EXISTING CONDITIONS REPORT

NORTH SHORE ROAD
ENVIRONMENTAL IMPACT STATEMENT

SWAIN COUNTY, NORTH CAROLINA

January 2004

Existing Conditions Report

North Shore Road Environmental Impact Statement Swain County, North Carolina

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Tables

Figures

Appendices

1. Introduction

1.1 Report Purpose

The purpose of this report is to document the existing conditions of the study area, including the cultural, natural, and human aspects of the environment. Other existing conditions include the transportation network, air quality, ambient noise levels, and hazardous material and waste sites. A summary of this report will be used in the Environmental Impact Statement (EIS). This report will provide the groundwork for developing alternatives and analyzing the anticipated impacts. Data for the report were collected by researching applicable literature and websites, conducting interviews with local authorities and field specialists, reviewing historical information relating to the project, performing site inspections of the study area, and reviewing public comments.

1.2 Study Area Description

Fontana Lake

The study area, shown in Figure 1, is in western North Carolina, in portions of Swain and Graham counties. It extends from just west of Fontana Village to the eastern municipal limits of Bryson City, covering an area of roughly 120,000 acres (48,562 hectares [ha]). Fontana Lake divides the study area into halves to include land south and north of the lake. The southern limits of the study area parallel just south of NC 28 and US 19/US 74 while the northern limits follow an arc that includes the majority of land transferred in the October 8, 1943, Memorandum of Agreement (1943 Agreement). The 1943 Agreement, included in Appendix A, is explained in more detail in Section 1.3 of this report.

In order to provide the full range of study alternatives and thorough analyses that are required by the National Environmental Policy Act (NEPA), the EIS study area covers a large expanse of land. Specifically, the inclusion of land south of Fontana Lake is necessary to evaluate the existing roadway network, the area's transportation needs, and potential access options across Fontana Lake. The inclusion of rural communities such as Lauada, Almond, and Stecoah, as well as Bryson City, to name just a few, provides insight on the local population's economy, demographics, and social values.

1.3 Project Purpose and Need and the 1943 Agreement

The purpose of the proposed action is to discharge and satisfy any obligations on the part of the United States that presently exist as the result of the 1943 Agreement between the United States Department of the Interior (DOI), the Tennessee Valley Authority (TVA), Swain County, North Carolina, and the state of North Carolina. The 1943 Agreement dealt with the creation of Fontana Dam and Reservoir that caused the flooding of lands and roads within Swain County. As part of the Agreement, 44,170 acres (17,875 ha) of land were ultimately transferred to the DOI and made part of Great Smoky Mountains National Park (GSMNP). The 1943 Agreement contained a provision by which the DOI was to construct a road through GSMNP, along the north shore of the newly formed Fontana Lake (generally located between Fontana Dam and Bryson City, North Carolina), to replace the flooded NC 288. The 1943 Agreement also called for the state of North Carolina to construct a road from Bryson City to the GSMNP boundary. This was completed in 1959.

Approximately 7.2 miles (11.5 kilometers [km]) of the originally proposed North Shore Road have been constructed within GSMNP, with the last segment being completed in the 1970s. The need of the project is to determine whether or not it is feasible to complete the road and to evaluate other alternatives that would satisfy the obligation. Both build (i.e., road or other facilities) and no-build alternatives will be developed to determine how the 1943 obligation will be met.

1.4 North Shore Road History

Construction of North Shore Road began in 1947 with roughly 7.2 miles (11.5 km) completed (1 mile [1.6 km] on the Fontana Dam side of GSMNP and 6.2 miles [10 km] on the Bryson City side of GSMNP). Due to environmental concerns and funding issues, the project ended in 1972 after completion of a tunnel on the Bryson City side of GSMNP. Today, the two completed segments of North Shore Road are known as Lake View Road (also known as Lakeview Drive).

In October 2000, Congress budgeted $16 million of U.S. Department of Transportation appropriations to resume construction of the North Shore Road. Because the road would be constructed on federal land with federal money, NEPA required the federal agencies involved in the project – the Federal Highway Administration (FHWA) and the National Park Service (NPS) – to prepare an EIS.

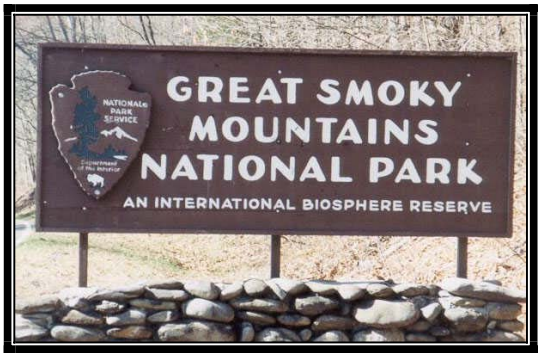
The North Shore Road project has a long and contested history, spanning nearly six decades. Advocates for the road maintain that the government has an obligation to uphold its part of the 1943 Agreement as a matter of principle and credibility. Families that lived along the north shore of the Little Tennessee River prior to the flooding of the river and the transfer of

land to GSMNP, feel that the road would allow access to old home sites and family cemeteries. Other proponents believe the road would provide economic benefits to Swain County in the form of increased tourism. Local and national environmental groups oppose the road because they contend that construction and use of the road would harm both terrestrial and aquatic species. Others support a cash settlement in lieu of the road to boost Swain County's economy.

1.5 Great Smoky Mountains National Park History

The NPS was created on August 15, 1916. Prior to this date, the DOI had been responsible for 14 national parks; however, there was no designated management. In an effort to rectify this, President Woodrow Wilson approved legislation to create the NPS. Today the NPS is responsible for 388 parks (http://www.cr.nps.gov/history_nps.htm 2003).

Although they were not the first to recognize the importance of protecting the southern Appalachians, Mr. and Mrs. Willis P. Davis started the movement in 1923 that ultimately led to the creation of GSMNP ("Great Smoky Mountains, The Story Behind the Scenery" 1998). Congress passed a bill authorizing the establishment of a national park in the Great Smoky Mountains in 1926. The bill gave North Carolina and Tennessee the responsibility of purchasing the land needed for the park (NPS No date). During the 1920s and 1930s, North Carolina and Tennessee purchased approximately 1,100 tracts of private land and on June 15, 1934, GSMNP was designated as a national park (http://www.nps.gov/grsm 2003). Including the lands transferred with the 1943 Agreement, the park totals approximately 521,000 acres (210,842 ha), making it "the largest federally protected upland landmass east of the Mississippi River" (http://data2.itc. nps.gov/nature/index.cfm?alphacode=grsm 2003). The park was recognized by the United Nations as an International Biosphere Reserve in 1976 and as a World Heritage Site in 1983. More information on these designations is included in Section 3.1.1.



GSMNP Sign

In an effort to reduce unemployment during the Depression, the Civilian Conservation Corps (CCC) was created in 1933 as part of President Franklin D. Roosevelt's New Deal programs. The CCC was responsible for conservation, rehabilitation, and construction projects in both the national and state parks. In GSMNP, the CCC had 22 camps (permanent and temporary). From these camps, the CCC built some of the hiking trails and roads, as well as other facilities in

GSMNP. Details on recreational facilities in GSMNP are included in Section 3.4 of this report.

2. Existing Roadway and Traffic Conditions

2.1 Roadway and Trail Conditions

This section summarizes an evaluation of existing roadway and trail conditions within the study area. The primary transportation network between Bryson City and Fontana Dam includes NC 28, US 19, and US 74.

2.1.1 Roadways

2.1.1.1 South of Fontana Lake

The primary east-west roadways south of Fontana Lake are US 19, US 74, and NC 28 as shown on Figure 1. These routes connect various secondary roads to regions outside the study area. The Statewide Planning Branch of the North Carolina Department of Transportation (NCDOT) records the functional classification of US 19 as a "major collector" and both US 74 and NC 28 as "principal arterials."

NC 28

US 19 is a two-lane facility that goes through downtown Bryson City before merging with US 74 southwest of town. The travel lanes are 12 feet (3.6 meters [m]) wide, and the overall pavement condition is fair with moderate to severe transverse cracking and occasional areas of patching. The shoulders are well maintained and range from 4 to 8 feet (1.2 to 2.4 m) wide. Roadside ditches are relatively narrow and often within 4 feet (1.2 m) of the travel lane edge. US 19 does not have control of access. There are a few locations where stopping sight distance may be below current NCDOT roadway design standards due to substandard horizontal or vertical curvature.

Beginning southwest of Bryson City, at the merge point of US 19 and US 74, US 19/US 74 is a four-lane divided facility with a grass median, which transitions to a five-lane undivided section west of the Little Tennessee River. There is no control of access west of the US 19 interchange with US 74 near Mallard Road, although driveways and intersections are

infrequent. The travel lanes are 12 feet (3.6 m) wide, and the overall pavement condition is good with very little transverse cracking. The shoulders and roadside ditches are wide and very well maintained.

Although overall a north-south route, NC 28 runs east-west through the study area. Within the study area, NC 28 was a secondary road prior to being added to the state numbered highway system in two sections in 1951 and 1954. Today, NC 28 merges with US 19/US 74 at the community of Lauada in Swain County and continues to approximately 2.2 miles (3.5 km) southwest of the Little Tennessee River where it diverges from US 19/US 74. It continues west as a divided four-lane highway in Graham County to SR 1231 (Tobacco Branch Road) and then transitions to two lanes. The NCDOT is currently widening NC 28 to a four-lane facility from SR 1231 to its intersection with NC 143 (Transportation Improvement Project (TIP) Number A-9). See Figures 3A and 3B. West of NC 143, NC 28 is an undivided two-lane facility with 12-foot (3.6 m) wide travel lanes. The pavement condition ranges from fair to good. The shoulders are generally narrow and occasionally steep. At some locations vertical rock slopes are within 10 feet (3 m) of the travel lane, steep fill slopes are within the clear recovery zone, and guardrail is absent. The section of NC 28 in Graham County has sharp curves and steep grades.

In the study area, NC 28 extends from US 19/US74 in Swain County to Lake Cheoah in Graham County. There is no record of NC 28 in this area prior to 1947. In 1947, a 16-foot (4.9-m) wide section of roadway was paved from US 19 to just west of Wolf Creek, and in 1951 the paving was extended to just east of Sawyer Creek. In 1954, these two sections of roadway were added to the NC 28 system.

In the period between 1954 and 1963, a number of improvements, which included a significant amount of realignment, were made to NC 28. New sections of NC 28 were built and the existing roadway was improved to a 22-foot roadway.

Between 1963 and 1997, most roadway improvements consisted of resurfacing and maintenance. In 1997, NC 28 was widened to a four-lane divided roadway from US 19/US 74 to just west of the Nantahala River. The widening of NC 28 (from the section that was completed in 1997 to Edwards Gap) to a four-lane, divided section has been underway since 1997. The 25-mile section of NC 28 from Edwards Gap to Fontana is two lanes in width. No historical record could be found for the section of roadway between SR 1245 (Fontana Dam Road) in Graham County and US 129 prior to 1951; however, records show the road existed prior to the early 1950s.

In 1951, the 20-foot paved section of roadway between Lake Cheoah and US 129 was signed as NC 28. In 1954 there was a short section reconstructed on new location and the segment of roadway between SR 1245 and Lake Cheoah was signed as NC 28. In 1965 the 20-foot

section of NC 28 between Lake Cheoah and US 129 was widened to a 24-foot, two lane highway. No major improvements, only general maintenance to include resurfacing, have been made to that section since 1965.

Within the study area, US 19 was constructed sometime prior to 1926 as a winding 12-foot (3.6-m) topsoil road. In 1926, some improvements were made to increase the width and to begin paving sections of the road. By 1941, the majority of US 19 within the study area had been widened to 20 feet and resurfaced with asphalt pavement. Between 1941 and 1956, only general maintenance and resurfacing were performed. In 1956-57, the pavement was widened to 24 feet throughout the study area. From 1957 to 1976, no roadway widening was undertaken within the study area limits of US 19. Only general maintenance and resurfacing were performed.

Between 1976 and 1983, improvements were made from the US 19/US 74 interchange to just east of the Little Tennessee River. During that time the 24-foot, two-lane, road was widened to a four-lane divided facility. In 1990-91, the section of roadway, signed as US 19/US 74/NC 28, was improved from two lanes to a five-lane, undivided roadway from just west of the Little Tennessee River to the NC 28 split.

US 74 between US 441 and the US 19/US 74 interchange was constructed in 1976 as a four-lane, divided facility with 12-foot (3.6-m) lanes. No major improvements have been made to this section of roadway since that time.

2.1.1.2 North of Fontana Lake

SR 1364 (Fontana Road) is a paved two-lane facility that intersects US 19 in Bryson City and extends northwest. The lanes are 11 feet (3.4 m) wide, and the overall pavement condition is good. The NCDOT has resurfaced a section of this roadway from the town limits to SR 1326 (Jordan Road). From Jordan Road to the boundary of GSMNP, the pavement has moderate transverse cracking. The shoulders and roadside ditches are narrow and well maintained.

At the boundary of GSMNP, Fontana Road becomes Lake View Road (also referred to as Lakeview Drive or North Shore Road). The lanes narrow to 10 feet (3 m), and the pavement condition ranges from fair to poor. The roadway is settling in several locations and the pavement surface is oxidized. A few areas have been patched but there are other locations where the asphalt

Terminus of Lake View Road beyond the Tunnel near Bryson City

surface is breaking. The shoulders and roadside ditches are narrow but well maintained. In some locations, ditches are paved adjacent to the travel lanes. In a few instances there are steep, high fill slopes without guardrail. Lake View Road has parking areas where GSMNP visitors can access hiking and horse trails. Immediately west of the parking areas is a tunnel that was completed in 1970. This segment is the last portion of Lake View Road that was constructed.

2.1.2 GSMNP Trails and Old Roadbeds

Within the GSMNP portion of the study area, many old roadbeds, including old railroad beds, built in the early 1900s, still exist. Although some of these old roadbeds have been completely abandoned, several of them, in whole or in part, have been converted to and are maintained as hiking trails (See Figure 2).

Of greatest significance is former route NC 288, which was constructed adjacent to the Tuckasegee and Little Tennessee rivers. NC 288 was a state-maintained gravel surface road that served as the primary access into the area. Much of this old road is now submerged under Fontana Lake; however, some sections are above the lake's high-water level. Most of these sections are now used for Lakeshore Trail. The old roadbed, including shoulders, varies in width up to approximately 30 feet (9 m) with narrow ditches that have become shallow over the years. Along the shoreline of Fontana Lake, the old roadbed has become densely vegetated. However, along the remaining portion of the old roadbed that is used as hiking trails, the gravel surface can still be seen. An occasional tree, greater than 6 inches (0.5 m) in diameter, has grown within the old roadbed.

Historically, several roads ran through the communities located north of the Little Tennessee and Tuckasegee rivers. Today, some of these old roads are used by the NPS as administrative roads for service vehicle access and are generally in fair condition, including Forney Creek Trail and Noland Creek Trail. There are sections of the administrative roads, such as those along Hazel Creek Trail, that are in poor condition due largely to stormwater erosion. These roads are generally 14 to 20 feet (4 to 6 m) wide and have a soil or gravel surface. Typically, bridge widths on these roads can accommodate only one service vehicle at a time.

The remaining roadbeds within GSMNP run primarily north and south following close to the bottom of the valleys. These roadbeds vary in width from 8 to 14 feet (2.4 to 4.0 m) and were constructed parallel to streams, often within 4 feet (1.2 m) of the stream banks. For example, a section of old roadbed along Possum Hollow has vertical stone walls. These roadbeds typically have no ditches or shoulders.

2.1.3 Tunnel and Bridge Conditions

The tunnel on Lake View Road is 30 feet (9.1 m) wide and 1,083 feet (300.1 m) long. The walls of the tunnel have mineral deposit buildup and the infiltration of water has eroded several of the construction joints. Concrete patching has been used to repair areas of joint erosion. The tunnel has never been opened to vehicular traffic; however, visitors commonly walk or ride horses through it. In 2001 both the NCDOT and FHWA inspected the bridges and culverts on the state highway system within the study area. The ratings ranged from fair to good, as detailed in Tables 1 and 2.

Table 1
Primary Bridges and Culverts on State Routes

NCDOT ID No.	County	Route	Year Built	Type	Sufficiency Rating (percentage)	Present Condition	Inspection Date	Est. Life Remaining (years)
370002	Graham	NC 28	1955	Culvert	80	Good	11/15/2001	40
370003	Graham	NC 28	1947	Culvert	99.9	Good	7/18/2001	20
370006	Graham	NC 28	1943	Culvert	99.5	Good	7/18/2001	20
370009	Graham	NC 28	1943	Bridge	66.4	Fair	7/16/2001	16
370138	Graham	NC 28	1952	Pipe	97.6	Good	7/19/2001	20
860008	Swain	US19/74, NC 28	1982	Bridge	95.0	Fair	10/1/2001	32
860009	Swain	NC 28	1988	Bridge	97	Good	10/1/2001	33
860010	Swain	SR 1140	1978	Bridge	95.9	Good`	10/30/2001	26
860011	Swain	US 19/74	1975	Bridge	95.7	Good	10/30/2001	26
860012	Swain	US 19/74	1975	Bridge	93.6	Good	10/30/2001	28
860013	Swain	US 19/74	1976	Bridge	95.5	Good	10/30/2001	26
860014	Swain	US 19/74	1978	Bridge	98.0	Good	11/5/2001	26
860015	Swain	US 19/74	1975	Bridge	97	Good	11/5/2001	22
860016	Swain	US 19/74	1976	Bridge	95.5	Good	10/30/2001	26
860129	Swain	SR 1364	1969	Bridge	76.9	Fair	10/2/2002	20
860148	Swain	SR 1304	1926	Bridge	61.6	Fair	10/24/2001	10
860153	Swain	SR 1323	1969	Bridge	80.6	Fair	10/2/2001	16
860165	Swain	NC 28	1960	Culvert	99.5	Good	9/19/2001	18
860186	Swain	NC 28	1997	Bridge	98	Good	10/1/2001	48
D5G00000099183D	Swain	Reservation Road	1946	Dam	74.2	-----	12/1993	-----

Note: Percentage based on 100% for a new pipe, culvert, bridge, or dam.

Table 2
Structures Within Great Smoky Mountains National Park Study Area

Structure No.	Location	Year Constructed	Year Reconstructed	Condition	Inspection Date	Est. Life Remaining (Yrs)
5460-126S	Bear Creek Trail Bridge No. 1 over Forney Creek	1956	1998	Good	8/10/2001	30-35
5460-127S	Bear Creek Trail Bridge No. 2 over Forney Creek	1959	1983	Fair	8/10/2001	30-35
5460-128S	Bear Creek Trail Bridge No. 3 over Bear Creek	1998	N/A	Good	8/10/2001	30-35
5460-152S	Hazel Creek Trail Bridge No. 1 over Hazel Creek	1987	1992	Fair	3/11/1998	8
5460-153S	Hazel Creek Trail Bridge No. 2 over Hazel Creek	1992	N/A	Good	8/17/2001	35
5460-154S*	Hazel Creek Trail Bridge No. 3 over Hazel Creek	1992	N/A	Good	8/17/2001	35-40
5460-155S	Hazel Creek Trail Bridge No. 4 over Hazel Creek	1992	N/A	Good	8/17/2001	35
5460-156S	Hazel Creek Trail Bridge No. 5 over Hazel Creek	1992	N/A	Good	8/17/2001	35-40
5460-157S	Hazel Creek Trail Bridge No. 6 over Hazel Creek	1992	N/A	Good	8/17/2001	35-40
5460-158S	Hazel Creek Trail Bridge No. 7 over Hazel Creek	1987	1990	Good	8/17/2001	30
5460-159S	Hazel Creek Trail Bridge No. 8 over Bone Valley Creek	1987	1992	Good	8/17/2001	35-40
5460-101P	NPS Route 9A over Noland Creek	1971	N/A	Good	8/8/2001	40-45
5460-131S	Noland Creek Trail Bridge No. 1 over Noland Creek	1948	N/A	Fair	8/10/2001	8
5460-132S	Noland Creek Trail Bridge No. 2 over Noland Creek	1973	N/A	Fair	8/10/2001	8
5460-133S	Noland Creek Trail Bridge No. 3 over Noland Creek	1948	N/A	Poor	8/10/2001	6
5460-134S	Noland Creek Trail Bridge No. 4 over Noland Creek	1943	N/A	Poor	8/10/2001	3
5460-135S	Noland Creek Trail Bridge No. 5 over Noland Creek	1982	N/A	Good	8/8/2001	30-35
5460-136S	Noland Creek Trail Bridge No. 6 over Noland Creek	1948	1987	Fair	8/10/2001	25-30
5460-167S	NPS Rte 9A (Lakeview Drive) through Buzzard Roost Mtn.	1969	N/A	Poor	8/8/2001	10

* This bridge was severely damaged in the May 2003 floods.

2.2 Existing Traffic Conditions

This section provides a summary of the existing traffic conditions within the study area. Included is an assessment of the primary roadway network south and east of Fontana Lake.

2.2.1 System Linkage

2.2.1.1 Road Network

The existing road network services the areas surrounding Fontana Lake and connects Bryson City and various secondary roads to regions outside the study area. As described previously in Section 2.1.1 of this report, the primary east-west roadways in the study area include NC 28, US 19, and US 74.

The 2003 average daily traffic (ADT) volumes for NC 28 range from approximately 230 to 2,100 vehicles per day (vpd) between Deal's Gap and US 19/US 74. The 2003 ADT volumes for US 74 range from approximately 8,600 to 10,200 vpd within the study area, while US 19 ranges from approximately 3,800 to 10,400 vpd from the US 74 interchange through Bryson City.

The posted speed limits along NC 28 between Deal's Gap and the US 19/US 74 intersection range between 20 and 55 miles per hour (30 and 90 kph). The speed limit along US 74 within the study area is constant at 55 miles per hour (90 kph). US 19 from the US 74 interchange through Bryson City has a variable posted speed limit ranging from 20 to 45 miles per hour (30 to 70 kph). Lake View Road from Bryson City into GSMNP has posted speed limits ranging from 20 to 35 miles per hour (30 to 55 kph). Other roads within Bryson City's limits typically have a posted speed limit of 20 miles per hour (30 kph). Roads outside the city limits have speed limits ranging from 20 to 45 miles per hour (30 to 72 kph).

2.2.1.2 Railroads

The Great Smoky Mountains Railroad services the Bryson City region, connecting Dillsboro, Bryson City, and Nantahala. The 53-mile (85-km) line was owned by Norfolk Southern Railroad until 1988, when it was purchased by the State of North Carolina and leased to the Great Smoky Mountains Railroad, Inc. It is now primarily used for passenger travel as a tourist attraction for the area. No other passenger or freight service is available in the study area.

2.2.1.3 Airports

No airports are in the study area. The nearest airport, Macon County Airport, which has one landing strip, is off NC 28 south of the study area. The nearest major airport, Asheville Regional Airport, is roughly 70 miles (112.7 km) northeast of the study area just off Interstate 40 in Buncombe County.

2.2.1.4 Bicycles and Pedestrians

There are no NCDOT-designated bicycle routes within the study area. However, due to the scenery and recreational characteristics of the study area in proximity to the Appalachian National Scenic Trail, the Mountains to Sea Trail, and the Blue Ridge Parkway, cyclists, hikers, and pedestrians are a common sight along some of the roadways within the study area, especially during the summer months. More information concerning biking and hiking trails within GSMNP and the Nantahala National Forest is included in Section 3.4 of this document. Within Bryson City itself, sidewalks and wide roadways serve pedestrian and bicycle traffic. Outside the city limits, all roadways are either two-lane rural highways with minimal shoulders or four-lane freeways, which are not bicycle or pedestrian friendly. No dedicated bicycle lanes are within the study area.

2.2.2 Transportation Plans

2.2.2.1 NCDOT Transportation Improvement Program

Four projects included in the NCDOT *2004-2010 TIP* are within the study area as shown on Figures 3A and 3B. The NCDOT's TIP is the state's plan for all transportation projects, including roadway, bicycle, aviation, and rail. Project B-3701 is a bridge replacement over Alarka Creek on SR 1309 (Lower Alarka Road), and B-3458 is a bridge replacement over Stecoah Creek on SR 1237 (Jenkins Road), both within the study area. These projects are scheduled for construction in the year 2003. Project No. E-4588 is a streetscape enhancement project to Everett Street in Bryson City, which is under construction.

Construction on NC 28, Summer 2003

In addition, the TIP includes Project No. A-9, which consists of a realignment of US 74 from US 19 east of Almond to Andrews, creating a four-lane divided freeway. Project A-9 is segmented into 10 smaller projects. Project Nos. A-9

DA through DD are within the study area and follow NC 28 from US 19 to Stecoah. Project Nos. A-9 DA through DC are complete and A-9 DD is currently under construction, predicted to be complete by the end of year 2003.

2.2.2.2 Thoroughfare Plan

A thoroughfare plan documents the long-range transportation planning efforts for a particular region. The *Thoroughfare Plan Technical Report for Graham County and Robbinsville*, November 1998, and the *Thoroughfare Plan for Bryson City*, March 1993, pertain to the study area. These suggested improvements are also shown on Figures 3A and 3B. While the study area is not part of a metropolitan planning organization, it may become part of a future rural planning organization. However, Swain and Graham counties are members of the Appalachian Regional Commission (ARC), a regional planning organization that includes planning for physical infrastructure.

The *Thoroughfare Plan Technical Report for Graham County and Robbinsville* recommends improvements for two roadway facilities. The first improvement involves relocation of US 74 as a four-lane divided facility in Swain County (partially following NC 28) south of Robbinsville to Cherokee County. It is suggested that this improvement may bring economic growth to Graham County. This project is listed as TIP A-9, as described previously in Section 2.2.2.1 of this report. The second recommendation is to upgrade existing NC 28 between Stecoah and Fontana Village to current standards.

The *Thoroughfare Plan for Bryson City* recommends numerous improvements to the roadway system throughout the city. Many of these recommendations are based on traffic demands during the summer tourist months. One recommendation is to construct a frontage road parallel to US 74 from SR 1160 (Wade Crain Road), across SR 1159 (Veterans Memorial Highway), on to SR 1158 (Arlington Avenue) to reduce traffic volumes on US 19 through Bryson City. Another recommendation is to realign SR 1336 (Depot Street) to tie into SR 1321 (Gibson Street), which would move Depot Street farther away from the railroad crossing and eliminate the unfavorable offset intersection condition. The plan also suggests widening US 19 and SR 1364 (Everett Street) to three or four lanes for additional capacity, allowing storage for turning vehicles. The roads recommended for improvement are all NCDOT-maintained roadways; however, they are not currently listed in the TIP for future enhancement.

2.2.3 Historic Traffic Growth

Based on NCDOT ADT maps for the years of 1995, 1999, 2000, and 2001, an annual traffic growth rate of 1.9 percent was calculated for the major routes in the study area. This growth

rate is also consistent with the annual increase used by NCDOT in the TIP Project No. A-9 traffic forecast (April 1996).

2.2.4 2003 Traffic Surveys

Traffic turning movement counts were performed at six major study area intersections, with 24-hour data collected for seven days at six primary mainline routes. The traffic surveys were conducted at the end of March 2003, with additional counts conducted in August 2003 during the peak tourist season to determine traffic volumes in the project study area. Seasonal multiplication factors (provided by the NCDOT's Traffic Survey Unit) were applied to predict peak traffic volumes to appropriately adjust the March 2003 data and determine the worst-case traffic scenario. Figure 4A depicts the intersection locations of the traffic surveys and Figure 4B shows adjusted turning movement volumes used for analysis.

Traffic turning movement counts were conducted at the following intersections:

- SR 1364 (Everett Street/Fontana Road) and SR 1336 (Depot Street) – Four-leg intersection at the base of Fontana Road in Bryson City, North Carolina.
- SR 1364 (Everett Street) and US 19 (Main Street) – Four-leg intersection in the heart of Bryson City, North Carolina.
- NC 28 and US 19/US 74 (East) – Three-leg intersection where NC 28 ties into US 19/ US 74 in Lauada, North Carolina.
- NC 28 and US 19/US 74 (West) – Three-leg intersection where NC 28 splits off from US 19/ US 74 near Almond, North Carolina.
- NC 28 and NC 143 – Three-leg intersection. NC 143 leads toward Robbinsville, North Carolina.
- NC 28 and SR 1246 (Welch Road) – Three-leg intersection at the entrance to Fontana Village, North Carolina, west of Fontana Lake.

Traffic counts were taken for the following study area roadways to collect 24-hour data:

- SR 1364 (Fontana Road/Everett Street) – a two-lane rural road that extends from Bryson City, North Carolina, into GSMNP. (930 Raw ADT, 1,110 Adjusted ADT)
- US 19, east of Bryson City – a two-lane, minor collector that gives access to and from Bryson City, North Carolina, to the east. (6,940 Raw ADT, 8,335 Adjusted ADT)

- US 19, west of Bryson City – a two-lane, minor collector that gives access to and from Bryson City, North Carolina, to the west. (8,855 Raw ADT, 10,640 Adjusted ADT)
- SR 1309 (Lower Alarka Road) at US 19/74 Interchange – a two-lane secondary collector road that connects a number of other secondary roads with US 19. (1,235 Raw ADT, 1,485 Adjusted ADT)
- SR 1159 (Veterans Boulevard) – an undivided, four-lane, minor collector that directly connects Bryson City, North Carolina, to US 74 to the south. (7,470 Raw ADT, 8,970 Adjusted ADT)
- NC 28, near Fontana Dam – a two-lane, minor collector that connects Tennessee and Fontana Village to Bryson City, North Carolina, and US 19/US 74. (370 Raw ADT, 780 Adjusted ADT)

2.2.5 Roadway Capacity

A capacity analysis was completed to determine the impact of the region's transportation demand on the study area's existing transportation network. Analyses were conducted for the current year 2003 using adjusted traffic volumes.

Level of service (LOS) is a qualitative measure used to describe the operating conditions of a roadway. The *Highway Capacity Manual* (Transportation Research Board 2000) generally describes level of service in terms of factors such as speed, travel time, freedom to maneuver, traffic interruptions, driver comfort and convenience, and safety. Level of service is represented by a ranking letter from "A" to "F," with "A" representing free flow conditions, and "F" representing traffic breakdown conditions. Levels of service are described as follows:

Level of Service A

- Vehicles move in free-flow traffic conditions to select their desired speed.
- Motorists have great maneuverability with the traffic stream.
- The general level of travel comfort and convenience is excellent.

Level of Service B

- Vehicles move in stable-flow conditions.
- Motorists' operating speeds are somewhat affected by other vehicles.
- Motorists experience a slight decline in the freedom to maneuver within the traffic stream.

Level of Service C

- Vehicles move in stable-flow traffic conditions.
- Motorists' operating speeds and maneuverability are substantially affected by other vehicles.
- The general level of comfort and convenience declines noticeably.

Level of Service D

- The stable traffic flow begins to become unstable due to a higher density of vehicles.
- Travel speeds and freedom to maneuver are severely restricted.
- The general level of comfort and convenience is poor.
- Operational problems occur with small increases in traffic volumes.

Level of Service E

- Vehicles move in unstable-flow traffic conditions.
- Speeds are uniformly reduced.
- Traffic volumes are at or approaching the roadway's capacity level.
- Motorists' freedom to maneuver within the traffic stream is extremely constrained.
- The general level of travel comfort and convenience is extremely poor.
- Breakdowns in the transportation system are caused by small increases in traffic volume.

Level of Service F

- Vehicles move in forced-flow (stop and go) traffic conditions.
- Traffic volumes exceed the roadway capacity level.
- Hazardous queues develop.
- Traffic congestion causes traffic to be stopped for long periods of time.

Operational capacity analyses, which determine the LOS of facilities, were conducted for existing US 74, US 19, NC 28, and Fontana Road utilizing *Synchro 5.0*, the *Highway Capacity Software Version 4.1* (FHWA 2000*),* and methodologies provided in the *Highway Capacity Manual* (HCM) (Transportation Research Board 2000*)*. Capacity is defined in the HCM as, "the maximum number of vehicles that can pass a given point during a specified

period under prevailing roadway, traffic, and control conditions." Level of Service for a signalized intersection is based on the overall delay associated with all vehicle movements passing through an intersection. For unsignalized intersections, LOS is assigned to each impeded movement through the intersection based on individual delay, while unimpeded vehicles are considered to be free-flowing and experience no delay.

2.2.5.1 Intersection Conditions

The study area intersection locations and the adjusted peak-hour traffic volumes for base year 2003 that were used for analysis are shown in Figures 4A and 4B. Traffic volumes were analyzed to determine the current LOS in the study area, based on existing lane configurations. The LOS for the selected unsignalized and signalized intersections are listed in Tables 3 and 4, respectively. The majority of intersections along US 74 and NC 28 operate at acceptable capacities, while intersections within Bryson City (such as Everett Street with Depot Street) can approach or operate at unacceptable capacity during peak hours throughout tourist season.

The unsignalized intersection of Everett Street and Depot Street within Bryson City operates at an unacceptable LOS during the p.m. peak-traffic hour. This is primarily due to the number of left-turning vehicles, coming from northeast Bryson City, on westbound Depot Street that must stop and wait for a pause in the Everett Street traffic. Since there are only single-lane approaches to this intersection (on all four legs), the number of traffic gaps available for turning movements is minimal. Furthermore, each stopped vehicle impedes all other movements on that leg, which can cause significant queues.

The LOS of the signalized intersection of US 19 and Veterans Boulevard was also found to deteriorate during the p.m. peak hour. This deficiency is due to the relatively large numbers of westbound and southbound left-turn movements, sharing lanes with through moving vehicles, under a two-phase signal control. Traffic counts performed in 1999 by NCDOT were available for this intersection's analysis, making it possible to use the 2 percent annual growth factor and NCDOT's seasonal multiplication factors to obtain peak traffic volumes associated with the summer tourist season.

Table 3

Intersection Level of Service – Unsignalized
(Year 2003)

Unsignalized Intersection	A.M. LOS	A.M. Delay (seconds)	P.M. LOS	P.M. Delay (seconds)
Everett Street and Depot Street	C		E	
SR 1364 – NB Left-Through-Right		7.8		7.9
SR 1364 – SB Left-Through-Right		8.		8.8
SR 1336 – WB Left-Through-Right		21.6		48.0
SR 1336 – EB Left-Through-Right		13.0		15.0
US 19/US 74 and NC 28 (East)	B		B	
US 19/US 74 – WB Left		8.4		8.3
NC 28 – NB Left-Right		10.7		10.3
US 19/US 74 and NC 28 (West)	C		C	
US 19/US 74 – EB Left		8.1		8.5
NC 28 – SB Left		16.0		17.3
NC 28 – SB Right		9.9		10.2
NC 28 and NC 143	B		B	
NC 28 – WB Through-Left		7.9		7.7
NC 143 – NB Left		12.9		13.3
NC 143 – NB Right		9.5		9.5
NC 28 and SR 1246 at Fontana Village	A		A	
NC 28 – WB Through-Left		7.3		7.4
SR 1246 – NB Left-Right		8.7		8.7

Table 4

Intersection Level of Service – Signalized
(Year 2003)

Signalized Intersection	A.M. LOS	A.M. Delay (seconds)	P.M. LOS	P.M. Delay (seconds)
US 19 and Veterans Boulevard (Based on 1999 counts)	B	12.0	C	21.3
US 19 and Everett Street	A	14.1	B	15.3

2.2.5.2 Corridor Conditions

Mainline LOS for the major roadways analyzed are listed in Table 5. Four of the five mainlines examined appear to operate at acceptable levels of service under current roadway conditions. The majority of the roadways within the study area are found to have an acceptable LOS due to low volumes of traffic, even during the area's peak tourism season. While most of the roadways studied operate at LOS A, SR 1364 (Fontana Road) from Bryson City to GSMNP appears to operate closer to capacity at a LOS C. This is likely due to a combination of steep grade and lack of passing zones. US 19 operates at LOS E through Bryson City, from the US 74 interchange to SR 1168 (Walker Woody Road), due to relatively heavy traffic volumes, and a large number of access points.

Table 5
Mainline Levels of Service (2003)

Mainline Roadway	Road Type	LOS During Peak
SR 1364 (Fontana Road)	2-lane undivided	C
US 19 from Bryson City to SR 1168 (Walker Woody Road)	2-lane undivided	E
US 19 from US 74 interchange to Bryson City	2-lane undivided	E
US 74 from NC 28 intersection to SR 1190 interchange	4-lane divided	A
NC 28 from Almond to Stecoah	4-lane divided	A
NC 28 from Stecoah to Fontana Village	2-lane undivided	A

2.2.6 Speed Study

A speed study was conducted on the main routes examined in the study area using machine counters (JAMAR TRAX Traffic Counting Units) in April, July, and August 2003. Table 6 lists the sections studied and the average calculated speed along those roadways versus the posted speed limits. The average traveling speeds along routes US 19, NC 28, SR 1159 (Veterans Boulevard), and SR 1364 (Fontana Road) were relatively close to the posted speed limits during the March 2003 data collection. This indicates that, on average, there are likely no substantial delays along these routes that impede traffic flows. However, observed travel speeds are typically higher than posted speed limits under normal conditions. This may not be the case for the roadways within the study area due to the horizontal and vertical curvature, which does not allow for safe maneuvering at higher speeds.

Table 6
Speed Study (2003)

Mainline Roadway	Lane Configuration	Actual Posted Speed Limit	Average Measured Speed Limit
US 19, east of Bryson City	2-lane undivided	35 mph (55 kph)	34 mph (54 kph)
US 19, west of Bryson City	2-lane undivided	35 mph (55 kph)	37 mph (60 kph)
Veterans Boulevard (SR 1159) between Main Street (US 19) and US 74 interchange	4-lane undivided	35 mph (55 kph)	36 mph (58 khp)
NC 28 near Fontana Dam, east of Fontana Village	2-lane undivided	45 mph (72 kph)	43 mph (69 kph)
Fontana Road (SR 1364) south of park entrance	2-lane undivided	45 mph (72 kph)	47 mph (76 kph)

2.3 Accident Analysis

Accident data were obtained from the Traffic Engineering Branch of the NCDOT for the study area. The data include 10 intersections along NC 28, US 19, US 74, and Fontana Road listed in Table 7. Data were also collected for the four mainline sections of roadway shown in Table 8. The data represent all reported accidents occurring within a three-year period from the fall of 1999 through the fall of 2002. These data provide the number of accidents at a specified location and the particular type of accident. While the main focus is on the study area's primary east-west route, other primary and secondary roadways in the study area were also examined for a local comparison. Since the study area is relatively large, not all of the accident data obtained are included in this report, only that data found to be applicable.

During the three-year period, 76 accidents were reported at the 10 main intersections and 208 accidents were reported along approximately 54.6 miles (88 km) of primary mainline sections, between intersections, within the study area. Rear-end accidents are the most common accident type for intersections, while vehicles driving off the road were most common along the mainline sections. Rear-end accidents typically occur where unexpected traffic queues force sudden stops, at signalized intersections during signal phase changes, and when drivers are distracted. They are also indicative of congestion and driver frustration. Vehicles tend to drive off the road when either there is an object in the roadway or the driver is distracted.

Table 7

Intersection Accident Data

(Fall 1999 through Fall 2002)

Intersection	Total Number of Crashes	Number of Vehicles Involved	Number of Deaths	Type of Accident (Percentage of Total Accidents)						Motorcycles
				Angle	Rear End	Animal	Left Turn	Off Road	Other	
US 74 and SR 1190 interchange	8	11	---	---	---	---	3 38%	5 62%	---	---
US 19 and SR 1168	9	17	---	2 22%	1 11%	---	5 56%	---	1 11%	---
US 19 and Everette Street (SR 1364)	13	25	---	1 8%	8 61%	---	3 23`%	1 8%	---	1 4%
US 19 and Main Street	5	10	---	1 20%	1 20%	---	1 20%	1 20%	1 20%	---
US 19 and Slope Street (SR 1323)	17	34	1	6 35%	7 41%	---	---	1 6%	3 18%	---
US 19 and US 74 interchange	7	9	---	---	1 14%	---	1 14%	5 72%	---	---
US 19/US 74 and NC 28 East	2	4	---	2 100%	---	---	---	---	---	---
US 19/US 74 and NC 28 West	4	9	---	1 25%	2 50%	---	---	---	1 25%	5 56%
NC 28 and NC 143	4	7	---	1 25%	2 50%	---	---	1 25%	---	---
Everette Street and Depot Street	7	15	---	3 43%	3 43%	---	1 14%	---	---	---
Total	76	141	1	17 22%	25 33%	0 0%	14 18%	14 18%	6 8%	6 4%

Note: Intersections not shown here had fewer than 2 crashes reported for that intersection during the 3-year study period.

Table 8

Mainline Accident Data
(Fall 1999 through Fall 2002)

Mainline Roadways (Excluding Intersections)	Number of Miles (km)	Total Number of Accidents	Number of Vehicles	Number of Deaths	Type of Accident (Percentage of Total Accidents)						Motorcycles (Percentage of total vehicles)
					Angle	Rear End	Animal	Left Turn	Off Road	Other	
US 74 from NC 28 West intersection near Almond to SR 1190 interchange	11.8 (19)	40	52	1	4 (10%)	2 (5%)	5 (13%)	1 (3%)	25 (63%)	3 (8%)	1 (2%)
US 19 from US 74 interchange to Ela, North Carolina	7.6 (12)	73	156	1	10 (14%)	27 (37%)	1 (1%)	12 (16%)	15 (21%)	8 (11%)	7 (4%)
NC 28 from US 19/US 74 intersection to US 129 intersection	32.2 (52)	92	131	4	6 (7%)	14 (15%)	1 (1%)	4 (4%)	33 (36%)	34 (37%)	41 (31%)
Fontana Road/Everette Street	3.0 (5)	3	6	0	0 (0%)	0 (0%)	0 (0%)	2 (67%)	0 (0%)	1 (33%)	0 (0%)
Total	54.6 (88)	208	345	6	20 (10%)	43 (21%)	7 (3%)	19 (9%)	73 (35%)	46 (22%)	49 (14%)

A relatively large amount of motorcycle traffic is in the study area during the summer and fall months. The region is likely very popular with motorcyclists because of the scenic views and curved roadways. Motorcycle racing has been reported along NC 28 between NC 143 and US 129 in Deals Gap. This activity has contributed to a high probability for motorcycle accidents. Roughly 14 percent of mainline roadway accidents involved motorcycles. According to local law enforcement officials, a large portion of racing accidents go unreported.

An accident rate is one measure of the relative safety of a roadway or intersection, indicating signs of capacity or safety deficiencies. Accident rates at intersections are calculated from the ADT entering the intersection and the number of recorded accidents within the proximity of that intersection. Accident rates for mainline sections of roadways are calculated from the ADT and the number of reported accidents along the studied roadway. North Carolina uses an accident rate of number of accidents per 100 million vehicle miles (161 million vehicle km) for roadways, and likewise accident rates for intersections are represented as number of accidents per 100 million vehicles entering an intersection. Average state accident rates for North Carolina roadways for the years 1999 through 2001 were obtained from the Traffic Safety Systems Management Unit of the Traffic Engineering and Safety Systems Branch at NCDOT. Average rates for intersections are not provided by NCDOT because of the numerous combinations of roadway types, geometric layouts, and sign/signal control at intersections.

Facilities with full control of access tend to have lower accident rates as compared to those that do not. Full control of access eliminates access to adjacent properties and avoids driveways that introduce conflicts caused by vehicles turning into the traffic stream. US 74 has control of access east of its interchange with US 19, near Mallard Road. Its accident rate of 40.62 is well below the average state rate of 126.75, as shown in Table 9. This rate is actually closer to the North Carolina accident rate for a Rural Interstate Highway.

US 19 has an accident rate of 230.94 accidents per 100 million vehicle miles (161 million vehicle km) as compared to the state average of 126.75 for rural US routes. This can be attributed to a number of factors. US 19 currently serves as the main thoroughfare through downtown Bryson City; all but a few of the intersections are currently unsignalized; and the number of vehicles in Bryson City practically doubles in the summer from that of the winter months, due to tourism. The majority of these drivers are unfamiliar with the area. Especially during the summer tourist season, the volume of traffic along portions of US 19 either approaches or exceeds its capacity.

Table 9
Corridor Accident Rates
Crashes per 100 Million Vehicle Miles (100 Million Vehicle km)
(Fall 1999 through Fall 2002)

Mainline Roadways (Including Intersections)	Number of Miles (km)	Number of Accidents	AADT (vpd)	Accident Rate per 100 million Miles (km)	NCDOT Accident Rates*
US 74 from NC 28 West intersection near Almond to SR 1190 interchange	11.8 (19)	42	8,003	40.62 (25.23)	126.75
US 19 from US 74 interchange to Ela, North Carolina	7.6 (12)	123	6,400	230.94 (143.44)	126.75
NC 28 from US 19/US 74 intersection to US 129 intersection	32.2 (52)	97	1,076	255.68 (150.80)	176.22
Fontana Road/Everette Street	3.0 (5)	40	3,650	333.60 (207.21)	335.16

*NCDOT Average Accident Rates for similar roadway types.

The accident rate for NC 28, at 255.68 accidents per 100 million vehicle miles (161 million vehicle km), is approximately 45 percent higher than the North Carolina average, which is listed at 176.22 for rural NC routes. This difference is most likely due to the mountainous terrain and the geometry of the road. It may also be a factor of the motorcycle racing mentioned previously.

The intersections with the highest accident rates (134.37 and 131.75 accidents per 100 million vehicles entering the intersection) were US 19 at SR 1168 (Walker Woody Road) and SR 1323 (Slope Street), respectively, within Bryson City. Neither of these intersections is currently signalized, but both experience high volumes of traffic relative to the number of lanes. A summary of accident rates for the study area intersections is listed in Table 10.

Table 10
Intersection Accident Rates
Accidents per 100 Million Vehicles Entering Intersection
(Fall 1999 through Fall 2002)

Intersection	Number of Accidents	Daily Intersection Volume (vpd)	Accident Rate
US 74 and SR 1190 interchange	8	9,500	76.90
US 19 and SR 1168	9	6,117	134.37
US 19 and Everette Street (SR 1364)	13	13,975	84.95
US 19 and Main Street	5	13,958	32.71
US 19 and Slope Street (SR 1323)	17	11,783	131.75
US 19 and US 74 interchange	7	11,092	57.64
US 19/US 74 and NC 28 East	2	8,250	22.14
Us 19/US 74 and NC 28 West	4	7,717	47.34
NC 28 and NC 143	4	2,883	126.69
Everette Street and Depot Street	7	6,825	93.67

2.3.1 Conclusion

Meetings held with the NCDOT Division Traffic Engineer, Scott E. Cook, Graham County Sheriff Bob DeBruhl, and Swain County Sheriff Bob Ogle reflect the results obtained in this analysis. Traffic within the study area appears to be adequately accommodated by the existing roadway system, even during the peak traffic volume months of July and August. Areas of moderate congestion occur during the summer months within Bryson City, and there are a few areas with capacity deficiencies. NCDOT representatives and both sheriffs expressed concern over the amount of motorcycle traffic on NC 28 between US 19/US 74 and Deals Gap. There are relatively low volumes of traffic within the study area, even during the peak summer months, with no apparent areas of significant congestion.

3. Existing Environmental Conditions

The study area is within the planning jurisdictions of Swain County, Bryson City, and Graham County. The TVA has jurisdiction over the land around Fontana Lake below 1,710 feet (521.2 m) in elevation from mean sea level (msl). The NPS has authority over GSMNP, while the United States Forest Service (USFS) has jurisdiction over Nantahala National Forest lands within the study area. The municipal limits of Bryson City, the boundaries of GSMNP and the Nantahala National Forest, areas of TVA authority, and the county boundaries are illustrated in Figure 5.

3.1 Land Use (Existing and Future)

3.1.1 Great Smoky Mountains National Park

GSMNP encompasses approximately 800 square miles (2,071.99 km^2) in Swain and Haywood counties in North Carolina, and Blount, Sevier, and Cocke counties in Tennessee (www.gsmnp.com 2003). The study area encompasses 56,196.25 acres (22,741.85 ha) within GSMNP. Virtually all parklands within the study area are forested. Land surrounding the park is primarily forested foothills and mountains, and nearly all cultivatable land is farmed. According to the GSMNP General Management Plan (GMP), "Land use before 1880 was predominantly agricultural. When commercial logging interests moved into the region, tourists, and tourist-related development began to replace traditional farms. Resort communities, second homes, and recreational facilities were developed on lands bordering the park" (NPS 1982).

GSMNP is one of approximately 29 NPS units within the United States designated by the United Nations Educational, Scientific, and Cultural Organization (UNESCO) as an "International Biosphere Reserve." UNESCO describes Biosphere Reserves as "areas of terrestrial and coastal ecosystems promoting solutions to reconcile the conservation of biodiversity with its sustainable use." They are internationally recognized, nominated by national governments and remain under sovereign jurisdiction of the states where they are located (www.unesco.org/mab 2003). The designation was launched in 1968 when the "Man and the Biosphere Programme" was organized within UNESCO to "strike a balance between the conflicting goals of conserving biodiversity, promoting economic and social development, and maintaining associated cultural values" (http://usparks.about.com. 2003).

GSMNP is one of 20 World Heritage Sites within the United States. The World Heritage program is part of the International Council on Monuments and Sites (ICOMOS) of UNESCO. The ICOMOS was established in 1965 as an international non-governmental organization of professionals dedicated to the conservation of the world's historic monuments and sites. In the United States, the NPS serves as director for the natural and cultural heritage

of the nation. GSMNP was designated based on its natural heritage criteria as seen in its 1983 inscription:

> *"The Great Smoky Mountains National Park protects one of the world's finest temperate deciduous forests and is a reminder of the tree-rich landscape of pre-Columbian America. Due to the fertile soil and abundant rain, this area boasts 1,520 flower species, 130 varieties of trees, 50 mammal species and 27* [now 30] *different kinds of salamanders. The plants are related to those found across the Pacific, testifying to the ancient migration of trees and flowers from Asia by way of the Bering land bridge. The Smokies also represent an important period in the earth's development when 300 million years ago, supercontinents collided and the earth's crust pushed upward forming high, jagged mountains. Over the course of time these mountains have been smoothed and softened by erosion. The geographical evidence, biological evolution and diversity make this park a superlative natural preserve* (NPS 2003a)*."*

The GSMNP GMP was published in 1982. The plan was developed with a 10- to 15-year planning horizon, although it is still used to meet the objectives and intentions established for GSMNP, which are to preserve the exceptionally diverse resources found in the park and to provide for public benefit from and enjoyment of them, without altering those resources (GMP 1982). The plan functions as a management guide for meeting these objectives. The plan designates management zones to indicate appropriate uses, activities, and management actions for the park. The GMP's Proposed Management Zoning Map is included as Figure 6.

Within the study area, the "Development" management zone includes a linear corridor along Lake View Road and a polygon around the Fontana Dam Area. The "Development Zone" was established for areas with access roads, parking, interpretive facilities, camping, picnic grounds, buildings, and utility systems, as well as parking areas and storage facilities for park operation and maintenance activities. Within the development management zone, these areas are considered part of the "Transportation Subzone," which is a classification for public road corridors. The "General Park Development Subzone" classification consists of picnic areas, camping areas, lodging areas, interpretive centers, major parking areas, park operational and maintenance facilities, and staff housing. A small polygon west of Forney Creek and north of Lake View Road has been given this designation. General development within the portion of the park in the study area includes the Tunnel Area (at the end of Lake View Road within GSMNP) as the future site of a picnic area (not to exceed 100 sites), an interpretive trail, and comfort stations (with water and sewer [septic tank] systems) for day use.

"Natural" management zones encompass the natural resource areas of the park, which is the predominant designation for the majority of the management zone areas. Within the study area, there are two locations classified as "Natural Environment Type II Subzone." This

subzone is designated for small tracts inside the park boundary and tracts adjacent to development zones that are established for developed uses or require mechanized equipment for entry, such as cemetery and utility access roads, stables, and paved or heavily used trails. Two such areas are a linear corridor that extends north from Lake View Road following Noland Creek that travels to Upper and Lower Noland Cemeteries, and an area along the backwaters of the Hazel Creek arm of Fontana Lake in the former town of Proctor that is home to Proctor and Bradshaw cemeteries.

