BIOLOGICAL ASSESSMENT

AN ASSESSMENT OF POTENTIAL EFFECTS TO FEDERALLY LISTED SPECIES

For

I-26 Connector
I-40 to US 19/23/70 North of Asheville
Buncombe County, Asheville, North Carolina

Federal Aid Project No. MA-NHF-26-1(53)
WBS No. 34165.1.1
S.T.I.P. No. I-2513

Federal Highway Administration
and
North Carolina Department of Transportation

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Prepared for:

Federal Highway Administration
and
North Carolina Department of Transportation

Prepared By:

CALYX Engineers and Consultants, Inc., an NV5 Company,
and Three Oaks Engineering, Inc.

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Glossary of Endangered Species Act Definitions:

Action Area - all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR §402.02). The Action Area is typically larger than the footprint of the project and its direct impacts.

Cumulative effects - for purposes of consultation under the Endangered Species Act, the effects of future state or private activities not involving federal activities that are reasonably certain to occur within the Action Area of an action subject to consultation.

Direct effects - effects that are caused by or will result from, and occur contemporaneous with, the proposed action (USFWS 1998a).

Discountable - are those effects that are extremely unlikely to occur. Based on best judgment, a person would not: (1) be able to meaningfully measure, detect, or evaluate insignificant effects; or (2) expect discountable effects to occur (USFWS 1998a).

Indirect effects - those effects that are caused by or will result from the proposed action and are later in time, but are still reasonably certain to occur (50 CFR §402.02).

Informal consultation - an optional process that includes all discussions and correspondence between the Services and a Federal agency or designated non-Federal representative, prior to formal consultation, to determine whether a proposed Federal action may affect listed species or critical habitat. This process allows the Federal agency to utilize the Services' expertise to evaluate the agency's assessment of potential effects or to suggest possible modifications to the proposed action which could avoid potentially adverse effects. If a proposed Federal action may affect a listed species or designated critical habitat, formal consultation is required (except when the Services concur, in writing, that a proposed action "is not likely to adversely affect" listed species or designated critical habitat) (50 CFR §402.02, 50 CFR §402.13).

Insignificant - responses that are incapable of being detected, measured, or evaluated. This analysis relates to the amount or extent of the impact. If the impact will likely be negative, but the consequences are so minute that a person could not measure or detect such responses, then it is appropriate to conclude insignificant effects. (USFWS 1998a).

Interdependent action - actions having no independent utility apart from the proposed action (50 CFR §402.02).

Interrelated action - actions that are part of a larger action and depend on the larger action for their justification (50 CFR §402.02).

Glossary of Freshwater Mussel and Bat Definitions:

Anterior - front or forward

Calcar - spur of cartilage arising from inner side of ankle/heel and running along part of the outer edge of the membrane that stretches between the hind leg bones and the tail bones in bats

Cardinal teeth - teeth located between the lateral teeth in Corbiculidae and Sphaeriidae mussel families

Dorsal - the top or back; in mussels, the hinge area

Gill - a thin plate-like paired structure within the mantel cavity, which serves as a respiratory organ in aquatic mollusks. In female unionids, all or a portion may serve as the marsupium

Glochidia - the bivalve larva of unionids that are generally parasitic on the gills of fish

Gravid - a female mussel that has embryos in the marsupium

Hibernaculum - cave, mine, or other structure where bats spend the winter. Plural form = hibernacula

Hinge ligament - an elastic, elongate, corneous structure that unites the two valves of a mussel dorsally along the hinge plate

Keel - protrusion sometimes present on calcar that projects toward the body of the bat

Marsupium - in unionids, a brood pouch for eggs and developing glochidia, formed by a restricted portion of the outer gill, the complete outer gill, or all four gills

Mantle - soft tissue enclosing the body of a mussel, the principal function of which is to secrete the shell. In some species of the Subfamily Lampsilinae, the posterior portion of the female mantle serves to attract host fish by mimicking the shape and movement of fish or crayfish

Nacre - the interior iridescent, thin layer of a mussel shell

Naiad - formerly a tribe of Mollusca nearly equivalent taxonomically to the family Unionidae, often used as a synonym of unionid

Periostracum - exterior or outside layer of the shell

Posterior - hind or rear

Pseudocardinal teeth - triangular-shaped hinge teeth near the anterior-dorsal margin of the shell

Salvage area - the construction footprint plus an up- and down-stream buffer from which freshwater mussels will be removed prior to construction

Tachytitic - mussels which are short-term breeders (e.g., glochidia are found in the gills of the female only during the summer)

Torpor - a state of lowered physiological activity typically characterized by reduced metabolism, heart rate, respiration, and body temperature that occurs in varying degrees especially in hibernating and estivating animals

Unionid – member of the freshwater mussel family “Unionidae"

Valve - the right or left half of a mussel (or unionid) shell

Ventral - the underside or bottom

Volant - capable of flight

1.0 INTRODUCTION

The North Carolina Department of Transportation (NCDOT), in cooperation with the Federal Highway Administration (FHWA), proposes improvements to upgrade the I-240 corridor in west Asheville, Buncombe County, NC for approximately seven miles (mi.) from south of the I-26/I-40/I-240 interchange through the I-240 interchange with US 19-23-74A/Patton Avenue west of the French Broad River so that I-240 can be re-designated as I-26. NCDOT proposes to upgrade the corridor to accommodate the amount and types of future traffic. NCDOT also proposes to upgrade the I-240 interchange with US 19-23-74A/Patton Avenue to provide an interstate highway to interstate highway interchange for I-240 and future I-26 (Figure 1). The project is included in the 2018–2028 *State Transportation Improvement Program* (STIP) as project number I-2513 (NCDOT 2018). The project design and construction services will be awarded as one contract (design-build).

The purpose of this Biological Assessment (BA) is the evaluation of potential effect of the project on federally listed and proposed species and designated critical habitat in accordance with Section 7 of the Endangered Species Act of 1973 (ESA) (16 United States Code [USC] 1536 (c)). Section 7(a)(2) of the ESA (16 USC 1531-1544 and Section 1536) requires that each Federal agency shall, in consultation with the United States Fish and Wildlife Service (USFWS), ensure that any action authorized, funded, or carried out by such agency, is not likely to jeopardize the continued existence of an endangered or threatened species, or result in the destruction or adverse modification of critical habitat. Since the proposed project includes funding by FHWA, and approval by the United States Army Corps of Engineers (USACE) pursuant to the Clean Water Act (CWA), the project is subject to consultation under Section 7 of the ESA.

This BA is provided to satisfy the action agencies' (FHWA and USACE) obligations under Section 7 of the ESA (See Glossary on Page viii of this report). FHWA is the lead federal agency for actions under the National Environmental Policy Act (NEPA) and the ESA.

FHWA and NCDOT are evaluating the project under NEPA, as amended (42 USC 4321, et seq.). This BA is primarily based upon information developed for the project, including the Acoustic Survey Report (Appendix B), Structure Survey Report (Appendix C), Freshwater Mussel Survey Report (Appendix D), Indirect Screening Report (URS 2015), Draft Environmental Impact Statement (DEIS) (NCDOT 2015), and other analyses detailed in this report (Appendices E-H). Note that the definitions for Indirect Effects and Cumulative Effects differ between NEPA and ESA.

The federally endangered gray bat (*Myotis grisescens;* MYGR) and Appalachian elktoe (*Alasmidonta raveneliana*), the federally threatened Northern long-eared bat (*Myotis septentrionalis;* MYSE), and the federally threatened (due to similarity of appearance) bog turtle (*Glyptemys muhlenbergii*) are listed by the USFWS for Buncombe County and are currently known or assumed to occur in areas that may be impacted by this project

1.1 Statutory Authority of Action

The proposed project is included in the NCDOT's STIP as project I-2513. NCDOT is proposing this project with funding from federal sources through FHWA. NCDOT derives their statutory authority via North Carolina General Statutes (NCGS) 143B-345 and 346 and FHWA derives their statutory authority via 49 USC 104. NCDOT has initiated informal consultation with the USFWS in accordance with the 2002 designation Title 50 Code of Federal Regulations (CFR), Section 402.08 (50 CFR § 402.08), entitled, Designation of Non-Federal Representative, which allows

Federal agencies to delegate informal consultation and preparation of biological studies to a non-Federal representative.

In accordance with the requirements of Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act of 1899, the USACE will review and authorize, as appropriate, the proposed impacts to Waters of the United States (e.g., streams, rivers, most wetlands, lakes, etc.) for this project.

1.2 Federally Listed Species

The USFWS maintains a list of federally protected species for each county in North Carolina, which was most recently accessed on August 2, 2019. The species list for Buncombe County, where the Action Area is located was last updated on June 27, 2018 (USFWS 2018) and includes 15 species. These species are listed in Table 1. The species list is based on the county boundaries and is larger than the Action Area. There is no designated critical habitat within the Action Area for the species listed in Table 1.

Table 1. Federally Protected Species in Buncombe County

Common Name	Scientific name	Federal Status	Listing Status	Species Present in Action Area
Appalachian elktoe	*Alasmidonta raveneliana*	E	Current	Yes^
Blue Ridge goldenrod	*Solidago spithamaea*	T	Current	No
Bog turtle	*Glyptemys muhlenbergii*	T(S/A)	Current	N/A
Bunched arrowhead	*Sagittaria fasciculata*	E	Historic	N/A
Carolina northern flying squirrel	*Glaucomys sabrinus coloratus*	E	Current	No
Gray bat	*Myotis grisescens*	E	Current	Yes
Mountain sweet pitcher plant	*Sarracenia rubra ssp. jonesii*	E	Current	No
Northern long-eared bat	*Myotis septentrionalis*	T	Current	Yes^
Rock gnome lichen	*Gymnoderma lineare*	E	Current	No
Rusty-patched bumble bee*	*Bombus affinis*	E	Historic	N/A
Spotfin chub (=turquoise shiner)	*Erimonax monachus*	T	Historic	N/A
Spreading avens	*Geum radiatum*	E	Current	No
Spruce-fir moss spider	*Microhexura montivaga*	E	Current	No
Tan riffleshell	*Epioblasma florentina walkeri* (=*E. walkeri*)	E	Historic and Obscure	N/A
Virginia spiraea	*Spiraea virginiana*	T	Historic	N/A

E = Endangered, T = Threatened, T(S/A) = Threatened due to similarity of appearance

^ = Due to nearby NCNHP records and appropriate habitat, this species is assumed to be present within the Action Area.
* = USFWS does not and will not require surveys for rusty-patched bumble bee in North Carolina because USFWS assumes the state is unoccupied by rusty-patched bumble bee

Current - the species has been observed in the county within the last 50 years
Historic - the species was last observed in the county more than 50 years ago
Obscure - the date and/or location of observation is uncertain

The official species list for this project was based on federally listed species in all of Buncombe County. The Action Area for the project is a smaller area than the counties' limits. Most species do not occur within the Action Area, and do not require consultation under Section 7 of the ESA. These species are addressed briefly in Section 9 with a "No Effect" or "Not Required" determination. The Appalachian elktoe and Northern long-eared bat (MYSE) are assumed to be present, and MYGR is known to occur within some portion of the Action Area (Table 1) and the potential project-related effects to these species are considered as the focus of this BA. One record of bog turtle is known from the Action Area, but no ESA Section 7 consultation is required for this species due to its federal status. Potential project effects to this species are discussed in Section 8.

1.3 Summary of Consultation History

The I-26 Connector was first funded in 1989 by the Trust Fund Act and added to the NCDOT STIP as project number I-2513. Informal consultation for the I-26 widening project began in 1993. At that time, the Asheville Connector project was included in a suite of projects termed the "Asheville Area Pilot Project". In 1995, NCDOT published the Phase I Environmental Analysis–Asheville Urban Area (Phase I Study) for the I-26 Connector (NCDOT 1995) and included a preferred corridor for the I-26 Asheville Connector. NCDOT continued to develop alternatives for the I-26/I-40/I-240 interchange and refined preliminary engineering designs for widening I-240 and the alternatives connecting I-240 to US 19-23-70. Agency coordination and public involvement activities continued and environmental studies regarding the effects of the alternatives were conducted, culminating in the preparation of a Draft Environmental Impact Statement (DEIS) in March 2008. However, after the addition of a new alternative and elimination of another alternative to Section B, and refinement of many of the technical studies supporting the DEIS, FHWA and NCDOT determined that it was necessary to completely rescind the 2008 DEIS and prepare a new DEIS to incorporate all the most current information available into a single document. Due to a new project funding priority rating system implemented by NCDOT in 2010, the DEIS was put on hold. Project development studies for the I-26 Connector were re-initiated in spring 2012. AECOM, Inc. (AECOM) was tasked with preparation of the DEIS and subsequent Final Environmental Impact Statement (FEIS). Designs were further modified, and new DEIS was signed in October 2015. The Merger Team met on May 18, 2016, to choose a preferred alternative. Section C – Alternative F-1, Section A – Widening Alternative, and Section B – Alternative 4-B, were chosen as the least environmentally damaging practicable alternative (LEDPA) (the Merger Team is a group of federal and state environmental agency partners). Documentation of the comprehensive project history is available here: https://xfer.services.ncdot.gov/PDEA/Web/I26/150827%20I-2513%20Project%20History.pdf. The FEIS is anticipated in summer 2019.

Informal consultation for MYGR for this project began in August 2016, after the North Carolina Wildlife Resources Commission (NCWRC) discovered MYGR roosting in a bridge near the project in Buncombe County. CALYX Engineers and Consultants, Inc., and NV5 Company (CALYX/NV5) was contracted by NCDOT in December 2016 to conduct surveys for MYGR and to complete the BA for MYGR. Through acoustic surveys, MYGR was confirmed to be present in several locations along the proposed project corridor. Three Oaks Engineering, Inc. (Three Oaks) was contracted by NCDOT in May 2017 to complete aquatic mussel surveys for the project. Appalachian elktoe was discovered in the main stem of the French Broad River, approximately 1.5 mi. upstream from the I-40 bridge over the French Broad River, in September 2017. Three Oaks was subsequently hired to complete the portion of this BA pertinent to Appalachian elktoe. A list of preparers can be found in Appendix J.

The following information provides a detailed consultation history for the subject project.

- June 8, 1993: USFWS submitted written comments to NCDOT for the Asheville Urban Area Pilot Project, which included the Asheville Connector project.
- May 17, 1994: USFWS submitted written comments to NCDOT for the Asheville Urban Area Pilot Project, which included the Asheville Connector project.
- In 1995, NCDOT published the final Phase I Environmental Analysis – Asheville Urban Area (NCDOT 1995). This publication contained a preferred corridor for the I-26 Asheville Connector. The USACE and the US Department of the Interior both approved the recommendations.

- January 16, 1996: NCDOT letter to USFWS requesting information regarding potential environmental impacts that could result from the project.
- January 24, 1996: USFWS letter to NCDOT in response to January 16, 1996. The letter stated that while there are no known occurrences of federally protected species within the general corridor area, thorough surveys have not been conducted, and the presence or absence of these species in the project area should be addressed in any environmental document prepared for this project.
- 2002-2008: NCDOT developed alternatives for the I-26/I-40/I-240 interchange and refined the preliminary engineering designs for widening I-240 and the alternatives connecting I-240 to US 19-23-70. Agency coordination continued.
- March 2008: a draft environmental impact statement (DEIS) was completed for the I-26 Connector. Due to the addition of an alternative and the elimination of another, as well as the refinement of many technical studies supporting the DEIS, FHWA and NCDOT determined that it was necessary to completely rescind the 2008 DEIS and prepare a new DEIS to incorporate all the most current information available into a single document.
- In 2015, the DEIS presented the biological conclusion of "may affect-not likely to adversely affect" for the Appalachian elktoe, and "unresolved": for MYGR (NCDOT 2015).
- December 7, 2015: USDOI provided written comments on the DEIS to FHWA. USDOI recommended that NCDOT and FHWA continue coordination with the USFWS in the Merger Process.
- July 19, 2016: MYGR discovered by NCWRC and USFWS in bridge roost approximately 2.5 mi. south of Action Area.
- May 2017: Three Oaks Engineering, Inc. (Three Oaks) was contracted by NCDOT to complete mussel surveys for the project. Although no Appalachian elktoe were found within the study area, they were found in the French Broad River 1.5 river mi. upstream from the study area in September of 2017 (see Mussel Survey Report in Appendix D).
- June 29, 2017: Meeting with USFWS, NCWRC, NCDOT, AECOM provided overall project status update and begin discussions about appropriate surveys for MYGR. The group decided that structure checks and acoustic surveys would be appropriate. NCDOT intends to fund a MYGR research project to improve knowledge of species ecology in NC. The possibility of a programmatic consultation for all NCDOT projects within the French Broad Watershed was also discussed.
- August 24, 2017 CALYX/NV5 discovers bat roost in culvert within the study area. MYGR believed to be present.
- September 7, 2017: NCWRC and USFWS confirm MYGR are using culvert roost discovered by CALYX/NV5 on August 24, 2017.
- October 3, 2017: Call with NCDOT, NCWRC, USFWS to discuss monitoring of MYGR activity at culvert roost.
- October 25, 2017: Meeting with USFWS, NCWRC, CALYX/NV5, NCDOT, AECOM to review surveys to date, plans for upcoming surveys (acoustic, structure, and culvert roost), and coordinate MYGR culvert safety inspection with NCDOT Division 13.
- July 17, 2018: CALYX/NV5, ISU, NCWRC provided update to USFWS and NCDOT on status of MYGR surveys in western North Carolina. Updates on acoustic, mist-netting, structure checks, and telemetry were provided
- July 18, 2018 - Section 404/NEPA Merger Process – CP4A Meeting. NCDOT assumed Appalachian elktoe are present and will comply with Section 7 of the ESA of 1973. Commitment to revisit CP4A after completion of the BA and study the hydraulic impacts of construction associated with major hydraulic structures. (Merger meetings consist of a group of federal and state environmental agency partners.) Merger packet included in Appendix G.

- July 25, 2018 - Biological Assessment and Bridge Construction Meeting with USFWS, FHWA, USACE, NCDOT, CALYX/NV5, and Three Oaks. Reviewed potential project commitments that NCDOT.
- September 17, 2018: CALYX/NV5 provided Structure Survey Report to USFWS on behalf of NCDOT.
- October 10, 2018: NCDOT and USFWS discussed conservation measures related to sediment and erosion control measures and the need to go "above and beyond" the typical requirements.
- November 14, 2018 - Bridge Construction and Biological Assessment Meeting with USFWS, FHWA, NCDOT, CALYX/NV5, and Three Oaks. Reviewed the project commitments for the Biological Assessment and discussed bridge construction and lighting on the project
- November 30, 2018: On behalf of NCDOT, CALYX/NV5 coordinated with USFWS to solidify a plan for acoustic surveys and data analysis for the upcoming season.
- February 20, 2018: Call with AECOM, CALYX/NV5, NCDOT, USFWS to discuss plan for acoustic surveys during 2018.
- March 7/8, 2018: Series of emails exchanged between USFWS, CALYX/NV5, and NCDOT finalizing the details of acoustic surveys for 2018.
- March 8, 2018: Call between NCDOT and USFWS to discuss acoustic surveys. Decision was made to collect acoustic data at all monitoring locations through the fall, whenever the bat activity ceases for the year. However, in the interest of the project schedule, and time needed to prepare the acoustic survey report and biological assessment, data analysis will cover the time frame from the beginning of the season through the last week in July.
- April 12, 2019: NCDOT, USFWS, CALYX/NV5 phone call to discuss plans for permanent lighting at bridge crossings.
- April 26, 2019: NCDOT and USFWS met in Asheville to discuss project commitments, and lighting commitments in particular.
- April 30, 2019: NCDOT, USFWS, CALYX/NV5 phone call to discuss plans for permanent lighting at multiple crossings.
- May 6, 2019: NCDOT provided a draft BA to USFWS for review
- May 20, 2019: NCDOT received Draft BA comments from USFWS.
- May 22, 2019: NCDOT provided the I-2513 lighting summary to USFWS
- May 23, 2019: NCDOT and USFWS discussed BA comments
- June 24, 2019: NCDOT received email from USFWS regarding lighting
- July 1, 2019: NCDOT responded to USFWS lighting email and comments regarding NLEB language
- August 7, 2019: USFWS responded via email regarding NLEB
- August 22, 2019: NCDOT provided a revised Draft BA to USFWS

2.0 PROJECT DESCRIPTION AND ACTION AREA

2.1 General Information

The proposed project lies in the Southern Blue Ridge Mountain physiographic region of North Carolina, in Buncombe County. Topography in the project vicinity ranges from very steep, rolling intermountain hills and narrow valleys to wide valleys and stream floodplains associated with the French Broad River. Elevations range from a low of 1,980 ft. above sea level near the confluence of Hominy Creek and the French Broad River to a high of 2,150 ft. along I-240 in the central portion of the project (NCDOT 2015).

The I-26 Connector Project will provide a needed link in the I-26 corridor by improving and constructing a multi-lane freeway, part of which is on new location, from I-26 southwest of Asheville to US 19-23-70 (Future I-26) in northwest Asheville (Figure 2 in Appendix A). The project spans approximately seven mi.; about two-thirds of the project is related to improvements to I-240 on the west side of Asheville. The project improvements are defined in three separate sections (A-C) (Figure 3 in Appendix A) that must be combined to comprise the entire project:

Section A includes a best-fit alignment for the widening and reconstruction of existing I-240 from a four-lane freeway to a six-lane freeway, includes reconstruction of the I-26/I-240 and NC 191 (Brevard Road) and SR 3556 (Amboy Road) interchanges, and upgrades the existing I-26/I-240 and US 19-23 Business (Haywood Road) interchange to a tight urban diamond interchange configuration.

Section B separates the local and I-240 traffic across the Captain Jeff Bowen Bridges (I-26/US 19/US 23, Patton Avenue) over the French Broad River and creates three new crossings over the river: two bridges carrying I-240 traffic, and a third carrying I-26. The design routes I-26 to the east and crosses the French Broad River approximately one-half mi. north of the Captain Jeff Bowen Bridges. An interchange at Patton Avenue would also be included. This section of the project also includes improvements to Riverside Drive, formerly STIP project U-5868, recently added to I-2513 (the improvements fall within the I-2513 DEIS study area).

Section C maintains the existing I-26/I-40/I-240 interchange configuration and adds a loop and a ramp to provide all ramp movements. It also includes the reconstruction of the I-40/US 19-23-74A (Smoky Park Highway) interchange. Riverside Drive will be widened from Hill Street to Broadway and includes a 10-foot multi-use path to the west of the roadway, between the railroad and Riverside Drive.

The I-2513 project requires a minimum of four and a maximum of eight basic freeway lanes on I-26 to meet the capacity requirements presented in the purpose and need for the project. I-26 sections have been designed with 12-foot travel lanes and 12-foot paved shoulders. South of the I-40 interchange, I-26 will be an eight-lane section with a varying median width divided by barriers and a retaining wall. In this area of the project, I-26 is transitioning to tie to the I-4400/I-4700 project (I-26 Widening). This project is in the preliminary design phase, so detailed drawings are not currently available.

Throughout the I-40 interchange, I-26 will use a basic four-lane section with a bifurcated median. This portion of the project uses standard cut and fill slopes to tie construction to existing ground. North of the I-40 interchange, I-26 will transition to a six-lane freeway section separated by a 35-foot median and a 41-foot concrete barrier. This portion of the project will also use standard cut and fill slopes to tie construction to existing ground. For I-26 north of the I-40 interchange to SR 1781 (Broadway), the median will narrow to 26 ft. over the French Broad River bridges, where it transitions to an eight-lane typical section from US 19-23-70 to SR 1781.

This project's construction schedule will likely overlap with that of the I-4400/4700 project (I-26 widening) to the south. Construction is expected to begin in 2022 and continue for approximately five years. The exact construction sequence will be determined during final design; however, it is anticipated that the new location construction will begin prior to the replacement of existing roadway. Construction activities associated with the proposed project may include, but are not limited to, clearing, grubbing, grading, installation of base material, installation of pavement, striping, signs, and lighting. Extensions of existing culverts, replacement of some existing bridges and culverts, and installation of new bridges and culverts will also be necessary. Earth-moving and road-building equipment of various kinds and sizes will be utilized to complete the project construction. The DEIS (NCDOT 2015) noted that the new location work in Section B will require substantial earthwork to provide level roadbed.

Multiple bridges will be built or replaced for the project, including three new bridges over the French Broad River. See Table 2 for list of bridges/crossing structures. Temporary causeways in waterways have been identified as the most likely mechanism to be used to access areas for bridge construction. Generally, construction locations will be reached using existing roadways where possible; temporary access roads may be constructed to get to locations where access is physically restricted. The creeks and rivers listed in this document are all used for recreation and cannot be closed for the duration of construction. Closures and portage options will be detailed in a separate document, a river user plan. Coordination with the City of Asheville regarding portage options will be conducted once designs are finalized.

Additional information can be found on the project website:
https://www.ncdot.gov/projects/asheville-i-26-connector/Pages/default.aspx.

The contract will be awarded as a Design-Build project. The Design-Build method accelerates project delivery, or shortens the project duration, in several ways. The contractor has flexibility in selecting the design, materials and construction methods based on the available equipment, work force and resources. The contractor also works closely with the designer, sharing his or her expertise, to reduce the risk of design errors and the need for redesigns, which can add to project costs and project delays. Allowing the contractor to tailor the project design and apply appropriate innovations provides flexibility for the contractor to manage and compensate for cost increases in one area through efficiencies in another. This does not include changes to environmental commitments, but control of the means and methods. Project commitments (conservation measures) that pertain to the species discussed in this document are listed in Section 7.0 (Conservation Measures). The NCDOT Design-Build Team will continue to follow the Merger Process, which includes USFWS and other stakeholders in ensure that environmental commitments are addressed through the design and construction process.

2.1.1 Hill Street Culvert Roost Area

A culvert system located within Section B, in the vicinity of the flyover bridges carrying I-26 and I-240 over the French Broad River that conveys hydraulic flow under Hill Street, has been identified as a roost for MYGR. Special precautions will be taken in this area to reduce disruption to the bats, particularly during the spring, summer, and fall months. NCDOT will monitor bat activity at the culvert before, during, and after construction. Acoustic monitoring and/or emergence surveys, as appropriate will be conducted between March and November.

The culvert system conveys an unnamed tributary (UT) to the French Broad River and drains approximately 0.25 mi^2. The UT flows approximately 175 ft. from the culvert outlet to the river. NCDOT will maintain water sources that provide baseflow to the culvert (non-stormwater sources) to provide a naturally occurring, continual water source.

The culvert system generally consists of a mixture of reinforced concrete box culvert (RCBC), corrugated metal arched pipe (CMAP), and corrugated metal pipe (CMP). The longest pipe run extends for approximately 3,700 ft. (0.7 mi) under a nearby interchange. In total, there is an estimated 14,700 linear ft. of pipe associated with this system under I-26, I-240, the I-26/I-240 interchange, Hill Street, Riverside Drive, Norfolk Southern Railroad, Atkinson Street, and other smaller roads. In some locations, the culverts are buried under 60-70 ft. of fill material. The system will be partially replaced or rehabilitated to ensure structural integrity and longevity. Construction activities associated with the culvert system may last 3 to 4 years and may occur during the day or night.

Two 63-in. CMAP are in place to convey stormwater and the UT to the French Broad River under the Norfolk Southern Railroad tracks and Riverside Drive, where they meet the main trunk line, an 8 ft. x 8 ft. RCBC. Moving upstream, the RCBC extends approximately 1,100 ft. until it meets an 84-in. corrugated metal pipe. Most of the pipes upstream from the junction of the RCBC and the 84" CMP junction are metal. The RCBC portion of the culvert system, as well as the dual CMAP at the culvert outlet will remain in place. No work on these portions of the culvert system will occur until bat activity ceases for the season (and bats are presumably no longer using the culvert for roosting). This time frame is approximately between November 15 and March 15. NCDOT will monitor the culvert with an acoustic detector and/or emergence counts to determine when bat activity ceases for the season. Then, a federally permitted bat biologist will enter the culvert to confirm no bats are present.

Work along Riverside Drive will involve widening the roadway, including nearby ramps and intersections for I-240 eastbound and westbound, and US 23 southbound, across the existing culvert system in the vicinity of the roost. Modifications to the main trunk line (8'x8' RCBC) are not anticipated in conjunction with the widening of Riverside Drive. However, the existing culvert branches must be removed and modified to accommodate the new roadway alignments. It is likely that the entire culvert system upstream from the junction of the RCBC and the 84-in. CMP will be replaced with concrete pipe or RCBC which will provide more potential bat roosting habitat. Attempts will be made to tie the modified culvert branches back into the RCBC. If connections cannot tie back to the main RCBC, then separate, shallow, systems will be put in place to handle drainage.

A 60" CMP is located adjacent to Courtland Avenue and the entrance to Isaac Dickson Elementary School that conveys stream flow under Hill Street to the RCBC. This section of the culvert system will either be replaced, or a liner will be inserted into the existing culvert to rehabilitate the section of culvert. During this process, a liner (can be steel, plastic, or a few other types) which is basically a smaller diameter pipe is pushed through an existing pipe. The end of the pipe in the space between the new pipe liner and the existing pipe is sealed. Then the void between the outside of the new liner and the inside of the existing pipe is filled with flowable fill or grout (concrete with no large aggregate). This process will take a few weeks. NCDOT will conduct this activity between October 15 and April 1, when most bats are hibernating elsewhere. Construction activities associated with areas other than the CMAP outlets, RCBC, and 60" CMP may occur at any time of year. NCDOT will install a barrier/baffle in the RCBC between the intersection with the 60" CMP (located adjacent to Courtland Ave. and the entrance to Isaac Dickson Elementary School that conveys flow under Hill Street) and the upstream end of the RCBC to buffer noise and light associated with the CMP replacements further upstream.

For the first step of the CMAP and RCBC work, areas identified as needing repair will be steam cleaned. After cleaning, the areas will be repaired using an epoxy or polyuria-based patch. It is not anticipated that large areas will need repair. Steam cleaning and repair will occur between when bats are hibernating elsewhere and may take up to one month to complete.

In order to clean and apply patching to the CMAP and RCBC, equipment must access the culvert outlets. Likewise, equipment must access the inlet of the 60" CMP to replace that segment or insert the liner. Operational work pad areas will be established near the culvert inlet and outlets to complete the work. These areas may be cleared of vegetation for up to approximately 50 ft. downstream, and to top of banks. Class I rip rap may be used to temporarily stabilize the stream banks, if needed. Grubbing of roots will be necessary so equipment can safely and efficiently move about the area to perform work. Grubbing of roots will also allow for better establishment of woody vegetation when replanting the area. The area cleared for the work pad will not be any larger than necessary to accomplish the construction activities. NCDOT will cut plants in the work pad area in a way that will not be detrimental to bats and their activity. For instance, vegetation will not be removed if the area will be left bare for many months prior to construction. Cutting of vegetation will be coordinated with USFWS and will not occur until all bats have left the culvert for the winter. This will be determined through acoustic monitoring and/or emergence counts and a physical check of the culvert for remaining bats. Cutting of vegetation will be limited to only what is necessary to complete the work, and no more than 50 ft. from culvert entrance.

An equipment staging area will also need to be established adjacent to the work pads near the culvert outlets and inlet areas to complete the culvert rehabilitation process. NDOT will attempt to use areas that are already cleared of vegetation whenever possible. Equipment involved in the culvert rehabilitation process may be parked at these areas to load/unload machinery and store supplies that will be used during the process. This area will only be used for culvert rehabilitation activity staging and will not be used for any other project construction purposes.

2.1.2 Smith Mill Creek Culvert Roost Area

Five MYGR were also found roosting in a triple-barrel 8 ft. x 11 ft. RCBC that carries Smith Mill Creek (Smith Mill Creek) under Patton Avenue west of the French Broad River and the I-26/I-240/Patton Avenue interchange (project Section B). The culvert has three sections. The upstream-most section that carries Smith Mill Creek under the ramps is 330 ft. ft. long, the middle section is 140 ft. ft. long, and the downstream-most section that carries Smith Mill Creek under Patton Avenue is 210 ft. long. After exiting the culvert, Smith Mill Creek flows 0.75 mi. to the French Broad River. The culvert will remain in place and will not be extended or shortened as part of this project. Repairs to this culvert are not anticipated at this time.

Equipment staging areas are not anticipated in the vicinity of the culvert inlet or outlet. After the pavement associated with the existing ramps is removed, minor regrading and revegetation will be necessary. It is not anticipated that any vegetation at the culvert inlet and outlet will be disturbed. There are currently no plans for development or designated open space for the area where the ramps will be removed, but a greenway path will likely be added to the south side of Patton Avenue in the area of the Smith Mill Creek culvert. On the outlet end, there is no proposed work directly at the outlet, but Regent Park Blvd, just west of and parallel to the culvert will be widened.

2.1.3 Bridge Replacements

Seven bridges (or bridge pairs) over waterways will be replaced as part of the project. Table 2 provides information on all the locations where bridges cross streams within the Action Area, and Figure 4 in Appendix A (including Figures 4A through 4D) shows the location of these crossings. Bridges on new location are discussed in Section 2.1.3. Bridge demolition and construction of replacement bridges may take up to five years.

Table 2. I-2513 Bridge Crossing Locations

Crossing Number	Project Section	New or Replacement	Road Carried	Water Body	Lanes	Notes
HC-1	C	Replacement	I-40 EB	Hominy Creek	4	
HC-2	C	Replacement	I-40 WB	Hominy Creek	4	
HC-3	C	Replacement	I-26 NB/I-240 NB	Hominy Creek	5	

HC-4	C	Replacement	I-26 SB/I-240 SB	Hominy Creek	4	
HC-5	C	Replacement	I-40	Hominy Creek	7	Replace dual structure with one new structure
FBR-1	C	Replacement	I-40	French Broad River	7	Replace dual structure with one new structure
HC-6	C	New	I-40 Ramp to 191	Hominy Creek	1	
HC-7	A	Replacement	I-26/I-240 NB and SB	Hominy Creek	10	Replace dual structure with one new structure
SMC-2	B	New	I-240 Ramps	Smith Mill Creek	2	Removing existing box culvert at this location
SMC-1	B	New	Resort Dr.	Smith Mill Creek	2	
SMC-3	B	New	I-26	Smith Mill Creek	8	
SMC-4	B	New	I-240 Ramps	Smith Mill Creek	1 lane & 2 lanes	Two ramps cross creek at this location
SMC-5	B	New	I-26	Smith Mill Creek	8	Creek is slightly under I-26 bridge here
SMC-6	B	New	I-240/I-26 Ramp	Smith Mill Creek	8 lanes & 2 lanes	Two bridges cross creek at this location
SMC-7	B	New	I-240 Ramp	Smith Mill Creek	1	Ramp to I-240 EB
SMC-8	B	New	I-240 Ramp	Smith Mill Creek	1	Ramp to I-240 EB
SMC-9	B	New	I-240 Ramp	Smith Mill Creek	1	Ramp to I-240 EB
EB-4	B	New	I-240 Ramp	Emma Branch	1	Exit ramp from I-240 WB to Patton Ave
EB-3	B	New	I-240/I-26 Ramps	Emma Branch	1 lane & 2 lanes	Two bridges cross creek at this location
EB-2	B	New	I-26	Emma Branch	7	I-26 Bridge
EB-1	B	New	I-240 Ramps	Emma Branch	3	I-240 EB Bridge
FBR-2	B	New	I-240 EB	French Broad River	3	I-240 EB
FBR-3	B	New	I-26 EB/WB	French Broad River	7	I-26 Bridge
FBR-4	B	New	I-240 WB	French Broad River	3	I-240 WB Bridge

2.1.3.1 French Broad River

The two existing bridges that carry I-40 over the French Broad River will be replaced by a single bridge in the same location (Figure 4B of Appendix A). A phased approach will be necessary to maintain traffic flow during construction. Span lengths and bent types will be determined during final design. It is estimated that three bents will be placed on riverbed for this bridge. Causeways are needed for construction and demolition (discussed in Section 2.1.3.5).

There is a greenway/recreational trail along each side of the French Broad River. Safety allowances will be made to allow the trail to remain open during construction, when feasible. The trail may need to be closed at times for the safety of the users. Regular updates will be made available via the City of Asheville. Refer to the communication plan (in development) for further details.

2.1.3.2 Hominy Creek

There are seven locations where the project will bridge Hominy Creek, six of which will be bridge replacements. The two existing bridges carrying I-40 across Hominy Creek (closest to the French Broad River) will be replaced by a single bridge in the same location (crossing HC-5, see Figure 4B in Appendix A). It is estimated that the bridge will have a total of five spans and one to two bents will be located at the water's edge, but none will be in the water. Causeways for demolition are anticipated, but not for construction (discussed below).

Portage may be available for creek recreational traffic on the adjacent greenway, but safety accommodations will need to be made as the greenway runs under the bridges. Further coordination with the City of Asheville will be done once designs are finalized.

Shortly upstream from I-40, the northbound (NB) and southbound (SB) bridges carrying I-240/I-26 across Hominy Creek will be replaced (crossing HC-7, Figure 4B in Appendix A). The new bridge will also cross a potentially historic bridge used for greenway traffic. The exact configuration of the new bridge bents is uncertain until further in the design process. It is anticipated that one bent may be placed in Hominy Creek with up to three bents located near the water's edge. However, as a worst-case estimate, it is assumed that four bents could be placed in Hominy Creek. The bridge bents will be separated and offset such that they do not affect the historic bridge. A causeway is expected to be used during demolition of the existing bridges. Phased construction will be used. Access to the site is available via NCDOT right-of-way. Portage for recreational creek traffic may be available, depending on construction phasing, as an existing greenway path is adjacent to the site. The proposed bridge will span this greenway and accommodations will need to be made for pedestrian traffic during construction. Although the new bridge is currently planned as a single structure spanning both the waterway and historic bridge, it may be separated into three to four smaller structures during final design to allow for strategic bent placement, potentially resulting in zero bents in the water.

As Hominy Creek meanders around, I-240/I-26 crosses it again further upstream, near the interchange with I-40. The bridges carrying I-26 NB and I-26 SB (crossings HC-3 and HC-4, respectively, Figure 4A), will both be replaced. The existing bridges do not have any bents in the water and are anticipated to be replaced in-kind. No bents are expected to be located within the water, but they could be near the water's edge. No causeways are expected to be needed for demolition or construction. These bridges will need to be constructed in phases to maintain traffic. Access to the site is available via NCDOT right-of-way.

Near the I-40/I-26 interchange, the pair of bridges carrying I-40 eastbound (EB) and westbound (WB) (crossings HC-1 and HC-2, respectively, Figure 4A) over Hominy Creek will be replaced. They currently have three bents each, none of which are in the water, and are anticipated to be replaced in kind, with no bents expected in the water. No causeways are anticipated for demolition or construction. Access to the site is available via the NCDOT right-of-way and phased construction is expected. Hominy Creek is used regularly for recreation and cannot be closed for the duration of construction. A greenway is located just to the east of Hominy Creek at the existing I-40 bridges. Using the greenway for portage may be possible for recreational creek traffic, but safety accommodations will need to be made as the greenway runs under the bridges.

For more details regarding I-2513 bridges, see Appendix E, Bridge Construction Document.

2.1.3.3 Demolition of Existing Bridges

A total of seven bridges will be demolished as part of I-2513, including a bridge pair over the French Broad River, carrying I-40 (crossing FBR-1). The remaining demolitions will all be at

Hominy Creek (crossings HC-1 through HC-5, and HC-7, Figures 4A and 4B in Appendix A). During demolition, each bent will be removed by either by tipping it over and removing the entire bent, or by cutting off the bent at riverbed elevation. Because the remnants of each cut-off bent will be at riverbed elevation, no backfill will be needed. Exposed steel will be cut off. The method of removal will be dependent on the foundation conditions present at the site. No loose portion of the existing bents will remain in the river.

Once the center bents are demolished, all remaining causeways will be removed, including causeway material left along the riverbank for temporary protection. Temporary access roads (discussed in Section 2.1.4) will also be removed.

Bridge demolition may occur during day or night. The timing (night versus day) of bridge demolition will be at the discretion of the contractor and is not required to occur at night. Nighttime bridge demolition activities typically involve the removal of the concrete bridge deck and lifting of existing beams. It is usually necessary when the contractor must sit in the existing roadway with a crane to lift off the bridge beams and load them on a truck. This requires a lane closure, which is a safety measure in areas of high daytime traffic volume. Contractors often prefer to perform bridge demolition from a causeway to avoid the added expense and safety risk involved with lane closures and night work. Demolition of individual bridges is anticipated to last a month or less per bridge, depending on the bridge size, material, and design.

2.1.3 New Construction Bridges

Multiple new bridges over waterways are necessary as part of the project. Table 2 provides information on all the locations where bridges cross streams within the Action Area, and Figure 4 (including Figures 4A through 4D) in Appendix A shows the location of these crossings. Replacement bridges were discussed in Section 2.1.2.

2.1.3.1 French Broad River

In Section B of the project, three flyover bridges carrying I-240 eastbound (EB) (FBR-2), I-26 (FBR-3) and I-240 westbound (WB) (FBR-4) over the French Broad River will be constructed on new location (Figure 4D, Appendix A) north of the existing Captain Jeff Bowen Bridges, which currently carry I-240/I-26/Patton Avenue. The new bridges will each be over one-half mi. long and will also span Smith Mill Creek and Emma Branch, which join and feed into the French Broad River nearby. The sections over the French Broad River are expected to consist of three main spans utilizing curved girders and three bents in the river each, totaling nine bents for this river segment. Due to the constricted turning radii of the bridge, long bridge spans are not feasible. The bridge decks will be approximately 66 (FBR-3), 91 (FBR-2), and 104 (FBR-4) ft. above the river. An uneven span arrangement is anticipated. The bridges will take an estimated three to four years to complete and will likely be phase-constructed. To build the three bridges, the use of access roads and causeways is anticipated.

2.1.3.2 Hominy Creek

The I-40 ramp to NC 191 (HC-6) will be constructed on new location over Hominy Creek, just north of I-40 (Figure 4B, Appendix A). No bents are expected to be in the water; the bridge is anticipated to span the creek and no causeways will be needed. Access to the site is available via NCDOT right-of-way.

2.1.3.2 Smith Mill Creek

Smith Mill Creek and its tributary, Emma Branch, will be crossed by bridges multiple times for I-2513. The new location bridges crossing Smith Mill Creek and Emma Branch will be part of the bridge network that combines the ramps and main lines to carry I-240 and its ramps across the

French Broad River (crossings SMC-1 through 9 and EB-1 through 4, see Table 2 and Figures 4C and 4D of Appendix A). The structures will extend across all three waterbodies; the Smith Mill Creek and Emma Branch structures all connect to or are part of the I-26 and I-240 French Broad River bridges (FBR-2, 3 and 4). The Smith Mill Creek bridges will likely be phase-constructed and take two to three years to build. None of the bridges will have bents in the water, and no causeways will be needed.

2.1.3.3 Investigative Drilling

In case drilled shafts will be used for bridge construction, investigative drilling for bridge footings will require roughly two 0.5 sq. ft. diameter borings for each bent to be placed in the water. Each boring will reach a depth of 25 to 30 ft. Investigative drilling will be conducted approximately ten hours/day, drilling roughly four holes per day (Jody Kuhne, NCDOT Regional Geological Engineer, personal communication). It will take approximately two months to complete the work in the French Broad River, including set-up time. The drill rig will sit on a 15 by 20 ft. (approximate) barge that is surrounded by a containment boom to minimize turbidity. If water levels do not allow the use of a barge, investigative drilling would happen immediately upon completion of bridge construction causeways, using the causeways for access.

Roughly 45-60 borings may be needed in the French Broad River, covering about 15 sq. ft. in total (Jody Kuhne, NCDOT Regional Geological Engineer, personal communication). Additional borings may be needed in Hominy Creek if bents will be placed in the water. The noise will be equivalent to or quieter than normal bridge traffic. The drilling fluid will be clear water and the output will consist of silt-sized rock dust, approximately one pound per hole, which is direct sediment output from the hole.

2.1.3.4 Construction Drilling

Geotechnical investigations have not been completed for this project; bridge footing sizes and types will not be known until those investigations have been performed. Information for spread footings is provided below in Section 6.1 (Construction Effects). Drilled shaft footings are also a potential construction method.

