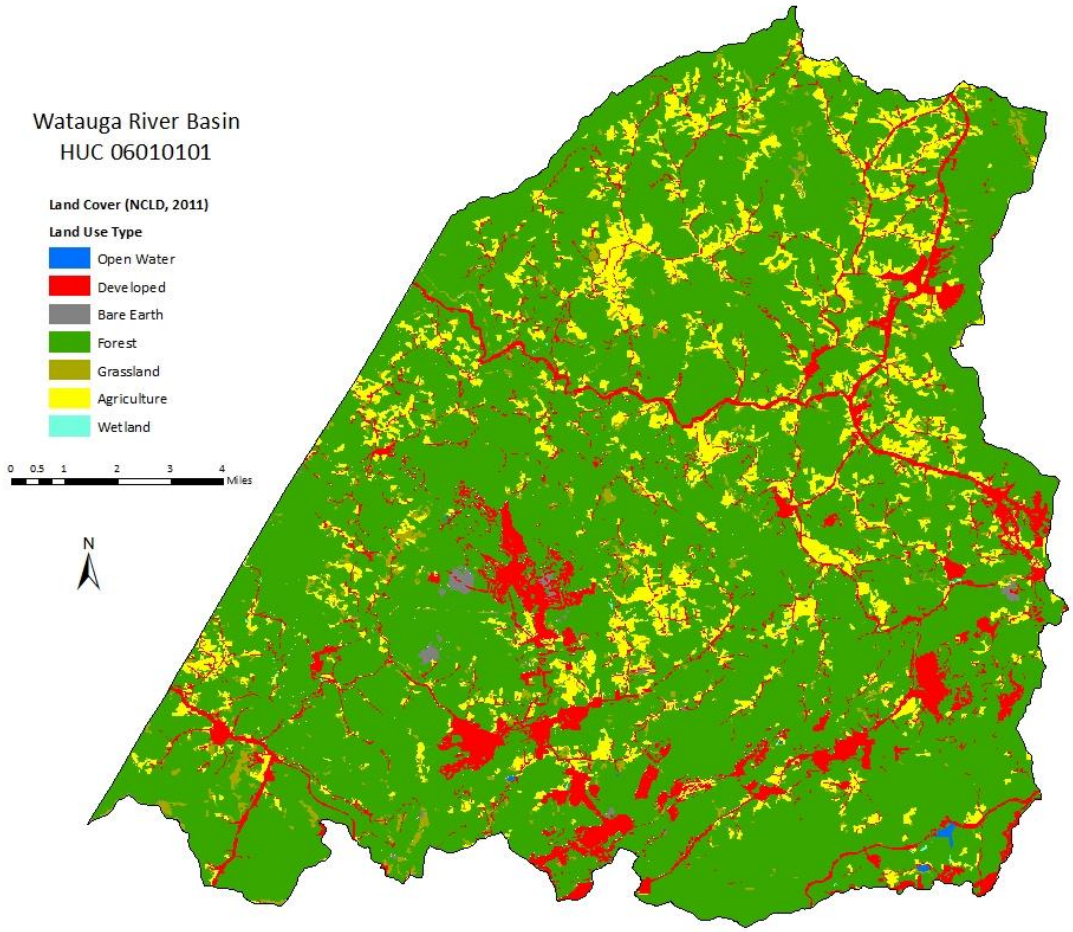
Land Cover Type	Acres	Percent
Developed Open Space	10,994	8.39
Developed, Low Intensity	819	0.62
Developed, Medium Intensity	450	0.34
Developed, High Intensity	25	0.02
Total Developed	**12,288**	**9.38**
Deciduous Forest	97,434	74.35
Evergreen Forest	2,117	1.62
Mixed Forest	1,956	1.49
Total Forestland	**101,507**	**77.46**
Shrub	1,728	1.32
Grassland/Herbaceous	1,570	1.20
Total Shrub/Herbaceous	3,298	2.52
Pasture/Hay	13,313	10.16
Cultivated Crop	73	0.06
Total Agriculture	**13,386**	**10.21**
Barren Land (Rock/Sand/Clay)	445	0.34
Woody Wetlands	60	0.05
Open Water	68	0.05
Totals	**131,052**	**100**



Some of the largest impacts to water quality are based on land use adjacent to and the headwaters of a watershed. In municipal areas, impervious surfaces can prevent rainfall from filtering into the ground. This filtering, in turn, can remove some of the nutrients and bacteria found in stormwater before the water enters the nearest waterbody. Stormwater and snow melt also recharges groundwater supplies.

In impervious areas, much of the stormwater is sent directly to storm drains and culverts. Many of the storm drains and culverts empty into the nearest waterbody. The direct delivery of stormwater to a stream can have multiple negative impacts to water quality and aquatic habitat including: elevated water temperature, increased sediment and nutrient delivery including chemical compounds that can be found on highways, city streets and neighborhood driveways, and excess erosion due to increased stream velocity. Slowing and diverting stormwater from streams can, in some cases, protect streams from severe erosion and sedimentation.

Figure 1.3: Land Use Cover – Watauga River Basin (NCLD, 2011)



1.3 Nonpoint Source Pollution

Nonpoint source pollution can result from any number of activities and land uses. Construction and land clearing activities, agricultural operations, golf courses, mining operations, solid waste disposal sites, tree harvesting, urban landscapes, and on-site wastewater treatment systems (septic systems) all contribute to nonpoint source pollution and can add sediment, nutrients, bacteria, heavy metals, oil, and grease to a waterbody. There are several programs in place through various organizations that protect water resources from nonpoint source pollution. Many include funding for best management practices (BMPs) that can reduce the amount of sediment, nutrients and bacteria entering a waterbody as well as protect streambanks, reduce erosion, and manage waste.

