STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

JOSH STEIN
GOVERNOR

DANIEL H. JOHNSON
SECRETARY

November 6, 2025

MEMORANDUM TO: Division Environmental and Construction Units

FROM: Michael A. Turchy, ECAP Group Leader
Environmental Analysis Unit

SUBJECT: Environmental Permit for the I-26 Asheville Connector from I-40 east of SR 1224, to US 19/23 near the Broadway St Interchange, Buncombe County, Division 13, **TIP: I-2513.**

Please find enclosed the following permits for this project:

Agency	Permit Type	Permit Expiration
US Army Corps of Engineers Section 404 Clean Water Act Permit	Individual Permit, dated 2/6/2024 *Authorizes construction of Sections AA, AB, and AC* *Does not authorize construction of Sections B, C, and D*	Dec. 31, 2034
	Individual Permit Modification, dated 6/26/2025 *Authorizes Geotechnical Investigations on Section BD*	
	Individual Permit Modification, dated 10/31/2025 *Authorizes Additional Utility Impacts on Section AA*	
NC Division of Water Resources Section 401 Water Quality Certification	Individual Cert. No. 006377, dated 10/30/2023 *Authorizes construction of Sections AA, AB, and AC* *Does not authorize construction of Sections B, C, and D*	Dec. 31, 2034
	Individual Certification Modification, dated 6/24/2025 *Authorizes Geotechnical Investigations on Section BD*	
	Individual Certification Modification, dated 10/9/2025 *Authorizes Additional Utility Impacts on Section AA*	

Work is authorized by the above referenced permit provided it is accomplished in strict accordance with the permitted plans.

The Environmental Coordination and Permitting Group or the Division Environmental Office must be consulted if any deviation from the permit(s) is required.

Mailing Address:
NC DEPARTMENT OF TRANSPORTATION
ENVIRONMENTAL ANALYSIS UNIT
1598 MAIL SERVICE CENTER
RALEIGH NC 27699-1598

Telephone: (919) 707-6000
Customer Service: 1-877-368-4968
Website: www.ncdot.gov

Location:
1000 BIRCH RIDGE DRIVE
RALEIGH NC 27610

DEPARTMENT OF THE ARMY PERMIT

Permittee **NORTH CAROLINA DEPARTMENT OF TRANSPORTATION**
ATTN: MR. MICHAEL A. TURCHY, ECAP GROUP LEADER

Permit No. **SAW-2004-9986803, STIP Project No. I-2513**

Issuing Office **CESAW-RG-D**

NOTE: The term "you" and its derivatives, as used in this permit, means the permittee or any future transferee. The term "this office" refers to the appropriate district or division office of the Corps of Engineers having jurisdiction over the permitted activity or the appropriate official of that office acting under the authority of the commanding officer.

You are authorized to perform work in accordance with the terms and conditions specified below.

Project Description: **To construct STIP I-2513, the project involves the permanent discharge of fill material into 6,425 linear feet (lf) of streams and 1.22 acres of wetlands along the 7-mile project corridor in Buncombe County, North Carolina.**

Project Location: **STIP I-2513 is located in Asheville, Buncombe County, North Carolina, and is commonly referred to as the I-26 Connector. The I-26 Connector project would connect I-26 from I-40 in southwestern Asheville to US 19-23-70 in northwest Asheville and have a total length of approximately 7 miles. Center coordinates for the project are 35.5671, -82.5878.**

THIS IS A PHASED PERMIT AUTHORIZATION: This permit only authorizes work on Sections AA, AB, and AC of STIP I-2513 (Phase 1 of the project). The Permittee is authorized to impact regulated waters along Sections AA, AB, and AC of STIP I-2513 (Phase 1) as follows: the permanent discharge of fill material into 1,780 lf of streams and 1.12 acres of wetlands. The permittee is also authorized to temporarily impact 395 lf of streams during construction. Construction on the remaining sections/phases of STIP I-2513 (i.e., Sections I-2513 B, I-2513 C, and I-2513 D) shall not commence until: (a) final design for those sections/phases has been completed and submitted to the U.S. Army Corps of Engineers (Corps); (b) the Permittee has minimized impacts to waters and wetlands to the maximum extent practicable for those sections/phases and the Corps concurs with this assessment through standard Merger 4B and 4C meetings; (c) any modification(s) to the permit plans for those sections/phases have been approved by the Corps in writing; (d) NCDOT submits final versions of the Bridge Construction and Demolition Plan, River User Safety Plan, and Strategic Communication Plan that adequately address the Corps' Public Interest Review Factors (to include recreation, safety, navigation, and flood hazards); and (e) a final compensatory mitigation plan for those sections/phases has been submitted by the Permittee and approved by the Corps.

Permit Conditions:

General Conditions:

1. The time limit for completing the work authorized ends on **December 31, 2034.** If you find that you need more time to complete the authorized activity, submit your request for a time extension to this office for consideration at least one month before the above date is reached.

2. You must maintain the activity authorized by this permit in good condition and in conformance with the terms and conditions of this permit. You are not relieved of this requirement if you abandon the permitted activity, although you

may make a good faith transfer to a third party in compliance with General Condition 4 below. Should you wish to cease to maintain the authorized activity or should you desire to abandon it without a good faith transfer, you must obtain a modification of this permit from this office, which may require restoration of the area.

3. If you discover any previously unknown historic or archeological remains while accomplishing the activity authorized by this permit, you must immediately notify this office of what you have found. We will initiate the Federal and state coordination required to determine if the remains warrant a recovery effort or if the site is eligible for listing in the National Register of Historic Places.

4. If you sell the property associated with this permit, you must obtain the signature of the new owner in the space provided and forward a copy of the permit to this office to validate the transfer of this authorization.

5. If a conditioned water quality certification has been issued for your project, you must comply with the conditions specified in the certification as special conditions to this permit. For your convenience, a copy of the certification is attached if it contains such conditions.

6. You must allow representatives from this office to inspect the authorized activity at any time deemed necessary to ensure that it is being or has been accomplished in accordance with the terms and conditions of your permit,

Special Conditions:

SEE ATTACHED SPECIAL CONDITIONS

Further Information:

1. Congressional Authorities: You have been authorized to undertake the activity described above pursuant to:

( ) Section 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. 403).

(X) Section 404 of the Clean Water Act (33 U.S.C. 1344).

( ) Section 103 of the Marine Protection, Research and Sanctuaries Act of 1972 (33 U.S.C. 1413).

2. Limits of this authorization.

a. This permit does not obviate the need to obtain other Federal, state, or local authorizations required by law.

b. This permit does not grant any property rights or exclusive privileges.

c. This permit does not authorize any injury to the property or rights of others.

d. This permit does not authorize interference with any existing or proposed Federal project.

3. Limits of Federal Liability. In issuing this permit, the Federal Government does not assume any liability for the following:

a. Damages to the permitted project or uses thereof as a result of other permitted or unpermitted activities or from natural causes.

b. Damages to the permitted project or uses thereof as a result of current or future activities undertaken by or on behalf of the United States in the public interest.

c. Damages to persons, property, or to other permitted or unpermitted activities or structures caused by the activity authorized by this permit.

d. Design or construction deficiencies associated with the permitted work.

e. Damage claims associated with any future modification, suspension, or revocation of this permit.

4. Reliance on Applicant's Data: The determination of this office that issuance of this permit is not contrary to the public interest was made in reliance on the information you provided.

5. Reevaluation of Permit Decision. This office may reevaluate its decision on this permit at any time the circumstances warrant. Circumstances that could require a reevaluation include, but are not limited to, the following:

a. You fail to comply with the terms and conditions of this permit.

b. The information provided by you in support of your permit application proves to have been false, incomplete, or inaccurate (See 4 above).

c. Significant new information surfaces which this office did not consider in reaching the original public interest decision.

Such a reevaluation may result in a determination that it is appropriate to use the suspension, modification, and revocation procedures contained in 33 CFR 325.7 or enforcement procedures such as those contained in 33 CFR 326.4 and 326.5. The referenced enforcement procedures provide for the issuance of an administrative order requiring you to comply with the terms and conditions of your permit and for the initiation of legal action where appropriate. You will be required to pay for any corrective measures ordered by this office, and if you fail to comply with such directive, this office may in certain situations (such as those specified in 33 CFR 209.170) accomplish the corrective measures by contract or otherwise and bill you for the cost.

6. Extensions. General condition 1 establishes a time limit for the completion of the activity authorized by this permit, Unless there are circumstances requiring either a prompt completion of the authorized activity or a reevaluation of the public interest decision, the Corps will normally give favorable consideration to a request for an extension of this time limit.

Your signature below, as permittee, indicates that you accept and agree to comply with the terms and conditions of this permit.

DocuSigned by:
Michael Turchy
3CFF2BCF59604C1...

05-February-2024

(PERMITTEE) **NC DEPARTMENT OF TRANSPORTATION**
ATTN: MR. MICHAEL A. TURCHY

(DATE)

This permit becomes effective when the Federal official, designated to act for the Secretary of the Army, has signed below.

Monte Matthews

2024.02.06 09:45:17 -05'00'

FOR
(DISTRICT COMMANDER) **BRAD A. MORGAN, COLONEL**

(DATE)

When the structures or work authorized by this permit are still in existence at the time the property is transferred, the terms and conditions of this permit will continue to be binding on the new owner(s) of the property. To validate the transfer of this permit and the associated liabilities associated with compliance with its terms and conditions, have the transferee sign and date below.

(TRANSFEREE)

(DATE)

*U.S. GOVERNMENT PRINTING OFFICE: 1986 - 717-425

SPECIAL CONDITIONS
FEBRUARY 5, 2024
ACTION ID. SAW-2004-9986803
NC DEPARTMENT OF TRANSPORTATION
STIP I-2513, BUNCOMBE COUNTY

Failure to institute and carry out the details of the following special conditions will result in a directive to cease all ongoing and permitted work within waters of the U.S. associated with the permitted project, or such other remedies and/or fine as the Wilmington District Engineer, or his authorized representatives, may seek.

WORK LIMITS

1) The entire 7 mile project is identified as STIP I-2513. This permit only authorizes work on Sections I-2513 AA, AB, and AC of STIP I-2513, also known as "Phase 1" for permitting purposes. Construction on the remaining sections/phases of the I-2513 project (i.e., Sections I-2513 B, I-2513 C, and I-2513 D) shall not commence until: (a) final design for those sections/phases has been completed and submitted to the U.S. Army Corps of Engineers (Corps); (b) the Permittee has minimized impacts to waters and wetlands to the maximum extent practicable for those sections/phases and the Corps concurs with this assessment through standard Merger 4B and 4C meetings; (c) any modification(s) to the permit plans for those sections/phases have been approved by the Corps in writing; (d) NCDOT submits final versions of the Bridge Construction and Demolition Plan, River User Safety Plan, and Strategic Communication Plan that adequately address the Corps' Public Interest Review Factors (to include recreation, safety, navigation, and flood hazards); and (e) a final compensatory mitigation plan for those sections/phases has been submitted by the Permittee and approved by the Corps.

2) All work authorized by this permit shall be performed in strict compliance with the following:

- The description of work in the revised application dated August 17, 2023.
- All information submitted in response to the Corps' requests for additional information.
- All final environmental commitments that NCDOT has agreed to, to include (but not limited to) the Biological Opinion (BO) and the Amended BO and Conference Opinion (special condition #14 of this permit), and the Section 106 Memorandum of Agreement (special condition #15 of this permit).
- The attached permit plans titled (1) "I-2513AA/AB", Permit Drawings Sheets 1-26, and (2) "I-2513AC", Permit Drawings Sheets 1-36.

The Permittee shall ensure that the construction design plans for this project do not deviate from the approved permit plans referenced above. Any modification to the approved permit plans must be approved by the U.S. Army Corps of Engineers prior to any active construction in waters or wetlands.

3) Unauthorized Dredge and/or Fill: Except as authorized by this permit or any U.S. Army Corps of Engineers approved modification to this permit, no excavation, fill, or mechanized land-clearing activities shall take place at any time in the construction or maintenance of this project, within waters or wetlands, nor shall any activities take place that cause the degradation of waters or wetlands. There shall be no excavation from, waste disposal into, or degradation of, jurisdictional wetlands or waters associated with this permit without appropriate modification of this permit, including appropriate compensatory mitigation. This prohibition applies to all borrow and waste activities connected with this project.

4) Maintain Flows and Circulation Patterns of Waters: Except as specified in the approved permit plans referenced above, no excavation, fill or mechanized land-clearing activities shall take place at any time in the construction or maintenance of this project in such a manner as to impair normal flows and circulation patterns within, into, or out of waters or wetlands, or to reduce the reach of waters or wetlands.

5) Permit Distribution: The Permittee shall require its contractors and/or agents to comply with the terms and conditions of this permit in the construction and maintenance of this project, and shall provide each of its contractors and/or agents associated with the construction or maintenance of this project with a copy of this permit. A copy of this permit, including all conditions, drawings and attachments shall be available at the project site during the construction and maintenance of this project.

NOTIFICATIONS

6) Pre-Construction Meeting: The Permittee shall schedule a pre-construction meeting between their representatives, the contractor, and the U.S. Army Corps of Engineers (Corps), Wilmington District, NCDOT Regulatory Project Manager for Division 13, prior to conducting any work in jurisdictional waters of the U.S. to ensure that there is a mutual understanding of all terms and conditions contained in this Department of the Army permit. To schedule this preconstruction meeting, the Permittee shall poll, at least two weeks ahead of any proposed meeting date, the representatives from the Corps and the North Carolina Division of Water Resources as to their availability; this poll shall include multiple potential dates and times for the preconstruction meeting. If other special conditions of this permit require other agency representatives (e.g., U.S. Fish and Wildlife Service, North Carolina Wildlife Resources Commission, etc.) to be invited to the preconstruction meeting, NCDOT shall include those agency representatives in the poll and shall schedule the meeting when all required agency representatives can attend the meeting. To determine if other agency representatives must be included in the poll for the preconstruction meeting, NCDOT shall review all other special conditions of the permit, to include all referenced documents, letters, correspondence, etc. The Permittee shall provide the Corps and all other required agency representatives with a copy of the final permit plans (if different than the approved permit plans referenced

above) at least two weeks prior to the preconstruction meeting along with a description of any changes that have been made to the project's design, construction methodology or construction timeframe.

7) Notification of Construction Commencement and Completion: The Permittee shall advise the U.S. Army Corps of Engineers in writing at least two (2) weeks prior to beginning the work authorized by this permit and again upon completion of the work authorized by this permit.

8) Reporting Address: All reports, documentation, and correspondence required by the conditions of this permit shall be submitted to the following: U.S. Army Corps of Engineers, Wilmington District Asheville Regulatory Field Office, Attn: Lori Beckwith, 151 Patton Ave., Room 208, Asheville, NC 28801-5006, or by email to loretta.a.beckwith@usace.army.mil . The Permittee shall reference the following permit number on all submittals: SAW-2004-9986803, STIP Project No. I-2513.

9) Reporting Violations: Violation of these permit conditions or violation of Section 404 of the Clean Water Act shall be reported to the U.S. Army Corps of Engineers by email to loretta.a.beckwith@usace.army.mil and by telephone at 828-230-0483, or 828-271-7980 (Asheville Office general number), within 24 hours of the Permittee's discovery of the violation.

10) Permit Revocation: The Permittee, upon receipt of a notice of revocation of this permit or upon its expiration before completion of the work will, without expense to the United States and in such time and manner as the Secretary of the Army or his authorized representative may direct, restore the water or wetland to its pre-project condition.

RELATED LAWS

11) Clean Fill: The Permittee shall use only clean fill material for this project. The fill material shall be free from items such as trash, construction debris, metal and plastic products, and concrete block with exposed reinforcement bars. Soils used for fill shall not be contaminated with any toxic substance in concentrations governed by Section 307 of the Clean Water Act. Unless otherwise authorized by this permit, all fill material placed in waters or wetlands shall be generated from an upland source.

12) Water Contamination: All mechanized equipment shall be regularly inspected and maintained to prevent contamination of waters and wetlands from fuels, lubricants, hydraulic fluids, or other toxic materials. In the event of a spill of petroleum products or any other hazardous waste, the Permittee shall immediately report it to the North Carolina Division of Water Resources at (919) 733-3300 or (800) 858-0368 and provisions of the North Carolina Oil Pollution and Hazardous Substances Control Act

shall be followed.

13) Endangered Species Act: The Permittee shall implement all necessary measures to ensure the authorized activity does not kill, injure, capture, harass, or otherwise harm any federally-listed threatened or endangered species. While accomplishing the authorized work, if the Permittee discovers or observes an injured or dead threatened or endangered species, the Permittee shall immediately notify the U.S. Army Corps of Engineers, Wilmington District, Asheville Field Office, Attn: Lori Beckwith (Corps Project Manager for NCDOT Division 13) at loretta.a.beckwith@usace.army.mil or by telephone at 828-230-0483, or 828-271-7980 (Asheville Office general number), so that the required Federal coordination can occur.

14) Endangered Species Act consultation: This Department of the Army permit does not authorize you to take a federally listed species. In order to legally take a federally listed species, you must have separate authorization under the Endangered Species Act (ESA) (e.g., an ESA Section 10 permit, or a Biological Opinion (BO) under ESA Section 7, with "incidental take" provisions with which you must comply). The U.S. Fish and Wildlife Service's (USFWS's) BO for this project titled, "Biological Opinion I-26 Connector from I-40 to US 19/23/70 North of Asheville Buncombe County, Asheville, North Carolina FWS Log # 02-252", dated June 19, 2020, was ammended on December 14, 2023 by a document titled, "Biological Opinion and Conference Opinion Addendum to the June 19, 2020 Biological Opinion for I-26 Connector from I-40 to US 19/23/70 North of Asheville, Buncombe County, North Carolina Service Log #02-252 NCDOT STIP I-2513"; these documents contain mandatory terms and conditions to implement the reasonable and prudent measures that are associated with incidental take for the species specified in these documents. Your authorization under this permit is conditional upon your compliance with all of the mandatory terms and conditions associated with incidental take of these documents. Failure to comply with the terms and conditions associated with incidental take detailed in these doucments, where a take of a federally listed species occurs, would constitute an unauthorized take, and it would also constitute non-compliance with your permit. The USFWS is the appropriate authority to determine compliance with the terms and conditions of these doucments/its Opinion(s), and with the ESA. These documents are attached to the pemit for this project.

15) National Historic Preservation Act: NCDOT shall abide by all stipulations identified in the executed Memorandum of Agreement titled, "MEMORANDUM OF AGREEMENT AMONG THE FEDERAL HIGHWAY ADMINISTRATION, the NORTH CAROLINA DEPARTMENT OF TRANSPORTATION, and the NORTH CAROLINA STATE HISTORIC PRESERVATION OFFICE PURSUANT TO 36 CFR 800.6 regarding the I-26 CONNECTOR BUNCOMBE COUNTY, NORTH CAROLINA NCDOT TIP No. I-2513 FA No. MANHF-26-1(53). This MOA is attached to the permit for this project.

AQUATIC LIFE/CULVERTS

16) Prohibitions on Concrete: The Permittee shall take all measures necessary to prevent live or fresh concrete, including bags of uncured concrete, from coming into contact with any water in or entering into waters of the United States. Water inside coffer dams or casings that has been in contact with concrete shall only be returned to waters of the United States when it no longer poses a threat to aquatic organisms (concrete is set and cured).

17) Aquatic Life Movement: No activity may substantially disrupt the necessary life cycle movements of those species of aquatic life indigenous to the waterbody, including those species that normally migrate through the area. All discharges of dredged or fill material within waters of the United States shall be designed and constructed to maintain low flows to sustain the movement of aquatic species.

18) Unless otherwise requested in the application and depicted on the approved permit plans, culverts greater than 48 inches in diameter shall be buried at least one foot below the bed of the stream. Culverts 48 inches in diameter and less shall be buried or placed on the stream bed as practicable and appropriate to maintain aquatic passage, and every effort shall be made to maintain existing channel slope. The bottom of the culvert shall be placed at a depth below the natural stream bottom to provide for passage during drought or low flow conditions. Culverts shall be designed and constructed in a manner that minimizes destabilization and head cutting.

19) Measures shall be included in the construction/installation of culverts that will promote the safe passage of fish and other aquatic organisms. The dimension, pattern, and profile of the stream above and below a pipe or culvert shall not be modified by widening the stream channel or by reducing the depth of the stream in connection with the construction activity. The width, height, and gradient of a proposed opening shall be such as to pass the average historical low flow and spring flow without adversely altering flow velocity. Spring flow should be determined from gauge data, if available. In the absence of such data, bankfull flow can be used as a comparable level.

SEDIMENT AND EROSION CONTROL

20) During the clearing phase of the project, heavy equipment shall not be operated in surface waters or stream channels. Temporary stream crossings will be used to access the opposite sides of stream channels. All temporary diversion channels and stream crossings will be constructed of non-erodible materials. Grubbing of riparian vegetation will not occur until immediately before construction begins on a given segment of stream channel.

21) No fill or excavation impacts for the purposes of sedimentation and erosion control shall occur within jurisdictional waters, including wetlands, unless the impacts are included on the approved plan drawings and specifically authorized by this permit. This includes, but is not limited to, sediment control fences and other barriers intended to catch sediment losses.

22) The Permittee shall use appropriate sediment and erosion control practices which equal or exceed those outlined in the most recent version of the “North Carolina Sediment and Erosion Control Planning and Design Manual” to ensure compliance with the appropriate turbidity water quality standard. Erosion and sediment control practices shall be in full compliance with all specifications governing the proper design, installation and operation and maintenance of such Best Management Practices in order to ensure compliance with the appropriate turbidity water quality standards. This shall include, but is not limited to, the immediate installation of silt fencing or similar appropriate devices around all areas subject to soil disturbance or the movement of earthen fill, and the immediate stabilization of all disturbed areas. Additionally, the project shall remain in full compliance with all aspects of the Sedimentation Pollution Control Act of 1973 (North Carolina General Statutes Chapter 113A, Article 4). Adequate sedimentation and erosion control measures shall be implemented prior to any ground disturbing activities to minimize impacts to downstream aquatic resources. These measures shall be inspected and maintained regularly, especially following rainfall events. All fill material shall be adequately stabilized at the earliest practicable date to prevent sediment from entering into adjacent waters or wetlands.

23) The Permittee shall implement all reasonable and practicable measures to ensure that equipment, structures, work, and operations associated with this project do not adversely affect upstream and/or downstream reaches. Adverse effects include, but are not limited to, channel instability, flooding, and/or stream bank erosion. The Permittee shall routinely monitor for these effects, cease all work when detected, take initial corrective measures to correct actively eroding areas, and notify this office immediately. Permanent corrective measures may require additional authorization by the U.S. Army Corps of Engineers.

24) The Permittee shall ensure that all excavation and/or construction areas in regulated waters, to inlcude wetlands, are temporarily dewatered during work.

25) Temporary Fills: Within thirty (30) days of the date of completing the authorized work, the Permittee shall remove all temporary fills in waters of the United States and restore the affected areas to pre-construction contours and elevations. The affected areas shall be re-vegetated with native, non-invasive vegetation as necessary to minimize erosion and ensure site stability.

BORROW AND WASTE

26) To ensure that all borrow and waste activities occur on high ground and do not result in the degradation of adjacent waters and wetlands, except as authorized by this permit, the Permittee shall require its contractors and/or agents to identify all areas to be used as borrow and/or waste sites associated with this project. The Permittee shall provide the U.S. Army Corps of Engineers with appropriate maps indicating the locations of proposed borrow and/or waste sites as soon as such information is available. The Permittee shall submit to the Corps site-specific information needed to ensure that borrow and/or waste sites comply with all applicable Federal requirements, to include compliance with the Endangered Species Act and the National Historic Preservation Act, such as surveys or correspondence with agencies (e.g., the U.S. Fish and Wildlife Service, the North Carolina Historic Preservation Office, etc.). The required information shall also include the location of all aquatic features, if any, out to a distance of 400 feet beyond the nearest boundary of the site. The Permittee shall not approve any borrow and/or waste sites before receiving written confirmation from the Corps that the proposed site meets all Federal requirements, whether or not waters of the U.S., including wetlands, are located in the proposed borrow and/or waste site. All delineations of aquatic sites on borrow and/or waste sites shall be verified by the U.S. Army Corps of Engineers and shown on the approved reclamation plans. The Permittee shall ensure that all borrow and/or waste sites comply with Special Condition #3 of this permit. Additionally, the Permittee shall produce and maintain documentation of all borrow and waste sites associated with this project. This documentation will include data regarding soils, vegetation, hydrology, any delineation(s) of aquatic sites, and any jurisdictional determinations made by the Corps to clearly demonstrate compliance with Special Condition #3. All information will be available to the U.S. Army Corps of Engineers upon request. The Permittee shall require its contractors to complete and execute reclamation plans for each borrow and/or waste site and provide written documentation that the reclamation plans have been implemented and all work is completed. This documentation will be provided to the U.S. Army Corps of Engineers within 30 days of the completion of the reclamation work.

COMPENSATORY MITIGATION

27) In order to compensate for impacts associated with this permit, mitigation shall be provided in accordance with the provisions outlined on the most recent version of the attached Compensatory Mitigation Responsibility Transfer Form. The requirements of this form, including any special conditions listed on this form, are hereby incorporated as special conditions of this permit.

DEPARTMENT OF THE ARMY
WILMINGTON DISTRICT, CORPS OF ENGINEERS
69 DARLINGTON AVENUE
WILMINGTON, NORTH CAROLINA 28403-1343

June 26, 2025

Regulatory Division

Action ID: SAW-2004-9986803, STIP Project No. I-2513

North Carolina Department of Transportation
Attn: Mr. Michael A. Turchy
Environmental Coordination and Permitting Group Leader
1598 Mail Service Center
Raleigh, North Carolina 27699-1598
Sent Via Email: maturchy@ncdot.gov

Dear Mr. Turchy:

I refer to your permit modification request dated May 22, 2025, for authorization to impact waters of the U.S. to conduct in-water geotechnical borings for Sections B&D of the I-2513 project. As background, the I-2513 project is 7 miles in length and is located in Asheville, Buncombe County, North Carolina. The U.S. Army Corps of Engineers (USACE) issued a Department of the Army Individual Permit to the North Carolina Department of Transportation (NCDOT) for Phase 1 (Sections AA, AB, and AC) of this project on February 6, 2024, under file number SAW-2004-9986803.

As noted in the modification request, refinements are being made by the NCDOT I-2513 B&D Design Build Team to collect additional input as the project's design continues to progress from preliminary to final stage. As a result, the team determined that the relatively low normal water level (less than two ft) in the French Broad River does not allow for proper draft of the previously proposed barge mounted equipment. NCDOT now proposes the use of drill rigs mounted to large diameter rubber tire all terrain carriers to perform the borings. Riverbed disturbance will occur along the routes that will be established for the carriers through repeated use, though it is noted that the low-pressure tires would minimize contact pressures with the riverbed. Drilling will be performed during low water levels within the river (approximately 2 feet). The drill rigs will be in the river during the day and then moved, whenever possible, to the adjacent floodplain during the night.

Approximately 30 borings will be needed in the French Broad River. The borings will cover 15 sq ft. in total. The total temporarily impacted riverbed will be approximately 12,000 sq ft. The approximate length of the travel paths is 2,300 feet with width of tires for rig carriers being 31 inches. The impacted area accounts for two-wheel paths.

The USACE coordinated the modification request with the U.S. Fish and Wildlife Service (USFWS), the U.S. Environmental Protection Agency, the N.C. Division of Water Resources (NCDWR), and the N.C. Wildlife Resources Commission on May 29, 2025. No objections were raised. Note that NCDOT consulted with the USFWS about this modification request and the USFWS issued a modified Biological Opinion (BO) for the modified work/geotechnical borings on May 12, 2025; however, this modified BO does not contain any additional reasonable and prudent measures or terms and conditions. Additionally, NCDWR issued a modification to the Section 401 Water Quality Certification (WQC) for this project on June 24, 2025 (enclosed).

The USACE has also reviewed NCDOT's modification request and has no objections. As such, NCDOT is authorized to impact waters of the U.S. to conduct the geotechnical investigations, as described in the permit modification request of May 22, 2025. This authorization is conditioned on compliance with the general and special conditions of the original permit issued on February 6, 2024, and with the following additional conditions:

1. This work shall be conducted in accordance with the requirements of the modified 401 WQC.

2. The permittee shall ensure that any equipment that is placed on the floodplain overnight, or at any other time, is moved to higher ground (above potential flooding) when either of the following situations is forecasted or anticipated: (1) the water level will rise to a point where the equipment could be flooded (even during work days), and/or (2) the water level is expected to rise overnight, or over a non-work period of time, to a point where the equipment could be flooded.

The expiration date of the USACE authorization for this project (December 31, 2034) remains unchanged. If you have any questions, please contact Lori Beckwith, Regulatory Project Manager, WRDA/Transportation Permitting at loretta.a.beckwith@usace.army.mil or at 828-230-0483.

Sincerely,

M. Scott Jones, PWS
WRDA / Transportation Branch Chief
USACE, Wilmington District

Enclosure

Copies furnished by email with enclosure:

USFWS, Ms. Holland Youngman
USEPA, Ms. Amanetta Sommerville
NCDWR, Ms. Amy Annino
NCWRC, Mr. Dave McHenry
NCDOT, Mr. Jeff Hemphill
NCDOT, Mr. Mike Sanderson

DEPARTMENT OF THE ARMY
WILMINGTON DISTRICT, CORPS OF ENGINEERS
69 DARLINGTON AVENUE
WILMINGTON, NORTH CAROLINA 28403-1343

October 31, 2025

Regulatory Division

Action ID: SAW-2004-9986803, STIP Project No. I-2513

North Carolina Department of Transportation
Attn: Mr. Michael A. Turchy
Environmental Coordination and Permitting Group Leader
1598 Mail Service Center
Raleigh, North Carolina 27699-1598
Sent Via Email: maturchy@ncdot.gov

Dear Mr. Turchy:

I refer to your permit modification request dated October 6, 2025, for authorization to impact waters of the U.S. to conduct in-water utility work in Sections AA&AB of the I-2513 project. As background, the I-2513 project is 7 miles in length and is located in Asheville, Buncombe County, North Carolina. The U.S. Army Corps of Engineers (USACE) issued a Department of the Army Individual Permit to the North Carolina Department of Transportation (NCDOT) for Phase 1 (Sections AA, AB, and AC) of this project on February 6, 2024, under file number SAW-2004-9986803. Additionally, on June 26, 2025, the USACE authorized impacts to waters of the U.S. to conduct geotechnical investigations in Sections B&D of this project (Modification #1).

As noted in the current request, a modification of the authorized impacts to waters of the U.S. would allow NCDOT to conduct necessary utility work at Site 2 in Sections AA&AB. This work would impact 30 linear feet (lf) of an unnamed tributary to Ragsdale Creek and 50 lf of Ragsdale Creek at Site 2.

The USACE coordinated the modification request with the U.S. Fish and Wildlife Service, the U.S. Environmental Protection Agency, the N.C. Division of Water Resources (NCDWR), and the N.C. Wildlife Resources Commission on October 7, 2025, and requested agency comment by October 21, 2025. The agencies did not raise any objections to the proposed work.

In response to NCDOT's request, NCDWR issued a modified Section 401 Water Quality Certification (WQC) on October 9, 2025.

The USACE also reviewed NCDOT's modification request and has no objections. As such, NCDOT is authorized to impact waters of the U.S. to conduct the in-water utility work, as described in the request of October 6, 2025. This authorization is conditioned on the work being conducted in strict accordance with the following:

- The description of work in the request dated October 6, 2025.
- The enclosed plans.
- The general and special conditions of the original permit that was issued on February 6, 2024.
- The requirements of the modified 401 WQC dated October 9, 2025 (enclosed).

The expiration date of the USACE authorization for the I-2513 project (December 31, 2034) remains unchanged. If you have any questions, please contact Lori Beckwith, Regulatory Project Manager, WRDA/Transportation Permitting Branch at loretta.a.beckwith@usace.army.mil or at 828-230-0483.

Sincerely,

M. Scott Jones, PWS
WRDA / Transportation Branch Chief
USACE, Wilmington District

Enclosures

Copies furnished by email with enclosure:

USFWS, Ms. Holland Youngman
USEPA, Ms. Amanetta Sommerville
NCDWR, Ms. Amy Annino
NCWRC, Mr. Dave McHenry
NCDOT, Ms. Erin Cheely
NCDOT, Mr. Jeff Hemphill

U.S. ARMY CORPS OF ENGINEERS
Wilmington District
Compensatory Mitigation Responsibility Transfer Form

Permittee: North Carolina Department of Transportation **Action ID: SAW-2004-9986803**
Project Name: Phase 1 of STIP Project No. I-253 (Sections AA, AB, and AC) **County: Buncombe**

Instructions to Permittee: The Permittee must provide a copy of this form to the Mitigation Sponsor, either an approved Mitigation Bank or the North Carolina Division of Mitigation Services (NCDMS), who will then sign the form to verify the transfer of the mitigation responsibility. Once the Sponsor has signed this form, it is the Permittee's responsibility to ensure that Wilmington District Project Manager identified on page two is in receipt of a signed copy of this form before conducting authorized impacts, unless otherwise specified below. If more than one Mitigation Sponsor will be used to provide the mitigation associated with the permit, or if the impacts and/or the mitigation will occur in more than one 8-digit Hydrologic Unit Code (HUC), multiple forms will be attached to the permit, and the separate forms for each Sponsor and/or HUC must be provided to the appropriate Mitigation Sponsors.

Instructions to Sponsor: The Sponsor verifies that the mitigation requirements (credits) shown below have been released and are available at the identified site. By signing below, the Sponsor is accepting full responsibility for the identified mitigation, regardless of whether they have received payment from the Permittee. Once the form is signed, the Sponsor must update the bank ledger and provide a copy of the signed form and the updated ledger to the Permittee, the Project Manager who issued the permit, the Bank Project Manager, and the District Mitigation Office (see contact information on page 2). The Sponsor must also comply with all reporting requirements established in their authorizing instrument.

Permitted Impacts and Compensatory Mitigation Requirements

Permitted Impacts Requiring Mitigation*: **8-digit HUC and Basin:** 06010105, French Broad River Basin

Stream Impacts (linear feet)			Wetland Impacts (acres)			
Warm	Cool	Cold	Riparian Riverine	Riparian Non-Riverine	Non-Riparian	Coastal
	1,656			1.12		

*If more than one mitigation sponsor will be used for the permit, only include impacts to be mitigated by this sponsor.

Compensatory Mitigation Requirements: **8-digit HUC and Basin:** 06010105, French Broad River Basin

Stream Mitigation (credits)			Wetland Mitigation (credits)			
Warm	Cool	Cold	Riparian Riverine	Riparian Non-Riverine	Non-Riparian	Coastal
	3,312			2.24		

Mitigation Site Debited: NCDMS
(List the name of the bank to be debited. For umbrella banks, also list the specific site. For NCDMS, list NCDMS. If the NCDMS acceptance letter identifies a specific site, also list the specific site to be debited).

Section to be completed by the Mitigation Sponsor

Statement of Mitigation Liability Acceptance: I, the undersigned, verify that I am authorized to approve mitigation transactions for the Mitigation Sponsor shown below, and I certify that the Sponsor agrees to accept full responsibility for providing the mitigation identified in this document (see the table above), associated with the USACE Permittee and Action ID number shown. I also verify that released credits (and/or advance credits for NCDMS), as approved by the Wilmington District, are currently available at the mitigation site identified above. Further, I understand that if the Sponsor fails to provide the required compensatory mitigation, the USACE Wilmington District Engineer may pursue measures against the Sponsor to ensure compliance associated with the mitigation requirements.

Mitigation Sponsor Name: NCDEQ - DMS

Name of Sponsor's Authorized Representative: Beth Harmon

Elizabeth Harmon — 02/06/2024

Signature of Sponsor's Authorized Representative **Date of Signature**

USACE Wilmington District
Compensatory Mitigation Responsibility Transfer Form, Page 2

Conditions for Transfer of Compensatory Mitigation Credit:

- Once this document has been signed by the Mitigation Sponsor and the District is in receipt of the signed form, the Permittee is no longer responsible for providing the mitigation identified in this form, though the Permittee remains responsible for any other mitigation requirements stated in the permit conditions.
- Construction within jurisdictional areas authorized by the permit identified on page one of this form can begin only after the District is in receipt of a copy of this document signed by the Sponsor, confirming that the Sponsor has accepted responsibility for providing the mitigation requirements listed herein. When NCDMS provides mitigation for authorized impacts conducted by the North Carolina Department of Transportation (NCDOT), construction within jurisdictional areas may proceed upon permit issuance; however, a copy of this form signed by NCDMS must be provided to the District within 30 days of permit issuance. NCDOT remains fully responsible for the mitigation until the District has received this form, confirming that the Sponsor has accepted responsibility for providing the mitigation requirements listed herein.
- Signed copies of this document must be retained by the Permittee, Mitigation Sponsor, and in the USACE administrative records for both the permit and the Bank/ILF Instrument. It is the Permittee's responsibility to ensure that the District Project Manager (address below) is provided with a signed copy of this form.
- If changes are proposed to the type, amount, or location of mitigation after this form has been signed and returned to the District, the Sponsor must obtain case-by-case approval from the District Project Manager and/or North Carolina Interagency Review Team (NCIRT). If approved, higher mitigation ratios may be applied, as per current District guidance and a new version of this form must be completed and included in the District administrative records for both the permit and the Bank/ILF Instrument.

Comments/Additional Conditions:

This form is not valid unless signed below by the District Project Manager and by the Mitigation Sponsor on Page 1. ***Once signed, the Sponsor should provide copies of this form along with an updated bank ledger to: 1) the Permittee, 2) the District Project Manager at the address below, 3) the Bank Manager listed in RIBITS, and 4) the Wilmington District Mitigation Office, 3331 Heritage Trade Drive, Suite 105, Wake Forest, NC 27587 (or by email to SAWMIT@usace.army.mil)***. Questions regarding this form or any of the permit conditions may be directed to the District Mitigation Office.

USACE Project Manager: Lori Beckwith
USACE Field Office: Asheville Regulatory Field Office
US Army Corps of Engineers
151 Patton Avenue, Room 208
Asheville, NC 28801-5006
Email: loretta.a.beckwith@usace.army.mil

Loretta A. Beckwith Digitally signed by Loretta A. Beckwith
Date: 2024.02.05 09:23:09 -05'00'

Wilmington District Project Manager Signature

February 5, 2024
Date of Signature

Current Wilmington District mitigation guidance, including information on mitigation ratios, functional assessments, and mitigation bank location and availability, and credit classifications (including stream temperature and wetland groupings) is available at http://ribits.usace.army.mil.

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ROY COOPER
Governor
ELIZABETH S. BISER
Secretary
RICHARD E. ROGERS, JR.
Director

NORTH CAROLINA
Environmental Quality

October 30, 2023

Mr. Michael Turchy
North Carolina Department of Transportation
1598 Mail Service Center
Raleigh, NC 27699-1598

Subject: 401 Water Quality Certification Pursuant to Section 401 of the Federal Clean Water Act with ADDITIONAL CONDITIONS for the proposed I-26 Asheville Connector (I-2513) in Buncombe County, Federal Aid Project No. NHF-26-1(53), TIP No. I-2513.
NCDWR Project No. 20231008

Dear Mr. Turchy:

Attached hereto is a copy of Certification No. 006377 issued to the North Carolina Department of Transportation (NCDOT) dated October 30, 2023.

If we can be of further assistance, do not hesitate to contact us.

Sincerely,

DocuSigned by:
AF4DD8F21EA846E...

Richard E. Rogers, Jr., Director
Division of Water Resources

Electronic copy only distribution:
Lori Beckwith, US Army Corps of Engineers Asheville Regulatory Field Office
Jeff Hemphill, NC Department of Transportation
Amanetta Somerville, Environmental Protection Agency
Dave McHenry, NC Wildlife Resources Commission
Holland Youngman, US Fish and Wildlife Service

File Copy

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401 Water Quality Certification Pursuant to Section 401 of the Federal Clean Water Act with ADDITIONAL CONDITIONS

THIS CERTIFICATION is issued in conformity with the requirements of Section 401 Public Laws 92-500 and 95-217 of the United States and subject to the North Carolina Division of Water Resources (NCDWR) Regulations in 15 NCAC 2H .0500. This certification authorizes the NCDOT to impact 2,185 linear feet of jurisdictional streams and 1.11 acres of wetlands in Buncombe County. The project shall be constructed pursuant to the application dated received July 19, 2023. The authorized impacts are as described below:

Stream Impacts in the French Broad River Basin

Site	Permanent Fill in Intermittent Stream (linear ft)	Temporary Fill in Intermittent Stream (linear ft)	Permanent Fill in Perennial Stream (linear ft)	Temporary Fill in Perennial Stream (linear ft)	Total Stream Impact (linear ft)	Stream Impacts Requiring Mitigation (linear ft)
Section AA,AB	131	37	789	134	1,091	0
Section AC	380	60	480	164	1,084	0
Utility Impacts	-	-	-	10	10	0
TOTAL	**511**	**97**	**1,269**	**308**	**2,185**	**0**

Total Stream Impact for Project: 1,780 linear feet of permanent and 405 linear feet of temporary.

Wetland Impacts in the French Broad River Basin

Site	Permanent Fill (ac)	Excavation (ac)	Mechanized Clearing (ac)	Hand Clearing (ac)	Total Wetland Impact (ac)	Wetland Impacts Requiring Mitigation (ac)
Section AA,AB	<0.01	<0.01	-	<0.01	<0.01	0.01
Section AC	0.76	0.03	0.31	-	1.10	1.10
Utility Impacts	-	<0.01	-	-	<0.01	-
TOTAL	**0.77**	**0.03**	**0.31**	**0.00**	**1.11**	**1.11**

Total Wetland Impact for Project: 1.11 acres of impact.

The application provides adequate assurance that the discharge of fill material into the waters of the French Broad River Basin in conjunction with the proposed development will not result in a violation of applicable Water Quality Standards and discharge guidelines. Therefore, the State of North Carolina certifies that this activity will not violate the applicable portions of Sections 301, 302, 303, 306, 307 of PL 92-500 and PL 95-217 if conducted in accordance with the application and conditions hereinafter set forth.

This approval is only valid for the purpose and design that you submitted in your application dated received July 19, 2023. Should your project change, you are required to notify the NCDWR and submit a new application. If the property is sold, the new owner must be given a copy of this Certification and approval letter and is thereby responsible for complying with all the conditions. If any additional wetland impacts, or stream impacts, for this project (now or in the future) exceed 0.1 acre or 300 linear feet, respectively, additional compensatory mitigation may be required as described in 15A NCAC 2H .0506 (c) (2) and (4).

For this approval to remain valid, you are required to comply with all the conditions listed below. In addition, you should obtain all other federal, state or local permits before proceeding with your project including (but not limited to) Sediment and Erosion control, Coastal Stormwater, Non-discharge, and Water Supply watershed regulations. This Certification shall expire on the same day as the expiration date of the corresponding Corps of Engineers Permit.

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Conditions of Certification:

Project Specific Conditions

1. The NCDOT Division Environmental Officer or Environmental Assistant will conduct a pre-construction meeting with all appropriate staff to ensure that the project supervisor and essential staff understand the potential issues with stream and pipe alignment at the permitted site. NCDWR staff shall be invited to the pre-construction meeting. [15A NCAC 02H.0506(b)(2) and (b)(3)]

2. Compensatory mitigation for 1.11 acres of wetland is required. We understand that you have chosen to perform compensatory mitigation for impacts to streams and wetlands through the North Carolina Division of Mitigation Service (DMS) (formerly NCEEP), and that the DMS has agreed to implement the mitigation for the project. The DMS has indicated in letters dated August 15, 2023, that they will assume responsibility for satisfying the federal Clean Water Act compensatory mitigation requirements for the above-referenced project, in accordance with the DMS Mitigation Banking Instrument signed July 28, 2010. [15A NCAC 02H .0506 (c)]

3. The Permittee shall comply with all applicable measures for Appalachian Elktoe detailed under the Project Commitments in the Record of Decision dated May 2023. [15A NCAC 02B .0211(1)]

4. Bridge deck drains shall not discharge directly into the stream. Stormwater shall be directed across the bridge and pre-treated through site-appropriate means (grassed swales, pre-formed scour holes, vegetated buffers, etc.) before entering the stream. To meet the requirements of NCDOT's NPDES permit NCS000250, please refer to the most recent version of the *North Carolina Department of Transportation Stormwater Best Management Practices Toolbox* manual for approved measures. [15A NCAC 02H .0506(b)(2)]

5. As a condition of this 401 Water Quality Certification, the bridge demolition and construction must be accomplished in strict compliance with the most recent version of NCDOT's Best Management Practices for Construction and Maintenance Activities. [15A NCAC 02H .0506(b)(2)]

6. If multiple pipes or barrels are required, they shall be designed to mimic natural stream cross section as closely as possible including pipes or barrels at flood plain elevation and/or sills where appropriate. Widening the stream channel should be avoided. Stream channel widening at the inlet or outlet end of structures typically decreases water velocity causing sediment deposition that requires increased maintenance and disrupts aquatic life passage. [15A NCAC 02H.0506(b)(2)]

7. When final design plans are completed for I-2513 Sections B, C, and D, a modification to the 401 Water Quality Certification shall be submitted to the NC Division of Water Resources. Final designs shall reflect all appropriate avoidance, minimization, and mitigation for impacts to wetlands, streams, and other surface waters. No construction activities that impact any wetlands, streams, or surface waters located in I-2513 Sections B, C, and D shall begin until after the permittee applies for, and receives a written modification of the 401 Water Quality Certification from the NC Division of Water Resources.

General Conditions

1. Unless otherwise approved in this certification, placement of culverts and other structures in open waters and streams shall be placed below the elevation of the streambed by one foot for all culverts with a diameter greater than 48 inches, and 20 percent of the culvert diameter for culverts having a diameter less than 48 inches, to allow low flow passage of water and aquatic life. Design and placement of culverts and other structures including temporary erosion control measures shall not be conducted in a manner that may result in dis-equilibrium of wetlands or streambeds or banks, adjacent to or upstream and downstream of the above structures. The applicant is required to provide evidence that the equilibrium is being maintained if requested in writing by NCDWR. If this condition is unable to be met due to bedrock or other limiting features encountered during construction, please contact NCDWR for guidance

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on how to proceed and to determine whether or not a permit modification will be required. [15A NCAC 02H.0506(b)(2)]

2. If concrete is used during construction, a dry work area shall be maintained to prevent direct contact between curing concrete and stream water. Water that inadvertently contacts uncured concrete shall not be discharged to surface waters due to the potential for elevated pH and possible aquatic life and fish kills. [15A NCAC 02B.0200]

3. During the construction of the project, no staging of equipment of any kind is permitted in waters of the U.S. or protected riparian buffers. [15A NCAC 02H.0506(b)(2)]

4. The dimension, pattern, and profile of the stream above and below the crossing shall not be modified. Disturbed floodplains and streams shall be restored to natural geomorphic conditions. [15A NCAC 02H.0506(b)(2)]

5. The use of rip-rap above the Normal High Water Mark shall be minimized. Any rip-rap placed for stream stabilization shall be placed in stream channels in such a manner that it does not impede aquatic life passage. [15A NCAC 02H.0506(b)(2)]

6. The Permittee shall ensure that the final design drawings adhere to the permit and to the permit drawings submitted for approval. [15A NCAC 02H .0507(c) and 15A NCAC 02H .0506 (b)(2) and (c)(2)]

7. All work in or adjacent to stream waters shall be conducted in a dry work area. Approved BMP measures from the most current version of NCDOT Construction and Maintenance Activities manual such as sandbags, rock berms, cofferdams and other diversion structures shall be used to prevent excavation in flowing water. [15A NCAC 02H.0506(b)(3) and (c)(3)]

8. Heavy equipment shall be operated from the banks rather than in the stream channel in order to minimize sedimentation and reduce the introduction of other pollutants into the stream. [15A NCAC 02H.0506(b)(3)]

9. All mechanized equipment operated near surface waters must be regularly inspected and maintained to prevent contamination of stream waters from fuels, lubricants, hydraulic fluids, or other toxic materials. [15A NCAC 02H.0506(b)(3)]

10. No rock, sand or other materials shall be dredged from the stream channel except where authorized by this certification. [15A NCAC 02H.0506(b)(3)]

11. Discharging hydroseed mixtures and washing out hydro seeders and other equipment in or adjacent to surface waters is prohibited. [15A NCAC 02H.0506(b)(3)]

12. The permittee and its authorized agents shall conduct its activities in a manner consistent with State water quality standards (including any requirements resulting from compliance with §303(d) of the Clean Water Act) and any other appropriate requirements of State and Federal law. If the NCDWR determines that such standards or laws are not being met (including the failure to sustain a designated or achieved use) or that State or federal law is being violated, or that further conditions are necessary to assure compliance, the NCDWR may reevaluate and modify this certification. [15A NCAC 02B.0200]

13. All fill slopes located in jurisdictional wetlands shall be placed at slopes no flatter than 3:1, unless otherwise authorized by this certification. [15A NCAC 02H.0506(b)(2)]

14. A copy of this Water Quality Certification shall be maintained on the construction site at all times. In addition, the Water Quality Certification and all subsequent modifications, if any, shall be maintained with the on-site project manager. [15A NCAC 02H .0507(c) and 15A NCAC 02H .0506 (b)(2) and (c)(2)]

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15. The outside buffer, wetland or water boundary located within the construction corridor approved by this authorization shall be clearly marked by highly visible fencing prior to any land disturbing activities. Impacts to areas within the fencing are prohibited unless otherwise authorized by this certification. [15A NCAC 02H.0501 and .0502]

16. The issuance of this certification does not exempt the Permittee from complying with any and all statutes, rules, regulations, or ordinances that may be imposed by other government agencies (i.e. local, state, and federal) having jurisdiction, including but not limited to applicable buffer rules, stormwater management rules, soil erosion and sedimentation control requirements, etc.

17. The Permittee shall report any violations of this certification to the Division of Water Resources within 24 hours of discovery. [15A NCAC 02B.0506(b)(2)]

18. Upon completion of the project (including any impacts at associated borrow or waste sites), the Permittee shall complete and return the enclosed "Certification of Completion Form" to notify the NCDWR when all work included in the 401 Certification has been completed. [15A NCAC 02H.0502(f)]

19. Native riparian vegetation must be reestablished in the riparian areas within the construction limits of the project by the end of the growing season following completion of construction. [15A NCAC 02B.0506(b)(2)]

20. There shall be no excavation from, or waste disposal into, jurisdictional wetlands or waters associated with this permit without appropriate modification. Should waste or borrow sites, or access roads to waste or borrow sites, be located in wetlands or streams, compensatory mitigation will be required since that is a direct impact from road construction activities. [15A NCAC 02H.0506(b)(3) and (c)(3)]

21. Erosion and sediment control practices must be in full compliance with all specifications governing the proper design, installation and operation and maintenance of such Best Management Practices in order to protect surface waters standards [15A NCAC 02H.0506(b)(3) and (c)(3]):

    a. The erosion and sediment control measures for the project must be designed, installed, operated, and maintained in accordance with the most recent version of the *North Carolina Sediment and Erosion Control Planning and Design Manual*.
    b. The design, installation, operation, and maintenance of the sediment and erosion control measures must be such that they equal, or exceed, the requirements specified in the most recent version of the *North Carolina Sediment and Erosion Control Manual*. The devices shall be maintained on all construction sites, borrow sites, and waste pile (spoil) projects, including contractor-owned or leased borrow pits associated with the project.
    c. For borrow pit sites, the erosion and sediment control measures must be designed, installed, operated, and maintained in accordance with the most recent version of the *North Carolina Surface Mining Manual*.
    d. The reclamation measures and implementation must comply with the reclamation in accordance with the requirements of the Sedimentation Pollution Control Act.

22. Sediment and erosion control measures shall not be placed in wetlands or waters unless otherwise approved by this Certification. [15A NCAC 02H.0506(b)(3) and (c)(3)]

Violations of any condition herein set forth may result in revocation of this Certification and may result in criminal and/or civil penalties. This Certification shall become null and void unless the above conditions are made conditions of the Federal 404 and/or Coastal Area Management Act Permit. This Certification shall expire upon the expiration of the 404 or CAMA permit.

This approval and its conditions are final and binding unless contested [G.S. 143-215.5]. Please be aware that impacting waters without first applying for and securing the issuance of a 401 Water Quality Certification violates Title 15A of the North Carolina Administrative Code (NCAC) 2H .0500. Title 15A NCAC 2H .0500 requires certifications pursuant to Section 401 of the Clean Water Act whenever construction or operation of facilities will

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result in a discharge into navigable waters, including wetlands, as described in 33 Code of Federal Regulations (CFR) Part 323. It also states any person desiring issuance of the State certification or coverage under a general certification required by Section 401 of the Federal Water Pollution Control Act shall file with the Director of the North Carolina Division of Water Quality. Pursuant to G.S. 143-215.6A, these violations and any future violations are subject to a civil penalty assessment of up to a maximum of $25,000.00 per day for each violation.

This Certification can be contested as provided in Chapter 150B of the North Carolina General Statutes by filing a Petition for a Contested Case Hearing (Petition) with the North Carolina Office of Administrative Hearings (OAH) within sixty (60) calendar days. Requirements for filing a Petition are set forth in Chapter 150B of the North Carolina General Statutes and Title 26 of the North Carolina Administrative Code. Additional information regarding requirements for filing a Petition and Petition forms may be accessed at http://www.ncoah.com/ or by calling the OAH Clerk's Office at (919) 431-3000.

A party filing a Petition must serve a copy of the Petition on:

William F. Lane, General Counsel
Department of Environmental Quality
1601 Mail Service Center
Raleigh, NC 27699-1601

If the party filing the Petition is not the permittee, then the party must also serve the recipient of the Certification in accordance with N.C.G.S 150B-23(a).

This the 30th day of October 2023

DIVISION OF WATER RESOURCES

DocuSigned by:
4F4DD2F21EA846E...
Richard E. Rogers, Jr., Director

WQC No. 006377

Docusign Envelope ID: 5F6E5600-7087-467B-8136-444560A9BEDA

JOSH STEIN
Governor
D. REID WILSON
Secretary
RICHARD E. ROGERS, JR.
Director

NORTH CAROLINA
Environmental Quality

June 24, 2025

Mr. Michael Turchy
North Carolina Department of Transportation
1598 Mail Service Center
Raleigh, North Carolina, 27699-1598

Subject: Modification to the 401 Water Quality Certification Pursuant to Section 401 of the Federal Clean Water Act with ADDITIONAL CONDITIONS for Proposed I-26 Asheville Connector (I-2513) in Buncombe County, Federal Aid Project No. NHF-26-I(53), TIP No. I-2513
NCDWR Project No. 20231008 v. 2

Dear Mr. Turchy:

Attached hereto is a modification of Certification No. 006377 issued to The North Carolina Department of Transportation (NCDOT) dated October 30, 2023.

If we can be of further assistance, do not hesitate to contact us.

Sincerely,

Signed by:
Susan Locklear
375CAE2BB9F540C...
Richard E. Rogers, Jr., Director
Division of Water Resources

Electronic copy only distribution:
Lori Beckwith, US Army Corps of Engineers, Asheville Regulatory Field Office
Mike Sanderson, Division 14 Environmental Officer
Jeff Hemphill, NC Department of Transportation
Amanetta Somerville, US Environmental Protection Agency
Holland Youngman, US Fish and Wildlife Service
Dave McHenry, NC Wildlife Resources Commission
File Copy

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Modification to the 401 Water Quality Certification Pursuant to Section 401 of the Federal Clean Water Act with ADDITIONAL CONDITIONS

THIS CERTIFICATION is issued in conformity with the requirements of Section 401 Public Laws 92-500 and 95-217 of the United States and subject to the North Carolina Division of Water Resources (NCDWR) Regulations in 15 NCAC 2H .0500. This certification authorizes the NCDOT to impact an additional 2,300 linear feet of jurisdictional streams in Buncombe County. The project shall be constructed pursuant to the modification received May 27, 2025. The authorized additional impacts are as described below:

Additional Stream Impacts in the French Broad River Basin

Site	Temporary Fill for Geotechnical Boring in Perennial Stream (linear ft)	Total Stream Impact (linear feet)	Stream Impacts Requiring Mitigation (linear ft)
Section BD	2,300	2,300	0
TOTAL:	2,300	2,300	0

Total Temporary Stream Impact for Section BD: 2,300 linear feet

The application provides adequate assurance that the discharge of fill material into the waters of the French Broad River Basin in conjunction with the proposed development will not result in a violation of applicable Water Quality Standards and discharge guidelines. Therefore, the State of North Carolina certifies that this activity will not violate the applicable portions of Sections 301, 302, 303, 306, 307 of PL 92-500 and PL 95-217 if conducted in accordance with the application and conditions hereinafter set forth.

This approval is only valid for the purpose and design that you submitted in your modified application dated received May 27, 2025. All the authorized activities and conditions of certification associated with the original Water Quality Certification dated October 30, 2023 still apply except where superseded by this certification. Should your project change, you are required to notify the NCDWR and submit a new application. If the property is sold, the new owner must be given a copy of this Certification and approval letter, and is thereby responsible for complying with all the conditions. If any additional wetland impacts, or stream impacts, for this project (now or in the future) exceed one acre or 150 linear feet, respectively, additional compensatory mitigation may be required as described in 15A NCAC 2H .0506 (h) (6) and (7). For this approval to remain valid, you are required to comply with all the conditions listed below. In addition, you should obtain all other federal, state or local permits before proceeding with your project including (but not limited to) Sediment and Erosion control, Coastal Stormwater, Non-discharge and Water Supply watershed regulations. This Certification shall expire on the same day as the expiration date of the corresponding Corps of Engineers Permit.

Condition(s) of Certification:

Project Specific Conditions

1. This modification is applicable only to the additional proposed activities. All of the authorized activities and conditions of certification associated with the original Water Quality Certification dated October 30, 2023, still apply except where superseded by this certification.

2. Heavy equipment necessary for geotechnical boring in the French Broad River may be operated within the river channel; however, its usage shall be minimized. In accordance with your application, drill rigs shall follow the planned path as depicted in the *French Broad River Path* figure included in the application; drill rigs shall be mounted to large-diameter rubber-tire all terrain carriers with low-pressure tires to minimize contact pressures with the riverbed; drilling shall be performed during low water levels within the river (approximately 2 feet); and drill rigs shall be moved to the adjacent floodplain during the night. [15A NCAC 02H.0506(b)(3)]

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3. The turbidity standard of 50 NTUs (Nephelometric Turbidity Units) shall not be exceeded as described in 15 A NCAC 02B .0200. Appropriate sediment and erosion control practices must be used to meet this standard. [15A NCAC 02B .0211 (21)]

4. In accordance with your application, NCDOT shall protect recreational river user safety in the project area through the following protocol: move drill rigs to the floodplain for storage during overnight hours; utilize orange and white mooring buoys in the water immediately around the drill rigs as a safety area that river users will need to avoid; position workers in the water in waders adjacent to drilling equipment to communicate to river users; and maintain a River User Page as a resource for recreational users. [15A NCAC 02H .0506 (b)(1) and (2); 15A NCAC 02H .0507 (c)]

Violations of any condition herein set forth may result in revocation of this Certification and may result in criminal and/or civil penalties. This Certification shall become null and void unless the above conditions are made conditions of the Federal 404 and/or Coastal Area Management Act Permit. This Certification shall expire upon the expiration of the 404 or CAMA permit.

If you wish to contest any statement in the attached Certification you must file a petition for an administrative hearing. You may obtain the petition form from the office of Administrative hearings. You must file the petition with the office of Administrative Hearings within sixty (60) days of receipt of this notice. A petition is considered filed when it is received in the office of Administrative Hearings during normal office hours. The Office of Administrative Hearings accepts filings Monday through Friday between the hours of 8:00am and 5:00pm, except for official state holidays. The original and one (1) copy of the petition must be filed with the Office of Administrative Hearings.

The petition may be faxed-provided the original and one copy of the document is received by the Office of Administrative Hearings within five (5) business days following the faxed transmission.
The mailing address for the Office of Administrative Hearings is:

Office of Administrative Hearings
6714 Mail Service Center
Raleigh, NC 27699-6714
Telephone: (919) 431-3000, Facsimile: (919) 431-3100

A copy of the petition must also be served on DEQ as follows:

Mr. Bill F. Lane, General Counsel
Department of Environmental Quality
1601 Mail Service Center

This the 24th day of June 2025

DIVISION OF WATER RESOURCES

Signed by:
Susan Locklear
375CAE2BB9F540C...
Richard E. Rogers, Jr., Director

WQC No. 006377

Docusign Envelope ID: B135FB3C-5D6A-4714-B7FF-81ADCA45219A

JOSH STEIN
Governor
D. REID WILSON
Secretary
RICHARD E. ROGERS, JR.
Director

NORTH CAROLINA
Environmental Quality

October 9, 2025

Mr. Michael Turchy
North Carolina Department of Transportation
1598 Mail Service Center
Raleigh, North Carolina, 27699-1598

Subject: Modification to the 401 Water Quality Certification Pursuant to Section 401 of the Federal Clean Water Act with ADDITIONAL CONDITIONS for Proposed I-26 Asheville Connector (I-2513) in Buncombe County, Federal Aid Project No. NHF-26-I(53), TIP No. I-2513
NCDWR Project No. 20231008 v. 3

Dear Mr. Turchy:

Attached hereto is a modification of Certification No. 006377 issued to The North Carolina Department of Transportation (NCDOT) dated October 30, 2023, and subsequently modified on June 24, 2025, and October 9, 2025.

If we can be of further assistance, do not hesitate to contact us.

Sincerely,

Signed by:
Faith Hardin
3185423092EA45E...
Faith Hardin, Supervisor
401 & Buffer Transportation Permitting Branch

Electronic copy only distribution:
Lori Beckwith, US Army Corps of Engineers, Asheville Regulatory Field Office
Mike Sanderson, Division 14 Environmental Officer
Jeff Hemphill, NC Department of Transportation
Amanetta Somerville, US Environmental Protection Agency
Holland Youngman, US Fish and Wildlife Service
Dave McHenry, NC Wildlife Resources Commission
File Copy

Docusign Envelope ID: B135FB3C-5D6A-4714-B7FF-81ADCA45219A

Modification to the 401 Water Quality Certification Pursuant to Section 401 of the Federal Clean Water Act with ADDITIONAL CONDITIONS

THIS CERTIFICATION is issued in conformity with the requirements of Section 401 Public Laws 92-500 and 95-217 of the United States and subject to the North Carolina Division of Water Resources (NCDWR) Regulations in 15 NCAC 2H .0500. This certification authorizes the NCDOT to impact an additional 80 linear feet of jurisdictional streams in Buncombe County. The project shall be constructed pursuant to the modification received October 7, 2025. The authorized additional impacts are as described below:

Additional Stream Impacts in the French Broad River Basin

Site	Permanent Fill in Intermittent Stream (linear feet)	Temporary Fill in Intermittent Stream (linear feet)	Permanent Fill in Perennial Stream (linear feet)	Temporary Fill in Perennial Stream (linear feet)	Total Stream Impact (linear feet)	Stream Impacts Requiring Mitigation (linear feet)
Original approved impacts at Site 2	0	0	191	10	201	0
New additional impacts with this approval at Site 2	0	0	0	80	80	0
TOTAL:	**0**	**0**	**191**	**90**	**281**	**0**

Total Stream Impact for (Site/Modification): 80 linear feet of temporary.

The application provides adequate assurance that the discharge of fill material into the waters of the French Broad River Basin in conjunction with the proposed development will not result in a violation of applicable Water Quality Standards and discharge guidelines. Therefore, the State of North Carolina certifies that this activity will not violate the applicable portions of Sections 301, 302, 303, 306, 307 of PL 92-500 and PL 95-217 if conducted in accordance with the application and conditions hereinafter set forth.

This approval is only valid for the purpose and design that you submitted in your modified application dated received October 7, 2025. All the authorized activities and conditions of certification associated with the original Water Quality Certification dated October 30, 2023, still apply except where superseded by this certification. Should your project change, you are required to notify the NCDWR and submit a new application. If the property is sold, the new owner must be given a copy of this Certification and approval letter, and is thereby responsible for complying with all the conditions. If any additional wetland impacts, or stream impacts, for this project (now or in the future) exceed one acre or 150 linear feet, respectively, additional compensatory mitigation may be required as described in 15A NCAC 2H .0506 (h) (6) and (7). For this approval to remain valid, you are required to comply with all the conditions listed below. In addition, you should obtain all other federal, state or local permits before proceeding with your project including (but not limited to) Sediment and Erosion control, Coastal Stormwater, Non-discharge and Water Supply watershed regulations. This Certification shall expire on the same day as the expiration date of the corresponding Corps of Engineers Permit.

Condition(s) of Certification:

1. This modification is applicable only to the additional proposed activities. All of the authorized activities and conditions of certification associated with the original Water Quality Certification dated October 30, 2023, and subsequent modification dated June 24, 2025, still apply except where superseded by this certification.

Violations of any condition herein set forth may result in revocation of this Certification and may result in criminal and/or civil penalties. This Certification shall become null and void unless the above conditions are made conditions of the Federal 404. This Certification shall expire upon the expiration of the 404.

Docusign Envelope ID: B135FB3C-5D6A-4714-B7FF-81ADCA45219A

If you wish to contest any statement in the attached Certification you must file a petition for an administrative hearing. You may obtain the petition form from the office of Administrative hearings. You must file the petition with the office of Administrative Hearings within sixty (60) days of receipt of this notice. A petition is considered filed when it is received in the office of Administrative Hearings during normal office hours. The Office of Administrative Hearings accepts filings Monday through Friday between the hours of 8:00am and 5:00pm, except for official state holidays. The original and one (1) copy of the petition must be filed with the Office of Administrative Hearings.

The petition may be faxed-provided the original and one copy of the document is received by the Office of Administrative Hearings within five (5) business days following the faxed transmission.
The mailing address for the Office of Administrative Hearings is:

Office of Administrative Hearings
6714 Mail Service Center
Raleigh, NC 27699-6714
Telephone: (919) 431-3000, Facsimile: (919) 431-3100

A copy of the petition must also be served on DEQ as follows:

Dan Hirschman, General Counsel
Department of Environmental Quality
1601 Mail Service Center
Raleigh, NC 27699-1601

This, the 9th day of October 2025

Signed by:
Faith Hardin
3185423002EA45E...
Faith Hardin, Supervisor
401 & Buffer Transportation Permitting Branch

WQC No. 006377

Docusign Envelope ID: B135FB3C-5D6A-4714-B7FF-81ADCA45219A

ROY COOPER
Governor
ELIZABETH S. BISER
Secretary
RICHARD E. ROGERS, JR.
Director

NORTH CAROLINA
Environmental Quality

NCDWR Project No.: _____ **County:** _____

Applicant: _____

Project Name: _____

Date of Issuance of 401 Water Quality Certification: _____

Certificate of Completion
Upon completion of all work approved within the 401 Water Quality Certification or applicable Buffer Rules, and any subsequent modifications, the applicant is required to return this certificate to the 401 Transportation Permitting Unit, North Carolina Division of Water Resources, 1617 Mail Service Center, Raleigh, NC, 27699-1617. This form may be returned to NCDWR by the applicant, the applicant's authorized agent, **or** the project engineer. It is not necessary to send certificates from all of these.

Applicant's Certification

I, _____, hereby state that, to the best of my abilities, due care and diligence was used in the observation of the construction such that the construction was observed to be built within substantial compliance and intent of the 401 Water Quality Certification and Buffer Rules, the approved plans and specifications, and other supporting materials.

Signature: _____ Date: _____

Agent's Certification

I, _____, hereby state that, to the best of my abilities, due care and diligence was used in the observation of the construction such that the construction was observed to be built within substantial compliance and intent of the 401 Water Quality Certification and Buffer Rules, the approved plans and specifications, and other supporting materials.

Signature: _____ Date:_____

Engineer's Certification

_____ Partial _____ Final

I, _____, as a duly registered Professional Engineer in the State of North Carolina, having been authorized to observe (periodically, weekly, full time) the construction of the project for the Permittee hereby state that, to the best of my abilities, due care and diligence was used in the observation of the construction such that the construction was observed to be built within substantial compliance and intent of the 401 Water Quality Certification and Buffer Rules, the approved plans and specifications, and other supporting materials.

Signature _____ Registration No. _____
Date _____

FW: [External] Final I-2513 Connector Biological Opinion

Cox, Marissa R <mrcox@ncdot.gov>

Tue 6/23/2020 9:55 AM

To: Hemphill, Jeffrey L <jhemphill@ncdot.gov>
Cc: Moore, Kevin E <kemoore2@ncdot.gov>; Turchy, Michael A <maturchy@ncdot.gov>

2 attachments

BO_I-2513_Connector FINAL.pdf; I-2513 BO Appendices.pdf;

Jeff,
I finally got the BO for I-2513. Literally completed a final T&C with Claire on her last day. There was some new informa on provided to us (her and I) after I submi ed the BA related to plans by AVL related to the Bowen Bridge that needed to be addressed in the BO that were not in the BA. I have included Michael on this email. Let me know if you guys want/need to discuss anything.
M

From: Mizzi, Janet <janet_mizzi@fws.gov>
Sent: Friday, June 19, 2020 3:49 PM
To: Felix Davila Felix.Davila <Felix.Davila@dot.gov> (Felix.Davila@dot.gov) <Felix.Davila@dot.gov>; Cox, Marissa R <mrcox@ncdot.gov>; Knepp, Cheryl L <clknepp@ncdot.gov>; Coleman, Clarence (FHWA) <Clarence.Coleman@dot.gov>; Weaver, Derrick G <dweaver@ncdot.gov>; Mckinney, Randall J <rmckinney@ncdot.gov>
Cc: Ellwanger, Claire F <claire_ellwanger@fws.gov>; Peeples, Gary <gary_peeples@fws.gov>
Subject: [External] Final I-2513 Connector Biological Opinion

Felix et al., attached is our final BO and appendices for the subject project. I understand there are a number of things that we will continue to coordinate on concerning this project so please keep me on your email string until we are able to fill behind Claire, whose last day with the FWS was today. Thank you all for your diligence.

Janet Mizzi
Field Supervisor
Asheville Field Office
U.S. Fish and Wildlife Service
160 Zillicoa St.
Asheville, NC 28801
Cell: 828-215-1741
Office: 828-258-3939 x42223

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

FWS Log # 02-252

Prepared by:
U.S. Fish and Wildlife Service
Asheville Ecological Services Field Office
160 Zillicoa St.
Asheville, NC 28801

JANET MIZZI

Digitally signed by JANET MIZZI
Date: 2020.06.19 15:17:47 -04'00'

Janet Mizzi, Field Supervisor

Date

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CONSULTATION HISTORY

The I-26 Connector was first funded in 1989 by the Trust Fund Act and added to the N.C. Department of Transportation (NCDOT) State Transportation Improvement Plan (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 Connector (I-2513). 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 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, elimination of another alternative to Section B of the project, and refinement of many of the technical studies supporting the DEIS, FHWA, and NCDOT determined that it was necessary to rescind the 2008 DEIS and prepare a new DEIS incorporating the most current information 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-2513 were re-initiated in spring 2012. AECOM, Inc. (AECOM) was tasked with preparing the DEIS and subsequent Final Environmental Impact Statement (FEIS). Designs were further modified, and the 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 was signed January 09, 2020.

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.

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

- June 8, 1993: U.S. Fish and Wildlife Service (USFWS) submitted written comments to NCDOT for the Asheville Urban Area Pilot Project, which included the I-2513 project.
- May 17, 1994: USFWS submitted written comments to NCDOT for the Asheville Urban Area Pilot Project, which included the I-2513 project.

- In 1995, NCDOT published the final Phase I Environmental Analysis – Asheville Urban Area (NCDOT 1995). This publication contained a preferred corridor for I-2513. The USACE 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, 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-2513. 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 rescind the 2008 DEIS and prepare a new DEIS to incorporate 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 updates and began 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 North Carolina. The possibility of a programmatic consultation for all NCDOT projects within the French Broad Watershed was 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, Indiana State University (ISU, See Section 2.3.7.3 for details), 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 – Concurrence Point 4a (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.
- July 25, 2018: Biological Assessment and Bridge Construction Meeting with USFWS, FHWA, USACE, NCDOT, CALYX/NV5, and Three Oaks. Reviewed NCDOT's potential project commitments.
- 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, 2019: Call with AECOM, CALYX/NV5, NCDOT, USFWS to discuss plan for 2019 acoustic surveys.
- March 7/8, 2019: Series of emails exchanged between USFWS, CALYX/NV5, and NCDOT finalizing the details of acoustic surveys for 2018.
- March 8, 2019: Call between NCDOT and USFWS to discuss acoustic surveys. Decision was made to collect acoustic data at all monitoring locations through the fall, until 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
- October 24, 2019: NCDOT provided the Final BA to USFWS
- March 2, 2020: USFWS provided the Draft Biological Opinion to NCDOT and FHWA
- March 11, 2020: FHWA provided comments to the USFWS
- April 15 2020: NCDOT provided comments to the USFWS
- April 24, 2020: NCDOT and USFWS discussed all BO draft comments
- April 29, 2020: USFWS provided new additions for review by FHWA and NCDOT
- May 5 & May 7, 2020: USFWS received comments from FHWA and NCDOT, respectively
- May 15, 2020: USFWS provided a revised Term and Condition for Bowen Bridge lighting to FHWA and NCDOT for comment
- June 16, 2020: USFWS and NCDOT finished Bowen Bridge Term and Condition revision discussions
- June 19, 2020: USFWS provided the Final Biological Opinion to NCDOT & FHWA

BIOLOGICAL OPINION

1. INTRODUCTION

The Federal Highway Administration (FHWA) and the North Carolina Department of Transportation (NCDOT) propose 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 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 of Appendix A).

Project construction is anticipated to begin approximately 2 months after the contract is let (finalized), and will continue for approximately 60 months (5 years). This Biological Opinion considers the effects of the Action on the Appalachian elktoe (*Alasmidonta raveneliana)* and the gray bat (*Myotis grisescens,* MYGR).

2. DESCRIPTION OF THE PROPOSED ACTION

2.1 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 by the Proposed Action. Under section 7(a)(2) of the Act and the recent update to the regulations, effective October 28, 2019, "effects of the action" to be analyzed in this Biological Opinion (BO) are all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed 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 by project activities. For example, noise and vibrations from project activities could potentially result in effects in immediately adjacent areas.

The project Action Area (Figure 5 of Appendix A) is primarily based on the Final Environmental Impact Study (FEIS) area (NCDOT 2020), 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 FEIS 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 BO submittal. Additional easements may be required for drainage, utilities, and construction.

2.2 Proposed Action

2.2.1 General Information

The I-2513 project will provide a 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 miles; 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, including 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 FEIS 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 FEIS (NCDOT 2020) 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 1 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.

It is anticipated that a portion or the entire project will be awarded as a Design-Build project. This method of project delivery can accelerate a project, in several ways. A Design-Build Team (DBT) is comprised of a Contractor and a design firm. The Contractor works closely with the designer, sharing his or her construction expertise, to reduce the need for redesigns based on constructability issues, 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 (CM)) that pertain to the species discussed in this document are listed in Section 7.0 (Conservation Measures). The DBT 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. The term "Contractor" shall be understood to mean Bid Build Contractor or Design-Build Team in this document.

2.2.2 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, has been identified as a roost for MYGR. Special precautions will be taken to reduce disruption to the bats, particularly during the spring, summer, and fall months (Section 2.3.1). 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 (Section 2.3.7).

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 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 three to four years and may occur during the day or night.

Two 63-in. CMAPs 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 streamflow 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 the culvert. During this process, a liner (possibly steel, plastic, or a few other types) which is a smaller diameter pipe, is pushed through an existing pipe and the end of the pipe is sealed in-between the liner and the existing pipe. Next, 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. 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.

Construction activities associated with areas other than the CMAP outlets, RCBC, and 60" CMP may occur at any time of year.

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 when bats are hibernating elsewhere and may take up to one month to complete.

To perform the required work to the CMAP, RCBC, and 60" CMP the Contractor shall access the hydraulic structures as follows:

- Clean and apply patching to the CMAP and RCBC - equipment must access the culvert outlets.
- Replace or insert the liner to the 60" CMP - equipment must access the inlet of the 60" CMP.

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 be established adjacent to the work pads near the culvert outlets and inlet areas to complete the culvert rehabilitation. NDOT will attempt to use areas 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 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.

2.2.3 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 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 carrying Smith Mill Creek under the ramps is 330 ft. long, the middle section is 140 ft. long, and the downstream-most section carrying 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.

2.2.4 Bridge Replacements

Seven bridges (or bridge pairs) over waterways will be replaced as part of the project. Table 1 provides information on all 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 locations are discussed in Section 2.1.3. Bridge demolition and construction of replacement bridges may take up to five years.

Table 1. Bridge Replacement and New Construction 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

2.2.4.1 French Broad River

The two existing bridges carrying 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 2.2.5.6).

2.2.4.2 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).

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, 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, Appendix A) 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 F, Bridge Construction Document.

2.2.4.3 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 2.2.6) will also be removed.

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.

2.2.5 New Construction Bridges

Multiple new bridges over waterways are necessary as part of the project. Table 1 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 2.2.4.

2.2.5.1 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 mile long and 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.

2.2.5.2 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.

2.2.5.3 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 1 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.

2.2.5.4 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.

2.2.5.5 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, but will not be continuous. 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.

2.2.5.6 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 38% of the river width at FBR-2 and FBR-3, and up to 26% at FBR-4 (Table 5). Each location will require 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 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 crossing 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.

2.2.6 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.

2.2.7 Culverts

According to the CP4A merger packet (NCDOT 2019, 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 (NCDOT 2019, 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.

2.2.8 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 accidental 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.

2.2.9 Lighting

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.

2.2.9.1 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 traveling public. Additional information about NCDOT lighting standards, and existing light conditions are provided below and in Appendix J (Lighting Summary).

2.2.9.2 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. Generally, the higher the lumen rating, the brighter the lamp will appear.

2.2.9.3 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 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.

2.2.9.4 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 J (Lighting Summary) describes the existing lighting conditions, initial

conceptual designs, and proposed (or "mitigation") designs for the I-2513 project. USFWS will be given the 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 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, which could impact MYGR, 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. However, MYGR are light averse (See Section 3.1.3), and this design was made without considering the potential impact of light on the species. The most effective way to reduce the amount of light cast onto the river and the culvert outlet while still providing adequate lighting for the driving public is to 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 this 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 two and a half times 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 J (Lighting Summary), due to the distances from the culvert and the existing vegetation, the existing 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.

2.2.10 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, agencies, and other interested parties 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.

2.2.11 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.

2.2.12 Highway Operations

Once I-2513 is widened and in operation, the additional capacity may allow for an increase in the number of vehicles travelling 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.

2.2.13 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.

2.3 CONSERVATION MEASURES

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

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.

2.3.1 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.

2.3.1.1 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.

2.3.1.2 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.

2.3.1.3 Additional Commitments

- An equipment staging area will 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 baseflow to the RCBC and CMAP portion of 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 (from here referred to as a 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.

2.3.2 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

2.3.2.1 Preservation of Riparian Vegetation

- NCDOT will ensure the Contractor preserves riparian buffer trees where practicable and feasible.

2.3.2.2 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.

2.3.3. 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

2.3.3.1 Access Roads

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

2.3.3.2 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 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 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.

2.3.3.3 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. See Term and Condition 12 for checks specific to culverts.
- 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.

2.3.3.4 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.

2.3.4 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.

2.3.4.1 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.

2.3.4.2 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.
- 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 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.

2.3.4.3 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 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.

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

2.3.5.1 Erosion Control Measures

- The Soil and Erosion Control (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).

2.3.5.2 Agency Coordination (Post-Biological Opinion Checkpoints)

NCDOT Requirements

- 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.
- NCDOT will provide USFWS with the final roadway lighting plans and allow 15 days for review upon acknowledgement of receipt of notice.
- 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.

- 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.
- Once ROW plans are developed where vegetation will be removed in riparian areas, NCDOT will meet with USFWS and NCWRC to discuss re-vegetation plans with the goal of establishing native forested buffers in all impacted areas (Hominy Creek, Smith Mill Creek, Emma Branch, and the French Broad River). NCDOT, USFWS and NCWRC will also discuss re-vegetation for acquired riparian ROW that was not forested when purchased. Additionally, NCDOT will coordinate with USFWS and NCWRC to develop a revegetation and invasive species management plan for these areas.

Bid Build Contractor Requirements

- The Bid Build Contractor shall meet with NCDOT personnel and USFWS and regulatory agency representatives immediately after contract execution to review the project and project commitments. At this time, the USFWS shall be afforded the opportunity to meet with key Bid Build Contractor members and NCDOT employees to provide education on the effects of artificial lighting, noise, and construction on nearby wildlife habitat and behavior. The Bid Build Contractor shall coordinate with the NCDOT Environmental Analysis Unit to schedule these meetings. This meeting shall be made prior to submitting any required permit modification application.
- The Bid Build Contractor shall provide USFWS with the construction phasing plan for each bridge.
- The Bid Build Contractor and / or NCDOT shall contact USFWS if new information about MYGR is discovered, as it relates to the project.
- The Bid Build Contractor shall report any dead bats found on the construction sites to USFWS.
- The Bid Build Contractor shall adhere to project commitments within the ROD and the Biological Opinion relating to Section 7 of the Endangered Species Act.

Design-Build Team Requirements

- NCDOT will arrange a meeting between each shortlisted DBT, representatives of the USFWS, and other 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 (DBT) to provide an opportunity for USFWS to convey their concern about potential effects to protected species. The DBT shall meet with NCDOT personnel and USFWS and regulatory agency representatives immediately after contract execution to review the project and project commitments. At this time, the USFWS shall be afforded the opportunity to meet with key DBT 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 Unit shall coordinate with the DBT and the NCDOT Environmental Analysis Unit to schedule this meeting. This meeting shall be made prior to submitting the permit application. This is prior to the standard pre-con environmental meeting.

- The DBT shall adhere to project commitments within the ROD and the Biological Opinion relating to Section 7 of the Endangered Species Act. The DBT will be required to prepare information 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 DBT 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 DBT shall 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 DBT shall provide USFWS with the sediment and erosion control plan and allow 15 days for review upon acknowledgement of receipt of notice.
- The DBT shall 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 DBT shall provide USFWS with the construction phasing plan for each bridge.
- The DBT and / or NCDOT shall contact USFWS if new information about MYGR is discovered, as it relates to the project.
- The DBT shall report any dead bats found on the construction sites to USFWS.
- The DBT shall include an Environmental Coordinator as a member of their Team who will be required to attend all design, merger, and preconstruction meetings, and who will consult bat and mussel experts, as needed.
- Once ROW plans are developed where vegetation will be removed in riparian areas, NCDOT will meet with USFWS and NCWRC to discuss re-vegetation plans with the goal of establishing native forested buffers in all impacted areas (Hominy Creek, Smith Mill Creek, Emma Branch, and the French Broad River). NCDOT, USFWS and NCWRC will also discuss re-vegetation for acquired riparian ROW that was not forested when purchased. Additionally, NCDOT will coordinate with USFWS and NCWRC to develop a revegetation and invasive species management plan for these areas. Certain ROW areas will not be forested because they must be mowed or maintained at a low height for safety purposes.

