Freshwater Mussel Survey Report

Bridge Group 8

I-26 Widening 1-40 to NC 225

TIP Nos. I-4700/I-4400

WBS 36030.1.2/34232.1.1

Buncombe/Henderson Counties, North Carolina

Prepared For:

NC Department of Transportation
Raleigh, North Carolina

October 24, 2013

Prepared by:

The Catena Group
410B Millstone Drive
Hillsborough, NC 27278
Tel: (919) 732-1300 Fax: (919) 732-1303

Table of Contents

Figures:

1.0 INTRODUCTION

The North Carolina Department of Transportation (NCDOT) proposes to widen I-26 from I-40 to NC 225 (TIP Nos. I-4700/I-4400) in Buncombe and Henderson Counties, North Carolina. The project may impact streams in the French Broad River Basin. The Federally Endangered Appalachian Elktoe (*Alasmidonta raveneliana*) is listed by the U.S. Fish and Wildlife Service (USFWS) for Buncombe and Henderson County and is currently known to occur within this portion of the French Broad River Basin in Henderson County. The Federally Endangered Tan Riffleshell (*Epioblasma florentina walkeri*) is listed by the USFWS for Buncombe County as "Historic and Obscure" based on museum shell records from the early 20th century collected from the Asheville area, however, the species has not been collected since. Additionally, The NC Scientific Council of Mollusks 2010 reevaluation of the listing status of NC mollusks recommended the species status be changed from Endangered to Extirpated, a recommendation which was accepted in February 2011. As such, the project will have "No Effect" on the Tan Riffleshell.

As part of the federal permitting process that requires an evaluation of potential project-related impacts to federally protected species, The Catena Group, Inc., (Catena) was contracted by NCDOT to conduct the freshwater mussel surveys targeting the Appalachian Elktoe.

2.0 WATERS IMPACTED

The project may impact waters crossed by the I-26 corridor from 1-40 to NC 225. Survey locations are shown in Figure 1. The following describes the 303(d) and NPDES dischargers within a two mile radius of the crossings evaluated from north to south, also shown in Figure 2. Sources consulted include the North Carolina Department of Environment and Natural Resources Division of Water Resources 2012 NC 303 (d) list (NCDENR 2012) and 2013 list of active individual permits, respectively (NCDENR 2013).

2.1. Hominy Creek

Hominy Creek, a tributary of the French Broad River, may be impacted by the proposed project. Hominy Creek is listed on the 303(d) list of impaired streams for Turbidity and Fair Bioclassification (Ecological/biological Integrity of Benthos) for a 7.8 mile segment. There is one permitted NPDES discharger upstream of the crossing, the Wedgefield Acres Mobile Home Park (NC0062634, 1.1 miles upstream) on Pond Branch. It is a minor discharger (less than 1 million gallons per day).

2.2. French Broad River

The French Broad River may be impacted by the proposed project at the crossing of Bridges 211 and 214. The French Broad is impaired for Turbidity over a 19 mile segment of the river, which

includes these bridge crossings. There are no permitted NPDES dischargers within a two-mile radius of these crossings.

2.3. UT French Broad River

An unnamed tributary (UT) to the French Broad River may be impacted by the proposed project. While additional small UTs will be crossed by and impacted by the project, based on the size of this evaluated tributary and the similar watershed characteristics of others to be crossed, it was determined that appropriate habitat for the target species is not present and therefore survey efforts for each unnamed tributary crossing are not needed. This UT is not listed as an impaired stream, but the French Broad River is listed at the confluence with the UT. The French Broad is impaired for Turbidity over a 19 mile segment of the river. There are no permitted NPDES dischargers upstream of the crossing. There are two permitted NPDES dischargers upstream of the crossing on the French Broad River, the Asheville Steam Electric Power Plant (NC0000396, 2.0 miles upstream), and on Lake Julian, the Asheville Steam Electric Power Plant (NC0000396, 3.0 miles upstream). Both of these dischargers are major dischargers (greater than 1 million gallons per day).

2.4. Cane Creek

Cane Creek is a tributary of the French Broad River and may be impacted by the proposed project at Bridges 233 and 234. Cane Creek is not impaired at the bridge crossing locations, though it is impaired 1.4 miles upstream for Poor Bioclassification (Ecological/biological Integrity of Benthos). The French Broad River is impaired at the confluence with Cane Creek for Fecal Coliform for a segment of 8.2 miles. There are no permitted NPDES dischargers upstream of the bridge crossings, but there is one at the confluence of Cane Creek and the French Broad River, the Fletcher Warehousing Company (NC0000094, 1.0 miles downstream), which is a minor discharger.

2.5. Byers Creek

Byers Creek is a tributary of Mud Creek and may be impacted by the proposed project. Byers Creek is not impaired. Mud Creek is listed as impaired for Fair Bioclassification for Ecological/biological Integrity of Benthos and Fish Communities for a segment of approximately 11 miles. There is one permitted NPDES discharger located upstream of the survey location on Byers Creek. The discharger is the Fletcher Academy WWTP (NC0036641, 0.9 miles upstream), which is a minor discharger.

2.6. Featherstone Creek

Bridge number 218 crosses Featherstone Creek, a tributary of Mud Creek that may be impacted by the proposed project. Featherstone Creek is not impaired at the Bridge 218 crossing. Mud

Creek is listed as impaired for Fair Bioclassification for Ecological/biological Integrity of Benthos and Fish Communities for a segment of approximately 11 miles. There are three permitted NPDES dischargers upstream of the Bridge 218 crossing: Brookside Village WWTP (NC0083313 , 0.5 miles upstream), Henderson's Assisted Living (NC0071897 , 0.6 miles upstream), and Mountain View Assisted Living (NC0074110 , 0.9 miles upstream), each of which is a minor discharger. The Hendersonville WWTP (NC0025534), a major discharger, is also upstream of the bridge crossings on Featherstone Creek (1.9 miles) and discharges into Mud Creek.

2.7. Clear Creek

Bridges 211 and 212 cross Clear Creek, a tributary of Mud Creek that may be impacted by the proposed project. Clear Creek is not impaired at the crossing of Bridges 211 and 212, but it is impaired for Poor Bioclassification approximately 3.7 miles upstream of the bridges. Mud Creek is listed as impaired for Fair Bioclassification for Ecological/biological Integrity of Benthos and Fish Communities for a segment of approximately 11 miles. There are several permitted NPDES dischargers upstream of Bridges 211 and 212, including Greystone Subdivision (NC0068799, 0.6 miles upstream), Pine Park Retirement Inn (NC0069370, 1.3 miles upstream), and Bon Worth WWTP (NC0037176, 1.0 miles upstream), each of which is a minor discharger. The Hendersonville WWTP (NC0025534), a major discharger, is downstream of the bridge crossings on Clear Creek (0.7 miles) and discharges into Mud Creek.

2.8. Devils Fork

Bridge number 178 crosses Devils Fork, which is a tributary of Mud Creek and may be impacted by the proposed project. Devils Fork is listed on the 303(d) list of impaired streams for Poor Bioclassification. Mud Creek is listed as impaired for Fair Bioclassification for Ecological/biological Integrity of Benthos and Fish Communities for a segment of approximately 11 miles. There are two NPDES permitted dischargers upstream of Bridge 178. Dana Hill Corporation (NC0073393, 1.0 miles upstream) and Hidden Gap Mobile Home Park Wastewater Treatment Plant (WWTP) (NC0075647, 1.8 miles upstream) are both minor dischargers.

2.9. Dunn Creek

Dunn Creek, a headwater of the Upper French Broad River, may be impacted by the proposed project. Dunn Creek flows into Bat Fork approximately 0.5 miles downstream of the project crossing. Dunn Creek is not listed as impaired on the 2012 303(d) list of impaired streams. Approximately 1.2 miles downstream of the Dunn Creek crossing, Bat Fork is impaired for Poor Bioclassification (Ecological/biological Integrity of the Fish Community). There are no NPDES dischargers upstream of the survey location.

3.0 NCNHP ELEMENT OCCURRENCE

The North Carolina Natural Heritage Program (NCNHP) element occurrence database was reviewed within a two mile radius of each crossing evaluated and the results of this search are provided in Figure 3. The review of the NCNHP element occurrence data reveals a record for Appalachian Elktoe in the mainstem French Broad near its confluence with the Swannanoa River (NCNHP 2013). This record is historic and represents the "type location" of the species (Lea 1834). No other records of the species within a two-mile radius of the project crossings are currently known. However, the species is known from the upper French Broad River near the confluence with the Mills River and the Little River (roughly 13 and 30 river miles, respectively, from the I-26 crossing of the main stem).

4.0 TARGET FEDERALLY PROTECTED SPECIES DESCRIPTION

4.1. Alasmidonta raveneliana (Appalachian Elktoe)

Status: Endangered
Family: Unionidae
Listed: September 3, 1993

4.1.1. Characteristics

Isaac Lea (1834) described the Appalachian Elktoe from the French Broad River system in North Carolina. Its shell is thin but not fragile, oblong and somewhat kidney-shaped, with a sharply rounded anterior margin and a broadly rounded posterior margin. Parmalee and Bogan (1998) site a maximum length of 3.1 inches (80 mm). However, individuals from the Little River (French Broad River Basin) in Transylvania County and West Fork Pigeon River (French Broad River Basin) in Haywood County measured in excess of 3.9 inches (100 mm) in length (personal observations). The periostracum (outer shell) of the Appalachian Elktoe varies in color from dark brown to yellowish-brown in color. Rays may be prominent in some individuals, usually on the posterior slope, and nearly obscure in other specimens. The nacre (inside shell surface) is a shiny bluish white, changing to salmon color in the beak cavity portion of the shell. A detailed description of the shell characteristics is contained in Clarke (1981). Ortmann (1921) provides descriptions of the soft anatomy.