1.3.1 Agriculture

Just over 10 percent of land use in the Watauga River basin is identified as agriculture with most of the land being used for pasture. Based on data available through the USDA Census of Agriculture, the number of farms and the land area utilized for farming operations in Avery and Watauga counties has remained relatively unchanged since 2002, but the number of animals for cattle and calf operations, as well as the number of chickens, have increased in both counties (Table 1.5). Based on the census data queried for 2002, 2007 and 2012, none of the poultry operations in Avery or Watauga counties are associated with large-scale contract production operations or facilities.

Table 1.5: USDA Census of Agriculture Data – Avery and Watauga Counties (2002, 2007 & 2012)

	2002	2007	2012	2002	2007	2012
	Number of Farms			Number of Acres		
Number of Farms & Land Area	1,226	1,064	1,092	82,372	73,600	83,989
Land Use	**Number of Farms**			**Number of Acres**		
Total Cropland	1,146	902	937	36,497	24,365	26,132
Harvested Cropland	1,040	843	895	18,785	18,932	20,176
Irrigated Land	90	72	54	625	463	402
Cut Christmas Trees (In production)	437	396	442	8,624	10,677	10,475
Cut Christmas Trees - Irrigated (In production)					44	6 (D)
Livestock Inventory	**Number of Farms**			**Number of Animals**		
Cattle and Calf	431	333	356	11,248	8,679	15,872
Hogs and Pigs	2	11	19	(D)	32	123
Sheep and Lambs	14	18	31	456 (D)	253	589
Chickens	23	24	100	431	1,042	2,202
Aquaculture - Trout		3	5			
Crops	**Number of Farms**			**Number of Acres**		
Corn for Grain	7	13	37	13 (D)	32 (D)	143
Corn for Sillage or Greenchop	8	5	7	46	46 (D)	112
Tobacco	224	15	10	586	39	41
Forage (Land used for hay, haylage, grass silage and greenchop)	430	332	357	6,976	6,295	7,897
Vegetables (Harvested for Sale)	43	71	84	88	159	252
Orchards	16	30	32	85	29 (D)	96
Fertilizers and Chemicals	**Number of Farms**			**Number of Acres**		
Commercial fertilizer, lime and soil conditioners	1040	699	606	16,325	16,687	14,310
Chemicals used to control growth, thin fruit, ripen or defoliate	34	14	14	708	41 (D)	135
Manure	152	112	119	(NA)	1,445	1,793
Acres treated with chemicals to control:						
Insects	559	361	387	7,048	7,555	7,916
Weeds, grass or brush	679	491	468	8,017	10,489	9,627
Nematodes	48	24	27	192	603	490
Diseases in crops and orchards	203	95	116	2,122	1,685	994

(D) Information withheld to avoid disclosing data for individual farms (USDA, 2012).

(NA) Information not available (USDA, 2012).

Many of the agricultural operations in the basin are in the valleys along the stream and river banks where they can have a direct impact on water resources. Biologists identified several stream segments throughout the basin that had some level of impact from adjacent agricultural land use with loss of riparian vegetation, streambank erosion and sedimentation identified as potential causes of habitat degradation. DWR encourages the agricultural community to continue voluntarily installing appropriate BMPs to reduce any potential nutrients that could reach surface water or groundwater and consider including the cost of reducing or mitigating environmental impacts into existing or new sustainable business plans.

1.3.2 Aquaculture

The most recent USDA Census of Agriculture reports that there are four trout farms in Avery County and one trout farm in Watauga County. The trout farm in Watauga County (Grandfather Mountain Trout Farm) is required to obtain an NPDES general permit (NCG530047). Permits are required when a cold-water fish farm harvests over 20,000 pounds of fish per year, feeds fish more than 5,000 pounds per month and discharges to surface water more than 30 days per year.

Water quality data collected in the Watauga River show that the water quality standards are being met; however, notices of violations (NOVs) have been issued to Grandfather Mountain Trout Farm. NOVs were issued in December 2014 and March 2015. The first was issued for monitoring frequency violations for stream flow, suspended solids, total suspended solids and dissolved oxygen. The second was issued because no monitoring records were available at the time of inspection. The DWR regional office staff has been working with the facility to ensure it remains in compliance with its permit.

Because the facility is not withdrawing more than 1,000,000 gallons per day, it is not required to register with DWR (General Statute 143-215.22H); however, DWR encourages the facility to manage water intake to ensure sufficient stream flow is available to maintain water quality downstream of the intake. Water conservation measures are also encouraged to ensure water is available for native fish populations during drought conditions. Nutrients, sediment and heated water discharged from a trout farm can impact the receiving waterbody. Best management practices are encouraged to reduce these potential impacts on the Watauga River.