If drilled shafts are used for bridge footings, drilling will be conducted in different phases for different bridges, potentially separated by significant periods of time. Each drilled shaft will be roughly 40 ft. deep and approximately eight ft. in diameter (Cameron Cochran, NCDOT Division 13 Regional Bridge Construction Engineer, personal communication). The total number of bents in the French Broad River may be up to 12, with a rough estimate of 63 shafts in the river (estimate based on two drilled shafts used in place of each spread footing). Drilling may take up to 95 weeks in the French Broad River. Additional drilling may occur in Hominy Creek, where up to four bents may be placed in the water. The drilling fluid will be a mixture of bentonite (a natural, inert clay material) and river water, the majority of which is recycled. The drilled core is typically pulled out by crane. If used, the area of riverbed to be affected by drilled shafts is approximately 3,165 sq. ft. for the French Broad River and approximately 502 sq. ft. for Hominy Creek.

2.1.3.5 Causeways

Temporary causeways are the preferred option for construction equipment to access the river, to operate safely, and to minimize the amount of time during which construction effects can occur. After access road construction is complete, causeway construction will begin. The causeways at each bridge end will extend along the riverbank from one edge of the proposed superstructure to the other. These causeways will be used as work pads for construction cranes and other equipment needed during demolition and construction activities.

The causeways needed for the three new location bridges over the French Broad River (bridges FBR-2 through 4) are estimated to use up to 50% of the river width at each crossing location, requiring multiple causeways during construction. Potential additional restrictions of the channel may be necessary for short durations, and these additional restrictions will be coordinated with USACE and USFWS prior to permitting.

Four causeways could be used to build the three bridges; one large causeway against the west bank to provide access to all the bridges crossing the French Broad at this location, and three smaller causeways serving the bridge construction on the east bank. The causeways may temporarily cover 197,700 sq. ft. of riverbed in total. This is a preliminary estimate based on planning level documents, with causeway sizes determined at the surface of the causeway, not the base. Actual causeway footprints may be greater, depending on side slopes of the causeways and the final design.

The two existing bridges that cross the French Broad River carrying I-40 will be replaced by a single bridge in the same location (crossing FBR-1). It is estimated that causeways will be used to demolish the existing bridges and to build the new substructure, covering up to 36,600 sq. ft. of riverbed in total.

The two existing bridges carrying I-40 across Hominy Creek will be replaced by a single bridge in the same location (crossing HC-5). A causeway is anticipated for demolition but not for construction. The size of the causeway is expected to be 825 sq. ft.

The NB & SB bridges carrying I-26 across Hominy Creek will be replaced by a single bridge (crossing HC-7). A causeway is expected to be used during demolition of the existing bridges, covering up to 1,225 sq. ft. Causeways are not anticipated for the remaining bridges over Hominy Creek or for the Smith Mill Creek/Emma Branch crossings.

Once bridge demolition/construction is complete, all causeways will be removed from the river. Length of time in water for the construction causeways will be determined after plan/phasing development. Estimating the length of time with accuracy is not currently possible given the limited amount of information available.

2.1.4 Access Roads

Construction locations will be reached using existing roadways where possible. However, temporary access roads may be needed for transporting materials and equipment to construction worksites. Some access roads will tie to the temporary causeways located on the corresponding side of the river. Areas used for access roads will be cleared of trees and other vegetation. Since this project is in the preliminary design phase, detailed drawings are not currently available.

Temporary access roads may be required to construct the portions of the I-240 and I-26 flyover bridges at the western bank of the French Broad River (crossings FBR-2, 3, 4), as access to the construction area on new location is highly constricted. Access to the east bank of the river will utilize acquired right-of-way for staging and construction.

The bridge network crossing Smith Mill Creek and Emma Branch (crossings SMC-1 through 9 and EB-1 through 4) will need temporary access roads in conjunction with the I-26/I-240 bridge access. The same access constraints exist at Smith Mill Creek as at the western bank of the French Broad River (rail lines, height restrictions, and limited road access). Temporary piping of the creeks may be required for access; if so, this information will be provided to resource agencies once final design is complete. Any temporary piping will be removed once building demolition and bridge construction are complete.

Access to I-40 over the French Broad River (crossing FBR-1) is limited by the Biltmore property to the east. An access road will need to be constructed within the right-of-way to build the eastern bents within the river. Access roads may also need to be constructed on the west bank for construction traffic.

It is anticipated that access to other bridge construction sites can be obtained via existing or acquired right-of-way.

2.1.5 Culverts

According to the CP4A merger packet (Appendix G), up to 23 jurisdictional streams will be affected by the project. Assuming all streams within a 25-ft. buffer of the slope stake limits will be affected, approximately 4,186 linear ft. of jurisdictional waterways will be permanently affected (Appendix G Actual effects may be reduced once final design is completed. Temporary culverts may be needed at Smith Mill Creek and/or Emma Branch to allow access to the I-26 bridge construction site at the French Broad River; the amount of temporary piping will depend upon final design and will be reported to USFWS and other resource agencies as soon as it is determined.

2.1.6 Utilities

Electric service to residents is provided by Progress Energy. There are electric transmission lines within the project study area that run east-west, south of the I-26/I-40/I-240 interchange. The transmission lines cross NC 191 south of I-40 before turning north and paralleling the French Broad River on the west bank. They continue north to Haywood Road where they proceed northwest over I-240 and Crowne Plaza before exiting the study area. These transmission towers and electric distribution poles may need to be adjusted or relocated within the right-of-way due to the project.

Water service is widespread in the urbanized portions of Asheville. Project construction may require relocation of water lines owned by the City of Asheville. However, the extent of those relocations will not be known until final design. Gas lines ranging from 2-12 inches in diameter have been identified that would require adjustment or relocation.

There are two sewer lines adjacent to the French Broad River in the vicinity of the Jeff Bowen Bridges. They are part of major trunk lines for the City of Asheville and must be maintained. The lines consist of pipes of at least 60 inches in diameter, with smaller branching sections. NCDOT will leave the sewer line in the vicinity of the Jeff Bowen Bridges in place (no relocation). A cleared sewer easement is located adjacent to Hominy Creek beneath the I-26 and I-40 bridges. No relocation is expected in the vicinity of these bridges. No pump stations are anticipated to be affected by the project. Other relocations will likely be required outside of the vicinity of the bridges.

Gas lines ranging from 2 to 12 in. in diameter have been identified that would require adjustment or relocation.

AT&T/BellSouth owns phone lines and fiber optic routes within the Action Area. Construction of the project would affect four major duct banks (multiple cables within a conduit used to protect from accident breakage) and nine fiber optic routes. Fiber optic cable runs along the major roads, including Patton Avenue. Buried cable lines are present near Brevard Road (NC 191). Additional survey work is needed to evaluate the extent of possible relocations.

2.1.7 Lighting

The I-2513 project is located in urban and suburban areas in and around the City of Asheville.. Permanent lighting in the form of commercial and residential fixtures, as well as temporary lighting from vehicle headlights are all present in the Action Area to varying degrees, depending on location. NCDOT will utilize temporary lighting associated with construction activities, as well as permanent lighting associated with roadway operation for this project. Light type, color, and intensity are variable, depending on location, light source types, and construction phase.

2.1.7.1 Light color

Light color is described in correlated color temperature (CCT) and measured in degree Kelvin (K). A warm light is around 2700K, moving to neutral white at around 4000K, and to cool white at 5000K or more. Light emitting diode (LED) lights can produce light anywhere within this range. High pressure sodium (HPS) fixtures have a warmer CCT in the 2,200K area. Metal halide (MH) fixtures are a cooler color in the 4,000-4,500K range. NCDOT's current specification requires the LED fixtures to have a CCT of 3,500-4,500K. All NCDOT-installed lighting along the I-26 corridor is 4,000K LED lights. The local utility in Asheville is in the process of upgrading all lighting to 4000K LED as well. While HPS fixtures remain in the area, the vast majority have been upgraded to 4000K LED.

Warmer, lower temperature lights typically don't have the same lumen output, requiring the use of more lights and a tighter pole spacing. This typically equates to increased maintenance for NCDOT and increased obstacles in the median or road shoulders, which generally decreases safety to the travelling public. Additional information about NCDOT lighting standards, and existing light conditions are provided below and in Appendix K (Lighting Summary).

2.1.7.2 Light Intensity and Brightness

A foot candle is a measure of illumination and is generally considered the illuminance produced by one candle at one foot. It relates to the brightness of light at the illuminated object. For reference, full, unobstructed sunlight has an intensity of approximately 10,000 fc. An overcast day will produce an intensity of around 100 fc. A full moon is generally considered to be 0.01 fc (Engineering Toolbox 2004).

Lumens measure the amount of light radiated from a source. So, in general, the higher the lumen rating, the brighter the lamp will appear.

2.1.7.3 Construction Lighting

Temporary lighting will be used during construction to meet safety requirements and aid in night work. Temporary lights used for construction activities could be of various types, colors, and brightness, depending on the activity and the equipment used by the construction contractor. All lights shall be directed towards the work area and will not shine out over any waterways. NCDOT commits to limit lighting to whatever is necessary to maintain safety in active work areas during construction. Lighting will be directed at active work areas. In addition, night work will be limited, and no nighttime lighting directed away from the work area will be permitted within 50 ft. of the French Broad River, Hominy Creek, Emma Branch, or Smith Mill Creek between March 15 and November 15.

2.1.7.4 Permanent Lighting

NCDOT policy requires the installation and maintenance of lighting systems at interchanges and along continuous sections of fully controlled access roadways which meet specific criteria established by the American Association of State Highway Transportation Officials (AASHTO) and the NCDOT Roadway Lighting Committee. NCDOT is currently in the process of updating all State owned and maintained lighting to LED. The existing lighting along the I-26 corridor has been upgraded to LED. Existing I-26 has continuous roadway lighting from the Woodfin Road interchange (Exit 23) south to the Brevard Road (NC 191) interchange (Exit 33). As part of the upcoming I-26 widening projects the existing lighting will have to be modified, and new lighting will be required in some locations. NCDOT plans to reuse the existing fixtures as part of the I-2513 project. Appendix K (Lighting Summary) describes the existing lighting conditions, initial conceptual designs, and proposed (or "mitigation") designs for the I-2513 project. USFWS will be given opportunity to discuss/review/comment on final lighting design.

I-26/I-240/Patton Avenue Connector Interchange

The I-26/I-240/Patton Avenue Connector (east of the Jeff Bowen Bridge) interchange is currently partially lit using a combination of high mast and single arm poles. The existing interchange will be redesigned as part of the I-2513 projects. Full interchange lighting which seamlessly ties into the existing lighting on I-240, Patton Avenue and the Captain Jeff Bowen Bridges will be included in the project.

Lighting Minimization at Named Stream and River Crossings

In order to achieve maximum pole spacing along continuously lit roadway corridors, the Department traditionally uses single arm and twin arm light poles with LED light fixtures mounted at a height of 45 ft. above the pavement surface. The specification that the Department has for LED light fixtures states that the low level 'cobrahead' fixtures may have a Backlight-Uplight-Glare (BUG) rating of 3-0-3. The light pattern from these fixtures is somewhat football shaped which leads to some light falling outside of the travel lanes. In most installations, this is a desired affect because lighting outside of the travel lanes can assist motorists in identifying hazards on the shoulder.

To reduce the amount of light projected outside of the roadway, the Department has committed to the following at all crossings of the French Broad River, Hominy Creek, Emma Branch, and Smith Mill Branch:

- using shorter poles which will provide an overall LED light fixture mounting height of 35' above the pavement surface
- using LED light fixtures with a more rectangular light pattern as well as house side shields to minimize lighting outside of the pavement area.
- using LED light fixtures with a BUG rating of 1-0-3 or less
- using LED light fixtures with a lower lumen output, reducing overall brightness

Lighting designs for interchanges or continuous sections of roadway that are approved for lighting by the Roadway Lighting Committee are designed to an average of 0.8 fc at a 4:1 uniformity ratio (average fc to minimum fc). The 2018 AASHTO Roadway Lighting Design Guide recommends interstate lighting facilities be designed to an average of 0.6 fc (down from a range of 0.6 fc to 0.8 fc in previous versions of the Guide) at 3:1 or 4:1 uniformity ratio, but also gives member States the option to design to higher values. The NCDOT has designed around 0.8 fc at 4:1 uniformity ratio for many years based on previous AASHTO guidance. To enhance the mitigation efforts to MYGR as part of this project, NCDOT commits to meeting the AASHTO minimum requirements of 0.6 fc at 4:1 uniformity at all crossing locations identified in Appendix K. This represents a 25% reduction in the average light on the pavement surface and should reduce the amount of light reaching the various crossings.

At all identified crossings, the proposed high mast poles and 45 ft. poles with GE Cobrahead (GE) fixtures (3-0-3 BUG) were removed and replaced with 35 ft. poles with Cooper Cobrahead

(Cooper) fixtures (1-0-3 BUG). Both the GE and Cooper fixtures have a Type 2 light distribution pattern, however the house side shield on the Cooper fixture significantly changes the backlight and overall shape of the light. From outer to inner, respectively, the rings of light shown emitting from the GE and Cooper fixtures are 0.1 fc, 0.2 fc, 0.4 fc, 0.8 fc, 1.0 fc and 1.2 fc.

Hill Street Culvert Roost Outlet Area and New French Broad River Bridge

As part of the installation of the new bridge and ramps associated with the new I-26 crossing of the French Broad River, new light fixtures will also be installed. Existing lighting in this area consists a variety of light colors, types, and brightness on private property and city streets. On the private property adjacent to the roost, there are seven light fixtures, of which, four are LED, two are HPS and one is an old NEMA fixture which is probably metal halide. The lights closest to the roost are LED. NCDOT will meet with landowners adjacent to the roost culvert to discuss replacement or augmentation of existing lighting to reduce existing baseline conditions determined by the NCDOT Roadway Lighting Squad.

NCDOT originally designed the lighting in the area of the new bridge crossing over the river utilizing high mast poles, flooding the entire area with generalized lighting. The most effective mitigation effort that can reduce the amount of light cast onto the river and the culvert outlet while still providing adequate lighting for the driving public is replace the 120 ft. and 100 ft. high mast poles with 35 ft. single arm light poles mounted on the bridge and flyover barriers.. To reduce impacts further, a light fixture with a very narrow distribution pattern will be used. This will keep more light on the bridges and flyovers and spill less light onto the river and the culvert outlet. Using the mitigation design results in zero calculated change to the baseline light levels at the culvert and the ditch near the culvert roost outlet. Additionally, the levels of light that are calculated to be cast onto the river are reduced by 94% to a value of roughly twice that of the light from a full moon.

Hill Street Culvert Roost Inlet Area

The City of Asheville currently maintains LED lighting on Houston Street and Courtland Avenue north of the culvert roost inlet, as well on the unnamed road that leads to the back entrance of Isaac Dickson Elementary School just south of the culvert opening. The original lighting design near the Hill Street culvert inlet called for 80 ft. high mast poles installed between I-26 and Hill Street. These high masts flooded the mainline, Hill Street, and the surrounding area with light. To address mitigation efforts and better align with the NCDOT Roadway Lighting Policy for NCDOT owned lighting inside of controlled access areas, the high mast poles were removed and replaced with GE light fixtures installed on twin arm poles on the mainline median barrier.

I-26/I-240/Patton Avenue Smith Mill Creek Culvert Area

As depicted in the diagram at the end of Appendix K (Lighting Summary), due to the distances from the culvert and the existing vegetation, the existing installed roadway lighting should provide little to no light at the culvert inlet. The existing high mast pole within the ramps near the culvert produces a small amount of light that shines in the area of the culvert outlet. The existing lighting system is currently not operational and is under repair, with full functionality expected by the end of 2019. This interchange will be completely reconfigured as part of the I-2513 project, with the existing ramps and loop at the culvert being removed. As a result of the reconfiguration, the existing lighting closest to the culvert opening will be removed. The proposed lighting system transitions the roadway light further away from the culvert inlet and outlet.

2.1.8 French Broad River Geomorphology & Water Quality Monitoring

To ensure the I-26 Connector (I-2513) and I-26 Widening (I-4400/I-4700) projects will not result in substantial changes to channel stability (scour, erosion, etc.) or water quality, NCDOT is working with the US Geological Survey (USGS) to evaluate the impacts of construction and temporary causeways on river habitat. The USGS investigation will help NCDOT ensure that the I-26 projects have minimal adverse effects on the French Broad River corridor. The monitoring will support NCDOT construction-site inspections, allow adaptive response to construction impacts, support holistic understanding of construction impacts over time, and provide the public with readily accessible information regarding conditions in the French Broad River corridor. Details of the proposed study are described below.

Terrestrial Light Detection and Ranging (T-LiDAR) technology will be used annually to produce a laser scan of river banks. Bathymetric surveys will be conducted concurrently one to two times a year. Bathymetric data will be used to generate a gridded surface representation (digital elevation model, or DEM) of the channel bed for each survey. A similar approach will be applied to T-LiDAR data to evaluate stream bank position between successive surveys.

Water quality monitoring will include real-time (continuous) data collection of temperature, turbidity, and specific conductance. Discrete water-quality samples will be collected during a variety of flow conditions to measure total suspended sediment (TSS) and suspended sediment concentration (SSC).

Continuous streamflow, precipitation, and water-quality (temperature, conductance, and turbidity) data will be available online at http://waterdata.usgs.gov/nc/nwis/rt/ and via text and email alerts. Yearly summaries for each monitoring site will be available on demand from the USGS National Water Information System web interface (NWISWeb). Real-time alerts will be available to NCDOT via the NWISWeb when temperature or turbidity concentrations spike or exceed a predetermined threshold.

2.1.9 Standard Stormwater Control

NCDOT's Construction General Permit (NCG01) allows for stormwater discharge under the National Pollutant Discharge Elimination System (NPDES). The terms and conditions associated with this permit apply to all sections of I-2513.

They include, but are not limited to the following:

- For all perimeter dikes, swales, ditches, and slopes steeper than 3:1, stabilization must occur within seven days.
- Slopes $\leq$ 3:1 that are greater than 50 ft. in length, must be stabilized within seven days.
- All other areas must be stabilized within 14 days. Areas where stabilization must happen in seven days versus 14 days must be shown in the Erosion and Sedimentation Control Plan.
- Sediment and erosion control measures must be inspected weekly and within 24 hours of any storm event greater than one-half inch during a 24-hour period.
- Other requirements cover the handling of building wastes such as concrete, inspection and reporting requirements, earthen stockpiles and sediment basins.

2.1.10 Highway Operations

Once I-2513 is widened and in operation, the additional capacity may allow for an increase in the number of vehicles that travel I-26 and I-240 in the Action Area. The following activities may be conducted as part of general highway operation: pavement maintenance, including re-painting lane markings, patching potholes and cracks, and repaving highway surfaces; vegetation management, including mowing, use of herbicides in selected areas, and removal of hazardous trees; winter maintenance, such as plowing, salting, and brining; bridge and culvert maintenance;

removal of trash, debris from wrecks, and animal carcasses; clean-up of spills; and maintaining ditches and stormwater control devices.

2.1.11 Project Design Modifications for Avoidance and Minimization

NCDOT has already begun to implement changes to the project design to avoid and minimize impacts to jurisdictional resources (streams and wetlands), including:

- Eliminated approximately 20,000 ft. of collector-distributer roads and added retaining walls added in Section C, along I-40. This resulted in reduction of impacts to Ragsdale Creek and avoidance of impacts to Upper Hominy Creek.
- Redesigned of the ramps associated with the new bridge over the French Broad River in Section B, resulting in the daylighting of approximately 440 ft. of Smith Mill Creek.
- Reduced overall permanent impacts to streams by 724 linear ft.
- Reduced overall impacts to wetlands by 0.63 ac.

Minimization of impacts to these resources will help protect water quality, which will benefit a variety of plant and animal species.

2.2 Description of Action Area

The Action Area as defined in 50 CFR 402.02 includes all areas in which federally listed species will be affected directly and indirectly by the Proposed Action. The "effects of the action" to be analyzed in the BA are defined as the direct and indirect effects of the action, together with the effects of other activities that are interrelated or interdependent with that action.

The Action Area for the project includes the immediate project footprint, including work areas, staging areas, and access areas, as well as areas immediately adjacent to areas affected directly by project activities. For example, noise and vibrations from project activities could potentially result in indirect effects in immediately adjacent areas.

The project Action Area (Figure 5 of Appendix A) is primarily based on the DEIS study area (NCDOT 2015), which includes the corridor required to improve existing I-240 from the I-26/I-40/I-240 interchange to the interchange with US 19-23-74A (Patton Avenue) west of the French Broad River. From this interchange northward, the Action Area broadens to provide for a freeway on new location that would cross the French Broad River and tie into existing US 19-23-70 on the east side of the French Broad River. The Action Area also includes the current I-40 interchange with US 19-23-74A (Smoky Park Highway) and the I-40 corridor between this interchange and the I-26/I-40/I-240 interchange.

The Action Area has been expanded from the DEIS study area in four locations:

- A section of Hominy Creek from where it leaves the I-2513 study area downstream to its confluence with the French Broad River (approximately 0.3 mi.).
- The French Broad River from the Hominy Creek confluence to where the river enters the project study area, approximately 0.3 mi. downstream (central portion of the project).
- A section of French Broad from where it leaves the central/eastern portion of the project study area downstream to where the Amboy Road (U-4739) study area begins (approximately 0.5 mi.).
- The French Broad River from where it leaves the project study area at the north end of the project to where an old rock dam is present, approximately one mi. north (downstream).

Preliminary roadway designs are in progress at the time of this BA submittal. Additional easements may be required for drainage, utilities, and construction.

2.3 Other Consultations in the Action Area

No previous consultations under Section 7 of the ESA with USFWS have been completed for other projects within the I-2513 Action Area.

One formal consultation for MYGR was completed in the USFWS Southeast Region in 2019. This consultation was for the NCDOT STIP project I-4400/I-4700, the widening of I-26 in Buncombe and Henderson Counties, NC, immediately south of I-2513, where MYGR are known to occur. One other consultation was completed in the Midwest Region in 2015. This consultation assumed presence of MYGR for an industrial development project in Missouri.

There have been multiple formal consultations for Appalachian elktoe in North Carolina in the recent past. Some recent consultations include the following NCDOT projects:

- 2005 - Bridge Replacement Projects on the North Toe River, Yancey and Mitchell Counties (STIP B-1443 and B-2848)
- 2005 - Natural Resource Conservation Service (NRCS) Stream Restoration Efforts in the Nolichucky River Basin, Yancey and Mitchell Counties.
- 2007 - US 19 and US 19E Widening, Madison, Yancey, and Mitchell Counties (STIP R-2518, R-2519A, R-2519B)
- 2013 - Bridge No. 134 over Cane River on SR 1379, Yancey County (17BP.13.R.107)
- 2014 - Bridge No. 172 Replacement over Little Tennessee River on SR 1456, Macon County (STIP No. B-3868)
- 2017 - Replacement of Bridge No.12 on SR 1538 over Hogsed Creek, Transylvania County (STIP B-4823)
- 2019 – I-26 widening south of Asheville and replacement of the I-26 bridge over the French Broad River (STIP I-4400/I-4700, immediately south of I-2513)

3.0 GRAY BAT SPECIES INFORMATION

A detailed description of characteristics and habitat requirements for the federally endangered MYGR is provided below.

Gray bat (*Myotis grisescens*) (A. H. Howell 1909)
Status: Endangered
Family: Vespertilionidae
Listing Date: April 28, 1976
Critical Habitat: None designated

3.1 Physical Characteristics

MYGR is one of the largest species in the genus *Myotis* in eastern North America, with a forearm length of 40 to 46 millimeters (mm), a weight of 7 to 16 grams (g) (usually 8 to 11g), and a wingspan of 27.4 to 30 centimeters (cm) (Barbour and Davis 1969). MYGR can most readily be distinguished from other *Myotis* by their wooly, unicolored dorsal fur, which may seem paler on the bats' belly. The fur appears gray after the mid-summer molt, becoming chestnut brown or bright russet leading to the next molt (Gore 1992). Another important characteristic is that the wing membrane, which is dark gray to black in color, connects to the foot at the ankle, rather than at the base of the toes (Howell 1909, Barbour and Davis 1969, Gore 1992). The nails on the feet are notched and the calcar is unkeeled (Harvey et al. 1981, Sealander 1979).

3.2 Distribution

MYGR is known to occur in 14 southeastern and midwestern states including Alabama, Arkansas, Florida, Georgia, Illinois, Indiana, Kansas, Kentucky, Missouri, North Carolina, Oklahoma, South Carolina, Tennessee, and Virginia. There is little variation between summer and winter ranges (NatureServe 2018) and population densities are highest in the limestone karst region (Hall and Wilson 1966, Barbour and Davis 1969, Tuttle 1976a, Harvey et al. 1981, Mitchell 1998).

North Carolina Natural Heritage Program (NCNHP) records (2019) confirm presence in six western North Carolina counties: Buncombe, Haywood, Madison, Swain, Transylvania, and Yancey. MYGR was also recently documented in Surry County (Cheryl Knepp, NCDOT, personal communication). The approximate locations of these records are presented in Appendix A, Figure 6, along with another occurrence that has not yet been incorporated into the NCNHP database, includes a record at the Cherokee/Clay County line. Records in North Carolina represent mist-net captures, NC State Laboratory of Public Health records, and summer roost locations.

There are no known MYGR hibernacula located in North Carolina. The closest MYGR hibernaculum is a cave located in Cocke County, Tennessee, approximately 70 mi. northwest of the Action Area (Sue Cameron, USFWS, personal communication).

MYGR are known to occur in the Action Area. The results of recent surveys for MYGR are discussed in Section 3.10.

3.3 Population Trends

In the late 1970s, Tuttle (1979) estimated the total population of MYGR to be approximately 2.25 million. The population was estimated at only 1.6 million in the early 1980s (Brady et al. 1982) and fell to 1.5 million within the next 10 years (Harvey 1992). By 2001, the population increased to 2.3 million (Mitchell and Martin 2002), and again to 2.5 million in 2003 (Harvey et al. 2004). This is a net increase in population size of 11.1 percent between the 1970's and 2003, and an increase of 66.7 percent from the smallest population estimate. In 2007, a study was conducted examining MYGR hibernacula and maternity roosts across the established range to ascertain the effectiveness of current conservation steps and suggest future actions. At that time, it was observed that populations had increased nearly 104 percent since 1982 (Martin 2007).

Indiana State University (ISU) is conducting an NCDOT-sponsored multi-year research study of MYGR in the French Broad River Basin. Emergence counts conducted by ISU at known roosts in western NC in 2018 suggest there are at least 1,300 MYGR in the French Broad River basin. Of the 488 MYGR captured in 2018 as part of the ISU research project, approximately 82% were adult males, 13% were adult females, 4% were juveniles and 1% unknown age. The sex ratio of the juveniles was roughly 27% female and 73% male (USFWS 2019).

As defined in the Gray Bat Recovery Plan, Priority 1 (P1) hibernacula include caves occupied now or in the past by more than 50,000 MYGR in northern Alabama and Tennessee, and 25,000 elsewhere (USFWS 1982). Most of the 17 current P1 caves were designated in the recovery plan, but several additional caves have been identified as having significant winter populations in more recent times. From 2013 -2015 many of the 17 P1 hibernacula were surveyed, however not all caves were surveyed in the same winter. In 2017, winter surveys of all P1s were conducted, including the largest hibernaculum, Fern Cave in Alabama. This coordinated, rangewide effort provided the best opportunity in decades to estimate the MYGR population, now estimated at approximately 4,358,263 (USFWS 2019).

3.4 Roost Habitats

MYGR is a cave obligate species, roosting almost exclusively in warmer caves during summer, and hibernating in cold caves in winter (Hall and Wilson 1966, Barbour and Davis 1969, Tuttle 1976a, Martin 2007), although roosts in mines have been occasionally documented (Sealander 1979, Thom 1981, Brack et al. 1984, Harvey and McDaniel 1988). Due to specific requirement needs for roost and habitat, such as temperature ranges between 57.2 and 77 ˚F, only a small portion of caves (fewer than 5 percent) provide a suitable environment (Tuttle 1979). MYGR exhibit pronounced philopatry to specific summering and wintering sites, commonly returning to the same caves each season (Tuttle 1976a, Tuttle 1979, Tuttle and Kennedy 2005, Martin 2007).

Preferred winter roosting caves are deep and vertical, providing cold air pockets. Trapped air affords a cool environment with mean annual temperatures of 42.8 °F below the above ground mean annual temperature (Tuttle 1979). Temperatures between 41 and 48.2 °F (Tuttle and Kennedy 2005) often occur in hibernation sites as they offer multiple entrances with good air flow (Martin 2007). Caves for summer dwelling are almost always located within 0.62 mi. of a body of water, such as a stream or reservoir, and are especially important for a maternity colony (Tuttle 1796b). Summer roosts typically contain temperatures ranging between 57.2 and 77 °F, with maternity caves being the warmest within the range (Brady et al. 1982). Tuttle (1976a) documented significant movement between caves within summer ranges (up to six different sites), but comparatively little variation in winter roosts during hibernation.

Summer cave roosts selected as maternity roosts serve as holding areas for pockets of warm air created by the presence of a large group of bats (Tuttle 1975, Tuttle and Stevenson 1978), while males and pre-reproductive females appear to be less particular when choosing roost sites throughout the year. During the transient periods of spring and fall, MYGR are less selective about which caves sites to use (Tuttle 1976b).

There are a few exceptions to this cave-specific roosting strategy. Many bat species have been documented using bridges as roost sites (Keeley and Tuttle 1999) and MYGR are no exception. Bridges provide a warm thermal refuge for individuals foraging far from their primary daytime roosts and have been documented as night roosts for MYGR in northwest Georgia (Johnson et al. 2002). MYGR maternity colonies have been found in storm drains (i.e. culverts) in Arkansas (Harvey and McDaniel 1988, Timmerman and McDaniel 1992), Kentucky (Hays and Bingham 1964), and Kansas (Decher and Choate 1988). Culvert conditions can mimic those found in natural caves in terms of high levels of humidity and clear running water. Maternity colonies have also turned up in more unusual places, such as a barn in Missouri (Gunier and Elder 1971) and the gate room of a large dam in Tennessee (Lamb 2000).

In North Carolina, MYGR have been documented using bridges as both day and night roosts during the summer months, with at least one of these bridges serving as a maternity roost (NCNHP 2019). CALYX/NV5 biologists discovered a MYGR roost inside a concrete box culvert in Asheville in August 2017. This roost lies within the Action Area. A check of the roost site during December 2017 revealed that no individuals were present. It has since been determined through mist-netting, emergence counts, and acoustic surveys that both sexes and age classes of MYGR are using this culvert, roughly from spring to fall. However, there is no evidence to confirm that the culvert functions as a maternity roost. Since this discovery, additional culvert roosts have been identified, mainly in the Buncombe County area. Culvert roosts that occur in the Action Area are further described in Section 3.10.4.

NCDOT is funding a comprehensive MYGR research project within the French Broad River watershed, which is being executed by Indiana State University. Field work for the project began in April 2018, and one of the goals is determining roost preferences of MYGR. Researchers identified three roost sites in buildings and three in sycamore trees, which are roost types previously undocumented for this species in North Carolina. One building roost contained up to 44 individuals; single individuals were located in the other building roosts; single individuals were in the tree roost. All these are considered secondary roosts. Additional roosts will likely be identified in the future as part of this project (Weber et al. 2018, and Joey Weber, ISU, personal communication).

3.5 Reproduction and Young

MYGR are reproductively mature at two years of age (Tuttle 1976a) and mating season takes place between September and October. Copulation occurs upon arrival at hibernating caves, whereupon females immediately enter hibernation. Mating males may take a few weeks to replenish fat stores but are typically in hibernation by early November (Tuttle 1976b, Tuttle and Stevenson 1978). Adult females store sperm throughout hibernation, a strategy known as delayed fertilization, and pregnancy begins following their emergence in the spring (Krulin and Sealander 1972). After a gestation period of 60 to 70 days (Saugey 1978), females give live birth to one young between late May and early June. During the reproductive season maternity caves are occupied by reproductively active females. All other individuals not actively mating, both male and female, occupy caves on the outlying edge of the home range (Tuttle 1976b).

Young, non-volant MYGR, experience healthy growth rates because their energy expenditure to thermoregulate is reduced by the roosting colony (Herreid 1963, 1967). In undisturbed colonies young may take flight within 20 to 25 days after birth; some up to 30 to 35 days if disturbed (Tuttle 1975). Hunting is primarily learned by young on their own after learning to fly (Stevenson and Tuttle 1981); though lactating females will continue to nurse their offspring for a short time after becoming volant. Roosts are cool during this period of lactation and females are often required to feed continuously to sustain the high body temperatures required to nurse (Tuttle and Stevenson 1977).

3.6 Survivorship

Survival and growth of volant young is inversely proportional to the distance travelled for shelter and food (Tuttle 1976a). MYGR have been recorded as living up to 17 years (Harvey 1992, Tuttle and Kennedy 2005), with a mean annual survival rate of 70 percent in males and 73 percent in females (Gunier and Elder 1971). While survivorship among juveniles is relatively high (Saugey 1978), only 50 percent of MYGR reach maturity (USFWS 1980). Mortality rates are higher during the spring migration when fat stores have been expended and food resources can be scarce (Tuttle and Stevenson 1977).

3.7 Foraging, Commuting, and Diet

MYGR forage primarily over open water where flying insects are abundant, and most foraging occurs within 6.5 to 9.8 ft. of the surface over open water near a forested shoreline (Tuttle 1976b, 1979, LaVal et al. 1977). In riparian areas, foraging occurs below treetop height, sometimes only 6 ft. above the water (LaVal et al. 1977, Brack 1985). Bats feed heavily along the edges of these aquatic resources, often observed within 16.4 ft. of the water's surface in Tennessee (Brady et al. 1982). In Missouri, MYGR were observed foraging low over the water, but also in the forest canopy near the river (LaVal et al. 1977). Abbreviated instances of bad weather in early spring and late fall are generally the only times that MYGR deviate from primarily feeding along local bodies of water, when they can be found foraging in the forest canopies (LaVal et al. 1977, Stevenson and Tuttle 1981). MYGR are known to establish foraging territories as insect numbers drop after dusk. Territories are controlled by reproductive females and are the preferred territories returned to annually (Brady et al. 1982, Goebel 1996).

Summer maternity roosts are typically located within 1.6 mi. of a river or reservoir over which the bats forage (Tuttle 1979) and are rarely located more than 13.1 mi. away from foraging areas (Tuttle 1976b). However, individuals may travel up to 114.8 mi. between prime feeding areas over lakes or rivers and occupied caves (LaVal et al. 1977, Tuttle and Stevenson 1977, Tuttle and Kennedy 2005). Forested areas along the banks of streams and lakes serve as corridors for travel and as protective feeding cover for newly volant young (Tuttle 1979, Brady et al. 1982), and MYGR of all ages use these protected areas between roosts and feeding areas whenever possible (USFWS 1982). In addition, young often feed and take shelter in forest areas near the entrance to cave roosts (Tuttle 1979). MYGR may forage very close to roost entrances in nearby forested areas during unusually cool spring weather. They also use the cover of forest canopy to travel more safely from roost to foraging areas, to avoid predators. Pups find forested areas adjacent to roosts advantageous when they are learning to fly. These areas not only serve to better protect them from aerial predators, but also provide temporary resting areas (Brady et al. 1982) MYGR generally do not feed in areas along rivers or reservoirs where the forest has been cleared (LaVal et al. 1977). Individuals may also fly over land from relatively land-locked roost sites to reach the main river channel or tributary systems that lead to open-water foraging sites (Thomas 1994, Best and Hudson 1996). Results of surveys conducted in Tennessee indicate that wetland depressions are also important foraging sites for MYGR (Lamb 2000). However, they do not feed in areas along rivers or reservoirs where the forest has been cleared (LaVal et al. 1977) and are rarely caught in the open or over streams (Caire et al. 1989). During times of limited food resources, males and pre-reproductive females may be excluded from foraging territories (Stevenson and Tuttle 1981).

MYGR of all ages feed almost exclusively on insects, with flies (Diptera), beetles (Coleoptera), caddisflies (Trichoptera), moths (Lepidoptera), wasps (Hymenoptera), stoneflies (Plecoptera), leafhoppers (Homoptera), and mayflies (Ephemeroptera) being the most important orders of insect prey (Rabinowitz and Turtle 1982, Brack 1985, Lacki et al. 1995, Best et al. 1997, Brack and LaVal 2006). Diet has been found to coincide most directly with the predominantly available prey species in the foraging area (Barclay and Bingham 1994), including both terrestrial and aquatic species (Brack and LaVal 2006, Lacki et al. 1995). A study examining fecal remains conducted by Brack and LaVal (2006) indicates that MYGR diets fluctuate to a minor degree depending upon varying factors such as age, sex, and location. While studies exist to support the ideas that MYGR can be both selective and opportunistic in their prey choices, it seems that it may be important to consider scale; on a macro-scale, MYGR tend to target aquatic habitats, where aquatic insect prey items are more abundant, but on a micro-scale, MYGR appear more opportunistic, feeding on the variety of available prey (Brack and LaVal 2006).

3.8 Migration

Gray bats migrate seasonally between wintering roosts and maternity caves. In the spring, bats emerge from hibernation and begin the migration to their summer habitats (Tuttle 1976b). Adult females typically leave the hibernaculum in late March or early April, with adult males and juveniles migrating several weeks later, between mid-April and mid-May (Harvey 1992). Though migratory distances for individual bats differs depending upon the specific geographic location, it is not uncommon for one-way migrations to vary anywhere from 27.3 to 845 mi. (Tuttle 1976a).

Fall migration most commonly begins in September and October (sometimes as late as December) and in the same fashion as spring migration, with adult females leaving the summering sites first and adult males and juveniles departing last (Tuttle 1976a). When migrating from summer maternity roosts to their winter hibernacula, individuals commonly move between 55.8 and 1,433.7 mi, with some examples traveling as far as 2,260.5 to 2,542.7 mi. (Hall and Wilson 1966, Tuttle 1976a, Tuttle and Kennedy 2005). These great distances may sometimes be split by a short layover in small caves (Smith and Parmalee 1954).

Due to specific roost requirements, MYGR typically migrate to the same wintering sites within a given area (Hall and Wilson 1966). In addition to the larger group migration, small flocks of migrating individuals are thought to occur (Barbour and Davis 1969). Due to low food stores and long traveling distances, migration can be dangerous and lead to increased rates of mortality (Tuttle and Stevenson 1977).

Prior to winter hibernation, MYGR exhibit swarming behavior soon after reaching the hibernacula (Whitaker and Hamilton 1998). Swarming is an activity in which great numbers of bats fly in and out of the entrances to potential hibernating sites from dusk until dawn (Cope and Humphry 1977). This behavior is largely believed to be a method for increasing variation in the gene pool of a population, as it promotes mating between summer colonies previously isolated from one another (Kerth et al. 2003). Swarming is also thought to be a method for evaluating the suitability of wintering sites (Fenton 1969), as well as a possible means of transferring information between individuals with regard to the location of hibernacula (Humphrey and Cope 1976).

3.9 Threats to Species

As discussed in Section 3.3, the species may be experiencing some recovery. However, important threats to the species remain a cause for concern.

3.9.1 Human Disturbance

The primary cause of population decline in MYGR can be attributed to human disturbance of their natural habitat (Barbour and Davis 1969, Mohr 1972, Harvey 1975, Tuttle 1979, USFWS 1982, USFWS 2009a), with wintering sites and maternity roosts being especially susceptible to disruption. Commercialization of caves that allows for public access, spelunking, and looting for archaeological artifacts are activities most commonly resulting in disturbance to roosting bats (USFWS 1982, USFWS 2009a). Disturbance in the hibernacula occurs when a human enters the cave and bats wake from hibernation, using vital energy stores that cannot be recovered before emerging in the spring (Tuttle 1976b). Approximately 20 to 30 days of stored energy is depleted with each arousal (Daan 1973). Losing these fat stores can cause bats to leave the roost prematurely in search of food during unsuitable circumstances, which may result in high mortality rates. During the first hour of arousal, individuals may lose up to 0.48 g. of body weight; a significant amount when contrasted with the typical hibernation losses of 0.01 g per day (Brady et al. 1982). When this human interference occurs in maternity caves it is typically most devastating in late spring and early summer (May to July), as non-volant offspring are in the roost. Thousands of bats may die from a single disruption (USFWS 1982). In addition, Stevenson and Tuttle (1981) found that banded MYGR tended to avoid roosts where they had been handled by researchers.

Humans are also impacting the environment in other ways that can negatively impact bats. Deforestation close to cave entrances and at foraging and commuting areas is likely to have negative effects on overall populations due to the removal of prey abundance and reduced cover from natural predators (Tuttle 1979). Whenever possible, MYGR of all ages fly in the protection of forest canopy between roosts and feeding areas (USFWS 1982). Recently volant young are especially susceptible to the effects of deforestation as they require the protection of forest cover while becoming more proficient fliers. Insecticide use has historically had a detrimental impact on bat populations, including MYGR populations (Clark 1988), though many of the toxic substances are now banned from the market. Modern pesticides such as organophosphates and carbonates are of current concern. These chemicals may kill MYGR as a result of direct exposure, though they do not appear to accumulate in body tissues (Shapiro and Hohmann 2005).

Siltation of waterways where bats forage and drink may also negatively affect the species. As previously stated in Section 3.7, a large portion of MYGR diet is comprised of adult aquatic insects such as mayflies, stoneflies, and caddisflies. These groups of aquatic insects are especially susceptible to degraded water quality. Any substantial declines in the populations of these insects may have a detrimental effect on MYGR populations as well (USFWS 1982). Tuttle (1979) presented a correlation between a decline in MYGR numbers and an increase in sedimentation in several Alabama and Tennessee waterways.

Tied to increased siltation of waterways is impoundment of streams and rivers to create reservoirs. While it was originally suspected that this practice would increase suitable foraging habitat for MYGR, it was ultimately found that the opposite is true (USFWS 1982). Disturbance to roosting bats utilizing caves adjacent to these impoundments has also been observed. Noise from passing watercraft increased, and access to cave roosts that were previously far from population centers and roads were made more accessible (USFWS 1982). Furthermore, to avoid human disturbance, bats sometimes seek out secluded summer roosts that happen to be located over areas of deep water, and as a result, individuals may drown if the site is flooded (Tuttle 1979).

3.9.2 Natural Phenomena

Natural phenomena have also been observed to negatively affect MYGR populations. Natural flooding and the associated collapse of caves have a negative influence due to the bats' high roost site fidelity. Effects on MYGR from natural flooding are similar to those caused by man-made flooding for the purposes of creating impoundments, as discussed in the previous section.

Another natural threat to MYGR populations comes in the form of increasing temperatures due to climate change. Since MYGR are a cave-obligate species requiring highly specific hibernacula, they are acutely at risk from fluctuating climate conditions. As temperatures within caves rise, they become less viable as winter roosts. In addition to the reduction of suitable wintering cave sites, the increase in overall temperatures may lead to earlier arousal from hibernation, resulting in higher energy expenditure and potentially premature parturition (Sherwin et al. 2013). A study examining the correlation between bat reproduction and climate change conditions draws similar conclusions. As global temperatures rise water resources diminish, in turn requiring higher energy costs from bats traveling further distances for food (Adams 2010). These changes may have particularly adverse effects on nursing females, as the costs associated with traveling longer distances for food and water result in longer lactation times, slowing overall juvenile development (Tuttle 1976b).

3.9.3 White-nose Syndrome

Perhaps the most serious natural threat to MYGR populations is the fungal disease white-nose syndrome (WNS). The disease is believed to be caused by a fungus known as *Pseudogymnoascus destructans*; and its physical symptoms manifest in the form of visible white fungal growth on the wings, ears, and muzzle of affected bats (Cryan et al. 2013). Since its discovery in New York in 2006, WNS has had an overwhelmingly negative effect on North American hibernating bats, eradicating over 5 million individuals. Mortality rates in afflicted bats often exceed 90 percent (Thogmartin et al. 2013). Bats that have been infected with WNS display erratic changes in behavior including daytime flying and recurring arousal during hibernation (Cryan et al. 2013).