Until recently, little was known about the reproductive biology of the Appalachian Elktoe. However, nearly all freshwater mussel species have similar reproductive strategies, which involve a larval stage (glochidium) that becomes a temporary obligate parasite on a fish. Many mussel species have specific fish hosts that must be present to complete their life cycle. Based upon laboratory infestation experiments, Watters (1994) lists the banded sculpin *(Cottus carolinae)* as the potential fish host for the Appalachian Elktoe; however, the ranges of these species rarely overlap. Keller documented transformation of Appalachian Elktoe glochidia on the mottled sculpin (*Cottus bairdi*) in 1999 (USFWS 2002), and ongoing research at Tennessee

Technical University (TTU) identified 10 fish species with encysted Appalachian Elktoe glochidia from the Little Tennessee River in North Carolina (Jim Layzer, TTU Personal Communication; Table 1).

Table 1. Fish species collected from the Little Tennessee River (NC) that contained encysted *Alasmidonta raveneliana* glochidia.

Common Name	Scientific Name
Banded darter	*Etheostoma zonale*
Wounded darter	*Etheostoma vulneratum*
Greenfin darter	*Etheostoma chlorobranchium*
Tangerine darter	*Percina aurantiaca*
Mottled sculpin	*Cottus bairdi*
Black redhorse	*Moxostoma duquesnei*
River redhorse	*Moxostoma carinatum*
Sicklefin redhorse	*Moxostoma sp.*
Northern hog sucker	*Hypentelium nigricans*
Warpaint shiner	*Luxilus coccogenis*

Additionally, nine species noted in Table 2 successfully transformed Appalachian Elktoe glochidia in laboratory induced infestations (Jim Layzer, TTU, personal communication). All the species listed in Table 2, with the exception of the river redhorse, sicklefin redhorse, wounded darter and rosyside dace are known to occur within the Nolichucky River Subbasin (Rohde et al. 1994, Menhenick 1991). Based on over two years of ongoing monitoring of the Appalachian Elktoe population in the Little Tennessee River by the NCWRC, it is apparent that the Appalachian elktoe is a bradytictic (long-term) breeder, with the females retaining glochidia in their gills from late August to mid-June (Steve Fraley, NCWRC, personal communication). Glochidia are released in mid-June attaching to either the gills or fins of a suitable fish host species, and encysting within 2-36 hours. Transformation time (time until encystment) for the Appalachian Elktoe occurs within 18-22 days, at a mean temperature of 18° C (Jim Layzer, TTU, personal communication). Encystment time for freshwater mussels is reduced at higher temperatures (Zale and Neves 1982). McMahon and Bogan (2001) and Pennak (1989) should be consulted for a general overview of freshwater 0mussel reproductive biology.

Table 2. Fish species collected from the Tuckasegee River (NC) on April 21, 2004, and used for laboratory induced infestations.

Common Name	Scientific Name	Number
Gilt darter	*Percina evides*	6
Banded darter	*Etheostoma zonale*	8
Wounded darter*	*Etheostoma vulneratum*	17
Greenfin darter*	*Etheostoma chlorobranchium*	32
Greenside darter*	*Etheostoma blennioides*	3

Olive darter	*Percina squamata*	1
Mottled sculpin *	*Cottus bairdi*	19
Rock bass	*Ambloplites rupestris*	1
River chub *	*Nocomis micropogon*	20
Northern hogsucker*	*Hypentelium nigricans*	3
Central stoneroller*	*Campostoma anomalum*	6
Longnose dace*	*Rhinichthys cataractae*	9
Rosyside dace*	*Clinostomus funduloides*	1
Mirror shiner	*Notropis spectrunculus*	3
Tennessee shiner	*Notropis leuciodus*	2
Total	15	131

* Species that successfully transformed *Alasmidonta raveneliana* glochidia.

4.1.2. Distribution and Habitat Requirements

At the time of listing, two known populations of the Appalachian Elktoe existed in North Carolina: the Nolichucky River including its tributaries, the Cane River and the North Toe River, and the Little Tennessee River and its tributaries. The record in the Cane River was represented by one specimen found just above the confluence with the North Toe River (USFWS 1996). Since listing, the Appalachian Elktoe has been found in additional areas. These occurrences include extensions of the known ranges in the Nolichucky River (North Toe River, South Toe River and Cane River) and Little Tennessee River (Tuckasegee River and Cheoah River) as well as a rediscovery in the French Broad River Basin (Pigeon River, Little River, Mills River and French Broad River). Many of these newly discovered populations are relatively small in size and range. The Appalachian Elktoe has been observed in gravelly substrates often mixed with cobble and boulders, in cracks of bedrock, and in relatively silt-free, coarse sandy substrates (USFWS 1996).

At the time of listing in 1993, the Appalachian Elktoe population in the Nolichucky River Basin appeared to be restricted to scattered pockets within a short reach of the North Toe River in Yancey and Mitchell counties in North Carolina and the main stem of the Nolichucky River in North Carolina extending downstream into the vicinity of Erwin, Unicoi County, Tennessee (USFWS 1996). A comprehensive and cooperative mussel survey effort was undertaken between 2000-2003 by the NCWRC, NCDOT, and USFWS throughout the upper Nolichucky River system in Yancey, Mitchell, and Avery counties, North Carolina. The primary goal for these surveys was a re-assessment of Appalachian Elktoe population status. Many areas in the Nolichucky system had not been surveyed since the early or mid- 1990's. The NCWRC and the USFWS efforts are part of their continuing cooperation to monitor populations of federally listed endangered and threatened species under Section 6 of the Endangered Species Act. The NCDOT also needed updated survey information to assess potential impacts from a number of highway

construction projects planned or proposed within the Nolichucky River Basin (Fraley and Simmons 2004).

As part of this effort, surveys were conducted in the vicinity of the US 19E crossings of the Cane River and South Toe River on September 9 and 10, 2002. Although no mussels were found under the two bridge sites during this survey, the Appalachian Elktoe was found short distances upstream and downstream from both bridges. Prior to this survey effort, one live Appalachian Elktoe was found under the US 19 E crossing of the South Toe River on September 9, 2000. These discoveries were significant extensions of the known ranges of this species in the two rivers. Subsequent surveys have located many individuals at the US 19E crossing of the South Toe River (NCWRC unpublished database).

The comprehensive survey efforts indicate that at least 73 miles (117 kilometers) of stream in the Nolichucky River system are presently occupied by the Appalachian Elktoe; an apparent increase of 15 miles (24 kilometers) over reported occupied habitat prior to 2000 (Fraley and Simmons 2004). The current range in the Nolichucky River drainage is more than twice the range documented prior to when the species was listed. These surveys also indicated that mussel populations appeared to be growing in numbers as well. Sites where mussels were found during 2000-2003, had higher Catches Per Unit Effort (CPUEs) than the nearest sites sampled prior to 2000 (Fraley and Simmons 2004). However, the comprehensive flooding events associated with tropical storms Frances, Ivan, and Jeanne in 2004 resulted in significant instream habitat disturbances that reduced the species numbers and distribution at several sites throughout the Nolichucky River system (USFWS 2009).

4.1.3. Threats to Species

The decline of the Appalachian Elktoe throughout its historic range has been attributed to a variety of factors, including sedimentation, point and non-point source pollution, and habitat modification (impoundments, channelization, etc.).

With the exception of the Nolichucky River population, the other populations are generally small in numbers and restricted to short reaches of isolated streams. The Little Tennessee River population was once considered the stronghold for the species; however, densities have declined by over 90% in the river since 2004, and the species is now very rare throughout most of the occupied reach. The cause of this decline remains uncertain (NCWRC unpublished data, NCWRC Aquatics Database).

The low numbers of individuals and the restricted range of many of the surviving populations make them extremely vulnerable to extirpation from a single catastrophic event or activity. Catastrophic events may consist of natural events such as flooding or drought, as well as human influenced events such as toxic spills associated with highways or railroads.

In 1998, a toxic spill resulting from a tanker truck accident that was carrying Octocure 554 (a chemical liquid used in the rubber making process), killed several miles of mussel populations in the Clinch River near Cedar Bluff, Virginia. The spill killed thousands of fish and mussels, including three federally protected species. The Clinch River contains one of the most diverse mussel faunas in the United States. The stretch of the river affected by the spill was one of the few remaining areas that contained a reproducing population of the Endangered Tan Riffleshell (*Epioblasma florentina walkeri*). The toxic spill is believed to have eliminated this population (Richmond Times Dispatch 1998). Biologists in Virginia feel that it could take more than 20 years before mussel populations in this area recover, if they recover at all (Bristol Herald Courier 1998). The Appalachian Elktoe population in the Nolichucky River Basin is large enough (at least 73 miles) and is dispersed well upstream into major tributaries (South Toe River, Cane River, North Toe River) such that a single catastrophic event like a chemical spill is not likely to cause extirpation from the river basin. However, an event such as this would obviously adversely affect the apparent recovery of the Appalachian Elktoe in the Nolichucky Basin that has occurred since the 1990s. The 2008 Burnsville WWTP discharge of toxic pollutants into the Cane River nearly eliminated Appalachian Elktoe in this watershed (USFWS 2009).

Siltation resulting from improper erosion control of various types of land usage, including agricultural, forestry, and development, has been recognized as a major contributing factor to degradation of mussel populations (USFWS 1996). Siltation has been documented to be extremely detrimental to mussel populations by degrading substrate and water quality, increasing potential exposure to other pollutants, and direct smothering of mussels (Ellis 1936, Marking and Bills 1979). Sediment accumulations of less than 1 inch (2.54 centimeters) have been shown to cause high mortality in most mussel species (Ellis 1936). In Massachusetts, a bridge construction project decimated a population of the endangered Dwarf Wedgemussel (*Alasmidonta heterodon*) because of accelerated sedimentation and erosion (Smith 1981). The abrasive action of sediment on mussel shells has been shown to cause erosion of the outer shell, which allows acids to reach and corrode underlying layers (Harman 1974). The soils in the Nolichucky River Basin are considered to be some of the most erodible soils in the state. The generally steep topography in the watershed increases the erosion potential.