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

2.3.6.1 Stormwater Control Measures

- NCDOT's stormwater commitment guidance, will apply at crossings of the French Broad River and its tributaries, and any portion of the NCDOT stormwater conveyance system draining to those waters within the right-of-way.
- NCDOT will prepare a stormwater management plan (SMP) to implement post-construction stormwater best management practices (BMPs) to the maximum extent practical, 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, 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 a feasible BMP.
- NCDOT will commit to evaluating the use of emerging BMP technologies that the Department has not yet published in its BMP Toolbox:
  - 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.

2.3.6.2 Permanent Lighting

(Crossing numbers in this section refer to Table 1 in Section 2.2.4 and Figures 4A-4D in Appendix A).

- General CM's for the entire project:
  - Use shorter poles, providing an overall LED light fixture mounting height of 35' above the pavement surface.
  - Use LED light fixtures with a more rectangular light pattern as well as house side shields to minimize lighting outside of the pavement area.
  - Use LED light fixtures with a BUG rating of 1-0-3 or less
  - Change the design standards to meet the AASHTO minimum requirements of an average 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 design near Southern States property results in zero calculated change to 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 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. The crossing is still centered between the Cooper fixtures, as it was for the GE 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 - Cooper fixtures located so the crossings are centered as best as possible between fixtures where the light level is the lowest.
- SMC culvert area – Existing high mast pole located within the interchange ramps will be removed.

2.3.7 Conservation Measures to Benefit Gray Bat

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

2.3.7.1 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 help 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 at a minimum 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. Please refer to Term and Condition 10 for clarification.

2.3.7.2 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 roostiwillng 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.

2.3.7.3 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 fund Indiana State University $900,000 to conduct the research project, 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.

2.3.7.4 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.

2.3.7.5 Gray Bat Conservation Funding

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

2.3.7.6 Installation of Temporary Bat Roost Panels on Bridges

- In their BA, NCDOT committed to temporarily installing modern bat roost panels or comparable structures on four bridges within the French Broad River basin that were currently or had recently been used by roosting bats. **However, NCDOT, FHWA, and USFWS have come to a new agreement, described below.**

- NCDOT will provide modern bat roost panels or comparable structures that could serve as a temporary alternate roost for bats potentially disturbed by work on the culvert roost for the duration of construction of the I-2513 project. This will be in the place of the panels on four bridges NCDOT has committed to in the BA, which were to be placed on bridges with documented signs of bat use. These bridges are all relatively far from the Hill Street Culvert roost. The USFWS believes that panels placed on one bridge close to the Hill Street Culvert roost has greater potential to minimize take than panels placed on four bridges farther away (Reasonable and Prudent Measure 3). Refer to Term and Condition 9 for more details.

2.3.8 Conservation Measures to Benefit Appalachian Elktoe

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

2.3.8.1 Appalachian Elktoe Conservation Funding

- NCDOT will provide $500,000 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 locate mussels; radio tracking equipment to study movement of mussels during high flow; 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.

2.3.8.2 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.

3. STATUS OF THE SPECIES

3.1 GRAY BAT

This section summarizes best available data about the biology and current condition of the gray bat (*Myotis grisescens* - gray bat) throughout its range that are relevant to formulating an opinion about the Action. The USFWS published its decision to list the gray bat as endangered on April 28, 1976. There is no designated critical habitat for this species.

3.1.1 Species Description and Life History

The gray bat is one of the largest species in the genus *Myotis* in eastern North America, with a forearm length of 40 to 46 millimeters, a weight of 7 to 16 grams (usually 8 to 11 grams), and a wingspan of 27.4 to 30 centimeters (Barbour and Davis 1969). Gray bats 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 the wing membrane, which is also gray, connects to the foot at the ankle rather than the base of the toes (Barbour and Davis 1969, Gore 1992). The nails on the feet are notched and the calcar is unkeeled (Harvey *et al.* 1981, Sealander 1979).

The primary range of the gray bat is concentrated in the cave regions of Alabama, Arkansas, Kentucky, Missouri and Tennessee, with smaller populations found in adjacent states, including a growing population in a quarry in Clark County, Indiana (Harvey *et al*. 1981, Brack *et al*. 1984, Harvey 1992, Harvey 1994, Mitchell 1998). Gray bats are one of the few species of bats in North America inhabiting caves year-round. The species occupies cold caves or mines in winter and warmer caves during summer (Tuttle 1976a, Harvey *et al*. 1981, Harvey 1994, Martin 2007). In winter, gray bats hibernate in deep vertical caves that trap large volumes of cold air and the species typically forms large clusters with some aggregations numbering in the hundreds of thousands of individuals (Harvey 1994, Tuttle and Kennedy 2005). The species chooses hibernation sites where there are often multiple entrances, good air flow (Martin 2007) and where temperatures are approximately 5°-9° C, though 1°-4° C appears to be preferred (Tuttle and Kennedy 2005). Tuttle (1979) noted that an estimated 95% of the range-wide population was confined to only nine hibernacula.

There are some exceptions to this cave-specific roosting strategy. Many bat species use bridges as roost sites (Keeley and Tuttle 1999) and the gray bat is no exception. Bridges provide a warm refuge for individuals either foraging far from their primary daytime roosts or can serve as primary roosts during summer months. Gray bat bachelor and maternity colonies have been found in 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). We are continually expanding our knowledge of where gray bats can roost, and bridge and culvert roosts are more common than previously thought.

Gray bats show strong philopatry to both summering and wintering sites (Tuttle 1976a, Tuttle 1979, Tuttle and Kennedy 2005, Martin 2007). Because of their highly specific roost and habitat requirements, only about 5% of available caves are suitable for occupancy by gray bats (Tuttle 1979, Harvey 1994). At all seasons, males and yearling females seem less restricted to specific cave and roost types (Tuttle 1976b). Bachelor males segregate in separate aggregations within a colony home range that usually includes several caves that may extend up to 70 kilometers along a particular river valley (Tuttle and Kennedy 2005).

Gray bat hibernacula are often comprised of individuals from large areas of summer range.

Based on band recovery data, Hall and Wilson (1966) calculated that a gray bat hibernaculum in Edmonson, County Kentucky attracted individuals from an area encompassing 27,195 square kilometers in Kentucky, southern Illinois, and northern Tennessee (Hall and Wilson 1966). Gray bats are documented to regularly migrate from 17 to 437 kilometers between summer maternity sites and winter hibernacula (Tuttle 1976b, Hall and Wilson 1966), with some individuals moving as much as 689 to 775 kilometers (Tuttle 1976b, Tuttle and Kennedy 2005).

Gray bats are reproductively mature at two years of age (Miller 1939, Tuttle 1976a) and mate 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 spring emergence (Krulin and Sealander 1972). After a gestation period of 60 to 70 days (Saugey 1978), females give birth to one pup between late May and early June. Newborn young weigh approximately one-third of their mother's weight and are volant within 21-33 days (Tuttle 1976b, Harvey 1994, Tuttle and Kennedy 2005).

In summer, female gray bats form maternity colonies of a few hundred to many thousands of individuals. Nursery colonies typically form on domed ceilings of caves that are capable of trapping the combined body heat from clustered individuals and where the temperature ranges between 14° and 25° C (Harvey 1992, Harvey 1994, Tuttle and Kennedy 2005 and Martin 2007). All other individuals not actively mating, both male and female, occupy caves on the outlying edge of the home range (Tuttle 1976b).

Gray bats feed 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, Clawson 1984, Brack 1985, Lacki *et al*. 1995, Best *et al*. 1997). Diet has been found to coincide most directly with the predominantly available prey species in the foraging area (Clawson 1984, Barclay and Bingham 1994), including both terrestrial and aquatic species (Clawson 1984). A study examining fecal remains conducted by Brack and LaVal (2006) indicates that gray bat diets fluctuate to a minor degree depending upon varying factors such as age, sex, and location.

Gray bat summer foraging is strongly correlated with open water of rivers, streams, lakes or reservoirs, where insects are abundant (Tuttle 1976b, LaVal *et al*. 1977). Results of surveys conducted in Tennessee indicate that wetland depressions are also important foraging sites for gray bats (Lamb 2000). Although the species may travel up to 35 kilometers between prime feeding areas over lakes and rivers and occupied caves, (LaVal *et al*. 1977, Tuttle and Kennedy 2005, Moore *et al*. 2017), most maternity colonies are usually located between 1-4 kilometers from foraging locations (Tuttle 1976b). Newly volant gray bats travel 0.0 – 6.6 kilometers between roost caves and foraging areas (Tuttle 1976a, Tuttle 1976b). At foraging sites, Tuttle (1976b) estimated that gray bats forage within roughly three meters of the water's surface. Abbreviated instances of bad weather in early spring and late fall are generally the only times gray bats deviate from primarily feeding along local bodies of water, and then they are found foraging in forest canopies (LaVal *et al*. 1977, Stevenson and Tuttle 1981).

Gray bats are known to establish foraging territories as insect numbers drop after dusk. Territories are controlled by reproductive females, which annually return to preferred territories (Brady *et al*. 1982, Goebel 1996). Gray bats tend to have large home ranges. Thomas and Best (2000) reported non-reproductive gray bats (males and females) from one northern Alabama cave foraged over areas of approximately 97 square kilometers. Moore *et al.* (2017) found reproductive female gray bats in Arkansas had a larger home range than previously thought, with an average of 159 square kilometers, and they depend on water for foraging and traveling. The home range for reproductive females may change depending on reproductive status, but could also change based on colony size, insect abundance, habitat continuity, land use, or a combination of these factors (Moore *et al.* 2017). During times of limited food resources, males and pre-reproductive females may be excluded from foraging territories (Stevenson and Tuttle 1981).

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, Moore *et al.* 2017). Whenever possible, gray bats of all ages fly in the protection of forest canopy between roosts and feeding areas (USFWS 1982). In addition, young often feed and take shelter in forest areas near the entrance to cave roosts (Tuttle 1979). Individuals may also fly overland 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). Gray bats do not feed in areas along rivers or reservoirs where the forest has been cleared (LaVal *et al.* 1977).

Young, non-volant gray bats experience healthy growth rates because their energy expenditure for thermoregulation is reduced by the roosting colony (Herreid 1963, 1967). In undisturbed colonies, young may take flight within 20 to 25 days after birth. However, young may not become volant for 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 they become volant. Survival and growth of volant young is inversely proportional to the distance travelled for shelter and food (Tuttle 1976a). 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). Distance traveled to feeding areas may also be correlated with adult mortality (Martin 2007).

Gray bats 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 gray bats 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).

3.1.2. Status and Distribution

The gray bat largely occupies a limited geographic range in karst areas of the southeastern United States. They are mainly found in Alabama, northern Arkansas, Kentucky, Missouri, and Tennessee. A few can be found in northwestern Florida, western Georgia, southeastern Kansas,

southern Indiana, southern and southwestern Illinois, northeastern Oklahoma, northeastern Mississippi, western Virginia, and western North Carolina.

In the late 1970s, Tuttle (1979) estimated the total population 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 approximately 10 percent between the 1970's and 2003, and an increase of 40 percent from the smallest population estimate. The status of hibernating populations of gray bats was further reviewed in 2006 (Harvey and Currie 2007). At that time, the population was estimated at 3,377,100 – an estimated increase of 104 percent from 1982 (Harvey and Currie 2007).

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 gray bats 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 gray bat population, now estimated at approximately 4,358,263 (Shauna Marquardt pers. comm.).

3.1.3 Threats

The primary cause of gray bat population decline is human disturbance of their natural habitat (Barbour and Davis 1969, Mohr 1972, Harvey 1975, Tuttle 1979, USFWS 1982, USFWS 2009b), with wintering sites and maternity roosts being especially susceptible to disruption. Commercialization of caves, spelunking, and looting for archaeological artifacts are activities that most commonly result in disturbance to roosting bats (USFWS 1982, USFWS 2009b). 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 gray bats 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, at foraging sites, and along commuting routes is likely to have negative effects due to the removal of prey abundance and reduced cover from natural predators (Tuttle 1979). Recently-volant young are especially susceptible to the effects of deforestation, as they require the protection of forest cover while becoming proficient fliers.

Insecticide use historically had a detrimental impact on gray bat populations (Clark *et al.* 1978, Clark *et al.* 1988), though many of the toxic substances are now banned from the market. The longevity, high metabolic rate, and insectivorous diet of bats increases their likelihood of exposure to bioaccumulating chemicals in the environment. While modern pesticides (e.g., organophosphates, neonicotinoids, pyrethroids, carbonates) aren't expected to bioaccumulate in tissues, they are still a concern, are highly toxic, and may kill bats from direct exposure (Shapiro and Hohmann 2005). The presence of other contaminants of concern that can bioaccumulate (e.g., pharmaceuticals, flame retardants) has been documented in bats (Secord *et al.* 2015), though additional research is needed to understand impacts. Additionally, pesticides and other pollutants could indirectly impact bats by reducing insect populations.

Siltation and nutrient loading of waterways where bats forage and drink may negatively affect the species. As previously stated, a large portion of the gray bat 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 gray bat populations as well (USFWS 1982). Tuttle (1979) presented a correlation between a decline in gray bat numbers and an increase in sedimentation in several Alabama and Tennessee waterways.

Tied to increased waterway siltation is impoundment of streams and rivers to create reservoirs. While it was originally suspected that this practice would increase suitable foraging habitat for gray bats, it was ultimately found that the opposite is true (USFWS 1982). Disturbance to roosting bats using caves adjacent to these impoundments has also been observed. Noise from passing watercraft increased, as did access to cave roosts previously far from population centers and roads (USFWS 1982).

Gray bat populations could also be impacted by temperature and precipitation changes due to climate change. Climate change will likely affect the distribution of suitable hibernacula for bats (Humphries *et al.* 2002). Since gray bats are a cave-obligate species, requiring highly specific hibernacula and maternity caves, they are acutely at risk from fluctuating climate conditions. As temperatures rise, conditions within gray bat hibernacula and maternity caves could change, making them less suitable. In addition, 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). Changes in precipitation is also of concern. Under drought conditions, bats have to travel further distances for food and more rainfall could inhibit insect flight and decrease prey availability. These changes could have particularly adverse effects on nursing females, as the energy costs associated with traveling longer distances for food and water result in longer lactation times, slowing overall juvenile development (Tuttle 1976b, Adams 2010). Furthermore, increased frequency of severe storms could lead to flooding of important roost sites.

Another potential threat to gray bat populations is the fungal disease white-nose syndrome (WNS). The disease is caused by the fungus *Pseudogymnoascus destructans*, which grows on the wings, ears, and muzzle of hibernating 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 millions of 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 day-time flying and increased frequency of arousal during hibernation (Cryan *et al.* 2013).

In 2012, USFWS confirmed the first instance of WNS in gray bats (USFWS 2012b). The full impact of WNS on overall gray bat populations is still being determined. It seems plausible that WNS would pose a serious threat to a species like the gray bat, 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 gray bat colonies as quickly as once expected, nor be as substantial a threat to the species as initially suspected (Flock 2014, USFWS 2012). 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 and sustained activity and foraging throughout winter (Bernard and McCracken 2017) may enable this species to prevent or minimize the colonization of *P. destructans* during torpor.

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.

3.2 APPALACHIAN ELKTOE

This section summarizes best available data about the biology and current condition of Appalachian elktoe (*Alasmidonta raveneliana*) throughout its range that are relevant to formulating an opinion about the Action. The USFWS published its decision to list Appalachian elktoe as endangered on September 3, 1993. There is no designated critical habitat for this species in the Action Area.

3.2.1 Species Description and Life History

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.

The reproductive cycle of the Appalachian elktoe is similar to 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). The Appalachian elktoe is a bradytictic (long-term) breeder, with the females retaining glochidia in their gills from late August to mid-June (USFWS 2009b). Glochidia are released in mid-June, attaching to either the gills or fins of a suitable fish host species. Transformation time for the Appalachian elktoe occurs within 18 to 22 days at a mean temperature of l 8°C. The Appalachian elktoe can use a variety of common fish hosts but appears to specialize on darters and sculpins, which are common in the action area.

3.2.2 Status and Distribution

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).

Although the complete historic range of the Appalachian elktoe is unknown, available information suggests that the species once lived in the majority of the rivers and larger creeks of the upper Tennessee River system in North Carolina, with the possible exception of the Hiwassee and Watauga River systems (the species has not been recorded from either of these river systems). In Tennessee, the species is known only from its present range in the main stem of the Nolichucky River. At the time of listing, two known populations of the Appalachian elktoe existed--the Nolichucky River, including its tributaries (the Cane River and the North Toe River), and the Little Tennessee River and its tributaries. The record in the Cane River was represented by one specimen found just above its confluence with the North Toe River (USFWS 1996). Since listing, the Appalachian elktoe has been found in additional areas. These occurrences include extensions of the known ranges in the Nolichucky River (North Toe River, South Toe River, and Cane River) and the Little Tennessee River (Tuckasegee River and Cheoah River) as well as a rediscovery in the French Broad River basin (Pigeon River, Little River, Mills River, and the main stem of the French Broad River). Many of these newly discovered populations are relatively small in numbers and range.

The Appalachian elktoe has experienced declines in two populations across its range. A sudden die-off in the Little Tennessee River, once considered the largest and most secure population, began in 2005 and continued through 2015, when periodic monitoring efforts failed to find any live individuals. Surveys during 2016 also failed to produce any observation of Appalachian elktoe, but surveys in 2017, 2018 and 2019 produced very low numbers, indicating a remnant population, but the population is limited and only a tiny fraction of its previous size. Appalachian elktoe also have declined in the lower portion of the Nolichucky River. Appalachian elktoe were once common in all three tributaries of the Nolichucky River: North Toe, South Toe and Cane River. In 2008, a fish kill linked to a waste water plant failure resulted in the death of most of the Appalachian elktoe in the Cane River. Beginning in 2013, the Appalachian elktoe population in the lower South Toe River declined steeply. This decline coincided with a major highway construction project and only occurred downstream of receiving streams from construction. Appalachian elktoe are still present in the South Toe River, but at

reduced densities. Appalachian elktoe are still present in the North Toe River, but at low densities. It appears that the North Toe population is limited by urban runoff and mining effects to the river. The other populations of Appalachian elktoe appear to be stable (Tuckasegee, Cheoah, and Pigeon Rivers) or expanding (French Broad River). A remnant population known in the Cheoah River since the early 2000's is presently being augmented by the NCWRC with hatchery-propagated individuals sourced from the Tuckasegee River. This effort appears to be successful in bringing this population back to a viable state. Prior to 2004, the French Broad River population appeared to be confined to two tributary streams (Little River, Mills River), but over the last few years the known range of Appalachian elktoe in the main stem of the French Broad River has expanded and now appears to be well established, albeit at low density, over a broad area.

3.2.3 Threats

The decline of the Appalachian elktoe throughout its historic range has been attributed to a variety of factors, including sedimentation, point and nonpoint-source pollution, and habitat modification (impoundments, channelization etc.). 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 or activity. Catastrophic events may consist of natural events, such as flooding or drought, as well as human influenced events, such as toxic spills associated with highways or railroads.

Natural flooding events combined with alteration of watersheds can lead to large fluctuations in abundance observed in Appalachian elktoe populations. Portions of the French Broad River basin and most of western North Carolina experienced catastrophic flooding in late summer 2004 as a result of Tropical Storms Francis, Ivan, and Jeanne. Numerous dead mussels, including the Appalachian elktoe, were observed in over-wash areas along the Little Tennessee River after the flood events. Additionally, surveys conducted in the Little Tennessee River after the flooding yielded noticeably lower catch per unit effort of live mussels, including the Appalachian elktoe, compared to past survey efforts in this section of the river (USFWS 2009).

Siltation resulting from improper erosion control of various types of land use, including agriculture, forestry, road construction, and development, has been recognized as a major contributing factor to the degradation of mussel populations (USFWS 1996). Siltation has been documented to be extremely detrimental to mussel populations by degrading substrate and water quality, increasing potential exposure to other pollutants, and direct smothering of mussels (Ellis 1936, Marking and Bills 1979). Sediment accumulations of less than an inch have been shown to cause high mortality in most mussel species (Ellis 1936). 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).

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 RM (3.22 km) below points of chlorinated sewage effluent. Most of the water bodies where Appalachian elktoe still exist have relatively few point source discharges within the watershed and are rated as having "good" to "excellent" water quality (NCDWR 2012**,** USFWS 1996).

The introduction of exotic species, such as the Asian clam (*Corbicula fluminea*) and zebra mussel (*Dreissena polymorpha*), has also been shown to pose significant threats to native freshwater mussels. The Asian clam is now established in most of the major river systems in the United States (Fuller and Powell 1973). At the time the Appalachian elktoe was listed, the Asian clam was not known from the stretch of the Little Tennessee River that it occupies; however, it has been observed in the Little Tennessee River in recent years and, as mentioned earlier, may be a contributing factor to the decline of that population. Concern has been raised over competitive interactions for space, food, and oxygen between this species and native mussels, possibly at the juvenile stages (Neves and Widlak 1987). When the Appalachian elktoe was listed, it was speculated that, due to its restricted distribution, it "may not be able to withstand vigorous competition" (USFWS 1996).

Another exotic species that has the potential to adversely impact aquatic species, including Appalachian elktoe, is the Japanese knotweed (*Fallopia japonica*). The plant is considered to be an invasive species that can reproduce from its seed or from its long, stout rhizomes. It can tolerate a variety of conditions, such as full shade, high temperatures, high salinity, and drought. It can be spread by wind, water, and soil movement to an area where it quickly forms dense thickets that exclude native vegetation and greatly alter the natural ecosystem. This species has become established in riparian habitats throughout western North Carolina. The species has a very shallow root system; because of this shallow root system and its preclusion of other vegetation, areas where this species has been established may be susceptible to erosion during flood events.

4. ENVIRONMENTAL BASELINE

Environmental baseline refers to the condition of the listed species or its designated critical habitat in the action area, without the consequences to the listed species or designated critical habitat caused by the proposed action. The environmental baseline includes the past and present impacts of all Federal, State, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of State or private actions which are contemporaneous with the consultation in process. The consequences to listed species or designated critical habitat from ongoing agency activities or existing agency facilities that are not within the agency's discretion to modify are part of the environmental baseline.

4.1 GRAY BAT

4.1.1 Species Status and Distribution in the Action Area

The best available information on the status of the species in and near the action area comes from pre-construction acoustic surveys (10 stations within the action area) and structure checks conducted by Calyx in 2017 and 2018; wider ranging acoustic surveys (12 stations throughout the FBR basin), radio telemetry, and emergence counts conducted during the ISU research project in 2018 and 2019, and telemetry by NCWRC in 2016 and 2017. Additional information on methods and results of these efforts can be found in appendices C and D.

Emergence counts conducted by Indiana State University (ISU) at known roosts in western NC in 2018 and 2019 suggest there are at least 1900–2300 MYGR in the French Broad River basin (USFWS 2019). Data collected during monitoring and research by Calyx and ISU indicate bats arrive on the landscape in March and depart by mid-November. Based on acoustics and emergence counts, gray bat numbers and activity appears to be low early in the season. Based on acoustics, activity levels increase later in the spring and peak in July and August after pups become volant. This makes sense because more individual bats are present on the landscape during this time. Counts at roosts produce large numbers of bats throughout the late spring, summer and fall. Numbers start to drop off in late October (Appendix C).

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) (Appendix C and D). Telemetry data also provided information on bridge and culvert roosts in and near the action area. (Appendix D and Joey Weber pers. com. 2019). A total of 31 roosts have been identified in the FBR basin and three of these occur in the action area: two in culverts and one in a building. One of the culverts (Hill Street culvert) is considered a primary roost (defined as having use by >=200 bats) and the others are secondary roosts. No evidence of bat use was found on any bridges or other culverts in the action area. Roosts within and near the action area are used in the spring, fall and summer (Appendix D). No hibernacula are known from North Carolina.

The Hill Street culvert is located adjacent to the French Broad River and conveys a UT under Riverside Drive. It is a primary roost used by at least 250 bats. For purposes of protection of the resource, the exact location of this structure will not be identified in this report. As described in Section 2.2.3, 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, flow from a perennial stream is present year-round. Unlike other culverts investigated for this project, there does not appear to be regular human activity in the culvert system.

Bats appear to use the Hill Street culvert throughout the spring, summer, and fall. Trapping efforts throughout this time period in 2018 and 2019 resulted in 223 and 117 captures, respectively. Only 12% of captures during 2018-2019 mistnetting efforts were female, whereas 88% were male. Volant juvenile gray bats (23) have been captured in July and August, so it is likely an important roost for young bats. Bats were trapped flying both out of and into the culvert, and bats tagged at the culvert also used other roost sites. During visits to the culvert for trapping and 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). Based on evidence from radio tracking and these observations, it appears the culvert is a significant night roost, in addition to serving as a day roost (Joey Weber, personal communication). A summary of other surveys and bat activity associated with culverts is included in Appendix L.

The other two roosts in the action area are Smith Mill Creek culvert, which carries Smith Mill Creek under Patton Avenue west of the FBR, and a shed located about 100 ft. from the Hill Street culvert. On September 12, 2019, five MYGR were found roosting at the top of the wall in

the Smith Mill Creek culvert, 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. A single adult male was tracked to the building roost in 2019. 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). This roost is also considered a secondary roost.

Radio telemetry tracking studies were conducted by NCWRC in 2016 and 2017, and ISU in 2018 and 2019 (although those data are not yet available) on bats captured at roosts near and within the Action Area. In addition to documenting new roosts, telemetry data provide information on foraging areas and behavior, commuting routes, and movement between roosts. Radio tracked bats commute and forage in and through the Action Area and have also been documented flying to a known hibernacula in Tennessee and to a separate known cave in Tennessee. Biologists have not been given permission to survey this second cave by the property owner, so it is unclear how the cave is used and by how many bats. (NCWRC 2017, Appendix D, Joey Weber, personal communication). Bats have been documented foraging at various locations along the FBR, along Hominy Creek, Bent Creek, Long Valley Lake, and Sandy Bottom Bog. In general, bats appear to forage mainly over water, usually along the French Broad River and associated tributaries. Bats also appear to commute back and forth to foraging areas by flying through the action area, primarily along waterways, but also over land. They clearly move between the various roosts within and near the action area. Use of the FBR and associated tributaries is also supported by acoustic surveys conducted by Calyx and ISU. Within the FBR basin, gray bats have been found roosting on 16 smaller tributaries, one of which was inside the Action Area (Smith Mill Creek). It appears bat activity is highest along the FBR, but larger tributaries also see significant bat activity.

4.1.2 Factors Affecting the Species' Environment in the Action Area

The main factor that could negatively impact gray bats in the Action Area is increasing urbanization. Development directly adjacent to the FBR has fragmented gray bat habitat by removing vegetation and creating more artificially lighted areas that the bats must avoid as they commute from roost areas to forage areas. However, other factors in the Action Area could have a positive impact on the species. Improvements in water quality in the FBR have likely increased the prey base and improved the overall ability of bats to feed over the river.

See the Biological Assessment, Section 4.1, Pg (34 - 38) for detailed baseline watershed conditions.

4.2 APPALACHIAN ELKTOE

4.2.1 Species Status and Distribution in the Action Area

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 E).

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.

4.2.2 Factors Affecting the Species' Environment in the Action Area

French Broad River water quality in the Action Area historically suffered from industrial and agricultural pollution. Beginning in the 1970's, efforts were begun to reduce pollution and sediment entering the River. While the FBR is much cleaner today than in the past century, there are still threats from ongoing development. Portions of the FBR and several of the larger tributaries are on the 303d list of impaired waters. There have been no previous formal sec.7 consultations for Appalachian elktoe in the FBR in the Action Area.

See the Biological Assessment, Section 4.1, Pg (34 - 38) for detailed baseline watershed conditions.

5. EFFECTS OF THE ACTION

5.1 GRAY BAT

Under section 7(a)(2) of the Act and the recent update to the regulations, effective October 28, 2019, "effects of the action" are all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action. A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action. The federal agency is responsible for analyzing these effects. The effects of the proposed action are added to the environmental baseline to determine the future baseline, which serves as the basis for the determination in this Opinion. Should the effects of the federal action result in a situation that would jeopardize the continued existence of the species, we may propose reasonable and prudent alternatives that the federal agency can take to avoid a violation of section 7(a)(2).

5.1.1 Factors to Be Considered

5.1.1.1 Proximity of the Action

Based on acoustic and telemetry surveys within the Action Area, the gray bat occurs throughout the Action Area from mid-March through mid-November. Three roosts were identified in the Action Area; one of which contained hundreds of bats, one which contained five bats, and one which had one bat for one night. Multiple roosts have also been identified nearby.

Based on the results of radio-tracking, we know that bats are flying into the Action Area from roosts 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.

Acoustic and telemetry studies showed that MYGR are present throughout the Action Area. They primarily use large waterways (the French Broad River) but are also present on smaller tributaries. Any work conducted over waterways when bats are present will impact the population. Although measures to avoid and minimize impacts to gray bats are included in the project plans, implementation of the project will result in unavoidable impacts to habitat and individual bats.

Surveys of all bridges in the Action Area (51) in 2017 and 2018 found no bats or evidence of bat use. However, MYGR change roosts throughout the summer, and could roost in bridges that will be demolished.

5.1.1.2 Nature of the Effect

Commuting and foraging habitat along the FBR and tributaries in the Action Area will be affected for the duration of the construction project and there could be permanent impacts in the form of new lighting along waterways.

- At the bridge replacement sites, additional lighting and noise from construction equipment may repel some bats, potentially causing them to find other areas for foraging and commuting. The addition of new structures in the waterways and new lighting could also have impacts. There is a chance bats could be forced to fly over the highways or through other open areas making them more susceptible to being hit by cars or predation.
- Riparian vegetation removed during construction will allow more light and noise from traffic and existing development to reach the river and tributaries, potentially repelling foraging bats.
- In-stream habitat for aquatic insects in the footprint of causeways will be impacted by the construction, and for some time after the construction is completed. There will be some

loss of in-stream habitat due to the presence of new bridge bents in the river and tributaries.
- Water quality impacts from construction and increased impervious surface runoff may decrease food and drinking water source quality for MYGR.
- Bats repelled from their forage areas and commuting routes may expend additional energy finding new foraging and commuting areas, which could result in lower fitness. Pregnant and lactating females will be particularly susceptible to impacts given the increased energy demands during this time period and could lose pups due to longer flight distances to forage.

Roosting bats will be impacted by work at the Hill Street Culvert and possibly during bridge demolition work that occurs when bats are on the landscape.

- Despite efforts to minimize direct impacts to bats roosting in the culvert through a barrier, bats may be disturbed by noise and potentially changes in the microclimate of the culvert from the temporary baffle, permanent changes to the culvert configuration, and removal of vegetation around the outlet.
- Depending on the timing of the work, the disturbance could cause bats to leave in daylight hours to find alternate roosts, or attempt to forage after being woken from torpor when sufficient food is not available, which could reduce fitness or result in mortality.

5.1.1.3 Disturbance Duration, Frequency and Intensity

Gray bats will be affected by the construction from mid-March through mid-November, when they are present in the action area for the duration of the project (estimated to be five years). Disturbance from elevated nighttime lighting and noise associated with construction will be temporary, but will exist until construction is complete. After the construction causeways are removed from the FBR, the substrate and its invertebrate population will continue to recover for some period of time as the river has bankfull flows that resort the riverbed and reestablish the riffle section. The widened highway and new river crossings are likely to result in more permanent impacts from noise associated with an increase in vehicles and the addition of permanent lighting, which may impact foraging and commuting bats, including bats traveling to and from the culvert roost. Tree clearing associated with the project will further fragment habitat and may leave openings that act as a barriers in certain locations since *Myotis* are reluctant to cross wide, open areas and some species of bats avoid lights and large roads (Berthinussen and Altringham 2012). Bats may temporarily abandon the culvert roost for the duration of construction because of noise, vibrations and/or changes in the microclimate. They could also abandon the roost due to the removal of trees near the outlet, which provides cover for bats entering and leaving the roost. If the microclimate of the culvert is significantly altered after repairs, bats may permanently abandon the roost.

5.1.2 Analysis of Effects of the Action

5.1.2.1 Beneficial Effects

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.

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.

5.1.2.2 Effects Likely to Adversely Affect Listed Species

5.1.2.2.1 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 when flying adjacent to or across active construction areas and when roosting in the Hill Street culvert. 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, estimated up to five years.

NCDOT has committed to the following minimization measures:

- 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 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 and 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.

One of the most critical time periods for reproductive success of bats is the maternity season, when females are pregnant, give birth to pups, and nurse pups until they can fly and forage on their own. This time period generally runs from early June through mid-July. Newly volant pups are also extremely vulnerable in late July as they are learning to fly and forage on their own. Although night work associated light and noise will be limited for two weeks of this two month time period, light and noise from construction in the other six weeks could increase stress on pregnant and lactating females, leading to reduced fitness and pup survivorship. These effects of light and noise on specific habitats are discussed in detail below.

5.1.2.2.1.1 Lighting Effects

The use of lighting after sunset will be necessary to complete some aspects of construction. Lighting associated with construction activities will be brighter than ambient light generated by headlights or nearby overhead lighting around interchanges or near developed areas. Nighttime construction activities could take place throughout the life of the project, with some restrictions stated above.

Night lighting could still occur for a large portion of the project while bats are present on the landscape. MYGR could be exposed to this stressor if they fly adjacent to or across active work zones. This stressor could cause them to abandon foraging areas and commuting areas, which could expose them to additional stressors, (e.g., increased energy expenditure, increased risk of predation, increased competition for resources).

Myotis sp. are light averse (Voigt 2018, More details in Section 3.1.3) and the addition of night lighting at the water level and in the riparian corridor will likely repel some bats from waterways where there is disturbance. More detail on potential impacts of lighting on specific bat activities is provided below.

5.1.2.2.1.1.1 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 and its tributaries where MYGR are foraging and commuting. Although the majority of construction will occur during the day, multiple major bridge construction activities

could occur at night. As previously stated, NCDOT will permit the following bridge construction activities from April 1 through October 15: causeway construction, drilled shafts, concrete pours, beam setting, and traffic shifts. Appendix K includes a detailed list of what these activities entail, the likelihood of occurrence and the type of lights that could be used. Any manner of construction activities could occur at night over the FBR and its tributaries in late March and late October to mid-November when some bats could still be on the landscape. Additional construction lighting from bridge demolition and construction (and from road work adjacent to the river) will create a temporarily elevated level of light, which may affect any MYGR that are present. Bridge construction/demolition activities will occur at multiple locations within the foraging and commuting area of bats that utilize the Action Area. One bridge will be demolished and replaced over the FBR, and three bridges (all near each other and near the primary culvert roost) will be constructed on a new location. Six bridges will be demolished and replaced over tributaries, and 14 will be constructed on new locations over tributaries to the FBR. 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. Construction activities that illuminate the river or riparian areas, especially on the causeways at the river level, could deter bats from foraging and commuting areas for the duration of the project. If MYGR avoid areas that are brighter than they are accustomed to, and particularly if they must do so for multiple years while construction is underway, this may lead to increased travel time/distance between their roosts and foraging areas. Additionally, although night work lighting will be limited for two weeks of the estimated two months most critical to the reproductive success of MYGR, night lighting on commuting and foraging habitat during the other six weeks of this time period could increase stress on pregnant and lactating females, leading to reduced fitness and pup survivorship. These activities are anticipated to have long term impacts on the local MYGR population.

5.1.2.2.1.1.2 Potential Light Impacts to Roosting Habitat

Hill Street Culvert Roost

Lights associated with construction equipment may illuminate culvert inlets during this process and disturb any bats that use the culvert for roosting. As previously mentioned, it appears that MYGR are roosting in the culvert both day and night during the active season and are utilizing multiple culvert inlets/outlets. However, MYGR do not appear to use the roost for winter hibernation. The CMAPs and RCBC portion of the culvert system are the primary areas used by MYGR and these will be repaired when bats have left the roost for the season. The 60” CMP confers flow under Hill Street and into the RCBC portion used by the bats. This section will be replaced or lined between October 15 and April 1, when most bats are at or are migrating to/from hibernacula. Since small numbers of bats could be present in the second half of March and mid-Oct. through early November, some individuals could be impacted by lighting associated with work on the 60” CMP as they commute to/from the roost. There are 14,700 feet of pipe associated with the culvert system, and work on the remainder of the culvert system may occur any time of year. Construction associated with the culvert system may last up to four years. Therefore, there is the potential that MYGR utilizing the culvert roost will be affected by light associated with these activities for up to four years. However, NCDOT will install a baffle between the RCBC portion used by bats and the 60” CMP section. This baffle should block light

from any work done on the 60" CMP section when bats are present and other sections outside of the RCBC portion of the culvert. The baffle will minimize the impact of light on roosting bats. The impact of tree clearing on culvert conditions, including elevating ambient light at certain inlets and the outlet, is discussed in Section 5.1.2.2.1.3.

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. Therefore, construction lighting should not shine into the culvert and impact any bats roosting there.

5.1.2.2.1.1.3 Construction Lighting effect summary

NCDOT's commitments to restrict rehabilitation activities associated with the RCBC and CMAPs to when the bats are not present, restrict the timing of the lining or replacement of the 60" CMP to when most of the bats are not present, and to install a baffle/barrier for work upstream of roosting bats (See Conservation measures, Section 2.3.2), will minimize impacts from lighting related to construction activities. We believe there will be little to no increase of lighting inside the culvert from construction activities when bats are roosting, and therefore little to no impact to roosting habitat. However, see Section 5.1.2.2.1.3 for potential impacts to roost suitability from vegetation removal and associated elevated ambient light.

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 could 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.

Although night work associated lighting will be limited for two weeks of the estimated two months most critical to the reproductive success of MYGR, night lighting on commuting and foraging habitat during the other six weeks of this time period could increase stress on pregnant and lactating females, leading to reduced fitness and pup survivorship. Considering the duration of combined activities in the Action Area (up to five years), we anticipate the stress associated with construction lighting will cause long term impacts to the local MYGR population.

5.1.2.2.1.2 Noise and Vibration Effects

The use of heavy equipment is anticipated to cause noise disturbance during construction activities within the Action Area. Noise will be generated primarily from work using heavy equipment such as drilling, jackhammering, running generators, and pile driving. Although the majority of construction will occur during the day, multiple major bridge construction activities

will occur at night. As previously stated, NCDOT will permit the following activities from April 1 through October 15: causeway construction, drilled shafts, concrete pours, beam setting, and traffic shifts. Appendix K includes a detailed list of what these activities entail, the likelihood of occurrence and the type of lights that could be used. Daytime and nighttime noise associated with these activities is expected to affect MYGR if it occurs near the culvert roost. Noise from nighttime construction activities will impact MYGR flying over or adjacent to the roadway and bridge construction locations. At these locations MYGR may be exposed to noise intensity that they may not have previously experienced in those locations and potentially for long durations. More details on the impacts of noise is provided below.

5.1.2.2.1.2.1 Potential Noise Impacts to Foraging and Commuting Habitat

Construction activities in or adjacent to foraging and commuting habitat will create a temporarily elevated noise level, which may affect any MYGR present. Bridge construction/demolition activities will occur at multiple locations within the foraging and commuting area of bats that utilize the Action Area. One bridge will be demolished and replaced over the FBR, and three bridges (a series of high flyover bridges estimated to be 66 (FBR-3), 91 (FBR-2), and 104 (FBR-4) feet tall)) will be constructed on a new location near the Hill Street Culvert Roost (See section 5.1.2.2.1.2.2 for impacts to the roost). Six bridges will be demolished and replaced over tributaries, and 14 will be constructed on new locations over tributaries to the FBR. 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.

Although night work associated noise will be limited for two weeks of the bat maternity season, (See Section 2.3.3 for restrictions on night work), noise from construction in commuting and foraging habitat during the other six weeks of this time period could increase stress on pregnant and lactating females, leading to reduced fitness and pup survivorship. Similar to lighting, noise may exacerbate the barrier effect of roads and may create a barrier along the FBR and tributaries. 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 construction is underway, this may lead to increased travel time/distance between their roosts and foraging areas. Potentially resulting in diminished fitness of adults and/or reduced survivorship of pups and/or adults.

5.1.2.2.1.2.2 Potential Noise and Vibration Impacts to Roosting Habitat

<u>Hill Street Culvert Roost</u>

The CMAPs and RCBC portion of the culvert system are the primary areas used by MYGR and these will be repaired when bats have left the roost for the season. The 60” CMP confers flow under Hill Street and into the RCBC portion used by the bats. This section will be replaced or lined between October 15 and April 1, when most bats are at or are migrating to/from hibernacula. Since small numbers of bats could be present in the second half of March and mid-

October through the beginning of November, some individuals could be impacted by noise and vibrations associated with work on the 60" CMP while roosting.

French Broad River Bridge Construction

Noise and vibrations associated with construction of the new French Broad River bridges near the roost may impact bats using the roost. Potential activities that would produce the highest decibel levels and most vibration include pile driving and drilling in bedrock. The I-240 eastbound ramp will be constructed closest to the culvert. The preliminary designs show the eastbound lane arching around the culvert inlet, approximately 500 feet away. The in water work is approximately 500 feet downstream from the culvert ditch outlet into the FBR. The other two major bridges are approximately 100 and 600 feet further downstream. Noise and vibrations from bridge construction in close proximity to the roost may deter bats from the area, causing them to use the roost less frequently or to abandon it. If noise and vibrations associated with work on the French Broad River Bridge reaches the culvert while bats are present, it may disturb them and cause them to be more active and expend more energy. This could lead to diminished fitness of adults. If disruptive enough, noise and vibrations could also cause all or a portion of the bats to abandon the roost. This could result in diminished fitness of adults and/or reduced survivorship of pups and/or adults

Repairs and replacement of the culvert structure upstream of the 60" CMP

While work occurs on the 60" CMP, a barrier/baffle will be in place to separate the area where the bats roost. However, it is unknown how effective the barrier will be at blocking noise and it will not block vibrations. Therefore, there is the potential that MYGR utilizing the culvert roost system will be affected by noise and vibration associated with culvert system and adjacent bridge and road construction. While the number of bats impacted during this time period is expected to be small, it is important to note that they may be particularly vulnerable during this time period. Bats are more likely to use torpor to conserve energy during cold spells in early spring and late fall. Arousal from noise and vibration associated with construction could lead to depleted fat reserves and reduced fitness or even death. Work on the remainder of the culvert system and the street above the culvert could occur any time of year, day and night, and associated noise could disturb roosting bats. If the noise and vibration is enough to disturb bats while roosting, it could cause them to be more active and expend more energy. If disruptive enough, they could leave the culvert during the day and seek an alternate roost, making them susceptible to predation. If they have difficulty finding a new roost, this could reduce the fitness of adults and/or reduce survivorship of pups and/or adults.

Repairs to the 60" CMP

As previously mentioned, bats could be present starting in early March through late November in the culvert, and the 60" CMP section could be replaced anytime from October 15th through April 1st. Although the baffle should block light, it is unknown how effective it will be at blocking noise and it will not minimize vibrations. Bats are vulnerable to disturbance in early spring and fall because they are relying on torpor to conserve energy when temperatures are fluctuating and food availability is not consistent. If bats are aroused from torpor due to noise or vibrations from

the nearby work on the "60 CMP section in March and after October 15th, when food may be limited, they could deplete fat reserves, which could lead to decreased fitness and even death.

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.

Factors considered for the baffle/barrier in the culvert roost effects

Additionally, it should be noted that although the baffle NCDOT has committed to install in the culvert before work begins on the "60 CMP and any upstream culvert system work, is intended to minimize impacts of construction (light and possibly noise), it may have unintended consequences. The baffle could be in place for three to four years while work on the upstream section of the culvert is ongoing. The baffle will be designed so that water flow is maintained (and NCDOT has committed to maintain base flow in the culvert) but it will alter airflow. This could alter the microclimate of the culvert so that it is undesirable to bats, causing them to abandon the roost, but we weighed the consequences and have decided that the potential benefits of blocking light and excluding bats from construction outweigh the risks of altering the microclimate.

5.1.2.2.1.3 Removal of Woody Vegetation

The project is anticipated to affect 374 acres of maintained/disturbed habitat and 191 acres of forested habitat Most of the proposed construction activities will occur within existing NCDOT right of way and/or other urbanized areas, where woody vegetation is limited. 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.

Forested areas in the Action Area are fragmented due to urban development. However, along the French Broad River and other major tributaries, there is generally a continuous, narrow riparian buffer. This buffer is important for blocking light from developments and roads on the water bodies and for providing cover for commuting and foraging bats. More detail on the potential impacts of removal of woody vegetation is provided below.

5.1.2.2.1.3.1 Potential Impacts to Foraging Habitat

MYGR are forest bats that typically forage and commute in/near forested areas. The removal of riparian forest adjacent to foraging habitat could lead to bats abandoning existing foraging areas and having to find new foraging areas. MYGR with foraging areas that will be fragmented, will have to expend increased energy to establish new foraging areas or new travel corridors between

roosting and foraging. Additionally, they may be subject to an increase in inter- and intra-specific competition. Bats remaining 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 that regularly forage in the Action Area will have difficulty establishing new foraging areas due to the availability of remaining suitable habitat in the surrounding landscape.

Removal of woody vegetation can also lead to increased sedimentation in waterways and subsequent reduction in aquatic insects, which are a primary food source for MYGR. This is further discussed in Section 5.1.2.2.1.4 (Water Quality).

As previously discussed in Sections 3.1.1 and Section 5.1.1, MYGR are active throughout the Action Area and are generally most active along the French Broad River and its tributaries, where they are foraging and commuting. Any clearing of woody vegetation associated with the project has the potential to affect MYGR using these areas. Riparian vegetation will be cleared for the following new bridges: four over the FBR, nine over Smith Mill Creek, four over Emma Branch, and one over Hominy Creek. Existing openings will also be widened for the following bridge replacements: six over Hominy Creek and one over the FBR.

5.1.2.2.1.3.2 Potential Impacts to Commuting Habitat

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 FBR, 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 and inlet (near Courtland Ave.). This area in front of the outlet may be cleared of vegetation for up to approximately 50 ft. downstream, and to the top of the bank. Vegetation could also be cleared up to 50 feet around the 60" CMP culvert inlet. Therefore, MYGR commuting to and from the culvert roost will be affected by these clearing activities (See Section 5.1.2.2.1.3.3 below for the impacts of clearing the roosting habitat).

MYGR are also using the French Broad River, Hominy Creek, Smith Mill Creek, and Emma Branch for commuting purposes as they move between roosts and foraging areas. MYGR experiencing fragmented commuting habitat could expend an increased amount of energy to establish 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 commuting 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.

MYGR will travel over land to reach roosts and foraging areas. From telemetry data we know that at least some of the population commutes over land and at least some individuals are moving over urban areas. Decreasing tree cover over land could also cause some bats to change commuting routes with possible consequences as described above. Further, bats that continue to use impacted routes are exposed to predation while outside the protection of forest canopy, and decreasing tree cover will increase predation risks.

It is unclear if MYGR will establish new commuting areas, and if they do, whether they will have difficulty establishing them due to the availability of remaining suitable habitat in the surrounding landscape. Additionally, they currently commute through a fragmented landscape both along waterways and over land. MYGR are tolerant of the current level of fragmentation, and may adjust to the increased loss of forested habitat, but there is probably some level of fragmentation that they will not be able to tolerate.

While it is likely that MYGR 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.

5.1.2.2.1.3.3 Potential Impacts to Roosting Habitat

Although three MYGR were separately tracked to two sycamore trees and one green ash tree adjacent to water as part of the ISU study, MYGR do not typically utilize trees for roosting and this behavior has not been documented before. While unusual, the potential for roosting in riparian trees further supports the importance of protecting riparian corridors. However, given gray bats are cave obligates, clearing of woody vegetation is not anticipated to diminish MYGR roost availability.

Tree clearing will occur at the inlet (60" CMP adjacent to Courtland Ave. and the entrance to Isaac Dickson Elementary School) and outlet (dual CMAPs) to establish work pads (weight bearing pad or slab for machinery operation) and equipment staging areas to complete the culvert rehabilitation process. The staging areas will only be used for equipment used during culvert rehabilitation and will not be used for any other project construction purposes. Additionally, NCDOT might be able to use existing open areas for staging equipment, which would help minimize tree clearing.

Removal of trees at the inlet and outlet will allow more light to hit the entrances during and after construction and the lack of cover could result in bats abandoning the roost temporarily or permanently or increased predation near the roost if bats continue to use it. NCDOT has committed to re-establishment of woody vegetation at the culvert outlet and inlet. These plantings will mature and over time, will restore and could even improve conditions at this roost. Additional information about these measures is included in Section 2. Additionally, although it is difficult to accurately predict changes in microclimate, it is possible that removal of woody vegetation may alter the internal microclimate of the culvert. If the microclimate changes, the roost may no longer be suitable, and bats could abandon it until vegetation matures and conditions are restored.

5.1.3.4 Summary of effects from removal of woody vegetation:

Cleared areas are susceptible to erosion, and this may contribute to increased suspended sediment in adjacent streams, and ultimately 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. 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, potentially reducing fitness in adults. Bats continuing to use cleared areas could be susceptible to increased predation. It would be difficult, if not impossible, to measure these effects.

If vegetation clearing impacts the suitability of the culvert roost by increasing light, changing the microclimate and/or reducing cover so that the entrances and exits are no longer desirable, all or a portion of the bats may abandon the roost and seek an alternate. This could result in diminished fitness of adults and/or reduced survivorship of pups and/or adults. Bats continuing to use the roost could be susceptible to increased predation because of the lack of cover.

5.1.2.2.1.4 Hydrology/Water Quality

NCDOT has implemented design changes to minimize impacts to surface waters and wetlands. However, not all impacts could be eliminated and 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 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, installation and removal of temporary causeways, removal of existing bents, and construction drilling, and
- accidental spills of petrochemicals, uncured concrete, etcetera

Twenty-three streams (NCDOT 2019, Appendix G), in addition to the French Broad River, will be impacted in some way by the project. Most of these 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/or reduce the quality of suitable drinking sources. Insects associated with aquatic habitats make up a large portion of the diet of MYGR Many species of aquatic insects can be negatively affected by a decrease in water quality. 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 (including both terrestrial and aquatic species).

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, MYGR may find the roost site less desirable and abandon it. However, NCDOT has committed to maintain water sources that provide baseflow to the culvert.

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 will be temporary, and are

likely to be undetectable due to the availability of alternative prey and drinking sources in the surrounding landscape. Additionally, with baseflow maintained in the culvert system, it is unlikely that flow will be altered enough to make the culvert an unsuitable roost. Therefore, we do not anticipate any measurable effect on MYGR due to potentially diminished water quality.

5.1.2.2.1.5 Stream Fill – Habitat Disturbance/Loss

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 and may cause some MYGR to seek alternative foraging locations. However, we do not anticipate being able to measure this effect, and believe it will be insignificant.

5.1.2.2.1.6 Physical loss of roosting structures

MYGR have been documented moving between roosts in and near the Action Area. Although structure checks of bridges in the Action Area did not find any bats or evidence of roosting bats, MYGR could use these bridges in the future. Considering the amount of predicted disturbance at the Hill Street culvert roost, MYGR may be more likely to seek out additional alternate roosts. The sections of the project are anticipated to be let from 2021 to 2025, which could result in a span of three to nine or more years since bridges were checked for bat use. Therefore, NCDOT has committed to the following avoidance and minimization measures (from Section 2.3.3.3).

<u>Pre-Demolition Check for Bats</u>

- 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.
- 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.

These measures will minimize take to an insignificant level from April 1st through October 15th. However, as previously discussed, bats can also be on the landscape in late March and mid-October to early November and are vulnerable to disturbance because they are relying more on torpor to conserve energy when temperatures are fluctuating and food availability is not consistent. If bats are aroused from torpor and abandon their roosts due to demolition activities in March and after October 15th, they could deplete fat reserves, which could lead to decreased fitness and even death. Additionally, if initial disturbances do not wake bats from torpor, they could be injured or killed as the bridge is demolished.

Although the culvert roost conditions may be altered so that the roost is undesirable during and post construction, it is not discussed in this section because the culvert will remain in place.

5.1.2.2.1.7 Summary of Construction Effects:

Lighting, noise, removal of woody vegetation, reduced water quality, stream fill and associated aquatic habitat alteration/destruction, could all adversely impact MYGR. Impacts to the Hill Street culvert roost, and to habitat at the French Broad River, Hominy Creek, Emma Branch, and Smith Mill Creek bridge crossings are anticipated to have the largest effect on MYGR. Construction lighting, noise, and the removal of woody vegetation for the construction of multiple bridges at the French Broad River, Hominy Creek, Emma Branch, and Smith Mill Creek are anticipated to be some of the most impactful activities. Additionally, work on and near the Hill Street culvert roost could have the most direct impact to bats, potentially causing them to abandon this primary roost. 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. Mortality is possible if bats are disturbed from torpor in March and after October 15th from work on the culvert roost and bridge demolition. If bats roost in bridges that are demolished, they could also be killed in March and after October 15th if they do not arouse from torpor.

5.1.2.2.2 Potential Effects from Highway Operation

Operational effects include those arising from daily vehicular use of the facility once it is in operation, as well as natural responses over time to the proposed action's post-construction effects. MYGR flying across or adjacent to the roadway during months when they are not hibernating, may be exposed to potential effects from highway operation including increased permanent lighting and increased traffic. The Traffic Forecast Report (AECOM 2016) indicates there will be an increase in traffic volume on all roadways associated with the project. With this increasewill come an associated increase in light, noise, and the elevated potential for bat-vehicle collisions. Increased permanent lighting along waterways could also impact bats post-construction. These impacts are discussed in more detail below.

5.1.2.2.2.1 Lighting from vehicles

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 tributaries would be most susceptible to increased light. As discussed in Section 5.1.2.2.1.1, lighting can induce a barrier effect for some bat species. If bats choose to avoid newly lit areas, they will need to find new travel corridors and foraging areas and could be impacted for some amount of time post-construction. Potential impacts include increased energy expenditure affecting fitness and reproductive success.

5.1.2.2.2.2 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 exposed to increased noise.

MYGR using roosts in bridges near the Action Area are accustomed to the associated level of traffic noise at those bridges. However, 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 from increased traffic may affect the bats using the culverts as 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 may decrease.

The results of studies conducted by Calyx and ISU and presented in Appendix C and Appendix D suggest MYGR activity throughout the action area, and theses bats are exposed to varying levels of noise from traffic. While traffic volumes are anticipated to increase (and associated noise will increase as well) we cannot predict how this might affect MYGR. There are no studies focused specifically on MYGR and noise effects. However, some studies suggest that *Myotis sodalis* (MYSO, a congener) may be able to tolerate disturbance from vehicular traffic noise at a roost near a large airport (Sparks et al. 2009). Although noise from traffic will increase in the action area, given the current level of noise tolerated by MYGR, and that traffic volumes will be lower at night, we do not anticipate an adverse impact to the species.

5.1.2.2.2.3 Vehicle Collisions

Bats attempting to cross the roadway will encounter a wider opening between areas of vegetated refugia where bridges are replaced, and will encounter new openings and obstacles where new bridges are constructed. MYGR attempting to cross the roadway could be struck by passing vehicles. Bats may be more likely to collide with cars when they are first confronted with new bridges, potentially deciding to fly over bridges. If this does occur, it would be more likely to occur with lower bridges and the risk would likely decrease as bats adjust to the structures. 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 to 10 ft. of the water surface (Tuttle 1976b, 1979, LaVal et al. 1977). Bat injury and mortality from vehicle strikes may increase within the Action Area from increased traffic.

5.1.2.2.2.4 Maintenance of Cleared Areas, 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 completion. Potential effects to MYGR from woody vegetation removal are described in Section 5.1.2.2.1.3. Maintenance of cleared areas near water will result in a permanent increase in lighting from road work and highway operation and reduced cover for foraging and commuting bats. Openings in forest cover will be relatively small in size, and it is difficult to assess their impact on MYGR. We anticipate that bats will eventually adjust to vegetation changes and will still be able to find dark corridors for commuting and foraging.

Additionally, 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. 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.

We do not anticipate any detectable effects from maintenance of openings or tree trimming and hazard tree removal on MYGR.

5.1.2.2.2.5 Permanent Lighting

New or replacement lighting will be required in multiple locations over water, as outlined in the Lighting Summary document (Appendix J) and Section 2.2.9.4 (Permanent Lighting). Much of the foraging and commuting habitat on the FBR and tributaries are dark, with some small areas of light from existing bridges and private development. Light does not typically reach all the way across any of the waterways. The largest concentration of new lighting will be associated with the new bridges over the French Broad River and associated ramps/approaches. However, there will also be numerous lit single crossings of tributaries utilized by MYGR that are currently mostly dark.

MYGR travelling across or adjacent to the roadway, particularly in areas near the river and its larger tributaries, will be exposed to increased light from upgraded or new lighting (See Section 2.2.9.4 for new permanent lighting details). As discussed in Section 5.1.1 and 3.2.3, lighting can 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.

Permanent lighting has been minimized by eliminating high mast poles close to waterways, increasing pole spacing, and selecting light fixtures with minimal spill off roadways (Section 2.2.9.4). Additionally, NCDOT decided not to light the I-40 bridge over the FBR, leaving a dark corridor in this area, and lights will likely be minimized on the Bowen bridge when it is converted to a residential street. Table 2 shows the level of light predicted to hit the FBR at the new crossing location (FBR-2 through FBR4). The light expected at the water surface after minimization efforts will be around 0.026 foot candles (fc) (Appendix J). The minimized

permanent lighting plan will not increase light levels at the Hill Street culvert or associated ditch. The light level predicted on the FBR from the new bridges is approximately 2.5 times the light of the full moon, which is 0.01 fc.

Table 2. Permanent Lighting Change from Initial Design

Area	Initial Design Assumed Measured Value	Minimization Design Assumed Measured Value	Percent Changed from Initial Design
Culvert Opening	0.25	0.13	-48%
Ditch	0.29	0.18	-38%
FBR	0.43	0.026	-94%

Lighting levels at the water level were not calculated for the other crossings where MYGR commute and forage on Hominy Creek, Smith Mill Creek, and Emma Branch. The mitigation lighting plan has minimized the placement of lighting so that typically only 0.10 fc will extend beyond the edge of the roadway. Due to the height of the lighting above the water, the light intensity at water level will generally be much less than 0.10 fc. Crossings HC-1 through HC-5 and HC-7 are bridge replacements with a new lighting design. Although these crossings already exist, in most of these locations the creek is not illuminated by road and bridge lighting. There will be one new crossing of Hominy Creek, nine new crossings of Smith Mill Creek, and four new crossings of Emma Branch. These locations were all previously dark. The areas illuminated will be relatively small, but will likely cover the width of the tributaries. The additional lighting could affect MYGR foraging and commuting behaviors, causing them to use illuminated areas less frequently, or avoid the creeks entirely. However, it is unknown what light level would lead to abandonment of habitat. It will be difficult, if not impossible, to measure the effect of increased permanent lighting on the population.

5.1.2.2.3 Consequences of other activities caused by the proposed action

Effects of the action are all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action. A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action. (See § 402.17).

5.1.2.2.3.1 Induced land development

Highway projects can induce changes in surrounding land use when they shorten commuting times or provide access to areas previously poorly served. The NCDOT studied the potential for changes in land use surrounding the Action Area (NCDOT 2016) and found that the nature of this project, as an upgrade to an existing roadway, without additional access along its length, would not induce significant amounts of additional development.

5.1.2.2.3.2 Waste and borrow sites

Another source of effects common to roadway projects is the siting of waste and borrow areas necessary for the temporary holding of construction materials. On large projects, the area

necessary for waste, borrow and staging operations can be large and under certain conditions could create additional negative effects for aquatic species. NCDOT allows the Contractor to manage placement and operation of the waste and borrow sites after the contract is awarded and does not consider effects of the waste and borrow sites to be part of the authorized action, however, NCDOT does provide standard guidance for borrow/fill sites that are intended to regulate the environmental effects of these areas and requires consultation with the Division Engineer if their placement could affect a federally listed species. If not for the proposed action, the waste and borrow sites would not be necessary. Therefore, we consider them consequences of the proposed action. However, if NCDOTs standard guidelines are followed, we believe they will effectively minimize additional effects associated with these sites.

5.1.2.2.3.3 Utility relocations

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 2.2.8 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.

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 insignificant.

5.2 APPALACHIAN ELKTOE

Under section 7(a)(2) of the Act and the recent update to the regulations, effective October 28, 2019, “effects of the action” are all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action. A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the action may occur later in

time and may include consequences occurring outside the immediate area involved in the action. The federal agency is responsible for analyzing these effects. The effects of the proposed action are added to the environmental baseline to determine the future baseline, which serves as the basis for the determination in this Opinion. Should the effects of the federal action result in a situation that would jeopardize the continued existence of the species, we may propose reasonable and prudent alternatives that the federal agency can take to avoid a violation of section 7(a)(2).

5.2.1 Factors to Be Considered

5.2.1.1 Proximity of the Action

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 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. For the purposes of this BO we will assume the Appalachian elktoe is present, but due to low density, was not encountered during preconstruction surveys.

5.2.1.2 Nature of the Effect

In-stream habitat in the FBR will be permanently affected by new bents in the river and temporarily impacted by causeways. 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. Work conducted in the FBR for bridge construction and demolition has the potential to kill mussels by crushing or burying them.

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.

Up to 23 jurisdictional streams within the Upper French Broad River sub-basin will be permanently 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 by the project (Appendix G), Temporary piping may be used in streams in order to access sites for bridge construction.

5.2.1.3 Disturbance Duration, Frequency, and Intensity

The highway construction will create disturbance to tributaries and downstream resources that will be ongoing in different segments of the project for years. With appropriate sediment and erosion control measures, large inputs of sediment should be avoided during construction. After

the project is completed and the roadway opens to traffic, there will be increases in stormwater runoff volume and pollutants, some of which may reach areas occupied by the Appalachian elktoe.

Disturbance to the riverbed from bridge construction and demolition will occur over three to four years. The causeways for construction and demolition will be in place for the length of time needed to construct and demolish the bridges. Although there will be direct impacts to the riverbed associated with the causeways, the construction of the causeways will be phased to limit the amount of causeway in the river at any one time, and only the causeways needed for an activity will be in place during that activity and will be removed when the action is completed. There will be temporary impacts to river hydrology both upstream and downstream of the causeways.

5.2.3 Analysis of Effects of the Action

5.2.3.1 Potential 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.

5.2.3.2 Effects Likely to Adversely Affect Listed Species

5.2.3.2.1 Construction Effects

The project design crosses the French Broad River as well as waterbodies that drain to habitat occupied by 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.

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.

5.2.3.2.1.1 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. 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.

5.2.3.2.1.2 French Broad River Bridge Demolition and Construction

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 a 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 3). 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 3. 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 5.2.3.2.1.6, Causeways).

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). During demolition NCDOT will remove the existing bridges using methods that minimize the amount of construction debris in the river, and due to the unknown nature of the existing foundation construction and condition, many decisions about removal will have to be made on site. Small amounts of bridge debris may fall into the river. However, it will be removed and we do not believe that small amounts of construction debris temporarily in the river will have any effect on Appalachian elktoe.

5.2.3.2.1.3 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. Details on the bridge replacements can be found in Section 2.2.4, and the sediment and erosion control impacts to Appalachian elktoe are discussed in Section 5.2.3.2.1.6 below.

5.2.3.2.1.4 Causeway Construction and Use

The causeways needed for bridge construction and demolition are summarized in Table 5. 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, needs to reach existing bents in the river, and could leave as little as 32% 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.

The long duration of causeway operation (French Broad River bridge work is anticipated to last three to four years) needed to construct this project creates an opportunity for related effects to Appalachian elktoe and habitat near the construction area. Rock causeway material may be washed away during high flow events, where it could have a negative effect on the species by crushing individuals or fouling habitat. Additionally, the disruption of stream bottom affected by the installation and removal of the causeways may cause temporary negative effects to the habitat. However, the probability of this causing direct mortality is low, due to the presumed low density of Appalachian elktoe in the area. Furthermore, because the habitat in the FBR is bedrock dominant, the USFWS believes this habitat will likely revert back to its present suitability within a few years post construction.

The operation of causeways can also increase stream bed and bank scour near the project area. The area downstream of the causeways will experience higher velocities while causeways are in place, and may experience higher rates of scour as a result. Scouring could affect any mussels in the riverbed, washing them downstream and/or causing shell erosion. NCDOT proposes to avoid disturbance to the area downstream of the causeways to the extent possible and to monitor the

area for scour. 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 2.3.8.2 for details). Other avoidance and minimization measures for causeways are discussed in Section 2.3.4.2. Should significant scour be detected, NCDOT has committed to making improvements to the causeway to prevent scour. The USFWS believes that the area, may be affected temporarily, but is likely to return to suitability within a few years post construction.

In addition to the potential changes in hydrology as a result of the causeways, there is the potential for the causeways to act as velocity barriers to fish movement. The disruption of fish movement could impact the Appalachian elktoe if fish hosts for the elktoe are unable to move freely in the river. These temporary disruptions to fish movement may cause some loss in recruitment to upstream or downstream areas for the period of time the causeways are in place. The USFWS believes the direction of disruption of fish host travel is primarily in the upstream direction. Downstream migration of fish is unlikely to be affected as strongly due to the nature of the causeways and associated flow disruptions. Since the distribution of the bulk of the Appalachian elktoe population is upstream of the project, and host fish directional movement downstream is the most important direction of movement in this case, the USFWS believes this effect will be minimal.

Table 5. 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.

5.2.3.2.1.5 Spills and Pollutant Discharge

The inadvertent spill or discharge of toxic pollutants, such as diesel fuel and hydraulic oil, into the river could result in mortality of Appalachian elktoe. Spills of construction fluids are not uncommon, and the long duration of heavy equipment use adjacent to waterways increases the possibility that a spill or discharge could occur. However, NCDOT has committed to conservation measures to refuel the equipment away from the water and to have spill kits near the equipment on the causeways, reducing the likelihood of a spill or discharge reaching the river. Spills could also take place near any other waterway and subsequently have an effect further downstream, but we believe normal spill response is capable of avoiding effects from minor spills. Major spills resulting from negligent operation are still possible, but unlikely.

5.2.3.2.1.6 Erosion and Sedimentation from Highway and Bridge Construction

Highway and bridge construction projects require significant earth moving activity. This includes clearing and grubbing, cut and fill, grading operations, etc., the impacts of which are discussed below.

5.2.3.2.1.6.1 Temporary Access Roads

Temporary access roads will be constructed to transport materials and construction equipment to bridge worksites. 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) will require an access road on the east bank, and possibly the west bank.

The access roads will require clearing of trees and other vegetation. The temporary access roads, if not maintained properly, could transport sediment into the river and its tributaries until disturbed slopes become stabilized with riprap, matting, or other measures. Since the roads slope down toward the river, they could channel sediment directly into Appalachian elktoe habitat. Access road designs will use DSSW for sediment and erosion control to minimize impacts.

5.2.3.2.1.6.2 Impacts to streams in the project area

Up to 23 jurisdictional streams (4,186 linear ft. of jurisdictional waterways) 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. Sediment from erosion associated with these impacts will reach the FBR, the impacts of which are discussed below.

5.2.3.2.1.6.3 Erosion and sedimentation impacts on Appalachian Elktoe

All activities that expose soil create an opportunity for soil erosion from the project into the river. This can negatively impact aquatic species, including the Appalachian elktoe. With a duration of up to five years, multiple bridges being constructed, and effects to 23 streams draining to the FBR, this project has significant potential to cause long duration, widespread, negative effects to Appalachian elktoe and its habitat. Two previous population declines in this

species coincided with erosive events. In the Little Tennessee River, hurricanes Frances and Ivan in 2004 caused major flooding resulting in landslides and chronically unstable banks throughout the watershed. Over the next few years, the population of Appalachian elktoe declined precipitously and is now critically imperiled. On the South Toe River, starting in 2013 a major road widening project began affecting dozens of tributaries of the South Toe River. Subsequently, the Appalachian elktoe population immediately downstream of this disturbance declined. Investigations into the mechanism that caused the decline are ongoing, but the proximity to potential erosive sources begs caution that this species is particularly sensitive to elevated levels of fine sediment.

The distribution of Appalachian elktoe in the FBR currently places most of them in the upper portions of the river. As previously described in the species baseline, the Appalachian elktoe appears to be currently expanding in the FBR and the known downstream extent of this species has expanded further every year since 2005. The known downstream range of the Appalachian elktoe is presently just upstream of the mouth of Hominy Creek. The presence of two other species of mussel downstream of this record and extending all the way into Tennessee gives us reason to believe that the downstream expansion of the Appalachian elktoe will continue unless external factors halt the population expansion. Due to the above mentioned losses in two other populations, the long term stability of the FBR population is a key factor in recovering this species.

The erosion control measures incorporated into the proposed action will reduce the levels of sedimentation into the FBR, but these measures have a design limit based on the amount of rainfall received at the project area. Rainfall events that are greater than the erosion control design limits will result in sediment loss into the river. The baseline levels of suspended sediment in the FBR are already elevated due to cumulative activity in the watershed. However, this baseline suspended sediment has allowed for recent population expansion. In 2018 the Asheville region experienced the highest level of rainfall on record. The previous record year was 2013. The five year duration of this project makes it possible that periods of significant rainfall will occur during the construction. In order to reduce the number and likelihood of sedimentation events from rainfall resulting in water quality impacts, the NCDOT has proposed several conservation measures to improve erosion control efficacy, monitor effectiveness and to fund resource agencies to plan for species recovery in case of unforeseen circumstances. However; if conditions are atypical or if effects to the species are greater than anticipated, NCDOT and USFWS have agreed to collaborate to seek solutions. Accordingly, we have included a Term and Condition that the USFWS can request an onsite meeting to discuss the project at any time. This will allow for adaptive improvements and ensure that problems are addressed early and impacts minimized.

5.2.3.2.2 Operation Effects

The construction of this project will lead to additional road surface drainage to the French Broad River indefinitely. The operation of roads is known to increase the rate of runoff into the river, causing potential destabilization of sensitive habitat within. Roadway runoff contains pollutants that may affect aquatic species at high concentration. Roadways are also a primary threat for toxic spills that could affect the river habitat.

5.2.3.2.2.1 *Impervious Surfaces*

The I-2513 project will increase impervious surface in the Action Area. There is an estimated increase of roadway pavement of 125 acres associated with this project. The increased impervious surfaces will cause an increase in stormwater runoff. NCDOT has committed to implementing stormwater control measures throughout the project where they are practical. We believe that proper stormwater controls will reduce the effects of stormwater on the receiving streams, but not entirely eliminate stormwater effects on the river, especially when rainfall rates are high. The increased stream velocities may have adverse erosive effects on tributary channels resulting in additional sedimentation in the river habitat. The NCDOT has committed to fixing erosion problems at culverts in tributary channels during construction. Proper outfall conditions should further reduce some erosion within the tributary channels. Therefore, based on the present conditions in the action area, as well as the conservation measures proposed we do not believe that the increase in impervious surface will significantly impact the suitability of the habitat in the future.

5.2.3.2.2.2 *Roadway Runoff*

There will be additional runoff due to the additional impervious surface created by the I-2513 project. Numerous pollutants have been identified in highway runoff, including various metals (e.g., lead, zinc, iron), sediment, pesticides, de-icing salts, nutrients (nitrogen, phosphorus), and petroleum hydrocarbons and many of these can be harmful to mussels. Mussels present in the Action Area may experience locally increased exposure to runoff from the I-2513 project and the resulting increase in impervious surface from the highway. The effects from roadway runoff will be long-lasting, spanning the life of the highway but will likely be sporadic and site specific. The long term effects of chronic exposure to roadway pollutants to mussels are poorly understood. The conservation funding provided by the NCDOT for activities aiding in the conservation of Appalachian elktoe will be expended to further study the health of the watershed, as well as the elktoe to aid in recovery of the species.

5.2.3.2.2.3 *Toxic Spills*

Toxic spills on roadways are a concern for aquatic species. This will be true any time large quantities of material are transported near waterways. Due to the large amount of existing roadway and train transport in the FBR basin, the I-2513 project will not appreciably increase the probability of a spill.

5.2.3.2.3 Consequences of other activities caused by the proposed action

Effects of the action are all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action. A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action. (See § 402.17).

5.2.3.2.3.1 Induced Land Development

Highway projects can induce changes in surrounding land use when they shorten commuting times or provide access to areas previously poorly served. These changes can be a consequence

of the action if they would not occur without construction of the project. The NCDOT studied the potential for changes in land use surrounding the Action Area (NCDOT 2016) and found that the nature of this project, as an upgrade to an existing roadway, without additional access along its length, would not induce significant amounts of additional development.

Another source of effects from consequences of the action common to roadway projects is the siting of waste and borrow areas necessary for the temporary holding of construction materials. On large projects, the area necessary for waste, borrow and staging operations can be large and under certain conditions could create additional negative effects for aquatic species. NCDOT allows the Contractor to manage placement and operation of the waste and borrow sites after the contract is awarded and does not consider effects of the waste and borrow sites to be part of the authorized action, however, NCDOT does provide standard guidance for borrow/fill sites that are intended to regulate the environmental effects of these areas and requires consultation with the Division Engineer if their placement could affect a federally listed species. If not for the proposed action, the waste and borrow sites would not be necessary. Therefore, we consider them consequences of the proposed action. However, if NCDOTs standard guidelines are followed, we believe they will effectively minimize additional effects associated with these sites.

6. CUMULATIVE EFFECTS

Gray bat and Appalachian elktoe

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 unrelated to the proposed action are not considered because they require separate consultation pursuant to Section 7 of the ESA.

The Asheville Regional Cumulative Effects Study (NCDOT 2014a) evaluated cumulative effects for the I-26 corridor under the National Environmental Policy Act (NEPA) and indicated the I-2513 project would result in minimal cumulative effects. The majority of activities identified in the report, and since its release, will likely require federal authorization or funding requiring their own ESA Section 7 consultation, and would not be considered a cumulative effect under the ESA. However, the French Broad River corridor throughout the action area continues to experience heavy growth, with many small developments contributing non-point source pollution to the river in the form of sedimentation during construction and/or increased runoff carrying pollutants from the roads or private lands during rain events.

7. CONCLUSION

7.1 GRAY BAT

After reviewing the current status of the gray bat; the environmental baseline for the action area; the effects of bridge construction, demolition, culvert maintenance and highway construction; conservation measures incorporated into the proposed action; any effects from consequences of the action; and any cumulative effects, it is the USFWS’s opinion that implementing this project

is not likely to jeopardize the continued existence of the gray bat. No critical habitat for gray bat exists within the Action Area, therefore, none will be affected.

7.2 APPALACHIAN ELKTOE

After reviewing the current status of the Appalachian elktoe; the environmental baseline for the action area; the effects of bridge construction, demolition, and highway construction; measures identified in the NCDOT's BA to help minimize the potential impacts of the proposed project and assistance in the protection, management, and recovery of the species; any effects from consequences of the action; and any potential cumulative effects, it is the USFWS's opinion that implementing this project is not likely to jeopardize the continued existence of the Appalachian elktoe. No critical habitat for Appalachian elktoe exists within the Action Area, therefore, none will be affected.

8. INCIDENTAL TAKE STATEMENT

Section 9 of the Act and federal regulations pursuant to section 4(d) of the Act prohibit the taking of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to engage in any such conduct. Harm is further defined by the USFWS to include significant habitat modification or degradation resulting in death or injury to listed species by significantly impairing essential behavioral patterns, such as breeding, feeding, or sheltering. Harass is defined by the USFWS as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns that include, but are not limited to, breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not for the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), incidental take is not prohibited under the Act, provided it is in compliance with the terms and conditions of this incidental take statement.

8.1 GRAY BAT

MYGR were observed roosting in two culverts and one building in the Action Area. One culvert and the building will not be affected. No evidence of bat roosting was observed on any bridges included in project construction activities, however, over the lifespan of the project, MYGR could roost in bridges planned for demolition. The USFWS anticipates incidental take of gray bats may occur as a result of impacts to the Hill Street culvert roost despite efforts to avoid and minimize take. Based on emergence counts, ISU estimates that there could be up to 250 bats using the Hill Street culvert. All or some portion of these bats may temporarily or permanently abandon the roost due to disturbance from construction and tree clearing. Most of the take associated with impacts to the Hill Street Culvert will be in the form of harm and harassment, but mortality of adult bats is possible. Noise and vibrations associated with work on and near the culvert system may cause bats to be more active and expend more energy, leading to diminished fitness. If disruptive enough, noise and vibrations could also cause all or a portion of the bats to abandon the roost. If bats are aroused from torpor due to noise from the nearby work on the 60" CMP section in March and after October 15th, when food may be limited, they could deplete fat reserves, which could lead to decreased fitness and even death. Mortality is also possible if bats

are disturbed from torpor in March and after October 15th from work associated with bridge demolition. Additionally if bats roost in bridges that are demolished, they could be killed in March and after October 15th if they do not arouse from torpor. Tree clearing at the culvert outlet and one inlet will temporarily increase ambient light and could change the microclimate inside the culvert until replanted vegetation grows back. Changes in habitat and cover from tree clearing at the culvert entrance and potential changes in airflow could disturb bats to the extent that they abandon the roost for the duration of construction or permanently. Additionally, if changes in the structure of the culvert system permanently alter the microclimate of the culvert, bats may abandon the roost permanently. The loss of the roost could result in diminished fitness of adults and/or reduced survivorship of pups and/or adults since bats will expend energy finding new roosts or flying further to other existing roosts.

The USFWS also anticipates incidental take of gray bats may occur as a result of impacts to foraging and commuting habitat from the I-2513 construction work at the French Broad River, Hominy Creek, Emma Branch, and Smith Mill Creek bridge crossings. During construction, individual bats may be repelled from forage areas in the bridge footprints, along the FBR and tributaries, potentially reducing adult and juvenile fitness and affecting pup birth and health before they are able to fly and forage on their own. Additionally, more bats may be killed due to predation and car strikes if they are repelled from areas of active construction and forced to fly over the highway or through more open areas. Permanent changes in lighting may reduce suitable forage and commuting areas so that the number of bats utilizing the area decreases over the long term if bats avoid the elevated light levels. The number of gray bats using the FBR and its tributaries within and near the action area is estimated at 1900 to 2300 individuals. An unknown number of these will be affected by the construction activities (including: temporary lighting, noise, causeways, decrease in water quality, and loss of woody vegetation). Most of the take associated with impacts to commuting and foraging habitat will be in the form of harm and harassment, but some mortality of adult bats and newly-volant juveniles is possible. Additionally, some loss of recruitment is expected due to stress on pregnant and lactating females and subsequent loss of pups. This harm is not expected to cause mortality of all individuals within the Action Area, but could reduce fecundity and recruitment within the Action Area for five years while the project is under construction. This project, could have long-term impacts on the bat population in this area.

Data used to determine the number of gray bats in the Action Area is a conservative estimate, and gray bat populations are known to fluctuate seasonally and annually in a given area, therefore it is difficult to base the amount of incidental take on numbers of individual bats. Additionally, it is difficult to measure take of gray bats resulting from the action. Due to these reasons, the amount of incidental take will be monitored using the duration of construction activities over and adjacent to the river, and those that impact the culvert roost, which are the most disruptive aspects of the project, as a surrogate measure of take. Bridge construction activities are expected to take 5 years, and culvert construction activities upstream of the 60' CMP are expected to take up to four years. The amount of incidental take will be exceeded if 1) night operations at river crossings exceed five years, 2) if disruptive construction on the Hill Street culvert system upstream of the 60" CMP exceeds four seasons when bats are present, or 3) if disruptive construction on the 60" CMP exceeds one season when bats are present (March 15th through April 1st, or October 15th through November 15th).

The population utilizing the FBR basin is estimated at 1,900 to 2,300, and the entire gray bat population is conservatively estimated at 4,358,263. This project will impact less than 0.001% of the gray bat population. Therefore, it is the opinion of the USFWS that the level of take is not likely to result in jeopardy to the gray bat. In addition to the subsequent measures listed in the Reasonable and Prudent Measures and Terms and Conditions sections of this Opinion, the measures listed in the Conservation Measures section of this opinion must be implemented for this determination to remain valid.

8.2 APPALACHIAN ELKTOE

The USFWS anticipates incidental take of the Appalachian elktoe may occur as a result of the construction of the four bridges over the FBR. During construction, individual mussels may be crushed, harmed by siltation or other water quality degradation, or dislocated because of physical changes in their habitat. Appalachian elktoe have not been found in the Action Area during surveys for this project. However, they have been found 1.5 miles upstream during surveys for the I-4400/I-4700 project. For this project, we assume Appalachian elktoe occur at the same density estimated upstream for I-4400/I-4700. Our knowledge of the density and distribution of Appalachian elktoe is based on a small number of documented occurrences.

The survey data is not sufficient to populate a robust population model, but in an effort to estimate potential take, the USFWS applied a simple model incorporating survey effort and catch rates to estimate a baseline density for Appalachian elktoe in the I-4400/I-4700 Action Area. We estimated an experienced surveyor could reasonably cover 400 square meters in an hour of surveying. The mussels are not always at the surface, and due to difficulty seeing the small apertures in the substrate, surveyors are not likely to find every mussel. To compensate for this we estimated that a capture efficiency of 25% was reasonable based on previous experience with mussel survey techniques, i.e. the number of mussels found reflect 25% of the total mussels in a given area. Therefore, the model estimates an Appalachian elktoe density of 0.0005 mussels per square meter in the I-4400/I-4700 Action Area. For I-2513 we assume that Appalachian elktoe occur in the same densities.

This project proposes to directly affect around 253,425 square feet of habitat that will be covered by rock causeways and bridge footings. Based on the estimated density, we expect around 12 Appalachian elktoe to be in the area to be buried by bridge construction.

Due to the large extent and duration of this project, it is possible Appalachian elktoe in the Action Area will be affected by habitat degradation from sediment eroded from the project and from the degradation of channels receiving additional stormwater from the project. Applying the model density to the area of habitat in the Action Area returns an estimated population of 402 adult Appalachian elktoe in the Action Area. In order for the population to remain stable, recruitment in the action area needs to equal natural mortality in the population. Appalachian elktoe are estimated to live about 12 years with about 10 years of reproductive lifespan. That requires a recruitment rate of 0.10 annually, in this case approximately 40 new recruits per year that could be affected by project related effects.

Conservation measures outlined in the BA are intended to minimize effects due to sedimentation in the FBR. Even under standard construction conditions, we expect Appalachian elktoe within

the Action Area may be harmed by the presence of turbidity or settling of sediment in depositional portions of its habitat. We expect this effect to be non-lethal harm to adults that could result in temporarily reduced recruitment throughout the duration of the project. The effects of sediment pollution within the Action Area should not reach a level that prevents recolonization of the Action Area after construction. However, if soil and erosion BMPs are not effectively implemented, prolonged increases in sediment transport in Appalachian elktoe habitat could cause habitat alteration that would prevent future population growth even after construction is finished, this take is not accounted for in this BO. Due to the difficulty of measuring these effects directly, the NCDOT proposes monitoring project erosion control with a study conducted by the USGS. USGS proposes to use existing water quality data available from the NCDEQ and combine it with pre-construction data collected from USGS monitoring stations to measure a baseline turbidity.

We believe the conservation measures and monitoring included in the BA are sufficient to reduce the effects of construction such that the population of Appalachian elktoe in the French Broad is likely to remain healthy and viable into the future. Therefore, in this Opinion, the USFWS has determined that this level of take is not likely to result in jeopardy to the Appalachian elktoe. In addition to the subsequent measures listed in the Reasonable and Prudent Measures and Terms and Conditions sections of this Opinion, the measures listed in the Conservation Measures section of this opinion must be implemented for this determination to remain valid.