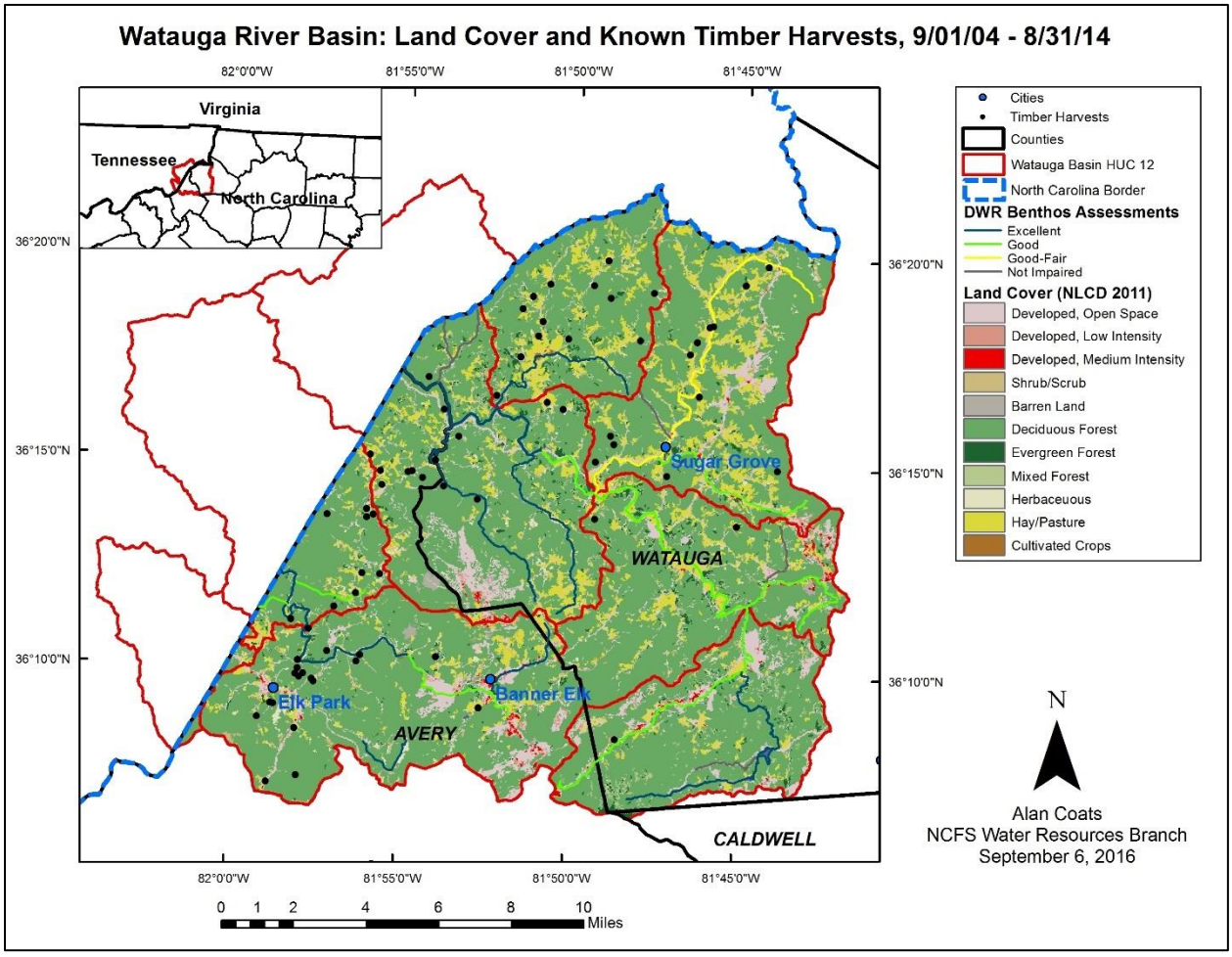
1.3.3 Forestry

When trees are harvested, sediment can have a significant impact on water quality. Sediment can be the result of exposed cuts for skid trails, slopes with bare soil and improperly constructed stream crossings. The North Carolina Forestry Service (NCFS) is delegated the authority to monitor and evaluate forestry operations. There are multiple state and federal rules in place to protect water resources where trees are being harvested. With any tree harvest, loggers are required to follow the nine standards defined in the N.C. Forest Practice Guidelines (FPGs) Related to Water Quality (02 NCAC 60C .0100-.0209) – a set of results-based guidelines meant to protect water quality. Topography, however, occasionally forces loggers to place landings and roads in areas where managing erosion and sediment may be more challenging to control. The NCFS can recommend BMPs that will take these challenges into consideration while attempting to protect water quality. The most recent NCFS BMP statewide monitoring survey (2016) found that BMPs for forestry were properly implemented in 82% of observations within the EPA Blue Ridge Level III ecoregion (66), compared to the statewide average of 84% implementation. When BMPs were properly implemented within Blue Ridge Level III ecoregion, a risk to water quality did not occur.

When BMPs were improperly implemented or missing, a risk to water quality occurred at 24% of observed sites.

In the Watauga River basin, the NCFS inspected 87 timber harvests between September 2004 and August 2014 totaling 4,698 acres (Figure 1.5). Of those harvests, 19 (22 percent) were found to be out of compliance with Forest Practice Guidelines (FPGs). On average, all were brought into compliance within 54 days from being found out of compliance. Landowners from 31 harvests (36 percent) received reforestation assistance from NCFS, reforesting 1,550 acres. Landowners are not required to notify NCFS of their plans after harvests, so the other 56 tracts may have been reforested without NCFS assistance, converted to other uses or left alone to follow ecological succession. In this basin, NCFS assisted with an additional 398 acres of reforestation not related to recent harvests. NCFS also assisted landowners with 133 forest management plans on 6,144 acres. Spatially, timber harvests mainly take place in the western and northern parts of this watershed. Only three harvests of 245 acres were listed in the Headwaters and Dutch Creek watersheds. Because landowners are not required to notify NCFS of timber harvesting or related forestry activities, it is likely the numbers found in these two watersheds is not a full representation of the timber harvests that occurred over the ten-year period (NCFS, 2016).

Figure 1.5: Timber Harvests Reported by NCFS 2004-2014 (NCFS, 2016)



Based on regional observations and survey results, harvests in the Watauga River basin are not necessarily clear cuts, since selection cuts are more prevalent in this part of the state. While loggers must still create skid trails to collect harvested timber, more vegetation is present in the midstory and understory than in the clear cuts more commonly seen in the Piedmont and Coastal Plain. If loggers have used chainsaws to fell trees, the only areas of noticeable soil exposure may be on the trails and landings distributed throughout the tract (NCFS, 2016).