The impact of impoundments on freshwater mussels has been well-documented (USFWS 1992a, Neves 1993). Construction of dams transforms lotic habitats into lentic habitats, which results in changes within aquatic community composition. These changes associated with inundation adversely affect both adult and juvenile mussels as well as fish community structure, which could eliminate possible fish hosts for glochidia (Fuller 1974). In addition, the construction of dams often results in fragmentation of mussel populations by effectively blocking upstream expansion and recruitment of mussel and fish species. Muscle Shoals on the Tennessee River in northern Alabama, once the richest site for naiads (mussels) in the world, is now at the bottom of Wilson Reservoir and covered with 19 feet (5.8 meters) of muck (USFWS 1992b). The

population of the Appalachian Elktoe in the Little Tennessee River is believed to have been reduced by the Fontana Lake and Lake Emory impoundments (USFWS 1996).

In addition to modification of habitat, the construction of dams can indirectly impact freshwater mussel species by posing a barrier to fish migration. The construction of the Petitcodiac River Causeway in Canada in 1968, resulted in the extirpation of the Dwarf Wedgemussel, because the causeway restricted the migration of the diadromous Inner Bay of Fundy stock of Atlantic salmon (*Salmo salar*), which serves as the fish host for the Dwarf Wedgemussel in this region (Locke et al. 2003).

Sewage treatment effluent has been documented to significantly affect the diversity and abundance of mussel fauna (Goudreau et al. 1988). Goudreau et al. (1988) found that recovery of mussel populations might not occur for up to 2 miles (3.2 kilometers) below points of chlorinated sewage effluent. Most of the water bodies where Appalachian Elktoe still exist have relatively few point source discharges within the watershed and are rated as having good to excellent water quality (USFWS 1996). The Town of Burnsville's Waste Water Treatment Plant discharges into the Cane River. This is the only facility in the subbasin required to perform whole effluent toxicity testing. As previously mentioned, this WWTP experienced an influx of toxic materials in 2008 that devastated the population of Appalachian Elktoe downstream of the discharge.

The introduction of exotic species such as the Asiatic clam (*Corbicula fluminea*) and zebra mussel (*Dreissena polymorpha*) has also been shown to pose significant threats to native freshwater mussels. The Asiatic clam is now established in most of the major river systems in the United States (Fuller and Powell 1973), including the Nolichucky Basin, where it is abundant in some areas (Tim Savidge, Catena personal observations). Concern has been raised over competitive interactions for space, food, and oxygen between this species and native mussels, possibly at the juvenile stages (Neves and Widlak 1987, Alderman 1997). When the Appalachian Elktoe was listed, it was speculated that due to its restricted distribution, it "may not be able to withstand vigorous competition" (USFWS 1996).

The zebra mussel, native to the Black, Caspian and Aral Seas, is an exotic freshwater mussel that was introduced into the Great Lakes in the 1980s. Since its introduction, this species has rapidly expanded its range into the surrounding river basins, including those of the South Atlantic slope (O'Neill and MacNeill 1991). This species competes for food resources and space with native mussels and is expected to contribute to the extinction of at least 20 freshwater mussel species if it becomes established throughout most of the eastern United States (USFWS 1996). The zebra mussel is not currently known from any river supporting Appalachian Elktoe populations.

Another exotic species that has the potential to adversely impact aquatic species, including the Appalachian Elktoe, is Japanese knotweed (*Fallopia japonica*). The plant is considered to be an invasive species that can reproduce from its seed or from its long stout rhizomes. It can tolerate

a variety of conditions such as full shade, high temperatures, high salinity, and drought. It can be spread by wind, water, and soil movement to an area where it quickly forms dense thickets that excludes native vegetation and greatly alters the natural ecosystem. This species has become established in riparian habitats throughout western North Carolina, including sections along the Cane, South Toe and North Toe Rivers and is present in the project area (Tom Dickinson, Catena personal observations). The species has a very shallow root system, and because of this shallow root system, and its preclusion of other vegetation, areas where this species has been established may be susceptible to erosion during flood events. Several areas where dense mats had been established were severely scoured during the flood events of 2004 discussed earlier. Although not measured, the severity of scour in these areas appeared to be comparatively greater than in areas that had established native vegetation (Marella Buncick, USFWS personal communication).

While there have been some improvement in the watershed, numerous potential threats to this population still exist (Table 3).

Table 3. Threats to Appalachian Elktoe in French Broad River.

Threat/Concern	Specific Problems	Potential Sources
Water Quality Degradation	Fecal coliform Ammonia Nitrate/Nitrite Chlorine Phosphorus Dissolved oxygen Copper Pesticides Toxic plumes	Wastewater treatment facilities Agricultural runoff Golf course runoff Lawn care chemicals Urban runoff Fertilizer applications Isolated spills
Habitat Degradation	Sediment Total suspended solids Riparian buffer loss Stream scour Stream/bank instability Habitat fill/disturbance	Changes in stream flow Increased stormwater runoff Construction Land development Recreational use (ATV) Poor land management practices In-stream construction (bridges, stream relocation, etc.)
Water Quantity Degradation	Mussel dislodgement Drought mortality	Increased stormwater volume/velocity Reduced infiltration and ground water recharge Increased impervious cover

Invasive Species	Uncertain, but likely competition for food and space resources (Asian clam), instability of riparian habitats (Japanese knotweed)	Asian clam, Japanese knotweed

Many of these threats are magnified by, or are the result of urbanization of the watershed. Although portions of this watershed are expected to develop in the future, primarily in areas of sewer and water services, the overall slow anticipated growth rate in this area may allow for conservation of this species and its Critical Habitat.

5.0 SURVEY METHODS

Mussel surveys were conducted for a distance of approximately 1,640 feet (500 meters) unless otherwise noted. Areas of appropriate habitat were searched, concentrating on the stable habitats preferred by the target species. The survey team spread out across the water body into survey lanes. Visual surveys were conducted using glass bottom view buckets (bathyscopes) and/ or mask/snorkle. All freshwater bivalves were recorded, photographed, and returned to the substrate. Timed survey efforts provided CPUE data for each species found. Relative abundance for freshwater snails and freshwater clam species were estimated using the following criteria:

- (VA) Very abundant > 30 per square meter
- (A) Abundant 16-30 per square meter
- (C) Common 6-15 per square meter
- (U) Uncommon 3-5 per square meter
- (R) Rare 1-2 per square meter
- (P-) Ancillary adjective "Patchy" indicates an uneven distribution of the species within the sampled site.

6.0 SURVEY RESULTS BY CROSSING

The results of individual survey efforts are provided below by the water body crossing evaluated from north to south.

6.1. Hominy Creek

Hominy Creek was visited by Catena personnel Tim Savidge and Ivy Kimbrough on September 17, 2013. The reach flows through mixed residential, agricultural, road, and commercial land uses. Within the surveyed reach, the creek channel ranged from 30-40 feet wide with areas of both stabilized (with concrete and rock rip rap) and unstable banks up to 15 feet high. In stream

habitat consists of a sequence of riffle, run, and pool. In order of dominance the substrate consisted of sand, cobble, boulder, and bedrock. The stream was running clear during the site visit.

A total of 2.33 person hours of survey time were spent in the surveyed reach during which no freshwater mussels were located. The only mollusk species encountered was the Asian Clam (*Corbicula fluminea*) (Table 4).

Table 4. Freshwater Mollusks Located

Scientific Name	Common Name	#	Relative Abundance
Corbicula fluminea	Asian Clam	~	R

6.2.French Broad River

The main stem French Broad was visited on September 16, 2013 by Catena personnel Tim Savidge, Tom Dickinson, Ivy Kimbrough, and Chris Sheats with assistance from John Fridell and Jason Mays from the USFWS. The reach flows through the mostly forested, pasture, agricultural, and road land uses of the Biltmore estate. Within the surveyed reach, the river channel ranged from 175-225 feet wide with areas of both stabilized and partially eroded banks up to 10 feet high. In stream habitat consists of a sequence of riffle and run. In order of dominance the substrate consisted of gravel, sand, cobble, and silt. The river was running clear during the site visit.

A total of 12 person hours of survey time were spent in the surveyed reach during which low numbers of two species of freshwater mussels, the Eastern Elliptio (*Elliptio complanata*) and Creeper (*Strophitus undulatus*) were found (Table 5). Other mollusk species encountered included the Asian Clam Pointed Campeloma (*Campeloma decisum*), and Sprite Elimia (*Elimia proxima*).

Table 5. Freshwater Mollusks Located

Scientific Name	Common Name	#	Relative Abundance/CPUE
Campeloma deciusm	Pointed Campeloma	~	P, R
Corbicula fluminea	Asian Clam	~	A
Elimia proxima	Sprite Elimia	~	P, R
Elliptio complanata	Eastern Elliptio	7	0.58
Strophitus undulatus	Creeper	1	0.08

6.3.UT French Broad River

This small unnamed tributary was visited by Catena personnel Tom Dickinson and Jonathan Hartsell on July 25, 2013. The reach flows through forested, road, and commercial land uses. Within the reach, the creek channel ranged from 3-6 feet wide with stable banks up to 2 feet high. In stream habitat consists of a sequence of riffle, run, and pool. In order of dominance the substrate consisted of bedrock, sand, cobble, gravel, and silt. The stream was running clear during the site visit.

A total of one person hour of survey time were spent evaluating habitat during which it was determined the stream was too small to support freshwater mussels. No freshwater mussels were located.