9. REASONABLE AND PRUDENT MEASURES

The USFWS believes the following reasonable and prudent measures are necessary and appropriate to minimize take of the gray bat and Appalachian elktoe. These non-discretionary measures include, but are not limited to, the commitments in the BA and the terms and conditions outlined in this Opinion.

1. The USFWS must be notified of any project modifications.

2. NCDOT will minimize impacts to roosting bats in the culvert roost to the extent possible through coordination with the USFWS for work that occurs between March 15th and November 15th.

3. NCDOT will provide modern bat roost panels or comparable structures that could serve as a temporary alternate roost for bats potentially disturbed by work on the culvert roost for the duration of construction of the I-2513 project. This will be in the place of the panels on four bridges NCDOT has committed to in the BA, which were to be placed on bridges with documented signs of bat use. These bridges are all relatively far from the Hill Street Culvert roost. The USFWS believes that panels placed on one bridge close to the Hill Street Culvert roost has greater potential to minimize take than panels placed on four bridges farther away.

4. NCDOT will minimize permanent lighting on waterways in the final lighting design plan to the extent possible, as well as current permanent lighting at the Hill Street Culvert Roost. Current plans for new permanent lighting (Appendix J) are preliminary in nature.

5. NCDOT will avoid and minimize potential take of bats roosting in culverts other than the Culvert Roost by conducting culvert checks before rehabilitation or repair work (see Term and Condition 12).

6. NCDOT will adhere to all BMPs for soil and erosion control, and will report to the USFWS (described in Term and Condition 7) if failures occur.

10. TERMS AND CONDITIONS

In order for the exemption from the take prohibitions of section 9(a)(1) of the ESA, the NCDOT must comply with the following terms and conditions, which implement the reasonable and prudent measures described previously and outline required reporting and/or monitoring requirements. These terms and conditions are non-discretionary. As necessary and appropriate to fulfill this responsibility, the NCDOT must require any permittee, Contractor, or grantee to implement these Terms and Conditions through enforceable terms that are added to the permit, contract, or grant document.

1. NCDOT will adhere to all measures listed in the Conservation Measures section of this Opinion and in the BA (if not revised in the BO).

2. NCDOT will simultaneously notify USACE and USFWS of any permit modification requests.

3. A USFWS biologist will be invited (at least seven days prior) to the preconstruction meeting(s) to review permit conditions and discuss any questions the Contractor has regarding implementation of the project. After the Contractor submits plans for various stages (outlined in post BO coordination Section 2.3.5.2) of the project, a USFWS biologist will review and provide comments (within 15 days upon acknowledgement of receipt of notice) on the plans and will be invited to attend any meetings to discuss implementation of the plans.

4. During construction, culvert inlets and outlets will be evaluated by the resident engineer with regard to stream stability immediately following installation and quarterly for a period of one year at each location. Indicators of instability, such as head cutting, scour, aggradation, or degradation, will be used to determine the need for corrective actions.

5. A final field inspection will be held with the Contractor to evaluate culvert placement and stream stability before the project is considered complete. If instability is detected during any of these reviews, corrective actions will be performed when deemed necessary by the engineer or by the conditions of any federal and state permits required by Section 404/401 of the Clean Water Act.

6. NCDOT and NCDEQ-DEMLR (land quality) will meet with USFWS to evaluate and discuss erosion control effectiveness if requested.

7. In the event of any failure of erosion control devices, within 48 hours, NCDOT will send a report to USFWS detailing the cause of the failure, photographs of the failure, and a plan for repair of the erosion control devices and reasonable methods to avoid future failure. NCDOT will notify the USFWS when failures are repaired.

8. To carry out Reasonable and Prudent Measure 2, the USFWS must be notified before work starts in the culvert.

- Work can only commence when the baffle is installed if work will occur from March 15th through November 15th.
- NCDOT will coordinate with the USFWS to determine the best timing for installing the baffle.
- The USFWS, or an individual approved by USFWS, must be present when trees are cleared near the culvert and when the baffle is installed if installation occurs when bats present.
- The USFWS may request that the baffle is moved, removed, or altered. It may be determined that disturbances from construction are less impactful than potential alterations to the culvert microclimate from the baffle, or noise levels no longer exceed the ambient level.
- If the RCBC outlet is needed to access other portions of the culvert, it will only be used when bats are not present.

9. The alternate bat roost structure from Reasonable and Prudent Measure 3 will consist of modern bat modular roost panels or comparable structures installed on a bridge over water as close to the culvert roost as possible, but out of areas disturbed by construction. Panels should be constructed of fiber-reinforced concrete with additives to mimic thermal mass and should be mounted using metal. Bridge selection and panel placement/design should be informed by work currently being conducted by Indiana State University. Panels must be installed before work starts on the culvert roost and should be checked for bat use once in early summer and once in late fall for three years following placement. The details of the location, size, design, and installation of the bat panels will be decided by a committee to include USFWS, NCWRC, and NCDOT. This panel will be installed temporarily for the duration of construction.

10. NCDOT will monitor bat activity before, during, and post construction.

- NCDOT has committed to conducting acoustic monitoring (and/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 related to construction. NCDOT will coordinate the locations and time frame for monitoring with USFWS. This will include monitoring the culvert roost, including before and after the baffle is installed.
- To investigate whether MYGR avoid active construction zones (including bridges and the Hill Street culvert roost) at night, NCDOT will explore 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 include telemetry, coordinated monitoring of roosts, monitoring of new panels, basin-wide acoustics to be conducted at key points during and after construction. The details of additional monitoring will be decided by a committee to include USFWS, NCWRC and NCDOT. Information gathered will be used to increase our knowledge of impacts to bats to help inform future consultation, to learn more about gray bats in the project area, to better conserve the species, and to track movements of bats and hopefully determine where bats go if they abandon the culvert roost and/or the area.

11. As part of Reasonable and Prudent Measure 4, NCDOT will give the USFWS the opportunity to discuss/review/comment on the lighting design drafts and final design plans (and allow 15 days for review upon acknowledgement of receipt of notice), including on the Bowen Bridge.

- Bowen Bridge: This bridge is being downgraded to carry four lanes of local traffic on the center lanes, and bike and pedestrian paths on the outer lanes. Lighting will be altered to accommodate these changes.
    - New lighting for vehicle and bike/pedestrian traffic will not exceed the current level of illumination on the water (an average of 0.10 foot-candle over an area that goes from shore to shore and extends approximately 50' to the north and south from the structures) as determined by a lighting engineer, and every effort will be made to reduce the level of illumination on the water.
    - NCDOT will work with USFWS to avoid and minimize impacts of light, including:
        - Light will be 3000 K or below
    - Proposed aesthetic panel lighting will not illuminate the water surface when bats are present (March 15th through November 15th). NCDOT and the City of Asheville will work with the USFWS to determine acceptable light color and levels when bats are present.
- Southern States: USFWS will be included in discussions about modifying the lights at Southern States to decrease light spill at the Hill Street culvert entrance. If the land owner does not agree to minimize lighting on their property, NCDOT will work with the USFWS to assess the effectiveness of and minimize light using a barrier (fence or vegetation) on their ROW easement.

12. In order to carry out Reasonable and Prudent Measure 5, NCDOT will conduct culvert checks for roosting bats within 30 days of rehabilitation or repair for any culverts five feet tall or higher, and 200 feet or longer, scheduled to occur from March 15th through November 15th. If bats are found, a similar protocol will be used to the pre-demolition check for bats in bridges.

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 culvert and work will begin after bats leave the culvert for the evening (if work occurs over multiple days, the culvert will need to be monitored each day work occurs), or
3. A permitted biologist will exclude bats from work area immediately prior to the start of work using acoustic deterrents (if this method is employed, the culvert will need to be checked each day work occurs to determine efficacy), or
4. A permitted biologist will hand remove bats from work area immediately prior to the start of work (the culvert will need to be checked each day work occurs to ensure bats do not return).

5. If pre-work check determines pups are present, NCDOT will refrain from culvert work until it can be determined by a biologist that the pups are volant, and then use the previous options to proceed with work.

13. The nearest flyover bridge to the culvert roost will not be closer than 300 feet from the outlet.

11. MONITORING AND REPORTING REQUIREMENTS

In order to monitor the impacts of incidental take, the NCDOT must report the progress of the Action and its impacts on the species to the USFWS. This section provides the specific instructions for such monitoring and reporting. As necessary and appropriate to fulfill this responsibility, the NCDOT must require any permittee, Contractor, or grantee implement these Terms and Conditions through enforceable terms that are added to the permit, contract, or grant document. Such enforceable terms must include a requirement to immediately notify the NCDOT and USFWS if the amount or extent of incidental take specified in this Incidental Take Statement is exceeded during action implementation.

NCDOT will provide a final report and yearly bat monitoring summaries to the Service by January 31st of each year starting at the end of the bat monitoring season, and concluding up to two years after construction is completed.

12. REINITIATION NOTICE

Formal consultation for the I-2513 project is concluded. Reinitiation of consultation is required by law if:

a. the amount or extent of incidental take is exceeded
    i. Gray Bats: If construction operations at the bridges cannot be completed after five years from the start of causeway construction without night operations, or culvert system work cannot be completed after four seasons when bats are not present, or 60" CMP work cannot be complete after one season when bats are not present, all work should stop, and the USFWS should be contacted immediately to reinitiate consultation.

    ii. If a continuing NOV* is issued to NCDOT, the USFWS should be contacted immediately to determine if consultation should be reinitiated with the FHWA.

    *If severe problems are found that may result in loss of sediment into waterbodies or onto adjacent property owners, a Notice of Violation (NOV) is issued by NCDEQ-Energy Mineral and Land Resources to NCDOT. Consequently, NCDOT and its contractors will react immediately to correct items noted in the NOV. If deficiencies are not corrected within the timeframe directed by the Energy, Mineral and Land Resources NOV, a Continuing NOV will be issued. A Continuing NOV indicates that sufficient progress has not been made to correct environmental deficiencies on a project.

b. new information reveals that the Action may affect listed species or designated critical habitat in a manner or to an extent not considered in this BO;
c. the Action is modified in a manner that causes effects to listed species or designated critical habitat not considered in this BO; or
d. a new species is listed or critical habitat designated that the action may affect.

13. Conservation Recommendations

We recommend the FHWA and NCDOT works with the USFWS to determine how roost panels on bridges could be installed permanently (with the option to remove them temporarily for maintenance), contributing to the FHWA 7(a)(1) commitments to proactively work toward recovery of the gray bat.

LITERATURE CITED

Adams, R. A. 2010. Bat reproduction declines when conditions mimic climate change projections for western North America. *Ecology*. 91(8):2437–2445.

AECOM. 2016. Traffic Forecast Report, TIP Project No. I-2513, I-26 Asheville Connector. Prepared by AECOM and Clearbox for North Carolina Department of Transportation. July 2016.

Barbour, R. W., and W. H. Davis. 1969. *Bats of America*. The University of Kentucky Press, Lexington, Kentucky.

Barclay, R. M. R. and R. M. Bingham. 1994. Constraints on optimal foraging: A field test of prey discrimination by echolocating insectivorous bats. *Animal Behavior*. 48:1013-1021.

Bernard R.F. and G.F. McCracken. 2017. Winter behavior of bats and the progression of white-nose syndrome in the southeastern United States. *Ecol Evol*. 7:1487–1496.

Bernard, R. F., E. V. Willcox, K. L. Parise, J. T. Foster, and G. F. McCracken. 2017. White-nose syndrome fungus, Pseudogymnoascus destructans, on bats captured emerging from caves during winter in the southeastern United States. *BMC Zoology*, 2(1):12.

Berthinussen A. and Altringham, J. 2012. The effect of a major road on bat activity and diversity. Journal of Applied Ecology, 49: 82-89.

Best, T. L. and M. K. Hudson. 1996. Movements of gray bats (*Myotis grisescens*) between roost sites and foraging areas. *The Journal of the Alabama Academy of Science*. 67:6-14.

Best, T. L., B. A. Milam, T. D. Haas, W. S. Cvilikas, and L. R. Saidak. 1997. Variation in diet of the gray bat (Myotis grisescens). *Journal of Mammalogy*. 78:569-583.

Blake D., A. M. Huston, P. A. Racey, J. Rydell, and J. R. Speakman. 1994. Use of lamplit roads by foraging bats in Southern England. *Journal of Zoology.* 234:453–462.

Brack, V., Jr., R. E. Mumford, and W. R. Holmes. 1984. The gray bat (*Myotis grisescens*) in Indiana. *American Midland Naturalist*. 111:205.

Brack, V., Jr. 1985. The foraging ecology of some bats in Indiana. *Indiana Academy of Sciences*. 94:231-237.

Brack, V., Jr. and R. K. LaVal. 2006. Diet of the gray myotis (*Myotis grisescens*): Variability and consistency, opportunism, and selectivity. *Journal of Mammalogy*. 87:7-18.

Brady, J. T., T. H. Kunz, M. D. Tuttle, and D. E. Wilson. 1982. Gray bat recovery plan. U.S. Fish and Wildlife Service, Denver, CO.

Clark, D. R., Jr., R. K. LaVal, and D. M. Swineford. 1978. Dieldrin-induced mortality in an endangered species, the gray bat (*Myotis grisescens*). *Science*. 199(4335):1357-1359.

Clark, D. R., Bagley, F.M., and Waynon Johnson, W. W., 1988. Northern Alabama colonies of the endangered grey bat *Myotis grisescens*: organochlorine contamination and mortality,
Biological Conservation. 43(3): 213-225.

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

Clawson, R. L. 1984. Investigations of endangered Indiana bat and gray bat summer ecology, distribution and status. Missouri Department of Conservation Surveys and Investigation Projects, Study Number 66.

Cryan, P. M., C. U. Meteyer, J. G. Boyles, and D. Blehert. 2013. White-nose syndrome in bats: illuminating the darkness. *BMC Biology*. 11:47.

Daan, S. 1973. Activity during natural hibernation in three specie of vespertilionid bats. *Netherlands Journal of Zoology.* 23:1-77.

Downs. N. C., V. B., J. Guest., J. Polanski., S. L. Robinson., and P. A. Racey. 2003. The effects of illuminating the roost entrance on the emergence behavior of *Pipistrellus pygmaeus*. *Biological Conservation, 111*, 247-252.

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

Engineering ToolBox. 2004. *Illuminance - Recommended Light Level*. [online] Available at:
https://www.engineeringtoolbox.com/light-level-rooms-d_708.html [Accessed March 25, 2019].

Flock, B. 2014. Bat Population Monitoring and White-Nose Syndrome Surveillance. Tennessee Wildlife Resources Agency. TWRA Wildlife Technical Report 14-07. Accessed on October 17, 2017.
http://www.tnbwg.org/Files/1407%202014%20Bat%20Hibernacula%20Surveys%20and%20WNS%20Monitoring.pdf.

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

Gaisler, J., Z. Řehák, and T. Bartonička. 2009. Bat casualties by road traffic (Brno-Vienna). *Acta Theriologica*. 54 (2):147.

Goebel, A. B. 1996. Temporal variation in movement patterns of adult female *Myotis grisescens* (Chiroptera: Vespertilionidae). M.S. thesis, Auburn University, Alabama.

Gore, J. A. 1992. Gray bat. Pages 63-70 *in* S. R. Humphrey and A. E. Ashton, Jr. (eds.) *Rare and Endangered Biota of Florida, Vol. 1, Mammals*. University Press of Florida, Gainesville.

Gorresen, P. M., Cryan, P. M., Dalton, D. C., Wolf, S., & Bonaccorso, F. J. 2015. Ultraviolet Vision May be Widespread in Bats. *Acta Chiropterologica, 17*(1), 193-198. doi:10.3161/15081109ACC2015.17.1.017

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

Gunier, W. J., and W. H. Elder. 1971. Experimental homing of gray bats to a maternity colony in a Missouri barn. *American Midland Naturalist*. 86:502-506.

Hall, J. S., and N. Wilson. 1966. Season population movements of the gray bat in the Kentucky area. *American Midlands Naturalist*. 75:317-324.

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

Harvey, M. J. 1975. Endangered Chiroptera of the southeastern United States. *Southeastern Association of Game and Fish Commissioners*. 29:429-433.

Harvey, M. J., J. J. Cassidy, and G. G. O'Hagan. 1981. *Endangered bats of Arkansas: distribution, status, ecology, and management: report to Arkansas Game and Fish Commission, US Forest Service, Ozark National Forest, [and] National Park Service, Buffalo National River*. Ecological Research Center, Department of Biology, Memphis State University, Memphis, Tennessee, 137pp.

Harvey, M. J. and V. R. McDaniel. 1988. Non-cave roosting sites of the endangered gray bat, *Myotis grisescens*, in Arkansas. (Abstract). *Bat Research News*. 29(4):47.

Harvey, M. J. 1992. *Bats of the eastern United States*. Arkansas Game and Fish Commission, Little Rock.

Harvey, Michael J. 1994. Status of the Endangered Gray Bat (*Myotis grisescens*) Hibernating Populations in Arkansas. Journal of the Arkansas Academy of Science: Vol. 48: 52.

Harvey, M. J., and R. R. Currie. 2007. Gray bat (*Myotis grisescens*) status review. Unpublished working paper, U.S. Fish and Wildlife Service, Asheville, NC. March 2007.

Hays, H. A. and D. C. Bingman. 1964. A colony of gray bats in southeastern Kansas. *Journal of Mammalogy*. 45:150.

Herreid, C. F., II. 1963. Temperature regulation of Mexican free-tailed bats in cave habitats. *Journal of Mammalogy*. 44:560-573.

Herreid, C. F., II. 1967. Temperature regulation, temperature preferences and tolerance, and metabolism of young and adult free-tailed bats. *Physiological Zoology*. 40:1-22

Humphries, M. M., D. W. Thomas, and J. R. Speakman. 2002. Climate-mediated energetic constraints on the distribution of hibernating mammals. *Nature* 418: 313–316.

Keeley, B. W. and M. D. Tuttle. 1999. Bats in American bridges. *Bat Conservation International,* Inc., Resource Publication No. 4, 40 pp.

Kiefer, A., H. Merz, W. Rackow, H. Roer, and D. Schlegel. 1995. Bats as traffic casualties in Germany. *Myotis*. *32*(33):215-220.

Krulin, G. S. and J. A. Sealander. 1972. Annual lipid cycle of the gray bat, *Myotis grisescens*. *Comparative Biochemistry and Physiology*. 42 A:537-549.

LaVal, R. K., R. L. Clawson, M. L. La Val, and W. Caire. 1977. Foraging behavior and nocturnal activity patterns of Missouri bats, with emphasis on the endangered species *Myotis grisescens* and *Myotis sodalis*. *Journal of Mammalogy*. 58:592-599.

Lacki, M. J., L. S. Burford, and J. O. Whittaker, Jr. 1995. Food habits of gray bats in Kentucky. *Journal of Mammalogy*. 76:1256-1259.

Lamb, J. W. 2000. Section 10 permit number SA 97-34 annual report for *Myotis grisescens* and *Myotis sodalis* on Arnold Air Force Base/Arnold Engineering Development Center (AEDC), Unpublished Report, ASC Environmental Services, Conservation, Arnold Air Force Base, TN.

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

Lesiński, G. 2007. Bat road casualties and factors determining their number. *Mammalia*. 71(3): 138-142.

Lesinski G., A. Sikora, and A. Olszewski. 2010. Bat casualties on a road crossing a mosaic landscape. *European Journal of Wildlife Research.* 57:217–223.

Lewanzik, D., & Voigt, C. C. 2017. Transition from conventional to light-emitting diode street lighting changes activity of urban bats. *Journal of Applied Ecology, 54*(1), 264-271.

Linley, G. D. 2017. The impact of artificial lighting on bats along native coastal vegetation. Australian Mammalogy, 39(2), 178-184. doi:10.1071/am15047

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

Martin, C. O. 2007. Assessment of the population status of the gray bat (*Myotis grisescens*). Status review, DoD initiatives, and results of a multi-agency effort to survey wintering populations at major hibernacula, 2005-2007. Environmental Laboratory, U.S. Army Corps of Engineers, Engineer Research and Development Center Final Report ERDC/EL TR-07-22. Vicksburg, Mississippi. 97pp.

Medinas, D., J. T. Marques, and A. Mira. 2013. Assessing road effects on bats: the role of landscape, road features, and bat activity on road-kills. *Ecological Research*. 28:227.

Miller, R. E. (1939), The reproductive cycle in male bats of the species *Myotis lucifugus* lucifugus and *Myotis grisescens*. J. Morphol., 64: 267-295.

Mitchell, W. A. 1998. Species profile: gray bat (*Myotis grisescens*) on military installations in the southeastern United States. U.S. Army Corps of Strategic Environmental Research and Development Program Technical Rep- SERDP-98-6, U.S. Army Corps of Engineers Waterways Experiment Station, Vicksburg, MS. 25pp.

Mitchell, W. A. and C. O. Martin. 2002. Cave- and Crevice-Dwelling Bats on USACE Projects: Gray Bat. *ERDC TN-EMRRP-SI-25*, 11 pp.

Mohr, C. E. 1972. The status of threatened species of cave-dwelling bats. Bulletin of the National Speleological Society. 34:33-37.

Moore, Patrick R., T.S. Risch, D.K. Morris, and V. Rolland. 2017. Habitat use of female gray bats assessed using aerial telemetry. Journal of Wildlife Management 81(7):1242-1253.

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

North Carolina Department of Transportation (NCDOT). 1995. Phase I Environmental Analysis – Asheville Urban Area. North Carolina Department of Transportation, Statewide Planning Branch. April 1995.

North Carolina Department of Transportation (NCDOT). 2014a. Asheville Regional Cumulative Effects Study – Final. 96 pp.

North Carolina Department of Transportation (NCDOT). 2014b. Post-Construction Stormwater Program - Post-Construction Stormwater Controls for Roadway and Non-Roadway Projects. Hydraulics Unit. Raleigh, April 2014.

North Carolina Department of Transportation (NCDOT). 2019. Biological Assessment for I-26 Connector, I-40 to US 19/23/70 North of Asheville, Buncombe County, Asheville, North Carolina.

North Carolina Department of Transportation (NCDOT). 2020. I-26 Asheville Connector. Final Environmental Impact Statement.

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

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

Powers, K. E., R. J. Reynolds, W. Orndorff, B. A. Hyzy, C. S. Hobson, W. M. and Ford. 2016. Monitoring the Status of Gray Bats (*Myotis grisescens*) in Virginia, 2009–2014, and Potential Impacts of White-Nose Syndrome. *Southeastern Naturalist.* 15(1):127-137.

Rabinowitz, A. R. and M. D. Tuttle. 1982. A test of the validity of two currently used methods of determining bat prey preferences. *ACTA TheriologicaI. 27*. 21:283-293.

Russell A. L., C. M. Butchkoski, L. Saidak, and G. F. McCracken. 2009. Road-killed bats, highway design, and the commuting ecology of bats. *Endangered Species Research.* 8:49–60.

Russo, D., L. Ancillotto, L. Cistrone, N. Libralato, A. Domer, S. Cohen and C. Korine, Effects of artificial illumination on drinking bats: a field test in forest and desert habitats, *Animal Conservation*, 22, 2, (124-133), (2018).

Rydell, J. 1992. Exploitation of insects around streetlamps by bats in Sweden. *Functional Ecology.* 6:744–750.

Rydell, J. and H. J. Baagøe. 1996. Gatlampor ökar fladdermössens pre-dation på fjärilar [Streetlamps increase bat predation on moths]. *Entomologisk Tidskrift*. 117:129–35.

Rydell, J., Eklof, J., & Sanchez-Navarro, S. 2017. Age of enlightenment: long-term effects of outdoor aesthetic lights on bats in churches. *Royal Society Open Science, 4*(8), 8.

Saugey, D. A. 1978. Reproductive biology of the gray bat, *Myotis grisescens*, in north-central Arkansas. M.S. Thesis, Arkansas State University, Jonesboro.

Sealander, J. A. 1979. *A guide to Arkansas mammals*. River Road Press, Conway. 313 pp.

Secord, A. L.; K.A. Patnode, C. Carter, E. Redman, D.J. Gefell, A.R. Major, and D.W. Sparks. 2015. Contaminants of emerging concern in bats from the Northeastern United States, Arch. Environ. Contam. Toxicol.

Shapiro, A., and M. G. Hohmann. 2005. Summary of threatened and endangered bat related restrictions on military training, testing, and land management. U.S. Army Engineer Research and Development Center Construction Engineering Research Laboratory ERDC/CERL Technical Report TR-05-13, ADA443510.

Shauna Marquardt, USFWS Gay bat species lead biologist. Columbia Missouri Field Office. Phone conversation 11 February, 2019.

Sherwin, H. A., W. I. Montgomery, and M. G. Lundy. 2013. The impact and implications of climate change for bats. *Mammal Review*. 43:171-182. doi: 10.1111/j.1365-2907.2012.00214.x.

Sparks, D. W., V. Brack, Jr., J. O. Whitaker, Jr., and R. Lotspeich. 2009. Reconciliation ecology and the Indiana Bat at Indianapolis International Airport, Chapter 3. in Airports: Performance, Risks, and Problems, (P. B. Larauge and M. E. Castille, eds.) Nova Science Publishers, Inc., Hauppauge, New York.

Spoelstra K., R.H.A. van Grunsven, J.J.C. Ramakers, K.B. Ferguson, T. Raap, M Donners, E.M. Veenendaal, M.E. Visser. 2017. Response of bats to light with different spectra: light-shy and agile bat presence is affected by white and green, but not red light. Proceedings of the Royal Society 284: 20170075.

Stevenson, D. E. and M. D. Tuttle. 1981. Survivorship in the endangered gray bat (*Myotis grisescens*). *Journal of Mammalogy*. 62(2):244-257.

Stone, E. L., G. Jones, and S. Harris. 2009. Street lighting disturbs commuting bats. *Current Biology.* 19:1123–1127.

Stone E. L., G. Jones, and S. Harris. 2012. Conserving energy at a cost to biodiversity? Impacts of LED lighting on bats. *Global Change Biology.* 19:2458–2465.

Thogmartin, W. E., C. Sanders-Reed, J. A. Szymanski, R. A. King, L. Pruitt, P. C. McKann, M. C. Runge, and R. E. Russell. 2013. White-nose syndrome is likely to extirpate the endangered Indiana bat over large parts of its range. *Biological Conservation*. 160:162-172.

Thomas, D. P. 1994. A radiotelemetric assessment of the foraging ecology of the gray bat (*Myotis grisescens*) at Guntersville Reservoir, Alabama. M.S. Thesis, Auburn University, AL.

Thomas, D.P., and T.L. Best. 2000. Radiotelemetric assessment of movement patterns of the gray bat (*Myotis grisiscens*) at Guntersville Reservoir, Alabama. Pages 27-39 in B.R. Chapman and J. Laerm, editors. Fourth Colloquium on Conservation of Mammals in the

Timmerman, L. and V. R. McDaniel. 1992. "Maternity Colony of Gray Bats in a Non-Cave Site," *Journal of the Arkansas Academy of Science*: 46:108-109.

Tuttle, M. D. 1975. Population ecology of the gray bat (*Myotis grisescens*): factors influencing early growth and development. *Occasional Papers of the Museum of Natural History, University of Kansas*. 36:1-24.

Tuttle, M. D. 1976a. Population ecology of the gray bat (*Myotis grisescens*): philopatry, timing, and patterns of movement, weight loss during migration, and seasonal adaptive strategies. *Occasional Papers of the Museum of Natural History University of Kansas*. 54:1-38.

Tuttle, M. D. 1976b. Population ecology of the gray bat (*Myotis grisescens*): Factors influencing growth and survival of newly volant young. *Ecology*. 57:587-595.

Tuttle, M. D. 1979. Status, causes of decline and management of endangered gray bats. *Journal of Wildlife Management*. 43: 1-17.

Tuttle, M.D. and D.E. Stevenson. 1977. An analysis of migration as a mortality factor in the gray bat based on public recoveries of banded bats. *American Midland Naturalist*. 91(1):235-240.

Tuttle, M. D. and D. E. Stevenson. 1978. Variation in the cave environment and its biological implications. Pages 108-21 *in* R. Zuber (ed). National cave management symposium proceedings, 1977, Big Sky, Montana.

Tuttle, M. D. and J. Kennedy. 2005. Field guide to eastern cave bats. Bat Conservation International, Inc., Austin, TX. 41 pp.

United States Fish and Wildlife Service (USFWS). 1980. Selected vertebrate endangered species of the seacoast of the United States - the gray bat. FWS/OBS-80/01.42, U.S. Fish and Wildlife Service, Slidell, LA.

United States Fish and Wildlife Service (USFWS). 1982. Gray Bat Recovery Plan. Minneapolis, MN, 26 pp.

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

United States Fish and Wildlife Service (USFWS). 2002. Endangered and Threatened Wildlife and Plants: Designation of Critical Habitat for the Appalachian Elktoe. CFR, Vol. 67, No. 188.

United States Fish and Wildlife Service (USFWS). 2009a. Gray bat (*Myotis grisescens*) 5-year Review. US Fish and Wildlife Service, Columbia, MO. 23 pp. + appendices.

United States Fish and Wildlife Service (USFWS). 2009b. Appalachian Elktoe (*Alasmidonta raveneliana*) 5-Year Review. Asheville, North Carolina, 22 pp

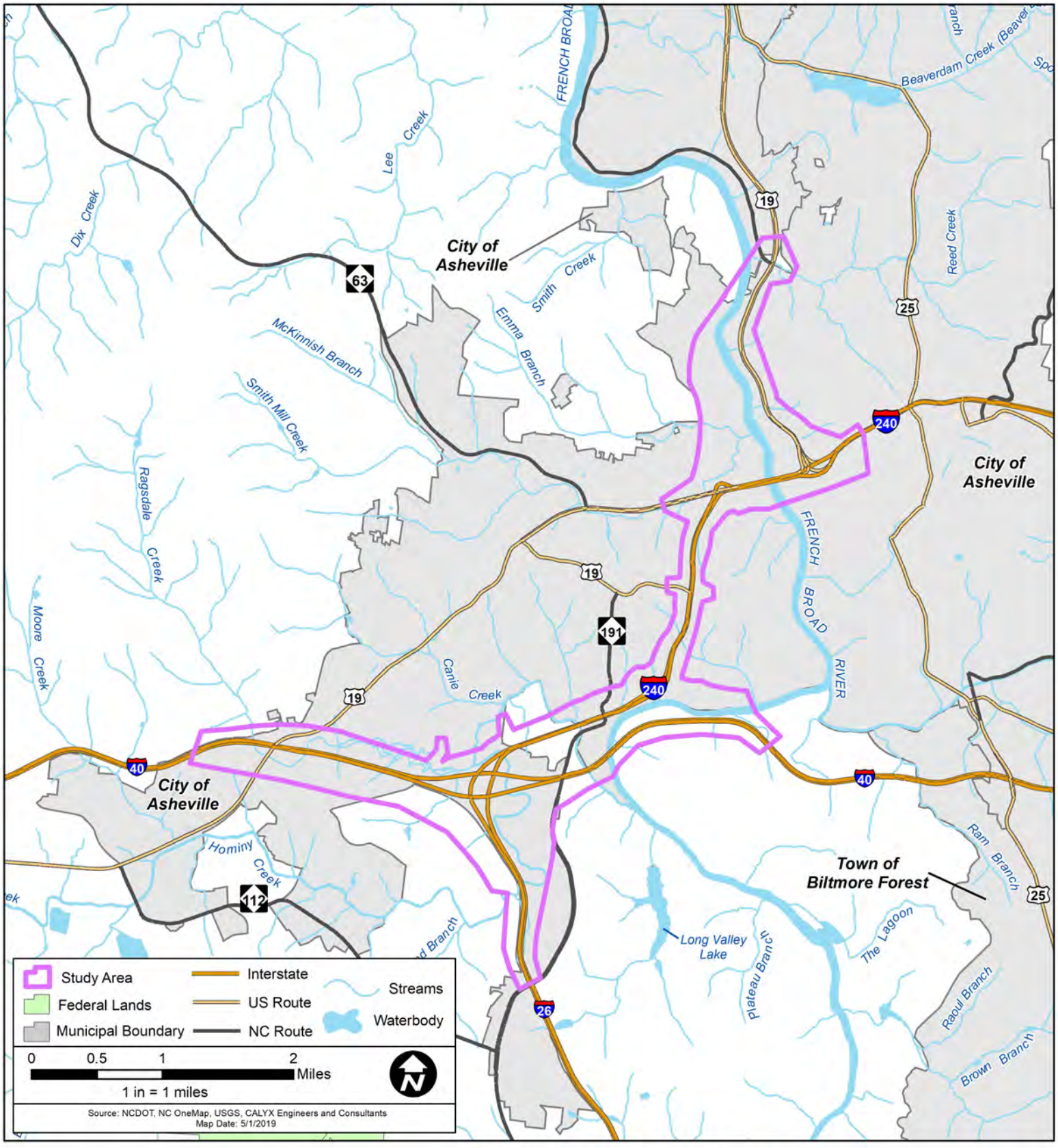
United States Fish and Wildlife Service (USFWS). 2012. White-nose Syndrome Confirmed in Federally Endangered Gray Bats. Accessed on September 12, 2017. https://www.fws.gov/external-affairs/public-affairs/.

Voigt, C C, A. C, Dekker, J, Ferguson, J, Fritze, M, Gazaryan, S, Hölker, F, Jones, G, Leader, N, Lewanzik, D, Limpens, H J G A, Mathews, F, Rydell, J, Schofield, H, Spoelstra, K and Zagmajster, M (2018) *Guidelines for consideration of bats in lighting projects.* Technical Report. UN Environment, UNEP/EUROBATS Secretariat, Bonn, Germany.

Wakefield, A., Broyles, M., Stone, E. L., Jones, G., & Harris, S. 2016. Experimentally comparing the attractiveness of domestic lights to insects: Do LEDs attract fewer insects than conventional light types? *Ecology and Evolution, 6*(22), 8028-8036.

Wakefield A, Broyles M, Stone EL, Harris S, Jones G. 2018. Quantifying the attractiveness of broadspectrum street lights to aerial nocturnal insects. J Appl Ecol. 55, 714–722. https://doi.org/10.1111/1365-2664.13004

APPENDIX A. FIGURES



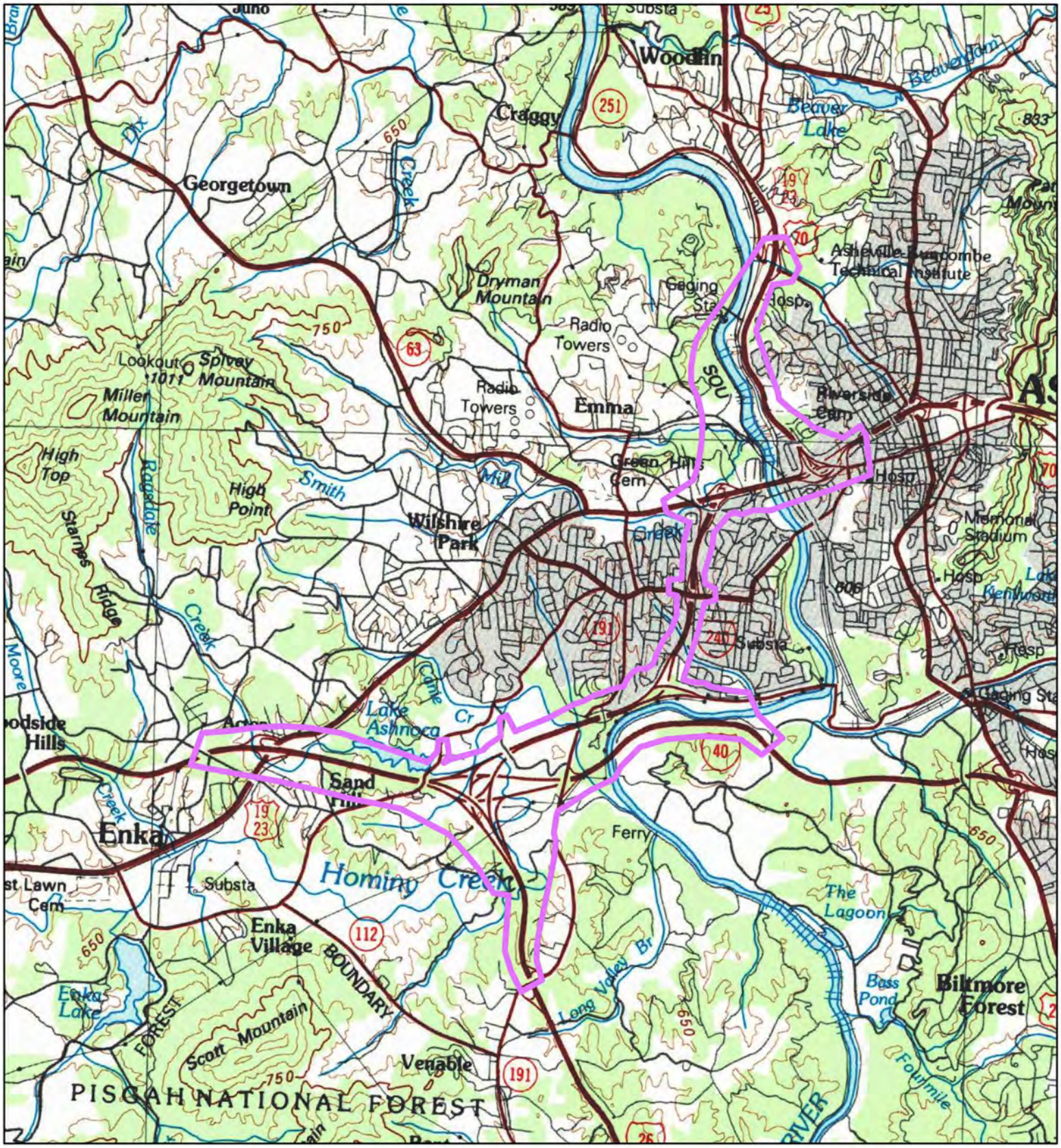
NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

I-26 Asheville Connector

TIP Project I-2513

Buncombe County, NC

Figure 1 - Project Vicinity



NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

I-26 Asheville Connector

TIP Project I-2513

Buncombe County, NC

Legend

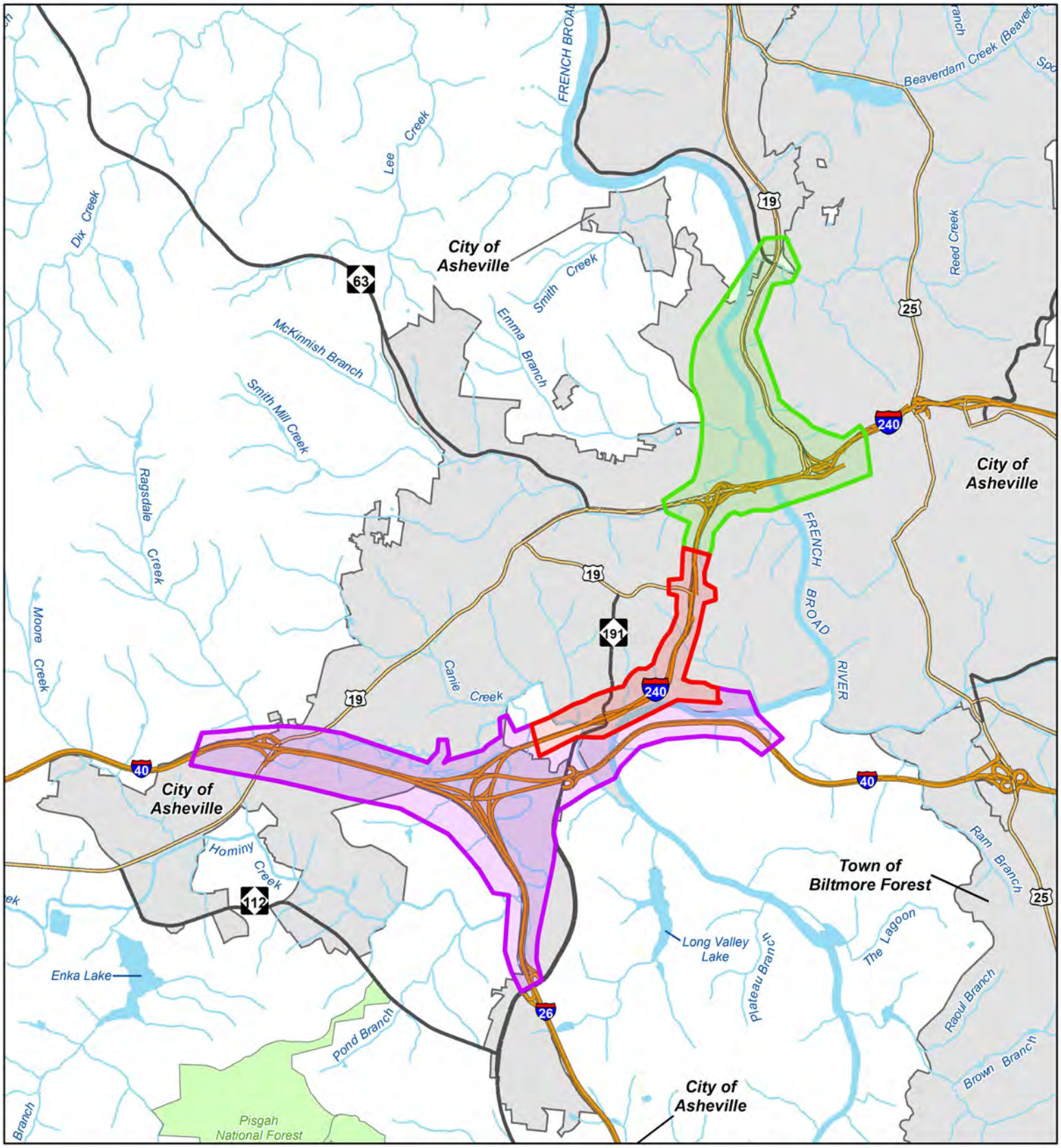
Study Area

0 0.5 1 2 Miles

1 in = 1 mile

Figure 2 - Landscape Position

Source: NC OneMap, CALYX Engineers and Consultants
Map Date: 1/14/2019



NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

I-26 Asheville Connector

TIP Project I-2513

Buncombe County, NC

Legend

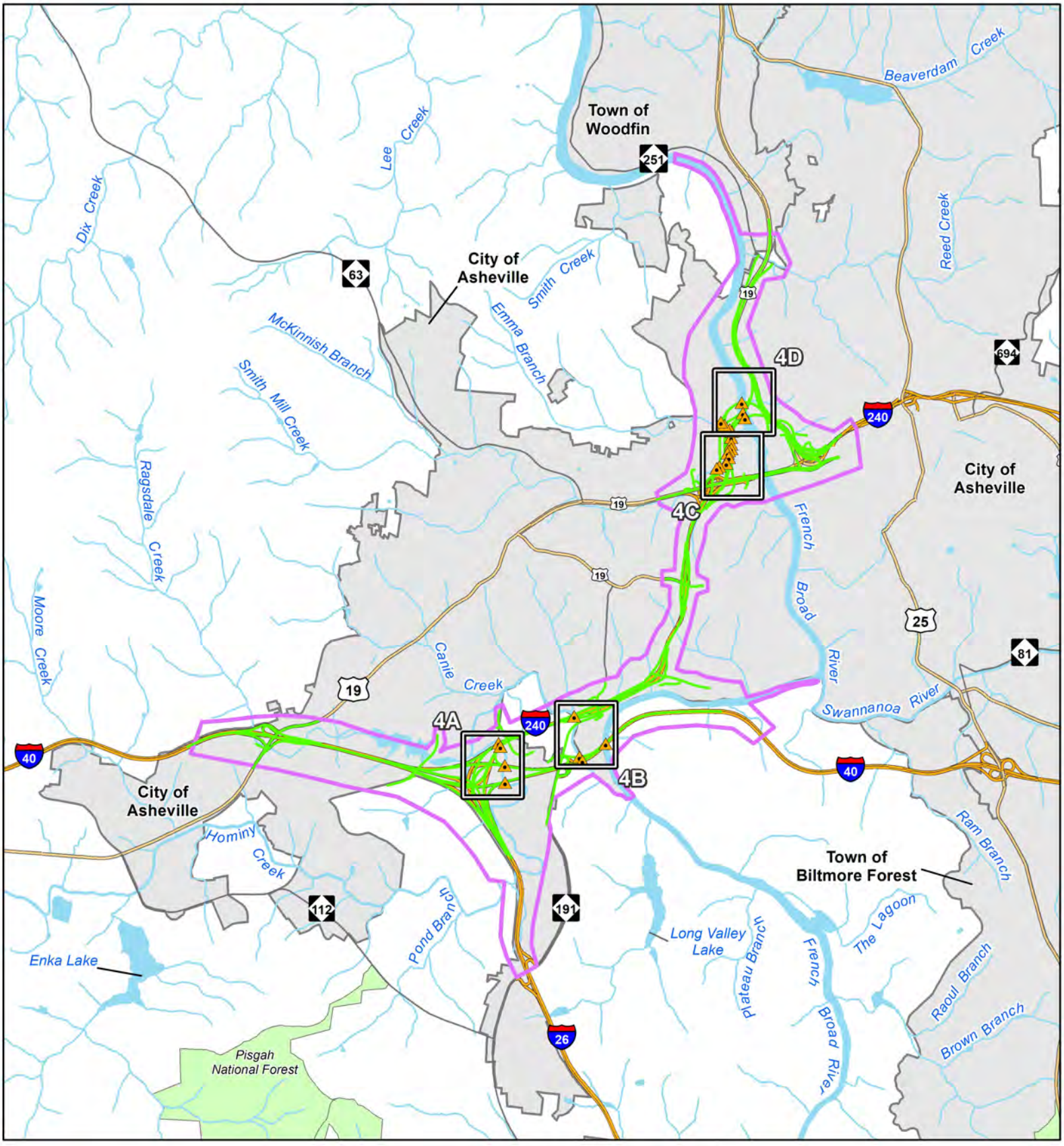
- Section A
- Section B
- Section C
- Interstate
- US Route
- NC Route
- Federal Lands
- Streams
- Waterbody

0 0.5 1 2 Miles

1 in = 1 mile

Figure 3
Project Study Area and Sections

Source: NCDOT, NC OneMap, USGS, CALYX Engineers and Consultants
Map Date: 1/14/2019



NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

I-26 Asheville Connector

TIP Project I-2513

Buncombe County, NC

Legend

- Crossing Location
- Map Tile
- Action Area
- Detailed Study Alternative
- Federal Land
- Municipal Boundary
- Waterbody
- Stream
- Interstate
- US Route
- NC Route
- Major Road

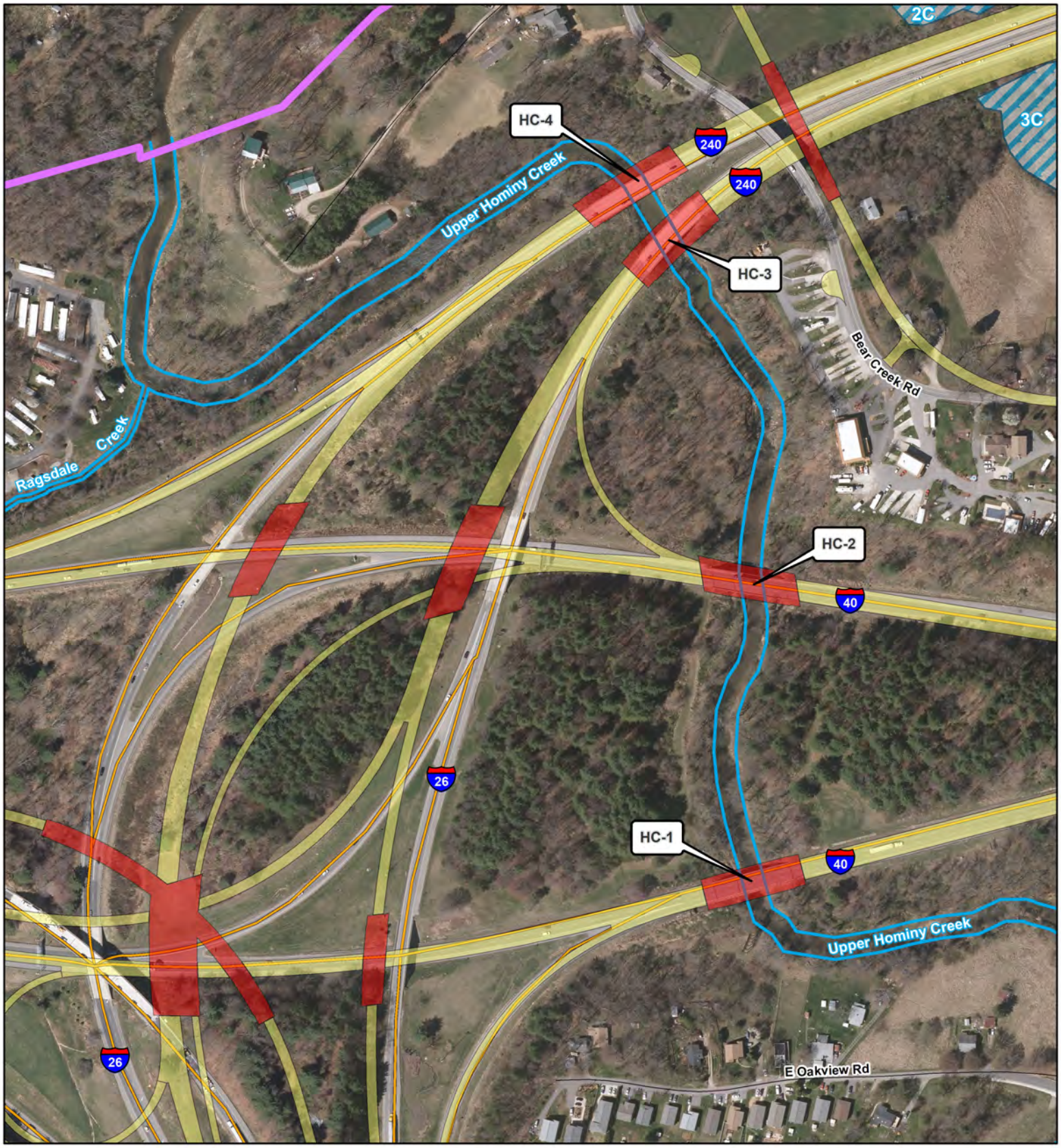
0 0.5 1 2 Miles

1 in = 1 miles

Figure 4

Crossing Locations Overview

Source: NC OneMap, CALYX Engineers and Consultants
Map Date: 5/2/2019



NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

I-26 Asheville Connector

TIP Project I-2513

Buncombe County, NC

Legend

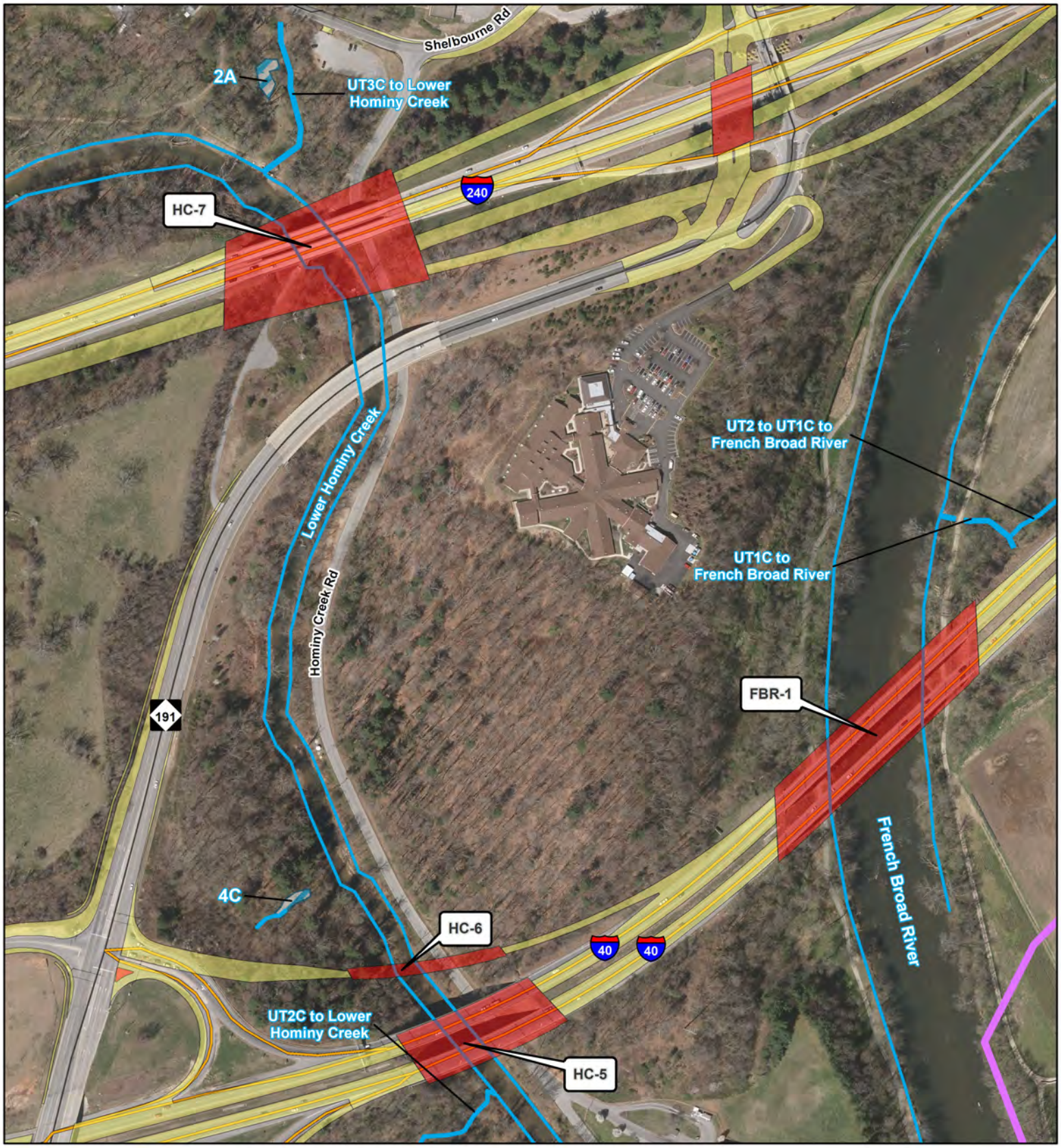
- Study Area
- HC-1 Crossing
- Proposed Bridge
- Proposed Roadway
- Delineated Wetland
- Delineated Stream
- Interstate
- US Route
- NC Route
- Major Road
- Local Road

0 150 300 600 Feet

1 in = 300 ft

Figure 4A
Crossing Locations

Source: NC OneMap, CALYX Engineers and Consultants
Map Date: 5/1/2019



NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

I-26 Asheville Connector

TIP Project I-2513

Buncombe County, NC

Legend

- Study Area
- HC-1 Crossing
- Proposed Bridge
- Proposed Roadway
- Delineated Wetland
- Delineated Stream
- Interstate
- US Route
- NC Route
- Major Road
- Local Road

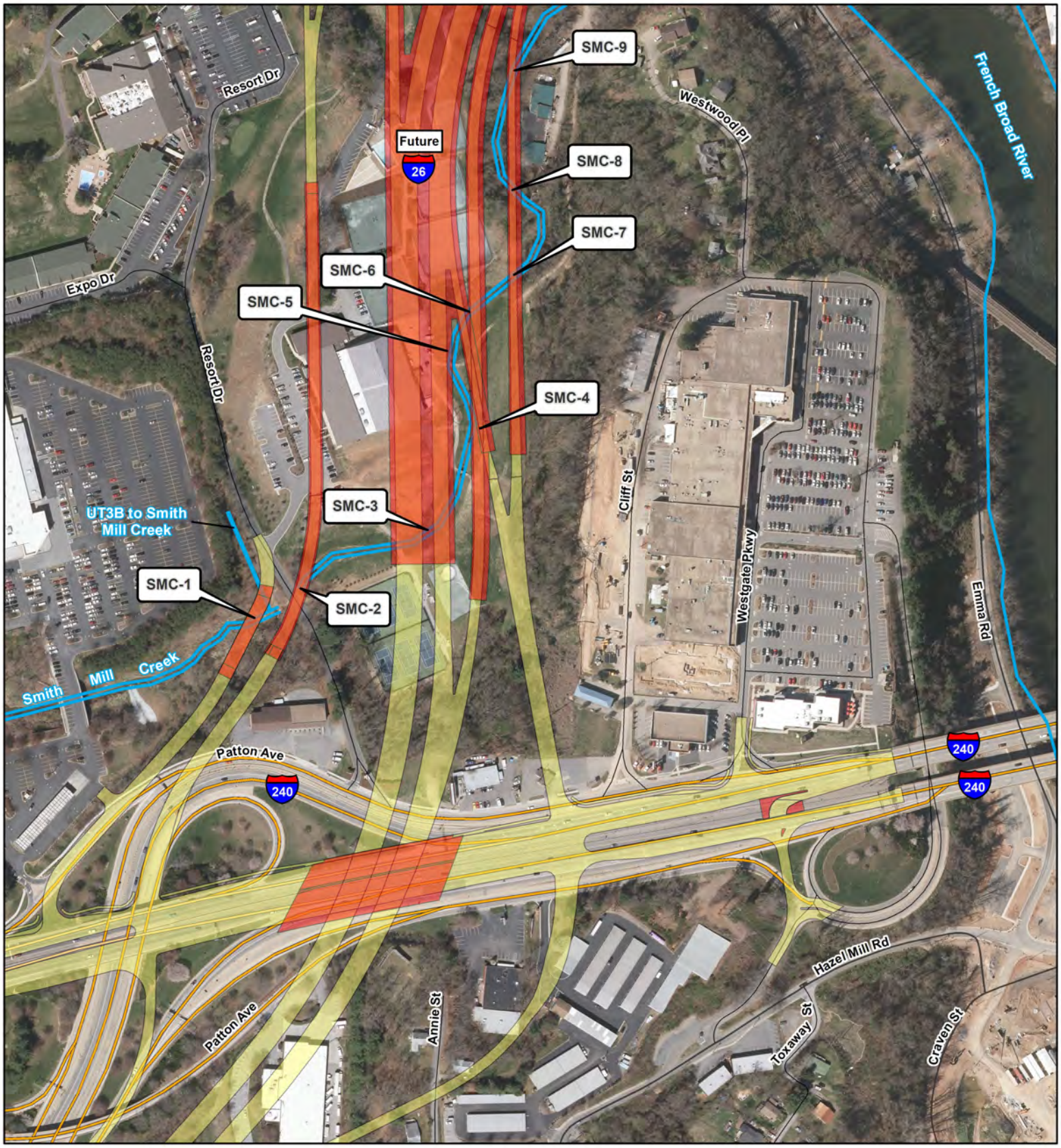
0 150 300 600 Feet

1 in = 300 ft

Figure 4B

Crossing Locations

Source: NC OneMap, CALYX Engineers and Consultants
Map Date: 5/1/2019



NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

I-26 Asheville Connector

TIP Project I-2513

Buncombe County, NC

Legend

- Study Area
- HC-1 Crossing
- Proposed Bridge
- Proposed Roadway
- Delineated Wetland
- Delineated Stream
- Interstate
- US Route
- NC Route
- Major Road
- Local Road

0 150 300 600 Feet

1 in = 300 ft

Figure 4C

Crossing Locations

Source: NC OneMap, CALYX Engineers and Consultants
Map Date: 5/1/2019

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

I-26 Asheville Connector

TIP Project I-2513

Buncombe County, NC

Legend

- Study Area
- HC-1 Crossing
- Proposed Bridge
- Proposed Roadway
- Delineated Wetland
- Delineated Stream
- Interstate
- US Route
- NC Route
- Major Road
- Local Road

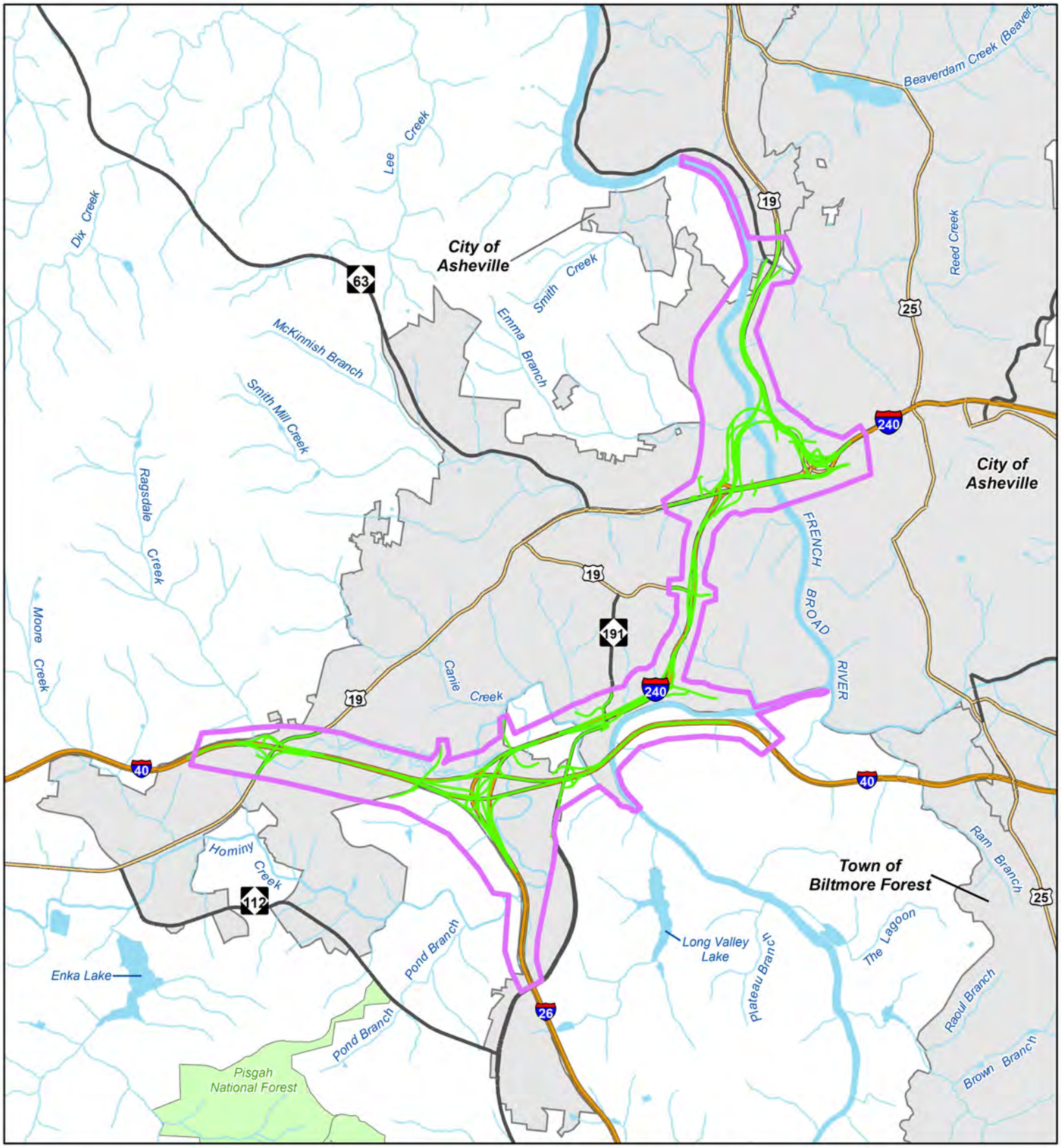
0 150 300 600 Feet

1 in = 300 ft

Figure 4D

Crossing Locations

Source: NC OneMap, CALYX Engineers and Consultants
Map Date: 5/1/2019



NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

I-26 Asheville Connector

TIP Project I-2513

Buncombe County, NC

Legend

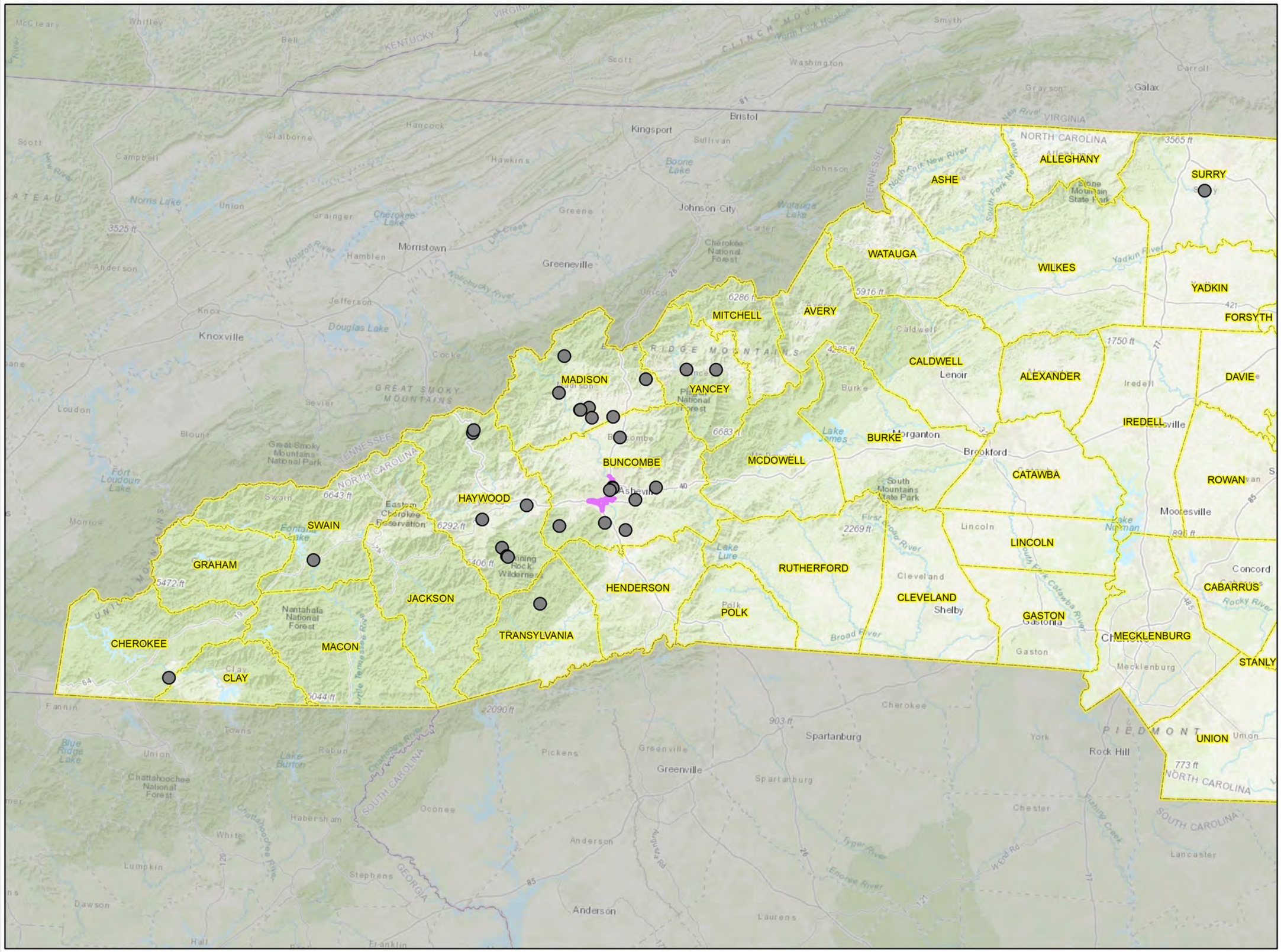
- Action Area
- Detailed Study Alternative
- Interstate
- US Route
- NC Route
- Federal Lands
- Municipal Boundary
- Streams
- Waterbody

0 0.5 1 2 Miles

1 in = 1 mile

Figure 5 - Action Area

Source: CALYX Engineers and Consultants
Map Date: 5/2/2019



Legend

- Bat Occurences
- Action Area
- County Boundary

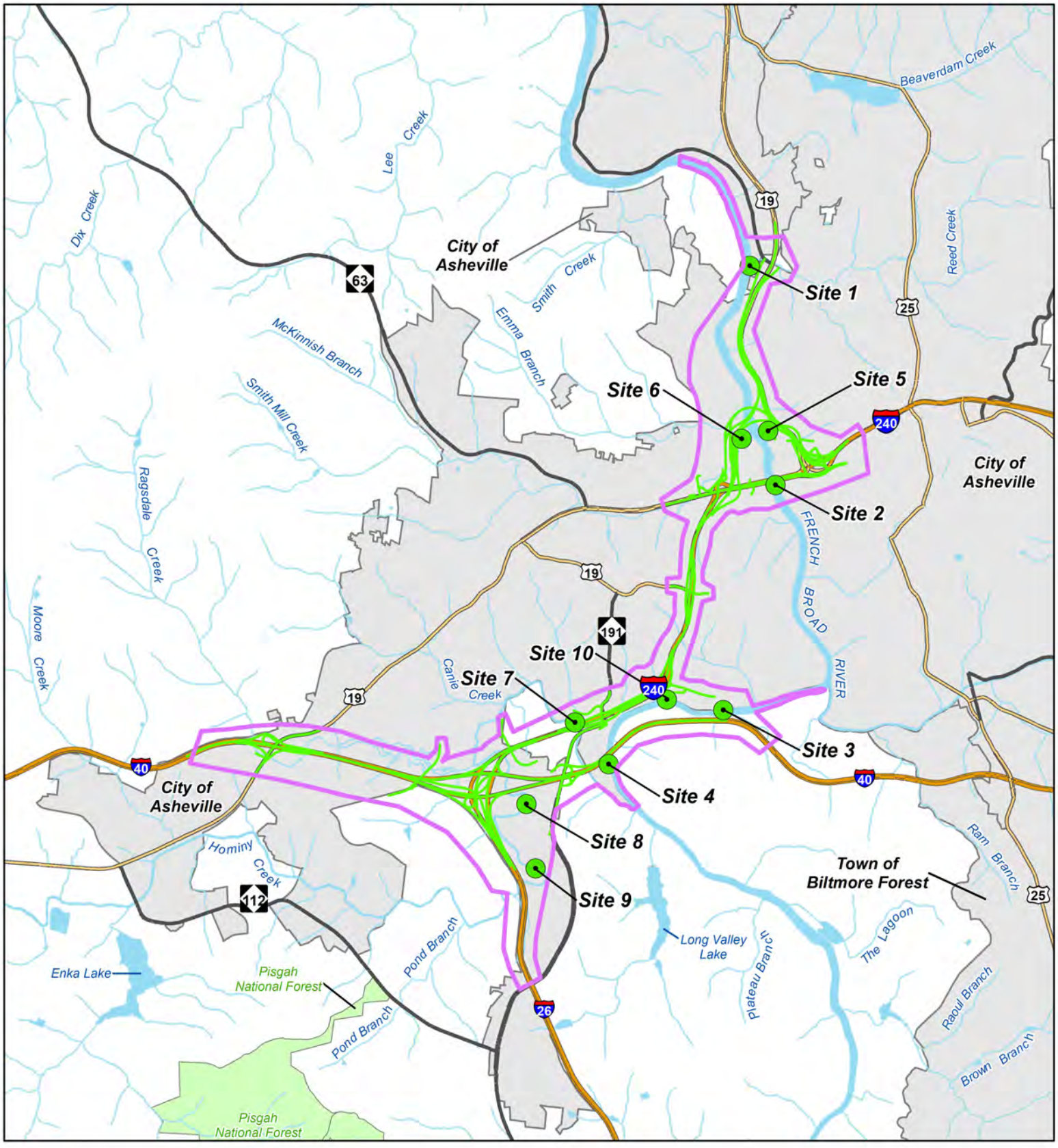
Figure 6

NC Gray Bat Occurrences

I-26 Asheville Connector
TIP Project I-2513

Buncombe County, NC

Source: ESRI, NCDOT, CALYX Engineers and Consultants, NCNHP (Tier 2 Data; released July 2018)
Map Date: 10/11/2019



NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

I-26 Asheville Connector

TIP Project I-2513

Buncombe County, NC

Legend

- Action Area
- Acoustic Detector Location
- Detailed Study Alternative
- Interstate
- US Route
- NC Route
- Federal Lands
- Municipal Boundary
- Streams
- Waterbody

0 0.5 1 2 Miles

1 in = 1 mile

Figure 7 - Acoustic Detector Locations

Source: NC OneMap, CALYX Engineers and Consultants
Map Date: 5/2/2019

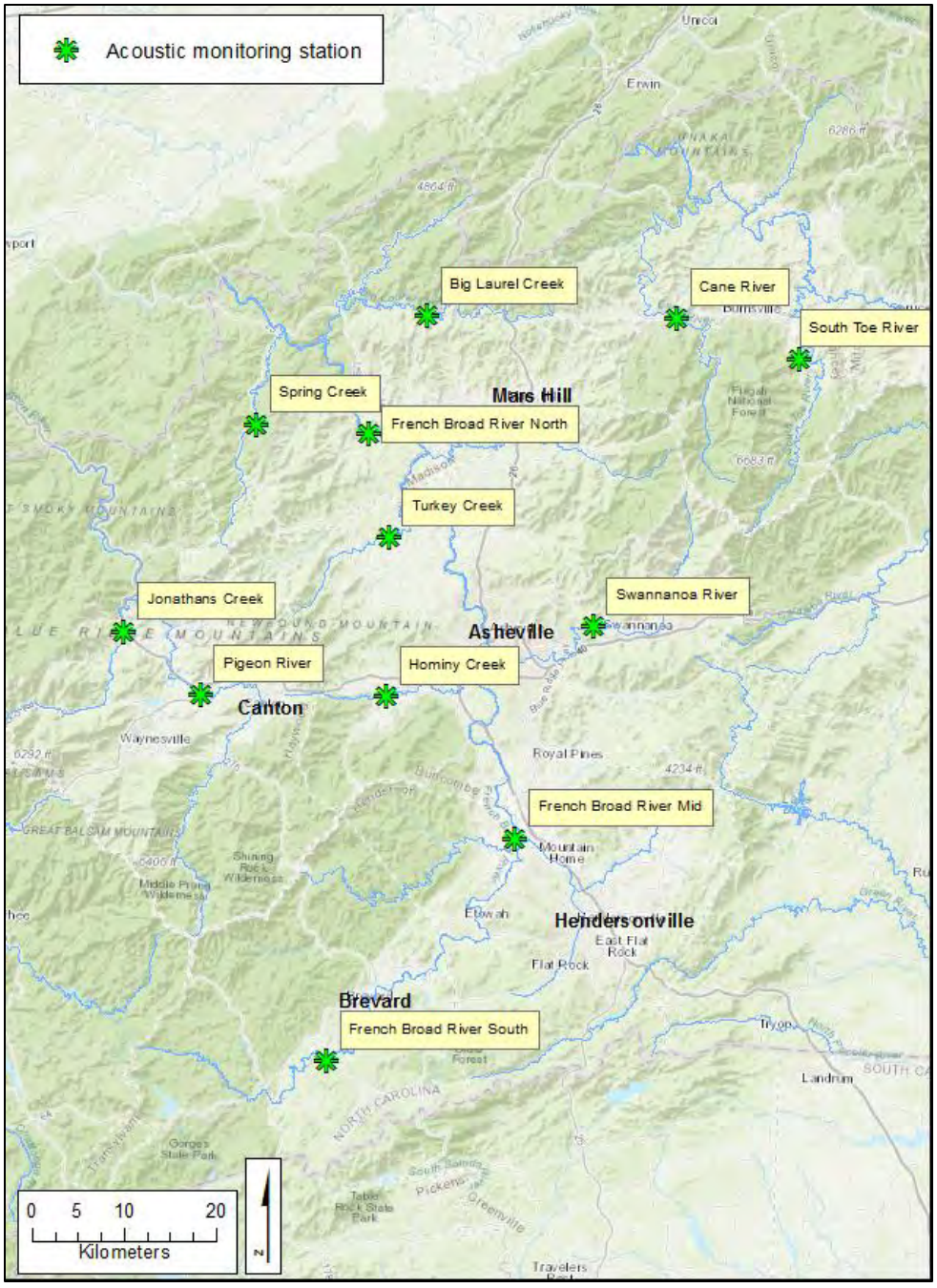
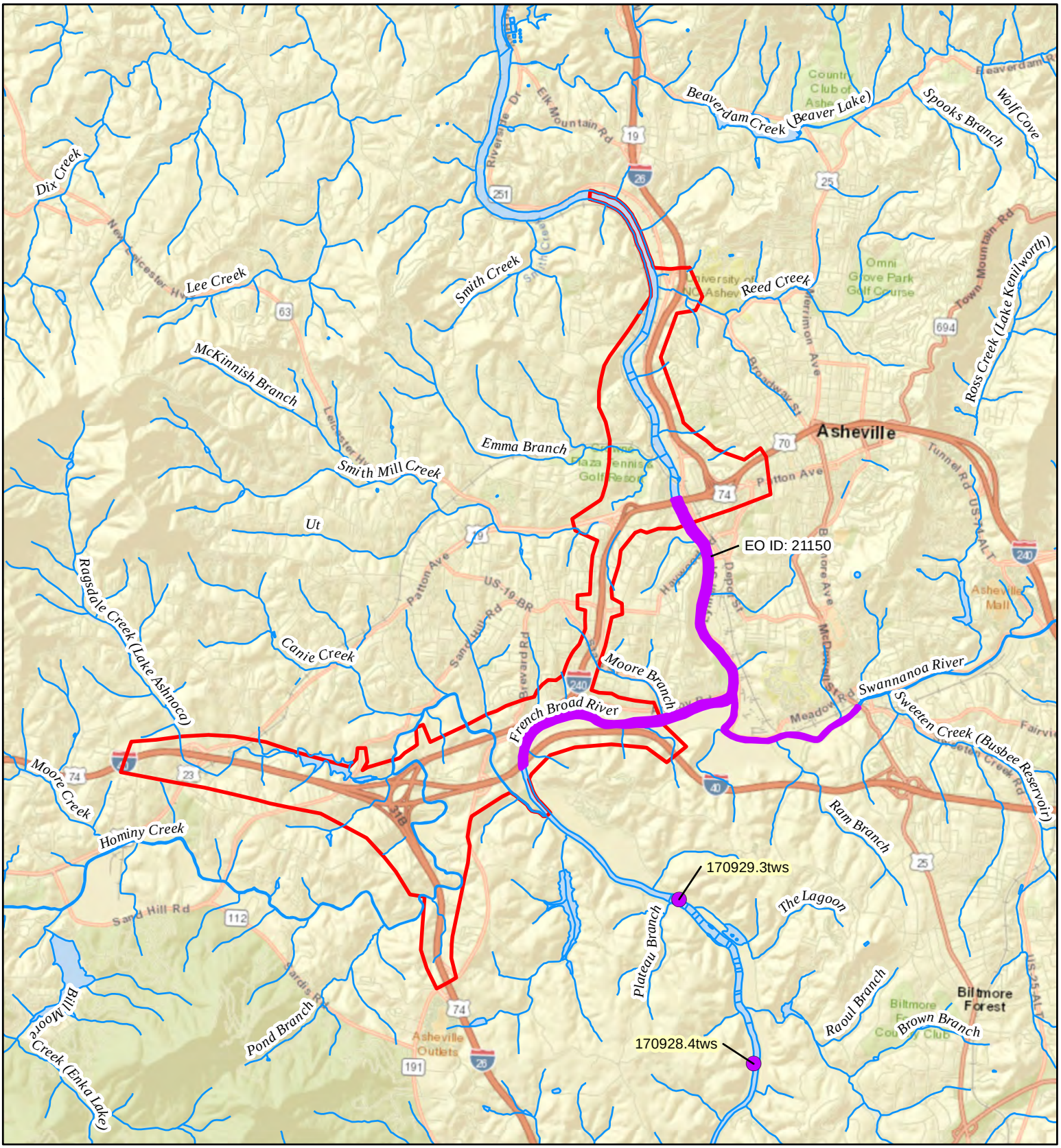


Figure 7a. (from Weber et al. 2018) ISU Acoustic monitoring station locations in the French Broad River Basin in Buncombe, Haywood, Henderson, Madison, Transylvania, and Yancey counties. We do not present data for the South Toe River station, which came online in late October.



NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

I-26 Asheville Connector

TIP Project I-2513

Buncombe County, NC

Legend

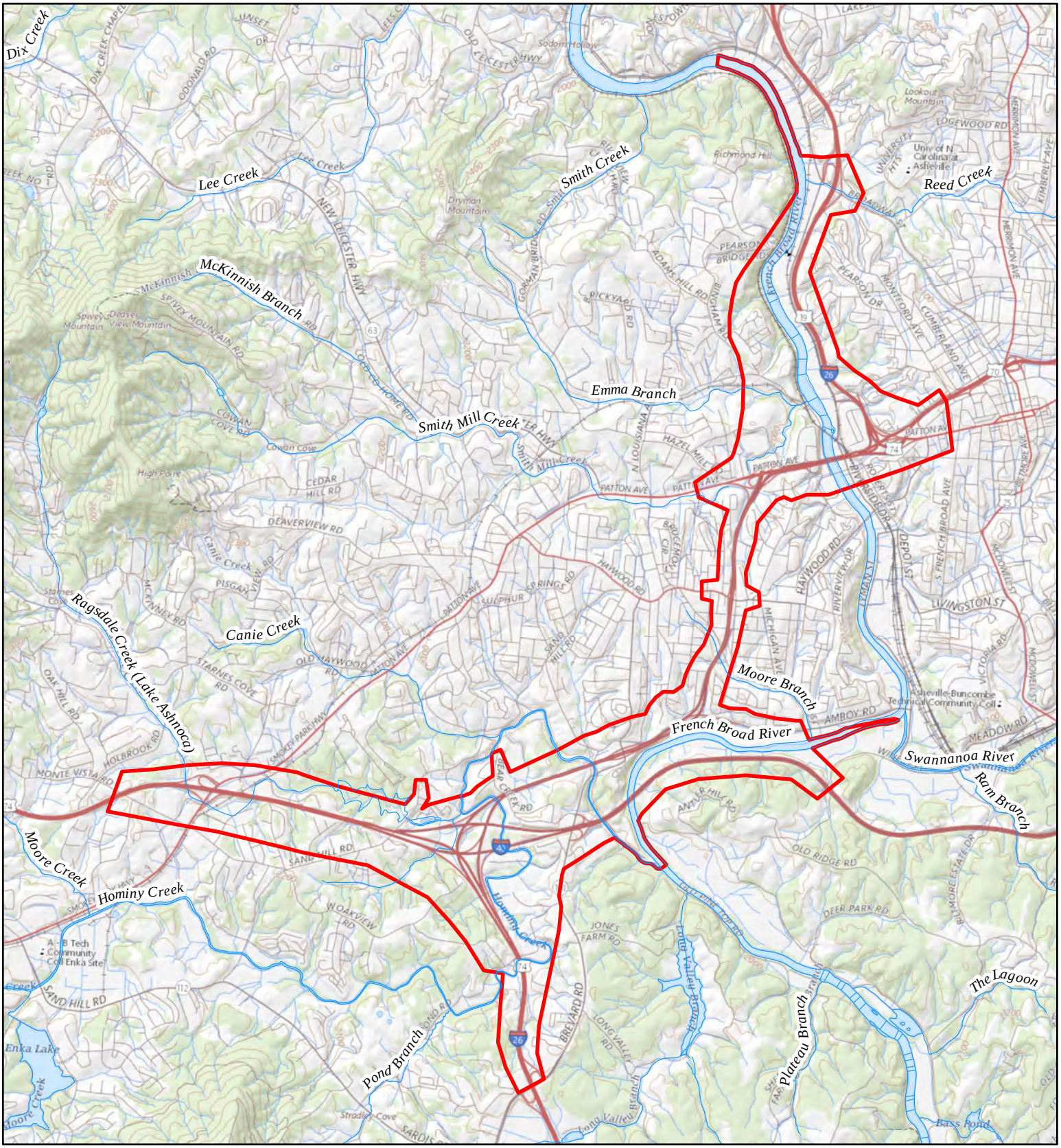
- Appalachian Elktoe Found During 2017 Surveys
- Appalachian Elktoe Element Occurrence
- French Broad River Basin Streams
- I-2513 Action

0 0.5 1 2 Miles

1 in = 1 mile

Figure 8 - Appalachian Elktoe Presence in Vicinity ofAction Area

Source: Three Oaks Engineering
Map Date: 3/8/2019



NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

I-26 Asheville Connector

TIP Project I-2513

Buncombe County, NC

Legend

French Broad River Basin Streams

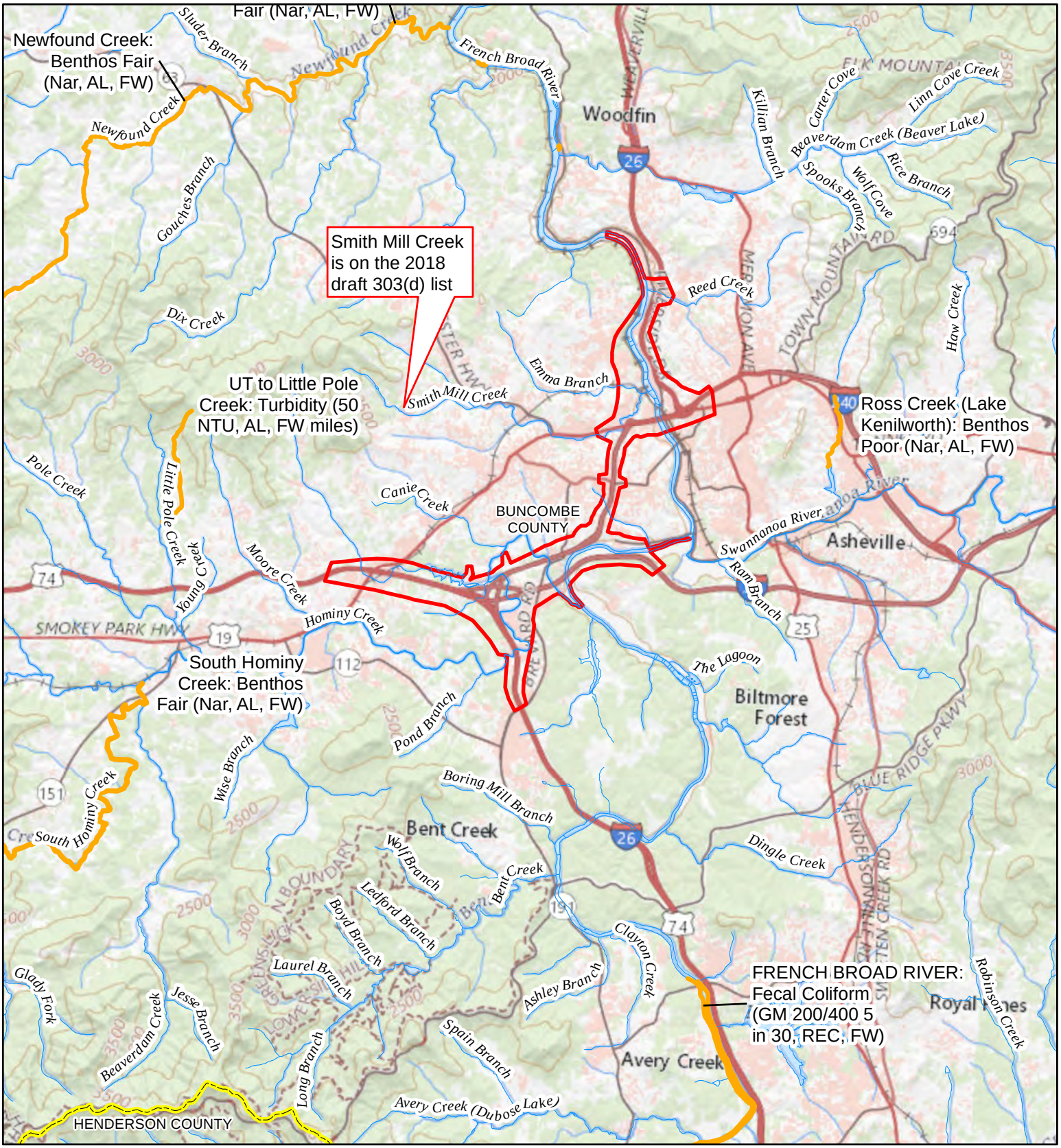
I-2513 Action Area

0 0.25 0.5 1 Miles

1 in = 1 mile

Figure 9 - Action Area Streams

Source: Three Oaks Engineering
Map Date: 3/8/2019



NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

I-26 Asheville Connector

TIP Project I-2513

Buncombe County, NC

Legend

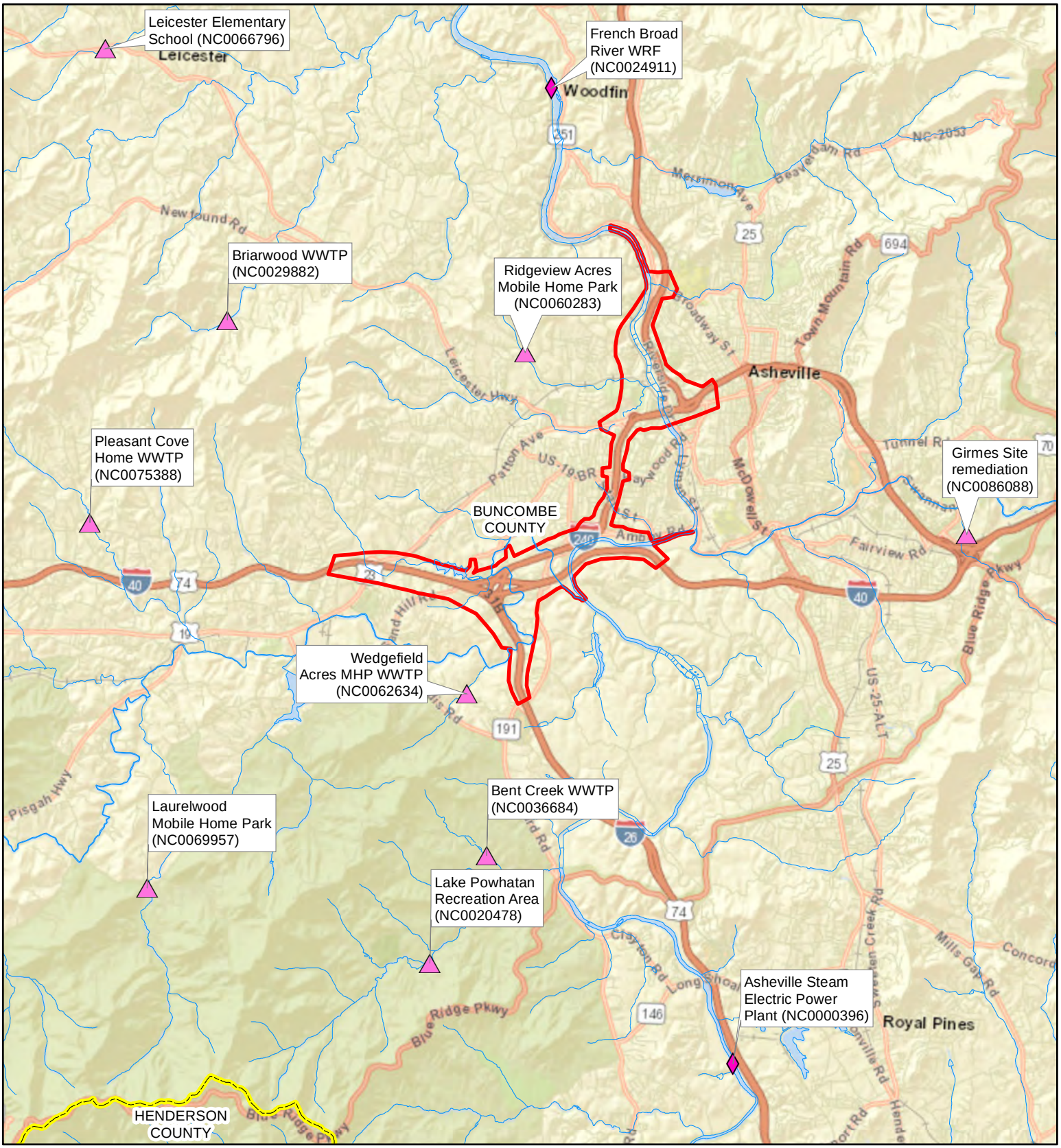
- 2016 303(d) Listed Streams
- French Broad River Basin Streams
- I-2513 Action Area
- County Boundary

0 0.75 1.5 3 Miles

1 in = 2 mile

Figure 10 - 303(d) Listed Streams

Source: Three Oaks Engineering
Map Date: 3/8/2019



NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

I-26 Asheville Connector

TIP Project I-2513

Buncombe County, NC

Legend

- Major NPDES Discharge
- Minor NPDES Discharge
- French Broad River Basin Streams
- I-2513 Action Area
- County Boundary

0 0.75 1.5 3 Miles

1 in = 2 mile

Figure 11 - National Pollutant Discharge Elimination System Discharges

Source: Three Oaks Engineering
Map Date: 3/8/2019

APPENDIX B. STRUCTURE SURVEY REPORT

FEDERALLY PROTECTED BAT SPECIES STRUCTURE SURVEY REPORT

I-26 Asheville Connector
Buncombe County, North Carolina
Federal Aid Project No. MA-NHF-26-1(53)
WBS Element No. 34165.1.1

TIP I-2513

Prepared for

The North Carolina Department of Transportation
Environmental Analysis and Permitting Unit
1598 Mail Service Center
Raleigh, NC 27699-1598
919.707.6000

September 2018

FEDERALLY PROTECTED BAT SPECIES STRUCTURE SURVEY REPORT

I-26 Asheville Connector
Buncombe County, North Carolina
Federal Aid Project No. MA-NHF-26-1(53)
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TIP I-2513

Prepared for

The North Carolina Department of Transportation
Environmental Analysis and Permitting Unit
1598 Mail Service Center
Raleigh, NC 27699-1598
919.707.6000

Prepared by

CALYX Engineers + Consultants
6750 Tryon Road, Cary, NC 27518
919.836.4800

September 2018

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1.0 PROJECT DESCRIPTION

The North Carolina Department of Transportation (NCDOT) obtained the services of CALYX Engineers and Consultants, Inc. (CALYX) to perform protected bat surveys for the proposed I-26 interstate freeway connector project. The project will connect I-26 in southwestern Asheville to US 19-23-70 in northwest Asheville (STIP Project No. I-2513) for a span of approximately 7 miles (mi.) within Buncombe County (NCDOT 2017) (Appendix A, Figure 1).

For purposes of this scope of work, the project footprint is defined as the study area to be depicted in the Final EIS, approximately 2,202 acres in total, roughly centered on the existing roadway with expansions around the major highway interchanges, and north of Patton Avenue at the French Broad River where a new bridge will be installed. Figure 2 (Appendix A) depicts the project study area.

The study area is situated in the Blue Ridge physiographic province of North Carolina. Topography in the project vicinity is characterized by gradual to steep slopes with narrow floodplains along drainage ways. Elevations range from a low of 1,980 feet (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 study area. Land use within the project vicinity is characterized by residential and urban development, forest land (including a portion of Pisgah National Forest), and agriculture (NCDOT 2015).

2.0 SPECIES INFORMATION

Two bat species are currently listed by the U.S. Fish and Wildlife Service (USFWS) as occurring in Buncombe County, NC (USFWS 2018a). One additional bat species may become listed in the county in the near future.

2.1 Gray Bat

As of April 28, 1976 the USFWS listed gray bat (*Myotis grisescens;* MYGR) as “Endangered” under the Endangered Species Act. As of August 10, 2018 (date accessed), MYGR was listed as “current” in Buncombe County (USFWS 2018a). This species is known or presumed to occur in this county only during summer months.

MYGR are typically a communally roosting, cave obligate species, meaning that groups of individuals are known to utilize caves for roosting in both summer and winter. This species has been documented using bridges and culverts as roosts during summer months. (Hayes and Bingman 1964, Keeley and Tuttle 1999).

Summer maternity roosts are typically located within 1 km of a river or reservoir over which the bats forage (Tuttle 1979), and are rarely located more than 4 km away from foraging areas (Tuttle 1976a). However, individuals may travel up to 35 kilometers 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).

A review of North Carolina Natural Heritage Program (NCHP) records (most recently updated July 2018, and viewed on August 10, 2018) indicates the nearest MYGR roost record at a location approximately 11 mi. north of the study area, and represents 40 bats observed roosting between

the expansion joints of a bridge in Madison County, NC (EO ID 37068, last observed in September 2016). The nearest MYGR mist net record represents a juvenile male captured at a creek in Buncombe County, NC (EO ID 21803, last observed in July 2003). This record is approximately seven mi. southwest of the study area. No hibernacula for this species have been documented in North Carolina (NCNHP 2018).

2.2 Northern Long-eared Bat

As of May 4, 2015 USFWS listed Northern long-eared bat (*Myotis septentrionalis;* MYSE) as "Threatened" under the Endangered Species Act. As of August 10, 2018 (date accessed), MYGR was listed as "current" in Buncombe County (USFWS 2018a). This species is known or presumed to occur in this county only during summer months.

In western North Carolina, MYSE spend winter hibernating in caves and mines. 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).

A review of NCNHP records (most recently updated July 2018 and viewed on August 10, 2018) indicates that the nearest MYSE hibernacula record is 18 mi. away (EO ID 32137) 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 ID 34294) is from a location approximately 5 mi. southwest of the study area, and represents multiple individuals (NCNHP 2018).

2.3 Indiana Bat

As of March 11, 1967 USFWS listed Indiana bat (*Myotis sodalis;* MYSO) as "Endangered" under the Endangered Species Act. As of August 10, 2018 (date accessed), MYSO was not listed in Buncombe County (USFWS 2018a). MYSO may be added to the list of federally protected species for Buncombe County in the near future (personal communication, Marella Buncick, USFWS). Therefore, to avoid any potential project delays, CALYX also assessed the study area for suitable MYSO habitat per the USFWS 2018 Range-wide Indiana Bat Summer Survey Guidelines (USFWS 2018b).

MYSO have different summer and winter habitat requirements. Winter habitat is in caves and abandoned mines that usually have standing water on the floor. The bats migrate to the winter habitat between September and November; they stay there with occasional periods of activity until they emerge in mid-March to early May. Hibernation only occurs in regions where winter temperatures are stable and around 40 degrees Fahrenheit. Suitable summer habitat includes roosting, foraging, and commuting areas. Summer roosting habitat includes forests and woodlots containing potential roost trees, which have exfoliating bark, cracks, or crevices in trees (alive or dying) or snags that are greater than 3 in. diameter-at-breast height (dbh). Roosting habitat may contain dense or loose aggregates of trees with variable amounts of canopy closure. (While any tree greater than 3 in. dbh has the potential to be MYSO summer roosting habitat, solid stands of 3 in. dbh and smaller trees are not considered suitable roosting habitat; suitable roosting habitat would generally consist of forest patches with larger trees also present.) Bridges are occasionally used for roosting by MYSO in the summer (USFWS 2007).

Foraging habitat consists of forested patches, wooded riparian corridors, and natural vegetation adjacent to these areas. Commuting habitat includes wooded tracts, tree-lines, wooded hedgerows, streams or other such pathways that are within or connected to roosting or foraging areas. Streams that have been stripped of their riparian vegetation do not appear to offer suitable foraging habitat. Rivers as foraging areas and as migration routes are extremely important to this species (USFWS 2007).

A review of NCNHP records (most recently updated July 2018, and viewed on August 10, 2018) indicates the nearest MYSO roost tree record at a location approximately 21 mi. west of the study area (EO ID 27984, last observed in 2008) in Haywood County, NC, and represents multiple roosting individuals. The closest mist net record (EO ID 33871, last observed in 2010) is from a location approximately 42 mi. west of the study area in Graham County, NC, and represents one adult male and one adult female. The nearest MYSO hibernacula (EO ID 17770) is recorded approximately 18 mi. southeast of the study area in Rutherford County, NC and represents multiple observations from 1980 to 1995 (NCNHP 2018).

3.0 METHODS

This section describes the methods used to perform surveys. All survey methods were developed in coordination with NCDOT, the Asheville USFWS Ecological Services Field Office and the North Carolina Wildlife Resources Commission (NCWRC).

3.1 Bridges and Culverts

Bridges (or bridge pairs) and large culverts (at least 5 ft. high and 200 ft. long) were assigned a unique identification number (CALYX ID) at the start of the study, as shown in Appendix A, Figures 3A through 3F, and Tables 1 and 2, in Section 4.1. These structures were visually inspected at least once during daylight hours by trained, experienced biologists or biological technicians.

In addition, five bridges (or pairs of bridges) that were particularly difficult to adequately check on foot were checked using a hydra lift truck; a machine typically used to conduct formal bridge safety inspections:

- I-40 over the French Broad River (CALYX ID B19)
- Haywood Road over I-26/I-240 (CALYX ID B29)
- Pearson Bridge Road over the French Broad River (CALYX ID B43)
- Haywood Road over the French Broad River (CALYX ID B52)
- Amboy Road over the French Broad River (CALYX ID B53)

Seven bridges (or pairs of bridges) were of particular concern to USFWS since they have both concrete decks and concrete beams, which are characteristics typically preferred by bats. These bridges were checked for evidence of bat use twice; once during 2017 and once during 2018.

- Oakview Road over Hominy Creek (CALYX ID B16)
- Pedestrian walkway over Hominy Creek/Hominy Creek Road (CALYX ID B24)
- Stewart Street over I-26/I-240 (CALYX ID B27)
- Sam's Club entrance bridge over Smith Mill Creek (CALYX ID 32)
- Emma Road (SR 1338) over Smith Mill Creek (CALYX ID 38)
- Craven Street over the French Broad River (CALYX ID B40)
- Southern Railroad over the French Broad River (CALYX ID B42)

Coordinates were obtained for all bridges and culverts that were surveyed. In addition, the NCDOT Bat Habitat Assessment Form for Bridges and Culverts was completed as specified in the Standard Operating Procedures (SOP): NCDOT Preliminary Bat Habitat Assessments (Structures, Caves and Mines) (NCDOT 2014) for each bridge, culvert, and structure that was surveyed. Photos were taken of any bridges, culverts, and structures that exhibited evidence of bat use.

3.2 Abandoned Structures

Structures within the project study area that appeared to be abandoned, and appeared to have potentially suitable habitat for bats would be checked on an opportunistic basis only.

3.3 Caves and Mines

USGS mapping was reviewed prior to field investigations to determine if any caves or mine are documented within three mi. of the project study area. If caves or mines were noted during field work, they are documented as part of this report.

3.4 MYSE and MYSO Habitat Assessment and Emergence Surveys

CALYX biologists assessed the study area for potentially suitable MYSE and MYSO habitat. This consisted of a general valuation of potential roosting and foraging habitat. Emergence surveys were conducted at any potential roost trees following protocols provided in the USFWS 2018 Range-wide Indiana Bat Summer Survey Guidelines (USFWS 2018b).

4.0 FINDINGS

This section describes the results of the structure surveys. Figures 3A through 3F (Appendix A) depict the project study area and other information discussed in this section.

4.1 Bridges and Culverts

A total of 51 bridges and 15 culverts were identified within the study area and checked in the field. Two bridges that were not identified within the study area were also checked (CALYX IDs B52, B53). CALYX biologists decided that it would be prudent to check these structures due to their close proximity to the project study area, and their location over large streams or rivers. Bridge and culvert surveys were performed between July 26 and September 17 in 2017, and May 31 and August 22 in 2018.

A comprehensive list of structure survey information is provided in Table 1 and Table 2, below. Data forms for each structure check are provided in Appendix B and Appendix C. CALYX ID numbers listed in Tables 1 and 2 are unique identification numbers assigned by CALYX as part of this study. NCDOT structure numbers were pulled directly from publicly available GIS data.

Bridge Checks with Hydra Lift

I-40 over French Broad River (CALYX ID B19)

This pair of bridges was checked with a hydra lift and on foot on September 16, 2017. No evidence of bat roosting was observed. There is an active colony of cliff swallows (*Petrochelidon pyrrhonota*) using this bridge. Approximately 30 nests were observed, along with a large number of pigeon droppings.

Haywood Road over I-26/I-240 (CALYX ID B29)

This bridge was checked with a hydra lift and on foot on August 23, 2017. No evidence of bat roosting was observed.

Pearson Bridge Road over French Broad River (CALYX ID B43)
This bridge was checked with a hydra lift and on foot on September 17, 2017. No evidence of bat roosting was observed.

Haywood Road over French Broad River (CALYX ID B52)
This bridge was checked with a hydra lift and on foot on September 17, 2017. No evidence of bat roosting was observed. There is an active colony of cliff swallows (*Petrochelidon pyrrhonota*) using this bridge. More than 75 nests were observed.

Amboy Road over French Broad River (CALYX ID B53)
This bridge was checked with a hydra lift and on foot on September 16, 2017. No evidence of bat roosting was observed. There is an active colony of cliff swallows using this bridge. Approximately 30 nests were observed, along with a large number of pigeon droppings.

Summary of Bridge and Culvert Check Results
No evidence of bat use was noted on any bridges. The culvert at Hill Street and Riverside Drive (CALYX ID C13) near the French Broad River is the only culvert where bats or evidence of bats was noted. 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. CALYX biologists documented bats using the culvert roost on August 24, 2017. The bats were tentatively identified as MYGR. Biologists chose to quickly exit the culvert upon unexpectedly disturbing the bats. On September 7, 2017, USFWS and NCWRC biologists performed an emergence survey and counted a total of at least 200 bats flying from the culvert system at the downstream outlet and a culvert inlet near Houston Street. On September 13, 2017 USFWS and NCWRC biologists returned to the culvert and confirmed that MYGR were present.

Indiana State University is currently conducting a research project for NCDOT on MYGR in the French Broad River Basin. Multiple emergence counts and trapping events have occurred in association with the culvert system. Additional counts and trapping will continue later in 2018, as well as in 2019 and 2020 (personal communication, Joey Weber, Indiana State University).

Table 1. Bridge Survey Results

CALYX ID	NCDOT Structure Number	Facility on Structure	Feature Under Structure	Date Surveyed	Emergence Survey	Comment
B1	100171	Brevard Rd/NC 191	I-26	5/31/2018	Y	*Quercus* sp. snag. No bats emerged 7/25/2018
B2	N/A	Private Road	Hominy Creek	9/7/2017	N	
B3	100235 (WBL) 100238 (EBL)	I-26	Hominy Creek	5/31/2018	N	
B4	100051	Pond Rd/SR 3431	Hominy Creek	5/31/2018	N	
B5	100295	Monte Vista Rd/SR 1224	I-40	8/22/2017	Y	*Juglans nigra* or *Carya* sp. snag. No bats emerged 7/25/2018
B6	100301	I-40	Smokey Park Hwy/US23/US74A	8/22/2017	N	
B7	100313	I-40	Railroad	8/22/2017	N	
B8	100326	I-40	Sand Hill Rd/SR 3412	8/22/2017	N	
B9	100253	I-26	I-40	8/24/2017	N	
B10	100254	US 74	I-26 /I-40	8/24/2017	N	
B11	100273	I-26	I-40	9/7/2017	N	
B12	100334	I-40	Hominy Creek	9/7/2017	N	
B13	100285	I-26	I-40	9/7/2017	N	
B14	100283	I-26	I-40	9/7/2017	N	
B15	100339	I-40	Hominy Creek	9/7/2017	N	
B16^	100052	E Oakview Rd	Hominy Creek	9/7/2017, 5/31/2018	N	
B17	100194	Brevard Rd/NC 191	I-40	9/7/2017	N	
B18	100037 (WBL) 100344 (EBL)	I-40	Hominy Creek	9/7/2017	N	
B19*	100356 (WBL) 100352 (EBL)	I-40	French Broad River	9/16/2017	N	Checked on foot and with lift truck. Approximately 30 cliff swallow nests; lots of pigeon droppings.
B20	100070 (WBL) 100066 (EBL)	I-26/I-240	Hominy Creek	9/7/2017	Y	*Platanus occidentalis* snag. Emergence survey on 7/26/2018, saw one bat possibly emerge from tree. Survey repeated on 8/8/2018. Again, one bat possibly emerged from snag. Anabat SD2 recorded bat calls during time of emergence. No calls consistent with any Myotis species.
B21	100182	S Bear Creek Rd/SR 3413	I-26/I-240	9/7/2017	N	
B22	100845	Brevard Rd/NC 191	Hominy Creek	8/11/2017	Y	*Platanus occidentalis* snag. No bats emerged 7/18/18.
B23	100208 (WBL) 100206 (EBL)	I-26/I-240	Hominy Creek/Private Road	8/11/2017	Y	*Platanus occidentalis* snag. No bats emerged 7/18/18.
B24^	100216	Pedestrian Walkway	Hominy Creek	8/11/2017, 5/31/2018	Y	*Platanus occidentalis* snag. No bats emerged 7/18/18.
B25	100242	Brevard Rd/NC 191	I-26/I-240	8/23/2017	N	
B26	100521	Amboy Rd/SR 3556	I-26	8/23/2017	Y	Unidentified snags. No bats emerged 7/18/18.
B27^	N/A	Stewart St	I-26/I-240	8/23/2017, 7/4/2018	N	
B28	100274	State St	I-26/I-240	8/23/2017	N	
B29*	100336	Haywood Rd/US 19B/US 23B	I-26/I-240	8/23/2017	N	Checked on foot and with lift truck.
B30	100191	US 19/US 23	I-240	8/23/2017	N	
B31	100168	US 19/US 23/US 74A/Patton Ave	I-26/I-240	8/23/2017	N	
B32^	N/A	Sam's Club Entrance	Smith Mill Creek	8/11/2017, 7/4/2018	Y	Unidentified snag. No bats emerged 7/19/18.
B33	N/A	Private Road	Smith Mill Creek	8/11/2017	Y	*Robinia pseudoacacia* with dead branches and *Liriodendron tulipifera* snag. No bats emerged 7/17/18.
B34	N/A	Private Road	Smith Mill Creek	8/11/2017	Y	*Robinia pseudoacacia* with dead branches and *Liriodendron tulipifera* snag. No bats emerged 7/17/18.

CALYX ID	NCDOT Structure Number	Facility on Structure	Feature Under Structure	Date Surveyed	Emergence Survey	Comment
B35	N/A	Private Road	Smith Mill Creek	8/11/2017	Y	*Robinia pseudoacacia* with dead branches and *Liriodendron tulipifera* snag. No bats emerged 7/17/18.
B36	N/A	Private Road	Smith Mill Creek	7/28/2017	N	
B37	N/A	Southern Railroad	Smith Mill Creek	7/28/2017	N	
B38^	100726	Emma Rd/SR 1338	Smith Mill Creek	7/28/2017, 7/5/2018	N	
B39	100277	Southern Railroad	Smith Mill Creek, Emma Rd/SR 1338	7/28/2017	N	
B40^	100743	Craven St	French Broad River	8/11/2017, 6/1/2018	N	Metal (on south side of bridge) and concrete (on north side) guard rails (each side is different).
B41a	100322 (WBL)	I-240/I-26/Patton Ave	French Broad River	7/26/2017	N	Snags (*Platanus occidentalis, Juglans nigra, Acer negundo, Pinus* sp.) present but unsuitable habitat due to proximity to I-240, I-26, and urban development.
B41b	100323 (EBL)	I-240/I-26/Patton Ave	French Broad River	7/26/2017	N	Snags (*Platanus occidentalis, Juglans nigra, Acer negundo, Pinus* sp.) present but unsuitable habitat due to proximity to I-240, I-26, and urban development.
B42^	N/A	Southern Railroad	French Broad River	8/11/2017, 7/4/2018	N	
B43*	100278	Pearson Bridge Rd/SR 1348	French Broad River	9/17/2017	Y	Checked on foot and with lift truck. Unidentified snag. No bats emerged on 7/16/2018. Surface mine within 0.5 mi.
B44	100289 (EBL) 100284 (WBL)	I-26	Reed Creek/Broadway	7/28/2017	N	Surface mine within 0.5 mi.
B45	100281	I-26	Hill St	8/11/2017	N	
B46	100279	Atkinson St	I-26	8/11/2017	N	
B47	100001	US 70 Ramp to I-240	I-240/I-26	9/6/2017	N	
B48	100348	I-240	I-26	9/6/2017	N	
B49	100034	US 19 Ramp	I-240	9/6/2017	N	
B50	100077	Patton Ave	I-240	9/6/2017	N	
B51	N/A	Pedestrian Bridge	I-240	8/10/2017	N	
B52*	100705	Haywood Rd/SR 3548	French Broad River	9/17/2017	N	Checked on foot and with lift truck. 75+ cliff swallow nests.
B53*	100521	Amboy Rd/SR 3556	French Broad River	9/16/2017	N	Checked on foot and with lift truck. Lots of pigeon droppings. Approximately 30 cliff swallow nests.

^ bat-friendly bridge; checked in 2017 and 2018.
*** Indicates bridge checked with hydra lift**

Table 2. Culvert Survey Results

CALYX ID	NCDOT Structure Number	Facility on Structure	Feature Under Structure	Date Surveyed	Emergence Survey	Comments
C1	N/A	I-26	UT to Hominy Creek	7/17/2018	Y	Unidentified snags. No bats emerged on 7/24/2018 or 7/25/2018.
C2	100297	I-40	Ragsdale Creek	8/22/2017	N	
C3	100771	US-19/Smokey Park Hwy/US 23/US 74A	Ragsdale Creek	8/22/2017	N	
C4	100320	I-40	Ragsdale Creek	8/24/2017	N	
C5	N/A	Sand Hill Rd/SR 3412	Ragsdale Creek	8/24/2017	N	
C6	N/A	US 74/I-40	Trent Branch	8/24/2017	N	
C7	N/A	I-26/I-240	UT to French Broad River	8/24/2017	N	
C8	N/A	I-26/I-240	UT to French Broad River	8/23/2017	N	
C9	N/A	I-26/I-240	Moore Branch	8/23/2017	N	
C11	100769	US 19/US 23/US 74A/Patton Ave	Smith Mill Creek	8/23/2017	N	
C12	100774	NC 251/Broadway	Reed Creek	7/28/2017	N	Surface mine within 0.5 mi.
C13	N/A	US 19/23/Riverside Dr	UT to French Broad River	8/24/2017	Y	MYGR roosting in culvert; emergence surveys performed by USFWS and NCWRC documented over 200 bats on September 7, 2017.
C14	N/A	US 19/23/Riverside Dr	UT to French Broad River	8/24/2017	N	
C15	N/A	I-26/Riverside Dr	UT Reed Creek	8/22/2018	N	
C16	N/A	I-26	UT Hominy Creek	8/22/2018	N	

4.2 Abandoned Structures

No abandoned structures within the project study area that could provide potential roosting habitat for bats were noted during the site visits. However, Indiana State University (ISU) researchers who are conducting a study on MYGR in the area tracked one MYGR to a building near Riverside Drive and Hill Street (personal communication, Joey Weber, ISU). An adult male MYGR used this roost for six days. The structure is infrequently used by humans, and will not be demolished as part of the project construction.

4.3 Caves and Mines

No caves or mines were observed during the field surveys. According to USGS mapping, there are three surface mines located within a ½-mi. radius of the study area (USGS 2018). Seven (7) mines are mapped between one half and three mi. of the project study area (Table 3 below). Wilson Road is the only mine that is questionable in terms of production type. Aerial mapping shows the location is a residentially developed area and no obvious mine location can be seen nearby. All other mines are identified as surface mines or processing plants. No mines were investigated in the field as part of this field survey.

Table 3. Mines within Three Miles of I-2513

Mine Name	Distance from Study Area	Mine Type
Asheville Portable Plant	Between ½ and 3 mi.	Processing Plant
Bell Mine	Within ½ mi.	Surface
Biltmore Plant	Between ½ and 3 mi.	Surface
Enka Quarry	Between ½ and 3 mi.	Surface
Enka Quarry	Between ½ and 3 mi.	Surface
Grove Pit	Between ½ and 3 mi.	Surface
Harmony Mine	Within ½ mi.	Surface
Harrin's Mine	Within ½ mi.	Surface
I-40 Stockpile & Plant	Between ½ and 3 mi.	Processing Plant
Wilson Road	Between ½ and 3 mi.	Unknown

In addition, Jody Kuhne, NCDOT Regional Geological Engineer for NCDOT, stated that no caves or cave like features, nor cliff forming units or rock outcrops (which might indicate the presence of caves) were noted during the geosocial studies performed in association with this project (personal communication, August 3, 2018).

4.4 MYSE and MYSO Habitat Assessment and Emergence Surveys

Suitable summer foraging habitat for MYSE and MYSO is present within the study area in the form of wooded habitats, emergent wetlands, adjacent edges of agricultural fields, old fields and pastures. However, due to the highly disturbed, urbanized nature of the study area, the habitat is considered poor, and it is unlikely that MYSE or MYSO would utilize these areas.

Potential roost trees were identified within the study area at several locations. Emergence surveys were performed at all the sites between July 16, 2018 and August 8. 2018, and Emergence Survey Datasheets are included in Appendix D. With the exception of one snag associated with B20, no bats were seen flying from potential roosts during emergence surveys. The snag associated with B20 was surveyed twice. The tree is situated in an area that is difficult to view at dusk. During the first survey, a bat potentially flew from the tree. The survey was repeated and another bat potentially flew from the tree. An ANABAT SD2 acoustic detector was

used during the second survey, and bat calls were recorded. None of the calls were consistent with any *Myotis* species.

4.5 Summary of Findings

After checking all potential bat roost sites located within (or in some cases, immediately adjacent to) the project study area, only one site was identified as a bat roost; the culvert near Hill Street and Riverside Drive near the French Broad River (CALYX ID C13).

The majority of the proposed road widening will occur within existing NCDOT right of way, including the existing median. These areas contain little to no woody vegetation. Areas outside the existing right of way that may require clearing include existing interchanges, and other urbanized areas which are already cleared of most woody vegetation.

Habitat for MYGR

Only one structure within the study area showed evidence of bat use. Furthermore, no underground mines are present within three mi. of the study area. Therefore, the only suitable roosting habitat for MYGR is the Hill Street culvert. Foraging and commuting habitat is present along the French Broad River and Hominy Creek.

Habitat for MYSE

Only one structure within the study area showed evidence of bat use. Furthermore, no underground mines are present within three mi. of the study area. Therefore, the only suitable winter roosting habitat for MYSE is the Hill Street culvert. However, this culvert was checked in December 2017 and no bats were present.

Although no MYSE roost tree surveys were conducted for this project, it is highly unlikely that MYSE would choose to roost in trees within the wooded areas immediately adjacent to NCDOT right of way due to elevated levels of disturbance caused by light and noise from passing vehicles. Likewise, wooded areas associated with commercial and residential development would also be subject to high levels of disturbance from general human activity, including light and noise. Overall, roosting, foraging, and commuting habitat for MYSE is poor.

Habitat for MYSO

Only one structure within the study area showed evidence of bat use. Furthermore, no underground mines are present within three mi. of the study area. Therefore, the only suitable winter roosting habitat for MYSO is the Hill Street culvert. However, this culvert was checked in December 2017 and no bats were present.

Potential MYSO roost tree surveys were conducted for this project. No MYSO were noted emerging from any of the trees. Furthermore, it is highly unlikely that MYSO would choose to roost in trees within the wooded areas immediately adjacent to NCDOT right of way due to elevated levels of disturbance caused by light and noise from passing vehicles. Likewise, wooded areas associated with commercial and residential development would also be subject to high levels of disturbance from general human activity, including light and noise. Overall, roosting, foraging, and commuting habitat for MYSO is poor.

5.0 REFERENCES

Brady, J. T., Kunz, T. H., Tuttle, M. D., and Wilson, D. E. (1982). "Gray bat recovery plan," U.S. Fish and Wildlife Service, Denver, CO.

Hays, H. A., and D. C. Bingman. 1964. A colony of gray bats in southeastern Kansas. Journal of Mammalogy 45:150.

Keeley, B. W., and M. D. Tuttle. 1999. Bats in American bridges. Bat Conservation International, Inc., Austin, Texas, Resource Publication 40 pp.

La Val, R. K., Clawson, R. L., La Val, M. L. and Caire, W. 1977. Foraging behavior and nocturnal activity patterns of Missouri bats, with emphasis on the endangered species Myotis grisescens and Myotis sodalis. Journal of Mammalogy 58: 592-599.

North Carolina Department of Transportation (NCDOT) 2014. Standard Operating Procedures (SOP): NCDOT Preliminary Bat Habitat Assessments (Structures, Caves and Mines).

North Carolina Department of Transportation (NCDOT) 2015. Draft Environmental Impact Statement, I-26 Connector, I-40 to US 19-23-70 North of Asheville Buncombe County, North Carolina.

North Carolina Department of Transportation (NCDOT) 2017. Draft 2017-2027 State Transportation Improvement Program. https://connect.ncdot.gov/projects/planning/STIPDocuments1/Draft%202017-2027%20STIP.pdf

North Carolina Department of Transportation (NCDOT) 2018. NCDOT Structures. https://www.arcgis.com/home/item.html?id=7367c33b80f346178ea5e158ec4d5b68. (Accessed August 10, 2018).

North Carolina Natural Heritage Program (NCNHP). The Natural Heritage Database. https://ncnhde.natureserve.org/ (Accessed August 10, 2018).

Tuttle, M. D., and J. Kennedy. 2005. Field guide to eastern cave bats. Bat Conservation International, Inc., Austin, TX. 41 pp.

Tuttle, M. D., and D. E. Stevenson. 1977. Variation in the cave environment and its biological implications. Pages 108-21 in R. Zuber, editor. National cave management symposium proceedings.

United States Fish and Wildlife Service (USFWS). 2007. Indiana Bat (Myotis sodalis) Draft Recovery Plan: First Revision. U.S. Fish and Wildlife Service, Fort Snelling, MN. 258 pp.

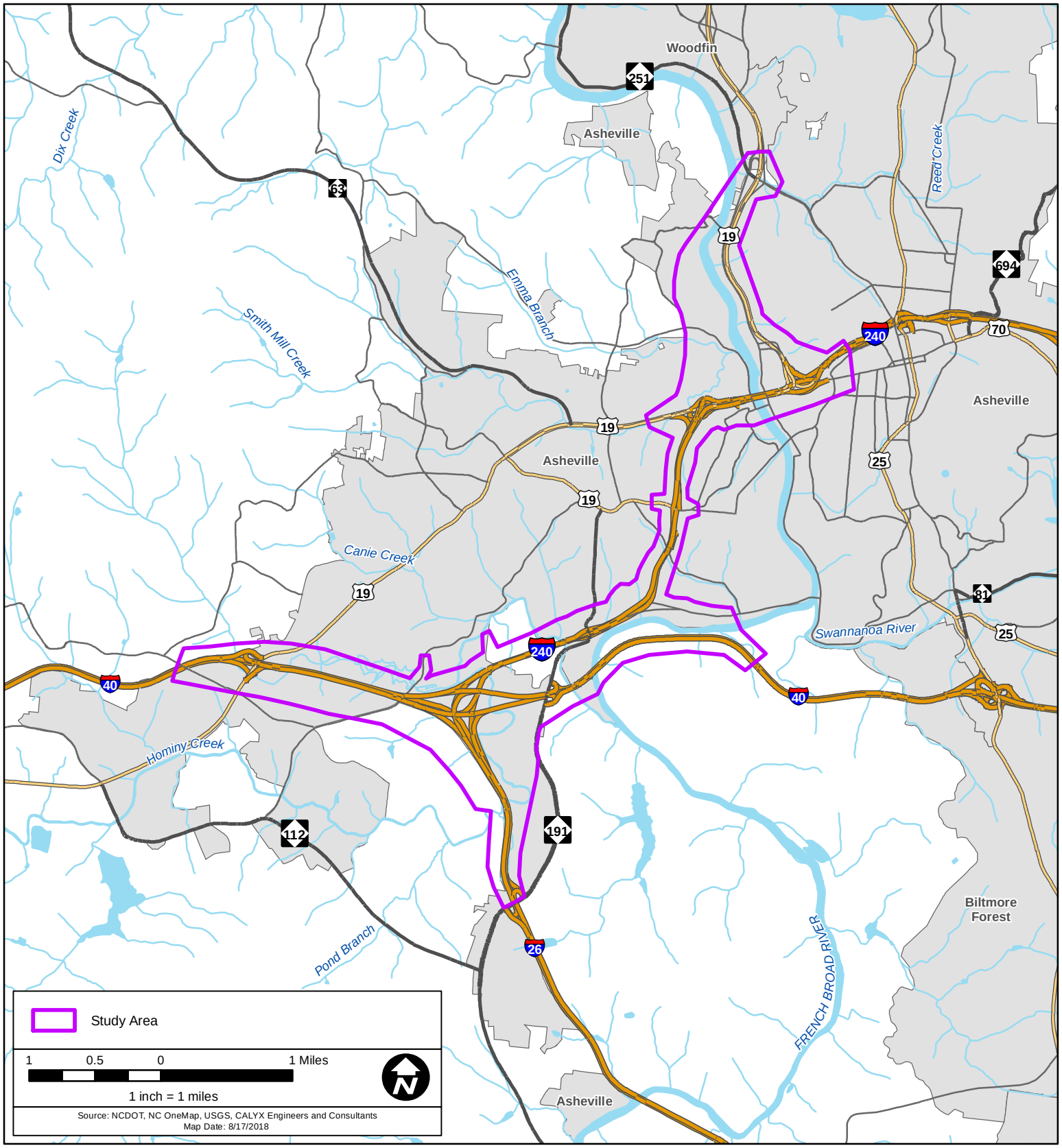
United States Fish and Wildlife Service (USFWS). 2015. Endangered and Threatened Wildlife and Plants; Threatened Species Status for the Northern Long-Eared Bat With 4(d) Rule; Final Rule and Interim Rule CFR, Vol. 63, No. 63.

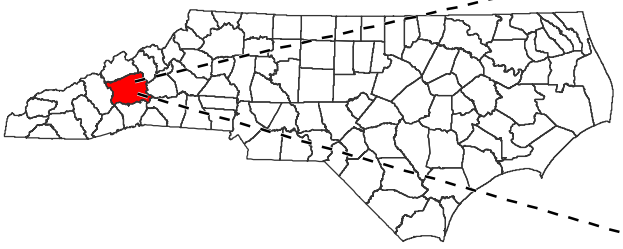
United States Fish and Wildlife Service (USFWS). 2018a. Endangered and Threatened Species and Species of Concern by County for North Carolina http://www.fws.gov/raleigh/species/cntylist/nc_counties.html (Accessed August 10, 2018)

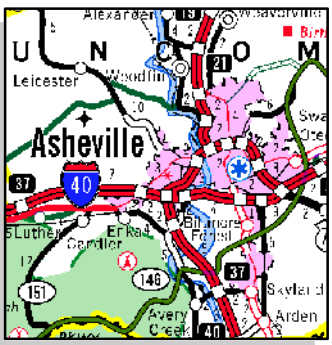
United States Fish and Wildlife Service (USFWS). 2018b. Range-wide Indiana Bat Summer Survey Guidelines. https://www.fws.gov/midwest/endangered/mammals/inba/surveys/pdf/2018RangewideIBatSurveyGuidelines.pdf (Accessed August 10, 2018).

United States Geological Survey (USGS). Search the Mineral Resources Data System. 2018. http://mrdata.usgs.gov/mrds/find-mrds.php (Accessed August 3, 2018).

Appendix A: Figures







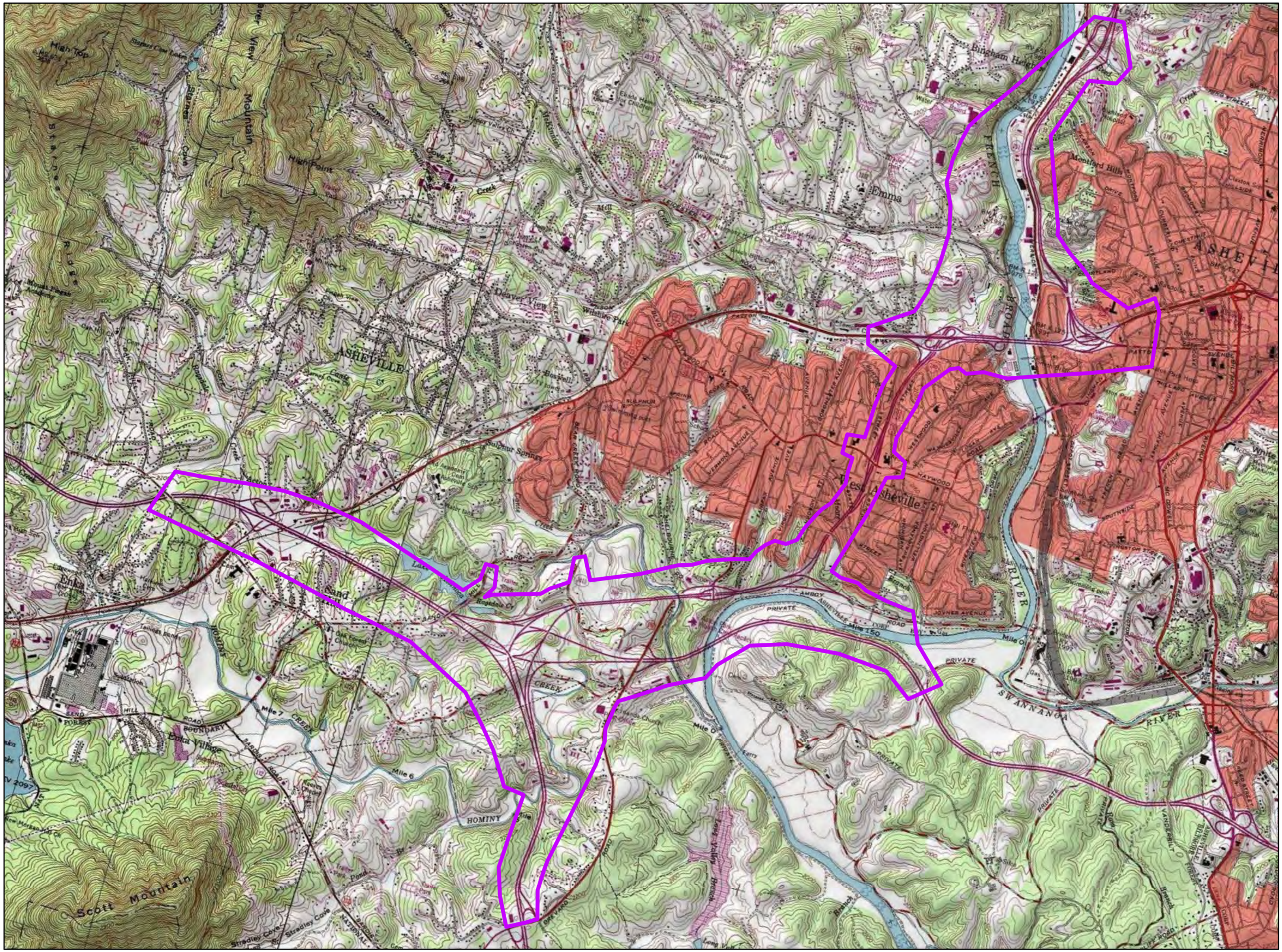
NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

I-26 Asheville Connector

TIP Project I-2513

Buncombe County, NC

Figure 1 - Project Vicinity



Legend

StudyArea

Figure 2

Project Footprint

I-26 Asheville Connector

TIP Project I-2513

Buncombe County, NC

Map Date: 8/17/2018

0.5 0.25 0 0.5

Miles

1 inch = 0.5 miles

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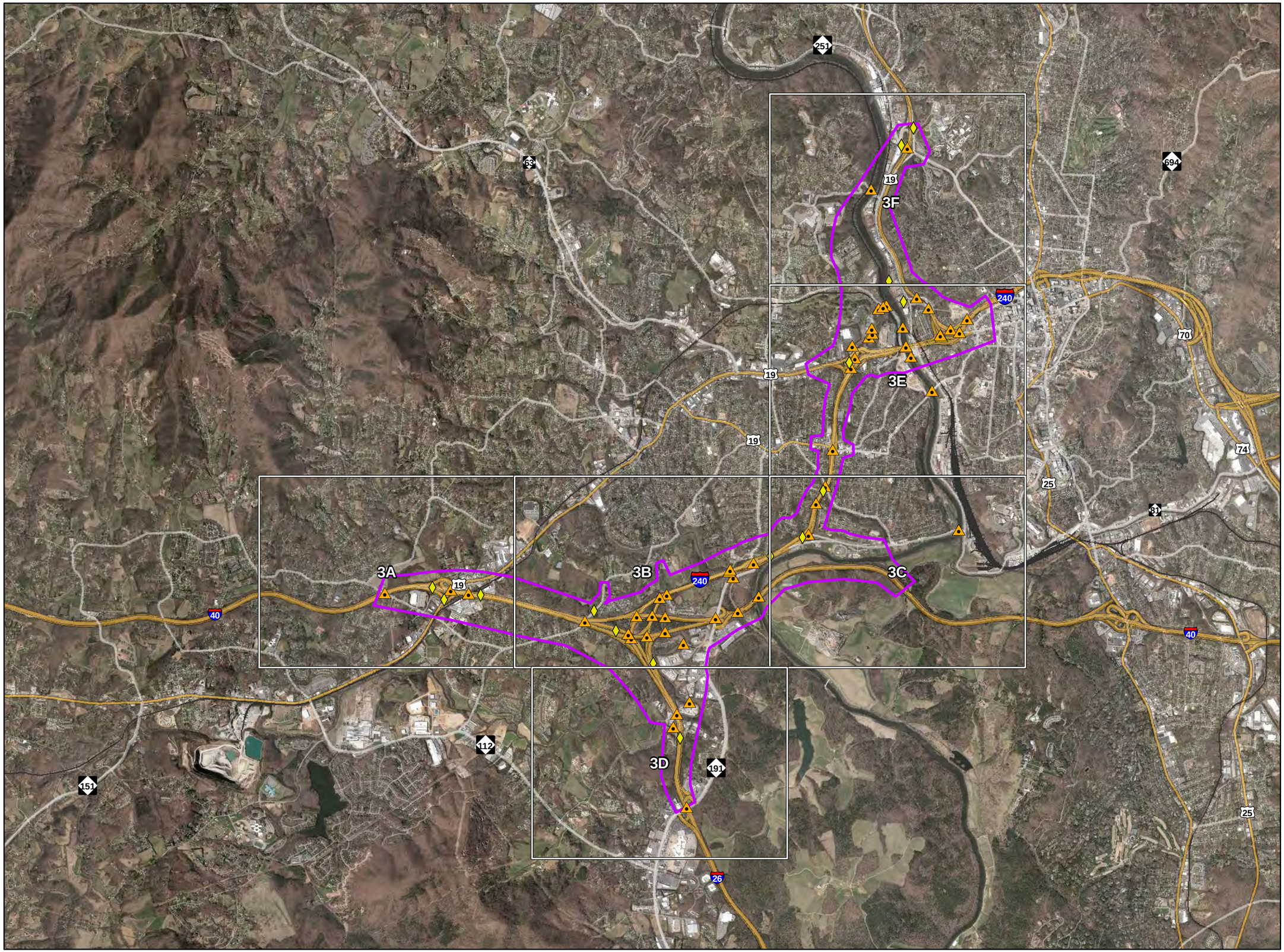
Sources: ESRI, Calyx Engineers and Consultants



Legend

- Bridge
- Culvert
- Railroad
- Map Tile
- StudyArea

Figure 3

Structure Locations Overview

I-26 Asheville Connector

TIP Project I-2513

Buncombe County, NC

Map Date: 8/17/2018

0.75 0.375 0 0.75

Miles

1 inch = 0.75 miles

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Sources: NCDEQ, NCDOT, Calyx Engineers and Consultants

Aerial Photography: NCDOT

Legend

- Bridge
- Culvert
- Railroad
- NCDEQ 24K Stream
- NCDEQ 24K Waterbody
- StudyArea

Figure 3A

Structure Locations

I-26 Asheville Connector

TIP Project I-2513

Buncombe County, NC

Map Date: 8/22/2018

800 400 0 800

Feet

1 inch = 800 feet

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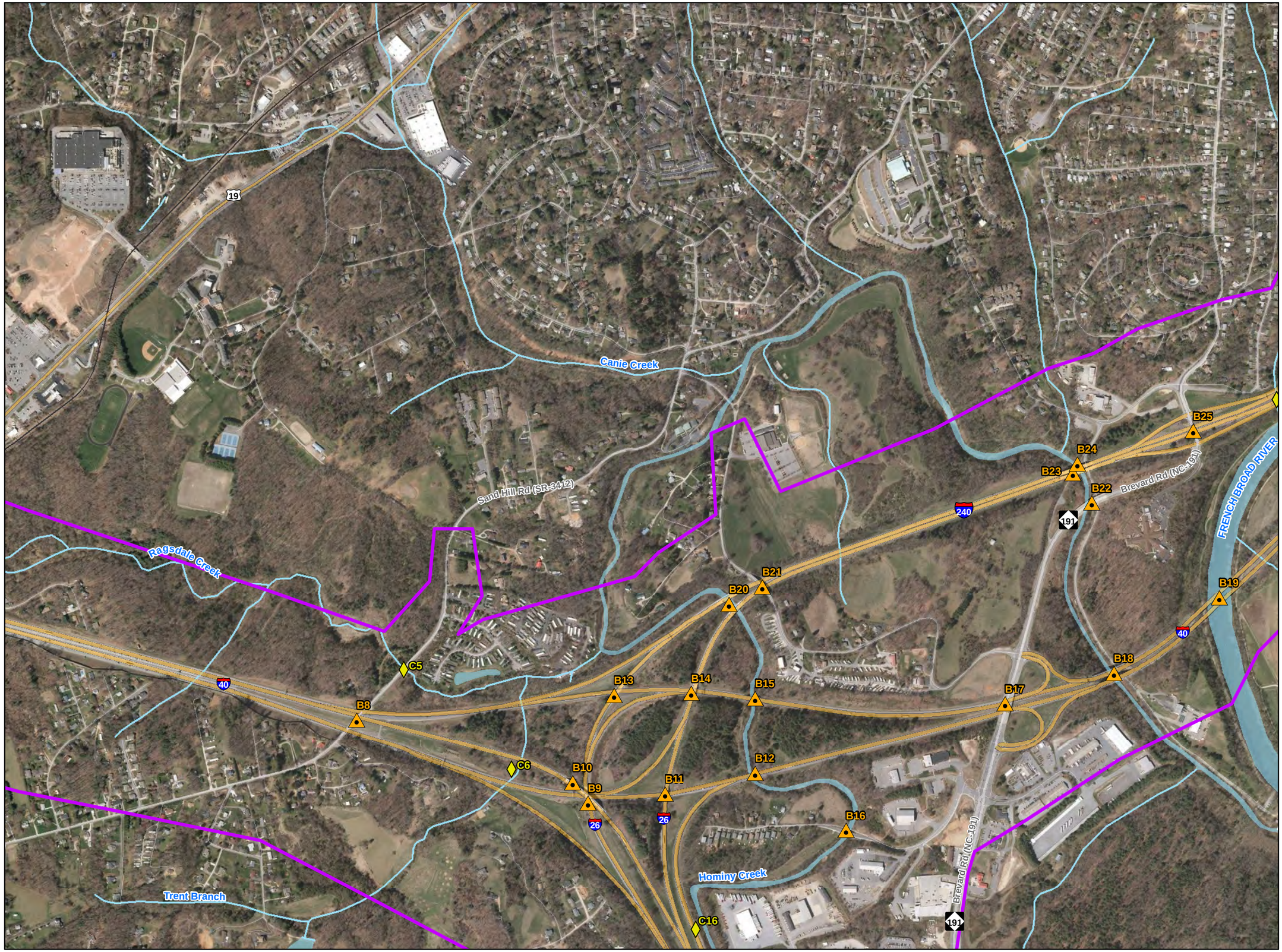
Aerial Photography: NCDOT



Legend

- Bridge
- Culvert
- Railroad
- NCDEQ 24K Stream
- NCDEQ 24K Waterbody
- StudyArea

Figure 3B

Structure Locations

I-26 Asheville Connector

TIP Project I-2513

Buncombe County, NC

Map Date: 8/22/2018

800 400 0 800

Feet

1 inch = 800 feet

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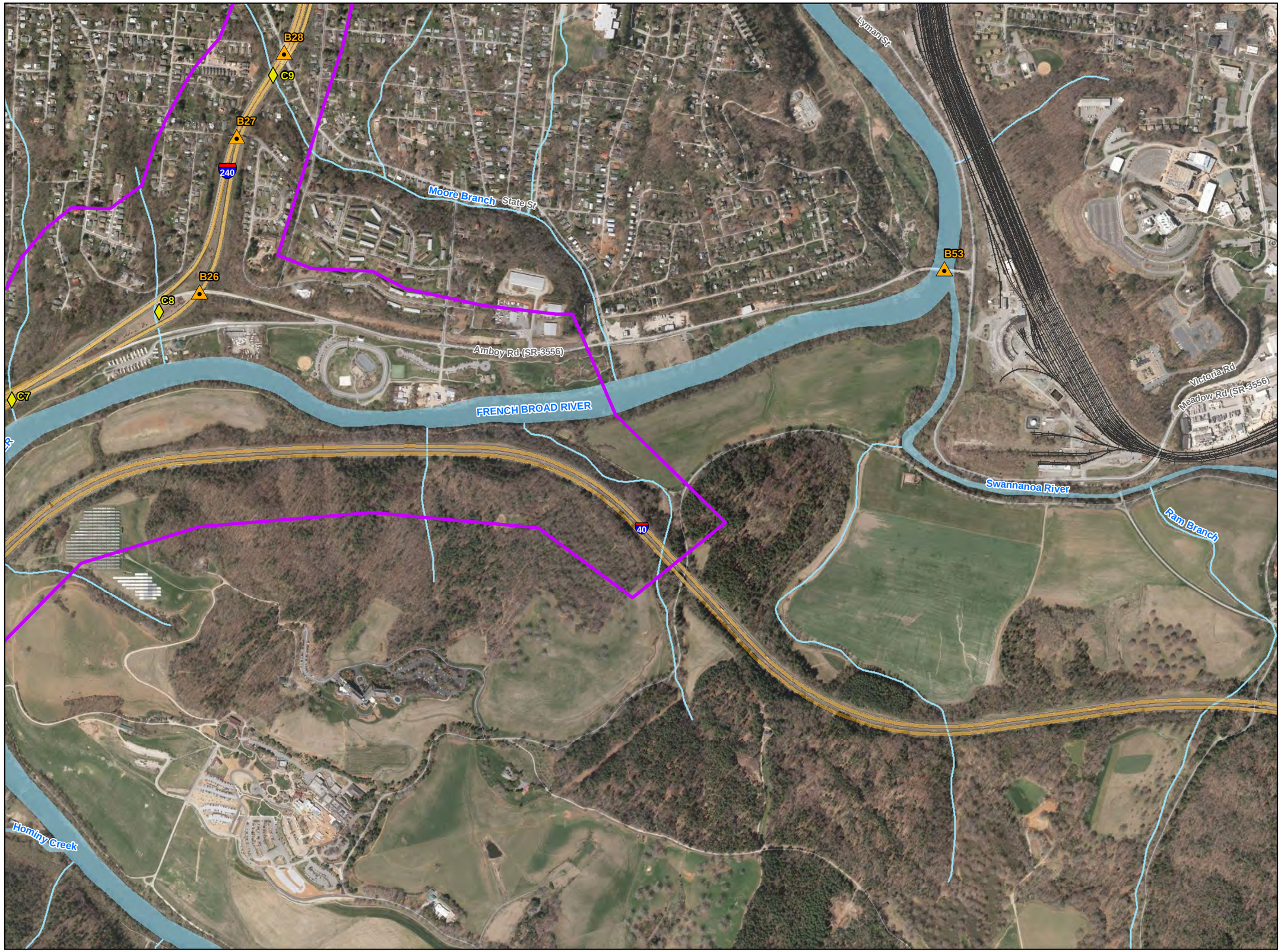
Sources: NCDEQ, NCDOT, Calyx Engineers and Consultants

Aerial Photography: NCDOT



Legend

- Bridge
- Culvert
- Railroad
- NCDEQ 24K Stream
- NCDEQ 24K Waterbody
- StudyArea

Figure 3C

Structure Locations

I-26 Asheville Connector

TIP Project I-2513

Buncombe County, NC

Map Date: 8/22/2018

800 400 0 800

Feet

1 inch = 800 feet

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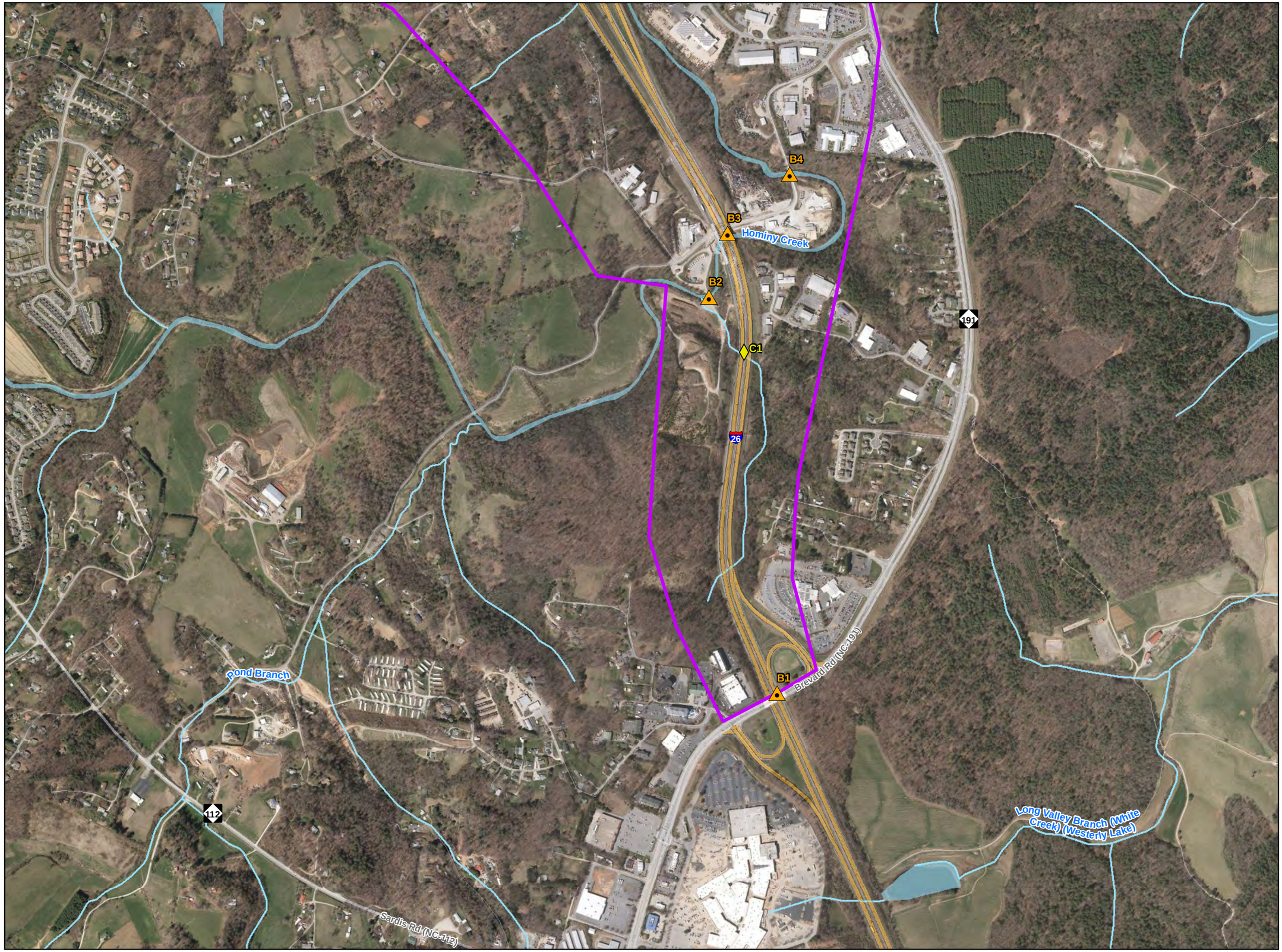

Legend

- Bridge
- Culvert
- Railroad
- NCDEQ 24K Stream
- NCDEQ 24K Waterbody
- StudyArea

Figure 3D

Structure Locations

I-26 Asheville Connector

TIP Project I-2513

Buncombe County, NC

Map Date: 8/22/2018

800 400 0 800

Feet

1 inch = 800 feet

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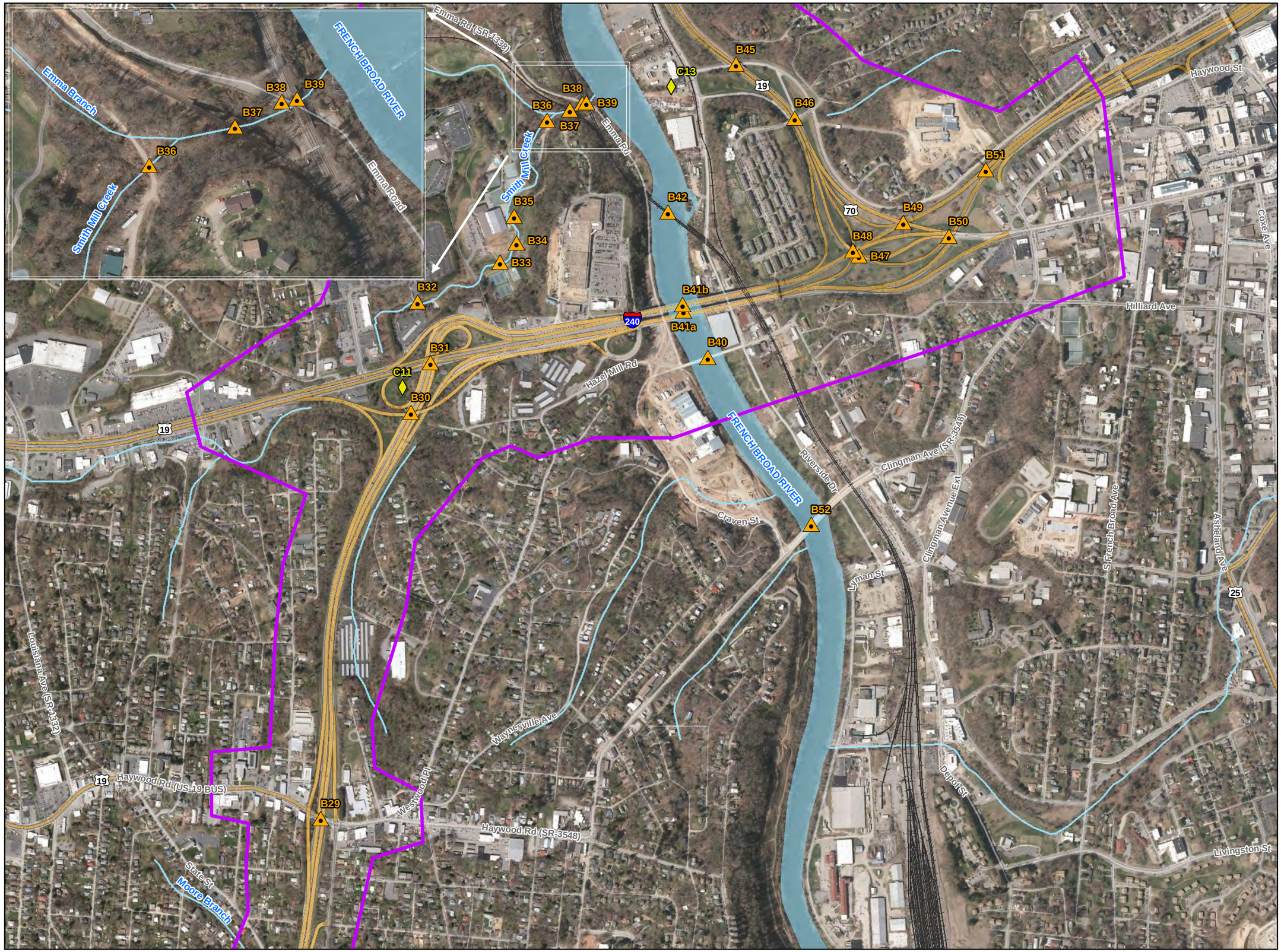
Aerial Photography: NCDOT



Legend

- Bridge
- Culvert
- Railroad
- NCDEQ 24K Stream
- NCDEQ 24K Waterbody
- StudyArea

Figure 3E

Structure Locations

I-26 Asheville Connector

TIP Project I-2513

Buncombe County, NC

Map Date: 8/17/2018

800 400 0 800

Feet

1 inch = 800 feet

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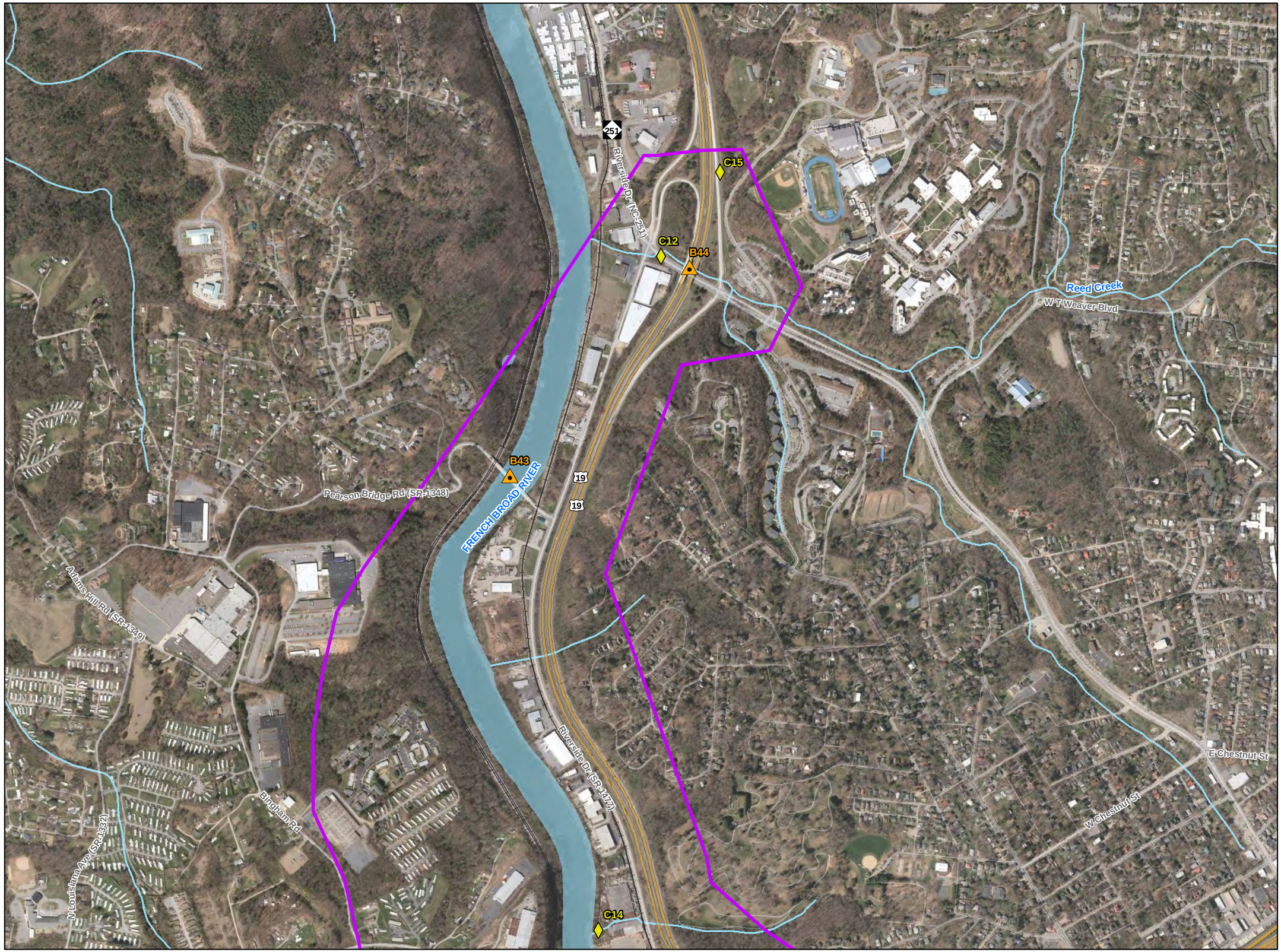
Sources: NCDEQ, NCDOT, Calyx Engineers and Consultants

Aerial Photography: NCDOT



Legend

- Bridge
- Culvert
- Railroad
- NCDEQ 24K Stream
- NCDEQ 24K Waterbody
- StudyArea

Figure 3F

Structure Locations

I-26 Asheville Connector

TIP Project I-2513

Buncombe County, NC

Map Date: 8/22/2018

800 400 0 800

Feet

1 inch = 800 feet

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Sources: NCDEQ, NCDOT, Calyx Engineers and Consultants

Aerial Photography: NCDOT

Appendix B: Bridge Habitat Assessment Forms

PAGES INTENTIONALLY REMOVED

Appendix C: Culvert Habitat Assessment Forms

PAGES INTENTIONALLY REMOVED

Appendix D: Emergence Survey Datasheets

PAGES INTENTIONALLY REMOVED

APPENDIX C. ACOUSTIC SURVEY REPORT

FEDERALLY PROTECTED BAT SPECIES
ACOUSTIC SURVEY REPORT

I-26 Asheville Connector
Buncombe County, North Carolina
Federal Aid Project No. MA-NHF-26-1(53)
WBS Element No. 34165.1.1

TIP I-2513

Prepared for

The North Carolina Department of Transportation
Environmental Analysis Unit
1598 Mail Service Center
Raleigh, NC 27699-1598
919.707.6000

March 2019

FEDERALLY PROTECTED BAT SPECIES ACOUSTIC SURVEY REPORT

I-26 Asheville Connector
Buncombe County, North Carolina
Federal Aid Project No. MA-NHF-26-1(53)
WBS Element No. 34165.1.1

TIP I-2513

Prepared for

The North Carolina Department of Transportation
Environmental Analysis Unit
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March 2019

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APPENDIX D: ACOUSTIC DATA SHEETS

1.0 PROJECT DESCRIPTION

The North Carolina Department of Transportation (NCDOT) obtained the services of CALYX Engineers and Consultants, Inc. (CALYX), an NV5 company, to perform acoustic surveys for gray bats (*Myotis grisescens*; MYGR) for the proposed I-26 interstate freeway connector project. The project will connect I-26 in southwest Asheville to US 19/23/70 in northwest Asheville (STIP Project No. I-2513) for a span of approximately 7 miles (mi), within Buncombe County (NCDOT 2017).

For purposes of this scope of work, the project footprint is defined as the study area to be depicted in the Final Environmental Impact Statement (EIS); Approximately 2,202 acres in total, roughly centered on the existing roadway with expansions around the major highway interchanges, and north of Patton Avenue at the French Broad River where a new bridge will be installed. Figure 1 (Appendix A) depicts the project vicinity, detailed study alternatives, and study area.

The study area is situated in the Blue Ridge physiographic province of North Carolina. Topography in the project vicinity is characterized by gradual to steep slopes with narrow floodplains along drainage ways. Elevations range from a low of 1,980 feet (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 study area. Land use within the project vicinity is characterized by residential and urban development, forested land (including a portion of Pisgah National Forest), and agriculture (NCDOT 2015). The project study area and its landscape position is illustrated in Figure 2, located in Appendix A.

2.0 SPECIES INFORMATION

As of April 28, 1976 the U.S. Fish and Wildlife Service (USFWS) listed MYGR as “Endangered” under the Endangered Species Act. As of February 20, 2019 (date accessed), MYGR was listed as “current” in Buncombe County (USFWS 2019). This species is known, or presumed to occur, in Buncombe County only during summer months. Although northern long-eared bats (*Myotis septentrionalis;* MYSE) are also listed, acoustic surveys focused on MYGR.

2.1 Nearby Records

North Carolina Natural Heritage Program (NCNHP) records (most recently updated January 22, 2019, and viewed on February 20, 2019) confirm presence in six western North Carolina counties: Buncombe, Haywood, Madison, Swain, Transylvania, and Yancey. In addition, 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 (NCNHP 2019). Based on surveys of bridges and culverts conducted by CALYX in 2017, a MYGR roost is known from the study area.

2.2 Natural History

MYGR are typically a communally roosting, cave obligate species, meaning that groups of individuals are known to utilize caves for roosting in both summer and winter. This species has been documented using bridges and culverts as roosts during summer months (Hayes and Bingman 1964, Keeley and Tuttle 1999).

Summer maternity roosts are typically located within 0.62 mi of a river or reservoir over which the bats forage (Tuttle 1979), and are rarely located more than 2.49 mi away from foraging areas

(Tuttle 1976). However, individuals may travel up to 21.75 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).

3.0 ACOUSTIC SURVEY METHODS

All survey methods were developed in coordination with NCDOT, the Asheville USFWS Ecological Services Field Office, and the North Carolina Wildlife Resources Commission (NCWRC). MYGR were known to be present within the project vicinity, so acoustic surveys were not designed to determine presence/absence. Alternatively, acoustic surveys served the purpose of determining areas of highest MYGR activity, and seasonal patterns of activity, if possible.

Qualifications of CALYX biologists who performed the work for this project are included in Appendix C.

3.1 Detector Locations

With regard to bat acoustic analysis, “clutter” is defined as anything that serves as a surface to reflect sound. This could be anything from grass, leaves, tree limbs, and water, to a human body, bridge, or even the detector itself. Bats produce differing echolocation calls depending on the type and amount of clutter. MYGR typically forage in areas of low clutter, over large streams and rivers. Low clutter detector locations typically produce recordings with longer call sequences where the individual pulses are complete, lower in slope, lower in frequency, and less likely to be confused with other species (which are more distinct), and therefore, increasing the chances of correct identification. Therefore, the project goal was to choose detector locations in these areas, with low amounts of clutter near the microphone.

Detectors were deployed to try to determine, without telemetry, bat movement and presence that would potentially be affected by the project. Based on the location of known roosts within and adjacent to the project study 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 Hominy Creek. In 2017, four detector sites were established in the highest quality MYGR foraging/commuting habitat within the study area at locations along the French Broad River. An additional detector was added at the MYGR culvert roost location (discovered in late summer 2017) to monitor MYGR activity there. Although placing a detector at a roost is not ideal in terms of collecting calls that are generally more ideal for call identification (i.e. search phase calls/pulses recorded in open areas), a detector was placed at the roost in an attempt to record calls made by bats travelling specifically to/from the culvert, rather than commuting or feeding along the adjacent French Broad River. Although the banks of the UT were heavily vegetated, an effort was made to point the microphone toward an area that had the least amount of clutter. The detector was placed approximately 20 ft. downstream from the culvert outlet.

In 2018, five additional detector locations were added, mainly to provide coverage to Hominy Creek and Smith Mill Creek/Emma Branch. Figure 3 and Figures 3A-3E, located in Appendix A, show the overall detector locations within the project study area and more specific locations of the ten detector sites, respectively. As requested by USFWS, a detector was deployed at the French Broad River crossing of I-26 south of Asheville, which is associated with the I-26 widening Project (STIP No. I-4400/I-4700) and was monitored with acoustic equipment in 2017. This site

(known as Site 11) was monitored again throughout the 2018 field season, and is shown on the inset of Figure 3.

3.2 Acoustic Equipment

The sites were monitored using Titley Scientific AnaBat Express passive monitoring devices using the latest firmware version (V5506L (3/1/2018), V5507H (6/28/18), and V5507I (7/12/2018)) with weatherproof directional microphones. Equipment failure occurred at a few sites, and was remedied by promptly replacing the faulty detector or reinstalling the firmware, as needed. All acoustic equipment and deployment techniques met the requirements outlined in the USFWS 2017 Range-wide Indiana Bat Summer Survey Guidelines (USFWS 2017) and the USFWS 2018 Range-wide Indiana Bat Summer Survey Guidelines (USFWS 2018). All detectors were serviced by Titley Scientific or purchased brand new during the spring of 2017 and 2018. Specific information about the detectors utilized at each site is presented in the acoustic survey data forms in Appendix D.

3.3 Detector Placement and Setup

The exact physical location, height, and orientation of the microphones were determined in the field by a qualified CALYX biologist and all sites were located using a handheld GPS unit. Detectors that were located near roadways were placed as far away from vehicles as possible while still utilizing forest edge habitat. In these cases, CALYX biologists placed the detectors in locations and orientations that would minimize noise from passing vehicles. This was accomplished by orienting microphones away from traffic, placing microphones downslope at a lower elevation than passing cars, or using other landscape features to block traffic noise. In general, the microphones were elevated a minimum of 12 feet from the ground or water surface to avoid the possibility of sound echoing off those surfaces toward the microphone. Microphone height was adjusted on a site by site basis, depending on height and thickness of understory vegetation.

Detectors were programmed to record nightly beginning 30 minutes prior to sunset and recording until 30 minutes after sunrise. Medium microphone sensitivity settings and data division ratios of 16 were chosen. Upon deployment of any detector, verification was made that the detector was functioning properly by performing a test of the system per the latest AnaBat Express Bat Detector User Manual [Version 1.5 (2/2/15), Version 1.6 (5/18/2018), Version 1.7 (7/12/2018), Version 1.8 (8/24/2018)] (Titley Scientific 2018). Photographs and site-specific information for each detector site and setup are recorded on the acoustic survey data forms presented in Appendix D.

3.4 Deployment Schedule

Detectors were deployed permanently at each site until MYGR activity trailed off for the season. Detectors were only removed from a site to prevent equipment damage from flood events. In the case of a malfunctioning detector, the detector was immediately replaced with another detector.

Acoustic surveys began on March 3 at Site 5, on April 5 at Sites 1-4 and 7-10, and on April 19 at Site 6. In total, 289 weeks of acoustic data were collected from the 10 different locations established throughout the project study area. In addition to those 10 detectors, another detector was deployed at Site 11 on March 3, which collected a total of 32 weeks of acoustic data. Acoustic surveys ended on October 31 at Site 11, on November 7 at Sites 1-4 and Sites 6-10, and on November 21 at Site 5.

3.5 Acoustic Analysis – Autoclassifier

All call files were processed with Bat Call Identification (BCID) Eastern USA Version 2.7d, a USFWS approved automated identification program. Default species filters were applied. At the

request of USFWS, filter settings were changed as follows: Minimum Percentage of Pulses for Species ID set to 70% and Discriminant Probability for Species ID set to 0.35. Using these conservative filter settings added even greater reliability to the identification of MYGR calls and discounted the need for manual vetting. Species identification per file, identification summary (including maximum likelihood estimate MLE) per week, and hourly breakdown per species were generated by BCID.

4.0 RESULTS

CALYX biologists visited the project site each week to download data, replace batteries, and perform detector maintenance. CALYX analyzed acoustic data as efficiently as possible to determine "real time" results, and periodically provided updates to NCDOT, NCWRC, and USFWS.