Sustainable forest management depends on how trees are harvested and utilized. The NCFS works to educate loggers on proper preharvest planning, BMP implementation, and postharvest rehabilitation, so that these issues can be avoided to the furthest practical extent. Tracts in this part of the state are almost all owned by individual private citizens, rather than large-scale forest products or timberland investment companies. Given this ownership pattern, most of the forestland is managed at a lower level of intensity, typically not utilizing such treatments as fertilizer or herbicides. The production of Christmas trees makes up a significant portion of the economy in this part of the state as well. Christmas trees are considered agriculture rather than forestry and it is not tracked by the NCFS. Industry-specific BMPs have been developed by North Carolina State University (NCSU) Cooperative Extension Service (CES) and NRCS to protect water quality in areas utilized for Christmas tree production (NCFS, 2016).

1.3.4 Stormwater

Stormwater runoff is rainfall or snowmelt that flows across the ground and impervious surfaces (e.g., buildings, roads, parking lots, etc.). In urbanized areas, stormwater systems often concentrate stormwater runoff into smooth, straight conduits. The runoff gathers speed and volume as it travels through the system before it is released. The outfall is often directed to a surface waterbody where the high velocity can scour streambeds, damage streambanks and vegetation, and destroy aquatic habitat. The volume can cause flooding, damage infrastructure, and cause unnaturally high fluctuations in stream flow.

Many daily activities have the potential to cause stormwater pollution, and in an area where activities (e.g., construction, land clearing, etc.) have the potential to contribute more pollutants through stormwater runoff, measures should be taken to minimize impacts from runoff. One major component in reducing impacts from stormwater runoff involves planning up front during the design process. New construction designs should include plans to prevent or minimize the amount of runoff leaving the site. Wide streets, large cul-de-sacs, long driveways, and sidewalks lining both sides of the street are all features of urbanizing areas that create excess impervious cover and consume natural areas.

The presence of intact riparian buffers, floodplains and/or wetlands in urban areas can reduce the impacts of urban development. These porous, natural landscapes hold rainwater and snowmelt and allow the water to infiltrate slowly. This slow infiltration also helps recharge groundwater supplies. Where feasible, establishing and protecting existing buffers, floodplains and wetlands should be considered, and the amount of impervious cover should be limited as much as possible. Preserving the natural streamside vegetation or riparian buffer is one of the most economical and efficient best management practices (BMP) for reducing the amount of stormwater reaching surface water. In addition, riparian buffers provide a variety of benefits including: moderating water temperature by providing shade, holding water and decreasing the high temperatures often measured in stormwater runoff; preventing erosion and lose of land; providing flood control; moderating stream flow; and providing food and habitat to aquatic and terrestrial life (Burgess, 2004).

1.3.5 Golf Courses

North Carolina is home to several golf courses with many of them being internationally recognized courses. Intensive turf management that relies heavily on the use of fertilizers and chemical pesticides has the potential to impact water quality. In addition, construction and site maintenance can alter the stream channel and result in narrow or nonexistent riparian areas which can impact habitat and aquatic life and irrigation can result in low stream flows during extreme environmental conditions. To improve or mitigate any potential pollution impacts, as well as improve public education and outreach related to golf course management, NCSU's Department of Crop Science provides resources to both the golf industry as well as the non-golfing public. Turfgrass production and management programs are constantly being updated and improved by evaluating new and existing production practices, fertility systems and pest management regimes to reduce the potential impacts the turf industry can have to water resources. Guidance related to turf management can also be found through the NCSU CES.

Five golf courses in the Watauga River basin are registered with the state to withdraw water from a combination of surface and ground water with an annual average daily use of 0.333 million gallons per day (MGD). More information about water use in the basin can be found in the chapter titled Water Use and Availability in the Watauga River Basin.

1.4 Aquatic Nuisance Species – Whirling Disease and Gill Lice

Aquatic nuisance species are organism that cause ecological and/or economic harm when introduced to a waterbody. They can be plant or animal and can be species specific or impact an entire stream ecosystem. In 2015, whirling disease was found for the first time in rainbow trout from the Watauga River near Foscoe. Whirling disease is caused by a microscopic parasite (*Myxobolus cerebralis*). It travels along the nervous system and damages cartilage and the skeletal tissue of trout. Once infected, the damaged cartilage causes the fish to swim in circles or in an abnormal "whirling" motion. Other signs include a black tail and deformities to the head or body. The abnormalities make the fish more susceptible to predation. Because swimming is inhibited, finding food is also more difficult. Very young fish are more susceptible to the disease than adults, and there is no known cure for the disease. Once in a river system, the parasite is almost impossible to eradicate. The disease is more likely to be found in cold water environments and requires two hosts – tubifex worms, which are very common in lakes and streams with abundant fine sediment and rich organic material, and fish of the salmonid family, which includes trout and salmon species. The disease does not affect other fish species or mammals. No harmful effects have been identified or associated with eating fish with whirling disease (NCSU CES, 2015; WRC, 2015a).

Biologists with the NC Wildlife Resources Commission (WRC) are concerned that the disease could impact the native brook trout populations across the cold-water regions of the state. Before stocking fish to Hatchery Supported Trout Waters, WRC tested fish from the Armstrong State Fish Hatchery in Marion as well as the Setzer State Fish Hatchery in Brevard to ensure the parasite was not being transported to stocked waterbodies from the hatcheries. After it was determined that the hatchery fish were disease free, stocking resumed (WRC, 2015b). To identify potential sources of the disease, WRC began working with the NCDA&CS and NCSU to sample commercial aquaculture operations in the region to identify the source of the disease before it has a detrimental impact to existing native populations (WRC, 2015a).

The disease is mainly spread by infected fish and fish parts. It can also be transmitted by birds as well as anglers who may unknowingly have the parasite on fishing equipment, boots and boats. WRC is asking the public to help prevent the spread of the disease by cleaning and drying equipment, clothing or

anything else that comes into contact with freshwater streams where trout are located and dispose of fish parts carefully by either sealing them in a garbage bag, burning them completely or burying deeply. In addition, a permit is required to move fish or aquatic life from one waterbody to another. Why? It gives biologists an opportunity to review the potential negative impacts to the environment before any species is introduced to another body of water. It is also illegal to move fish to a new waterbody without a permit (NCSU CES, 2015; WRC, 2015a).