6.4. Cane Creek

Cane Creek was visited by Catena personnel Tim Savidge and Ivy Kimbrough on September 17, 2013. The reach flows through mixed pasture, agricultural, road, and commercial land uses. Within the surveyed reach, the creek channel ranged from 20-30 feet wide with areas of both stabilized and partially eroded banks up to 15 feet high. In stream habitat consists of a sequence of riffle, run, and pool. In order of dominance the substrate consisted of sand, gravel, and cobble. The stream was running clear during the site visit.

A total of 2.6 person hours of survey time were spent in the surveyed reach during which one live Creeper and one fresh dead shell were located. Additionally, the Asian Clam was present (Table 6).

Table 6. Freshwater Mollusks Located

Scientific Name	Common Name	#	Relative Abundance
Corbicula fluminea	Asian Clam	~	P, C
Strophitus undulatus	Creeper	1	0.08

6.5. Byers Creek

Byers Creek was visited on September 17, 2013 by Catena personnel Tom Dickinson and Chris Sheats with assistance from John Fridell. The reach flows through mostly forested, agricultural, and road land uses. Within the surveyed reach, the creek channel ranged from 10-15 feet wide with partially eroded banks up to 10 feet high. In stream habitat consists of a sequence of riffle, run, and pool. In order of dominance the substrate consisted of sand, gravel, and silt. The stream was running clear during the site visit.

A total of 1.35 person hours of survey time were spent in the surveyed reach during which no freshwater mussels were located. The only mollusk species encountered was the Sprite Elimia (Table 7).

Table 7. Freshwater Mollusks Located

Scientific Name	Common Name	#	Relative Abundance
Elimia proxima	Sprite Elimia	~	P, U

6.6. Featherstone Creek

Featherstone Creek was visited on September 17, 2013 by Catena personnel Tom Dickinson and Chris Sheats with assistance from John Fridell. The reach flows through mostly forested, residential, and commercial land uses. Within the surveyed reach, the scoured creek channel ranged from 6-12 feet wide with eroded banks 3-6 feet high. In stream habitat consists of a sequence of riffle, run, and pool. In order of dominance the substrate consisted of sand, silt, and pebble. The stream was running clear during the site visit.

A total of 1.5 person hours of survey time were spent in the surveyed reach during which no freshwater mussels were located.

6.7. Clear Creek

Clear Creek was visited on September 17, 2013 by Catena personnel Tom Dickinson and Chris Sheats with assistance from John Fridell. The reach flows through mixed forested, agricultural, road, and residential land uses. Within the surveyed reach, the creek channel ranged from 25-40 feet wide with areas of both stabilized and partially eroded banks up to 15 feet high. In stream habitat consists of a sequence of riffle, run, and pool. In order of dominance the substrate consisted of sand, gravel, silt, and cobble. The stream was running clear during the site visit.

A total of 3.75 person hours of survey time were spent in the surveyed reach during which no freshwater mussels were located. The only mollusks species encountered were the Asian Clam and the Sprite Elimia (Table 8).

Table 8. Freshwater Mollusks Located

Scientific Name	Common Name	#	Relative Abundance
Corbicula fluminea	Asian Clam	~	C
Elimia proxima	Sprite Elimia	~	P, C

6.8. Devils Fork

Devils Fork was visited by Catena personnel Tom Dickinson and Jonathan Hartsell on July 25, 2013. The channelized reach flows through mixed agricultural, residential, road, and forested land uses. Within the surveyed reach, the creek channel ranged from 10-20 feet wide with unstable banks up to 12 feet high. In stream habitat consists of a sequence of riffle, run, and pool. Evidence of a former beaver (*Castor canadensis*) impoundment was present. Substrate was dominated almost entirely by unconsolidated sand. The stream was running clear during the site visit.

A total of 1.33 person hours of survey time were spent in the surveyed reach during which no freshwater mussels were located.

6.9. Dunn Creek

Dunn Creek was visited by Catena personnel Tom Dickinson and Jonathan Hartsell on July 25, 2013. The channelized reach flows through mixed commercial, forested and road land uses. Within the surveyed reach, the creek channel ranged from 10-25 feet wide with areas of both stabilized and unstable banks up to 12 feet high. In stream habitat consists of a sequence of run and pool. Beaver impoundments were present in the reach. Substrate was dominated almost entirely by unconsolidated sand with occasional areas of gravel and cobble. The stream was running clear during the site visit.

A total of 2.0 person hours of survey time were spent in the surveyed reach during which no freshwater mussels were located.

7.0 DISCUSSION/CONCLUSIONS BY CROSSING

7.1. Hominy Creek: No Effect

Habitat for Appalachian Elktoe in the surveyed reach is poor in Hominy Creek, with only the tolerant Asian Clam being located in very low numbers. As such, a Biological Conclusion with the finding of **No Effect** has been reached for this crossing.

7.2. French Broad River: May Affect Not Likely To Adversely Affect

Appropriate habitat for Appalachian Elktoe is present in the surveyed reach, and two species of freshwater mussels, including the associate Creeper were located. Due to the fact the target species was not found and has not been recently located in this reach of the French Broad River, impacts are unlikely to occur. However, the species is known from the mainstem French Broad River upstream in Henderson County in habitats similar to those observed in the project area. Additionally, this population appears to be expanding its range in the river in recent years

(NCWRC unpublished data, 2009, NCWRC Aquatics Database). As such, impacts cannot be completely discounted. Strict adherence to erosion control standards should minimize the potential for any adverse impacts to occur. As such, a Biological Conclusion with the finding of **May Affect Not Likely To Adversely Affect** has been reached for this crossing.

7.3.UT French Broad River: May Affect Not Likely To Adversely Affect

Due to the small size of this UT, no appropriate habitat for Applachian Elktoe is present in the stream. However, due to the stream's proximity to the main stem French Broad River, impacts to the species cannot be completely discounted. Strict adherence to erosion control standards should minimize the potential for any adverse impacts to occur. As such, a Biological Conclusion with the finding of **May Affect Not Likely To Adversely Affect** has been reached for this crossing. This conclusion should be applied to similarly sized small tributaries crossings that enter the French Broad River within the project action area (<400 meters downstream).

7.4. Cane Creek: May Affect Not Likely To Adversely Affect

Appropriate habitat for Appalachian Elktoe is present in the surveyed reach, and the associate Creeper was located in low numbers. Due to the fact the target species was not found and has not been located in the area, impacts are unlikely to occur. However, the species is known from habitats similar to those observed in the project area and associate species are present in the project area. As such, impacts cannot be completely discounted. Strict adherence to erosion control standards should minimize the potential for any adverse impacts to occur. As such, a Biological Conclusion with the finding of **May Affect Not Likely To Adversely Affect** has been reached for this crossing.

7.5. Byers Creek: No Effect

Habitat for Appalachian Elktoe in the surveyed reach is marginal in this portion of Byers Creek, with only the Sprite Elimia being located in very low numbers. As such, a Biological Conclusion with the finding of **No Effect** has been reached for this crossing.

7.6. Featherstone Creek: No Effect

Habitat for Appalachian Elktoe in the surveyed reach is poor in this portion of Featherstone Creek and no mollusks were located during this survey effort. As such, a Biological Conclusion with the finding of **No Effect** has been reached for this crossing.

7.7. Clear Creek: May Affect Not Likely To Adversely Affect

Appropriate habitat for Appalachian Elktoe is present in the surveyed reach, and the associate Creeper has been found during recent survey efforts at the project crossing (John Fridell,

personal communication), although it was not found during these efforts. Due to the fact the target species was not found and has not been located in the area, impacts are unlikely to occur. However, the species is known from habitats similar to those observed in the project area and associate mussel species have been recently found. As such, impacts cannot be completely discounted. Strict adherence to erosion control standards should minimize the potential for any adverse impacts to occur. As such, a Biological Conclusion with the finding of **May Affect Not Likely To Adversely Affect** has been reached for this crossing.

7.8. Devils Fork: No Effect

Habitat for Appalachian Elktoe in the surveyed reach is poor in this portion of Devils Fork and no mollusks were located during this survey effort. As such, a Biological Conclusion with the finding of **No Effect** has been reached for this crossing.

7.9. Dunn Creek: No Effect

Habitat for Appalachian Elktoe in the surveyed reach is poor in this portion of Dunn Creek and no mollusks were located during this survey effort. As such, a Biological Conclusion with the finding of **No Effect** has been reached for this crossing.

The USFWS is the regulating authority for Section 7 Biological Conclusions and as such, it is recommended that they be consulted regarding their concurrence with the findings of this document.

8.0 LITERATURE CITED

Alderman, J.M. 1997. Monitoring the Swift Creek freshwater mussel community. Pages 98-107 in K.S. Cummings, A.C. Buchanan, C.A. Mayer, and T.J. Naimo, eds. 1997. Conservation and Management of Freshwater Mussels II: Initiatives for the future. Proceedings of a UMRCC symposium, 16-18 October 1995, St. Louis, Missouri. Upper Mississippi River Conservation Committee, Rock Island Illinois. 293 pp.

Bristol Herald Courier, 1998. The Spill Kill. Friday September 4, 1998, Bristol Virginia.

Clarke, A. H. 1981. The tribe Alasmidontini (Unionidae: Anodontinae), Part I: Pegias, Alasmidonta, and Arcidens. Smithsonian Contributions to Zoology, (326), 101 pp.

Ellis, M.M. 1936. Erosion silt as a factor in aquatic environments. Ecology. 17:29-42.

Fraley, S.J., and J.W. Simmons. 2004. A Preliminary Report on Cooperative Mussel Surveys in the Upper Nolichucky River Basin in Western North Carolina, 200-2003. Draft Report, North Carolina Wildlife Resources Commission, Raleigh, NC. 3 pp.