In 2012, USFWS confirmed the first instance of WNS in MYGR (USFWS 2012b). The full impact of WNS on overall MYGR populations is still being determined. It seems plausible that WNS would pose a serious threat to a species like MYGR, where individuals overwinter in few high-density hibernacula, should it infect those colonies. However, some studies have found that *P. destructans* may not spread through MYGR colonies as quickly as once expected, nor be as substantial a threat to the species as initially suspected (Flock 2014, USFWS 2014). As of spring 2017, the species has yet to experience any WNS-related declines and their populations appear to have remained stable within Tennessee (Bernard et al. 2017) and Virginia (Powers et al. 2016). Several behavioral traits, such as preferred microclimates within hibernacula, sustained activity and foraging throughout winter (Bernard and McCracken 2017), and year-round cave use (Stevenson and Tuttle 1981, Tuttle 1976a) may enable this species to prevent or minimize the colonization of *P. destructans* during torpor.

3.10 Status of Gray Bat in the Action Area

As discussed in Section 3.3, Emergence counts conducted by ISU at known roosts in western NC in 2018 suggest there are at least 1,300 MYGR in the French Broad River basin (USFWS 2019).

Extensive acoustic surveys were conducted during the latter part of the summer of 2017 and the entire 2018 season, and results indicated that MYGR are present in the action area spring through fall (Appendix B). MYGR activity was generally highest along the French Broad River and at the culvert roost, and lower along smaller streams like Hominy Creek, Emma Branch, and Smith Mill Creek.

Surveys of bridges and culverts were also conducted to identify evidence of bat use (Appendix C). One roost was identified in a culvert, but no evidence of bat use was found on any other bridges or culverts. ISU studies resulted in the identification of additional maternity, bachelor, and transient roosts within or near the Action Area (Weber et al. 2018). No hibernacula are known from North Carolina.

Radio telemetry tracking studies were conducted by NCWRC in 2016 and 2017, and ISU in 2018 on bats captured at roosts near and within the Action Area. The results of these studies indicate that MYGR flying in and through the Action Area are from these nearby roost sites (NCWRC 2017, Weber et al. 2018). Additional information is summarized in Section 3.10.3.

3.10.1 Acoustic Surveys

The French Broad River flows through all three sections of the I-2513 project, generally in a northerly direction. The river flows north into the C section, crossing under I-40, then turns east in the A section, flowing between I-40 and I-240, until it leaves the Action Area for roughly two mi. Once back in the Action Area within Section B, it parallels I-26 to the west, and continues north, eventually running all the way to Tennessee.

Detectors were deployed to try to determine, without telemetry, bat movement and presence and seasonal trends in bat activity that would potentially be affected by the project. Based on the location of known roosts within and adjacent to the project Action Area, the results of telemetry work conducted by NCWRC, and because MYGR typically use large streams and rivers for foraging and commuting, most of the acoustic detector sites were established at strategic locations along the French Broad River and large tributaries within or very close to the Action Area. No detectors were deployed at the western end of Section C due to the lack of suitable deployment locations (very small streams, access issues, too much vegetative clutter, etc.) and because construction impacts associated with improvements to I-40 in this area are expected to be minimal (Appendix C).

In 2018, all detectors were deployed for the entire season, roughly from the beginning of March through the middle of November. Bats were recorded at the culvert roost (Site 5) the third week in March last year. However, no substantial bat calls were recorded at most other sites until the second week in April. Bats activity dropped to zero or near zero by the second week in November.

After processing all recorded call files through BCID Eastern USA, MYGR calls were identified at all 10 detector sites within the Action Area. In addition to Site 5, which was a known MYGR roost, Sites 1, 2, and 10 produced the largest number of MYGR calls. It is important to note that Sites 1, 2, and 10 were all located adjacent to the French Broad River. Table 3 provides information on location, associated waterway, weeks of deployment, and numbers of bat calls for each site.

Table 3. Acoustic Detector Sites, Deployment Time, and Call Totals

Detector Site #	Site Name	Associated Waterbody	2018			
			Date Deployed	Approx. # Weeks Deployed*	Total # Bat Calls*	Total # MYGR Calls*
1	Grainger	French Broad River	20180405	30 Weeks	20,020	573
2	Smoky Park Bridge	French Broad River	20180405	29 Weeks	18,134	799
3	Carrier Park	French Broad River	20180503	25 Weeks	8,194	58
4	I-40 and Greenway	French Broad River	20180405	29 Weeks	3,877	146
5	Culvert	UT French Broad River	20180301	34 Weeks	14,804	4,711
6	Smith Mill Creek	Smith Mill Creek	20180419	28 Weeks	13,835	132
7	Hominy Creek and I-240	Hominy Creek	20180405	30 Weeks	8,574	15
8	Oakview Road	Hominy Creek	20180405	26 Weeks	3,925	26
9	Pond Road	Hominy Creek	20180405	28 Weeks	6,519	206
10	Outdoor Center	French Broad River	20180405	30 Weeks	19,952	704
11	I-26 Bridge	French Broad River	20180301	32 Weeks	51,497	26,009

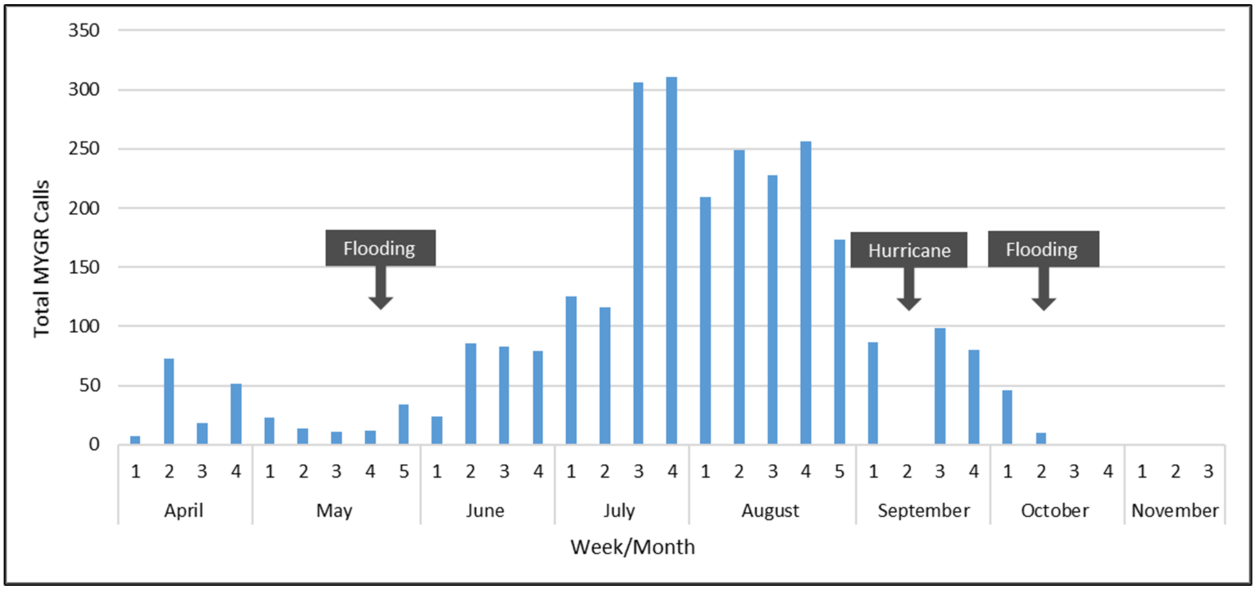
*Excluding weeks with less than 6 full nights of data (due to detector malfunctions and/or severe flooding)

While sites 1, 2, and 10 along the French Broad River produced the highest number of calls, aside from the culvert roost site, other sites along the river produced numbers of calls similar to, or in some cases lower than sites along smaller waterways. The fewest MYGR calls were recorded at Site 7 where Hominy Creek flows under I-240, and adjacent to a secondary road and greenway trail. Noise, light, and human activity at this location may have an influence on bat activity, especially when coupled with the smaller size of the stream where less prey may be available.

For all sites, there is a general trend toward increased activity as pups become volant in late summer/early fall. This makes sense because more individual bats are present on the landscape during this time. Due to low sample size, seasonal activity patterns are more difficult to interpret at detector locations where total numbers of calls were lower overall, such as sites 3, 7, and 8.

Considering the weekly totals for the entire 2018 recording season, across all detector sites, excluding the one at the culvert roost (Site 5) where bat activity is proportionally expected to be elevated all season, MYGR activity peaks the last two weeks of July and steadily declines through the end of the 2018 season (Chart 1). After the first week in October, the number of MYGR calls drops dramatically as the last of the MYGR leave the area and move toward their winter roosts. This aligns with the general trends observed at individual detector sites, as shown on the corresponding charts on Figures 3A-3F in Appendix A.

Chart 1: 2018 Weekly Total MYGR Calls at Sites 1-4 and 6-10.



3.10.2 Structure Surveys

A total of 51 bridges and 15 culverts were identified within the Action Area and checked in the field for the presence of bats or evidence of bat use (guano, staining, and/or urine). Bridge and culvert surveys were performed between July 26 and September 17 in 2017, and May 31 and August 22 in 2018. Figures 3A through 3F of the Structure Survey Report in Appendix B show the location of the bridges and culverts that were inspected. There was evidence of bat use in only one structure (a culvert) within the Action Area. A summary of other surveys and bat activity associated with this culvert is included below in Section 3.10.4.

As a result of telemetry work, ISU identified a secondary roost site, used by an adult male, in a small building about 100 ft. from the culvert roost. The bat was documented using the roost only one night, and no bats were observed emerging from the structure during subsequent emergence surveys (Joey Weber, personal communication). Although within the Action Area, this roost will not be demolished as part of the project activities.

While checking culverts as part of their research project, ISU documented another culvert in the Action Area that conveys Smith Mill Creek under Patton Avenue west of the French Broad River as a MYGR roost (Joey Weber, personal communication). More detailed info on this discovery is included below in Section 3.10.4.2.

3.10.3 Telemetry Surveys

Telemetry data indicates that MYGR are flying through and foraging within the Action Area. NCWRC staff attached transmitters to MYGR from the nearby maternity roost during 2016 and 2017. In 2016, two bats were tracked for 12 days and the bats returned to the roost each night. Bat A foraged along Hominy Creek in the area near Pond Road. Bat B foraged along the French Broad River just north of the I-40 crossing (NCWRC 2017).

In 2017, three individuals were captured at the maternity roost and tracked for 13 days. On most nights, the bats returned to the maternity roost. However, one bat traveled over 20 mi. to a roost in Madison County on three nights. On seven nights, bat roost locations could not be found. Unlike the bats tracked in 2016, bats tracked in 2017 did not consistently return to the same foraging areas. One bat travelled south to forage along the French Broad River just north of Long Shoals Road. The other bats flew north from the roost and foraged along Hominy Creek, Bent Creek, Long Valley Lake (on Biltmore Estate property), and various locations on the French Broad River (NCWRC 2017).

In 2018, transmitters were placed on 90 bats as part of the ISU research project in part to collect information on foraging and commuting areas. Bats appear to forage mainly over water, usually the French Broad River and associated tributaries. However, individuals were also detected in other areas that were not associated with water. During August 2018, two bats were tracked via car from two roosts near the Action Area and were found foraging within the Action Area. MYGR were tracked via ground telemetry throughout the Action Area. Similarly, two different bats were located within the Action Area during aerial telemetry in October 2018; one along Hominy Creek near I-40 and Sand Hill Rd., and the other with multiple foraging points south and north of the Captain Jeff Bowen Bridges (I-26/US 19/US 23, Patton Avenue). Two other bats were detected very close to the Action Area in the vicinity of the I-40 bridges over the French Broad River, and another on the east side of I-26 at the Riverside Cemetery (Weber et al. 2018).

Telemetry towers equipped with dataloggers were also set up throughout the French Broad watershed to collect additional data on radio-tagged bats. Two of these towers are located within the project area and tagged bats were detected at both. One tower located near the culvert roost recorded 22 radio-tagged bats, and another tower located on Hominy Creek between I-240 and I-40 recorded 6 radio-tagged bats (Joey Weber, ISU, personal communication). This further confirms areas of MYGR activity within the Action Area.

3.10.4 Culvert Roosts

Two MYGR culvert roosts have been identified within the Action Area. This section summarizes all the information gathered to date about MYGR activity at these culverts.

3.10.4.1 Hill Street Culvert Roost

All bridges and culverts in the action area were checked for evidence of bat use, and only one culvert showed evidence of bats. The culvert is located adjacent to the French Broad River and conveys a UT under Riverside Drive. For purposes of protection of the resource, the exact location of this structure will not be identified in this report. As described in Section 2.1.1, the main culvert is an 8 ft. by 8 ft. concrete box culvert that is over 1000 ft. in length. The downstream end of the culvert has two smaller metal pipes attached. Multiple corrugated metal pipes of various lengths and diameters join the box culvert along its length and at its upstream end. These pipes and drop inlets provide other potential points of entry/exit for bats. Although the culvert system carries stormwater from a relatively large area, a baseflow is present year-round. Unlike other culverts that were investigated as part of this project, there does not appear to be regular human activity in the culvert system.

A timeline of notable events associated with the culvert roost follows:

- August 24, 2017: CLAYX biologists discover 10-15 bats flying inside culvert and staining on culvert walls. The bats were tentatively identified as MYGR. Biologists chose to quickly exit the culvert upon unexpectedly disturbing the bats.

- September 7, 2017: NCWRC and USFWS conducted an emergence count at the culvert. Two bats were seen flying from one of the culvert inlets and approximately 200 bats were seen flying from the culvert outlet. Results of acoustic recordings were inconclusive, probably due to the nature of the (social) calls being produced by the bats as they left the roost.
- September 13, 2017: NCWRC and USFWS enter culvert and identify a MYGR. To avoid further disturbance to the colony, they did not proceed deeper into the culvert.
- December 13. 2017: NCWRC and CALYX/NV5 checked the culvert for bats, and none were found. Guano and staining were not concentrated in any particular area.
- February 15, 2018: NCDOT contractors inspected culvert system. No bats were present.
- Week of March 15, 2018: Over 100 calls identified as MYGR were recorded at the culvert outlets. Previous weeks of call data had fewer than 10 calls per week.
- April 19, 2018: Trapping yielded 6 adult male MYGR
- April 27, 2018: Trapping yielded 11 adult male MYGR
- Week of May 28, 2018: Substantial flooding; backwater from river left approximately one foot of open space at the top of the culvert outlets.
- June 4, 2018: Emergence survey yielded no bats
- July 3, 2018: Emergence survey yielded no bats
- July 26, 2018: Trapping yielded 5 adult female, 28 adult male, and 7 juvenile MYGR
- August 6, 2018: Trapping yielded 2 adult female, 19 adult male, and 8 juvenile MYGR
- August 15, 2018: Trapping yielded 8 adult female, 40 adult male, and 2 juvenile MYGR
- September 16-20, 2018: Substantial flooding from Hurricane Florence; backwater from French Broad River
- September 13, 2018: Emergence survey yielded 35 bats
- October 11, 2018: Substantial flooding; backwater from French Broad River
- Week of October 18, 2018: Notable decline in the number of MYGR calls recorded at the culvert outlet. Low numbers of calls were recorded through the middle of November.
- January 16, 2019: NCDOT used a crawler system to inspect the culvert and produce a video recording of the interior for purposes of determining the integrity of the structure. No bats were observed inside the culvert on the recording.
- March 22, 2019: ISU entered the culvert and observed five MYGR roosting in the RCBC section of the culvert system. No other bats were present.
- April 16, 2019: One male MYGR captured during trapping and tagged with a radio-transmitter.
- April 26, 2019: Trapping at culvert yielded no MYGR
- May 5, 2019: No bats observed leaving culvert during emergence survey.
- July 3, 2019: No bats observed leaving culvert during emergence survey.
- July 15, 2019: 47 bats of both sexes and age classes were trapped at the culvert. Individuals were captured flying both into and out of the culvert.
- August 1, 2019: Twelve adult MYGR (males and females) were captured flying both into and out of the culvert.
- August 28, 2019: Nine bats flew from the culvert outlet during an emergence survey.
- September 16, 2019: Three female and 5 male MYGR were captured during harp trapping. One male was a recapture
- September 26, 2019: One female and 12 male MYGR were captured during harp trapping. Two males were recaptures.
- October 5, 2019: 29 male (six recaptures) were captured during harp trapping.

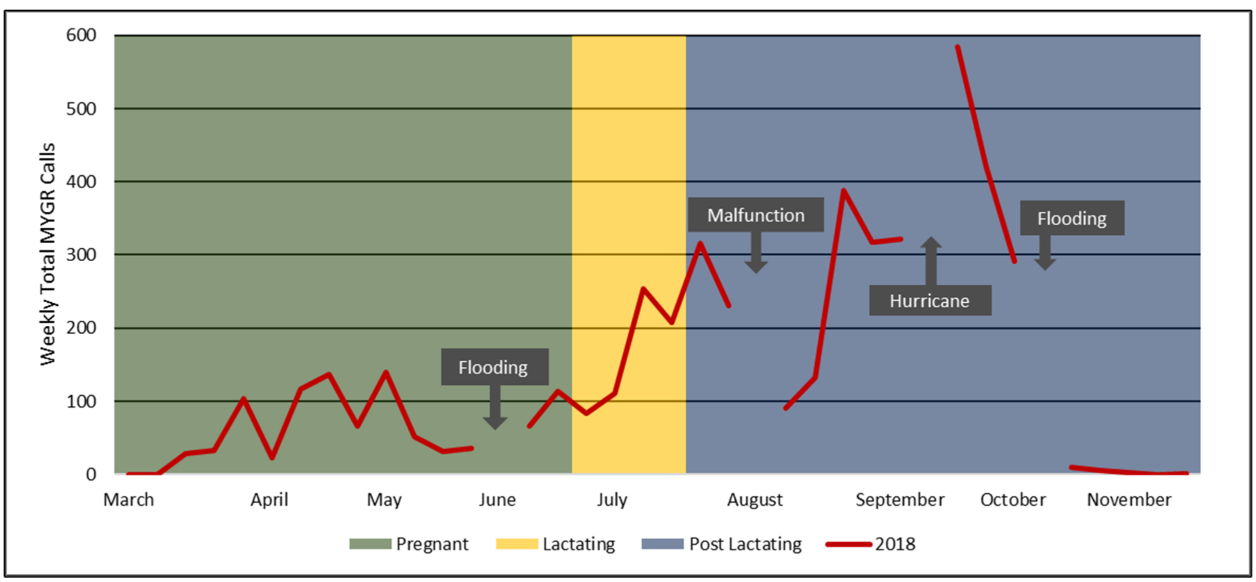
Based on emergence counts, ISU estimates the number of bats using the culvert to be at least 250. However, some emergence surveys recorded no individuals emerging from the culvert. This suggests that use of the culvert may be intermittent or seasonal. During emergence counts on 4 June and 3 July in 2018 (≥5 potential entrances were watched; thermal imaging and/or night vision devices were used on 3 entrances), no bats were detected emerging from the culvert. Trapping at the culvert outlet produced captures of mostly adults (males and females), but juveniles of both sexes have also been captured during 2018 and 2019 trapping events. Bats were trapped flying both out of and into the culvert, and bats tagged at the culvert also used other roost sites. During additional visits to the culvert for trapping or general observation, it was noted that bats seem to be emerging well after sunset, and activity at the culvert (bats flying in and out) continues well into the night or early morning. (Joey Weber, personal communication).

We do not know with certainty that the site is not being used as a MYGR maternity roost. Flooding that occurred the week of May 28, 2018 caused the French Broad River to escape its banks and resulted in standing water in the culvert for an unknown number of days. This may have caused pregnant females to select another roost site for the season and may also explain the lack of bats counted during some emergence counts.

During trapping/netting, bats regularly fly in from other locations 20 minutes to an hour after emergence time and try to get past the trap/nets to get into the culvert. It is likely that bats from the nearby maternity roost are flying up to the culvert at dusk. In fact, radio-tagged bats have been tracked doing this very thing. Therefore, it appears the culvert is a significant night roost, in addition to serving as a day roost (Joey Weber, personal communication). During trapping events in late 2019, it was noted that more bats were captured flying from the culvert rather than into the culvert than on previous trapping events that year (Joey Weber, personal communication).

Considering MYGR acoustic activity at the culvert roost (Site 5), we see a general trend in increasing calls over the course of the season (Chart 2) like many of the other detector sites. There is a general trend of increasing activity throughout the season, a decrease in calls that coincides with a detector malfunction in August, then a sustained drop in calls during the middle of October.

Chart 2: Total Weekly MYGR Calls, Per Season, at Site 5 Culvert Roost



When evaluating nightly activity at the culvert roost during various reproductive seasons, we notice a high level of activity when MYGR females are typically pregnant before midnight. No pattern of activity is discernible while females are lactating, but after pups become volant, activity at the culvert remains consistent throughout the night. Charts 5-7 in Appendix C illustrate these patterns. This pattern is consistent with reports from ISU while they were at the culvert for trapping and observation.

3.10.4.2 Smith Mill Creek Culvert Roost

As part of their research project, ISU biologists checked the culvert that carries Smith Mill Creek under Patton Avenue west of the French Broad River on September 12, 2019. They found five MYGR roosting at the top of the culvert wall, near the intersection of the upstream and middle sections. Two of the bats had forearm bands, one of which was identified as an ISU band. ISU checked this culvert in summer 2018 and did not see any bats (Joey Weber, ISU, personal communication). CALYX biologists checked the culvert in August 2017 and did not see any bats or evidence of bat use. No evidence of frequent bat use (i.e. guano, staining) was noted on the culvert walls. No emergence or acoustic surveys have been conducted at this culvert. Due to the small number of bats that were documented using this culvert as a roost, as well as the presumed infrequent use, this site is considered a secondary roost site for MYGR.

4.0 SPECIES STATUS FOR APPALACHIAN ELKTOE

Appalachian elktoe is assumed to occur within a portion of the Action Area, specifically the main stem of the French Broad River (Figure 8 of Appendix A). Freshwater mussel surveys were conducted June 12 through October 6, 2017, and the results of these surveys are included in the Freshwater Mussel Survey Report (Appendix D).

Although no Appalachian elktoe were found within the Action Area, they were found in the French Broad River approximately 1.5 river mi. upstream from the Action Area in September 2017 (Three Oaks Engineering 2018). Based on habitat conditions and the difficulty detecting species that are present in low numbers, it is possible that the Appalachian elktoe occurs within the Action Area in the French Broad River but was not detected during survey efforts.

4.1 Watershed Conditions Baseline

The following information describes factors affecting the environment of Appalachian elktoe in the Action Area. The current physical and chemical conditions of the French Broad watershed are primary factors that influence the population status of the respective species. Land use along the proposed I-2513 corridor is mixed, with residential development throughout the urbanized areas of the Action Area. Large amounts of land are utilized for commercial purposes in downtown Asheville and along several interchanges. Undeveloped land is scattered along I-40 and the French Broad River (NCDOT 2015)

The Action Area is contained within the Upper French Broad River subbasin (USGS hydrologic unit code [HUC] 06010105), which covers an area of approximately 1,000,000 acres, draining Asheville, Brevard, Hendersonville, and many other municipalities. The headwaters of the Upper French Broad River are in western Transylvania County, which flow north through Asheville to the Tennessee-North Carolina state line (North Carolina Department of Environment and Natural Resources [NCDENR] 2011). The I-2513 project roughly parallels the French Broad River and then traverses upland areas away from the river where large tributaries and smaller feeder streams are crossed.

The French Broad River basin has been impacted by various actions in the past that have likely affected the Appalachian elktoe. Past impacts to the river basin and the species, and how they relate to the present conditions and population status, are discussed below.

Beginning with the arrival of European settlers in the late 18th century, the French Broad River basin became home to many industrial facilities, including paper mills, tanneries, manufacturing, and tobacco production. With no regulations to limit what could be dumped in the river, the river became polluted. These industries began to decline at the end of the 20th century. With public outcry over the state of the river, the French Broad River was slowly cleaned up (Dykeman 1955). The passage of the CWA in 1972, as amended, also improved water quality. The involvement of community initiatives, such as the Asheville Riverfront, continues to push forward the restoration of the French Broad River. Today, the river is used for recreation, such as tubing and rafting, as well as a source of drinking water for local municipalities; however, it is not completely restored and still faces threats from coal ash leachate and continued development (Delaney 2013).

Water quality monitoring programs have been implemented by the North Carolina Division of Water Resources (NCDWR) to assess water quality trends in North Carolina waters. One method used is the monitoring of benthic macroinvertebrates, or benthos, to assess water quality by sampling for selected organisms. A biodiversity rating is based on the taxa richness of the stream and qualitative sampling for invertebrates intolerant of degraded water quality, such as mayflies (Ephemeroptera), stoneflies (Plecoptera), and caddisflies (Trichoptera), collectively referred to as EPT. Excellent and Good ratings indicate that the best usage classification for that stream is being supported. A rating of Good-Fair indicates that the usage is supported but is threatened. A Fair rating relates to a partial support of the best usage. A Poor rating indicates that the best usage classification for that stream is not being supported.

Monitoring stations demonstrated overall improvements in EPT scores throughout the Upper French Broad River subbasin (North Carolina Division of Environmental Quality [NCDEQ] 2018a), with ratings of Poor or Fair in the late 1990s improving to Good-Fair in the early 2000s. Hominy Creek showed improved scores from 2007 to 2012 (NCDEQ 2018a), while conditions at French Broad monitoring stations remained stable at NC 146 (upstream of the Action Area) from 1987-2007 and improved at SR 1348 (within the Action Area). The most recent available EPT scores from monitoring stations within five mi. upstream of the I-2513 Action Area are listed in Table A of Appendix F.

Another method of assessing water quality is a fish community assessment, which assigns an Index of Biotic Integrity (IBI). The IBI is a measure of species richness and composition, trophic composition, and fish abundance and condition. There are four IBI sites within five mi. upstream of the Action Area (Table 4; NCDEQ 2014). Results indicate mainly stable fish communities over the course of sampling; however, data points per site are sparse and recent data are not available.

Table 4. Fish Community Assessments within Five Miles of the Action Area

Water Body	Location	Date	IBI Score/Rating*
Bent Creek	Off NC 191	6/27/2012	50/Good
Hominy Creek	NC 151	6/26/2012	50/Good
South Hominy Creek	NC 151	6/27/2012	50/Good
Swannanoa River	US 25	6/27/1993	32/Poor

*Data provided by NCDEQ Fish Community Mapping – Most Recent Rating Per Station (as of Dec. 2014)

4.1.1 Best Usage Classification

NCDWR assigns a best usage classification to all waters of North Carolina. These classifications provide a level of water quality protection to ensure that the designated usage of that water body is maintained.

The minimum designation of Class C waters imposes a minimum standard of protection for all waters of North Carolina; they are protected for secondary recreation, fishing, wildlife, fish and aquatic life propagation/survival, and agriculture. Table 5 lists the named streams within the Action Area, their Usage Classification and NCDWR index number (NCDWR 2017). Unnamed tributaries carry the classification of the receiving water body (Figure 9 of Appendix A).

Table 5. Named Streams within the Action Area

Stream Name	Map ID	NCDWR Index Number	Best Usage Classification*
French Broad River	SA	6-(54.5)	B
Lower Hominy Creek	SB	6-76	C
Upper Hominy Creek	SX	6-76	C
Moore Branch	SC	6-77	C
Ragsdale Creek	SV	6-76-11	C
Reed Creek	SJ	6-80	C
Smith Mill Creek	SR	6-79	C
Trent Branch	SW	6-76-10	C
Emma Branch	SP	6-79-2	C

*B = Primary Recreation, Fresh Water; C = Aquatic Life, Secondary Recreation, Fresh Water

4.1.2 Impaired 303(d) Listing

Under Section 303(d) of the CWA, impaired waters are defined as water bodies that do not meet water quality standards even after the minimum required levels of pollution control technology have been installed at point sources of pollution. Failures to meet standards may be due to an individual pollutant, multiple pollutants, or unknown causes of impairment. Streams on the 303(d) list are categorized based on type of impairment. The North Carolina 2018 Section 303(d) list identifies Smith Mill Creek from its source to the French Broad River (within the Action Area) for exceeding criteria; the parameter of interest is Benthos (NCDEQ 2019). Table 6 lists all impaired streams within five mi. of the Action Area as an indication of general water quality draining to the Action Area (NCDEQ 2019). They are also shown in Figure 10 (Appendix A).

There are no North Carolina Wildlife Resources Commission (NCWRC) designated trout waters, water supply watersheds (WS-I or WS-II), High Quality Waters (HQW), or Outstanding Resource Waters (ORW) within 1.0 mile downstream of the Action Area.

Table 6. 2016 303(d) Category 5 Streams within Five Miles of the Action Area

Stream	AU Number*	Length/Area	Reason for Rating	Parameter (Year)
Smith Mill Creek	6-79	5.37 FW mi	Exceeding Criteria	Benthos – Fair (2016)
UT to Little Pole Creek	6-76-6-2ut1	1.7 FW mi.	Exceeding Criteria	Turbidity (2014)
South Hominy Creek	6-76-5b	8.05 FW mi.	Exceeding Criteria	Benthos – Fair (2012)
Ross Creek (Lake Kenilworth)	6-78-23b	1.14 FW mi.	Exceeding Criteria	Benthos – Poor (2000)
Newfound Creek	6-84a	3.97 FW mi.	Exceeding Criteria	Benthos – Fair (2002)
	6-84b	0.83FW mi.	Exceeding Criteria	Benthos – Fair (2002)
	6-84c	3.36 FW mi.	Exceeding Criteria	Benthos – Fair (2002)
	6-84d	4.65 FW mi.	Exceeding Criteria	Benthos – Fair (2007)
	6-84e	1.66 FW mi.	Exceeding Criteria	Benthos – Fair (2012); Fish Community – Poor (2013)

*AU = Assessment Unit; FW = Freshwater

4.1.3 Point Source Pollution

Point source discharge is defined as discharge that enters surface waters through a pipe, ditch, or other well-defined point of discharge. Section 402 of the Clean Water Act establishes the National Pollutant Discharge Elimination System (NPDES) permitting program. In North Carolina, NCDWR is responsible for permitting and enforcement of the NPDES program. NPDES dischargers are divided into two categories: individual and general. General permits are issued for specific activities, including non-contact cooling water discharges, petroleum-based groundwater remediation, sand dredging, and domestic discharges from single family residences. Individual permits are issued on a case-by-case basis for activities not covered under general permits. Individual permits are divided into two classes: major discharges permitted to discharge one million gallons per day or greater and minor discharges permitted to discharge less than one million gallons per day (NCDEQ 2018b).

According to the NCDEQ (2018b), there are no NPDES permitted discharges within the I-2513 Action Area. Within five mi. of the Action Area, there are ten NPDES individual permitted discharges (Table B of Appendix F and Figure 11 of Appendix A) and 13 NPDES general permitted discharges (Table B of Appendix F and Figure 11 of Appendix A).

4.1.4 Non-point Source Pollution

Non-point source (NPS) pollution refers to runoff that enters surface waters through stormwater or snowmelt. There are many types of land use activities that contribute to NPS pollution, including land development, construction activities, animal waste disposal, mining, agriculture, and forestry operations, as well as impervious surfaces such as roadways and parking lots. A discussion of land cover within the Action Area can be found in Section 4.3, along with the effects of non-point pollution on aquatic species from human development and associated impervious surface area.

NCDOT has an individual NPDES permit (NCS000250) which permits stormwater discharge from roadway drainage systems, construction activities, borrow pits, and industrial sites. Part II, Section D – Construction of the permit, provides the objectives for NCDOT's Sediment and Erosion Control Program (SECP):

- Require construction site operators to implement appropriate sediment and erosion control practices.
- Require site inspection and enforcement of control measures.

- Establish requirements for construction site operators to control waste that may cause adverse impacts to water quality such as discarded building materials, concrete truck washout, chemicals, litter and sanitary waste at the construction.

The SECP requires the submission and approval of erosion control plans on all projects disturbing one or more acres prior to construction. The NCDOT, in cooperation with NCDWR, has developed a sedimentation control program for highway projects, which adopts formal Best Management Practices (BMPs) for protection of surface waters (NCDOT 2003).

4.2 Appalachian Elktoe Species Information

A detailed description of characteristics and habitat requirements for the federally endangered Appalachian elktoe is provided below.

Appalachian elktoe (*Alasmidonta raveneliana*) (I. Lea 1834)
Status: Endangered
Family: Unionidae
Listing Date: September 3, 1993
Critical Habitat: Designated, see Section 4.5

4.2.1 Species Characteristics

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) cite a maximum length of 8 cm. 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 more than 9.9 cm in length (USFWS 2009b). 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.

Many 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. Research at Tennessee Technical University identified 10 fish species with encysted Appalachian elktoe glochidia from the Little Tennessee River in North Carolina (Jim Layzer, Tennessee Tech University, personal communication; Table 7).

Table 7. Fish Species Collected from the Little Tennessee River (NC) with 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 fish species (Table 8) successfully transformed Appalachian elktoe glochidia in laboratory induced infestations (Jim Layzer, Tennessee Tech University, personal communication). All of the species listed in Table 7, with the exception of the wounded darter and rosyside dace, are known to occur within the Upper French Broad River subbasin (Rhode et al. 1994, Menhenick 1991). Based on 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, formerly of 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 to 36 hours. Transformation time (time until encystment) for the Appalachian elktoe occurs within 18 to 22 days, at a mean temperature of 64 °F (Jim Layzer, Tennessee Tech University, personal communication).

Table 8. Fish Species Collected from the Tuckasegee River (NC) Used for Laboratory Induced Infestation

Common Name	Scientific Name	Number
Wounded darter	*Etheostoma vulneratum*	17
Greenfin darter	*Etheostoma chlorobranchium*	32
Greenside darter	*Etheostoma blennioides*	3
Mottled sculpin	*Cottus bairdi*	19
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

4.2.2 Distribution and Habitat Requirements

The Appalachian elktoe is known only from the mountain streams of western North Carolina and eastern Tennessee. It is found 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, two known populations of the Appalachian elktoe existed in North Carolina: the Nolichucky River and its tributaries, and the Little Tennessee River and its tributaries. Historically, the species had also been recorded from Tulula Creek (Tennessee River drainage), the main stem of the French Broad River, and the Swannanoa River (French Broad River system) (Clarke 1981), but it was reported to have been eliminated from these streams (USFWS 1994, USFWS 1996). In fact, Ortmann (1921) reported that the mussel fauna in the French Broad River had been eliminated by pollution coming from lumber production in the Davidson River. Since listing, the Appalachian elktoe has been found in additional areas, including the French Broad River basin (Pigeon River, Little River, Mills River, and French Broad River). Since 2004, the known range of Appalachian elktoe in the main stem of the French Broad River has expanded and now appears to be established at low density over a broad area (USFWS 2017a). The USFWS (2017a) notes that overall, most of the surviving Appalachian elktoe populations are comprised of scattered occurrences, restricted to pockets or short reaches of suitable habitat.

4.2.3 Environmental Baseline in the French Broad River

At the time of listing, the Appalachian elktoe was thought to have been eliminated from the main stem of the French Broad River (USFWS 1994, USFWS 1996), as no modern records of this species existed previously from the river, which was attributed to decades of pollution and development that had degraded the habitat. Records available from the NCWRC's database indicate that Appalachian elktoe were collected in 2005 from the French Broad River main stem at the Crab Creek Road crossing, just downstream of the Little River confluence in Transylvania County.

Since the rediscovery in 2005, the known range of the Appalachian elktoe has expanded considerably; it is now known to occupy a substantial portion of the Upper French Broad River, extending downstream of Mills River, NC. Given that the rediscovery in the main stem of the French Broad River was close to the confluence with the Little River, where it was already known to occur, and the upstream and downstream direction of subsequent "discoveries" in the river, the scientific consensus is that these recent records of the Appalachian elktoe in the French Broad represent a range expansion from the Little River, rather than it having been previously overlooked (Jason Mays, USFWS, and Steve Fraley, formerly of NCWRC, personal communication). Reasons for potential population expansion in the Upper French Broad River basin may include improved water quality, stabilization of suitable habitat providing for mussel colonization, and increased abundance of host fish. The population in the Upper French Broad River may be considered viable if it continues to increase (USFWS 2017a).

Mussel surveys were conducted for I-2513 June 12 through October 6, 2017, at eight distinct sites in the French Broad River and two sites in Hominy Creek (Appendix D). The Appalachian Elktoe was not found at any sites within the Action Area, but recent survey data for I-4400/I-4700 indicate Appalachian elktoe are present in the mainstem of the French Broad River approximately 1.5 river mi. upstream of the Action Area (Three Oaks Engineering 2018). Based on habitat conditions and the difficulty detecting species that are present in low numbers, it is possible that the Appalachian elktoe occurs at other sites surveyed on the French Broad River but was not detected. The species is assumed to be present in the French Broad River throughout the Action Area and continuing downstream to the Metropolitan Sewerage District of Buncombe County wastewater treatment plant (WWTP).

4.3 General Threats to Species

The cumulative effects of several factors, including habitat loss and alteration associated with impoundments, channelization, mining, and dredging operations; pollutants in wastewater discharges (sewage treatment plants and industrial discharges); and runoff of silt, fertilizers, pesticides, and other pollutants from land disturbance have contributed to the decline of the Appalachian elktoe throughout its range (USFWS 1996, 2017a).

Although the 2017 status review for Appalachian elktoe (USFWS 2017a) notes that some populations appear to be stable (Tuckasegee, Cheoah, and Pigeon Rivers), others have experienced declines. A die-off in the Little Tennessee River, once considered the largest and most secure population, began in 2005 and continued through 2015, at which time monitoring efforts failed to find any live individuals, which led to the conclusion that the population remains at or below detectable levels; the loss marks a substantial decrease of the global population (USFWS 2017a). However, a few live individuals were found in the Little Tennessee River during monitoring in 2018 (Luke Etchinson, NCWRC, personal communication). The cause of this sudden decline remains unknown despite efforts to reveal a cause. Appalachian elktoe has also declined in portions of the South Toe River population (discussed in Section 4.3.1). The remaining populations are isolated from one another by impoundments, and natural gene flow is not possible between the populations due to these barriers (USFWS 2017a). Since most Appalachian elktoe populations are restricted to scattered areas of suitable habitat, they are vulnerable to extirpation from catastrophic events (USFWS 2017a). 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, railroads, or industrial-municipal complexes.

USFWS (2017a) states that most of the surviving populations of the Appalachian elktoe continue to face substantial threats associated with development activities, agriculture operations, wastewater discharges, stormwater runoff, and nonpoint source pollutants.

4.3.1 Sedimentation

Siltation resulting from substandard land-use practices associated with activities such as agriculture, forestry, and land 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 by direct smothering of mussels (Ellis 1936; Marking and Bills 1979). In addition, 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). Sediment accumulations of less than 25 mm have been shown to cause high mortality in most mussel species (Ellis 1936).

Appalachian elktoe have declined in the lower portion of the South Toe River, a tributary of the Nolichucky River. The cause appears to be related to sediment pollution deriving from the construction of a large highway project and other non-point sources of sediment in the South Toe River watershed, as well as a WWTP (USFWS 2017a). Appalachian elktoe are still present, but at reduced density in the affected reach.

The Little Tennessee River population of Appalachian elktoe occurs below the dam at Lake Emory. The river channel above Lake Emory carries a very high load of unstable sediments and is devoid of mussels. It is believed that Lake Emory previously served as a sediment trap that helped to protect the integrity of the river below the dam. However, the lake has filled in with sediment, and sediment accumulations affecting habitat quality in the river below the lake have become increasingly common (USFWS 2009b).

4.3.2 Habitat Alteration

The impact of impoundments on freshwater mussels has been well documented (Neves 1993). Construction of dams transforms lotic habitats into lentic habitats, which results in changes in aquatic community composition. The changes associated with inundation adversely affect both adult and juvenile mussels as well as fish community structure, which could eliminate possible fish hosts for upstream transport of glochidia. In addition, the construction of dams often results in fragmentation of mussel populations, effectively blocking upstream expansion and recruitment of mussel and fish species and creating a barrier to fish migration. The construction of the Petitcodiac River Causeway in Canada in 1968 resulted in the extirpation of the dwarf wedgemussel (*Alasmidonta heterodon*), because the causeway restricted the migration of Atlantic salmon (*Salmo salar*), which served as the fish host for the dwarf wedgemussel in this region (Locke et al. 2003).

4.3.3 Toxic Contaminants

Pollution in waterways is known to adversely affect aquatic organisms in a variety of ways (Choudri and Baawain 2016). Regarding freshwater mussels, the presence of toxic contaminants has been shown to contribute to widespread declines of populations (Havlik and Marking 1987; Bogan 1993; Neves et al. 1997; Richter et al. 1997; Strayer et al. 2004; Henley et al. 2016). In 2004, hundreds of Appalachian elktoe and other mussel species were found dead in a short reach of the Little Tennessee River immediately below the dam at Lake Emory (Mark Cantrell, USFWS, personal communication). The cause of this kill is unknown, but a local resident reported smelling a strong chlorine odor in the area the day before the kill was discovered (USFWS 2009b). Toxic contaminants can produce lethal or sub-lethal responses in freshwater mussels. The sensitivities of freshwater mussels to toxic contaminants is variable based on species, life stage (glochidium, juvenile, or adult), and environmental conditions, as well as concentration and exposure type (water column, sediments, etc.), frequency, and duration. Several studies have indicated that early life stages of freshwater mussels are among the most sensitive aquatic organisms to various inorganic toxicants such as copper (Jacobson et al. 1993; Jacobson et al. 1997; Milam et al. 2005; Wang et al. 2007a; Wang et al. 2007b), manganese, and ammonia (Archambault et al. 2017, Wade 1992; Augspurger et al. 2003; Newton et al. 2003; Wang et al. 2007a; Wang et al. 2007b; Grabarkiewicz and Davis 2008).

Anthropogenic sources of ammonia and copper in surface waters include sewage treatment effluent, industrial wastewater effluent, and runoff and ground water contamination from agriculture, lawn/turf management, livestock operations, roadways, and faulty septic systems. Additionally, exposure to raw sewage can have numerous impacts on aquatic organisms, resulting in fish kills and damage to shellfish beds (USEPA 2011).

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 mi. below discharges of chlorinated sewage effluent. Similarly, Gillis et al. (2014) found that mussels were absent for 4.3 mi. below a WWTP on the Grand River in Ontario, Canada. Water quality measurements demonstrated that ammonia and nitrate concentrations, along with diel declines in oxygen, were associated with the extirpation of mussels in that 4.3-mi. reach.

In addition, studies indicate other toxicants present in wastewater effluent such as pharmaceuticals and personal care products (fluoxitine, estrogenic compounds, opiate derivatives etc.) cause a wide array of neurotoxicological (Gagné et al 2007a), reproductive (Bringolf et al. 2010; Gagné et al 2007b), and behavioral (Hazelton et al. 2013, Bringolf et al. 2010) impacts to freshwater mussels (de Solla et al. 2016).

Most of the streams that support Appalachian elktoe populations do not have adequate designations for protecting occupied reaches from pollutants associated with new or expanded wastewater discharges (USFWS 2017a). In 2008, problems with the effluent from the Burnsville WWTP on the Cane River coincided with the loss of the Appalachian elktoe from approximately 19 river mi. of the river (John Fridell, formerly of USFWS, personal communication).

Other sources of toxic contaminants in surface waters arise from highway and urban runoff. Gillis (2012) demonstrated that chronic exposure to a combination of WWTP effluent and highway runoff negatively affected freshwater mussel health and life span in urbanized watersheds. Although a specific cause was not identified, the assumption is that chronic exposure to multiple contaminants negatively effects health and longevity. Numerous pollutants have been identified in highway runoff, including various metals (lead, zinc, iron, copper, cadmium, etc.), sediment, pesticides, deicing salts, nutrients (nitrogen, phosphorus), and petroleum hydrocarbons (Gupta et al. 1981; Yousef et al. 1985; Davis et al. 2001; Gillis et al. 2014). The sources of these runoff constituents range from construction and maintenance activities to daily vehicular use.