These same measures can also prevent the spread of gill lice. Gill lice was found for the first time in August 2015 on rainbow trout collected from Boone Fork (AU 8-7). It was first detected in the state on brook trout from the Cullasaja River in the Little Tennessee River basin in 2014 (WRC, 2005c). Gill lice are copepods (tiny, white crustaceans) that attach to a fish's gills. The infestation can traumatize the gills and impact the fish's ability to breathe. Most fish can tolerate a mild infestation, but if other environmental stressors are present (drought, high water temperature, etc.), the infestation can have a major impact on fish populations and result in fish kills (WRC, 2014).

Gill lice found on the rainbow trout in the Watauga River basin was a different species than that found on the brook trout in the Little Tennessee River basin. While the previously identified species (*Salmincola edwardsii*) is found only on brook trout, the newly identified species (*Salmincola californiensis*) is found on rainbow trout and kokanee salmon. Kokanee salmon are only found in Nantahala Lake in the Little Tennessee River basin indicating that the gill lice was easily transferred from one waterbody to the next. The appearance of gill lice in the Watauga basin highlights the ongoing and increasing concern of aquatic nuisance species across the state (WRC, 2015c).

1.5 Surface Freshwater Classifications and Water Quality Standards

Each surface water in the state is assigned a *primary* classification that is appropriate to protect designated best uses of that water. In addition to primary freshwater classifications, surface waters may be assigned one or more *supplemental* classifications. Most supplemental classifications have been developed to provide special protections to sensitive or high resource waters. Table 1.8 briefly describes the designated best uses of each classification applicable to freshwaters in the Watauga River basin. Surface water quality standards for Class C, Trout (Tr) and High Quality Waters (HQW) are shown in Table 1.9. A full description of classifications is available online through the Classification & Standards Branch website and in the Guide to Freshwater Classifications Chart.

1.5.1 Primary Recreation (Class B)

There are nearly 44 stream miles classified for primary recreation in the basin. Waters classified as Class B are protected for primary recreation, include frequent or organized swimming, and must meet water quality standards for fecal coliform bacteria. Sewage and all discharged wastes into Class B waters must be treated to avoid potential impacts to the existing water quality.

1.5.2 Water Supply Watersheds (Class WS)

Water supply classifications are assigned to watersheds based on land use characteristics. Water supply classifications are assigned based on the following criteria:

- WS-I are waters generally located in natural and undeveloped watersheds in public ownership.
- WS-II are waters generally located in predominantly undeveloped watersheds.
- WS-III are waters generally located in low to moderately developed watersheds.

- WS-IV are waters generally located in moderately to highly developed watersheds.
- WS-V are waters generally located upstream of and draining to Class WS-IV waters, waters used by industry to supply their employees with drinking water or waters formerly used as a public water supply.

Table 1.8: Primary and Supplemental Surface Water Classifications for Freshwaters in the Watauga River Basin

Primary Freshwater Classifications	
Class	**Best Uses**
C	Aquatic life including propagation, survival and maintenance of biological integrity, secondary recreation, fishing, wildlife, fish consumption and agriculture.
B	Primary recreation and Class C uses.
Water Supply Waters (WS) (WS-I through WS-V)*	Drinking, culinary or food processing uses and Class C uses.
Supplemental Classifications	
Trout (Tr)	Natural trout propagation and survival of stocked trout.
High Quality Waters (HQW)	Waters that have excellent water quality or primary nursery areas and other functional nursery areas.
Outstanding Resource Waters (ORW)	Unique and special waters having excellent water quality and of exceptional state or national recreational or ecological significance.
Unique Wetlands (UWL)	Wetlands of exceptional state or national ecological significance.

* WS-I, WS-II and ORW waters are also High Quality Waters (HQW). Waters for which DWR has received a petition for a WS-I or WS-II reclassification are also considered HQW.

A WS Critical Area (CA) is designated within one-half mile and draining to a WS intake or WS reservoir within WS-II, WS-III and WS-IV watersheds. The water supply restrictions applied in the CA are more stringent than the restrictions applied in the remainder of the watershed draining to a WS intake or WS reservoir. For a WS-IV watershed, the remainder of the watershed is called a Protected Area, and is defined as 5 miles and draining to the normal pool elevation of a reservoir, or 10 miles upstream of and draining to a river intake. No land management restrictions are associated with the WS-V classification.

Approximately seven stream miles are classified for water supply in the basin (WS-II and WS-III). Streams designated as WS-II are also HQW by definition. Streams classified as WS-II and WS-III require local governments with jurisdiction in these water supply watersheds adopt and implement land use ordinances for new development. New development ordinances are required to be at least as stringent as the state's minimum requirements which include a 30-foot vegetated buffer on perennial streams in areas considered for new low-density development and a 100-foot vegetated buffer on perennial streams in areas considered for new high-density development. There are also restrictions on wastewater discharges, landfills and residual application sites. These restrictions help control the impacts of point and nonpoint sources of pollution to public water supplies. Buckeye Creek and two of its tributaries are

classified as WS-II. West Fork Pond Creek is classified as WS-II, and East Fork Pond Creek is classified as WS-III. West Fork Pond Creek and East Fork Pond Creek are tributaries to Pond Creek. Buckeye Creek and Pond Creek are located in the Beech Creek watershed.