Fuller, S.H. 1974. Clams and mussels (Molluska: Bivalva). Pp 215-273 in J.W. Hart and S.H. Fuller, eds. Pollution Ecology of Freshwater Invertebrates. Academic Press, New York City, NY.

Fuller, S.L.H. and C.E. Powell. 1973. Range extensions of *Corbicula manilensis* (Philippi) in the Atlantic drainage of the United States. Natilus. 87(2):59.

Goudreau, S.E., R.J. Neves, and R.J. Sheehan. 1988. Effects of sewage treatment effluents on mollusks and fish of the Clinch River in Tazewell County, Virginia. Final Rep., U.S. Fish and Wildl. Serv. 128 pp.

Harman, W.N. 1974. The effects of reservoir construction and channelization on the mollusks of the upper Delaware watershed. Bull. Am. Malac. Union 1973:12-14.

Lea, I. 1834. Observations on the naiads and descriptions of new species of that and other families. Transactions of the American Philosophical Society 5: 23-119, plates 1-19.

Locke, A., J.M. Hanson, G.J. Klassen, S.M. Richardson, and C.I. Aube. 2003. The Damming of the Petitcodiac River: Species, populations, and habitats lost. Northeastern Naturalist: 10 (No. 1), pp. 39-54.

Marking, L.L., and T.D. Bills. 1979. Acute effects of silt and sand sedimentation on freshwater mussels. Pp. 204-211 in J.L. Rasmussen, ed. Proc. of the UMRCC symposium on the Upper Mississippi River bivalve mollusks. UMRCC. Rock Island IL. 270 pp.

McMahon, R.F. and A.E. Bogan. 2001. Mollusca: Bivalva. Pp. 331-429. In: J.H. Thorpe and A.P. Covich. Ecology and Classification of North American freshwater invertebrates. 2nd edition. Academic Press.

Menhenick, E.F. 1991. The freshwater fishes of North Carolina. Raleigh, NC, North Carolina Wildlife Resources Commission.

NCDENR- Division of Water Resources. 2012. 2012 North Carolina 303(d) List. http://portal.ncdenr.org/web/wq/ps/mtu/assessment

NCDENR-Division of Water Resources. 2013. List of active individual permits. 9/6/13. http://portal.ncdenr.org/web/wq/swp/ps/npdes

NCNHP. 2013. Element Occurrences. Unpublished data.

Neves, R.J. 1993. A state of the Unionids address. Pp. 1-10 in K.S. Cummings, A.C. Buchanan, and L.M. Kooch, eds. Proc. of the UMRCC Symposium on the Conservation and Management of Freshwater Mussels. UMRCC. Rock Island IL.189 pp.

Neves, R.J., and J.C. Widlak. 1987. Habitat ecology of juvenile freshwater mussels (Bivalvia: Unionidae) in a headwater stream in Virginia. Amer. Malacol. Bull. 1(5):1-7.

O'Neill, C.R., Jr., and D.B. MacNeill. 1991. The zebra mussel (*Dreissena polymorpha*): an unwelcome North American invader. Sea Grant, Coastal Resources Fact Sheet. New York Sea Grant Extension. 12 pp.

Ortmann, A. E. 1921. The anatomy of certain mussels from the Upper Tennessee. The Nautilus 34(3):81-91.

Parmalee, P.W. and A.E. Bogan. 1998. Freshwater Mussels of Tennessee. University of Tennessee Press, Knoxville.

Pennak, R.W. 1989. Fresh-water invertebrates of the United States, Protozoa to Mollusca Third Edition, John Wiley & Sons, Inc. New York, 628 pp.

Rohde, F.C., R.G. Arndt, D.G. Lindquist, and J.F. Parnell. 1994. Freshwater fishes of the Carolinas, Virginia, Maryland, and Delaware. Chapel Hill, NC. The University of North Carolina Press.

Richmond Times-Dispatch, 1998. Spill poses a danger to mussel/Tan riffleshell eliminated from Clinch, professor says. Wednesday, September 2, 1998, Richmond Virginia.

Smith, D. 1981. Selected freshwater invertebrates proposed for special concern status in Massachussetts (Mollusca, Annelida, Arthropoda). MA Dept. of Env. Qual. Engineering, Div. of Water Pollution Control. 26 pp.

U.S. Fish and Wildlife Service. 1992a. Special report on the status of freshwater mussels.

U.S. Fish and Wildlife Service. 1992b. Endangered and Threatened species of the southeast United States (The red book). Prepared by Ecological Services, Div. of Endangered Species, Southeast Region. Government Printing Office, Washington, D.C. 1,070 pp.

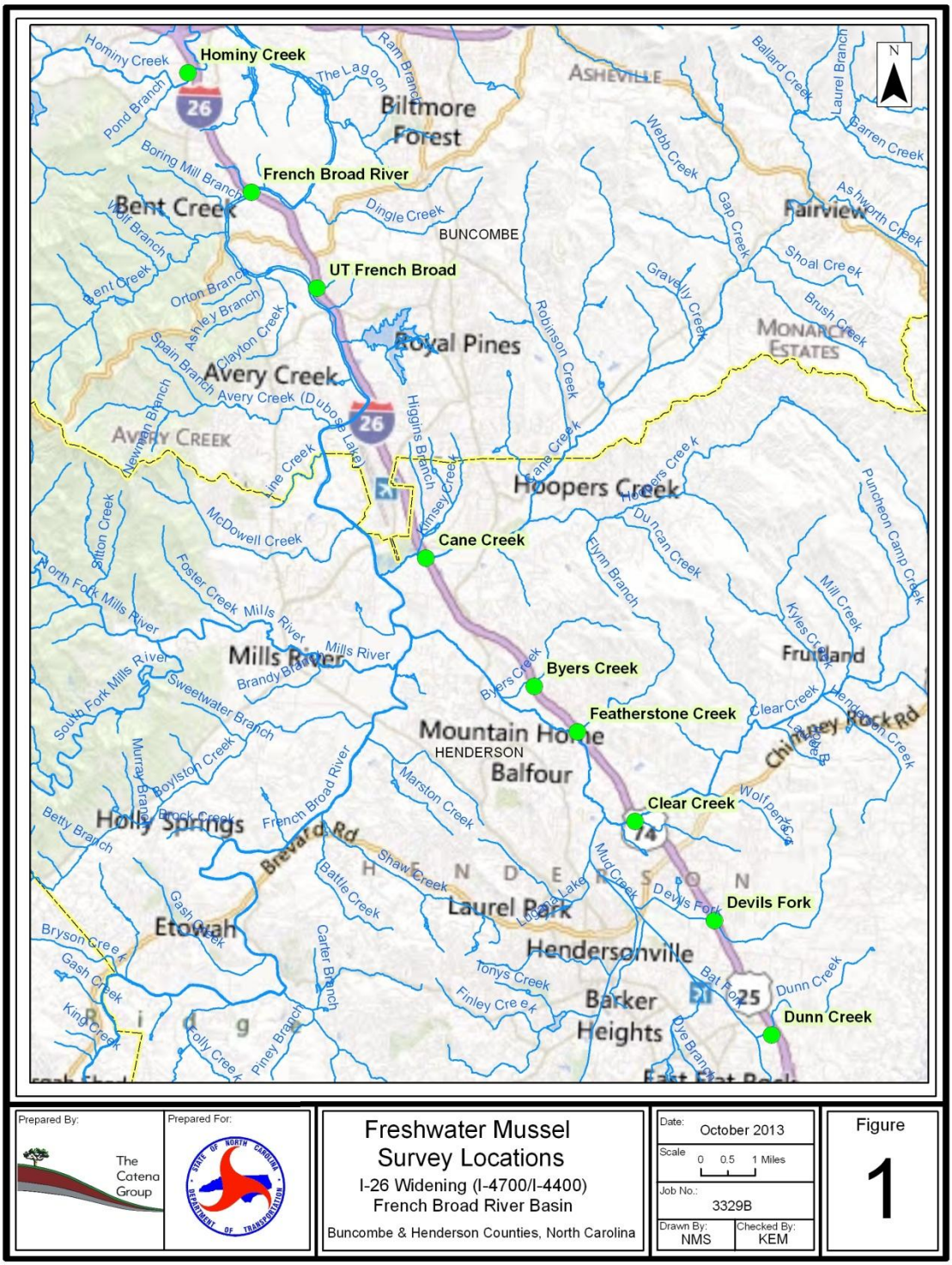
U.S. Fish and Wildlife Service. 1996. Appalachian Elktoe (*Alasmidonta raveneliana*) Recovery Plan. Atlanta, Georgia, 30 pp