Hoffman et al. (1984) concluded that highway runoff can contribute up to 80 percent of the total pollutant loadings to receiving water bodies, identifying, among others, petroleum hydrocarbons, polycyclic aromatic hydrocarbons (PAHs), lead, and zinc. PAH compounds are largely derived from petroleum related sources (e.g., gasoline, oil) and are of major concern from transportation-related runoff to aquatic systems due to their potential acute and chronic toxic properties (Humphries 2006). Potential effects of highway runoff have often been inferred from studies conducted on urban runoff; however, the relative loadings of pollutants are often much greater in urban runoff, because of a larger drainage area and lower receiving water dilution ratios (Dupuis et al. 1985). The negative effects of urban runoff inputs on benthic macroinvertebrate communities have been well documented (Garie and McIntosh 1986; Jones and Clark 1987; Field and Pitt 1990; Lieb and Carline 2000). The effects of highway runoff on freshwater bivalves have not been studied extensively. Augspurger (1992) compared sediment samples and soft tissues of three eastern elliptios (*Elliptio complanata*) upstream and downstream of the I-95 crossing of Swift Creek of the Tar River Basin in Nash County, North Carolina. The sediment samples, as well as the mussels, exhibited higher levels of aliphatic hydrocarbons, arsenic, lead, zinc, and other heavy metal contaminants in the downstream samples. In another study, contaminant analysis of stream sediments showed an increase of PAHs and some metals downstream of road crossings, although there was no direct correlation found between increasing contaminant levels and decreasing mussel abundance at these crossings (Levine et al. 2005). Humphries (2006) showed that mussels from streams with higher average daily traffic counts (ADTC) exhibited greater levels of genetic damage compared to mussels from streams with lower ADTC values. Additionally, laboratory data showed increasing DNA damage relative to increasing PAH concentration. Humphries (2006) concluded that "PAHs are not likely contributing to acute toxicity of mussels in North Carolina streams, but the chronic, long-term pervasive effect of PAHs on native freshwater mussels remains uncertain." Further research is needed before the effects of highway runoff on sensitive mussel species such as the Appalachian elktoe can be determined.

Contamination of surface water from toxic spills along roadways is known to have substantial impacts to aquatic communities. 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 mi. of mussel populations in the Clinch River near Cedar Bluff, Virginia (Richmond Times-Dispatch 1998). The spill killed thousands of fish and mussels, including three federally protected species. The presence of hazardous spill basins adjacent to crossings of waterways that support sensitive species provides the potential to avoid and/or minimize major kills such as this.

4.3.4 Hydrologic Changes Due to Changes in Land Use

The correlation of increasing development within a watershed and decreasing water quality is well documented (Lenat et al. 1979; Garie and McIntosh 1986; Crawford and Lenat 1989; Lieb and Carline 2000) and is largely associated with increases in impervious surface area. These increases in impervious surface area can affect water quality in a variety of ways, particularly regarding changes to stream flow, water temperature, total suspended sediment, and pollutant loadings.

Multiple studies have demonstrated that water quality and stream ecosystem degradation begin to occur in watersheds that have approximately 10 percent coverage by impervious surfaces (Schueler 1994; Arnold and Gibbons 1996; Stewart et al. 2001). NCWRC recommendations for management of protected aquatic species watersheds are to limit imperviousness to 6 percent of the watershed (NCWRC 2002).

The I-2513 Action Area is approximately 75 percent developed, with 3.3 percent in high intensity development (80 to 100 percent impervious surfaces), 12.6 percent in medium intensity development (50 to 79 percent impervious surfaces), 25.7 percent low intensity development (20 to 49 percent impervious surfaces), and 33.3 percent open space development (less than 20 percent impervious surfaces), based on the 2015 National Land Cover Dataset (NLCD, Homer et al. 2015).

Per the CP4A Merger Packet, the project is anticipated to affect 374 acres of maintained/disturbed habitat and 191 acres of forested habitat (I-2513 CP4A Merger Packet, Appendix G). There will be an increase in impervious surfaces of approximately 125 acres (Appendix G).

4.3.4.1 Peak Discharge

Peak discharge is the maximum rate of stormwater flow expected from a storm event, measured in cubic ft. per second (cfs). Increases in peak discharge equates to higher velocity, which in turn increases the scouring effect (surface erodibility) of the runoff. Accordingly, sedimentation will increase as erosion rates increase. Increases of peak discharge rates, coupled with deforestation, have been shown to result in stream narrowing and incision and subsequent loss of ecosystem function (Sweeney et al. 2004). Shields et al. (1994) found that during base flows, incised streams contained fewer habitat types, particularly pool habitats, and lower fish species diversity than non-incised streams. Conversely, increases in peak discharge can also result in channel widening, as streambanks become susceptible to mass failure (Simon and Rinaldi 2006). Harvey and Watson (1986) found that increases in channel cross-sectional area of up to 1,000 percent can occur within a few years.

4.3.4.2 Runoff Volume

Runoff volume is the amount of stormwater expected from a storm event. Like peak discharge, runoff volume is another metric often used in determining effects of development. For example, increases in the amount of runoff normally equates to increased sediment. While the two indicators are related, when analyzed separately, both are useful in assessing impacts to aquatic systems.

In a stable system, an increase in volume may have little impact if velocity does not change, provided that measures to slow increased velocity have been implemented. However, increased runoff volume may have enough sediment to cause detrimental effects. Regardless, it is important to consider both the rate (peak discharge) and the amount (runoff volume) when assessing effects to aquatic systems. Sufficient stormwater controls accompanying future development activities are important considerations for conservation of sensitive aquatic species such as Appalachian elktoe.

4.3.4.3 Base Flow

Increases of impervious surface lead to decreases in infiltration and base flow (groundwater flow) within adjacent streams. This can result in the following:

- Less water to cover the stream bottom during periods of reduced base flow.
- Increases in water evaporation and temperature in widened streams because of reduced overhanging tree cover and increased exposure to sunlight, especially in areas with shallower water.
- Extension of WWTP effluent “plumes” further downstream: if base flow is reduced and WWTP discharge remains constant or increases, then it takes longer for the stream to dilute the nutrients and other toxins in the effluent.

Just as the road network in a watershed affects peak discharge, it also can lead to a reduction of base flow. While the total amount of water remains relatively constant, base flows decrease because the rapid runoff (increases in the timing and volume of peak discharge) reduces the total amount of water that can infiltrate and be stored in the soil (Castro 2003).

Prolonged periods of drought have been shown to adversely impact mussel species (Johnson et al. 2001; Gagnon et al. 2004; USFWS 2012a), as mussels may face increased water temperatures and reduced DO concentrations (hypoxia, or eventually anoxia), increased predation, and emersion or stranding (Johnson et al. 2001). Exceptional drought conditions are becoming an increasing threat to the Appalachian elktoe because of the associated lack of dilution of pollutants in WWTP discharges, increasing accumulations of sediment from lack of flushing flows, and elevated water temperature (USFWS 2009b).

While drought is recognized as a major threat for many mussel species, the actual low flow requirements of mussels is poorly understood. Johnson et al. (2001) and Gagnon et al. (2004) assessed drought impacts on mussel assemblages in a number of streams in the Flint River basin of southwestern Georgia. Sites that ceased flowing during drought had substantial declines in the abundance of all mussels as well as declines in species richness. However, sites that maintained some flow during drought had increases in stable species of mussels and no change in special concern or endangered species through the drought. Mortality of mussels at sites that ceased flowing was attributed to reductions in DO concentration, which was highly correlated with water velocity.

Large reaches of many of the streams that support the Appalachian elktoe have been degraded by past and/or ongoing land disturbing activities and alterations to natural flow. In many instances, habitat for the Appalachian elktoe has been degraded and is marginal or unsuitable (USFWS 2017a).

4.3.5 Thermal Pollution

Concerns over effects of thermal pollution from urban runoff on aquatic systems have increased in recent years. Elevation of stream temperature can raise biochemical oxygen demand (BOD), lower dissolved oxygen (DO), and alter faunal composition (Poole et al. 2001, Roa-Espinosa et al. 2003). Typically, runoff from an impervious area will have a temperature like that of the impervious area. During the hot summer months, this could potentially make the stormwater runoff reach temperatures up to and above 90°F, which could be detrimental to aquatic life. Rising stream water temperatures have been shown to have lethal and sub-lethal effects on freshwater mussels during different life stages. Thermal stress on juvenile mussels was demonstrated to result in reduced burrowing capacity and inhibited byssal thread production, which may hamper their ability to escape predation or extreme high or low flows, as well as limit their attachment and dispersal capabilities (Archambault et al. 2013). The thermal tolerance of freshwater mussels “is controlled by multiple interacting and complex factors” (Pandolfo et al. 2012). For example, mussels are not only limited by their own thermal tolerances, but also by those of their host fish (Pandolfo et al. 2012). Pandolfo et al. (2010) suggested that freshwater mussels “already might be living close to their upper thermal tolerances in some systems.”

Various stormwater BMPs have been shown to be effective in ameliorating temperature effects, for example, bioretention devices were shown to reduce runoff temperature by 50°F (Sustainable Technologies Evaluation Program 2014). The loss of riparian buffers as well as peak discharge related to channel widening can also contribute to stream temperature increases by increasing sunlight exposure and decreasing water depth.

4.3.6 Invasive Species

The introduction of exotic species such as the Asian clam (*Corbicula fluminea*) and zebra mussel (*Dreissena polymorpha*) has also been shown to pose substantial threats to native freshwater mussels. The Asian clam is now established in the French Broad basin as well as most of the major river systems in the United States (Fuller and Powell 1973). When Appalachian elktoe was listed as an endangered species, it was speculated that due to its restricted distribution, it “may not be able to withstand vigorous competition” (USFWS 1996). Concern has been raised over competitive interactions for space, food, and oxygen with this species and native mussels, possibly at the juvenile stages (Neves and Widlak 1987; Alderman 1995). The zebra mussel, native to the drainage basins of the Black, Caspian, and Aral Seas, is an exotic freshwater mussel that was introduced into the Great Lakes in the 1980s and 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 has been predicted to contribute to the extinction of dozens of freshwater mussel species if it becomes established throughout the Mississippi River basin (Stein and Flack 1996). The zebra mussel is not currently known from any river supporting Appalachian elktoe populations.

4.3.7 Loss of Riparian Buffers

Loss of riparian buffers can lead to degradation of adjacent aquatic habitats. The role of forested riparian buffers in protecting aquatic habitats is well documented (NCWRC 2002). Riparian buffers provide many functions including pollutant reduction and filtration, a primary source of carbon for aquatic food webs, stream channel stability, and maintenance of water and air temperatures. Numerous studies have recommended a range of buffer widths needed to maintain these functions. Recommended widths vary greatly depending on the parameter or function evaluated. Wide contiguous buffers of 100 to 300 ft. are recommended to adequately perform all functions (NCWRC 2002). The NCWRC recommends a minimum 200 ft. native, forested buffer on perennial streams and a 100 ft. forested buffer on intermittent streams in watersheds that support federally endangered and threatened aquatic species (NCWRC 2002).

4.4 Potential Effects of Roadway Projects on Freshwater Mussels and Habitat

There are a number of direct and indirect effects to freshwater mussels and their habitat that can result from roadway construction projects. In addition to direct impacts that occur during roadway construction, the roadway project can continue to result in indirect effects post-construction (operational effects, as well as indirect effects associated with project-induced development). While several threats are recognized, potential roadway construction effects on freshwater mussels and habitat fall into three main categories:

- Physical effects (habitat degradation, direct mortality of individuals and host fish species).
- Water quality effects (chemical, temperature, and biological pollutants).
- Water quantity effects (changes in peak and base flows).

4.4.1 Physical Effects

Physical effects associated with road construction include, but are not limited to, riparian land-clearing, physical loss of habitat (substrate fill), stream re-channelization, hydrologic modification, and erosion associated with construction in the project corridor and within fill/borrow areas. The potential effects of these activities include physical injury to individual mussels from substrate disturbance and/or sediment deposition. Potential physical effects to mussel habitat include channel and stream bank scouring, channel erosion, and sedimentation, all of which reduce habitat suitability.

4.4.2 Water Quality Effects

Roadway construction can result in a variety of chemical and thermal water quality effects during construction as well as induced land use changes post-construction. These effects include the addition of various chemical and thermal pollutants to waterways originating from the project construction and facility footprint, as well as pollutants originating from induced land-use changes, particularly from commercial and/or residential developments (e.g., urban runoff, fertilizers, pesticides).

Numerous factors influence the potential for toxins from highway runoff to reach occupied mussel habitat, including:

- Traffic volumes
- Distance of road crossing structure to occupied stream habitat
- Watershed size
- Stream gradient and characteristics (i.e. presence of natural low gradient pools or beaver dams or other structures that may attenuate transport of toxins)
- Toxin attributes that affect exposure pathways (i.e. toxins binding to sediment)

The magnitude of the effects associated with roadway runoff originating from a specific crossing is also dependent on the amounts of toxins entering occupied habitat via other pathways (other tributaries, atmospheric deposition, runoff from adjacent land use, ground water inputs, etc.).

4.4.3 Water Quantity Effects

Water quantity effects are temporary and permanent alteration of flows. These include construction impacts (temporary dewatering, causeway construction, channel restriction, etc.), as well as hydrologic impacts from induced land use changes, as described above (increased runoff and storm flows, decreased infiltration and associated base flow).

4.4.4 I-26 Widening and Replacement of the I-26 Bridge

A previous Section 7 consultation under the ESA was the I-26 widening (STIP I-4400/I-4700), which included the replacement of the I-26 bridge over the French Broad River, roughly five river mi. upstream of I-2513. The project is likely to effect Appalachian elktoe in the French Broad River from temporary causeways, which were estimated to cover an acre of riverbed, and from bridge demolition, erosion and sedimentation. Some of the I-26 widening project may be under construction while I-2513 is under construction; however, water quality effects from the widening project are not anticipated to reach the I-2513 Action Area. USFWS (2019) determined that direct effects would be unlikely to have long-term effects on the stability of the Appalachian elktoe population, and that indirect effects would temporarily reduce fecundity and recruitment.

5.0 EVALUATED EFFECTS OF PROPOSED ACTION ON GRAY BAT

Implementation of this project has the potential to affect MYGR in a variety of ways, both during construction and once roadway improvements are in use (operational effects, as well as indirect effects associated with project-induced development). Potential project-related impacts to MYGR are considered in this section. The potential project-related impacts are presented in three categories:

1. Potential Effects from Highway Construction
2. Potential Effects from Highway Operation
3. Potential Effects from Interrelated/Interdependent Effects

Based on acoustic survey data conducted by CALYX/NV5, MYGR are known to be present in the Action Area between mid-March and mid-November. MYGR calls were recorded at all detector locations along the French Broad River, as well as Hominy Creek, Emma Branch, and Smith Mill Creek. Calls were most numerous along the River, and the number of calls at each site generally increased throughout the summer. Two roosts were identified in the Action Area; one of which contained hundreds of bats, while the other was only documented to have one bat for one night. Maternity, bachelor, and transient roosts have also been identified nearby. All the roost locations documented in North Carolina, including those within or near the Action Area, are in close proximity to large streams or rivers.

Based on the results of radio-tracking, we know that bats are flying into the Action Area from roosts that lie outside the Action Area. NCWRC telemetry studies in 2016 and 2017 (NCWRC 2017) and ISU telemetry work in 2018 (Weber et al. 2018) revealed that MYGR who left the closest primary roost are using the French Broad River for commuting and foraging, although some individuals abandoned the river, choosing to fly over land or along large tributaries to the French Broad River such as Hominy Creek and Bent Creek. A smaller number of individuals also foraged in locations that were more unusual for the species, such as heavily wooded areas along the Blue Ridge Parkway, and partially wooded areas like the Riverside Cemetery, with no associated water sources.

While acoustic and telemetry surveys revealed the presence of MYGR in association with smaller waterways, the likelihood of effects generally declines the further the action occurs from the French Broad River. This coincides with information that is commonly reported in scientific literature regarding the species' preference to concentrate activity near large waterways (Section 3.7). Impacts associated with this project are absent in winter months (roughly mid-November to mid-March) when MYGR are hibernating and are diminished during daylight hours in summer months while bats are roosting. An exception to this is the impacts to any bats that may be roosting in the culvert during summer months, where daytime activities in close proximity to this site could negatively impacts those individuals. Similarly, the severity of potential effects is inversely related to proximity to the French Broad River and the culvert roost, where MYGR activity is generally higher than other locations.

5.1 Potential Effects from Highway Construction

Construction activities associated with the project may include, but are not limited to clearing, grubbing, grading, installation of base material, installation of pavement, culvert extensions and replacements, bridge installations and replacements, striping, signs, and lighting. MYGR are present in the Action Area and most vulnerable to effects from highway construction from mid-March to mid-November and when flying adjacent to or across the active construction areas. Stressors from highway construction are generally long term in nature near the French Broad River, Hominy Creek, Emma Branch, and Smith Mill Creek bridge crossings, as well as at the Hill Street culvert roost, and generally short term in nature elsewhere, but short-term effects could occur periodically during the entire construction process.

5.1.1 Lighting Effects

For the safety of the construction personnel, equipment may be used to illuminate construction activities that may take place at night. Lighting associated with construction activities may be brighter than ambient light generated by headlights or nearby overhead lighting around interchanges or near developed areas. Nighttime construction activities could take place at any time throughout the life of the project. MYGR could be exposed to this stressor if they fly adjacent to or across active work zones during the months when they are not hibernating. This stressor could cause them to abandon foraging areas, and commuting areas, which could expose them to additional stressors, (increased energy expenditure, increased risk of predation, increased competition for resources).

Bats and Light

Studies have consistently shown that bat species richness decreases with the presence of artificial lighting in foraging and roosting areas, with *Myotis* species being particularly vulnerable (Spoelstra et al. 2017; Stone et al. 2012; Downs 2003; Linley 2017).

Lighting may exacerbate the barrier effect of roads, since those species reluctant to cross open spaces are also those most likely to avoid light. There are no data specific to MYGR for the use or avoidance of lighted areas that may occur along roadways. Research by Rydell and Baagøe (1996) indicates that bats in the genera *Eptesicus* (big brown bats, *Eptesicus fuscus*) and *Lasiurus* (red and hoary bats, *Lasiurus borealis* and *L. cinereus,* respectively) are the species typically noted foraging around artificial lights. In contrast, they noted that bats in the genus *Myotis* seem to avoid open spaces, preferring to feed in woodlands or low over water. Additional studies (e.g. Rydell 1992; Blake et al. 1994; Stone et al. 2009, 2012) have shown that road lighting deters many bat species, notably slow-flying, woodland-adapted species such as members of the genera *Rhinolophus, Myotis* and *Plecotus*, from approaching the road. Therefore, it is possible that artificial lighting may cause avoidance behavior in MYGR.

Type and color of artificial lighting has been shown to impact bat species differently. Studies have shown a significant decrease in *Myotis* foraging activity levels under white and green light (4000K and higher) (Spoelstra et al. 2017). Red light (approximately 3000K) has been shown to cause a minimum amount of disturbance activity levels of *Myotis* bats when compared to dark foraging areas (Downs 2003).

Bats' eyes have evolved to function in low light and are less effective in brightly lit areas, and some groups of bats, including three species of *Myotis* occurring in North America, can detect UV light (Gorresen et al. 2015). Artificial lighting of any kind can cause a delay in emergence and increase the overall duration of emergence (Stone et al. 2009; Rydell et al. 2017). This in turn decreases available foraging time, juvenile growth rates, and the overall colony health (Stone et al. 2015). Studies have shown that bats using roosts lit by artificial light exhibit delayed emergence (Stone et al. 2009; Rydell et al. 2017); while one study has noted an overall drop in bat activity at artificially lit sites (Linley 2017). The presence of artificial lighting may force light-shy bats to use suboptimal flight routes or fly further to reach foraging sites and require them to expend more energy in the process (Stone et al. 2009; Stone et al. 2012). Artificial roost sites lit omnidirectionally, leaving no dark corridor to and from the roost, show high colony loss (Rydell, et al. 2017). Additionally, *Myotis* sp. have shown an increased avoidance of drinking areas lit by LED lighting (Russo et al. 2017). But both HPS and LED light disturbance caused spatial avoidance of preferred commuting routes by *R. hipposideros* and *Myotis* spp. (Stone et al. 2009).

LED lights produce a small amount of light in the UV range, when compared to other light sources like fluorescent, HPS, and MH (Lewanzik and Voight 2017, Wakefield et al. 2016, Wakefield et al. 2018). Insect activity has been shown to increase with the presence of ultraviolet (UV) light (Wakefield et al. 2016; Lewanzik and Voight 2017). More specifically, Wakefield et al. (2018) found greater numbers of insects were attracted to MH streetlights and a greater diversity of insects were attracted to white LEDs compared with long-wavelength-dominated HPS lights. While UV-producing lights may attract a larger number or greater diversity of insects, Lewanzik and Voight (2017) found that the number of *Myotis* calls increased after MH streetlights were backfitted with LED lights. This may be because of their sensitivity to UV light (Gorresen et al. 2015), causing them to avoid those areas.

MYGR Activity and Existing Light Conditions

Although the acoustics surveys associated with this project were designed to identify seasonal trends in MYGR activity and hotspots of activity within the Action Area, it may be possible to draw some broad inferences based on existing lighting and the results of acoustic data collection. MYGR calls were recorded at all detector locations, including those where ambient lighting is rather bright. For instance, bats were recorded and visually observed flying through the area between the culvert outlet and the River. This area is currently lit at levels that are more than 20 times the light produced by a full moon (Appendix K, Lighting Summary). Conversely, one of the darkest sites (Site 3), had the lowest amount of MYGR activity among all the detectors along the

River. There are many environmental factors at play that could contribute to the differences in numbers of calls from one detector to the next; light being only one of them.

5.1.1.1 Light Associated with Bridge Demolition/Construction

As previously discussed in Sections 3.10.1 and Section 5.0, MYGR are active at all detector locations within the Action Area and are generally most active along the French Broad River. Nighttime demolition of bridges is possible, so effects to MYGR from this activity are also possible. Demolition of individual bridges may last up to one month depending on bridge materials, size, and design. It is anticipated that additional lighting generated during nighttime bridge demolition/construction activities at the French Broad River, Smith Mill Creek, Emma Branch, and Hominy Creek bridges will affect the MYGR that utilize these areas. Bridge demolition/construction is anticipated to last up to five years, which is a particularly long period of exposure time, and may occur concurrently at multiple locations within the Action Area. In addition, replacement of the I-26 bridge over the French Broad River (part of the I-4400/I-4700 project) will also occur during the same time frame.

5.1.1.2 Potential Light Impacts to Foraging and Commuting Habitat

As previously mentioned, within the Action Area, MYGR activity is generally highest along the French Broad River, where MYGR are presumably foraging and commuting. This means their exposure to construction lighting will be limited since most of the construction will occur during the day. Although no correlation between lighting and bat activity at the various detector sites could be established, additional construction lighting will create a temporarily elevated level of light, which may affect any MYGR that may be present. Bridge construction/demolition activities will occur at multiple locations within the foraging and commuting area of bats that utilize the Action Area as well as adjacent areas (including the French Broad River where a bridge replacement will occur during the same general time frame I-440/I/4700). These activities are anticipated to have long term impacts to the local MYGR population.

5.1.1.3 Potential Light Impacts to Roosting Habitat

Hill Street Culvert Roost

Activities associated with construction of the I-26/I-240 bridge over the French Broad River and improvements to Riverside Drive will occur near the Hill Street culvert roost and may take place during day or night, any time of year. Lights associated with construction equipment may illuminate culvert inlets during this process and disturb any bats that use the culvert for night roosting. As previously mentioned, it appears that MYGR are utilizing multiple culvert inlets/outlets, but do not appear to use the roost for winter hibernation. The CMAPs and RCBC portion of the roost will be repaired when bats have left the roost for the season, and the 60" CMP that convers flow under Hill Street will be replaced or lined between October 15 and April 1, when most bats are hibernating elsewhere. Other construction activities associated with pipe replacements may occur any time of year, and construction associated with the culvert system may last up to four years. Therefore, there is the potential that MYGR utilizing the culvert roost system will be affected by light associated with these activities for a rather long period of time.

Smith Mill Creek Culvert Roost

The Smith Mill Creek culvert will remain in place, and no construction activities at the inlet or outlet are anticipated as part of this project. Repairs to this culvert are not anticipated at this time. Furthermore, woody vegetation is in place adjacent to the Smith Mill Creek culvert inlet and outlet which provides a buffer to incoming light, and construction activities associated with the removal of the interchange ramps will not involve removal of woody vegetation near the culvert inlet/outlet. Therefore, construction lighting should not shine into the culvert and impact any bats that might choose to roost there.

Conservation measures for light effects:
During roadway construction, NCDOT will limit all construction-related lighting to whatever is necessary to maintain safety in active work areas closest to the French Broad River, Hominy Creek, Emma Branch, and Smith Mill Creek bridges. Construction-related lighting will be indirect in nature and will not project into adjacent forested areas or over the water surface of the French Broad River, Hominy Creek, Emma Branch, or Smith Mill Creek, whenever practicable.

Although acoustic surveys revealed that MYGR activity is generally lower along Hominy Creek, Smith Mill Creek, and Emma Branch, than along the French Broad River, NCDOT recognizes the importance of these areas for MYGR commuting and foraging, as well as the portions of the project that lie closest to the River, where MYGR activity is generally higher. Due to MYGR activity on the landscape NCDOT will limit all construction-related lighting to whatever is necessary to maintain safety in active work areas closest to the French Broad River, Hominy Creek, Emma Branch, and Smith Mill Creek. Therefore, construction-related lighting will be indirect in nature, and will not project into adjacent wooded areas or over the water surface of these water bodies whenever practicable.

Bridge Construction
There are many construction activities associated with bridge replacement and construction. However, some construction activities associated with bridge replacement and construction will take place after sunset and will not occur on a regular schedule. NCDOT will limit the use of nighttime construction lighting within 50' of the French Broad River, Hominy Creek, Emma Branch, or Smith Mill Creek between April 1 and October 15 to only the following activities: causeway construction, drilled shafts, concrete pours, beam setting, and traffic shifts. These activities, their likelihood of occurrence, and the type of light generated may include:

- Causeway construction – *Will occur* – Access road and causeway construction and removal may take place at night throughout the life of the project. This will allow the contractor to utilize the lower traffic volume to access the site. Installing the access roads and causeways at night allows longer-term operations to be constructed during daylight hours. Due to the easier site access the contractor may be able to construct the access roads and causeways more quickly. Constructing the access roads and causeways will be at the discretion of the contractor and not required at night.
    - Lighting for this operation will likely consist of one to two light plants that will be used to directly light up the construction area. Care will be taken to not shine light directly out into the river or into the adjacent forest.
- Drilled shafts – *Possible* – This is dependent upon construction schedule, contract, and availability of the concrete plant.
    - Lighting for this operation will be at water level. Lights on the drill rig will be used, and one light plant may be used if needed. Only the active work area (where the hole is currently being drilled) will be lit. No lights will be shining down from the bridge deck during this operation.
- Concrete pours during hot weather – *Will occur* – Night pours of concrete are required during hot weather to achieve the proper cure. These pours may include elements such as bent caps, end bents, and barrier rail wall.
    - The use of lights for this operation will be minimal. Because these will be small area and short duration (six hours or less) pours. Lights will generally be set up on the causeway, shining upward at the bridge member being poured. Small lights, such as headlights, will be used on the structure. There will be pump truck and concrete trucks with headlights either on the bridge deck or on the causeway.

- Deck concrete pours from May to November (summer) – *Will occur* – Deck concrete pours are generally larger, more complex, and more time consuming than other types of concrete pours. Consequently, they will need to occur at night between May and November depending on temperature and weather. These pours may be able to begin at midnight and pour into the morning hours.
    - Of all potential nighttime operations, this will be the operation with the most lighting. It is important to note that these operations will consist of one night of activity at a time; there will be no long-term consecutive nights of operation. The majority of lighting will be at bridge deck level, with lights shining toward the bridge rather than down toward the river. Any lighting that shines down toward the river or adjacent woods will be indirect and minimal.
    - A pump truck will be positioned either at the end of the bridge at road surface elevation, or on the causeway. The vehicle's headlights will be used. Headlights on concrete delivery trucks will also be used.
    - Two to four light plants will be used on the bridge deck, depending on the size of the pour. These will most likely be positioned at either end of the pour shining down toward the deck and in toward the bridge; not facing toward the river. Small lights, similar to headlights, may be used to illuminate the screed (concrete surface), if needed.
- Beam setting – *Will occur* – Setting beams at night is required due to the volume of daytime traffic and the need to maintain traffic.
    - Cranes sitting on either of the causeways or on the new or existing bridges will be used to set the beams for the new bridges. There will be a light plant on the structure where the truck with the beams is parked, either on the new or existing structure. These lights will be shining toward the truck. There will also be lights shinning toward each structure where the beam ends sit.
    - It is difficult to determine if the lights will be placed on the causeway shining up toward the structure, or on the bridge deck shining down. This decision will need to be made on site at the time of the activity.
    - It is important to note that this operation will happen once every 1-2 months only during certain periods of construction. For each new span, this operation will occur for one to two nights, and for roughly six hours or less.
- Traffic shifts – *Will occur* – Traffic shifts will be necessary to construct the new bridge. These shifts will occur at night and be of short duration and will likely require minimal lighting on the bridge. All other activities with traffic shifts will occur beyond the end bents of the bridge and will not be part of the work on the bridge or in the area of the river.
- Bridge demolition – *Possible* – As described in Section 2.1.2, replacement of seven bridges will be necessary in order to accommodate roadway widening and/or other improvements associated with the project. Nighttime demolition activities will require lighting associated with construction equipment and light plants. A tractor trailer truck, up to two cranes, and possibly a track hoe are needed for bridge demolition. This equipment will have integrated lighting. Lights will be at deck height, shinning on the deck. The timing (night versus day) of bridge demolition will be at the discretion of the contractor and is not required to occur at night.

There are other operations that may occur at night at the bridges; however, this would be unusual and evaluated on a case-by-case basis. The previously listed operations are not operations that occur on a regular schedule.

Between June 1 and August 1, female MYGR are pregnant, give birth, and raise their pups until they are volant. This is a critical time in the life cycle of MYGR, when females need to obtain sufficient nutrition to raise healthy pups, and both adult females and juveniles are most susceptible to disturbance. Therefore, NCDOT shall commit to restrict the construction contractor to no night work at crossings of the French Broad River, Hominy Creek, Smith Mill Creek, and Emma Branch to minimize potential impacts to lactating females and their pups, between June 1 and June 14, Between June 15 through August 1, NCDOT will also commit to restrict the construction contractor to no more than 28 total nights of work, with no more than four consecutive nights. Lighting used for construction will be limited to what is necessary to maintain safety standards and will only be directed toward active work areas.

As part of their commitment to river users' safety, as well as minimization of effects to MYGR, NCDOT will place solar-powered, steady-state red lights on the causeways to alert river users to its location. Generators will not be used to provide power. These lights will be atop permanent structures, such as poles, on each causeway for the duration of the project. Red lights are unlikely to interfere with the normal activity of Myotis species foraging in this area (Spoelstra et al. 2017).

Hill Street Culvert Roost

NCDOT will monitor bat activity at the culvert before, during, and after construction. Acoustic monitoring and/or emergence surveys, as appropriate, will be conducted between March and November.

The RCBC portion of the culvert system, as well as the dual CMAP at the culvert outlet will remain in place. Work on the RCBC portion of the culvert will not occur until bat activity ceases for the season (and bats are presumably no longer using the culvert for roosting). This time frame is approximately between November 15 and March 15. NCDOT will monitor the culvert with an acoustic detector and/or emergence surveys, as appropriate, to determine when bat activity ceases for the season. After bat activity ceases for the season, federally permitted bat biologist will enter the culvert to confirm no bats are present. NCDOT will either replace or install a sleeve in the 60" CMP adjacent to Courtland Avenue and the entrance to Isaac Dickson Elementary School between October 15 and April 1, when most bats are hibernating elsewhere. Given these restrictions, lighting associated with construction activities at the RCBC, CMAPs, and 60" CMP located adjacent to Courtland Avenue and the entrance to Isaac Dickson Elementary School, which are the most important portions of the culvert system for MYGR, effects from these construction activities are expected to be minimal.

An equipment staging area will also need to be established adjacent to the work pads near the culvert outlets and inlet areas near Courtland Avenue to complete the culvert rehabilitation process. These areas will only be used for culvert rehabilitation activity staging and will not be used for any other project construction purposes. Work pads will also be established at the culvert outlets and the inlet of the 60" CMP adjacent to Courtland Ave. and the entrance to Isaac Dickson Elementary School. Given NCDOT's commitment to restrict rehabilitation activities associated with the RCBC CMAPs, and the lining or replacement of the 60" CMP, activity at these staging areas will also be restricted, and will result in very limited light effects from construction activities on bats that use the culvert for roosting.

In an effort to minimize construction light effects to MYGR that might potentially use the culvert for roosting, NCDOT will install a barrier/baffle in the RCBC between the intersection with the 60" CMP (located adjacent to Courtland Ave. and the entrance to Isaac Dickson Elementary School that conveys flow under Hill Street) and the upstream end of the RCBC to buffer the light associated with the CMP replacements further upstream.

NCDOT has committed to re-establishment of woody vegetation in some areas of the project. In time, these plantings will mature and provide a barrier between light sources and commuting, foraging, and roosting habitat. Additional information about these measures is included in Section 5.1.3.

Prosecution of Work
Contract language will include the following, or similar language as appropriate for bridges over the French Broad River, “The Contractor will be required to prosecute the work in a continuous and uninterrupted manner from the time work begins until completion of each phase of structure construction, demolition, and completion. The Contractor will not be permitted to suspend operations except for reasons beyond their control or except where the Engineer has authorized a suspension of the Contractor’s operations in writing.” Proceeding with construction in this manner will minimize the time that construction activities might affect MYGR in the area.

Summary of effects from light effects:
Most construction activities associated with the project will occur during the day, when bats are not actively foraging or commuting. While lighting will be minimized during construction, there is the potential that the light generated by these activities could have a negative effect on MYGR in the area. Construction lighting associated with bridges is of great concern. At many bridge crossing locations, the bats that regularly fly through these areas are accustomed only to ambient light generated by traffic in an otherwise dark landscape.

Light associated with construction activities at the Hill Street culvert roost will be limited as well. Cleaning and repair of the CMAPs and RCBC will not occur when MYGR are present. Replacement or sleeving of the 60” CMP located adjacent to Courtland Ave. and the entrance to Isaac Dickson Elementary School that conveys flow under Hill Street to the RCBC will occur when most bats are hibernating elsewhere. NCDOT will install a barrier/baffle in the RCBC between the intersection with the 60” CMP and the upstream end of the RCBC to buffer the noise and light associated with the CMP replacements further upstream. Construction activities at other locations along the culvert system may occur at any time of year, day or night, so any bats using these areas potentially be affected by the lights.

Due to the limited MYGR use of the Smith Mill Creek culvert, and the lack of construction activities associated with the culvert inlets/outlets, as well as very limited construction activities in the nearby area, adverse effects from construction activities on MYGR that use the culvert for occasional roosting are not anticipated.

Construction lighting may exacerbate the barrier effect of roads. Therefore, it is anticipated that MYGR will modify their preferred foraging and commuting areas, and potentially their roosting areas, due to increased light associated with construction activities. If MYGR avoid areas that are brighter than they are accustomed to, and particularly if they must do so for multiple years while bridge construction is underway, this may lead to increased travel time/distance between their roosts and foraging areas. This potentially may result in diminished fitness of adults and/or reduced survivorship of pups and/or adults. Bats that continue to utilize areas that are brightly lit may experience higher levels of predation.

In general, effects from lighting associated with construction will occur, but will be limited during the time of year that is most critical to the reproductive success of MYGR. However, considering the activities that will occur at the Hill Street culvert roost, the duration of combined activities in the Action Area (up to five years), and the fact that the same population of bats will experience similar stressors associated with a nearby construction project (I-4400/I-4700) in some of their other foraging and commuting range, the stress associated with construction lighting will cause long term impacts to the local MYGR population.

5.1.2 Acoustic Effects

The use of construction equipment is anticipated to cause increased noise disturbance during construction activities within the Action Area. Noise will be generated primarily from heavy equipment used to transport materials and conduct construction activities (such as drilling, jackhammering, running generators, and pile driving). Most construction activities will take place during daylight hours and will be temporary in nature. The noise associated with these activities is generally not expected to affect MYGR, unless it occurs near the culvert roost. However, MYGR flying over or adjacent to the roadway where active nighttime construction is occurring, during months when they are not hibernating (generally mid-March through mid-November), may be exposed to this stressor. During these times, MYGR may be exposed to overall noise levels, or intensity of noise that they may not have previously experienced in those locations. This stressor could cause them to abandon foraging areas, and commuting areas, which could expose them to additional stressors, (increased energy expenditure, increased risk of predation, and increased competition for resources).

5.1.2.1 Noise and Vibration Associated with Bridge Demolition/Construction

As previously discussed in Sections 3.10.1 and Section 5.0, MYGR are active at all detector locations within the Action Area and are generally most active along the French Broad River. Nighttime demolition of bridges is possible, so effects to MYGR from this activity are also possible. It is anticipated that additional noise generated during nighttime bridge construction activities at the French Broad River, Smith Mill Creek, Emma Branch, and Hominy Creek bridges will affect MYGR that utilize these areas. Demolition of individual bridges may last up to one month depending on bridge materials, size, and design. Bridge demolition/construction is anticipated to last up to five years, which is a particularly long period of exposure time, and may occur concurrently at multiple locations within the Action Area. In addition, replacement of the I-26 bridge over the French Broad River (part of the I-4400/I-4700 project) will also occur during the same time frame.

Pile driving associated with bridge construction may be needed for the new bridge over the French Broad River that is located near the roost. If pile driving is used for end bents, it may last several days per bent. It is too soon in the design process to determine if pile-driving will occur for the project, or how long it may take place. USFWS will be provided with this information as project design progresses. It is difficult to predict whether pile driving activities will create enough noise and vibration to affect bats roosting in the culvert.

5.1.2.2 Potential Noise Impacts to Foraging and Commuting Habitat

As previously mentioned, within the Action Area, MYGR activity is generally highest along the French Broad River where MYGR are presumably foraging and commuting at night. This will limit their exposure to construction noise while foraging and commuting since most of the construction will occur during the day. Although no correlation between noise and bat activity at the various detector sites could be established, construction activities in or adjacent to foraging and commuting habitat will create a temporarily elevated level of noise, which may affect any MYGR that may be present. Bridge construction/demolition activities will occur at multiple locations within the foraging and commuting area of bats that utilize the Action Area as well as adjacent areas. These activities are anticipated to have long term impacts to the local MYGR population.

5.1.2.3 Potential Noise and Vibration Impacts to Roosting Habitat

Hill Street Culvert Roost

Activities associated with construction of the I-26/I-240 bridge over the French Broad River and improvements to Riverside Drive will occur near the Hill Street culvert roost and may take place during day or night, any time of year. Noise associated with construction equipment may disturb any bats that use the culvert for night or day roosting. As previously mentioned, it appears that MYGR are utilizing multiple culvert inlets/outlets, but do not appear to use the roost for winter hibernation. The CMAPs and RCBC portion of the roost will be repaired when bats have left the roost for the season, and the 60" CMP that convers flow under Hill Street will be replaced or lined between October 15 and April 1, when most bats are hibernating elsewhere. Other construction activities associated with pipe replacement may occur any time of year, and construction associated with the culvert system may last up to four years. In addition, pile driving associated with the new French Broad River bridge near the roost may also be necessary. Therefore, there is the potential that MYGR utilizing the culvert roost system will be affected by noise and vibration associated with these activities.

Smith Mill Creek Culvert Roost

The Smith Mill Creek culvert will remain in place, and no construction activities at the inlet or outlet are anticipated as part of this project. Repairs to this culvert are not anticipated at this time. Furthermore, woody vegetation is present at the culvert inlet and outlet, which provides a buffer to incoming noise, and construction activities associated with the removal of the interchange ramps should not involve removal of woody vegetation near the culvert inlet/outlet. Therefore, construction noise is unlikely to increase above ambient noise and impact any bats that might choose to roost there.

Conservation measures for acoustic effects:

Bridge Construction

There are many construction activities associated with bridge replacement and construction. However, some construction activities associated with bridge replacement and construction will take place after sunset and will not occur on a regular schedule. NCDOT will limit the use of nighttime construction within 50' of the French Broad River, Hominy Creek, Emma Branch, or Smith Mill Creek between April 1 and October 15 to only the following activities: causeway construction, drilled shafts, concrete pours, beam setting, and traffic shifts. These activities, and their likelihood of occurrence may include:

- Causeway construction – *Will occur* – Access road and causeway construction and removal may take place at night throughout the life of the project. This will allow the contractor to utilize the lower traffic volume to access the site. Installing the access roads and causeways at night allows longer-term operations to be constructed during daylight hours. Due to the easier site access the contractor may be able to construct the access roads and causeways more quickly. Constructing the access roads and causeways will be at the discretion of the contractor and not required at night.
  - Noise will be created by mainly by dump trucks and generators used to power light plants.
- Drilled shafts – *Possible* – This is dependent upon construction schedule, contract, and availability of the concrete plant.
  - Noise for this operation will be at water level, and will be created by generators used to power light plants and drill rigs.
- Concrete pours during hot weather – *Will occur* – Night pours of concrete are required during hot weather to achieve the proper cure. These pours may include elements such as bent caps, end bents, and barrier rail wall.

- Noise will be produced by pump trucks and concrete trucks on the bridge deck or on the causeway.

- Deck concrete pours from May to November (summer) – *Will occur* – Deck concrete pours are generally larger, more complex, and more time consuming than other types of concrete pours. Consequently, they will need to occur at night between May and November depending on temperature and weather. These pours may be able to begin at midnight and pour into the morning hours.
  - It is important to note that these operations will consist of one night of activity at a time; there will be no long-term consecutive nights of operation. The majority of noise will be at bridge deck level, and will be created by pump trucks, concrete trucks and generators used to power light plants.
- Beam setting – *Will occur* – Setting beams at night is required due to the volume of daytime traffic and the need to maintain traffic.
  - Cranes sitting on either of the causeways or on the new or existing bridges will be used to set the beams for the new bridges. Trucks carrying the beams, and light plants will be positioned on the bridge. Light plants and associated generators may also be placed on the causeways.
  - It is important to note that this operation will happen once every 1-2 months only during certain periods of construction. For each new span, this operation will occur for one to two nights, and for roughly six hours or less.
- Traffic shifts – *Will occur* – Traffic shifts will be necessary to construct the new bridge. These shifts will occur at night and be of short duration and will likely require minimal lighting on the bridge. All other activities with traffic shifts will occur beyond the end bents of the bridge and will not be part of the work on the bridge or in the area of the river. This operation is expected to create minimal additional noise beyond ambient levels.
- Bridge demolition – *Possible* – As described in Section 2.1.2, replacement of seven bridges will be necessary in order to accommodate roadway widening and/or other improvements associated with the project. Nighttime demolition activities will require noise associated with construction equipment and light plants, which will also produce noise. A tractor trailer truck, up to two cranes, and possibly a track hoe are needed for bridge demolition. This equipment will have integrated engines which will generate noise. The timing (night versus day) of bridge demolition will be at the discretion of the contractor and is not required to occur at night. Noise levels associated with bridge demolition is expected to be moderate; slightly louder than ambient traffic noise.

There are other operations that may occur at night at the bridges; however, this would be unusual and evaluated on a case-by-case basis. The previously listed operations are not operations that occur on a regular schedule.

Between June 1 and August 1, female MYGR are pregnant, give birth, and raise their pups until they are volant. This is a critical time in the life cycle of MYGR, when females need to obtain sufficient nutrition to raise healthy pups, and both adult females and juveniles are most susceptible to disturbance. Therefore, NCDOT shall commit to restrict the construction contractor to no night work at crossings of the French Broad River, Hominy Creek, Smith Mill Creek, and Emma Branch to minimize potential impacts to lactating females and their pups, between June 1 and June 14, Between June 15 through August 1, NCDOT will also commit to restrict the construction contractor to no more than 28 total nights of work, with no more than four consecutive nights. Noise associated with light plants (generators) that illuminate active construction areas will be limited to what is necessary to maintain safety standards.