A large tract of land within GSMNP (44,170 acres [17,875 ha]), and almost completely within the study area boundary, was transferred to the NPS from the TVA in 1949. This tract is also part of a larger area (425,384 acres [172,147 ha]) that has been recommended by the NPS for designation as a "Wilderness" area. The 44,170-acre (17,875-ha) tract is considered a "Reserved Rights Subzone" within the "Special Use" management zone. Rights-of-way, water rights, burial rights, and other reserved rights limit NPS jurisdiction and management of this area. However, NPS maintains this area as if it were part of the "Natural" management zone to the fullest extent possible (GMP 1982).

3.1.2 Nantahala National Forest

The southern portion of the study area includes parts of Nantahala National Forest, one of four national forests in North Carolina. Nantahala, which means "land of the noon day sun," has over half a million acres (202,343 ha) in its jurisdiction and approximately 19,294 acres (7,808 ha) are in the study area. The study area in Nantahala National Forest is part of the Cheoah Ranger District, which is comprised of 120,500 acres (48,765 ha) in Graham and Swain counties.

The USFS developed a Land and Resource Management Plan (1986-2000) for Nantahala and Pisgah national forests. The plan guides natural resource management activities and establishes management standards for the two national forests. It describes care and protection of the land, resource management practices, outputs of goods and services, and the availability and suitability of lands for various uses for the period from 1986 to 2000 (USDA 1987).

The plan describes the desired conditions for which the forest will be managed. They include:

- Provide a forest environment for the public to enjoy while complying with laws, regulations, and procedures established for the administration of National Forest Service (NFS) lands;

- Provide public goods and services that satisfy short-term demands while improving program efficiency and long-term health of the forest environment;
- Administer the forests to fulfill public needs and desires by meeting management standards established by the Regional Guide for the South;
- Maintain or improve water quality through appropriate management standards;
- Maintain or increase populations of all existing native vertebrates; and
- Maintain the unique character of special interest and specially designated areas, including Wilderness, research natural areas, developed recreation and scenic areas, Native American religious sites, and significant cultural resources (USFS 1987).

The plan describes land acquisition guidelines for the forests. It states, "Land is acquired through purchase, exchange, or donation to provide protection within wilderness and along the Appalachian National Scenic Trail, provide recreation management opportunities, and to consolidate public ownership for efficient administration." In general, land is purchased or donated from willing constituents. According to the plan, approximately 900 acres (364 ha) are purchased each year and 400 acres (162 ha) are acquired through exchange. For future growth, the plan dictates approximately 800 acres (324 ha) per year are planned for purchase and about 400 acres (162 ha) will be acquired through exchange (USFS 1987).

Within the study area portion of Nantahala National Forest, there are two special day use areas. The Tsali Recreation Area is located near the Panther Creek, Murphy Branch, Town Branch, Mouse Branch, and Meadow Branch arms of the backwaters of Fontana Lake, north of NC 28. Tsali is nationally known for its 42-mile (68-km) trail system. The four-loop network is open to hikers and horses, but the system is best known as a challenging mountain bike course. The area has a 42-site campground with accessible showers and restrooms, a boat ramp, fishing areas, and picnic areas (USFS 2003). The Cable Cove Recreation Area is located near the Powell Branch arm of the backwaters of Fontana Lake, north of NC 28 and four miles (6.4 km) from Fontana Dam. This area offers boating access, camping facilities (26 sites), and hiking trails (USFS 2003).

There are pockets of privately owned land within Nantahala National Forest. They make up roughly 30,016 acres (12,147 ha) within the study area. These areas are mostly developed for residential or agricultural use where the land is tillable. There is a wide network of NFS roads within the study area constructed to support forest management and logging operations.

3.1.3 Swain County

Swain County was first settled by Native Americans. Soon after the Cherokee Indian cession of 1798, European settlement began along the Oconaluftee and Tuckasegee rivers. In 1871, Swain became a North Carolina county, taking land from Jackson and Macon counties.

The majority of the study area is within Swain County. GSMNP and Nantahala National Forest encompass roughly 69 percent of Swain County. Because of the rural conditions and the high percentage of land not under the jurisdiction of Swain County, no land use or zoning regulations are in place for the county. According to county personnel, residents are hesitant to plan land use or impose zoning regulations in an area with so much land under federal jurisdiction.

The eastern portion of the study area includes Bryson City, Swain County's largest city. The majority of development in Swain County occurs along major roads and highways such as US 19, US74, and NC 28. Small communities in the Swain County portion of the study area in the vicinity of Bryson City include Franklin Grove, School House Hill, Deep Creek, and Lackey Hill. Development is predominantly residential and is constrained by topography and the provision of public utilities.

3.1.4 Graham County

The southern portion of the study area is in Graham County, which was formed in 1872 from parts of Cherokee County. The town of Robbinsville, outside the study area, is the county seat.

Currently, there are no land use plans or regulations in effect for Graham County. There is no zoning within the portions of the study area in Graham County. More than half of Graham County (59 percent) is under the jurisdiction of Nantahala National Forest.

Small communities in the Graham County portion of the study area include Fontana Village, Tuskegee, Stecoah, Hidetown, Almond, Roundhill, Carson Mill, Maple Springs, Lauada, De Hart Mill, and Jackson Line.

3.1.5 Bryson City

Bryson City, originally called "Charleston" by European settlers, is the Swain County seat and was founded in 1887. It is along the Tuckasegee River at the base of the Cowee Mountain Range. According to *A Visitors Guide to Swain County and the Great Smoky Mountains*, by the Swain County Chamber of Commerce, Bryson City is "a quiet, restful

getaway . . . in a beautiful natural setting, an unspoiled retreat" (Swain County websites 2003).

Bryson City, like Swain and Graham counties, does not have planning documents to guide land use and development. Land use in downtown Bryson City is predominantly commercial business mixed with some residential development. Land use surrounding Bryson City is predominantly scattered large-lot residential development. Most development is situated linearly along the highway and main roads on non-federal lands.

Downtown Bryson City

US 19 and US 74 traverse Bryson City. The main roads in Bryson City include the north-south Veterans Boulevard, which turns into Slope Street through downtown Bryson City and into Franklin Grove Church Road north of town. Old NC 288, Bryson Walk, Depot Street, Locust Street, and Old River Road follow the Tuckasegee River through downtown Bryson City. Fontana Road begins as Rector Street in downtown Bryson City and becomes Everett Street to the north. At the GSMNP boundary, Fontana Road becomes Lake View Road, known locally as "The Road to Nowhere." It extends approximately 7.2 miles (11.6 km) into GSMNP, ending at the mouth of the tunnel.

As previously states, communities in the vicinity of Bryson City include Lackey Hill, School House Hill, Deep Creek, and Franklin Grove. All are residential areas. Lackey Hill includes the West Care Medical Park, and the Franklin Grove Church is central to the Franklin Grove community. School House Hill is home to the Grace Christian Academy and Swain County Middle School. Deep Creek is a residential community along Deep Creek just north of Lackey Hill.

The NCDOT *Thoroughfare Plan for Bryson City*, March 1993, indicates, "Future development is likely to occur west of town along US 19, due to favorable water and sewer conditions, reasonable accessibility, and topographic advantages. There is also some potential for redevelopment and infill in the central part of town. Significant portions of the land north of the Tuckasegee River are either inappropriately or inadequately utilized" (NCDOT 1993).

3.1.6 Tennessee Valley Authority

The inception of the TVA came during the presidency of Franklin D. Roosevelt. President Roosevelt proposed the TVA to help spur economic development by bringing affordable power to the region. Congress passed the TVA Act on May 18, 1933. The TVA was charged with many tasks, including conservation, public utility regulation, regional planning, agricultural development, and the social and economic improvement of the people of the Tennessee Valley (www.newdeal.feri.org 2003). Construction of the Fontana Dam started on January 1, 1942, and Fontana Lake was created in 1944.

The most dramatic change in valley life came from the electricity generated by TVA dams (www.tva.gov 2003). The price of electricity reached an all-time low, allowing the rural farmers of the valley access to modern amenities. With it, modern appliances such as electric stoves, refrigerators, and electric washing machines became more affordable, and the people of the valley experienced a change in lifestyle that added efficiency to everyday life (www.newdeal.feri.org 2003).

Access to modern technology did not come without a price. The affected communities identified TVA most clearly with dam construction and the trauma of land acquisition (USDA 1983). Some parts of the Tennessee Valley had not felt hard-hit by the depression because the standards of living had not changed with the economic downturn. The TVA was bringing affordable electricity to the rural farming communities of the valley; however, it did nothing to increase the popularity of the new agency or the federal government because of the number of families being displaced. The dam flooded areas that had been inhabited in some cases for generations by the people of the valley. In the study area, the construction of Fontana Dam caused the flooding of NC 288, which for some residents was their only means in and out of the area.

Once Fontana Dam controlled the water flow of the Little Tennessee River, causing the flooding of NC 288, residents' only means of access in and out of the area was by boat, across the newly formed Fontana Lake. According to a June 14, 1984, article in The SENTINEL, a Winston-Salem newspaper, and public comments from the North Shore Road EIS March 2003 scoping meetings, some families chose not to leave their homes until they had no other way out than by boat.

Not everyone in the valley disapproved of TVA authority. The construction and other TVA responsibilities brought about jobs for thousands of people in the Tennessee Valley. Villages were established to house the workers and their families during construction of the dams. One such village was Fontana, in the southwestern portion of the study area. Many of the 6,340 or so men and women who were assembled to build Fontana Dam called Fontana home for nearly three years (TVA 1996). Fontana Village became a year-round resort area for

vacationers in the 1950s and today it is still a TVA property, operated by Government Services Inc. (GSI). Prior to the growth of Fontana Village from the TVA dam construction, two other Fontana Villages had been established nearby. The first was built as a logging camp in 1906 by Montvale Lumber Company on the banks of Eagle Creek. The second, now under the lake's waters, was located at the confluence of Eagle Creek and the Little Tennessee River and was built for copper miners of the North Carolina Exploration Company in the 1930s (Holland 2001).

Fontana Dam Historic Marker

At 480 feet (146 m), Fontana Dam is the highest of the TVA dams in the valley. It has an approximate length of 2,365 feet (721 m) and a power generating capacity of 225,000 kilowatts. Fontana Lake drains an area of approximately 1,005,440 acres (406,890 hectares). The reservoir itself encompasses roughly 11,685 acres (4,729 ha) with 240 miles (386 km) of shoreline (TVA 1996). The TVA property encompasses the area below 1,710 feet (521 m) above msl around Fontana Lake (USFS 2003).

The TVA land-management philosophy is guided by the mandate that states it must consider the effects of its activities in land reclamation, public recreational use, economic development, and wildlife preservation. The TVA has established business principles to support its environmental policy. These include management commitments, environmental compliance, environmental protection and stewardship, pollution prevention and control, partnerships and public involvement, and innovation and technology development (www.tva.com 2003).

Environmental principles and policy adopted by the TVA board on January 24, 2001, include the following (www.tva.com 2003):

Management Commitments

- Integrate responsible environmental practices into business operations by establishing goals, measuring progress, and reporting performance through a comprehensive environmental management system.
- Factor environmental considerations into business decisions.

- Train TVA employees on their environmental processes and hold them accountable for their performance.

Environmental Compliance

- Comply with environmental laws and regulations.
- Assess the effects of TVA operations on the environment.
- Operate with a goal of continuous improvement.

Environmental Protection and Stewardship

- Manage the competing demands on the river system and valley resources by optimizing their value to diverse stakeholder interests.
- Practice responsible environmental stewardship of the valley's natural resources.
- Encourage customers, suppliers, and partners to do the same.

Pollution Prevention and Control

- Minimize the effects of operations on the environment through a combination of:

    - Demand-side management,
    - Source reduction,
    - Recycling and reuse, and
    - Pollution control.

Partnerships and Public Involvement

- Build partnerships through effective two-way communications with stakeholders and customers.
- Solicit and respond to public input that enables regional influence over regional resources.

Innovation and Technology Development

- Use integrated power system as a living laboratory to showcase energy innovations and solutions.
- Develop technologies and expertise to serve the public good by finding new and better solutions for environmental protection.

3.2 Socioeconomic and Community Features

3.2.1 Demographic Profile of the Project Study Area

The 2000 U.S. Census was used to gather information on the population and demographics of the project study area. Data from the 1990 U.S. Census were used to determine growth trends and for comparison. United States Census Tracts 9602 and 9603 in Swain County and Tract 9801 in Graham County encompass the study area for this project. Block group data were used for accuracy, as the block group statistical geographic area is substantially smaller than that of the census tract. A small portion of Census Tract 9802 is included in the study area; however, in an effort to avoid skewing the census information, data from this tract were not utilized. Figure 7 depicts the boundaries of the Census geographies within the study area.

Census Tract 9603 includes the northwestern and southeastern portions of the study area. A portion of Census Tract 9602 is in the northeast corner of the study area and includes nearly the entire northern half of Bryson City. Census Tract 9801 encompasses the Graham County portion of the study area.

3.2.1.1 Population Growth Trends

According to U.S. Census data, the populations of North Carolina, Swain County, Graham County and Bryson City all experienced growth from 1990 to 2000. Bryson City saw an increase in population of 23.2 percent, which is comparable with the statewide increase of 21.4 percent. The changes in county populations were significantly lower, at 15.1 percent for Swain County and 11.1 percent for Graham County. Census Tract 9602 in Swain County experienced half the rate of the county's growth with 7.9 percent. Block Group 9602-002 (Census Tract numer, Block Group number) actually decreased in population by 2.4 percent and Block Group 9602-001 only increased by 3.3 percent. Block Group 9602-003 includes the northwest portion of Bryson City. The 10-year growth rate for Block Group 9602-003 was a 21.2 percent increase, which is comparable to Bryson City's and North Carolina's growth. The majority of Bryson City is encompassed by Block Group 9603-003, which experienced comparable growth at 24.5 percent. Census Tract 9801, located on the southern side of Fontana Lake in Graham County, experienced a 40.2 percent increase in population from 1990 to 2000, nearly double the state's increase. Table 11 below depicts the percent of population change at the state, county, place, census tract, and block group levels between 1990 and 2000.

Trends over the last decade for the study area include the following:

- A high growth rate was exhibited in the southwest portion of the study area, south of NC 28 in Census Tract 9801.

- Within Bryson City, the northwest and southwest quadrants experienced higher growth rates.
- Very limited growth occurred north, west, and northwest of the Bryson City limits.
- Census Tract 9603 includes a portion of the study area in GSMNP, a portion of the study area south of the Tuckasegee River and east of the Little Tennessee River, as well as a large portion of land south of the study area. Growth in this census tract occurred only in its southern portions, outside of GSMNP.

Table 11

1990-2000 Population Growth for State, County, Place, Census Tract, and Block Group

Category	1990 Population	2000 Population	Increase	% Change
North Carolina	6,628,637	8,049,313	1,420,676	21.4
Swain County	11,268	12,968	1,700	15.1
Bryson City	1,145	1,411	266	23.2
Graham County	7,196	7,993	797	11.1
Tract 9602	2,726	2,941	215	7.9
Block Group 1	979	1,011	32	3.3
Block Group 2	794	775	-19	-2.4
Block Group 3	953	1,155	202	21.2
Tract 9603	4,696	5,562	866	18.4
Block Group 2	1,419	1,655	236	16.6
Block Group 3	885	1,102	217	24.5
Block Group 4	813	884	71	8.7
Block Group 5	657	755	98	14.9
Block Group 6	693	885	192	27.7
Tract 9801	1,407	1,972	565	40.2
Block Group 1	371	516	145	39.1
Block Group 2	441	484	43	9.8
Block Group 3	595	984	389	65.4

Source: 2000 and 1990 U.S. Census

3.2.1.2 Ethnicity and Race

Using 1990 census data, a breakdown of the ethnicity and racial characteristics at the state, county, place, tract, and block group level was completed and is shown in Table 12. The percentage as a part of each population total is shown in parenthesis for each ethnicity. The same information using 2000 census data is shown in Table 13.

Table 12
Ethnicity and Race by State, County, Place, Census Tract, and Block Group for 1990

Category	Total Population	White	Black	American Indian, Eskimo, or Aleut	Asian or Pacific Islander	Other race	Hispanic origin (of any race)
North Carolina	6,628,637	5,008,491 (75.6%)	1,456,323 (22.0%)	80,155 (1.2%)	52,166 (0.8%)	31,502 (0.5%)	76,726 (1.2%)
Swain County	11,268	7,950 (70.6%)	196 (1.7%)	3,075 (27.3%)	31 (0.3%)	16 (0.1%)	78 (0.7%)
Bryson City	1,145	1,064 (92.9%)	4 (0.3%)	64 (5.6%)	12 (1.0%)	1 (0.1%)	6 (0.5%)
Graham County	7,196	6,731 (93.5%)	1 (0.0%)	454 (6.3%)	6 (0.1%)	4 (0.1%)	29 (0.4%)
Tract 9602	2,726	2,602 (95.5%)	27 (1.0%)	93 (3.4%)	3 (0.1%)	1 (0.0%)	13 (0.5%)
Block Group 1	979	934 (95.4%)	1 (0.1%)	44 (4.5%)	0 (0.0%)	0 (0.0%)	5 (0.5%)
Block Group 2	794	771 (97.1%)	0 (0.0%)	20 (2.5%)	3 (0.4%)	0 (0.0%)	5 (0.6%)
Block Group 3	953	897 (94.1%)	26 (2.7%)	29 (3.0%)	0 (0.0%)	1 (0.1%)	3 (0.3%)
Tract 9603	4,696	4,395 (93.6%)	14 (0.3%)	269 (5.7%)	15 (0.3%)	3 (0.1%)	13 (0.3%)
Block Group 2	1,419	1,264 (89.1%)	4 (0.3%)	149 (10.5%)	0 (0.0%)	2 (0.1%)	4 (0.3%)
Block Group 3	885	797 (90.1%)	4 (0.5%)	71 (8.0%)	12 (1.4%)	1 (0.1%)	6 (0.7%)
Block Group 4	813	792 (97.4%)	6 (0.7%)	15 (1.8%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Block Group 5	657	652 (99.2%)	0 (0.0%)	5 (0.8%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Block Group 6	693	690 (99.6%)	0 (0.0%)	1 (0.1%)	2 (0.3%)	0 (0.0%)	3 (0.4%)
Tract 9801	1,407	1,389 (98.7%)	0 (0.0%)	18 (1.3%)	0 (0.0%)	0 (0.0%)	7 (0.5%)
Block Group 1	371	362 (97.6%)	0 (0.0%)	9 (2.4%)	0 (0.0%)	0 (0.0%)	3 (0.8%)
Block Group 2	441	435 (98.6%)	0 (0.0%)	6 (1.4%)	0 (0.0%)	0 (0.0%)	1 (0.2%)
Block Group 3	595	592 (99.5%)	0 (0.0%)	3 (0.5%)	0 (0.0%)	0 (0.0%)	3 (0.5%)

Source: 1990 U.S. Census

Table 13
Ethnicity and Race by State, County, Place, Census Tract, and Block Group for 2000

Category	Total Population	White	Black or African American	American Indian, or Alaska Native	Asian	Native Hawaiian or other Pacific Islander	Some other race alone	Two or more races	Hispanic or Latino of any race
North Carolina	8,049,313	5,804,656 (72.1%)	1,737,545 (21.6%)	99,551 (1.2%)	113,689 (1.4%)	3,983 (0.0%)	186,629 (2.3%)	103,260 (1.3%)	378,963 (4.7%)
Swain County	12,968	8602 (66.3%)	221 (1.7%)	3,765 (29.0%)	20 (0.2%)	1 (0.0%)	63 (0.5%)	296 (2.3%)	191 (1.5%)
Bryson City	1411	1,283 (90.9%)	28 (2.0%)	70 (5.0%)	5 (0.4%)	0 (0.0%)	9 (0.6%)	16 (1.1%)	24 (1.7%)
Graham County	7,993	7,346 (91.9%)	15 (0.2%)	547 (6.8%)	13 (0.2%)	1 (0.0%)	10 (0.1%)	61 (0.8%)	60 (0.8%)
Tract 9602	2,941	2,693 (91.6%)	30 (1.0%)	164 (5.6%)	3 (0.1%)	1 (0.0%)	18 (0.6%)	32 (1.1%)	17 (0.6%)
Block Group 1	1,011	910 (90.0%)	0 (0.0%)	75 (7.4%)	5 (0.5%)	0 (0.0%)	0 (0.0%)	21 (2.1%)	6 (0.6%)
Block Group 2	775	749 (96.6%)	0 (0.0%)	26 (3.4%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	4 (0.5%)
Block Group 3	1,155	1,052 (91.1%)	25 (2.2%)	59 (5.1%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	19 (1.6%)	7 (0.6%)
Tract 9603	5,562	4,969 (89.3%)	53 (1.0%)	428 (7.7%)	12 (0.2%)	0 (0.0%)	22 (0.4%)	78 (1.4%)	73 (1.3%)
Block Group 2	1,655	1,393 (84.2%)	32 (1.9%)	205 (12.4%)	0 (0.0%)	0 (0.0%)	7 (0.4%)	18 (1.1%)	20 (1.2%)
Block Group 3	1,102	932 (84.6%)	45 (4.1%)	67 (6.1%)	4 (0.4%)	0 (0.0%)	36 (3.3%)	18 (1.6%)	24 (2.2%)
Block Group 4	884	855 (96.7%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	29 (3.3%)	17 (1.9%)
Block Group 5	755	685 (90.7%)	39 (5.2%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	31 (4.1%)	10 (1.3%)
Block Group 6	885	885 (100.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	2 (0.2%)
Tract 9801	1,972	1,922 (97.5%)	3 (0.2%)	28 (1.4%)	5 (0.3%)	0 (0.0%)	2 (0.1%)	12 (0.6%)	20 (1.0%)
Block Group 1	516	461 (89.3%)	0 (0.0%)	23 (4.5%)	32 (6.2%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	9 (1.7%)
Block Group 2	484	467 (96.5%)	0 (0.0%)	17 (3.5%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (0.2%)
Block Group 3	984	948 (96.3%)	0 (0.0%)	19 (1.9%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	17 (1.7%)	10 (1.0%)

Source: 2000 U.S. Census

According to U.S. Census data, the majority of the populations of North Carolina and of Graham and Swain counties is racially white. North Carolina has an American Indian and Alaska Native population of 1.2 percent, which is consistent from 1990. Graham County and Bryson City have a higher percentage at 6.8 percent and 5.0 percent, respectively. According to the 2000 U.S. Census, nearly one-third of Swain County residents were classified as American Indian or Alaska Natives. These percentages are slightly higher than those in the 1990 census data. Based on the 2000 census geographical information, higher concentrations of American Indian, Eskimo, or Aleutians are within Census Tract 9603, Block Groups 2 and 3, which are south of Bryson City. The Black or African American population in 2000 remained similar to 1990 data, with less than 2 percent of the population at the county and census tract level, as compared to 21.6 percent of the state's population.

3.2.1.3 Income Levels

The FHWA's "Actions to Address Environmental Justice in Minority and Low-Income Populations" in compliance with EO 12898 dated February 11, 1994, defines low-income as a household income at or below the Department of Health and Human Services (DHHS) poverty guidelines. For the purposes of this analysis, census poverty thresholds were used rather than poverty guidelines of the DHHS in that there is very little difference between the United States Bureau of the Census poverty thresholds (by household size) and the DHHS poverty guidelines (by household size), and the poverty thresholds are updated each year by the Census Bureau. Associated demographic data were collected and classified into degrees of poverty according to the United States Bureau of the Census poverty thresholds. The weighted average poverty threshold for 1999, according to the census, is an annual income of $17,029 for a family of four.

Household income levels within the study area for 1999 can be found in Table 14. Also shown in Table 14 is the percentage of the total number of households each income level comprises. According to the U.S. Census, 6.3 percent of North Carolina families were living below the poverty level in 1999. A higher percentage of the population of Swain and Graham counties was living below the poverty level, with 9.5 percent in Swain County and 10.5 percent in Graham County. In the study area, the census tracts had a poverty level of just below 8 percent. However, at the block group level, the poverty level rates vary drastically from Block Group 9602-002 at 2.9 percent to nearly 20 percent in Block Group 9801-003.

The median household income for the state is $39,184. Swain and Graham counties have substantially lower median household incomes of $28,608 and $26,645, respectively. Bryson City's median household income is lower at $23,232. The census tracts' median household incomes are similar to the counties with $28,785 for Census Tract 9602, $30,033 for Census Tract 9603, and $27,008 for Census Tract 9801. Block Group 9603-006 had a median

household income that was significantly higher than the remainder of the study area and very close to the North Carolina average at $40,673.

Table 14

Income Levels and Poverty Status for Households in the Study Region for 1999

Category	North Carolina	Swain County	Bryson City	Graham County	Tract 9602	Block Group 1	Block Group 2	Block Group 3
Total Number of Households (family and non-family)	3,133,282	5,131	578	3,375	1,277	421	385	471
Family households below Poverty Level (as a % of total households)	6.3%	9.5%	8.0%	10.4%	6.4%	7.8%	2.9%	8.1%
Less than $10,000	328,770 (10.5%)	743 (14.5%)	114 (19.7%)	630 (18.7%)	178 (13.9%)	57 (13.5%)	56 (14.5%)	65 (13.8%)
$10,000 to $14,999	201,123 (6.4%)	525 (10.2%)	62 (10.7%)	414 (12.3%)	130 (10.2%)	50 (11.9%)	48 (12.5%)	32 (6.8%)
$15,000 to $24,999	431,701 (13.8%)	1015 (19.8%)	142 (24.6%)	556 (16.5%)	269 (21.1%)	82 (19.5%)	67 (17.4%)	120 (25.5%)
$25,000 to $34,999	435,975 (13.9%)	688 (13.4%)	67 (11.6%)	501 (14.8%)	180 (14.1%)	54 (12.8%)	70 (18.2%)	56 (11.9%)
$35,000 to $49,999	553,041 (17.7%)	983 (19.2%)	86 (14.9%)	583 (17.3%)	239 (18.7%)	82 (19.5%)	56 (14.5%)	101 (21.4%)
$50,000 to $74,999	608,777 (19.4%)	692 (13.5%)	55 (9.5%)	425 (12.6%)	199 (15.6%)	65 (15.4%)	65 (16.9%)	69 (14.6%)
$75,000 to $99,999	279,020 (8.9%)	288 (5.6%)	29 (5.0%)	151 (4.5%)	44 (3.4%)	14 (3.3%)	14 (3.6%)	16 (3.4%)
$100,000 to $149,000	188,621 (6.0%)	121 (2.4%)	17 (2.9%)	85 (2.5%)	26 (2.0%)	8 (1.9%)	9 (2.3%)	9 (1.9%)
$150,000 to $199,999	50,650 (1.6%)	45 (0.9%)	0 (0.0%)	27 (0.8%)	3 (0.2%)	3 (0.7%)	0 (0.0%)	0 (0.0%)
$200,000 or more	55,604 (1.8%)	31 (0.6%)	6 (1.0%)	3 (0.1%)	9 (0.7%)	6 (1.4%)	0 (0.0%)	3 (0.6%)
Median Household Income	$39,184	$26,608	$23,232	$26,645	$28,785	$30,313	$26,734	$30,298

Source: 2000 U.S. Census

Table 14 (Continued)

Income Levels and Poverty Status for Households in the Study Region for 1999

Category	Tract 9603	Block Group 2	Block Group 3	Block Group 4	Block Group 5	Block Group 6	Tract 9801	Block Group 1	Block Group 2	Block Group 3
Total Number of Households (family and non-family)	2319	707	414	386	341	337	870	240	221	409
Family households below Poverty Level (as a % of total households)	7.6%	4.8%	7.7%	5.2%	11.4%	10.4%	7.9%	8.3%	15.8%	19.8%
Less than $10,000	293 (12.6%)	31 (4.4%)	74 (17.9%)	60 (15.5%)	59 (17.3%)	52 (15.4%)	127 (14.6%)	22 (9.2%)	35 (15.8%)	70 (17.1%)
$10,000 to $14,999	235 (10.1%)	86 (12.2%)	50 (12.1%)	65 (16.8%)	26 (7.6%)	8 (2.4%)	101 (11.6%)	29 (12.1%)	15 (6.8%)	57 (13.9%)
$15,000 to $24,999	427 (18.4%)	160 (22.6%)	85 (20.5%)	72 (18.7%)	44 (12.9%)	49 (14.5%)	158 (18.2%)	51 (21.3%)	48 (21.7%)	59 (14.4%)
$25,000 to $34,999	343 (14.8%)	104 (14.7%)	46 (11.1%)	43 (11.1%)	92 (27.0%)	50 (14.8%)	156 (17.9%)	58 (24.2%)	43 (19.5%)	55 (13.4%)
$35,000 to $49,999	519 (22.4%)	139 (19.7%)	71 (17.1%)	73 (18.9%)	87 (25.5%)	83 (24.6%)	124 (14.3%)	14 (5.8%)	35 (15.8%)	75 (18.3%)
$50,000 to $74,999	268 (11.6%)	77 (10.9%)	28 (6.8%)	73 (18.9%)	26 (7.6%)	47 (13.9%)	93 (10.7%)	26 (10.8%)	20 (9.0%)	47 (11.5%)
$75,000 to $99,999	140 (6.0%)	56 (7.9%)	36 (8.7%)	0 (0.0%)	7 (2.1%)	32 (9.5%)	65 (7.5%)	24 (10.0%)	14 (6.3%)	27 (6.6%)
$100,000 to $149,000	50 (2.2%)	35 (5.0%)	15 (3.6%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	36 (4.1%)	16 (6.7%)	4 (1.8%)	16 (3.9%)
$150,000 to $199,999	22 (0.9%)	3 (0.4%)	3 (0.7%)	0 (0.0%)	0 (0.0%)	16 (4.7%)	7 (0.8%)	0 (0.0%)	7 (3.2%)	0 (0.0%)
$200,000 or more	22 (0.9%)	16 (2.3%)	6 (1.4%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	3 (0.3%)	0 (0.0%)	0 (0.0%)	3 (0.7%)
Median Household Income	$30,033	$31,490	$24,821	$24,412	$29,961	$40,673	$27,008	$28,448	$26,448	$26,850

Source: 2000 U.S. Census

Trends in income levels evident for the study area include the following:

- The areas north and south of Bryson City have a higher median household income than Bryson City and the area just west of the city. These areas with higher median household income levels also exhibited slower growth rates over the past decade.

- Block Group 9603-006, which includes a portion of the study area in GSMNP, exhibited the highest median household income of the study area. Since the park is uninhabited by people, this statistic likely reflects the area south of GSMNP as well as the area south of the study area.

- Nearly the entire study area population has a higher rate of people living below the poverty level when compared with the statewide average of 6.3 percent. Block Group 9801-003 depicted the highest percent of the population living below the poverty level of the study area census geographies. Block Group 9801-003 also exhibited over 65 percent growth between 1990 and 2000.

3.2.1.4 Housing

According to the 2000 U.S. Census, 88.9 percent of housing units in North Carolina are occupied, 69.4 percent by the owner. In Swain and Graham counties, 72.3 percent and 66 percent, respectively, are occupied, with 76.8 percent and 82.7 percent occupied by the owner. The percentage of vacant units in the study area is higher than in North Carolina as a whole. This can be explained by the high percentage of seasonal, recreational, or occasional-use units. In North Carolina, only 3.8 percent of vacant units are in this category. In Swain and Graham counties, 18 percent and 26.6 percent, respectively, of vacant units are for seasonal use. In Block Group 9801-001, with 61.3 percent vacant units, 91.2 percent are for seasonal use. Census Tract 9801 as a whole has nearly 90 percent of vacant units for seasonal, recreational, or occasional use. Census Tract 9603 is also high with 69.8 percent. Except for Bryson City, with 41.8 percent renter-occupied units, the study area has a lower rate of renters than the state. Occupancy rates are shown in Table 15.

Table 15

Housing Units for 2000

Category	Total Housing Units (Vacant or Occupied)	Total Occupied Units	Owner-Occupied Units (% of occupied units)	Renter-Occupied Units (% of occupied units)	Total Vacant Units	For seasonal, recreational, or occasional use (% of vacant units)
North Carolina	3,523,944	3,132,013 (88.9%)	2,172,355 (69.4%)	959,658 (30.6%)	391,931 (11.1%)	134,870 (3.8%)
Swain County	7,105	5,137 (72.3%)	3,946 (76.8%)	1,191 (23.2%)	1,968 (27.7%)	1,281 (18.0%)
Bryson City	713	588 (82.5%)	342 (58.2%)	246 (41.8%)	125 (17.5%)	28 (3.9%)
Graham County	5,084	3,354 (66.0%)	2,773 (82.7%)	581 (17.3%)	1,730 (34.0%)	1,350 (26.6%)
Tract 9602	1,721	1,279 (74.3%)	956 (74.7%)	323 (25.3%)	442 (25.7%)	254 (57.5%)
Block Group 1	647	427 (66.0%)	348 (81.5%)	79 (18.5%)	220 (34.0%)	143 (65.0%)
Block Group 2	489	359 (73.4%)	255 (71.0%)	104 (29.0%)	130 (26.6%)	81 (62.3%)
Block Group 3	585	493 (84.3%)	353 (71.6%)	140 (28.4%)	92 (15.7%)	30 (32.6%)
Tract 9603	3,590	2,324 (64.7%)	1,815 (78.1%)	509 (21.9%)	1,266 (35.3%)	884 (69.8%)
Block Group 2	1,141	713 (62.5%)	582 (81.6%)	131 (18.4%)	438 (37.5%)	307 (71.7%)
Block Group 3	521	431 (82.7%)	270 (62.6%)	161 (37.4%)	90 (17.3%)	31 (34.4%)
Block Group 4	576	373 (64.8%)	327 (87.7%)	46 (12.3%)	203 (35.2%)	154 (75.9%)
Block Group 5	498	322 (64.7%)	270 (83.9%)	52 (16.1%)	176 (35.3%)	113 (64.2%)
Block Group 6	697	360 (51.6%)	277 (76.9%)	83 (23.1%)	337 (48.4%)	264 (78.3%)
Tract 9801	1,912	859 (44.9%)	771 (89.8%)	88 (10.2%)	1,053 (55.1%)	934 (88.7%)
Block Group 1	591	229 (38.7%)	201 (87.8%)	28 (12.2%)	362 (61.3%)	330 (91.2%)
Block Group 2	335	211 (63.0%)	192 (91.0%)	19 (9.0%)	124 (37.0%)	100 (80.6%)
Block Group 3	986	419 (42.5%)	378 (90.2%)	41 (9.8%)	567 (57.5%)	504 (88.9%)

Source: 2000 U.S. Census

The 2000 U. S. Census provided information regarding tenure of homes in the study area. Tenure indicates the length of time a population has lived in their homes. It can be an indicator as to the age or the migratory nature of a population. The census data show that tenure in the study area is very comparable to the state. The largest percentage of householders in North Carolina, Swain and Graham counties, and Bryson City moved into their homes between 1995 and 1998. Block Groups 9603-004, 9603-005, and 9801-003 all had their highest percentages of residents in their homes before 1990. Block Group 9801-002 had a quarter of its population move into their homes before 1970. Nearly 44 percent of Block Group 9603-005 has lived in their homes since before 1980. Table 16 shows tenure of households in North Carolina and the study area.

Table 17 depicts the values of specified owner-occupied units. The median value of homes in the study area is lower than the state median value of $108,300. The majority of homes in North Carolina, Swain and Graham counties, and Census Tracts 9602, 9603 and 9801 are valued below $100,000. Block Group 9603-006 has a median home value of $125,900, well above the state average. This could be explained by the short tenure of residents in the area; most have moved in since 1999. Block Group 9801-003 has a lower median home value than the rest of the study area at $69,800, which could be a result of a more mature tenure, since most residents moved in prior to 1980.

Trends in housing statistics from the U.S. Census include:

- The median value of homes throughout the study area census geographies are low when compared with the statewide average.

- Block Group 9603-006 had the highest median home value for the study area. The majority of development in this block group is located south of Fontana Lake and south of the study area along the Little Tennessee and Nantahala rivers. Block Group 9603-006 also had the highest median household income in the study area and a growth rate slightly higher than the statewide average.

- Block Group 9801-003 had a low median home value compared with the state and the study area. This block group had a large percentage of the population living below the poverty level, low median household income, and the highest growth rate for the study area.

- The number of vacant units used for seasonal, recreational, or occasional use in the study area is substantially higher than the statewide average. Nearly all of the block groups within the study area had over half of their vacant housing units inhabited on a seasonal basis.

- Bryson City and Block Group 9603-003 have a larger percentage of renter-occupied housing units compared with the rest of the study area.

Table 16

Housing Tenure for 2000

Category	Occupied Housing Units	Year Householder Moved into Unit					
		1999 to March 2000	1995 to 1998	1990 to 1994	1980 to 1 989	1970 to 1979	1969 or earlier
North Carolina	3,132,013	652,745 (20.8%)	910,690 (29.1%)	479,481 (15.3%)	458,864 (14.7%)	303,106 (9.7%)	327,127 (10.4%
Swain County	5,137	718 (14.0%)	1,179 (23.0%)	890 (17.3%)	969 (18.9%)	760 (14.8%)	621 (12.1%)
Bryson City	584	128 (21.9%)	136 (23.3%)	98 (16.8%)	76 (13.0%)	81 (13.9%)	65 (11.1%)
Graham County	3,354	435 (13.0%)	767 (22.9%)	485 (14.5%)	634 (18.9%)	530 (15.8%)	503 (15.0%)
Tract 9602	1,279	189 (14.8%)	316 (24.7%)	188 (14.7%)	211 (16.5%)	198 (15.5%)	177 (13.8%)
Block Group 1	423	74 (17.5%)	91 (21.5%)	85 (20.1%)	55 (13.0%)	59 (13.9%)	59 (13.9%)
Block Group 2	363	55 (15.2%)	96 (26.4%)	39 (10.7%)	59 (16.3%)	70 (19.3%)	44 (12.1%)
Block Group 3	493	60 (12.2%)	129 (26.2%)	64 (13.0%)	97 (19.7%)	69 (14.0%)	74 (15.0%)
Tract 9603	2,324	347 (14.9%)	478 (20.6%)	431 (18.5%)	415 (17.9%)	355 (15.3%)	298 (12.8%)
Block Group 2	717	90 (12.6%)	180 (25.1%)	164 (22.9%)	94 (13.1%)	111 (15.5%)	78 (10.9%)
Block Group 3	434	78 (18.0%)	90 (20.7%)	106 (24.4%)	57 (13.1%)	51 (11.8%)	52 (12.0%)
Block Group 4	367	62 (16.9%)	58 (15.8%)	31 (8.4%)	95 (25.9%)	79 (21.5%)	42 (11.4%)
Block Group 5	319	14 (4.4%)	71 (22.3%)	16 (5.0%)	77 (24.1%)	66 (20.7%)	75 (23.5%)
Block Group 6	356	86 (24.2%)	57 (16.0%)	87 (24.4%)	83 (23.3%)	20 (5.6%)	23 (6.5%)
Tract 9801	857	97 (11.3%)	275 (32.1%)	94 (11.0%)	110 (12.8%)	145 (16.9%)	136 (15.9%)
Block Group 1	224	51 (22.8%)	94 (42.0%)	26 (11.6%)	13 (5.8%)	9 (4.0%)	31 (13.8%)
Block Group 2	209	12 (5.7%)	60 (28.7%)	25 (12.0%)	40 (19.1%)	19 (9.1%)	53 (25.4%)
Block Group 3	424	34 (8.0%)	121 (28.5%)	43 (10.1%)	57 (13.4%)	117 (27.6%)	52 (12.3%)

Source: 2000 U.S. Census

Table 17
Housing Values (Owner-Occupied) for 2000

Category	Specified owner-occupied units	Less than $50,000	$50,000 to $99,999	$100,000 to $149,999	$150,000 to $199,999	$200,000 to $299,999	$300,000 or more	Median Value
North Carolina	1,615,713	140,292 (8.7%)	591,362 (36.6%)	421,786 (26.1%)	219,174 (13.6%)	152,531 (9.4%)	90,568 (5.6%)	$108,300.00
Swain Co.	2,490	495 (19.9%)	1,001 (40.2%)	557 (22.4%)	206 (8.3%)	150 (6.0%)	81 (3.3%)	$86,800.00
Bryson City	237	23 (9.7%)	125 (52.7%)	36 (15.2%)	30 (12.7%)	15 (6.3%)	8 (3.4%)	$84,400.00
Graham Co.	1,563	412 (26.4%)	700 (44.8%)	204 (13.1%)	119 (7.6%)	93 (6.0%)	35 (2.3%)	$76,100.00
Tract 9602	672	91 (13.5%)	275 (40.9%)	176 (26.2%)	63 (9.4%)	50 (7.4%)	17 (2.5%)	$93,900.00
Block Group 1	230	38 (16.5%)	106 (46.1%)	39 (17.0%)	30 (13.0%)	10 (4.3%)	7 (3.0%)	$79,400.00
Block Group 2	185	22 (11.9%)	72 (38.9%)	58 (31.4%)	7 (3.8%)	22 (11.9%)	4 (2.2%)	$99,400.00
Block Group 3	257	31 (12.1%)	97 (37.7%)	79 (30.7%)	26 (10.1%)	18 (7.0%)	6 (2.3%)	$100,200.00
Tract 9603	1,075	240 (22.3%)	415 (38.6%)	213 (19.8%)	84 (7.8%)	66 (6.1%)	57 (5.3%)	$87,000.00
Block Group 2	313	63 (20.1%)	128 (40.9%)	54 (17.3%)	20 (6.4%)	20 (6.4%)	28 (9.0%)	$90,400.00
Block Group 3	184	24 (13.0%)	101 (54.9%)	21 (11.4%)	16 (8.7%)	11 (6.0%)	11 (6.0%)	$80,800.00
Block Group 4	215	93 (43.3%)	35 (16.3%)	65 (30.2%)	12 (5.6%)	0 (0.0%)	10 (4.7%)	$80,500.00
Block Group 5	158	24 (15.2%)	75 (47.5%)	26 (16.5%)	8 (5.1%)	17 (10.8%)	8 (5.1%)	$84,600.00
Block Group 6	146	8 (5.5%)	45 (30.8%)	47 (32.2%)	28 (19.2%)	18 (12.3%)	0 (0.0%)	$125,900.00
Tract 9801	441	107 (24.3%)	204 (46.3%)	68 (15.4%)	31 (7.0%)	20 (4.5%)	11 (2.5%)	$76,000.00
Block Group 1	105	14 (13.3%)	78 (74.3%)	7 (6.7%)	6 (5.7%)	0 (0.0%)	0 (0.0%)	$74,600.00
Block Group 2	111	21 (18.9%)	45 (40.5%)	26 (23.4%)	13 (11.7%)	6 (5.4%)	0 (0.0%)	$86,000.00
Block Group 3	225	72 (32.0%)	81 (36.0%)	35 (15.6%)	12 (5.3%)	14 (6.2%)	11 (4.9%)	$69,800.00

Source: 2000 U.S. Census

3.2.2 Environmental Justice

3.2.2.1 Regulations

The term *Environmental Justice* embodies the concept that everyone within the United States deserves equal protection under the country's laws. In 1994, President Clinton signed Executive Order (EO) 12898, which explains the federal government's commitment to promote environmental justice. All federal agencies were directed to incorporate EO 12898 into their programs, policies, and procedures. The FHWA has provided guidance addressing three principles. The three principles of Environmental Justice are to avoid, minimize, or mitigate disproportionately high and adverse human health and environmental effects, including social and economic effects, on minority populations and low-income populations; to ensure the full and fair participation by all potentially affected communities in the transportation decision-making process; and to prevent the denial of, reduction in, or significant delay in the receipt of benefits by minority and low-income populations (FHWA 2000b).

In addition to EO 12898 on Environmental Justice, Title VI of the Civil Rights Act of 1964 makes it illegal to show discrimination in the conduct of all federal activities. More specifically, Title VI states that, "No person in the United States shall, on the ground of race, color, or national origin be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any program or activity receiving Federal financial assistance" (FHWA 2000).

3.2.2.2 Census Data and Other Statistics

Although the study area is predominantly a homogeneous population of Caucasians, census data show a higher percentage of American Indian or Alaska Natives inhabiting the study area census geographies when compared with the North Carolina percentage. U.S. Census data show Graham and Swain counties have substantially lower median household incomes compared with the state. In addition, Graham County's monthly unemployment rates for May 2002 through May 2003 were higher than the statewide average. Swain County's monthly unemployment rates for the same periof were approximately at or above the statewide average. Household income data gathered from the U.S. Census indicate Graham and Swain counties also exhibit a higher percentage of the population living below the poverty level, as well as lower median value of homes when compared with the state. The North Carolina Department of Commerce Economic Development Information System (EDIS) indicates that less than half of the populations of Graham and Swain counties are in the labor force, and weekly earnings for agriculture, construction, finance/insurance/real estate, government, manufacturing, retail trade, wholesale trade, service, and

transportation/communications/public utilities industries are all lower than the statewide earnings (EDIS 2001).

The study area has a large percentage of federally owned lands. When these federal purchases occurred in the early 1900s, a decline in population followed. U.S. Census data show that the population density for the year 2000 in Graham and Swain counties was approximately four to seven people per acre higher than it was in 1900 (US Census 2000; FS-380 1983). According to *Mountaineers and Rangers, A History of Federal Forest Management in the Southern Appalachians 1900-81*, the greatest migration losses (40 percent or more) from 1940 to 1950 included Swain County (USDA 1983).

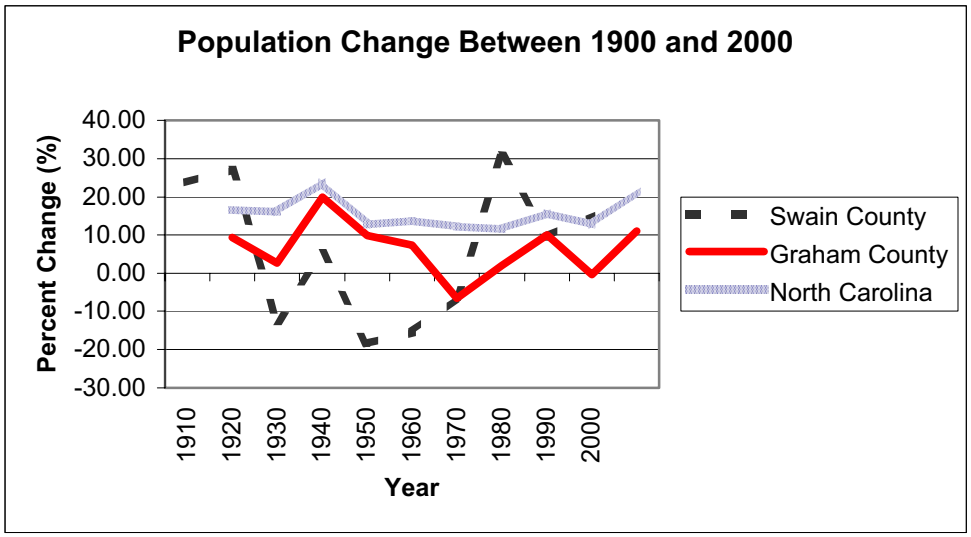
To illustrate the change in population over the last century, Table 18 and the associated graph depict population change for Graham and Swain counties as compared with North Carolina. Sharp declines in population were experienced during several periods for both Swain and Graham counties. For Swain County, the graph illustrates these departures from growth occurred generally during the years 1920 to 1930, 1940 to 1950, and 1970 to 1980. Graham County exhibited similar statistics, but to a lesser degree, while North Carolina maintained a steady rate of population growth ranging from approximately 10 percent to 20 percent per decade.

Table 18

Population Change Between 1900 and 2000

Census Geography	Population	Year	Percent Change	Census Geography	Population	Year	Percent Change	Census Geography	Population	Year	Percent Change
Swain County	8,401	1900		Graham County	4,343	1900		North Carolina	189,3810	1900	
	10,403	1910	+23.83		4,749	1910	+9.35		2,206,287	1910	+16.50
	13,224	1920	+27.12		4,872	1920	+2.59		2,559,123	1920	+15.99
	11,568	1930	-12.52		5,841	1930	+19.89		3,170,276	1930	+23.88
	12,177	1940	+5.26		6,418	1940	+9.88		3,571,623	1940	+12.66
	9,921	1950	-18.53		6,886	1950	+7.29		4,061,929	1950	+13.73
	8,387	1960	-15.46		6,432	1960	-6.59		4,556,155	1960	+12.17
	7,861	1970	-6.27		6,562	1970	+2.02		5,082,059	1970	+11.54
	10,283	1980	+30.81		7,217	1980	+9.98		5,881,766	1980	+15.74
	11,268	1990	+9.58		7,196	1990	-0.29		6,628,637	1990	+12.70
	12,968	2000	+15.09		7,993	2000	+11.08		8,049,313	2000	+21.43

Source: U.S. Census



Source: U.S. Census

Within the study area in Graham and Swain counties, the majority of federal lands are under the jurisdiction of the NPS, the USFS, and the TVA. Economic development during World War II and the continuing expansion of TVA programs in the Tennessee Valley area have contributed to economic benefits in the region. However, people had to move to urban industrial centers to participate in most of these economic opportunities (USDA 1983).

3.2.2.3 Effects on the Economy

The study area is in the southern Appalachians, inhabited historically by a self-sustaining and low-income population, owing to the isolation of the area. Most of the early settlers farmed the land for a living or grew enough to feed their families. Steep mountainous terrain and severe erosion made the land less than ideal for agricultural use. Logging operations brought a boom to the economy of the southern Appalachians through the 1920s. During the years of the Great Depression, involvement by federal agencies was greatly increased in the southern Appalachian highlands. Public welfare and employment programs were established under the administration of Franklin D. Roosevelt and his New Deal programs. Studies showed that in North Carolina, people living in the mountain region enjoyed a comfortable standard of living when they were able to combine subsistence farming with part-time employment off the farm (USDA 1983).

Federally owned lands are excluded from the tax base for local jurisdictions. Swain County has roughly 80 percent of its land under federal jurisdiction, while Graham County has over 50 percent under federal jurisdiction. Workforce statistics from the North Carolina

Department of Commerce show the government employs nearly 22 percent of the workforce in Graham County and nearly 16 percent of the workforce in Swain County.

3.2.2.4 Effects on the People

Incidents involving allegedly unfair treatment predate federal regulations that now protect the rights of minority and low-income populations, such as the Civil Rights Act of 1964 and EO 12898. These issues have contributed to anti-government sentiment in the area today. One such incident was the "Trail of Tears" of the Native Americans who were forced off their land by the U.S. Government in 1838 and sent west to Oklahoma. A band of approximately 1,000 Indians, now known as the Eastern Band of Cherokee Indians (EBCI), hid in the mountains of western North Carolina. In 1878, with the aid of an attorney, William H. Thomas, the EBCI obtained title to the land that is now the present Qualla Reservation (USDA 1983). The reservation encompasses roughly 56,572 acres (22,894 ha) within Swain, Jackson, Graham, and Cherokee counties.

Federal acquisition of forestland in the southern Appalachians began after the Weeks Act of 1911. At the beginning of the twentieth century, the area was characterized by an economy of self-sufficient small farms settled in the river valleys, isolated from each other by steep, parallel ridges (USDA 1983). Large timber companies and coal companies had invested in this relatively cheap land that had prolific natural resources. The USFS purchased land primarily on an ad hoc basis, mostly from willing sellers (USDA 1983). By the 1920s, the Forest Service had succeeded in purchasing tracts of land for what is now Nantahala National Forest in Graham and Swain counties. Today, Nantahala National Forest makes up more than half (roughly 59 percent) of Graham County.