Table 1.9: Surface Water Quality Standards for Freshwater*

Pollutant	Aquatic Life (Class C)	Trout (Tr)	High Quality Waters (HQW)
Chlorophyll-a	40 μg/L (N)	15 μg/L (N)	-
Cadmium, acute**	Calculated standard	Calculated standard	-
Dissolved Oxygen (DO)	≥ 5.0 mg/L (N) measured as a daily average with a minimum instantaneous value of ≥ 4.0 mg/L (N)	≥ 6.0 mg/L (N)	≥ 6.0 mg/L (E)
Toluene	11 μg/L	0.03 μg/L	-
Turbidity	50 NTU (N)	10 NTU (N)	-
Total Suspended Solids (TSS)	-	< 10 mg/L (E)	< 20 mg/L (E)
Temperature***	(N)	(N)	-
(N) Narrative Standard. Refer to 15A NCAC 02B .0211 & .0212-.0218 for specific language.			
(E) Effluent Limits Only. Refer to 15A NCAC 02B .0224 for specific language.			
* The water quality standards in this table do not substitute for any written regulations nor are they themselves regulations. The table does not include all North Carolina's surface water quality standards. Instead, the table compares a handful of water quality standards for Class C waters to those with supplemental classifications of Trout and/or HQW. See 15A NCAC 02B .0200 rules for current values. When determining which standard to use, use the most stringent. In most cases, the human health standard is the most stringent water quality standard.			
** The water quality standard for acute cadmium protects aquatic life from exposure to the dissolved portion of cadmium in surface waters. The standard is calculation based and toxicity is dependent on the instream water hardness at the time of sample collection. See 15A NCAC 02B .0211 for how to calculate the hardness-dependent water quality standard for dissolved cadmium.			
*** Not to exceed natural water temperature by more than 2.8° C (5.04° F) and in no case to exceed 29° C (84.2° F) for Mountain and Upper Piedmont waters. (See rule for temperature standards for streams located in the Piedmont and Coastal Plains.) For trout waters, the temperature shall not increase by more than 0.5° C (0.9° F) due to discharge of heated liquids but in no case to exceed 20° C (68° F).			

1.5.3 Trout Waters (Class Tr)

There are nearly 142 stream miles classified as Trout (Tr) waters in the basin. Different water quality standards for dissolved oxygen (DO), temperature, chlorophyll a, cadmium and turbidity have been developed to protect freshwater for natural trout propagation and survival of stocked trout. These water quality standards may result in more restrictive limits for wastewater discharges to Trout waters.

There are no NC DWR watershed development restrictions associated with the Trout classification; however, the NC Division of Energy, Mineral and Land Resources (DEMLR), under the NC Sedimentation and Pollution Control Act (SPCA), has requirements to protect trout streams from land-disturbing activities. Under General Statue 113A-57(1), "waters that have been classified as trout waters by the Environmental Management Commission (EMC) shall have an undisturbed buffer zone 25 feet wide or of

sufficient width to confine visible siltation within the twenty-five percent of the buffer zone nearest the land-disturbing activity, whichever is greater." The Sedimentation Control Commission, however, can approve land-disturbing activities along Trout waters when the duration of the disturbance is temporary and the extent of the disturbance is minimal. Unnamed tributaries flowing to Trout waters also carry the Trout classification. Buffer zone requirements for Trout streams can be found under Administrative Code 15A NCAC 04B .0125(b) and in the Trout Waters Classification Guide.

1.5.4 High Quality Waters (Class HQW)

Nearly 32 stream miles are classified as HQW waters in the basin. HQW management strategies are intended to prevent degradation of water quality from both point and nonpoint sources. The HQW designation requires that new wastewater discharge facilities and facilities that are expanding beyond permitted loadings address oxygen-consuming wastes, total suspended solids, disinfection, emergency requirements, volume, nutrients (where nutrient over enrichment is projected to be a concern) and toxic substances.

For nonpoint source pollution, new development activities which drain to and are within one mile of HQW waters and which require (1) a Sedimentation and Erosion Control Plan in accordance with rules established by the NC Sedimentation Control Commission or (2) an approved local erosion and sedimentation control program must control runoff using either a low-density or high-density option. Both options require a 30-foot vegetated buffer between new development activities and a HQW classified water. New high-density development also requires structural stormwater controls (i.e., stormwater infiltration system, wet detention ponds, etc.) between new development activities and a HQW classified water.

1.5.5 Outstanding Resource Waters (Class ORW)

There are approximately 10 stream miles of ORW waters in the basin. These waters have excellent water quality (based on biological, physical or chemical sampling) and have unique and special characteristics exhibited by one or more outstanding resource values or uses.

The same regulations for HQW waters apply to ORW waters, but wastewater discharge requirements for ORW waters are more stringent than those for HQW waters. Specific protection measures that apply to North Carolina ORW waters are set forth in Rule 15A NCAC 2B .0225. At a minimum, no new discharges or expansions are permitted, and a 30-foot vegetated buffer or stormwater controls are required for new developments. New high-density developments require that stormwater be controlled using engineered structural practices. In the Watauga River basin, ORW management strategies are required in the Boone Fork watershed.

1.6 Stream Flow and Impoundments

1.6.1. Stream Flow

Stream flow is monitored by the U.S. Geological Survey (USGS) at selected gauging stations across the state. Flow (abbreviate "Q") is measured in terms of volume of water per unit of time, usually cubic feet per second (cfs). Minimum flows are intended to be occasional short-term events that maintain stream conditions in order for aquatic life to survive. One example is the 7Q10. It is the lowest flow that occurs for seven consecutive days with the probability of occurring once every 10 years. The 7Q10 is a drought flow statistic. It is used to determine wastewater effluent limits such that the pollutant load can still be assimilated and chemical water quality standards can still be maintained during the driest week in a giving