Hill Street Culvert Roost
The same commitments to monitoring of bat activities, and restrictions on the timing of construction activities and staging areas and work pads near the culvert that were discussed above in the lighting section are applicable to this section as well. All these commitments will reduce effects of noise on MYGR that utilize the culvert for roosting, as well as the surrounding areas for commuting.

Prosecution of Work
Contract language will include the following, or similar language as appropriate for bridges over the French Broad River, “The Contractor will be required to prosecute the work in a continuous and uninterrupted manner from the time work begins until completion of each phase of structure construction, demolition, and completion. The Contractor will not be permitted to suspend operations except for reasons beyond their control or except where the Engineer has authorized a suspension of the Contractor’s operations in writing.” Proceeding with construction in this manner will minimize the time that construction activities might affect MYGR in the area.

Summary of acoustic effects:
Most construction activities associated with the project will occur during the day, when bats are not actively foraging or commuting. While some activities will occur at night, the duration of these activities will be relatively short. However, there is the potential that the noise generated by these activities could have a negative effect on MYGR in the area. Construction noise associated with bridges is of concern, particularly since some construction activities may take place at night. At many bridge crossing locations, the bats that regularly fly through these areas are accustomed only to ambient noise generated by traffic.

Construction activities associated with the Hill Street culvert system may last 3 to 4 years and may occur during the day or night. Cleaning and repair of the CMAPs and RCBC will not occur when MYGR are present. Replacement or sleeving of the 60” CMP located adjacent to Courtland Ave. and the entrance to Isaac Dickson Elementary School that conveys flow under Hill Street to the RCBC will occur when most bats are hibernating elsewhere. NCDOT will install a barrier/baffle in the RCBC between the intersection with the 60” CMP and the upstream end of the RCBC to buffer the noise and light associated with the CMP replacements further upstream. Construction activities at other locations along the culvert system may occur at any time of year, so any bats using these areas when they are not hibernating would potentially be affected by the noise and/or vibration. The noise from pile driving associated with the new French Broad River bridge, if needed, may also affect bats roosting in the Hill Street culvert if the activity occurs during the day.

Due to the limited MYGR use of the Smith Mill Creek culvert, and the lack of construction activities associated with the culvert inlets/outlets, as well as very limited construction activities in the nearby area, adverse effects from construction activities on MYGR that use the culvert for occasional roosting are not anticipated.

Like lighting, noise may exacerbate the barrier effect of roads. Therefore, it is anticipated that MYGR will modify their preferred foraging and commuting areas due to increased noise associated with construction activities. If MYGR avoid areas that are noisier than they are accustomed to, and particularly if they must do so for multiple years while bridge construction is underway, this may lead to increased travel time/distance between their roosts and foraging areas. This potentially may result in diminished fitness of adults and/or reduced survivorship of pups and/or adults.

In general, effects from noise associated with construction will occur, but will be limited during the time of year that is most critical to the reproductive success of MYGR. However, considering the activities that will occur at the Hill Street culvert roost, the duration of combined activities in the Action Area (up to five years), and the fact that the same population of bats will experience similar stressors associated with a nearby construction project (I-4400/I-4700) in some of their other foraging and commuting range, the stress associated with construction noise will cause long term impacts to the local MYGR population.

5.1.3 Removal of Woody Vegetation

Per the CP4A meeting information, the project is anticipated to affect 374 acres of maintained/disturbed habitat and 191 acres of forested habitat (Appendix G). Most of the proposed construction activities will occur within existing NCDOT right of way and/or other urbanized areas. Woody vegetation is already limited within the Action Area. Areas outside the existing right of way that may require clearing are largely limited to existing interchanges, which are already cleared of most woody vegetation, and other areas that tend to be urbanized.

Clearing will likely begin approximately one year after the project is let for construction and may continue for a period of up to two years. Clearing may occur at different locations and at different times along the length of the project, depending on construction timing/phasing. Clearing activities will take place during daylight hours. MYGR flying across or adjacent to the roadway at night during months when they are not hibernating (mid-March through mid-November), may be exposed to this stressor.

It is reasonable to assume there is a parallel between cave roosts and culvert roosts, like the roost associated with this project. As presented in Section 3.7 (Foraging, Commuting, and Diet), whenever possible, MYGR of all ages fly in the protection of forest canopy between roosts and feeding areas (USFWS 1982), and clearing of areas near cave roost entrances or between those caves and nearby waterbodies where MYGR feed may have detrimental effects on individual MYGR (Brady et al. 1982). Although they are partial to riparian areas, MYGR use forested areas of all kinds for foraging and commuting, and these areas also provide safety from predators (LaVal et al. 1977).

Forested areas in the Action Area are fragmented due to urban development. However, in general, there is a consistent, yet narrow riparian buffer along the French Broad River and the other major waterways. Bats were recorded at acoustic detectors throughout the Action Area, and foraging data shows that bats are not only flying through the area but utilizing some locations with very sparse trees. So, it is assumed that the clearing of woody vegetation anywhere within the Action Area has a potential effect on MYGR.

5.1.3.1 Potential Impacts to Foraging Habitat

There is evidence to suggest that *Myotis* foraging strategies may be more suited to foraging in forested areas than open areas (Humphrey et al. 1977; LaVal et al. 1977; Brack 1985; Garner and Gardner 1992; Gardner et al. 1996; Murray and Kurta 2004). However, MYGR are not typically observed foraging in forest canopies, other than during inclement weather and during early spring and late fall (LaVal et al. 1977, Stevenson and Tuttle 1981). Their typical foraging locations are lakes, rivers, and other large, open water bodies (Tuttle 1976b, 1979, LaVal et al. 1977), and in riparian areas associated with these resources (Brack and LaVal 2006). Removal of woody vegetation can also lead to increased sedimentation in waterways, and reduction in aquatic insects, which are a primary food source for MYGR. This is further discussed in Section 5.1.4 (Water Quality).

To avoid flying through active construction areas, MYGR whose foraging areas occur within the Action Area, or whose foraging areas will be substantially fragmented, will have to expend an increased amount of energy to establish new foraging areas or new travel corridors between roosting and foraging areas. Additionally, they may be subject to an increase in inter- and intra-specific competition. Bats that remain loyal to certain foraging areas may continue to cross through newly cleared areas in the activity footprint and may have an increased risk of mortality from predation, although this risk is not detectable or measurable. It is unclear whether MYGR who regularly forage in the Action Area will have trouble in establishing new foraging areas due to the availability of remaining suitable foraging habitat in the surrounding landscape. However, MYGR are "selective opportunists", meaning they consume a wide variety of insect prey, choosing the most ideal prey items available at the time, and adjusting their foraging locations based on prey availability (Brack and LaVal 2006).

As previously discussed in Sections 3.10.1 and Section 5.0, MYGR are active at all detector locations within the Action Area and are generally most active along the French Broad River, where they are presumably foraging and commuting. Any clearing of woody vegetation associated with the project has the potential to affect MYGR using this area, as well as those individuals using smaller streams such as Hominy Creek, Smith Mill Creek, and Emma Branch.

5.1.3.2 Potential Impacts to Commuting Habitat

While MYGR foraging and commuting activity is typically associated with open water, the species is known to use forest interior or commute over land in some instances. MYGR, especially juveniles, are known to commute through heavily forested areas between roosts and foraging areas (Tuttle 1979, Brady et al. 1982), and LaVal et al. (1977) stated that some individuals, particularly males, flew "cross country" when leaving their roost in a forested setting, but always in a direction that took them to a nearby body of water within minutes of leaving the roost.

As previously mentioned, MYGR are roosting in a large culvert system under Riverside Drive and I-26, and are utilizing multiple culvert inlets/outlets, but do not appear to use the roost for winter hibernation. Bats utilize the vegetated corridors between the culvert inlets, and particularly the culvert outlet to access the French Broad River, where they forage or commute to other foraging locations. In order to clean and apply patching to the CMAP and RCBC, equipment must access the culvert outlet. This area may be cleared of vegetation for up to approximately 50 ft. downstream, and to top of banks. Therefore, MYGR commuting to and from the culvert roost will be affected by these clearing activities. MYGR are also presumably using the French Broad River, Hominy Creek, Smith Mill Creek, and Emma Branch for commuting purposes as they move from roosts outside the Action Area to nearby foraging areas or from one foraging area to another.

As discussed in Section 3.4, other MYGR roosts exist within the French Broad River basin outside the Action Area. Any individuals who occupy these roosts and utilize portions of the Action Area for commuting may also be affected by removal of woody vegetation, particularly riparian vegetation, although it is unclear how severe the impact will be. The nearest known maternity roost outside the Action Area is in a two-lane bridge high above the river, rather than in a cave in a forested setting, which is more typical for the species. Therefore, it is unclear how having a roost in this setting influences the bats' commuting preferences. Furthermore, in 2016 and 2017, NCWRC tracked five bats initially following the river downstream, then travelling over land, rather than using the French Broad River for commuting. Based on the locations where transmitter signals were received, at some point, some of the bats crossed not only I-26, but I-40 and I-240 as well (NCWRC 2017). During telemetry studies in 2018 at least four bats were observed displaying a similar pattern of commuting from known roosts across interstates and over land (away from the river and large streams) (Weber et al. 2018).

In summary, based on information in the literature and the results of acoustic and telemetry surveys performed for this project, MYGR appear to be somewhat tolerant of breaks in forest cover. While it is likely that MYGR foraging and commuting behavior will be altered by tree clearing during project construction, we do not anticipate the ability to measure, detect, or evaluate the effects to MYGR from these activities. No direct mortality is expected as a result of tree clearing, since MYGR very rarely utilize trees for roosting.

5.1.3.3 Potential Impacts to Roosting Habitat

Although three MYGR were tracked to a sycamore tree as part of the ISU study, MYGR do not typically utilize trees for roosting and this behavior is highly unusual for the species, so clearing of woody vegetation as part of this project is not anticipated to have an effect on MYGR roost trees. However, it is difficult, if not impossible to separate the impacts of clearing woody vegetation adjacent to the Hill Street culvert roost from impacts to the roost itself. For instance, removal of woody vegetation at the culvert inlets/outlets may change patterns of airflow inside the culvert, which may change its appeal as a MYGR roost site. The bats could potentially abandon the roost if changes to internal conditions are too drastic. Due to the limited MYGR use of the Smith Mill Creek culvert, and no expected clearing at the culvert inlet/outlet, adverse effects from construction activities on MYGR that use the culvert for occasional roosting are not anticipated.

Conservation measures for tree clearing:
NCDOT developed conservation measures associated with tree clearing specific to the culvert roost area, as well as more generalized measures applicable to the entire Action Area.

Hill Street Culvert Roost
An operational work pad area will be established near the culvert outlets to complete the culvert rehabilitation process, as well as at the inlet near Courtland Avenue where the 60” CMP will be replaced or lined. Vegetation must be cleared to allow room for the work pad. NCDOT will cut plants in the work pad area in a way that will minimize impacts to bats and their activity by implementing the following measures: vegetation will not be removed if the area will be left bare for many months prior to construction; cutting of vegetation will be coordinated with USFWS and will not occur until all bats have left the culvert for the winter. This will be determined through acoustic monitoring and/or emergence counts and a physical check of the culvert for remaining bats; and limiting cutting to only what is necessary to complete the work and no more than 50 ft. from culvert inlet/outlets.

- NCDOT will acquire a permanent drainage easement (PDE) or additional right of way at the culvert inlet (near Courtland Ave.) and outlets, where replanting with containerized, native, woody vegetation will occur. In addition, if NCDOT acquires additional right-of-way or conservation easements along the French Broad River or adjacent to the culvert, NCDOT will replant with native, woody vegetation to provide, in time, a buffer for noise, light, and surface water runoff. NCDOT will coordinate with USFWS and NCWRC to develop a revegetation and invasive species management plan for these areas.

Project-Wide
- NCDOT will direct the contractor to preserve riparian buffer trees where practicable and feasible.
- NCDOT will revegetate all access roads created for bridge construction and replacement activities where practicable.
- NCDOT recognizes forests as important habitat for MYGR and therefore will consider the detrimental effects to forest habitat when making BMP selections. Where maintenance and access of traditional BMPs would necessitate permanent clearing beyond the

minimum limits needed for roadway construction and erosion control, traditional BMPs may be alternatively designed to minimize or avoid permanent clearing and designed to minimize or avoid maintenance of the BMP.

Summary of effects from removal of woody vegetation:
Cleared areas are susceptible to erosion, and this may contribute to an increase in suspended sediment into adjacent streams, and ultimately to the French Broad River. This aspect of project construction is further discussed in the next section (Water Quality). Cleared areas may serve as ecological barriers for some species, including bats. The loss or fragmentation of foraging and commuting habitat associated with the proposed project could impact MYGR habitat in a variety of ways; including disruption of foraging and commuting activity. However, it would be difficult, if not impossible to measure these effects or determine the severity of their effect.

NCDOT is committed to minimizing clearing associated with riparian areas, replanting all access roads used for bridge construction, and using native, woody vegetation for replanting areas adjacent to the culvert roost system, and any other areas acquired by acquisition or easement, which will be a long-term benefit to MYGR in the Action Area.

Despite these commitments, it is unclear how removal of woody vegetation associated with the project in the already fragmented urban environment will affect MYGR. If MYGR avoid areas where clearing is occurring/has occurred, this may lead to increased travel time/distance between their roosts and foraging areas. This potentially may result in diminished fitness of adults and/or reduced survivorship of pups and/or adults.

5.1.4 Hydrology/Water Quality

Per the CP4A meeting information, the project is anticipated to affect 374 acres of maintained/disturbed habitat and 191 acres of forested habitat (Appendix G). The clearing of forested areas, in particular, may result in areas of exposed soil that could contribute to sediment in nearby waterways. A typical NCDOT project includes several measures to avoid, minimize, and offset the impacts to water quality during all phases of the project. For this proposed project, NCDOT has already implemented design changes to minimize impacts to surface waters and wetlands (Section 2.1.11, and Appendix G). NCDOT has also committed to default to the most-restrictive SEC measure requirement. (Section 6.1.4) and will prepare a stormwater management plan that implements structural and non-structural post-construction stormwater BMPs to the maximum extent practical (Appendix I).

Despite these measures, NCDOT activities may negatively affect water quality within the Action Area. These effects are anticipated to be short term in nature, and may include:

- temporary sedimentation from land-clearing and earth moving activities to construct the roadway such as preparation, installation of drainage features, utility installation, culvert installation/extension, and grading activities;
- temporary sedimentation from in-water work associated with bridge demolition and construction activities such as investigative drilling for bridge footings, instillation and removal of temporary causeways, removal of existing bents, and construction drilling, and
- accidental spills of petrochemicals, uncured concrete, etcetera

The extent of sediment inputs into waterways associated with the project is very difficult to determine. Duration and timing of rainfall, extent of clearing, proximity to waterbody, slope of cleared area, and other factors can all have a bearing on the amount of sediment that may potentially be generated during rainfall events. Likewise, the type, timing, amount, and proximity to a water source of any accidental spills relate to the magnitude of effect in the event of an accidental spill.

There will be an increase in impervious surfaces of approximately 125 ac. (Appendix G). Increased impervious surfaces in a watershed result in higher volumes of stormwater runoff. This stormwater often contains high amounts of fertilizers, pesticides, and roadway pollutants.

The installation of culverts, pipes, and bridge substructures can cause a geomorphically stable waterway to become unstable. The resulting scour and associated sedimentation will continue until the stream can return to a stable state. This stressor is likely to be more impactful to Appalachian elktoe, so a more detailed explanation of these processes is included in Section 6.1.6.

Twenty-three (23) streams, not including the French Broad River (Table 11) will be impacted in some way by the project. Most of them are small streams, which MYGR do not typically utilize for foraging and commuting, but activities associated with these streams may contribute to diminished water quality within the Action Area. Diminished water quality caused by sedimentation, contamination, and the destruction of wetlands and stream habitats where MYGR are present may reduce the availability of certain aquatic insects and reduce the availability or quality of suitable drinking sources. Insects associated with aquatic habitats make up a large portion of the diet of MYGR (Rabinowitz and Tuttle 1982, Brack 1985, Lacki et al. 1995, Best et al. 1997). Many species of aquatic insects can be negatively affected by a decrease in water quality (Hilsenhoff 1982, Lenat 1993, Barbour et al. 1999, Ramezani et al. 2014). Therefore, a change in water quality can affect a portion of the prey base of the species. However, MYGR diet has been found to coincide most directly with the predominantly available prey species in the foraging area (Barclay and Bingham 1994), including both terrestrial and aquatic species (Brack and LaVal 2006, Lacki et al. 1995).

The Hill Street culvert system where MYGR are roosting conveys a perennial stream as well as stormwater from surrounding areas. There is concern that if the hydrology of this system is altered, either temporarily during construction, or permanently as a result of construction, that the MYGR may find the roost site less desirable and abandon it.

MYGR foraging along waterways within the Action Area, and particularly along the river, may be exposed to this stressor. If excess sediment or chemical pollutants make their way to the river where MYGR tend to commute and forage, exposure to this stressor may be later in time in the form of reduced prey base. If the prey base is reduced and MYGR are forced to find other foraging areas, this may lead to increased travel time/distance between their roosts and other foraging areas. This potentially may result in

Conservation measures for water quality:
NCDOT shall commit to numerous measures to avoid and minimize effects to MYGR that may result from construction activities. Many commitments serve dual purposes, also reducing impacts from light, noise, removal of woody vegetation, etc. and are explained elsewhere in the relevant sections of this document. Some conservation measures specific to maintaining or improving water quality are:

Bridge Construction

- NCDOT will require the contractor to use clean rock (free of debris and pollutants) for the construction of the causeways to minimize unnecessary sediment input into the river.

- Construction fabric will not be used under the causeway material, as it tends to tear into tiny pieces and float downstream during removal.
- Any equipment that is placed on the causeways will be removed any time throughout a workday when the water level rises, or is expected to rise overnight, to a point where the equipment could be flooded, or during periods of inactivity (two or more consecutive days). The only exception to this measure is that the drill rig and crane may be left in place for periods of inactivity; however, they must also be removed if the water rises, or is expected to rise, to a point where the drill rig and crane could be flooded.
- NCDOT will require its contractor to have clean, non-leaking equipment, diapers on-site for each causeway, and spill kits located at each causeway.
- Causeways needed for the new bridges over the FBR will be designed so that during a 100-year storm event there will not be a rise in water surface elevation outside the Action Area greater than normal seasonal variation.
- All construction equipment shall be refueled above the 100-year base flood elevation plus a foot of freeboard and be protected with secondary containment. During crucial periods of construction and demolition, when the drill rig and crane cannot be moved, the drill rig and crane can be refueled while inside the 100-year floodplain provided that spill response materials (such as spill blankets and fueling diapers) are used during the refueling. Hazardous materials, fuel, lubricating oils, or other chemicals will be stored above the 100-year base flood elevation plus a foot of freeboard.
- Areas used for borrow or construction by-products will not be located within wetlands or the 100-year base flood elevation plus a foot of freeboard.
- When constructing drilled piers for the I-240, I-40 and I-26 French Broad River bridges, a containment system will be developed so that material does not enter the river. Material by-product will be pumped out of the shaft to an upland disposal area to the extent practicable and treated through a proper stilling basin or silt bag.
- Construction of all bridges will be accomplished in a manner that prevents uncured concrete from coming into contact with water entering or flowing in the river.

Hill Street Culvert Roost

- NCDOT will maintain water sources that provide baseflow to the culvert (non-stormwater sources) to provide a naturally occurring, continual water source.

Erosion Control Measures

- The SEC plan will be in place prior to any ground disturbance for all bridge replacements and construction. When needed, combinations of erosion control measures (such as silt bags in conjunction with a stilling basin) will be used to ensure that the most protective measures are being implemented.
- NCDOT standard procedures dictate that when a project has both Environmentally Sensitive Areas and a requirement to follow DSSW, and uses the GP NCG01 permit, NCDOT will default to the most-restrictive SEC measure requirement. (Appendix H)

Contract language will include the following, or similar language as appropriate for bridges over the French Broad River

- The Contractor will be required to prosecute the work in a continuous and uninterrupted manner from the time work begins until completion of each phase of structure construction, demolition, and completion. The Contractor will not be permitted to suspend operations except for reasons beyond their control or except where the Engineer has authorized a suspension of the Contractor's operations in writing.

Summary of effects of water quality:
Overall, we do not anticipate any measurable effect on MYGR due to potentially diminished water quality. Perhaps the biggest concern about water quality is how it pertains to the culvert roost. With the commitment to maintain baseflow in the culvert system, and the implementation of the most restrictive sediment and erosion control measures, changes to water quality that might negatively impact MYGR are unlikely.

Due to the dilution effect of the large volume of water carried by the French Broad River, and the implementation of the most restrictive sediment and erosion control measures, sedimentation associated with construction is unlikely to affect MYGR that utilize the French Broad River for foraging and commuting. Smaller streams may be impacted by sedimentation on a smaller, scale for a shorter duration, but we do not anticipate there will be long-term effects on MYGR that utilize those streams for foraging or commuting.

Although water quality impacts may cause a reduction in specific portions of the prey base and diminish the quality of drinking sources for MYGR, adverse effects are likely to be undetectable due to the availability of alternative prey and drinking sources in the surrounding landscape. Bats may seek different areas for drinking and may turn to other types of prey.

5.1.5 Stream Fill – Habitat Disturbance/Loss

Highway construction within and around water bodies often results in the placement of fill into streams and adjacent floodplains. Two types of fill may occur: permanent and temporary. Permanent fill consists of bridge bents and abutments, culvert and pipe construction or extensions, and roadway fill slopes. Temporary construction causeways used for equipment access, as well as coffer dams and turbidity curtains are examples of temporary fill.

5.1.5.1 Potential Impacts to Foraging Habitat

Both temporary and permanent fill may reduce the amount of instream habitat available for colonization by aquatic insects. This is especially important considering large causeways are planned for demolition of existing bridges and construction of new bridges along several waterways, including the French Broad River, where bat activity was highest. As mentioned in Section 6.1.1.6 (Causeways) there may be up to 236,350 sq. ft. of temporary fill associated with causeways required for demolition and construction activities, and this fill may be in place, at various locations within the Action Area, for up to five years while bridge demolition and construction is underway.

Temporary fill in relatively small, unnamed tributaries to the French Broad River is unlikely to affect MYGR, since MYGR do not typically use smaller streams for foraging. However, MYGR likely use larger (named) tributaries for foraging and commuting. Acoustic surveys identified MYGR calls at some of the large tributaries within the Action Area, although small tributaries were not surveyed. Construction work and fill material in tributaries to the river may cause impacts to MYGR by affecting stream stability, resulting in sedimentation/erosion that could result in adverse effects to MYGR foraging habitat.

Temporary fill will also cover the channel bottom at bridge locations, thus eliminating habitat for aquatic insects, a primary food source for MYGR, wherever this fill is present. Although temporary fill impacts may cause a reduction in specific portions of the prey base in localized areas, adverse effects are likely to be undetectable due to the availability of alternative prey in the surrounding landscape. Bats may seek different areas for foraging and may turn to other types of prey.

Conservation measures for stream fill:
Project design modifications for avoidance and minimization were described in Section 2.1.11. Modifications to project design have resulted in reduction in overall permanent impacts to stream by 724 ft. This means that associated permanent fill created by culvert installation will also be reduced. Project design will continue to be modified to further reduce impacts to streams whenever feasible.

Additional conservation measures related to minimization of stream fill include:

- Causeways will not restrict more than 50% of the existing channel width of the French Broad River, Hominy Creek, and Smith Mill Creek. Potential additional restrictions of the channel may be necessary for short durations, and these additional restrictions will be coordinated with USACE and USFWS prior to permitting.
- Causeway material will be removed to the extent practicable and either disposed of off-site or used in areas that require permanent stone protection after project completion. NCDOT will also require that concrete barriers (barrier rail) be placed along the downstream edge of each causeway to limit the downstream movement of causeway material during high flow events.
- If the final causeway plan is staged, causeway material will be added/removed as needed for each stage to minimize the causeway footprint over the length of the project.
- To minimize disturbance to the riverbed, all readily detectable causeway material will be removed, to the extent practicable, while removing as little of the original riverbed as possible.
- Removal of existing bridges shall be performed so as not to allow debris to fall into the water. If debris is dropped in a waterway, it will be immediately removed.
- NCDOT will continue to identify avoidance and minimization measures to all Waters of the U.S. and ensure that major hydraulic structures associated with the project are designed and installed to minimize negative impacts to stream stability (and therefore, water quality) to the greatest extent practicable. As part of this process, NCDOT and the NCDOT Design-Build Team will continue to coordinate with the Merger Team to identify avoidance and minimization measures and ensure that project impacts are minimized to every practicable extent, including impacts to federally protected species.
- NCDOT will provide USFWS with the results of the hydrology modeling (described below) as it becomes available, including change in French Broad velocity with causeways in place, and change in water surface elevation with causeways in place.

Summary of effects from stream fill:
It is anticipated that the temporary fill associated with the causeways in the French Broad River Smith Mill, Creek, and Hominy Creek will have some effect on MYGR. It is difficult to predict whether the potential changes to flow velocities, and any associated increases in sedimentation produced by the temporary causeways will affect MYGR that utilize these areas for foraging or commuting. However, the causeways will temporarily reduce the available habitat for aquatic insects in these streams, where MYGR are known to forage. If the prey base in this area is reduced while causeways are in place, and MYGR are forced to find other foraging areas, this may lead to increased travel time/distance between their roosts and other foraging areas. We anticipate that temporary stream fill that may remain in place in various locations throughout the Action Area, in conjunction with similar construction activities associated with the I-4400/I-4700 project may cause some MYGR to seek alternative foraging locations. This may potentially result in diminished fitness of adults and/or reduced survivorship of pups and/or adults.

5.1.6 Utility Relocation

The preliminary project designs do not include utilities design, which will be completed during the final design phase. However, it seems feasible that some utility relocations will be necessary. The areas where utilities are currently located, as well as areas where they could potentially be moved are largely covered by maintained/disturbed habitat. Therefore, little woody vegetation is likely to be removed for the relocations, and the impact to MYGR is expected to be negligible.

5.1.7 Summary of Construction Effects:

Lighting, noise, removal of woody vegetation, reduced water quality, stream fill and associated aquatic habitat alteration/destruction, and utility relocation are stressors on MYGR created by construction activities associated with the project. Stressors that occur at the Hill Street culvert roost, French Broad River, Hominy Creek, Emma Branch, and Smith Mill Creek bridge crossings are anticipated to have the largest effect on MYGR, since acoustic surveys revealed a high level of MYGR activity at these locations. Construction lighting, noise, and the removal of woody vegetation at the French Broad River are anticipated to be the most impactful activities. Reduced water quality, stream fill, and utility relocation have effects that are not as well understood, and harder to quantify, but are nevertheless predicted to have at least some negative effect on the species. In total, construction effects from these stressors are likely to adversely affect MYGR by potentially diminishing the fitness of adults and/or reducing the survivorship of pups and/or adults.

5.2 Potential Effects from Highway Operation

Operational effects include effects that arise from maintenance and daily vehicular use of the facility once it is in operation, as well as natural responses over time to the proposed action's construction effects that occur post-construction. MYGR flying across or adjacent to the roadway during months when they are not hibernating, may be exposed to potential effects from highway operation.

5.2.1 Traffic Volume Increase

The Traffic Forecast Report (AECOM 2016) indicates that there will be an increase in traffic volume on all roadways associated with the project. With this increase in traffic will come an associated increase in light, noise, and the elevated potential for bat-vehicle collisions. This stressor could affect MYGR if they fly adjacent to or across the roadways.

5.2.1.1 Lighting

Once the proposed roadway is in operation, and as traffic volume increases, the amount of ambient light generated by headlights will increase. MYGR travelling across or adjacent to the roadway, particularly in areas near the River and its larger (named) tributaries, during the months when they are not hibernating would be most susceptible to increased light. As discussed in Section 5.1.1, lighting has been shown to induce a barrier effect for some bat species.

5.2.1.2 Noise

Effects from noise associated with increased traffic volume after the roadway is completed will become permanent and will increase over time. It is difficult to predict the degree to which MYGR could be disturbed by the noise associated with the completed project. MYGR travelling across or adjacent to the roadway during the months when they are not hibernating would be most susceptible to increased noise.

As is evident by the presence of the various MYGR roosts that have been recently discovered in bridges near the Action Area, MYGR do not seem to be bothered by the associated level of traffic noise at those bridges. Although, it should be noted that most of the roosts are located on two-lane roads with lower traffic volumes than those associated with this project.

It is unclear how increased noise associated with increased traffic volume may affect the bats that use the culverts as a roosts. The interior of the Hill Street culvert is currently somewhat noisy due to multiple openings such as drop inlets and culvert inlets near the interstate and secondary roads. It is very difficult to predict how noisy the interior of the culvert will become after construction is complete. The interior of the Smith Mill Creek culvert is not as noisy as the interior of the Hill Street culvert, and since nearby ramps will be removed and no new construction will occur near the culvert inlet/outlet, noise levels in this culvert are not likely to change. In fact, noise levels may decrease since the existing ramps will be removed and the existing nearby interchange will be moved further east.

No effects from increased noise associated with operational activities of the proposed roadway are expected to occur at winter roosts, because none have been documented in North Carolina.

The results of acoustic studies presented in Appendix C reveal that there is MYGR activity at all detector locations, including those in areas with elevated noise levels such as Sites 2, 4, 5, and 7. This would suggest that MYGR are not deterred by the noise created by the current traffic volume at these locations. While traffic volumes at these locations are anticipated to increase (and associated noise will increase as well) we cannot predict how this might affect MYGR at these locations. There are no studies focused specifically on MYGR and noise effects. However, some studies suggest that MYSO (a congener) may be able to tolerate disturbance from vehicular traffic noise at a roost near a large airport (Sparks et al. 2009). Another study (Gomes et al. 2016) concluded that fringe-lipped bats (*Trachops cirrhosus*) in South America successfully shifted their foraging strategy with increased noise.

Conversely, bats in Indiana were twice as likely to display avoidance behavior when attempting to cross roads if vehicles were passing by; reversing course an average of 98 ft. from the vehicle. However, the height a bat flew, speed of the vehicle, type of vehicle or level of noise emitted by vehicles had no effect on the likelihood of bats reversing course an average of 98 ft. from the vehicle (Zurcher et al. 2010). Additionally, a comparison of echolocation search calls produced by Mexican free-tailed bats (*Tadarida brasiliensis*) at sites with and without anthropogenic noise from natural gas compressors revealed that bats modified their echolocation search calls in noise; producing longer calls with a narrower bandwidth. This alteration of calls might affect prey detection (Bunkley 2015).

5.2.1.3 Vehicle Collisions

Bats attempting to cross the roadway will encounter a wider opening between areas of vegetated refugia, as well as, to a lesser extent, roadways in locations where they do not currently exist. MYGR that attempt to cross over the roadway could potentially be struck and injured or killed by passing vehicles. MYGR will be exposed to this stressor indefinitely into the future, particularly at bridge crossings.

Bat mortality caused by impacts with passing vehicles is widely documented (Kiefer et al. 1995, Lesiński 2007, Gaisler et al. 2009, Russell et al. 2009, Lesinski et al. 2010, Medinas et al. 2013). Bat mortality may occur within the Action Area if bats fly too low to traffic when crossing over a bridge or roadway, typically when they are commuting. MYGR are probably less susceptible to vehicle collisions while foraging, because they typically forage within 6.5 to10 ft. of the water surface (Tuttle 1976b, 1979, LaVal et al. 1977).

Since MYGR activity is so closely tied to large waterways, and they typically fly low to the water, one would expect them to fly under bridges during most commuting and foraging. However, the greatest concern with regard to vehicle collisions has more to do with commuting bats that fly over land and need to fly across roads or choose to cross over a bridge rather than under the bridge because of lighting/noise at water level during bridge construction.

Direct mortality is difficult, if not impossible, to quantify. A carcass search of the road shoulder is the most effective way to do this. However, any bats killed at bridge crossings may fall into the water below and wash downstream. Also, due to the volume and speed of traffic which poses a safety hazard for pedestrian surveys, as well as the speed with which bat carcasses tend to be consumed by scavengers, estimating the number of direct mortalities is not feasible.

Conservation measures for increased traffic volume:
No conservation measures are proposed to reduce the amount of traffic after project construction is complete. However, as previously mentioned, NCDOT will acquire a permanent drainage easement (PDE) or additional right of way at the culvert inlet (near Courtland Ave.) and outlets, where replanting with containerized, native, woody vegetation will occur. In addition, if NCDOT acquires additional right-of-way or conservation easements along the French Broad River or adjacent to the culvert, NCDOT will replant with native, woody vegetation to provide, in time, a buffer for noise, light, and surface water runoff. NCDOT will coordinate with USFWS and NCWRC to develop a revegetation and invasive species management plan for these areas.

Summary of effects for traffic volume increase:
Increases in noise, light, and vehicle collisions are all anticipated as a result of increased traffic volume once the widened roadway is in operation. Effects from these stressors are expected to be long term in nature, more severe in areas where mature riparian vegetation is removed, at night, for individuals who choose to fly over land or over bridges, during times of year when MYGR are not hibernating, at the new crossing of the French Broad River where MYGR activity is particularly high, and along Hominy Creek, Emma Branch, and Smith Mill Creek.

It is unclear whether MYGR will adjust to new, higher levels of light and noise associated with the increase in traffic volume. However, as already discussed under “Potential Effects from Highway Construction”, increases in light and noise may exacerbate the barrier effect of roads. Therefore, it is anticipated that MYGR may modify their preferred foraging and commuting areas due to these stressors. It is impossible to determine the number of MYGR that may be killed due to direct mortality from vehicle strikes, although we anticipate that there may be an increase in this type of mortality once traffic volumes increase. If MYGR alter their foraging and commuting habits due to the increased light, noise, or potential for vehicle collisions, this could lead to increased travel time/distance between their roosts and other foraging areas. This potentially may result in diminished fitness of adults and/or reduced survivorship of pups and/or adults.

The conservation measures that NCDOT will implement should reduce the effects from these stressors. The woody vegetation that will be retained or replaced will aid in buffering light and noise along adjacent waterways. Furthermore, this will reduce the overall distance that bats must travel through open space (i.e. barrier effect) should they choose to fly over the road. This may reduce direct mortality caused by impacts with passing vehicles.

5.2.2 Tree Trimming and Hazard Tree Removal
Forested areas that are cleared as part of the construction process will need to be maintained in low growing, or herbaceous vegetation in most areas after construction is complete. Tree trimming and hazardous tree removal activities occur along roadside ROWs to reduce safety hazards from falling trees or limbs, or to improve line-of-sight issues. Potential effects to MYGR from this activity are described in Section 5.1.3. Hazardous tree-removal occurs on an as-needed basis, so quantifying the amount of habitat lost from this activity is not practicable. No MYGR

roosts are anticipated to be impacted by this activity, and any clearing of this type along waterways where MYGR might be foraging or commuting is expected to be minimal. Therefore, we do not anticipate any detectable effects from tree trimming and hazard tree removal on MYGR.

5.2.3 Water Quality

An estimated 125 acres of impervious surface will be added as part of this project in the form of widened and new location roadways, and new bridges. There is the potential for an increase in the input of toxic chemicals that drip or drain from passing vehicles to be washed into nearby waterways during rain events, due to the anticipated increase in traffic volume. There is also the potential for sediment input, through the alteration of hydrology in the Action Area, caused by the increase in impervious surfaces or increases in permanent fill in waterway from culvert extensions. These stressors may have a detrimental effect on MYGR foraging areas and have already been discussed in Sections 5.1.4 and 5.1.5. It is important to bear in mind that MYGR prefer to spend their time foraging along the French Broad River, which has an extremely large watershed (more than 660 sq. mi.). Therefore, water quality in the river nearest the proposed project is influenced by a variety of factors and activities, not only the activities associated with the proposed project.

If the prey base in the section of the river nearest the proposed project is diminished, or if drinking water quality suffers, MYGR may be forced to find alternative foraging areas. This could lead to increased travel time/distance between their roosts and other foraging areas. This potentially may result in diminished fitness of adults and/or reduced survivorship of pups and/or adults.

Conservation measures for water quality:
NCDOT will implement measures to minimize effects from stormwater associated with the completed roadway to MYGR (and Appalachian elktoe). As outlined in Appendix I, these include:

- NCDOT has developed stormwater commitment guidance, which will apply at crossings of the French Broad River and any tributaries draining to the French Broad River, any portion of the NCDOT stormwater conveyance system draining to an outfall discharging to the river within the NCDOT right of way (Appendix I)
- NCDOT will prepare a stormwater management plan (SMP) that implements structural and non-structural post-construction stormwater best management practices (BMPs) to the maximum extent practical, which is consistent with the Department's National Pollutant Discharge Elimination System (NPDES) Post-Construction Stormwater Program.
- When preparing the SMP, NCDOT commits to using a hierarchical BMP selection process, which is optimized to treat silt, nutrients, and heavy metals.
- At each discharge location outside of the 100-year floodplain, the hydraulics engineer will evaluate the feasibility of installing either an infiltration basin or a media filter as described in NCDOT's BMP Toolbox. If neither is feasible, the hydraulics engineer will select another BMP that is feasible.
- NCDOT will commit to evaluating the use of emerging BMP technologies that the Department has not yet published in its BMP Toolbox. These emerging BMP technologies are as follows:
    - Bioswales
    - Bioembankments
    - Biofiltration conveyances
    - Soil improvement to maximize infiltration
- The NCDOT hydraulics engineer will consult with the State Hydraulics Engineer and obtain prior approval before proposing one of these BMP technologies in the SMP.

Summary of effects from water quality:
Although the watershed is quite large, and NCDOT has made for commitments for stormwater control, the effects from roadway runoff will be long-lasting, spanning the life of the highway. There are no existing data to determine if this potential increase in pollutant exposure would pass a threshold that would adversely affect MYGR in area. Any effects to MYGR that might occur would be extremely difficult to assess, and we expect that we would not be able to measure, detect, or evaluate the effect.

The effects of increased exposure will be minimized by stormwater BMPs, described in NCDOT's BMP Toolbox manual (2014b), and implemented by NCDOT's Post-Construction Stormwater Program (NCDOT 2014c).

5.2.4 Permanent Lighting

As mentioned earlier, the existing lighting installed on I-26 has already been upgraded to 4000K LED, and the local utility in Asheville is in the process of upgrading all lighting to 4000K LED as well. While a few HPS fixtures (which produce UV light) remain in the area, the vast majority have already been upgraded to 4000K LED. New or replacement lighting will be required in some locations, as outlined in the Lighting Summary document (Appendix K) and Section 2.1.7.4 (Permanent Lighting). The largest concentration of new lighting will be associated with the new bridge over the French Broad River and associated ramps/approaches.

Conservation measures for permanent lighting:
NCDOT commits to reducing impacts from permanent lighting on MYGR in a variety of ways, including general commitments that apply to the entire project, as well as commitments specific to individual crossings as well as the culvert roost area. Additional details on differences between original and refined lighting design are included in Appendix K (Lighting Summary). Crossing numbers in this section refer to those identified in Table 2 in Section 2.1.2 and Figures 4A-4F in Appendix A.

- Applicable to the entire project:
    - NCDOT plans to install 3500K to 4000K LED fixtures wherever new or replacement lighting is required.
    - Using shorter poles which will provide an overall LED light fixture mounting height of 35' above the pavement surface.
    - Using LED light fixtures with a more rectangular light pattern as well as house side shields to minimize lighting outside of the pavement area.
    - Using LED light fixtures with a BUG rating of 1-0-3 or less
    - NCDOT is committed to changing the design standards to meet the AASHTO minimum requirements of 0.6 fc at 4:1 uniformity at all crossing locations identified in the lighting document, from the original design of 0.8 fc at 4:1 uniformity.
    - At all identified crossings, the proposed high mast poles and 45' poles with GE Cobrahead (GE) fixtures (3-0-3 BUG) were redesigned with 35' poles with Cooper Cobrahead (Cooper) fixtures (1-0-3 BUG).
- Hill Street Culvert Outlet – The current NCDOT design near Southern States property results in zero calculated change to the baseline light levels at the culvert opening and ditch leading to the French Broad River.
- Hill Street Culvert Outlet – NCDOT will meet with landowners adjacent to the roost culvert to discuss replacement or augmentation of existing lighting to reduce existing baseline conditions determined by the NCDOT Roadway Lighting Squad.

- Hill Street Culvert inlet – The original lighting design near the Hill Street culvert inlet had 80' high mast poles installed between the mainline and Hill Street behind the Isaac Dickson Elementary School. NCDOT is revising this design to remove the high mast poles and to replace them with GE light fixtures installed on twin arm poles on the mainline median barrier.
- New French Broad Crossing (NFBC) – Use of single arm light poles mounted on the bridge and flyover barriers in place of the 120' and 100' high mast poles.
- NFBC – 35' single arm poles with a narrow distribution light fixture and a house side shield will be used.
- FBR-1 – The GE fixtures were replaced with the lower BUG rated Cooper fixtures.
- FBR-1 – Fixtures were redesigned to have the outer ring (as shown in the figures within the lighting document) ending roughly 115' from the west bank of the FBR.
- FBR-2, FBR-3, & FBR-4 – All high mast poles within the connector interchange were removed and replaced with Cooper fixtures mounted on the outer and/or center bridge barrier rail.
- FBR-2, FBR-3, & FBR-4 – The Cooper fixtures are located so the crossings are centered between fixtures where the light level is the lowest.
- HC-1 – Replacing the GE fixtures with the Cooper fixtures.
- HC-1 - Replacing the 120' high mast pole with an 80' high mast pole.
- HC-2 & HC-3 – Removal of a 120' high mast pole and replaced with Cooper fixtures.
- HC-2 & HC-3 - The Cooper fixtures are located so the crossings are centered between fixtures where the light level is the lowest.
- HC-4 - The Cooper fixtures are located so the crossings are centered between fixtures where the light level is the lowest.
- HC-5 & HC-6 – Removal of 80' high mast pole and replacing with Cooper fixtures along the mainline and ramp in both directions.
- HC-5, HC-6, HC-7 – The Cooper fixtures are located so the crossings are centered between fixtures where the light level is the lowest.
- All SMC and EBC – Removal of all high mast poles within the connector interchange and replaces them with Cooper fixtures mounted on the outer and/or center bridge barrier.
- All SMC and EBC - The Cooper fixtures are located so the crossings are centered as best as possible between fixtures where the light level is the lowest.
- SMC culvert area – the existing high mast pole located within the interchange ramps will be removed.

Summary of effects from lighting:
MYGR travelling across or adjacent to the roadway, particularly in areas near the River and its larger tributaries, during the months when they are not hibernating would be most susceptible to increased light. As discussed in Section 5.1.1, lighting has been shown to induce a barrier effect for some bat species. It is unclear whether there is a threshold of ambient light that would induce this effect for MYGR.

Since insect activity may increase around UV lights, it's possible that any UV lighting on private property adjacent to the river or other large waterways within the Action Area has the potential to attract insects that would normally be available as food for MYGR. These lighted areas may currently be blocked by existing riparian vegetation. If this vegetation is cleared as part of project construction, the light may become more visible (and therefore attractive) to the insects associated with waterways where MYGR forage. Furthermore, as explained in Section 5.1.1, UV lighting can be detected by Myotis bats, potentially causing them to avoid these areas.

NCDOT plans to utilize LED lighting for any new lights that are installed as part of this project, which will help reduce impacts from permanent lighting on MYGR. NCDOT will greatly minimize the potential effects from permanent lighting on MYGR within the Action Area by committing to do the following: space the lights in such a way that lighting over waterways at bridge crossings is minimized, use fewer high mast poles, install fixtures that minimize or eliminate backlight, uplight, and glare, adjust the placement of fixtures to minimize light spill into surrounding forest areas.

It is anticipated that the additional lighting required for to meet minimum safety standards will affect MYGR foraging and commuting behaviors. However, it will be difficult, if not impossible to measure this effect.

5.2.5 Summary of Operational Effects

Tree trimming and hazardous tree removal, and changes to water quality are not anticipated to have a measurable effect on MYGR. However, traffic volume increases and associated increases in ambient light and noise, as well as MYGR-vehicle collisions are anticipated to occur when the roadway becomes operational. Due to MYGR's strong association with waterways, these stressors are likely to be most impactful at large stream and river crossings, and where the highway runs adjacent to these waterways. However, bats commuting overland may also be affected by these stressors. Operational effects from these stressors are likely to adversely affect MYGR by potentially diminishing the fitness of adults and/or reducing survivorship of pups and/or adults.