The TVA was established in 1933 in an effort to spur economic development in the region, increase the production of electricity for the war effort using the natural energy of the rivers of the Tennessee Valley (hydroelectric power), and serve as flood control within the Tennessee Valley. By 1942, workers had started on the construction of Fontana Dam, the largest of TVA's power-generating dams towering 480 feet (146.3 m). The flooding of the Little Tennessee River by TVA caused the loss of railroad lines and NC 288, the area's main roadway, both of which paralleled the river at low elevations.

In 1934, GSMNP was established. In 1943, the DOI, the TVA, Swain County and the state of North Carolina signed a Memorandum of Agreement, which transferred a tract of land on the northern shore of Fontana Lake to GSMNP. The tract of land covered an area of approximately 44,000 acres (17,806 ha). The 1943 Agreement stipulated that in exchange for this tract of land the DOI would build a road along the northern shore of Fontana Lake from the park boundary near Bryson City to Fontana Dam as replacement for existing NC 288 that was to be flooded by the rising waters of the reservoir. According to an Asheville Citizen

Times article dated August 3, 1986, some residents and descendents of residents who lived within the 44,000-acre (17,806-ha) tract believe that if the road were rebuilt along the northern shore of Fontana Lake, they would then have access to their family cemeteries and previous homesteads. In a letter from the TVA to Mr. L. B. Cook dated July 31, 1943, the TVA indicated that to reach his family cemetery (Proctor Cemetery) "…it will be necessary to walk a considerable distance until a road is constructed in the vicinity of the cemetery, which is proposed to be completed after the war has ended." However, in 1983 the U.S. District Court ruled that the 1943 Agreement did not address access to cemeteries and was not intended for that benefit any more so than for any other citizen of the county or state. The decision was upheld by the Fourth District Court of Appeals, and by the United States Supreme Court, which refused to hear the issue. The 1943 Agreement stipulates that the TVA was to pay $400,000 to the State Treasurer of North Carolina to hold in trust for Swain County. The funds were to be applied exclusively to the payment of the principal of the county's road bonds that were then outstanding and unpaid. The historical record of the management and disbursement of the trust fund is currently being researched.

GSMNP was set aside as a national park, and the TVA regulated Fontana Lake and its shoreline. The TVA possessed the power of eminent domain, resulting in the condemnation of the properties of those families who were unwilling to leave. Payment for the land taken as a result of the Fontana project averaged roughly $37 an acre (0.4 ha) (TVA 1950). Compensation for land taken reflected the economy, the remote setting, and the type of land that previously had been logged with many of the valuable river bottom parcels already acquired. According to the U.S. Department of Labor, Bureau of Labor Statistics inflation calculator, $37 roughly calculates to $396.09 in 2003, based on the average Consumer Price Index for a given calendar year (http://data.bls.gov/cgi-bin/cpicalc.pl 2003). However, current land value cannot be compared with the land value from the early 1940s without conducting a real estate market analysis comparing information regarding land use, land condition, proximity to adjacent real estate, and other economic factors. Estimates relating only the price per acre plus inflation to current costs do not take into account fluctuations and influences, such as timber and clear cutting, and are therefore deemed inaccurate. Although many aspects of the project were positive for the region and the nation, the relocations resulted in long-standing local grievances with the TVA and the NPS. In particular, many local residents consider the unsettled 1943 Agreement, "a promise broken" by the federal government.

As in the case of the neighboring national forest, the land that makes up GSMNP within the study area was inhabited by numerous families, making up towns and villages along the creeks and along the shores of the Little Tennessee River. According to *Technical Report No. 12, The Fontana Project*, an account written by the TVA, the final total of removals for the Fontana Project was 1,311 families, of whom 711 were transients and 600 (99 farm families, 103 non farm families, 82 tenant farm families, and 316 tenant non-farm families)

were residents of the area before construction of the dam began. In addition to families and homesteads, 74 institutions were destroyed or displaced, including churches, stores, schools, grist mills, and mines. The nearby post office of Japan, serving a few families, was also eliminated. More than 1,000 graves were moved from cemeteries that were to be inundated or isolated by the project (TVA 1950).

Of the 600 original families who left the reservoir area, 269 relocated in the county of original residence. Within the roughly 44,000-acre (17,806-ha) tract on the northern shore of Fontana Lake that was ultimately transferred to the NPS, approximately 200 families were relocated. The sites of three communities, Bushnell (including the village of Forney) with approximately 205 families, and Almond and Judson with approximately 143 families, were inundated by the lake. The Proctor community consisted of approximately 163 families who were relocated, and 52 of the 300 families in Stecoah were relocated. These relocations were a result of a loss of access and inundation (TVA 1950).

3.2.3 Community and Social Features

Bryson City, located in the eastern portion of the study area, is the county seat of Swain County. GSMNP makes up nearly the entire northern half of the study area and is undeveloped, while portions of Nantahala National Forest make up the southern portion of the study area along with sparse development.

Graham and Swain counties are subdivided into townships or unorganized territories (UT), according to the U.S. Census Bureau. The subdivisions are illustrated in Figure 5. Charleston Township, Forney's Creek UT, and Nantahala Township make up Swain County. Cheoah Township, Stecoah Township, and Yellow Creek Township make up Graham County.

Small communities are prevalent in the study area. They are characterized by residential development, recreational opportunities, and having such amenities as a grocery store, gas station, church, boat dock, school, and/or gift shops, among other things. These communities are located primarily along NC 28, US 19, andUS 74 in the study area.

3.2.3.1 Communities

Within the study area townships, there are small communities that include Fontana Village, Tuskegee, Stecoah, Hidetown, Lauada, and Almond that border NC 28. Maple Springs is south of NC 28. Carson Mill, Roundhill, De Hart Mill, and Jackson Line are south of Fontana Lake but north of NC 28. Franklin Grove, Deep Creek, School House Hill, and Lackey Hill are small communities near Bryson City. Camping and recreational

communities within the southern portion of the study area include Fontana, Tsali, and Cable Cove.

3.2.3.2 Community Facilities

Within the study area, the majority of the community facilities are located along NC 28 or US 19/US 74, and in Bryson City. Community facilities and other study area development are illustrated in Figure 8.

The westernmost portion of the study area is home to Fontana Village. The village offers year-round vacation opportunities. Welch Cove Primitive Baptist Church is located just east of Fontana Village on SR 1263 (Bee Cove Road). Cable Cove recreation area is located north of NC 28 on SR 1287 (Cable Cove Road). The Cable Cove area is also home to the Cable Cove Baptist Church.

Following NC 28 east from Cable Cove is the small community of Tuskegee. Tuskegee has several commercial businesses along NC 28. Accessed from SR 1242 (Upper and Lower Tuskegee Roads), is scattered residential development. Tuskegee Baptist Church, Yellow Branch Cemetery, Eternal Believers Missionary Baptist Church, and Sawyers Creek Baptist Church are located north of NC 28 in the Tuskegee area.

The community of Stecoah is east of Tuskegee along NC 28 and is home to the Stecoah Valley Center (the former Stecoah School). The Stecoah Valley Center is a non-profit organization formed by a group of local citizens dedicated to the preservation of mountain culture, the local community, and the former Stecoah School. The Stecoah Valley Center offers a library, family resource center, senior citizens center, after-school programs, summer youth programs, and a gymnasium, among other things. The community of Stecoah is residentially developed with some commercial businesses and has its own volunteer fire department.

The Stecoah Valley Center

Hidetown is adjacent to Stecoah along NC 28. It has a small dirt racetrack likely used to race go-carts or similar vehicles and signed as a "speedway." Hidetown also has some residential development and a few commercial businesses. Along the upstream end of the open water portions of the Panther Creek and Murphy Branch arms of Fontana Lake east of Hidetown are several boat docks, an unnamed cemetery, and Panther Creek Baptist Church.

The Lemmons Branch Boat Access and Turkey Creek Campground are found near Tsali. Recreational opportunities in the study area are described in Section 3.4 of this report.

The small crossroads community of Almond is located along NC 28, where the Nantahala River is impounded as backwaters of Fontana Lake. Almond has its own Baptist Church and cemetery along the lakeshore, as well as a park for recreational vehicles and a boat dock. The Maple Springs community is located off SR 1113 (Needmore Road), south of US 19/US 74/NC 28. Maple Springs is home to the West Swain Volunteer Fire Department, scattered residential development, and the Maple Springs Baptist Church and cemetery.

Nearby, at the intersection of NC 28 and US 19/US 74, is the small crossroads community of Lauada. Several commercial businesses, Southwestern Community College and Smart Start, and Sawmill Hill Freewill Baptist Church and cemetery are located in Lauada.

Lauada Cemetery

North of Lauada, along the upstream end of the open water portion of the Alarka Creek arm of Fontana Lake is the community of Carson Mill. Sawyer Cemetery, Mt. Zion Church, and the Evangelistic Tabernacle Church are located in the vicinity of Carson Mill. North of

Carson Mill, along SR 1311 (Grassy Branch Road) is the community of Roundhill. SR 1313 (Greasy Branch Road) is the location of Roundhill Missionary Baptist Church and cemetery, a private residential development, Jenkins Cemetery, a boat dock, and a wildlife boat access.

De Hart Mill is a small residential community located on SR 1309 (Lower Alarka Road, Stephenson Branch Road). The True Gospel Independent Baptist Church and De Hart Cemetery are located in the De Hart Mill area. Along NC 28 in the vicinity of De Hart Mill are Swain County West Elementary School, the New Life Assembly of God Church, Cold Springs Baptist Church, and commercial businesses.

The small community of Jackson Line is adjacent to the De Hart Mill community along US 19 and SR 1373 (De Hart Cemetery Road). Jackson Line is home to the Jackson Line Baptist Church and residential development.

Northwest of the Bryson City limits is the community of Franklin Grove. Franklin Grove is a medium-density residential area that houses the Franklin Grove Baptist Church. Also in the vicinity of Franklin Grove are Watkins Cemetery, Victory Baptist Church, Rock Creek Baptist Church, apartment complexes, Grace Christian Academy, and Swain County High School.

Franklin Grove Baptist Church

Northeast of Bryson City is the community of Lackey Hill. Residential development characterizes Lackey Hill. The Swain County Recreational Park is located on 32 acres

(13 ha) in the Lackey Hill vicinity. The park can be accessed from SR 1337 (West Deep Creek Road).

Deep Creek is a residential community located north of Lackey Hill along the Deep Creek in the vicinity of Bryson City. The Bryson City Church of God, Deep Creek Missionary Baptist Church, and Randall Cemetery are located in the Deep Creek area. School House Hill is a residential area located between US 19 and US 74, south of the Little Tennessee River in Bryson City. Swain County Middle School and the Grace Christian Academy are located at School House Hill along with residential development.

3.2.4 Economy and Employment

GSMNP, Nantahala National Forest, and the TVA lands encompass approximately 66 percent of Graham and Swain counties. The federally-owned lands are omitted from the area's tax base. However, they do not require county services, are maintained with federal funds, and provide a substantial job base for the area. Even though the available area for development of each county is less than half the total land mass, GSMNP, TVA, and the national forest make payments to the counties in lieu of taxes. The region has limited highway access due to the mountainous terrain and the number of land reserves in the area. In addition, population densities within Graham and Swain counties are some of the lowest in the state.

3.2.4.1 Regional Economy

The western North Carolina region has exhibited slower population and employment growth than the state (EDIS 1994). Compared with the state, business failure rate and business start-up rate are slightly lower, and the unemployment rate and poverty rate are higher than those of the region (EDIS 1994). In addition, educational attainment, which can be an indicator of an area's prosperity, is lower in this region when compared with the state's educational attainment for the percent of the population having completed a high school or college education. Within Graham and Swain counties, less than 60 percent of the workforce has graduated from high school, while approximately 10 percent has obtained a college education (EDIS 2001). According to EDIs, the fastest growing sectors of the region's economy in 1994 were construction and services. Average weekly earnings in all industry sectors for Graham and Swain counties were lower than the state earnings (EDIS 2001).

The TVA mission has been to generate prosperity in the Tennessee Valley. The agency has been a substantial contributor to the economic development of the region since its inception. TVA has several programs and services to facilitate economic development in the region. TVA sponsors an Economic Development Loan Fund designed to stimulate investment and job creation in the region. TVA's Special Opportunities Counties Fund gives financial help to counties with low per capita incomes. The Tennessee Valley Industrial Development Association provides industrial prospects with an integrated package of economic incentives. The TVA has a comprehensive electronic system that offers site selection characteristics information to prospective industries as well as economic and research analysis, engineering and architectural design, and environmental review services. Community development programs sponsored by the TVA include the Quality Communities Program, which helps communities improve their long-term economic competitiveness; and the ARC Administration, which is a partnership that supports regional economic and social development between the federal government and the governors of 13 Appalachian states. The TVA also offers small and minority business support services (TVA 2003).

Fontana Dam

The USFS has also had an impact on the region's economy over the past century. The forests are important to the local economy. According to the Land and Resource Management Plan for Nantahala and Pisgah national forests, some individuals and communities depend on wood products from the forests and spending by recreational users of the forests for at least part of their livelihood. Forest products, such as firewood, galax, moss, and ginseng, provide important additions to the livelihood of many residents. Payments in lieu of taxes for lands in public ownership are returned to the state of North Carolina and its counties to help provide services for local communities (USFS 1987).

The ARC was established by Congress in 1965 to support economic and social development in the Appalachian region. The mission of the ARC is to "be an advocate for and partner with the people of Appalachia to create opportunities for self-sustaining economic development and improved quality of life." The ARC is comprised of 13 Appalachian states and a presidential appointee representing the federal government. The ARC helps to fund projects that directly address ARC's five goal areas: education and workforce training,

physical infrastructure, civic capacity and leadership, business development, and health care. Current programs and initiatives include an Economic and Human Development program, a Distressed Counties program, an Entrepreneurship initiative, a Local Development District program, a Telecommunications program, a Research and Technical Assistance program, a J-1 Visa Waiver program, a Business Development Revolving Loan Fund program, and various grants. The ARC analyzes the economic status of the 410 Appalachian counties in their programs. The economic status of a county is determined by the ARC using information from the U.S. Bureau of Labor Statistics, U.S. Bureau of Economic Analysis, and the U.S. Census Bureau. According to the ARC, both Swain and Graham counties were considered economically "distressed" in fiscal year 2003, where "distressed" refers to counties having poverty and unemployment rates that are at least 150 percent of the national averages and per capita market incomes that are no more than two-thirds of the national average (www.arc.gov, October 2003).

3.2.4.2 Major Employers

The EDIS (2001) indicates government employment makes up 15.7 percent of the Swain County workforce and 21.9 percent of the Graham County workforce. Over half (55.1 percent) of Swain County's workforce and 17.5 percent of Graham County's workforce are employed in the service industry. Nearly 30 percent (26.7 percent) of Graham County's workforce is employed in manufacturing. Approximately 21 percent of Swain County's workforce is employed in retail trade. Workforce statistics by industry are listed in Table 19.

Table 19
Workforce by Industry

Industry	Swain County	Graham County
Agriculture	0.3%	1.0%
Construction	1.8%	15.6%
Finance/Insurance/Real Estate	1.2%	1.7%
Government	15.7%	21.9%
Manufacturing	3.4%	26.7%
Retail Trade	20.9%	12.3%
Wholesale Trade	0.7%	1.0%
Service	55.1%	17.5%
Transportation/Communications/Public Utilities	1.0%	1.8%

Note: Mining is excluded because of its very small share of employment in North Carolina and for confidentiality requirements set by the North Carolina Department of Commerce.

Souce: EDIS, 2nd Quarter 2001

The largest manufacturers in Graham and Swain counties are listed in Table 20. Figure 9 illustrates the locations of the major employers within the study area.

Table 20

Largest Manufacturers in Graham and Swain Counties

Company	City	Primary Product	Staff	Year Est.	Address
Stanley Furniture Co., Inc.	Robbinsville	Wood Household Furniture	577	1986	68 Snowbird Road
American Uniform Co.	Robbinsville	Men's and Boy's Work Clothing	40	1972	Old Tallulah Road
Robbinsville Pallet Co.	Robbinsville	Wood Pallets and Skids	25	1984	85 Sawmill Road
Bee Global Inc.	Robbinsville	Manufacturing Industries, NEC	2	1996	121 School House Drive
*Consolidated Metco	Bryson City	Plastic Products	170	1995	1821 Hwy 19 S
The Cherokees	Cherokee	Apparel and Accessories, NEC	70	1954	680 Acquoni Road
*Smoky Cove Industries	Bryson City	Millwork	43	1991	819 Bryson Walk
*Maness Manufacturing Co.	Bryson City	Wood Pallets and Skids	24	1945	81 Ramseur Steet
*Diversified Exposition Services, Inc.	Sylva	Trade show exhibits, showcases, wood manufacturing	21	1994	264 Wilkes Crescent Drive
*American Floor Finishing Co.	Bryson City	Pre-finished hardwood flooring	20	2000	77 Industrial Park Road
*Monteith Lumber Co., Inc	Bryson City	Hardwood Dimension and Flooring Mills	16	1972	Hyatt Creek Road
CBC Printing Inc.	Cherokee	Commercial Printing: Lithographic	14	1984	149 Children's Home Road
Morgan Mills Resorts Inc.	Brevard	Fish and Seafoods, Fresh and Frozen	6	1983	Big Cove Road
*Smoky Mountain Times	Bryson City	Newspapers: Publishing and Printing	4	1884	6 River Street
*Chicago Metal	Bryson City	Fabricated Pipe and Pipe Fittings	4	1952	601 Bryson Walk
*Ye Old Cabinet Shop	Bryson City	Wood Kitchen Cabinets	2	1977	1 River Street

Source: EDIS, 2nd quarter 2001.

* Denotes manufacturers located within the study area.

3.3 Cultural Resources

The study area's rich history is detailed in the November 2003 *Cultural Resources Existing Conditions Report, North Shore Road EIS, Swain and Graham Counties, North Carolina*, by TRC Garrow Associates, Inc., and is briefly summarized below.

Many families in Swain and Graham counties have deep roots in the Little Tennessee Valley and the southern Appalachians. The area witnessed Native American occupation for at least the past 10,000 years, including several hundred years of Historic Cherokee presence. Although most members of the Cherokee Nation were forcibly removed from the region in 1838, others remained in the area and formed the nucleus of the present-day Eastern Band of Cherokee Indians. European-Americans began to enter the area primarily in the 1820s, living first in dispersed settlements, some of which later developed into such communities as Bryson City, Bushnell, Proctor, Almond, and Judson. The relatively self-sufficient farming/herding/hunting lifestyles of the nineteenth century began to change with the arrival of the railroad and the beginning of logging and mining operations in the 1880s and 1890s. Lifestyles were modified greatly with the commencement of large-scale logging operations by about 1910. Lumber companies such as Ritter, Norwood, Whiting, and Montvale logged extensive parts of the study area before leaving in the late 1920s. By the time the lumber companies left, the Aluminum Company of America (Alcoa) had developed plans for Fontana Dam and Reservoir along the Little Tennessee and had begun buying bottomland in the area. TVA took over the Fontana Project in 1941, and completed construction of the dam and reservoir in 1944.

Relatively few cultural resource studies have been conducted in the study area, and the coverage and resulting data are extremely uneven. Consequently, a combination of current documentation, historic information, and physiographic-based predictive modeling has been used to provide information on the quantity and likely distribution of cultural resources in the study area. Several types of cultural resources are known or potentially present, including archaeological sites, historic structures and other above-ground resources, cemeteries, and Traditional Cultural Properties (TCPs). The significance of these resources is evaluated in terms of their eligibility for the National Register of Historic Places (NRHP), as outlined in 36 CFR 60.4. The NRHP Eligibility Criteria state:

> The quality of significance in American history, architecture, archeology, engineering, and culture is present in districts, sites, buildings, structures and objects that possess integrity of location, design, setting, materials, workmanship, feeling and association.
>
> (a) That are associated with events that have made a significant contribution to the broad patterns of our history; or

(b) That are associated with the lives of persons significant in our past; or

(c) That embody the distinctive characteristics of a type, period, or method of construction; or that represent the work of a master, or that possess high artistic values; or that represent a significant and distinguishable entity whose components may lack individual distinction; or

(d). That have yielded, or may be likely to yield, information important in prehistory or history.

The regulations also outline several criteria considerations that specify circumstances in which a property that might not otherwise meet the *Eligibility Criteria* might still be NRHP-eligible. For example, although cemeteries are not usually considered eligible resources, a cemetery can qualify for the NHRP if it is an integral part of a historic district or "derives its primary significance from graves of persons of transcendent importance, from age, from distinctive design features, or from association with historic events".

3.3.1 Archaeological Sites

Systematic attempts to inventory and evaluate archaeological sites have been conducted over an estimated 3 percent of the study area, with the most extensive surveys covering the 1,350-acre (546-ha) Davis Cemetery tract (Webb et al. 1993) and 1,636 acres (662 ha) in the Nantahala National Forest. This area of ~~the~~ Nantahala National Forest involved three surveys, a 770-acre (312-ha) tract (Noel and Snedeker 1998), a 606-acre (245-ha) tract (including some areas outside the study area) (Ashcraft et al. 1994), and a 260-acre (105-ha) tract (Noel and Snedeker 1999). These four surveys recorded 129 sites, or 51.6 percent of the 250 recorded sites in the study area. Another 23 sites, or 9.2 percent of the total, were recorded by a survey of an estimated 250 acres (101 ha) of exposed lake shoreline surrounding the Davis Cemetery Tract (Shumate et al. 1996). That work represents the only systematic survey of the Fontana Lake shoreline, and partly as a result archaeological sites are dramatically underrepresented at Fontana Lake in comparison to other TVA reservoirs (Ahlman et al. 2003:Table 3.1-01). Finally, no large-scale intensive surveys have been conducted on GSMNP or on privately owned lands within the study area.

The 250 recorded sites are primarily prehistoric in age, with about 195 (78.0 percent) containing prehistoric components. The data are incomplete and difficult to summarize, but it is clear that most of the prehistoric sites contain Archaic period (pre 1000 B.C.) or unidentified lithic components; only about 45 (18.0 percent) of the total sites are known to have Woodland period (ca. 1000 B.C. – A.D. 1000) or other ceramic components. Another eight sites (3.2 percent) are recorded as having Historic Cherokee components, although Cherokee components may also be present on a few sites that are recorded as Mississippian (ca. A.D. 1000-1540). Historic European-American components are present on about 79

(31.6 percent) of the recorded sites, with most if not all of the recorded components dating to the late-nineteenth century or later. The ages and cultural affiliations of another nine sites (3.6 percent) are unknown. An additional 16 sites are known in the project area but have not been officially recorded; these include 11 prehistoric and five historic period sites.

A total of 149 (59.6 percent) of the recorded sites have been determined to be ineligible for the NRHP, and the eligibility of another 96 sites (38.4 percent) has not been assessed. All sites within GSMNP are considered unassessed and potentially eligible for the NRHP. Four of the five sites determined NRHP-eligible include one (31SW265) dating to the Middle and Late Archaic periods (Shumate and Evans – Shumate 1996; Shumate and Kimball 2001a), one (31SW263) that contains Archaic and Pisgah (Mississippian) materials (Shumate and Evans –

Shumate 1996; Shumate and Kimball 1996), one (31SW273/273**[1]) containing an early Historic Cherokee component (as well as earlier prehistoric and later Euro-American components) (Shumate and Evans – Shumate 1996:229–249; Shumate and Kimball 1997, 1998, 2001b), and one (31SW365**) that appears to represent a mid-nineteenth-century Cherokee homestead (Riggs and Shumate 2003). Data recovery excavations have been conducted at all four of these sites, although only one (31SW365**) has been completely reported. The fifth NRHP-eligible site (31SW366**) is a nineteenth-to-twentieth-century Historic Cherokee cemetery.

Most of the prehistoric sites appear to be habitation sites. There are no recorded lithic quarries in the study area, although soapstone quarries may be present in the Welch Cove/Fontana Village area (Snedeker, pers. comm. 2003). One rock art site is known to be present (but officially unrecorded) in the study area; that site is located beneath the full pool of Fontana Lake in the Bushnell area and appears likely to date to the historic period (Oliver 1996; Ashcraft, pers. comm. 2003). Similarly, at least one fish trap is historically known to have been present near Fishtrap Branch along the Little Tennessee River near the former site of Judson (Justice 2002), but has not been recorded as an archaeological site.

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[1] Cultural and historic resources are given a reference code. For archaeological sites, the number 31 designates the State of North Carolina. The letters SW indicate Swain County. The digits that follow notes the site number established by the Office of State Archaeology. The symbol "**" following a site number indicates that it is a historic resource rather than a prehistoric site.

Most of the historic period sites appear to date to the late nineteenth century or later, and most appear to represent domestic sites. With the exception of 31SW365**, the nineteenth century Historic Cherokee and early to mid-nineteenth century European-American occupations in the area are essentially unrepresented among the recorded sites. The later European-American domestic occupations are also dramatically unrecorded, even though the locations of many such sites are easily discernable. In addition, none of the known logging or mining related sites on the northern shore of Fontana Lake have been officially recorded. A single transportation-related site (part of the former NC 10) has been recorded and assessed on the Davis Cemetery Tract (Webb et al. 1993; Shumate 1994).

These data have several implications for future archaeological research in the study area. It is clear that the great majority of the study area has not been adequately surveyed for archaeological resources. The extant data, as well as information from other regional studies and historical sources, do indicate that prehistoric, Historic Cherokee, and historic European-American sites are abundant in the area and provide some information as to their likely locations.

A variety of recent studies have provided predictions concerning the likely location of prehistoric and Historic Cherokee sites in the region. Davis (1990) summarized site distributional data in the lower Little Tennessee Valley and documented extensive Archaic use of both upland and lowland zones as well as increasing intensity of alluvial terrace use during the Late Archaic and Woodland periods. Recent work in GSMNP has also documented a previously unsuspected high density of upland prehistoric sites (Kreusch, pers. comm. 2003; Yu 2001), and work on the Ravensford Tract has shown that intact Early to Middle Archaic sites may be located beneath alluvial and colluvial deposits on fans and along valley margins, while larger Late Archaic and Woodland sites are present on the alluvial terraces (Webb 2002). Other regional projects (e.g., Ashcraft et al. 1994) have documented relatively low frequencies of occupation of rugged uplands immediately adjacent to major drainage (as are present south of the Little Tennessee River), likely because such locations were not advantageous for exploiting either the alluvial landforms below or the upland coves, saddles, gaps, and benches further from the river. Studies have also provided information on the typical locations of Historic Cherokee farmsteads, which are usually situated on colluvial fans or benches, generally adjacent to water sources and frequently on the north or northwestern sides of valleys (Riggs 1996). Finally, considerable map and anecdotal data on the factors affecting the later historic European-American land use are available for the study area and elsewhere, although those data have not been synthesized.

Joy (2002, 2003) has developed (and to some degree tested) a model of site location for Santeetlah Reservoir, southwest of the study area. The final Santeetlah predictive model used landform, slope, distance to water, and distance to a stream confluence to identify high, moderate, or low probability zones for site occurrence (Joy 2003). Reduced to its essentials,

that model identified moderate to high probability zones for site occurrence as those located within 984 feet (300 m) of water and possessing less than 15 percent slope. The final model successfully placed 100 percent of 250 identified prehistoric, Historic Cherokee, or historic European-American components in the Santeetlah area within the moderate to high probability zones. The model is likely not a good predictor of some specialized site types (such as quarries or rock shelters), for which other factors are likely more important. A similar 15 to 20 percent cut-off for likely site occurrence is also used as a rule-of-thumb for surveys on both USFS and GSMNP lands in western North Carolina (Kreusch, pers. comm. 2003; Rodney Snedeker, pers. comm. 2003), and has also been employed on surveys of private lands in the region (e.g., Idol 2001).

Working from this premise, it is reasonable to assume that archaeological sites in the study area will be found almost exclusively in locations with less than 15 percent slope, and that the slope variable (supplemented by existing data on known and potential site locations) can be used to identify those areas within the study area that have a moderate to high potential for containing archaeological sites. In order to implement this assumption, areas of 15 percent or lesser slope have been identified based on 33-foot (10-m) (horizontal) interval Digital Elevation Models (DEMs) of the area obtained from the USGS. This information has been supplemented with data on all known site locations, as well as data on known former historic period structure locations derived from a variety of nineteenth and early-to-mid-twentieth century maps. Derived from pre-1942 maps, the locations of 1,716 potential historic period sites and the locations of all known archaeological sites are illustrated in *Cultural Resources Existing Conditions Report, North Shore Road EIS, Swain and Graham Counties, North Carolina*, by TRC Garrow Associates, Inc. (2003).

3.3.2 Historic Structures and Other Aboveground Resources

There are four NRHP-listed structures in the study area, including one in GSMNP and three in private or public ownership in Bryson City. The NRHP-listed structure in GSMNP is the Hall (Hall/Kress) cabin, a 17 x 24-foot (5.2 x 7.3-m) poplar log structure that was built by Crate Hall in Bone Valley in 1892. It was incorporated into a hunting lodge complex built by the Kress family around 1940, but survived when the larger structure burned (Gordon 1973; Holland 2001; Oliver 1989; Parris 1978).

NRHP-listed structures elsewhere in the study area include the Frye-Randolph house, Fryemont Inn, and the old Swain County Courthouse, all in Bryson City. The Frye-Randolph house and Fryemont Inn are adjacent buildings built about 1895 and 1923, respectively and were listed on the NRHP in 1982 (Southern and Sumner 1982; Bisher et al. 1999). The nearby Swain County Courthouse is a two-story Neo-Classical structure built in 1908 and was listed in the NRHP in 1979 (North Carolina State Historic Preservation Office (SHPO) 2001).

At least 40 other structures, structural complexes, or similar aboveground resources in the project area have been recorded to some degree by previous researchers or during the preliminary work for this study. Since these have not been formally evaluated, they are considered potentially NRHP-eligible (generally under Criteria A and/or C) for the purpose of this study. These include a number of structures identified by Williams (1998), Bisher et al. (1999), and others, a few of which have been documented in detail and officially placed on the SHPO study list (e.g., the Calhoun Hotel in Bryson City and the Bryson City Down Town Historic District). Others have not been recorded in detail, but have been noted as worthy of further study. The distribution of known NRHP-eligible and potentially eligible structures and other aboveground resources in the project area is highly concentrated in the Bryson City area and along historic roadways. A few of these resources are discussed individually below.

Within GSMNP, the Calhoun House is a frame house that was built in 1928 at the close of the Ritter Lumber Company era and was occupied by Granville and Lily Calhoun until 1944; it was later used as the Hazel Creek Ranger Station (Oliver 1998). Although, "not especially handsome and not an example of Ritter construction, [it] was large enough," and appropriately situated to be preserved for Park use after 1944 (Oliver 1989). A 1997 NPS condition assessment recommended removal of a 1966 NPS addition to restore the structure's "character and originality," as well as stabilization or reconstruction of a river rock wall and other protective measures (Miri 1997). Those changes were completed between 1997 and 2000 (Kreusch, pers, comm. 2003).

The Calhoun Hotel in Bryson City was built about 1925 and purchased by Granville Calhoun in 1946. It is a brick foursquare structure that played a part in the early development of tourism in the area and served as a meeting place for community leaders and others during the planning and construction of Fontana Dam and the development of the Cherokee Historical Association. The Bryson City Historic District covers about 25 acres (10 ha) of the town's commercial district, including such notable structures as the former Bennett Drug Store and the Old Pillar Building.

The NRHP-eligibility of Fontana Dam and its affiliated structures has not been assessed, although these structures are considered potentially NRHP-eligible under Criterion A and possibly Criterion C. The dam is a straight-crested, concrete gravity structure, and according to Jackson (1988), "occupies a particularly beautiful spot in the Smoky Mountains. In fact, historian Carl Condit considers the dam 'a perfect symbol of man and nature in harmony.'" Similarly, Bisher et al. (1999) describe the dam's "simple grandeur," as well as the architectural presence of the associated powerhouse and visitor's center.

Fontana Village has functioned as a resort community since shortly after completion of the dam, but, "retains a number of the community facilities and houses built by the TVA in the early 1940s. These structures have attracted scholarly attention for their importance in the

history of manufactured housing," (Bisher et al. 1999) and include a variety of "permanent," "temporary," "demountable," and trailer houses. The potential significance of Fontana Village as a historic district remains to be assessed, but minimally it is likely that some of the remaining structures (if not the complex itself) are eligible under Criteria A or C. The village also includes the ca. 1875 Gunter house, a two-room log house of half-dovetailed construction (Bisher et al. 1999); it might be eligible under Criterion A and/or C and could also have associated archaeological resources, making it eligible under Criterion D.

A few other standing structures or objects within GSMNP must also be considered potentially NRHP-eligible, including extant shafts, hoists, boilers, support structures, and other features associated with the Fontana and Hazel Creek mines and Westfeldt and other prospects. These features, along with associated ruins and archaeological deposits, need to be assessed as a potentially NRHP-eligible historic mining district (under Criteria A and D), as outlined by Noble and Spude (1997). The NRHP-eligibility of the standing dry kilns, pump houses, stream gauge, and other structural features at the Ritter mill site in Proctor also need to be assessed (Criteria A and D), preferably along with associated ruins and archaeological deposits as part of a potential Proctor historic district.

There is only one recorded NRHP-eligible or potentially NRHP-eligible bridge in the study area. That structure is an 1899 through-truss railroad bridge over the Tuckasegee River at Bryson City and was relocated to its present location from a Nantahala River crossing in 1944 prior to construction of Fontana Lake (Bisher et al. 1999). The last potentially significant bridge in the GSMNP part of the study area was removed in 1992 (Anonymous 1992; Hunter 1986; Scott 1991), and the extant bridges over Hazel Creek and other park streams are relatively recent. It is possible that some bridges elsewhere in the study area (such as the 1944 Southern Railway Bridge over the Little Tennessee River near Almond [TVA 1950]) might eventually be considered significant due to their historic associations (Criterion A) or structural characteristics (Criterion C).

Road segments merit some attention as aboveground resources or as archaeological sites. The constructed portion of Lake View Road was recorded by Williams (1998) and has been documented to Historic American Buildings Survey/Historic American Engineering Record standards by the NPS (1996). While most segments of the road presently do not meet the NRHP criteria consideration concerning age (having been constructed primarily in the early 1960s), the completed segments need to be evaluated for their potential significance under Criterion A for their association with the history of GSMNP and the area's North Shore Road controversy. Surviving segments of NC 288 along the northern shore of Fontana Lake need to be considered potentially eligible under Criterion A for the same reason. Other surviving nineteenth to mid-twentieth century road segments or other transportation features (such as railroad grades, trestle remnants, or tunnels) in GSMNP, beneath Fontana Lake, and elsewhere in the study area should also be evaluated. Finally, the NRHP-eligibility of the

short section of road built during World War II by the United States Army Corps of Engineers (USACE) in the Pinnacle Creek area (in the Eagle Creek drainage) (NPS 1996; Oliver 1989; Taylor 2001) also needs to be evaluated.

The potential significance of twentieth century hiking trails (and any older trails) also needs to be considered. Although there are no known CCC-built hiking trails or shelters in GSMNP within the study area (Chapman, pers. comm. 2003); the potential historic significance of the Appalachian National Scenic Trail in the area should be assessed in addition to considerations related to its designation as a National Scenic Trail. Two segments of the Appalachian National Scenic Trail are within the study area, an approximately 6-mile (9.7-km) section extending about 3.25 miles (5.2 km) north and 2.75 miles (4.4 km) south of Fontana Dam, and a 2,000-foot (610-m) section west of NC 143 through Sweetwater Gap. Most of this mileage dates to 1946 or later; only the Sweetwater Gap portion of the trail within the study area appears to follow or closely parallel a pre-1946 route (ATC 1973). Even these later trail segments potentially could be NRHP-eligible. There are no potentially significant Appalachian National Scenic Trail shelters likely within the study area. The nearest potentially historic trail structure in the study area is the log lean-to shelter at Cable Gap (about 1,312 feet [400 m] southwest of the study area), which was built in 1939 by the CCC under the direction of Nantahala National Forest (ATC 1973; Sommerville, pers. comm. 2003).

Finally, there is the potential for historic tree carvings in the study area, as have been documented elsewhere in the region (Kreusch, pers. comm. 2003). If present, such carvings could be NRHP-eligible under Criterion A. As previously discussed in Section 3.3.1 of this report as a potential archaeological site, at least one (presumably historic period) rock carving is known in the area.

3.3.3 Cemeteries

Cemeteries and other burial sites represent a unique class of cultural resources. Although cemeteries are generally not considered eligible for the NRHP, in some cases they have been determined to be NRHP-eligible or listed on the NRHP either as part of larger NRHP districts or because they meet one or more of the NRHP criteria considerations mentioned above (Potter and Boland 1992). In addition, the special importance of cemeteries as spiritual places is widely recognized. They are protected by such federal and state statutes as the Archaeological Resources Protection Act (ARPA) (graves over 100 years old), Native American Graves Protection and Repatriation Act (NAGPRA) (Native American graves on federal land), and North Carolina General Statutes 65 (*Cemeteries*) and 70.3 (*The Unmarked Human Burial and Skeletal Remains Protection Act*). A similar statute applies to cemeteries on EBCI tribal lands, but no such lands are contained within the project study area.

There are at least 87 known or reported cemeteries in the project area, including one possible and 22 known locations within GSMNP and 64 outside the park. That total includes the cemeteries affected by the Fontana Dam Project, but does not include 10 former cemeteries from which all graves were reportedly moved by the TVA prior to construction of Fontana Dam. A few of the 87 cemeteries are known only from historic or map references. Additional marked or unmarked gravesites may be present in the study area.

In 1943, local residents had the opportunity to have family graves relocated from cemeteries that would be flooded, disturbed by dam construction, or made inaccessible by the construction of Fontana Dam and the resulting flooding of NC 288 (TVA 1950). While some people agreed to cemetery relocation, others chose not to have graves moved from cemeteries located outside the reservoir pool. Some family members explain that their choices not to relocate graves were based on the promise of a new road to replace NC 288, which would facilitate access to graves remaining north of Fontana Lake. After construction of the Lake View Road halted in the early 1970s, NPS began ferrying relatives across Fontana Lake to visit the family cemeteries. Since the late 1970s, NPS personnel have provided ferry trips across the lake to access the cemeteries (15 to 20 trips annually). These trips have helped to maintain local ties to the area and are frequently referred to as "Homecomings" and "Decoration Days." Since 1943, there has been considerable debate regarding whether cemetery access was part of the 1943 Agreement, resulting in a lawsuit filed by the North Shore Cemetery Association in 1980 to resume road construction and provide access to family cemeteries. In November 1983, the U.S. District Court dismissed the North Shore Cemetery Association's lawsuit as not relevant to the 1943 Agreement's obligations. The decision was upheld by the fourth District Court of Appeals and by the United States Supreme Court, which refused to hear the issue.

Some of the cemeteries in the study area, especially those off the northern shore of Fontana Lake, could be NRHP-eligible due to their importance to local communities and/or their association with the North Shore Road controversy (Criterion A), their association with important individuals (Criterion B), the presence of distinctive grave markers or other features (Criterion C), or even for their data potential (Criterion D) (Potter and Boland 1992). One Cherokee cemetery (the Cat or Catt cemetery) east of Almond has been determined to be NRHP-eligible as an archaeological site (31SW366**). The 10 former cemetery locations from which TVA moved graves may also merit NRHP consideration, primarily due to the potential presence of remaining graves or grave markers, as at the former Judson Cemetery.

The approximately 9,000 known graves do not represent all the individuals who have been buried in the study area since the early 1800s. In particular, nineteenth century graves are likely underrepresented among the recorded interments, and it is likely that many early historic period Historic Cherokee, European-American, or Native American interments exist as unmarked graves in either the recorded or the unrecorded cemeteries. Other graves, such

as a potential twentieth century cemetery on Eagle Creek, could contain individuals who died in outlying locations during the logging era (Oliver 1992). Also, many prehistoric Native American or early Historic Cherokee graves are likely present, but unrecorded, in the study area. All graves merit the same protection afforded to marked cemeteries by state and federal laws. As might be expected, there is a general correlation between the locations of the 87 known or suspected cemeteries and those areas with dense historic period settlement.

3.3.4 Traditional Cultural Properties

TCPs are defined as places that are associated with the cultural practices or beliefs of a living community. Such properties can be determined eligible for the NRHP under Criterion A if they are rooted in that community's history and are important in maintaining the continuing cultural identity of the community (Parker and King 1992). Although TCPs are often thought of as Native American "sacred sites," they can also be traditional resource procurement areas (locations at which groups traditionally gathered foodstuffs, medicinal plants, or other materials) or sacred or secular locations important to other ethnic groups.

Since TCPs by their definition are of special importance to a community, information on their locations and significance may not be published or otherwise widely disseminated. These details are frequently restricted to elders, religious leaders, or other specific segments of the community. Consequently, identifying TCPs is often a difficult and complicated process and may require extensive and intensive consultation with the communities involved. Initial attempts to identify TCPs in the project area have been limited to the examination of published sources. Coordination with the EBCI Tribal Historic Preservation Officer is ongoing, however, and any further identification of Cherokee TCPs must await the results of this coordination.

In addition, there is potential for TCPs associated with the later historic period occupation of the area. In particular, some cemeteries north of Fontana Lake were clearly given special importance prior to the depopulation of the area in the 1940s (Oliver 1989). The Decoration Days described by Duane Oliver for the pre-1944 period were revived in the late 1970s by former residents and their descendants. These cemetery visitations have clearly played a major role in maintaining group identity among the people who were dispossessed of their former lands (Anonymous 1978; Cable 1998; Cantrell 2000; Chandler 1986; Holland 2001; Taylor 2001). Other areas may also merit consideration as TCPs, including the "hot pit" at Guardhouse Mountain on the former Welch property east of Chambers Creek (Parris 1962, 1986) or the "Elephant Rock," a large rock situated on the banks of Hazel Creek below Proctor.

3.3.5 Other Cultural Resources

Another potential type of Cultural Resource is the Cultural Landscape, which is defined as:

> a geographic area, including both natural and cultural resources, associated with a historic event, activity, or person. The National Park Service recognizes four cultural landscape categories: historic designed landscapes, historic vernacular landscapes, historic sites, and ethnographic landscapes (NPS 1998a:87).

Although historic designed landscapes and historic sites (which in this sense are associated with important events, activities, and persons [NPS 1998a]) are unlikely to be present in the study area, the potential for historic vernacular landscapes and ethnographic landscapes must be considered. As defined by the NPS (1998a:87), "historic vernacular landscapes illustrate peoples' values and attitudes towards the land and reflect patterns of settlement, use, and development over time." One particular type of historic vernacular landscape is the Rural Historic Landscape, which consists of:

> a geographical area that historically has been used by people, or shaped or modified by human activity, occupancy, or intervention, and that possesses a significant concentration, linkage, or continuity of areas of land use, vegetation, buildings and structures, roads and waterways, and natural features [McClelland et al. 1999].

Such landscapes could potentially be NRHP-eligible under Criteria A, B, C, or D, but are probably most frequently considered eligible under Criterion A.

No previous attempts have been made to identify Rural Historic Landscapes within the study area. It is unlikely that any areas within GSMNP or Nantahala National Forest would meet the definition and registration requirements, due to the extensive reforestation (and in some cases, other landscape changes) that has occurred since they were occupied. Landscape features within these areas are probably best treated as archaeological sites, or as part of potential NRHP districts constructed primarily around archaeological resources. There is some potential for rural historic landscapes in other parts of the study area that may have maintained their traditional character.

Ethnographic landscapes are, "associated with contemporary groups and typically are used or valued in traditional ways" (NPS 1998a). Given the history of the project study area, there is some potential for ethnographic landscapes associated with both Cherokee and European-American populations in the area. Similarly, it may be necessary to consider the potential presence and significance of other types of ethnographic resources in or adjacent to the study area (NPS 1998a).

Finally, the potential for other types of non-traditional NRHP districts in the area should also be considered. Such districts could include a variety of structures, archaeological sites, or other resources associated with a particular individual, such as Horace Kephart, or with a historical event or process, such as the logging on Hazel Creek, the construction of Fontana Dam, or even the North Shore Road controversy itself.

3.3.6 Summary

Almost 2,000 known and potential cultural resources, including 109 NRHP-eligible or potentially eligible archaeological sites, 16 other reported site locations, 44 structures and other aboveground resources, 97 cemeteries or former cemeteries, and 1,716 former historic structure locations derived from historic maps were identified within the study area. Even this figure certainly underestimates the number of resources in the study area. It is necessary to supplement these data with predictive statements concerning the locations of areas of moderate to high probability for site occurrence. Field verification of the cultural resources locations will occur in the EIS.

3.4 Parklands and Recreational Facilities

Recreational opportunities abound in the study area (see Figure 10). The NPS, the USFS, and the TVA all encourage the use of federally designated lands for recreation. The majority of the study area is within GSMNP. While Nantahala National Forest encompasses a portion of the study area south of Fontana Lake, the TVA owns Fontana Lake and its shoreline.

The NPS Organic Act of August 25, 1916, states that the fundamental purpose of national parks is, “to conserve the scenery and the natural and historic objects and the wildlife therein and to provide for the enjoyment of the same such manner and by such means as will leave them unimpaired for the enjoyment of future generations.” Recreational development began in the study area with the commitment of land for GSMNP, Nantahala National Forest, and the TVA. By 1920 Nantahala National Forest was organized from tracts of land that had been purchased after the Weeks Act of 1911. For GSMNP, the majority of land that makes up the park had been purchased and set aside as a preserve by 1934. The TVA transferred Fontana Village to GSI in the 1950s; however, the mountains of North Carolina were a popular vacation spot well before the creation of the Fontana Village Resort.

The Conservation Movement (1850-1920) in American history marked the beginning of the nation’s era to preserve and protect American heritage. During that time, a heightened conservation consciousness first emerged as a political and cultural movement, based largely on a growing appreciation for the importance of nature as an economic, aesthetic, and spiritual resource, together with a newly urgent conviction that nature's resources were increasingly imperiled. This movement led to unprecedented public and private initiatives,

such as the establishment of the national parks system, intended to ensure the wise and scientific use of natural resources and the preservation of wildlife and of landscapes of great natural beauty (http://lcweb2.loc.gov/ammem/amrvhtml/conshome.html 2003).

3.4.1 Great Smoky Mountains National Park

3.4.1.1 Park Visitor Use, Operations, and Management

GSMNP, which encompasses more than 521,000 acres (210,842 ha), is the most visited park in the nation (Cox 1998). Total recreation visits for 2002 were 9,215,806 (www.gsmnp.com 2003). The highest recorded visitation occurred in 1999 with 10.3 million visitors. October is the single busiest month according to park officials. However, the summer months of June to August see the most visitors in a three-month period.

The Cooperative Park Studies Unit at the University of Idaho completed a Visitor Studies Report for GSMNP in 1997. The studies were conducted in the summer and fall of 1996. In the summer, 1,191 questionnaires were distributed with 919 returned, a response rate of 77 percent. The fall response rate was higher at 82 percent (1,158 questionnaires distributed and 945 returned).

Family groups comprised the majority of summer and fall visitors. The age of visitors varied in the summer and fall. Visitors aged 31 to 50 years old accounted for 39 percent of the visitors in the summer. Another 26 percent of summer visitors were 15 years old or younger. Fall visitors were older, with 45 percent aged 46 to 65 years old (Littlejohn 1997).

International visitors accounted for 2 percent of the total visitors in both the summer and fall. Of the international visitors, the largest group was from England, totaling 23 percent in the summer and 26 percent in the fall. Tennessee residents accounted for 17 percent of the United States' visitors in both seasons. Florida followed closely with 11 percent in the summer and 14 percent in the fall. GSMNP was the primary destination for over half of the visitors in the summer and fall. Furthermore, 65 percent of summer visitors and 79 percent of fall visitors had previously visited at GSMNP (Littlejohn 1997).

The most popular activities for summer and fall visitors were viewing scenery, wildlife, and wildflowers; photography; and visiting historic sites. Most visitors entered and exited the park from Gatlinburg during both seasons. Approximately two-thirds of summer and fall visitors stayed less than one day in the park. The most visited place in the park was Cades Cove Loop Road (54 percent in the summer and 61 percent in the fall). The overall quality of services in the park were rated as "good" or "very good" by 90 percent of visitors in the summer and 91 percent of visitors in the fall (Littlejohn 1997).

The park administers a permit system for use of its backcountry campsites to protect the park and its resources. Through use of the system, the park strives to offer the highest quality visitor experience without degrading the natural environment. According to George Minnigh with GSMNP, approximately 13,000 permits are issued yearly. On average, the permits are for 2.5 persons.

The park's GMP, updated in 1982, establishes long-range strategies for resource management and visitor use. In order to meet these objectives, the plan established management zones, which indicate appropriate uses, activities, and management actions for the park. The management zones are discussed in Section 3.1.1 of this report.

Administrative roads throughout GSMNP are used for maintenance and emergency response. In addition, the park provides transportation and/or maintains access to the cemeteries located within its boundary. Within the study area, vehicular access to most of the cemeteries was eliminated with the flooding of NC 288. For these cemeteries, annual access is provided by the NPS and includes boat access across Fontana Lake and vehicular access to or to the vicinity of the cemeteries. For those cemeteries accessible by land, the park maintains access corridors to them.

GSMNP was designated as a World Heritage Site in 1983, as detailed in Section 3.1.1 of this report (http://www.nps.gov/grsm).

Wilderness, as defined in the 1964 Wilderness Act, is "an area of undeveloped federal land retaining its primeval character and influence, without permanent improvements or human habitation, which is protected and managed so as to preserve its natural conditions and which (1) generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable; (2) has outstanding opportunities for solitude or a primitive and unconfined type of recreation; (3) has at least 5,000 acres (2,023.4 ha) of land or is of sufficient size as to make practicable its preservation and use in an unimpaired condition; and (4) may also contain ecological, geological, or other features of scientific, educational, scenic, or historical value."

The Wilderness Act directed the Secretary of the Interior to study all roadless National Park areas of 5,000 or more contiguous acres (2,023.4 ha) for wilderness designation. In accordance with these requirements, the NPS conducted a wilderness suitability study of GSMNP and in 1966 released to the public a recommendation that approximately 247,000 acres (99,957.5 ha) be designated as wilderness in an effort to protect and perpetuate the park's scenic and biotic resources. Due to public request for inclusion of additional lands in the designation, the NPS subsequently released a revised recommendation. President Ford transmitted the 1974 Wilderness Recommendation to Congress, accompanied by a Draft EIS (DEIS). The recommendation proposed that 390,500 acres (158,030 ha) within the park be

designated as wilderness. However, Congress did not pass the 1974 recommendation, and in 1978 the DOI recommended that no action be taken until some resolution was reached concerning the 1943 Agreement pertaining to North Shore Road.

In 1979, another attempt was made to address the wilderness issue. This revision totaled 425,384 acres (172,147.1 ha) to include, among other things, the roughly 44,000-acre (17,806-ha) former North Shore/TVA tract. However, the revision was never transmitted to Congress. In 1999, the original GSMNP recommendation of 390,500 acres (158,030 ha) from 1974 was approved for retransmittal to Congress because it was the only recommendation that had NEPA compliance documents. However, the Council on Environmental Quality (CEQ) was not willing to re-transmit the recommendations to Congress because the 1974 compliance documents were outdated. In light of the 1999 decision by CEQ, the designation of any lands within GSMNP as wilderness will require the completion of a new wilderness suitability assessment and proposal. The NPS has recognized that in light of the difficulties encountered in the previous wilderness proposals, any future consideration of wilderness designation should not take place until the North Shore Road issue is resolved. However, the park currently manages all of the proposed area in accordance with NPS wilderness policies to preserve the characteristics that make it eligible as a designated wilderness.

The portion of the project study area within GSMNP, along with a larger portion of GSMNP contiguous with the study area, is one of the largest land tracts in the eastern United States that is not impacted by or easily accessible from modern roads.