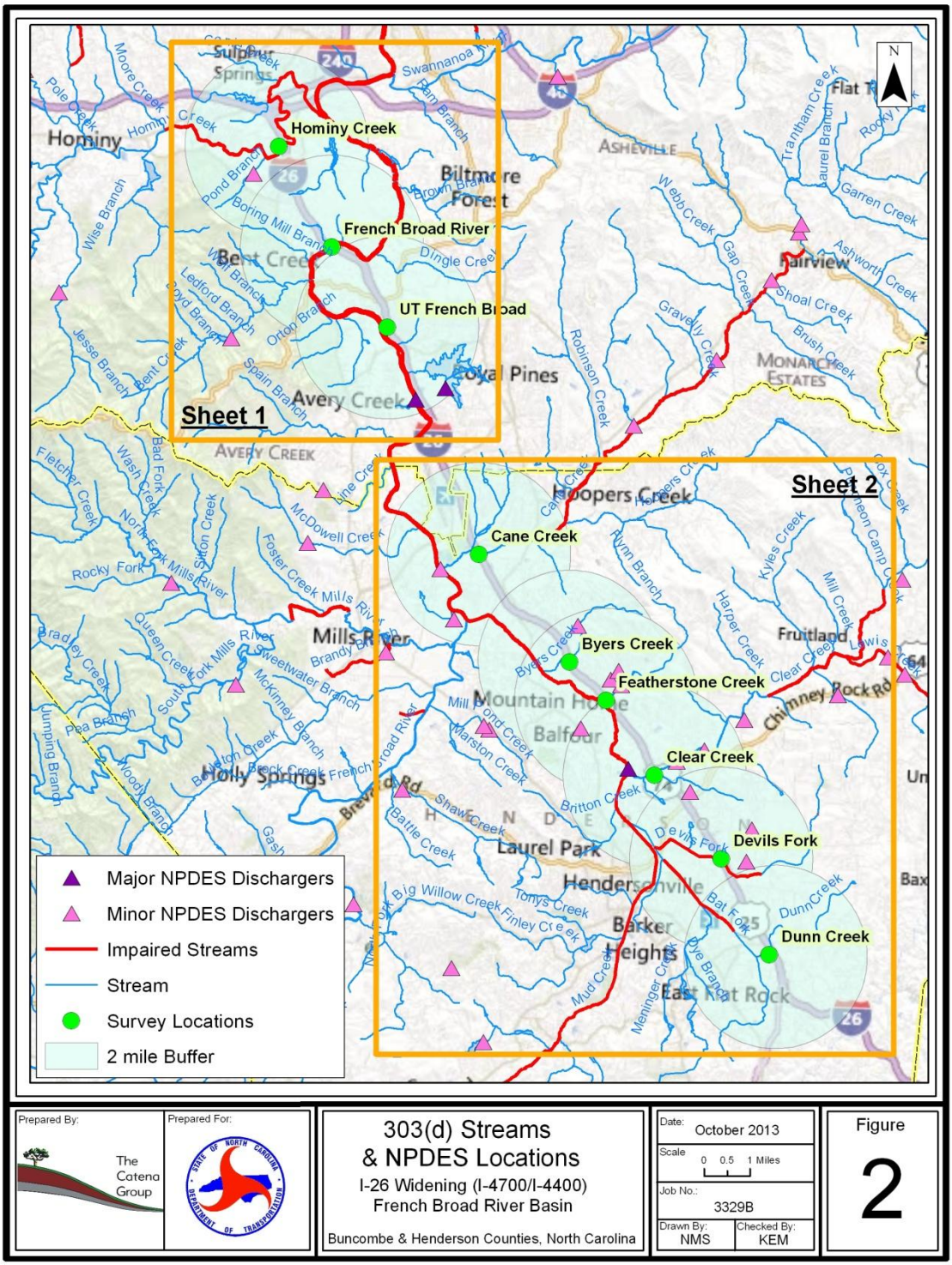
U.S. Fish and Wildlife Service. 2002. Endangered and Threatened Wildlife and Plants: Designation of Critical Habitat for the Appalachian Elktoe. CFR, Vol. 67, No. 188.

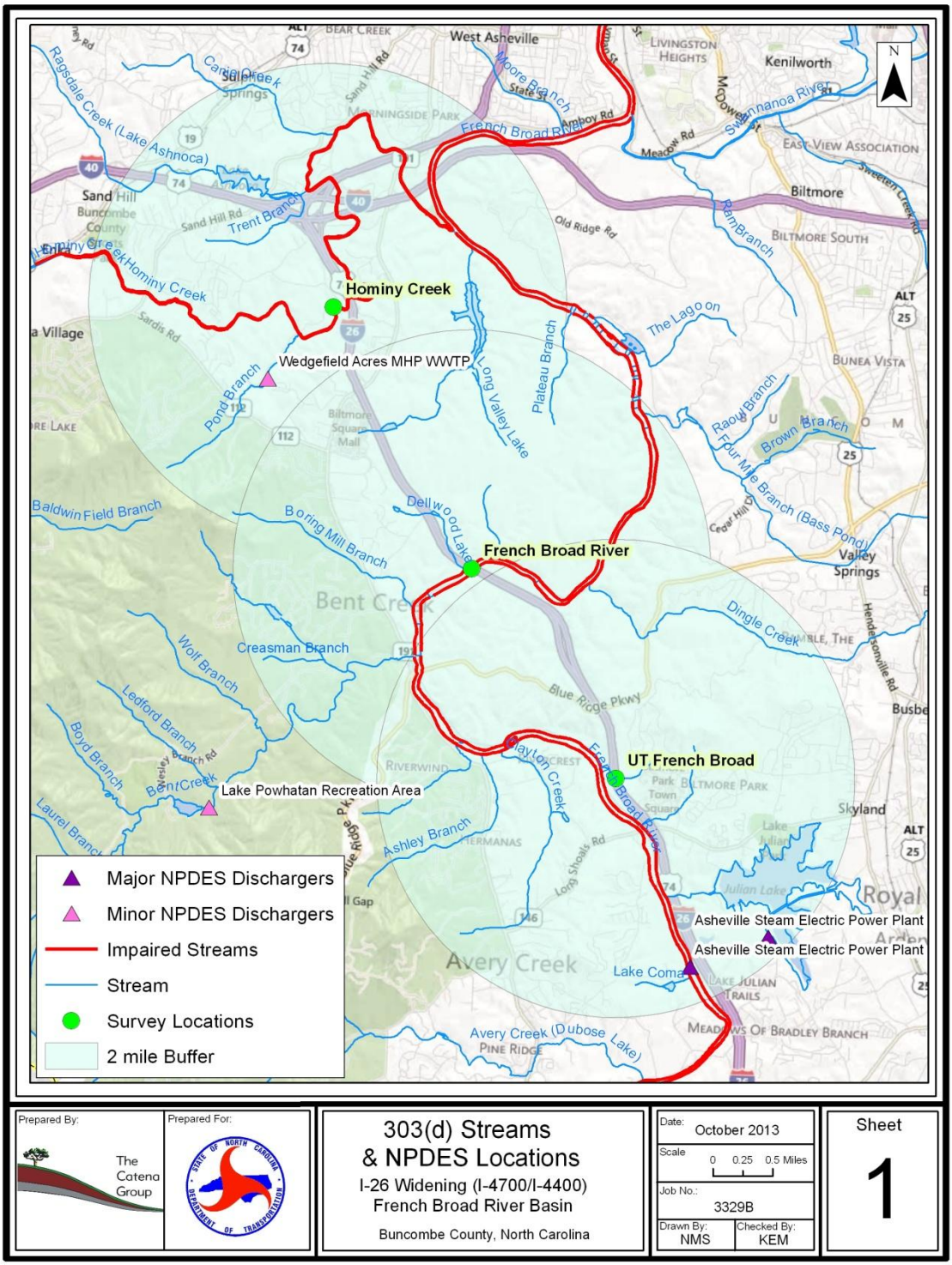
U.S. Fish and Wildlife Service. 2009. Appalachian Elktoe (*Alasmidonta raveneliana*) 5-Year Review. Asheville, North Carolina, 22 pp

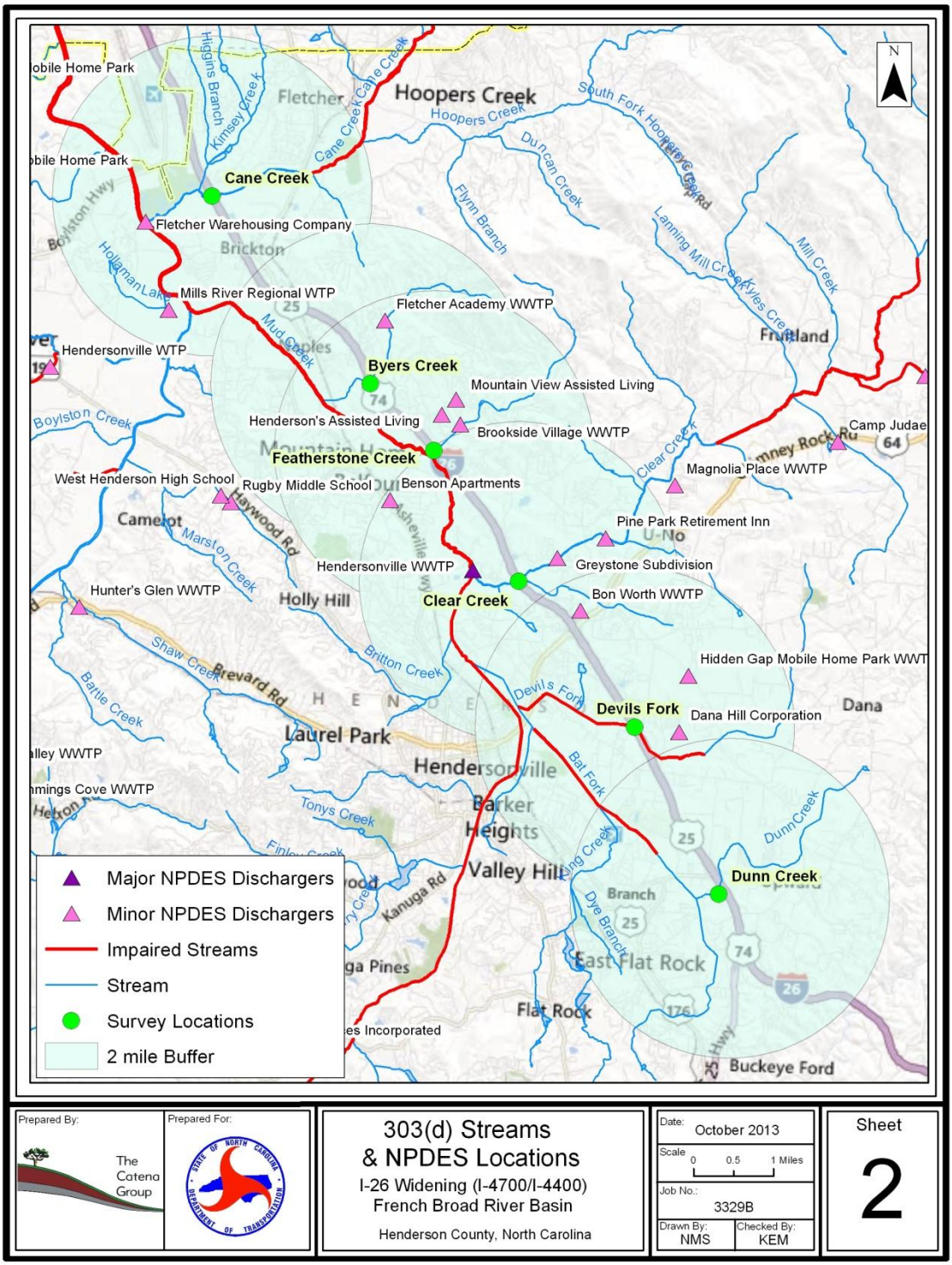
Watters, G.T. 1994. An annotated bibliography of the reproduction and propagation of the Unionidae (Primarily of North America). Ohio Biological Survey Miscellaneous Contributions(1): 158.