5.3 Interrelated/Interdependent Effects

Interrelated actions are those that are part of the larger action and depend on the larger action for their justification. Similarly, interdependent actions are those that have no independent utility apart from the action under consideration. (50 CFR §402.02)

5.3.1 Induced Land Development Effects

Project-induced changes in land use can be part of the indirect impacts of a road construction project, resulting from modifications in access to parcels of land and from modifications in travel time between various areas (Mulligan and Horowitz 1986).

Indirect and cumulative effects were studied for the proposed I-2513 project as part of a larger regional area that encompasses the reasonable and foreseeable projects along the I-26 Corridor (NCDOT 2014a). The Future Land Study Area (FLUSA) used in the study was based on a two-mile radius of the interchanges along I-26. Based on a close examination of "probable development areas," land use changes as a result of the proposed project are expected to be minimal within the FLUSA and should be minimal as well within the smaller Action Area for the project. The pace of infill and redevelopment may be accelerated somewhat in the FLUSA; however, commercial, residential, and industrial growth and redevelopment is already occurring and is expected to continue with or without the proposed project (NCDOT 2015).

The project may have the ability to accelerate current growth and development patterns, particularly near interchange modifications; however, local ordinances are in place to regulate such growth, which will limit potential effects of development. The Indirect Screening and Land Use Scenario Assessment (URS 2015) concluded that I-2513 was not expected to result in notable impacts to natural resources or downstream water quality that would not otherwise occur.

Potential land use effects as a result of the project are tempered by the fact that the project is not expected to provide many new access points or opportunities for traffic exposure to properties along the major roadways. Local planners have indicated that commercial, industrial, and residential development is anticipated to occur regardless of whether the project advances (NCDOT 2015).

Development can and often does lead to a reduction in forest cover, increase in impervious surface area (which can negatively affect water quality), increase in noise generated by vehicles and machines, and an increase in lighting associated with commercial and residential expansion, among other stressors. These can affect MYGR if individuals are using undeveloped areas for foraging, commuting, or roosting. However, the potential for induced growth generated by the proposed project is limited. Therefore, impacts to potential MYGR habitat in areas adjacent to the proposed project are unlikely to result from the proposed project.

5.3.2 Utilities

Utility relocations required for I-2513 have the potential to affect local water quality through erosion and sedimentation, which could result in effects to MYGR if sediment reaches the French Broad River or the large tributaries to the River (see project description in Section 2.1.6 for information on potential utility relocations). The removal of woody vegetation associated with utility relocations could also adversely affect MYGR. Quantifying the degree of deforestation, or water quality degradation is difficult to project and depends on the location of the future activities, the amount of impervious surface area associated with the activity, and any stormwater controls that are put in place. Any such effects are likely to be localized and temporary.

Utility relocations that are small, such as overhead electric distribution lines, fiber optic lines, buried cable lines, and small gas lines should have minimal, if any, effects to MYGR, especially if located relatively far from the French Broad River. Larger relocations with associated land-clearing and relocations closer to the French Broad River and its larger tributaries have the potential to affect MYGR until the relocation areas can be stabilized. Electric transmission towers, some of which parallel the French Broad River, may need to be relocated as a result of I-2513. Water lines are wide-spread in urbanized areas, but the extent of those relocations will not be known until final designs are complete. Sewer lines are adjacent to the French Broad River and Hominy Creek, but relocations are not currently anticipated.

5.3.3 Effects Associated with Borrow/Fill, Staging and Storage

The contractor may use areas outside the Action Area for borrow pits or spoil areas. Waste and borrow areas will likely be required to dispose of and obtain materials for earthwork and are also subject to clearing and grubbing. Construction contractors are responsible for addressing federally listed threatened and endangered species issues per NCDOT standard specifications. Most borrow and waste areas are sited in upland areas of previously disturbed habitat where tree removal is minimal. Appropriate SEC measures will be required in these areas. We do not anticipate the ability to measure, detect, or evaluate the effects to MYGR from these activities.

5.4 Cumulative Effects

Cumulative effects are defined under the ESA as "those effects of future State or private activities, not involving Federal activities, that are reasonably certain to occur within the Action Area of the Federal action subject to consultation" (50 CFR 402.02). Future federal actions that are unrelated to the proposed action are not considered under these effects because they require separate consultation pursuant to Section 7 of the ESA.

The potential NEPA cumulative effects of reasonable and foreseeable projects within the regions for the I-26 Corridor were evaluated in the Asheville Regional Cumulative Effects Study (CES) per NEPA guidelines (NCDOT 2014a). Most of the activities identified in the CES will likely require federal authorization, such as a CWA 404 permit, and would therefore have their own ESA Section 7 consultation and not be considered a cumulative effect under the ESA for this action. NCDOT has not identified any specific future actions that are reasonably certain to occur that would fit into Cumulative Effects under the ESA.

Under the Asheville Regional Cumulative Effects Study, future urbanization and suburbanization of the region that affect MYGR in the Action Area. The increases in impervious surfaces associated with the construction of buildings, homes, and parking areas could lead to a local deterioration of water quality (NCDOT 2015). Future effects to water quality were determined to have medium to medium-low potential due to the lack of comprehensive protection standards and ordinances, potential of urbanization and suburbanization, and the presence of BMPs (NCDOT 2015). The values “medium” and “medium-low” were based on NCDOT’s Indirect and Cumulative Effects Screening Tool, which rated the magnitude of concern associated with potential cumulative effects (NCDOT 2014a). Changes in water quality could affect drinking water sources and/or alter benthic macroinvertebrate habitat through sedimentation. Local planners indicated that commercial, industrial, and residential development were anticipated to occur regardless of whether or not projects such as I-2513 advanced forward (NCDOT 2014a).

Small-scale road or utility improvements have the potential to affect local water quality in the Action Area, which could result in effects to MYGR. Applications of pesticide along adjacent utility lines could ultimately reach waterways and foraging and commuting habitat. Roadside trash could wash into the French Broad River and its tributaries, adversely affecting areas of habitat. Quantifying the degree of water quality degradation is difficult to project and will depend on the location of the future activities, the amount of impervious surface area associated with the activity, and any stormwater controls that are put in place. Any such effects are likely to be localized.

Loss of forested habitat, particularly if adjacent to waterways or the French Broad River or its larger tributaries, and an increase in sedimentation due to an expansion of impervious surfaces, particularly to the river, could prove detrimental to MYGR for reasons already discussed. Lighting around these developed areas or noise associated with construction activities may also prove detrimental to MYGR, depending on the exact location and proximity to MYGR foraging, commuting, and roosting habitat.

5.5 Beneficial Effects

The USFWS Endangered Species Act Consultation Handbook (1998a) states that “beneficial effects have contemporaneous positive effects without any adverse effects to the species or habitat,” While many of the effects discussed in this document may be adverse, some potential effects of the proposed project may be beneficial to federally protected species.

5.5.1 Waters of the United States Compensatory Mitigation

NCDOT is required to mitigate for impacts to wetlands and streams as per Section 404 of the CWA. Typically, NCDOT offsets unavoidable impacts through a combination of restoration, enhancement, and preservation activities.

The primary beneficial effects of compensatory wetland and stream mitigation activities for MYGR are generated by the restoration of wetland and stream ecology as well as by the long-term stewardship and protection of the land acquired to perform these efforts. Mitigation activities include restoration of the hydrology, soils, and vegetation to wetland systems; bank stabilization and in-channel habitat restoration of streams; and reforestation of riparian buffers. These large areas of mitigation are protected in perpetuity through conservation easements or fee simple acquisitions. Restrictions on the land prohibit tree removal, development, and disturbance of the natural community. These mitigation activities provide beneficial effects of habitat enhancement, preservation, and replacement for MYGR. Bats that utilize the Action Area will also utilize areas within the larger basin where mitigation projects will occur.

In addition to physical habitat protection, these mitigation activities have the beneficial effect of pollutant removal from stormwater, dissipation of surface flows, and increased groundwater storage, all of which contribute to improved water quality. Water quality improvements can increase the productivity of aquatic insect prey and suitable drinking sources for MYGR.

5.5.2 Reduction in Permanent Fill at French Broad River Crossings

The I-40 bridge replacement over the French Broad River (crossing FBR-1) will reduce the number of bents in the water (from five to three). This means that more of the river bed will be available for colonization of aquatic fauna, including aquatic insects, which are the main food source for MYGR. Furthermore, MYGR will have fewer vertical impediments to navigate as they fly near the water surface through this section of the river while foraging and commuting.

Eliminating deck drains over water on replacement bridges, especially bridges over the French Broad River, could result in an overall net benefit with localized improvements to water quality, potentially resulting in a beneficial effect for MYGR.

5.5.3 Removal of Impervious Surfaces

Numerous industrial and commercial facilities, which account for large impervious surfaces near the French Broad River and Smith Mill Creek, will be demolished to construct the I-2513 project. It is estimated that over 7.7 acres of pre-1975 buildings will be removed (City of Asheville 2019) that were constructed before stormwater control devices would have been used. (This acreage was not factored into the impervious surface calculation for the project.) Although portions of the building footprints will be covered by the new I-26, stormwater control measures will be used where they had not been previously, helping to improve water quality along the river. The post-construction re-establishment of vegetation will also help provide buffer treatment. Although some of the buildings will be removed to make way for the new I-26 bridge (including ramps and flyovers), details of what will be in place post-construction will not be available until project plans are more complete. It is likely that some locations where buildings are removed, will be covered by bridges, rather than filled to create approaches to bridge ramps, which will allow for infiltration of water into the ground, where impervious surfaces previously existed.

5.6 Biological Conclusion for Gray Bat

No bats or evidence of bats were observed on any bridges within the Action Area. MYGR were observed roosting in two culverts and one building in the Action Area. The building will not be removed as part of this project. The RCBC portion of the Hill Street culvert system that passes under Riverside Drive and conveys a UT to the French Broad River will be repaired and portions of CMP that lie upstream will be replaced. No repairs to the Smith Mill Creek culvert, nor clearing of vegetation near the inlet or outlet are anticipated as part of this project. Construction activities associated with removal of the ramps and reconfiguration of nearby lighting are anticipated. Impacts to MYGR due to modification of the Hill Street summer culvert are anticipated as part of this project.

There are not any known MYGR hibernacula in Buncombe County, and there are no underground mines located within the Action Area or within 3 mi. of the Action Area. Therefore, no impacts to MYGR winter roosting habitat are anticipated.

Construction of the I-2513 project is expected to result in unavoidable adverse effects to MYGR foraging and commuting habitat, particularly at the French Broad River, Hominy Creek, Emma Branch, and Smith Mill Creek bridge crossings, and will also impact summer roosting habitat at the Hill Street culvert. Effects are anticipated to last up to five years while construction activities associated with this project. In addition, the same population of bats will experience similar stressors associated with a nearby construction project (I-4400/I-4700) in some of their other foraging and commuting range. The combination of stressors is expected to cause long term impacts to the local MYGR population.

FHWA concludes that the proposed action **"May Affect, Likely to Adversely Affect"** MYGR. Incorporation of conservation measures into the project will offset some of those effects. These measures are consistent with the recovery objectives outlined in the recovery plan for the MYGR (Brady et al. 1982), aiding particularly in the control of habitat destruction.

6.0 EVALUATED EFFECTS OF PROPOSED ACTION ON APPALACHIAN ELKTOE

Based on mussel survey data, the Appalachian elktoe is assumed to be present at potentially very low numbers within the Action Area (Figure 8 of Appendix A). Any adults or juveniles present will be in the riverbed, while glochidia may be attached to host fish that reside in or move through the Action Area within the French Broad River and potentially some of the tributaries, especially near their respective confluences with the French Broad River. Project construction has the potential to adversely affect the Appalachian elktoe in a variety of ways, both during construction and once the bridges and roadways are in use. Potential effects to the Appalachian elktoe could happen within the construction footprint, as well as areas downstream. Therefore, the Action Area includes portions of the French Broad River and a section of a tributary (Hominy Creek) that are downstream of the construction footprint (see Section 2.2 for Action Area description and Figure 5 of Appendix A).

Effects of the action refer to the direct and indirect effects on the species and/or critical habitat, together with the effects of other activities that are interrelated or interdependent with the action, which will alter the environmental baseline. Direct effects are caused by the proposed action and generally occur at the same time and place as the project. Indirect effects are those that are caused by the proposed action and are later in time or distance, but still are reasonably certain to occur. These types of effects can include natural responses to the proposed action's direct effects or can include human induced effects associated with the proposed action (50 CFR 402.02).

Interrelated actions are defined as actions that are part of a larger action and depend on the larger action for their justification. Interdependent actions are those that have no independent utility apart from the action under consideration. Interrelated/Interdependent actions include project-associated utility relocations, as well as construction borrow pits, haul roads, staging areas, and human development and patterns induced by the action.

Cumulative effects are those of future state or private activities, not involving federal activities, which are reasonably certain to occur within the Action Area of the proposed federal action. In addition to highway improvements, other infrastructure projects such as water and sewer service have the potential to stimulate land development and directly or indirectly result in effects within the Action Area. However, these other types of infrastructure will likely require some type of federal authorization, such as a CWA Section 404 permit, and would, therefore, have their own ESA Section 7 consultation and not be considered a cumulative effect under the ESA for this Action. Thus, most anticipated cumulative effects are likely to be localized and small in scale, but when added to other effects, they may further affect the species in question.

Potential direct, indirect, and cumulative effects to the Appalachian elktoe and its habitat were evaluated regarding this project and are discussed below. The project-related effects are presented in three categories:

1. Construction Effects
2. Operation Effects
3. Interrelated/Interdependent Effects

Measures that have been incorporated into the development of this project to avoid or minimize effects to Appalachian elktoe are also included in this evaluation.

6.1 Construction Effects

The project design crosses the French Broad River as well as waterbodies that drain to presumed occupied Appalachian elktoe habitat in the French Broad River. As a result, there is potential for construction effects to occur that originate in areas not immediately adjacent to the French Broad River. Although construction-related effects could occur at any stream crossing within the watershed, the likelihood of such effects generally declines the farther the crossing is from occupied habitat.

There is the potential for accidental spills of petrochemicals from construction equipment and uncured concrete at bridge construction sites. The type, timing, amount, and proximity to a water source of any accidental spills would determine the magnitude of effect in the French Broad River in the event of an accidental spill.

6.1.1 Stream Substrate (Habitat) - Disturbance/Loss

Highway construction within and around water bodies often results in the placement of permanent and/or temporary fill into streams and adjacent floodplains. Examples of permanent fill are bridge bents and abutments, culvert and pipe construction or extensions, and roadway fill slopes. There will be fill in a portion of the French Broad River floodplain where I-240/I-26 is parallel to the river. Two retaining walls, each approximately 1,000 ft. long, will be used to reduce the amount of fill, which will extend 40-70 ft. into the floodplain. Design Standards for Sensitive Watersheds (DSSW) will be used in this area to address sediment and erosion control (detailed below), however a large flood event during construction, before the area is stabilized, could cause sediment to discharge to the river (Appendix H).

Temporary construction causeways and work bridges used for equipment access, as well as coffer dams and turbidity curtains are examples of temporary fill. Fill material in waterways can temporarily or permanently eliminate mussel habitat, or bury mussels, if they are present. Temporary fill also has the potential to release sediment into waterways downstream, if a storm event should occur before the fill is stabilized.

6.1.1.1 French Broad River Bridges

The French Broad River will be crossed by the project four times, with one bridge replacement and three bridges on new location. Construction work in or adjacent to the French Broad River has a greater potential to affect Appalachian elktoe due to its immediate proximity to occupied habitat, compared to construction on, or near other waterways.

Geotechnical investigations have not yet been completed for this project. The required bridge footing sizes and types will not be known until those investigations have been performed. For the purposes of a "worst-case" scenario, footings were estimated to be of a spread type, sized as 25x25 sq. ft. per two lanes of traffic. Effects of drilled shaft footings, which would have a smaller footprint on the riverbed, have also been assessed in case they are used instead of spread footings.

The French Broad River crossing of I-40 will be at an existing crossing location (crossing FBR-1), where one new bridge will replace two existing structures, reducing the number of bents in the water from five for the existing structures to three with the new bridge. Fewer bents will allow for a larger hydraulic opening which will likely locally reduce scour potential to the riverbed and sheer stress to the riverbanks. Using an estimate for a worst-case scenario, the spread footings may cover as much as 6,600 sq. ft. of riverbed. Drilled shaft footings may be used as a construction method instead of spread footings, which would require a smaller footprint on the river bottom, but the construction methods will not be determined until later in the project design process.

The three bridges (FBR-2 through 4) carrying I-26 and I-240 over the French Broad River will be constructed on new location north of the existing Captain Jeff Bowen Bridges. The bridges will each be over one-half mile long and will also span Smith Mill Creek and Emma Branch. The bridges will take three to four years to complete and will likely be phase-constructed. The bridges will each require three bents in the river, for a total of nine bents. The estimated spread footing sizes for these bridges in the French Broad River are 1,875 sq. ft. (crossing FBR-2), 9,375 sq. ft. (crossing FBR-3), and 1,875 sq. ft. (crossing FBR-4), for a total of 13,125 sq. ft.

In total, up to 12 bents will be placed in the French Broad River (Table 9). Actual foundation/bent sizes and types cannot be established without geotechnical reports, borings, and other investigation into the locations. Details will be provided to USFWS as project design progresses. If drilled shafts are used for bridge footings, there will be an estimated 63 shafts in the river. The area of riverbed be affected by drilled shafts would be approximately 3,165 sq. ft.

Table 9. Bridge Footing Estimates

Crossing Number #	Road Carried	Water Body	Current # bents in water	Future # bents in water (max estimate)	*Total spread footing size (sq. ft.)	Notes/ Assumptions
FBR-1	I-40	French Broad River	5	3	6,600	
HC-7	I-26 NB & SB	Hominy Creek	1	4**	3,125	**worst-case estimate
FBR-2	I-240	French Broad River	N/A	3	1,875	
FBR-3	I-26	French Broad River	N/A	3	9,375	
FBR-4	I-240	French Broad River	N/A	3	1,875	

*Use of spread footings assumed, with each footing 25x25 ft.

Any mussels present in the bridge construction areas could be killed by drilled shafts or placement of spread footings, placement of causeways, and/or the demolition and removal of existing bridges, all of which are described below. If sedimentation were to occur from any of those actions, it could affect mussels downstream. Land disturbance associated with accessing the river for construction is likely to be the greatest source of sedimentation. Potential effects to mussels could last for the duration of construction.

All four of the French Broad River bridges will need causeways for construction, demolition, or both. Causeways are discussed below (Section 6.1.1.6, Causeways).

6.1.1.2 Bridge Work - Tributaries to French Broad River

Hominy Creek and Smith Mill Creek are not considered to be occupied habitat for Appalachian elktoe. Both are urbanized streams with degraded habitat. Nevertheless, bridge construction in these tributaries has the possibility to affect Appalachian elktoe downstream in the French Broad River if sediment and erosion control measures are not properly developed and maintained. Construction work could result in sedimentation/erosion with temporary effects downstream in the French Broad River, altering mussel habitat or potentially smothering mussels.

Hominy Creek will be crossed by the project seven times. There will be six replacement bridges for I-40 and I-26 (HC-1 through 5, HC-7) and one new construction bridge for the I-40 ramp to NC 191 (HC-6). The nearest Hominy Creek crossing is 0.46 river mi. away from the French Broad River (crossing HC-5), while the furthest is 2.38 river mi. away (crossing HC-4).

The two bridges carrying I-40 across Hominy Creek that are closest the French Broad River will be replaced by a single bridge in the same location (crossing HC-5). It is estimated that the bridge will have a total of five spans; it is likely that no bents will be placed in the water, although one to two bents will be located at the water’s edge, which may be in the water during high flows. Currently there are one or two bents in the water, depending on the water level.

Existing I-26 across Hominy Creek will be replaced (crossing HC-7); the current bridge has one bent in the water. The configuration of the bents for the proposed bridge is unknown and may change during the upcoming design process. Up to four bents could be placed in Hominy Creek, covering as much as 3,125 sq. ft. for spread footings, assuming a worse-case scenario. It is possible that this bridge may be split into three structures as project design progresses, resulting in no bents in the water.

It is anticipated that I-26 across Hominy Creek (crossing HC-7) will be the only Hominy Creek bridge with footings in the water. Five of the bridges over Hominy Creek (HC-1 through 4, HC-6) are unlikely to need causeways. The causeways needed at the remaining two bridges (HC-5 and HC-7) are discussed below (Section 6.1.1.6, Causeways).

The proposed structures crossing Smith Mill Creek and Emma Branch are part of the combined bridge network that will carry I-240 and its ramps across the French Broad River (crossings SMC-1 through 9 and EB-1 through 4). (Note that crossing numbers do not equate to bridges; rather, they indicate the number of times each waterway will be crossed by a structure. Due to the meandering of Smith Mill Creek, one bridge structure may cross it multiple times.) These bridge crossings will likely be phase-constructed and take two to three years to build. The nearest crossing to the French Broad River is at Emma Branch (EB-1), approximately 0.11 river mi. upstream. The furthest crossing from the river is Resort Drive over Smith Mill Creek (SMC-1), 0.45 river mi. away. None of the Smith Mill Creek/Emma Branch bridge structures will require bents in the water or causeways.

6.1.1.3 Investigative Drilling

During investigative drilling for bridge footings, any mussels present in the drilling area, about 15 sq. ft. in the French Broad River, will be killed. Drilling noise may potentially affect Appalachian elktoe if they are present in the vicinity when drilling occurs (discussed below in Section 6.1.3, Acoustic Effects on Appalachian Elktoe), or if host fish carrying their glochidia are present (discussed below in Section 6.1.2, Fish Host Effects). The cuttings (rock dust) from drilling could potentially smother any mussels that happen to be in the area. Given the rarity of Appalachian elktoe within the French Broad River, the chances of an individual occurring within the location of the borings is small but cannot be completely discounted. Investigative drilling in Hominy Creek, if needed, should have no effect on Appalachian elktoe, as they are not known to occur there.

6.1.1.4 Construction Drilling

If drilled shafts are used for bridge footings, a containment system will be developed around the drilling area so that drilling slurry does not enter the river and adversely affect Appalachian elktoe by impairing water quality.

If drilled shafts are used, drilling may take up to 95 weeks. Additional drilling may occur if drilled shafts are needed in Hominy Creek, where up to four bents may be placed in the water. The area of stream bed that could be affected by drilled shafts is estimated at 3,165 sq. ft. for the French Broad River, and 502 sq. ft. for Hominy Creek

As noted above, there is potential for individual mussels to occur within the location of the bridge footings in the French Broad River; any that are present will be killed. Drilling noise may adversely affect mussels or host fish in the vicinity; see Sections 6.1.2 and 6.1.3 for more information. Construction drilling in Hominy Creek, if needed, should not affect Appalachian elktoe since they are not known to be present.

6.1.1.5 Demolition of Existing Structures

Seven bridges will be demolished for I-2513, including one bridge over the French Broad River, carrying I-40 (crossing FBR-1). The remaining demolitions will all be at Hominy Creek (HC-1 through 5, HC-7).

Every effort will be made to avoid dropping pieces of existing bridges into waterways. NCDOT shall provide USFWS with bridge demolition plans and allow 15 days for review prior to plan finalization. All resource agencies will be invited to review the demolition plans and will be notified prior to start of demolition so they may have a representative on site. It is not possible to predict the amount of, or if any bridge material will be dropped into the French Broad River; however, this possibility was factored into the assessment of effects. If bridge material does inadvertently fall into the river, it will be removed promptly. Any mussels or host fish present may be crushed by toppling or dragging a bent. Given the rarity of Appalachian elktoe within the French Broad River, the chance of an individual occurring within the demolition area is low. The demolition of the Hominy Creek bridges has the potential to temporarily affect Appalachian elktoe in the French Broad River, if any turbidity caused by demolition carries downstream.

6.1.1.6 Causeways

Causeway size will be minimized as much as possible during each stage of construction to maximize the free flow area of the river. Pipes will not be used in causeway construction due to safety concerns for river users. Causeways shown in Table 10 are at their maximum expected envelope. Smaller sizes may be possible, depending on construction phasing as decided by the construction contractor. The length of time in-water for causeways will be determined after plan/phasing development.

Three of the bridges over the French Broad River, for I-240 and I-26 (FBR-2 through 4), will need causeways for bridge construction. The fourth French Broad River bridge, for I-40, (FBR-1) will need causeways for both demolition and construction. The demolition causeway for I-40, needed to reach existing bents in the river, may cover up to 68% of the free-flowing river; however, the causeway will only be in place for a limited duration, and its placement will be coordinated with resource agencies prior to project construction. The total causeway footprint in the French Broad River will be 234,300 sq. ft. Estimated sizes are for the surface of each causeway, not the base on the riverbed.

Two of the bridges over Hominy Creek (HC-5 and 7) will need causeways, but only for bridge demolition, not for construction. The causeways will cover 2,050 sq. ft. of the creek bed in total. The Hominy Creek causeway nearest to the French Broad River, for I-40 (crossing HC-5), will be 0.46 river mi. away; while it may not directly affect Appalachian elktoe, it has the potential to cause sedimentation downstream, where occupied habitat occurs in the French Broad River.

None of the crossings over Smith Mill Creek or Emma Branch (crossings SMC-1 through 9, EB-1 through 4) will need causeways.

The total area anticipated to be covered by causeways in all Waters of the US for new bridge construction and bridge replacements is 236,350 sq. ft. These estimates are based on the maximum expected footprint. Smaller causeways may be possible, depending on construction phasing and final design. All causeway sizes are given as rough estimates at water level, not at the base of the causeway. Actual causeway sizes will be reported to USFWS and USACE once they are available. The length of time in-water for causeways will be determined after plan/phasing development.

To minimize disturbance to the riverbed, all readily detectible causeway material will be removed, to the extent practicable, while removing as little of the original riverbed as possible. Causeway material will be disposed of off-site or used in areas that require permanent stone protection after project completion. If the final causeway plan is staged, causeway material will be added/removed as needed for each stage to minimize the causeway footprint over the length of the project.

Any mussels present in the French Broad riverbed where causeway fill is to be placed will be buried, either crushed or trapped under layers of rock. Mussels could also be buried if causeway material washes downstream during high flow events, potentially crushing, trapping, or smothering mussels or fouling their habitat. If they are present in the bridge construction areas, the number is expected to be low, given the rarity of Appalachian elktoe within the French Broad River. Host fish carrying glochidia may be temporarily disrupted when causeway construction begins, but they may be able to swim away if not trapped by the causeway material.

Table 10. Causeway Estimates

Crossing Number	Road Carried	Water Body	Causeway 1 Length X Width (ft)	Causeway 2 Length X Width (ft)	Causeway 3 Length X Width (ft)	Demolition Causeway Length X Width (ft)	Total Causeway Footprint (sq ft)	River Width (ft)	River Free-Flow with Widest Causeway in Place
HC-5	I-40	Hominy	0	0	0	825	825	50	35 ft, 70%
FBR-1	I-40	French Broad	18,000	9,000	0	9,600	36,600	235	^75 ft, 32% (for demolition causeway)
HC-7	I-26/I-240 NB and SB	Hominy	0	0	0	1,225	1,225	70	35 ft, 50%
FBR-2	I-240 EB	French Broad	45,500	15,600	12,000	0	73,100	350	220 ft, 62%
FBR-3	I-26 EB/WB	French Broad	27,000	45,500	0	0	72,500	350	220 ft, 62%
FBR-4	I-240 WB	French Broad	8,000	4,4100	0	0	52,100	350	260 ft, 74%
Total							**236,350**		

^ Demolition causeways will remain in place for limited duration.

Although the loss of habitat from the causeways is temporary (French Broad River bridge work is anticipated to last three to four years), the causeways could have long-lasting effects on the Appalachian elktoe's re-colonization of the habitat if there are areas of riverbed that are substantially disrupted during the removal of the causeways. In areas where the riverbed is bedrock, substantial compaction of the substrate is unlikely, thus, long-term adverse effects to habitat suitability are anticipated to be minimal. The effects of the causeways on river flow, including the potential effects of riverbed scouring downstream and pooling of water upstream, are discussed in Section 6.1.5, Alteration of Flows/Channel Stability. The greatest potential effects from alterations in flow will occur when the French Broad River is most constricted, during the placement of the demolition causeway for I-40 (crossing FBR-1), when 68% of the river may be restricted in order to remove existing bents. This causeway would be in place for a limited time and will be coordinated with resource agencies as design work progresses.

To ensure bridge construction will not result in substantial changes to channel stability (scour, erosion, etc.), NCDOT will conduct river channel and bank monitoring (see Section 2.1.6 for details). If monitoring reveals excessive bank erosion, bank instability, and/or sedimentation associated with bridge work, NCDOT will work to identify the cause and will make improvements to address the problems in a timely manner. Other avoidance and minimization measures for causeways are discussed in Section 7.1.

6.1.1.7 Access Roads

Temporary access roads for bridge construction, if not maintained properly, could transport sediment into waterways until disturbed slopes become stabilized with riprap, matting, or other measures. Access roads leading to the French Broad River have the most potential for causing adverse effects to Appalachian elktoe, due to their proximity to occupied habitat. Roads that slope toward the river could channel sediment directly into Appalachian elktoe habitat.

Temporary access roads may be required to construct the portions of the I-240 and I-26 bridges and ramps that lay at the western bank of the French Broad River (FBR-2 through 4). Temporary access roads will need to be installed to construct the crossings of Smith Mill Creek and Emma Branch (crossings SMC3 through 9 and EB-1 through 4) in conjunction with the I-240 and I-26 bridge access.

Access to I-40 over the French Broad River (crossing FBR-1) is limited by the Biltmore property to the east. An access road will need to be constructed within the right-of-way to build the eastern bents within the river. Access roads may need to be constructed on the west bank for construction traffic.

Access to the remaining bridges should be available on existing roadways with minimal, if any, temporary access roads needed. While there is a broad, flat floodplain on the east side of the French Broad River at the I-26 bridge crossing site, other crossings have more topography, so any roads needed to access causeways will have steeper slopes and greater potential for erosion.

The potential effects to water quality from sediment will be temporary, but adverse effects to Appalachian elktoe habitat could be long-lasting if riverbed habitat became covered with sediment. Access road designs will use DSSW to address sediment and erosion control; however, sediment and erosion effects cannot be entirely eliminated. Numerous factors influence the extent and magnitude of these types of effects, making them difficult to quantifiably predict. As such, some level of direct sedimentation/erosion-related adverse effects are anticipated to occur as a result of project construction, which could temporarily or permanently affect mussels by smothering them, disrupting feeding and breeding activity, or altering their habitat.

6.1.1.8 Culverts

According to the CP4a merger packet (Appendix G), major hydraulic structures include three culverts to be replaced; seven to be extended (some of which include multiple barrels), and six to be retained as they currently are (major hydraulic structures are those with a drainage area requiring a conveyance greater than a 72-inch pipe). Retaining or extending structures instead of replacing them will substantially reduce the potential for construction effects to extend downstream to mussel habitat in the French Broad River. Potential downstream effects will depend upon the degree of erosion/sedimentation caused by construction work, the amount of flow in the stream and distance to occupied habitat. Streams to be affected by construction vary greatly in distance to the French Broad River; some are immediately adjacent, while others are many river mi. upstream (see Table 11). Ten streams will be crossed via culverts within 0.5 river mi. of the French Broad River.

Up to 23 jurisdictional streams within the Upper French Broad River subbasin will be permanently affected by the project, assuming all streams within a 25-ft. buffer of the slope stake limits will be affected. Temporary fill may occur during construction from piping streams to create access roads. Potential effects from this have not been finalized yet, but NCDOT will notify resource agencies once they are.

Detailed hydraulic designs for affected streams have not been developed yet, although major hydraulic structures are presented in Tables 1-3 of Appendix G.

Table 11. Effects to French Broad River Tributaries

Jurisdictional Stream Description	NRTR Map ID	Classification	River Miles to Occupied Habitat	Stream Impacts [b]		
				Section C	Section A	Section B
Ragsdale Creek	SV	P	2.30	219	N/A	N/A
Trent Branch	SW	P	2.48	147	N/A	N/A
UT1C to French Broad River	SAB	I	0.03	18	N/A	N/A
UT1C to Lower Hominy Creek	SAC	I	0.57	79	N/A	N/A
UT1C to Ragsdale Creek	SAD	P	3.23	109	N/A	N/A
UT2 to UT1C to French Broad	SAG	I	0.05	224	N/A	N/A
UT2C To French Broad River	SE	P	0.11	20	N/A	N/A
UT2C to Ragsdale Creek	SAK	I	3.31	109	N/A	N/A
UT3C To Ragsdale Creek	SAN	P	3.74	102	N/A	N/A
UT1 to UT1C to Trent Branch	SY	P	2.71	82	N/A	N/A
UT1C to Trent Branch	SAE	P	2.67	244	N/A	N/A
UT2 to UT1C to Trent Branch	SAH	P	2.70	22	N/A	N/A
UT1A to French Broad River	SD	P	0.002	N/A	238	N/A
UT2A to French Broad River	SF	P	0.04	N/A	164	N/A
UT3C to Lower Hominy Creek	SH	P	0.98	N/A	7	N/A
Moore Branch	SC	P	0.83	N/A	188	N/A
Lower Hominy Creek	SB	P	0.46	N/A	43	N/A
Smith Mill Creek	SR	P	0.33	N/A	N/A	348
UT1B to Smith Mill Creek	SG	I	0.93	N/A	N/A	1,355
UT2B to Smith Mill Creek	SU	P	0.93	N/A	N/A	299
UT2B to French Broad River	SI	I	0.08	N/A	N/A	120
UT3B to French Broad River	SO	P	0.10	N/A	N/A	17
UT4B to French Broad River	SK	P	0.03	N/A	N/A	32
Total				**1,375 ft**	**640 ft**	**2,171 ft**

[a] P=Perennial stream, I=Intermittent stream; [b] Effects calculated based on current design proposed 2:1 slope stake limits plus 25 ft. Does not include temporary impacts.

Culverts can initiate channel erosion when the outlet end is above the streambed (perched culvert) creating a waterfall that can lead to bed scouring and bank erosion as well as acting as a barrier to fish migration. The potential for these types of effects will be taken into consideration when extending the structures at each crossing. With proper installation, the lengthened crossing structures are not anticipated to result in substantial degradation of the stream channels, beyond the effects of the structures currently in place. Improvements such as low flow channels and the elimination of perched outlets will be incorporated into culvert extensions as practicable.

Although the proposed avoidance and minimization measures discussed below (Section 7.0) will help reduce effects to Appalachian elktoe habitat, there is the potential for temporary effects from erosion and sedimentation during construction. Excessive sediment could smother mussels permanently cover some areas of habitat. The closer a stream is to the French Broad River, the greater the potential for effects to occupied habitat. Approximately 4,186 linear ft. of jurisdictional waterways will be permanently affected by the project (Appendix G), not including temporary impacts from causeways or temporary piping. This estimate is based on 2:1 slope stake limits plus a 25-ft. buffer. Permanent effects may be reduced once final design is completed. Fill in jurisdictional wetlands is anticipated to be 1.34 acres. Temporary piping of streams may be needed to allow access roads to be built; if so, this information will be provided to resource agencies once final design is complete.

Roughly a quarter of the stream impacts will occur to an unnamed tributary (UT1B) to Smith Mill Creek, an intermittent stream with 1,355 linear ft. of fill. Although there will be significant effects to the stream, they will occur approximately 0.93 river mi. from occupied habitat in the French Broad River. The distance of the effects and the intermittent nature of the stream lessen the potential for adverse effects to occupied habitat in the French Broad; effects could be reduced if work is conducted during the dry season, when there is no flow in the stream channel.

6.1.2 Fish Host Effects

There is the potential for fish infested with Appalachian elktoe glochidia to be present in the French Broad River and potentially some tributaries (primarily at tributary confluences with the French Broad) while highway crossing structures are being constructed or modified. Lethal and sub-lethal effects to these fish from construction would, in turn, affect the attached mussel glochidia.

6.1.2.1 Physical Effects to Fish Hosts

Mortality of individual fish can occur during construction in a variety of ways. Individuals can be crushed while shafts are drilled for bridge footings or causeway placement, or during bridge demolition, if the structure is dropped into the river. Demersal species like darters are inherently more susceptible to this type of injury than pelagic species like shiners, as they have an affinity to the stream bottom and seek cover within the substrate when threatened. Shiners occur more in the water column and would swim away from the impact area. Most potential fish host species identified for the Appalachian elktoe are demersal.

Causeway construction may also strand individuals in areas that are dewatered or force them to congregate into ponded areas where temperature and dissolved oxygen levels may affect their health and/or survival. Dispersal of host fish from the areas being affected by construction may temporarily increase their susceptibility to predation while they seek alternate habitats. The results to glochidia may range from sub-lethal effects like physiological stress to mortality. The duration of potential effects to host fish will last through the construction phase of the project.

6.1.2.2 Acoustic Effects on Fish Hosts

Acoustic effects can also occur to fish in the French Broad River while shafts are drilled in the riverbed for geotechnical investigation and bridge construction during bridge demolition and causeway placement/removal. Underwater sound waves emitting from these actions can cause potentially lethal tissue damage to fish. Sound generated at drilling sites may be transmitted into the water in two ways. The first is where the noise is transmitted from the drill bit-sediment interface into the surrounding substrate before becoming refracted back into the water column. The second is where vibrations travel up the drill shaft and then become transmitted into the water (Kongsberg Maritime Limited 2015).

Investigative drilling is anticipated to last approximately two months in the French Broad River. Drilled shafts, if used for bridge footings, may last approximately 95 weeks in the French Broad River, assuming the substrate is mostly rock. Acoustic effects to fish infested with Appalachian elktoe glochidia in tributaries to the French Broad River are less likely, since the species is not known to occur in project area tributaries.

If pile driving is used for end bents, it may last several days per bent. Although pile-driving would take place on land, there is the potential that the sound may transfer into the river. It is too soon in the design process to determine if pile-driving will occur for the project, or how long it may take place. USFWS will be provided with this information as project design progresses.

There are several factors that affect the level of acoustic effect, including frequency, sound pressure, acoustic impulse, and distance from source (Caltrans Office of Environmental Engineering 2001). In addition, factors such as shallow water depth, temperature gradients, soft-bottom substrate, bottom topography, and currents can cause noise levels to attenuate (Washington State Department of Transportation [WSDOT] 2017).

Anatomical and physiological traits of the fish species may also influence their susceptibility to sound effects. Fish with a close coupling between the swim bladder and the inner ear are most sensitive (WSDOT 2017). For example, shiners and other ostariophysan fishes contain a series of small bones called Weberian Ossicles that connect the auditory system to the swim bladder, whereas, darters and other species in the Neotelostei clade do not have a close swim bladder-auditory system connection.

In fish species that are hearing specialists, the gas-filled swim bladder acts as a transducer that converts noise pressure waves to vibrations, allowing the fish to detect noise and vibration. Fish species with no swim bladder, or a small one, tend to have a relatively low auditory sensitivity. Studies have shown that the level of inflation of the swim bladder greatly influenced hearing sensitivity of species with Weberian Ossicles and had no significant effect on species without this structure (Moyle and Cech 1988).

The size of the fish also influences sensitivity to sound effects, as larger fish appear to be able to withstand a greater sound impulse than small sized fish (Caltrans Office of Environmental Engineering 2001, Yelverton et al. 1975). A further summary of the effects of acoustics on fish, including bridge construction related effects, are provided in Caltrans Office of Environmental Engineering (2001) and references contained within.

Acoustic effects may be lethal to host fish and any glochidia they may be carrying. Sub-lethal effects can range from tissue damage to impacts to the fish sensory system, which may affect their ability to detect predators. These could in turn affect the ability of attached glochidia to successfully transform into juveniles. Although the noise that causes these potential effects will be temporary, damage to fish tissues and/or sensory systems could be permanent. Acoustic effects associated with bridge construction may extend over the course of several years, depending on how bridge construction over the French Broad River is staged.

To summarize, project construction has the potential to result in lethal and non-lethal effects to fish hosts and the glochidia they are carrying. Given the rarity of the Appalachian elktoe in the I-2513 Action Area, adverse effects to individual fish serving as fish hosts are unlikely to occur but cannot be discounted entirely. Any adverse effects to fish hosts are not expected to hinder the long-term expansion of the Appalachian elktoe population in the river.

6.1.2.3 Disruption of Fish Host Migration

In addition to the effects of bridge and causeway construction and culvert/pipe crossings that were discussed above, another concern with construction of these structures is the potential to create barriers to fish migration. Disruption of fish migration can indirectly affect freshwater mussels if the individual fish that are disturbed serve as fish hosts for the mussel species and are infested with glochidia at the time when their migration patterns are disrupted. Temporary causeways placed in flowing waters can disrupt migration patterns of host fish by creating a physical obstruction in the streambed or by creating increased velocities from channel constriction that are too high for fish to swim through.

Causeways will be needed for construction and/or demolition at all four of the French Broad River bridge crossings for I-2513. Causeways will also be used at two of the Hominy Creek bridge crossings; however, Hominy Creek is not known to provide habitat for Appalachian elktoe, so effects to individual fish hosts are not anticipated. The total time for which causeways will be in place in the French Broad River could last up to five years. Individual causeways may in place for shorter periods. Estimating the length of time with accuracy is not possible given the limited amount of information available. With causeways in place, the river flow will be constricted, potentially affecting river velocity. Hydrologic modeling of the proposed bridge construction layouts, including footings and causeways, will be performed prior to construction. It is anticipated to be completed in the spring/summer of 2019; results will be provided to USFWS.

Because the causeways are temporary, they are not expected to permanently interfere with normal migration of any fish species in the French Broad River. Temporary disruptions to the migration of individuals of some fish species may occur while the causeways are in place. Due to an increase in river velocity, individual fish may be restricted or deterred from swimming upstream of the causeways. In addition, noise and disruptions from causeway and bridge construction (drilled shafts, pile driving) may also affect fish movements such as migration and dispersal.

The temporary restriction of individual fish from habitat upstream or downstream of the causeways and bridge construction sites will not affect the existing distribution of the Appalachian elktoe, as all of the identified potential fish host species that occur in the French Broad are widely distributed throughout the river. Quantifying potential disruptions to fish host migration on glochidia transformation would be very difficult and require intensive fish sampling and examination.

Since Appalachian elktoe are not known to occur in French Broad tributaries affected by I-2513, work on tributary causeways or culverts is unlikely to affect the species. Adverse effects to individual fish serving as fish hosts are unlikely to occur but cannot be discounted entirely. Any adverse effects to fish hosts are not expected to hinder the expansion of the Appalachian elktoe population in the French Broad River.

6.1.3 Erosion/Sedimentation from Construction

Excessive suspended solids in the water column, sedimentation, and turbidity result in reduced biodiversity as well as a decline in productivity at all trophic levels (Gilbert 1989). The detrimental effects of erosion/sedimentation on freshwater mussels were discussed above (see General Threats to Species, Section 4.3). Due to topographic relief in the project area, ground-disturbing activities associated with I-2513 may negatively affect water quality downstream within the Action Area. These effects are anticipated to be short term in nature, and may include: temporary sedimentation from land-clearing and earth-moving activities such as preparation, installation of drainage features, utility installation, culvert installation/extension, and grading activities; temporary sedimentation from in-water work associated with bridge demolition; and construction activities such as drilling in the riverbed for bridge footings, and installation and removal of temporary causeways.

The DEIS (NCDOT 2015) notes that the new location work in Section B of the project would require substantial earthwork in order to provide a level roadbed, since existing development limits the use of existing grade. Due to the proximity of Section B to the French Broad River and Smith Mill Creek, sediment could adversely affect habitat in the river, if sediment and erosion control devices are not properly installed or maintained, or if large storm events occur before construction areas can be stabilized. Temporary access roads for bridge construction could be especially vulnerable to eroding into Appalachian elktoe habitat, especially if they lead directly to the French Broad River.