3.4.1.2 Recreational Amenities and Facilities

GSMNP accounts for roughly 52,600 acres (21 ha) of the study area. The park's recreational facilities make it popular for both local and destination travel. The park operates 10 developed campgrounds (frontcountry), which total approximately 980 campsites. In addition to the developed campgrounds, 89 backcountry campsites and 15 backcountry shelters are available to overnight visitors (GSMNP 2001). Vehicle access is available to the developed campgrounds, while campers are required to hike to the backcountry campsites. Approximately 850 miles (1,368 km) of hiking trails connect the backcountry campsites throughout the park (www.nps.gov 2003). Of the 850 miles (1,368 km) of hiking trails, approximately 550 miles (885 km) allow horses. In addition, there are five horse camps in GSMNP. Although bicycles are not allowed on any trails within the study area, bicycles can travel on some trails and most roads within the remainder of the park.

3.4.1.2.1 Study Area

The portion of GSMNP within the study area is considered backcountry. Backcountry campsites and trails are the only facilities within the study area. Of the park's 89 backcountry campsites, 22 are within the study area. Fifteen trails traverse the study area, providing access to these campsites. Within the study area, horses are allowed on all but one of the trails. Park facilities within the study area are shown on Figure 10.

3.4.1.2.2 Other Facilities Outside the Study Area

Three visitor centers are located within GSMNP: Cades Cove Visitor Center, Oconaluftee Visitor Center, and Sugarlands Visitor Center. Ranger-led programs are conducted seasonally from each of these visitor centers. Other places to visit within the park include Cades Cove Loop Road, Foothills Parkway, Roaring Fork Motor Trail, Cable Mill Complex (water-powered grist mill), Mingus Mill (turbine-powered grist mill), Newfound Gap, Clingmans Dome, Chimney Tops, Laurel Falls, Mountain Farm Museum, and Cataloochee.

In addition, 27.5 miles (44 km) of the Mountains to Sea Trail (MST) traverses GSMNP northeast of the study area (http://www.ils.unc.edu/parkproject/trails/m2c/ about.html 2003). When complete, the MST will cover approximately 900 miles (1,448 km) from Clingmans Dome in GSMNP to Jockey's Ridge State Park on the Outer Banks of North Carolina. Currently, approximately 400 miles (644 km) are complete.

3.4.2 Appalachian National Scenic Trail

The Appalachian National Scenic Trail (AT) crosses the western portion of the study area. The AT covers 2,167 miles (3,487 km) from Katahdin Mountain in Maine to Springer Mountain in north Georgia, traversing 14 states (http://www.nps.gov/appa 2003). Completed in 1937, the trail was designated as the first National Scenic Trail by the National Trails System Act of 1968. National Scenic Trails are defined by the act as "extended trails so located as to provide for maximum outdoor recreation potential and for the conservation and enjoyment of the nationally significant scenic, historic, natural, or cultural qualities of the areas through which such trails may pass" (GMP 1982). The act lists facilities and uses that are allowed along the trail. Trail management within GSMNP is implemented through a backcountry management plan. The backcountry management plan meets the objectives of the park's GMP (GMP 1982). Within GSMNP, the AT covers approximately 70 miles (113 km). It crosses the

Appalachian Trail Hiking Marker

study area at Fontana Dam and runs to Stecoah Gap at an elevation of 3,165 feet (965 m), and then on to Nantahala Gorge. Another approximately 2,000-foot (610-m) section crosses the study area west of NC 143 through Sweetwater Gap. Roughly 6 miles (9.7 km) of the AT are within the study area. These portions of the AT are open to hikers only. However, horse use is allowed on other portions of the AT within GSMNP.

3.4.3 Nantahala National Forest

Nantahala National Forest offers similar opportunities to those of GSMNP as well as gamelands for hunting and mountain bike trails at the Tsali recreation area. The USFS Land and Resource Management Plan for Nantahala and Pisgah national forests speaks to the location and type of recreational opportunities offered. It indicates approximately 180 developed recreation areas exist within Nantahala and Pisgah national forests, including campgrounds, picnic areas, trailheads, swimming, observation areas, among others. The USFS also allows motorized recreation such as the use of off-road vehicles on approximately 100,000 acres (40,469 ha) of forest land (USFS 1987).

The Plan's goals include "providing for a forest environment for the public to enjoy while complying with laws and regulations established for the administration of USFS lands, and to maintain the unique character of special interest and specially designated areas, including Wilderness, research natural areas, developed recreation and scenic areas, Native American religious sites, and significant cultural resources" (USFS 1987).

Recreational opportunities at Fontana Lake are also numerous. They include water skiing, canoeing, sailing, windsurfing, fishing, swimming, hiking, nature photography, picnicking, bird watching, and camping. The TVA Visitor's Center offers hot showers and picnic tables. The lake has boat docks and launching ramps. Fishing is popular at Fontana Lake with its abundant supply of rainbow, brown, and brook trout, largemouth and smallmouth bass, walleye, pike, perch, sunfish, and crappie. The historic Fontana Village Resort is a year-round vacation spot appealing in part due to its ideal location adjacent to GSMNP.

3.4.4 Other Study Area Parks and Recreational Facilities

The Swain County Parks and Recreation Master Plan (2002-2012) mission statement is to "provide a broad spectrum of quality leisure services and facilities in order to meet public needs for social, physical, moral, and economic benefits gained through recreational opportunities." The master plan was designed as a guide for recreational programs, facilities, and finances for the communities of Swain County and Bryson City (Swain County/Bryson City Parks and Recreation Department 2002).

Riverside Park in Bryson City

Existing park facilities for Swain County and Bryson City include the Swain County Recreation Park and the Tuckasegee River Parks System, which includes Ela Riverside Park, Bryson Island Park, Riverfront Park, and Governors Island Park. The Swain County Recreation Park sits on 32 acres (13 ha) in a residential neighborhood (Lackey Hill area) in the northwest portion of Bryson City. The park was developed over several years, between 1974 and 1993. The park offers ball fields, tennis courts, a picnic shelter, a swimming pool complex, playgrounds, basketball courts, horseshoe pits, beach volleyball court, multi-use field, walking trails, and maintenance facility (Swain County/Bryson City Parks and Recreation Department 2002).

The Tuckasegee River Parks System consists of Ela Riverside Park, Bryson Island Park, Riverfront Park, and Governors Island Park. The Ela Park is 4 miles (6.4 km) east of Bryson City along the river. It was constructed with TVA funds in 1985 and has a canoe and kayak launch and a picnic area. The Bryson Island Park is located at the Bryson City portion of the Tuckasegee River on 7 acres (2.8 ha). It was developed with Land and Water Conservation Funds in 1987. The island has bordered walkways, an interpretive center, a canoe and kayak launch, and picnic areas. Riverfront Park is located within the study area just west of Bryson City along the Tuckasegee River. Riverfront Park consists of bordered, lighted trails, picnic areas, a kayak and raft launch, and a pavilion. Development of Riverfront Park began in 1986 and is ongoing. Governors Island Park is located east of Bryson City along the Tuckasegee River.

Swain County and Bryson City have developed a master plan for a greenway system along the Tuckasegee River. The Swain County-Bryson City Greenway Feasibility Study Master Plan and Report indicates a greenway system would be a valuable asset to the community because it would provide an alternate means of transportation, become an economic stimulus to the downtown district, and provide additional recreation opportunities to visitors and area residents. The proposed route is along an 11-mile (17.7 km) corridor that runs from Fontana Lake eastward through Bryson City, around the Governors Island area to the TVA Recreation Area at the eastern point, beyond Kituwah (Swain County Economic Development and Planning Office 2001).

Future plans for Swain County include developing a Tourism Development Plan that incorporates trails and greenway projects in the county and includes a proposed museum and trails along the Nantahala River, downtown revitalization efforts, and a riverwalk in downtown Bryson City along the Tuckasegee River (NCCES 1999).

Graham County does not have a formal master plan for recreation programs and facilities; however, a greenway along Long Creek has been proposed within the town of Robbinsville, as well as a county mountain bike trail system, nearly 95 percent of which would be on USFS lands. In addition, a trail is proposed along Dry Creek in the EBCI community (NCCES 1999).

3.5 Topography, Geology, and Soils

3.5.1 Topography

The project study area is part of the Great Smoky Mountains. The terrain of the study area is primarily mountainous. Specifically, it consists of three regions. There are broad to narrow flats as floodplains of major rivers and large streams, such as the Tuckasegee and Little Tennessee Rivers. Rolling hills and shallow slopes are found on lower intermediate mountains and side ridges. Steep slopes are found on the larger high mountain divides such as Welch Ridge. The elevations range from approximately 1,350 feet (412 m) msl at the Little Tennessee River on the westernmost edge of the study area to approximately 5,000 feet (1,524 m) msl along the top of Welch Ridge, as depicted on the following USGS 7.5-minute quadrangle maps: Bryson City, Cades Cove, Fontana Dam, Noland Creek, Silers Bald, Thunderhead Mountain, Tuskeegee, and Wesser.

3.5.2 Regional Geology

GSMNP lies within the Blue Ridge physiographic province. The Blue Ridge is bounded on the northwest by the Ridge and Valley province, and the boundary is defined by the trace of the northeast to southwest (NE/SW) trending Blue Ridge Fault System. South and east of GSMNP, the Blue Ridge borders the Piedmont province of North Carolina with the boundary following the NE/SW trending Brevard Fault Zone. Rocks within the GSMNP include metamorphic Precambrian crystalline basement rocks, metamorphic Precambrian sedimentary rocks, metavolcanic Precambrian rocks, and limited sedimentary rocks associated with the Ridge and Valley province.

The crystalline basement rocks are primarily gneisses with granitic protoliths (parent rock or rock type prior to metamorphism) and metamorphic facies ranging from amphibolite to granulite. Also, pelitic schists and migmatities are locally abundant (Hatcher and Goldberg 1991). Based on radiometric data, the age of most basement rocks is approximately 1200

million years before present (Ma). However, some geologists believe that some basement rocks within GSMNP are as old as 1800 Ma.

The most extensive group of rocks within GSMNP are the unfossiliferous, Precambrian metamorphosed sedimentary rocks (Espenshade 1963; Hatcher and Goldberg 1991; Moore 1988; Southworth 1995). These rocks belong to the Ocoee Supergroup and consists mostly of rocks referred to as metasedimentary, meaning that although the rocks are metamorphosed, they retain much of their sedimentary structure. The Ocoee includes mainly slates, phyllites, schists, and quartzites – all with varying grades of metamorphism. The Ocoee Supergroup has been divided into the following three lithologic units: the Snowbird Group, Great Smoky Group, and Walden Creek Group. Deposition of the Ocoee Supergroup is believed to be related to late Precambrian rifting events, which opened the Iapetus Ocean along the margin of what is now the North American continent. Clastic sediment is believed to have derived from natural weathering processes of the basement rocks and was most likely deposited in elongated, subaqueous rift basins by turbidity currents. Metamorphism occurred later as a result of the deformation related to the Appalachian Orogen. In the western portion of the park, the Ocoee rocks are only slightly metamorphosed (chlorite grade, resulting from low pressure and low temperature) while metamorphic grade increases to the southeast including kyanite and sillimanite-grades (medium to high pressure and temperature) with metamorphic isograds tending to follow low-angle thrust faults (Hatcher and Goldberg 1991).

3.5.3 Local Geology

In 1992, Wiener and Merschat completed a regional (1:250,000) geologic map of southwestern North Carolina, northeastern Georgia, and east Tennessee that includes the entire study area. Also within the study area, three 7.5-minute quadrangles have been mapped showing much greater detail of the local geology and geologic structures. In 1975, Mohr mapped the entire Noland Creek quadrangle, and Southworth (1995) has completed preliminary mapping of GSMNP within the Fontana Dam and Tuskeegee quadrangles. However, Mohr and Southworth's detailed field mapping does not cover the entire study area.

Study Area Rock Formation

3.5.3.1 Geologic Descriptions along the North Shore of Fontana Lake

Locally, rocks along the northern shore of Fontana Lake and within the study area are predominately Late Proterozoic, clastic, metasedimentary rocks of the Ocoee Supergroup. The two exceptions are the basement complex rocks underlying the surrounding area at Bryson City, and two small mafic intrusive rocks exposed between Eagle Creek and Hazel Creek in the northwest quadrant of the study area (Wiener and Merschat 1992). A geologic map of the study area is included as Figure 11. In the following paragraphs, rock units along the north side of Fontana Lake are being described from east to west across the study area with descriptions beginning at the intersection of Fontana Road and US 19 in Bryson City.

Rocks surrounding Bryson City are the oldest rocks within the study area. These rocks are considered the basement complex rocks, and are generally metamorphosed granitic and biotite gneisses. Gneiss is generally a regionally metamorphosed rock in which grainy minerals separate from platy minerals resulting in foliation or banding of like minerals. Wiener and Merschat (1992) described this basement rock as a biotite granitic gneiss (Ybgg), pinkish-gray to light gray, well-foliated to massive, biotite granitic to quartz monzonitic (contains more feldspars and less quartz), with local mylonitization (grains are pulverized during shear, typical within thrust zones) and showing variable grades of metamorphism. Following Fontana Road, the western-most contact of this basement rock and the Copperhill Formation (Zch) is approximately 1.7 miles (2.7 km) northwest of the Fontana Road and US 19 intersection.

The Copperhill Formation (Zch) is primarily a light gray, coarse- and medium-grained, massive- to thick-bedded feldspathic metasandstone (Southworth 1995) or metagraywacke (Wiener and Merschat 1992). It also includes beds of metaconglomerates and nodular calc-silicate granofels (medium- to coarse-grained rock with little to no foliation or lineation) throughout, and minor proportions of a graphitic and sulfidic mica schist. With exception of the basement complex rocks, the Copperhill Formation is the oldest Proterozoic formation in the study area.

Approximately 0.25 mile (0.4 km) farther west along Fontana Road, lies the conformable (no apparent missing time in deposition) contact between the Copperhill Formation and younger Wehutty Formation. The Wehutty Formation (Zwe), as described by Wiener and Merschat (1992), is characterized as being dominated by a dark-gray, graphitic and sulfidic, fine-grained schist with interbedded gray metagraywacke and metaconglomerate and interlayers of muscovite schist. Schists are strongly foliated metamorphic crystalline rocks that can be easily split in thin flakes or plates, and metagraywacke is a metamorphosed sandstone that contains primarily quartz and feldspar grains as well as grains of accessory minerals. Mohr (1975) mapped this unit as the Anakeesta Formation and divided it into five sub-units. He divided the formations using an upper and lower sandstone separated by upper, middle and

lower schists. Southworth's (1995) description of the Wehutty includes a metasandstone, metasiltstone, and phyllite (a low-grade metamorphic argillaceous rock with shiny cleavage surfaces). He also states, "they (Wehutty rocks) contain abundant graphite and sulfide minerals and they physically resemble rocks of the Anakeesta Formation." However, Southworth (1995) went on to state that cross sections by earlier authors have shown that the Wehutty Formation is stratigraphically and structurally higher than the Anakeesta Formation. Therefore, the Anakeesta Formation is nonexistent within the study area. However, dark schists and metashales similar to the Anakeesta rocks are found throughout the study area.

Lake View Road extends across a complete section of the Wehutty Formation and reenters the Copperhill Formation within the western limb of the Murphy synclinorium. Lake View Road trends north for approximately 0.2 mile (0.3 km) and turns 180 degrees back due south, crossing back into the Wehutty Formation. Lake View Road begins a westward trend and after approximately 2 miles (3.2 km) the road leaves the Wehutty Formation and crosses back into the Copperhill Formation. This contact crosses beneath Lake View Road while descending the ridgeline to cross Noland Creek. Approximately 1.2 miles (1.9 km) northwest, Lake View Road ends within the Copperhill Formation at the end of the existing tunnel.

The eastern contact separating the Copperhill Formation from a subdivision known as the Slate of the Copperhill Formation is approximately 13 miles (21 km) due west (Wiener and Merschat 1992). The Slate of the Copperhill Formation (Zchs), as described by Wiener and Merschat (1992), consists of mappable bodies of dark-gray to black, graphitic, sulfidic slate, phyllite and schist. This formation includes interbedded, dark-gray metagraywacke ranging from fine-grained to conglomeratic. This formation contains the massive sulfide deposits associated with the Swain County copper districts. Southworth (1995) described these rocks as forming steep, rusty-stained cliff exposures with no vegetation and being very similar to the Anakeesta and Wehutty Formations. Locally, some metagraywacke units within this area are slightly calcareous and weather easily upon exposure (Espenshade 1963).

The exposed width of the Slate of the Copperhill Formation varies due to folding related to the Murphy Synclinorium. The exposure is widest in the study area and narrows as it trends northeast toward Clingman's Dome. Near the Swain County, North Carolina, and Sevier County, Tennessee line, this formation follows an eastern trend and shows its structural relation within the Murphy Synclinorium.

Approximately 2.8 miles (4.5 km) due west, lies the western contact separating the subdivided slate unit from the main body of the Copperhill Formation. From that contact west to the boundary of the study area, the rocks are mapped as the previously described Copperhill Formation.

Within the Slate of the Copperhill Formation, two small yet mappable mafic intrusive dikes (Pzd) are shown. A dike is a discordant, tabular intrusive rock that crosscuts the surrounding country rock (or rock that was in place prior to intrusion). Wiener and Merschat (1992) described these dike rocks as metadiorite, metabasalt, and amphibolite. These dikes are dark gray to black, medium- to coarse-grained rocks containing primarily well formed, equigranular crystals of hornblende and plagioclase.

3.5.3.2 Geologic Descriptions in the Southeastern Quadrant of the Study Area

Rocks of the Ocoee Supergroup dominate the southeastern portion of the study area. The one exception is the Tusquitee Quartzite, a member of the Murphy Group. In this location, the rocks make up the interior of the Murphy Synclinorium, and the fold axis separating each limb is approximately located along a large thrust fault that follows the Graham and Swain county boundaries and terminates prior to crossing Fontana Lake. These rocks are stratigraphically higher (or younger) than the rocks previously discussed.

Four additional formations and one subdivision, as described by Wiener and Merschat (1992), appear within the study area's southeast quadrant. The formation names and map units as shown in Figure 11 are as follows: The Grassy Branch Formation (Zgb), the Ammons Formation (Zam), the Horse Branch member (Zamh) of the Ammons Formation, the Dean Formation (Zd), and the Tusquitee Quartzite (Znt).

The Grassy Branch Formation is a metasandstone and muscovite schist unit divided into upper and lower parts. The upper portion contains a gray to dark-gray, porphyroblastic muscovite schist and gray metasandstone. The lower member is primarily a gray metasandstone with subordinate muscovite schist. Mohr (1975) mapped and named this unit, and his description also includes bedded and nodular calc-silicate granofels. Porphyroblasts include chlorite, biotite, garnet, and staurolite. He described the metasandstone as fine-grained to pebbly containing quartz, feldspar with minor biotite and with bed thicknesses of approximately 6 feet (1.8 m). The lower unit shows graded bedding within the metasandstone separated by 1-foot (0.3-m) thick beds of muscovite schist. The Grassy Branch Formation is conformably overlain by the Ammons Formation (Mohr 1975).

The Ammons Formation (Zam) is a metasandstone with abundant metasiltstone and muscovite schist. The metasandstone is medium- to fine-grained, quartz, feldspar and biotite, light-gray in color. The schist and metasiltstone contain the same minerals with the addition of minor amounts of magnetite (Wiener and Merschat 1992).

The Ammons Formation contains even beds of metasandstone approximately 4 feet (1.2 m) thick separated by thin (few inches thick [±7.6 cm]) beds of schist and metasiltstone with a total thickness of approximately 4,000 to 5,000 feet (1,219 to 1,524 m) (Mohr 1975). Within

the study area, one subdivision of the Ammons Formation is exposed. The Horse Branch Member (Zamh) conformably overlies the Ammons Formation west of a fault trace in Graham County. The unit is primarily a dark-gray, graphitic and sulfidic mica schist and metasiltstone with interbeds of light-colored metagraywacke, metasiltstone, and muscovite schist. Also, the Horse Branch Member contains a white to bluish-white, thick-bedded, metaquartzite and a porphyroblastic mica schist with garnet and biotite porphyroblasts (Mohr 1975; Wiener and Merschat 1992).

The youngest unit of Ocoee rocks in the study area is the Dean Formation (Zd). Wiener and Merschat (1992) described the Dean Formation as a light-colored sericite schist containing cross-biotite, garnet, and staurolite porphyroblasts. Also, this formation contains beds of metagraywacke and quartz pebble conglomerate in minor amounts in the middle and upper portions (Wiener and Merschat 1992). Mohr (1975) described the Dean Formation as dominated by a metasandstone and porphyroblastic muscovite schist. The description also included nodular and bedded calc-silicate granofels. The metasandstone is gray, fine- to coarse-grained, graded and evenly bedded with bed thicknesses of approximately 6 feet (1.8 m). Mohr (1975) states that the upper portion of the Dean Formation has been removed from the local area by faulting.

The Tusquitee Quartzite/Nantahala Formation (Znt) lies east of the Dean Formation across the Swain County line. This rock unit is predominantly a white to buff feldspathic quartzite with numerous thin layers of dark-gray argillite and dark-gray sulfidic, thin-bedded argillite (Wiener and Merschat 1992). The Noland Creek geologic quad shows the Nantahala Formation separate from the Tusquitee Quartzite and includes the Tusquitee as a subgroup of the Nantahala Formation (Mohr 1975). The description includes a black, sulfidic schist interlaminated with a dark-gray to white quartzose metasiltstone. Mohr (1975) also described this unit as containing a few 3-foot (0.9-m) thick beds of white metaquartzite.

3.5.3.3 Quaternary Deposits

Southworth (1995) mapped alluvial, diamicton, and terrace deposits separately within the Tuskeegee and Fontana Dam quadrangles. These deposits are the result of a variety of mass-wasting events that occur in mountainous terrain. The alluvial deposits are described and mapped as the unconsolidated mixtures of clay, silt, sand, gravel, cobbles, and boulders underlying the floodplains of creeks, streams, and tributaries. These 40-foot (12-m) thick deposits are well- to poorly-stratified and fining upward. Tributaries located in steep terrain are commonly underlain by boulder and cobble-sized rock debris (Southworth 1995).

Diamicton deposits occur in hillside depressions, hollows and coves throughout the study area. These units are unconsolidated, non-sorted to poorly sorted, boulders and cobble-sized deposits of metasandstone transported by gravity and debris flows. These deposits have a

sand, silt, and clay matrix. They are generally transitional to alluvial deposits in stream valleys. Diamicton deposits range in thickness from a thin veneer to a maximum of 40 feet (12 m) thick (Southworth 1995).

The Eagle Creek area contains terrace deposits of unconsolidated sands, gravels, cobbles, and small boulders. These deposits exist as nearly flat-lying benches above the Eagle Creek channel. The terrace deposits are as thick as 10 feet (3 m) and occur as high as 160 feet (49 m) above the Eagle Creek channel (Southworth 1995).

3.5.4 Mineral Resources

The Swain County copper district consisted of two separate mines, the Fontana mine (known locally as the Eagle Creek mine) and the Hazel Creek mine (known locally as the Sugar Fork mine). A brief period of mining operations occurred in 1900 at the Hazel Creek mine; however, these operations ended the same year. This mine remained closed until late 1942. The Fontana mine was discovered by the Montvale Lumber Company in the early 1900s and was later owned by the Ducktown Mining and Iron Co., followed by the Tennessee Corporation. Both mines ceased operations in 1944 following the flooding of the Little Tennessee River, which inundated transportation facilities. The Hazel Creek mine produced in excess of 415,722 pounds (188,568 kilograms [kg]) of copper, and the Fontana mine, during 18 years of operations, produced approximately 83 million pounds (37.6 million kg) of copper (Espenshade 1963).

A 1991 NPS memorandum from the Chief of the Mineral Resources Section of the Mining and Minerals Branch Land Resources Division to the Chief of the Mining and Minerals Branch Land Resources Division regarding the “Investigation of Abandoned Copper Mines in Great Smoky Mountains National Park to Determine their Suitability as Nonpoint Source Projects” examined the safety of the mine openings at Fontana mine and Hazel Creek mine. The memo indicated that in 1987, actions were taken to preserve the bat habitat and safety measures were also taken at both sites to ensure some measure of public safety. However, some mine openings were left unfenced or ungated and these still pose a potential safety hazard to the public due to their age and instability (NPS 1991).

The ore bodies within the mining district contain the copper sulfide ore mineral chalcopyrite, the iron sulfide ore mineral pyrrhotite, and the zinc sulfide ore mineral sphalerite. While these sulfides were the primary ore minerals of interest at that period, other ore minerals within the ore bodies included the galena (lead sulfide), magnetite (iron oxide), and an arsenic ore mineral possibly realgar (arsenic sulfide). Secondary trace minerals like gold and silver were included in this ore deposit, and an undocumented quantity of these minerals were extracted during the mining operations (Southworth 1995). Also, gossan deposits exist within the mining district. A gossan deposit is an iron-bearing weathered zone overlying or

capping the sulfide deposit. This zone occurs as a result of groundwater infiltration and the leaching of copper from the overlying deposit. This copper leaching results in a zone of enriched copper underlying the gossan cap.

In addition to the Swain County Copper District, numerous small exploration pits and prospects exist throughout the study area. Mohr (1975) mapped six separate prospects within the Noland Creek quadrangle. These prospects were primarily developed for sulfide ores; however, kaolinite, beryl, and quartzite were also prospected in these locations (Mohr 1975).

3.5.5 Structural Geology

Regionally, the Blue Ridge is marked by major thrust faulting events, which have occurred at different intervals in its geologic history. Thrust faults are shallow dipping reverse faults in which the rock becomes detached and gets shoved on top and across the underlying rock. Hatcher and Goldberg (1991) described these thrust systems as containing thin-skinned thrust sheets. That is, rocks have become completely detached from the basement rocks and deformation within the separated thrust sheets occurs independently. All rocks exposed in the study area are the hanging-wall rocks of the large thrusts, or simply the rock mass that has been transported above the fault surface. Thrust faults in this area show a direction of displacement toward the northwest with dip direction to the southeast (Espenshade 1963).

More evidence of thrust faulting occurs within the study area at the contact between the basement complex and the Copperhill Formation. Structurally, this area is mapped as a fenster (or a window through the thrust sheet created by erosional processes that exposes underlying rocks of the footwall), in which the basement gneiss (Ybgg) is totally surrounded by metasedimentary rocks of the Copperhill Formation (Zch). The window to the basement rocks, shown in plain view as a thrust fault on Figure 11, is an elliptical-shaped opening that encompasses an area of approximately 2 miles (3.2 km) by 6 miles (9.7 km) with the long-axis oriented northeast and southwest.

Another large structure underlying the eastern portion of the study area is the Murphy Synclinorium. This structure is a regional composite of lesser folds and is recognized in Figure 11 where the Wehutty Formation (Zwe) forms a northeasterly point just outside the study area above Lake View Road. The Wehutty rocks are surrounded or wrapped by older strata (Copperhill Formation), and younger strata line the interior of the Wehutty following the same curvature. Mohr's (1975) map includes a cross section showing the western limb of the Murphy Synclinorium.

As is commonly associated with thrust systems, the study area includes smaller scale folding and faulting throughout. This type of deformation creates both convex and concave folds (plastic deformation) until the rocks cannot withstand the stresses being applied. When this

occurs, the rocks become detached along weak planes creating faults (brittle deformation). Southworth (1995) and Mohr (1975) show alternating synclines (hinge down) and anticlines (hinge up) separated by occasional faults in each of their cross sections. The hinge lines of these folds and strike of the faults are generally oriented northeast and southwest. Locally, strike and dip of bedding and cleavage surfaces vary across the site due to multiple episodes of deformation.

3.5.6 General Geotechnical and Geologic Design Considerations

The extension of Lake View Road from Swain County west through GSMNP will cover complex mountainous terrain with complicated geologic structures. Steep terrain and complex geological issues will necessitate geological, geotechnical, and engineering expertise throughout all phases of the project, including design and construction. The following paragraphs discuss some of the factors that could impact the overall geotechnical design.

3.5.6.1 Acid-Producing Rock Units

A review of published geologic data indicates that due to their mineral content, rocks underlying the entire study area have the propensity to produce acidic drainage. Acid drainage results from the chemical breakdown of iron sulfide minerals like pyrite and pyrrhotite. Although natural weathering of these rocks generates acidic conditions, their excavation (without proper handling) can expedite and exacerbate the production of acid drainage. Unless abated, acid drainage can adversely impact water quality by becoming enriched with heavy metals such as copper, zinc, and lead (Seal et al. 1995).

Seal et al. (1995) concurred that the shale units and the metamorphic equivalents, such as the Anakeesta Formation as mapped by Mohr (1975), the Wehutty Formation (Zwe) and portions of the Copperhill Formation (Zch), have acid-producing potential with an extremely low acid-buffering capacity. Each of these units contains varying amounts of pyrite and pyrrhotite, which is a significant source of acid (Seal et al. 1995). Southworth (1995) stated that the rocks within the study area naturally affect the pH of surface water. Stream and spring affluent samples collected along the study area in the Wehutty Formation contained pH values as low as 2.7. Also, sediments collected along the mouth of Hazel Creek in Fontana Lake showed an elevated increase in copper content, which indicates the input of metal compounds (Southworth 1995).

The name Anakeesta has become a generic term for rocks capable of producing acid drainage, especially in the Blue Ridge region that embraces GSMNP. The name Anakeesta Formation was applied to a rock unit within the Great Smokey Group of rocks by P.B. King during the geologic mapping program in the northwestern portion of GSMNP, and indeed this rock unit does have high potential to generate acid drainage. However, there are some

misunderstandings about the use of the term Anakeesta, especially among non-geologists. One misconception is that the Anakeesta Formation is the only rock unit within the Ocoee Supergroup capable of producing acid drainage when essentially all of the rock units can contain sufficient concentrations of minerals such as pyrite to produce acid drainage. The fact that the Anakeesta Formation is not shown on the geologic maps of the southeastern portion of the GSMNP embracing the North Shore Road project does not mean that Anakeesta-like rocks are not present.

D. W. Byerly (1981, 1982, 1987, 1988a, 1988b, 1989, 1990a, 1990b, 1991a, 1991b, 1993, 1994, 1995, and 1996), Professor Emeritus of Geological Sciences at the University of Tennessee, has conducted research on the production of acid drainage associated with rocks in the Blue Ridge including those of the Ocoee Supergroup present in the project study area. Dr. Byerly has assisted with design and construction of various facilities, including roads, in the same rocks. According to Dr. Byerly (pers. comm. 2003):

- Anakeesta-like formations should not be considered the sole rock type with acid-generating potential. Carbonaceous rocks such as dark-colored schists, slates or phyllites are not the only rock types to produce acid. Sulfide minerals may be disseminated with significant concentrations in light-colored rocks like graywacke, conglomerates, and their metamorphic equivalents etc…. the pyrite, pyrrhotite, or marcasite (pyrite polymorph) is often scattered throughout these rock types, and of a form that easily decomposes (Byerly 1990).

- It is likely that 99% of rocks within the study area could generate acid. These rocks, when excavated, would require special handling during all phases of construction, especially if used for fill material.

- The Copperhill Formation (Zch) is a serious acid-producing formation. This rock unit dominates the study area and is the only rock unit left between the unconnected segments of Lake View Road.

Generally, the more carbonaceous and finer-textured rocks have the highest potential for producing acid drainage. This is a characteristic related to the ancient environments in which the sediment comprising these rock types was deposited. All rocks can contain concentrations of the minerals capable of producing acid drainage, but these occurrences cannot be predicted with certainty even with the use of geophysical testing techniques such as the Self-Potential (SP) and Induced Polarization (IP) methods. No geological testing is anticipated for the EIS process. Because of the nature of these rocks, it is therefore prudent to consider all of the rocks capable of producing acid drainage (Byerly 2003). Engineering properties of soil and rock vary dramatically across the study area. If a build or partial build alternative is selected as the preferred alternative, geotechnical investigations will be completed as necessary.

3.5.6.2 Exposure of Acid-Producing Rock

Excavations and rock cuts within regions of substantial topographic relief usually require relatively large easements to effectively lay back slopes and minimize the potential of rockslides or landslides. In steep terrain, the use of a 2:1 or greater slope to minimize surface area disturbance could still lead to an extensive amount of surface area necessary for exposing acid-generating rock materials. Areas requiring cut and fill designs will require detailed studies of the geologic structures and characteristics to minimize stability issues as well as potential acid drainage.

The design of traditional cut-and-fill roads in mountainous terrain generally requires that very large volumes of material be disturbed while excavating cut slopes and building road embankments. When the surface area of acid-producing material is increased during excavation, natural weathering processes are accelerated and the potential for acid drainage is increased (Byerly 1990). When dealing with acid-producing rock units, Byerly (1996) believes that mountainous terrains in humid, warm environments present the greatest challenge. In these situations, substantial volumes of excavated acid-producing material can be disturbed and exposed, and the fresh, in-situ rocks of the cuts are permanently exposed to weathering elements. Also, the warm and wet climate greatly increases the rate at which oxidation of the exposed material occurs (1996).

To avoid or minimize adverse impacts to plants, wildlife, and water quality when excavating acid-producing material, special design and construction practices are required. Such practices include, but are not limited to the following:

- excavation of acid-producing rock should be avoided where possible and always minimized (Byerly 1990a);
- sites for disposal of all anticipated acid-producing rocks should be identified during the corridor selection phase;
- using state-of-the-art technology in the design of encapsulating sites to isolate and neutralize materials with acid-potential and prevent the mobilization of metals;
- designing road grades and alignments based on the rock's acid-producing potential, including the use of bridging, cantilevered roadways, and "top-down" construction techniques in areas where minimal disturbance is necessary;
- designing diversion systems to prevent surface drainage and groundwater from contacting excavations and embankments where acid-producing material is used for fill; and

- monitoring water quality and the surrounding plant and animal life.

There are several methods used to mitigate excavated acid-producing material. For example, The FHWA uses mitigation guidelines (Byerly 1990a) based on the results of preliminary design Net Acid-Base Accounting (NAB) tests. The following is a brief description of NAB procedures taken from Byerly (1996). NAB tests are conducted on rock samples taken from the proposed alignment. For NAB, pulverized rock is tested in a laboratory to determine the rock's acid-producing potential (AP) as well as its acid-neutralizing potential (NP). Both the AP and NP are expressed in tons of calcium carbonate per 1,000 pounds of excavated material. The net neutralization potential (NNP) is the NP excess or deficiency determined by subtracting the value of AP from the value of NP. The NNP values are used to extrapolate quantities of the material that is to be disturbed. When the NNP values show excess quantities of AP material, FHWA guidelines as well as Tennessee Department of Transportation guidelines (1990) outline mitigation procedures for this material using a combination of the following five techniques:

- Complete removal offsite to a landfill or area designed to accept the material may be required if neutralizing material is not readily available for encapsulation or if excess quantities of fill materials are exposed.

- Blending is used for relatively low acid-producing material. Blending involves mixing rocks with AP with rocks that have NP to create fill material for embankments.

- Treatment is used when acid potential is relatively low to medium. This technique is a modified blending process that requires the placement of pulverized agricultural lime at predetermined intervals atop the blended fill material.

- Encapsulation is used when acid potential is relatively medium to high. This process involves totally encompassing the acidic rock with neutralizing material, low-permeability soils, and geotextile membranes to prevent exposure to water and oxygen.

- An engineered drainage system is required to prevent surface drainage and groundwater from passing through the deleterious rock fill area.

Acid-producing rock material not used for fill will require expedited removal and transport to an appropriate landfill or designated site for proper disposal. The quantity of acid producing material generated during excavations and the quantity of neutralizing material, such as lime, limestone, and cover material, must be carefully evaluated prior to construction to ensure quality control.

3.5.6.3 Exposure of Acid-Producing Rock in Tunnel Design

Should more tunneling be considered within areas of substantial vertical relief, detailed geological and geotechnical studies must be conducted to minimize geologic hazards in this structurally complex region. As previously stated, regional structures strike northeast/southwest and dip to the southeast; however, local attitudes of minor folds, faults, cleavage, bedding planes, and joint sets throughout the study area show moderate to steep dip angles with varying strike and dip directions. In these situations, slope stability and the structural geology of localized areas should be thoroughly investigated to minimize the potential of future wedge failures and other mass wasting events that could potentially impact the road surface. Tunneling would also expose large volumes of rock material that would require mitigation if NNP values showed acid potential.

3.5.7 Soils

The process of soil development depends on both biotic and abiotic influences. These influences include past geologic activities, nature of parent materials, environmental and human influences, plant and animal activity, time, climate, and topographic position. Soil surveys from the 1940s and 1950s exist for Graham and Swain counties; however, this information is so outdated that it has become somewhat useless. According to Mr. Tim Harlan, Swain County Natural Resources Conservation Service soil scientist, updated soil surveys for the counties have not been completed. Soil mapping on privately held lands in Graham and Swain counties is approximately 50 percent completed. (Harlan, pers. comm. 2003). Soil mapping within GSMNP is expected to be completed within two years. (Thomas, pers. comm. 2003).

As of November 2003, an interim soil association map had been developed for the GSMNP. However, this is interim information and is subject to change once soil mapping has been completed. (USDA 2003). For the remaining portions of the project study area, Mr. Harlan, in cooperation with Mr. Thomas, developed a generalized soil association map using an existing geologic map (received by ARCADIS on May 27, 2003). The information provided by Mr. Harlan and Mr. Thomas is based on incomplete field data and should be considered as a rough draft. Figure 12 shows the information from the interim and draft soil associations maps for the project study area.

Soil associations serve as the primary data for understanding the types of soils that exist within the study area. A soil association generally consists of a distinct pattern of soils, relief, and drainage. Typically, a soil association consists of one or more major soils and some minor soils. It is named for the major soils; however, the soils making up one soil association can also occur in other soil associations. Therefore, soil associations provide a broad perspective of the soils and the landscapes in a particular area. According to the interim soil

association map, the following five soil associations are located within the GSMNP portion of the project study area: Cataska-Sylco-Spivey Association, Cataska-Sylco-Tsali Association, Junaluska-Brasstown-Spivey Association, Oconaluftee-Guyot-Chiltoskie Association, and Soco-Stecoah-Spivey Association. According to the rough draft soil association map, the following three soil associations are located in the remaining portions of the project study area: Sylco-Cataska-Spivey-Junaluska-Tsali Association, Evard-Cowee-Trimont Association, and Soco-Stecoah-Cheoah-Spivey-Junaluska-Brasstown Association.

The Cataska-Sylco-Spivey Association in the project study area follows a geologic feature extending from Fontana Dam to the northern boundary of the project study area. Soils in this association are found along side slopes, ridges, and drainageways. These soils range from moderately deep to shallow and are very low in plant nutrients. Upland soils, landslides, and heath balds dominate the landscape where this association occurs. Soils found on heath balds can be in both frigid or mesic temperature regimes. The minor soils included in this association are Clingman and Peregrine, both of which are found on heath balds.

The Cataska-Sylco-Tsali Association covers the far eastern section of the GSMNP portion of the project study area. Soils found in this association are similar to the soils found in the Cataska-Sylco-Spivey Association and, therefore, the association description is the same as above.

The Junaluska-Brasstown-Spivey Association is found north of Fontana Lake from Noland Creek to just east of Hazel Creek. Soils in this association were formed from shale, slate, and metasandstone. Junaluska soils dominate the association and are moderately deep to soft bedrock. Brasstown soils are deep to soft metasandstone. Both of these soils are residual and well drained. Spivey soils were formed from colluvial material that was deposited in the drains and cove-like areas and is very deep and well drained.

The Oconaluftee-Guyot-Chiltoskie Association can be found along higher elevations on Welch Ridge in the project study area. This association is comprised of upland soils found on rock outcrops and heath balds. Oconaluftee and Guyot soils are located on side slopes and Chiltoskie soils are located in colluvial areas. These soils range from very deep to moderately deep. Minor soils in this association include Cataloochee on the residual side slopes and ridges, Breakneck and Pullback on very steep side slopes, Heintooga and Horsetrough in colluvial areas, Clingman and Pergrine on heath balds, and Alarka, Wesser, and Whiteside in hanging coves with organic mats.

The Soco-Stecoah-Spivey Association encompasses the majority of the GSMNP portion of the project study area. Soils in this association are likely to be found on heath balds, rock outcrops, colluvial areas, and shaded head slopes. They range from moderately deep to deep. Soco and Stecoah soils are found on side slopes and ridges and Spivey soils are found in

colluvial areas. Minor soils in this association include Junaluska and Brasstown on side slopes and ridges, Cheoah on shaded head slopes, Clingman and Peregrine on heath balds, Ditney and Unicoi on very steep sides slopes, Santeelah and Nowhere in colluvial areas, and Alarka, Wesser, and Whiteside in hanging coves with rhododendron and white pine or hemlock canopy.

The Sylco-Cataska-Spivey-Junaluska-Tsali Association covers a large portion of the southeastern quarter of the project study area from Meetinghouse Mountain to Jackson Line Mountain. This association is also found on the western side of the study area, including Fontana Dam and Jenkins Ridge. Soils in this association are typically found in coves, on toe slopes, and along drainageways associated with intermediate sized mountains. Slopes in these areas range from 30 to 95 percent. This association is comprised of an equal mix of the nominal soil types, with the minor soils occupying approximately 37 percent of the mapping unit.

The moderately deep, well-drained Sylco soils and the shallow, excessively drained Cataska soils are found on ridgetops and side slopes in the intermediate mountains. These soils are on moderately steep to very steep slopes and are underlain by hard weathered slate. Spivey soils are very deep, well-drained, cobbly soils that typically occur in coves, on toe slopes, and along drainageways. They formed in colluvium and local alluvium moved downslope from soils underlain by slightly to highly metamorphosed rocks of sedimentary origin (USDA 2003). Junaluska and Tsali soils are well drained and on steep south-facing ridgetops and side slopes. The primary difference between these two soil types is depth to bedrock, with Junaluska soils being moderately deep and Tsali soils being somewhat shallow. The minor soils of this first association include Santeetlah soils in drainageways and Cheoah soils on north facing side slopes.

The Evard-Cowee-Trimont Association is present within the far eastern section of the study area, encompassing the relatively flat Bryson City area. Soils in this association are typically found on low mountains that have long side slopes and narrow, winding ridgetops and drainageways. Evard soils comprise over half of the soils in this association with Cowee and Trimont comprising a significantly lesser extent. The minor soils occupy approximately 30 percent of the land area.

The Evard series consists of very deep, well-drained, moderately permeable soils on ridgetops and sideslopes that are commonly south-facing. Cowee soils are similar to Evard, except that they are generally shallower. Once considered a minor soil, the Trimont series is now considered to be common. It is present in cool, shaded side slopes and heads of coves. Beyond differences in topographical position, the Trimont soils are similar to Evard soils. The minor soils include Dellwood, French, Nikwasi, and Reddies soils on flood plains;

Cullasaja, Tate, and Tuckasegee soils in coves; Chestnut and Edneyville soils on intermediate mountains; and Fannin soils in areas that have a higher content of mica on low, rolling hills.

The Soco-Stecoah-Cheoah-Spivey-Junaluska-Brasstown Association covers the central portion of the study area and small areas in the western and eastern corners. The central portion of the study area includes Cable Cove and Stecoah Creek on the southern side of Fontana Lake, and Hazel and Forney creeks on the northern side of Fontana Lake. Soils in this association are typically found in coves, on toe slopes, and along drainageways in the intermediate mountains. Soco and Stecoah soils are dominant, and combined they occupy approximately half of the land area within the association. The Cheoah, Spivey, Junaluska, and Brasstown soils collectively cover more than 25 percent of the land area in the association, with the minor soils occupying the remaining land.

The moderately deep, well-drained Soco soils and the deep, well-drained Stecoah soils are found on ridgetops and side slopes that are usually south-facing. These soils are found on moderately steep to very steep slopes and underlain by weathered, fractured metamorphic rock. The Cheoah series consists of deep, well-drained soils on side slopes that are commonly north facing. Spivey soils, as previously noted, are very deep, well-drained, cobbly soils that typically occur along drainageways. They formed in colluvium and local alluvium moved downslope from soils underlain by slightly to highly metamorphosed rocks of sedimentary origin (USDA 2003). Junaluska soils are moderately deep, well-drained, and located on steep south facing ridgetops and side slopes. Brasstown soils are deep, well drained, and also located on ridgetops and side slopes (USDA 2003). The minor soils include Dellwood, French, Nikwasi, and Reddies soils along flood plains, and Santeetlah soils in coves and on toe slopes.

Hydric soils are defined as soils that are saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions that favor the growth and regeneration of hydrophytic vegetation (Coward et al. 1979). Due to the lack of functional soil surveys for the area, the extent and location of hydric soils in the project study area is unknown. The NRCS has listed Cullowhee-Nikwasi complex, Hemphill clay loam, and Nikwasi loam as hydric soils in Graham County (December 1996) and Silva-Whiteside complex as a hydric soil in Swain County (January 1997).

Due to the immensity of the project study area, engineering constraints and geo-technical properties of the soils vary dramatically across the landscape. Presently, no information concerning the engineering constraints or geo-technical properties of the soils is available. However, if a build or partial-build alternative is selected as the preferred alternative, appropriate investigations of the soils' properties will be conducted within the preferred alternative corridor.

3.6 Water Resources

The study area is within the Little Tennessee River Basin, which is in the Blue Ridge physiographic province of the Appalachian Mountains. The boundaries of the Little Tennessee River Basin lie in North Carolina or on the Tennessee line with the headwater reaches located in Georgia. The basin includes approximately 1,800 miles (2,897 km) of stream channel in Macon, Swain, Jackson, Clay, Graham, and Cherokee counties of North Carolina. The Cherokee Indian Reservation and federal lands account for approximately 49 percent of the basin's watershed. Nearly all of the federal lands are forested, as are most of the privately held lands. The portion of the watershed that is not forested is primarily utilized for agriculture or for residential homes (North Carolina Division of Water Quality [NCDWQ] 2002).

The Southeast Regional Climate Center (SERCC) monitors weather stations across the southeastern United States; one of its sites is located less than 10 miles (16 km) northeast of Bryson City (35°31'N, 83°18'W). Data were collected at this station from November 1958 through December 2001, with monthly normal climate data summarized from 1971 to 2000. The normal annual precipitation for the area is 58.4 inches (148.3 centimeters [cm]), with March and September having the highest and lowest monthly rain totals, respectively (SERCC 2003). The normal daily maximum temperature is 68.5 °F (20.3 °C), and the average daily minimum temperature is 38.9 °F (3.8 °C) (SERCC 2003).

3.6.1 Surface Waters

The largest surface waters within the project study area include Fontana Lake, the Tuckasegee River, the Little Tennessee River, and the Nantahala River. Additionally, there are a large number of tributary streams to the larger surface waters. The project study area is situated in U.S. Geological Survey (USGS) hydrologic unit 06010203 and NCDWQ Subbasin 04-04-02. Surface waters that are discussed in this report are limited to named, perennial streams, as depicted on the USGS 7.5-minute topographic quadrangle maps of the project study area. These USGS maps include Bryson City, Cades Cove, Fontana Dam, Noland Creek, Silers Bald, Thunderhead Mountain, Tuskeegee, and Wesser. Surface waters are listed in Appendix B by NCDWQ Stream Index number. Figure 13 identifies the surface waters in the project study area.

Typical of Streams in Study Area

The NCDWQ classifies surface waters of the state based on their existing or proposed uses. The primary

classification system distinguishes the following three basic usage categories: waters used for public water supply and food processing (Classes WS-I through WS-V); waters used for frequent swimming or bathing (Class B); and waters used for neither of these purposes (Class C) (NCDWQ 2002). Public water supply watersheds are designated WS-I, WS-II, WS-III, WS-IV, or WS-V depending on the type and density of development in the watershed, with WS-I as the least developed and WS-V as the most densely urbanized. Class B waters are protected for primary recreation activities, including swimming, and all Class C uses. Class C waters are protected for fishing, boating, aquatic life, and other uses.

Supplemental classifications may be applied to surface waters that identify unique characteristics of that system and may add additional protective measures. The supplemental classification critical area, denoted CA, means the area is adjacent to a water supply intake or reservoir where the risk associated with pollution is greater than from the other portions of the watershed. The critical area is defined as extending either 0.5 mile (0.8 km) from the normal pool elevation of the reservoir in which the intake is located or to the ridgeline of the watershed. The NCDWQ or local governments may extend the critical area for added protection (15A NCAC 02B .0202). Water supply watersheds and critical areas are depicted on Figure 13.

The supplemental classification Tr denotes Trout Waters. Designated Trout Waters are protected for natural trout propagation and survival of stocked trout. In order to adequately protect these sensitive fish, more protective standards for turbidity, dissolved oxygen, toluene, chlorophyll-a, cadmium, and total residual chlorine levels may be applied. Streams designated as Trout Waters in GSMNP are managed by the Park for native trout. The Park does not stock its streams. The following streams in the study area outside of GSMNP are stocked with rainbow, brook, and brown trout by the North Carolina Wildlife Resources Commission (NCWRC): Panther Creek, Stecoah Creek, Deep Creek, and Alarka Creek.

3.6.1.1 Lower Little Tennessee River Major Drainage Area

The Little Tennessee River is the primary drainage for the project study area. The Nantahala River drains the southeastern portion of the project study area and empties into the Little Tennessee River at Fontana Lake. The Tuckasegee River drains the eastern and northeastern portions of the project study area and empties into the Little Tennessee River at Fontana Lake. All streams draining into the main body of Fontana Lake will be included in the discussion of the Lower Little Tennessee River drainage area. The Nantahala and Tuckasegee rivers and Fontana Lake are discussed in the following sections.

The Little Tennessee River flows in a northerly direction from Georgia into North Carolina, is impounded as Fontana Lake, continues into Tennessee, and empties into the Tennessee River. The Little Tennessee River flows into Fontana Lake at the southeastern edge of the

study area. The backwaters of the lake extend beyond the project study area. Alarka Creek drains the eastern portion of the study area and flows into the lake at Grant Branch. Eagle, Hazel, and Chambers creeks are the main tributaries north of Fontana Lake and are located within GSMNP. The southern portion of the study area is drained by Wolf, Stecoah, Sawyer, and Tuskegee creeks. Cheoah Lake begins immediately downstream of Fontana Dam. Tributaries to Cheoah Lake within the project study area include Walker Branch, Panel Branch, Welch Cove Branch, Gold Branch, Lewellyn Branch, and Sweet Branch.

The Basinwide Water Quality Management Plan for the Little Tennessee River (NCDWQ 2002) lists 149 streams or stream reaches within the Little Tennessee River major drainage area. Of the 149 named streams and reaches within this drainage area, 48 are Class C, 59 are Class C Tr, 3 are Class B, and the remaining 39 are WS-IV waters. Some of the WS-IV waters are additionally classified as WS-IV CA, WS-IV Tr, WS-IV Tr CA, or WS-IV B CA waters. Specifics for all these tributaries are listed in Appendix B. All streams within the project study area of the Little Tennessee River are fully supporting their designated uses (NCDWQ 2002).

3.6.1.2 Nantahala River Major Drainage Area

The Nantahala River drains a small region of the southeastern portion of the project study area. The river begins in Macon County, North Carolina, flows in a northeasterly direction, and empties into the Little Tennessee River at Fontana Lake. Backwaters of Fontana Lake extend beyond the project study area. Four named streams drain the area adjacent to the Nantahala River arm of Fontana Lake in the project study area. They include Jake Branch, Siles Branch, Long Branch, and Pump Branch. (Long Branch is a tributary of Siles Branch.) These four streams are all Class C waters, and the Nantahala River is Class B Tr (NCDWQ 2002). Specifics for all these tributaries are listed in Appendix B. All streams within the Nantahala River drainage area within the project study area are fully supporting their designated use.

3.6.1.3 Tuckasegee River Major Drainage Area

The Tuckasegee River drains the eastern and northeastern portions of the project study area. The Tuckasegee River runs through Bryson City and empties into the Little Tennessee River at Fontana Lake. The major tributaries of this river in the study area include Noland, Forney, Lands, and Deep creeks. (NCDWQ 2002) lists 51 named, perennial streams within the study area portion of the Tuckasegee River drainage area. Of these 51 streams and reaches, 24 are Class C, 22 are Class C Tr, two are Class B, one is Class B Tr, one is Class C Tr HQW, and one is WS-I HQW. The two stream reaches, Jenkins Branch and Lands Creek, are designated High Quality Waters (HQW) from the source of each stream to the Bryson City Water Supply Intake. Specifics for all these tributaries are listed in Appendix B. All streams within

the project study area of the Tuckasegee River drainage area are fully supporting their designated use (NCDWQ 2002).