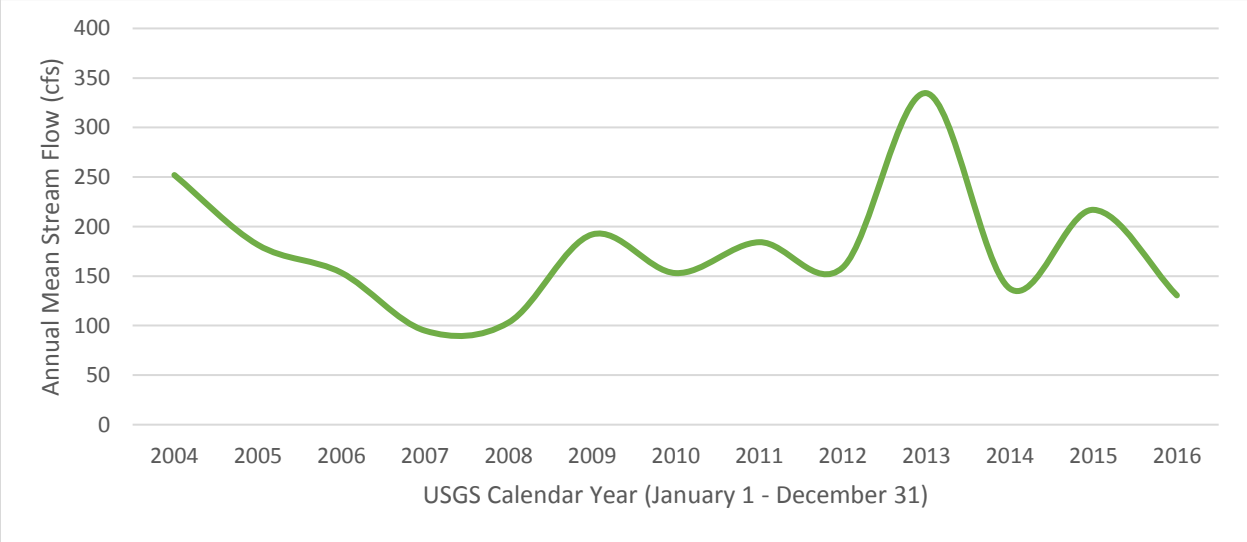
10-year period. Minimum flow will not protect ecological integrity if it is the only flow in the stream and /or occurs for long periods of time. It also does not incorporate critical characteristics of a flow regime (magnitude, timing, frequency, duration, variability and rate of change) needed to protect ecological integrity. Minimum flows lack the variability between different times of year (month and seasonal), as well as the inter-annual variability between different climate years (wet, dry, average).

During the ten-year assessment period (September 2004 - August 2014), the Watauga River basin experienced extreme weather conditions including extreme drought and above average rainfall. For a three-week period in September 2004, the remnants of three hurricanes led to widespread flooding throughout the central and northern mountains of Western North Carolina. In the Watauga River basin, the peak flow reached 17,000 cfs September 7-9, 2004 and 23,000 cfs September 17-18, 2004. The first has an approximate recurrence interval of 10 to 25 years with an approximate recurrence for the second event of once every 50 years.

Between 2000 and 2008, the area-weighted averages for the basin ranged from Abnormally Dry to Exceptional. Since January 2000, the basin has been in a Moderate, Severe, Extreme or Exceptional drought more than 40 percent of the time. Normal conditions have prevailed slightly less than 45 percent of the time. Low flows may accentuate the effect of point source discharges by providing less dilution for wastes. Changes in benthic macroinvertebrate communities may also be partly due to changes in flow.

Between 2012 and 2013, the basin experienced exceptionally high flows due to increased precipitation. High flows magnify the potential effects of nonpoint source runoff. In areas of high imperviousness, it often leads to streambed and bank scour, substrate instability and reduced periphyton growth. Figure 1.6 provides annual flow rates (cfs) recorded at USGS gauge station 03479000 near Sugar Grove from 1990 to 2015.

Figure 1.6: Annual Mean Stream Flow (cfs) in the Watauga River – USGS Gauge Station 03479000



1.6.2 Impoundments/Dams in the Watauga River Basin

By design, dams alter the natural flow of a river. By altering the natural flow, dams also alter the river's ecosystem (i.e., water quality, sediment transport and deposition, fish migrations and reproduction, and riparian and floodplain habitat and the organisms that rely on that habitat) (Raphals, 2001). Dams require

ongoing maintenance to avoid losing storage capacity as sediments accumulate behind the structure and can often be a liability to the landowner.

The Dam Safety Program in the Division of Energy, Mineral and Land Resources (DEMLR) provides statewide oversight to dams and works to prevent property damage, personal injury and loss of life due to dam failures. Under the North Carolina Dam Safety Law, flow requirements may be included as conditions to construct or repair dams to maintain adequate quantity and quality of water downstream of the impoundment. DWR, in conjunction with the North Carolina Wildlife Resources Commission (WRC), provide recommendations to DEMLR related to the amount and timing of flows to satisfy stream flow requirements. Table 1.7 is a list of dams in the Watauga River basin that are included in the Dam Safety Program.

Table 1.7: Impoundments included in the Dam Safety Program – Watauga River Basin

Name of Dam (Alternate Name)	Waterbody	Purpose	Drainage Area (mi^2) [b]	Minimum Release (cfs)[c]
Tynecastle (Inver Lochy)	Watauga River	Recreation	0.23	None
Sugar Mountain Dam (Snow Lake)	Flattop Creek	Other [a]	0.57	None
Wildcat Lake Dam	Wildcat Creek	Recreation	0.51	None
Mill Pond Dam	Elk River	Recreation	11.0	None
Andrews Dam	UT to Hanging Rock Creek	Recreation	0.22	None
Sims Pond	Sims Creek	Recreation	0.64	None
Price Lake	Boone Fork Creek	Recreation	4.71	None
Devils Lake Dam (Seven Devils Dam)	Watauga River	Recreation	0.37	None
Snow Lake	King Creek	Recreation	0.12	None
Rosasco Dam Lower (Victoria Lake Dam)	Baird Creek	Recreation	0.05	None
Rosasco Lake Dam Upper (Dexter Lake)	Baird Creek	Recreation	15.0	None
Sweetgrass Dam (Appalachian Crest or Broyhill Dam)	Boone Fork	Recreation/Irrigation	2.25	None
Beech Mountain Water Supply Dam (Buckeye Creek)	Buckeye Creek	Water Supply	3.34	None [d]

[a] The purpose of "other" includes waste and treatment lagoons. In the case of Sugar Mountain, it is used for snow making during winter months.