NCDOT shall commit to measures to avoid and minimize effects to Appalachian elktoe and its habitat that may result from construction activities:

- Design Standards for Sensitive Watersheds (DSSW) will be used to address sediment and erosion control (Appendix H),
- The SEC plan will be in place prior to any ground disturbance. When needed, combinations of erosion control measures (such as silt bags in conjunction with a stilling basin) will be used to ensure that the most protective measures are being implemented.
- Contract language will include the following, or similar language as appropriate for bridges over the French Broad River
    - The Contractor will be required to prosecute the work in a continuous and uninterrupted manner from the time work begins until completion of each phase of structure construction, demolition, and completion. The Contractor will not be permitted to suspend operations except for reasons beyond their control or except where the Engineer has authorized a suspension of the Contractor's operations in writing.

The amount of sediment input into waterways associated with the project and the level to which it adversely effects Appalachian elktoe habitat in the French Broad River is difficult to predict and is dependent on several factors, such as the frequency and duration of rainfall events during construction that exceed the erosion control device design, construction duration and adherence to proper maintenance of erosion control devices, proximity to waterbody, slope of cleared area, and the promptness to respond to and remediate erosion control failures. Other factors include overland surface roughness, size of disturbance, and size of the drainage area, all of which vary across the project. Jurisdictional streams affected by the project range in distance from immediately adjacent to occupied habitat in the French Broad River up to 3.3 river mi. away (see Table 10).

Clearing may occur at different locations at different times as work progresses along the length of the project, depending on construction timing/phasing. Although clearing and grubbing for the project may continue for an extended period of time, the potential for erosion and sedimentation should end once construction is completed.

Ambient turbidity in the French Broad River varies; monitoring stations on the French Broad River closest to the Action Area have measured turbidity ranges from 1.5-140 NTUs (Nephelometric Turbidity Units) upstream and 1.7-190 NTUs downstream of the Action Area (NCDENR 2011). The USGS monitoring to be conducted on the French Broad River for this project and for the I-26 widening will include real-time (continuous) monitoring of turbidity, which will allow for quick responses for issues regarding sediment/erosion control.

6.1.4 Alteration of Flows/Channel Stability

Geomorphically stable stream channels and banks are essential for the survival and conservation of many freshwater mussel species, including Appalachian elktoe. Stream channel instability can result from bridge construction and culvert/pipe crossings. Natural stream stability is achieved when the stream exhibits a stable dimension, pattern, and profile such that over time, the channel features are maintained, and the channel neither aggrades, nor degrades. Channel instability occurs when scour results in degradation or when sediment deposition leads to aggradation (Rosgen 1996). The placement of fill, such as bridge piers, culverts, pipes, and causeways into streams can alter the normal flow pattern of a water body by reducing flow velocities upstream and increasing sedimentation and flow velocities downstream, resulting in scour and erosion.

Effects to mussels in tributaries to the French Broad River from the alteration of flow or channel stability are not expected, since Appalachian elktoe are not known to occur in any tributaries in the Action Area. Adverse effects to tributaries have potential to affect Appalachian elktoe habitat however, depending on the amount of scour, the resulting sedimentation, and the distance the sediment travels downstream to the French Broad River, where mussels or their habitat could become smothered. The potential for this effect will continue until the affected stream becomes stabilized. The degree of this potential effect will vary, depending on the amount of stream disturbance, stream flow, and the distance to the French Broad River.

The initial construction of a bridge is known to cause changes in the flow of the river and corresponding erosive processes that can alter the adjacent habitat. Adding and removing bents in the river will likely cause minor local scour on the riverbed until a state of equilibrium is reached. The design of the bridges crossing the French Broad River will minimize the number of in-stream bents as much as practicable. In areas where the French Broad River substrate consists of bedrock, the degree of riverbed scouring is expected to be minimal.

The effects of increased velocities on channel stability are expected to last while causeways are in place, reverting to normal conditions once the causeways are removed. Table 9 summarizes causeway widths versus the width of free-flowing river.

The causeways are likely to restrict river flow, potentially resulting in upstream pooling with a decrease in flow rate and an increase in water surface elevation, depending on the size of the causeways in place at a given time and the baseline water level of the river. As the river channel is reduced by a causeway, the velocity of the river water passing through the causeway opening is expected to increase. Hydrologic modeling of the proposed bridge construction layouts, including footings and causeways is anticipated to be completed in the spring/summer of 2019; results will be provided to USFWS.

Increases in water surface elevation do not result in adverse effects to mussels in and of themselves; however, the additional water surface elevation could potentially affect mussels by slowing flow rate, which could result in increased sediment deposition, smothering mussels or their habitat. Increased velocity from the causeway constriction could result in streambed scour. Scouring could affect any mussels in the riverbed, washing them downstream and/or causing shell erosion. The effects of scouring on the riverbed will be limited where there is bedrock. Higher velocities could also disrupt movement of host fish as discussed above.

Whether or not causeway-induced changes in velocity and water surface elevation are significantly greater than the seasonal variation in the French Broad River cannot be determined until hydrologic modeling is completed. USFWS will be provided with model results as soon as they are available. The size of the causeways in place at any given time and the amount of free-flowing river left open will be key factors in determining if Appalachian elktoe habitat will be adversely affected.

It is anticipated that some configuration of causeways will be in the river throughout the construction of the French Broad River bridges, which could take three to four years. Potential effects from the alteration of flow in the French Broad River from causeways may occur as long as the causeways are in place. Any changes in habitat that may result from riverbed scour or sedimentation may last longer, depending on the degree of effect.

To ensure bridge construction at the French Broad River crossing will not result in significant changes to channel stability (scour, erosion, etc.), NCDOT will conduct river channel and bank monitoring (see Section 2.1.6, French Broad River Geomorphology & Water Quality Monitoring). If monitoring reveals substantial changes to channel stability associated with the bridge replacement, NCDOT will work to identify the cause and will make improvements to address the problems in a timely manner. Other avoidance and minimization measures for the causeways are discussed in Section 7.

6.1.5 Summary of Construction Effects

Permanent and temporary stream and river effects associated with the construction of I-2513 may adversely affect Appalachian elktoe individuals present in the Action Area. Project construction includes a cumulative 234,300 sq. ft. of temporary causeway footprint in the French Broad River and 19,725 sq. ft. of permanent fill for bridge footings, assuming spread footings are used. Fill material could bury or crush mussels if they are present.

Temporary causeway fill in tributaries to the French Broad River (Hominy Creek) will total 2,050 sq. ft. The total area to be covered by bridge footings in French Broad River tributaries (Hominy Creek) is estimated to be 3,125 sq. ft., assuming spread footings will be used. There will be permanent fill in 4,186 linear ft. of jurisdictional waterways that drain to the French Broad River for culverts. Temporary piping may be used in streams in order to access sites for bridge construction.

Mussels in the Action Area downstream of construction areas could be affected by sedimentation associated with construction, should it occur, but the degree of this effect would be difficult to quantify. Work associated with construction of the French Broad River bridges, including causeways, drilling for bridge footings, and removal of the existing I-40 bridge has the greatest potential to directly affect mussels.

6.2 Operational Effects

6.2.1 Post Construction Alteration of Flows/Channel Stability

As noted above, geomorphically stable stream channels and banks are essential for the survival of many freshwater mussel species, including Appalachian elktoe. Once construction is completed, stream channel instability can occur over time as streams adjust to the channel alterations from construction, which could eventually affect occupied habitat and/or host fish species. The constructed project network within a watershed can be a factor affecting channel stability as increased impervious surfaces can alter the timing and volume of peak flows by intercepting rainfall that would otherwise become subsurface water and decreasing the time for overland runoff to reach the stream channel. As a result, even though a watershed receives the same amount of precipitation, it is transported through the system much more quickly, thus resulting in higher peak discharges and resultant increases in stream power. This increased stream power can more effectively erode the streambed and banks (Castro 2003).

There will be an increase in impervious surfaces of approximately 125 acres from the I-2513 project (Appendix G), which will cause an increase in stormwater runoff. It is not possible to calculate the change in runoff until project design is more complete; however, expected effects on surface water are generally proportional to the amount of increase in impervious surface. Hydraulic design for the project will take the increase in stormwater into account as design work continues, in order to prevent stream instability. Increases in impervious surfaces can result in extremes (either high or low) in peak discharge, runoff volume, and base flow conditions (see Section 4.3.4 for more information), primarily in smaller drainages; minimal effects are anticipated in the French Broad River. Increases in peak discharge (increased runoff velocities) and runoff volume cause erosion and sedimentation, which could bury mussels or degrade their habitat.

The addition of stream crossing structures (bridges, culverts, pipes, etc.) can lead to channel instability. In the past, culverts have been particularly problematic. Culverts have often led to channel instability by constricting the flow which increases erosional forces. Historically, the design of culverts only accounted for the passing of water, and did not include provisions for bed materials, sediment, or woody debris. As such, significant problems at culverts have occurred including "(1) plugging due to large wood transport, (2) sediment deposition at the inlet due to the backwater effect, and (3) high velocity flows exiting the culvert resulting in channel scour" (Castro 2003). Channel instability associated with a culvert crossing is not static, rather the instability can be far reaching and effect the channel, and in turn the aquatic community, for considerable distances both upstream and downstream, as "streams are linear systems that move mass and energy along the channel primarily in upstream/downstream directions and through the floodplain in all directions" (Castro 2003).

The post-construction influence of crossing structures on channel destabilization that could affect mussel habitat depends on the following factors:

- design of the structure
- distance of crossing structure to occupied habitat
- watershed size
- stream gradient and characteristics, i.e. presence of natural grade control (bedrock outcropping, etc.)
- low gradient pools, beaver dams or other structures that may attenuate flow velocity, and
- conditions adjacent to the structure, including degree of development and road network (impervious surfaces).

Some post-construction alteration of flows/stability in the French Broad River are expected, since the three new French Broad bridges (crossings FBR-2, 3, 4) will have three bents each in the water. The existing I-40 bridge over the French Broad (crossing FBR-1), which will be replaced, currently has five bents in the water, so there will be an overall increase of seven bents in the French Broad River for the four bridges. Alteration of stability in the French Broad River could affect any Appalachian elktoe that are downstream due to localized scouring, turbidity, or sedimentation. The effect would last until the channel became stable again.

Post-construction alteration of flows in tributaries to the French Broad may occur from bridge work. The seven Hominy Creek bridges to be built or replaced for I-2513 will have a total of up to four bents in the water; currently there are two to three, depending on the water level. The Smith Mill Creek bridges are not anticipated to have any bents in the water. Since Appalachian elktoe are not known to occur in any tributaries within the Action Area, post-construction alteration of flows/stability are unlikely to affect Appalachian elktoe, unless channel instability caused enough turbidity to reach the French Broad River downstream. This would be a temporary effect, lasting until the channel stabilized.

Up to 23 jurisdictional streams within the Upper French Broad River subbasin will be permanently affected by the project from the addition of new culverts and culvert extensions (see Table 10). Temporary culverts may occur at Smith Mill Creek and Emma Branch to allow for access roads. It should be noted that the interchange at I-26/I-240/Patton Avenue in the 2018 FEIS designs are being reconfigured, which may further reduce stream impacts at this location. Further refinements will occur to designs for the remainder of the project and will be presented to the NEPA/Section 404 Merger Team at CP4B 30% Hydraulic Review and CP4C Permit Drawing Review merger meetings.

For streams receiving culvert extensions, any major alterations of flows/stability would presumably occur during the initial construction and early operation of the culvert. During final design for culvert replacements, there is the potential for improvements in flow within the existing crossing structures, such as the creation of low-flow channels and remediation of perched outlets.

6.2.2 Roadway Runoff

An increase in stormwater runoff rates will be a long-term effect resulting from construction. The following pollutants may be contained in the stormwater:

- pesticides, herbicides, and fertilizers used to plant and maintain highway landscaping,
- petrochemicals, oil, grease, and heavy metals associated with operation of vehicles,
- salt, brine and sand from winter road-clearing,
- trash and debris discarded by highway users, and
- chemicals and hazardous materials accidentally spilled during transport.

Numerous pollutants have been identified in highway runoff, including various metals (e.g., lead, zinc, iron), sediment, pesticides, deicing salts, nutrients (nitrogen, phosphorus), and petroleum hydrocarbons (see Section 4.3.3, Toxic Contaminants, for details on how these pollutants affect freshwater mussels). The French Broad River already receives runoff from roadways including I-40, I-240, and existing I-26, which cross the river or run parallel to it at least briefly. Tributaries to the French Broad indirectly contribute runoff from multiple roadways; Hominy Creek, for example, is already crossed by I-40 and existing I-26 six times within the Action Area.

The increase in impervious surfaces of approximately 125 acres from I-2513 will have the potential to create higher volumes of stormwater runoff; this will be addressed by the stormwater management plan to the maximum extent practical. Any Appalachian elktoe present in the Action Area may experience locally increased exposure to runoff due to the I-2513 project as well as increased exposure to thermal pollution from the project-related increase in impervious surfaces.

The effects from roadway runoff will be long-lasting, spanning the life of the highway. There are no existing data to determine if this potential increase in pollutant exposure would pass a threshold that would adversely affect the mussels.

The effects of increased exposure will be minimized by stormwater BMPs, described in NCDOT's BMP Toolbox manual (2014b), and implemented by NCDOT's Post-Construction Stormwater Program (NCDOT 2014c). Stormwater commitments include the following:

- Stormwater commitment guidance will apply at any portion of the NCDOT stormwater conveyance system draining to an outfall discharging to the French Broad River within the NCDOT right-of-way
- NCDOT will prepare a stormwater management plan that implements post-construction stormwater best management practices (BMPs) to the maximum extent practical.
- NCDOT commits to using a hierarchical BMP selection process, which is optimized to treat silt, nutrients, and heavy metals.
- NCDOT will minimize the use of large footprint BMPs and associated maintenance access roads if such construction would necessitate permanent clearing beyond the minimum limits needed for roadway construction and erosion control.
- At each discharge location outside of the 100-year floodplain, the hydraulics engineer will evaluate the feasibility of installing either an infiltration basin or a media filter. If neither is feasible, the hydraulics engineer will select another BMP that is feasible.
- NCDOT will commit to evaluating the use of emerging BMP technologies that the Department has not yet published in its BMP Toolbox.

Stormwater commitments are detailed in Section 7.4.

6.2.3 Toxic Spills

Roadway construction can also affect the aquatic environment by increasing the potential for toxic spills from vehicular accidents once the facility is in operation. As evidenced from the Clinch River in Virginia (Section 4.3.3), toxic spills resulting from traffic accidents can be devastating to mussel populations. The type (i.e. commercial truck, etc.) and volume of traffic affect the potential for toxic spills to occur. The locations where there is the greatest potential for hazardous spills to affect Appalachian elktoe will be at the crossings over the French Broad River (I-40, I-240, I-26), although any spill within the watershed has the potential to affect the species. The Texas Department of Transportation and the FHWA commissioned a study that evaluated roadway hazardous material spill incidents associated with transportation on Texas highways. The study found that between 2002–2006, more than 900 hazardous material spills of varying volumes were recorded in the state, and it was speculated that rainy/wet roadway conditions may be a factor in the frequency of spills. The results were used to develop design guidelines and parameters to reduce the risk of exposure to travelers and individuals responsible for spill cleanup (Thompson et al. 2011).

There is no way to accurately predict where and when toxic spills associated with the facility will occur; such an event could occur during the lifetime of the facility. According to the US Department of Transportation, there were 391 reported transportation related incidents involving hazardous materials in North Carolina in 2017 (USDOT 2017). For more information about the effect of toxins on mussels, see Section 4.3.3. It is difficult to predict the magnitude of the effects to Appalachian elktoe if such a spill were to occur, due to the following variables: actual presence of Appalachian elktoe in the vicinity of the spill, the toxicity of the contaminants, the amount spilled, and the quantity of river flow. The elimination of bridge deck drains over the French Broad River would lessen the potential of adverse effects associated with toxic spills. Appalachian elktoe are already at-risk from potential toxic spills along existing I-26, I-40 and I-240 but if traffic speeds increase post-project due to reduced congestion, it may increase the risk for crashes with the potential for more toxic spills.

6.2.4. Highway Maintenance

Maintenance work on bridges, culverts, road shoulders, or ditches could result in small-scale land-disturbing activities that could lead to minor erosion and sedimentation in waterways. Maintenance work could also result in wet concrete dropping in the French Broad River. Quantifying the degree of water quality degradation is difficult to project and depends on the location of the activity. Any such effects are likely to be localized and temporary.

6.3 Interrelated/Interdependent Effects

6.3.1 Induced Land Development

Indirect and cumulative effects were studied for the proposed I-2513 project as part of a larger regional area that encompasses the reasonable and foreseeable projects along the I-26 Corridor (NCDOT 2014a). The Future Land Study Area (FLUSA) used in the study was based on a two-mile radius of the interchanges along I-26. Based on a close examination of “probable development areas,” land use changes as a result of the proposed project are expected to be minimal within the FLUSA and should be minimal as well within the smaller Action Area for the project. The pace of infill and redevelopment may be accelerated somewhat in the FLUSA; however, commercial, residential, and industrial growth and redevelopment is already occurring and is expected to continue with or without the proposed project (NCDOT 2015).

The project may have the ability to accelerate current growth and development patterns, particularly near interchange modifications; however, local ordinances are in place to regulate such growth, which will limit potential effects of development. The Indirect Screening and Land Use Scenario Assessment (URS 2015) concluded that I-2513 was not expected to result in notable impacts to natural resources or downstream water quality that would not otherwise occur.

Potential land use effects as a result of the project are tempered by the fact that the project is not expected to provide many new access points or opportunities for traffic exposure to properties along the major roadways. Local planners have indicated that commercial, industrial, and residential development is anticipated to occur regardless of whether the project advances (NCDOT 2015).

6.3.2 Utilities

Utility relocations required for I-2513 have the potential to affect local water quality through erosion and sedimentation, which could result in adverse effects to the Appalachian elktoe if sediment reaches the French Broad River (see project description in Section 2.1.5 for potential utility relocations). Quantifying the degree of water quality degradation is difficult to project and depends on the location of the future activities, the amount of impervious surface area associated with the activity, and any stormwater controls that are put in place. Any such effects are likely to be localized and temporary.

Utility relocations that are small in size, such as overhead electric distribution lines, fiber optic lines, buried cable lines, and small gas lines should have minimal, if any, effects to Appalachian elktoe or occupied habitat, especially if located relatively far from the French Broad River. Larger relocations with associated land-clearing and relocations closer to the French Broad River have the potential to affect Appalachian elktoe until the relocation areas can be stabilized. Electric transmission towers, some of which parallel the French Broad River, may need to be relocated as a result of I-2513. Water lines are wide spread in urbanized areas, but the extent of those relocations will not be known until final designs are complete. Sewer lines are adjacent to the French Broad River and Hominy Creek, but relocations are not currently anticipated.

6.3.3 Effects Associated with Borrow/Fill, Staging and Storage

The contractor may use areas within the Action Area for staging, storage, refueling, borrow pits, or spoil areas. Any of these areas that occur within the watershed of occupied habitat have the potential to result in adverse effects to Appalachian elktoe by affecting water quality from sedimentation, erosion, and introduction of toxic compounds into streams via stormwater channels, ditches, and overland runoff or from spills/leaks during the hauling process. The extent and magnitude of these effects is dependent upon distance to occupied habitat, as well as soils and topography, which influence transport of sediment and toxicants to occupied habitat.

The potential for these effects to occur can be minimized by developing measures to control sedimentation, erosion, and prevent the introduction of toxic compounds from entering streams in these areas. No state riparian buffer rules apply to the Action Area; however Environmentally Sensitive Areas will be in effect along the French Broad River within construction limits. Staging areas for construction equipment will be confined to NCDOT right-of-way as much as possible to limit the amount of land disturbance that will occur during construction.

At this time, the locations of potential borrow/spoil sites, staging areas, equipment storage areas, and refueling areas have not been chosen. NCDOT standard guidance for borrow/fill sites provides a layer of environmental protection for waterbodies. Before they are permitted, staging sites are required to be identified by the contractor and discussed with NCDOT and USFWS, and they are subject to the same regulations and guidance as the rest of the project. Water quality effects associated with borrow/fill, staging, and storage have the potential to occur throughout project construction, but existing regulations and the review process make it unlikely that project-related effects will occur.

6.4 Cumulative Effects

Cumulative effects are defined under the ESA as "those effects of future State or private activities, not involving Federal activities, that are reasonably certain to occur within the Action Area of the Federal action subject to consultation" (50 CFR 402.02). Future federal actions that are unrelated to the proposed action are not considered under these effects because they require separate consultation pursuant to Section 7 of the ESA.

The potential NEPA cumulative effects of reasonable and foreseeable projects within the regions for the I-26 Corridor were evaluated in the Asheville Regional Cumulative Effects Study (CES) per NEPA guidelines (NCDOT 2014a). The majority of the activities identified in the CES will likely require federal authorization, such as a CWA 404 permit, and would therefore have their own ESA Section 7 consultation and not be considered a cumulative effect under the ESA for this action. NCDOT has not identified any specific future actions that are reasonably certain to occur that would fit into Cumulative Effects under the ESA.

Under the Asheville Regional Cumulative Effects Study, future urbanization and suburbanization in the Action Area may affect water quality and mussel habitat. The increases in impervious surfaces associated with the construction of buildings, homes, and parking areas could lead to a local deterioration of water quality (NCDOT 2015). Future effects to water quality were determined to have medium to medium-low potential due to the lack of comprehensive protection standards and ordinances, potential of urbanization and suburbanization, and the presence of BMPs (NCDOT 2015). The values “medium” and “medium-low” were based on NCDOT’s Indirect and Cumulative Effects Screening Tool, which rated the magnitude of concern associated with potential cumulative effects (NCDOT 2014a). Changes in water quality could affect Appalachian elktoe physiologically or could alter mussel habitat through sedimentation. Local planners indicated that commercial, industrial, and residential development were anticipated to occur regardless of whether or not projects such as I-2513 advanced forward (NCDOT 2014a).

Small-scale road or utility improvements have the potential to affect local water quality in the Action Area, which could result in adverse effects to the Appalachian elktoe. Applications of pesticide along adjacent utility lines could ultimately reach waterways and habitat occupied by Appalachian elktoe. Roadside trash could wash into the French Broad River, adversely affecting areas of habitat. Quantifying the degree of water quality degradation is difficult to project and will depend on the location of the future activities, the amount of impervious surface area associated with the activity, and any stormwater controls that are put in place. Any such effects are likely to be localized.

6.5 Beneficial Effects

The I-40 bridge replacement over the French Broad River (crossing FBR-1) will reduce the number of bents in the water (from five to three); the larger hydraulic opening in the river will have fewer adverse effects on the riverbed and may result in localized improvement of habitat suitability for the Appalachian elktoe.

Eliminating deck drains over water on replacement bridges could result in an overall net benefit with localized improvements to water quality, potentially resulting in a beneficial effect on the Appalachian elktoe. The effects at the French Broad River bridges would be greater than at the tributaries, due to the immediate presence of occupied habitat. The duration of the effects would last the lifetime of each bridge, potentially several decades.

Numerous industrial and commercial facilities, which account for large impervious surfaces near the French Broad River and Smith Mill Creek, will be demolished to construct the I-2513 project. Over 7.7 acres of pre-1975 buildings will be removed (City of Asheville 2019) that were constructed before stormwater control devices would have been used. (This acreage was not factored into the impervious surface calculation for the project.) Although portions of the building footprints will be covered by the new I-26, stormwater control measures will be used where they had not been previously, helping to improve water quality along the river. The post-construction re-establishment of vegetation will also help provide buffer treatment. Although some of the buildings will be removed to make way for the new I-26 bridge (including ramps and flyovers), details of what will be in place post-construction will not be available until project plans are more complete. It is likely that some locations where buildings are to be removed will be covered by bridges, rather than filled to create approaches to bridge ramps, which will allow for infiltration of water into the ground, where impervious surfaces previously existed.

6.6 Biological Conclusion for Appalachian Elktoe

While the Appalachian elktoe is currently rare in the French Broad River, the population appears to be expanding, albeit slowly. The I-26 Connector project, I-2513, is expected to result in unavoidable adverse effects to Appalachian elktoe. Assuming under a worst-case scenario that 5.83 acres of French Broad riverbed will be affected by causeways and bridge footings, and using a high-end estimate of 0.002 Appalachian elktoe per square meter (Jason Mays, USFWS, personal communication), it is estimated that 47 individual mussels at most will be directly affected by project construction. FHWA concludes that the proposed action "**May Affect, Likely to Adversely Affect**" Appalachian elktoe. The changes to the environmental baseline of the Appalachian elktoe population within the Action Area as a result of direct and indirect adverse effects from this project should not preclude the expansion of the Appalachian elktoe through the Action Area. Incorporation of conservation measures into the project will offset some of the effects. These measures are consistent with the recovery objectives (A-1, C-4) outlined in the recovery plan for the Appalachian elktoe (USFWS 1996) and will help further facilitate the expansion of the French Broad River population.

7.0 CONSERVATION MEASURES

As previously mentioned, NCDOT has already implemented design changes that will reduce impacts to Waters of the United States. These include:

- Eliminated approximately 20,000 ft. of collector-distributer roads and added retaining walls added in Section C, along I-40. This resulted in reduction of impacts to Ragsdale Creek and avoidance of impacts to Upper Hominy Creek.
- Reduced overall permanent impacts to streams by 724 linear ft.
- Reduced overall impacts to wetlands by 0.63 ac.

In addition, the following measures are being implemented by NCDOT to avoid/minimize and offset potential effects from construction activities and roadway operation to MYGR and Appalachian elktoe. These conservation measures fall into two general categories:

1. Measures to avoid/minimize effects
2. Measures to compensate for, or partially offset anticipated effects

Some of these efforts directly benefit one species or the other, but many are beneficial to both species. These measures are summarized below and categorized per the species that may derive the most benefit from the activity. These measures have been further classified by the broad groups of activity associated with this project: road construction, culvert construction, bridge replacement, and road operation.

7.1 Measures to Avoid/Minimize Effects to Gray Bat during Culvert Roost Construction

The following measures are proposed by NCDOT to avoid/minimize potential impacts to MYGR during construction activities associated with the culvert roost.

7.1.1 Timing of Construction

- The RCBC portion of the culvert system, as well as the dual CMAP at the culvert outlet will remain in place. Work on this portion of the culvert system will not occur until bat activity ceases for the season (and bats are presumably no longer using the culvert for roosting). This time frame is approximately between November 15 and March 15. NCDOT will monitor the culvert with an acoustic detector and/or emergence counts to determine when bat activity ceases for the season. After bat activity ceases for the season, a federally permitted bat biologist will enter the culvert to confirm no bats are present. This will determine when construction activity may safely begin, and/or when it should end to avoid effects to MYGR that may use the culvert system for roosting.
- NCDOT will conduct sleeving or replacement of the 60" CMP adjacent to Courtland Ave. and the entrance to Dickson Elementary School (that conveys flow under Hill Street to the RCBC) between October 15 and April 1.

- NCDOT will monitor bat activity at the culvert before, during, and after construction. Acoustic monitoring and/or emergence surveys will be conducted between March and November.

7.1.2 Vegetation Removal

- An operational work pad area will be established near the culvert outlets to complete the culvert rehabilitation process, as well as at the inlet near Courtland Avenue where the 60" CMP will be replaced or lined. Vegetation must be cleared to allow room for the work pad. NCDOT will cut plants in the work pad area in a way that will minimize impacts to bats and their activity by implementing the following measures: vegetation will not be removed if the area will be left bare for many months prior to construction; cutting of vegetation will be coordinated with USFWS and will not occur until all bats have left the culvert for the winter. This will be determined through emergence counts and/or acoustic monitoring and a physical check of the culvert for remaining bats; and limiting cutting to only what is necessary to complete the work and no more than 50 feet from culvert inlet/outlets.

7.1.3 Additional Commitments

- An equipment staging area will also need to be established adjacent to the work pads near the culvert outlets and inlet areas near Courtland Avenue to complete the culvert rehabilitation process. NCDOT will attempt to use areas that are already cleared of vegetation whenever possible. This area will only be used for culvert rehabilitation activity staging and will not be used for any other project construction purposes.
- NCDOT will maintain water sources that provide baseflow to the culvert (non-stormwater sources) to provide a naturally occurring, continual water source.
- NCDOT will either replace or install a liner in the 60" CMP located adjacent to Courtland Ave. and the entrance to Isaac Dickson Elementary School that conveys flow under Hill Street to the RCBC. NCDOT will complete this activity between October 15 and April 1.
- NCDOT will install a barrier/baffle in the RCBC between the intersection with the 60" CMP (located adjacent to Courtland Ave. and the entrance to Isaac Dickson Elementary School that conveys flow under Hill Street) and the upstream end of the RCBC to buffer noise and light associated with the CMP replacements further upstream.

7.2 Measures to Avoid/Minimize Effects to Gray Bat during Road Construction

The following measures are proposed by NCDOT to avoid/minimize potential impacts to MYGR during road construction activities

7.2.1 Preservation of Riparian Vegetation

- NCDOT will direct the contractor to preserve riparian buffer trees where practicable and feasible.

7.2.2 Roadway Construction Lighting

- Due to MYGR activity on the landscape, NCDOT will limit all construction-related lighting to whatever is necessary to maintain safety in active work areas closest to the French Broad River, Hominy Creek, Emma Branch, and Smith Mill Creek.
- Construction-related lighting will be indirect in nature and will not project into adjacent forested areas or over the water surface of the French Broad River, Hominy Creek, Emma Branch, or Smith Mill Creek, whenever practicable.

7.2 Measures to Avoid/Minimize Effects to Gray Bat during Bridge Construction

The following measures are proposed by NCDOT to avoid/minimize potential impacts to MYGR during bridge construction activities

7.2.1 Access Roads

- NCDOT will revegetate all access roads created for bridge construction and replacement activities where practicable.

7.2.2 Nighttime Construction Activities

- NCDOT will limit the use of nighttime construction within 50' of the French Broad River, Hominy Creek, Emma Branch, or Smith Mill Creek between April 1 and October 15 to only the following activities: causeway construction, drilled shafts, concrete pours, beam setting, and traffic shifts.
- NCDOT shall commit to restrict the construction contractor to no night work at crossings of the French Broad River, Hominy Creek, Emma Branch, and Smith Mill Creek to minimize potential impacts to lactating females and their pups between June 1 and June 14. Between June 15 through August 1, NCDOT will also commit to restrict the construction contractor to no more than 28 total nights of work, with no more than four consecutive nights. Lighting used for construction will be limited to what is necessary to maintain safety standards and will only be directed toward active work areas.

7.2.3 Pre-Demolition Check for Bats

- If bridge demolition is required between April 1 and October 15, NCDOT will conduct a check of all subject bridges within 30 days of demolition to determine if bats are present. This will also apply to the culvert under Resort Drive that carries Smith Mill Branch.
- If bats are present, one of the following options will be implemented (options listed in order of preference). NCDOT will:
    1. Wait for bats to leave for the season (approximately mid-October to early November) before beginning work; or
    2. A biologist will monitor the bridge and work will begin after bats leave the bridge for the evening, or
    3. A permitted biologist will exclude bats from work area immediately prior to the start of work using acoustic deterrents, or
    4. A permitted biologist will hand remove bats from work area immediately prior to the start of work.
    5. If pre-demo check determines pups are present, NCDOT will refrain from bridge demolition until it can be determined by a biologist that the pups are volant, and then use the previous options to proceed with demolition.

7.2.4 Red Safety Lighting

- As part of NCDOT's Communication Plan specific to the construction/demolition of the bridges over the French Broad River, NCDOT will place solar-powered, steady-state red lights on the causeways to alert river users to their locations. Generators will not be used to provide power.

7.3 Measures to Avoid/Minimize Effects to Gray Bat and Appalachian Elktoe during Bridge Construction

Various measures have been incorporated into the project to avoid and minimize adverse effects to MYGR and Appalachian elktoe by reducing impacts to the French Broad River and its tributaries.

7.3.1 Contract Language

Contract language will include the following, or similar language as appropriate for bridges over the French Broad River

- The Contractor will be required to prosecute the work in a continuous and uninterrupted manner from the time work begins until completion of each phase of structure construction, demolition, and completion. The Contractor will not be permitted to suspend operations except for reasons beyond their control or except where the Engineer has authorized a suspension of the Contractor's operations in writing.

7.3.2 Causeways – French Broad River, Hominy Creek, and Smith Mill Creek

- Causeways will not restrict more than 50% of the existing channel width of the French Broad River, Hominy Creek, and Smith Mill Creek. Potential additional restrictions of the channel may be necessary for short durations, and these additional restrictions will be coordinated with USACE and USFWS prior to permitting.
- NCDOT will require the contractor to use clean rock (free of debris and pollutants) for the construction of the causeways to minimize unnecessary sediment input into the river.
- Causeway material will be removed to the extent practicable and either disposed of off-site or used in areas that require permanent stone protection after project completion. NCDOT will also require that concrete barriers (barrier rail) be placed along the downstream edge of each causeway to limit the downstream movement of causeway material during high flow events.
- If the final causeway plan is staged, causeway material will be added/removed as needed for each stage to minimize the causeway footprint over the length of the project.
- To minimize disturbance to the riverbed, all readily detectible causeway material will be removed, to the extent practicable, while removing as little of the original riverbed as possible.
- Construction fabric will not be used under the causeway material, as it tends to tear into tiny pieces and float downstream during removal.
- Any equipment that is placed on the causeways will be removed any time throughout a work day when the water level rises, or is expected to rise overnight, to a point where the equipment could be flooded, or during periods of inactivity (two or more consecutive days). The only exception to this measure is that the drill rig and crane may be left in place for periods of inactivity; however, they must also be removed if the water rises, or is expected to rise, to a point where the drill rig and crane could be flooded.
- NCDOT will require its contractor to have clean, non-leaking equipment, diapers on-site for each causeway, and spill kits located at each causeway.
- Causeways needed for the new bridges over the FBR will be designed so that during a 100-year storm event there will not be a rise in water surface elevation outside the Action Area greater than normal seasonal variation.

7.3.3 Containment

- All construction equipment shall be refueled above the 100-year base flood elevation plus a foot of freeboard and be protected with secondary containment. During crucial periods of construction and demolition, when the drill rig and crane cannot be moved, the drill rig and crane can be refueled while inside the 100-year floodplain provided that spill response materials (such as spill blankets and fueling diapers) are used during the refueling. Hazardous materials, fuel, lubricating oils, or other chemicals will be stored above the 100-year base flood elevation plus a foot of freeboard.

- Areas used for borrow or construction by-products will not be located within wetlands or the 100-year base flood elevation plus a foot of freeboard.
- When constructing drilled piers for the I-240, I-40 and I-26 French Broad River bridges, a containment system will be developed so that material does not enter the river. Material by-product will be pumped out of the shaft to an upland disposal area to the extent practicable and treated through a proper stilling basin or silt bag.
- Construction of all bridges will be accomplished in a manner that prevents uncured concrete from coming into contact with water entering or flowing in the river.
- Removal of existing bridges shall be performed so as not to allow debris to fall into the water. If debris is dropped in a waterway, it will be immediately removed.
- NCDOT will not place bridge bents in Smith Mill Creek or Emma Branch.

7.3 Measures to Avoid/Minimize Effects to Gray Bat and Appalachian Elktoe during Road Construction and Bridge Replacement

7.3.1 Erosion Control Measures

- The SEC plan will be in place prior to any ground disturbance for all bridge replacements and construction. When needed, combinations of erosion control measures (such as silt bags in conjunction with a stilling basin) will be used to ensure that the most protective measures are being implemented.
- NCDOT standard procedures dictate that when a project has both Environmentally Sensitive Areas and a requirement to follow DSSW, and uses the GP NCG01 permit, NCDOT will default to the most-restrictive SEC measure requirement. (Appendix H)

7.3.2 Agency Coordination (Post-Biological Opinion Checkpoints)

- NCDOT will arrange, for each shortlisted team, a meeting with representatives of the USFWS and regulatory agencies prior to the due date for the submission of Technical and Price Proposals. The discussions and answers provided at these meetings are not contractually binding but intend to offer the shortlisted teams an opportunity to inquire as to the permitting process as well as specific team concepts.
- NCDOT will arrange a meeting with the selected Design-Build team to provide an opportunity for USFWS to convey their concern about potential effects to protected species.
- NCDOT will revisit CP4A with the Merger Team after the BA is submitted to discuss any new avoidance and minimization efforts for major crossings of the French Broad River and Hominy Creek including those in the Biological Assessment.
- The NCDOT Design-Build Team will adhere to project commitments within the ROD and the Biological Opinion relating to Section 7 of the Endangered Species Act. The NCDOT Design-Build Team will be required to prepare information required for any event in which NCDOT and FHWA reinitiate Section 7 consultation with the USFWS. It is possible that consultation be reinitiated prior to Concurrence Point 4B and again at Concurrence Point 4C.
- NCDOT will continue to identify avoidance and minimization measures to all Waters of the U.S. and ensure that major hydraulic structures associated with the project are designed and installed to minimize negative impacts to stream stability (and therefore, water quality) to the greatest extent practicable. As part of this process, NCDOT and the NCDOT Design-Build Team will continue to coordinate with the Merger Team to identify avoidance and minimization measures and ensure that project impacts are minimized to every practicable extent, including impacts to federally protected species.

- The NCDOT Design-Build Team shall meet with NCDOT personnel and USFWS and regulatory agency representatives around the time of the 4C meeting to review the project and project commitments. At this time, the USFWS shall be afforded the opportunity to meet with key NCDOT Design-Build Team members and NCDOT employees to provide education on the effects of artificial lighting, noise, and construction on nearby wildlife habitat and behavior. The NCDOT Design-Build Team shall contact NCDOT Environmental Analysis Unit to schedule these meetings. Every effort shall be made to have this meeting prior to submitting the permit application.
- The NCDOT Design-Build Team will invite USFWS and regulatory agency representatives to the pre-construction meeting for the proposed project, as well as to all subsequent field inspections prior to construction, to ensure compliance with all special project commitments.
- The NCDOT Design-Build Team will provide USFWS with the sediment and erosion control plan and allow 15 days for review upon acknowledgement of receipt of notice.
- The NCDOT Design-Build Team will provide regulatory agency representatives with the demolition plan for all bridges and allow 15 days for review upon acknowledgement of receipt of notice. All agencies will be notified prior to start of demolition so they may have a representative on site.
- The NCDOT Design-Build Team will provide USFWS with the construction phasing plan for each bridge.
- The NCDOT Design-Build Team will provide USFWS with the final roadway lighting plans and allow 15 days for review upon acknowledgement of receipt of notice.
- The NCDOT Design-Build Team will contact USFWS if new information about MYGR is discovered, as it relates to the project.
- The NCDOT Design-Build Team will report any dead bats found on the construction sites to USFWS.
- The NCDOT Design-Build Team will include an Environmental Coordinator who will be invited to attend all design, merger, and preconstruction meetings, and who will consult bat and mussel experts, as needed.
- NCDOT will provide USFWS with the total size of bridge footings in the water as project design progresses and the information becomes available.
- NCDOT will provide USFWS with the results of the hydrology modeling (described below) as it becomes available, including change in French Broad velocity with causeways in place, and change in water surface elevation with causeways in place.

7.4 Measures to Avoid/Minimize Effects to Gray Bat and Appalachian Elktoe During Roadway Operation

7.4.1 Stormwater Control Measures

- NCDOT has developed stormwater commitment guidance, which will apply at the crossings of the French Broad River and any tributaries draining to the French Broad River, any portion of the NCDOT stormwater conveyance system draining to an outfall discharging to those waters within the right-of-way.
- NCDOT will prepare a stormwater management plan (SMP) that implements structural and non-structural post-construction stormwater best management practices (BMPs) to the maximum extent practical, which is consistent with the Department's National Pollutant Discharge Elimination System (NPDES) Post-Construction Stormwater Program.
- When preparing the SMP, NCDOT commits to using a hierarchical BMP selection process, which is optimized to treat silt, nutrients, and heavy metals.
- At each discharge location outside of the 100-year floodplain, the hydraulics engineer will evaluate the feasibility of installing either an infiltration basin or a media filter as described in

NCDOT's BMP Toolbox. If neither is feasible, the hydraulics engineer will select another BMP that is feasible.

- NCDOT will commit to evaluating the use of emerging BMP technologies that the Department has not yet published in its BMP Toolbox. These emerging BMP technologies are as follows:
  - Bioswales
  - Bioembankments
  - Biofiltration conveyances
  - Soil improvement to maximize infiltration
- The NCDOT hydraulics design engineer will consult with the State Hydraulics Engineer and obtain prior approval before proposing one of these BMP technologies in the SMP.

7.4.2 Permanent Lighting

(Crossing numbers in this section refer to Table 2 in Section 2.1.2 and Figures 4A-4F in Appendix A).

- General CM's for the entire project:
  - NCDOT plans to install 3500K to 4000k LED fixtures wherever new or replacement lighting is required.
  - Using shorter poles which will provide an overall LED light fixture mounting height of 35' above the pavement surface.
  - Using LED light fixtures with a more rectangular light pattern as well as house side shields to minimize lighting outside of the pavement area.
  - Using LED light fixtures with a BUG rating of 1-0-3 or less
  - NCDOT is committed to changing the design standards to meet the AASHTO minimum requirements of 0.6 fc at 4:1 uniformity at all crossing locations identified in the lighting document, from the original design of 0.8 fc at 4:1 uniformity.
  - At all identified crossings, the proposed high mast poles and 45' poles with GE Cobrahead (GE) fixtures (3-0-3 BUG) were redesigned with 35' poles with Cooper Cobrahead (Cooper) fixtures (1-0-3 BUG).
- Culvert Outlet – The current NCDOT design near Southern States property results in zero calculated change to the baseline light levels at the culvert opening and ditch leading to the FBR.
- Culvert Outlet – NCDOT will meet with landowners adjacent to the roost culvert to discuss replacement or augmentation of existing lighting to reduce existing baseline conditions determined by the NCDOT Roadway Lighting Squad.
- Culvert inlet – The original lighting design near the Hill Street culvert inlet had 80' high mast poles installed between the mainline and Hill Street behind the Isaac Dickson Elementary School. NCDOT is revising this design to remove the high mast poles and to replace them with GE light fixtures installed on twin arm poles on the mainline median barrier.
- New French Broad Crossing (NFBC) – Use of single arm light poles mounted on the bridge and flyover barriers in place of the 120' and 100' high mast poles.
- NFBC – 35' single arm poles with a narrow distribution light fixture and a house side shield will be used.
- FBR-1 – The GE fixtures were replaced with the lower BUG rated Cooper fixtures.
- FBR-1 – Fixtures were redesigned to have the outer ring (as shown in the figures within the lighting document) ending roughly 115' from the west bank of the FBR.
- FBR-2, FBR-3, & FBR-4 – All high mast poles within the connector interchange were removed and replaced with Cooper fixtures mounted on the outer and/or center bridge barrier rail.

- FBR-2, FBR-3, & FBR-4 – The Cooper fixtures are located so the crossings are centered between fixtures where the light level is the lowest.
- HC-1 – Replacing the GE fixtures with the Cooper fixtures.
- HC-1 - Replacing the 120' high mast pole with an 80' high mast pole.
- HC-2 & HC-3 – Removal of a 120' high mast pole and replaced with Cooper fixtures.
- HC-2 & HC-3 - The Cooper fixtures are located so the crossings are centered between fixtures where the light level is the lowest.
- HC-4 - The Cooper fixtures are located so the crossings are centered between fixtures where the light level is the lowest.
- HC-5 & HC-6 – Removal of 80' high mast pole and replacing with Cooper fixtures along the mainline and ramp in both directions.
- HC-5, HC-6, HC-7 - The Cooper fixtures are located so the crossings are centered between fixtures where the light level is the lowest.
- All SMC and EBC – Removal of all high mast poles within the connector interchange and replaces them with Cooper fixtures mounted on the outer and/or center bridge barrier.
- All SMC and EBC - The Cooper fixtures are located so the crossings are centered as best as possible between fixtures where the light level is the lowest.
- SMC culvert area – the existing high mast pole located within the interchange ramps will be removed.

7.5 Conservation Measures to Benefit Gray Bat

The following conservation measures will be undertaken by NCDOT to benefit MYGR.