3.6.1.4 Fontana Lake

The TVA impounded the Little Tennessee River to form Fontana Lake in 1944. The lake is used for generating hydroelectric power and also provides flood control to the river. The lake extends for 29 miles (24 km) along the southern boundary of GSMNP and has a perimeter of approximately 240 miles (386 km). Although the mean depth of the lake is approximately 135 feet (41 m), it may reach a maximum depth of 440 feet (134 m). More than 1,570 square miles (4,066.3 km^2) of mountainous terrain drain into the lake (TVA no date).

The lake is separated into numerous segments for its best use classification. Various segments of the lake are suitable for water supply, primary recreation, and secondary recreation uses and may also be classified as trout waters. The classes assigned to the segments of the lake include WS-IV Tr CA, WS-IV B CA, B, and C. Specific descriptions of the lake classifications are listed in Table 21. Each section of the lake is fully supporting its designated uses.

Table 21

Fontana Lake Classification of Designated Use and NCDWQ Stream Index Number, Graham and Swain Counties, North Carolina

Stream Name	Description	Classification	Basin	Stream Index #
Nantahala River Arm of Fontana Lake, Little Tennessee River below elevation 1,708 msl	Entire Arm	B Tr	Little Tennessee	2-(56)
Little Tennessee River (Fontana Lake below elevation 1,708 msl)	From Nantahala River arm of Fontana Lake to the upstream side of mouth of Shoal Branch	B	Little Tennessee	2-(66)
Tuckasegee River Arm of Fontana Lake, Little Tennessee River, below elevation 1,708 msl	That portion of the Tuckasegee River arm of Fontana Lake above the upstream side of the mouth of Noland Creek	C	Little Tennessee	2-(78)
Tuckasegee River Arm of Fontana Lake, Little Tennessee River, below elevation 1,708 msl	That portion of the Tuckasegee River arm of Fontana Lake below the upstream side of the mouth of Noland Creek	B	Little Tennessee	2-90

Table 21 (Continued)

Fontana Lake Classification of Designated Use and NCDWQ Stream Index Number, Graham and Swain Counties, North Carolina

Stream Name	Description	Classification	Basin	Stream Index #
Little Tennessee River (Fontana Lake below elevation 1,708 msl)	From the upstream side of Shoal Branch to Fontana Dam	WS-IV, B CA	Little Tennessee	2-(140.5)
Hazel Creek Arm of Fontana Lake, Little Tennessee River, below elevation 1,708 msl	Entire arm	WS-IV; Tr CA	Little Tennessee	2-(145)
Eagle Creek Arm of Fontana Lake, Little Tennessee River, below elevation 1,708 msl	Entire arm	WS-IV Tr; CA	Little Tennessee	2-(158)
Little Tennessee River (Cheoah Lake, Calderwood Lake)	From Fontana Dame to North Carolina-Tennessee State Line	C Tr	Little Tennessee	2-(167)

Source: NCDWQ, 2002

3.6.2 Wild and Scenic Rivers

National wild and scenic rivers (WSR) are designated by 16 USC 1271-1287. Selected water bodies possess outstanding remarkable scenic, recreational, geological, fish and wildlife, historic, cultural, or other similar values, and shall be preserved in free-flowing conditions. There are no WSR designations within the project study area (NPS 2003b).

The Nationwide Rivers Inventory (NRI) is a register of river segments that potentially qualify as national wild, scenic, or recreational rivers areas under Section 5(d) of the National Wild and Scenic Rivers Act (NPS 2001a). Eligibility requirements consist of an examination of the river's hydrology and an inventory of its natural, cultural, and recreational resources. A set criteria of outstanding remarkable values (ORVs) are used to determine a river's eligibility. Portions of two stream segments within the project study area are listed on the NRI (Table 22). These segments are depicted on Figure 13.

Table 22
Stream Segments on the National Rivers Inventory Within the Project Study Area

River	Reach	Length (mi)	Year Listed/ Updated	ORVs	Description
Nantahala River	Lake Fontana to Nantahala Lake	18	1982/ 1993	S, R, G, W	Nantahala Gorge is most extensive formation in southwestern North Carolina of limestone and Murphy marble. Number of rare or endemic plants. Whitewater boating, fishing, and viewing scenery.
Tuckasegee River	RM, Bryson City, to RM 53 Lake Cedar Cliff Impoundment	38	1982	S, R, G, F, W, H, C	Scenic, natural stream that flows through ancestral home of members of the Cherokee Nation; significant potential for recreational activities.

RM – River Mile
ORVs: S-Scenery; R-Recreation; G-Geology; W-Wildlife; F-Fish; H-History; C-Cultural
Source: NPS 2001b

3.6.3 Water Quality

3.6.3.1 Overview

The Lower Little Tennessee River subbasin, including the project study area, contains some of the most pristine area and some of the cleanest water in North Carolina (NCDWQ 1997). The portion of the basin surrounding Fontana Lake also contains some of the most famous trout streams in the state, including Hazel, Forney, Deep, and Noland creeks (NCDWQ 1997). There are several existing factors that could potentially degrade water quality in the project study area. GSMNP, including the project study area, receives high total atmospheric deposition of sulfur and nitrogen. In addition, there are large areas of shallow, poorly buffered soil. Over time, this acidic rainfall and poorly buffered soil could eventually lead to increased acidity of the waters, including Fontana Lake, within the project study area (Flum and Nodvin 1995).

Streams in the Lower Little Tennessee River subbasin were characterized by NCDWQ (1997) as slightly acidic pH, low in nutrient concentrations, and low conductivity. All of these conditions indicate good water quality. The good water quality is likely the result of a dominantly forested watershed. More than 89 percent of the land in the basin is forested, and less than 5 percent falls into the urban/developed category (NCDWQ 2002).

Streams in undeveloped areas generally exhibit excellent water quality (NCDWQ 2002). Streams in developed areas often have elevated turbidity after storms due to increased

erosion. NCDWQ (1997) found that most major streams become turbid after rain events, and increased sediment inputs have caused habitat degradation and stress to aquatic organisms. Erosion is an example of nonpoint source pollution.

Point source dischargers throughout North Carolina are regulated through the National Pollutant Discharge Elimination Shystem (NPDES) program. Dischargers are required by law to register for a permit. According to NCDWQ (2002), there are three minor dischargers within the project study area. The three dischargers are the Bryson City Wastewater Treatment Plant (WWTP), the TVA – Fontana Hydro Plant, and the Peppertree Fontana Village WWTP (Table 23). The permit issued for the Bryson City WWTP requires monitoring of the whole effluent toxicity. The plant has no history of noncompliance (NCDWQ 2002). Reports were not available for Fontana Hydro Plant and Peppertree Fontana Village.

Table 23

National Pollutant Discharge Elimination System Permit Holders Within the Project Study Area

Permit Number	Facility	Type, Class	Receiving Stream
NC0026557	Bryson City WWTP	Municipal, Minor	Tuckasegee River
NC0027341	Fontana Hydro Plant	Industrial Process & Commercial, Minor	Little Tennessee River (Cheoah Lake)
NC0023086	Peppertree Fontana Village	Industrial Process & Commercial, Minor	Little Tennessee River (Cheoah Lake)

Source: NCDWQ 2002

NCDWQ sampled Fontana Lake in 1981, 1982, 1987, and 1994. Results from all four sampling events revealed a North Carolina Trophic State Index (NCTSI) score indicative of oligotrophic conditions (NCDWQ 1997). The NCTSI is computed using the following measured parameters: total phosphorus, total organic nitrogen, secchi depth, and chlorophyll-a. As a result, lakes are classified as oligotrophic, mesothropic, eutrophic, or hypereutrophic. Oligotrophic conditions characterize a lake with low biological productivity as a result of very low concentrations of available nutrients in the water, whereas eutrophic conditions characterize high biological activity as a result of high nutrient availability. Lakes with oligotrophic conditions are typically very clear and have good water quality. Oligotrophic lakes in North Carolina are generally found in the mountain region or in undisturbed (natural) watersheds.

TVA monitored Fontana Lake annually from 1993 until 1996 and biennially thereafter. In 2000, Fontana Lake rated fair. This monitoring indicated a decrease in dissolved oxygen levels in the bottom waters of the lake. In addition, the monitoring has shown a gradual increase in chlorophyll levels in the middle of the lake. This may be an early sign of nutrient enrichment. There was no change in the fair rating for fish communities in 2000 from previous years, and there were no fish consumption advisories. Low levels of pesticides were found in sediment samples in the Tuckasegee River arm of Fontana Lake. However, little to no pesticides were found in the sediments in the Little Tennessee River at and near the dam of Fontana Lake. Fecal coliform bacteria levels were below North Carolina limits for safe water contact; therefore, there were no advisories against swimming in Fontana Lake in 2000 (TVA 2003).

A 1978 study of sediments in Fontana Lake found manganese, copper, and zinc in concentrations similar to areas receiving industrial pollution (Abernathy et al. 1984). Higher copper concentrations were found in Hazel and Eagle creeks than any other sampling locations. These concentrations were attributed to former copper mines in the drainage basins of those streams. High levels of manganese and zinc were attributed to geologic sources. Chemical analysis of Anakeesta rock formations showed relatively high concentrations of the same metals found in the sediments. (These rocks have been determined not to be Anakeesta rock, but a similar acid-producing rock. More detailed geology information is available in Section 3.5.) Currently, the metal accumulations in the sediment do not pose a risk; however, an increase in the acidity of the lake water would increase the biological risk of the heavy metals in the sediment.

In general, the water quality of Fontana Lake is good; however, the lake should be monitored regularly for changes as development in the watershed continues. Based on data collected by TVA, Fontana Lake is starting to exhibit degraded water quality with increased chlorophyll-a levels and decreased oxygen levels.

3.6.3.2 Benthic Evaluation

Benthic macroinvertebrate monitoring provides a reliable tool for determining water quality conditions over several years. Benthic macroinvertebrates are sensitive to subtle changes in water quality and have a short life cycle, ranging from six months to over one year. The benthic macroinvertebrates that are most often tracked for water quality determinations are the pollutant intolerant Orders of Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies), collectively referred to as EPTs. The NCDWQ has developed a biotic index (NCBI) and in conjunction with taxa richness classifies the water quality of each stream as Excellent, Good, Good-Fair, Fair, and Poor. The NCBI was developed by NCDWQ specifically for North Carolina and is based on the abundance and tolerance value of a species. The lower the NCBI the higher the stream water quality (NCDWQ 2001).

NCDWQ has seven benthic macroinvertebrate monitoring stations within the project study area. The monitoring stations are located, in order from upstream to downstream, at Deep Creek near SR 1340, Noland Creek near its mouth with Fontana Lake, Forney Creek near its mouth with Fontana Lake, Bear Creek near its mouth with Fontana Lake, Panther Creek near SR 1233, Stecoah Creek near SR 1237, and Hazel Creek near its mouth with Fontana Lake.

Sampling was conducted in 1999, which resulted in an Excellent bioclassification at all seven stations (NCDWQ 2002). An older sampling study from 1994 generated a bioclassification of Good for the Stecoah Creek monitoring station and Excellent for the other six stations (NCDWQ 1997). The NCDWQ attributes the bioclassification change of Stecoah Creek to a change in the flow regime of the stream rather than to a true improvement in water quality of the stream. The 1994 sampling was performed during a period of high flow, and the 1999 sampling was performed under low-flow conditions. High-flow conditions tend to scour some of the more intolerant taxa from the streambeds and produce a lower water quality rating. Based on the benthic macroinvertebrate data, water quality throughout the basin appears to be stable.

Two sampling sites are located on Deep Creek, near SR 1340, which is within the project study area, and above the campground, which is upstream of the project study area within GSMNP. The second Deep Creek site is in a part of the stream that receives heavy recreational use in the summer. Both sites had similar EPT taxa richness scores in 1994 (47 and 50) and 1999 (47 and 45); however, the number of less tolerant species declined at the downstream site, indicating slightly degraded conditions (NCDWQ 1997; 2000; 2002). Since there were few differences in water quality between the two sites, the decline in EPT species could be the result of habitat differences between the two sites, including a more embedded substrate, more breaks in the riparian buffer, fewer pools, and greater periphyton growths at the downstream site. However, both sites on Deep Creek are classified as having Excellent water quality.

Noland Creek's watershed is located within GSMNP and is characterized by high quality riparian and in-stream habitat. The 1999 sampling study was the first study at this site near Fontana Lake. An EPT taxa richness of 40 classifies the stream with Excellent water quality (NCDWQ 2000; 2002).

Like Noland Creek, Forney Creek is also located within GSMNP and is characterized by good habitat and water quality. Sampling in 1994 and 1999 resulted in identical EPT values (46) and nearly identical taxa richness scores (79 and 81, respectively). The NCBI scores are the best values recorded in the state (NCDWQ 1997; 2000; 2002).

Bear Creek, a tributary to Forney Creek, is the third stream sampled that is situated within GSMNP. Like Noland and Forney creeks, the drainage area that feeds this stream is located

in an undisturbed, forested portion of the park. Sampling was conducted only in 1994. The rocky substrate and clear water in Bear Creek support high EPT taxa richness (44) and overall taxa richness of 71. The taxa represented in the creek are dominated by highly intolerant species (NCDWQ 1997).

Hazel Creek watershed is located entirely within GSMNP. Due to its relatively undisturbed setting, high quality habitats are found in Hazel Creek. The total and EPT taxa richness scores were 96 and 47 in 1994 and 106 and 56 in 1999 (NCDWQ 1997; 2000; 2002). Nine new EPT taxa were collected in 1999 that were not observed in the 1994 study. Again, the increase in taxa richness from 1994 to 1999 is attributed to a difference in flow regime. Hazel Creek was classified as Excellent in both sampling years.

Sampling from Panther Creek, on the south side of Fontana Lake at SR 1233, produced slightly lower EPT taxa richness than above. The EPT taxa richnesses were 37 and 39 in 1994 and 1999, respectively. The stream is still classified as Excellent water quality; however, the stream was noted to exhibit many of the habitat degradation issues consistent with residential and agricultural development in the southern portion of the basin (NCDWQ 1997; 2000; 2002).

Stecoah Creek is also situated in a developed area of the southern portion of the project study area. The bioclassification was rated Good in 1994 and Excellent in 1999 (NCDWQ 1997; 2000; 2002). The change was based on a significant increase in the EPT taxa richness (29 and 39, respectively). Some of the less tolerant species that were abundant in the 1999 sampling were rare or absent in the 1994 collections. High-flow conditions in 1994 were indicated as the reason for the taxa flucuations. The NCDWQ expects the bioclassification of Stecoah Creek to fluctuate between Good and Excellent as flow conditions fluctuate.

The NCDWQ lists the primary water quality problem in the basin as nonpoint source runoff due to development along the various streams in the basin (NCDWQ 2000). The runoff contributes to elevated inputs of nutrients and/or sediment. Residential and agricultural development is most prevalent along stream corridors where inadequate riparian buffers are being left intact (NCDWQ 2000). Sediment and nutrients are moving into the streams at increasing rates. The documented changes in the affected streams do not indicate a degradation of the water quality, but do indicate a degradation of the stream habitat. Habitat degradation in the basin includes few pools, relatively uniform riffles and runs, an embedded substrate, elevated conductivity, sediment deposition, riparian zone with frequent breaks or narrow width, bank erosion, and abundant periphyton. Benthic macroinvertebrates are more sensitive to changes in water quality than to changes in habitat. The habitat degradation is expected to have a greater effect on the fish in the streams than on the benthic macroinvertebrates, although there are no recent data to verify this hypothesis (NCDWQ 2000).

Negative effects of the habitat degradation on benthic macroinvertebrate species richness are not sufficient to lower the bioclassification of the stream. Undisturbed streams are characterized by highly intolerant species and a very low biotic index score. Disturbed streams have fewer individuals of the highly intolerant species, but the resulting biotic index score is still within the Excellent bioclassification range. Habitat degradation effects may not be reflected in the bioclassification for this reason.

3.6.3.3 Great Smoky Mountains National Park Studies

3.6.3.3.1 Hazel Creek Watershed

Data obtained from GSMNP include specific water quality data for Hazel Creek watershed (Robinson et al. 2003). Within the project study area, there are eight monitoring sites on Hazel Creek. Data were collected quarterly between March 1994 and November 2002. Table 22 summarizes key parameters to characterize the water quality of the watershed. Sites are listed in order from upstream to downstream, with site 479 collected at the mouth of Hazel Creek and Lake Fontana. Sugar Fork is a tributary to Hazel Creek whose confluence with Hazel Creek is located upstream of site 311.

Stream pH is an overall indicator of the ability of the stream to sustain aquatic life. Baker et al. (1996) propose that streams with pH greater than 6.5 have no adverse biological effects; pH between 6.5 and 6.0 has loss of sensitive benthic invertebrates; pH between 6.0 and 5.5 has loss of acid-sensitive fish; pH between 5.5 and 5.0 has loss of most fish and EPT species; and pH less than 5.0 has loss of all fish species. In the study, median pH values were slightly below or equal to 6.5, although minimum values were always greater than 6.0. Biological sampling has shown no decline in macroinvertebrate species. Therefore, the pH of streams within the project study area does not appear to be degraded. Acid-neutralizing capacity (ANC), related to pH, is a measure of the ability of a stream to neutralize a strong acid. ANC greater than 50 microequivalent per liter (µeq/L) are within the acceptable range (Rounds and Wilde 2001). All streams within the Hazel Creek watershed portion of the project study area are within the acceptable range.

Atmospheric deposition is the main source of nitrate and sulfate in surface waters within GSMNP. Generally, nitrate concentrations are very low on Sugar Fork Creek and slightly higher on Hazel Creek (Table 24). In general, median nitrate concentrations increase with elevation. Robinson et al. (2002) found similar results on a park-wide analysis of data. Sulfate concentrations were higher on Sugar Fork Creek compared to Hazel Creek. Little Fork, a tributary to Sugar Fork Creek, had median sulfate concentrations twice as high as any other site. This high concentration may be due to undisturbed parent rock material or disturbed waste rock from mines. These average values are indicative of high water quality within Hazel Creek and its watershed.

Cations, calcium, and magnesium are dissolved in water and are important to vegetation and aquatic species. Cations in the terrestrial ecosystem provide a buffering effect to acidic atmospheric deposition. Leaching of calcium and magnesium from the watershed may result in higher nitrate and sulfate concentrations (within the watershed and stream) and consequently lower stream pH. Median concentrations of both calcium and magnesium were higher on Sugar Fork Creek compared to Hazel Creek (Table 24). Similar studies on Noland Creek from 1991 to 1996 suggest that the export of calcium concentrations is increasing over time (Flum et al. 1997). However, there are not enough data available in the Hazel Creek watershed to determine if a similar trend exists (Robinson, pers. comm. 2003).

Table 24

Summary of Hazel Creek Water Quality Data, Sampling from 1994-2002

Site ID	pH	ANC µeq/L	NO_3^- µeq/L	SO_4^{2} µeq/L	Ca* µeq/L	Mg* µeq/L
Sugar Fork Creek						
(482) Above Little Fork	6.49	81.16	2.41	20.96	45.45	34.98
481 Little Fork	6.47	83.04	0.00	52.29	53.93	44.69
(483) Above Haw Gap Creek	6.51	84.24	0.00	29.20	47.23	33.25
(480) Campsite 84	6.51	79.73	1.86	21.36	45.95	27.00
Hazel Creek						
(484) Above Bone Valley Creek	6.44	53.11	6.46	16.19	34.10	18.44
(310) Bone Valley Creek	6.49	71.41	4.05	20.82	44.20	25.35
(311) Below Sugar Fork Creek	6.48	63.54	4.59	17.22	38.50	20.82
(479) Campsite 86	6.46	67.75	3.68	17.66	41.15	21.89

* Sampling from May 2000 to November 2002.

NO_3^- = Nitrate SO_4^{2-} = Sulfate Ca = Calcium Mg = Magnesium

(µeq/L) = microequivalent per liter

Source: Robinson et al. 2003

3.6.3.3.2 Effects of Acid Deposition

The NPS has conducted studies of the streams within GSMNP to monitor the potential impacts from acidic atmospheric deposition (NCDWQ 2000; Flum et al. 1997; Robinson et al. 2002; Robinson et al. 2003). The studies include the collection of over 2,500 pH measurements from 350 streams in the park. Low pH values were found in several tributaries

of Fontana Lake, including Noland, Forney, and Eagle creeks (NCDWQ 2000). The tributaries identified have headwaters in old growth, undisturbed forests at elevations above 4,000 feet (1,219 meters) above msl. Years of acid rain and other acid precipitation have saturated the forest system with nitrogen. The system's ability to neutralize the resulting acidity is depleted, and high concentrations of aqueous nitrate result and are carried into the streams.

Streams within GSMNP have elevated levels of nitrate throughout the year. Streams that do not receive acid rain have normal stream concentrations ranging from 1 to 3 µeq/L (Flum et al. 1997). Flum et al. (1997) have shown that nitrate concentrations increase with elevation within GSMNP. Areas around Clingman's Dome appear to have high enough concentrations to be close to nitrogen saturation.

The Noland Divide Watershed (NDW) was set up as a small watershed study to examine the long-term relationship between deposition and stream water quality (Flum et al. 1997). Sampling stations included an atmospheric deposition collector at 5,709 feet (1,740 meters) above msl, a soil station, and a stream gauging station. Results from 1991 to 1996 indicate high rates of nitrogen and sulfur deposition, 893 and 2,100 equivalent per hectare per year (eq/ha/yr), respectively, compared to other areas in the United States that also receive acid rain. Two streams within the watershed were monitored for water quality. In the study area, nitrate was the predominant acid anion in these streams (Nodvin et al. 1995). Generally, nitrogen is limiting in forested ecosystems and all available nitrogen is consumed by biological uptake. This is not the case at NDW; instream nitrate concentrations ranged from 40 to 80 µeq/L with seasonal variation of higher concentrations in the winter. The concentration of sulfur ranged between 20 and 75 µeq/L, also with seasonal variation of higher concentrations in the winter. These sulfur concentrations are low compared to other streams in the northeastern United States. These results suggest that sulfur adsorption is high whereas nitrogen adsorption is low.

The amount of nitrogen entering the watershed through atmospheric deposition equals the amount of nitrogen exiting the watershed in the streams. This suggests that the NDW is near the saturation point. It is unknown if most of the nitrogen in the streams is from precipitation moving rapidly through the watershed with little interaction within the watershed or how much is the result of high nitrogen cycling after vegetation interaction. Vegetation uptake influences the amount of nitrogen leaching to streams. A young forest will uptake more nitrogen than an older forest. Therefore, as a forest ages nitrate leaching will increase. Additionally, nitrate leaching will be greater in the dormant season.

The major concern for water quality in the NDW is the low level of base cations such as calcium. Low concentration of cations means that anions (i.e., nitrate) will be balanced by hydrogen ions or potentially toxic aluminum ions. The effects of nitrate and sulfate reaching

the streams are sufficiently high enough to create chronically low pH and low ANC. Leaching rates are thus the key to understanding the loss of base cations, soil acidification, and ultimately stream acidification in GSMNP (Flum et al. 1997).

Water quality sampling throughout GSMNP indicates that water quality in NDW is typical of water quality at high elevations throughout the park. Although stream acidification is occurring at high elevations, water quality is generally not impacted below approximately 3,000 feet (914 meters) above msl (Flum et al. 1997). The main concern is that the process of nitrogen saturation and subsequent stream acidity increases at higher elevations will eventually impact lower elevation streams and lakes.

3.6.3.3.3 Effects of Historical Mining Operations

The USGS has conducted studies of the effects of historical mining operations on the groundwater and surface waters in the area surrounding the mines (Seal et al. 1997). The two historical mines that were researched and studied are the Fontana Mine, located near the headwaters of Eagle Creek, and the Hazel Creek Mine, located near the headwaters of Hazel Creek. Commodities produced from these mines include copper, zinc, lead, silver, and gold. Both mines are classified as massive sulfide deposits, being more than 50 percent dominated by heavy sulfide minerals (Seal et al. 1997). The sulfide minerals common to the mine areas include pyrrhotite, pyrite, chalcopyrite, sphalerite, and galena. The sulfide deposits are situated between thick sequences of metamorphosed sedimentary or volcanic rocks. The sulfide minerals are easily oxidized or decomposed to sulfuric acid enriched with heavy metals, but the surrounding rock formations are limited in their capability to neutralize the acid. By this mechanism, water quality can be adversely affected by rock formations of this type.

The mineral deposits at the mines are highly weathered, with the primary sulfide ore being oxidized, decomposed, and overlain by an intermediate zone of secondary enrichment that is situated between the unweathered sulfide ore and the reddish-brown cap of iron-oxide material (Seal et al. 1997). The intermediate zone is formed when the sulfide minerals at the surface are weathered and react with groundwater; the copper that is released leaches downward through the profile to form new copper minerals. The zone typically contains very high-grade ores. Water table and climatic variability over time cause more of the primary ore to be affected by the intermediate zone. The iron-oxide cap also contains the remnants of weathered sulfides.

Current threats to water quality in the streams associated with and surrounding the mines include weathering of unmined primary sulfide ore, unmined ore from the intermediate zone, and pyretic county rocks (Seal et al. 1997). Water samples were collected from surface waters within the mines, streams that flow past the mines, and streams in watersheds other

than those affected by the historical mining operations. The samples were analyzed to determine the effects of the exposed rocks and minerals on the quality of the waters flowing through the mines, the waters into which the minerals may be carried through surface or subsurface flow, and to compare the effects to those associated with waters flowing through or over undisturbed mineral deposits of similar composition.

Results from the water sampling showed a wide range of pH values and concentrations of dissolved metals and other constituents. The most extreme values were found in the samples taken from the waters associated with the Fontana Mine, where the lowest pH value was found to be 2.4 (Seal et al. 1997). Maximum values for all dissolved constituents investigated were found to be well above regulatory standards (Table 25).

Samples taken from the Hazel Creek Mine and nearby streams indicated a minimum pH of 3.7 and lower maximum values for dissolved constituent concentrations than those associated with Fontana Mine waters. Lead is the one metal for which the maximum concentration found in the waters associated with Hazel Creek Mine is greater than that of the Fontana Mine. Lead solubility may be related to the solubility of the lead-sulfate mineral, anglesite. Lower sulfate concentrations are associated with higher lead concentrations, and the lowest sulfate concentration found in the Fontana Mine waters is greater than the highest sulfate concentration found in the Hazel Creek Mine waters. It is also important to note that all mine waters exceeded aluminum toxicity limits for freshwater fish, and mine effluent waters exceeded the toxicity limits of zinc and lead in all samples and aluminum in some samples (Seal et al. 1997).

Results from sampling the waters near the mines reveal variability in the water quality both upstream and downstream of the mine sites. The range of pH values is 5.5 to 7.8, which is slightly more basic than the range found for streams that drain areas underlain by the Anakeesta and Copper Hill formations (4.0 to 7.0 pH range) (Seal et al. 1997). With the exceptions of iron and aluminum, the dissolved constituent concentrations in these streams, waters near the mines, were lower than those in the mine waters and higher than those in the waters situated away from known mining activity. In the cases of iron and aluminum, the waters away from the mines contain higher concentrations than do the waters near the mines. It is presumed that areas of natural “acid-rock drainage” within the Anakeesta formation away from the mines are the cause of the elevated levels of dissolved iron and aluminum in these waters (Seal et al. 1997).

Sampling was also performed in portions of Fontana Lake in order to determine the effects of the mining activities on the water quality of the lake. The samples taken from within 3 meters of the mouth of the stream that flows past Fontana Mine are indistinguishable from the samples taken from the center of the lake and from the bottom of the dam (Seal et al. 1997). From these data, it is concluded that the historic mining activity in the Fontana Lake

watershed area currently negatively impacts the water quality of nearby surface waters; however, the mining activity is not currently having a negative impact on the waters of the lake. Natural dilution of the stream waters as they flow downstream toward the lake appears to be an effective mitigation process (Seal et al. 1997). If a build or partial-build alternative is selected as the preferred alternative in the EIS process, mining surveys will be conducted if applicable.

Table 25

Comparison of Selected Water Quality Parameters for Fontana and Hazel Creek Mines

	Fontana Mine		Hazel Creek Mine		
Parameter	High	Low	High	Low	Acute Toxicity[1]
pH	3.2	2.4	6.4	3.7	
Dissolved Oxygen (mg/L)	12.0	8.0	8.0	6.0	
Alkalinity (mg/L $CaCO_3$)	0.0	0.0	3.0	0.0	
SO_4 (mg/L)	11000.0	270.0	150.0	19.0	
Hardness (mg/L $CaCO_3$)	988.0	94.2	76.0	8.3	
Fe (µg/L)	2600000.0	9.7	7800.0	0.1	
Al (µ g/L)	140000.0	8300.0	3300.0	<0.01	
Cu (µg/L)	290000.0	11000.0	16000.0	<0.5	0.97
Zn (µg/L)	430000.0	7500.0	11000.0	960.0	8.73
Cd (µg/L)	840.0	9.2	30.0	<0.02	0.137
Pb (µ g/L)	380.0	33.0	620.0	<0.05	2.11
Total Base Metals (mg/L)	722.4	18.7	27.6	1.7	

[1] Criterion Maximum Concentrations were calculated based on the average hardness (4.8 g/L $CaCO_3$) of the streams away from areas of past mining.

µg/L	micrograms per liter	mg/L	milligrams per liter
$CaCo_3$	Calcite	SO_4	Sulfate
Fe	Iron	Al	Aluminum
Cu	Copper	Zn	Zinc
Cd	Cadmium	Pb	Lead

Source: Seal et al. 1997

3.6.4 Sole Source Aquifiers

The United States Environmental Protection Agency (USEPA) protects waters that are designated as a sole source aquifer. The designation is given to waters that are the only or one of few sources of drinking water for an area. If sole source aquifer waters are contaminated, use of an alternative source of drinking water would be extremely expensive. In order to ensure protection of these waters, any proposed project within a designated area receiving federal funding must be reviewed by USEPA. No sole source aquifer areas are designated within the project study area (USEPA 2003).

3.6.5 Wellhead Protection Program

The USEPA developed the Wellhead Protection Program (WHPP) as part of the 1986 amendments to the Safe Drinking Water Act. The WHPP requires each state to develop a program to protect wellhead areas from contaminants that may present a health risk to the persons drinking the water. North Carolina's WHPP provides support to communities within the state that choose to develop and implement a community-wide WHPP. The list of participating communities with an approved wellhead protection plan changes frequently. Currently, no wellhead protection plans have been approved for any community within the project study area (NCDENR 2003).

3.6.6 Groundwater Recharge Areas

Groundwater recharge occurs when water moving into the groundwater system arrives at the top of the saturated zone. The North Carolina Division of Environmental Management calculates the total recharge areas by subtracting the total discharge area from the total land area. Less than 0.03 percent or 38.5 acres (15.6 ha) of the project study area is mapped as a discharge area (Heath 1994). Therefore, almost the entire project study area is considered a recharge area.

Study Area Wetland

Climate, vegetation, land use, and soil characteristics are factors that affect the rate of recharge. The recharge rate for most of the Blue Ridge physiographic region, including the project study area, is estimated as 600,000 gpd/square mile (5,883 cmd/km^2) (Heath 1994). Estimates of recharge on such a regional scale are based on the assumptions of uniform conditions in

the aquifer and in the drainage basin. Therefore, refinement of characteristics specific to the project study area may result in a different estimated groundwater recharge rate (Daniel and Dahlen 2002).

3.7 Wetlands

This section provides information on jurisdictional waters, both as wetlands and surface waters, and the regulations governing activities in these areas.

"Waters of the United States" or jurisdictional waters are defined in the Clean Water Act (CWA) as water bodies including lakes, rivers and streams, and wetlands. Wetlands for the purposes of the CWA, are those areas that are inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support, and under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions (33 CFR 328.3). A second definition of wetlands, developed by the United States Fish and Wildlife Service (USFWS), views wetlands from a more ecological standpoint. This classification system is used for mapping wetlands for the National Wetlands Inventory (NWI) Project. Wetlands must have one or more of the following three attributes: (1) at least periodically, the land supports predominantly hydrophytes; (2) the substrate is predominantly undrained hydric soil; or (3) the substrate is nonsoil and is saturated with water or covered by shallow water at some time during the growing season of each year (Cowardin et al. 1979). Finally wetlands and surface waters may be viewed from a very strict standpoint such as navigable waters or as the shoreline of the TVA reservoirs, the Tennessee River, and its tributaries. All of these definitions or classifications, along with their corresponding regulations or guidelines, are applicable in the project study area.

3.7.1 Regulatory Requirements

Actions that affect wetlands and surface waters are guided and regulated by numerous federal laws and orders including EO 11990, the Clean Water Act, the Rivers and Harbor Act, and the TVA Act. These laws and orders are described below along with any associated management plans and state regulations.

Executive Order 11990 establishes the "Protection of Wetlands" for federal agencies in order to "...avoid to the extent possible the long and short term adverse impacts associated with the destruction or modification of wetlands and to avoid the direct or indirect support of new construction in wetlands wherever there is a practicable alternative." The NPS policies, requirements, and standards for implementing EO 11990 are established in Director's Order (DO) #77-1. The responsibilities and procedures described in EO 11990 and the DO #77-1 are detailed in the Procedure Manual #77-1. In a manner consistent with EO 11990, the NPS has adopted a goal of "no net loss of wetlands" and was directed to conduct park-wide

wetland inventories. The USFWS's classification system by Cowardin et al. was adopted by the NPS for defining, classifying, and inventorying wetlands. The USFS Manual Section 2527 (Floodplain Management and Wetlands Protection) in compliance with EO 11990, establishes guidelines to minimize destruction, loss, and degradation of wetlands and preserves/restores the functions of wetlands.

The CWA, passed into legislation in October of 1972, requires regulation of discharges into "Waters of the United States." The objective of the CWA is to maintain and restore the chemical, physical, and biological integrity of the Waters of the United States. The USEPA is the principal administrative agency of the CWA; however, the USACE has the responsibility for implementation, permitting, and enforcement of provisions of the Act. Specifically, Section 404 of the CWA authorizes the USACE to issue permits for the discharge of dredged or fill material into the "Waters of the United States," including wetlands. The USACE regulatory program is defined in 33 CFR 320-330. Before any activities occur, applicable permits must be obtained and any compensatory mitigation must be determined.

Under Section 401 of the CWA, a Section 401 General Water Quality Certification is also required for any activity which may result in a discharge into "Waters of the United States" or for which an issuance of a federal permit or license is issued. In North Carolina, the NCDWQ is responsible for issuing a Water Quality Certification. They will certify that a given project will not degrade waters of the State or otherwise violate state water quality standards (15A NCAC 2B.0200). The USACE cannot issue a Section 404 permit until a Section 401 certification is issued.

The CWA, under Section 402, also provides guidelines and limitations for effluent discharges from point source discharges that are administered as the NPDES (15A NCAC 02H). NPDES permits in North Carolina are obtained from NCDWQ. A NPDES permit is required for stormwater discharges into "Waters of the United States" associated with construction activities. The NPDES permit requirements include the implementation of a comprehensive stormwater management program, monitoring of the program, and annual reports to outline the program's effectiveness and direction.

The Rivers and Harbors Act of 1899 (33 USC 403) prohibits the creation of any obstruction to the navigable capacity of any "Waters of the United States" without approval of the USACE. Section 9 of this Act prohibits the construction of any bridge, dam, dike, or causeway over or in navigable waterways of the United States without approval. Structures authorized by state legislatures may be built if the affected navigable waters are totally within one state, provided that the plan is approved by the USACE (33 USC 401). Section 10 of this Act requires permits to be issued whenever Section 404 permits are issued for wetlands that are defined as navigable. Under Section 10 of the Act, the building of any wharfs, piers,

jetties, and other structures is prohibited without approval, and excavation or fill within navigable waters requires the approval of the USACE.

Section 26a of the TVA Act of 1933 (48 Stat. 58-59, 16 USC 831) requires that TVA approval be obtained before any construction activities may be conducted that affect navigation, flood control, or public lands along the shoreline of the TVA reservoirs or in the Tennessee River or its tributaries. Construction projects that require TVA approval include bridges, culverts, and fill or construction within the floodplain.

A determination of regulatory and permit applicability cannot be made at this time due to the lack of study alternatives. As alternatives are developed through the NEPA process, permit applicability will be reevaluated.

3.7.2 Mitigation

Depending on the alternatives developed for this project and the quantity of impacts, if any, to "Waters of the United States" mitigation is likely to be required. The USACE has adopted, through the Council on Environmental Quality (CEQ), a mitigation policy which embraces the concepts of "no net loss of wetlands" and sequencing. The purpose of this policy is to restore and maintain the chemical, biological, and physical integrity of "Waters of the United States," specifically wetlands. Mitigation of wetland impacts has been defined by the CEQ to include: avoidance of impacts, minimizing impacts, rectifying impacts, reducing impacts over time, and compensating for impacts (40 CFR 1508.20). Each of these three aspects (avoidance, minimization, and compensatory mitigation) must be considered in sequential order.

Avoidance examines all appropriate and practicable possibilities of averting impacts to "Waters of the United States." According to a 1990 Memorandum of Agreement between the USEPA and the USACE, in determining "appropriate and practicable" measures to offset unavoidable impacts, such measures should be appropriate to the scope and degree of those impacts and practicable in terms of cost, existing technology, and logistics in light of overall project purposes.

Minimization includes the examination of "appropriate and practicable" steps to reduce adverse impacts to "Waters of the United States." Implementation of these steps will be required through project modifications and permit conditions. Minimization typically focuses on decreasing the footprint of the proposed project. Other methods may include enforcing best management practices to control sedimentation during project construction, minimizing "in-stream" activities, and use of responsible litter control practices.

Compensatory mitigation is not normally considered until anticipated impacts to "Waters of the United States" have been avoided and minimized to the maximum extent possible. It is recognized that " no net loss of wetlands" functions and values may not be achieved in every permit action. "Appropriate and practicable" compensatory mitigation is required for unavoidable adverse impacts that remain after all "appropriate and practicable" minimization has been required. Compensatory actions often include restoration, creation, and enhancement of "Waters of the United States," specifically wetlands. Such action should be undertaken in areas adjacent to or contiguous to the discharge site.

Final compensatory mitigation requirements of USACE permits will be commensurate with the type and amount of impact associated with the permitted activity. Due to a lack of alternatives for the proposed project, it is unknown if compensatory mitigation will be required. NCDWQ may also require stream mitigation for its associated Section 401 Water Quality Certification.

Executive Order 11990 addresses actions that should be taken for a proposed new development or other new activities, plans, or programs that either are located in or otherwise have the potential for direct or indirect adverse impacts on wetlands. The NPS will employ a sequence of avoiding adverse wetlands impacts to the extent practicable, minimizing impacts that could not be avoided, and compensating for remaining unavoidable adverse impacts via restoration of degraded wetlands. After avoidance and minimization of wetland impacts have been applied, remaining wetland degradation or loss must be offset. For the NPS, compensation refers to restoring natural wetland function in degraded or former natural wetland habitats of NPS lands. It does not refer to creating wetlands where they did not previously exist. For the purpose of wetland compensation, wetland restoration proposals must, at a minimum, provide one-to-one wetland function replacement and at a minimum of one-to-one wetland acreage replacement (NPS 1998b).

3.7.3 Wetlands in the Project Study Area

The existing acreage and classification of wetlands within the study area was determined from digital USFWS NWI maps. These maps show the location, size, and type of wetland within defined geographical areas and are typically used for planning purposes only. NWI maps attempt to show all types of wetlands, not just ones regulated by the USACE's three-parameter method. These maps are not field verified and tend to omit drier type or forested wetlands.

The descriptions of the existing wetlands are taken from the USFWS classification system for wetlands and deepwater habitats (Cowardin et al. 1979). This classification hierarchy describes wetland systems into three broad categories: Systems, Subsystems, and Classes. These categories are based on various characteristics including, but not limited to,

topographic location, physiographic location, proximity to various water bodies, soil and substrate composition, vegetation patterns, and flood frequency. Freshwater wetlands or deepwater habitats are classified into three Systems: Riverine, Palustrine, and Lacustrine. Riverine wetlands include all wetlands and deepwater habitats contained within a channel, with the exception of wetlands dominated by persistent vegetation and habitats with salinity greater than 0.5 parts per thousand (ppt). Palustrine wetlands include all non-tidal wetlands dominated by trees, shrubs, persistent emergent plants, emergent mosses or lichens, and all such wetlands that occur in tidal areas where salinity due to ocean derived salts is below 0.5 ppt. Lacustrine wetlands include wetlands and deepwater habitats that are situated in a topographic depression or an impounded river. Wetlands in this classification lack trees, shrubs, persistent emergent plants, emergent mosses or lichens, and occupy more than 20 acres (8 ha).

Digital NWI mapping indicates approximately 10,333 acres (4,182 ha) of wetlands are within the project study area (Table 26). These wetlands are depicted on Figure 14.

Table 26

Area and Description of NWI Mapped Wetlands and Deepwater Habitat Within the Project Study Area

Wetland Classification	Area acres (hectares)	Description
R3UBH	60.7 (24.6)	Riverine, upper perennial, unconsolidated bottom, permanently flooded
PEM1A	1.9 (0.8)	Palustrine, emergent, persistent, temporarily flooded
PEM1C	0.2 (0.1)	Palustrine, emergent, persistent, seasonally flooded
PEM1Ch	0.5 (0.2)	Palustrine, emergent, persistent, seasonally flooded, impounded
PEM1Fh	1.0 (0.4)	Palustrine, emergent, persistent, semipermanently flooded, impounded
PFO1A	4.1 (1.7)	Palustrine, forested, broad leaved deciduous, temporarily flooded
PFO1B	0.6 (0.3)	Palustrine, forested, broad leaved deciduous, saturated
PSS1A	2.5 (1.0)	Palustrine, scrub shrub, broad leaved deciduous, temporarily flooded
PSS1Ah	3.8 (1.5)	Palustrine, scrub shrub, broad leaved deciduous, temporarily flooded, impounded
PSS1Fx	2.0 (0.8)	Palustrine, scrub shrub, broad leaved deciduous, semipermanently flooded
PUBHh	17.2 (6.9)	Palustrine, unconsolidated bottom, permanently flooded, impounded
PUBHx	1.1 (0.4)	Palustrine, unconsolidated bottom, permanently flooded, excavated
PUSCh	1.0 (0.4)	Palustrine, unconsolidated shore, seasonally flooded, impounded

Table 26 (Continued)

Area and Description of NWI Mapped Wetlands and Deepwater Habitat Within the Project Study Area

Wetland Classification	Area acres (hectares)	Description
L1UBHh	10,231.6 (4,140.4)	Lacustrine, limnetic, unconsolidated bottom, permanently flooded, impounded
L2USAh	4.3 (1.8)	Lacustrine, littoral, unconsolidated shore, temporarily flooded, impounded
L2USCh	0.4 (0.2)	Lacustrine, littoral, unconsolidated shore, seasonally flooded, impounded

Three different systems are present in the study area: lacustrine, riverine, and palustrine. The largest deepwater habitat within the study area is classified as lacustrine with limnetic waters (greater than 6.6 feet [2.0 m] deep) and an unconsolidated bottom that is permanently flooded due to impoundment (L1UBHh). This system refers to the open waters of Fontana Lake and is mapped as 10,231.6 acres (4,140.4 ha). The segment of the Tuckasegee River immediately upstream of Fontana Lake was mapped as 60.7 acres (24.5 ha) of riverine wetland (R3UBH). The combination of 28 small mapped wetland areas equals the 17.2 acres (6.9 ha) of palustrine wetland that have been impounded (PUBHh). These wetlands, most likely agricultural irrigation ponds, are located within the southern portion of the project area. The combined area of the remaining 13 wetlands, which are scattered throughout the study area, is 23.4 acres (9.5 ha). These 13 wetlands are primarily shrubby or forested areas that are temporarily flooded. As noted above, NWI maps are not field verified and tend to omit drier type or forested wetlands. On-the-ground surveys for wetlands will be conducted once the study alternatives have been developed.

3.7.4 Navigable Waters

According to the Asheville Field Office of the USACE, the Little Tennessee River and Fontana Lake are the only navigable waters in the project study area.

3.8 Floodplains

The Federal Emergency Management Agency (FEMA), in cooperation with state and local governments, has developed flood boundary and flood insurance mapping for a large portion of North Carolina as part of the National Flood Insurance Program (NFIP). The NFIP defines a floodplain as any land area susceptible to being inundated by water. The floodplain is divided into two sections, the floodway and floodway fringe. The floodway is defined as the channel of the stream and adjacent floodplain area that should be kept free of encroachment so that a 100-year flood event may occur without increasing the level and extent of the base flood elevations. The base, or 100-year, flood is defined as an event that is equaled or exceeded, on average, once every 100 years. The floodway fringe, or the 100-year

floodplain, is the area between the floodway boundary and the 100-year floodplain boundary (FEMA 2001).

In NFIP regular program communities, FEMA, in cooperation with other federal agencies and state and local governments, conducts detailed flood studies to determine designated floodways to safely remove floodwater during flood events. These studies result in floodway boundaries, which are illustrated on Flood Insurance Rate Maps. The information obtained through these studies is utilized by local jurisdictions in their land development ordinances and regulations to discourage development in flood-prone areas. Approximate analyses were performed for those areas in which the potential for development is low (FEMA 1983). These low development potential areas include GSMNP. For these areas, floodplain mapping is not expected to be precise or include all flood-prone areas. However, more detailed information will be obtained in the EIS process, which will include a hydraulic study. The FEMA maps that cover the project study area include panel numbers 0075 C, 0100 C, 0125 C, 0138 C, 0139 C, 0200 C, 0202 C, 0206 C, 0207 C, and 0225 C of community map number 370227 for Swain County (revised December 15, 1989), map 370228 0005 B for Bryson City (effective December 4, 1984), and panel numbers 0025 B and 0050 B for community map 370105 for Graham County (effective July 17, 1986). Based on FEMA mapping for the project study area, the extent of floodplains is limited to second order or greater tributaries, primarily along the southern side of Fontana Lake. General topography in this region is steep, and most stream valleys are confined so that the extent of floodplain is limited. Those streams with larger watersheds and broad valleys are more susceptible to flooding during major precipitation events. Figure 15 illustrates the extent of FEMA mapped floodplains in the project study area.

Executive Order 11988, Floodplain Management, directs federal agencies ". . . to avoid to the extent possible the long and short term adverse impacts associated with the occupancy and modification of floodplains and to avoid direct or indirect support of floodplain development wherever there is a practicable alternative" (EO 1977). Development of floodplains within GSMNP is protected and monitored under DO #77-2: Floodplain Management, which is scheduled to be released in final form in 2003 (NPS 2003c). Development of floodplains within the national forest is protected and monitored under the Forest Service Manual Section 2500: Watershed and Air Management.

3.9 Biological Resources

3.9.1 Vegetative Communities

The study area encompasses approximately 120,000 acres (48,564 ha). Due to the immensity of the study area, the subsequent plant community discussion is based on land cover data that was obtained from the following three sources: GSMNP, the USFS, and the North Carolina

Center for Geographic Information and Analysis (NCCGIA). Relationships between the overall southern Appalachian ecosystem and the plant and animal communities, especially in regards to increased regional development, will be studied as part of the indirect and cumulative impact analysis in the DEIS, as necessary.

GSMNP provided a draft vegetative database and maps for the study area inside the park boundaries. The Center for Remote Sensing and Mapping Science at the University of Georgia created the detailed database and maps by utilizing 1:12,000- and 1:40,000-scale color infrared aerial photographs. The park-wide data includes 100 overstory and 70 understory association-level vegetation classes. The vegetation classification is based on the USGS Biological Resources Division/National Park Service National Vegetation Classification System developed by The Nature Conservancy (TNC) as part of a nationwide vegetation mapping program (Welch et al. 2002). Detailed descriptions of the vegetation communities found in GSMNP are available as part of TNC's nationwide vegetation classification and may be accessed at www.NatureServe.org or in the *International Classification of Ecological Communities: Terrestrial Vegetation – Great Smoky Mountains National Park subset* (ICEC-GSMNP) (NatureServe 2003) (incorporated as part of Vegetation Classification of Great Smoky Mountains National Park: Unpublished report, 2003).

The USFS provided the second source of vegetative cover mapping for areas inside Nantahala National Forest boundaries. The data included information pertaining to the overstory canopy composition and offered no information on understory or herbaceous composition. Specifically, the data indicated the dominant canopy tree(s) of a given stand or location. The vegetative classification scheme utilized by the USFS in this dataset is a regionally developed scheme. Information regarding the forest type and management type utilized in the USFS map is detailed in Southern Regional Silvicultural Examination and Prescription Field Book (undated).

The final source of vegetative information was obtained through the NCCGIA. This center continually creates and maintains a statewide GIS database encompassing an array of information. The land cover data obtained from the NCCGIA is a general overview for the entire study area, but it was specifically used in this application for only those areas not covered by the other more focused datasets. Like the USFS data, this vegetative classification scheme does not correspond to any published vegetation classification system.

The differences in the vegetative data supplied by the Park Service, Forest Service, and the NCCGIA limited cross-comparability of the three sources. In an attempt to provide a unified vegetation community profile of the area and to simplify later discussions, the vegetative communities identified in the each of the three sources have been sorted into one of six general vegetative categories. They are Upland Hardwood Forest, Alluvial/Bottomland

Forest, Mixed Pine/Hardwood Forest, Pine Forest, Early Successional Forest, and Urban/Disturbed/Agricultural. Table 27 is a matrix showing the best approximation of cross-comparability among the three datasets. Figure 16 shows the unified data map for the project study area based on the general categories. The Miscellaneous category is a "catch-all" group for communities in the three datasets that did not reasonably appear to fit into another general category or lacked defining information.

Table 27
Cross-Reference of Vegetative Communities Found Within the Project Study Area

General Categories	GSMNP	Forest Service	NCCGIA
Upland Hardwood Forest Community	Cove Mixed Hardwood Northern Hardwood Forest Sub Mesic to Mesic Oak/ Hardwood Sub Xeric Oak/Hardwood Montane Northern Red Oak-White Oak	Hardwood Type	Mixed Hardwoods Other Broadleaf Deciduous Forest
Alluvial/Bottomland Forest Community	Montane Alluvial	None	Bottomland Hardwood Hardwood Swamps
Mixed Pine/Hardwood Forest Community	White Pine-Sub Xeric Oak Pine-Sub Xeric Oak	Pine-Hardwood Type Hardwood-Pine Type	Mixed Hardwoods/Conifers
Pine Forest Community	Eastern White Pine Pine	Pine Type	Mountain Conifers
Early Successional Forest Community	Southern Appalachian Early Successional Hardwoods	None	Unmanaged Upland Herbaceous Deciduous Shrubland Mixed Shrubland
Urban/Disturbed/ Agricultural Community	Human Influence Roads Pasture	None	High Intensity Developed Low Intensity Developed Cultivated Managed Herbaceous Cover
Miscellaneous	Eastern Hemlock Dead Vegetation Grape Vines Graminoid Rocks with Sparse Vegetation Inundated Gravel, Rock, or Sand, Successional Vegetation Shrubland Water	None	Exposed Rock Unconsolidated Sediment

The Upland Hardwood Forest category is the most prevalent in the project study area, covering approximately 75 percent of the study area. The Alluvial/Bottomland Forest Community is the least prevalent, covering less than 5 percent of the study area. It is found primarily along the banks of the Little Tennessee River in the southern portion of the study area. Urban/Disturbed/Agricultural Community is found in and surrounding Bryson City and in smaller communities found primarily along the US 19/US 74 and NC 28 corridors.

The following discussion has been included in order to provide as much detail as possible from each of the three datasets. The discussion is arranged by data source (GSNMP, USFS, and NCCGIA), but within each the discussion is relative to the six general categories noted above. Names and descriptions of plant species generally follow Radford et al. (1968), unless more current information is available. Scientific nomenclature and common names (when applicable) are provided for each plant species listed. Subsequent references to the same species include the common name only.