Table 1, below, shows the 2018 deployment sites and schedule, including each site's general location, deployment start date, and deployment duration. Also included is each site's total number of bat calls and number of MYGR calls. Table 2, located in Appendix B, includes both the 2017 and 2018 deployment schedule and results. Although Sites 1-5 were established in 2017, not enough data was collected in 2017 to determine any significant trends; only 2018's full season of data will be used in the data analysis. Site 11 is included as a basis for comparison in some discussions that follow. Notice that bat activity in general, and MYGR activity in particular, is exponentially higher at Site 11 than at any of the sites located within the project study area.

Table 1: 2018 Deployment Schedule & Results

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)

Refer to the acoustic survey data forms in Appendix D for each site's detailed results (weekly total calls, weekly MYGR calls, number of nights recorded, etc.).

4.1 Data Analysis

Surveying for bats using acoustic methods can be challenging for a variety of reasons. Acoustic detectors are limited in their ability to detect and record bats, distinguish bat calls from other sounds, and withstand environmental factors. Acoustic analysis software is also limited in its ability to distinguish bat calls from other sounds, and to correctly identify bats to the species level.

In addition to a variety of environmental and technical factors that may interfere with the software's ability to identify the species, individual bats may change their calls depending on their activity and specific location within their environment. There is no method to identify bat species acoustically with 100% accuracy. In fact, it is impossible to be definitive about *Myotis* species identification (and in some cases other North American bat species), unless the bat is in hand. It can only be concluded that a given call sequence from an individual bat may likely be attributable to a particular species based on comparison with a known call sequence from a bat flying in a similar situation.

That said, it is possible to definitively identify high quality calls to the genus *Myotis*, and MYGR are one of the more readily identifiable species of *Myotis* based on calls. In addition, we can feel more confident about identification when conservative filter settings are used during the automated identification process, as is the case in this study. The use of conservative filter settings is particularly useful in situations like the culvert roost, where an abundance of calls are recorded, but many calls may not be search phase calls.

In order to minimize the many challenges inherent to species identification based on acoustic data, CALYX biologists were diligent about monitoring site conditions, detector setups, detector function, and subsequent data collected to ensure that call files of the best possible quality were recorded. Only weeks with 6 or 7 full nights of data were included in the data analysis in order to compose a standard week of data.

A major flood event occurred on May 30. Flooding was too severe at Sites 1-4, 6-7, and 10 to physically access the detectors. They were left to record as long as possible before their batteries died. The detectors were serviced on June 5, once the floodwaters receded. It was possible to reach detectors at Site 5 and Site 11 on May 30. Site 5 was redeployed on June 1 and Site 11 was redeployed on June 5. Detectors at Site 8 and Site 9 malfunctioned during the flooding. In summary, data was either lost or not able to be recorded at most detectors for at least a portion of the time period between May 30 and June 5.

To avoid equipment damage caused by Hurricane Florence, all of the detectors were preemptively removed on September 12, resulting in one missing night of data. The detectors were redeployed on September 20, after floodwaters receded, resulting in an additional week of missing data.

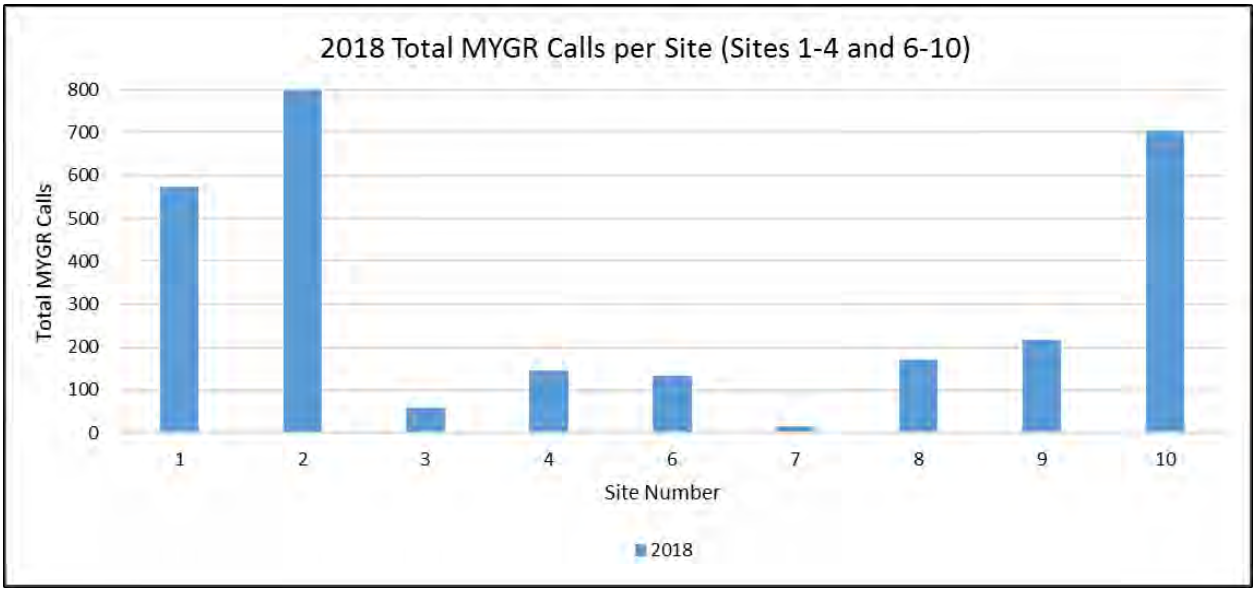
Additional flooding occurred on October 11, preventing the scheduled maintenance to occur on detectors at Sites 1-5, all of which are along the French Broad River. Without replacement batteries, only two full nights of data were recorded at the affected sites during that week of data collection.

After processing all recorded call files through BCID Eastern USA, MYGR calls were identified at all of the 10 detector sites within the study area. In addition to Site 5, which was a known MYGR roost, Sites 1, 2, and 10 produced the largest number of MYGR calls. Looking at total number of MYGR calls, Site 1 recorded 573, Site 2 recorded 799, and Site 10 recorded 704 MYGR calls. It is important to note that Sites 1, 2, and 10 were all located adjacent to the French Broad River. Chart 1, below, shows the total number of MYGR calls at each site. Site 5, with 4,711 total MYGR calls for the season, was not included since it is such a strong outlier, and resulted a presentation that made differences in call totals difficult to discern.

It should be noted that 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.

Chart 1



It is important to discern differences in activity at the various detector locations based on the reproductive cycle of MYGR in the area. Although the exact time frames are not known when MYGR in the area are pregnant, give birth, or when pups become volant, some generalizations were made for purposes of data analysis. Therefore, reproductive phases were assigned the following timeframes: pre-lactating/pregnant (beginning when MYGR emerge from hibernation through the third week of June), lactating (last week of June through the third week of July), and post lactating, when pups are volant and feeding on their own (last week of July through the time when MYGR begin hibernation).

Charts that show total MYGR calls for each detector location, overlaid on demarcations of reproductive seasons, are included in Figures 3A through 3E in Appendix A, to provide a visual representation of activity within each phase of the MYGR reproductive cycle at each detector location. 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. Seasonal activity patterns may be less meaningful at detector locations where total numbers of calls were lower overall, such as sites 3, 7, and 8.

Looking at weekly totals for the entire 2018 recording season, across all detector sites (Chart 2, below), the number of MYGR calls increased substantially during the last two weeks of July. This aligns with the trends observed at individual detector sites. It is important to note that variation in number of calls from week to week could potentially be affected by local weather conditions. Rain, high winds, or unusually cool temperatures can all affect bats' ability or desire to forage. Extreme weather events that affected recording are indicated on relevant charts. Furthermore, MYGR may utilize waterways for foraging based on prey availability, so if insect numbers drop for a particular period of time, that may be reflected in overall number of calls for that period.

Chart 2

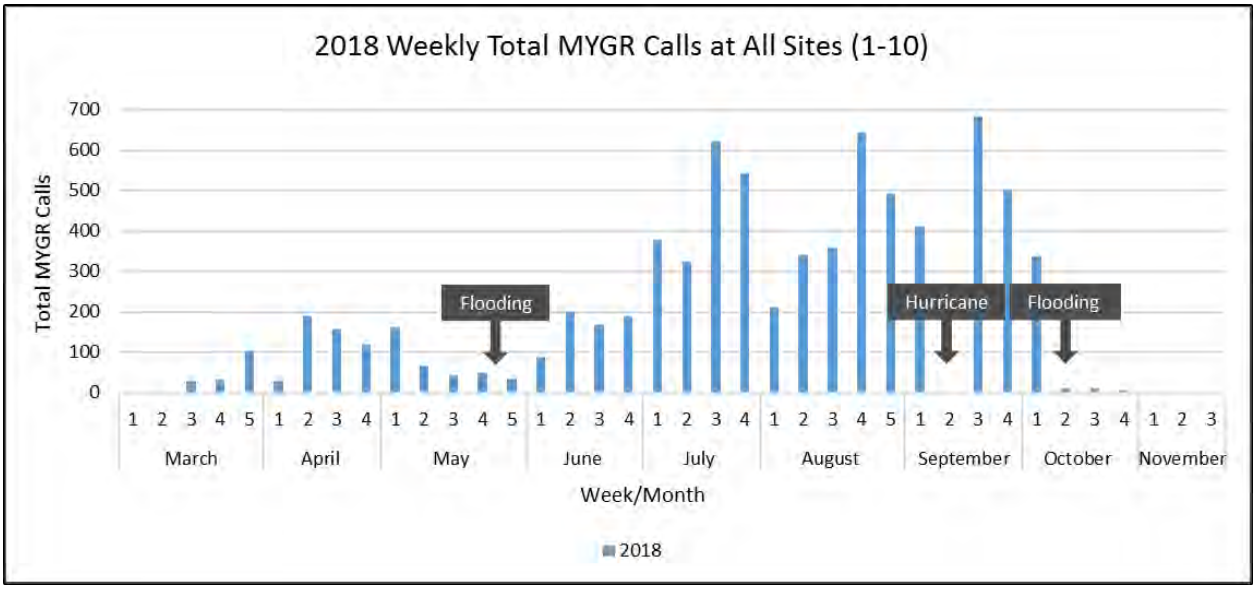
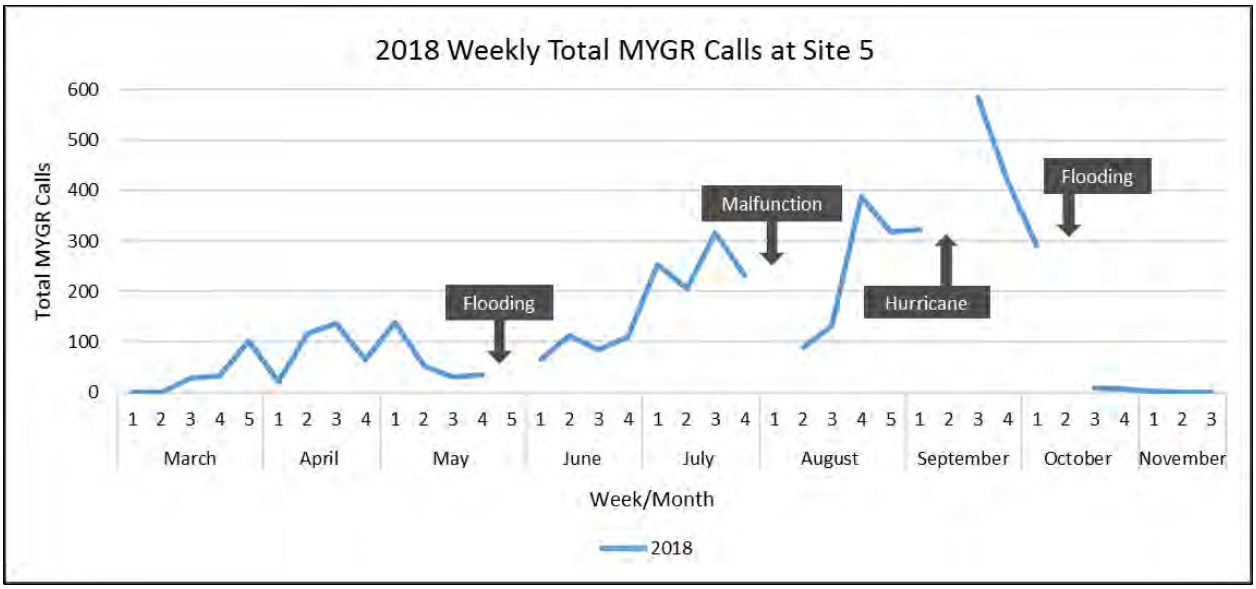


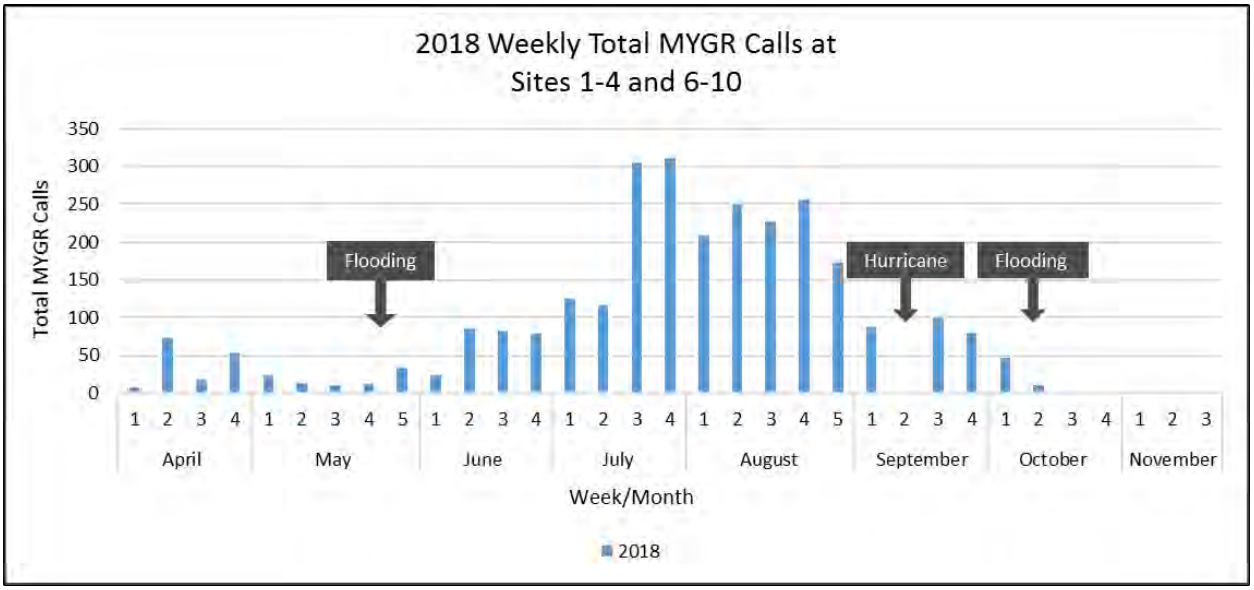
Chart 3, below, details the total number of MYGR calls per week specifically at Site 5, the MYGR culvert roost. Detector malfunctions and extreme weather events are displayed to explain gaps in the data. There is a general trend of increasing activity throughout the season. There is a drop in calls around the beginning of August simultaneous with the detector malfunctioning.

Chart 3



Removing the call data for Site 5, where the MYGR culvert roost is located, potentially gives a better representation of what occurred at the more traditional detector locations, not associated with known MYGR roosts, and more likely to be representative of activity at foraging and commuting locations. Chart 4, below, shows the weekly total number of MYGR calls at only Sites 1-4 and Sites 6-10. MYGR activity peaks the last two weeks of July and steadily declines through the end of the 2018 season. 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.

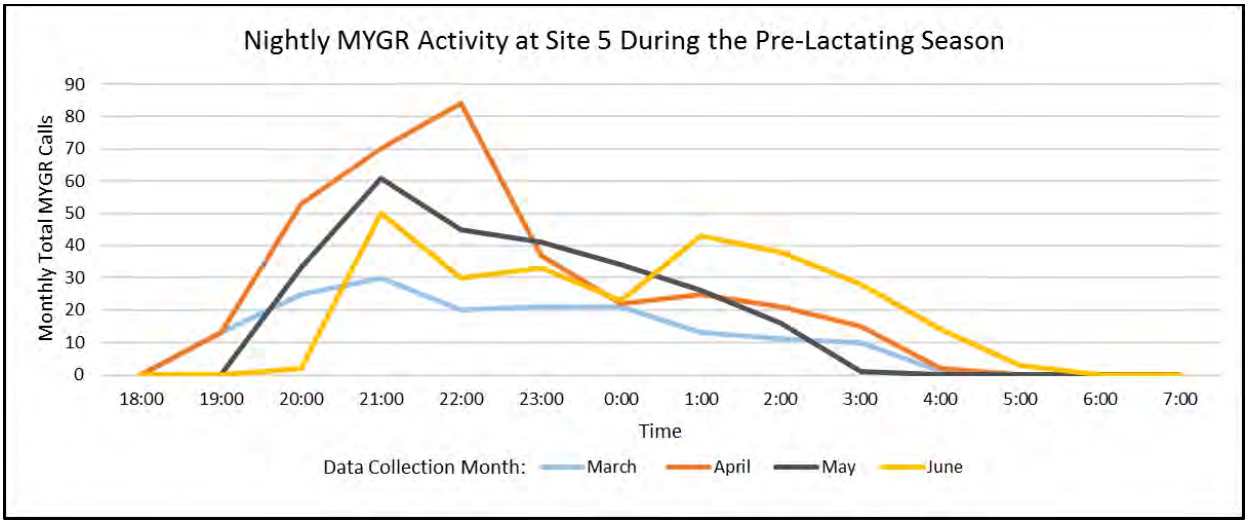
Chart 4



4.2 Nightly Activity at the Culvert Roost

BCID creates an output file that indicates the number of calls, per species, per hour for each week of data collection. The number of calls per week were summed to provide the total number of MYGR calls per hour for each month in each of the three reproductive periods throughout the summer. The following three charts provide a visual representation of seasonal MYGR activity at Site 5, the culvert roost, based on traditional phases of MYGR reproduction. Total number of MYGR calls were analyzed. Chart 5 shows activity during the pre-lactating period (when females are pregnant; typically through the third week of June), Chart 6 shows activity during the lactating period (when females are nursing pups; typically between the last week of June and the third week of July), and Chart 7 shows activity during the post-lactating period (when pups are volant and feeding on their own; typically beginning the last week of July).

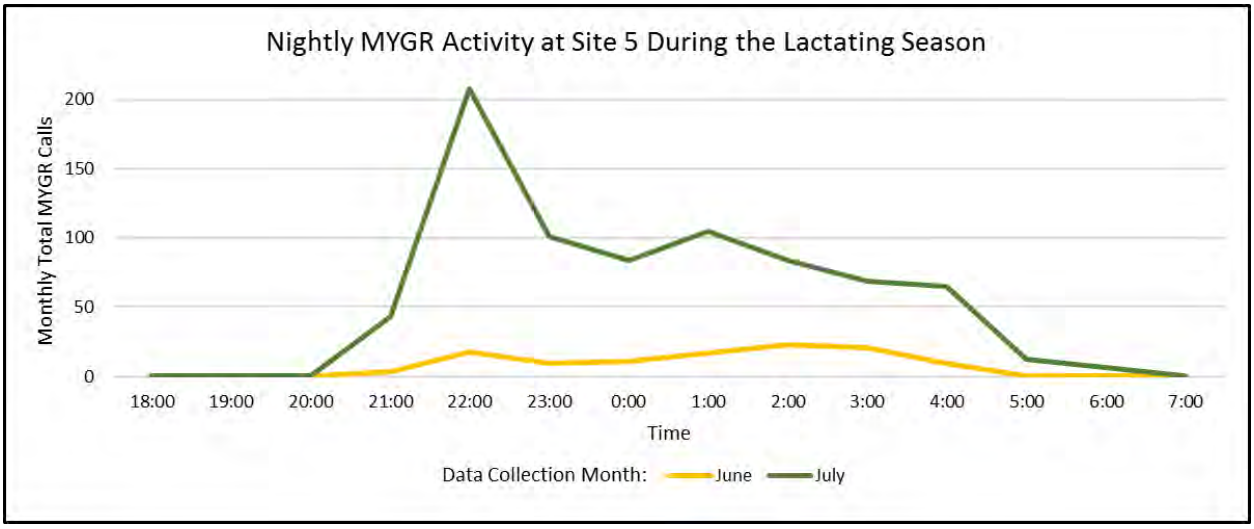
Chart 5



Based on the results of this analysis, it appears that, during the pre-lactating season, MYGR activity peaks after sunset between 21:00 and 22:00. Activity then decreases as the night

progresses. The total number of MYGR calls per hour for each of the pre-lactating season months is much lower compared to the total number of MYGR calls per hour in the lactating and post-lactating time periods.

Chart 6



The lactating season, the shortest of the three time periods, occurs only in June and July. The month of June had far fewer calls than July, making it difficult to see a significant trend. It does seem that there is a peak around 22:00 and then again at 02:00. The data from July shows a peak in activity at 22:00 before activity declines as the night progresses.

Chart 7

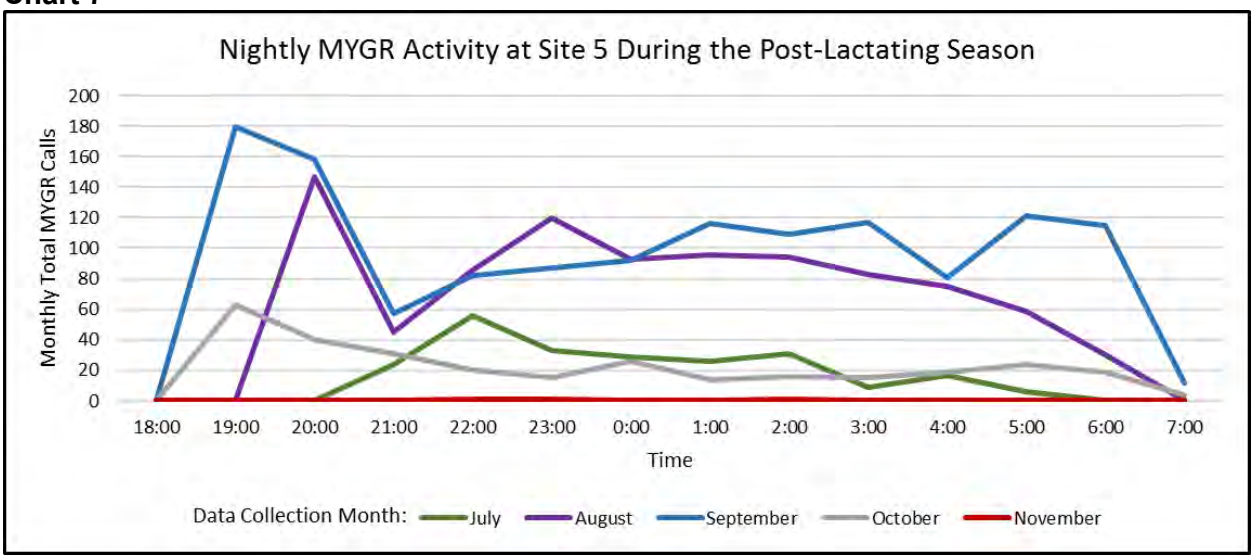
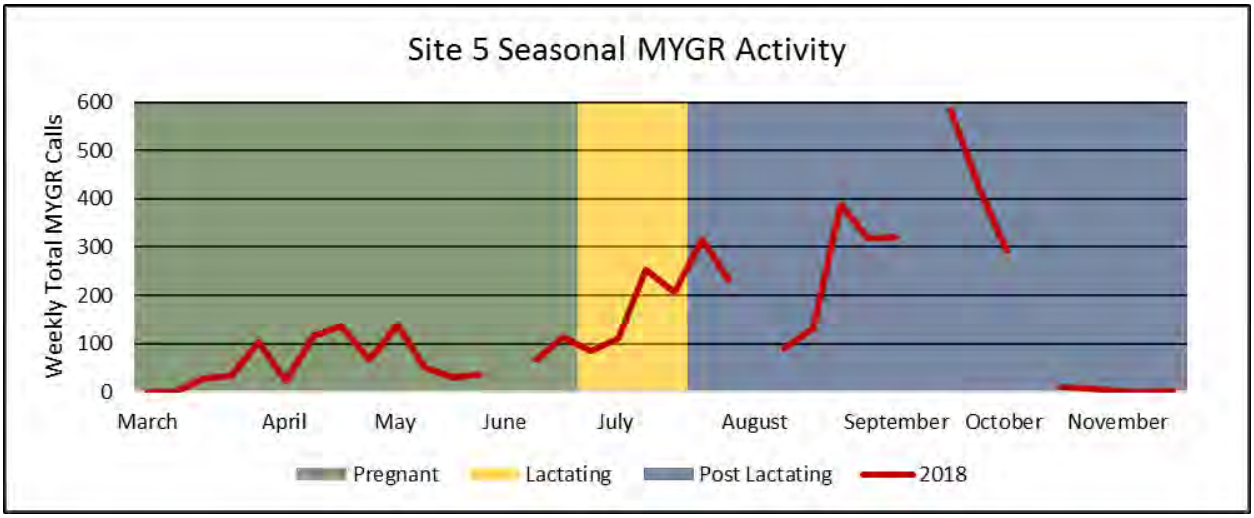


Chart 7, above, shows the activity throughout the night once pups became volant. There is high activity between 19:00 and 20:00, which is around time of sunset. It is important to note that the activity in the post-lactating season differs from the activity in the pre-lactating and lactating seasons. The activity in the post-lactating season does not decrease as the night progresses as it does in the pre-lactating and lactating seasons. Instead, activity stays relatively constant until 05:00 and 06:00 before dropping off, generally around sunrise.

Chart 8, below, shows the relationship between number of MYGR calls recorded and the main time periods. There is activity while gray bats are pregnant, but the number of MYGR calls starts to increase while females are lactating. There is a fall in recorded calls after pups become volant, but the number of calls increases to a maximum of 584 MYGR calls.

Chart 8

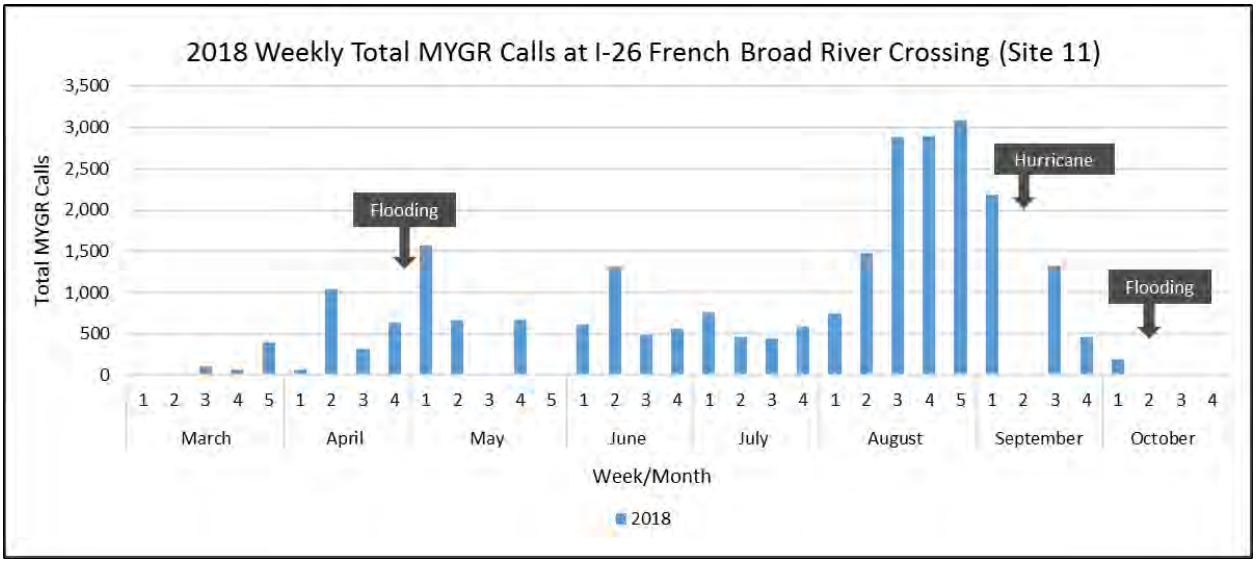


4.3 Comparative Data from Site 11

As part of the effects analysis associated with the widening of I-26 (NCDOT STIP Nos. I-4400/I*4700), an acoustic detector was placed at the I-26 crossing of the French Broad River (approximately 3 miles south of the I-40/I-240 interchange). A large amount of MYGR activity was documented at this location (Site 11) in 2017, and USFWS requested that additional monitoring continue at this location during 2018. The detector at Site 11 recorded an exponentially higher number of MYGR calls than any of the sites in the I-2513 study area. Site specific information is located on Site 11's acoustic survey data form in Appendix D. Information regarding the total number of MYGR calls recorded in 2017 and 2018 can be found in Table 2, Appendix B.

Chart 9, below, shows the total number of MYGR calls identified by BCID at Site 11 by week. Unlike sites 1-10, which had a significant increase in total MYGR calls during the last two weeks in July, peak MYGR activity at Site 11 occurred a few weeks later in mid to late August. This peak is later than the traditional time when pups become volant, and may be related to insect activity specific to the location. Unlike sites within the I-2513 study area, activity at Site 11 started to decrease at the beginning of September.

Chart 9



4.4 Summary

After analyzing the data, it is clear that the number of calls recorded at each site varies greatly. Site 5 produced the highest number of MYGR calls, as expected. The sites with the next highest number of calls, Sites 1, 2, and 10 were all located along the French Broad River. Not all sites along the river experienced the same level of activity. Site 3, located downstream from Site 10, recorded the second lowest number of MYGR calls out of all the sites.

Although there were slight differences, the overall trends in seasonal activity coincided with one another. The height of bat activity generally occurred from the end of July, when pups became volant, through the end of August. In September bat activity begins to decline as MYGR leave the area for their winter roosts, and few bats remain on the landscape after the beginning of October.

Looking more closely at nightly data, specifically at Site 5 during the post-lactating period, there is no specific time of night when MYGR activity slows down. During the pre-lactating and lactating periods, there is a clear trend in activity. However, the total number of calls during these two periods are lower than the number of calls during the post-lactating period.

MYGR calls were first recorded at Site 5 the third week of March and were recorded throughout the season until the first week of November. At Sites 1-4 and Sites 6-10, MYGR calls were recorded the first week of April when the detectors were deployed.

Call data from Site 11 reflects a significantly higher amount of MYGR activity than at any of the sites within the I-2513 study area. However, general trends of activity at Site 11 mirror those seen at Sites 1-10.

5.0 REFERENCES

Brady, J. T., Kunz, T. H., Tuttle, M. D., and Wilson, D. E. (1982). "Gray bat recovery plan," U.S. Fish and Wildlife Service, Denver, CO.

Hays, H. A., and D. C. Bingman. 1964. A colony of gray bats in southeastern Kansas. Journal of Mammalogy 45:150.

Keeley, B. W., and M. D. Tuttle. 1999. Bats in American bridges. Bat Conservation International, Inc., Austin, Texas, Resource Publication 40 pp.

La Val, R. K., Clawson, R. L., La Val, M. L. and Caire, W. 1977. Foraging behavior and nocturnal activity patterns of Missouri bats, with emphasis on the endangered species Myotis grisescens and Myotis sodalis. Journal of Mammalogy 58: 592-599.

North Carolina Department of Transportation (NCDOT) 2015. Draft Environmental Impact Statement, I-26 Connector, I-40 to US 19-23-70 North of Asheville Buncombe County, North Carolina.

North Carolina Department of Transportation (NCDOT) 2017. Draft 2017-2027 State Transportation Improvement Program. https://connect.ncdot.gov/projects/planning/STIPDocuments1/Draft%202017-2027%20STIP.pdf

North Carolina Natural Heritage Program (NCNHP). The Natural Heritage Database. https://ncnhde.natureserve.org/ (Accessed February 20, 2019).

Titley Scientific. AnaBat Express Bat Detector User Manual, Version 1.8. https://www.titley-scientific.com/us/downloads/dl/file/id/16/product/0/anabat_express_user_manual_v1_5.pdf (Accessed August 24, 2018)

Tuttle, M. D. 1976. Population ecology of the gray bat (*Myotis grisescens*): philopatry, timing, and patterns of movement, weight loss during migration, and seasonal adaptive strategies. Occasional Papers of the Museum of Natural History University of Kansas. 54: 1-38.

Tuttle, M. D. 1979. Status, causes of decline and management of endangered gray bats. Journal of Wildlife Management. 43: 1-17.

Tuttle, M. D., and J. Kennedy. 2005. Field guide to eastern cave bats. Bat Conservation International, Inc., Austin, TX. 41 pp.

Tuttle, M. D., and D. E. Stevenson. 1977. Variation in the cave environment and its biological implications. Pages 108-21 in R. Zuber, editor. National cave management symposium proceedings.

United States Fish and Wildlife Service (USFWS). 2017. Range-wide Indiana Bat

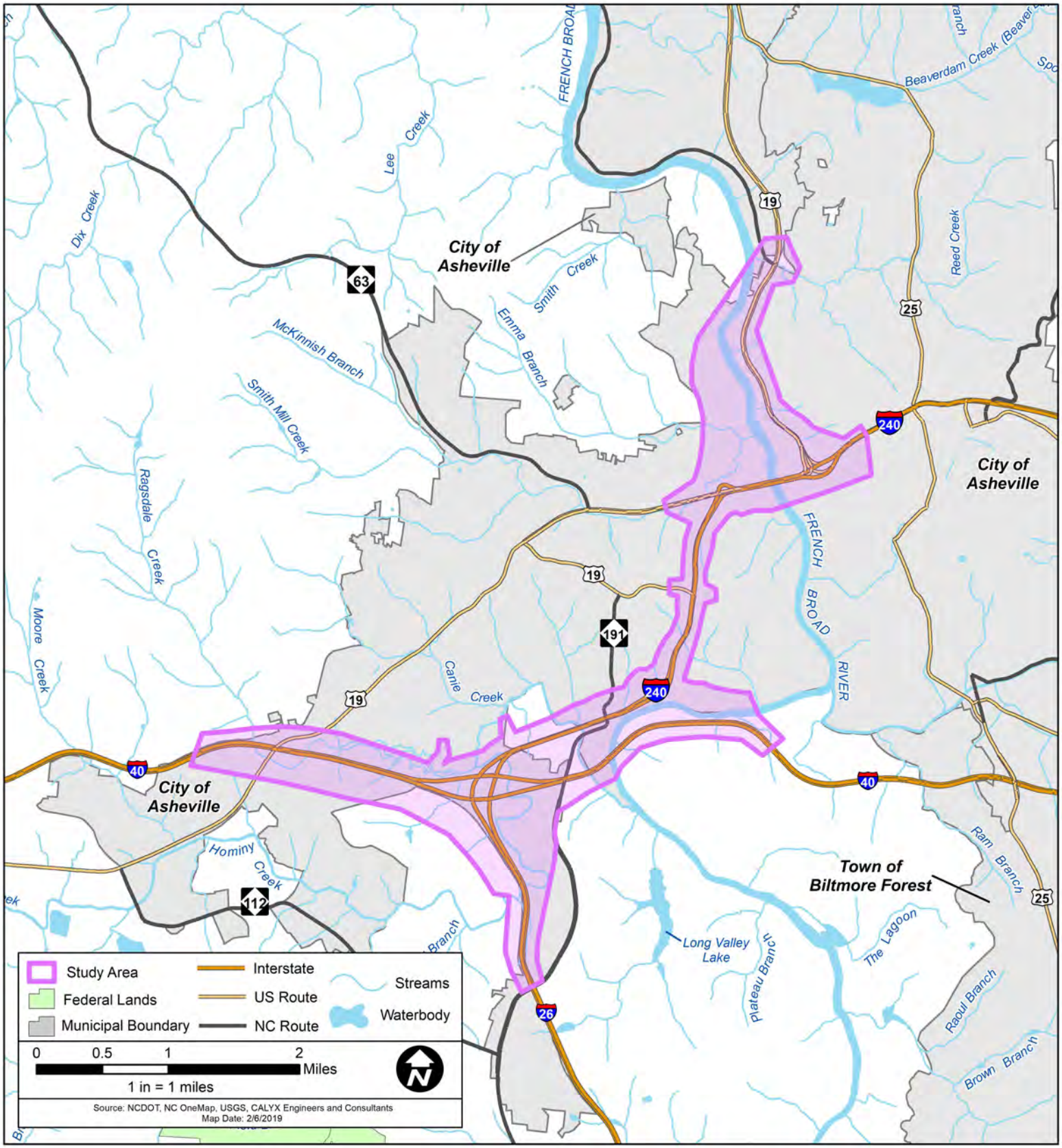
Summer Survey Guidelines. https://www.fws.gov/midwest/endangered/mammals/inba/surveys/pdf/2017INBASummerSurveyGuidelines9May2017.pdf

United States Fish and Wildlife Service (USFWS). 2018. Range-wide Indiana Bat Summer Survey Guidelines https://www.fws.gov/midwest/endangered/mammals/inba/surveys/pdf/2018RangewideIBatSurveyGuidelines.pdf

United States Fish and Wildlife Service (USFWS). 2019. Endangered and Threatened Species and Species of Concern by County for North Carolina http://www.fws.gov/raleigh/species/cntylist/nc_counties.html (Accessed February 20, 2019)

Appendix A

Figures



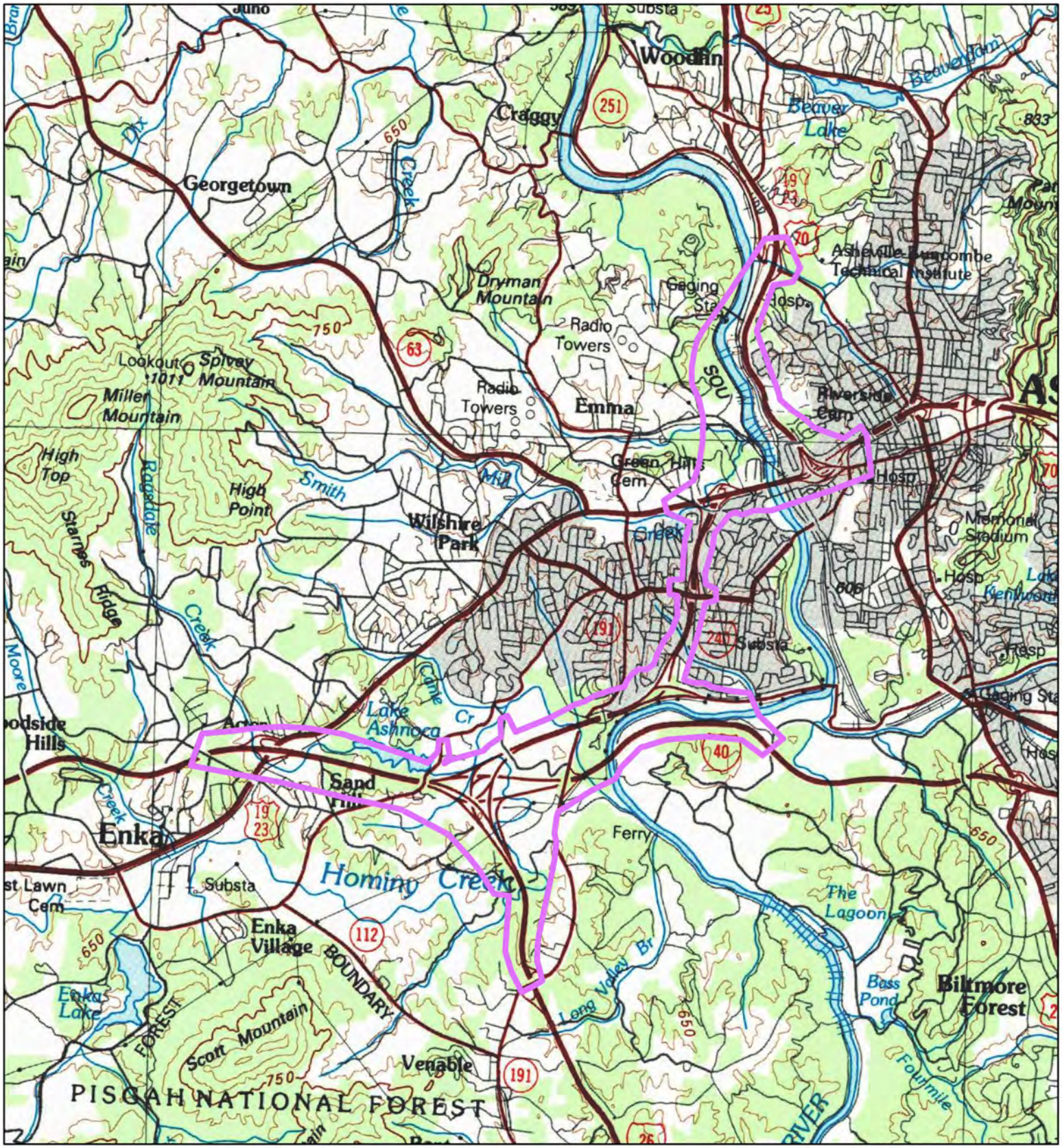
NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

I-26 Asheville Connector

TIP Project I-2513

Buncombe County, NC

Figure 1 - Project Vicinity



NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

I-26 Asheville Connector

TIP Project I-2513

Buncombe County, NC

Legend

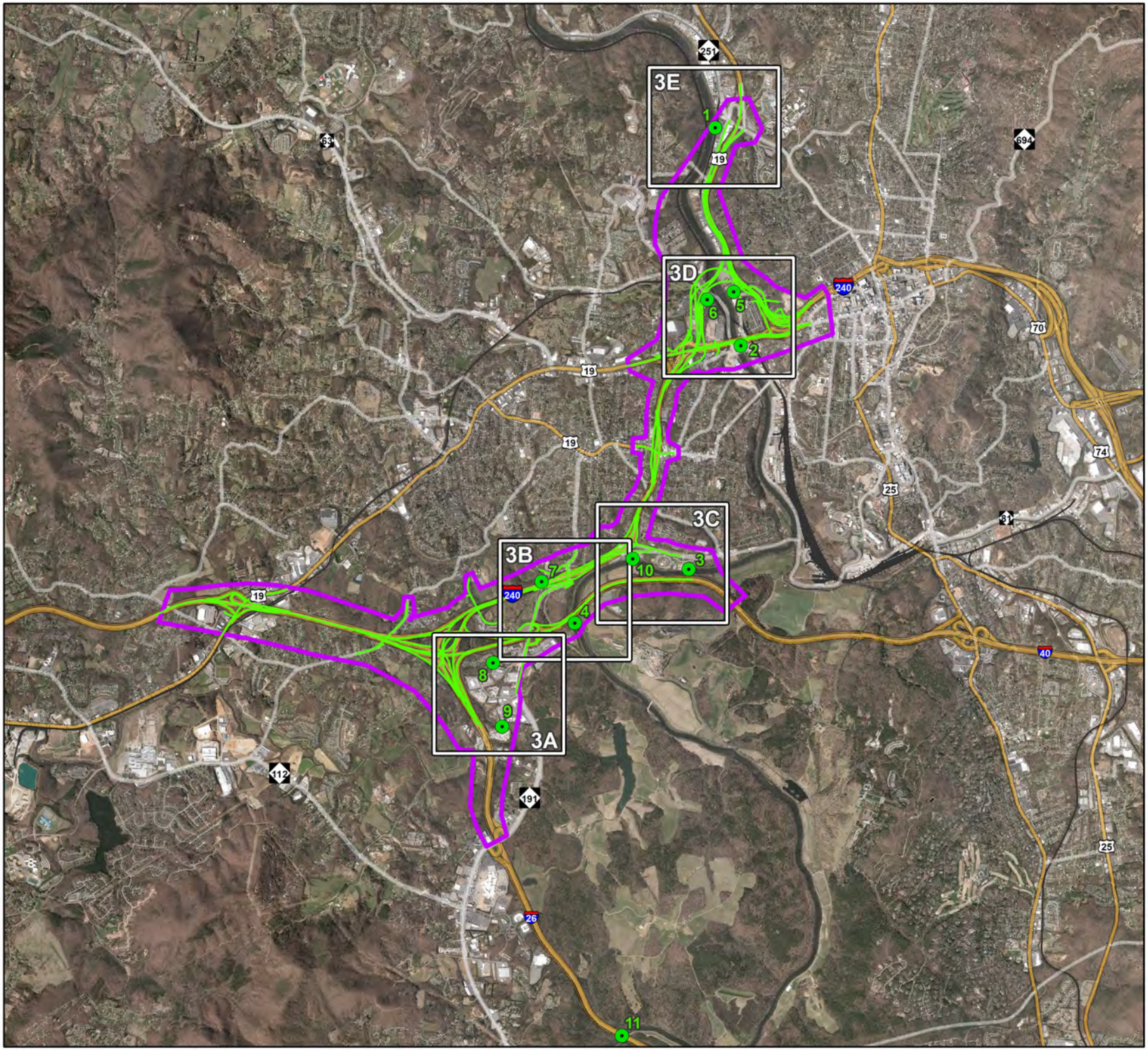
Study Area

0 0.5 1 2 Miles

1 in = 1 mile

Figure 2 - Landscape Position

Source: NC OneMap, CALYX Engineers and Consultants
Map Date: 2/25/2019



Legend

- Map Tile
- Study Area
- Detector Locations
- Detailed Study Alternative

Figure 3

Acoustic Detector Locations Overview

I-26 Asheville Connector

TIP Project I-2513

Buncombe County, NC

Map Date: 3/4/2019

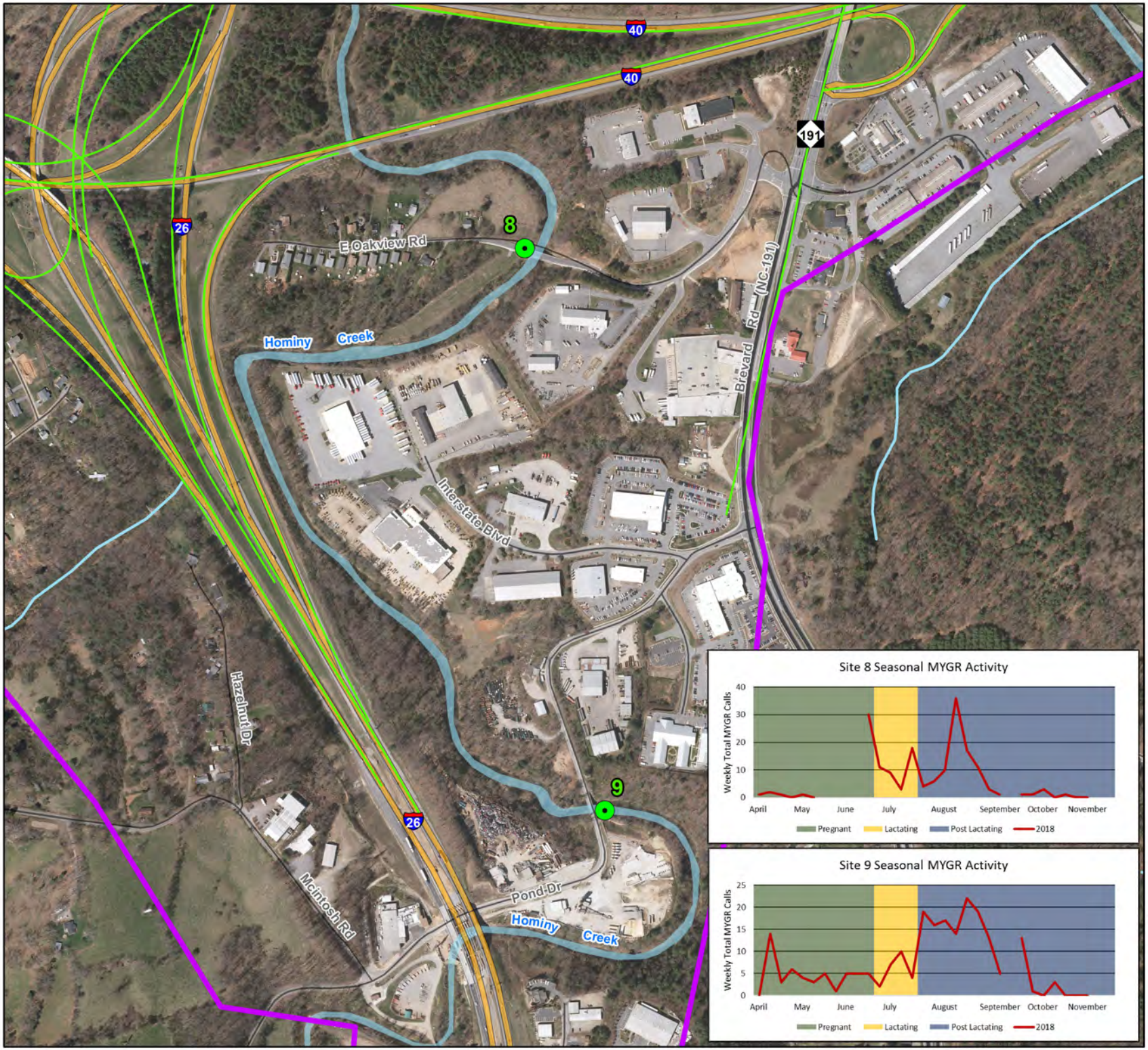
0 0.5 1 Miles

1 inch = 1 mile

This Exhibit is for planning purposes only and information shown hereon does not meet The Standards of Practice for Land Surveying in North Carolina (21 NCAC 56.1600). The Exhibit was compiled from available information obtained from the sources listed below. Streams and Wetlands: All features located in the field were recorded using a mapping grade Trimble GeoXT

Sources: NCDEQ, NCDOT, Calyx Engineers and Consultants

Aerial Photography: NC OneMap



Legend

- Study Area
- Detector Locations
- Detailed Study Alternative
- NCDEQ 24K Stream
- NCDEQ 24K Waterbody

Figure 3A

Acoustic Detector Locations

I-26 Asheville Connector

TIP Project I-2513

Buncombe County, NC

Map Date: 2/26/2019

0 300 600 Feet

1 inch = 600 feet

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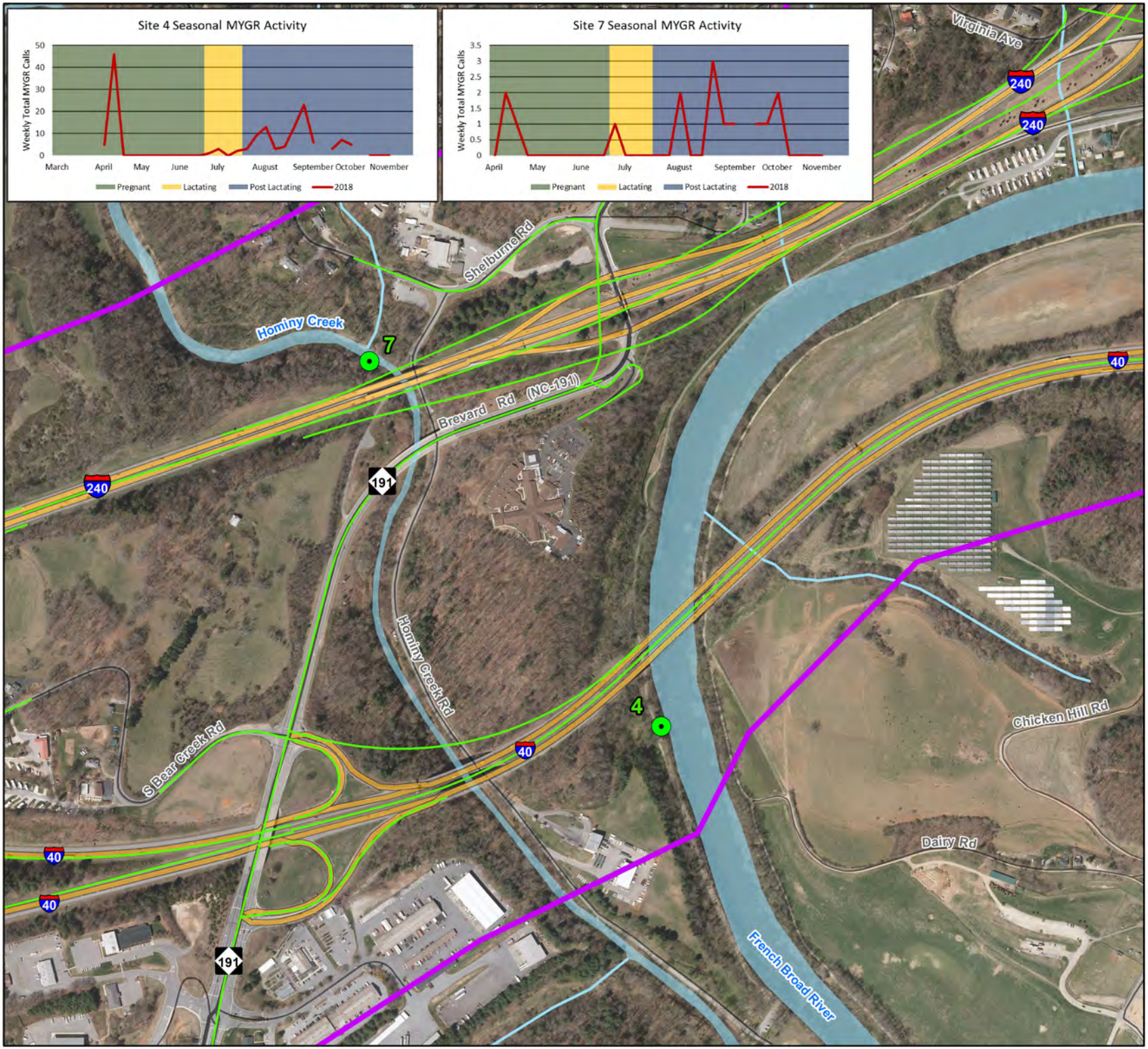
Sources: NCDEQ, NCDOT, Calyx Engineers and Consultants

Aerial Photography: NC OneMap



Legend

- Study Area
- Detector Locations
- Detailed Study Alternative
- NCDEQ 24K Stream
- NCDEQ 24K Waterbody

Figure 3B

Acoustic Detector Locations

I-26 Asheville Connector

TIP Project I-2513

Buncombe County, NC

Map Date: 2/26/2019

0 300 600 Feet

1 inch = 600 feet

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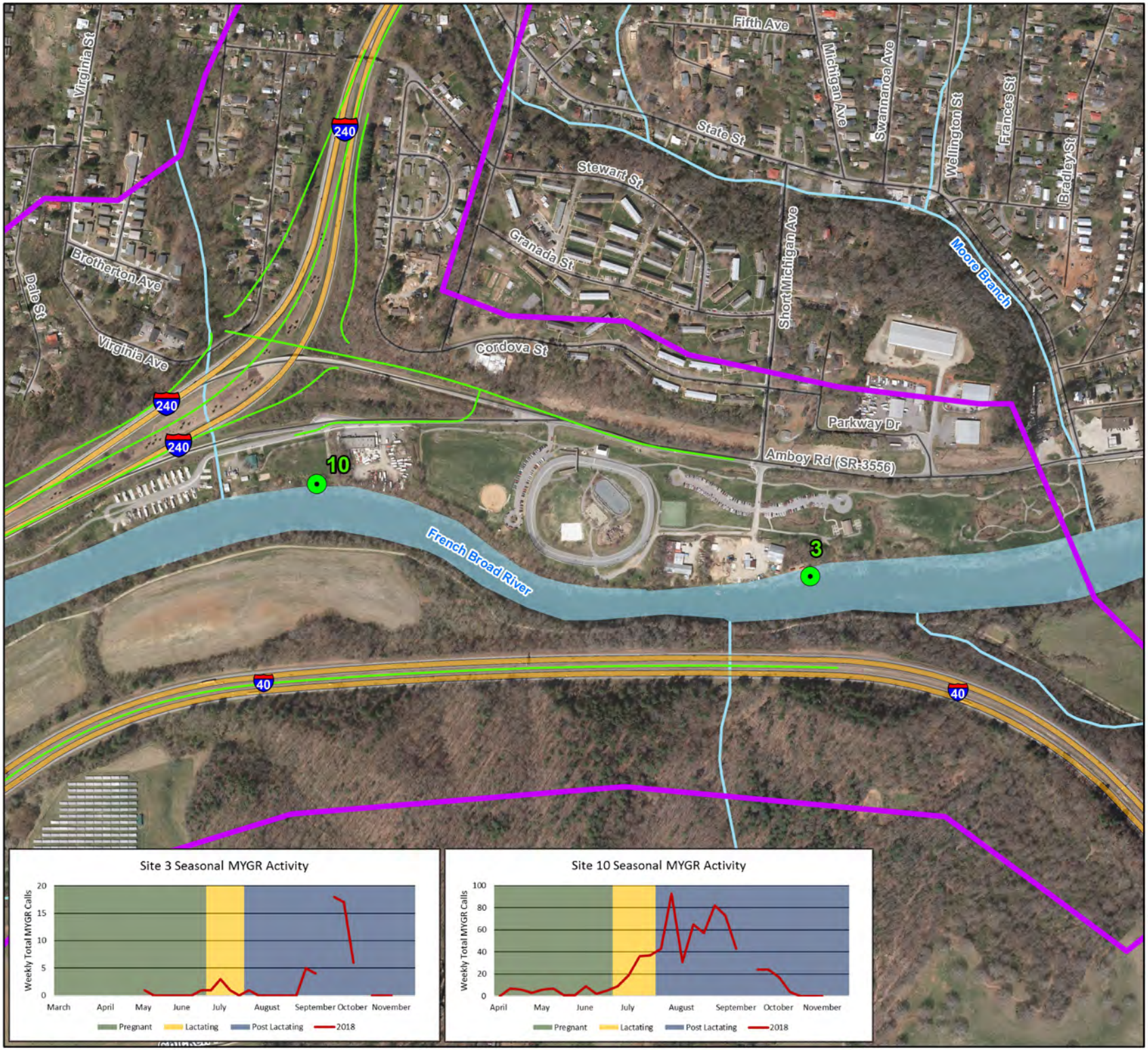
Sources: NCDEQ, NCDOT, Calyx Engineers and Consultants

Aerial Photography: NC OneMap



Legend

- Study Area
- Detector Locations
- Detailed Study Alternative
- NCDEQ 24K Stream
- NCDEQ 24K Waterbody

Figure 3C

Acoustic Detector Locations

I-26 Asheville Connector

TIP Project I-2513

Buncombe County, NC

Map Date: 2/26/2019

0 300 600

Feet

1 inch = 600 feet

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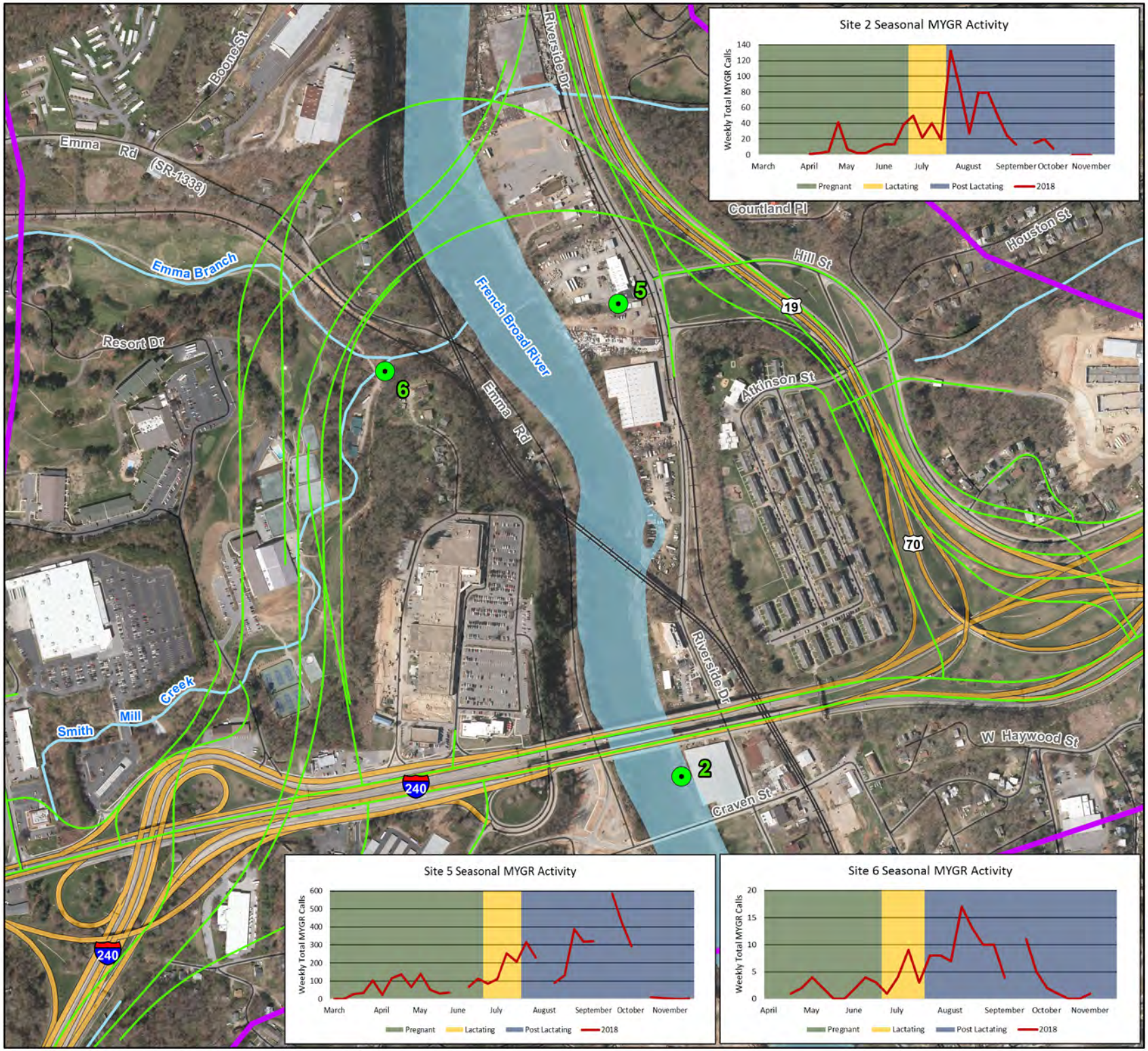
Sources: NCDEQ, NCDOT, Calyx Engineers and Consultants

Aerial Photography: NC OneMap



Legend

- Study Area
- Detector Locations
- Detailed Study Alternative
- NCDEQ 24K Stream
- NCDEQ 24K Waterbody

Figure 3D

Acoustic Detector Locations

I-26 Asheville Connector

TIP Project I-2513

Buncombe County, NC

Map Date: 2/26/2019

0 300 600

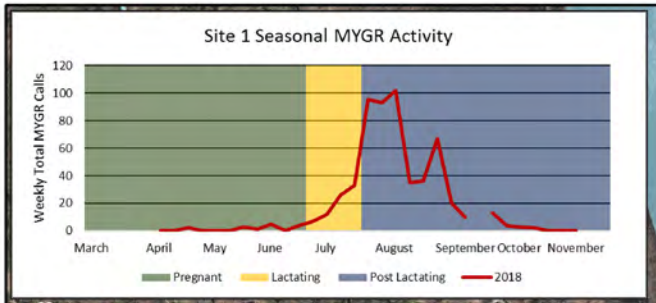
Feet

1 inch = 600 feet

This Exhibit is for planning purposes only and information shown hereon does not meet The Standards of Practice for Land Surveying in North Carolina (21 NCAC 56.1600). The Exhibit was compiled from available information obtained from the sources listed below. Streams and Wetlands: All features located in the field were recorded using a mapping grade Trimble GeoXT

Sources: NCDEQ, NCDOT, Calyx Engineers and Consultants

Aerial Photography: NC OneMap



Legend

- Study Area
- Detector Locations
- Detailed Study Alternative
- NCDEQ 24K Stream
- NCDEQ 24K Waterbody

Figure 3E

Acoustic Detector Locations

I-26 Asheville Connector

TIP Project I-2513

Buncombe County, NC

Map Date: 2/26/2019

0 300 600 Feet

1 inch = 600 feet

This Exhibit is for planning purposes only and information shown hereon does not meet The Standards of Practice for Land Surveying in North Carolina (21 NCAC 56.1600). The Exhibit was compiled from available information obtained from the sources listed below. Streams and Wetlands: All features located in the field were recorded using a mapping grade Trimble GeoXT

Sources: NCDEQ, NCDOT, Calyx Engineers and Consultants

Aerial Photography: NC OneMap

Appendix B

Tables

Table 2: 2017 & 2018 Deployment Schedule & Results

Detector Site #	Site Name	Associated Waterbody	2017				2018			
			Date Deployed	Approx. # Weeks Deployed*	Total # Bat Calls*	Total # MYGR Calls*	Date Deployed	Approx. # Weeks Deployed*	Total # Bat Calls*	Total # MYGR Calls*
1	Grainger	French Broad River	20170727	7 Weeks	5,734	273	20180405	30 Weeks	20,020	573
2	Smoky Park Bridge	French Broad River	20170727	7 Weeks	8,001	545	20180405	29 Weeks	18,134	799
3	Carrier Park	French Broad River	20170727	4 Weeks	5,342	490	20180503	25 Weeks	8,194	58
4	I-40 and Greenway	French Broad River	20170727	7 Weeks	7,601	270	20180405	29 Weeks	3,877	146
5	Culvert	UT French Broad River	20171009	5 Weeks	1,082	117	20180301	34 Weeks	14,804	4,711
6	Smith Mill Creek	Smith Mill Creek	N/A - Sites not established until 2018				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	20170518	22 Weeks	59,121	17,767	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)

Appendix C

Qualifications of Key Personnel

QUALIFICATIONS OF KEY PERSONNEL

Investigator:	Heather Wallace
Education:	B.S. Ecology, 1997
Experience:	Environmental Group Manager, CALYX, Inc., 2018-Present Environmental Project Manager, CALYX, Inc., 2015-2018 Environmental Program Consultant, NCDOT, 2013-2015 Environmental Senior Specialist, NCDOT, 2007-2013 Environmental Scientist, H.W. Lochner, 2003-2007 Biologist, Earth Tech, 2000-2003
Responsibilities:	Field investigation, detector deployment, data management, document preparation,
Other:	USFWS Endangered & Threatened Sp. Recovery Permit Number TE81430B-0 (northern long-eared bat, gray bat, Indiana bat, Virginia big-eared bat)

Investigator:	Dominique DiLandro
Education:	B.S., Fisheries, Wildlife, and Conservation Biology, 2017
Experience:	Jr. Environmental Scientist, CALYX, Inc., 2018-Present Environmental Technician, CALYX, Inc., 2017-2018
Responsibilities:	Field investigation, detector deployment, data management, document preparation

Investigator:	Kathryn Cunningham
Education:	B.S., Fisheries and Wildlife, concentration in Wildlife, 2006
Experience:	Senior Biologist, CALYX, Inc., 2017-Present Wildlife Biologist, Jackson Group, 2013-2017 Research Assistant, West Virginia University, 2008-2009
Responsibilities:	Field investigation, detector deployment
Other:	USFWS Endangered & Threatened Sp. Recovery Permit Number TE48049B-1 (northern long-eared bat, Indiana bat)

Investigator:	Mack Des Champs
Education:	B.S., Zoology, 2015
Experience:	Jr. Environmental Scientist, CALYX, Inc., 2017-Present Environmental Technician, CALYX, Inc., 2017-2017
Responsibilities:	Detector deployment, data management

Investigator:	Blake Ellett
Education:	M.N.R. (Masters of Natural Resources), 2016 B.S., Natural Resource and Environmental Management, 2012
Experience:	Environmental Scientist, CALYX, Inc., 2012-Present
Responsibilities:	Detector deployment, data management

Appendix D

Acoustic Survey Data Forms

Acoustic Survey Data Form

Project Name:	I-2513 Asheville Connector	**Site Number:**	1
Project #:	2015066.15	**Site Name:**	Grainger
State:	North Carolina	**Latitude:**	35.614356
County:	Buncombe	**Longitude:**	-82.576342
Nearest town:	Woodfin	**Elevation (m):**	596.494

Map:

Biologist selecting site: Heather Wallace

Habitat/Site description:

Detector located between RR tracks and river. Quiet, low human activity. Mature riparian vegetation nearby.

Acoustic Survey Data Form

Detector Make/Model/Serial:	Anabat Express
Firmware:	V5506L
FS or ZC:	Zero cross
Mic type:	omnidirectional
Weatherproofing	none
Horizontal Orientation:	300 degrees
Vertical Orientation:	0 degrees
Test Func Method:	rub fingers
Mic height (m):	3.658
Mic distance from vegetation (m):	4.5
Clutter:	low
Traffic noise:	low

Site Photo:

Detector settings:

night mode; data div = 16 ; sensitivity = 115.

Results: Site 1

Week		No. of Nights	Detector Serial #	Biologist Deployed	Time		Total # of Bat Calls	# of MYGR Calls
Start Date	End Date				Start Time	End Time		
Week 1 (April)		7	593	HW	19:30	7:35	502	0
20180405	20180411							
Week 2 (April)		7	593	HW	19:30	7:35	4048	0
20180412	20180418							
Week 3 (April)		7	593	HW	19:30	7:35	1355	2
20180419	20180425							
Week 4 (April)		7	593	HW	19:30	7:35	1457	0
20180426	20180502							
Week 1 (May)		7	593	HW	19:50	7:00	3046	0
20180503	20180509							
Week 2 (May)		7	593	HW	19:50	7:00	1052	0
20180510	20180516							
Week 3 (May)		7	593	HW	19:50	7:00	463	3
20180517	20180523							
Week 4 (May)*		6	593	HW	19:50	7:00	601	1
20180524	20180530							
Week 5 (May)*		6	593	HW	19:50	7:00	398	5
20180531	20180606							
Week 1 (June)**		7	593	HW	20:10	6:45	530	0
20180607	20180613							
Week 2 (June)		7	593	HW	20:10	6:45	875	4
20180614	20180620							
Week 3 (June)		7	593	HW	20:10	6:45	730	7
20180621	20180627							

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Acoustic Survey Data Form

Week		No. of Nights	Detector Serial #	Biologist Deployed	Time		Total # of Bat Calls	# of MYGR Calls
Start Date	End Date				Start Time	End Time		
Week 4 (June)		7	593	HW	20:10	6:45	260	12
20180628	20180704							
Week 1 (July)		7	593	HW	20:20	6:50	473	26
20180705	20180711							
Week 2 (July)		7	593	HW	20:20	6:50	238	33
20180712	20180718							
Week 3 (July)		7	593	HW	20:20	6:50	499	95
20180719	20180725							
Week 4 (July)		7	593	HW	20:20	6:50	630	93
20180726	20180801							
Week 1 (August)		7	593	HW	20:05	7:10	564	102
20180802	20180808							
Week 2 (August)		7	593	HW	20:05	7:10	414	35
20180809	20180815							
Week 3 (August)		7	593	HW	20:05	7:10	274	36
20180816	20180822							
Week 4 (August)		7	593	HW	20:05	7:10	468	67
20180823	20180829							
Week 5 (August)		7	593	HW	20:05	7:10	160	20
20180830	20180905							
Week 1 (September)*		6	593	HW	19:20	7:35	109	10
20180906	20180912							
Week 2 (September)*		N/A	593	HW	19:20	7:35	N/A	N/A
20180913	20180919							
Week 3 (September)		7	593	HW	19:20	7:35	466	13
20180920	20180926							
Week 4 (September)		7	593	HW	19:20	7:35	133	4
20180927	20181003							
Week 1 (October)		7	593	HW	18:40	8:00	153	3
20181004	20181010							
Week 2 (October)		7	593	HW	18:40	8:00	46	2
20181011	20181017							
Week 3 (October)		7	593	HW	18:40	8:00	12	0
20181018	20181024							
Week 4 (October)		7	593	HW	18:40	8:00	37	0
20181025	20181031							
Week 1 (November)		7	593	HW	18:40	8:00	27	0
20181101	20181107							
TOTALS		207	---	---	---	---	20020	573

Comments:
*Indicates missing data due to flooding/hurricane
**Indicates data was rearranged due to flooding
(Data was not used if there was less than 6 full nights of data)

Acoustic Survey Data Form

Project Name:	I-2513 Asheville Connector	**Site Number:**	2
Project #:	2015066.15	**Site Name:**	Smoky Park Bridge
State:	North Carolina	**Latitude:**	35.590214
County:	Buncombe	**Longitude:**	-82.571736
Nearest town:	Asheville	**Elevation (m):**	606.552

Map:

Biologist selecting site: Heather Wallace

Habitat/Site description:

Slightly narrower opening in vegetation than is optimal. Good riffle downstream.

Acoustic Survey Data Form

Detector	
Make/Model/Serial:	Anabat Express
Firmware:	V5506L
FS or ZC:	Zero cross
Mic type:	omnidirectional
Weatherproofing	none
Horizontal Orientation:	245 degrees
Vertical Orientation:	0 degrees
Test Func Method:	rub fingers
Mic height (m):	3.658
Mic distance from vegetation (m):	2.5
Clutter:	low
Traffic noise:	moderate

Site Photo:

Detector settings:

night mode; data div = 16; sensitivity = 115.

Results: Site 2

Week		No. of Nights	Detector Serial #	Biologist Deployed	Time		Total # of Bat Calls	# of MYGR Calls
Start Date	End Date				Start Time	End Time		
Week 1 (April)		7	869	HW	19:30	7:35	186	1
20180405	20180411							
Week 2 (April)		7	869	HW	19:30	7:35	641	2
20180412	20180418							
Week 3 (April)		7	869	HW	19:30	7:35	623	4
20180419	20180425							
Week 4 (April)		7	869	HW	19:30	7:35	717	41
20180426	20180502							
Week 1 (May)		7	869	HW	19:50	7:00	900	7
20180503	20180509							
Week 2 (May)		7	869	HW	19:50	7:00	669	2
20180510	20180516							
Week 3 (May)		7	869	HW	19:50	7:00	128	2
20180517	20180523							
Week 4 (May)		7	869	HW	19:50	7:00	206	9
20180524	20180530							
Week 5 (May)**		7	869	HW	19:50	7:00	203	13
20180531	20180606							
Week 1 (June)**		7	869	HW	20:10	6:45	252	13
20180607	20180613							
Week 2 (June)		7	869	HW	20:10	6:45	1716	38
20180614	20180620							
Week 3 (June)		7	869	HW	20:10	6:45	1590	50
20180621	20180627							

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Acoustic Survey Data Form

Week		No. of Nights	Detector Serial #	Biologist Deployed	Time		Total # of Bat Calls	# of MYGR Calls
Start Date	End Date				Start Time	End Time		
Week 4 (June)		7	869	HW	20:10	6:45	996	22
20180628	20180704							
Week 1 (July)		7	869	HW	20:20	6:50	1101	40
20180705	20180711							
Week 2 (July)		7	869	HW	20:20	6:50	375	19
20180712	20180718							
Week 3 (July)		7	869	HW	20:20	6:50	1134	133
20180719	20180725							
Week 4 (July)		7	869	HW	20:20	6:50	1010	86
20180726	20180801							
Week 1 (August)		7	869	HW	20:05	7:10	557	27
20180802	20180808							
Week 2 (August)		7	869	HW	20:05	7:10	883	79
20180809	20180815							
Week 3 (August)		7	869	HW	20:05	7:10	799	79
20180816	20180822							
Week 4 (August)		7	869	HW	20:05	7:10	796	51
20180823	20180829							
Week 5 (August)		7	869	HW	20:05	7:10	799	25
20180830	20180905							
Week 1 (September)*		6	869	HW	19:20	7:35	429	13
20180906	20180912							
Week 2 (September)*		N/A	869	HW	19:20	7:35	N/A	N/A
20180913	20180919							
Week 3 (September)		7	869	HW	19:20	7:35	520	15
20180920	20180926							
Week 4 (September)		7	869	HW	19:20	7:35	589	20
20180927	20181003							
Week 1 (October)		7	869	HW	18:40	8:00	270	8
20181004	20181010							
Week 2 (October)*		N/A	869	HW	18:40	8:00	N/A	N/A
20181011	20181017							
Week 3 (October)		7	869	HW	18:40	8:00	6	0
20181018	20181024							
Week 4 (October)		7	869	HW	18:40	8:00	26	0
20181025	20181031							
Week 1 (November)		7	869	HW	18:40	8:00	13	0
20181101	20181107							
TOTALS		**202**	---	---	---	---	**18134**	**799**

Comments:
*Indicates missing data due to flooding/hurricane
**Indicates data was rearranged due to flooding
(Data was not used if there was less than 6 full nights of data)

Acoustic Survey Data Form

Project Name:	I-2513 Asheville Connector	**Site Number:**	3
Project #:	2015066.15	**Site Name:**	Carrier Park
State:	North Carolina	**Latitude:**	35.565097
County:	Buncombe	**Longitude:**	-82.577786
Nearest town:	Asheville	**Elevation (m):**	603.809

Map:

Biologist selecting site: Heather Wallace

Habitat/Site description:

Quiet location with low human activity. Flatwater nearby.

Acoustic Survey Data Form

Detector Make/Model/Serial:	Anabat Swift/Express
Firmware:	V5506L (Express)
FS or ZC:	Zero cross
Mic type:	omnidirectional
Weatherproofing	none
Horizontal Orientation:	220 degrees
Vertical Orientation:	0 degrees
Test Func Method:	rub fingers
Mic height (m):	2.743
Mic distance from vegetation (m):	2.0
Clutter:	low
Traffic noise:	low

Site Photo:

Detector settings:

night mode; data div = 16; sensitivity = 115.

Results: Site 3

Week		No. of Nights	Detector Serial #	Biologist Deployed	Time		Total # of Bat Calls	# of MYGR Calls
Start Date	End Date				Start Time	End Time		
Week 1 (April)***		N/A	960	HW	19:30	7:35	N/A	N/A
20180405	20180411							
Week 2 (April)***		N/A	960	HW	19:30	7:35	N/A	N/A
20180412	20180418							
Week 3 (April)***		N/A	905	HW	19:30	7:35	N/A	N/A
20180419	20180425							
Week 4 (April)***		N/A	905	HW	19:30	7:35	N/A	N/A
20180426	20180502							
Week 1 (May)		7	352	HW	19:50	7:00	246	1
20180503	20180509							
Week 2 (May)		7	352	HW	19:50	7:00	181	0
20180510	20180516							
Week 3 (May)		7	352	HW	19:50	7:00	107	0
20180517	20180523							
Week 4 (May)		7	352	HW	19:50	7:00	59	0
20180524	20180530							
Week 5 (May)**		7	352	HW	19:50	7:00	179	0
20180531	20180606							
Week 1 (June)**		7	352	HW	20:10	6:45	208	0
20180607	20180613							
Week 2 (June)		7	905	HW	20:10	6:45	335	1
20180614	20180620							
Week 3 (June)		7	905	HW	20:10	6:45	183	1
20180621	20180627							

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Acoustic Survey Data Form

Week		No. of Nights	Detector Serial #	Biologist Deployed	Time		Total # of Bat Calls	# of MYGR Calls
Start Date	End Date				Start Time	End Time		
Week 4 (June)		7	905	HW	20:10	6:45	304	3
20180628	20180704							
Week 1 (July)		7	905	HW	20:20	6:50	277	1
20180705	20180711							
Week 2 (July)		7	905	HW	20:20	6:50	264	0
20180712	20180718							
Week 3 (July)		7	905	HW	20:20	6:50	119	1
20180719	20180725							
Week 4 (July)		7	905	HW	20:20	6:50	199	0
20180726	20180801							
Week 1 (August)		7	905	HW	20:05	7:10	196	0
20180802	20180808							
Week 2 (August)		7	905	HW	20:05	7:10	320	0
20180809	20180815							
Week 3 (August)		7	905	HW	20:05	7:10	599	0
20180816	20180822							
Week 4 (August)		7	905	HW	20:05	7:10	612	0
20180823	20180829							
Week 5 (August)		7	905	HW	20:05	7:10	1236	5
20180830	20180905							
Week 1 (September)*		6	905	HW	19:20	7:35	989	4
20180906	20180912							
Week 2 (September)*		N/A	905	HW	19:20	7:35	N/A	N/A
20180913	20180919							
Week 3 (September)		7	905	HW	19:20	7:35	764	18
20180920	20180926							
Week 4 (September)		7	905	HW	19:20	7:35	546	17
20180927	20181003							
Week 1 (October)		7	905	HW	18:40	8:00	161	6
20181004	20181010							
Week 2 (October)*		N/A	905	HW	18:40	8:00	N/A	N/A
20181011	20181017							
Week 3 (October)		7	905	HW	18:40	8:00	32	0
20181018	20181024							
Week 4 (October)		7	905	HW	18:40	8:00	71	0
20181025	20181031							
Week 1 (November)		7	905	HW	18:40	8:00	7	0
20181101	20181107							
TOTALS		**174**	**---**	**---**	**---**	**---**	**8194**	**58**

Comments:
*Indicates missing data due to flooding/hurricane
**Indicates data was rearranged due to flooding
***Indicates missing data due to detector malfunction.
(Data was not used if there was less than 6 full nights of data)

Acoustic Survey Data Form

Project Name:	I-2513 Asheville Connector	**Site Number:**	4
Project #:	2015066.15	**Site Name:**	I-40 and Greenway
State:	North Carolina	**Latitude:**	35.558631
County:	Buncombe	**Longitude:**	-82.593067
Nearest town:	Asheville	**Elevation (m):**	603.504

Map:

Biologist selecting site: Heather Wallace

Habitat/Site description:

Very open location along river. Adjacent to greenway.

Acoustic Survey Data Form

Detector Make/Model/Serial:	Anabat Express
Firmware:	V5506L
FS or ZC:	Zero cross
Mic type:	omnidirectional
Weatherproofing	none
Horizontal Orientation:	70 degrees
Vertical Orientation:	0 degrees
Test Func Method:	rub fingers
Mic height (m):	3.658
Mic distance from vegetation (m):	4.5
Clutter:	low
Traffic noise:	low

Site Photo:

Detector settings:

night mode; data div = 16; sensitivity = 115.