7.5.1 Monitoring for MYGR Return and Activity

- NCDOT will conduct acoustic monitoring (or emergence counts, as appropriate) for MYGR at some locations immediately before, during and up to two years after construction. This monitoring may help determine changes in bat activity due to construction. NCDOT will coordinate the locations and time frame for monitoring with USFWS.
- To determine whether MYGR avoid active construction zones at night, NCDOT will investigate the use of night-vision video recordings, or other methods, in an attempt to monitor bat activity at locations where they may be most susceptible to disturbance.
- NCDOT will conduct additional monitoring/research to potentially include additional telemetry, coordinated monitoring of roosts, monitoring of new panels, basin-wide acoustics to be conducted at key points during and after construction. This additional monitoring will be coordinated with USFWS, NCWRC and NCDOT.

7.5.2 Hill Street Culvert Roost Area

- NCDOT will replace most, if not all the CMP within the culvert system upstream from the RCBC with RCBC and/or concrete pipe, which will effectively create additional bat roosting habitat.
- NCDOT will meet with landowners adjacent to the roost culvert to discuss replacement or augmentation of existing lighting to reduce existing baseline conditions determined by the NCDOT Roadway Lighting Squad.
- NCDOT will acquire a permanent drainage easement (PDE) or additional right of way at the culvert inlet (near Courtland Ave.) and outlets, where replanting with containerized, native, woody vegetation will occur. In addition, if NCDOT acquires additional right-of-way or conservation easements along the French Broad River or adjacent to the culvert, NCDOT will replant with native, woody vegetation to provide, in time, a buffer for noise, light, and surface

water runoff. NCDOT will coordinate with USFWS and NCWRC to develop a revegetation and invasive species management plan for these areas.

7.6.2 NCDOT-Sponsored Gray Bat Research Project

NCDOT, with the cooperation of the USFWS and NCWRC, committed to a three-year study on MYGR within the French Broad River Basin. This study will serve as a conservation measure for NCDOT projects within the Divisions 13 and 14 for a limited time. NCDOT will provide $900,000 in funding Indiana State University to conduct the research project, which will aid in the recovery and conservation of MYGR. The end goal is to gather the information needed to allow NCDOT and USFWS to enter a programmatic consultation to cover MYGR for NCDOT Divisions 13 and 14, as well as help to develop species-specific avoidance and minimization measures. This agreement was reached, in part, for the I-4400/I-4700 (I-26 widening) project in Buncombe and Henderson Counties, but also benefits this project.

7.6.3 Protection of Culvert Roost Entrance

- NCDOT will coordinate with USFWS to assess the need to deter trespassing/use of the culvert by humans, and install signage or barriers, as needed.

7.6.4 Gray Bat Conservation Funding

- NCDOT will provide $350,000 in funding to be utilized for measures that are consistent with the recovery objectives outlined in the recovery plan for the MYGR (Brady et al. 1982).

7.6.5 Installation of Temporary Bat Roost Panels on Bridges

- NCDOT will have Modern Bat roost panels or comparable structures temporarily installed on four bridges within the French Broad River basin that are currently or have recently been used by roosting bats. The sites will be selected by a team of USFWS and NCDOT personnel and will be installed as soon as possible. The panels will remain in place until project construction is complete; approximately 2026. The panels will be monitored for bat use while they are in place. The team will determine the appropriate number of panels for each bridge as well as the monitoring protocol.

7.7 Conservation Measures to Benefit Appalachian Elktoe

The following conservation measures will be undertaken by NCDOT to benefit Appalachian elktoe.

7.7.1 Appalachian Elktoe Conservation Funding

- NCDOT will provide $500,000 in funding to the North Carolina Nongame Aquatic Projects Fund for the French Broad River Conservation Plan (FBRCP) proposed by USFWS, which will aid in the recovery and conservation of Appalachian elktoe. The funding will be held by the NCWRC. A multi-agency/organization group of mussel species experts, including USFWS, will determine how to expend the funds.
- The French Broad River Conservation Plan proposes to improve aquatic habitat and diversity and to mitigate risks in the French Broad River. It may include the following:
    - Species Reintroduction: Developing a normal cohort of companion species will benefit long-term Appalachian elktoe recruitment and survival; mussel species are healthier in dense multi-species mussel beds (Vaughn et al. 2008).
    - Early Warning and Emergency Capacity: A monitoring network and propagation facility devoted to species introduction pairs an early warning system with emergency production capacity to immediately mitigate unforeseen effects to the Appalachian elktoe population should the need arise.

- Genetic Management Program: A study of the genetic health/potential genetic drift of the population will provide feedback to the previous two program aspects and will fine tune management of Appalachian elktoe.
- Miscellaneous: Other projects could include development of technologies such as the use of passive integrated transponder (PIT) tags to passively locate mussels; radio tracking equipment to study movement of mussels during high flow events; development of techniques to artificially stabilize habitat for the placement of propagated mussels; and/or a cost-benefit study of watershed improvement options.

This agreement was reached, in part, for the I-4400/I-4700 (I-26 widening) project in Buncombe and Henderson Counties, but also benefits this project.

7.7.2 French Broad River Geomorphology Monitoring

- NCDOT is working with the US Geological Survey (USGS) to evaluate the impacts of construction and temporary causeways on river habitat. This monitoring project encompasses several Transportation Improvement Projects (I-2513, I-4400 and I-4700). Therefore, the monitoring project will span several years to accommodate the varying construction schedules.
    - Terrestrial Light Detection and Ranging (T-LiDAR) technology will be used annually to produce a laser scan of river banks. Bathymetric surveys will be conducted concurrently one to two times a year. Bathymetric data will be used to generate a gridded surface representation (digital elevation model, or DEM) of the channel bed for each survey. A similar approach will be applied to T-LiDAR data to evaluate stream bank position between successive surveys.
    - Water quality monitoring will include real-time (continuous) data collection of temperature, turbidity, and specific conductance. Discrete water-quality samples will be collected during a variety of flow conditions to measure total suspended sediment (TSS) and suspended sediment concentration (SSC).
    - Continuous streamflow, precipitation, and water-quality (temperature, conductance, and turbidity) data will be available online at http://waterdata.usgs.gov/nc/nwis/rt/ and via text and email alerts. Yearly summaries for each monitoring site will be available on demand from the USGS National Water Information System web interface (NWISWeb). Real-time alerts will be available to NCDOT via the NWISWeb when temperature or turbidity concentrations spike or exceed a predetermined threshold.
    - If monitoring at the French Broad River reveals excessive bank erosion, bank instability, or sedimentation associated with the bridge replacement, NCDOT will work to identify the cause and will make improvements to address the problems in a timely manner.

7.8 Avoidance and Minimization Measures to Benefit Northern Long-eared Bat

The following avoidance and minimization measures have been proposed to minimize adverse effects of the proposed action on Northern long-eared bat:

- No alterations of a known hibernacula entrance or interior environment if it impairs an essential behavioral pattern, including sheltering northern long-eared bats (January 1 through December 31);
- No tree removal within a 0.25-mile radius of a known hibernacula (January 1 through December 31); and

- No cutting or destroying a known, occupied maternity roost tree, or any other trees within a 150-foot radius from the known, occupied maternity tree during the period from June 1 through and including July 31.

8.0 OTHER FEDERALLY LISTED SPECIES WITHIN THE ACTION AREA

In addition to MYGR and Appalachian elktoe, MYSE is assumed to be present in the Action Area. A brief description of characteristics and habitat requirements for this listed species is provided below, along with a Biological Conclusion concerning potential impacts to the species from the proposed action.

8.1 Northern Long-eared Bat

Status: Threatened
Family: Vespertilionidae
Listed: May 4, 2015
Critical Habitat: None Designated

8.1.1 Species Characteristics

MYSE is a medium-sized bat with an average adult body weight of 5 to 8 g, and an average body length of nearly 4 in. Fur can be medium to dark brown dorsally, with lighter brown fur ventrally. Ears, tail, and wing membrane are all dark brown. As the common name implies, this species can be distinguished from other Myotids by its characteristically long ears, which extendbeyond the tip of the nose when pressed forward (USFWS 2015).

8.1.2 Distribution and Habitat Requirements

In North Carolina, the MYSE occurs in the mountains, with scattered records in the Piedmont and coastal plain. In western North Carolina, MYSE spend winter hibernating in caves and mines. Since this species is not known to be a long-distance migrant, and caves and subterranean mines are extremely rare in eastern North Carolina, it is uncertain whether or where MYSE hibernate in eastern North Carolina. During the summer, MYSE roost singly or in colonies underneath bark, in cavities, or in crevices of both live and dead trees (typically ≥3 in. dbh). Males and non-reproductive females may also roost in cooler places, like caves and mines. This bat also has been found, rarely, roosting in structures like barns and sheds, under eaves of buildings, behind window shutters, in bridges, and in bat houses. Foraging occurs on forested hillsides and ridges, and occasionally over forest clearings, over water, and along tree-lined corridors. Mature forests may be an important habitat type for foraging (USFWS 2015).

8.1.3 General Threats to Species

The biggest threat to the species is the infectious wildlife disease known as white-nose syndrome. There are other factors that cause mortality and harm to the northern long-eared bat and these include: wind energy development, habitat destruction or disturbance (e.g., vandalism to hibernacula, roost tree removal), and environmental contaminants such as pesticides and fracking wastewater (USFWS 2015).

8.1.4 Presence in Action Area

Forested habitat which could be used for roosting or foraging is present in the Action Area, and the species is assumed to be present.

No mist-netting or acoustic surveys were conducted specifically for MYSE. Structure checks were performed for all bridges and large culverts within the Action Area, and as described in Section

3.10.2, only one had evidence of bat use. Although this structure is expected to be included in construction activities, no MYSE were confirmed using this roost site. All mines within 3 mi. of the proposed project are either known or presumed to be surface mines, and no caves or mines were observed during site visits (Appendix C).

A review of NCNHP records, updated July 2019 indicates that the nearest MYSE hibernacula record is 22.5 mi. southeast of the Action Area (EO 32137) in Henderson and Rutherford Counties, and represents the Bat Site Preserve with multiple observations from 1980 to 2014. No known MYSE roost trees occur within 150 ft. of the project area. The nearest mist net record (EO 34294) is from a location approximately 5.5 mi. south of the Action Area in Buncombe County and represents multiple individuals.

8.1.5 Conclusion of Effects – Northern Long-eared Bat

The majority of the proposed construction activities will occur within existing NCDOT right of way and/or other urbanized areas. Woody vegetation is already limited within the Action Area. Areas outside the existing right of way that may require clearing are largely limited to existing interchanges, which are already cleared of most woody vegetation, and other areas that tend to be urbanized.

Although no MYSE roost tree surveys were conducted for this project, it is highly unlikely that MYSE would choose to roost in trees within this urban area, or in any wooded areas immediately adjacent to the interstates and secondary roads due to elevated levels of disturbance caused by light and noise from passing vehicles, and/or residential and commercial activities.

Incidental take of MYSE that may occur complies with the 4(d) rule and thus not prohibited. It has been determined that the action described herein “May Affect, Not Likely to Adversely Affect” MYSE and will not cause prohibited incidental take. However, because of the potential for the 4(d) rule to be rescinded during the life of this project, it has been deemed prudent by FHWA to choose to proceed with a standard ESA Section 7 consultation procedure. Since forested habitat which could be used for roosting or foraging is present in the Action Area, and the species is assumed to be present, the following avoidance and minimization measures have been proposed to minimize adverse effects of the proposed action on MYSE:

1. No alterations of a known hibernacula entrance or interior environment if it impairs an essential behavioral pattern, including sheltering northern long-eared bats (January 1 through December 31);
2. No tree removal within a 0.25-mile radius of a known hibernacula (January 1 through December 31); and
3. No cutting or destroying a known, occupied maternity roost tree, or any other trees within a 150-foot radius from the known, occupied maternity tree during the period from June 1 through and including July 31.

9.0 FEDERALLY LISTED SPECIES NOT PRESENT IN ACTION AREA

The official species list for this project was based on federally listed species potential to occur in all of Buncombe County (Table 1 Section 1.2). The Action Area for the project is a smaller area than Buncombe County’s limits. Consequently, some of the species on the official species list occur outside the Action Area and the project will have no effect on those species. This section discusses the characteristics and current status of these thirteen federally protected species throughout their ranges. Biological Conclusions of “No Effect” or “Not Required” are given for these species.

9.1 Blue Ridge Goldenrod

Status: Threatened
Family: Asteraceae
Listed: March 28, 1985
Critical Habitat: None designated

9.1.1 Species Characteristics

Blue Ridge goldenrod is a small perennial herb (four to eight in. tall). Its golden-yellow flowers appear from late July to September, and fruits form and ripen from July to October. Although there are many species of goldenrod, this one can be distinguished by its flat-topped flowers, small stature, smooth foliage, and toothed, non-clasping stem leaves (USFWS 1987).

9.1.2 Distribution and Habitat Requirements

Blue Ridge goldenrod is endemic to the Appalachian Mountains of North Carolina and Tennessee and occurs in the High Elevation Rocky Summit natural community at or above elevations of 4,600 ft. above mean sea level along cliffs, ledges, balds, and dry rock crevices of granite outcrops of the higher mountain peaks. This early pioneer herb grows in full sun or generally acidic soils of shallow humus or clay loams that are intermittently saturated. Roan Mountain bluet, Heller's blazing star, and spreading avens are a few of its common associate species (USFWS 1987).

9.1.3 General Threats to Species

The encroachment of woody vegetation such as ericaceous shrubs can eliminate the goldenrod through competition and shading (USFWS 1987).

9.1.4 Presence in Action Area

Suitable habitat for the Blue Ridge goldenrod does not exist within the Action Area. Elevations in the Action Area do not exceed 2,150 ft. above mean sea level. A review of the NCNHP records, updated July 2019, indicates no known Blue Ridge goldenrod occurrence within 1 mi. of the Action Area.

9.1.5 Conclusion of Effects – Blue Ridge Goldenrod

Since there will be no direct or indirect effects in any areas known to support Blue Ridge goldenrod, and due to the lack of EO records within or near the Action Area, the project will have "No Effect" on this species.

9.2 Bog Turtle

Status: Threatened Due to Similarity of Appearance
Family: Emydidae
Listed: November 4, 1997
Critical Habitat: None designated

9.2.1 Species Characteristics

The bog turtle is one of the smallest turtles in North America, rarely exceeding 4 in. in length and weighing only about 4 oz. The orange to yellow patch on either side of the neck, against a dark brown or ebony skin and carapace color easily distinguishes it from other turtles (USFWS 2001).

9.2.2 Distribution and Habitat Requirements

Bog turtles inhabit slow, shallow, muck-bottomed rivulets of sphagnum bogs, calcareous fens, marshy/sedge-tussock meadows, spring seeps, wet cow pastures, and shrub swamps, all with saturated, muddy substrates and open canopies. Sedges, rushes, herbs, and small shrubs like blueberry and tag alder are common. Mosses and carnivorous plants may also be present. The turtles depend on a mosaic of microhabitats for foraging, nesting, basking, hibernation, and shelter (USFWS 2001). Beaver, deer, and cattle may be instrumental in maintaining the essential open-canopy wetlands (USFWS 2001, USFWS 2011).

9.2.3 General Threats to Species

There are two major threats to the species' continued existence: habitat loss due to the draining and filling of wetlands for farming and development, including housing, roads, and golf courses, and the illegal collection of wild bog turtles for the pet trade (USFWS 2011).

9.2.4 Presence in Action Area

The southern population of bog turtle is listed as Threatened due to similarity of appearance with the northern bog turtle population. The southern population of the species is not subject to section seven consultations requirements under the Endangered Species Act.

The Action Area occurs in historically developed and disturbed areas, and palustrine wetlands proposed for potential impacts offer poor bog turtle habitat. There are no bog wetlands in the Action Area. Freshwater wetlands within the Action Area are forested riparian systems. A review of NCNHP records, updated July 2019 indicates an occurrence (EO 10451) recorded in 1978 within Section C of the Action Area that extends southeast of the French Broad River. Records indicate that three individuals were observed on Biltmore Estate Property by a reliable source but considered unverified. This occurrence record is considered historic by NCNHP.

9.2.5 Conclusion of Effects – Bog Turtle

Species listed as threatened due to similarity of appearance do not require Section 7 consultation with the USFWS, therefore, no conclusion of effects is required for this species. However, this project is not expected to affect the bog turtle because no suitable habitat is present within the Action Area.

9.3 Bunched Arrowhead

Status: Endangered
Family: Alismataceae
Listed: August 31, 1979
Critical Habitat: None designated

9.3.1 Species Characteristics

Bunched arrowhead is a small herbaceous plant (15 to 16 in. tall) that grows in saturated soils. It is the only *Sagittaria* species in the Southern Appalachians that does not have arrowhead-shaped leaves. Emergent leaves are broad and tapered at the tip and up to 12 in. long and one to 2 in. wide. The white flowers begin blooming in mid-May and continue through July. The fruits mature a few weeks after flowering (USFWS 1983a).

9.3.2 Distribution and Habitat Requirements

Bunched arrowhead, endemic to the southern Appalachian Mountains of North Carolina and upper Piedmont of South Carolina, is rooted in shallow water seepage areas of bogs, wooded swamps, and deciduous woodlands. This early-successional perennial herb occurs in Swamp Forest-Bog Complex (Typic Subtype) and Southern Appalachian Bog (Southern Subtype) natural communities. A known occurrence also occurs in a maintained power line right-of-way along the headwaters of a river. The plant requires a slight but continuous and steady flow of cool, clean water that saturates or floods but does not stagnate. The species typically occurs in sandy loam soils found underneath a 10-24 in. deep layer of muck, sand, and silt. Undisturbed occurrences are usually located just below the origin of the seep on gently sloping terrain at the bluff-floodplain ecotone. While shaded areas contain the most vigorous plants, it will also grow in either full sun or partial shade beneath red maple, black gum, and alder at the base of steep slopes (USFWS 1983a).

9.3.3 General Threats to Species

The primary factor determining the rarity of bunched arrowhead is the current rarity of its required habitat. The seepage habitat in which bunched arrowhead occurs is extremely threatened, and remaining bunched arrowhead populations are threatened by residential and industrial development, conversion to pasture, and invasive exotic species (USFWS 1983a).

9.3.4 Presence in Action Area

A review of NCNHP records, updated July 2019, indicates one historic bunched arrowhead element occurrence (EO 38028, last observed in 1896) within the Action Area.

9.3.5 Conclusion of Effects – Bunched Arrowhead

USFWS does not require surveys, a biological conclusion, or consultation for species with a historic record status.

9.4 Carolina Northern Flying Squirrel

Status: Endangered
Family: Sciuridae
Listed: July 1, 1985
Critical Habitat: None designated

9.4.1 Species Characteristics

There are two species of flying squirrels in the Southern Appalachians – the northern (*Glaucomys sabrinus*) and southern (*Glaucomys volans*). Northern flying squirrels are about one-third larger than the very common southern species. Also, northern flying squirrels are brown on their backs, and their fur fades to a buff white on the belly. Southern flying squirrels are grayer on their backs with bright white bellies, and a clearly defined (usually black) line separates the fur colors. The endangered Carolina northern flying squirrel is a subspecies of the northern flying squirrel (USFWS 1990a).

9.4.2 Distribution and Habitat Requirements

There are several isolated populations of the Carolina Northern flying squirrel in the mountains of North Carolina. This nocturnal squirrel prefers the ecotone between coniferous (red spruce, Fraser fir, or hemlock) and mature northern hardwood forests (beech, yellow birch, maple, hemlock, red oak, and buckeye), typically at elevations above 4,500 ft. above mean sea level. In some instances, the squirrels may be found on narrow, north-facing valleys above 4,000 ft. above mean sea level. Both forest types are used to search for food and the hardwood forest is used for nesting sites. Mature forests with a thick evergreen understory and numerous snags are most preferable. In winter, squirrels inhabit tree cavities in older hardwoods, particularly yellow birch (USFWS 1990a).

9.4.3 General Threats to Species

The limited and discontinuous range of this species makes it vulnerable to a number of natural and human-related impacts. Human impacts far outweigh natural threats and include habitat destruction and fragmentation or other alterations associated with the clearing of forests, introduced exotic pests, recreational and residential development, and pollution (heavy metals and acid rain) (USFWS 1990a).

9.4.4 Presence in Action Area

Suitable habitat for the Carolina northern flying squirrel does not exist within the Action Area. Elevations in the Action Area do not exceed 2,150 ft. above mean sea level. A review of the NCNHP records, updated July 2019, indicates no known Carolina northern flying squirrel occurrence within 1 mi. of the Action Area.

9.4.5 Conclusion of Effects – Carolina Northern Flying Squirrel

Since there will be no direct or indirect effects in areas known to support Carolina Northern flying squirrel and due to the lack of EO records within or near the Action Area, the project will have "No Effect" on this species.

9.5 Mountain Sweet Pitcher Plant

Status: Endangered
Family: Sarraceniaceae
Listed: September 30.1998
Critical Habitat: None designated

9.5.1 Species Characteristics

Mountain sweet pitcher plant is a carnivorous perennial herb with tall, hollow pitcher-shaped leaves and red sweet-smelling flowers. The hollow leaves contain liquid and enzymes. When insects fall into the pitchers, they are digested and the nutrients are incorporated into the plant's tissues. The unusual red flowers (yellow in rare cases) appear from April to June, with fruits ripening in August. Flowering plants reach heights of 29 in. (USFWS 1990b).

9.5.2 Distribution and Habitat Requirements

Mountain sweet pitcher plant, endemic to the Blue Ridge Mountains of North and South Carolina, is found in shrub/herb-dominated, seepage-fed mountain bogs (Southern Appalachian Bog-Southern Subtype). Bog habitats are usually situated along intermittently exposed to intermittently flooded level depressions associated with valley floodplains. These habitats, typically on soils of the Toxaway or Hatboro series, contain deep, poorly drained, saturated soils of loam, sand, and silt with a high organic matter content and medium to high acidity. A few occurrences of the pitcher plant also grow in cataract bogs, either in thin strips along the edges of waterfalls or on soil islands over granite rock faces, where sphagnum and other bog plant species line the sides. This early successional species relies on natural disturbance (*e.g.*, drought, water fluctuation, periodic fire, ice damage) to maintain its habitat by preventing the establishment of later successional woody seedlings (USFWS 1990b).

9.5.3 General Threats to Species

The most serious threat to mountain sweet pitcher plant is the destruction or degradation of its small wetland habitat. Collecting from wild populations continues to be a problem for carnivorous plants, even though cultivated sources are available for almost all species (USFWS 1990b).

9.5.4 Presence in Action Area

The project Action Area contains no bogs or granite rock faces which might provide suitable habitat for the mountain sweet pitcher plant. A review of the NCNHP records, updated July 2019, indicates no known mountain sweet pitcher plant occurrence within 1 mi. of the Action Area.

9.5.5 Conclusion of Effects – Mountain Sweet Pitcher Plant

Since there will be no direct or indirect effects in any areas known to support mountain sweet pitcher plant and due to the lack of EO records within or near the Action Area, the project will have "No Effect" on this species.

9.6 Rock Gnome Lichen

Status: Endangered
Family: Cladonia
Listed: January 18, 1995
Critical Habitat: None designated

9.6.1 Species Characteristics

Rock gnome lichen occurs in dense colonies of narrow strap-like lobes that are about 0.04 in. across and generally one to 0.78 in. long. These lobes are blue gray on the terminal upper surface, and generally shiny white on the lower surface, grading to black near the base. The fruiting bodies are born on the tips of these lobes, are black, and have been found from July through September. The primary means of propagation appears to be asexual, with colonies spreading clonally (USFWS 1997).

9.6.2 Distribution and Habitat Requirements

Rock gnome lichen occurs in high elevation coniferous forests (particularly those dominated by red spruce and Fraser fir) usually on rocky outcrop or cliff habitats. This squamulose lichen only grows in areas with a great deal of humidity, such as high elevations above 5,000 ft. mean sea level where there is often fog, or on boulders and large outcrops in deep river gorges at lower elevations. Habitat is primarily limited to vertical rock faces where seepage water from forest soils above flows only at very wet times. The species requires a moderate amount of sunlight but cannot tolerate high-intensity solar radiation. The lichen does well on moist, generally open sites with northern exposures, but requires at least partial canopy coverage on southern or western aspects because of its intolerance to high solar radiation (USFWS 1997).

9.6.3 General Threats to Species

One of the greatest threats to the rock gnome lichen is trampling and associated soil erosion and compaction from hikers, climbers and sightseers. The areas where the lichen is found, both at high elevation, and along streams, are both threatened by invasive insects, which can kill large areas of native trees often associated with rock gnome lichen. The removal of these trees could diminish the amount of shade on lichen sites, exposing the lichen to excess sunlight. Other threats include recreational and residential development, collection, and air pollution (USFWS 1997).

9.6.4 Presence in Action Area

Suitable habitat for the rock gnome lichen does not exist within the Action Area. There are no rocky outcrops or cliff habitats with a great deal of humidity and seepage that flows only during wet periods. Elevations in the Action Area do not exceed 2,150 ft. above mean sea level. A review of the NCNHP records, updated July 2019, indicates no known rock gnome lichen occurrence within 1.0 mi. of the Action Area.

9.6.5 Conclusion of Effects – Rock Gnome Lichen

Since there will be no direct or indirect effects in any areas known to support rock gnome lichen and due to the lack of EO records within or near the Action Area, the project will have "No Effect" on this species.

9.7 Rusty-patched Bumble Bee

Status: Endangered
Family: Apidae
Listed: March 21, 2017
Critical Habitat: None designated

9.7.1 Species Characteristics

Rusty-patched bumble bees live in relatively large colonies that include a single queen and female workers. All individuals of this species have entirely black heads while only males and workers have a rusty, reddish patch on the center of their backs.

9.7.2 Distribution and Habitat Requirements

The species was historically distributed across 28 states in the eastern and upper Midwest of the United States, and in two Canadian provinces. It is now known from 13 states and one province. It is assumed that the species no longer occurs in North Carolina (USFWS 2017b).

9.7.3 General Threats to Species

Threats to the continued survival of the species include habitat loss and degradation, intensive farming, disease caused by pathogens and parasites, pesticides, and global climate change (USFWS 2017b).

9.7.4 Presence in Action Area

A review of NCNHP records, updated July 2019, indicates one historic element occurrence of rusty patched bumble bee (EO 37137 last observed in 1935) within 1.0 mi. of the Action Area.

9.7.5 Conclusion of Effects – Rusty patched Bumble Bee

USFWS does not and will not require surveys for rusty-patched bumble bee in North Carolina because it is assumed that the species does not occur in the state. Therefore, no Section 7 survey, conclusion, or consultation is required at this time.

9.8 Spotfin Chub

Status: Threatened
Family: Cyprinidae
Listed: October 11, 1977
Critical Habitat: None within Action Area

9.8.1 Species Characteristics

The spotfin chub was first described from the North Fork Holston River in Smyth County, Virginia. This small (maximum size 3.6 in.) Cyprinid (minnow) is described as having a slightly compressed, elongate body with a color pattern of olive green above the lateral line and silver on the lower sides bordered mid-dorsally and dorso-laterally by gold and green stripes (Jenkins and Burkhead 1984). The common name, spotfin chub, is derived from the distinctive, prominent black spot on the lower part of the caudal fin. This species has also been referred to as the turquoise shiner due to the brilliant metallic blue color above the lateral line in nuptial (breeding) males (USFWS 1983b).

9.8.2 Distribution and Habitat Requirements

The spotfin chub is endemic to the Tennessee River drainage in Alabama, Georgia, North Carolina, Tennessee, and Virginia. The historic range of this species encompassed 12 tributary systems in four physiographic provinces: Blue Ridge (French Broad River and Little Tennessee River systems), Ridge and Valley (Clinch River, Powell River, Holston River [North and South Forks] and Chickamauga Creek systems), Cumberland Plateau (Emory River and Whites Creek systems) and Interior Low Plateau (Shoal Creek, Little Bear Creek and Duck River systems). Presently it is known to survive in only four isolated tributary systems (Duck, Little Tennessee, Emory and North Fork Holston River systems) (USFWS 1983b).

Habitat for this species has been described as moderate to large streams, 49 to 230 ft. in width. These streams should have, clear water, cool to warm temperatures, and pools alternating with riffles. Specimens of spotfin chub have been taken from a variety of substrates, but rarely from substantially silted substrates.

9.8.3 Threats to Species

Many of the same factors (described above) that have contributed to the decline of the freshwater mussels including the Appalachian elktoe have contributed to the decline of the spotfin chub as well. Jenkins and Burkhead (1984) and USFWS (1983) cite impoundments, channelization, pollution, and turbidity or siltation as likely factors that resulted in a decline of the species. Overcollection has also been suggested to be a factor, as a massive application of ichthyocide wiped out the entire Abrams Creek population, and seining efforts in the North Fork Holston River sharply depleted populations (USFWS 1983b). The recovery plan for this species lists all the factors that have contributed to declines in each of the historically known populations (USFWS 1983b).

9.8.4 Presence in Action Area

Extensive fish survey work has been done in the French Broad River Basin. Spotfin chub has not been collected in these surveys, and it is thought to have been extirpated from the French Broad River Basin in North Carolina. A review of the NCNHP records, updated July 2019, indicates no known spotfin chub occurrence within 1 mi. of the Action Area.

9.8.5 Conclusion of Effects – Spotfin Chub

USFWS does not require surveys, a biological conclusion, or consultation for species with a historic record status.

9.9 Spreading Avens

Status: Endangered
Family: Rosaceae
Listed: October 11, 1997
Critical Habitat: None designated

9.9.1 Species Characteristics

Spreading avens is a perennial herb in the rose (Rosaceae) family. It has basal rosettes of leaves with large terminal lobes and small lateral lobes arising from horizontal rhizomes. Rosettes, which usually have no more than two flowering stems each, can measure up to 35 in. New plants can be produced through sexual or asexual means. Large bright yellow flowers are born in an indefinite cyme on stems that are 1.6 to 2.3 ft, tall. Flowering occurs from June through September and fruits (achenes) are produced from August through October (USFWS 1993).

9.9.2 Distribution and Habitat Requirements

Spreading avens occurs in areas exposed to full sun on high elevation cliffs, outcrops, and bases of steep talus slopes. This perennial herb also occurs in thin, gravelly soils of grassy balds near summit outcrops. The species prefers a northwest aspect, but can be found on west-southwest through north-northeast aspects. Forests surrounding known occurrences are generally dominated by either red spruce-Fraser fir, northern hardwoods with scattered spruce, or high-elevation red oaks. Spreading avens typically occurs in shallow, acidic soil (such as the Burton series) in cracks and crevices of igneous, metamorphic, or metasedimentary rocks. Soils may be well drained but almost continuously wet, with soils at some known occurrences subject to drying out in summer due to exposure to sun and shallow depths. Known populations occur at elevations ranging from 4,296 to 6,268 ft. above mean sea level. Blue Ridge goldenrod, Heller's blazing star, and Roan Mountain bluet are a few of its common associate species (USFWS 1993).

9.9.3 General Threats to Species

Being confined to small areas on a few rocky mountain summits, this species is extremely vulnerable to such seemingly minor threats as trampling by hikers, climbers, and sightseers, as well as to more pervasive threats such as acid precipitation, and other forms of air pollution. An exotic insect, the balsam woolly adelgid, contributes to the decline of the fir forests adjacent to the cliffs where spreading avens grows. Although spreading avens does not grow beneath dense forest, the death of the adjacent forests results in drier and hotter conditions, as well as increased soil erosion. These factors threaten the last remaining spreading avens populations (USFWS 1993).

9.9.4 Presence in Action Area

There is no suitable habitat for spreading avens within the Action Area. There are no areas exposed to full sunlight at or above 4,200 ft. above mean sea level within the Action Area. Elevations in the Action Area do not exceed 2,150 ft. above mean sea level. A review of the NCNHP records, updated July 2019, indicates no known spreading avens occurrence within 1 mi. of the Action Area.

9.9.5 Conclusion of Effects – Spreading Avens

Since there will be no direct or indirect effects in any areas known to support spreading avensand due to the lack of EO records within or near the Action Area, the project will have "No Effect" on this species.

9.10 Spruce-fir Moss Spider

Status: Endangered
Family: Dipluridae
Listed: February 6, 1995
Critical Habitat: None within Action Area

9.10.1 Species Characteristics

Spruce-fir moss spiders belong to the arachnid infraorder Mygalomorphae, which are identified by having two pairs of book lungs and by the articulation of the cheliceral fangs, which open and close along a plane running parallel to the long axis of the body. Coloration of the species ranges from light brown, to yellow-brown, to a darker reddish brown. No markings are present on the abdomen. 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 (USFWS 1998b).

9.10.2 Distribution and Habitat Requirements

This species is known only from spruce-fir forests in the Appalachian mountains of North Carolina and Tennessee. The spruce-fir moss spider occurs in well-drained moss and liverwort mats growing on rocks or boulders. These mats are found in well-shaded areas in mature, high elevation (>5,000 ft.) Fraser fir and red spruce forests. The spruce-fir moss spider is very sensitive to desiccation and requires environments of high and constant humidity. The need for humidity relates to the moss mats, which cannot become too parched or else the mats become dry and loose. Likewise, the moss mats cannot be too wet because large drops of water can also pose a threat to the spider. The spider constructs its tube-shaped webs in the interface between the moss mat and the rock surface. Some webs have been found to extend into the interior of the moss mat (USFWS 1998b).

9.10.3 General Threats to Species

The biggest threat to the continued existence of spruce-fir moss spider is habitat loss (USFWS 1998b).

9.10.4 Presence in Action Area

Suitable habitat for the spruce-fir moss spider does not exist within the Action Area. Elevations in the Action Area do not exceed 2,150 ft. above mean sea level. A review of the NCNHP records, updated July 2019, indicates no known spruce-fir moss spider occurrence within 1.0 mile of the Action Area.

9.10.5 Conclusion of Effects – Spruce-fir Moss Spider

Since there will be no direct or indirect effects in any areas known to support spruce-fir moss spider and due to the lack of EO records within or near the Action Area, the project will have “No Effect” on this species.

9.11 Tan Riffleshell

Status: Endangered
Family: Unionidae
Listed: September 26, 1977
Critical Habitat: None designated

9.11.1 Species Characteristics

Two subspecies of *Epioblasma florentina* are currently recognized based on differences in shell morphology; the tan riffleshell (*Epioblasma florentina walkeri*), described by Wilson and H. W. Clark (1914) from the East Fork of the Stones River, Rutherford County, Tennessee and the yellow blossom (*E. florentina florentina)* described from the Tennessee River in Florence, Alabama by Issac Lea (1834). These two purported subspecies represent two extremes of a cline, with the yellow blossom being the “big river form” and the tan riffleshell the “headwater form”. The yellow blossom form occurring in big rivers is presumed extinct and the tan riffleshell form occurring in head water streams is very restricted. In 1976, the USFWS listed the yellow blossom (*E. florentina*) as endangered. While Turgeon et al. (1988) did not recognize the separate subspecies, the USFWS listed the tan riffleshell as a subspecies and endangered in 1977.

The tan riffleshell is a relatively small mussel, seldom exceeding 2.36 in. in length. Its periostracum is a dull brownish green or yellowish green in color with numerous faint green rays evenly distributed over the entire valve surface; the nacre is a bluish white. Its shell outline is irregularly elliptical or obovate with inequilateral valves, subinflated, and rather solid. Both valves contain two small triangular pseudocardinal teeth. Lateral teeth are double in the left valve, single or sometimes double in the right; they are short and curved. Anterior muscle scars are well-impressed, while posterior muscle scars are shallow; the pallial line is distinct only anteriorly.

The tan riffleshell shows sexual dimorphism in many features. Males have a slightly protruding posterior end while females have a pronounced posterior marsupial swelling defined by anterior and posterior sulchi and are often serrated along the ventral margin. The posterior ridge of the male shell appears faintly doubled, ending in a slight biangulation posteriorly while it is scarcely visible in females. In male shells the umbo is quite full and elevated and located slightly anterior of middle while in females you find it in the anterior third of the shell. Additionally, the posterior end of female shells is especially thin and iridescent.

Like many other freshwater mussels, life history information is limited for this species. It is assumed that their reproductive cycle is like that of other native freshwater mussels. Males release sperm into the water column, and the sperm are then taken in by the female through their siphons during feeding and respiration. The females retain the fertilized eggs in their gills until the larvae (glochidia) fully develop. The mussel glochidia are released into the water, and within a few days they must attach to the appropriate species of fish, which they parasitize for a short time while they develop into juvenile mussels. They then detach from their fish host and sink to the stream bottom where they continue to develop, provided they land in a suitable substrate with the correct water conditions (USFWS 2002). Rogers et al. (2001), working with the Indian Creek population in southwest Virginia, reported collecting gravid females of the tan riffleshell from February through August with glochidia being released principally in May and June. A fecundity estimate of almost 20,000 glochidia from one female was made. Maximum age of individuals from this population was estimated at 11 years based on shell thin sections (Rogers et al. 2001).

Laboratory tests of the tan riffleshell glochidia resulted in identification of five species of fish as suitable hosts (Table 12) (Watson and Neves 1996; Rogers et al. 2001). Of the 16 species tested, it was the benthic, riffle-dwelling species that were successful fish hosts (Rogers et al. 2001).

Table 12. Laboratory Identified Fish Hosts for Tan Riffleshell

Common Name	Scientific Name
Banded sculpin	*Cottus bairdi*
Mottled sculpin	*Cottus carolinae*
Greenside darter	*Etheostoma blennioides*
Fantail darter	*Etheostoma flabellare*
Redline darter	*Etheostoma ruflineatum*

9.11.2 Distribution and Habitat Requirements

Historically the tan riffleshell was wide spread in the headwaters of the Tennessee and Cumberland River drainages. Recent populations of the tan riffleshell have been reported from the Duck River (Tennessee), Hiwassee River (Tennessee), Middle Fork Holston River (Virginia), Clinch River (Virginia), Indian Creek (Virginia), and the Big South Fork Cumberland River (Tennessee) (Parmalee and Hughes 1994, Rogers et al. 2001, Jones et al. 2004, Jones et al. 2006). The tan riffleshell is known in North Carolina from two museum lots from the French Broad River, Asheville, Buncombe County (identifications by D. H. Stansbery and confirmed by J. W. Jones).

Extant populations of the tan riffleshell in the Clinch (Virginia) and Hiwassee (Tennessee) River drainages are found in less than 3 ft. of flowing water in a substrate of coarse sand, gravel, and some silt (Parmalee and Hughes 1994).

9.11.3 Threats to Species

Threats to the tan riffleshell are similar to those described for the Appalachian elktoe and have contributed to the decline of this species throughout its range. The remaining tan riffleshell populations are generally small in numbers and restricted to short reaches of isolated streams. The low numbers of individuals, and the restricted range of most of the surviving populations, make them extremely vulnerable to extirpation from a single catastrophic event.

9.11.4 Presence in Action Area

Extensive mussel survey work has been done in the French Broad River Basin. Tan riffleshell has not been collected in these surveys, and it is thought to have been extirpated from the French Broad River Basin in North Carolina. A review of the NCNHP records, updated July 2019, indicates no known tan riffleshell occurrence within 1 mi. of the Action Area.

9.11.5 Conclusion of Effects – Tan Riffleshell

The tan riffleshell was not found during mussel surveys conducted for this project. Records in this portion of the French Broad River Basin are historic, and USFWS (2018) lists the species as Historic and Obscure in Buncombe County.

USFWS does not require surveys, a biological conclusion, or consultation for species with a historic record status.

9.12 Virginia Spiraea

Status: Threatened
Family: Rosaceae
Listed: June 15, 1990
Critical Habitat: None designated

9.12.1 Species Characteristics

Virginia spiraea is a clonal shrub with a modular growth form. It grows from 2 to 10 ft. tall and usually has arching and profusely branching stems. The alternate leaves are ovate to lanceolate, 1.2 to 6 in. long and 0.8 to 2 in. wide and mucronate. They have an acute base and are glaucous beneath and may be darker green above. Margins are entire to completely serrate with coarse to fine single teeth that are occasionally curved. Yellowish-green to clear pale white flowers are produced on a 2 to 8.7 in. corymb from late May to late July (USFWS 1992b).

9.12.2 Distribution and Habitat Requirements

Virginia spiraea occurs in flood-scoured, high-gradient sections of rocky river banks of second and third order streams, often in gorges or canyons. This perennial shrub grows in sunny areas on moist, acidic soils, primarily over sandstone. The shrub tends to be found in thickets with little arboreal or herbaceous competition along early successional areas that rely on periodic disturbances such as high-velocity scouring floods to eliminate such competition. Virginia spiraea also occurs on meander scrolls and point bars, natural levees, and other braided features of lower stream reaches, often near the stream mouth. Scoured, riverine habitat sites are found where deposition occurs after high water flows, such as on floodplains and overwash islands, rather than along areas of maximum erosion. Occurrences in depositional habitats are found among riparian debris piles, on fine alluvial sand and other alluvial deposits, or between boulders (USFWS 1992b).

9.12.3 General Threats to Species

Due to its specific habitat requirements, Virginia spiraea is vulnerable to alterations of streamflow patterns. Impoundments, road construction, unmanaged recreational use of river corridors, industrial development, lack of watershed management, and uncontrolled development of river corridors have already threatened and exterminated several populations of this species. Another threat to Virginia spiraea is competition from exotic invasive plants (USFWS 1992b).

9.12.4 Presence in Action Area

A review of the NCNHP records, updated July 2019, indicate that an occurrence of Virginia spiraea (EO 28930) has been documented approximately 900 ft. east of the Action Area near the northern portion of Section A. The known population of Virginia spiraea was planted by the Asheville Botanical Gardens. No other current records of Virginia spiraea exist within the county.

9.12.5 Conclusion of Effects – Virginia Spiraea

USFWS does not require surveys, a biological conclusion, or consultation for species with a historic record status.

10.0 DETERMINATION OF EFFECTS

As presented in Table 13, FHWA, made the following determinations of effect for federally listed and proposed species under the ESA for the I-26 Widening project.

Table 13. Federally Protected Species in Buncombe County

Common Name	Scientific name	Federal Status	Listing Status	Species Present in Action Area	Determination of Effect
Appalachian elktoe	*Alasmidonta raveneliana*	E	Current	Yes^	MALTAA
Blue Ridge goldenrod	*Solidago spithamaea*	T	Current	No	No Effect
Bog turtle	*Glyptemys muhlenbergii*	T(S/A)	Current	N/A	NR
Bunched arrowhead	*Sagittaria fasciculata*	E	Historic	N/A	NR
Carolina northern flying squirrel	*Glaucomys sabrinus coloratus*	E	Current	No	No Effect
Gray bat	*Myotis grisescens*	E	Current	Yes	MALTAA
Mountain sweet pitcher plant	*Sarracenia rubra ssp. jonesii*	E	Current	No	No Effect
Northern long-eared bat	*Myotis septentrionalis*	T	Current	Yes^	MANLTAA
Rock gnome lichen	*Gymnoderma lineare*	E	Current	No	No Effect
Rusty-patched bumble bee	*Bombus affinis*	E	Historic	N/A	NR
Spotfin chub (=turquoise shiner)	*Erimonax monachus*	T	Historic	N/A	NR
Spreading avens	*Geum radiatum*	E	Current	No	No Effect
Spruce-fir moss spider	*Microhexura montivaga*	E	Current	No	No Effect
Tan riffleshell	*Epioblasma florentina walkeri* (=*E. walkeri*)	E	Historic and Obscure	N/A	NR
Virginia spiraea	*Spiraea virginiana*	T	Historic	N/A	NR

E = Endangered, T = Threatened, T(S/A) = Threatened due to similarity of appearance

^ = Due to nearby NCNHP records and appropriate habitat, this species is assumed to be present within the Action Area.
* = USFWS does not and will not require surveys for rusty-patched bumble bee in North Carolina because USFWS assumes the state is unoccupied by rusty-patched bumble bee

Current - the species has been observed in the county within the last 50 years
Historic - the species was last observed in the county more than 50 years ago
Obscure - the date and/or location of observation is uncertain

NR = No Section 7 survey, conclusion, or consultation is required at this time.
MALTAA = may affect, likely to adversely affect, MANLTAA = may affect, not likely to adversely affect.

FHWA, as the lead federal agency on this consultation document, has determined that the project will likely adversely affect MYGR and Appalachian elktoe. FHWA has determined the project may affect but is not likely to adversely affect MYSE.

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