3.9.1.1 GSMNP Vegetation Mapping

The draft GSMNP vegetative distribution map is depicted in Figure 17A. The draft GSMNP vegetative data for the study area includes approximately 23 different communities. Thirteen of the communities correspond to one or more detailed vegetation communities in the ICEC-GSMNP and are discussed in detail below. The 10 remaining communities in the GSMNP dataset are not defined by the vegetation classification system. They were allocated to the Urban/Disturbed/Agricultural category or the Miscellaneous category, as appropriate. Examplex of an undefined community are “dead vegetation” and “water.”

3.9.1.1.1 Upland Hardwood Forest Category

Five of the vegetative communities mapped by GSMNP can be characterized in the Upland Hardwood Forest Category. They include Cove Mixed Hardwoods, Northern Hardwoods, Montane Northern Red Oak-White Oak, Sub Mesic to Mesic Oak/Hardwoods, and Sub Xeric Oak/Hardwoods.

The first detailed upland hardwood forest type is Cove Mixed Hardwoods. The Cove Mixed Hardwood forest mapped in the study area of the GSMNP is best described as a Southern Appalachian Cove Forest in the ICEC-GSMNP. This community is located along several of the first-order streams found in the study area. It occurs between 2,000 and 4,500 feet (609 and 1371 m) msl on concave lower slopes and flats. The species that dominate the overstory are a mixture of mesophytic species such as yellow buckeye (*Aesculus flava*), white ash (*Fraxinus americana*), white basswood, cucumber magnolia (*Magnolia acuminata*), and other more tolerant species such as yellow poplar, red maple, eastern hemlock, and sweet

birch. The herbaceous layer is typically very species-rich and dense and includes species like black bugbane (*Actaea racemosa*), hairy sweet cicely (*Osmorhiza claytonii*), and wood nettle.

The second detailed upland hardwood forest type is Northern Hardwood. It only occurs in the north-central portion of the study area. This forest is defined as including portions of two communities in the ICEC-GSMNP classification system, the Southern Appalachian Northern Hardwood Forest (Typic Type) and the Southern Appalachian Northern Hardwood Forest (Rich Type). The Typic Type is typically found over 4,000 feet (1,219 m) msl on open, north-facing slopes in the Southern Blue Ridge. The overstory canopy is usually dominated by yellow birch (*Betula alleghaniensis*), American beech (*Fagus grandifolia*), and yellow buckeye. Other overstory trees that may be present are sugar maple (*Acer saccharum*), black cherry (*Prunus serotina*), red oak (*Quercus rubra*), and silverbell (*Halesia tetraptera var. monticola*; syn. *H. carolina*). The understory shrub layer that can vary from absent to moderately dense includes hobblebush (*Viburnum lantanoides*), wild hydrangea (*Hydrangea arborescens*), mountain holly (*Ilex montana*; syn. *I. Ambigua* var. *montana*), and red elderberry (*Sambucus racemosa var. pubens*). The herbaceous cover is usually a mixture of sedges, ferns, and other forbs and is dominated by Appalachian heartleaf aster (*Eurybia chlorolepis*) and fancy fern (*Dryopteris intermedia*). The Rich Type are found on more sheltered slopes with deep, rocky soils and have canopies dominated by yellow birch, American beech, yellow buckeye, and silver maple. Other overstory species that may be present are white basswood (*Tilia montana* var. *heterophylla*), red oak, and silverbell. The typically open shrub layer is dominated by mountain maple (*Acer spicatum*), striped maple *(Acer pensylvanicum*), and Allegheny serviceberry (*Amelanchier laevis*). This type of northern hardwood forest has a rich herbaceous layer that is dominated by blue cohosh (*Caulophyllum thalictroides*) and wood nettle (*Laportea canadensis*).

The third upland forest type is Montane Northern Red Oak-White Oak Forest. It is found along the northern edge of the project study area and covers approximately 2 percent of the study area in GSMNP. According to the ICEC-GSMNP, this community occurs along ridges and mid-to-upper slopes on south- and southeastern-facing slopes between 3,500 and 5,000 feet (1,070 and 1,525 m). The canopy of this community is dominated by red oak. The shrub layer is typically more than 50 percent evergreen species and is dominated by mountain laurel (*Kalmia latifolia*), Catawba rhododendron (*Rhododendron catawbiense*), and great rhododendron (*R. maximum*). The herbaceous layer is usually sparse and is generally dominated by galax (*Galax urceolata*).

The fourth upland forest type is Sub-Mesic to Mesic Oak/Hardwood Forest. It comprises approximately 50 percent of the total study area located in GSMNP and is represented by three ICEC-GSMNP communities, Appalachian Montane Oak Hickory Forest (Typic Acidic Type), Appalachian Montane Oak Hickory Forest (Red Oak Type), and Appalachian Montane Oak Hickory Forest (Rich Type). The Typic Acidic Type is typically found on

lower slopes, bottoms, and coves between 2,000 and 4,500 feet (609 and 1,371 m) msl. The canopy of this community is dominated by white oak (*Quercus alba*) as well as other oak species like red oak, rock chestnut oak (*Q. prinus*), and scarlet oak (*Q. coccinea*). Other canopy species include mockernut hickory (*Carya alba*), pignut hickory (*Carya glabra*), yellow poplar (*Liriodendron tulipifera*), red maple (*Acer rubrum*), and Fraser magnolia (*Magnolia fraseri*). The sparse to very dense shrub layer is generally dominated by mountain laurel, bear huckleberry (*Gaylussacia montana*), and flame azalea (*Rhododendron calendulaceum*). The herbaceous layer ranges from sparse to moderate, but can be species rich. The dominants in this layer are two ferns, New York fern (*Thelypteris noveboracensis*) and Christmas fern (*Polystichum acrostichoides*). The Red Oak Type community occurs along mid- to upper-, moderately steep, northern to eastern and southeastern facing slopes between 2,000 and 4,000 feet (609 and 1,219 m) msl. The canopy is usually dominated by red oak and co-dominated by red maple, yellow poplar, and white oak. The understory is comprised of silverbell, sweet birch (*Betula lenta*), eastern hemlock (*Tsuga canadensis*), flowering dogwood (*Cornus florida*), striped maple, and sourwood (*Oxydendrum arboreum*). The sparse shrub layer is dominated by bear huckleberry or great rhododendron, and the sparse to moderate species rich herbaceous layer is dominated by New York fern. The Rich Type community is dominated by white oak and occurs from 2,000 to 4,500 feet (609 to 1,371 m) msl on both exposed and protected sites. Other canopy species include northern red oak, scarlet oak, rock chestnut oak, pignut hickory, and mockernut hickory. Common species in the subcanopy are sourwood and flowering dogwood. The herbaceous layer is typically diverse and dominated by richweed (*Collinsonia canadensis*), mayapple (*Podophyllum peltatum*), and bloodroot (*Sanguinaria canadensis*).

The final upland hardwood forest type defined in GSMNP is Sub Xeric Oak/Hardwood Forest. It occurs throughout the study area in GSMNP. The two ICEC-GSMNP communities that best describe this forest are the Appalachian Montane Oak-Hickory Forest (Chestnut Oak Type) and the Chestnut Oak Forest (Xeric Ridge Type). The Appalachian Montane Oak-Hickory Forest (Chestnut Oak Type) is generally located below 3,000 feet (914 m) msl on moderately steep to steep, northern- to southwestern-facing slopes. The overstory is dominated by rock chestnut oak and co-dominated by red maple. Other overstory species include pignut hickory, yellow poplar, and northern red oak. The subcanopy is often dominated by flowering dogwood. The shrub layer is sparse and no one species is dominant. Species found in this layer include bear huckleberry, wild hydrangea, snowy hydrangea (*Hydrangea radiata*), mountain laurel, Fraser magnolia, sassafras (*Sassafras albidum*), and early lowbush blueberry (*Vaccinium pallidum*). The herbaceous layer is also sparse; however, it can be diverse. Typical species are white wood-aster (*Eurybia divaricata*), striped pipsissewa (*Chimaphila maculata*), bare-stemmed tick-trefoil (*Desmodium nudiflorum*), panic grass (*Dichanthelium* spp.), and rattle-snake root (*Prenanthes* spp.). The Chestnut Oak Forest (Xeric Ridge Type) community commonly occurs on ridgetops and south- to west-facing slopes over shallow, acidic, rocky soils. The dominant canopy species

include rock chestnut oak and scarlet oak, with other canopy species such as black oak (*Quercus velutina*), northern red oak, southern red oak (*Q. falcata*), sourwood, blackgum (*Nyssa sylvatica*), and red maple. The dense shrub layer can be dominated by either evergreen or deciduous species including mountain laurel, great rhododendron, deerberry (*Vaccinium stamineum*), early low bush blueberry, bear huckleberry, black huckleberry (*Gaylussacia baccata*), and American chestnut (*Castanea dentata*) as abundant stump sprouts. The herbaceous layer is usually sparse and may include species such as trailing arbutus (*Epigaea repens*), galax, and wintergreen (*Gaultheria procumbens*).

3.9.1.1.2 Alluvial/Bottomland Forest Category

One vegetative community, Montane Alluvial, mapped by GSMNP can be characterized in the Alluvial/Bottomland Forest Category.

The Montane Alluvial community occurring within the study area in GSMNP is represented in the ICEC-GSMNP as Appalachian Montane Alluvial Forest. This community is found along the majority of the streams in the study area and is documented as occurring below 3,000 feet (914 m) on narrow, rocky floodplains and islands in medium-sized rivers. The overstory dominants include sycamore (*Platanus occidentalis*), yellow poplar, white ash, yellow birch (*Betula alleghaniensis*), and sweet birch. Other canopy/subcanopy species that may be present are ironwood (*Carpinus caroliniana*), river birch (*Betula nigra*), red maple, Virginia pine (*Pinus virginiana*), eastern white pine (*P. strobus*), and eastern hemlock. The shrub layer may be dense and dominated by either mountain doghobble (*Leucothoe fontanesiana*) or great rhododendron. Vines that can be found in this community include pipevine (*Aristolochia macrophylla*), Virginia creeper (*Parthenocissus quinquefolia*), whiteleaf greenbrier (*Smilax glauca*), common greenbrier (*S. rotundifolia*), and summer grape (*Vitis aestivalis*). The herbaceous layer may be sparse on the rocky floodplain. Common species that occur in this layer are sedges (*Carex* spp.), American hog-peanut (*Amphicarpaea bracteata*), subarctic lady-fern (*Athyrium filix-femina*), Indian cucumber-root (*Medeola virginiana*), and smooth white violet (*Viola blanda*).

3.9.1.1.3 Mixed Pine/Hardwood Forest Category

Two vegetative communities mapped by GSMNP can be characterized in the Mixed Pine/Hardwood Forest Category. The vegetative communities include the White Pine – Sub Xeric Oak and Pine – Sub Xeric Oak.

In the ICEC-GSMNP, Appalachian White Pine – Xeric Oak Forest best represents the White Pine – Sub Xeric Oak community. This forest is mapped as occurring in small pockets in the western portion of the study area. It is generally located below 3,000 feet (914 m) msl on exposed upper slopes and ridgetops. The canopy is typically dominated by white pine, rock

chestnut oak, and scarlet oak. Sourwood, red maple, blackgum, and flowering dogwood are dominates in the subcanopy. The shrub layer is dominated by either deerberry or bear huckleberry.

The Pine – Sub Xeric Oak is described in the ICEC-GSMNP as the Appalachian Low Elevation Mixed Pine/Hillside Blueberry Forest. This community is found throughout the study area. It is usually located on low-elevation ridges and steep upper slopes over shallow, infertile soils. The dominant overstory species is Virginia pine, with other dry site oaks such as rock chestnut oak and scarlet oak occurring as co-dominates. The very dense to sparse shrub layer is dominated by early lowbush blueberry, deerberry, and mountain laurel. Common species that may be present in the sparse herbaceous layer are galax, striped pipsissewa, variable witchgrass (*Dichanthelium commutatum*), trailing arbutus, bracken fern (*Pteridium aquilinum var. latiusculum*), and little bluestem (*Schizachyrium scoparium*).

3.9.1.1.4 Pine Forest Category

Two vegetative communities mapped by GSMNP can be characterized in the Pine Forest Category. They are the Eastern White Pine forest and the Pine forest.

The Eastern White Pine community is represented in the ICEC-GSMNP as Eastern White Pine Successional Forest. The majority of the occurrences of this community in the study area are found near a number of streams and Fontana Lake. This community typically has a very dense canopy and little understory and is located in former old fields and formerly cleared flats along streams. Eastern white pine dominates the canopy with yellow poplar, red maple, pitch pine (*Pinus rigida*), and sweetgum (*Liquidambar styraciflua*) as co-dominants. Eastern hemlock is known to form a dense shrub layer. The herbaceous layer is commonly dominated by species found in open and disturbed areas.

Virginia Pine Successional Forest is the community for the ICEC-GSMNP that best describes the Pine forest. The GSMNP map indicates this community is located near streams and Fontana Lake. This community has a dense canopy dominated by Virginia pine and little understory. It is known to occur in dry, open areas with bare mineral soil created by old fields, old pastures, clearcuts, and burning or erosion. Other species likely to be present in the canopy include red maple, sweetgum, yellow poplar, and red, black and scarlet oaks. The sparse shrub and herbaceous layer is generally comprised of ruderal and exotic species found in open and disturbed areas.

3.9.1.1.5 Early Successional Forest Category

One vegetative community mapped by GSMNP can be characterized in the Early Successional Forest Category, the Southern Appalachian Early Successional Hardwoods.

This community is defined in the ICEC-GSMNP as the Early Successional Appalachian Hardwood Forest. It is typically located in upland areas that were once clearcut, old fields, strip-mined, cleared by fire or other natural disturbances, and are in the process of revegetation by root and stump sprouts. Typically, stands are approximately 20 to 40 acres (8 to 16 ha) in size. They are dominated by early successional species such as yellow poplar, red maple, and a small number of black locust (*Robinia pseudoacacia*). Virginia pine may also occur as a canopy species in these stands. Shrubs can be sparse to moderate in coverage, with varying composition, but often are composed of saplings of the canopy species. The herbaceous layer can vary from containing shade-intolerant species to shade-tolerant species depending on site conditions and can be dominated by dense clumps of fan club-moss (*Lycopodium digitatum*). Vine species are common and often abundant. Typical vines are Virginia creeper, whiteleaf greenbriar, common greenbriar, and poison ivy.

3.9.1.1.6 Urban/Disturbed/Agricultural Category

Communities mapped by GSMNP that can be categorized as Urban/Disturbed/ Agricultural are the areas of Human Influence, Roads, and Pastures. The Roads and Pasture communities are widely scattered in very small pockets throughout the study area. Both the Human Influence and Rocks with Sparse Vegetation communities tend to be concentrated around Fontana Dam. The Rocks with Sparse Vegetation community is thought to correspond with two powerline rights-of-way heading west from the Dam. The communities in this category do not correspond to any described in the ICEC-GSMNP, and therefore no additional detail can be provided.

3.9.1.1.7 Miscellaneous

This category is a catch-all group for communities that cannot readily be included in the six previous categories. Communities including Dead Vegetation; Graminoid; Inundated Gravel, Rock, or Sand; Rocks with Sparse Vegetation; Sparse Vegetation; Successional Vegetation; and Water, as mapped by GSMNP, have no cross reference to any of the ICEC-GSMNP communities and no definitions have been provided. The Dead Vegetation community occurs along the eastern end of the study area and in a few small pockets in the center of the study area. The Pasture community is located in a small area along Hazel Creek near Proctor. The Graminoid community is found in the far southeastern corner of the study area in GSMNP. The Inundated Gravel, Rock, or Sand community occurs along the borders of Eagle and Hazel creeks and Fontana Lake. The Sparse Vegetation community is found in two small areas near Proctor and other areas in the western end of the study area. The Successional Vegetation community is located in five small areas in the eastern half of the study area. The Water designation referrs to the water in Fontana Lake and the major streams in the study area.

The remaining three communities Eastern Hemlock, Grape Vines, and Shrubland do have corresponding ICEC-GSMNP communities. The Eastern Hemlock community is best described as the Southern Appalachian Eastern Hemlock Forest (Typic Type). There are 11 small patches of this community scattered throughout the study area. This community is typically found in lower or protected slopes and terraces above 1,800 feet (548 m) msl. It is dominated by eastern hemlock and co-dominated by yellow poplar, white basswood, eastern white pine, Fraser magnolia, red maple, and white ash. Shrub layer dominants include mountain sweet pepperbush (*Clethra acuminata*) and mountain doghobble. The sparse to moderate herbaceous layer may be comprised of spotted wintergreen (*Chimaphila maculata*), Indian cucumber-root, Christmas fern, and beetle-weed.

The Grape Vine community is defined in the ICEC-GSMNP as the Montane Grape Opening. This community is mapped in a very small area in the far northwestern edge of the study area. It is dominated by summer grape (*Vitis aestivalis*), which covers 50 to 100 percent of the area where it is found hanging in almost all the trees and on the ground. Trees in the canopy and subcanopy have less than 50 percent coverage and the shrub and herbaceous layers are typically sparse. In the study area this community occurs on steep to very steep, north-facing slopes between 2,000 and 3,500 feet (600 and 1,000 m) msl.

The Shrubland community is defined in the ICEC-GSMNP as the Southern Appalachian Mountain Laurel Bald. In the study area this community is mapped on Welch Ridge and in a small area along the western edge. This community is typically found between 4,000 and 5,000 feet (1,219 and 1,524 m) msl on ridges and steep, rocky slopes. Natural disturbances such as windfall, landslides, and small lightning-caused fires are needed to establish and maintain these communities. It is dominated by shrubs such as mountain laurel and Catawba rhododendron and co-dominated by black huckleberry, mountain fetterbush (*Pieris floribunda*), and highbush blueberry (*Vaccinium corymbosum*). These shrubs can form dense thickets with only small openings over exposed rock that may have some growth of lichens or herbs. The herbaceous layer is absent or sparse in this community and only a few, scattered seedlings of red maple, Fraser magnolia, and northern red oak are present.

3.9.1.2 Forest Service Vegetation Mapping

The Forest Service vegetative data for the study area is mapped in Figure 17B. It includes four major types of vegetative communities. Each major forest type is further divided by dominant species and management code. This classification system is based solely on the canopy species. There is no reference to understory or herbaceous species within the community descriptions. No information is provided that would allow for cross-referencing to a published classification such as the ICEC-GSMNP. The purpose of the USFS classification system appears to be for the management of forest resources. The dataset

provided by the USFS does not cover a portion of Nantahala National Forest in the east-central portion of the project study area.

3.9.1.2.1 Upland Hardwood Forest Category

The Forest Service Hardwood Type vegetative class is included in the Upland Hardwood Forest Category. The Forest Service defines this community as at least 70 percent of the dominant and co-dominant trees are hardwoods, based on basal area. This community covers approximately 50 percent of the area mapped by the USFS with the majority of the community concentrated in the southwestern portion of the study area.

There are 32 forest subtypes within the Hardwood Type vegetative class; however, only eight subtypes are located with the project study area. The subtypes within the study area include Yellow Poplar, Post Oak-Black Oak, Chestnut Oak, White Oak-Red Oak-Hickory, Northern Red Oak, Yellow Poplar-White Oak-Red Oak, Scarlet Oak, and Chestnut Oak-Scarlet Oak. Each of these subtypes is acceptable as a management type when approved by the regional forester through the land management planning process.

3.9.1.2.2 Alluvial/Bottomland Forest Category

There is no corresponding vegetative class within the Forest Service classification system that meets the description of the Alluvial/Bottomland Forest Category.

3.9.1.2.3 Mixed Pine/Hardwood Forest Category

The USFS Pine-Hardwood and Hardwood-Pine Types are included in the Mixed Pine/Hardwood Forest Category. The Forest Service defines these two vegetative classes as stands in which 51 to 69 percent of the dominant and co-dominant basal areas are softwoods or hardwoods, respectively. These two communities comprise approximately 30 percent of the area mapped by the USFS and occur in proximity to Fontana Lake and the streams feeding into it.

There are 13 subtypes within the Pine-Hardwood Type community; however, there are only four subtypes found within the study area including White Pine-Cove Hardwood, White Pine-Upland Hardwood, Shortleaf Pine-Oak, and Pitch Pine-Oak. There are ten subtypes within the USFS Hardwood-Pine Type with only the following five subtypes in the study area: Cove Hardwoods-White Pine-Hemlock, Southern Red Oak-Yellow Pine, Chestnut Oak-Scarlet Oak- Yellow Pine, White Oak-Black Oak-Yellow Pine, and Northern Red Oak-Hickory-Yellow Pine. Yellow Pine refers to any of the following species of pine: loblolly, shortleaf, longleaf, slash, Virginia, pitch, or pond. All of the subtype communities within the

Pine-Hardwood and Hardwood Pine Type Communities are acceptable as a management type when approved by the regional forester through the land management planning process.

3.9.1.2.4 Pine Forest Category

The USFS Pine Type can be classified in the Pine Forest Category. The Pine Type class is defined by the USFS as stands in which at least 70 percent of the dominant and co-dominant species are softwoods, based on basal area. The Forest Service has mapped the Pine Type community as occurring adjacent to streams with the largest portion of this community found along tributaries to Wolf Creek.

There are 21 subtypes within this major community type with five subtypes identified within the project study area. The Pine subtype vegetative communities within the study area include White Pine, White Pine-Hemlock, Yellow Pine, Shortleaf Pine, and Pitch Pine. All of these subtypes are acceptable as management types except for White Pine-Hemlock subtype which is an unacceptable management type.

3.9.1.2.5 Early Successional Forest Category

There is no vegetative community within the Forest Service classification system that meets the description of Early Successional Forest Category.

3.9.1.2.6 Urban/Disturbed/Agricultural Category

There is no vegetative community within the Forest Service classification system that meets the description of Urban/Disturbed/Agricultural Category.

3.9.1.3 NCCGIA Land Cover Data

The NCCGIA land cover data for the study area is mapped on Figure 17C. It includes 12 different communities. NCCGIA's classification is based on EOSAT Landsat Thematic Mapping for land cover and does not correspond with any published classification system. The purpose of the dataset is to depict the land cover and land use across North Carolina and within 0.6 mile (1 km) of the state's borders for management purposes. The source of the Land Cover – TM is the North Carolina Geographic Database and was published in 1998.

3.9.1.3.1 Upland Hardwood Forest Category

Mixed Hardwoods and Other Broadleaf Deciduous Forest are two land cover types that are included in the Upland Hardwood Forest Category. Both cover types are areas where the dominant deciduous woody vegetation is above 10 feet (3 m) in height and has a crown

density of at least 25 percent. NCCGIA has mapped these communities over 65 percent of the entire study area.

3.9.1.3.2 Alluvial/Bottomland Forest Category

Bottomland Hardwoods/Hardwood Swamps occur in lowland and wet areas and are included in the Alluvial/Bottomland Forest Category. This land cover type is dominated by deciduous woody vegetation above 10 feet (3 m) in height and with a crown density of at least 25 percent. This community is mapped as occurring in the eastern half of the study area in scattered areas near streams making up less than 5 percent of the total study area.

3.9.1.3.3 Mixed Pine/Hardwood Forest Category

The Mixed Hardwoods/Conifers land cover category is equivalent to the Mixed Pine/Hardwood Forest Category. NCCGIA describes this community as forestland with at least a 25 percent intermixture of deciduous and evergreen species. In the mountains, this classification has hardwoods (mainly oak) that constitute a plurality of stocking, but pines also account for 25 to 50 percent of the stocking. This community is scattered throughout, occurring close to streams over approximately 10 percent of the study area.

3.9.1.3.4 Pine Forest Category

NCCGIA's Mountain Conifers land cover is included as the Pine Forest Category. Mountain Conifers include areas where stocking of trees is 75 percent evergreen needle leaf and broad leaf species, including the following forest types: white pine, hemlock, and spruce-fir. The NCCGIA has mapped this community as covering approximately 10 percent of the study area with the largest proportion occurring adjacent to streams.

3.9.1.3.5 Early Successional Forest Category

Three NCCGIA land cover categories are included in the Early Successional Forest Category including Unmanaged Upland Herbaceous, Deciduous Shrubland, and Mixed Shrubland. Unmanaged Upland Herbaceous areas are covered by herbaceous vegetation that is not characteristic of riverine or estuarine environments. Deciduous Shrubland communities are areas where deciduous vegetation is dominated by shrubs and/or woody plants below 10 feet

(3 m) in height; whereas, Mixed Shrubland communities are dominated by neither evergreen or deciduous shrubs and/or woody plants below 10 feet (3 m) in height. These communities are mapped in a few scattered areas in the eastern half of the study area and comprise less than 5 percent of the total study area.

3.9.1.3.6 Urban/Disturbed/Agricultural Category

Four NCCGIA land cover communities within the project study area are comparable to the Urban/Disturbed/Agricultural Category: High Intensity Developed, Low Intensity Developed, Cultivated, and Managed Herbaceous Cover. High Intensity Developed is defined as more than 80 percent coverage by synthetic land cover and Low Intensity Developed is defined as between 50 and 80 percent coverage by synthetic land cover. Cultivated lands are areas that are occupied by row and root crops that are in distinguishable rows and patterns. Managed Herbaceous Cover are areas used for the production of grass and other forage crops, and other actively managed areas of herbaceous cover such as golf courses and cemeteries. The largest concentration of these communities is mapped as occurring at or near Bryson City in the eastern portion of the study area.

3.9.2 Terrestrial Wildlife

GSMNP and Nantahala National Forest compose the majority of the project study area. Collectively, the project study area provides diverse habitats for wildlife due to large expanses of contiguous forest, various plant communities, ample water and food supply, and elevations that range from approximately 1,700 feet (518 m) msl to 5,000 feet (1,524 m) msl. The uninterrupted nature of some forested tracts in the project study area allows the proliferation of interior woodland species, while areas of disturbed lands provide habitat for edge species. Wildlife for this report includes terrestrial members of the animal kingdom that

occur within the study area, including mammals, birds, reptiles, and amphibians. Terrestrial invertebrates in the study area are represented by many species-rich groups. GSMNP is habitat for a number of groups that have regional, continental, or global centers of diversity. Examples of these animals include moths, land snails, arachnids, beetles, wasps, and many others. Many of the species are restricted to specialized habitats controlled by geology, soils, and topographic position, among other factors. These species play critical roles in the ecosystem, such as parasite/predators of other invertebrates, pollinators, decomposers, and herbivores.

Initial screening-level surveys for wildlife in the project study area were conducted in May and June 2003. These surveys included active searching and capture (as allowed by permit),

* Indicates evidence or direct sightings of species during field reconnaissance.

as well as observing the characteristic signs including sounds, tracks, scat, and burrows. Animal names and descriptions follow Conant and Collins (1998), Lee et al. (1980 et seq.), Linzey (1995), and Rohde et al. (1994). Scientific nomenclature and common names (when applicable) are provided for each animal species listed. Subsequent references to the same organism include only the common name. Evidence or direct sightings of species during field reconnaissance is indicated by an asterisk (*).

Though most animals do not consciously remain within strict plant community boundaries they are influenced to a great extent by the presence of varying vegetative communities. The broad vegetative communities found within the study area include Upland Hardwood Forest Community, Alluvial/Bottomland Forest Community, Mixed Pine/Hardwood Forest Community, Pine Forest Community, Early Successional Forest Community, and Urban/Disturbed/Agricultural Community. These vegetative communities are defined and discussed in detail in Section 3.9.1.

Each vegetative community offers a unique assemblage of food and cover determined by numerous factors including elevation, geology, microclimate, available seed source, hydrology, and natural and human-influenced disturbance. The availability of food, water and cover are the primary factors that determine wildlife distribution. There is often a rough correlation between vegetative communities and wildlife distribution, especially for animals with specific habitat requirements. Generalists such as the white tailed deer* (*Odocoileus virginianus*) and American black bear* (*Ursus americanus*) are found across a wide range of vegetative communities due to their ability to utilize a wide range of food sources. Given the variations in animal habit it is difficult and somewhat misleading to group wildlife based on strictly defined individual natural community types.

For the purposes of this report, animals that regularly inhabit all or most of the ecosystems present within the study area, the generalists, are discussed first. Afterward, the wildlife more restricted in range is described for the lowest elevation ecosystems followed by those found at increasing elevations. It is understood that this approach has some innate inconsistencies because elevation is the primary factor used to determine placement of wildlife within the natural communities. All of the ecosystems discussed are referenced to the vegetative communities previously discussed.

In order to keep the substantial list of wildlife species to a manageable number, only a portion of the total species found within the study area are discussed below. More extensive checklists of species are provided by the Great Smoky Mountains Natural History Association. The checklist pamphlets include Mammals of the Great Smoky Mountains, Birds of the Great Smoky Mountains, and Amphibians and Reptiles of the Great Smoky

* Indicates evidence or direct sightings of species during field reconnaissance.

Mountains. Additional information regarding mammal and bird species and their distribution in GSMNP is available at www.dlia.org. A checklist pamphlet from the Great Smoky Mountains Natural History Association of Butterflies and Skippers of the Great Smoky Mountains is also available, but these species are not discussed in this report.

In general, animals adapt to various habitats or natural communities based on the availability of adequate food and cover. Animals that are successful in adapting to multiple environments are found throughout the entire study area. These animals represent a diverse cross section of behaviors and each has successfully carved a niche for itself in competitive environments.

3.9.2.1 All Communities

Mammals found throughout the six vegetative communities include opportunistic omnivores such as the Virginia opossum (*Didelphis virginiana*), striped skunk (*Mephitis mephitis*), and raccoon* (*Procyon lotor*). The latter two species are categorized as carnivores, but often eat vegetative matter. These omnivores feed on a wide assortment of items including blackberries, wild grapes, acorns and other nuts, earthworms, shrews, insects, bird eggs, snakes, wood frogs, and toads. These three species are primarily nocturnal. They all occupy slightly different niches in the ecosystem with the opossum nesting in almost any crevice using leaves and grass for cover, the striped skunk residing in a subterranean den often vacated by other mammals such as woodchucks (*Marmota monax*), and the raccoon utilizing mostly hollow logs for dens.

Omnivorous rodents such as the eastern chipmunk* (*Tamias striatus*), white-footed mouse* (*Peromyscus leucopus*), and deer mouse (*Peromyscus maniculatus*) can also be found throughout the natural and man-influenced environments. These smaller mammals eat a similarly diverse diet as described above but without the larger vertebrates such as snakes and frogs. The eastern chipmunk resides beneath any natural structure large enough to conceal a burrow. The white-footed mouse resides either beneath leaves and grasses on the ground or above the forest floor in abandoned nests of other animals. The golden mouse is often found at slightly higher elevations but with a lifestyle and range that is very similar to the white-footed mouse.

The much larger, omnivorous black bear is a solitary animal that consumes a variety of berries and nuts, grasses, beetles and other insects such as wasps and ants, honey, and carrion. They can be active all year around; however, during the winter months most bears hibernate in tree cavities, hollow logs, overhanging rock ledges, and fallen evergreen trees. Due to their curious and wandering nature, the black bear is found throughout the numerous vegetative communities within the study area. There are approximately 1,800 black bears in

* Indicates evidence or direct sightings of species during field reconnaissance.

GSMNP and are considered the park's largest native mammal. VanManen (1994), studying bear habitat use in GSMNP, found that female black bears frequently used habitats that were characterized by tulip poplar, mesic mixed hardwood and xeric oak vegetation types (Upland Hardwood Forest Communities in this report), high vegetation richness, middle elevations, moderately steep slopes, northwestern aspects, historic settlement, in proximity to trails, and large distances from human activity sites and improved roads. Male black bears used similar habitat, but were also frequently found in pine woodlands, areas closer to human activity sites, and historically uncut areas. The GSMNP portion of the study area contains most of the black bear frequent-use characteristics, with the exception of a northwestern aspect. The black bear has no known natural predators besides man and is protected within GSMNP, as is all wildlife. However, those bears found outside the park are considered game animals and can be killed during specified hunting seasons.

In addition to the omnivores, carnivores also range throughout the numerous vegetative communities within the study area and enjoy a wide array of food sources. These carnivores include the least shrew (*Cryptotis parva*), masked shrew (*Sorex cinereus*), eastern mole (*Scalopus aquaticus*), long-tailed weasel (*Mustela frenata*), coyote (*Canis latrans*), and bobcat (*Lynx rufus*). The shrews feed on many terrestrial invertebrates including insects, earthworms, and snails and sometimes small vertebrates such as snakes and frogs. For cover, the shrews construct nests of grass and leaves underneath rocks, logs, stumps, or metal. The eastern mole has a similar diet to the shrews, but is almost exclusively a subterranean species living in burrows just below the soil surface. The long-tailed weasel's primary food sources are small rodents. They den in almost any sheltered area including abandoned burrows, hollow logs, woodpiles, and structures such as barns. Perhaps the most secretive is the coyote, which resides by day in subterranean dens. At night the coyote hunts rabbits and rodents, seeks carrion, and is known to also eat vegetable matter such as fruits. Coyotes have expanded their range from the western states into the eastern portion of the country over the past several decades. In 1982, the first coyote was observed in GSMNP, and coyotes have been reported in low numbers in many sections of the park since then. This migration is thought to be due to many reasons including the clearing of forests, extirpation of wolves in the eastern states, the construction of roadways used as corridors for travel, and intentional release by humans. The bobcat is also nocturnal and feeds mainly on smaller mammals such as the eastern cottontail, eastern chipmunk, and mice. Dens are constructed on the ground in brush piles or hollow trees.

Three major herbivores that occur throughout all of the vegetative communities within the study area are the gray squirrel* (*Sciurus carolinensis*), woodland vole (*Microtus pinetorum*), and white-tailed deer. The gray squirrel feeds on acorns and nuts from mast producing trees, and constructs nests in these same trees. The woodland vole constructs an extensive system

* Indicates evidence or direct sightings of species during field reconnaissance.

of tunnels for food and cover. Their primary food sources are shoots, roots, and seeds. The larger, white-tailed deer is a browser and feeds on the leaves and twigs of a wide variety of plants, including agricultural crops. They occur at low densities throughout the study area and are active mainly during the early morning and early afternoon. Besides man, their main predators are dogs that chase them to the point of exhaustion and then kill them. Other predators of deer include the bobcat, coyote, and black bear. For cover, the white-tailed deer beds down beneath the forest canopy, which in the early successional and urban/disturbed/ agricultural communities can be quite dense and low hanging.

An often overlooked group of mammals present throughout the study area is bats. There are 11 known species of bats within the study area. All 11 species feed on insects in the warmer months and either hibernate or migrate in the colder months. Bats have poorly developed sense of sight and depend on echolocation to determine where they are and to locate food. They feed on mosquitoes, moths, beetles, mayflies, and other flying insects. Two common bats likely to be present throughout the study area are the eastern pipistrelle (*Pipistrellus subflavus*) and red bat (*Lasiurus borealis*). The eastern pipistrelle roosts in caves, rock crevices, and mines, while the red bat roosts in trees and shrubs. The Rafinesque's big-eared bat (*Plecotus rafinesquii* or *Corynorhinus rafinesquii*) is a federal species of concern that is known to occur within the study area. They are likely to be one of the most common bats in the study area. The largest known hibernating colony of this species is found in the abandoned mines in the northwestern portion of the study area (Linzey, 1995).

Correct climate is important for all animals, but is critical for the survival of snake species. Within the correct climate, food and cover remain the determining factors for their distribution. Snake species that are adaptable to the numerous vegetative communities found throughout the study area include the midland brown snake (*Storeria dekayi wrightorum*), eastern garter snake (*Thamnophis sirtalis sirtalis*), northern black racer* (*Coluber constrictor constrictor*), timber rattlesnake (*Crotalus horridus*), and black rat snake (*Elaphe obsoleta obsoleta*). Depending on the species, snakes forage on anything including slugs, earthworms, insects, small mammals, eggs, fish, and amphibians. These generalist snakes tend to reside in rocky sheltered den sites along warm south-facing slopes.

Both migratory and resident birds have the ability to travel great distances in search of good food sources, and thus many species of birds are found throughout the numerous and diverse vegetative communities within the study area. The year-round bird species found throughout the study area include downy woodpecker* (*Picoides pubescens*), northern cardinal* (*Cardinalis cardinalis*), pileated woodpecker* (*Dryocopus pileatus*), red-bellied woodpecker* (*Melanerpes carolinus*), Carolina chickadee* (*Poecile carolinensis*), American robin* (*Turdus migratorius*), and blue jay* (*Cyanocitta cristata*). These species primarily eat

* Indicates evidence or direct sightings of species during field reconnaissance.

insects in warm weather months and berries or birdseed in winter months. Other year-round bird species common throughout the study area, but who eat primarily nuts or berries include the dark-eyed junco* (*Junco hyemalis*), white-breasted nuthatch* (*Sitta carolinensis*), and cedar waxwing (*Bombycilla cedrorum*). The eastern phoebe (*Sayornis phoebe*) is a common insectivorous year-round resident. The ruby-throated hummingbird (*Archilochus colubris*) also eats insects, but its primary food is the nectar in flowers. Predatory birds expected to be in these communities are the red-tailed hawk (*Buteo jamaicensis*) and eastern screech owl (*Otus asio*). These predatory birds primarily consume rodents and other small animals. Birds that can reside in all of the vegetative communities are generalists and typically nest in trees or man-made structures.

3.9.2.2 Urban/Disturbed/Agricultural Habitats

Many mammals primarily utilize the urban/disturbed/agricultural communities, largely due to the relatively open environments. This vegetative community usually occurs at low to moderate elevations in the study area. Sparse and/or immature vegetation or crops dominate the vegetation in early successional and agricultural areas. Large, well-spaced mature trees are present within residential areas. This combination of vegetation encourages the proliferation of edge species. Edge species have become accustomed to human activity and generally use the mature trees for cover and the open areas as a source for food.

Herbivores such as the eastern cottontail* (*Sylvilagus floridanus*) and eastern harvest mouse (*Reithrodontomys humulis*) are often found in old fields or residential backyards. The eastern cottontail has a widely variable diet, but herbaceous perennials provide the primary food source. Nests are constructed in small holes on the ground using any plant material available and lined with fur. The eastern harvest mouse is limited to the lowest elevations of the project study area, primarily around the Bryson City area. Seeds provide the majority of their food source and their globular nests are made from plant material. Mice are hunted relentlessly by snakes and birds in these areas.

Several mammals found within the human-influenced communities take advantage of the food and shelter provided by man. Rodents, including the Norway rat (*Rattus norvegicus*), black rat (*Rattus rattus*), and house mouse (*Mus musculus*), exploit the resources provided by man. These rodents nest in residences, sewers, or garbage dumps and often need to be controlled due to their prolific reproduction. All three rodents feed on anything edible including garbage, grains, birds, rabbits, and even their own young. These rodents were all introduced to North America from Europe and few are found in natural undisturbed habitats.

* Indicates evidence or direct sightings of species during field reconnaissance.

Although herbivores have an apparent advantage in these human-influenced vegetative communities, there are omnivores that are successful in surviving here. These unique mammals include the woodchuck and hispid cotton rat (*Sigmodon hispidus*). Woodchucks typically reside in burrows along roadsides or forest edges and are often seen sitting on their haunches surveying their domain. Although they are known to eat animal matter, it is rare and not the preferred food source. Likewise, the hispid cotton rat rarely eats animal matter, subsisting primarily upon shoots, seeds, and roots. These rodents are often found in dense grasses that provide good cover.

The changes man has brought to North America over the past several hundred years drove out many species of birds; however, some adapted quite well and have thrived in this man-influenced environment. These birds include the chimney swift (*Chaetura pelagica*), mourning dove* (*Zenaida macroura*), tufted titmouse* (*Baeolophus bicolor*), American crow* (*Corvus brachyrhynchos*), indigo bunting (*Passerina cyanea*), eastern bluebird (*Sialia sialis*), barn swallow (*Hirundo rustica*), song sparrow (*Melospiza melodia*), white-eyed vireo (*Vireo griseus*), and eastern meadowlark (*Sturnella magna*). Many of these bird species have come to depend upon man for food, but all tend to eat insects in the summer and vegetable matter in the winter. These birds, more so than the generalists that reside throughout all communities, live either in structures provided by man or in nearby trees that are protected by man. Two carrion feeders likely to be found in these open communities are the black vulture (*Coragyps atratus*) and turkey vulture (*Cathartes aura*). Both vultures are known to feed on dead carcasses; however, the black vulture prefers larger prey than the turkey vulture. Vultures do not construct nests, preferring instead to reside in dark locations such as caves, hollow trees, and abandoned buildings. The American kestral (*Falco sparverius*) is a common predatory bird of open areas, especially pastures and cultivated fields. They are often observed on utilities poles in search of prey, which includes insects, small rodents, and small birds.

In the urban/disturbed/agricultural habitats, amphibian species are likely to be scarce. Few undisturbed breeding pools are likely to be found in agricultural fields or in the urban developed areas such as Bryson City. The American bullfrog (*Rana catesbeiana*) is the most likely amphibian to be seen in this community. It prefers to be near permanent bodies of water and may be found along the larger streams or ponds in this habitat.

In developed areas, reptile species such as snakes may be more frequent due to the abundance of rodents near residences and agricultural lands. The snakes found in disturbed habitats are typically generalists, those species noted previously that are present throughout the study area. Two lizards likely to inhabit these communities are the northern green anole (*Anolis carolinensis carolinensis*) and northern fence lizard* (*Sceloporus undulates hyacinthinus*).

* Indicates evidence or direct sightings of species during field reconnaissance.

Both of these species are insectivores and are often seen sunning themselves on stumps, logs, and fences.

Some animals prefer moist to wet meadows and other wet grassy environments. Wet meadows are found in floodplains or other low-lying regions. They often contain thick herbaceous vegetation and a diverse and plentiful insect community, thus supporting both herbivores and omnivores. The mammals present in this type of ecosystem include the meadow vole (*Microtus pennsylvanicus*), meadow jumping mouse (*Zapus hudsonius*), and the southern bog lemming (*Synaptomys cooperi*). The meadow vole resides in runways they build on the ground surface within thick grasses. These grasses also comprise their primary diet; however, they are known to eat insects. A similar omnivorous diet is shared by the meadow jumping mouse. This mouse constructs nests of grass and leaves underground for hibernation during the winter months. In contrast to the meadow vole and meadow jumping mouse, the southern bog lemming is a strict herbivore feeding on succulent grasses and sedges present in this moist environment. Similar to the meadow vole, this lemming resides in grassy runways.

The numerous small rodent population present in this open and moist environment attracts the attention of predatory birds. The broad-winged hawk (*Buteo platypterus*) is a good example of an opportunistic predator present in this environment. This hawk perches and nests in large trees or utility poles that overlook relatively large areas in quiet search for food. Other non-predatory birds also thrive in this environment due to a wide array of food and man-made structures for nesting and perching. These birds include the eastern towhee* (*Pipilo erythrophthalmus*), red-winged blackbird (*Agelaius phoeniceus*), and Carolina wren* (*Thryothorus ludovicianus*). The eastern towhee consumes a wide array of grasses present in this moist environment, while the Carolina wren eats the insects present on these grasses. The opportunistic red-winged blackbird feeds upon both the plant material and insects available. This gregarious bird is often observed singing from a perch atop shrubbery in a marsh or along the edge of a stream or river.

3.9.2.3 Early Successional Forest Habitats

The early successional forest community contains dense shrubby vegetation and young trees and is found on areas of abandoned farmland, logged lands, or forests regenerating from natural disturbance. Animals that utilize these successional areas will also tend to utilize the transition zone from primarily open, grassy environments into forested environments. The smoky shrew (*Sorex fumeus*) is likely to occur in this environment. It is a carnivore that takes advantage of its environment by feeding on salamanders, insects, centipedes, and

* Indicates evidence or direct sightings of species during field reconnaissance.

earthworms. For cover, this shrew nests in the leaves and other organic matter on the forest floor.

Another mammal often found in the early successional forest community and forested edges is the red fox (*Vulpes vulpes*). These animals are most active at night and tend to avoid areas with regular human activity, with the exception of roadways. The food and cover available along the open forest and field edges is what attracts these mammals to these ecosystems.

The wild turkey* (*Meleagris gallopavo*) is good example of a bird species that utilizes this environment between the immature early successional forests and mature mixed pine/hardwood forests. This bird was hunted to the point of near extirpation several decades ago; now the wild turkey has seen a large increase in its population due primarily to extensive wildlife management and restoration efforts. These efforts have allowed the wild turkey to once again become a somewhat common sight and major game species. It primarily feeds on vegetable matter plentiful in cutovers, fields, along utility easements, and along roadways; however, it is known to feed on insects, frogs, lizards, and nuts such as acorns found in more mature woodlands. The nest of the wild turkey consists of a few dead leaves and twigs on the ground beneath thick shrubbery.

3.9.2.4 Alluvial/Bottomland Forest Habitats

In general, the lowest-elevation forested natural community is alluvial/bottomland forest community. While water bodies including, streams, ponds, and lakes are found throughout most of the ecosystems within the study area, the alluvial/bottomland forest community is unique to the floodplains of the larger stream and river courses. This natural community provides a bounty of food and dense cover for small and large animals to thrive. Animals residing in these areas must in turn cope with the periodic flooding characteristic of this vegetative community type. Most of these animals fear humans and adapt poorly to a changing environment caused by human activity.

Mammals accustomed to life partially spent in water include the beaver (*Castor canadensis*), muskrat (*Ondata zibethicus*), mink (*Mustela vison*), and northern river otter (*Lutra canadenis*). These animals were prized for their pelts and trapped extensively by early European residents of the region. The beaver was exterminated from the area in the early 1900s; however, recently a few dams have been observed in GSMNP along Noland Creek, Hazel Creek, the Oconaluftee River, Deep Creek, and Abrams Creek. They are voracious herbivores, eating grasses, aquatic plants, and corn, as well as the soft tissue just below the bark of trees. These industrious rodents are capable of altering forests in the vicinity of their home stream by felling numerous trees to construct a dam. These dams block water in

* Indicates evidence or direct sightings of species during field reconnaissance.

streams, ultimately flooding areas outside the stream banks and creating ponds. Beavers then build lodges of logs, sticks, and mud along the edge of these ponds for cover and protection; however, in GSMNP most lodges are found in the stream banks. In contrast, the herbaceous muskrat is smaller in size relative to the beaver and they do not construct dams. They build a lodge along the edges of existing stream banks or beaver impoundment. Their lodges consist of aquatic vegetation, mud, small sticks, and other debris.

Unlike the beaver and muskrat, mink are carnivorous, feeding on fish, frogs, crustaceans, birds, and small mammals. Mink are known to use abandoned dens of beaver and muskrat or make their own in hollow logs. In addition, the study area is host to the large, semiaquatic northern river otter. This mammal was heavily trapped and exterminated from the park by 1927. In the mid-eighties a reintroduction effort began and was completed in 1994 with a total release of 137 otters. Otters feed primarily on slow moving fish such as suckers, carp, and catfish, but are also known to eat crayfish, crabs, amphibians, and other aquatic organisms.

The moist environment of the alluvial/bottomland forest community is ideal for salamanders and other amphibians, and most are associated with small streams and seepages. The Great Smoky Mountains are known to contain approximately 30 species of salamanders. Salamanders tend to hide during the day under rocks and logs and forage for insects (both aquatic and terrestrial), crustaceans, worms, and other organisms along the forest floor and in streams at night. Salamanders are often confused with lizards, a group of reptilian species. However, a salamander's skin lacks scales, their toes have no claws, and a clear jelly surrounds their eggs. Lizards, on the other hand, have scales, claws on their toes, and dry, leathery eggshells. Salamanders such as the red spotted newt* (*Notophthalmus viridescens viridescens*), Jordan's salamander (*Plethodon jordani*), three-lined salamander (*Eurycea guttolineata*), Blue Ridge two-lined salamander (*E. wilderae*), seal salamander (*Desmognathus monticola*), Ocoee salamander* (*D. ocoee*), and seepage salamander (*D. aeneus*) are some of the species that may exist within the alluvial/bottomland forest community within the study area. The red spotted newt is the only salamander listed that spends its juvenile life in wooded areas adjacent to streams and its adulthood as an aquatic in streams. Information regarding salamanders will be updated in the DEIS.

Other amphibians such as the American toad* (*Bufo americanus*) and Fowler's toad* (*B. woodhousii fowleri*) may also be present in these communities. The American toad can be found in moist woods and shallow pools of water, while Fowler's toad is usually found in sandy areas of river valleys. Both of these toads, as well as all adult amphibians, are carnivorous and are known to feed on insects and other small invertebrates. Terrestrial

* Indicates evidence or direct sightings of species during field reconnaissance.

amphibians tend to reside beneath rocks or leaf litter, while the aquatic amphibians live within the water bodies along roots or rocks.

The alluvial/bottomland forest community includes reptiles that require constant interaction with a water source. Snakes often present in this environment include the northern water snake (*Nerodia sipedon*), queen snake (*Regina septemvittata*), and northern rough greensnake (*Opheodrys aestivus aestivus*). These snakes are known to forage on small fish, salamanders, frogs, and insects. The northern water snake and queen snake typically are found beneath rocks in streams; however, the northern rough greensnake is rarely found beneath rocks, preferring instead to reside clutching to shrubs. The most ancient of all living reptiles are turtles, which are generally omnivorous and found in or near water. Turtles are reptiles, thus they lay hard, shelled eggs that are deposited on dry land. Turtle species that are likely to be found within the study area include the snapping turtle (*Chelydra serpentina*), and eastern spiny softshell (*Apalone spinifera spinifera*).

Birds that feed on aquatic or semi-aquatic animals such as fish, insects, mollusks, and snails tend to remain entirely within the alluvial/bottomland forest community. Common species include the green heron (*Butorides virescens*), belted kingfisher* (*Ceryle alcyon*), and Louisiana waterthrush (*Seiurus motacilla*). These birds construct nests on or near the ground from available vegetation material. Also present within this vegetation community, but in a somewhat different role, is the American woodcock (*Scolopax minor*). Living within large, dense alluvial areas, the American woodcock feeds on earthworms, slugs, insects, and seeds. This secretive game species constructs well-hidden nests using twigs and dried leaves. A bird that is found near open water is the bald eagle (*Haliaeetus leucocephalus*). Eagles are becoming a common site along the shores of Fontana Lake. This protected raptor is thought to be establishing a breeding population in the area.

3.9.2.5 Mixed Pine/Hardwood Forest, Pine Forest, and Upland Hardwood Forest Habitats

At a slightly higher elevation the alluvial forests grades upward to a drier forested community. These drier forested community types include the mixed pine/hardwood forest, pine forest, and upland hardwood forest communities. Though this ecosystem may contain mid-elevation small streams, flooding would be unexpected due primarily to the headwater nature of this ecosystem. High elevation ridges and knolls dominated by mast-producing trees are common. The unique feature of this environment is its large contiguous forested areas, which are critical to interior species. Though evidence of past human activity can be found, these areas have been left relatively unmanaged (in the classical sense) for many years. As a result, these interior species found here adapt poorly to unnatural influences in their ecosystems.

* Indicates evidence or direct sightings of species during field reconnaissance.

Squirrels, including the red squirrel (*Tamiascurius hudsonicus*) and the southern flying squirrel (*Glaucomys volans*), are common because of the dominance of large pine and mast-producing trees with an open understory. Hollow trunks often associated with mature forests provide the red squirrel with locations for dens. Also available is a relatively constant supply of pine nuts, acorns, and other nuts from hardwood trees. Like the red squirrel, the southern flying squirrel will build nests in tree cavities, but is also known to nest on limbs or in abandoned nests of other animals. They feed on acorns, nuts, and seeds as well as insects, eggs, and carrion. Another small mammal found in this environment is the eastern woodrat (*Neotoma floridana*). The eastern woodrat prefers the steep, moist slopes this environment offers to construct nests for protection from predators, and is a native herbivore feeding on a wide range of plant material.