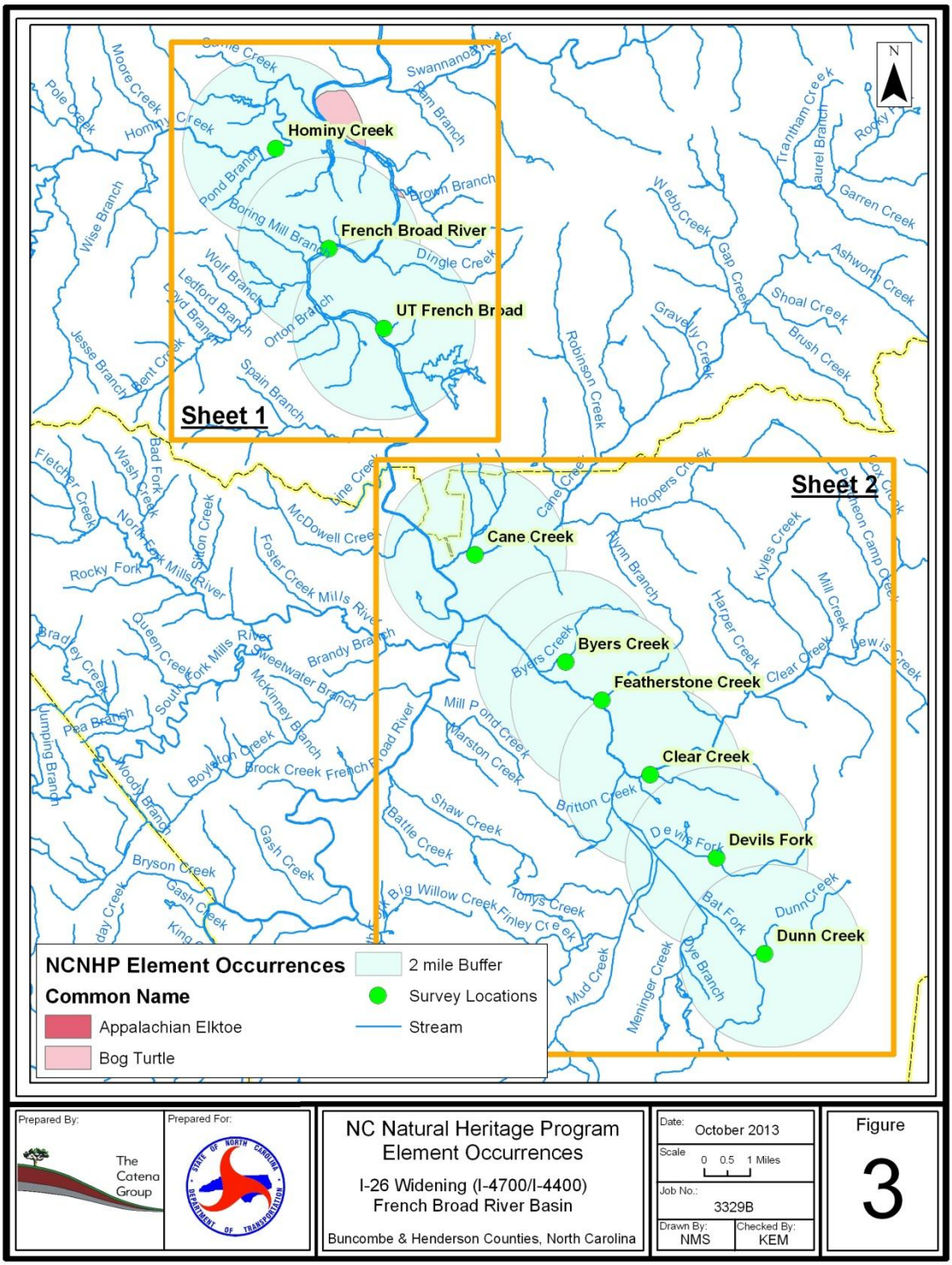
Zale, A.V. and R.J. Neves. 1982. Reproductive biology of four freshwater mussel species (Mollusca: Unionidae) in Virginia. Freshwater Invertebrate Biology. 1: 17-28.

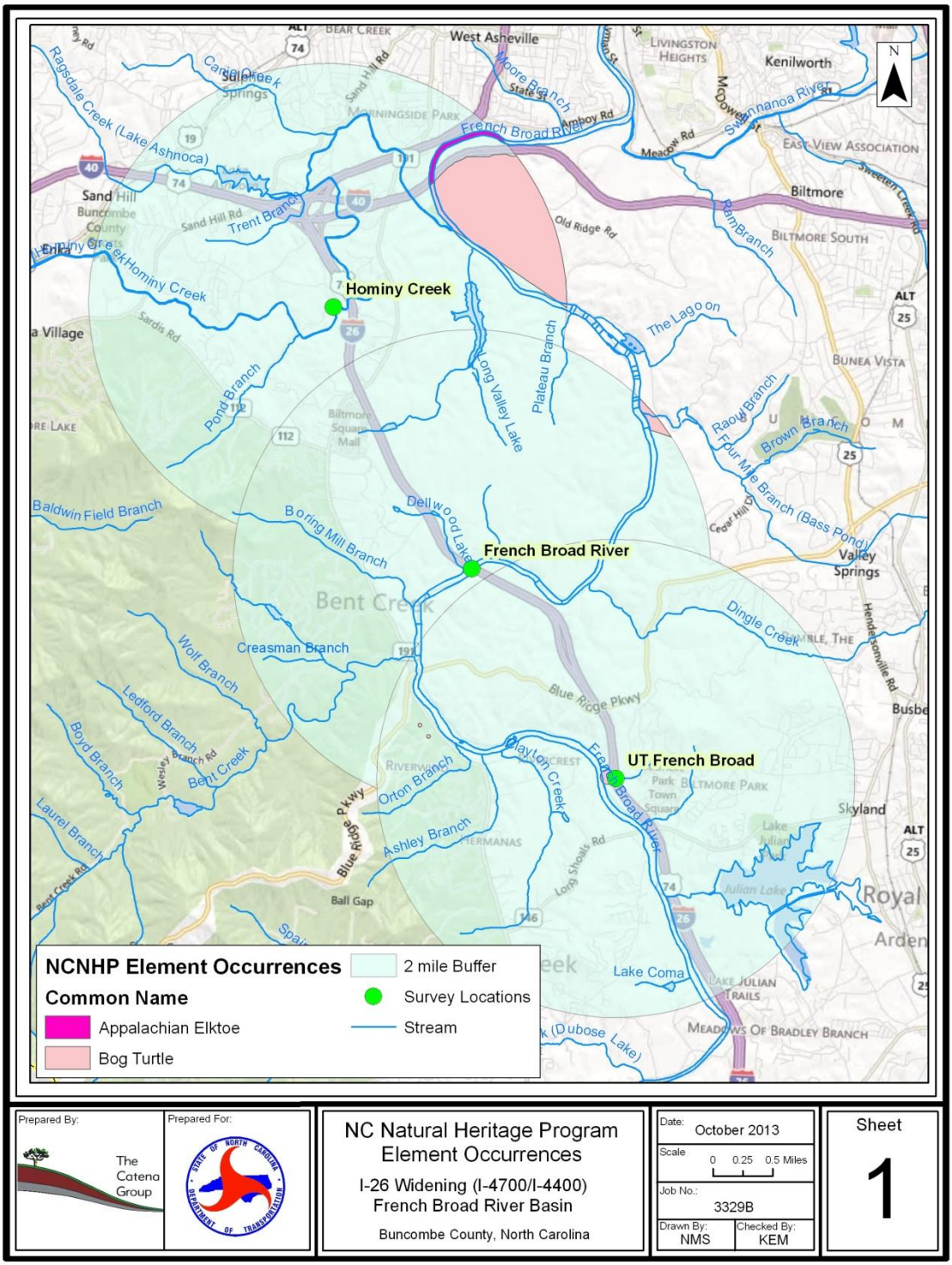

Hominy Creek
French Broad River
UT French Broad
Cane Creek
Byers Creek
Featherstone Creek
Clear Creek
Devils Fork
Dunn Creek
Biltmore Forest
Bent Creek
Royal Pines
Avery Creek
Hoopers Creek
Mills River
Fruitland
Mountain Home
HENDERSON
Balfour
Holly Springs
Laurel Park
Etowah
Hendersonville
Barker Heights
Fairview
BUNCOMBE
ASHEVILLE
Freshwater Mussel Survey Locations
I-26 Widening (I-4700/I-4400)
French Broad River Basin
Buncombe & Henderson Counties, North Carolina
Prepared By:
The Catena Group
Prepared For:
Date: October 2013
Scale 0 0.5 1 Miles
Job No.: 3329B
Drawn By: NMS
Checked By: KEM
Figure 1