Results: Site 4

Week		No. of Nights	Detector Serial #	Biologist Deployed	Time		Total # of Bat Calls	# of MYGR Calls
Start Date	End Date				Start Time	End Time		
Week 1 (April)		7	622	HW	19:30	7:35	285	5
20180405	20180411							
Week 2 (April)		7	622	HW	19:30	7:35	1385	46
20180412	20180418							
Week 3 (April)		7	622	HW	19:30	7:35	423	0
20180419	20180425							
Week 4 (April)		7	622	HW	19:30	7:35	222	0
20180426	20180502							
Week 1 (May)		7	622	HW	19:50	7:00	65	0
20180503	20180509							
Week 2 (May)		7	622	HW	19:50	7:00	39	0
20180510	20180516							
Week 3 (May)		7	622	HW	19:50	7:00	22	0
20180517	20180523							
Week 4 (May)		7	622	HW	19:50	7:00	28	0
20180524	20180530							
Week 5 (May)**		7	622	HW	19:50	7:00	20	0
20180531	20180606							
Week 1 (June)**		7	622	HW	20:10	6:45	96	0
20180607	20180613							
Week 2 (June)		7	622	HW	20:10	6:45	498	0
20180614	20180620							
Week 3 (June)		7	622	HW	20:10	6:45	151	1
20180621	20180627							

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Acoustic Survey Data Form

Week		No. of Nights	Detector Serial #	Biologist Deployed	Time		Total # of Bat Calls	# of MYGR Calls
Start Date	End Date				Start Time	End Time		
Week 4 (June)		7	622	HW	20:10	6:45	75	3
20180628	20180704							
Week 1 (July)		7	622	HW	20:20	6:50	95	0
20180705	20180711							
Week 2 (July)		7	622	HW	20:20	6:50	63	2
20180712	20180718							
Week 3 (July)		7	622	HW	20:20	6:50	53	3
20180719	20180725							
Week 4 (July)		7	622	HW	20:20	6:50	93	9
20180726	20180801							
Week 1 (August)		7	622	HW	20:05	7:10	78	13
20180802	20180808							
Week 2 (August)		7	622	HW	20:05	7:10	34	3
20180809	20180815							
Week 3 (August)		7	622	HW	20:05	7:10	26	4
20180816	20180822							
Week 4 (August)		7	622	HW	20:05	7:10	40	13
20180823	20180829							
Week 5 (August)		7	622	HW	20:05	7:10	40	23
20180830	20180905							
Week 1 (September)*		6	622	HW	19:20	7:35	15	6
20180906	20180912							
Week 2 (September)*		N/A	622	HW	19:20	7:35	N/A	N/A
20180913	20180919							
Week 3 (September)		7	622	HW	19:20	7:35	8	3
20180920	20180926							
Week 4 (September)		7	622	HW	19:20	7:35	12	7
20180927	20181003							
Week 1 (October)		7	622	HW	18:40	8:00	9	5
20181004	20181010							
Week 2 (October)*		N/A	622	HW	18:40	8:00	N/A	N/A
20181011	20181017							
Week 3 (October)		7	622	HW	18:40	8:00	1	0
20181018	20181024							
Week 4 (October)		7	622	HW	18:40	8:00	1	0
20181025	20181031							
Week 1 (November)		7	622	HW	18:40	8:00	0	0
20181101	20181107							
TOTALS		**202**	---	---	---	---	**3877**	**146**

Comments:
*Indicates missing data due to flooding/hurricane
**Indicates data was rearranged due to flooding
(Data was not used if there was less than 6 full nights of data)

Acoustic Survey Data Form

Project Name:	I-2513 Asheville Connector	**Site Number:**	5
Project #:	2015066.15	**Site Name:**	Culvert
State:	North Carolina	**Latitude:**	35.596128
County:	Buncombe	**Longitude:**	-82.573072
Nearest town:	Asheville	**Elevation (m):**	599.237

Map:

Biologist selecting site: Heather Wallace

Habitat/Site description:

Not ideal location for acoustic recording due to heavy clutter and proximity to roost.

Acoustic Survey Data Form

Detector	
Make/Model/Serial:	Anabat Express
Firmware:	V5506L
FS or ZC:	Zero cross
Mic type:	omnidirectional
Weatherproofing	none
Horizontal Orientation:	71 degrees
Vertical Orientation:	0 degrees
Test Func Method:	rub fingers
Mic height (m):	3.658
Mic distance from vegetation (m):	2.0
Clutter:	moderate
Traffic noise:	moderate

Site Photo:

Detector settings:

night mode; data div = 16; sensitivity = 115.

Results: Site 5

Week		No. of Nights	Detector Serial #	Biologist Deployed	Time		Total # of Bat Calls	# of MYGR Calls
Start Date	End Date				Start Time	End Time		
Week 1 (March)		7	887	HW	19:30	7:35	3	0
20180301	20180307							
Week 2 (March)		7	887	HW	19:30	7:35	7	0
20180308	20180314							
Week 3 (March)		7	887	HW	19:30	7:35	162	29
20180315	20180321							
Week 4 (March)		7	887	HW	19:30	7:35	149	33
20180322	20180328							
Week 5 (March)		7	887	HW	19:30	7:35	482	103
20180329	20180404							
Week 1 (April)		7	887	HW	19:30	7:35	237	22
20180405	20180411							
Week 2 (April)		7	887	HW	19:30	7:35	590	117
20180412	20180418							
Week 3 (April)		7	887	HW	19:30	7:35	376	137
20180419	20180425							
Week 4 (April)		7	887	HW	19:30	7:35	166	66
20180426	20180502							
Week 1 (May)		7	887	HW	19:50	7:00	295	139
20180503	20180509							
Week 2 (May)		7	887	HW	19:50	7:00	122	52
20180510	20180516							
Week 3 (May)		7	887	HW	19:50	7:00	76	31
20180517	20180523							

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Acoustic Survey Data Form

Week		No. of Nights	Detector Serial #	Biologist Deployed	Time		Total # of Bat Calls	# of MYGR Calls
Start Date	End Date				Start Time	End Time		
Week 4 (May)*		6	887	HW	19:50	7:00	103	35
20180524	20180530							
Week 5 (May)*		N/A	887	HW	19:50	7:00	N/A	N/A
20180531	20180606							
Week 1 (June)**		7	887	HW	20:10	6:45	232	66
20180607	20180613							
Week 2 (June)		7	887	HW	20:10	6:45	253	114
20180614	20180620							
Week 3 (June)		7	887	HW	20:10	6:45	189	84
20180621	20180627							
Week 4 (June)		7	887	HW	20:10	6:45	297	111
20180628	20180704							
Week 1 (July)		7	887	HW	20:20	6:50	646	254
20180705	20180711							
Week 2 (July)		7	887	HW	20:20	6:50	539	207
20180712	20180718							
Week 3 (July)		7	887	HW	20:20	6:50	811	316
20180719	20180725							
Week 4 (July)		7	887	HW	20:20	6:50	810	231
20180726	20180801							
Week 1 (August)***		N/A	887	HW	20:05	7:10	N/A	N/A
20180802	20180808							
Week 2 (August)		7	887	HW	20:05	7:10	340	90
20180809	20180815							
Week 3 (August)		7	887	HW	20:05	7:10	429	132
20180816	20180822							
Week 4 (August)		7	887	HW	20:05	7:10	1177	388
20180823	20180829							
Week 5 (August)		7	887	HW	20:05	7:10	1307	318
20180830	20180905							
Week 1 (September)*		6	887	HW	19:20	7:35	1765	322
20180906	20180912							
Week 2 (September)*		N/A	887	HW	19:20	7:35	N/A	N/A
20180913	20180919							
Week 3 (September)		7	887	HW	19:20	7:35	1316	584
20180920	20180926							
Week 4 (September)		7	887	HW	19:20	7:35	1177	421
20180927	20181003							
Week 1 (October)		7	887	HW	18:40	8:00	677	291
20181004	20181010							
Week 2 (October)*		N/A	887	HW	18:40	8:00	N/A	N/A
20181011	20181017							
Week 3 (October)		7	887	HW	18:40	8:00	23	9
20181018	20181024							
Week 4 (October)		7	887	HW	18:40	8:00	16	6
20181025	20181031							
Week 1 (November)		7	887	HW	18:40	8:00	5	2
20181101	20181107							

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Acoustic Survey Data Form

Week 2 (November)		7	887	HW	18:40	8:00	22	0
20181108	20181114							
Week 3 (November)		7	887	HW	18:40	8:00	5	1
20181115	20181121							
TOTALS		236	---	---	---	---	14804	4711

Comments:
*Indicates missing data due to flooding/hurricane
**Indicates data was rearranged due to flooding
***Indicates missing data due to detector malfunction.
(Data was not used if there was less than 6 full nights of data)

Acoustic Survey Data Form

Project Name:	I-2513 Asheville Connector	**Site Number:**	6
Project #:	2015066.15	**Site Name:**	Smith Mill Creek
State:	North Carolina	**Latitude:**	35.595192
County:	Buncombe	**Longitude:**	-82.576586
Nearest town:	Asheville	**Elevation (m):**	613.258

Map:

Biologist selecting site: Heather Wallace

Habitat/Site description:

Hardwood forest adjacent to heavily incised stream. Riparian veg mainly Japanese knotweed.

Acoustic Survey Data Form

Detector Make/Model/Serial:	Anabat Express
Firmware:	V5506L
FS or ZC:	Zero cross
Mic type:	omnidirectional
Weatherproofing	none
Horizontal Orientation:	320 degrees
Vertical Orientation:	0 degrees
Test Func Method:	rub fingers
Mic height (m):	3.658
Mic distance from vegetation (m):	6
Clutter:	low
Traffic noise:	low

Site Photo:

Detector settings:

night mode; data div = 16; sensitivity = 115.

Results: Site 6

Week		No. of Nights	Detector Serial #	Biologist Deployed	Time		Total # of Bat Calls	# of MYGR Calls
Start Date	End Date				Start Time	End Time		
Week 3 (April)		7	903	HW	19:30	7:35	72	1
20180419	20180425							
Week 4 (April)		7	903	HW	19:30	7:35	109	2
20180426	20180502							
Week 1 (May)		7	903	HW	19:50	7:00	169	4
20180503	20180509							
Week 2 (May)		7	903	HW	19:50	7:00	164	2
20180510	20180516							
Week 3 (May)		7	903	HW	19:50	7:00	145	0
20180517	20180523							
Week 4 (May)		7	903	HW	19:50	7:00	385	0
20180524	20180530							
Week 5 (May)**		7	903	HW	19:50	7:00	649	2
20180531	20180606							
Week 1 (June)**		7	903	HW	20:10	6:45	836	4
20180607	20180613							
Week 2 (June)		7	903	HW	20:10	6:45	693	3
20180614	20180620							
Week 3 (June)		7	903	HW	20:10	6:45	453	1
20180621	20180627							
Week 4 (June)		7	903	HW	20:10	6:45	498	4
20180628	20180704							
Week 1 (July)		7	903	HW	20:20	6:50	825	9
20180705	20180711							

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Acoustic Survey Data Form

Week		No. of Nights	Detector Serial #	Biologist Deployed	Time		Total # of Bat Calls	# of MYGR Calls
Start Date	End Date				Start Time	End Time		
Week 2 (July)		7	903	HW	20:20	6:50	1034	3
20180712	20180718							
Week 3 (July)		7	903	HW	20:20	6:50	854	8
20180719	20180725							
Week 4 (July)		7	903	HW	20:20	6:50	756	8
20180726	20180801							
Week 1 (August)		7	903	HW	20:05	7:10	818	7
20180802	20180808							
Week 2 (August)		7	903	HW	20:05	7:10	552	17
20180809	20180815							
Week 3 (August)		7	903	HW	20:05	7:10	602	13
20180816	20180822							
Week 4 (August)		7	903	HW	20:05	7:10	417	10
20180823	20180829							
Week 5 (August)		7	903	HW	20:05	7:10	950	10
20180830	20180905							
Week 1 (September)*		6	903	HW	19:20	7:35	586	4
20180906	20180912							
Week 2 (September)*		N/A	903	HW	19:20	7:35	N/A	N/A
20180913	20180919							
Week 3 (September)		7	903	HW	19:20	7:35	761	11
20180920	20180926							
Week 4 (September)		7	903	HW	19:20	7:35	649	5
20180927	20181003							
Week 1 (October)		7	903	HW	18:40	8:00	666	2
20181004	20181010							
Week 2 (October)		7	903	HW	18:40	8:00	136	1
20181011	20181017							
Week 3 (October)		7	903	HW	18:40	8:00	6	0
20181018	20181024							
Week 4 (October)		7	903	HW	18:40	8:00	38	0
20181025	20181031							
Week 1 (November)		7	903	HW	18:40	8:00	12	1
20181101	20181107							
TOTALS		195	---	---	---	---	13835	132

Comments:
*Indicates missing data due to flooding/hurricane
**Indicates data was rearranged due to flooding
(Data was not used if there was less than 6 full nights of data)

Acoustic Survey Data Form

Project Name:	I-2513 Asheville Connector	**Site Number:**	7
Project #:	2015066.15	**Site Name:**	Hominy Creek and I-240
State:	North Carolina	**Latitude:**	35.563131
County:	Buncombe	**Longitude:**	-82.597792
Nearest town:	Asheville	**Elevation (m):**	609.905

Map:

Biologist selecting site: Heather Wallace

Habitat/Site description:

mature hardwoods along creek with lots of Japanese knotweed along bank. Nice riffle, rock outcrop near detector.

Acoustic Survey Data Form

Detector Make/Model/Serial:	Anabat Express
Firmware:	V5506L
FS or ZC:	Zero cross
Mic type:	omnidirectional
Weatherproofing	none
Horizontal Orientation:	30 degrees
Vertical Orientation:	0 degrees
Test Func Method:	rub fingers
Mic height (m):	3.658
Mic distance from vegetation (m):	4
Clutter:	low
Traffic noise:	low

Site Photo:

Detector settings:

night mode; data div = 16; sensitivity = 115.

Results: Site 7

Week		No. of Nights	Detector Serial #	Biologist Deployed	Time		Total # of Bat Calls	# of MYGR Calls
Start Date	End Date				Start Time	End Time		
Week 1 (April)		7	616	HW	19:30	7:35	26	0
20180405	20180411							
Week 2 (April)		7	616	HW	19:30	7:35	667	2
20180412	20180418							
Week 3 (April)		7	616	HW	19:30	7:35	122	1
20180419	20180425							
Week 4 (April)		7	616	HW	19:30	7:35	111	0
20180426	20180502							
Week 1 (May)		7	616	HW	19:50	7:00	97	0
20180503	20180509							
Week 2 (May)		7	616	HW	19:50	7:00	54	0
20180510	20180516							
Week 3 (May)		7	616	HW	19:50	7:00	55	0
20180517	20180523							
Week 4 (May)		7	616	HW	19:50	7:00	45	0
20180524	20180530							
Week 5 (May)**		7	616	HW	19:50	7:00	51	0
20180531	20180606							
Week 1 (June)**		7	616	HW	20:10	6:45	132	0
20180607	20180613							
Week 2 (June)		7	616	HW	20:10	6:45	160	0
20180614	20180620							
Week 3 (June)		7	616	HW	20:10	6:45	142	1
20180621	20180627							

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Acoustic Survey Data Form

Week		No. of Nights	Detector Serial #	Biologist Deployed	Time		Total # of Bat Calls	# of MYGR Calls
Start Date	End Date				Start Time	End Time		
Week 4 (June)		7	616	HW	20:10	6:45	223	0
20180628	20180704							
Week 1 (July)		7	616	HW	20:20	6:50	308	0
20180705	20180711							
Week 2 (July)		7	616	HW	20:20	6:50	120	0
20180712	20180718							
Week 3 (July)		7	616	HW	20:20	6:50	262	0
20180719	20180725							
Week 4 (July)		7	616	HW	20:20	6:50	778	0
20180726	20180801							
Week 1 (August)		7	616	HW	20:05	7:10	468	2
20180802	20180808							
Week 2 (August)		7	616	HW	20:05	7:10	437	0
20180809	20180815							
Week 3 (August)		7	616	HW	20:05	7:10	452	0
20180816	20180822							
Week 4 (August)		7	616	HW	20:05	7:10	537	3
20180823	20180829							
Week 5 (August)		7	616	HW	20:05	7:10	1626	1
20180830	20180905							
Week 1 (September)*		6	616	HW	19:20	7:35	1111	1
20180906	20180912							
Week 2 (September)*		N/A	616	HW	19:20	7:35	N/A	N/A
20180913	20180919							
Week 3 (September)		7	616	HW	19:20	7:35	225	1
20180920	20180926							
Week 4 (September)		7	616	HW	19:20	7:35	200	1
20180927	20181003							
Week 1 (October)		7	616	HW	18:40	8:00	117	2
20181004	20181010							
Week 2 (October)		7	616	HW	18:40	8:00	13	0
20181011	20181017							
Week 3 (October)		7	616	HW	18:40	8:00	8	0
20181018	20181024							
Week 4 (October)		7	616	HW	18:40	8:00	23	0
20181025	20181031							
Week 1 (November)		7	616	HW	18:40	8:00	4	0
20181101	20181107							
TOTALS		**209**	---	---	---	---	**8574**	**15**

Comments:
*Indicates missing data due to flooding/hurricane
**Indicates data was rearranged due to flooding
(Data was not used if there was less than 6 full nights of data)

Acoustic Survey Data Form

Project Name:	I-2513 Asheville Connector	**Site Number:**	8
Project #:	2015066.15	**Site Name:**	Oakview Road
State:	North Carolina	**Latitude:**	35.553911
County:	Buncombe	**Longitude:**	-82.603992
Nearest town:	Asheville	**Elevation (m):**	616.610

Map:

Biologist selecting site: Heather Wallace

Habitat/Site description:

nice open area along creek. Good riffle habitat nearby.

Acoustic Survey Data Form

Detector Make/Model/Serial:	Anabat Express
Firmware:	V5506L
FS or ZC:	Zero cross
Mic type:	omnidirectional
Weatherproofing	none
Horizontal Orientation:	160 degreees
Vertical Orientation:	0 degrees
Test Func Method:	rub fingers
Mic height (m):	3.658
Mic distance from vegetation (m):	>5
Clutter:	low
Traffic noise:	low

Site Photo:

Detector settings:

night mode; data div = 16; sensitivity = 115.

Results: Site 8

Week		No. of Nights	Detector Serial #	Biologist Deployed	Time		Total # of Bat Calls	# of MYGR Calls
Start Date	End Date				Start Time	End Time		
Week 1 (April)		7	888	HW	19:30	7:35	6	1
20180405	20180411							
Week 2 (April)		7	888	HW	19:30	7:35	318	2
20180412	20180418							
Week 3 (April)		7	888	HW	19:30	7:35	87	1
20180419	20180425							
Week 4 (April)		7	888	HW	19:30	7:35	106	0
20180426	20180502							
Week 1 (May)		7	888	HW	19:50	7:00	313	1
20180503	20180509							
Week 2 (May)		7	888	HW	19:50	7:00	70	0
20180510	20180516							
Week 3 (May)***		N/A	888	HW	19:50	7:00	N/A	N/A
20180517	20180523							
Week 4 (May)***		N/A	888	HW	19:50	7:00	N/A	N/A
20180524	20180530							
Week 5 (May)***		N/A	888	HW	19:50	7:00	N/A	N/A
20180531	20180606							
Week 1 (June)***		N/A	888	HW	20:10	6:45	N/A	N/A
20180607	20180613							
Week 2 (June)		7	356	HW	20:10	6:45	268	30
20180614	20180620							
Week 3 (June)		7	356	HW	20:10	6:45	267	11
20180621	20180627							

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Acoustic Survey Data Form

Week		No. of Nights	Detector Serial #	Biologist Deployed	Time		Total # of Bat Calls	# of MYGR Calls
Start Date	End Date				Start Time	End Time		
Week 4 (June)		7	356	HW	20:10	6:45	248	9
20180628	20180704							
Week 1 (July)		7	888	HW	20:20	6:50	77	3
20180705	20180711							
Week 2 (July)		7	888	HW	20:20	6:50	359	18
20180712	20180718							
Week 3 (July)		7	888	HW	20:20	6:50	156	4
20180719	20180725							
Week 4 (July)		7	888	HW	20:20	6:50	322	6
20180726	20180801							
Week 1 (August)		7	888	HW	20:05	7:10	645	10
20180802	20180808							
Week 2 (August)		7	888	HW	20:05	7:10	256	36
20180809	20180815							
Week 3 (August)		7	888	HW	20:05	7:10	203	17
20180816	20180822							
Week 4 (August)		7	888	HW	20:05	7:10	77	11
20180823	20180829							
Week 5 (August)		7	888	HW	20:05	7:10	20	3
20180830	20180905							
Week 1 (September)*		6	888	HW	19:20	7:35	46	1
20180906	20180912							
Week 2 (September)*		N/A	888	HW	19:20	7:35	N/A	N/A
20180913	20180919							
Week 3 (September)		7	888	HW	19:20	7:35	29	1
20180920	20180926							
Week 4 (September)		7	888	HW	19:20	7:35	13	1
20180927	20181003							
Week 1 (October)		7	888	HW	18:40	8:00	10	3
20181004	20181010							
Week 2 (October)		7	888	HW	18:40	8:00	5	0
20181011	20181017							
Week 3 (October)		7	888	HW	18:40	8:00	8	1
20181018	20181024							
Week 4 (October)		7	888	HW	18:40	8:00	10	0
20181025	20181031							
Week 1 (November)		7	888	HW	18:40	8:00	6	0
20181101	20181107							
TOTALS		**181**	---	---	---	---	**3925**	**170**

Comments:
*Indicates missing data due to flooding/hurricane
***Indicates missing data due to detector malfunction.
(Data was not used if there was less than 6 full nights of data)

Acoustic Survey Data Form

Project Name:	I-2513 Asheville Connector	**Site Number:**	9
Project #:	2015066.15	**Site Name:**	Pond Road
State:	North Carolina	**Latitude:**	35.546828
County:	Buncombe	**Longitude:**	-82.602439
Nearest town:	Asheville	**Elevation (m):**	613.562

Map:

Biologist selecting site: Heather Wallace

Habitat/Site description:

great riffle habitat and rocky ledges nearby. Also good pools just up and downstream. Mature hardwoods nearby.

Acoustic Survey Data Form

Detector	
Make/Model/Serial:	Anabat Express
Firmware:	V5506L
FS or ZC:	Zero cross
Mic type:	omnidirectional
Weatherproofing	none
Horizontal Orientation:	50 degrees
Vertical Orientation:	0 degrees
Test Func Method:	rub fingers
Mic height (m):	3.658
Mic distance from vegetation (m):	>5
Clutter:	low
Traffic noise:	low

Site Photo:

Detector settings:

night mode; data div = 16; sensitivity = 115.

Results: Site 9

Week		No. of Nights	Detector Serial #	Biologist Deployed	Time		Total # of Bat Calls	# of MYGR Calls
Start Date	End Date				Start Time	End Time		
Week 1 (April)		7	881	HW	19:30	7:35	4	0
20180405	20180411							
Week 2 (April)		7	881	HW	19:30	7:35	141	14
20180412	20180418							
Week 3 (April)		7	881	HW	19:30	7:35	47	3
20180419	20180425							
Week 4 (April)		7	881	HW	19:30	7:35	78	6
20180426	20180502							
Week 1 (May)		7	881	HW	19:50	7:00	152	4
20180503	20180509							
Week 2 (May)		7	881	HW	19:50	7:00	120	3
20180510	20180516							
Week 3 (May)		7	881	HW	19:50	7:00	67	5
20180517	20180523							
Week 4 (May)		7	881	HW	19:50	7:00	13	1
20180524	20180530							
Week 5 (May)***		N/A	881	HW	19:50	7:00	N/A	N/A
20180531	20180606							
Week 1 (June)**		7	881	HW	20:10	6:45	115	5
20180607	20180613							
Week 2 (June)***		N/A	881	HW	20:10	6:45	N/A	N/A
20180614	20180620							
Week 3 (June)		7	881	HW	20:10	6:45	32	2
20180621	20180627							

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Acoustic Survey Data Form

Week		No. of Nights	Detector Serial #	Biologist Deployed	Time		Total # of Bat Calls	# of MYGR Calls
Start Date	End Date				Start Time	End Time		
Week 4 (June)		7	881	HW	20:10	6:45	157	7
20180628	20180704							
Week 1 (July)		7	960	HW	20:20	6:50	187	10
20180705	20180711							
Week 2 (July)		7	960	HW	20:20	6:50	114	4
20180712	20180718							
Week 3 (July)		7	960	HW	20:20	6:50	427	19
20180719	20180725							
Week 4 (July)		7	960	HW	20:20	6:50	836	16
20180726	20180801							
Week 1 (August)		7	960	HW	20:05	7:10	1369	17
20180802	20180808							
Week 2 (August)		7	960	HW	20:05	7:10	1008	14
20180809	20180815							
Week 3 (August)		7	960	HW	20:05	7:10	618	22
20180816	20180822							
Week 4 (August)		7	960	HW	20:05	7:10	464	19
20180823	20180829							
Week 5 (August)		7	960	HW	20:05	7:10	293	13
20180830	20180905							
Week 1 (September)*		6	960	HW	19:20	7:35	87	5
20180906	20180912							
Week 2 (September)*		N/A	N/A	HW	19:20	7:35	N/A	N/A
20180913	20180919							
Week 3 (September)		7	960	HW	19:20	7:35	81	13
20180920	20180926							
Week 4 (September)		7	960	HW	19:20	7:35	27	1
20180927	20181003							
Week 1 (October)		7	960	HW	18:40	8:00	22	0
20181004	20181010							
Week 2 (October)		7	960	HW	18:40	8:00	26	3
20181011	20181017							
Week 3 (October)		7	960	HW	18:40	8:00	7	0
20181018	20181024							
Week 4 (October)		7	960	HW	18:40	8:00	22	0
20181025	20181031							
Week 1 (November)		7	960	HW	18:40	8:00	5	0
20181101	20181107							
TOTALS		195	---	---	---	---	6519	206

Comments:
*Indicates missing data due to flooding/hurricane
**Indicates data was rearranged due to flooding
***Indicates missing data due to detector malfunction.
(Data was not used if there was less than 6 full nights of data)

Acoustic Survey Data Form

Project Name:	I-2513 Asheville Connector	**Site Number:**	10
Project #:	2015066.15	**Site Name:**	Outdoor Center
State:	North Carolina	**Latitude:**	35.566053
County:	Buncombe	**Longitude:**	-82.585486
Nearest town:	Asheville	**Elevation (m):**	618.744

Map:

Biologist selecting site: Heather Wallace

Habitat/Site description:

thin strip of riparian vegetation along both banks at this location. Not much riffle habitat nearby.

Acoustic Survey Data Form

Detector Make/Model/Serial:	Anabat Express
Firmware:	V5506L
FS or ZC:	Zero cross
Mic type:	omnidirectional
Weatherproofing	none
Horizontal Orientation:	198 degrees
Vertical Orientation:	0 degrees
Test Func Method:	rub fingers
Mic height (m):	2.743
Mic distance from vegetation (m):	3
Clutter:	low
Traffic noise:	low

Site Photo:

Detector settings:

night mode; data div = 16; sensitivity = 115.

Results: Site 10

Week		No. of Nights	Detector Serial #	Biologist Deployed	Time		Total # of Bat Calls	# of MYGR Calls
Start Date	End Date				Start Time	End Time		
Week 1 (April)		7	948	HW	19:30	7:35	84	0
20180405	20180411							
Week 2 (April)		7	948	HW	19:30	7:35	255	7
20180412	20180418							
Week 3 (April)		7	948	HW	19:30	7:35	258	6
20180419	20180425							
Week 4 (April)		7	948	HW	19:30	7:35	228	3
20180426	20180502							
Week 1 (May)		7	948	HW	19:50	7:00	258	6
20180503	20180509							
Week 2 (May)		7	948	HW	19:50	7:00	244	7
20180510	20180516							
Week 3 (May)		7	948	HW	19:50	7:00	160	1
20180517	20180523							
Week 4 (May)		7	948	HW	19:50	7:00	123	1
20180524	20180530							
Week 5 (May)**		7	948	HW	19:50	7:00	325	9
20180531	20180606							
Week 1 (June)**		7	948	HW	20:10	6:45	570	2
20180607	20180613							
Week 2 (June)		7	948	HW	20:10	6:45	839	5
20180614	20180620							
Week 3 (June)		7	948	HW	20:10	6:45	764	9
20180621	20180627							

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Acoustic Survey Data Form

Week		No. of Nights	Detector Serial #	Biologist Deployed	Time		Total # of Bat Calls	# of MYGR Calls
Start Date	End Date				Start Time	End Time		
Week 4 (June)		7	948	HW	20:10	6:45	1214	19
20180628	20180704							
Week 1 (July)		7	948	HW	20:20	6:50	718	36
20180705	20180711							
Week 2 (July)		7	948	HW	20:20	6:50	899	37
20180712	20180718							
Week 3 (July)		7	948	HW	20:20	6:50	1135	43
20180719	20180725							
Week 4 (July)		7	948	HW	20:20	6:50	1764	93
20180726	20180801							
Week 1 (August)		7	948	HW	20:05	7:10	904	31
20180802	20180808							
Week 2 (August)		7	948	HW	20:05	7:10	1236	65
20180809	20180815							
Week 3 (August)		7	948	HW	20:05	7:10	1714	57
20180816	20180822							
Week 4 (August)		7	948	HW	20:05	7:10	1118	82
20180823	20180829							
Week 5 (August)		7	948	HW	20:05	7:10	2346	73
20180830	20180905							
Week 1 (September)*		6	948	HW	19:20	7:35	1201	43
20180906	20180912							
Week 2 (September)*		N/A	N/A	HW	19:20	7:35	N/A	N/A
20180913	20180919							
Week 3 (September)		7	948	HW	19:20	7:35	547	24
20180920	20180926							
Week 4 (September)		7	948	HW	19:20	7:35	431	24
20180927	20181003							
Week 1 (October)		7	948	HW	18:40	8:00	307	17
20181004	20181010							
Week 2 (October)		7	948	HW	18:40	8:00	146	4
20181011	20181017							
Week 3 (October)		7	948	HW	18:40	8:00	41	0
20181018	20181024							
Week 4 (October)		7	948	HW	18:40	8:00	101	0
20181025	20181031							
Week 1 (November)		7	948	HW	18:40	8:00	22	0
20181101	20181107							
TOTALS		**209**	---	---	---	---	**19952**	**704**

Comments:
*Indicates missing data due to flooding/hurricane
**Indicates data was rearranged due to flooding
(Data was not used if there was less than 6 full nights of data)

Acoustic Survey Data Form

Project Name:	I-26 Widening (STIP I-4400/I-4700)	**Site Number:**	11
Project #:	2015066.14	**Site Name:**	I-26 Bridge
State:	North Carolina	**Latitude:**	35.512805
County:	Buncombe	**Longitude:**	-82.583988
Nearest town:	Bent Creek	**Elevation (m):**	609.295

Map:

Biologist selecting site: Heather Wallace

Habitat/Site description:

Permanent detector location at I-26 bridge over French Broad River.

Acoustic Survey Data Form

Detector Make/Model/Serial:	Anabat Express
Firmware:	V5506L
FS or ZC:	Zero cross
Mic type:	omnidirectional
Weatherproofing	none
Horizontal Orientation:	315
Vertical Orientation:	0 degrees
Test Func Method:	rub fingers
Mic height (m):	3.65
Mic distance from vegetation (m):	4
Clutter:	low
Traffic noise:	high

Site Photo:

Detector settings:

night mode; data div = 16; sensitivity = 115.

Results: Site 11

Week		No. of Nights	Detector Serial #	Biologist Deployed	Time		Total # of Bat Calls	# of MYGR Calls
Start Date	End Date				Start Time	End Time		
Week 1 (March)		7	578	HW	19:30	7:35	0	0
20180301	20180307							
Week 2 (March)		7	578	HW	19:30	7:35	0	0
20180308	20180314							
Week 3 (March)		7	578	HW	19:30	7:35	1743	100
20180315	20180321							
Week 4 (March)		7	578	HW	19:30	7:35	229	67
20180322	20180328							
Week 5 (March)		7	578	HW	19:30	7:35	863	390
20180329	20180404							
Week 1 (April)		7	578	HW	19:30	7:35	176	64
20180405	20180411							
Week 2 (April)		7	578	HW	19:30	7:35	3467	1038
20180412	20180418							
Week 3 (April)		7	578	HW	19:30	7:35	643	325
20180419	20180425							
Week 4 (April)		7	578	HW	19:30	7:35	1163	633
20180426	20180502							
Week 1 (May)		7	578	HW	19:50	7:00	3010	1568
20180503	20180509							
Week 2 (May)		7	578	HW	19:50	7:00	1459	661
20180510	20180516							
Week 3 (May)*		N/A	578	HW	19:50	7:00	N/A	N/A
20180517	20180523							

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Acoustic Survey Data Form

Week		No. of Nights	Detector Serial #	Biologist Deployed	Time		Total # of Bat Calls	# of MYGR Calls
Start Date	End Date				Start Time	End Time		
Week 4 (May)*		6	578	HW	19:50	7:00	1212	670
20180524	20180530							
Week 5 (May)*		N/A	578	HW	19:50	7:00	N/A	N/A
20180531	20180606							
Week 1 (June)		7	578	HW	20:10	6:45	1406	613
20180607	20180613							
Week 2 (June)		7	578	HW	20:10	6:45	2625	1318
20180614	20180620							
Week 3 (June)		7	578	HW	20:10	6:45	1501	484
20180621	20180627							
Week 4 (June)		7	578	HW	20:10	6:45	1657	555
20180628	20180704							
Week 1 (July)		7	578	HW	20:20	6:50	1646	758
20180705	20180711							
Week 2 (July)		7	578	HW	20:20	6:50	1021	460
20180712	20180718							
Week 3 (July)		7	578	HW	20:20	6:50	892	451
20180719	20180725							
Week 4 (July)		7	578	HW	20:20	6:50	1107	579
20180726	20180801							
Week 1 (August)		7	578	HW	20:05	7:10	1331	744
20180802	20180808							
Week 2 (August)		7	578	HW	20:05	7:10	3017	1485
20180809	20180815							
Week 3 (August)		7	578	HW	20:05	7:10	4875	2882
20180816	20180822							
Week 4 (August)		7	578	HW	20:05	7:10	4791	2894
20180823	20180829							
Week 5 (August)		7	578	HW	20:05	7:10	4907	3083
20180830	20180905							
Week 1 (September)*		6	578	HW	19:20	7:35	3729	2188
20180906	20180912							
Week 2 (September)*		N/A	578	HW	19:20	7:35	N/A	N/A
20180913	20180919							
Week 3 (September)		7	578	HW	19:20	7:35	1986	1329
20180920	20180926							
Week 4 (September)		7	578	HW	19:20	7:35	628	456
20180927	20181003							
Week 1 (October)		7	578	HW	18:40	8:00	346	191
20181004	20181010							
Week 2 (October)		7	578	HW	18:40	8:00	37	17
20181011	20181017							
Week 3 (October)		7	578	HW	18:40	8:00	12	2
20181018	20181024							
Week 4 (October)		7	578	HW	18:40	8:00	18	4
20181025	20181031							
TOTALS		**222**	---	---	---	---	**51497**	**26009**

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Acoustic Survey Data Form

Comments:
*Indicates missing data due to flooding/hurricane
(Data was not used if there was less than 6 full nights of data)

Appendix D : Indiana State University 2018 Activity Report

Activity Report 18 November 2018

Distribution, Roosting & Foraging Ecology, & Migration Pathways for Gray Bats in Western NC

Prepared by Joey Weber, Joy O'Keefe, and Brianne Walters

Center for Bat Research, Outreach, and Conservation

Indiana State University, Terre Haute, IN

Introduction

Until recently, gray bats (*Myotis grisescens*), a federally endangered species, were thought to be uncommon in western North Carolina (WNC). However, 2016–2017 survey work by the NC Wildlife Resources Commission (NCWRC) and others has shown that large gray bat colonies are using manmade structures in the French Broad River (FBR) basin in Buncombe and Madison counties, NC, including bridges and a culvert. The presence of gray bats in structures constructed and maintained by the North Carolina Department of Transportation (NCDOT) and the foraging and roosting habits of the bat has the potential to affect multiple large scale projects and a range of smaller projects and maintenance activities in NCDOT Divisions 13 and 14.

To address NCDOT research needs, we are conducting a 3-year (2018–2020) study with 5 major objectives. The first field season (March to November 2018) involved intensive field work by a crew of personnel dedicated to this project and partners from NCDOT, UNC-Asheville, NCWRC, NPS, USFWS, and other agencies. Herein we report data from this first field season; note that these data are preliminary and that some results and conclusions may change with additional analyses.

Objectives

1) Literature Review and Data Synthesis Review existing literature on gray bat distribution, roosting and foraging habitat requirements, migration patterns, and use of anthropogenic structures. Synthesize all previously-collected data from the FBR basin, including data collected via NCDOT and NCWRC.

2) Distribution Use bridge checks, acoustic monitoring, and winter surveys across 2 years to describe the distribution of the gray bat in WNC. Conduct micro- and macrohabitat assessments at used and unused bridges, including collecting detailed temperature and humidity measurements where bats are/are not roosting. We will merge bridge assessment data with existing data that NCDOT has collected at more than 600 bridges from 1996–2017. For 2 full calendar years, we will collect acoustic data at regular monitoring stations across the FBR basin to identify high, low, and no activity sites for gray bats. We will also aid in winter surveys in suspected gray bat hibernacula in WNC and will communicate with biologists in other states to attempt to recover information on bands placed on bats in WNC.

3) Roost Sites We will track 90 bats per year (45 with beeper tags and 45 with coded tags) for 2 years to locate additional daytime roosts. Because of the long distance capabilities of gray bats, we suspect we may only locate about half of the bats carrying beeper tags and fewer carrying coded tags. We will conduct exit counts at all known roosts to describe the relative importance of each roost found.

4) Foraging Areas We will use a combination of ground-based telemetry and datalogging towers to identify foraging areas and ranges of radio-tagged gray bats during 3 periods per year for 2 years. With ground-based telemetry, we will attempt to track up to 45 bats with beeper tags each year. With datalogging towers, we will record the nightly locations and movements (between towers) of 45 bats with coded tags each year. Data from aerial telemetry searches during autumn will also yield data on gray bat foraging areas.

5) Migration Pathway We will use a combination of telemetry (ground and aerial), datalogging towers, and acoustic surveys to describe the migration pathways of gray bats in autumn. With telemetry, we will focus on bats carrying beeper tags (15 each autumn), while datalogging towers will be re-positioned along suspected pathways to track the movements of bats carrying coded tags (15 each autumn).

Methods

1) Literature Review and Data Synthesis We reviewed 14 published papers on gray bats, summarizing the salient parts of each article. We will continue to add to this review during the 2018–2019 winter/spring.

2) Distribution

We conducted structure checks at 100(+) bridges in the FBR basin (Figure 1). We randomly selected 100 bridges from bridges located within 400 m of major streams in the FBR Basin. At each bridge we performed a thorough survey for bats and evidence of use by bats, then recorded descriptive information mostly based on NCDOT's standard operating procedures (SOP) for bat habitat assessments (see Appendix A for our datasheet). We also opportunistically surveyed 6 bridges for bats, but did not record descriptive information.

We deployed bat detectors at 12 stations throughout the FBR basin (Figure 2). We selected major streams in the FBR basin from a major hydrography layer available at nconemap.org. For each stream, we selected a site 0.1–6.6 km from the midpoint. We divided the FBR into 3 sections (North, Middle, South) and created a station near the midpoints of those sections. Each station had two Anabat SD1s or SD2s (Titley Scientific, Inc., USA), with directional hi-type, weatherproofed microphones (housed inside a 31.75 mm PVC tube with a 40° axis angle) on 10-m cables, powered by a combination of 12V batteries and a solar panel. The mics were elevated 1.5–2.5 meters above ground level and set so one recorded upstream and the other downstream.

We downloaded calls from compact flash cards and organized data by site, mic direction, and night. We used automated identification software, Bat Call Identification (BCID; v2.7c; Bat Call Identification 2016), to identify bat echolocation calls to species from a list of 13 species that occur in western North Carolina (*Tadarida brasiliensis* is not an option).By default, BCID discards files that have noise or no bat pulses, where a pulse is defined as an individual sound wave that is a part of the larger bat echolocation call sequence; files that pass the filter are identifiable sequences of search phase calls. For species identification, we required call sequences with a 5-pulse minimum within 15 s, a 70% species confidence level (at least 4 pulses identified as 1 species), and minimum discriminant probability of 0.35. If the minimum discriminant probability was not met, BCID marked the file as unknown.

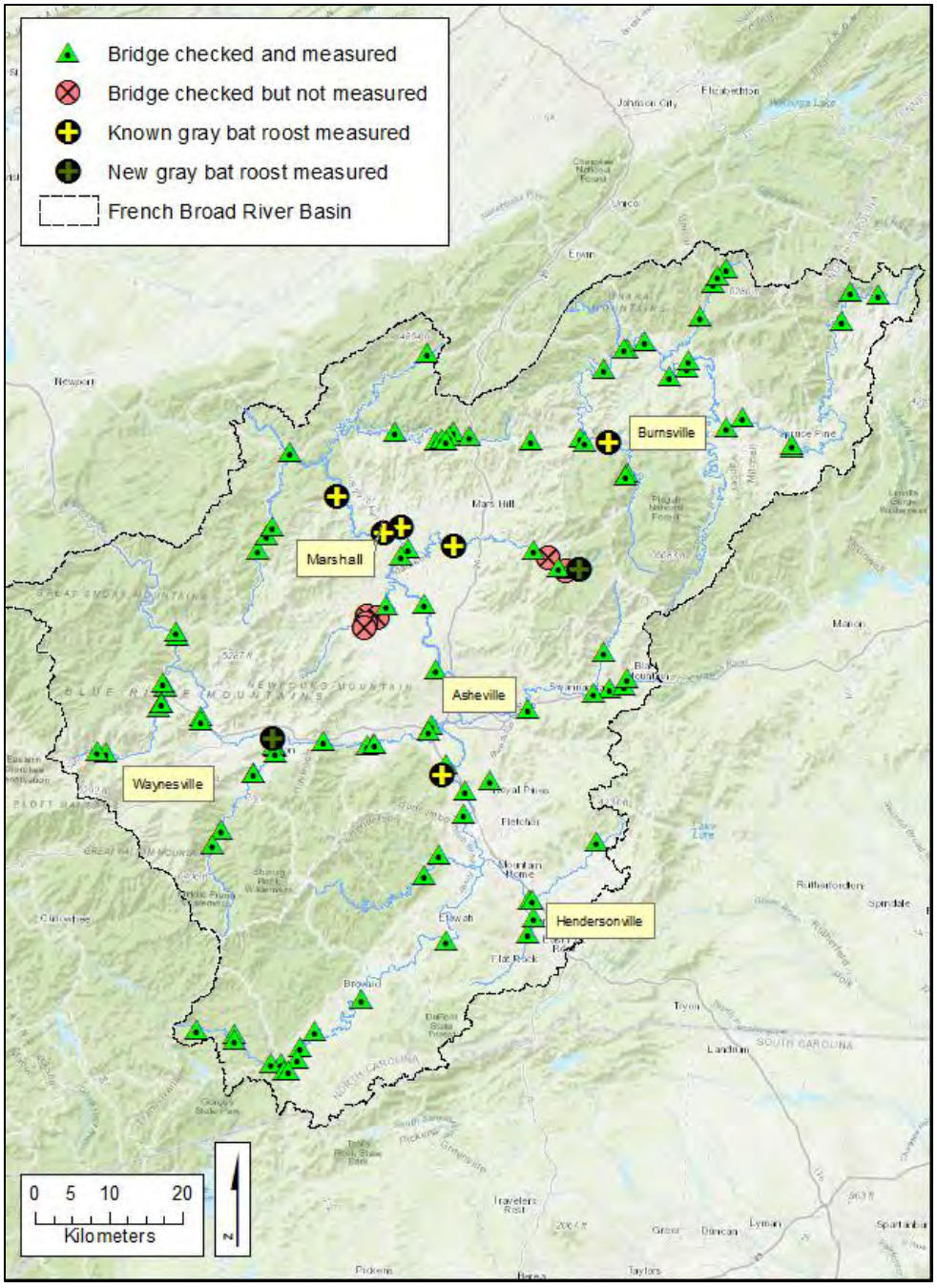

Figure 1. Bridges surveyed for gray bats in the French Broad River Basin (Avery, Buncombe, Haywood, Henderson, Madison, Mitchell, Transylvania, and Yancey counties) between 29 May–14 July 2018. Note: This map does not show all known gray bat roosts; rather, it shows those we measured.

For this report, we present the number of files identified as gray bats according to the BCID criteria above. We also present the calls per detector night, where a detector night is one detector active for one entire night (dusk to dawn).

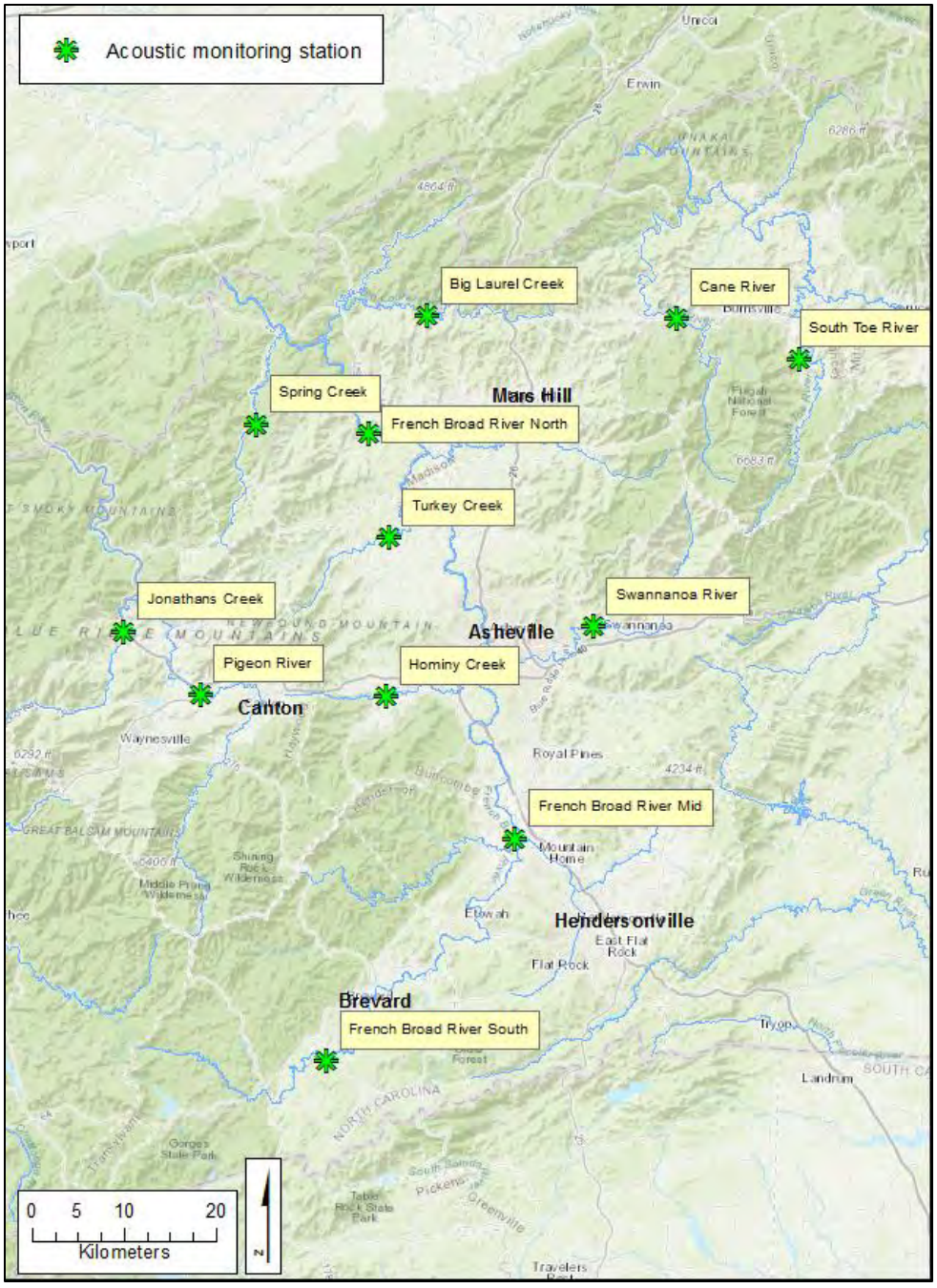

Figure 2. Acoustic monitoring station locations in the French Broad River Basin in Buncombe, Haywood, Henderson, Madison, Transylvania, and Yancey counties. We do not present data for the South Toe River station, which came online in late October.

We have not yet completed any winter surveys, but have engaged in discussions with NCWRC and Tennessee Wildlife Resources Agency (TWRA) about checking their winter hibernacula for banded gray bats.

3) Roost Sites

We used mistnets and a harp trap to capture bats at known roosts and additional net sites. We banded >97% of gray bats we handled and usually did not band other species. We attached radio tags to 91 bats (45 coded tags and 46 beeper tags) between 15 April and 25 October 2018. By tracking bats during the day, we mainly confirmed their use of structures already known to us when the project began. However, we also discovered some new roosts via radio telemetry and opportunistic searches.

We checked known roosts as often as possible to assess the presence of gray bats and population sizes. We conducted simultaneous, coordinated exit counts on known roosts on 3 occasions. We also conducted additional exit counts on a few primary roosts or suspected roosts. For example, we returned to 3 potential roosts to do exit counts after structure checks indicated bats were present.

4) Foraging Areas

To identify foraging areas, we followed 2–3 bats per night, as feasible. From immediately after emergence time (around 20:00 EDT) until as late as 02:06, we recorded a series of simultaneous multi-azimuth (2–5) triangulations/biangulations at 5–6 minute intervals to obtain location estimates for foraging bats. We stationed personnel at various points on the landscape around a focal bat's foraging area, with each person recording an azimuth or bearing for the focal bat at set time intervals. Azimuths were recorded on a 5-minute cycle when a single bat was being tracked or a 3-minute cycle when multiple bats were being tracked; thus, when tracking two bats, personnel recorded azimuths for each bat every six minutes. We converted foraging telemetry triangulations/biangulations to point location estimates using the program Locate III, Version 3.34 (Nams 2006). When estimating point locations, we excluded biangulations that were < 15 degrees different, and triangulations or biangulations with lines that did not cross. Also, we recorded areas where we tracked foraging bats but did not obtain triangulations/biangulations. Copperhead Consulting also provided some foraging locations, which we present without correction/modification in Appendix C.

We positioned 16 fixed telemetry towers 5–10 km apart from each other and centered in Asheville on the midpoint between the confluences of Hominy Creek and Swannanoa Rivers with the FBR (Figure 3). Tower sites were along the FBR, Hominy Creek, Swannanoa River, and at Lake Julian. Each fixed telemetry tower consisted of a SRX-DL1 or SRX800-D datalogging telemetry receiver (Lotek Wireless, Inc., Newmarket, Ontario) powered by a 12V battery, two 9-element Yagi antennae, and one antenna mast (approximately 5–6 m elevation for antennae). One antenna pointed upstream and the other downstream. We checked or changed batteries regularly, but at times the towers were not operational because the battery died.

The dataloggers allowed for simultaneous monitoring of 15 coded tags with the same frequency but digitally-encoded unique IDs that could be separated by the datalogging telemetry receivers. Coded tags transmitted a signal every 5 seconds. When analyzing data from the datalogging receivers, we considered signals to be detections if they were at 5-second intervals and there were ≥ 3 detections within one minute of each other; thus, if there were two signals at a 5-second interval within one minute of each other but no other signals within a minute's time, we did not consider this a detection.

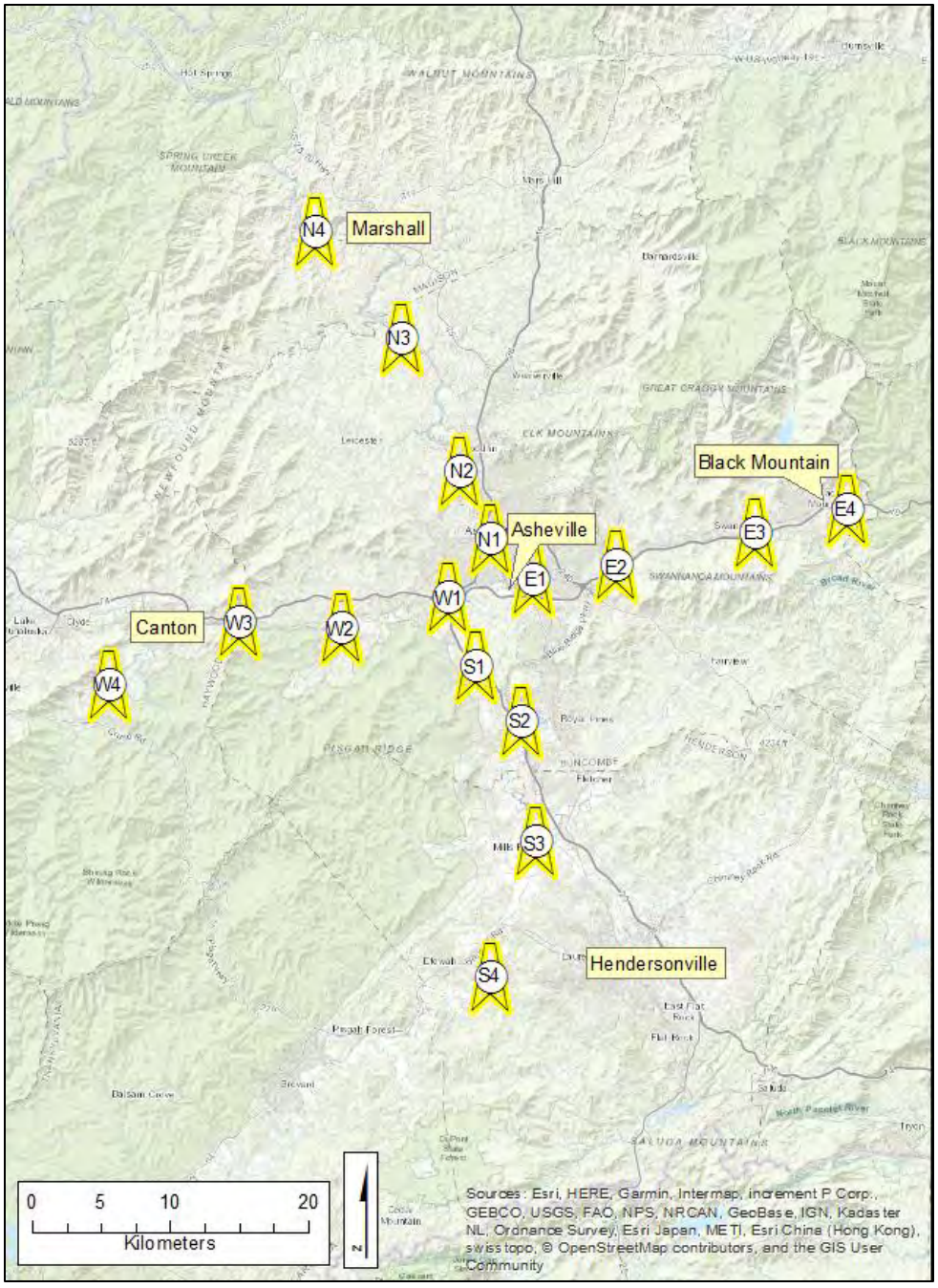

Figure 3. Telemetry tower locations along the French Broad River, Hominy Creek, Swannanoa River, and Lake Julian. Gray bats were radio-tagged at roost sites in Asheville, Canton, and Marshall; towers recorded their movements between 18 April and early-November.

5) Migration Pathway

We maintained all telemetry towers through Nov 6 and kept the 4 towers north of Asheville (along the FBR) active through 15 November. We will use tower data to assess migration movements of bats radio tagged in September and October 2018.

In addition to the 16 fixed telemetry towers centered on Asheville, we deployed 1 additional datalogger at the N4 tower to record beeper transmitters on 31 October and 4 dataloggers (3 beeper and 1 coded) at the entrance to Rattling Cave (a known gray bat hibernaculum) near Newport, TN between 3 October–mid November. Rattling Cave is ~0.4 km from the Pigeon River and < 3 km from the FBR. Beeper tags transmitted a signal approximately every 2 seconds. When analyzing data from the datalogging receivers for beeper transmitters, we considered signals to be detections if they were at 2-second intervals and there were 4 consecutive detections within 8 seconds; if there were ≤ 3 consecutive signals at a 2-second interval, we did not consider this a detection. We also did not consider it a detection if the beeps per minute of the signals varied by more than 1 beep per minute. Note: we positioned dataloggers at Pearson Cave (about 3 hrs north of Asheville) and at the confluence of the FBR and the Pigeon River in TN from early to late October, but did not have any detections.

We contracted Copperhead Consulting to conduct aerial searches for bats beginning in early October. Their start date was delayed due to Hurricane Michael, which passed through the Southeast 8–11 October. Copperhead flew the nights of 12, 13, 15, 17, 18, and 19 October; we asked them to discontinue flights after it became apparent that we were not picking up on migration flights for females. Copperhead collected foraging data for several bats, mostly males, captured at Blue Ridge Parkway Bridge, Southern States Culvert, and Blackwell Canton Bridge (see Foraging Areas, above, and Appendix C).

Results and Discussion

1) Literature Review and Data Synthesis

The summary of available literature is provided as Appendix B.

2) Distribution

Of the 113 bridges we surveyed, 99 were bridges that we randomly selected for recording descriptive information (Figure 1). Of those 99 bridges, we documented gray bat usage at 2 bridges, at the Blackwell Canton Bridge on the Pigeon River (NCDOT #430445) and at the Dillingham Bridge on Dillingham Creek (NCDOT #100148). Not including those 2 bridges or previously-known gray bat bridges, we recorded evidence of use (guano or bats), but did not confirm the bat species at 23 bridges.

We recorded gray bats at each of the 11 acoustic stations deployed in late summer through fall (Table 1, see also Figure 2). Considering calls/detector night, activity was greatest at the Pigeon River (22.2 calls/detector night), followed by Swannanoa River and Hominy Creek (> 7 calls/detector night). The lowest activity levels were at French Broad Middle and French Broad South. We recorded < 1 gray bat call/detector night at each of these stations. Given their proximity to known gray bat roosts, we suspect the low activity rates may reflect the greater distance from the mics to the center of the river relative to other acoustic stations. It is noteworthy that activity is high along the Swannanoa River by Warren Wilson College (second highest activity rate), as we have not located any roosts due east of Asheville and also have not tracked bats in this direction. Summing data across all acoustic stations, it appears there was a substantial drop off in activity in mid-October (data not shown). However, during this time we also removed half of the detectors to reduce the risk of inundation with floodwaters and thus missed the opportunity to adequately capture the decline in acoustic activity as bats moved to wintering site(s).

Table 1. Summary of acoustic data recorded at 11 Anabat stations deployed throughout the French Broad River basin (see Figure 2 map). Each station had 2 Anabat detectors, with microphones pointing upstream and downstream. A detector night is 1 detector operational for a night (dusk to dawn). Typically a station would yield 2 detector nights for each calendar night.

Site	Sum of MYGR calls	Detector Nights	Calls/detector night
Big Laurel	110	32	3.4
Cane River	70	41	1.7
FB Middle	65	80	0.8
FB North	322	92	3.5
FB South	33	168	0.2
Hominy Creek	1027	143	7.2
Jonathans Creek	564	111	5.1
Pigeon River	2642	119	22.2
Spring Creek	605	181	3.3
Turkey Creek	439	123	3.6
Swannanoa River	1009	128	7.9

3) Roost Sites

We captured bats at 3 roost sites along the FBR (BR Parkway Bridge, Marshall Bridge, and Southern States Culvert; Table 2). We also surveyed Sandy Bottoms, a net site near the FBR. In October 2018, we netted a newly discovered roost in Canton (Blackwell Canton Bridge N) and then a nearby bridge (not known to be a roost; Blackwell Canton Bridge S). We captured 488 gray bats, 41 big brown bats (EPFU, all at BR Parkway Bridge), 3 eastern red bats (LABO), 1 tri-colored bat (PESU), and 316 Mexican free-tailed bats (TABR, at BR Parkway and Marshall bridges). Approximately 82% of the gray bat captures were adult males, 12% were adult females, and 4% were juveniles. These calculations are for first time captures only. We recaptured 1 adult female at the BR Parkway Bridge, 26 adult males, and 1 male of unknown age (bat got out of hand). We caught our last female gray bat on 13 October, even though we netted and caught male gray bats on 4 later nights (14–25 October).

Table 2. Captures for 2018 season by site (roost or net) and date. Gray bat (MYGR) captures divided by age and sex. Recaptures are indicated after a plus (+). We also present data for big brown bats (EPFU), red bats (LABO), tri-colored bats (PESU), and Mexican free-tailed bats (TABR), which were not banded in 2018.

		Species (ages and sexes encountered indicated below species code)									
		MYGR						EPFU	LABO	PESU	TABR
Site Name	Date	AF	AM	JF	JM	UF	UM	AF, AM, J	F + M	AF	AF, AM, J
Blackwell Canton Bridge N	Oct 4	4	29								
Blackwell Canton Bridge S	Oct 13	1	20								
BR Parkway Bridge	Apr 18		5					1	2		
	Apr 25		1					2 + 1			
	Jul 21	3	17		1			12	1		7
	Jul 22	4	9		3			7			40
	Aug 3							1 + 1			35
	Aug 9	1	4 + 1		1	1					24
	Sept 25	2 + 1	7					5 + 1			107
	Sept 26	3	16					5			14
	Oct 3	1	19								29
	Oct 14		25 + 5				1				53
Marshall Bridge	Apr 20	5	14								
	Apr 21	5	19 + 1								2
	Apr 28	4	7							1	
	Apr 29	2	3								1
	Apr 30	2									
	Jul 15	1	5 + 1								
	Aug 14	2	6								2
	Sept 28	2	25 + 1								2
	Oct 18		1 + 1								
Sandy Bottom Net Site	Jul 18		1								
Southern States Culvert	Apr 19		6								
	Apr 27		10 + 1								
	Jul 26	5	27 + 1	4	3						
	Aug 6	2	17 + 2	2	6						
	Aug 15	8	40		2						
	Oct 1	4	33 + 5				0 + 1				
	Oct 8		12 + 3								
	Oct 10	1	20 + 1								
	Oct 19		4 + 2								
	Oct 25		0 + 1								

We surveyed 4 primary roost sites; 3 were known before the study began and Blackwell Canton North was discovered during a structure survey. Via radio telemetry and opportunistic searches (some prior to 2018), we and others discovered 11 secondary roost sites for gray bats (Figure 4).

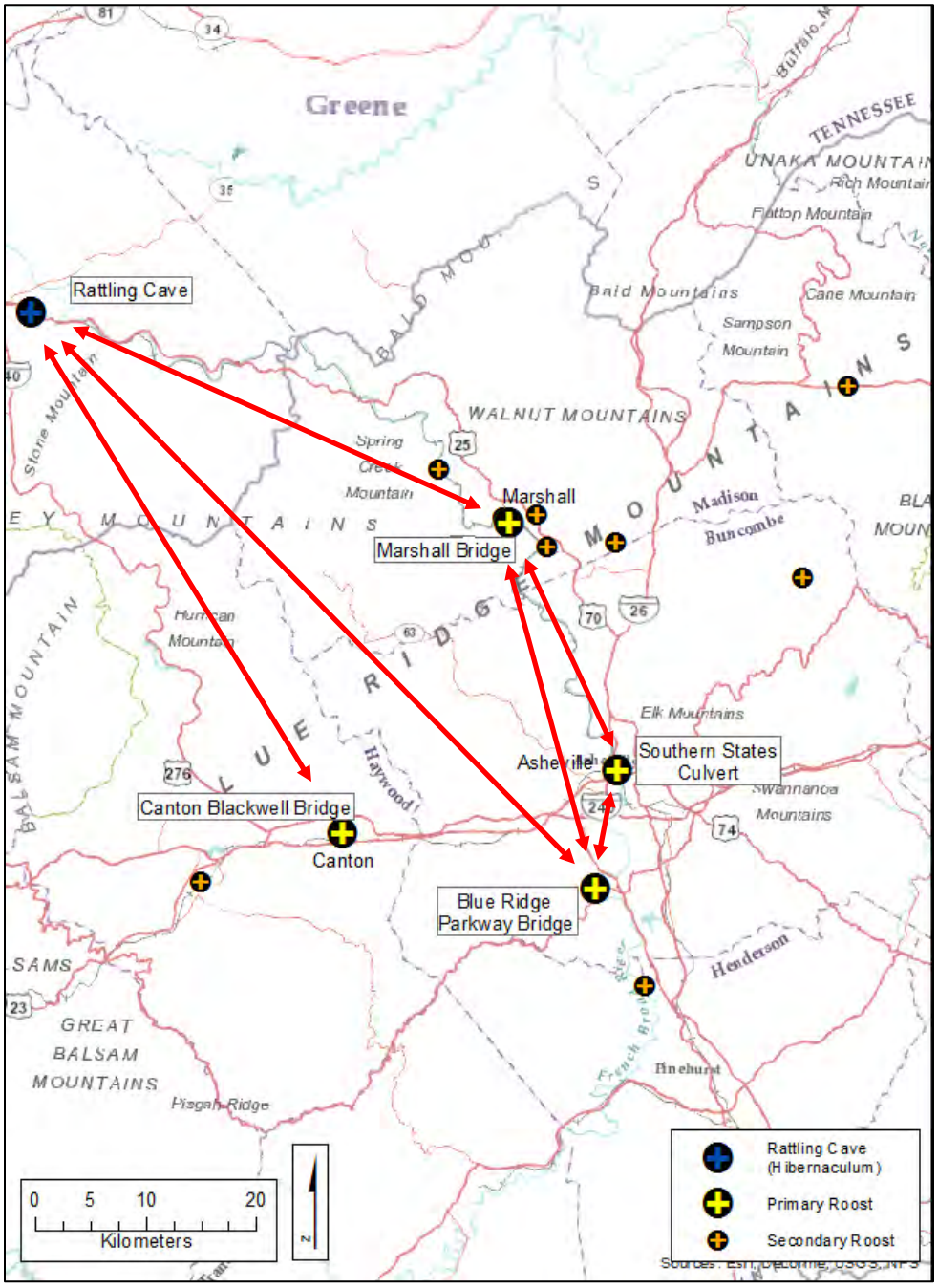

Figure 4. Gray bat roosts in the French Broad River Basin in North Carolina as of November 2018. Primary roosts were used by >100 gray bats and secondary roosts were used by <100 gray bats. Three secondary roosts are hidden under points of primary roosts (Marshall Bridge and Southern States Culvert). Arrows depict movements (but not necessarily actual routes taken) between primary roosts by individual bats, as recorded by radio-telemetry and capture data. Rattling Cave (a known hibernaculum) is located in Tennessee.

Table 3. Counts of bats observed via exit counts (bold numbers) and spotlight checks at known primary (significant) roosts for the gray bat population in the French Broad River Basin, NC, 2018.

		French Broad River						Pigeon River	
		Blue Ridge Parkway Bridge		Marshall Bridge		Southern States Culvert		Blackwell Canton (NCDOT# 430445)	
Months	Date (2018)	MYGR	UNKWN	MYGR	UNKWN	MYGR	UNKWN	MYGR	UNKWN
Apr	21-Apr	0	0						
	22-Apr	0	0						
	23-Apr	8	0						
	25-Apr								
May	2-May	12	0						
	4-May		1						
	7-May			83	0				
	16-May								
	24-May								
	26-May								
Jun	4-Jun		**373**		**2**	**0**	**0**		
	16-Jun			160	0				
	23-Jun			250	0				
Jul	3-Jul		**731**	**240**	0	0	0		
	8-Jul		11						
	12-Jul			130	0				
	14-Jul			150	0				
	15-Jul			0	0				
Aug	9-Aug		2						
	13-Aug			275	0				
Sep	10-Sep			1005	0				
	13-Sep		**703**	**498**	0	**35**	0		
	14-Sep							**361**	0
	24-Sep			489	0				
Oct	12-Oct		**382**	**8**	0			**61**	**0**
	13-Oct		**546**						
	14-Oct		**687**						
	15-Oct		**623**						
	19-Oct		**322**						
	20-Oct		**235**						
	28-Oct			4	0				

From simultaneous exit counts at known primary roosts, which occurred on 4 June, 3 July, and 13 September, we can assess the size of the gray bat population in the Asheville area. One primary roost was not detected until mid September, so it was not included in earlier counts. Combining data for 13–14 September, there were approximately 1600 bats in the four known primary roosts. Capture data indicates that the BR Parkway holds gray bats and Mexican free-tailed bats in similar numbers (see Table 2; note we do not band TABR so we do not account for recaptures in these data) and fewer big brown bats. We occasionally capture another species at the Marshall Bridge, but these bats are likely just flying through the area. We are confident the numbers in Table 3 represent mainly gray bats. At Southern States Culvert and Blackwell Canton Bridge, our observations during capture surveys suggest the population is entirely gray bats. Further, we are likely undercounting the bats at the Culvert, which has many entrances and is difficult to count.

Counts at secondary roosts were typically made by spotlight checks (Table 4). The 25/70 Bridge and Lower Gabriel's Bridge offer good views of gray bats at roost. We are confident in gray bats use of a hole in the outside of the Marshall Community Center, as we have tracked multiple bats to this building.

Table 4. Counts of bats observed via exit counts (bold numbers) and spotlight checks at known secondary (alternate) roosts for the gray bat population in the French Broad River Basin, NC, 2018.

		Hwy 280 Bridge		25/70 Bridge		Barnard Bridge		Lower Gabriel's Creek Bridge		Clyde McIntosh Bridge		Dillingham Bridge		Marshall Community Center		Al's Used Cars Building		Marshall Sycamore Tree	
	Date (2018)	MYGR	UNKWN	MYGR	UNKWN	MYGR	UNKWN	MYGR	UNKWN	MYGR	UNKWN	MYGR	UNKWN	MYGR	UNKWN	MYGR	UNKWN	MYGR	UNKWN
Apr	22-Apr			0	51		20	7	0										
	23-Apr							7	2										
	24-Apr							5	2										
	27-Apr							17	1										
May	1-May							0	0							**1**	0		
	2-May							2	0										
	4-May													**3**	0				
	5-May							1	0										
	12-May													**0**	0				
	15-May			15															
	22-May			0	25			0	0										
	30-May							0	0										
Jun	4-Jun													**0**	0	**0**	**0**		
	18-Jun																		
	23-Jun			0	50														
Jul	3-Jul			0	15									**0**	0				
	5-Jul									1	0								
	12-Jul							0	0										
Aug	1-Aug											1	0						
	19-Aug									1	0								
	20-Aug	1	0																
	24-Aug								1										
Sep	7-Sep									3	0								
	12-Sep			0				21	10										
	13-Sep													**0**	0				
	19-Sep									1	0								
	24-Sep							0	0										
	30-Sep																	**1**	**0**
Oct	2-Oct													**44**	0				
	12-Oct													**0**	0				

4) Foraging Areas

We conducted ground-based foraging telemetry in 3 areas. Near the Blue Ridge Parkway Bridge we tracked 3 gray bats while they foraged on 4 nights in July, August, and October (Figure 5a). These bats foraged south of the Blue Ridge Parkway Bridge mostly along the FBR, but also in the Sandy Bottom area across Hwy 191. In Asheville we tracked 3 bats while they foraged in and near the I-2513 Project Study Area (Figure 5b and Figure 6). For one of these bats, NCWRC A3740, we were able to obtain a relatively complete foraging range, except for when we lost her on the Biltmore Estate and Biltmore Farms properties. On 1 night in May we tracked a male bat north of Asheville (~10 km) near Hwy 251 along the FBR (Figure 7a). In May we also tracked a female bat ~0.9 km northwest of the Marshall Bridge while she foraged along the FBR (Figure 7b).

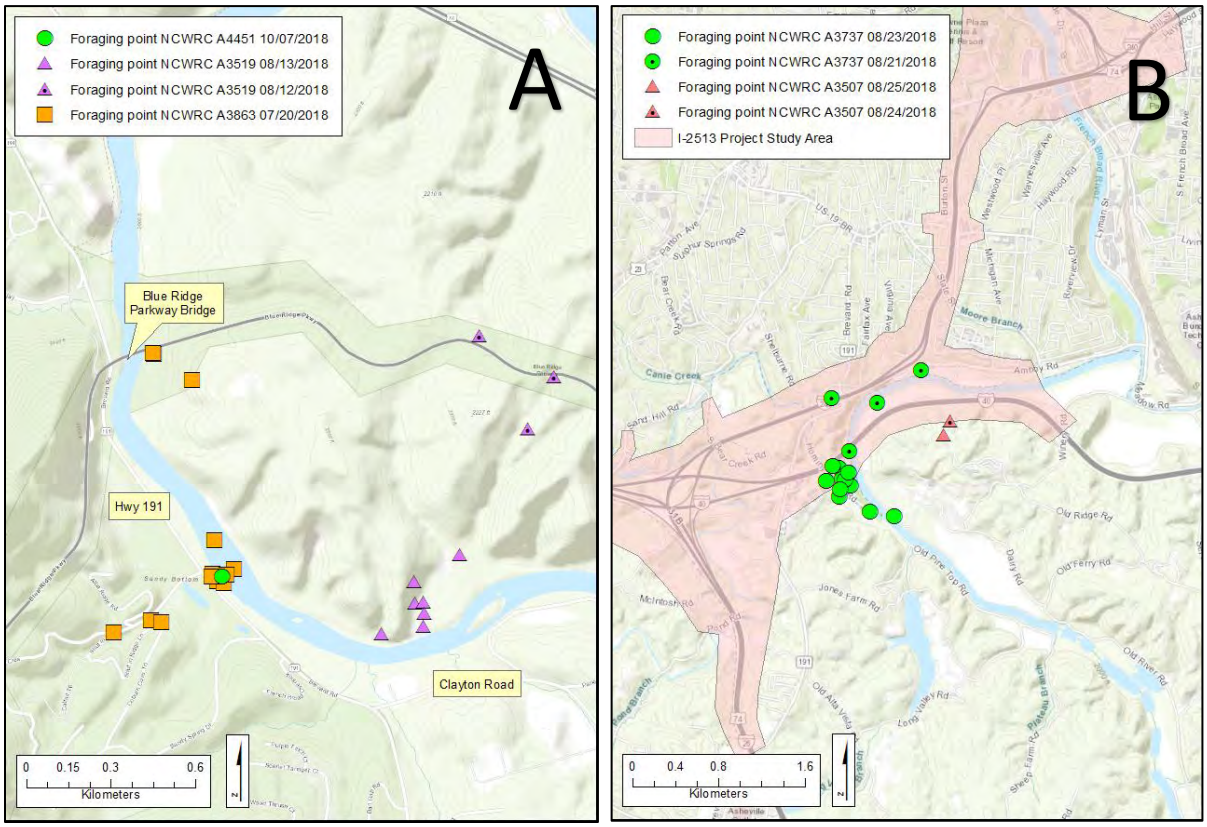

Figure 5. Foraging areas near the Blue Ridge Parkway Bridge and Asheville for 5 gray bats tracked on 8 nights in June, July, August, and October 2018.

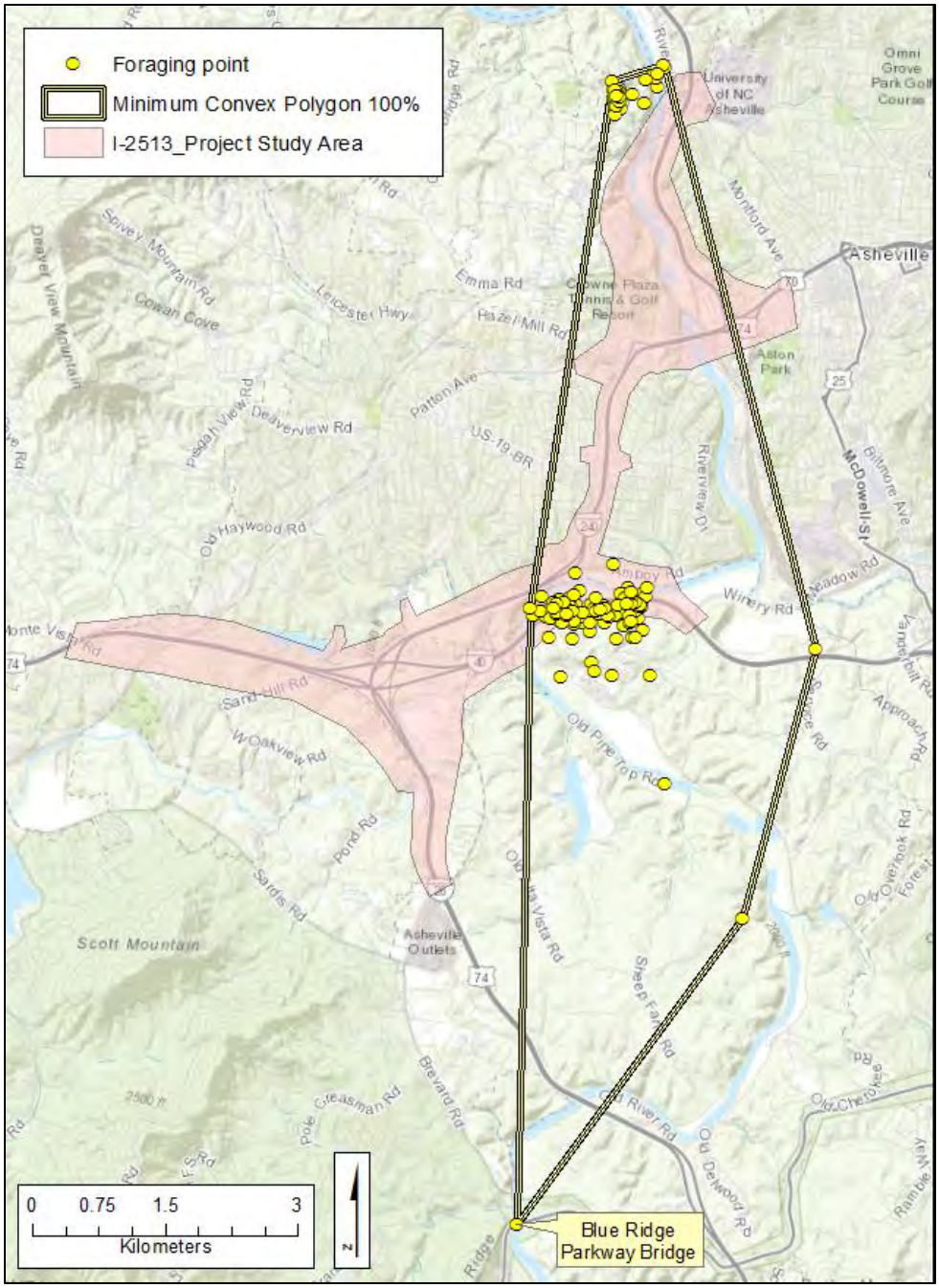

Figure 6. Foraging range of bat NCWRC A3740 in and around Asheville for the dates of 22–30 August 2018. There were 165 foraging points gathered for this bat.

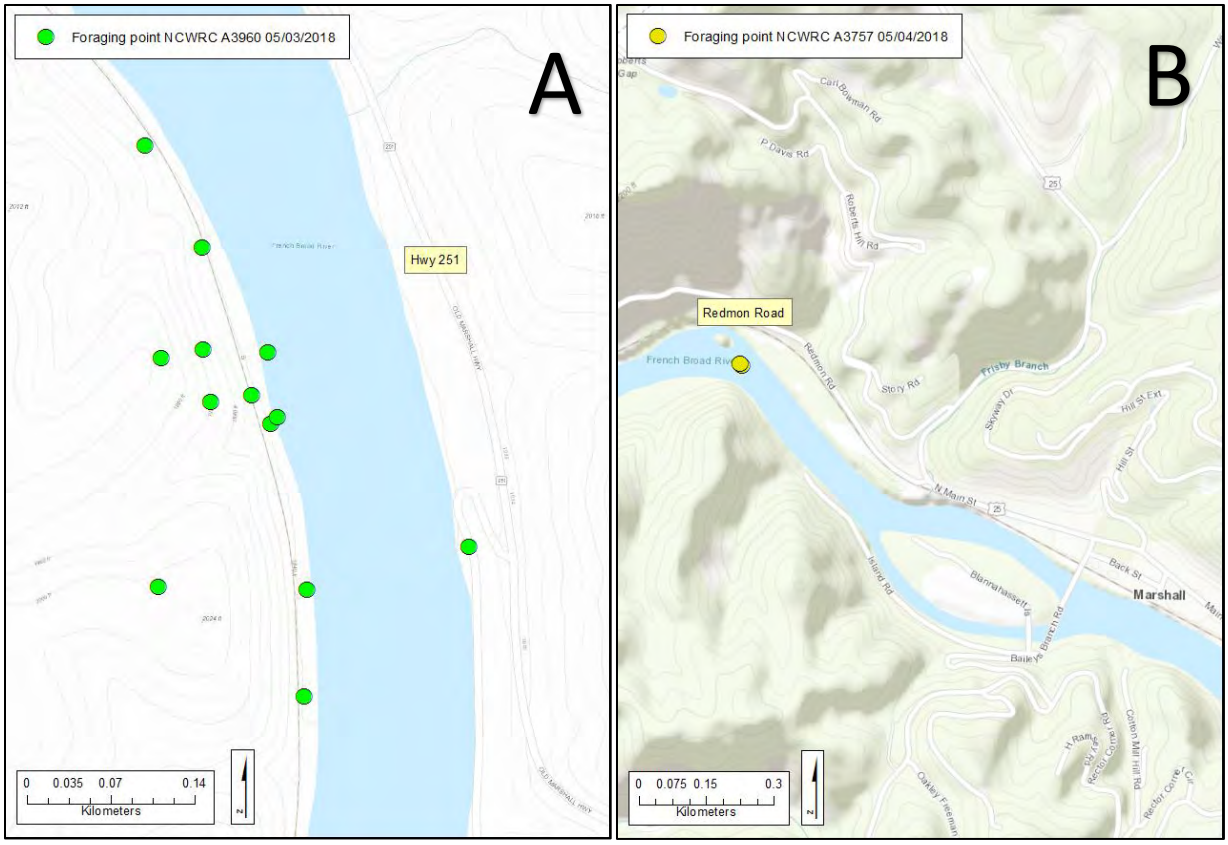

Figure 7. Foraging areas north of Asheville and Marshall for 2 gray bats tracked on 2 nights in May 2018.

We also followed other bats while they foraged by tracking them from a vehicle (but without attempting triangulation, as bats were moving too quickly). We recorded bats foraging along the FBR as far north as Ledges Whitewater River Park (~21.5 km north of the Blue Ridge Parkway Bridge). We tracked foraging bats near the Southern States Culvert, north of the Southern States Culvert behind the Mattress Mart on Riverside Drive and as far north as Ledges Whitewater River Park, west and north of Carrier Park, along the FBR east of the state farmer's market, and at locations between the state farmer's market and south of the Blue Ridge Parkway, including west of Hwy 191. We have tracked radio-tagged gray bats at night everywhere that the connector project I-2513 comes near the FBR. We have followed other foraging bats in Madison County, NC.

We have detected bats on 9 of 16 telemetry towers, mostly along the axis of the FBR north and south of Asheville, but also west along Hominy Creek (Table 5, Figure 3). Activity as measured by the number of tagged bats detected, is highest at N4 (north of Marshall), N1 (within Connector project boundaries), and N2 (Riverside Dr. near water treatment plant) (Table 2). On a few occasions, bats traveled from tower S1 or S2 to N4 in one evening.

Table 5. Number of radio-tagged gray bats detected by each telemetry tower (see Figure 3 for tower locations) from April–November 2018.

Tower	Number of Bats Detected
N1	22
N2	17
N3	14
N4	23
S1	16
S2	6
S3	4
S4	0
W1	6
W2	2
W3	0
W4	0
E1	0
E2	0
E3	0
E4	0

5) Migration Pathway

We did not detect any bats along the east axis of towers, nor on West 3–4. However, we did not deploy coded tags at the Blackwell Canton Bridge until mid-October, so we may have missed the opportunity to detect bats from this bridge on towers W1–W4. Most activity was along the north-south axis of the FBR throughout the three tracking periods and these data strongly suggest the north portion of the FBR is a migration corridor. We will analyze the data for individual bats to look for patterns in movements in fall.