In contrast, the European wild hog* is non-native species thought to have entered GSMNP during the 1940s. They have since dispersed and hybridized with feral domestic pigs. The hogs can be found at all elevations and in a variety of habitats and can reach up to 3 feet (0.9 m) in height and weigh over 400 pounds (180 kg). These wild hogs are omnivorous and tend to eat acorns during the fall, winter, and spring and foliage, roots, and herbs during the spring and summer. They also will eat invertebrates and small vertebrates like salamanders all year. The few predators known to prey on the hogs include bobcats, black bears, and coyotes. In order to decrease the population in the park, trapping and shooting of the wild hog began in 1959. Since 1959, more than 10,000 wild hogs have been removed from GSMNP.

Reptiles that occur in these mid to high elevation environments are often found in multiple vegetative communities. However, a few are exclusive to contiguous forest habitat; one of the best examples is the northern ring snake (*Diadophis punctatus edwardsii*). The northern ring snake spends its life eating salamanders, earthworms, and frogs that reside beneath rocks and logs. Other snake species that could be encountered include the eastern worm snake (*Carphophis amoenus amoenus*) and northern copperhead (*Agkistrodon contortrix mokasen*). The eastern worm snake lives in shallow burrows, and earthworms comprise the bulk of their diet. Northern copperheads, by contrast, enjoy the plentiful amounts of mice, lizards, amphibians, and insects found in this environment. In the spring and fall these venomous snakes tend to aggregate near century-old den sites found in the steep portions of this environment. Lizards found within the southeastern United States enjoy this type of wooded environment and feed primarily on insects. They tend to live in warm habitats using the sun to warm their bodies. The nine lizard species known to occur in the Great Smoky Mountainss are found at fairly low elevations. Two lizard species that are likely to be observed in the study area include the common five-lined skink* (*Eumeces fasciatus*) and broadhead skink (*E. laticeps*). A final reptile species found in forested communities is the eastern box turtle* (*Terrapene carolina carolina*). This is the only turtle found in the region

* Indicates evidence or direct sightings of species during field reconnaissance.

with a hinged shell that allows it to fit the upper and lower shells into a tight box. Box turtles can live to the remarkably old age of at least fifty years. They are omnivores eating a variety of plant and animal material including berries, mushrooms, insects, snails, earthworms, and carrion.

Bird species such as the barred owl (*Strix varia*) that require deep, unfractured forests are likely to be found in this environment. This inquisitive owl is active day or night. It mainly consumes rodents and other small animals. They reside primarily in hollow logs and in the abandoned nests of hawks and crows. Other bird species known to require this type of environment include the veery (*Catharus fuscescens*), northern parula (*Parula americana*), black-throated green warbler* (*Dendroica virens*), black-throated blue warbler* (*Dendroica caerulescens*), blackburnian warbler (*Dendroica fusca*), scarlet tanager (*Piranga olivacea*), and wood thrush* (*Hylocichla mustelina*). These insectivores generally use the tall mature trees to construct their nests in for protection. Ruffed grouse* (*Bonasa umbellus*) is the best example of a game species present within this unfractured, interior forest environment. This quick bird builds nests immediately below the ground surface and feeds primarily on vegetable matter.

The relatively undisturbed, contiguous nature of the forests contained within GSMNP and Nantahala National Forest offer optimal habitat conditions for neotropical migrant birds. Neotropical migrants are those birds that breed in North America in the warmer seasons and migrate to Central and South America in the colder seasons. In recent years there has been a population decline in these migrants, which is thought to be associated with increasing forest fragmentation of eastern deciduous forests of North America and deforestation of tropical forests. The neotropical migrants breeding in North America tend to have a short breeding season, small clutch size, and open nests that are on or near the ground. This breeding behavior and increasing forest fragmentation and deforestation has left the migrants susceptible to predation and nest parasitism (Robbins 1989). The brown-headed cowbird *(Molothrus ater*) is the commonly noted species when discussing the threat of nest parasitism. The cowbird is a common species in the project study area and is usually observed in grassy fields and along woodland edges. However, because of the relatively infrequent occurrence of cowbirds in the park compared with surrounding areas, the park is an important refuge from cowbird parasitism for many songbirds, such as the neotropical migrants (DLIA 2003).

* Indicates evidence or direct sightings of species during field reconnaissance.

3.9.3 Aquatic Wildlife

3.9.3.1 Fontana Lake

The quality and diversity of aquatic habitat in Fontana Lake and the streams within the project study area are expected to be high due to the limited amount of disturbance in their respective watersheds. The only readily observed land disturbances or land uses that could affect water quality within the project study area are timber harvesting operations, agriculture, individual housing construction, and trout farming. Detailed information concerning the waters within the project study area is included in Section 3.7.

Sport fishing within both Fontana Lake and the numerous streams that empty into it has become a major use by visitors to the area. Management of these fish resources is essential to the continued survival of fish and the enjoyment of anglers. To achieve these goals, GSMNP, Nantahala National Forest, and the state of North Carolina have set limits on daily takes and have required licenses. Continued enforcement, though not an easy task, is needed to ensure the survival of the primary game species actively hunted within GSMNP.

The open water environment found within Fontana Lake encourages the proliferation of many types of fish. The major sport fish within Fontana Lake include smallmouth bass* (*Micropterus dolomieu*), largemouth bass* (*M. salmoides*), and walleye (*Stizostedion vitreum*). Other fish present within Fontana Lake include gizzard shad (*Dorosoma cepedianum*), muskellunge (*Esox masquinongy*), bluegill* (*Lepomis macrochirus*), common carp (*Cyprinus carpio carpio*), channel catfish (*Ictalurus punctatus*), and yellow perch* (*Perca flavescens*). Though these fish are primarily found in Fontana Lake, they will venture into the lower stream reaches.

Other major sport fish found in the larger study area streams and in Fontana Lake, are the rainbow trout* (*Oncorhynchus mykiss*) and brown trout (*Salmo trutta*). These introduced fish spawn in the cool, fast flowing streams then often travel back into open water. For the rainbow trout, spawning season is in the spring, while the brown trout spawns in the fall. Although many trout return to the open water after spawning, there are those who remain in the streams if plentiful food and cover are available. This has made fly fishing for trout a year round draw to the numerous streams feeding Fontana Lake. Rainbow, brown and brook trout (*Salvelinus fontinalis*) are stocked by NCWRC in the following streams in the study area: Panther Creek, Stecoah Creek, Deep Creek, and Alarka Creek. No trout are stocked in GSMNP.

* Indicates evidence or direct sightings of species during field reconnaissance.

Other aquatic species likely to be found in the study area include several of the previously mentioned amphibian, reptilian, and mammal species. Salamanders, frogs, turtles, and muskrat are a few of the taxa that inhabit both terrestrial and aquatic communities. Mollusk species are known to occur in this portion of North Carolina; however, no mollusk shells were observed.

3.9.3.2 Stream Habitats

The native brook trout is a resident in the smaller headwater streams within the study area. Due to competition from the exotic rainbow and brown trout, and due to former forestry and industrial activities, the brook trout populations saw major declines during the twentieth century. Their numbers are low enough now that these fish are protected throughout GSMNP. Other fish that may inhabit streams within the study area include mountain brook lamprey (*Ichthyomyzon greeleyi*), central stoneroller (*Campostoma anomalum*), warpaint shiner (*Luxilus coccogenis*), river chub (*Nocomis micropogon*), Tennessee shiner (*Notropis leuciodus*), silver shiner (*N. photogenis*), mirror shiner (*N. spectrunculus*), fatlips minnow (*Phenacobius crassilabrum*), black redhorse (*Moxostoma duquesnei*), rock bass (*Ambloplites rupestris*), greenside darter (*Etheostoma blennioides*), greenfin darter (*E. chlorobranchium*), gilt darter (*Percina evides*), longnose dace (*Rhinichthys cataractae*), creek chub* (*Semotilus atromaculatus*), northern hog sucker (*Hypentelium nigricans*), and mottled sculpin (*Cottus bairdi*). All of the fish listed feed on a variety of living and organic matter including algae, insects, worms, crustaceans, snails, and detritus.

Three aquatic amphibians that are likely to occur in the project study area include the mudpuppy (*Necturus maculosus maculosus*), hellbender (*Cryptobranchus alleganiensis*), and American bullfrog (*Rana catesbeiana*). The mudpuppy and the hellbender are the only two entirely aquatic salamanders known in GSMNP. Both the mudpuppy and American bullfrog are likely to be found in lakes, ponds, and slow moving rivers and large streams. The hellbender inhabits fast-flowing streams and rivers with rocky substrates and consumes crayfish and aquatic insects.

Other aquatic species likely to be found in the study area include several of the previously mentioned amphibian, reptilian, and mammal species. Salamanders, frogs, turtles, and muskrat are a few of the taxa that inhabit both terrestrial and aquatic communities. Mollusk species are known to occur in this portion of North Carolina; however, no mollusk shells were observed.

* Indicates evidence or direct sightings of species during field reconnaissance.

3.9.3.3 Aquatic Macroinvertebrates

Different aquatic macroinvertebrates can be found within the following zones of Fontana Lake. The surface of the lake may have species such as water striders (Gerridae), whirligig beetles (Gyrinidae), and mosquito larvae (Culicidae). In the shallow, open water or limnetic zone, a few nektonic species are found that feed on plankton. Most aquatic macroinvertebrates will be found in the near shore or littoral zone of the lake. The diversity of species depends on the abundance of vegetation and difference in substrates. The deep, open water or profundal zone is limited to few species. Aquatic macroinvertebrates that may be found in Fontana Lake include *Hexagenia* sp., *Ephemera* sp., *Chironomus* sp., *Tanytarsus* sp., and *Megaloptera* sp (Merrit and Cummins 1984).

Benthic macroinvertebrates are very abundant in the streams within the project study area, especially within GSMNP. Macroinvertebrates are an important step in the food chain, breaking down organic matter and feeding on living plants within the stream and providing food for numerous fish found in the streams. NCDWQ (2002) found over 186 species of macroinvertebrates in the streams within the project study area. Some common species likely to occur include *Baetis tricaudatus*, *Epeorus rubidus*, and *Stenonema pudicum* from the Ephemeroptera Order (mayflies); *Acroneuria abnormis*, *Leuctra* spp., and *Tallaperla* spp. From the Plecoptera Order (stoneflies); and *Brachycentrus spinae*, *Neophylax consimilis*, and *Rhyacophila fuscula* from the Trichoptera Order (caddisflies). Numerous chironomids (Chironomidae Family) most likely occur in all streams. Several species from the taxa of Diptera, Oligochaeta, Crustacea, Pelecypoda, Gastropoda, Odonata, and Megaloptera will also be present.

According to The Nature Conservancy and the Association for Biodiversity Information in *Precious Heritage: The Status of Biodiversity in the United States* (2000), the southern Appalachian Mountains are renowned as one of the nation's six biological hot spots . These six areas are classified as biological hot spots due to the richness and relative rarity of the species that inhabit each area. The diversity of freshwater organisms, including fishes and mussels, contribute greatly to the biodiversity of the southern Appalachians. The Tennessee River system, which includes the project study area, is noted as the nation's most biologically diverse drainage system, and one river basin within the Tennessee River System is noted as being home to more species of fishes than the continent of Europe. Another river in the Tennessee River system flows through these mountains in southwestern Virginia and northeastern Tennessee and is home to at least 29 rare mussels and 19 rare fish. The biodiversity of cave-dwelling invertebrates is also significant in these mountains. More than 30 species new to science have been discovered in the natural underground caves in the region in the past few years. These mountains are also recognized as the world's center for

* Indicates evidence or direct sightings of species during field reconnaissance.

salamander diversity. Imperiled groups in the southern Appalachian Mountains include species of freshwater mussels, fishes, cave invertebrates, plants, and amphibians.

3.9.4 Invasive Exotic Species

A variety of animal and plant species inhabit the project study area. While the majority of those species are native to the region there are a few that have been introduced by man. The introduced species are referred to as exotics. Most of the exotic species are harmless and cause no real concern. However, there are those exotic species that have become invasive and negatively impact native animal and plant communities. The impacts caused by the invasive exotics include a decrease in biodiversity, a disturbance to or elimination of habitat for rare and endangered species as well as for native species, and an alteration of the relationship between native animal and plant communities (Tennessee Exotic Pest Plant Council 2001).

Five types of invasive exotics are aquatic animals, terrestrial animals, forest insects, terrestrial plants, and forest diseases. According to the TVA, the invasive exotic aquatic animals likely to occur in this region include common carp (*Cyprinus carpio*) and Asiatic clam (*Corbicula fluminea*) (undated memo). The TVA also noted the following terrestrial animals as invasive exotics: the European boar, European starling (*Sturnus vulgaris*), house sparrow (*Passer domenticus*), and rock dove (*Columba livia*). As noted in the pervious section, the European hog is a major pest in GSMNP and significant efforts are made to control its populations. Other invasive terrestrial animals of concern are the house mouse and Norway rat.

Exotic forest insects include the balsam woolly adelgid (*Adelges piceae*), the hemlock woolly adelgid (*Adelges* tsugae), Asian tiger mosquito (*Aedes albopictus*), and gypsy moth (*Lymantria dispar*). The hemlock woolly adelgid is a new, significant threat to hemlock trees in the Southern Appalachians. It was first spotted in these mountains in 2002, although it has been in the United States for many years. This small insect can kill an adult hemlock tree within two years of infestation. Major efforts and research are ongoing across the region to control the spread of this insect.

According to GSMNP (1989), 98 percent of the area covered by invasive exotic plant species in disturbed areas of GSMNP backcountry are accounted for by the following eight species: English ivy (*Hedera helix*), air-potato (*Dioscorea batatas*), periwinkle (*Vinca minor*), multiflora rose (*Rosa multiflora*), tall fescue (*Festuca elatior*), sericea lespedeza (*Lespedeza cuneata*), Japanese honeysuckle (*Lonicera japonica*), and Nepalgrass (*Microstegium vimineum*).

* Indicates evidence or direct sightings of species during field reconnaissance.

The National Park Service (2003d) mapped the locations of exotic plant species occurring within the GSMNP. Those species found in the GSMNP portion of the project study area include the common mullein (*Verbascum thapsus*), Japanese honeysuckle, kudzu (*Pueraria montana*), mimosa(*Albizia julibrissin*), multiflora rose, Oriental bittersweet (*Celastrus orbiculatus*), princess tree (*Paulownia tomentosa*), Chinese privet (*Ligustrum sinense*), periwinkle, white poplar (*Populus alba*), and wisteria (*Wisteria floribunda*).

Additionally, invasive exotic forest diseases threaten the native vegetation in the study area. These diseases include chestnut blight (*Cryphonectria parasitica*), Dutch elm disease (*Ophistoma ulmi*), butternut canker (*Sirococcus clavigignenti juglandaceaerum*), beech bark disease (*Nectria coccinea faginata*), and dogwood anthracnose (*Discula destrictiva*).

3.9.5 Protected Species

3.9.5.1 Federally Protected Species

Bog Turtle

Some populations of fauna and flora have been or are in the process of decline due to either natural forces or their inability to coexist with humans. Federal law (under the provisions of Section 7 of the Endangered Species Act [ESA] of 1973, as amended) requires that any action likely to adversely affect a species classified as federally protected be subject to review by the USFWS. Other species may receive additional protection under separate laws. As of February 18, 2003, the USFWS identified four Endangered (E) species, one Threatened (T) species, and one species threatened due to similarity of appearance (T[S/A]) as potentially occurring in Graham County. As of February 25, 2003, the USFWS had identified seven Endangered species and three Threatened species as potentially occurring in Swain County. Table 28 lists these federally protected species, their status, the county where they are listed, and whether a review of GSMNP and/or North Carolina Natural Heritage Program (NCNHP) maps of known populations of these federally protected species identified populations within or near the project study area. Descriptions of these species and their habitats are discussed below. Figure 18 depicts the best estimate of potential habitat in the study area for each of these federally protected species. No surveys in the study area have been conducted to date for these federally protected species. Investigations regarding these species will be determined in consultation with the USFWS once detailed study corridors have been selected for evaluation in the DEIS.

* Indicates evidence or direct sightings of species during field reconnaissance.

Table 28

Federally Protected Species Known from Graham and Swain Counties, North Carolina

Scientific Name	Common Name	Federal Status	State Status	County	Habitat Available	Identified In or Near Project Area*
Vertebrates						
Clemmys muhlenbergii	Bog turtle	T(S/A)	T	G	Yes	No
Glaucomys sabrinus coloratus	Carolina northern flying squirrel	E	E	G, S	Yes	No
Felis concolor couguar	Eastern cougar	E	E	S	Yes	Yes**
Myotis sodalis	Indiana bat	E	E	G, S	Yes	No
Cyprinella (=Hybopsis) monacha	Spotfin chub	T	T	S	Yes	Yes
Invertebrates						
Alasmidonta raveneliana	Appalachian elktoe	E	E	G, S	Yes	Yes
Microhexura montivaga	Spruce-fir moss spider	E	SR	S	No	No
Patera clarki nantahala	Noonday globe	T	T	S	Yes	No
Pegias fabula	Little-wing pearlymussel	E	E	S	Yes	No
Vascular Plants						
Spiraea virginiana	Virginia spiraea	T	E	G, S	Yes	No
Nonvascular Plants						
Gymnoderma lineare	Rock gnome lichen	E	T	G, S	Yes	No

Notes: E – Endangered; T – Threatened; G – Graham County; SR – State Rare; T(S/A) – Threatened Due to Similarity of Appearance; S – Swain County

* Populations of these species have been identified in the project study area or within a 2-mile (3.2-km) radius of the project study area as reported by the NCNHP.

** Cougars, according to NPS biologists, are not currently known to occur in the GSMNP portion of the project study area. The last known documented sighting, based on USFWS and NCNHP records, was over 20 years ago.

3.9.5.1.1 Vertebrates

Bog Turtle (*Clemmys muhlenbergii*)

Federal Status: THREATENED (SIMILAR APPEARANCE)

State Status: THREATENED

GRAHAM COUNTY

Bog turtles are small (3 to 4.5-inch [7.6 to 11.4 cm]) reptiles with a weakly keeled carapace (upper shell) that ranges in color from light brown to ebony. This species is easily distinguished from other turtles by a large, conspicuous, bright orange to yellow blotch on each side of its head. Bog turtles are semi-aquatic and inhabit muddy, bog-like habitats. They can be found during the spring mating season from June to July and at other times from April to October when the humidity is high and temperatures are in the 70s. Bog turtle habitat consists of bogs, swamps, marshy meadows, and other wet environments, specifically those that exhibit soft muddy bottoms.

In November 1987 the northern population of the bog turtle (from New York south to Maryland) was listed as federally threatened, and the southern population (from Virginia south to Georgia) was listed as federally threatened due to similarity of appearance. Therefore, the southern populations are not protected under Section 7 of the ESA; however, the T(S/A) designation bans the collection and interstate or international commercial trade of bog turtles from the southern population. In addition to its official status as T(S/A), the USFWS considers the southern population of the bog turtle as a Federal Species of Concern (FSC) due to habitat loss (Russo 2000).

Habitat is available in the Graham County portion of the project study area, along the floodplains of the numerous streams.

Carolina northern flying squirrel (*Glaucomys sabrinus coloratus*)

Federal Status: ENDANGERED

State Status: ENDANGERED

GRAHAM AND SWAIN COUNTIES

Carolina northern flying squirrels are nocturnal mammals. This squirrel measures about 10 to 12 inches (25.4 to 30.5 cm), with the broad, flattened tail accounting for nearly half its total length. They have a large fold of fully haired skin that runs from the front legs to the hind legs, enabling the squirrel to glide. This squirrel is found in the western regions of the state,

typically in the transition zone between high elevation coniferous forests and mature northern hardwood forests. The optimal transition zone contains forests that are moist with mature, widely spaced trees and an abundance of snags. These regions usually occur above 4,500 feet (1,371.6 meters) msl. The Carolina northern flying squirrel nests in cavities of hardwood trees through the winter and in leaf nests on tree branches through the summer (Russo 2000).

A survey for the Carolina northern flying squirrel was conducted from 1987 to 1989 in GSMNP. During the 2-year study, seven trapping locations were established approximately 10 miles (16 km) northeast of the project study area. Seven squirrels were captured, including one recapture, and all were trapped in similar habitats that consisted of high altitude, mixed forests of spruce-fir and northern hardwoods (Weigl 1990). A more recent survey conducted by the NCWRC (2003) resulted in seven captured squirrels in areas approximately 10 to 25 miles (16 to 40 km) northeast of the project study area boundary.

Suitable habitat for the Carolina northern flying squirrel is located in the project study area. Elevations exceeding 4,500 feet (1,371.6 meters) msl with northern hardwood vegetation occur north of Fontana Lake along Welch Ridge. However, there are no documented populations of this species by either GSMNP or the NCNHP within a two-mile (3.2-km) radius of the project study area.

Eastern Cougar (*Puma concolor couguar*)

Federal Status: ENDANGERED

State Status: ENDANGERED

SWAIN COUNTY

The eastern cougar is described as a large, unspotted, long-tailed cat. Its body and legs are a uniform fulvous or tawny hue and its belly is pale reddish or reddish-white. The inside of this cat's ears are light-colored, with a blackish color behind the ears. Cougars feed primarily on deer, but their diet may also include small mammals, wild turkeys, and occasionally domestic livestock. Cougars begin breeding when 2 or 3 years old and breed thereafter once every 2 to 3 years. A typical litter size is three, with the newborn kittens weighing 8 to 16 ounces (272 to 454 grams).

The primary habitat appears to be large wilderness areas with an adequate food supply. Cougars avoid human-developed areas and have been considered by some as extirpated for this reason. Male cougars typically occupy a range of 25 or more square miles (65+ km^2), and females from 5 to 20 square miles (13 to 52 km^2). Sightings have been reported in three North Carolina areas, including Nantahala National Forest, the northern portion of Uwharrie National Forest, and the state's southeastern counties. The remaining population of this species is extremely small, with exact numbers unknown (USFWS 2001a).

Suitable habitat for the eastern cougar is available in the project study area due to the large expanse of relatively undeveloped lands in GSMNP and Nantahala National Forest. A record of a cougar sighting was documented by GSMNP and/or NCNHP approximately 1.5 miles (2.4 km) from the project study area in the area delimited by the USGS Bryson City 7.5-minute quadrangle map. NCNHP records indicate that the species was last observed in Swain County over 20 years ago. The species is believed to be extirpated from the county.

Indiana bat (*Myotis sodalis*)

Federal Status: ENDANGERED

State Status: ENDANGERED

GRAHAM AND SWAIN COUNTIES

The Indiana bat is a small flying mammal approximately 2 inches (5.1 cm) long, with a wingspan that ranges from 9.5 to 10.5 inches (24.1 to 26.7 cm). They have mouse-like ears, a plain nose, dull grayish fur on the back and lighter cinnamon-brown fur on the belly. Typical prey consists of flying insects available along river and lake shorelines, in the crowns of trees in floodplains, and in upland forests. The life expectancy of the Indiana bat is approximately 15 years.

Indiana bats hibernate for the winter in limestone caverns and abandoned mines, usually near water, and in large colonies. Hibernating individuals characteristically form large, compact clusters of as many as 5,000 individuals (averaging 500 to 1,000 bats per cluster). The bats roost during the summer months in snags or in shaggy-barked live trees near water and exposed to the sun. These "roost trees" can be found within riparian areas, bottomland hardwoods, and upland hardwoods. Dead trees standing in sunny openings are attractive because the air spaces and crevices under the bark are warmer.

Mating occurs from late August to early October prior to hibernation or in spring. Ovulation takes place after the bats arouse in spring, and young are born in June and July. One young is born to each mother, and they leave the roost approximately 30 days after birth.

During July 2000 mist net surveys for Indiana bats were conducted just southwest of GSMNP near the border of North Carolina and Tennessee. The surveys resulted in the capture of three Indiana bats at two sites. These sites were located approximately 6 miles (9.6 km) west of the project study area. One of the sites bordered a pond along a forest edge and the other site was an upland, forested area along the AT (Eco-Tech, Inc. 2000).

Suitable habitat for the Indiana bat is found within the study area. Vegetation adequate to meet both their roosting and foraging needs is available throughout the study area along with

caves needed for hibernation. There are no documented populations of this species by either GSMNP or the NCNHP within a 2-mile (3.2-km) radius of the project study area.

Spotfin Chub (*Cyprinella monacha*)

Federal Status: THREATENED

State Status: THREATENED

SWAIN COUNTY

This small fish, approximately 2.6 to 4.2 inches (6.6 to 10.7 cm) long, has a slender, flattened body with a long snout that extends over the mouth and a small barbel at the corner of the mouth. Juveniles, females, and nonbreeding males have tan-, gray-, or olive-colored backs, bright silvery sides, and white bellies. The spotfin chub spawns from mid-May to early September. Females deposit eggs in crevices between rocks, and males fertilize the eggs and stay to defend the eggs by swimming repeatedly over the nest site. Most spotfin chubs reach sexual maturity at 2 years of age and do not live past 3 years of age.

The spotfin chub inhabits clear water over gravel, boulders, and bedrock in large creeks and medium-sized rivers having moderate current. The fish is rarely seen over sand, and this species appears to avoid silty areas. The spotfin chub feeds by sight and taste on tiny insect larvae that occur on the stream bottom. The spotfin chub is now restricted to a few tributary systems of the Little Tennessee River drainage. Its habitat has been destroyed or seriously altered due to impounded waters, forestry activities, and various waste inputs (Rohde, et al. 1994). In September 1977, the USFWS identified this fish as a threatened species and designated critical habitat. The critical habitat includes the main stem of the Little Tennessee River from the North Carolina-Georgia state line downstream to the backwaters of Fontana Lake, a portion of which lies within the project study area.

In 1988 a program was established to reintroduce the spotfin chub to Abrams Creek in Blount County, Tennessee. This project transported 250 chubs during October 1988 from the Little Tennessee River upstream of Fontana Lake to Abrams Creek, upstream from Chilhowee Lake. This relocation site is approximately 12 miles (19 km) west of the project study area. The reintroduction efforts continued for the next 4 years.

Three occurrences of the spotfin chub have been documented by GSMNP and/or NCNHP in or near the project study area. Two of the occurrences are located on the northern side of the area delimited by the USGS Fontana Lake in the Noland Creek 7.5-minute quadrangle map. The other occurrence is located approximately one mile (1.6 km) south of the project study area in the area delimited by the USGS Wesser 7.5-minute quadrangle map.

3.9.5.1.2 Invertebrates

Appalachian Elktoe (*Alasmidonta ravenaliana*)

Federal Status: ENDANGERED

State Status: ENDANGERED

GRAHAM AND SWAIN COUNTIES

The Appalachian elktoe is a mollusk restricted to the far eastern portions of the Tennessee River watershed. It inhabits streams with a sand and gravel bed substrate, a moderate flow, and less than 3 feet (0.9 m) deep. The mussel remains attached underneath flat cobbles and boulders. The shells are oblong, somewhat kidney-shaped, moderately inflated, and thin. The anterior margin is sharply rounded, the posterior margin is broadly rounded, and the ventral and dorsal margins are nearly straight. The beak sculpture consists of a few heavy straight or slightly double looped bars that terminate at the posterior ridge. The outside surface is mostly smooth, interrupted by concentric growth circles. The outside color of the shell varies from yellowish-brown to black, and the inside color of the shell varies from bluish-white to lavender (Parmalee and Bogan 1998).

The USFWS finalized the designation of critical habitat areas for this mussel on September 27, 2002. In Graham County, the designated area includes the main stem of the Cheoah River from Santeetlah Dam, downstream to its confluence with the Little Tennessee River. In Swain County, the designated area includes the following river reaches: the main stem of the Little Tennessee River from the Lake Emory Dam downstream to the backwaters of Fontana Reservoir and the main stem of the Tuckasegee River from the Town of Cullowhee to north of Bryson City. Portions of the Little Tennessee River and Tuckasegee River designated as critical habitat for this species occur within the project study area.

Many of the streams in the project study area provide suitable habitat for the Appalachian elktoe. Two occurrences of this species have been documented by GSMNP and/or the NCNHP near the project study area. One occurrence is located approximately 1.5 miles (2.4 km) east of the project study area in the area delimited by the USGS Bryson City 7.5-minute quadrangle map. The other occurrence is located approximately 1 mile (1.6 km) south of the project study area in the area delimited by the USGS Wesser 7.5-minute quadrangle map.

Little-wing pearlymussel (*Pegias fabula*)

Federal Status: ENDANGERED

State Status: ENDANGERED

SWAIN COUNTY

The little-wing pearlymussel is a mollusk that is found in the drainage basins of the Tennessee and Cumberland rivers. The shells are small, rarely exceeding 1.38 inches (3.5 cm) in length. The beak consists of heavy, subconcentric ridges, these being most prominent and persistent on the posterior ridges. The inside of the shells is whitish to salmon-colored. The little-wing pearlymussel inhabits cool, clear, high-gradient small to medium sized streams. It is usually found lying on top of or partially imbedded in sand and fine gravel between cobbles in only 6 to 10 inches (15 to 25 cm) of water, often in riffles. Host fish for this mussel include the greenside darter (*Etheostoma blennioides*) and the emerald darter (*E. baileyi*) (Parmalee and Bogan 1998).

No current populations are known to exist in North Carolina; however, there is an obscure record of a population in Cherokee County from more than 50 years ago. Even though this mussel species is thought to be extirpated from North Carolina it inhabits much smaller streams than most mussels and a population may still exist in North Carolina.

Suitable habitat consisting of cool, clear, high-gradient water bodies is available in most of the smaller streams in the project study area. However, there are no documented occurrences of the little-wing pearlymussel within a 2-mile (3.2-km) radius of the project study area.

Noonday globe (*Patera clarki nantahala*)

Federal Status: THREATENED

State Status: THREATENED

SWAIN COUNTY

The noonday globe is a moderately sized land snail. It has a shiny red shell that is sculptured with coarse lines. The area around the shell opening is white with a long curved tooth located on the inside portion of the opening. The noonday globe's body is black. Little is understood concerning the animal's diet; however, animals in this family typically feed on the subsurface hairlike structures (mycelia) of fungi. The species appears to be most active during wet weather when it is frequently found on the surface of vegetation rather than under the leaf litter on the forest floor. The noonday globe is prey for many species including small rodents and carnivorous land snails. Information concerning the reproductive habits of the noonday globe has yet to be determined.

The noonday globe is restricted to a 2-mile (3.2-km) section of high cliffs within the Nantahala Gorge in Swain County, North Carolina. The cliffs in this region are very wet and intersected by many small streams and waterfalls. The forests are mature with a thick, rich humus layer and exposed calcareous rocks. This population of snails has declined due to the loss of the forest canopy at many locations in the Nantahala Gorge. This has allowed more sunlight to penetrate the gorge and dried the lower slope of the gorge, thus significantly altering their environment (USFWS 2000).

The Nantahala Gorge is located approximately 2 miles (3.2 km) south of the project study area; however, suitable habitat for the noonday globe (moist steep cliffs) is present in the project study area. There are no documented populations of this species by either GSMNP or the NCNHP within a 2-mile (3.2-km) radius of the project study area.

Spruce-fir moss spider (*Microhexura montivaga*)

Federal Status: ENDANGERED

State Status: SIGNIFICANTLY RARE

SWAIN COUNTY

It is one of the smallest members of the primitive suborder of spiders that are often popularly referred to as "tarantulas." Adults of this species measure only 0.10 to 0.15 inch (0.25 to 0.38 cm) with a yellow-brown to a darker reddish-brown color. The most reliable field identification characteristics for the spruce-fir moss spider are chelicerae that project forward well beyond the anterior edge of the carapace, a pair of very long posterior spinnerets, and the presence of a second pair of book lungs, which appear as light patches posterior to the genital furrow.

The spruce-fir moss spider is known from only Fraser fir (*Abies fraseri*) and red spruce (*Picea rubens*) forests on the highest mountain peaks (at and above 5,400 feet [1,646 m] in elevation) in the Southern Appalachian Mountains of North Carolina and Tennessee. The typical habitat of this spider is found in damp but well-drained moss mats growing on rock outcrops and boulders in well-shaded situations within these forests. The moss mats cannot be too dry (the species is very sensitive to desiccation) or too wet (large drops of water can also pose a threat to the spider). The spider constructs tube-shaped webs in the interface between the moss mat and rock surface. The abundant springtails in the moss mats provide the most likely source of food for the spider. Populations of the spruce-fir moss spider have declined due in large part to the declining numbers of stands of Fraser fir and red spruce forests (USFWS 1998).

According to the Federal Register on July 6, 2001, critical habitat for the spruce-fir moss spider has been designated in portions of Avery, Caldwell, Mitchell, Swain, and Watauga

counties in North Carolina and became effective on August 6, 2001. These designated critical habitats include areas within GSMNP, Pisgah National Forest, Cherokee National Forest, and Grandfather Mountain (managed by TNC). The critical habitat area designated in GSMNP lies several miles north of the project study area. The remainder of the critical habitat areas are well outside the project study area.

In 1989 and 1990 a survey for the spruce-fir moss spider was conducted in GSMNP, and a total of seven spiders were found.

Suitable habitat for the spruce-fir moss spider is not available in the project study area. Neither the elevation nor the vegetation required for habitat is found in the project study area. There are no documented populations of this species by either GSMNP or the NCNHP within a 2-mile (3.2-km) radius of the project study area.

3.9.5.1.3 Vascular Plants

Virginia spiraea (*Spiraea virginiana*)

Federal Status: THREATENED

State Status: ENDANGERED

GRAHAM AND SWAIN COUNTIES

Virginia spiraea is a perennial shrub, 2 to 10 feet (0.6 to 3.0 m) tall with arching, upright stems. The plants may grow alone or in dense clumps. The leaf shape typically appears as a narrow ellipse with a tapered base and a short bur at the end of the tip. The leaf margins are entire to simply crenate-serrate. The underside of the leaf is smooth with a whitish bloom. The flowers contain five white and very short petals and grow in flat-topped clusters at the ends of a branching stalk. Flowering occurs June through July, and fruiting occurs through September. The Virginia spiraea fruit is small, dry, smooth, and glossy. This plant grows in sunny, flood-scoured, high-gradient rocky riverbanks; braided areas of lower stream reaches; gorges; and canyons, as well as disturbed right-of-ways (Russo 2000).

The study area contains many high-velocity streams that could provide adequate sandy to cobbled scour-area habitat. The study area also has many disturbed rights-of-way near wetlands or streams that may also provide habitat for this plant. However, there are no documented populations of this species by either GSMNP or the NCNHP within a 2-mile (3.2-km) radius of the project study area.

3.9.5.1.4 Nonvascular Plants

Rock Gnome Lichen (*Gymnoderma lineare*)

Federal Status: ENDANGERED

State Status: THREATENED

GRAHAM AND SWAIN COUNTIES

Rock gnome lichen consists of a dense colony of narrow, strap-like lobes, the tips of which are blue-gray on the upper surface and usually shiny white below, with the color darkening to black near the base of the lobes. The slightly branched lobes are less than 0.06 inch (0.15 cm) across, between 0.4 and 0.8 inch (1 to 2 cm) long, and grow parallel to the substrate with tips that stand up almost erect. Fruiting occurs from July to September producing extremely small, black or brown fruiting bodies, which occur at the tip of the lobes.

Rock gnome lichen occurs in areas of high humidity, either on high-elevation cliffs where there is frequent fog or in deep river gorges at lower elevations. Most populations occur above 5,000 feet (1,524 m) msl. It is primarily limited to vertical rock faces that receive infrequent seepage water and to streamside boulders in areas that receive a moderate amount of light but not high-intensity solar radiation (USFWS 2001b).

The majority of the project study area is below 5,000 feet (1,524 m) in elevation. However, some lower-elevation areas that may contain suitable habitat exist in the study area. Areas of moist, steep rock faces exist, especially south of Fontana Lake. There are also many streams in the study area that may provide the humid rock habitat this lichen requires. There are no documented populations of this species by either GSMNP or the NCNHP within a 2-mile (3.2-km) radius of the project study area.

3.9.5.2 Federal Species of Concern

There are 19 FSC listed by the USFWS for Graham County and 36 FSC for Swain County. These species are not protected under the provisions of Section 7 of the ESA. FSC are defined as species under consideration for listing for which there is insufficient information to support listing as threatened or endangered (formerly C2 candidate species). The status of these species may be upgraded at any time; therefore, they are included here for consideration. Table 29 lists the federal species of concern, their state status, where they are protected, the existence of suitable habitat within the project study area, and whether a review of GSMNP and/or NCNHP maps of known populations of these federal species of concern identified populations within or near the project study area. Information regarding these species gathered during survey of the detailed study corridors will be incorporated into the DEIS.

Table 29

Federal Species of Concern Known from Graham and Swain Counties, North Carolina

Scientific Name	Common Name	Federal Status	State Status	County	Habitat Requirements	Available Habitat	Identified In or Near Project Area**
Vertebrates							
Aegolius acadicus	Southern Appalachian saw-whet owl	FSC	T	G, S	Transition habitat between spruce-fir and hardwood forests.	Yes	No
Clinostomus funduloides ssp.1	Little Tennessee River rosyside dace	FSC	SC	S	Typically in small to medium streams with clear to turbid water and moderate current.	Yes	Yes
Contopus cooperi [1]	Olive-sided flycatcher	FSC	SC	S	Hemlock and spruce-fir forests.	Yes	No
Corynorhinus rafinesquii	Rafinesque's big-eared bat	FSC	T	G, S	Buildings, caves, mines, hollow trees, or loose bark near permanent water.	Yes	Yes
Cryptobranchus alleganiensis	Hellbender	FSC	SC	G, S	Clear, fast-flowing streams and rivers with rocky bottoms	Yes	Yes
Dendroica cerulea	Cerulean warbler	FSC	SR	G	Mature hardwood forests with open understory	Yes	Yes
Eurycea junaluska	Junaluska salamander	FSC	T	G	Along streams within Cheoah River watershed	No	No
Loxia curvirostra	Southern Appalachian red crossbill	FSC	SC*	G, S	Coniferous, mixed coniferous-deciduous, pine savannas, and pine-oak habitats.	Yes	No
Microtus chrotorrhinus carolinensis	Southern rock vole	FSC	SC	S	Rocky habitats within high mountain forests or open fields.	Yes	No
Moxostoma sp.	Sicklefin redhorse	FSC	SR (PT)	S	Medium to large creeks and rivers with a gravel, cobble, or boulder streambeds.	Yes	Yes

Table 29 (Continued)

Federal Species of Concern Known from Graham and Swain Counties, North Carolina

Scientific Name	Common Name	Federal Status	State Status	County	Habitat Requirements	Available Habitat	Identified In or Near Project Area**
Myotis leibii	Eastern small-footed myotis	FSC	SC	S	In hemlock forests under boulders, in rock crevices, and in caves and mines.	Yes	No
Neotoma floridana haematoreia	Southern Appalachian woodrat	FSC	SC	S	Talus slopes rocky outcrops, bluffs, cliffs, crevices or caves	Yes	Yes
Percina squamata	Olive darter	FSC	SC	S	Fast riffles in small to medium-sized rivers with gravel to boulder streambeds	Yes	Yes
Pituophis melanoleucus melanoleucus	Northern pine snake	FSC	SC	G, S	Pine-oak woodlands, pine flatwoods, and fields flatwoods,	Yes	Yes
Poecile atricapilla practica	Southern Appalachian black-capped chickadee	FSC	SC*	G, S	Nests in holes of dead trees, near open areas.	Yes	No
Sorex palustris punctulatus	Southern water shrew	FSC	SC	S	In bogs or montane alluvial forests near stream banks	Yes	No
Sphyrapicus varius appalachiensis	Southern Appalachian yellow-bellied sapsucker	FSC	SC	G, S	Most wooded community types	Yes	No
Sylvilagus transitionalis[2]	Appalachian cottontail	FSC	SR	G, S	Thick cover of mountain laurel, rhododendron, or blueberries in coniferous forests.	Yes	No
Invertebrates							
Fumonelix wheatleyi clingmanicus[3]	Clingman covert[3]	FSC	T	S	Clingmans Dome region of Great Smoky Mountains National Park	Yes	No
Macromia margarita	Margarita River skimmer	FSC	-	S	Moderate elevation, high-quality streams and rivers	Yes	No
Nesticus cooperi	Lost Nantahala cave spider	FSC	SR	S	Caves and along Nantahala River	Yes	No

Table 29 (Continued)

Federal Species of Concern Known from Graham and Swain Counties, North Carolina

Scientific Name	Common Name	Federal Status	State Status	County	Habitat Requirements	Available Habitat	Identified In or Near Project Area**
Phyciodes batesii maconensis	Tawny crescent	FSC	SR	G, S	Elevations above 4,000 feet (1219.2 m) above msl	Yes	Yes
Speyeria diana	Diana fritillary butterfly	FSC	SR	G, S	Hardwood and mixed forests, and fields	Yes	Yes
Vascular Plants							
Abies fraseri	Fraser fir	FSC	-	S	Boreal forests and balds above 4,500 feet (1371.6 m)	Yes	No
Buckleya distichophylla	Piratebush	FSC	E	S	In hemlock stands on cliffs or bluffs	Yes	No
Cardamine clematitis	Mountain bittercress	FSC	SR-T	G, S	In and along rocky streams	Yes	No
Desmodium ochroleucum	Creamy tick-trefoil	FSC	SR-T	S	Sandy, open woods, especially in clearings	Yes	No
Euphorbia purpurea	Glade spurge	FSC	SR-T	G, S	Low woodlands	Yes	No
Glyceria nubigena	Smoky Mountain mannagrass	FSC	T	G, S	Seepage areas.	Yes	No
Juglans cinerea	Butternut	FSC	-	G, S	Well-drained soils of bottomlands and floodplains	Yes	Yes
Monotropsis odorata	Sweet pinesap	FSC	SR-T	S	Mixed deciduous woods	Yes	No
Rugelia nudicaulis	Rugel's ragwort	FSC	T	S	Spruce-fir forests	Yes	No
Saxifraga caroliniana	Carolina saxifrage	FSC	SR-T	G	Rocky woods	Yes	Yes
Shortia galacifolia var galacifolia	Southern oconee bells	FSC	E-SC	S	On stream banks in rich woods	Yes	No
Silene ovata	Mountain catchfly	FSC	SR-T	S	Rich woods in NC mountains	Yes	Yes
Thaspium pinnatifidum	Mountain thaspium	FSC	SR-T	S	In forests and woodlands with calcareous bedrock	Yes	No
Vaccinium hirsutum	Hairy blueberry	FSC	-	G, S	Deciduous woods at high elevations	Yes	No

Table 29 (Continued)

Federal Species of Concern Known from Graham and Swain Counties, North Carolina

Scientific Name	Common Name	Federal Status	State Status	County	Habitat Requirements	Available Habitat	Identified In or Near Project Area**
Nonvascular Plants							
Plagiochila sullivantii var. sullivantii	Liverwort	FSC	SR-T	S	On bark of Fraser firs in spruce-fir forests	Yes	No
Porella wataugensis	Liverwort	FSC	SR-L	G	Rocks in humid gorges	Yes	No
Sphenolobopsis pearsonii	Liverwort	FSC	PE	S	On bark of Fraser firs in spruce-fir forests	Yes	No

Status: E – Endangered: A taxon which "is in danger of exgtinction throughout all or a significant portion of its range."
T – Threatened: A taxon "which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.
FSC – Federal Species of Concern: A taxon which may or may not be listed in the future (formerl;y Federal C2 candidate species).
P – Proposed SC – State Species of Concern SR – State determined rare species.

County: G – Graham County S – Swain County

Synonym: 1 *Contopus borealis*
2 Sylvilagus obscurus
3 Mesodon wheatleyi clingmanicus

* These FSC species have not been listed in Graham County by the NCNHP.

** Populations of these FSC species are identified in the project study area or in a 2-mile (3.2-km) radius of the project study area.

Source: USFWS 2003 NCNHP 2003

3.9.5.3 Additional Federally Protected Species not currently listed for Graham or Swain Counties

The following are federally protected species that have historic ranges included within the study area or are thought to be expanding their ranges into the study area. They are not currently listed on either the USFWS or the NCNHP lists as being known from Graham or Swain counties. The status of the species in the study area may change at any time, therefore they are included here for consideration.

Red wolf (*Canis rufus*)

Federal Status: ENDANGERED

State Status: ENDANGERED

The red wolf is a medium-sized canine that resembles both the coyote (*Canis latrans*) and the gray wolf (*C. lupus*). The red wolf is distinguishable from the coyote by its larger and more robust body, longer ears and legs, more pronounced tawny element in coloration, and coarser pelage. The red wolf is smaller, has a more slender and elongated head, and has shorter and coarser pelage than the gray wolf. Red wolves den in hollow tree trunks, stream banks, and abandoned dens of other animals. Studies indicate that the wolves need 25 to 50 square miles (65 to 130 km^2) of contiguous area for their home ranges (USFWS 1993). Suitable habitat for the species includes any area in the southeastern United States of sufficient size in heavy vegetation that provides adequate food and water sources for survival. Food sources for the species include small to medium-sized mammals that are available in abundance, particularly rodents, rabbits, carrion, and occasionally white-tail deer and livestock.

The Red Wolf Recovery Program's stated management goal was to conduct a pilot reintroduction of the red wolf in GSMNP, with cooperation from the NPS, to evaluate the feasibility of reestablishing this animal permanently (Schildwachter 1994). The pilot reintroduction was performed in two phases. The first phase was a short-term release of two pairs of adult red wolves into GSMNP that was intended to last for about a year (USFWS 1991). The second phase was to be pursued if the first phase had positive results and would involve permanent reintroduction of red wolves into GSMNP. The first phase began in 1991, and the decision to pursue the second phase was made in the fall of 1992 (GSMNP 1992). A total of 37 red wolves were released into GSMNP, but the project was terminated in 1998 due to the low survival rate of the pups born in the wild and the difficulty of keeping wolves in GSMNP (DLIA 2003).

Bald eagle (*Haliaeetus leucocephalus*)

Federal Status: THREATENED – proposed delisted

State Status: ENDANGERED

The mature bald eagle (usually 4+ years in age) can be identified by its large white head and short white tail. The body plumage is dark-brown to chocolate-brown in color. Bald eagles can easily be distinguished from other birds by their flat wing soar. They are primarily associated with large bodies of water where food is plentiful. Eagle nests are found in proximity to water (usually within 0.5 mile [0.8 km]) with a clear flight path to the water, in the largest living tree in an area, with an open view of the surrounding land. Human

disturbance can cause nest abandonment. The breeding season for the bald eagle begins in December and January. Fish are the major food source, although forage items include coots, herons, wounded ducks, and carrion.

For the last several years there have been regular sightings of bald eagles utilizing Fontana Lake. It is believed that there may be a nesting site near the western end of the lake, possibly in the vicinity of Pikey and Whiteside creeks. Surveys to locate the possible nest have not been conducted.

As of July 6, 1999, this species was under consideration by the USFWS for a proposed de-listing of its threatened status. However, this raptor will still be protected under the Migratory Bird Treaty Act and the Bald and Golden Eagle Protection Act, and populations will continue to be monitored for at least another five years under provisions of the ESA.

Red-cockaded woodpecker (*Picoides borealis*)

Federal Status: ENDANGERED

State Status: ENDANGERED

The red-cockaded woodpecker (RCW) is 7 to 8 inches (18 to 20 cm) long with a wing span of 14 to 15 inches (35 to 38 cm). It is identified by plumage that is entirely black and white except for small red streaks on the sides of the nape of the male. The back of the RCW is black and white horizontal stripes and it has a large white cheek patch surrounded by a black cap, nape, and throat. This woodpecker's diet is composed mainly of insects, including ants, beetles, wood-boring insects, caterpillars, and corn ear worms, if available. About 16 to 18 percent of the diet includes seasonal wild fruit (USFWS 2000).

The RCW is found in open pine forests in the southeastern United States. The RCW is unique among woodpeckers because it nests exclusively in living pine trees. The RCW uses open old growth stands of southern pines for foraging and nesting habitat. In the mountains, the RCW prefers to forage and nest in shortleaf, Virginia, and pitch pines (*Pinus echinata, P. virginiana,* and *P. rigida*) (Dimmick et al. 1980). A forest ideally should contain at least 50 percent pine and lack a thick understory. These birds excavate nests in pines greater than 60 years old and contiguous with pine stands at least 30 years of age. The foraging range of the RCW may extend 500 acres (200 ha) and must be contiguous with suitable nesting sites. In good, well-stocked pine habitat, sufficient foraging substrate can be provided on 80 to 125 acres (32.4 to 50.6 ha).

Living pines infected with red-heart disease (*Formes pini*) are often selected for cavity excavation because the inner heartwood is usually weakened. Cavities are located from 12 to

100 feet (3.6 to 30.3 m) above ground level and below live branches. These trees can be identified by "candles," a large encrustation of running sap that surrounds the tree. Clusters consist of one to many of these candle trees. The RCW lays its eggs in April, May, and June; the eggs hatch approximately 38 days later. Most often, the parent birds and some of their male offspring from previous years form a family unit called a group. Commonly, these groups are comprised of three to five birds. Rearing the young birds becomes a shared responsibility of the group. However, a single pair can breed successfully without the benefit of the helpers.

Within GSMNP, the RCW has had a small presence since its discovery in the mid-1930s, based on documented reports, but the species has not been common (Dimmick et al. 1980). Dimmick et al. searched approximately 30 percent of the most favorable habitat in the southwestern portion of GSMNP, which encompassed a portion of GSMNP that is located in Blount County, Tennessee (1980). Dellinger (1983) later searched the remaining portions of the area of the most favorable habitat. The findings of Dimmick et al. along with those of Dellinger, determined that one colony area exists within the area they searched. These searches revealed only one active cavity tree, with a few inactive cavity trees nearby. The limiting factor for the RCW in this portion of the site is reported to be a lack of suitable colony and foraging habitat, as pure mature pine stands were not observed (Dimmick et al. 1980). The RCW was last known to nest in GSMNP in the 1980's (NPS 1997).

3.9.5.4 State-Protected Species

In North Carolina, General Statutes 113-331 to 113-337, effective 1987, authorized the NCWRC to develop a system to monitor and protect rare animal species in the state. The Plant Protection and Conservation Act (Chapter 106, Article 19B; 202.12-202.22; of the General Statutes of North Carolina), authorizes the North Carolina Department of Agriculture to monitor and protect rare plant species in the state. While state laws do not normally apply to a federal project, it is NPS policy "to inventory, monitor, and manage state and locally listed species in a manner similar to its treatment of federally listed species, to the greatest extent possible (NPS 2001c). The NCNHP lists of May 2003 for Graham County identified 18 species receiving protection under state laws. The NCNHP lists of May 2003 for Swain County included most of these species and additional 18 species receiving protection under state laws. Information regarding these species gathered during survey of the detailed study corridors will be incorporated into the DEIS. Table 30 lists these species.