[b] Calculated using USGS StreamStats.

[c] Even though there is no minimum flow, the project must operate in a run-of-river mode (instantaneous flow equals instantaneous outflow. A noncompliant project can noticeably alter the stream flow.

[d] Minimum flow January – September 1.5 cfs. Minimum flow October – December is 2.8 cfs. A higher minimum flow is required due to brook trout spawning season. Minimum flow requirements are not being met. The town is working with DWR to identify additional water supply sources in order to meet current and projected demands. More information can be found in the section titled Beech Mountain HUC 060101030305.

The Federal Energy Regulatory Commission (FERC) licenses most dams associated with hydropower under the Federal Power Act (FPA). Wards Mill Dam on the Watauga River is subject to FERC rules and regulations. A water quality certificate is also issued by DWR. The water quality certificate is a requirement under Section 401 of the CWA, and North Carolina's regulations found under 15A NCAC 02H .0500.

Originally constructed sometime during the 1800's, Wards Mill Dam has historically provided electrical or mechanical power to facilities directly adjacent to the river. After a period of inactivity, the site was rehabilitated in 1982, and in September 1986, a 30-year license was issued by FERC for Wards Mill Dam. In September 2016, FERC issued a Notice of Authorization for Continued Project Operation, and a new license was issued in February 2017. Upon review of the new license, the licensee (Ray F. Ward) declined the license and submitted an application to surrender the existing license and stop generating electricity.

The dam is 130-feet long and 20-feet high and constructed of rock and concrete with two gates. It is a 4.6-acre impoundment that is 2,500-feet long with a gross storage capacity of 16.3 acre-feet. The powerhouse contains two turbines with a total installed capacity of 168 kilowatts (kW). A portion of the electricity produced is used by a sawmill owned and operated by the licensee and the excess is sold to Blue Ridge Electric Membership Cooperative. The sawmill is no longer used for commercial production. The project area also consists of an existing 250-foot portage trail and includes put-in and take-out areas along the river as well as a parking area. Wards Mill Dam has a drainage area of approximately 92.6 square miles.

Wards Mill Dam is manually operated as run-of-river where outflow from the powerhouse and water flowing over the dam are approximately equal to inflow into the reservoir. To maintain habitat downstream of the dam, the new license required Mr. Ward to install and maintain gauges to measure the stage and flow of the river as well as the amount of water held in and withdrawn from the impoundment. As part of the application process to surrender the license, the licensee had to address how the facility will be decommissioned as well as any environmental issues that may be encountered as a result of the facility no longer being used to generate electricity. The agent for the licensee contacted several local entities to receive comments about decommissioning the facility. The draft application to surrender the license included a description on how the equipment used to generate the electricity would be decommissioned. The application indicated that all other aspects of the project (dam, portage trail, parking area) would remain intact.

Local, state and federal agencies, as well as the public, were encouraged to provide comments related to surrendering the license. Comments received from American Whitewater encouraged the removal of the dam. American Whitewater wrote that removing the dam could "eliminate the liability and maintenance costs of owning the dam, restore fish and aquatic organism passage and allow the public to paddle through the area instead of using the portage trail" (Colburn, 2017). DWR and the United States Department of Interior (DOI) also provided comments. Removing the dam was not recommended as a condition for surrendering the license, but both agencies, along with the WRC, are committed to working with local entities to review potential environmental issues related to surrendering the license and/or removing the dam. DWR noted that removal of the dam would require a Clean Water Act Section 404 permit issued by the United States Army Corps of Engineers (USACOE) as well as a 401 Water Quality Certification from the 404 & Buffer Permitting Branch in DWR.

In January 2018, FERC issued an order approving the surrender of the license associated with Wards Mill Dam. As part of the surrender process, the dam was inspected by staff from FERC's Division of Dam Safety and Inspections and DEQ's DEMLR. FERC determined that all visible portions of the project features were in fair condition. DEMLR determined the dam to be low hazard and exempt from the North Carolina Dam Safety Law. The order states that the surrender of the license will not be complete until FERC's Division of Dam Safety and Inspections has determined that the facility has been decommissioned in accordance with the surrender order. Upon surrender, all flow will be released over the dam and the existing canoe portage will continue to be maintained by the licensee with no oversight by FERC.

In February 2018, a report was submitted to FERC indicating that the facility was decommissioned. The report included photos and a letter from Blue Ridge Electric Membership Corp. (BREMC) that the transfer and purchase of electricity generated from Wards Mill Dam ended in August of 2017. On March 28, 2018, FERC issued a reply stating that the report fulfills the requirements approving the surrender of the license. Documents related to Wards Mill Dam can be found on the FERC e-library website using the project number P-9842.

Shulls Mill is a breached dam on privately owned land near the headwaters of the Watauga River. The Hellbender (*Cryptobranchus alleganiensis*) has been documented immediately upstream and downstream of the structure as well as in a nearby tributary, Boone Fork (Nolt, 2005; Mayasich, et al, 2003). The Watauga Riverkeeper advocates removing the structure to improve water quality and increase aquatic ecosystem and floodplain connectivity. Removing the structure would also eliminate a potential liability for the property owner (Hill, 2018.).

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