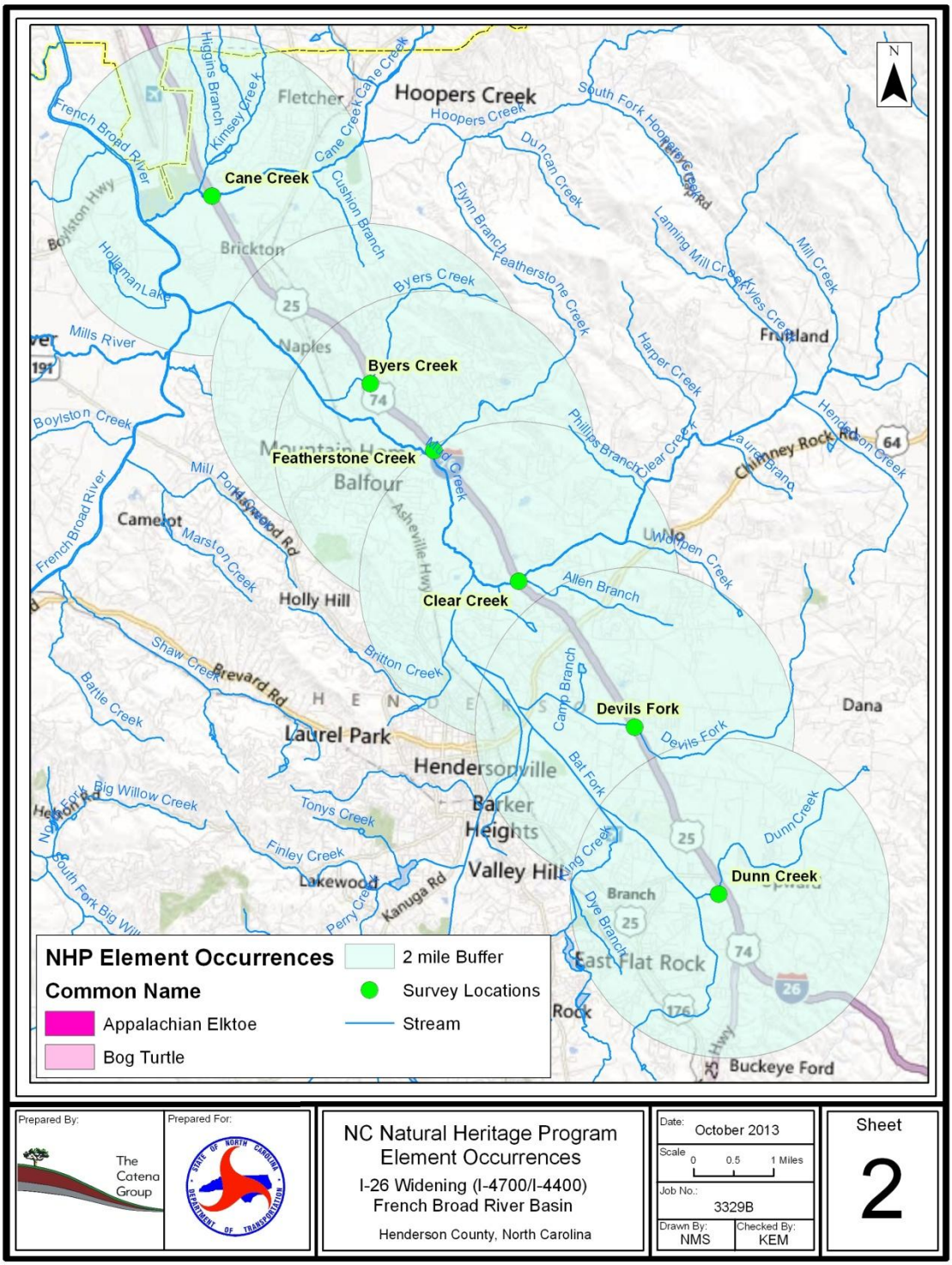

Hominy Creek
French Broad River
UT French Broad
Cane Creek
Byers Creek
Featherstone Creek
Clear Creek
Devils Fork
Dunn Creek
Sheet 1
Sheet 2
Major NPDES Dischargers
Minor NPDES Dischargers
Impaired Streams
Stream
Survey Locations
2 mile Buffer
Prepared By:
The Catena Group
Prepared For:
303(d) Streams
& NPDES Locations
I-26 Widening (I-4700/I-4400)
French Broad River Basin
Buncombe & Henderson Counties, North Carolina
Date: October 2013
Scale 0 0.5 1 Miles
Job No.: 3329B
Drawn By: NMS
Checked By: KEM
Figure
2


Hominy Creek
Wedgefield Acres MHP WWTP
French Broad River
UT French Broad
Lake Powhatan Recreation Area
Asheville Steam Electric Power Plant
Asheville Steam Electric Power Plant
Major NPDES Dischargers
Minor NPDES Dischargers
Impaired Streams
Stream
Survey Locations
2 mile Buffer
Prepared By:
The Catena Group
Prepared For:
303(d) Streams
& NPDES Locations
I-26 Widening (I-4700/I-4400)
French Broad River Basin
Buncombe County, North Carolina
Date: October 2013
Scale 0 0.25 0.5 Miles
Job No.: 3329B
Drawn By: NMS
Checked By: KEM
Sheet 1


Major NPDES Dischargers
Minor NPDES Dischargers
Impaired Streams
Stream
Survey Locations
2 mile Buffer
Cane Creek
Byers Creek
Featherstone Creek
Clear Creek
Devils Fork
Dunn Creek
Fletcher Warehousing Company
Mills River Regional WTP
Fletcher Academy WWTP
Hendersonville WTP
Mountain View Assisted Living
Henderson's Assisted Living
Brookside Village WWTP
West Henderson High School
Rugby Middle School
Benson Apartments
Magnolia Place WWTP
Pine Park Retirement Inn
Greystone Subdivision
Hendersonville WWTP
Bon Worth WWTP
Hunter's Glen WWTP
Hidden Gap Mobile Home Park WWT
Dana Hill Corporation
Hoopers Creek
Fletcher
Brickton
Laurel Park
Hendersonville
Barker Heights
Valley Hill
East Flat Rock
Flat Rock
Buckeye Ford
Dana
Camelot
Holly Hill
Camp Judae
Prepared By:
The Catena Group
Prepared For:
303(d) Streams
& NPDES Locations
I-26 Widening (I-4700/I-4400)
French Broad River Basin
Henderson County, North Carolina
Date: October 2013
Scale 0 0.5 1 Miles
Job No.: 3329B
Drawn By: NMS
Checked By: KEM
Sheet
2


Hominy Creek
French Broad River
UT French Broad
Sheet 1
Sheet 2
Cane Creek
Byers Creek
Featherstone Creek
Clear Creek
Devils Fork
Dunn Creek
NCNHP Element Occurrences
Common Name
Appalachian Elktoe
Bog Turtle
2 mile Buffer
Survey Locations
Stream
Prepared By:
The Catena Group
Prepared For:
NC Natural Heritage Program
Element Occurrences
I-26 Widening (I-4700/I-4400)
French Broad River Basin
Buncombe & Henderson Counties, North Carolina
Date: October 2013
Scale 0 0.5 1 Miles
Job No.: 3329B
Drawn By: NMS
Checked By: KEM
Figure
3


Hominy Creek
French Broad River
UT French Broad
NCNHP Element Occurrences
Common Name
Appalachian Elktoe
Bog Turtle
2 mile Buffer
Survey Locations
Stream
Prepared By:
The Catena Group
Prepared For:
NC Natural Heritage Program
Element Occurrences
I-26 Widening (I-4700/I-4400)
French Broad River Basin
Buncombe County, North Carolina
Date: October 2013
Scale 0 0.25 0.5 Miles
Job No.: 3329B
Drawn By: NMS
Checked By: KEM
Sheet 1


Cane Creek
Byers Creek
Featherstone Creek
Clear Creek
Devils Fork
Dunn Creek
Hoopers Creek
Fletcher
Brickton
Naples
Balfour
Camelot
Holly Hill
Laurel Park
Hendersonville
Barker Heights
Valley Hill
Lakewood
Fruitland
Dana
East Flat Rock
Buckeye Ford
French Broad River
Mills River
Boylston Creek
Mud Creek
Allen Branch
Britton Creek
Shaw Creek
Big Willow Creek
Tonys Creek
Finley Creek
Perry Creek
Bat Fork
Dunn Creek
Dye Branch
Flynn Branch
Duncan Creek
Harper Creek
Phillips Branch
Clear Creek
Marston Creek
Battle Creek
Camp Branch
Cane Creek
Cushion Branch
Higgins Branch
Kimsey Creek
Byers Creek
Mill Creek
Lanning Mill Creek
Kyles Creek
Henderson Creek
Laurel Branch
Uwharrie Creek
Dunn Creek
Kanuga Rd
Brevard Rd
Chimney Rock Rd
Asheville Hwy
Boylston Hwy
Hollman Lake
Mill Pond Rd
Hogwood Rd
NHP Element Occurrences
Common Name
Appalachian Elktoe
Bog Turtle
2 mile Buffer
Survey Locations
Stream
N
Prepared By:
The Catena Group
Prepared For:
NC Natural Heritage Program
Element Occurrences
I-26 Widening (I-4700/I-4400)
French Broad River Basin
Henderson County, North Carolina
Date: October 2013
Scale 0 0.5 1 Miles
Job No.: 3329B
Drawn By: NMS
Checked By: KEM
Sheet
2