Table 30

State Species of Concern Known from Swain and Graham Counties, North Carolina

Scientific Name	Common Name	Federal Status	State Status	County	Habitat Available	Identified In or Near Project Area*
Vertebrates						
Certhia americana	Brown Creeper	-	SC	Swain	Yes	No
Crotalus horridus	Timber Rattlesnake	-	SC	S,G	Yes	No
Desmognathus aeneus	Seepage Salamander	FSC**	SR	Graham	Yes	Yes
Etheostoma vulneratum	Wounded Darter	-	SC	Swain	Yes	Yes
Eurycea longicauda	Longtail Salamander	-	SC	Graham	Yes	No
Hemidactylium scutatum	Four-toed Salamander	-	SC	Graham	Yes	No
Myotis septentrionalis	Northern Myotis	-	SC	S,G	Yes	Yes
Noturus flavus	Stonecat	-	E	Swain	Yes	No
Sorex dispar	Long-tailed Shrew	-	SC	Swain	Yes	No
Invertebrates						
Alasmidonta viridis	Slippershell Mussel	-	E	Swain	Yes	Yes
Appalachina chilhoweensis	Queen Crater	-	SC	S,G	Yes	No
Elliptio dilatata	Spike	-	SC	Swain	Yes	Yes
Invertebrates (Cont.)						
Fumonelix jonesiana	Big-tooth Covert	-	T	Swain	No	No
Fusconaia barnesiana	Tennessee Pigtoe	-	E	Swain	Yes	Yes
Glyphyalinia junaluskana	Dark Glyph	-	SC	S,G	Yes	No
Glyphyalinia pentadelphia	Pink Glyph	-	SC	S,G	Yes	No
Haplotrema kendeighi	Blue-footed Lancetooth	-	SC	Swain	Yes	No
Helicodiscus bonamicus	Spiral Coil	-	SC	S,G	Yes	No
Helicodiscus fimbriatus	Fringed Coil	-	SC	Graham	Yes	No
Inflectarius ferrissi	Smoky Mountain Covert	-	T	Swain	Yes	No
Lampsilis fasciola	Wavy-rayed Lampmussel	-	SC	Swain	Yes	Yes
Pallifera hemphilli	Black Mantleslug	-	SC	Swain	Yes	No
Paravitrea clappi	Mirey Ridge Supercoil	-	SC	Swain	Yes	No

Table 30 (Continued)

State Species of Concern Known from Swain and Graham Counties, North Carolina

Scientific Name	Common Name	Federal Status	State Status	County	Habitat Available	Identified In or Near Project Area*
Paravitrea lacteodens	Ramp Cove Supercoil	-	SC	Graham	Yes	Yes
Paravitrea lamellidens	Lamellate Supercoil	-	SC	S,G	Yes	No
Paravitrea placentula	Glossy Supercoil	-	SC	Swain	Yes	No
Paravitrea umbilicaris	Open Supercoil	-	SC	Graham	Yes	Yes
Patera clarki	Dwarf Proud Globe	-	SC	S,G	Yes	No
Stenotrema depilatum	Great Smoky Slitmouth	-	SC	S,G	Yes	No
Villosa iris	Rainbow	-	SC	Swain	Yes	Yes
Zonitoides patuloides	Appalachian Gloss	-	SC	Swain	Yes	No
Vascular Plants						
Cystopteris tennesseensis	Tennessee Bladder-fern	-	E-SC	Graham		No
Hydrastis canadensis	Goldenseal	-	E-SC	Swain	Yes	Yes
Ilex collina	Long-stalked Holly	-	T	Swain	Yes	No
Trichomanes petersii	Dwarf Filmy-fern	-	T	Graham	Yes	No
Nonvascular Plants						
Schlotheimia lancifolia	Highlands Moss	-	T	Graham	Yes	No

Status: E – Endangered: A taxon which "is in danger of exgtinction throughout all or a significant portion of its range."

T – Threatened: A taxon "which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

FSC – Federal Species of Concern: A taxon which may or may not be listed in the future (formerl;y Federal C2 candidate species).

P – Proposed SC – State Species of Concern SR – State determined rare species.

County: G – Graham County S – Swain County

* Populations of these species are identified in the project study area or in a 2-mile (3.2-km) radius of the project study area.

Source: USFWS 2003 NCNHP 2003

3.9.5.5 Proposed, Endangered, Threatened, and Sensitive Species

The Proposed, Endangered, Threatened, and Sensitive (PETS) Species List was developed by the U.S. Forest Service for each of the national forests. The PETS list for Nantahala National Forest includes 468 species of animals and plants. However, only 20 species are noted in this report. The 20 species were included because they were documented in Nantahala National Forest only and are listed on either the Graham or Swain County NCNHP list or the USFWS Endangered and Threatened list. Table 31 lists these PETS species, their designation, global ranking, the county where they are listed, and whether a review of NCNHP maps of known populations of these species identified populations within or near the project study area.

Table 31

Element Occurrences of Protected, Endangered, Threatened, and Sensitive (PETS) Species in Graham and/or Swain County, North Carolina

Scientific Name	Common Name	Designation	G-Rank	County	Identified within or near Nantahala National Forest in the Study Area*
Vertebrates					
Desmognathus santeetlah	Santeetlah dusky salamander	Sensitive	G3Q	G, S	No
Eurycea junaluska	Junaluska salamander	Sensitive	G3Q	G	No
Myotis sodalis	Indiana Bat	Endangered	G2	G, S	No
Plethodon aureolus	Tellico salamander	Sensitive	G2G3Q	G	No
Invertebrates					
Glyphyalinia junaluskana	Dark glyph	Locally rare	G?[G3]	G, S	No
Glyphyalinia pentadephia	(Pink glyph)	Locally rare	G?[G3]	G, S	No
Haplotrema kendeighi	Blue-footed lancetooth	Locally rare	G?[G2]	S	No
Helicodiscus bonamicus	Spiral coil	Locally rare	G?[G2]	G, S	No
Helicodiscus fimbriatus	Fringed coil	Locally rare	G?[G3]	G	No
Paravitrea lacteodens	Ramp cove supercoil	Locally rare	G?[G1Q]	G	No
Paravitriea umbilicaris	Open supercoil	Locally rare	G?[G3]	G	No
Patera clarki clarki	Dwarf proud globe	Locally rare	G?[G2]	G, S	No
Zonitoides patuloides	Appalachian gloss	Locally rare	G?[G2]	S	No

Table 31 (Continued)

Element Occurrences of Protected, Endangered, Threatened, and Sensitive (PETS) Species in Graham and/or Swain County, North Carolina

Scientific Name	Common Name	Designation	G-Rank	County	Identified within or near Nantahala National Forest in the Study Area*
Vascular Plants					
Carex purpurifera	Purple Sedge	Locally rare	G4?	G	Yes
Desmodium ochroleucum	Cream tick-trefoil	Sensitive	G2G3	S	No
Liatris squarrulosa	Earle's Blazing Star	Locally rare	G4G5	G, S	Yes
Milium effusum	Millet-grass	Locally rare	G5	S	No
Rhododendron cumberlandense	Cumberland Azalea	Locally rare	G4?	G	No
Rugelia nudicaulis	Rugel's ragwort	Sensitive	G3	S	No
Synandra hispidula	Synandra	Locally rare	G4	S	No

Notes: G-Graham County S-Swain County

* Populations of these species have been identified in the project study area or within a 2-mile (3.2-km) radius of the project study area as reported by the NCNHP.

G-Rank = Global Ranking

- G1 Critically imperiled globally because of extreme rarity or otherwise very vulnerable to extinction throughout its range.
- G2 Imperiled globally because of rarity or otherwise vulnerable to extinction throughout its range.
- G3 Either very rare and local throughout its range, or found locally in a restricted area.
- G4 Apparently secure globally, although it may be quite rare in parts of its range (especially at the periphery).
- G5 Demonstrably secure globally, although it may be quire rare in parts of its range (especially at the periphery).
- GH Of historical occurrence throughout its range.
- GX Believed to be extinct throughout its range.
- GU Possibly in peril, but status uncertain; more information is needed.
- G? Unranked, or rank uncertain.
- G_Q Of questionable taxonomic status.
- G_T Status of subspecies or variety; the G-rank refers to the species as a whole, the T-rank to the subspecies.

3.9.5.6 Species New to Science

GSMNP is acknowledged for the biodiversity it contains. There is an ongoing effort to inventory all of the species living in the park in an effort to better understand and thus manage the ecosystem. This effort has been designated as the All Taxa Biodiversity Inventory (ATBI). The ATBI at GSMNP was conceived in late 1997, in part as a prototype for other reserves. It utilizes both traditional and structured approaches to surveying for species. The traditional approach utilizes the knowledge and experience of taxonomic specialists, who visit GSMNP and make collections of their organisms. The structured approach is based on the use of selected, standardized, bulk sampling devices (traps) in an array of 2.5-acre (1-ha) plots. The plots, only a few of which presently are in place, are distributed across the Smokies landscape using a Geographic Information System analysis of physical, biotic, and historic land-use parameters to ensure as complete and objective coverage as feasible. One of the outcomes of this intensive survey is discovery of species that have never been classified before or "species new to science." As of October 2003, surveys in GSMNP have resulted in 410 species new to science (DLIA 2003). The majority of these species are algae, arachnids, crustaceans, and various insects. Since very little information is know about these species it is unknown if they are rare, what their appropriate habitats are, and if any populations exist in the study area. If species new to science are found during field surveys, they will be described in the DEIS.

3.10 Aesthetics and Viewsheds

This section contains a generalized overview of aesthetics and viewsheds in the study area. More detailed information and evaluation will be provided in the EIS. The scenic environment of the study area is an important part of the natural setting of GSMNP. The scenic environment of the study area is also integral to recereational resources throughout the area. The aesthetics and viewsheds in the study area can be looked at in terms of preferred landscapes or scenic vistas that "involve" the viewer, which allure and elicit emotion through the viewing experience.

According to the Bureau of Land Management (BLM) *Visual Resource Management Manual*, landscape character is determined by the visual elements of form, line, color, and texture. Modifications to the landscape that repeat the landscape's basic elements are said to be in harmony with their surroundings. Modifications that do not harmonize often look out of place and are said to contrast or stand out in unpleasing ways (BLM 1984). This is similar to USFS scenery management guidelines, which refer to "scenic integrity" as a measure of the degree of visible disruptions of the landscape character (USFS 1995).

Scenic views contribute to feelings of community pride and value. A scenic view is taken from the user's perspective and leaves an impression of the area on the beholder as well as the surrounding community. Aesthetic quality is also dependent on the value system of the viewer. Numerous scenic views with aesthetic value exist within the study area, such that any location within it could be considered aesthetically pleasing.

Aesthetics and scenic views are important characteristics of the study area. The preservation of the land in its natural state has attracted tourists from all over the world in search of the unfettered scenery at GSMNP. All of the mountain peaks in the park provide scenic views. Many of the peaks are bald, providing a panoramic 360-degree view. Scenic overlooks are plentiful throughout the study area in locations such as along NC 28, various hiking trails, and Fontana Dam.

Within the interior of GSMNP there are numerous areas of unique visual quality. The wide valleys of Hazel Creek and Eagle Creek provide a clear view to the top of the highest ridges in the park. The lookout atop Shuckstack Mountain in the westernmost portion of the study area gives a panoramic view that includes Fontana Lake.

Scenic overlook on NC 28 looking north toward GSMNP

An example of an interior viewshed can be witnessed at High Rocks, located along the spine of Welch Ridge. Atop High Rocks, the panoramic view includes the highest peaks in the North Carolina portion of GSMNP, as well as Fontana Lake and all the knobs and streams in between.

The grassy bald surrounding the old Bone Valley settlement is another notable view. Footings still mark the location of buildings that have long since vanished. A restored cabin nestled in the woods creates an indelible image. The remnants of the former town offer a glimpse of its bustling past in the early 1900s. Similar scenes are located within the former town of Proctor.

3.10.1 Scenic Byways

NC 28 in the study area is part of the Indian Lakes Scenic Byway designated by the NCDOT. North Carolina Scenic Byways are selected based on natural, cultural, and historic features along the route. They embody the diverse beauty and culture of the state and provide travelers with a safe and interesting alternate route. The Indian Lakes Scenic Byway is named for the many lakes with Native American names along its path. It traverses roughly 60 miles (97 km) from Almond, through Fontana Village, to Tapoco and Topton. The Indian Lakes Scenic Byway connects into the Nantahala Byway that travels along US 19/US 74/ US129 from Whittier to Marble, North Carolina. The Nantahala Byway traverses 43 miles (69 km) in Cherokee, Jackson, Swain, and Graham counties (NCDOT 2001).

3.11 Air Quality

3.11.1 Regulatory Status

The USEPA and the North Carolina Department of Environment and Natural Resources (NCDENR) are responsible for protecting air quality within the state. The USEPA established criteria for evaluating air quality in accordance with the 1970 Clean Air Act (CAA) and 1990 CAA Amendments. Two National Ambient Air Quality Standards (NAAQS), primary and secondary, were established for defining air quality. Primary standards refer to air quality levels required to protect public health with an adequate margin of safety. Secondary standards or welfare standards refer to air quality levels required to safeguard visibility, comfort, animals, and property from the deleterious affects of poor air quality. NAAQS were established for the following six air pollutants (criteria pollutants): carbon monoxide (CO), lead (Pb), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), ozone (O_3), and particulate matter (PM). Particulate matter includes those particles with diameters of roughly 0.0004 inches (10 µm) or less in size (PM 10) and 0.0001 inches (2.5 µm) or less in size (PM 2.5). The NAAQS are shown in Table 32. The state of North Carolina has adopted these same standards. Also shown in Table 32 are monitored values of O_3, PM 10, PM 2.5, and SO_2 from an air quality monitoring site in Bryson City on Center Street. Monitored values for CO, NO_2, and Pb are not shown, as these pollutants are not monitored in the vicinity of the study area. Although the monitored values can be compared to the NAAQS, the values may not be representative of the air quality throughout the entire study area.

Table 32

NAAQS and Monitored Concentrations for Criteria Pollutants

Pollutant	Type of Standard	Averaging Time	Standard Value**	Monitored Value	Location
Carbon Monoxide (CO)	Primary	8-hour* 1-hour*	9 ppm (10 mg/m^3) 35 ppm (40 mg/m^3)	----------	----------
Nitrogen Dioxide (NO_2)	Primary and Secondary	Annual Arithmetic Mean	0.053 ppm (100 µg/m^3)	----------	----------
Ozone (O_3)	Primary and Secondary	8-hour^ 1-hour^	0.08 ppm (157 µg/m^3) 0.12 ppm (235 µg/m^3)	0.074 ppm 0.091 ppm	Bryson City Bryson City
Particulate Matter (PM 10)	Primary and Secondary	Annual Arithmetic Mean	50 µg/m^3	21 µg/m^3	Bryson City
		24-hour	150 µg/m^3	100 µg/m^3	Bryson City
Particulate Matter (PM 2.5)	Primary and Secondary	Annual Arithmetic Mean	15 µg/m^3	13.4 µg/m^3	Bryson City
		24-hour	65 µg/m^3	30.9 µg/m^3	Bryson City
Sulfur Dioxide (SO_2)	Primary	Annual Arithmetic Mean	0.030 ppm (80 µg/m^3)	0.0016 ppm	Bryson City
		24-hour	0.14 ppm (365 µg/m^3)	0.008 ppm	Bryson City
	Secondary	3-hour	0.50 ppm (1,300 µg/m^3)	0.013 ppm	Bryson City
Lead (Pb)	Primary and Secondary	Quarterly Average	1.5 µg/m^3	----------	----------

* Not to be exceeded more than once per year.

^ To attain the 8-hour standard, the 3-year average of the fourth-highest daily maximum 8-hour average of continuous ambient air monitoring data over each year must not exceed the standard value. To attain the 1-hour standard, the daily maximum 1-hour average concentration measured by a continuous ambient air monitor must not exceed the standard value more than once per year, averaged over 3 consecutive years.

** Parenthetical value is an approximately equivalent concentration. Units of measure for the values are parts per million (ppm) by volume, milligrams per cubic meter of air (mg/m^3), and micrograms per cubic meter of air (µg/m^3).

Sources: www.epa.gov/airs/criteria.html USEPA, Air Quality System Quick Look Report 2000, 2001, and 2002

According to NCDENR, Swain and Graham counties are currently classified as attainment areas for all criteria pollutants. Attainment areas are considered to have air quality that meets or exceeds the NAAQS. The USEPA is currently reviewing an NCDENR recommendation to classify the North Carolina side of GSMNP, including portions of the study area, as an 8-hour ozone nonattainment area. The final designation will be made April 15, 2004. A

nonattainment area is an area where pollution levels have exceeded the NAAQS. This designation requires that these areas implement strategies to improve air quality. Results from ozone monitoring at Clingmans Dome in Tennessee and at Barnett Knob in North Carolina show that both locations do not meet the 8-hour ozone NAAQS. Both monitoring locations border Swain County, North Carolina, and can be indicative of air quality in the study area.

Air Quality

3.11.2 The Clean Air Act and Class 1 Areas

The CAA passed in 1970 established national policy to preserve, protect, and enhance air quality. The 1977 CAA Amendments established the Prevention of Significant Deterioration (PSD) Class 1 area. All national parks that exceed 6,000 acres (2,428 ha) in size are designated Class 1 areas, including GSMNP. Class 1 areas are afforded the greatest degree of air quality protection under the Act. Pollution increments have been set for sulfur dioxide, particulate matter, and nitrogen oxides within the Class 1 areas. New or expanding facilities that will potentially affect the air quality of a Class 1 area must prove that they will not cause pollutant concentrations to go above these increments. In addition, Federal land managers (FLMs) have the responsibility to protect the quality of air in Class 1 areas. Reviewing permits for new and expanding sources of air pollution is part of their responsibility. This review process allows the FLMs the opportunity to comment on whether these new sources of pollution will adversely affect the air quality of nearby Class 1 areas.

Protecting the air quality of Class 1 areas, specifically GSMNP, is difficult because most of the air pollutants threatening the park, are emitted outside the park. Due to prevailing air currents and the terrain of the region, pollutants from industrial developments in the Tennessee, Ohio, and Mississippi river valleys are trapped and concentrated in the southern Appalachians. In addition, pollutants from the Northeast, Southeast, and Midwest threaten the air quality of the region.

Sulfur dioxide and nitrogen oxides, emitted from the burning of fossil fuels, are responsible for the majority of air quality impacts. These emissions convert to harmful secondary pollutants (e.g. sulfate, nitrates, and ozone). Ozone pollution is responsible for injuring vegetation. In addition, acid deposition is adversely affecting streams and soils in the Noland Divide Watershed in Swain County. In fact, the Noland Divide receives a higher deposition of nitrogen and sulfur than any other monitored location in North America. The degradation

of these resources is impacting aquatic as well as terrestrial resources. Furthermore, visitor enjoyment and human health are also jeopardized by poor air quality in the area. Visibility at GSMNP has been greatly degraded due to air pollution during the last 50 years. The average visibility range at scenic views is currently 25 miles (40.2 km), when historically it was over 110 miles (177 km) (NPS 2001d).

3.12 Noise

Dominant sounds throughout the study area include wind, thunder, and moving water as well as those sounds produced by animals, such as mating calls. These sounds comprise the natural soundscape. Human-caused sound from such sources as traffic or motorized equipment can degrade the natural soundscape. Preservation of the natural soundscape is a goal of the NPS. The natural soundscapes throughout the study area provide an intrinsic value, which adds to the solitude and unique experience it presents.

This report utilizes the Leq noise descriptor. The equivalent sound pressure level, Leq (A-weighted), is formulated in terms of the equivalent steady-state noise level, which in a defined period of time contains the same noise (acoustic) energy as a time-varying noise during the same period of time. The Leq is an energy summation integration and, as such, does not rely on statistical parameters like the L_{10} scheme. Leq has a significant advantage over the L_{10} scheme since the L_{10} scheme cannot adequately consider single event noises.

As part of this evaluation, current noise levels were determined in the study area. Ambient noise measurement sites are shown in Figure 19 and are listed in Tables 33 and 34.

3.12.1 Characteristics of Noise

Noise is basically defined as unwanted sound. It is emitted from many sources, including airplanes, factories, railroads, power generation plants, and traffic. Traffic noise is usually a composite of several vehicle noise sources. These sources include the vehicle engine exhaust, drive train, and interaction of tires with the roadway causing noise due to friction.

The magnitude of noise is usually described by its sound pressure. Since the range of sound pressure varies greatly, a logarithmic scale is used to relate sound pressures to some common reference level, usually the decibel (dB). Sound pressures described in decibels are called sound pressure levels and are often defined in terms of frequency weighted scales (A, B, C, or D).

The A-weighted scale approximates the frequency response of the human ear by placing most emphasis on the frequency range of 1,000 to 6,000 Hertz. Because the A-weighted scale

closely describes the response of the human ear to sound, it is used almost exclusively in vehicle noise measurements. Sound levels measured using A-weighting are often expressed as dBA. Throughout this report references will be made to dBA, which means an A-weighted decibel level. Several examples of noise pressure levels in dBA are listed in Table 35.

Table 33

Dominating Noise Sources (30-Minute Reading Sites)

Ambient Noise Measurement Site	Measured Leq (dBA)	Dominating Noise Sources
1	43.0	Wind, birds
2	43.5	Wind, birds, Hazel Creek in the distance
3	42.0	Wind, birds, NC 28, parking lot
4	53.0	Wind, birds, NC 28
5	52.7	Wind, birds, NC 28
6	53.2	Wind, birds, NC 28
7	57.5	Wind, birds, NC 28
8	55.0	Wind, birds, NC 28
9	46.5	Wind, birds, NC 28
10	50.0	Wind, birds, NC 28
11	55.0	Wind, birds, NC 28
12	38.7	Wind, birds, boats
13	41.0	Wind, birds, parking lot traffic
14	59.0	Wind, birds, road traffic, people talking
15	56.5	Wind, birds, road traffic, helicopter
16	42.5	Wind, birds, access road
17	62.5	Wind, birds, NC 28, ambulance
18	55.0	Wind, birds, NC 28
19	59.0	Wind, birds, NC 28
20	64.5	Wind, birds, NC 28
21	60.5	Wind, birds, NC 28
22	62.5	Wind, birds, NC 28, construction area traffic
23	74.0	Wind, birds, NC 28, NC 143
24	65.0	Wind, birds, NC 28

Table 33 (Continued)
Dominating Noise Sources (30-Minute Reading Sites)

Ambient Noise Measurement Site	Measured Leq (dBA)	Dominating Noise Sources
25	65.0	Wind, birds, NC 28
26	65.5	Wind, birds, NC 28
27	60.0	Wind, birds, NC 28, construction area traffic
28	62.8	Wind, birds, NC 28
29	64.7	Wind, birds, Newfound Gap Road
30	63.0	Wind, birds, Newfound Gap Road, Tow String Road
31	61.0	Wind, birds, Newfound Gap Road, Clingmans Dome Road
32	61.0	Wind, birds, Newfound Gap Road, parking lot traffic
33	58.5	Wind, birds, Newfound Gap Road
34	55.5	Wind, birds, Newfound Gap Road
35	61.2	Wind, birds, NC 28, Almond Boat Park Road
36	58.5	Wind, birds, NC 28, parking lot traffic
37	41.0	Wind, birds, parking lot traffic
38	79.0	Wind, birds, NC 28, stream
39	43.5	Wind, birds, Lake View Road
40	41.5	Wind, birds, Lake View Road.
41	55.5	Wind, birds, Lake View Road, stream
42	46.8	Wind, birds, Lake View Road
43	35.0	Wind, birds
44	41.0	Wind, birds, light drizzle
45	43.5	Wind, birds, Lake View Road
46	58.0	Wind, birds, New Fontana Road
47	35.0	Wind, birds, airplane

Table 34

Dominating Noise Sources (24-Hour Reading Sites)

Ambient Noise Measurement Site	Measured Leq (dBA)	Dominating Noise Sources
1	44.3	Wind, birds, boats
2	43.6	Wind, birds, NC 28
3	49.3	Wind, birds, NC 28
4	53.0	Wind, birds, NC 28, little rain
5	44.6	Wind, birds, little rain
6	43.0	Wind, birds
7	43.3	Wind, birds, Sam Davis Road

Review of Table 35 indicates that most individuals in urbanized areas are exposed to fairly high noise levels from many sources as they go about their daily activities. The degree of disturbance or annoyance from unwanted sound depends essentially on three things: (1) the amount and nature of the intruding noise; (2) the relationship between the background noise and the intruding noise; and (3) the type of activity occurring where the noise is heard.

In considering the first of these three factors, it is important to note that individuals have different hearing sensitivity to noise. Loud noises bother some more than others and some individuals become aroused to anger if an unwanted noise persists. The time patterns of noise also enter into an individual's judgment of whether or not a noise is objectionable. For example, noises occurring during sleeping hours are usually considered to be much more objectionable than the same noises during waking hours.

With regard to the second factor, individuals tend to judge the annoyance of an unwanted noise in terms of its relationship to noise from other sources (background noise). The blowing of a car horn at night when background noise levels are approximately 45 dBA would generally be much more objectionable than the blowing of a car horn in the afternoon when background noises might be 55 dBA.

Table 35
Typical Human Hearing Levels

Decibels		
140	Shotgun blast, jet 100 feet (30 m) away at takeoff	Painfully loud
		Human ear pain threshold
130		
	Firecrackers	
120	Severe thunder, pneumatic jackhammer	
	Hockey crowd	
	Amplified rock music	Uncomfortably loud
110		
	Textile loom	
100	Subway train, elevated train, farm tractor	
	Power lawn mower, newspaper press	
	Heavy city traffic, noisy factory	Loud
90		
	Diesel truck 40 mph (65 kph), 50 feet (15 m) away	
80	Crowded restaurant, garbage disposal	
	Average factory, vacuum cleaner	
	Passenger car 50 mph (65 mph), 50 feet (15 m) away	Moderately loud
70		
	Quiet typewriter	
60	Singing birds, window air conditioner	
	Quiet automobile	
	Normal conversation, average office	Quiet
50		
	Household refrigerator	
	Quiet office	Very quiet
40		
	Average home	
30	Dripping faucet	
	Whisper 5 feet (1.5 m) away	
20		
	Light rainfall, rustle of leaves	
		Average person's threshold of hearing
	Whisper	Just audible
10		
0		Threshold for acute hearing

Source: World Book, Rand McNally Atlas of the Human Body, Encyclopedia Americana, "Industrial Noise and Hearing Conversation" by J. B. Olishifski and E. R. Harford (Researched by N. Jane Hunt and published in the Chicago Tribune in an illustrated graphic by Tom Heinz).
Original table title, "Hearing: Sounds that Bombard Us Daily."

The third factor is related to the interference of noise with activities of individuals. In a 60-dBA environment, normal conversation would be possible while sleep might be difficult. Work activities requiring high levels of concentration may be interrupted by loud noises while activities requiring manual effort may not be interrupted to the same degree.

Over a period of time, individuals tend to accept the noises that intrude into their lives, particularly if noises occur at predicted intervals and are expected. Attempts have been made to regulate many of these types of noises, including airplane noise, factory noise, railroad noise, and highway traffic noise. Methods of noise analysis and control have developed rapidly over the past few years.

3.12.2 Noise Abatement Criteria

In order to determine if future traffic noise levels are compatible with various land uses, the FHWA has developed noise abatement criteria (NAC) and procedures to be used in the planning and design of highways. A summary of the NAC for various land uses is presented in Table 36. The Leq levels given in Table 36 represent the upper limit of acceptable noise conditions as established by FHWA.

Noise abatement must be considered if the NAC Leq values are approached or exceeded, or if there are substantial increases over the ambient noise levels. The NCDOT has adopted Noise Abatement Guidelines to define terms used in noise abatement. The NCDOT definition of "approach" is 1 dBA less than those shown in Table 36. “Substantial” increase is defined as either a 15-dBA or greater increase above existing noise levels less than or equal to 50 dBA, or a 10-dBA increase above existing noise levels greater than 50 dBA.

Abatement is only necessary where frequent human use occurs and in which a lowered noise level would be of benefit. Exceptions to this rule include areas where serenity and quiet are considered essential even though the areas may not be subject to frequent human use. A noise analysis will be conducted in the future in accordance with 23 CFR Part 772.

Table 36
Noise Abatement Criteria

Activity Category	Leq (hr)	Description of Activity Category
A	57 (Exterior)	Lands on which serenity and quiet are of extraordinary significance and serve an important public need where the preservation of those qualities is essential if the area is to continue to serve its intended purpose.
B	67 (Exterior)	Picnic areas, recreation areas, playgrounds, active sports areas, parks, residences, motels, hotels, schools, churches, libraries, and hospitals.
C	72 (Exterior)	Developed lands, properties, or activities not included in Categories A or B above.
D	-----	Undeveloped lands.
E	52 (Interior)	Residences, motels, hotels, public meeting rooms, schools, churches, libraries, hospitals, and auditoriums.

Source: 23 CFR Part 772, U.S. Department of Transportation, FHWA.

3.12.3 Ambient Noise Levels

The ambient noise is that resulting from natural and mechanical sources as well as human activity, which is considered to usually be present in a particular area. A noise-monitoring program was conducted in the project study area utilizing a Norsonic Nor-116 Type I sound level meter for the 24-hour readings and a Delta OHM HD-9020 Type I sound level meter for the 30-minute readings in order to measure ambient noise levels. Noise measurements were conducted at seven 24-hour reading sites and 47 30-minute reading sites in and around the study area. Out of the 47 30-minute reading sites, six measurements (as shown on Figure 19) were conducted along Newfound Gap Road as a basis of comparison to what an existing, heavily traveled road in GSMNP may be like. The noise level measurements were conducted using standard data collection techniques as outlined in the FHWA report *Sound Procedures for Measuring Highway Noise: Final Report*. The purpose of this noise-level information was to quantify the existing acoustic environment and to provide a base for assessing potential future impacts. Differences in the measured noise levels are likely attributed to variations in site conditions and traffic volumes.

3.12.4 Summary

Overall, the noise range distribution for the study area falls between 35 dBA and 79 dBA. The higher range values occur on NC 28 in the vicinity of existing road construction. The

majority of the lower-range values occur in and close to GSMNP. This shows that the areas with more human development and higher traffic volumes typically have higher noise values.

3.13 Hazardous Material and Waste Sites

Hazardous material and waste sites are regulated by the Resource Conservation and Recovery Act of 1976 (RCRA), as amended; the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended; and the Superfund Amendments and Reauthorization Act of 1986 (SARA). Hazardous waste is generally defined as any material that has or, when combined with other materials, will have a deleterious effect on humans or the natural environment. Characterized as reactive, toxic, infectious, flammable, explosive, corrosive, or radioactive, hazardous waste may be solid, sludge, liquid, or gas. Potential hazardous material and waste sites include service stations, landfills, dumps, pits, lagoons, salvage yards, and industrial sites, as well as above and underground storage tanks (AST and UST).

Environmental Data Resources, Inc. (EDR) was contracted to search the appropriate federal and state databases for facilities of potential concern that may be located within the study area. Figure 20 illustrates the approximate location of known hazardous material and waste sites within the study area. In addition to these sites, other potential hazardous material and waste sites may exist within the study area due to illegal dumping, lack of compliance with regulatory reporting practices, and limited regulatory data. It is likely that homes and businesses within the study area utilize tanks for heating fuel and farm equipment supply. Prior to its conversion into GSMNP, the development along what is now the northern shore of Fontana Lake consisted of residential, commercial, and industrial uses. Although not documented, the use of ASTs and USTs likely occurred. Furthermore, mining operations were once active at such locations as Hazel Creek and Eagle Creek. The presence of hazardous material and waste sites related to these operations as well as the aforementioned land uses is unknown.

EDR identified 22 UST sites, 8 Facility Index System (FINDS) sites, 12 Incident Management Database (IMD) sites, four leaking underground storage tank (LUST) sites, two State Trust Fund Database (LUST TRUST) sites, two North Carolina Hazardous Substance Disposal Site (NCHSDS) sites, one Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) site, one Resource Conservation and Recovery Information System (RCRIS) Large Quantity Generator (LQG) site, one RCRIS Small Quantity Generator (SQG) site, and one Mines Master Index File (MINES) site. EDR identified sites are shown in Table 37. The Map ID Number listed corresponds to the numbers on Figure 20. The sites listed below may no longer be in operation or may have

relocated; however, site identification continues to be important due to the possibility of remaining contaminants. It should be noted that the presence of hazardous materials at a certain location does not indicate that the location is a threat to public health. Furthermore, these sites were identified during a records search, which indicates that they are registered with the proper agencies.

Table 37
Hazardous Material and Waste Sites Identified by EDR

Map ID Number	Facility	Location	Database(s)
1	Alarka General Store	3091 Highway 19 South, Bryson City	UST
2	Almond Elementary School	10 Almond School Road, Bryson City	UST
3*	Amoco West End Food Stop #210	240 West Bessemer Street, Bryson City	IMD
4	Aztex #210	110 Highway 19 South, Bryson City	UST
5	Belk Department Store	107 Everett Street, Bryson City	UST
6	Bill Moody Funeral Home	285 Main Street, Bryson City	IMD, UST, LUST TRUST
7	Carolina Building Supply	100 Greenlee Street, Bryson City	IMD
8*	Consolidated Metco Bryson City (Conmet)	1821 Highway 19 South, Bryson City	FINDS, RCRIS-LQG
9	Edwards Amoco Service Station	2291 Highway 19 South, Bryson City	UST
10	Express Lane Market	US Highway 19, Bryson City	IMD
11	Federal Building	50 Main Street, Bryson City	RCRIS-SQG, FINDS
12	Fontana Motel	NC 28, Tuskegee	IMD
13	Fontana Peppertree	737 Welch Road, Bryson City	LUST TRUST, IMD, LUST
14	Fontana Texaco	Highway 28, Fontana Dam	IMD
15	Hot Spot #1102	1030 Main Street, Bryson City	UST

Table 37 (Continued)
Hazardous Waste Sites Identified by EDR

Map ID Number	Facility	Location	Database(s)
16	Hyatt Creek Exxon	Hyatt Road US 19 Bypass, Bryson City	LUST, UST
17	JC Cope	Highway 19 West, Bryson City	UST
18	JL Colville Construction Company	No address available	MINES
19	Johnsons Grocery	Highway 28 South, Fontana Dam	UST
20	Kirkland Creek Grocery	1755 East Main Street, Bryson City	UST
21	Lois King	5501 Highway 19 West, Bryson City	UST
22	Maness Manufacturing Company	80 & 81 Ramseur Street, Bryson City	FINDS
23	Midtown Shell Station	Main Street, Bryson City	IMD, LUST
24	Mountain Outdoor	7530 Highway 19 West, Bryson City	UST
25	Nantahala Food Mart	12121 Highway 19 West, Bryson City	IMD, LUST, UST
26	Nantahala Village	4 Highway 19 West, Bryson City	IMD
27	NCDOT (Division 14)	345 Toot Hollow Road, Bryson City	UST
28	Powell Industries-Smoky Cove	1019 Bryson Walk, Bryson City	FINDS
29	Powell Lumber & Kiln Inc./ Powell Industries, Inc.	1011 Bryson Walk, Bryson City	FINDS
30	Singer Furniture Division	1011 Bryson Walk, Bryson City	UST, NC HSDS
31	Smoky Mountain Tire Company	66 US 19 North, Bryson City	UST
32	Southern Concrete Materials (former Owens Concrete Company)	160 Slope Street, Bryson City	UST, FINDS
33	Swain County Bus Garage	344 Highway 19 North, Bryson City	UST
34	Swain County High School	1415 Fontana Road, Bryson City	UST

Table 37 (Continued)
Hazardous Waste Sites Identified by EDR

Map ID Number	Facility	Location	Database(s)
35*	Swain County Landfill	Buckner Branch Rd, Bryson City	CERCLIS, FINDS, NC HSDS
36	Swain County Sanitation	School House Road, Bryson City	IMD
37	Swain County Sheriff's Department	Everett Street & Main Street, Bryson City	FINDS
38	Swain County West Elementary	4142 Highway 19 West, Bryson City	UST
39	The Pit Stop	223 East Main Street, Bryson City	UST
40	Wallace Tube Company	Pine Street off Gibson Avenue, Bryson City	IMD
41	Wiggins 66 Station	315 Main Street, Bryson City	UST

* Indicates these sites are listed on both Table 37 and Table 38.

Key:

LUST: The Leaking Underground Storage Tank Incident Reports

UST: The Underground Storage Tank Database

FINDS: The Facility Index System contains both facility information and "pointers" to other sources of information that contain more detail.

RCRIS-SQG: The Resource Conservation and Recovery Information System includes selected information on sites that generate, transport, store, treat, and/or dispose of hazardous waste as defined by the RCRA. The sites included in this database are small quantity generators (SQG).

RCRIS-LQG: The Resource Conservation and Recovery Information System includes selected information on sites that generate, transport, store, treat, and/or dispose of hazardous waste as defined by the RCRA. The sites included in this database are large quantity generators (LQG).

IMD: The Incident Management Database lists groundwater and/or soil contamination incidents. The information is obtained from the NCDENR.

LUST TRUST: The State Trust Fund Database contains information about claims against the State Trust Funds for reimbursements for expenses incurred while remediating LUSTs.

MINES: The Mines Master Index File data is obtained from the Department of Labor, Mine Safety and Health Administration.

CERCLIS: The Comprehensive Environmental Response, Compensation, and Liability Information System contains data on potentially hazardous waste sites pursuant to the CERCLA.

NC HSDS: The Hazardous Substance Disposal Site database includes the locations of uncontrolled and unregulated hazardous waste sites.

In addition to Internet research, a field reconnaissance survey was conducted in June 2003 to field check orphan sites identified by EDR. Orphan sites is a term used by EDR and refers to those facilities that cannot be mapped due to poor or inadequate address information. Most of the orphan sites were determined to be outside the study area. Of the 74 orphan sites, five were identified within the study area during the field reconnaissance survey and Internet research. The five located sites actually represent 15 of the orphan sites, due to variations and duplications in the federal and state databases. For example, the Swain County Landfill was listed three times due to name and address variations. In addition, Fontana Dam was listed several times due to multiple incidents. Table 38 lists the identified orphan sites, also shown in Figure 20. The Map ID Number listed corresponds to the numbers on Figure 20.

Table 38

Hazardous Material and Waste Sites (Orphan Sites)

Map ID Number	Facility	Location	Database(s)
3*	Amoco West End Food Shop #210/West End Amoco #210	Highway 19 West	LUST, LUST TRUST
42	Fontana Dam	Highway 28	ERNS
43	Former Marks Exxon	131 Highway 19 North, Bryson City	LUST
8*	Gichner Shelter Systems (is now Conmet)	1821 Highway 19 South, Bryson City	IMD
35*	Swain County Landfill	Buckner Branch Road, Bryson City	OLI, SHWS

* Indicates these sites are listed on both Table 37 and Table 38.

Key:

ERNS: The Emergency Response Notification System records and stores information on reported releases of oil and hazardous substances.

OLI: The Old Landfill Inventory list old landfill sites. The information is obtained from the NCDENR.

SHWS: The Inactive Hazardous Sites Inventory is the state's equivalent to CERCLIS.

3.13.1.1 Landfills

The Swain County Landfill, now closed to municipal waste, is located on Buckner Branch Road. The facility continues to accept construction demolition debris and runs a recycling

facility. Municipal waste for the county is taken to the EBCI transfer station, on the Cherokee Indian Reservation east of the study area. The waste is then hauled to Palmetto Landfill in South Carolina. The transfer station can handle 300 tons of waste per day.

3.14 Utilities

3.14.1 GSMNP

Facilities within GSMNP that require utilities are concentrated around developed areas such as the visitor centers and the campgrounds. No utilities are provided within the study area portion of the park. However, a power transmission line servicing Fontana Dam traverses the western portion of the study area within GSMNP's boundary. Due to the park's size and the fact that it encompasses portions of two states and five counties, electricity providers and water and sewer services vary throughout the park. Five electricity providers service the park. Water and sewer service includes wells, septic tanks, municipal providers, and on-site sewage treatment facilities.

3.14.2 TVA's Fontana Reservoir

The original authorized purposes of Fontana Reservoir, operated by the TVA, were for flood control, navigation, and power generation. Water supply, water quality, power plant cooling, and recreation are also supported by the operation of Fontana Reservoir. The Tennessee Valley Public Power Association, Inc. (TVPPA) is the non-profit, regional service organization that represents the interests of consumer-owned electric utilities operating within the TVA service area. Members of the TVPPA include both municipal and electric cooperatives, and they serve more than 8.5 million customers in Alabama, Georgia, Tennessee, Mississippi, Kentucky, Virginia, and North Carolina (although not within the study area) (http://www.tvppa.com/ 2003).

Fontana Reservoir provides 300 MW of electrical generating capacity and 583,000 acre-feet (774,383 ha-m) of flood storage capacity. It also plays an important role in operation of downstream hydro plants operated by Tapoco and the TVA, and in providing summer cooling water for downstream nuclear plants at Watts Bar, Sequoyah, and Browns Ferry. It is the largest tributary reservoir in terms of generating capacity and one of the most important tributary reservoirs in the operation of TVA's integrated river management system.

Because of its large flood storage capacity and protected watershed, which prevents sedimentation, the lifetime of the reservoir is estimated to exceed 100 years. With appropriate maintenance, Fontana Dam should be able to operate almost indefinitely. Water

releases from Fontana Reservoir help to maintain minimum navigational depth, as well as to maintain and improve water quality and aquatic habitat throughout the TVA system (TVA 2003).

3.14.3 Remaining Study Area Utilities

3.14.3.1 Electric Power

Electrical service within the study area is provided by Duke Power in both Swain and Graham counties. Major power transmission lines and substations are shown on Figure 21.

3.14.3.2 Natural Gas

Natural gas is not currently available in the study area. However, Public Service North Carolina (PSNC) Energy is in the process of expanding its natural gas service to Bryson City. This expansion is expected to be completed by the end of 2003. According to Kenneth Owenby with PSNC Energy, there are no plans to provide other portions of Swain County with gas service at this time. Mr. Owenby also indicated that PSNC Energy has relinquished its franchise rights for Graham County. There are no plans to provide Graham County with natural gas service at this time.

3.14.3.3 Water and Wastewater Facilities

Bryson City provides water and sewer services for residences within its municipal limit. Water and sewer service outside the town's municipal limits is scattered and primarily serves the developed areas north of town. Graham County does not provide its citizens with water and sewer services. Residences in the study area not serviced by Bryson City rely on private wells and septic systems. The location of water and sewer lines and the wastewater treatment plant are shown on Figure 21.

3.15 Public Projects in the Vicinity of the Study Area

The public projects described below will be evaluated in the DEIS for their potential, when combined with the North Shore Road project, to have cumulative impact on the study area. The CEQ defines cumulative impacts as "impacts on the environment which result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or nonfederal) or person undertakes such other actions" (40 CFR 1508.7). Public projects in the vicinity of the study area are described below and include NCDOT TIP projects, projects discussed in local

Thoroughfare Plans, and GSMNP projects such as the rehabilitation of Newfound Gap Road, Ravensford Land Exchange, Cades Cove Opportunities Plan, Foothills Parkway, and Elkmont Historic District Planning. The Wilderness Designation and the Fontana Dam Project are also discussed.

3.15.1 NCDOT Transportation Improvement Program Projects

3.15.1.1 Project No. A-9

TIP Project No. A-9 (A-9) consists of widening US 74 from Andrews to NC 28 east of Almond to a four-lane divided facility. The improvements will consist of primarily new location roadway. A-9 is segmented into 10 smaller projects. Four of these, A-9 DA – DD, are within the study area and consist of improvements to NC 28 from US 19 to Stecoah. These improvements are expected to be complete by the end of 2003. An FEIS was completed in February 1984 for A-9. Re-evaluations of the FEIS were completed in the mid 1990s for the segments within the study area.

3.15.1.2 Other NCDOT Projects

Project Nos. B-3701 and B-3458, both scheduled for construction in 2003, are bridge replacements within the study area. B-3701 involves the construction of a bridge over Alarka Creek on Lower Alarka Road. B-3458 involves construction of a bridge over Stecoah Creek on Jenkins Road. Project No. E-4588 is a streetscape enhancement project to Everette Street in Bryson City and is currently under construction.

3.15.2 Thoroughfare Plans

Thoroughfare Plans are completed by the NCDOT Statewide Planning Branch in conjunction with local jurisdictions. The plans document existing and future deficiencies in the local and regional transportation system and long-range plans for new or improved facilities. The recommended projects must be funded locally or placed on the NCDOT TIP to be constructed. Following are summaries of the Thoroughfare Plans for Bryson City and Graham County.

3.15.2.1 Bryson City

The *Thoroughfare Plan for Bryson City*, updated in 1993, discusses several transportation improvements. Widening projects include Spring Street, US 19, Main Street, Everette Street, Slope Street, Gibson Street, and Locust Street. Other improvements include a new frontage

road and interchange along US 74. The Spring Street widening is complete. No other improvements have been completed nor are any listed on the NCDOT TIP.

3.15.2.2 Graham County

Updated in 1998, the *Thoroughfare Plan Technical Report for Graham County and Robbinsville* addresses two projects that are in the NCDOT TIP. Project A-9, currently under construction, involves the widening and realigning of NC 28. The second project, TIP Project No. R-2407, ties into A-9 and also involves the widening and realigning of NC 28. However, this project is currently not funded.

3.15.3 GSMNP Projects

3.15.3.1 Rehabilitation of Newfound Gap Road

Rehabilitation improvements are planned for Newfound Gap Road from the GSMNP entrance near Cherokee and extend to Gatlinburg, Tennessee. Improvements include turn lanes and various intersection improvements. The improvements are broken into five phases with the first one scheduled for construction in Fall 2004. Appropriate environmental documents are required for two of the five phases and will be completed prior to construction.

3.15.3.2 Ravensford Land Exchange

A land exchange between the EBCI and NPS is currently being studied. EBCI proposed the exchange, which would allow them to acquire land for new schools. The Ravensford Site, located more than 10 miles (16 km) northeast of the project study area, is the proposed location for the new schools. In exchange for the Ravensford site, NPS would receive the Yellowface tract near the Waterrock Knob overlook of the Blue Ridge Parkway, which is near the Jackson and Haywood county line more than 15 miles (24 km) due east of Bryson City. The Yellowface tract can be seen from the Waterrock Knob Visitor Center and Overlook and from the Blue Ridge Parkway. The NPS has recently completed a DEIS for the exchange. The Record of Decision is anticipated for the project.

3.15.3.3 Cades Cove Opportunities Plan

The Cades Cove area of GSMNP receives over two million visitors each year making it one of the most visited areas in the National Park system. During the 20-year period between 1976 and 1997, visitation to Cades Cove increased 300 percent. Due to the high visitation and use of this resource, the integrity of Cades Cove is being jeopardized. GSMNP is

currently studying alternatives that would address a range of issues identified during scoping for the Cades Cove Development Concept and Transportation Management Plan. While many issues have been identified, one major issue faced in Cades Cove is congestion. The 11-mile loop road that encircles the valley floor is at a LOS of E or F 50 percent of the time during peak visitation (June, July, August, and October). Five alternatives (one No-Action and four action alternatives) are currently being studied for Cades Cove. The action alternatives are comprised of varying combinations of the following options: completing roadway and parking improvements, requiring reservations for private vehicular use of the road, utilizing a transit bus system, use of message signs, and construction of visitor centers. GSMNP is preparing an EIS to identify a preferred alternative for Cades Cove.

3.15.3.4 Foothills Parkway

The Foothills Parkway, conceived in the late 1920s, was authorized by Congress as a scenic parkway on February 22, 1944 with the passing of Public Law 232. The purpose of the Foothills Parkway as stated in the Law is to provide beautiful vistas of the Great Smoky Mountains along their northern flank and to disperse visitor traffic. The State of Tennessee purchased the right-of-way for the 72-mile (115.9-km) parkway, which is administered as a part of GSMNP. To date, only two discontinuous segments, totaling 22.5 miles (36.2 km), have been completed and opened to vehicular traffic. The Parkway parallels GSMNP's northern boundary as it extends east from Chilhowee Lake on US 129 to I-40 near Cosby, Tennessee.

In 1984 and 1985, two contracts were awarded to construct 16.1 miles of the Parkway between Walland and US 321 in Wears Valley. Both projects experienced such severe slides and erosion problems that work was suspended, leaving a 1.6-mile "Missing Link." A new design, which uses 10 bridges to minimize surface disturbance and resulting environmental impacts, was developed for this 1.6-mile segment. To date, only two bridges have been completed. It is expected that construction on another bridge will begin in spring 2004. Completion of the "Missing Link" is a priority, but it is dependent on available funding. Completion of the remainder of the Parkway is also dependent on available funding, provided that environmental impacts can be adequately mitigated and that sufficient base funding can be allocated for operation of the highway.

3.15.3.5 Elkmont Historic District Planning

The Elkmont Historic District is located north of the study area on the Tennessee side of GSMNP. Elkmont was developed in the early 1900s as a logging community. Adjoining

vacation, country club, resort communities followed prior to the establishment of GSMNP. When land for GSMNP was being set aside in the 1920s and 1930s, owners within the club towns were offered one-half payment for their property in exchange for a lifetime lease of the structures. All leases expired in 1992, with the exception of two that expired in 2001. The GSMNP GMP states that all buildings are to be removed upon termination of the leases and the building sites are to be returned to a natural state. The GMP has not been implemented on this issue due to the fact that Elkmont was listed on the NRHP as an historic district in 1994. The historic district consists of 74 structures. As part of the listing, 49 of the 74 structures were listed as "contributing elements" to the historic district. The environmental compliance process, formally began in spring 2002, effectively combines guidelines laid out by the National Historic Preservation Act and NEPA. An EIS and GMP Amendment are being prepared to enable the Park to make a decision on future management of this district. Alternatives being developed include various mixes of cultural and natural preservation strategies, which range from complete removal of structures to varying degrees of uses and preservation of structures. GSMNP expects to reach a decision on this issue by the end of 2004.

3.15.4 Wilderness Designation

As discussed in Section 3.4 of this report, the Wilderness Act (September 1964) directed the Secretary of the Interior to study all roadless National Park areas of 5,000 or more continuous acres (2,023.4 ha) for wilderness designation. Since 1966, the NPS has been pursuing wilderness designation for GSMNP in an effort to protect and perpetuate its scenic and biotic resources. Throughout the 1980s and 1990s, Congress debated the issue and drafted numerous bills either for or against designation of wilderness within GSMNP.

3.15.5 Fontana Dam Project

The Fontana Dam Project brought about major changes for the region (discussed in Section 3.2.2 of this report). Once completed in 1944, Fontana Lake flooded more than 10,000 acres (4046.9 ha) of the Little Tennessee, Tuckasegee, and Nantahala valleys, causing the loss of many farms and communities, as well as railroad lines and NC 288, the area's main east-west roadway. More than 44,000 (17,806.2 ha) acres along the north shore of Fontana Lake became inaccessible due to the flooding. The land was then acquired by the TVA and added to GSMNP.

3.16 Private In-Holdings

Private in-holdings refer to privately owned properties that are either fully or partially located within the boundaries of Nantahala National Forest, GSMNP, or TVA lands in the study area.

Private in-holdings were inventoried based on data provided by the NPS, the USFS, and the NCCGIA. Figure 22 illustrates the location of private in-holdings within the study area.

The majority of private in-holdings were identified within the USFS lands, as they have historically purchased lands on an ad hoc basis depending on funding and availability of land. Approximately 34,290 acres (13,876.7 ha) within the study area portion of Nantahala National Forest are privately owned lands. The majority of these lands are southwest of Bryson City, south of Fontana Lake at Walnut Hollow Gap and Sawyer Creek, and at Fontana Village.

According to the GSMNP GMP, several areas within the park are zoned as "Special Use." These areas are defined by a lack of NPS administrative control or curtailed by other interests (GSMNP 1982). They include the "Reserved Rights Subzone" that encompasses the approximately 44,000-acre (17,806.2-ha) tract transferred to the NPS by the TVA in 1949. This large expanse is within GSMNP; however, it is the location of former towns and cemeteries that existed prior to the preservation of the land as a reserve and prior to the construction of Fontana Dam. Rights-of-way, water rights, burial rights, and other reserved rights limit NPS management of this area (GSMNP 1982).

The area designated "Reservoir Subzone" within GSMNP is a management subzone that comprises the water surface, the islands, and the intermittently submerged lands of Fontana Reservoir between the southern boundary of the park and the 1,710-foot (521-m) contour on the northern shore of Fontana Lake (the southern boundary of the park is legislatively designated as the now submerged southern banks of the former Little Tennessee and Tuckasegee rivers) (GSMNP 1982). The land within the Reservoir Subzone is owned and administered by the TVA.

Transmission lines that traverse the park are designated within the "Utilities Subzone." This subzone exists along the park's southwestern boundary (GSMNP GMP 1982).

The "Private Management Subzone" is made up of private lands in the northeastern and eastern boundaries of the park. Within the study area, this designation includes tracts of land in the Eagle Creek drainage areas that were a part of the historic copper mine owned by the North Carolina Exploration Company. Portions of this area are submerged by Fontana Lake; however, mineral rights are still owned by the successors to the North Carolina Exploration Company, Cities Services Company. These lands total approximately 2,343.7 acres (948.5 ha) within the GSMNP boundary (GSMNP 1982).

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Appendix A

Memorandum of Agreement of
October 8, 1943

Appendix B

Stream Classifications