Tracking beeper bats on the ground and via air was difficult due to weather. We did not detect bats migrating away from the Asheville area via active radio telemetry. However, we did detect 5 bats at Rattling Cave in Newport, TN (Table 6). Bat 151.513 (BRR A5589) was the only female we detected there; she was radio tagged on 13 October at Blackwell Canton Bridge. This bat foraged around the paper mill along the Pigeon River on the night of 15 October, but disappeared around 23:15 (see Appendix C). The next night, 16 October, we heard her foraging in the same spot, but she disappeared again at 19:50. The plane was grounded that night due to storms. Based on the detection at Rattling Cave the morning of 17 October, we suggest 151.513 traveled to the cave in one night (16–17 October).

Table 6. Bats detected via datalogging receivers positioned at the entrance to Rattling Cave in Newport, TN.

Band #	Radio	Date	Start time
BRR A5589	151.513	10/17/2018	4:47:10
NCWRC A4406	151.148	10/22/2018	22:55:58
BRR A5579	151.239	10/28/2018	23:48:50
NCWRC A4403	151.350	10/31/2018	23:06:50
NCWRC A4451	151.389	11/6/2018	6:16:35
NCWRC A4451	151.389	11/6/2018	6:19:55

Bat 151.148 (NCWRC A4406) was radio tagged at the Southern States Culvert on 10 October. He roosted in the BR Parkway Bridge 16–17 October. He was detected at Rattling Cave on 22 October.

Bat 151.239 (BRR A5579) was radio tagged at the Marshall Bridge on 18 October and detected foraging around the bridge that night (see Appendix C). He roosted in the Marshall Bridge again on 20 October and again 27–28 October. Based on the detection at Rattling Cave the night of 28 October at 23:48, we suggest 151.239 traveled to the cave, 47 km north, in a few hours on one night (28 October).

Bat 151.350 (NCWRC A4403) was radio tagged at Southern States Culvert on 19 October. Shortly after being tagged, he moved to the BR Parkway Bridge (see Appendix C). He roosted in the BR Parkway Bridge until 30 October. He was detected at Rattling Cave on the evening of 31 October.

Bat 151.389 (NCWRC A4451) was radio tagged at BR Parkway Bridge on 3 October. He roosted in the BR Parkway Bridge off and on throughout October and up until 5 November. He was detected at Rattling Cave on the morning of 6 November. Based on the detection at Rattling Cave the morning of 6 November, we suggest 151.389 traveled to the cave, 73 km north, in one night (5–6 November).

It seems likely that more of the Asheville area gray bats are in Rattling Cave, which will be surveyed by TWRA this winter.

Preliminary Conclusions

Acoustic surveys, and to a lesser extent structure checks, indicate that gray bats are relatively widespread in the FBR basin in western North Carolina. We feel that we have not fully captured their distribution with this first year of survey work and, thus, will aim to expand our coverage within the basin via structure checks and acoustic surveys.

This population of gray bats appears to use primarily manmade structures (bridges, culverts, and buildings). However, because we often lost radio-tagged bats, we believe there are additional roosts in the FBR basin that are still to be found. In 2019, we plan to use Copperhead Consulting for aerial surveys during parts of the summer in order to find some of those unknown roosts. Primary bridge roosts were mainly concrete bridges over relatively large bodies of water. The bats roosted in large expansion joints, which were sometimes covered in metal (BR Parkway and Canton bridges). Secondary roosts tended to be in bridges, but were also in buildings near primary roosts. Two secondary roosts were over small streams.

This gray bat population forages mainly over water, usually the FBR and associated tributaries. The bats appear to be comfortable foraging in the urban areas of Asheville (see Figure 6, for example), but also use less developed lands like the Biltmore Estate and Farms and the FBR near Marshall, NC.

While we did not successfully track bats as they migrated, the relatively quick movements between known roosts and Rattling Cave indicates that bats can travel fairly quickly. Based on what is known of the gray bat's biology (see Appendix B), we suspect these bats traveled mainly via the major river corridors (French Broad and Pigeon Rivers). We will deploy Copperhead Consulting earlier in the fall of 2019 in hopes of capturing the flights of females as they move to hibernacula.

APPENDIX E. MUSSEL SURVEY REPORT

Freshwater Mussel Surveys:

I-26 Connector Final Report

TIP No. R-2513

WBS 34165.1.2

Buncombe County, North Carolina

Creeper in situ French Broad River Site 171005.2ted

Prepared For:

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January 3, 2018

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Figure 1: Project Vicinity & Survey Reach
Figure 2: 303(d) Listed Streams and NPDES Discharges
Figure 3: NCNHP Element Occurrences
Figure 4: Survey Locations

1.0 INTRODUC TION

The North Carolina Department of Transportation (NCDOT) proposes an I-26 connector (TIP No. R-2513) in Buncombe County, North Carolina (Figure 1). The project will cross streams in the French Broad River Basin. The Federally Endangered Appalachian Elktoe (*Alasmidonta raveneliana*) is listed by the U.S. Fish and Wildlife Service (USFWS) for Buncombe and Henderson Counties and is currently known to occur in portions of the French Broad River Basin in Henderson County. The Federally Endangered Tan Riffleshell (*Epioblasma florentina walkeri*) is listed by the USFWS for Buncombe County as "Historic and Obscure" based on museum shell records from the early 20th century collected from the Asheville area, however, the species has not been collected since. Additionally, The NC Scientific Council of Mollusks 2010 reevaluation of the listing status of NC mollusks recommended the species status be changed from Endangered to Extirpated, a recommendation which was accepted in February 2011. As such, the project will have "No Effect" on the Tan Riffleshell.

According to the NC Natural Heritage Program database (NCNHP 2017), two element occurrence (EO) for Appalachian Elktoe are located near the Project Study Area (Figure 2). The most downstream EO (EO ID: 21150) is a historic record located in the French Broad River at the study area. This occurrence includes part of the Swannanoa River, is about 5.3 RM in length, and captures the original description of the species collected in the early 19th century. Continuing upstream, there is a current EO in the Mills River (EO ID: 7990) approximately 2.8 RM in length. It is approximately 18.9 RM upstream of the I-40 crossing of the French Broad River in the study area, was first observed in July 2003 and last observed in October 2014.

As part of the federal permitting process that requires an evaluation of potential project-related impacts to federally protected species, Three Oaks Engineering (Three Oaks) was contracted by NCDOT to conduct surveys targeting Appalachian Elktoe.

2.0 WATE RS IMP ACTED

The project is located in the Upper French Broad River subbasin (HUC# 06010105).

2.1 303(d) Classification

French Broad River is listed on the NCDWR 2014 303(d) list of impaired streams for fecal coliform approximately 9.1 RM upstream of the study area (Figure 3). Additionally, the French Broad River is also listed for Benthos (fair) greater than 10 RM downstream of the study area.

2.2 NDPES dischargers

There are multiple minor permitted NPDES dischargers in the French Broad survey area. Two major permitted dischargers in the immediate vicinity of the study area are the Asheville Steam Electric Power Plant (NC 0000396) and the French Broad River WRF (NC0024911) (Figure 3).

3.0 TARGET FEDERALLY PROTECTED SPECIES DESCRIPTIONS

3.1 Appalachian Elktoe (Alasmidonta raveneliana)

3.1.1 Characteristics

Isaac Lea (1834) described 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. Parmelee and Bogan (1998) site a maximum length of 3.1 inches (80 mm). However, recently observed individuals from the Little River (French Broad River Basin) in Transylvannia County and West Fork Pigeon River (French Broad River Basin) in Haywood County measured in excess of 3.9 inches (100 mm) in length (USFWS 2009). The periostracum (outer shell) of the adult Appalachian Elktoe varies in color from dark brown to yellowish-brown. 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.

The reproductive cycle of Appalachian Elktoe is similar to 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).

Many mussel species have specific fish hosts that must be present to complete their life cycle. Based upon laboratory infestation experiments (Watters 1994), Banded Sculpin (*Cottus carolinae*) was identified as a potential fish host for Appalachian Elktoe; however, the ranges of these two species rarely overlap. Keller documented transformation of Appalachian Elktoe glochidia on Mottled Sculpin (*Cottus bairdi*) in 1999 (USFWS 2002), and ongoing research at Tennessee Technical University (TTU) identified 10 fish species with encysted Appalachian Elktoe glochidia from the Little Tennessee River in North Carolina (Jim Layzer and Kendall Mole, TTU personal communication; Table 1).

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

Common Name	Scientific Name
Banded Darter	*Etheostoma zonale*
Wounded Darter	*Etheostoma vulneratum*
Greenfin Darter	*Etheostoma chlorobranchium*
Tangerine Darter	*Percina aurantiaca*
Mottled Sculpin	*Cottus bairdi*
Black Redhorse	*Moxostoma duquesnei*
River Redhorse	*Moxostoma carinatum*
Sicklefin Redhorse	*Moxostoma sp.*
Northern Hog Sucker	*Hypentelium nigricans*
Warpaint Shiner	*Luxilus coccogenis*

Additionally, nine of the species shown in Table 2 were shown to successfully transform Appalachian Elktoe glochidia in laboratory induced infestations (Jim Layzer and Kendall Mole, TTU, personal communication). Based on over two years of ongoing monitoring of Appalachian Elktoe population in the Little Tennessee River by the NC Wildlife Resource Commission (NCWRC), it is apparent that Appalachian Elktoe is a bradytictic (long-term) breeder, with the females retaining glochidia in their gills from late August to mid-June (USFWS 2009). Glochidia are released in mid-June attaching to either the gills or fins of a suitable fish host species, and encysting within 2-36 hours. Transformation time (time until encystment) for Appalachian Elktoe occurs within 18-22 days at a mean temperature of 18° C (Jim Layzer, TTU, personal communication). Encystment time for freshwater mussels is reduced at higher temperatures (Zale and Neves 1982). McMahon and Bogan (2001) and Pennak (1989) should be consulted for a general overview of freshwater mussel reproductive biology.

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

Common Name	Scientific Name	Number
Gilt Darter	*Percina evides*	6
Banded Darter	*Etheostoma zonale*	8
Wounded Darter *	*Etheostoma vulneratum*	17
Greenfin Darter *	*Etheostoma chlorobranchium*	32
Greenside Darter *	*Etheostoma blennioides*	3
Olive Darter	*Percina squamata*	1
Mottled Sculpin *	*Cottus bairdi*	19
Rock Bass	*Ambloplites rupestris*	1
River Chub *	*Nocomis micropogon*	20
Northern Hogsucker *	*Hypentelium nigricans*	3
Central Stoneroller *	*Campostoma anomalum*	6
Longnose Dace *	*Rhinichthys cataractae*	9
Rosyside Dace *	*Clinostomus funduloides*	1
Mirror Shiner	*Notropis spectrunculus*	3

Common Name	Scientific Name	Number
Tennessee Shiner	*Notropis leuciodus*	2
Total	**15**	**131**

* Species that successfully transformed *Alasmidonta raveneliana* glochidia.

3.1.2 Distribution and Habitat Requirements

Appalachian Elktoe is known only from the mountain streams of western North Carolina and eastern Tennessee. Historically, the species has 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). Currently, it is known to occur in low numbers in a reach of the mainstem French Broad River in Transylvania County (see discussion below). It is unclear whether this represents a re-colonization, or an erroneous conclusion of extirpation. There is also a historical record of Appalachian Elktoe from the North Fork Holston River in Tennessee (S.S. Haldeman collection); however, this record is believed to represent a mislabeled locality (Gordon 1991). If the historical record for the species in the North Fork Holston River was a valid record, the species has apparently been eliminated from this river as well.

Although the complete historic range of Appalachian Elktoe is unknown, available information suggests that the species once lived in the majority of the rivers and larger creeks of the upper Tennessee River system in North Carolina, with the possible exception of the Hiwassee and Watauga River systems (the species has not been recorded from either of these river systems). At the time of listing, two known populations of the Appalachian Elktoe existed, the Nolichucky River including its tributaries, the Cane River and the North Toe River, and the Little Tennessee River and its tributaries. The record in the Cane River was represented by one specimen found just above the confluence with the North Toe River (USFWS 1996). Since listing, the Appalachian Elktoe has been found in additional areas. These occurrences include extensions of the known ranges in the Nolichucky River (North Toe River, South Toe River and Cane River) and Little Tennessee River (Tuckasegee River and Cheoah River) as well as a rediscovery in the French Broad River Basin (Pigeon River, Little River, Mills River and main stem French Broad River). Many of these newly discovered populations are relatively small in size and range.

Of the known surviving Appalachian Elktoe populations, two – the Nolichucky River system population and the Tuckasegee River population – currently appear to meet the definition of a viable population given in the Recovery Plan (though the number of individuals needed to comprise a viable population is presently unknown and is one of the tasks identified in the Recovery Plan to be completed).

The other populations of Appalachian Elktoe currently appear to be comprised of scattered individuals restricted to very short stream reaches and their viability is questionable (USFWS 2009). The Cheoah River, Pigeon River, Little River, Mills River and French Broad River populations are restricted to scattered areas of suitable habitat in stream reaches of approximately 5.8 km (3.60 RM), 22.6 km (14.04 RM), 17.8 km (11.1 RM), 3.2 km (2.0 RM), and 28 km (17.4 RM), respectively, making them vulnerable to extirpation from a single catastrophic event such as a major chemical spill (USFWS 2009).

3.1.3 Threats to Species

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

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 or activity. Catastrophic events may consist of natural events such as flooding or drought, as well as human influenced events such as toxic spills associated with highways or railroads.

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

The impact of impoundments on freshwater mussels has been well-documented (USFWS 1992, Neves 1993). Construction of dams transforms lotic habitats into lentic habitats, which results in changes with aquatic community composition. These changes associated with inundation adversely affect both adult and juvenile mussels as well as fish community structure, which could eliminate possible fish hosts for glochidia (Fuller 1974). In addition, the construction of dams often results in fragmentation of mussel populations by effectively blocking upstream expansion and recruitment of mussel and fish species. Along with modification of habitat, dams can indirectly impact freshwater mussel species by posing as a barrier to fish migration. The construction of the Petitcodiac River Causeway in Canada in 1968, resulted in the extirpation of the Dwarf Wedgemussel because the causeway restricted the migration of the diadromous Inner Bay of Fundy stock of Atlantic salmon (*Salmo salar*), which served as the fish host for the Dwarf Wedgemussel in this region (Locke et al. 2003).

Sewage treatment effluent has been documented to significantly affect the diversity and abundance of mussel fauna (Goudreau et al. 1988). Goudreau et al. (1988) found that recovery of mussel populations might not occur for up to 2 mi (3.2 km) below points of chlorinated sewage effluent. Most of the water bodies where Appalachian Elktoe still exist have relatively few point source discharges within the watershed and are rated as having ‘good’ to ‘excellent’ water quality (NCDWQ 2012, USFWS 1996).

The introduction of exotic species such as the Asian Clam (*Corbicula fluminea*) and Zebra Mussel (*Dreissena polymorpha*) has also been shown to pose significant threats to native freshwater mussels. The Asian clam is now established in most of the major river systems in the

United States (Fuller and Powell 1973). Concern has been raised over competitive interactions for space, food, and oxygen between this species and native mussels, possibly at the juvenile stages (Neves and Widlak 1987; Alderman 1997). When Appalachian Elktoe was listed, it was speculated that due to its restricted distribution, it "may not be able to withstand vigorous competition" (USFWS 1996).

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

Another exotic species that has the potential to adversely impact aquatic species, including Appalachian Elktoe, is Japanese Knotweed (*Fallopia japonica*). The plant is considered to be an invasive species that can reproduce from its seed or from its long, stout rhizomes. It can tolerate a variety of conditions such as full shade, high temperatures, high salinity, and drought. It can be spread by wind, water, and soil movement to an area where it quickly forms dense thickets that excludes native vegetation and greatly alters the natural ecosystem. This species has become established in riparian habitats throughout western North Carolina. The species has a very shallow root system; because of this shallow root system and its preclusion of other vegetation, areas where this species has been established may be susceptible to erosion during flood events.

3.2 Tan Riffleshell (Epioblasma florentina walkeri)

3.2.1 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 (1857). 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 US Fish and Wildlife Service (USFWS) listed the Yellow Blossom (*E. florentina*) as endangered. While Turgeon et al. (1988, 1998) 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 60 mm 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 female you find it in the anterior third of the shell. Additionally, the posterior end of female shell 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 (See Section *3.1.1*). 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 3) (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 3. 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*

3.2.2 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 three feet of flowing water in a substrate of coarse sand, gravel, and some silt (Parmalee and Hughes 1994).

3.2.3 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. All 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.

4.0 MUSSEL SURVEY EFFORTS

Surveys were led by Three Oaks Engineering with the personnel listed on the following dates (Table 4):

Table 4. Survey Dates and Personnel

Date	Surveyors
6-12-17	Tom Dickinson (TD, Permit 17-ES00343), Jonathan Hartsell (JH)
8-25-17	Tim Savidge (TS, Permit 17-ES0034), John Fridell (JF), Mary Frazer (MF), Luke Etchinson (NCWRC, LE), Morgan Harris (NCWRC, MH)
10-5-17	TD, Lizzy Stokes-Cawley (LSC), Chris Sheats (CS)
10-6-17	TS, Evan Morgan (EM), Nathan Howell (NH), LE, MH

4.1 Survey Methodology

Mussel surveys were conducted at ten distinct sites: eight sites in the French Broad River and two sites in Hominy Creek (Figure 4). The reach length and methodologies were determined individually for each site in the field based on habitat and survey conditions and survey crew size. Areas of appropriate habitat were searched, concentrating on the stable habitats preferred by the target species. The survey team spread out into survey lanes. Visual surveys were conducted using either mask/snorkel, SCUBA, glass bottom view buckets (bathyscopes), or a combination of the above depending upon survey conditions. Tactile methods were employed, particularly in streambanks under submerged rootmats. Further description of the methodologies used for each site are provided by site. All freshwater bivalves were recorded and returned to the substrate. Timed survey efforts provided Catch Per Unit Effort (CPUE) data for each species. Relative abundance for freshwater snails and freshwater clam species were estimated using the following criteria:

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

5.0 MUSSEL SURVEY RESULTS

The following details survey results for the project by site.

5.1 Hominy Creek 170612.1 ted

This survey reach extends from Hominy Creek's confluence with the French Broad to the I-40 crossing. The creek was approximately 60 feet wide with banks 10 to 12 feet high that exhibited some erosion and undercutting. Habitat consisted of a shallow run with primarily fine unconsolidated shifting sand and silt substrates. A total of 1.6-person hours of survey time with bathyscopes was spent in the reach during which no mussels were located. The only mollusk species found was the Asian Clam, which was uncommon. A narrow buffer was present to surrounding urban land uses.

5.2 Hominy Creek 170612.2ted

This survey was conducted in the vicinity of the South Bear Creek Road crossing. The creek was approximately 50 feet wide with banks over 12 feet high that were stabilized with rock. Habitat consisted of a riffle, run, pool sequence. Unconsolidated sand and silt substrates were dominant, with areas of gravel, cobble, and boulder interspersed in the reach. A total of 1.33-person hours of survey time with bathyscopes was spent during which no mussels were located. The only mollusk species found was the Asian Clam, which was uncommon. A narrow to nonexistent buffer was present to surrounding residential land use.

5.3 French Broad River Site 170825.1tws

The survey reach occurs adjacent to Carrier Park. Surveys were completed by a five-person crew using mask/snorkel focusing mainly on areas considered to provide the best habitat attributes for the targeted species based on professional opinion. However, all in-stream habitat types (pool, riffle, slackwater, etc.) were surveyed to some degree. Each surveyor stayed in a loosely defined survey lane of variable width, but were basically segmented into left, middle, and right thirds of the river. Surveys proceeded in an upstream direction in a zigzag manner and generally followed the upstream transitions between microhabitats. The rate at which the surveyor moved through the lane was dependent on microhabitat conditions within the respective lanes to maximize coverage of the "best" habitats. For example, an area of solid bedrock, with no crevices, or a slackwater areas with large accumulations of silt, which are generally considered "poor" habitat for mussels were traversed more quickly than a bedrock area with crevices, or a cobble/gravel dominated area.

The river was approximately 170-210 feet wide in this location with relatively stable banks up to 16 feet high. Wooden steps and a gravel ramp used for hand launching small vessels (canoes, kayaks, inflatable rafts, etc.) occurred along the left descending bank near the upstream portion of the reach. Water depth ranged from six inches along the bank to four feet in the deepest pools; however, over 70% was between 1.5 and 2.5 feet. The weather was warm and mostly sunny, and the water was clear.

General habitat conditions consisted of a pool/riffle/run sequence with the pool occurring in the upper third of the reach. The substrate was well sorted and consisted of cobble, gravel, and sand with scattered bedrock and boulders. Large boulder accumulations within the general run habitat create pool/riffle/run sequences on a smaller scale. A slackwater area approximately 200 feet long by 20 feet wide occurs along the left descending bank in a back eddy just above the ramp and steps.

A total of 8.75 person hours of survey time were spent in the reach during which no mussels were located. The only mollusk species found were the Asian Clam (common), the Pointed Campeloma represented by shell evidence, and Sprite Elimia (patchy uncommon).

5.4 French Broad River Site 170825.2tws

The survey reach occurs adjacent to the French Broad River Park immediately below the Amboy Road crossing, which crosses the river at its confluence with the Swannanoa River. Surveys were completed by a five-person crew using mask/snorkel in a similar manner as site 170825.1tws. The river was approximately 220-235 feet wide in this location with banks up to eight feet high that have been stabilized with rip rap in some areas. Water depth ranged from six inches along the bank to three feet. The weather was warm and mostly sunny, and the water was slightly turbid.

General habitat conditions consisted of a relatively high gradient long riffle/run sequence. The substrate was well sorted and consisted of cobble, gravel, and sand with scattered bedrock and boulders. Large boulder accumulations within the general run habitat create pool/riffle/run sequences on a smaller scale.

A total of 3.33 person hours of survey time was spent in the reach during which no mussels were located. The only mollusk species found were the Asian Clam (abundant), and the Pointed Campeloma and Sprite Elimia (present and patchy common, respectively).

5.5 French Broad River Site 170825.3tws

The survey reach occurs above the Amboy Road crossing and the confluence with the Swannanoa River. Surveys were completed by a four-person crew using mask/snorkel in a similar manner as site 170825.1tws. The river was 250 feet wide in this location with relatively stable banks up to eight feet high. Water depth ranged from six inches along the bank to three feet. The weather was warm and mostly sunny and the water was slightly turbid.

General habitat conditions consisted of a pool/run sequence. The substrate was well sorted and consisted of cobble, gravel, and sand with scattered bedrock and boulder. Large boulder accumulations within the general run habitat created pool/riffle/run sequences on a smaller scale.

A total of 4.0 person hours of survey time was spent in the reach during which no mussels were located. The only mollusk species found were the Asian Clam (abundant) and the Sprite Elimia (patchy common).

5.6 French Broad River Site 171005.2ted

This survey reach was approximately 1,500 feet in length starting near the confluence of Hominy Creek and extending upstream near the Antler Hill Village area of Biltmore. Surveys were completed by a three-person crew using view bathyscopes and mask/snorkel.

The river was approximately 200 feet wide with variably stable to moderately eroded banks six to 10 feet high. Water depths searched ranged from one to three feet. The weather was warm and sunny, and the water was clear.

The survey reach occurred in a section of uniform run habitat with a consistent mix of sand, gravel, and cobble; little bedrock or boulder was present

A total of 4.5 person hours of survey time was spent in the reach. Two Creeper and one individual Eastern Elliptio comprised the mussel species observed (Table 5).

Table 5. CPUE for Freshwater Mussels at Site 171005.2ted

Scientific Name	Common Name	# live	Abundance/ CPUE
Freshwater Mussels			**CPUE**
Elliptio complanata	Eastern Elliptio	1	0.22/hr
Strophitus undulatus	Creeper	2	0.44/hr
Freshwater Snails and Clams			**Relative Abundance**
Corbicula fluminea	Asian Clam	~	C

5.7 French Broad River Site 171005.3ted

This approximately 600-foot reach was surveyed in the vicinity of the Pearson Bridge Road crossing. Surveys were completed by a three-person crew using bathyscopes.

The river was approximately 250 feet wide in this location with generally stable banks 10-15 feet high. The weather was warm and mostly sunny, and the water was clear.

The survey reach occurs within a higher gradient riffle/run section with a large amount of bedrock and boulder and interspersed patches of sand, gravel, and cobble. Riverweed (*Podostemum* sp.) covered all rocky substrates.

A total of 1.5 person hours of survey time was spent in the reach during which no mussels were located. The only mollusk species found were the Asian Clam (common) and the Sprite Elimia (patchy common).

5.8 French Broad River Site 171005.4ted

This approximately 800-foot reach was surveyed in the vicinity of the Salvage Station. Surveys were completed by a three-person crew using bathyscopes.

The river was approximately 280 feet wide in this location with stabilized banks 10-15 feet high. The weather was warm and sunny, and water was clear.

The reach occurs within a riffle/run section with sand, gravel, cobble, and bedrock substrate. Riverweed covered all rocky substrates.

A total of 1.7 person hours of survey time was spent in the reach during which no mussels were located. The only mollusk species found were the Asian Clam (common) and the Sprite Elimia (patchy common).

5.9 French Broad River Site 171006.1tws

The survey reach occurs in the French Broad River at Haywood Bridge Road. Surveys were completed by a five-person crew using mask/snorkel.

The river was approximately118-130 feet wide in this location and the banks approximately 11 feet high with some erosion and undercutting. Water depth ranged from six inches along the bank to four feet in the deepest pools; with the majority of the area between 1.5 and 2.5 feet deep. The weather was cool and mostly sunny and the water was clear.

The survey reach occurs within a riffle/run section below the bridge and a long pool above the bridge. The substrate consisted of bedrock and cobble and gravel and sand of varying depth over bedrock.

A total of 5.0 person hours of survey time was spent in the reach. The only mollusk species found were the Asian Clam (abundant), Sprite Elimia (patchy common), and Pointed Campeloma (present).

5.10 French Broad River Site 171006.2tws

The survey reach occurs in the French Broad River adjacent to Lyman Street at the Foundation. Surveys were completed by a five-person crew using mask/snorkel.

The river was approximately 125-140 feet wide in this location the banks approximately 11 feet high; manmade stabilization is present along the banks. Water depth ranged from six inches along the bank to five feet in the deepest pools; with the majority of the area between 1.5 and 2.5 feet. The weather was cool, mostly sunny, and the water was clear.

The survey reach occurs within a riffle, run, pool sequence. The substrate consisted of cobble and sand of varying depth over bedrock.

A total of 5.0 person hours of survey time was spent in the reach. The Eastern Elliptio was observed along with the Asian Clam and Sprite Elimia (Table 6).

Table 6. CPUE for Freshwater Mussels at Site 171006.2tws

Scientific Name	Common Name	# live	Abundance/ CPUE
Freshwater Mussels			**CPUE**
Elliptio complanata	Eastern Elliptio	1	0.2/hr
Freshwater Snails and Clams			**Relative Abundance**
Corbicula fluminea	Asian Clam	~	A
Elimia proxima	Sprite Elimia	~	P-C

6.0 DISCUSSION/CONCLUSIONS

The Appalachian Elktoe was not found at any sites within the subject study area, but recent survey data indicates Appalachian Elktoe are present in the mainstem French Broad upstream of surveyed sites, approximately 1.5 RM from the study area boundary. These upstream locations are a significant expansion (32 RM downstream) of the previously known extant range of this species in the river. 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 Tan Riffleshell was not found during the surveys. Records of this species in this portion of the French Broad River Basin are historic.

Based on these survey results, impacts could occur in the project area. Biological conclusions on potential impacts from the project to these two species are provided below.

Biological Conclusion Appalachian Elktoe: Unresolved

Biological Conclusion Tan Riffleshell: No Effect

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

7.0 LITERATURE CITED

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

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

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

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

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

Gordon, M.E. 1991. Species account for the Appalachian Elktoe (*Alasmidonta raveneliana*). Unpublished report to The Nature Conservancy. 5 pp.

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

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

Jones, J. W., R. J. Neves, S. A. Ahlstedt, and E. M. Hallerman. 2004. Final Report. Taxonomic evaluation of two closely related endangered freshwater mussel species, the Oyster Mussel, *Epioblasma capsaeformis* and Tan Riffleshell *Epioblasma florentina walkeri* (Bivalvia: Unionidae). Final Report submitted to U.S. Fish and Wildlife Service, Asheville, North Carolina.118 pages.

Jones, J. W., R. J. Neves, S. A. Ahlstedt, and E. M. Hallerman. 2006. A holistic approach to taxonomic evaluation of two closely related endangered freshwater mussel species, the Oyster Mussel, *Epioblasma capsaeformis* and Tan Riffleshell *Epioblasma florentina walkeri* (Bivalvia: Unionidae). Journal of Molluscan Studies 72:267-283.

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

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

Lea, I. 1857. Description of thirteen new species of uniones, from Georgia. Proceedings of the Academy of Natural Sciences of Philadelphia 9: 31-32.

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

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

NCDWQ. 2012. Little Tennessee River Basinwide Water Quality Plan. N.C. Department of Environment and Natural Resources, Division of Water Quality, Raleigh, NC.

North Carolina Department of Natural Resources (NCDENR) - Division of Water Resources. 2014. 2014 Draft North Carolina 303(d) List. http://portal.ncdenr.org/web/wq/ps/mtu/assessment

North Carolina Department of Natural Resources (NCDENR) - Division of Water Resources. 2014. List of active individual permits. 8/1/14. https://deq.nc.gov/about/divisions/water-resources/planning/classification-standards/303d/303d-files

North Carolina Natural Heritage Program (NCNHP). 2017. *nheo-2017-07*. Natural Heritage Element Occurrence polygon shapefile. July 2017 version.

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

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

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

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

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

Parmalee, P. W., and M. H. Hughes. 1994. Freshwater mussels (Bivalvia: Unionidae) of the Hiwassee River in east Tennessee. American Malacological Bulletin 11:21-27.

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

Rogers, S.O., Watson, B.T., and Neves, R.J. 2001. Life history and population biology of the endangered Tan Riffleshell (*Epioblasma florentina walkeri*) (Bivalvia: Unionidae). Journal of the North American Benthological Society 20(4): 582-594

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

Turgeon, D. D., A. E. Bogan, E. V. Coan, W. K. Emerson, W. G. Lyons, W. L. Pratt, C. F. E. Roper, A. Scheltema, F. G. Thompson, and J. D. Williams. 1988. Common and Scientific Names of Aquatic Invertebrates from the United States and Canada: Mollusks. American Fisheries Society, Special Publication 16. 277 pp, 12 plates.

Turgeon, D. D., J. F. Quinn, A. E. Bogan, E. V. Coan, F. G. Hochberg, W. G. Lyons, P. Mikkelsen, R. J. Neves, C. F. E. Roper, G. Rosenberg, B. Roth, A. Scheltema, F. G. Thompson, M. Vecchione, and J. D. Williams. 1998. Common and Scientific Names of Aquatic Invertebrates from the United States and Canada: Mollusks. Second edition. American Fisheries Society, Special Publication 26. 526 pp.

U.S. Environmental Protection Agency Office of Water. NPDES facilities by permit type. NPDESPERMIT_WMERC. Accessed November 7, 2017. https://watersgeo.epa.gov/arcgis/rest/services/OWPROGRAM/NPDESPERMIT_WMERC/MapServer

USFWS. 1992. Special report on the status of freshwater mussels.

USFWS. 1994. Endangered and Threatened Wildlife and Plants; Appalachian Elktoe Determined to Be an Endangered Species. CFR, Vol. 59, No. 225.

USFWS. 1996. Appalachian Elktoe (*Alasmidonta raveneliana*) Recovery Plan. Atlanta, Georgia, 30 pp

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

USFWS. 2009. Appalachian Elktoe (*Alasmidonta raveneliana*) 5-Year Review: Summary and Evaluation. Asheville, NC.

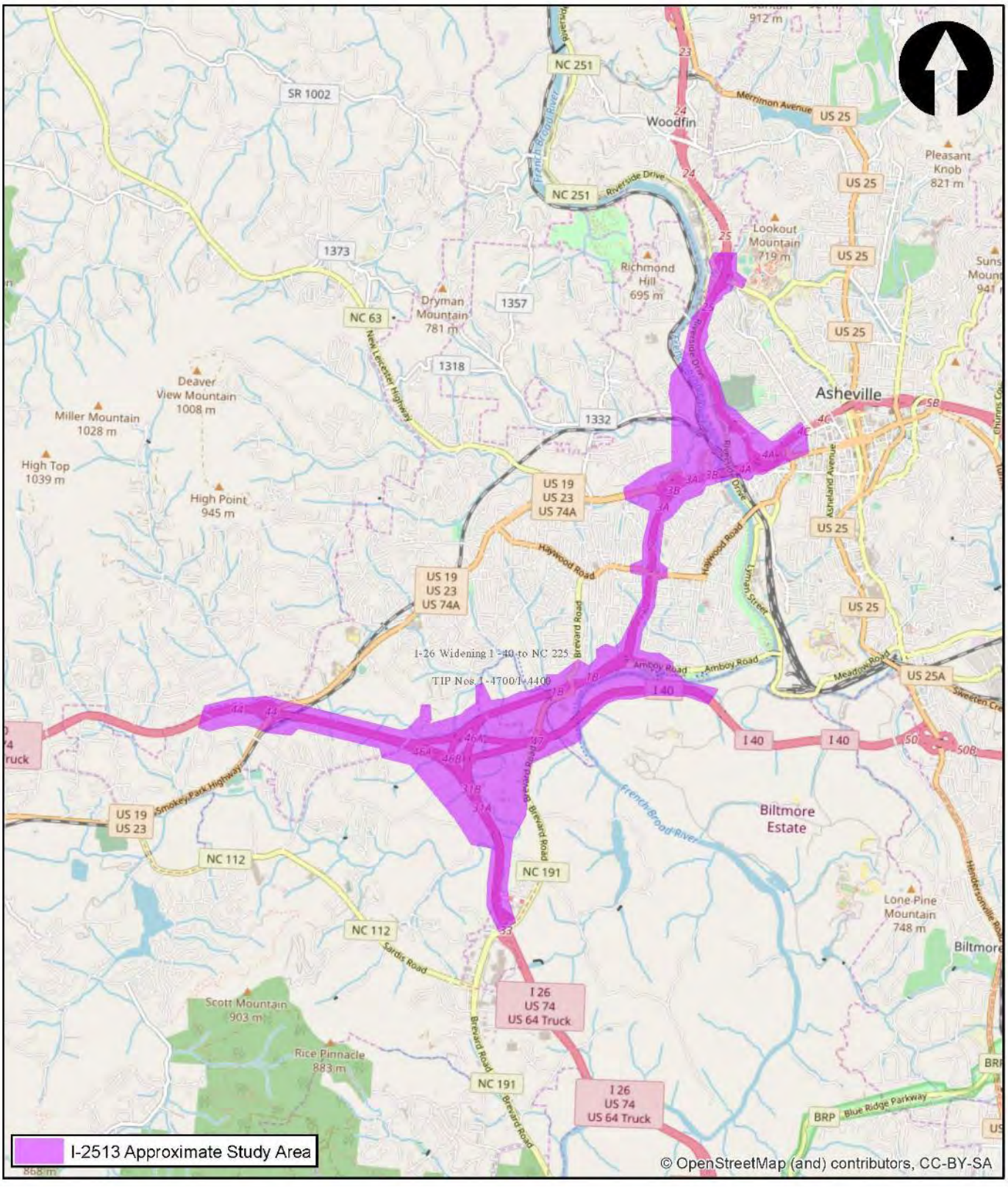
Watson, B. T., and R. J. Neves. 1996. Host fishes for two federally endangered species of mussels. Triannual Unionid Report 10:13.

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

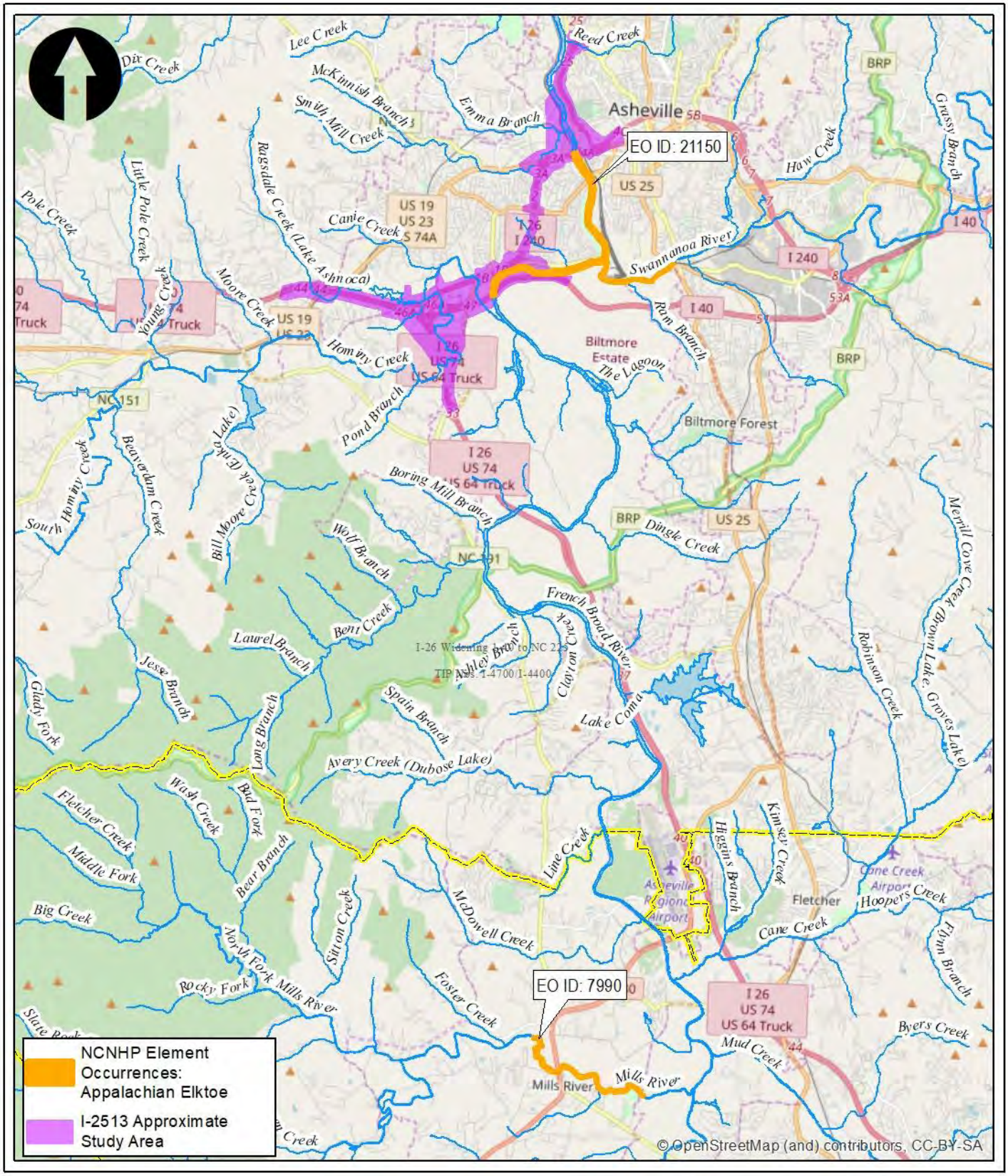
Wilson, C. B., and H. W. Clark. 1914. The mussels of the Cumberland River and its tributaries. U.S. Bureau of Fisheries Document 781:1–63.

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

Appendix A: Figures



THREE OAKS ENGINEERING	Prepared For: NC DEPARTMENT OF TRANSPORTATION	**Freshwater Mussel Surveys** I-26 Connector (TIP No. I-2513) Vicinity Map Buncombe County, North Carolina	Date: November 2017 Scale: 0 2,000 4,000 Feet Job No.: 17-311 Drawn By: KEMS Checked By: TED	Figure 1



THREE OAKS ENGINEERING

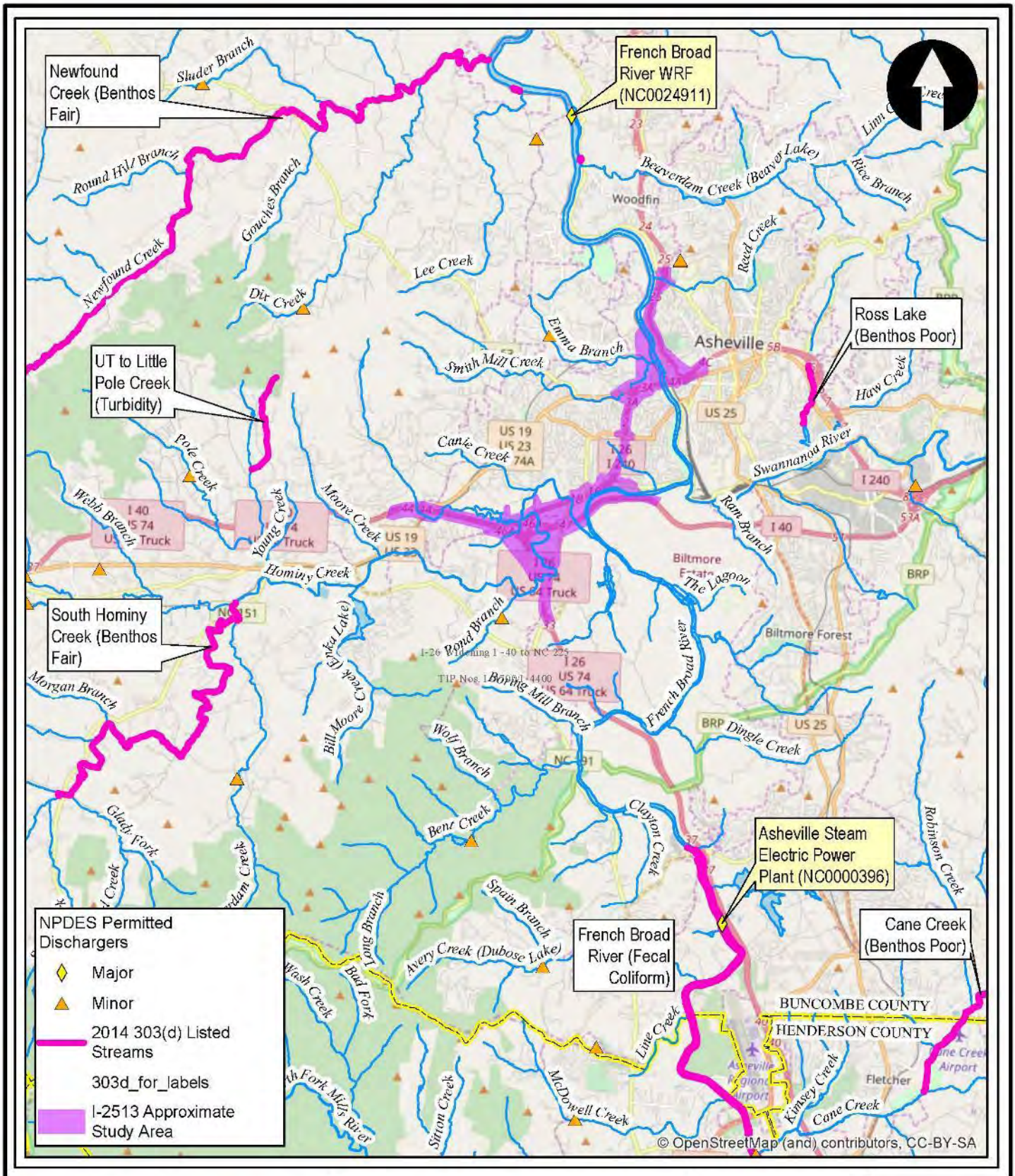
Prepared For: State of North Carolina Department of Transportation

Freshwater Mussel Surveys
I-26 Connector
(TIP No.I-2513)
NCNHP Element Occurrences: Appalachian Elktoe

Buncombe County, North Carolina

Date:	November 2017
Scale:	0 3,000 6,000 Feet
Job No.:	17-311
Drawn By:	KEMS
Checked By:	TED

Figure 2



Prepared For:

Freshwater Mussel Surveys

I-26 Connector
(TIP No. I-2513)
NPDES Discharges &
303(d) Listed Streams

Buncombe County, North Carolina

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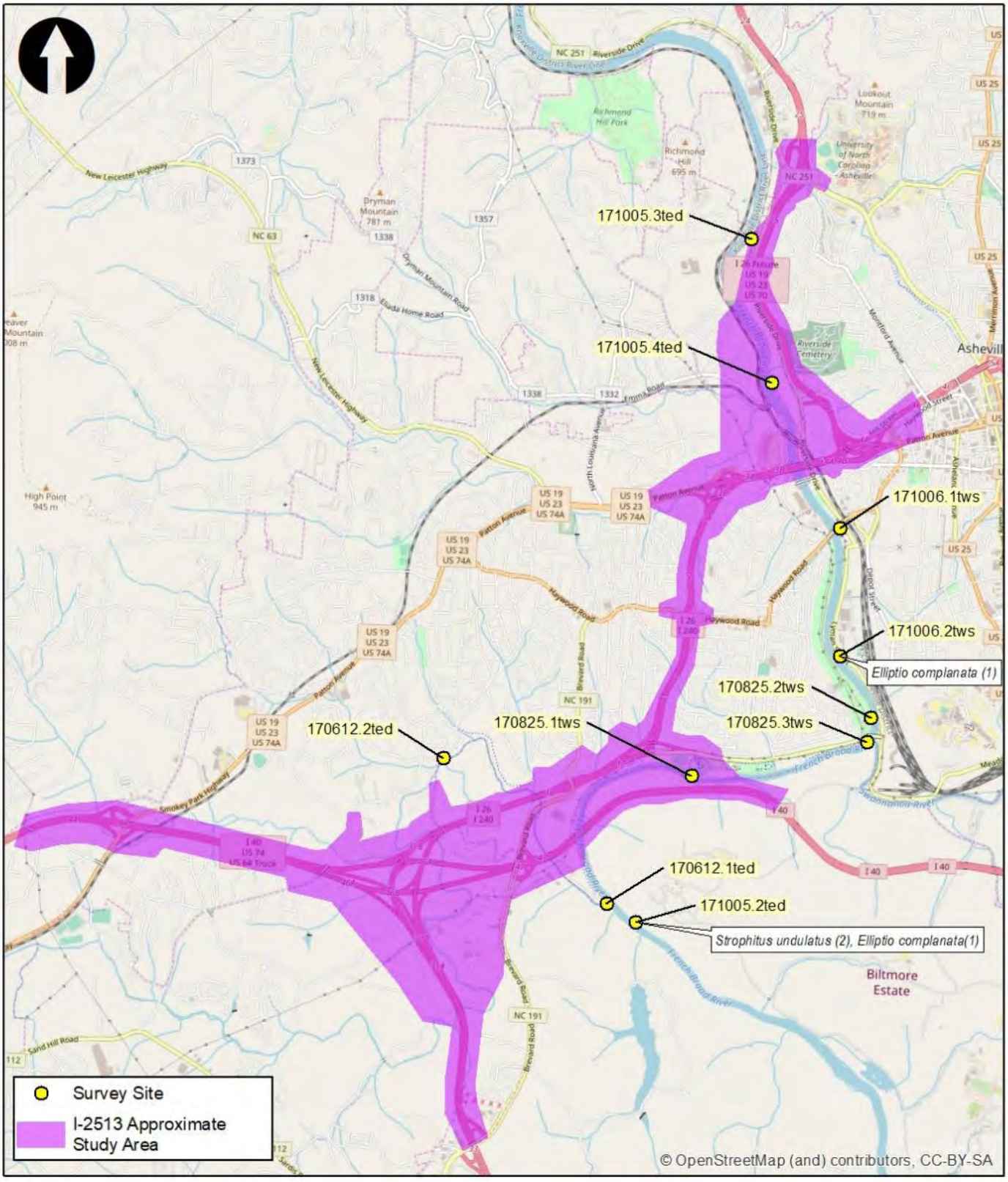
Job No.:	17-311
Drawn By:	KEMS
Checked By:	TED

Figure

3



Prepared For:

Freshwater Mussel Surveys

I-26 Connector
(TIP Nos. I-2513)
Survey Locations

Buncombe County, North Carolina

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Job No.:	17-311
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Checked By:	TED

Figure

4

APPENDIX F. BRIDGE CONSTRUCTION DOCUMENT

I-26 CONNECTOR BRIDGE CONSTRUCTION AND DEMOLITION

I-26 Asheville Connector
Buncombe County, North Carolina

STIP I-2513

North Carolina Department of Transportation

October 2019

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1 INTRODUCTION

As part of the North Carolina Department of Transportation's (NCDOT) State Transportation Improvement Program (STIP) Project No. I-2513, the roadways associated with I-40, I-240, and I-26 will be upgraded to accommodate additional traffic needs. The French Broad River, Hominy Creek, Emma Branch, and Smith Mill Creek are bridged by existing and proposed roadways and lie within an area occupied by two federally protected species: gray bat (*Myotis grisescens*) and Appalachian elktoe (*Alasmidonta raveneliana*). For the purposes of securing compliance with Section 7 of the Endangered Species Act and preparing a Biological Assessment (BA) for review by the US Fish and Wildlife Service (USFWS), the NCDOT evaluated the various constraints associated with construction of new bridges, the replacement of existing bridges, and the expansion of roadways and impervious surfaces within the I-2513 project. NCDOT has coordinated with the US Army Corps of Engineers (USACE), USFWS, the Federal Highway Administration (FHWA), NC Department of Water Resources (NCDWR), and the NC Wildlife Resources Commission (NCWRC) to gain input on the considerations and likely construction methods.

NCDOT has identified that the two existing bridges over the French Broad River carrying I-40 will likely be replaced, as will four bridges carrying I-40 and four bridges carrying I-240 over Hominy Creek. Twelve new bridges carrying I-240, I-240 ramps, and I-26 will be constructed on new location. (Note: these bridges may be identified separately however may be a part of a larger structure crossing multiple water bodies.) Preliminary designs were used to establish potential impacts in a "worst-case scenario" given the current designs at the time. This project has been identified to be let as a design-build project, and as such, the final designs may differ from those presented herein.

This document describes the likely structure type, possible construction and demolition staging, and the additional challenges associated with construction and demolition as currently known. All claims are based on the preliminary designs that were utilized during project development, although designs may change during the final design process.

A map key identifying the bridge crossing ID is included in the Appendix.

2 STRUCTURES

2.1 I-40 OVER THE FRENCH BROAD RIVER (FBR-1)

EXISTING

The existing two bridges carry I-40 utilizing eight spans. The bridges are approximately 575 feet long each and have a clear space between them of approximately 35 feet. Each structure has spread footings. The river is approximately 235 feet wide at this location. It is estimated that five bents are located in the waterway.

PROPOSED

The project is still in the preliminary design phase, therefore detailed bridge drawings are not currently available. The bridge pair is expected to be replaced in place by one bridge using three bents, each within the water. Property to the east is owned by the Biltmore Estate and is not available for use during construction. Each side of the river, beneath the bridge, has a greenway trail. Access to the site can be

made by moving goods within the right-of-way of the existing roadway. Property to the west includes a power line right-of-way that may be utilized also. Access will occur parallel to the existing roadway, within the right-of-way. Areas adjacent to the bridges will be cleared to the right-of-way limits; however this area would need to be cleared as part of typical construction process for this project.

For the purposes of establishing a "worst-case scenario" of impacts at this location, a 25x25-foot spread footing has been used for estimates because it covers more square footage of the river bottom. Using the basic estimate for a "worst case", spread footings may cover as much as 6,600 square feet in the river. Drilled shafts may also be used, but the construction method will ultimately be decided during final design. An uneven span arrangement will allow for avoidance of existing foundations, thereby limiting the river disturbance.

The current bridge foundations exist within the waterway of the French Broad River. During construction, the existing piers will be either removed or cut below water level. To accomplish this, causeways may need to be constructed that, for short durations, cover more than 50 percent of the river. It is estimated that causeways will be used to demolish the existing bridges and to build the new substructure, totaling up to 36,600 square feet coverage (temporary fill) of the riverbed. Further discussion of causeways can be found in section 3.1.

2.2 I-40 over Hominy Creek (HC-1, HC-2, HC-5, HC-6)

Existing

I-40 crosses Hominy Creek in two locations: over Upper Hominy Creek and over Lower Hominy Creek. The existing pair of bridges carrying I-40 eastbound and I-40 westbound over Lower Hominy Creek (HC-5) includes five spans each and are approximately 357 and 345 feet long, respectively. The existing bridges have two bents adjacent to the water's edge currently. The structures have spread footings and the creek is approximately 50 feet wide at this location. The I-40 bridges crossing Upper Hominy Creek are adjacent to the I-26/I-40 interchange. The pair have 3 spans each. The I-40 eastbound bridge (HC-1) is 180 feet long while the westbound bridge (HC-2) is approximately 170 feet long. They currently each have three bents each, none of which are in the water, and are expected to be replaced in kind. The creek is approximately 50 feet wide at this location also.

Proposed

The project is still in the preliminary design phase, so detailed bridge drawings are not currently available. The existing bridges carrying I-40 across Lower Hominy Creek (HC-5) will be replaced by a single bridge in the same location. 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. Causeways for demolition are anticipated, covering 825 square feet of creek bed, but none are anticipated for construction. No more than 50 percent of the width of the river will be blocked by the causeways at any point during demolition or construction.

The I-40 ramp to NC 191 will be constructed on new location (HC-6). No bents are expected to be located in the water at this location; the bridge is expected to span the creek and no causeways will be needed.

Access to the site may be available via the existing right-of-way. Additional access may be necessary via Hominy Creek Road; however this serves as a main access for the Buncombe County Transfer Station and will likely require an agreement with the county so as not to block access. Parallel access roads may need to be constructed adjacent to the roadway on the west bank, however the area where they may be constructed will be cleared during construction.

The pair of Upper Hominy Creek bridges carrying I-40 eastbound (HC-1) and I-40 (HC-2) westbound east of the I-40/I-26/I-240 interchange are also called for replacement. No new bents are expected in the water. No causeways are anticipated for demolition or construction of these bridges. Access to the site is available via the NCDOT right-of-way on both sides of the creek, and phased construction is expected.

2.3 I-26 over Hominy Creek (HC-3, HC-4, HC-7)

Existing

I-26 crosses Upper Hominy Creek just west of Bear Creek Road (HC-3, HC-4), then it crosses Lower Hominy Creek near Brevard Road (HC-7). The existing pair of bridges over Upper Hominy Creek have 3 spans each. The bridge carrying the eastbound lanes is 170 feet long and the bridge carrying the westbound lanes is 200 feet long. The bridge pair over Lower Hominy Creek utilize 3 spans with continuous girders. They are 300 feet (eastbound) and 330 feet long (westbound). The creek is approximately 50 feet wide at both of these locations along Hominy Creek. The bridges spanning Lower Hominy Creek also span another, potentially historic, bridge. The historic bridge currently functions as a footbridge for greenway traffic and is closed to vehicles. This bridge has a single bent in the waterway of Hominy Creek and is in disrepair.

Proposed

The bridges over Upper Hominy Creek are expected to be replaced in kind, but widened to accommodate 3 lanes of traffic each. No bents are expected to be placed in the water at this location, and no causeways are anticipated for construction. The bents can currently be reached from land, so causeways needed during demolition would be minimal, if even needed at all. The bridges can be accessed via existing right-of-way in this vicinity.

The bridges over Lower Hominy Creek are expected to be replaced with a single bridge structure that spans the creek and the potentially historic bridge. However, this proposal may be altered by the design-build team. As it is shown in the preliminary plans, an uneven span arrangement would be necessary to avoid placing bents in the water and avoid hitting the lower bridge. It is anticipated that one bent could be expected in Lower Hominy Creek, with up to 3 additional bents located near the water. The bridge bents would be separated and offset such that they do not affect the historic bridge. A worst-case estimate assumes that all 4 bents may be placed in the water, with up to 3,125 square feet of spread footings located on the creek bed, depending on final bent design.

2.4 I-40/I-240 Smith Mill Creek and Emma Branch Bridges (SMC-1, SMC-2, SMC-3, SMC-4, SMC-5, SMC-6, SMC-7, SMC-8, SMC-9, EB-1, EB-2, EB-3, EB-4)

Existing

No bridges exist in the project construction area along Smith Mill Creek and Emma Branch. One existing culvert, carrying Resort Drive, will be removed as part of the project.

Proposed

Three bridges and associated ramps are proposed to cross the French Broad River north of existing I-26 (described below in Section 2.5). In addition to crossing the French Broad River, the proposed structure will cross Smith Mill Creek and Emma Branch at 13 locations. No bridge bents are expected to be constructed within the waterway of Smith Mill Creek or other waterways. No causeways are anticipated for the Smith Mill Creek and Emma Branch bridges.

Access to the bridge construction site will be obtained by purchasing right-of-way. Construction activities associated with the structures is expected to occur wholly within the right-of-way. SR 1338 (Emma Road) crosses the alignment and may be needed for construction traffic. Special considerations may need to be taken to accommodate residences along Emma Road. Additionally, the alignment crosses the Norfolk Southern rail corridor and coordination with the rail will be necessary.

2.5 I-26/I-240 Bridges over the French Broad River (FBR-2, FBR-3, FBR-4)

Existing

There are no existing bridges carrying vehicle traffic over the French Broad River downstream of the Captain Jeff Bowen Bridges within the project study area. The project includes new location bridges to carry I-26 and I-240 over the French Broad River. A railroad bridge crosses the French Broad River upstream of the proposed new bridge crossing.

Proposed

Three bridges are proposed to cross the French Broad River north of existing I-26. The Captain Jeff Bowen Bridges that carry existing I-26/I-240/Patton Avenue over the river are to remain in place. The three new bridges include one bridge for carrying I-26 (FBR-3), and two flyover bridges to carry I-240 eastbound (FBR-2) and westbound (FBR-4). The I-26 bridge is expected to be wide enough to carry five lanes of traffic in each direction, though only three through-lanes will be utilized. Additional space is necessary for shoulders and auxiliary lanes. Analyzing a “worst-case scenario”, the footing size estimates for these bridges in the French Broad River are 1,875 square feet (FBR-2), 9,375 square feet (FBR-3), and 1,875 square feet (FBR-4), for a total of 13,125 square feet. It is assumed that 100-foot maximum length curved steel spans will likely be used.

The two flyover bridges carrying I-240 eastbound and westbound are expected to have the same 100-foot curved steel girders. These two bridges will each be smaller than the I-26 bridge. They are expected to be approximately two lanes wide each.

These three bridges will require causeways during construction. Access to the crossing site is limited due to the railroad bridge to the west of the river. A temporary rail crossing may be required for

construction. Limited access may be available via Emma Road from the west, and by way of right-of-way from the south. “Top-down” construction will be considered as a viable construction method to reduce the access requirements needed, but the decision on the method used will be made during final design development. Construction activities originating from the east bank of the river will utilize acquired right-of-way for staging and construction. Construction time in the river shall be reduced as much as possible, and causeways will remain in place for as short of a period as practicable. No more than 50 percent of the river width shall be blocked by causeways at any one period. The river width at this location is approximately 350 feet.

Detailed construction methods and timelines/phasing will be developed during the final design process.

3 DEMOLITION AND CONSTRUCTION ACTIVITIES AND METHODS

At the time of this writing, Smith Mill Creek has been proposed to be included on the 2018 303(d) list for North Carolina. Design Standards for Sensitive Waters (DSSW) will be used within one mile of the French Broad River and Environmentally Sensitive Areas will apply within 50 feet of the river to mitigate the amount of sediment and erosion that enters the French Broad River Environmentally Sensitive Areas (ESAs) require a 50-foot buffer between construction and stream. USFWS and USACE will have the opportunity to review the design of the SEC measures prior to construction. 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. A revegetation and monitoring plan shall be developed for the bridge once the project is complete.

3.1 CAUSEWAYS

Due to the length of the bridges and the location of the existing and proposed interior bents, causeways will be required to provide construction access for some of the bridges. For the purposes of this report, causeway sizes are estimated based on the width of the bridge and the location of the bridge bents. The size, width, and length of the causeways will vary depending on the construction activities taking place. Causeways will be removed from the river when possible, and causeways will not block more than half of the river width unless agreed upon by USACE and USFWS.

Causeway sizes and locations will be determined during final design; however the table below summarizes the anticipated sizes of the causeways in the river needed to perform demolition and construction of the bridges.

TABLE 1. BRIDGE CONSTRUCTION CROSSINGS AND CAUSEWAY SIZE ESTIMATES

Crossing ID	Existing/ New Bridge	Road Carried	Waterbody	Causeway 1 Size[a]	Causeway 2 Size[a]	Causeway 3 Size[a]	Demolition Causeway Size[a]	Total Causeway Area (ft^2)
HC-1	Existing	I-40 EB	Hominy Creek	0	0	0	N/A	0
HC-2	Existing	I-40 WB	Hominy Creek	0	0	0	N/A	0
HC-3	Existing	I-26 NB/I-240NB	Hominy Creek	0	0	0	N/A	0
HC-4	Existing	I-26 SB/I-240 SB	Hominy Creek	0	0	0	N/A	0
HC-5	Existing	I-40	Hominy Creek	0	0	0	55X15	825
FBR-1	Existing	I-40	French Broad River	200X90	100X90	0	60X160	36,600
HC-6	New	I-40 RAMP TO 191	Hominy Creek	0	0	0	N/A	0
HC-7	Existing	I-26/I-240 NB AND SB	Hominy Creek	0	0	0	35X35	1,225
NONE	Existing	NC 191	Hominy Creek	0	0	0	N/A	0
SMC-1	New	RESORT DRIVE	Smith Mill Creek	0	0	0	N/A	0
SMC-2	New	I-240 RAMPS	Smith Mill Creek	0	0	0	N/A	0
SMC-3	New	I-26	Smith Mill Creek	0	0	0	N/A	0
SMC-4	New	I-240 RAMPS	Smith Mill Creek	0	0	0	N/A	0
SMC-5	New	I-26	Smith Mill Creek	0	0	0	N/A	0
SMC-6	New	I-240/I-26 RAMPS	Smith Mill Creek	0	0	0	N/A	0
SMC-7	New	I-240 RAMPS	Smith Mill Creek	0	0	0	N/A	0
SMC-8	New	I-240 RAMPS	Smith Mill Creek	0	0	0	N/A	0
SMC-9	New	I-240 RAMPS	Smith Mill Creek	0	0	0	N/A	0
EB-1	New	I-240 RAMPS	Emma Branch	0	0	0	N/A	0
EB-2	New	I-26	Emma Branch	0	0	0	N/A	0
EB-3	New	I-240/I-26 RAMPS	Emma Branch	0	0	0	N/A	0
EB-4	New	I-240 RAMPS	Emma Branch	0	0	0	N/A	0

FBR-2	New	I-240 EB	French Broad River	350X130	260X60	150X80	N/A	73,100
FBR-3	New	I-26 EB/WB	French Broad River	300X90	350X130	0	N/A	72,500
FBR-4	New	I-240 WB	French Broad River	100X80	490X90	0	N/A	52,100
							TOTAL	**236,350**

[a] Causeway size is an estimated length times width in feet based on the 2018 preliminary designs. Estimated sizing was determined per coordination with NCDOT Division 13 on 12/18/2018. . Estimated sizes are for the surface of each causeway, not the base on the riverbed. Actual sizes will be determined during final design.

Demolition of the existing bridges, including superstructure and interior bents, will occur in conjunction with the construction of the new bridges. The phases will be staggered to allow for traffic to be maintained during construction. Due to the design-build nature of this project, the selected contractor will be permitted to establish their preferred construction phasing plan once a design has been finalized. However, it is anticipated that for existing bridges, traffic will be rerouted to accommodate construction. For new bridges, construction will occur without the interference of roadway traffic. Some causeways may need to be extended to cover greater than 50% of the waterway to allow for demolition activities. The length of time these causeways are in place will be minimized as much as possible. Time estimates for this length of time will be available during final design. These additional restrictions will be coordinated with USACE and USFWS prior to permitting.

NCDOT has committed to performing a channel morphology study of the French Broad River to determine the preconstruction channel condition, as well as any effects of the causeways during and after construction.

3.2 Access Roads

Generally, construction locations will be reached using existing roadways where possible and temporary access roads may be constructed to physically restricted locations. Access roads will be constructed where no existing right-of-way is available for use. The construction of the flyover bridges over the French Broad River will likely require the use of access roads due to vertical height restrictions near the site, and the constricted access due to the railroad line on the west bank of the French Broad River. Additional bridge-specific access road considerations are discussed above.

3.3 Construction Lighting

As part of its evaluation, NCDOT also took into consideration the time of day when construction and demolition may take place. It was determined that some work would likely need to be completed at night. These activities may include setting girders, drilling shafts, concrete pours, deck concrete pours, beam setting, construction material(s) stockpiling, and traffic shifts. The amount and type of lighting for all activities will be minimized to the extent possible. All lights will be directed towards the work area and will not shine out over any waterways 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. Below is a list of some construction operations that may occur at night, as well as the likelihood and/or circumstances under which the operation may occur. Lighting considerations for each night operation are also included.

- 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.

    - 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 headlamps, 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.
    - Of all potential night time operations, this will be the operation with the most lighting. 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.
    - Headlights on concrete delivery trucks will also be used.
- 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.
- Traffic shifts – Will occur – Traffic shifts will be necessary to construct the new bridges on existing location. 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.

There are other operations that may occur at night; however, this would be evaluated after phasing and final design. The previously listed operations are not operations that occur on a regular schedule.

3.4 Demolition of Existing Structures

During demolition, removal of the bents will be accomplished by tipping them over and removing the entire bent, or by cutting the bent off at stream bed elevation or, if the bent is on land, one foot below ground elevation. Because the base of the remaining bent in the stream is at stream elevation, no material will be put back over the remaining bent. The method of removal will be dependent on the foundation conditions present at the site. No loose portion of the existing bents can remain in the streambed.

Causeways have been identified as the most likely mechanism to be used during bridge demolition and construction. Work bridges are not anticipated to be used. Demolition and construction are expected to take place from temporary causeways placed in waterways where needed, not covering more than 50 percent of the waterway width. Channel restrictions greater than 50 percent may be necessary for short durations, and these additional restrictions will be coordinated with USACE and USFWS prior to permitting. See Table 1 for estimates of the causeway sizes needed for demolition.

Removal of the existing bridges shall be performed in a manner that prevents debris from falling into the water. The Contractor shall remove the bridges and submit plans for demolition in accordance with Article 402-2 of the Standard Specifications. However, if bridge material inadvertently ends up in the river, it will be removed.

USFWS will review the demolition plans, from an environmental permitting perspective prior to the finalization of the plans. USFWS will also be notified prior to the start of bridge demolition, so they may have a representative on-site during that stage of the project.

3.5 Bridge Summary

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 square feet, of which 234,300 square feet will be in the French Broad River. The total area to be covered by bridge footings is 22,850 square feet. The footing totals for the French Broad River are 19,725 square feet.

3.6 Other Considerations

Additional measures to protect the French Broad River, Smith Mill Creek, Hominy Creek, and Emma Branch during construction will be taken and are summarized in the Avoidance and Minimization Measures.

4 Hydraulics

A review of flood map data of the study area and bridge vicinities indicates that there are several residential and commercial structures that are currently located in the 100-year floodplain. During the construction of the proposed bridges, should causeways be used, they will create a temporary constriction in the flow of the river that will cause the upstream water surface elevation (WSE) to rise. The extent of the rise will be determined once the causeway phasing and bridge construction phasing is determined during final design. Should the final design minimize the number of bridge bents located in

the waterways, the potential for debris to become lodged and the potential for a WSE rise as a result is lessened. Dangers to river users will also be lessened. Strides shall be made to minimize the number of bents in the river and streams.

4.1 Analysis

Hydraulic analysis of the French Broad River will be performed in conjunction with final design. Impacts will be modeled using the US Army Corps of Engineers (USACE) Hydrologic Engineering Center's River Analysis System (HEC-RAS). Per the USACE website, HEC-RAS "allows the user to perform one-dimensional steady flow, one-dimensional steady flow, and one- and two-dimensional unsteady flow calculations, sediment transport/mobile bed calculations, and water temperature/water quality modeling." For this project, HEC-RAS models are under development to guide final design. The proposed designs and construction phasing will be input into the models and storm return periods will be run that will represent conditions during flood events along the French Broad River. The approximate cross sections of the model are shown in Appendix A. Using the Flood Risk Information System (FRIS) database provided by the North Carolina Emergency Management (NCEM) and the Flood Inundation Mapping Alert Network (FIMAN) data, impacts to properties can be estimated, if present.

The HEC-RAS model is scheduled to be competed in spring/summer 2019.

4.2 Stormwater and Erosion Control

Access roads, if needed, will use Design Standards for Sensitive Waters (DSSW) to mitigate the amount of sediment and erosion control material that enters the French Broad River, Smith Mill Creek, or Hominy Creek. 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. Roadway and bridge construction will be in accordance with appropriate permitting and stormwater plans.

Sediment and Erosion control plans are required to be in place prior to any ground disturbance. When needed, combinations of erosion control measures will be used to ensure protective measures are being implemented.

NCDOT is working with the USGS to install/monitor gages along the French Broad River to collect continuous streamflow, precipitation, and water-quality (temperature, conductance, and turbidity) data. The baseline information can be used to compare to water quality in the river during construction.

4.3 Deck Drainage

NCDOT makes every attempt to eliminate direct deck drainage into water bodies whenever federally protected aquatic species or sensitive habitats are present. It is anticipated that direct drainage into the French Broad River can be avoided by conveying runoff via the deck over water. Overland discharge via deck drains will provide treatment through vegetative conveyance or other stormwater BMPs.

5 AVOIDANCE AND MINIMIZATION

The avoidance and minimization measures are summarized below.

Project Design Modification for Avoidance and Minimization

- 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.

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

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.

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.

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.

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

Preservation of Riparian Vegetation

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

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.

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

Access Roads

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

Nighttime Construction Activities

- NCDOT will limit the use of night time 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.

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.

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.

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

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.

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 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.

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.

Avoidance/Minimization to Gray Bat and Appalachian elktoe during Road Construction and Bridge Replacement

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.

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.

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

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.

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).
- 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 FBR.
- 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.

Conservation Measures to Benefit Gray Bat

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.

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 during 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.

NCDOT-Sponsored MYGR 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.

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.

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).

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.

<u>Conservation Measures to Benefit Appalachian Elktoe</u>

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.

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.

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.

6 RIVER USER SAFETY

Because the French Broad River, Hominy Creek, and Smith Mill Creek are regularly used for recreation, they cannot be closed for the life of construction. NCDOT shall commit to providing a safe passage lane for users of the French Broad River, Hominy Creek, and Smith Mill Creek. To do so, NCDOT shall employ safety measures, including catchment devices on overhead structures to prevent material from falling on river users. In addition, floating navigational aids will be used to guide river users to the safe passage lane and away from the causeways/construction zone. Certain activities, such as setting girders, will require temporary river closure to ensure the safety of river users. Most of these activities are anticipated to occur at night when working with existing bridges. For new bridges, most work is expected to take place during the day. NCDOT will work with river users, businesses, and recreational river and civic groups to insure public notification of the temporary closures.

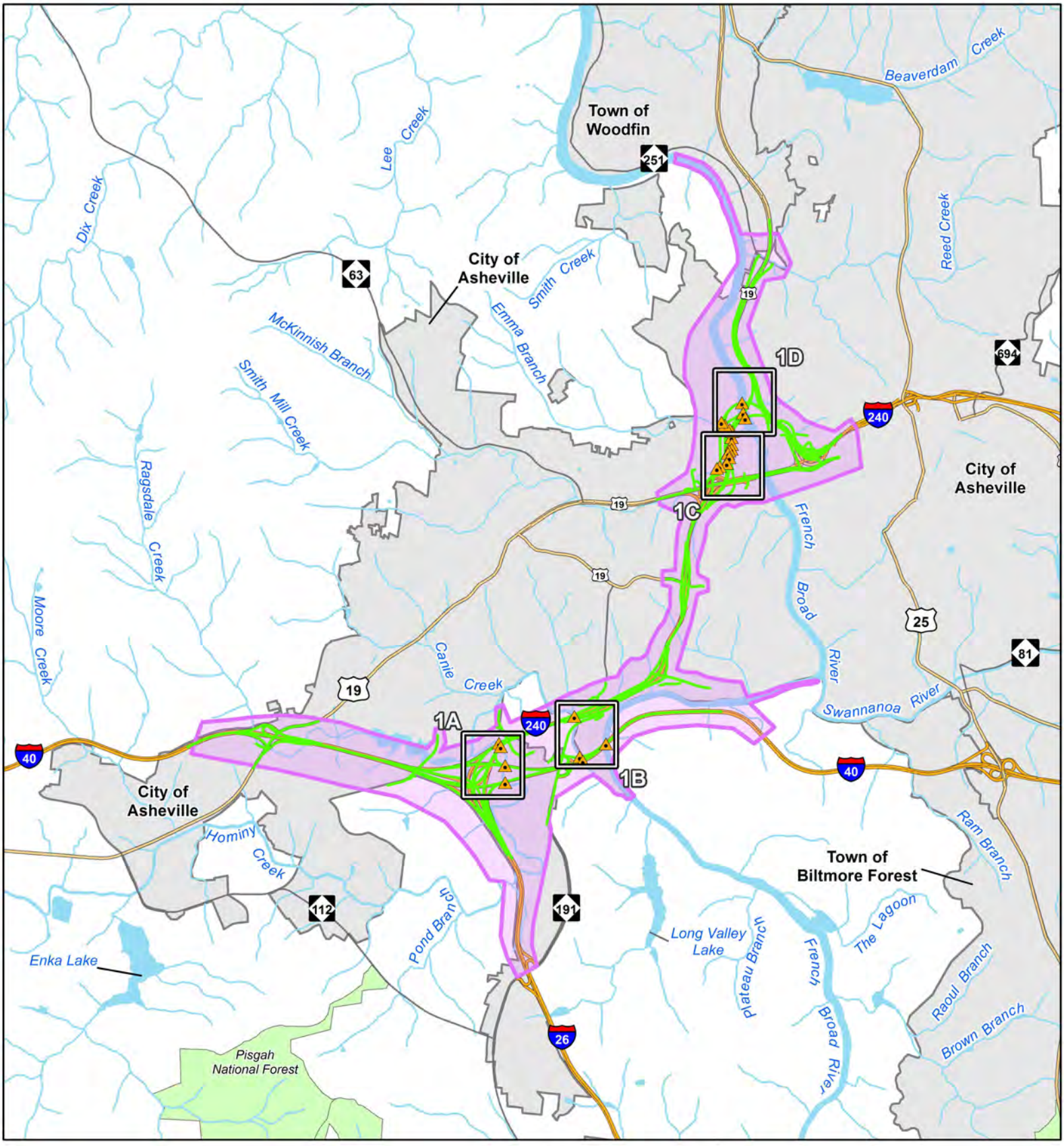
The safe passage lane for river users will be located in a portion of the river away from the causeways for the majority of the life of the project. NCDOT shall use a floating navigational aid to guide river users to the safe passage lane.

NCDOT shall commit to including a rigid, non-drooping, catchment device on the overhead structures to prevent material from falling on river or greenway users, or in the water. NCDOT shall place steady-state red lights that are solar-powered on the causeway to alert river users to its location. Generators will not be used to provide power. These lights will be atop permanent structures, such as a pole, on each causeway for the duration of the project. The contractor will be responsible for maintaining these lights at all times during construction, replacing them as necessary.

It is expected that there will be times when the river, creeks or greenways must be closed for the safety of recreational users due to the type of work being done (e.g. setting girders, removal of bent caps). These closures are not expected to last more than two days and are expected to occur predominantly at night. Care will be taken to not close the waterways or greenways during known peak user times, particularly the Memorial Day, Fourth of July, and Labor Day weekends.

NCDOT will develop a Communication Plan for the Construction of the I-26 Connector Bridges. This plan focuses on specific activities to alert recreational users to the hazards of bridge construction and will be appended to larger communication plan for the entire I-26 project.

Communication plans include holding small group meetings; placing signage upstream of the construction zone at river access points; and alerting greenway and river users through various traditional and social media outlets of construction schedules, including closures and other pertinent information.



NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

I-26 Asheville Connector

TIP Project I-2513

Buncombe County, NC

Legend

- Crossing Location
- Map Tile
- Action Area
- Detailed Study Alternative
- Federal Land
- Municipal Boundary
- Waterbody
- Stream
- Interstate
- US Route
- NC Route
- Major Road

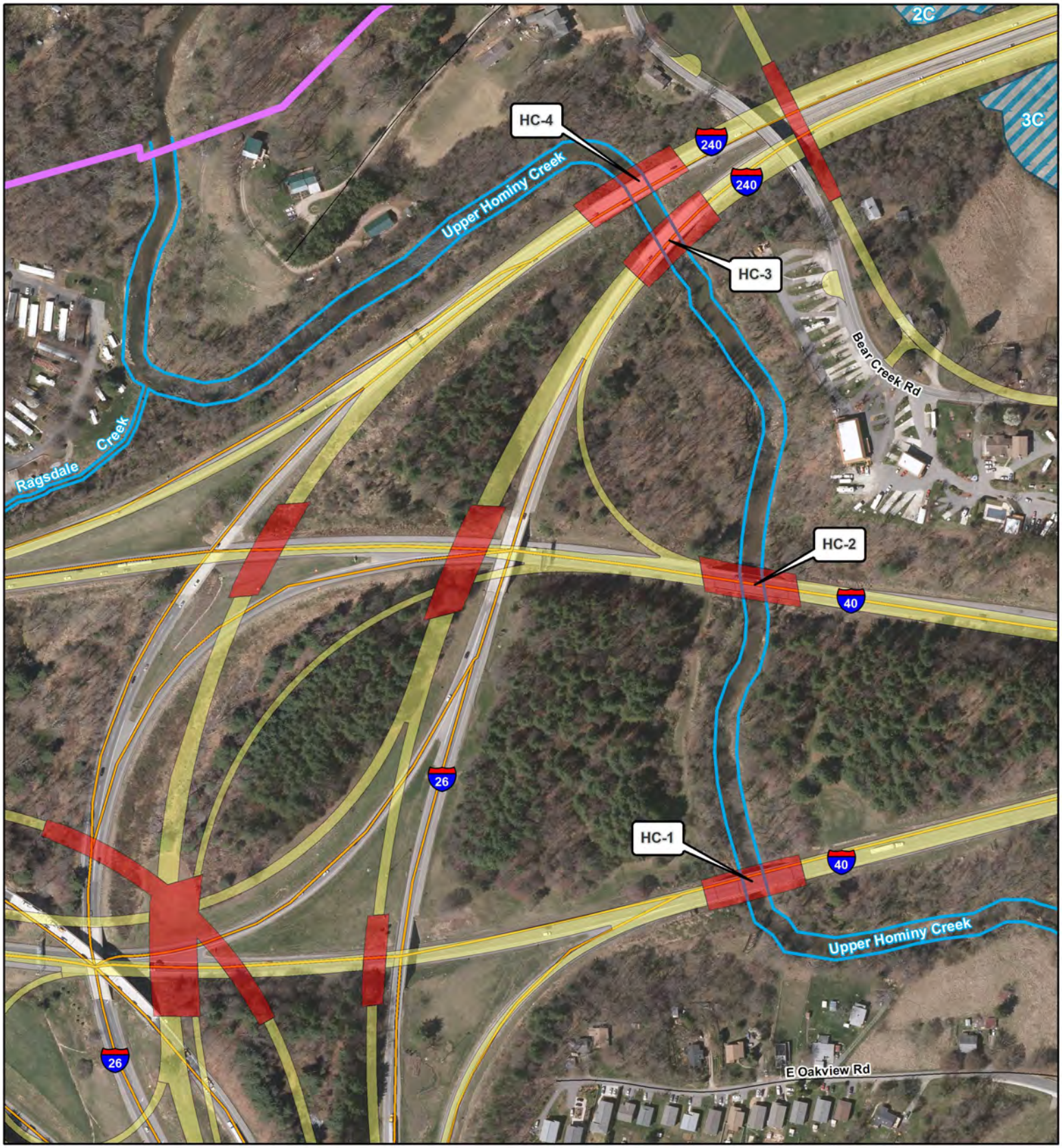
0 0.5 1 2 Miles

1 in = 1 miles

Figure 1

Crossing Locations Overview

Source: NC OneMap, CALYX Engineers and Consultants
Map Date: 2/20/2019



NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

I-26 Asheville Connector

TIP Project I-2513

Buncombe County, NC

Legend

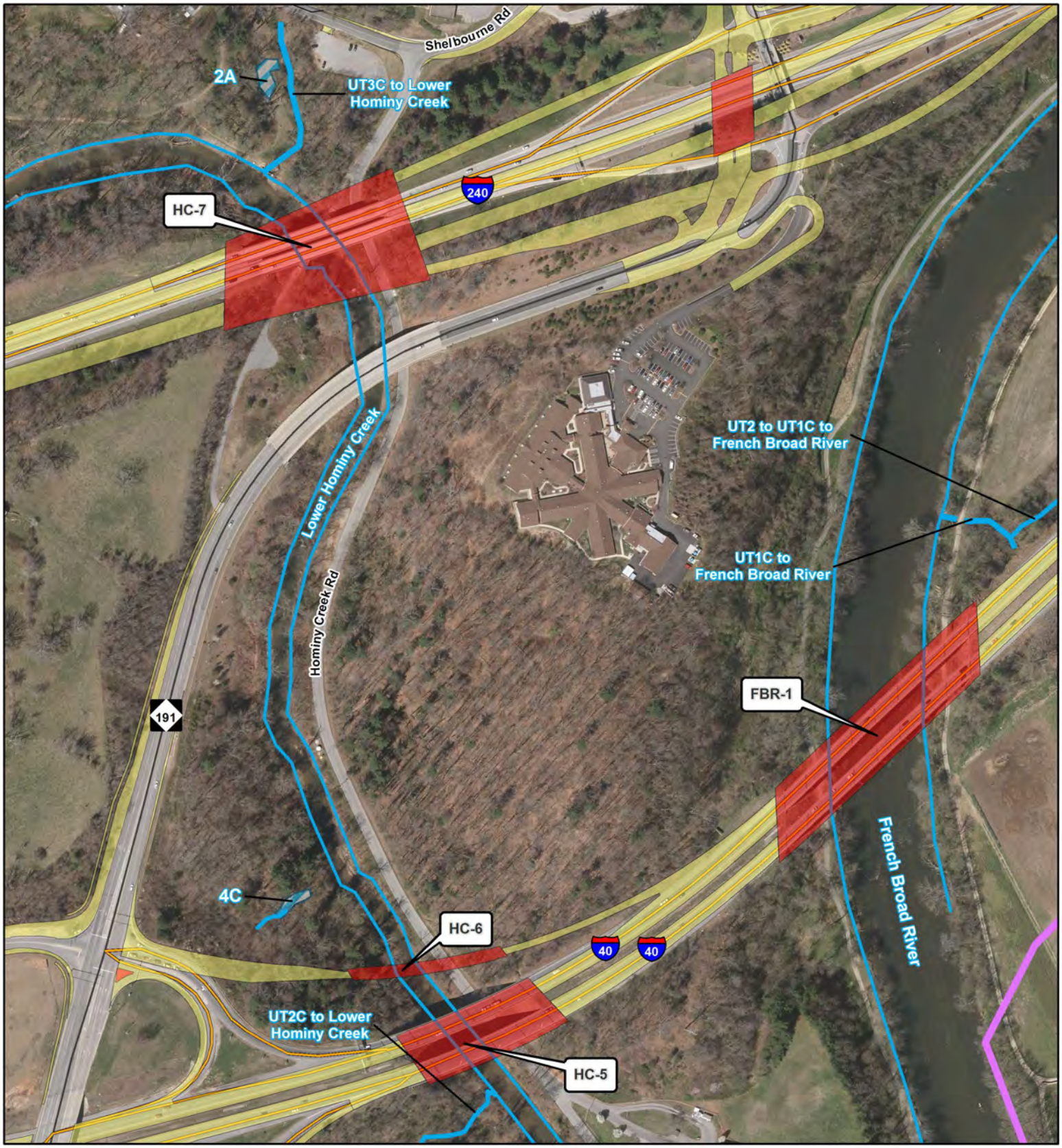
- Action Area
- HC-1 Crossing
- Proposed Bridge
- Proposed Roadway
- Delineated Wetland
- Delineated Stream
- Interstate
- US Route
- NC Route
- Major Road
- Local Road

0 150 300 600 Feet

1 in = 300 ft

Figure 1A
Crossing Locations

Source: NC OneMap, CALYX Engineers and Consultants
Map Date: 2/20/2019



NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

I-26 Asheville Connector

TIP Project I-2513

Buncombe County, NC

Legend

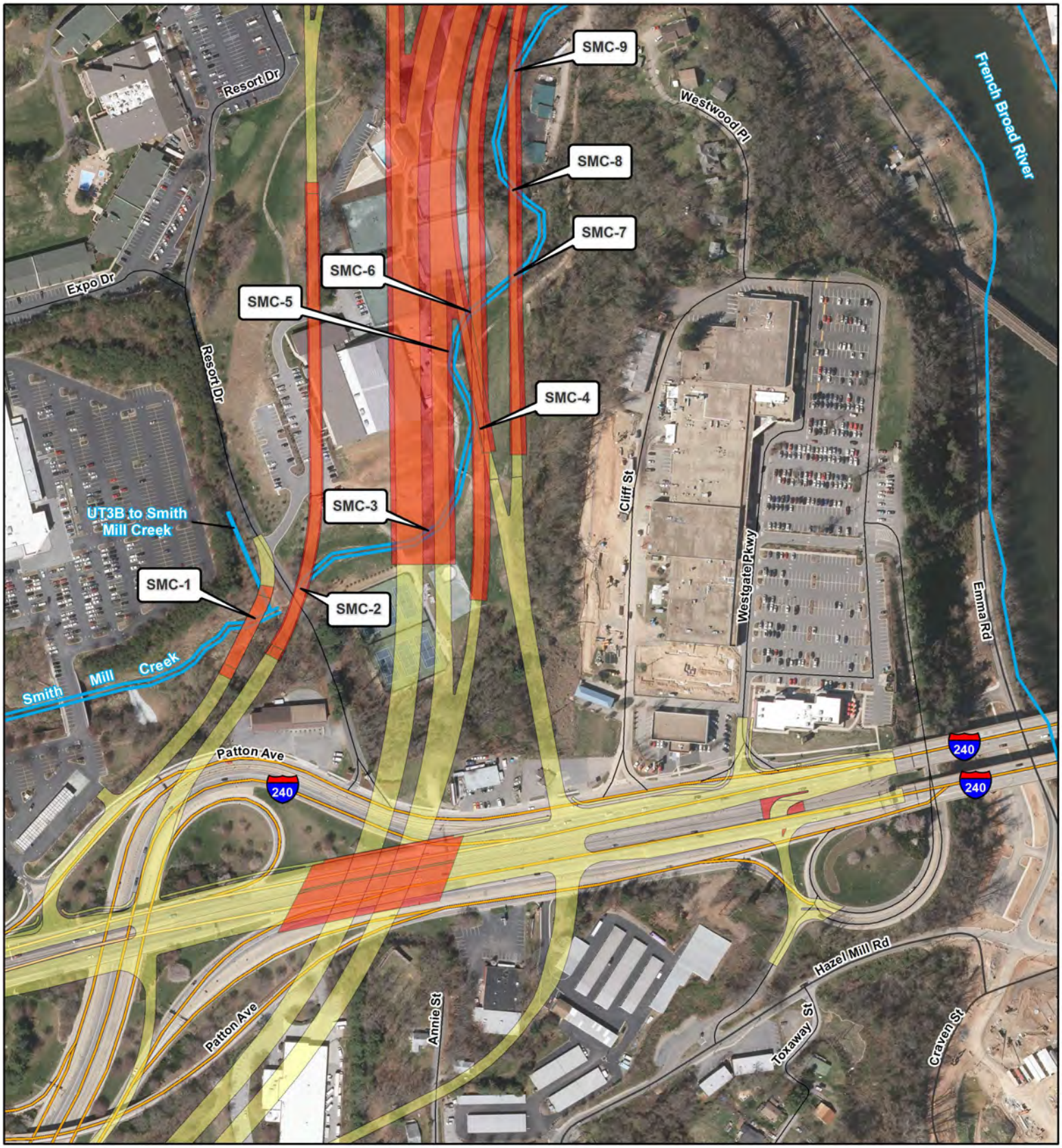
- Action Area
- HC-1 Crossing
- Proposed Bridge
- Proposed Roadway
- Delineated Wetland
- Delineated Stream
- Interstate
- US Route
- NC Route
- Major Road
- Local Road

0 150 300 600 Feet

1 in = 300 ft

Figure 1B
Crossing Locations

Source: NC OneMap, CALYX Engineers and Consultants
Map Date: 2/20/2019



NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

I-26 Asheville Connector

TIP Project I-2513

Buncombe County, NC

Legend

- Action Area
- HC-1 Crossing
- Proposed Bridge
- Proposed Roadway
- Delineated Wetland
- Delineated Stream
- Interstate
- US Route
- NC Route
- Major Road
- Local Road

0 150 300 600 Feet

1 in = 300 ft

Figure 1C
Crossing Locations

Source: NC OneMap, CALYX Engineers and Consultants
Map Date: 2/20/2019

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

I-26 Asheville Connector

TIP Project I-2513

Buncombe County, NC

Legend

- Action Area
- HC-1 Crossing
- Proposed Bridge
- Proposed Roadway
- Delineated Wetland
- Delineated Stream
- Interstate
- US Route
- NC Route
- Major Road
- Local Road

0 150 300 600 Feet

1 in = 300 ft

Figure 1D
Crossing Locations

Source: NC OneMap, CALYX Engineers and Consultants
Map Date: 2/20/2019

APPENDIX G. WATERSHED CONDITIONS BASELINE TABLES

Table A. EPT Scores for Water Bodies within Five Miles of the Action Area

Water Body	Location	Date	Rating
UT to Little Pole Creek	Off SR 1223	6/3/2010	Excellent
Beaverdam Creek	SR 3449	5/12/2002	Good
Moore Branch	Amboy Road	5/23/2006	Poor
French Broad River	NC 146	8/15/2007	Good-Fair
		9/10/2002	Good-Fair
		7/8/1997	Good-Fair
		7/8/1992	Good
		7/26/1990	Good-Fair
		8/4/1987	Good-Fair
Swannanoa River	US 25	7/25/2012	Good
		8/15/2007	Good-Fair
		11/29/2004	Fair
		8/28/2002	Good-Fair
		7/09/1997	Good-Fair
		7/08/1992	Good-Fair
		7/27/1989	Fair
		3/24/1988	Poor
		10/05/1987	Fair
		7/24/1987	Good-Fair
		8/12/1985	Poor
Swannanoa River	Thompson St near Stoner Rd	3/24/1988	Fair
Swannanoa River	Haw Creek	3/24/1988	Fair
	Azalea Park	8/27/2002	Good-Fair
Dingle Creek	Blue Ridge Parkway	2/10/87	Fair
Wesley Branch	“AB riprap”	11/6/2001	Not Impaired
Bent Creek	Forest Service Rd 479	8/29/2007	Good
	Wolf Branch	8/6/2014	Good
	AB Wolf Branch	8/5/2014	Good
	Ledford Branch	8/6/2014	Good
	BE Lake Powhatan	8/5/2014	Good-Fair
	AB Lake Powhatan	8/5/2014	Good
	BE Boyds Branch	11/7/2001	Excellent
	Bent Creek Gap Road	6/2/2010	Excellent

Table A. EPT Scores for Water Bodies within Five Miles of the Action Area

Water Body	Location	Date	Rating
Hominy Creek	SR 3412	7/24/2012	Good-Fair
		8/16/2007	Fair
		5/16/2002	Fair
		9/9/1997	Fair
		10/7/1997	Fair
		09/7/1992	Poor
Hominy Creek	SR 1123	7/23/2012	Good
		8/17/2007	Good-Fair
Hominy Creek	NC 112	5/16/2002	Good-Fair
		9/09/1997	Fair
		09/7/1992	Fair
Hominy Creek	NC 151	5/14/2002	Good
		9/10/1997	Good-Fair
		7/09/1992	Good
UT to French Broad	SR 1332	5/23/2006	Good-Fair
French Broad River	SR 1348	8/16/2007	Good-Fair
		7/10/2002	Good
		7/09/1997	Good-Fair
		7/23/1992	Good-Fair
		8/03/1987	Good-Fair
		8/13/1985	Fair
		8/18/1983	Fair

Table B. Individual NPDES Permitted Dischargers within Five Miles of the Action Area

Permit #	Facility	Type	Flow (gpd)*	Waterbody
NC0062634	Wedgefield Acres MHP** WWTP***	Minor	25,000	Pond Branch
NC0020478	Lake Powhatan Recreation Area	Minor	20,000	Bent Creek
NC0036684	Bent Creek WWTP	Minor	100,000	Wesley Creek (Bent Creek Ranch Lake)
NC0069957	Laurelwood Mobile Home Park	Minor	2,000	Beaverdam Creek
NC0086088	Girmes Site remediation	Minor	108,000	Gashes Creek (Cedar Mountain Lake)
NC0075388	Pleasant Cove Home WWTP	Minor	12,000	Pole Creek
NC0060283	Ridgeview Acres Mobile Home Park	Minor	7,800	Smith Mill Creek
NC0024911	French Broad River WRF^	Major	40,000,000	French Broad River
NC0029882	Briarwood WWTP	Minor	7,500	Dix Creek

*gpd = gallons per day; **MHP = mobile home park; ***WWTP = wastewater treatment plant; ^WRF = wastewater reclamation facility

Table C. General NPDES Permitted Dischargers within Five Miles of the Action Area

Permit #	Facility	Type	Waterbody
NCG550306	93 Hidden Falls Drive	*SFD	Reems Creek
NCG500627	Adams Products Company	**CBBWW	Swannanoa River
NCG550346	18 Terrace Drive	SFD	Reems Creek
NCG550425	648 Macedonia Road	SFD	Lee Creek
NCG551146	58 Massey Road	SFD	UT to French Broad River
NCG550710	840 Emma Road	SFD	UT to Smith Mill Creek
NCG550429	594 Cowan Cove Road	SFD	Smith Mill Creek
NCG551061	Silver Creek Apartments	SFD	Pole Creek
NCG550653	1109 Newfound Road	SFD	Jones Branch
NCG551216	218 Kirk Way	SFD	Pole Creek
NCG551217	220 Kirk Way	SFD	Pole Creek
NCG551228	224 Kirk Way	SFD	Pole Creek
NCG550413	21 Shackleford Drive	SFD	Wesley Creek (Bent Creek Ranch Lake)

*SFD = Single family domestic; **CBBWW = Non-contact cooling, boiler blowdown wastewater

Table D. Rare Aquatic Species in the Upper French Broad River Subbasin in North Carolina

Scientific Name	Common Name	NC Status*	Federal Status
Acipenser fulvescens	Lake sturgeon	SC	FSC
Alasmidonta raveniliana	Appalachian elktoe	E	E
Alasmidonta viridis	Slippershell mussel	E	FSC
Cambarus reburrus	French Broad River crayfish	SR	FSC
Carpiodes carpio	River carpsucker	SC	~
Carpiodes cyprinus	Quillback	SR	~
Cottus carolinae	Banded sculpin	T	~
Cryptobranchus alleganiensis	Hellbender	SC	ARS
Erimystax insignis	Blotched chub	SR	~
Etheostoma jessiae	Blueside darter	SC	~
Etheostoma simoterum	Tennessee snubnose darter	SC	~
Etheostoma vulneratum	Wounded darter	SC	FSC
Fusconaia subrotunda	Longsolid	SR	FSC
Hiodon tergisus	Mooneye	SC	~
Ichthyomyzon bdellium	Ohio lamprey	SR	~
Ictiobus bubalus	Smallmouth buffalo	SR	~
Ictiobus niger	Black buffalo	SR	~
Lampsilis fasciola	Wavy-rayed lampmussel	E	~
Lethenteron appendix	American brook lamprey	T	~
Luxilus chrysocephalus	Striped shiner	SC	~
Moxostoma breviceps	Smallmouth redhorse	SR	~
Necturus maculosus	Mudpuppy	SC	~
Notropis micropteryx	Highland shiner	SR	~
Notropis volucellus	Mimic shiner	SR	~
Noturus eleutherus	Mountain madtom	SC	~
Noturus flavus	Stonecat	E	~
Percina caprodes	Logperch	T	~
Percina squamate	Olive darter	SC	FSC
Percina williamsi	Sickle darter	SC	FSC
Pleurobema oviforme	Tennessee clubshell	E	FSC
Polyodon spathula	Paddlefish	E	FSC
Potamilus alatus	Pink heelsplitter	SR	~
Sander canadensis	Sauger	SR	~
Strophitus undulatus	Creeper	T	~

* E=Endangered; T=Threatened; FSC=Federal Species of Concern; SC=Special Concern; SR = Significantly Rare; ARS =At Risk SPecies; ~ = no federal status.

APPENDIX H. DESIGN STANDARDS FOR SENSITIVE WATERSHEDS & ENVIRONMENTALLY SENSITIVE AREAS

Erosion control measures that exceed standard BMPs, as outlined in DSSW (15A NCAC 04B .0124 (a) – (e)), are implemented by NCDOT for projects within WS-I or WS-II water supply watersheds, Critical Areas, or any waters designated by NCDWR as HQW. When projects occur in watersheds that contain federally-listed aquatic species, NCDOT incorporates erosion control measures that meet DSSW, regardless of the NCDWR stream classification. DSSW apply for portions of projects within one mi. and draining to streams where aquatic threatened or endangered species are present.

Table A lists the I-2513 waterways where the following DSSW will be applied:

- Uncovered areas shall be limited to a maximum total area of 20 acres.
- Erosion and sedimentation control measures shall be designed and constructed to provide protection from the runoff of the 25-year storm event, instead of a 10-year storm.
- Sediment basins will have a settling efficiency of at least 70 percent for the 40-micron (0.04mm) sized soil particle transported into the basin by the runoff of a two-year storm.
- Newly constructed open channels shall be constructed with side slopes no steeper than two horizontal to one (2:1) vertical if a vegetative cover is used for stabilization. The angle for side slopes shall be sufficient to restrain accelerated erosion.

Table A. I-2513 Waterways Where DSSW Will Apply

Jurisdictional Stream Description	NRTR Map ID	Classification[a]	River Miles to Occupied Habitat	Stream Impacts based on SS+25 ft
French Broad River	SA	P	-	0
UT1C to French Broad River	SAB	I	0.03	18
UT1C to Lower Hominy Creek	SAC	I	0.57	79
UT2 to UT1C to French Broad	SAG	I	0.05	224
UT2C To French Broad River	SE	P	0.11	20
UT2C to Lower Hominy Creek	SAJ	P	0.44	0
UT1A to French Broad River	SD	P	0.002	238
UT2A to French Broad River	SF	P	0.04	164
UT3C to Lower Hominy Creek	SH	P	0.98	7
Moore Branch	SC	P	0.83	188
Lower Hominy Creek	SB	P	0.46	43
Smith Mill Creek	SR	P	0.33	348
UT1B to Smith Mill Creek	SG	I	0.93	1,355
UT2B to Smith Mill Creek	SU	P	0.93	299
UT3B to Smith Mill Creek	SS	P	0.45	0
UT1B to French Broad River	SN	I	0.02	0
UT2B to French Broad River	SI	I	0.08	120
UT3B to French Broad River	SO	P	0.10	17
UT4B to French Broad River	SK	P	0.03	32
UT5B to French Broad River	SL	I	0.11	0
UT6B to French Broad River	SM	I	0.06	0
UT7B to French Broad River	ST	I	0.14	0
UT3C to French Broad River	SAM	P	0.12	0
UT4C to French Broad River	SAP	I	0.05	0
UT5C to French Broad River	SAQ	P	0.04	0

Jurisdictional Stream Description	NRTR Map ID	Classification[a]	River Miles to Occupied Habitat	Stream Impacts Based on SS+25 ft
UT1 to UT5C to French Broad River	SAA	I	0.08	0
Reed Creek	SJ	P	0.07	0
UT4B to Smith Mill Creek [Emma Branch]	SP	P	0.17	0
UT1 to UT4B to Smith Mill Creek [Emma Branch]	SQ	I	0.30	0

a: P=Perennial stream; I=Intermittent stream

For I-2513, Environmentally Sensitive Areas (ESAs) will be defined by a 50-ft. buffer zone on both sides of the French Broad River, measured from top of the bank, in which the following shall apply:

- The Contractor may perform clearing operations, but not grubbing operations until immediately prior to beginning grading operations.
- Once grading operations begin, work shall progress in a continuous manner until complete.
- Erosion control devices shall be installed immediately following the clearing operation.
- Seeding and mulching shall be performed on the areas disturbed by construction immediately following final grade establishment.
- Seeding and mulching shall be done in stages on cut and fill slopes that are greater than 20 ft. in height measured along the slope, or greater than 2 acres in area, whichever is less.
- All sedimentation and erosion control measures, throughout the project limits, must be cleaned out when half full of sediment, to ensure proper function of the measures.

APPENDIX I. STORMWATER TREATMENT

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

ROY COOPER
GOVERNOR

JAMES H. TROGDON, III
SECRETARY

DATE: June 20, 2019

TO: Marissa Rodman Cox
NCDOT Biological Surveys Group Supervisor

FROM: Stephen Morgan, PE
NCDOT State Hydraulics Engineer DS SRM

SUBJECT: Biological Assessment for the STIP I-2513 Asheville I-26 Connector Project – Clarification of NCDOT's commitment to treat post-construction stormwater discharges to the French Broad River to protect endangered species

Background:

NCDOT is proposing to connect I-26 in southwest Asheville to US 19/23/70 in northwest Asheville. The project has been divided into three sections which include upgrades to sections of interstate highway, improvements to several interchanges, and building interstate on new location. Because the planned improvements will result in an increase in built upon area, the Department's Post-Construction Stormwater Program (PCSP) will apply as defined in NPDES stormwater permit NCS000250.

The PCSP describes a process by which decisions are made to treat post-construction stormwater runoff to the maximum extent practical (MEP). The MEP standard is intended to be flexible and is allowed to vary between projects and over time. However, given the presence of two endangered species within the project area – the gray bat and the Appalachian elktoe mussel – it is prudent for the Department to clarify the MEP stormwater treatment standard for discharges to the French Broad River in the context of the STIP I-2513 project.

Due to project documentation requirements and associated scheduling constraints the following stormwater treatment commitment language was developed prior to final drainage design information being available. Hence, it is not appropriate at this time to make commitments for implementation of specific stormwater treatment best management practices (BMPs) at any given location. Instead the commitment language is intended to lead the hydraulic engineer through a thought process for selecting the maximum extent practical stormwater treatment options for a discharge to the French Broad River.

Mailing Address:
NC DEPARTMENT OF TRANSPORTATION
HYDRAULICS UNIT
1590 MAIL SERVICE CENTER
RALEIGH, NC 27699-1590

Telephone: (919) 707-6700
Fax: (919) 250-4108
Customer Service: 1-877-368-4968

Website: www.ncdot.gov

Location:
1000 BIRCH RIDGE DRIVE
RALEIGH, NC 27610

The following commitment guidance is intended to apply to STIP I-2513 at the crossings of the French Broad River and any tributaries draining to the French Broad River and any portion of the NCDOT stormwater conveyance system draining to an outfall discharging to those waters within the right-of-way.

Post-Construction Stormwater Treatment Commitment:

NCDOT will prepare a stormwater management plan (SMP) that implements structural and non-structural post-construction stormwater BMPs to the MEP, which is consistent with the Department's NPDES Post-Construction Stormwater Program. The goal of the SMP is to provide long term protection for federally listed species which depend on the French Broad River. To demonstrate attainment of the MEP standard NCDOT commits to the following set of guidelines for preparation of the SMP:

1. NCDOT recognizes that the Appalachian elktoe and the gray bat are sensitive to excessive amounts of silt, nutrients, and heavy metals. Therefore, when preparing the SMP NCDOT commits to using a hierarchical BMP selection process that is optimized to treat the above three pollutant categories. 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 one of these BMP types are a feasible option, then NCDOT commits to including such BMP in the SMP. If an infiltration basin or a media filter is not feasibledue to site constraints (e.g. topography, high water table, etc) then NCDOT commits to providing a description of these constraints in the SMP as supporting information for the MEP BMP selection decision. In such cases the hydraulics engineer will select another BMP type from NCDOT's Toolbox that is feasible. Preference will be given to water quality swales, vegetative conveyances, vegetated filter strips, and preformed scour holes (PSHs). In flat, bottomland terrain PSHs will be used to the MEP to eliminate outfalls by converting concentrated flow into distributed flow thus maximizing infiltration and evapotranspiration of the runoff.

2. NCDOT recognizes forests as important habitat for the gray bat 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.

3. NCDOT recognizes the presence of two endangered species - one aquatic and one terrestrial, but aquatic dependent – within the project area presents unique stormwater management challenges. Optimizing BMP selection for one species may be suboptimal or even detrimental to the other. Because of this unique situation, NCDOT will commit to evaluating the use of emerging BMP technologies that the Department has or is currently researching, but has not yet published in its BMP Toolbox. These emerging BMP technologies are as follows:

    - ✓ Bioswales
    - ✓ Bioembankments
    - ✓ Biofiltration Conveyances
    - ✓ Soil improvement to maximize infiltration

Because design standards have not yet been formally approved by NC Department of Environmental Quality (NCDEQ) for inclusion in the BMP Toolbox, the hydraulics design engineer will be required to consult with the State Hydraulics Engineer and obtain prior approval before proposing one of these BMP technologies in the SMP. In consultation with the State Hydraulics Engineer, the hydraulics design engineer will use the following guidelines, in addition to an evaluation of site constraints, to determine the appropriateness of one of these emerging BMP technologies:

Bioswale Guidelines – for typical sections that include a vegetated median, a bioswale may be considered. For vegetated conveyances in other areas of the project where swale criteria can be met (refer to the BMP Toolbox for criteria) the hydraulics engineer should evaluate if a bioswale would be feasible in lieu of a traditional swale. If a bioswale is not feasible then the engineer should document in the SMP the constraints as justification for the MEP decision.

Bioembankment Guidelines – bioembankments can be used on slopes 4:1 or flatter and outside of the clear recovery zone. Discharges of treated runoff should be to a stable conveyance or energy dissipator. A geotechnical engineer should be consulted in the design of the bioembankment to ensure the stability of the side slope.

Biofiltration Conveyance Guidelines – biofiltration conveyances may be used along steep conveyances provided it is outside of the 100-year floodplain. A maintenance access road should be provided in compliance with clearing requirements in guideline #1.

Soil Improvement Guidelines – soil improvement practices may be considered in areas where compacted soil is not required for the structural integrity of the roadway facility. Improved areas should be planted with native, pollinator-friendly plants in consultation with the Division Roadside Environmental Engineer.

These commitments will meet the need for more stringent guidance for the area of environmental concern for the project. It is expected during the design phase additional coordination and clarification of these stormwater best management practices will occur through consultation with the Stormwater group in Hydraulics.

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SRM/ahm

APPENDIX J. LIGHTING SUMMARY

Lighting Summary

Roadway lighting is beneficial in the reduction of nighttime accidents and in the identification of conflict points along the roadway by motorists. Because it is not economically feasible to light every conflict point along the roadways of the State, it is the policy of the Department to construct and maintain 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.

Engineers within the Lighting and Electrical Team apply the lighting evaluation techniques detailed in the Total Design Process (TDP), as defined in National Cooperative Highway Research Program (NCHRP) Report 152, to all interchanges and continuous sections of fully controlled access roadways that may warrant lighting. The TDP generates a Priority Index based on a numerical weighting and scoring process. The TDP incorporates roadway geometrics, nighttime average daily traffic and the annual cost of providing lighting to develop the Priority Index for an interchange or continuous section of roadway. If the Priority Index meets or exceeds the Base Priority Index established by the Roadway Lighting Committee, the Lighting and Electrical Team Leader submits a request to the Lighting Committee to include lighting in the roadway contract.

There is existing lighting throughout the I-26 corridor that is being widened or relocated as part of the I-2513 project. The Department's practice is to upgrade and relocate existing services, such as lighting, when those services are in conflict with the construction of the roadway project. Because of this practice, a TDP was not performed for this corridor.

In most cases, the Department maximizes the use of high mast light poles of varying heights (80', 100' or 120') to flood interchange areas with lighting. Shoulder mounted single arm poles or median mounted twin arm poles, both having a 'cobrahead' style LED light fixture mounting height of 45' above the pavement surface, are used to supplement the high mast lighting at the interchange tie in and taper points, and along continuously lit corridors of roadways.

The Department's lighting designs are initially optimized using GE cobrahead style fixtures and Holophane high mast style fixtures.

Lighting Mitigation at Culvert

Existing Baseline Conditions

On February 26th, members of the Roadway Lighting Squad (RLS) traveled to Asheville to measure the light levels near the culvert where the gray bats are present. Measurements began at 7:20 and were taken at various points around the fence of the property at Southern States. On this property there are seven light fixtures, of which, four are LED, two are high pressure sodium (HPS) and one is an old NEMA fixture which is probably metal halide. The measurement points are shown as the numbered blue dots in Figure 1 below. The dashed blue line shows the approximate culvert opening and ditch line that runs to the French Broad River (FBR).

Figure 1: Southern States store property with light measurement locations

It was conveyed to the RLS that measurements at points 1-3 would be the most critical due to their location near the culvert opening. The measurements, in foot-candle (fc), conducted at all points can be seen in Table 1. Also contained in Table 1 is the calculated light level at each point based on the types of light fixtures installed in the Southern States property. Calculations were performed using photometric analysis software (AGi32).

***Table 1**: Measured and Calculated Values of light in the Southern States property.*

Location	Measured Value	Calculated Value
Point 1	0.524	0.342
Point 2	0.413	0.300
Point 3	0.362	0.264
Point 4	0.002	0.002
Point 5	0.009	0.004
Point 6	0.008	0.004

**NOTE: light from a full moon is 0.01 fc.*

As shown, in nearly all cases, the calculated light levels are lower than the measured light levels. This is likely due to atmospheric conditions, including pollution from other light sources in the area that cannot be captured for inclusion in the calculations. For points 1-3, the calculated values are, on average, 31% lower than the measured values.

Due to site conditions, the RLS was unable to physically take light measurements at the culvert opening or along the ditch. AGi32 was again used to calculate the light levels at those areas. The calculated light levels were increased by 31% to match the delta between the measured and calculated light levels at points 1-3 above. Calculated values are shown in Figure 2.

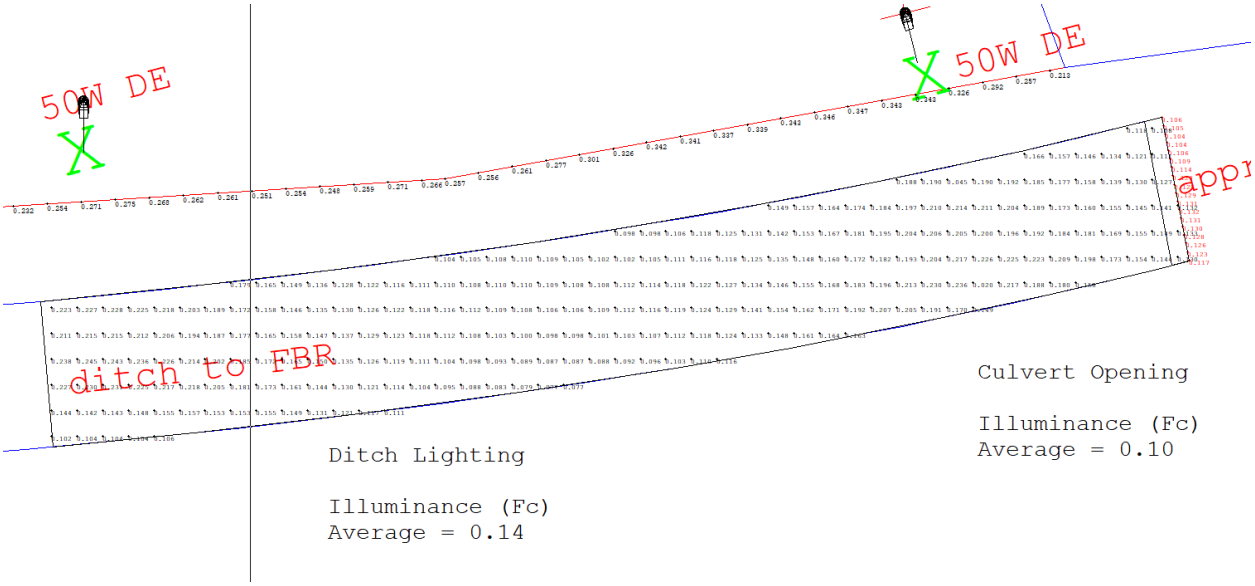


Figure 2: Calculated light levels at the culvert and the ditch

Increasing these calculated light levels by 31% results in an average of 0.18 fc in the ditch and 0.13 fc at the culvert opening. It can be reasonably assumed that these levels are likely not this high given the amount of vegetative overgrowth around the ditch and culvert.

Proposed Lighting for New French Broad River Crossing (Initial Conceptual Design)

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 (I-2513A/B/C) the existing lighting will have to be modified. The intention of the RLS is to provide lighting that is as good or better than what is currently installed. In most cases, this will mean removing the existing single arm light poles that are currently installed on the outside shoulder of the roadway and installing twin arm light poles on the proposed median barrier. At interchanges throughout the corridor, a combination of single arm poles, twin arm poles and high mast poles will be used.

At the new FBR crossing, the intent of the RLS was to provide high mast lighting on 120’ poles to flood the entire area, including all flyover and interstate bridges, with light. High mast lighting is preferred because this type of lighting is installed far from traffic, eliminates the addition of roadside obstacles and can be maintained without requiring lane closures. Figure 3 below depicts the desired conceptual lighting design using high mast poles exclusively at the FBR crossing. The circular iso foot-candle templates show the varying foot-candle levels distributed from each high mast pole. The outer iso foot-candle ring is 0.1 fc. Two single arm poles were also needed on one of the flyover bridges to complete the lighting design.

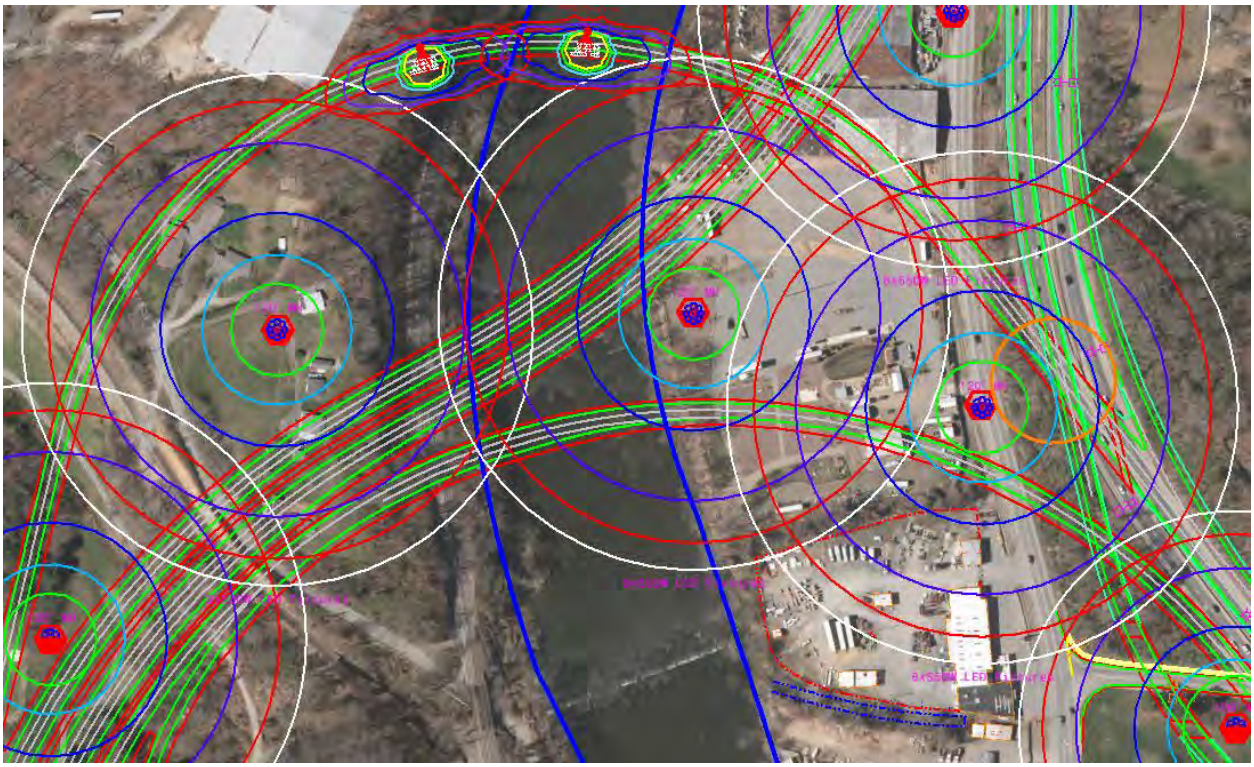


Figure 3: Proposed FBR crossing with conceptual lighting design layout.

At the time this design was conceptualized, the RLS was not aware of the gray bat population located in the culvert. In meetings with the Environmental Analysis Unit, the RLS was informed that the lighting in the area near the FBR could have a detrimental effect on gray bats. We were asked what, if any, mitigation efforts could be made to the lighting design to reduce impacts to gray bats, particularly in terms of the amount of light being cast onto the FBR. The RLS committed to investigate what lighting mitigation measures could be taken.

In the initial design shown in Figure 3 there is a significant amount of light being dispersed onto the FBR. This design was imported into AGi32 to calculate the impact on the FBR. The overall project layout and zoomed in areas over the FBR and the culvert and ditch area are shown in Figures 4, 5 and 6 below.

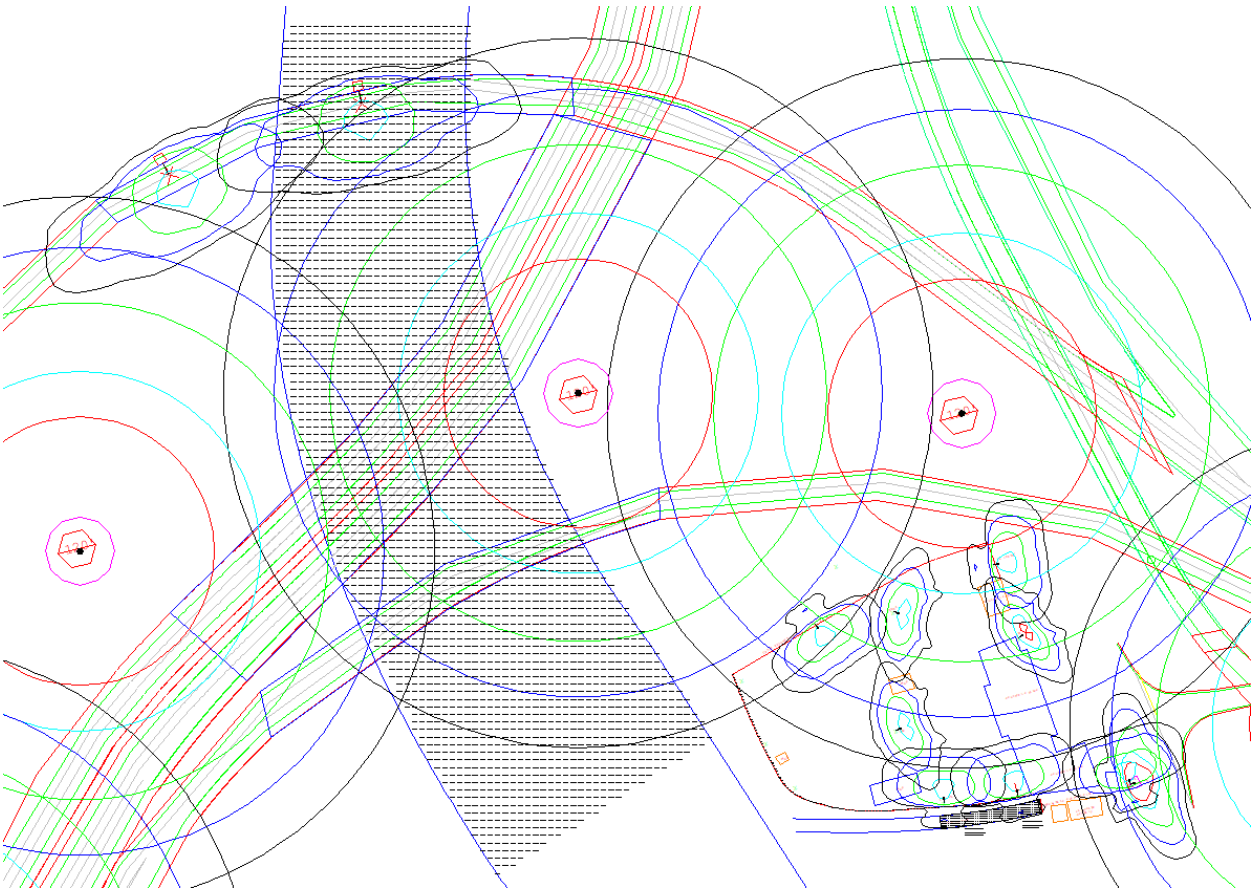


Figure 4: Conceptual lighting design layout in AGi32. The Southern States property is in the lower right.

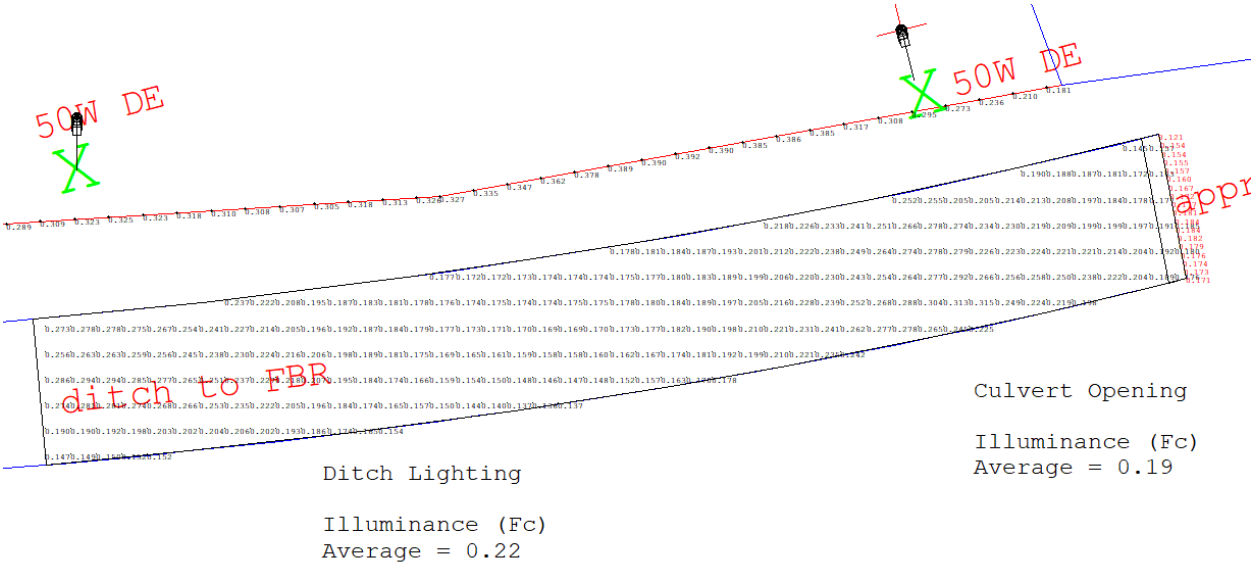


Figure 5: Calculated light levels at the culvert and ditch using the conceptual lighting design layout.

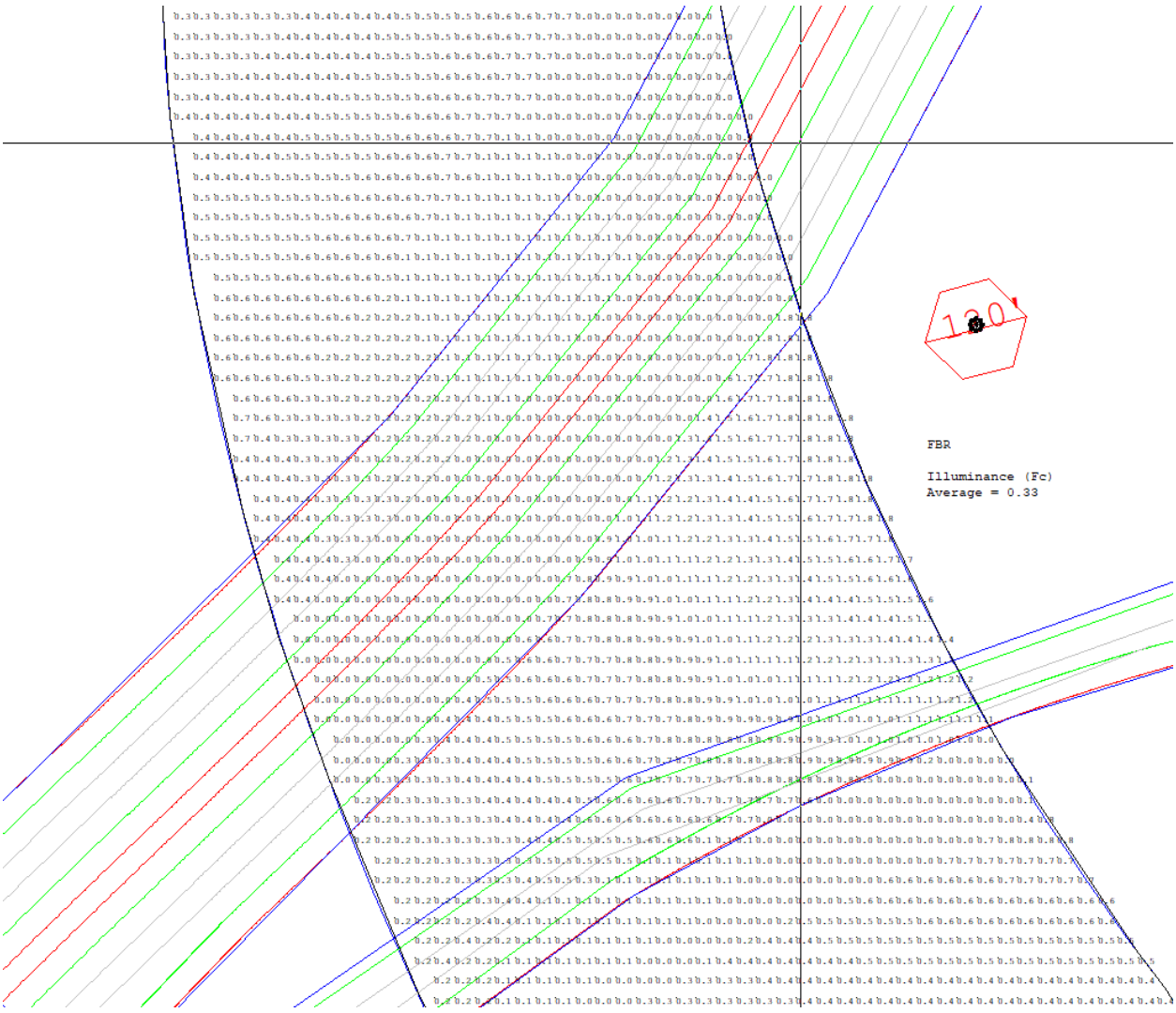


Figure 6: Calculated light levels on the FBR using the conceptual lighting design layout.

Using the same 31% increase over calculated values from before, the assumed effective lighting in foot-candle for the culvert, ditch and FBR would be as shown in Table 2.

***Table 2**: Calculated and Assumed Measured Values of Light in the Culvert and Ditch*

Area	Calculated Value	Assumed Measured Value	Percent Change from Baseline
Culvert Opening	0.19	0.25	+92.3%
Ditch	0.22	0.29	+61.1%
FBR	0.33	0.43	N/A

Proposed Lighting for New French Broad River Crossing (Mitigation Design)

The most effective mitigation effort that can reduce the amount of light cast onto the FRB and the culvert while still providing adequate lighting for the driving public is to use single arm light poles mounted on the bridge and flyover barriers in place of the 120' and 100' high mast poles. To reduce impacts further, a light fixture with a very narrow distribution pattern can be used. This will keep more light on the bridges and flyovers and spill less light onto the FRB and the culvert.

Figure 7 shows the lighting layout using 35’ single arm poles with a narrow distribution light fixture and a house side shield. The house side shield aids in preventing excessive light from being distributed behind the luminaire. The large iso foot-candle templates present when using high mast poles have been replaced with much tighter iso foot-candle templates showing the narrow distribution of the fixture used in the calculations. Figures 8 and 9 show the zoomed in images of the lighting at the culvert area and FBR crossing.

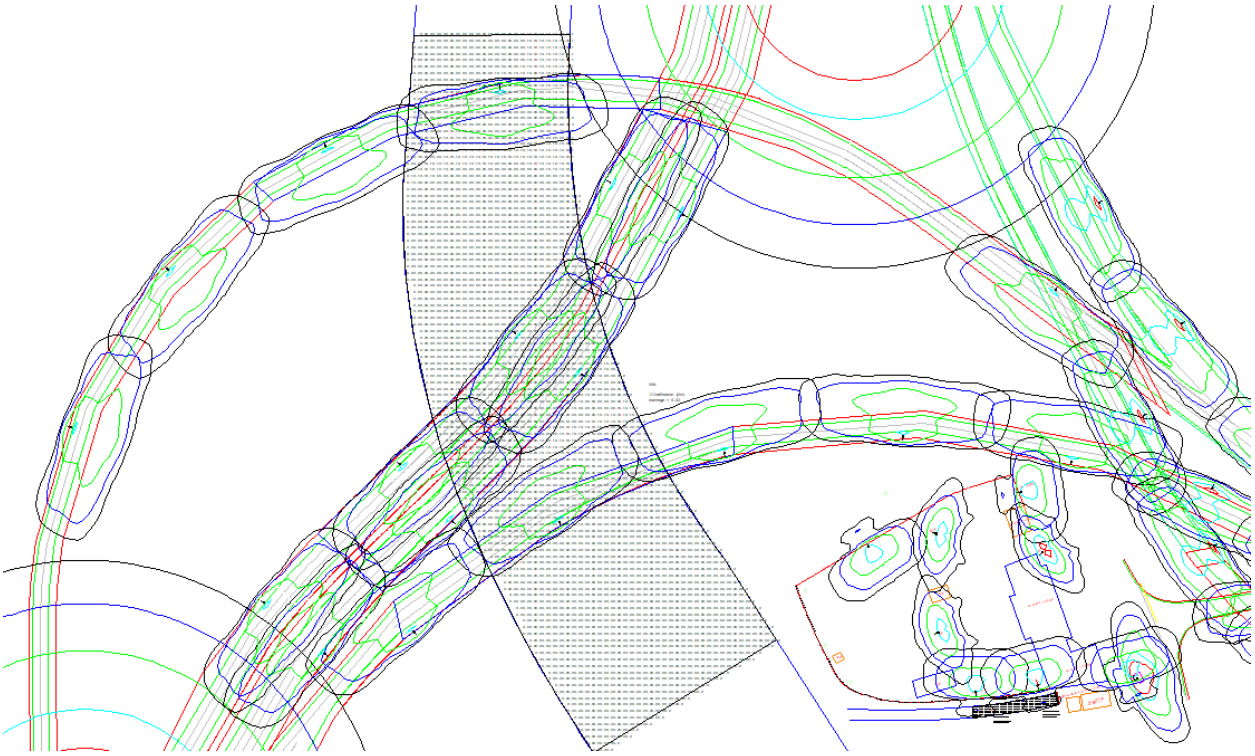


Figure 7: Mitigation lighting design layout in AGi32. The Southern States property is in the lower right.

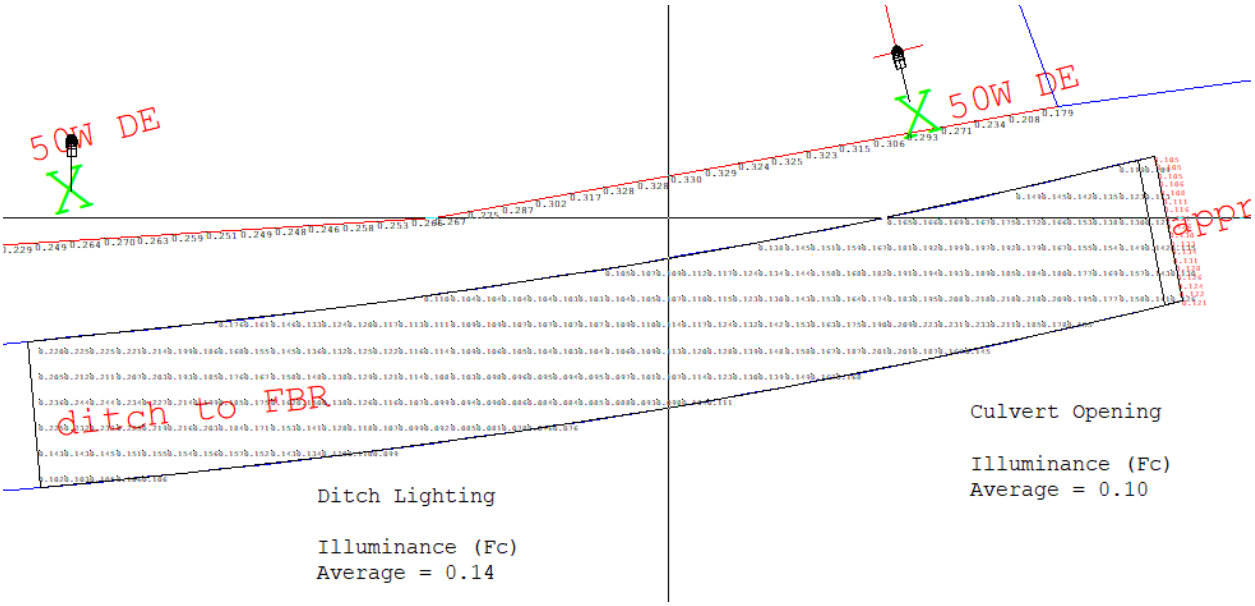


Figure 8: Calculated light levels at the culvert and ditch using the mitigation lighting design layout.

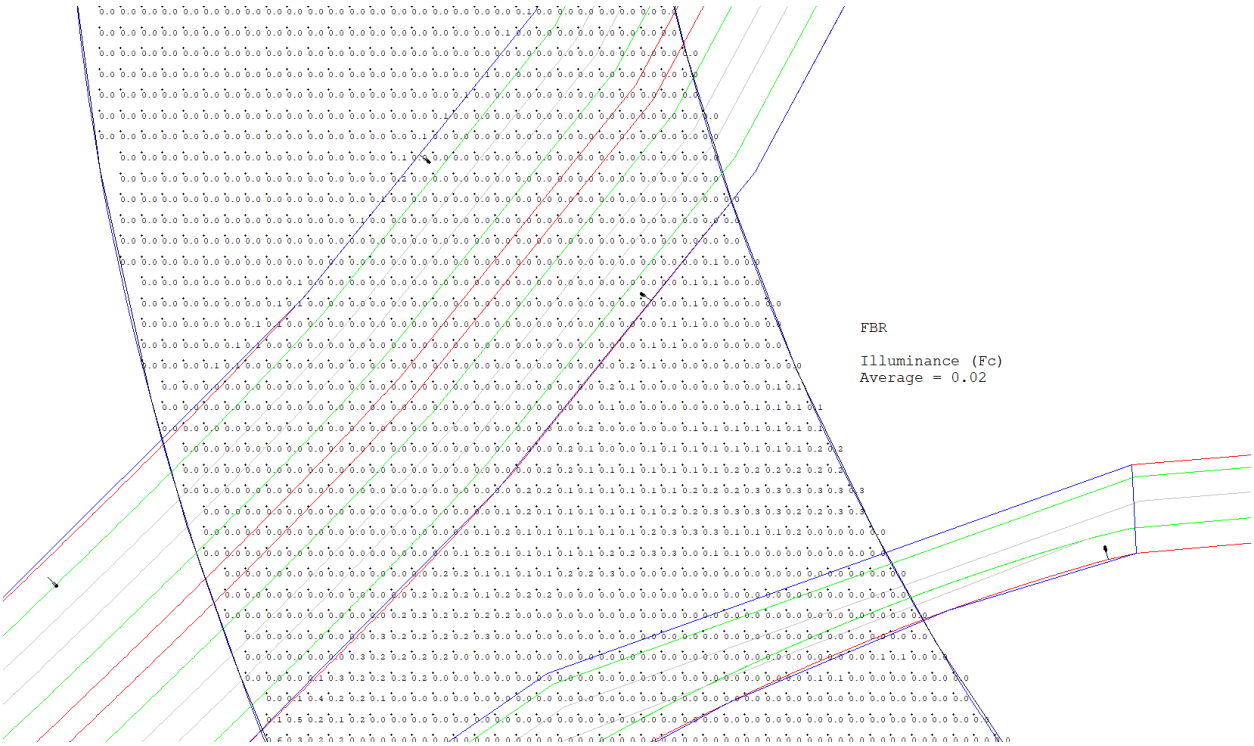


Figure 9: Calculated light levels on the FBR using the mitigation lighting design layout.

Using the same 31% increase over calculated values from the initial conceptual design, the assumed effective lighting in foot-candle for the culvert, ditch and FBR would be as shown in Table 3.

***Table 3**: Comparison of Conceptual and Mitigation Values of Light in the Culvert and Ditch*

Area	Calculated Value	Assumed Measured Value	Percent change from conceptual design	Percent change from baseline
Culvert Opening	0.10	0.13	-48%	0%
Ditch	0.14	0.18	-38%	0%
FBR	0.02	0.026	-94%	N/A

Results

Using the mitigation design results in zero calculated change to the baseline light levels at the culvert and the ditch near the Southern States property. Additionally, the levels of light that are calculated to be cast onto the FBR are reduced by 94% to a value of roughly 2x that of the light from a full moon.

There are potential drawbacks to using the mitigation lighting design. The largest of those drawbacks is that the mitigation design requires that single arm poles be installed on the barrier rail of the interstate and flyover bridges and beside the shoulder of the interstate and ramps. These poles introduce roadside obstacles that are not present in the conceptual lighting design. Additionally, these poles will require lane closures when maintenance is required. Lane closures introduce another obstacle to drivers, particularly on the narrow flyover bridges.

It should be noted that all light calculations were performed with LED light fixtures having a 4000 degree Kelvin (4000K) color temperature. 4000K is considered natural white in color. The existing lighting installed on I-26 has already been upgraded to 4000K LED. The local utility in Asheville is in the process of upgrading all lighting to 4000K LED as well. While a few high pressure sodium (HPS) fixtures remain in the area, the vast majority have already been upgraded to 4000K LED.

Lighting Mitigation Efforts at 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' 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.

In an effort to reduce the amount of light projected outside of the roadway, the Department has committed to the following at all crossings identified in this Appendix:

- 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. See Figure 11 on the following page for an image of a house side shield installed on a LED fixture.
- using LED light fixtures with a BUG rating of 1-0-3 or less
- Use LED light fixtures with a lower lumen output, reducing overall brightness

The Department reached out to various lighting vendors in an attempt to find identify LED light fixtures with a Backlight rating of 0. Through our research, it was determined that only lower power LED light fixtures have a Backlight rating of 0. These low power fixtures are not designed to be used on interstate facilities. They may work on small, low speed local roadways or in parking areas.

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 foot-candle (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. In an attempt to enhance the mitigation efforts to the gray bats as part of this project, the NCDOT is committed to lowering the design standards to meet the AASHTO minimum requirements of 0.6 fc at 4:1 uniformity at all crossing locations identified in this Appendix. 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' poles with GE Cobrahead (GE) fixtures (3-0-3 BUG) were removed and replaced with 35' 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. See the figures on the following page for generic distribution types and specific GE and Cooper distribution patterns.

Lighting Distribution Types, Shields and Patterns

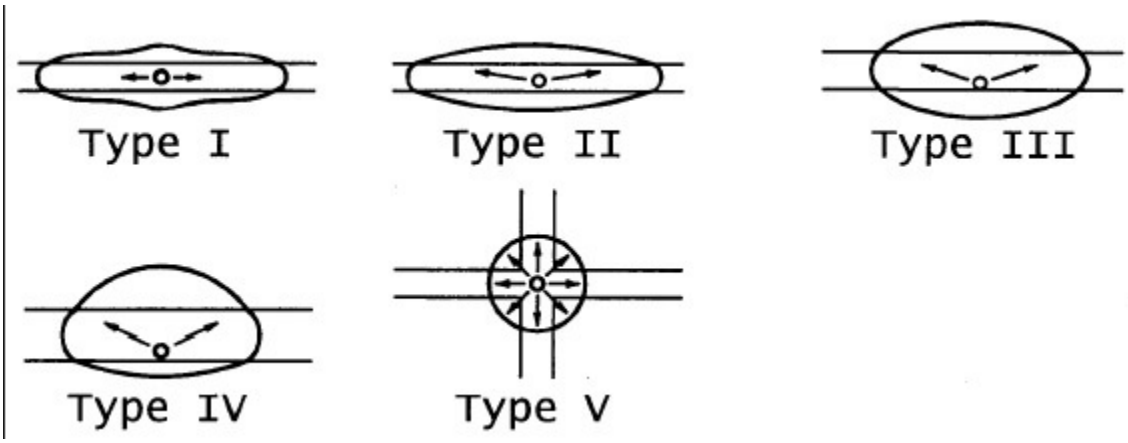


Figure 10: Light Distribution Types.

Figure 11: House side shield installed on LED fixture to limit backlight.

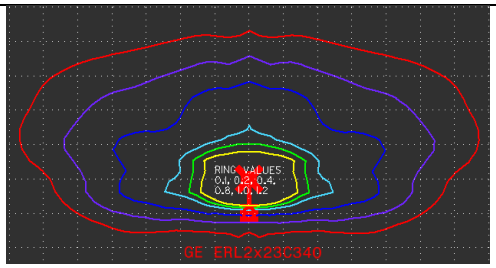
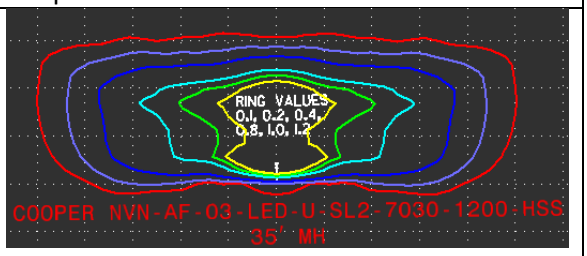
GE Distribution	Cooper Distribution
	

Figure 12: Light distribution patterns. Note the gridlines for each fixture are 25' x 25'.

French Broad River Crossings

FBR-1 Original

The original design had GE cobrahead fixtures to the west of the crossing with the outer 0.1 foot-candle ring being located roughly even with the west bank of the FBR. There were no proposed fixtures east of the crossing. See Figure 13 below.

Figure 13: Original lighting layout at FBR-1, HC-5, HC-6 & HC-7 crossings.

FBR-1 Mitigation

In the mitigation design, all GE fixtures west of FBR-1 to HC-5 and HC-6 were changed to Cooper fixtures. The outer 0.1 fc ring from the Cooper fixture ends roughly 115' from the west bank of the FBR. See Figure 14 below.

Figure 14: Mitigation lighting layout showing new 1-0-3 BUG fixtures at FBR-1, HC-5, HC-6 & HC-7 crossings.

FBR-2, FBR-3 & FBR-4 Original

As detailed in the "Lighting Mitigation at Culvert" section above, the original design flooded these crossings with light from 120' high mast poles installed east and west of the FBR. In addition to the 120' high mast poles flooding the connector interchange with light, two GE fixtures were needed directly over the FBR-4 crossing to adequately light the flyover bridge.

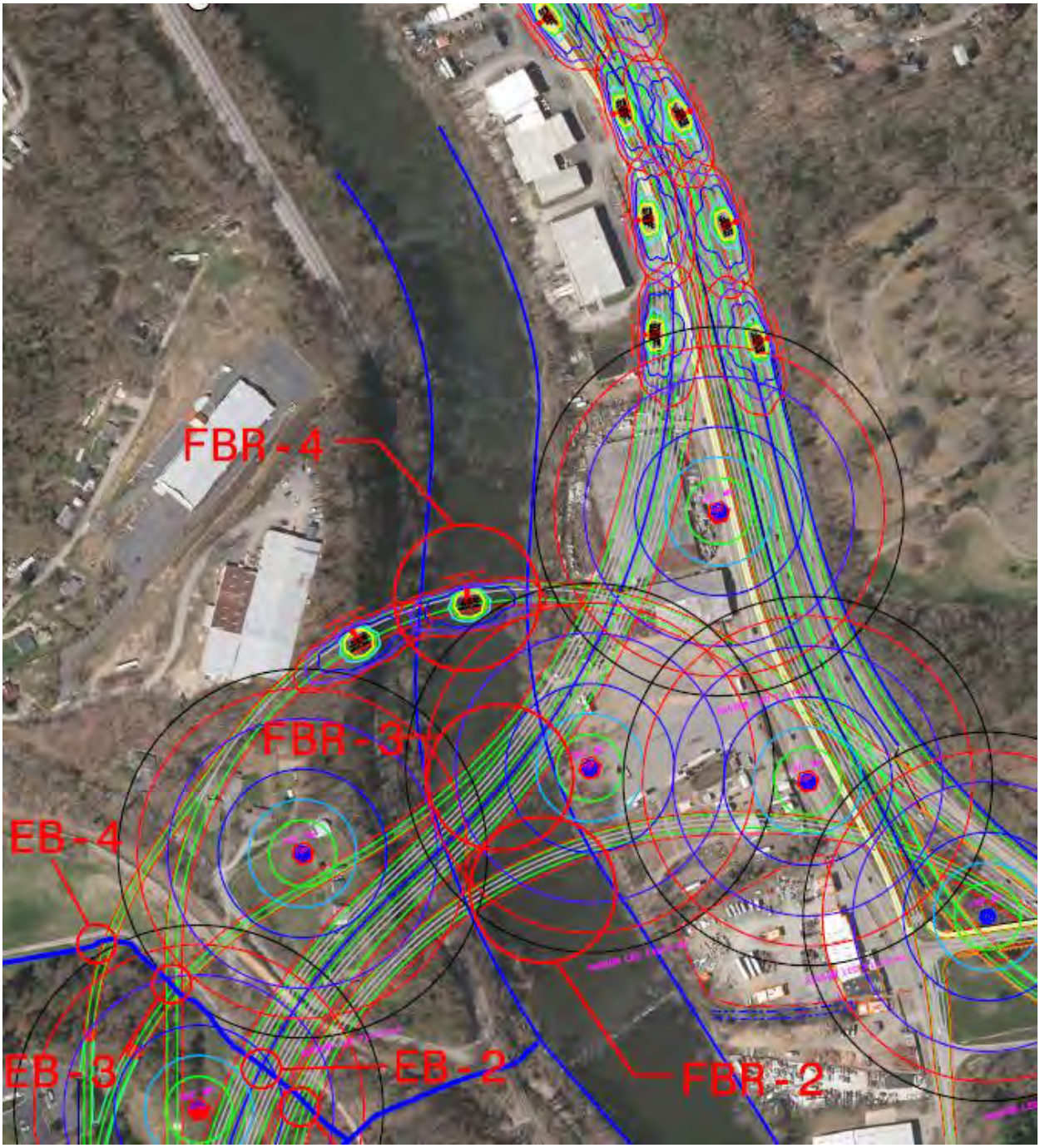


Figure 15: Original lighting layout at FBR-2, FBR-3 & FBR-4 crossings.

FBR-2, FBR-3 & FBR-4 Mitigation

The mitigation design removes all high mast poles within the connector interchange that crosses the French Broad River and replaces them with Cooper fixtures mounted on the outer bridge barrier rail and/or on the center bridge barrier. After receiving feedback from the USFWS the crossings were centered between the Cooper fixtures as best as possible.

Where I-26 and I-40 mainline structures with median barrier between the travel lanes is proposed, 45' poles were required in order to provide reasonable pole spacing. In these instances, the Cooper fixture was still used, so there was no change to the BUG rating of the fixture.

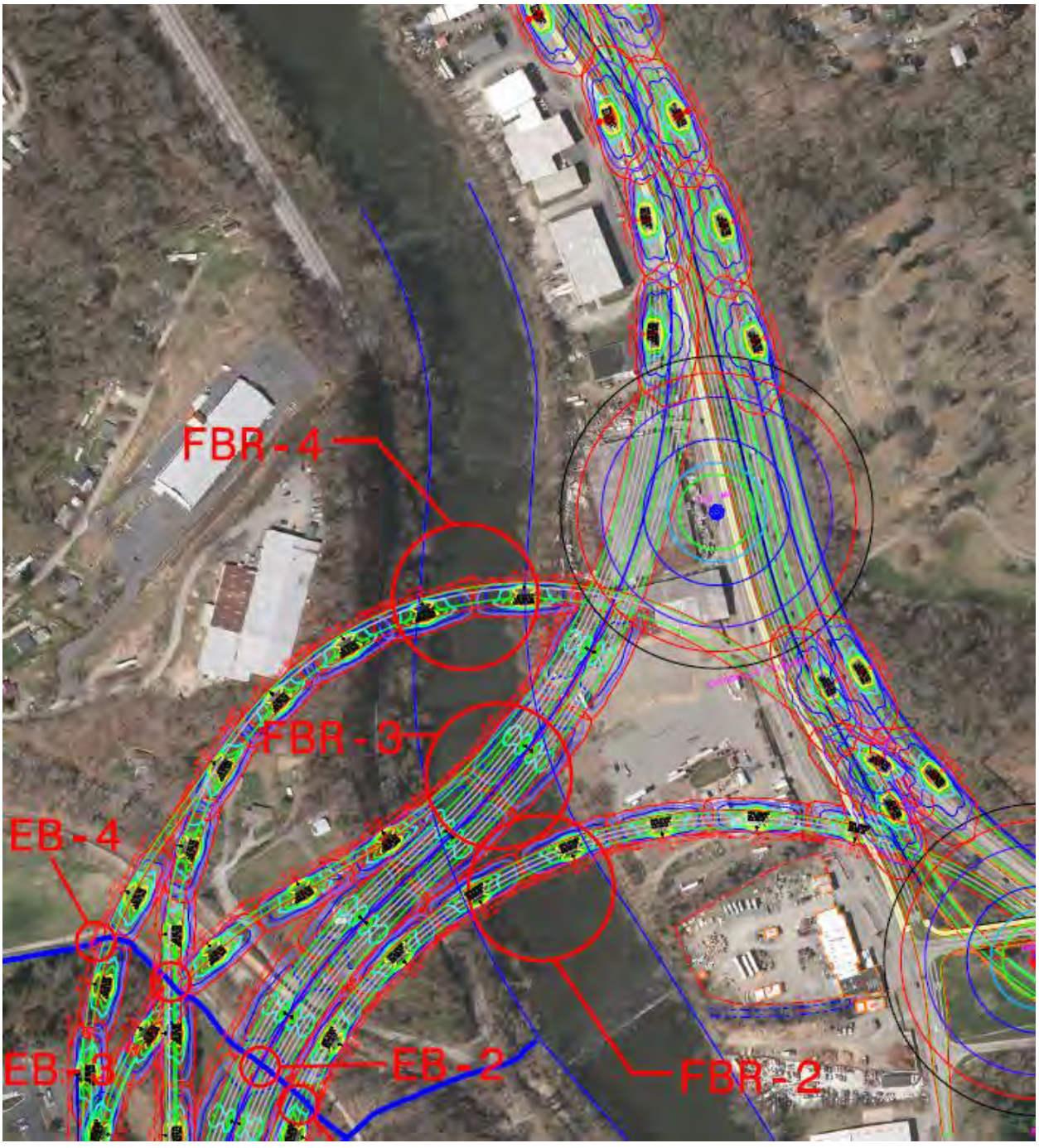


Figure 16: Mitigation lighting layout showing removed high mast poles at FBR-2, FBR-3 & FBR-4 crossings.

Hominy Creek Crossings

HC-1, HC-2, HC-3 & HC-4 Original

The original design at HC-1 had the crossing centered between GE fixtures and a had a 120' high mast located approximately 700' west of the crossing. The original design for HC-2 and HC-3 had GE fixtures east of HC-2, a 120' high mast pole west of HC-2 and HC-3 and a GE fixture directly over HC-3. The original design for HC-4 had a GE fixture directly over the east bank of the crossing and continued the GE fixtures in the east and west directions.

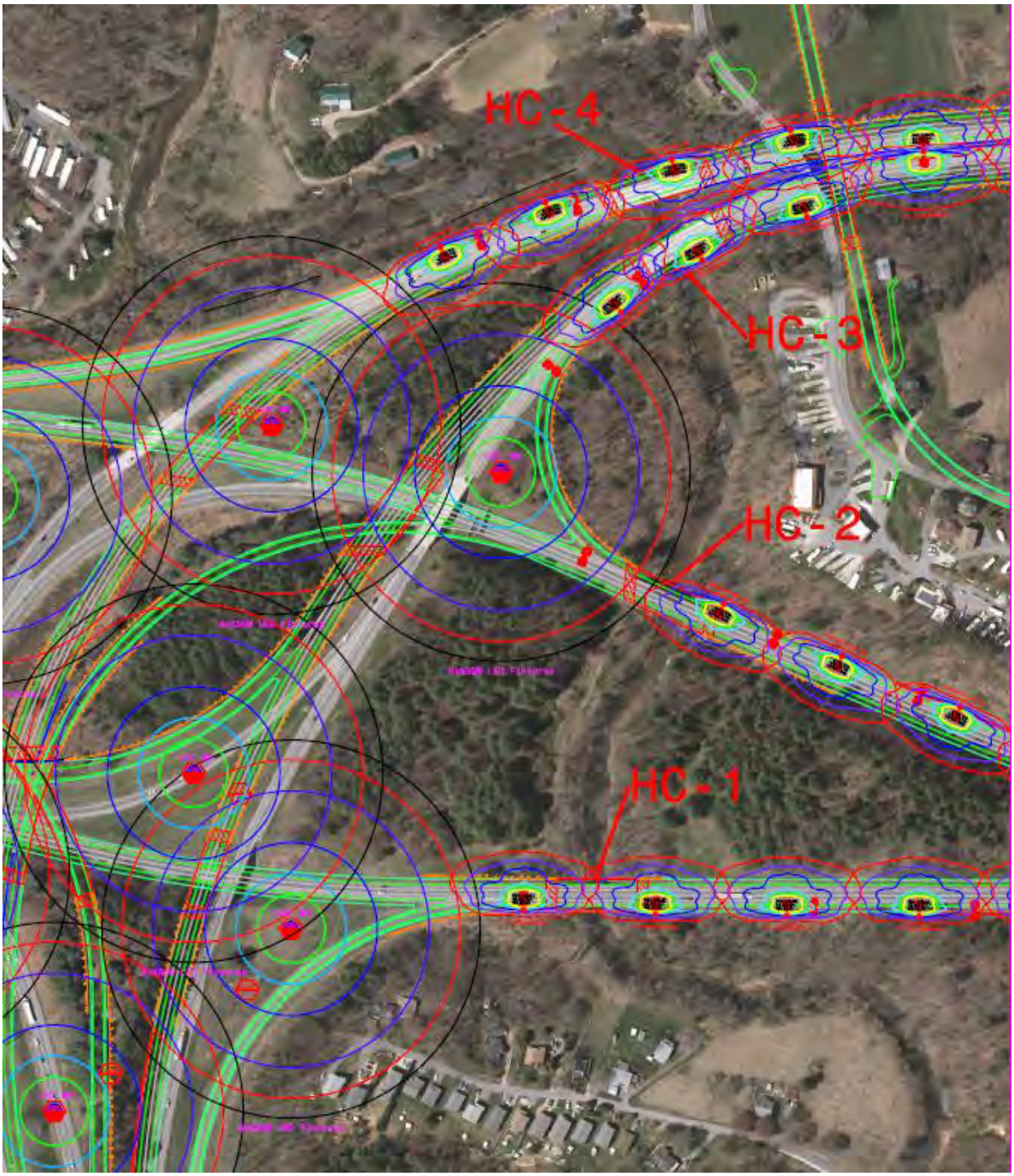


Figure 17: Original lighting layout at HC-1, HC-2, HC-3 & HC-4 crossings.

HC-1, HC-2, HC-3 & HC-4 Mitigation

The mitigation design for HC-1 replaces the GE fixtures with the Cooper fixtures, extends the Cooper fixtures further east and west and replaces the 120' high mast with an 80' high mast in the same approximate location. The crossing is still centered between the Cooper fixtures. The mitigation design for HC-2 and HC-3 removes the 120' high mast pole and includes Cooper fixtures from approximately 300 east of HC-2, along the proposed ramp to a point approximately 350' east of HC-3. Additionally, HC-2 and HC-3 are centered between the Cooper fixtures. The mitigation design for HC-4 centers the crossing between two Cooper fixtures and extends the Cooper fixtures approximately 380' to the west and 350' to the east.

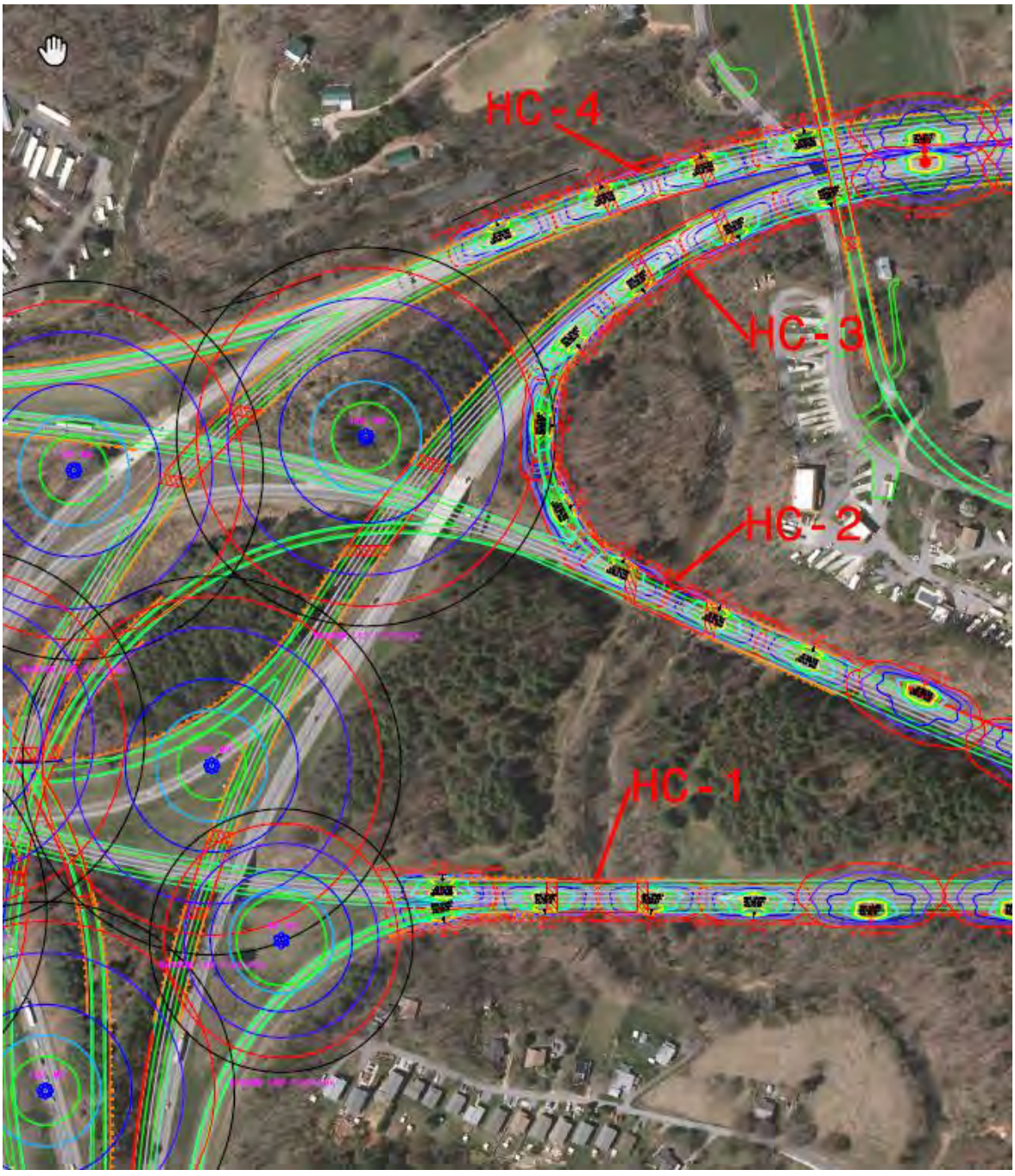


Figure 18: Mitigation lighting layout at HC-1, HC-2, HC-3 & HC-4 crossings.

HC-5, HC-6 & HC-7 Original

The original design at the HC-5 and HC-6 locations had an 80' high mast pole approximately 170' west of HC-5 and 110' west of HC-6 and GE fixtures east of both crossings. The original design at HC-7 had a twin arm pole with GE fixtures installed on the mainline barrier directly over the crossing. See Figure 13 above.

HC-5, HC-6 & HC-7 Mitigation

The mitigation design at HC-5 and HC-6 removes the 80' high mast pole, adds Cooper fixtures along the mainline and ramp in both directions and centers both crossings between the Cooper fixtures. The mitigation design for HC-7 may ultimately wind up adding more light on the crossing. Because the GE fixtures have more forward throw to them, the twin arm pole mounted on the mainline barrier is able to adequately light both ramps as well as the mainline, with very little light making to the crossing. In the mitigation design, since the Cooper fixtures do not throw the light forward like the GE fixtures do, in addition to the Cooper fixture mounted to a twin arm pole on the mainline barrier a Cooper fixture also had to be in included on each ramp to prevent the ramps from being too dark in these locations. The crossing is centered between the Cooper fixtures on the ramps and the mainline and the Cooper fixtures were extended for approximately 360' to the west and 640' to the east. See Figure 14 above.

Smith Mill Creek and Emma Branch Crossings

Similar to the FBR-2, FBR-3 and FBR-4 crossings, in the original design these crossing were all flooded with light from 120' high mast poles. See Figure 15 above for all original Emma Branch crossings. The existing lighting at the Patton Avenue interchange will be redesigned due to the significant interchange reconfiguration. The existing lighting east of the interchange and on the Captain Jeff Bowen Bridges are the GE fixtures as shown on the right in Figure 19.

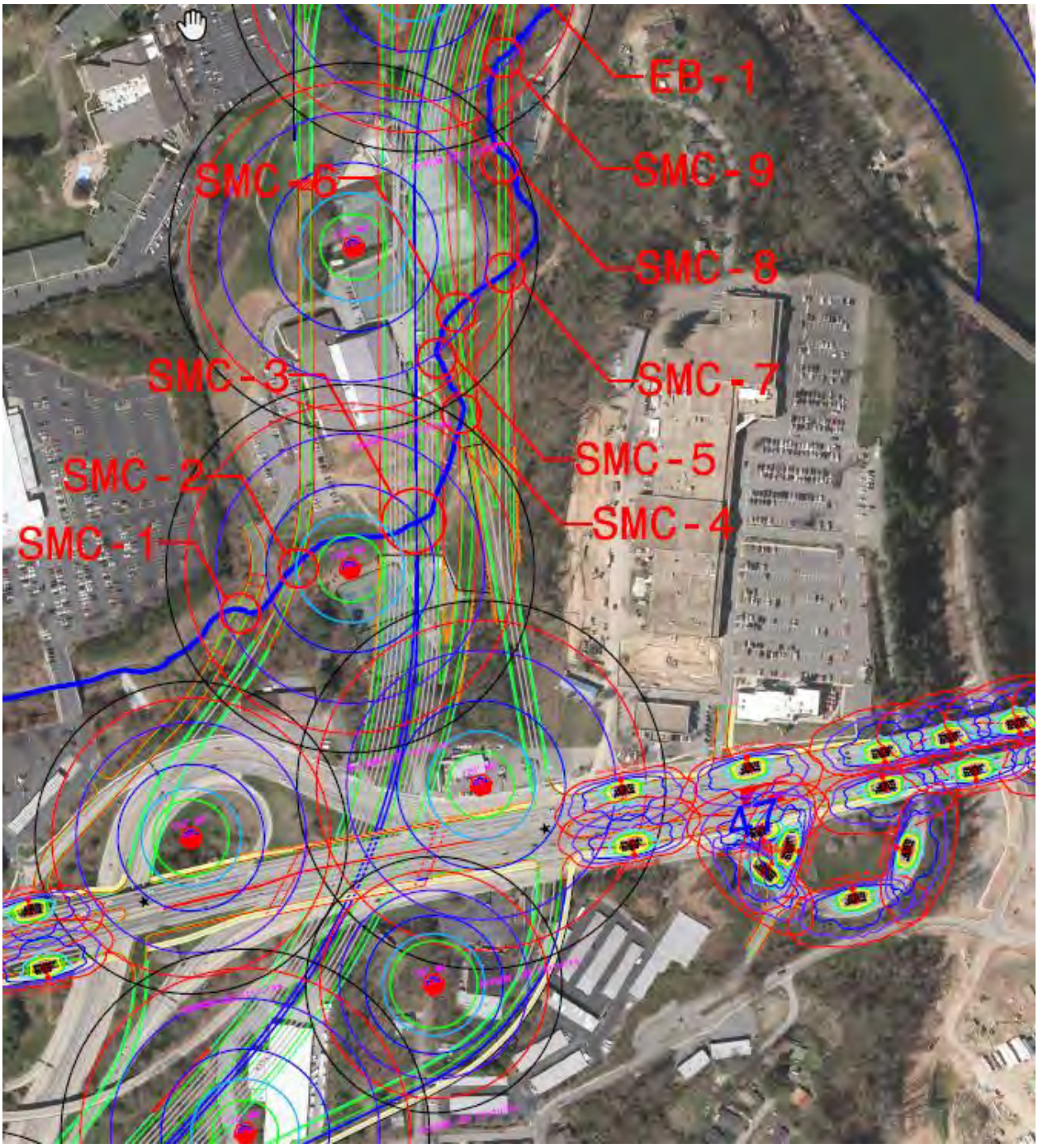


Figure 19: Original lighting layout at Smith Mill Creek and Emma Branch crossings.

The mitigation design removes all high mast poles within the connector interchange and the northern most high mast pole from the Patton Avenue interchange and replaces them with Cooper fixtures mounted on the outer bridge barrier rail and/or on the center bridge barrier. The crossings were centered between the Cooper fixtures as best as possible. See Figure 16 above for all Emma Branch mitigation crossings. The lighting east of the Patton Avenue interchange and on the Captain Jeff Bowen Bridges was not modified from the existing configuration.

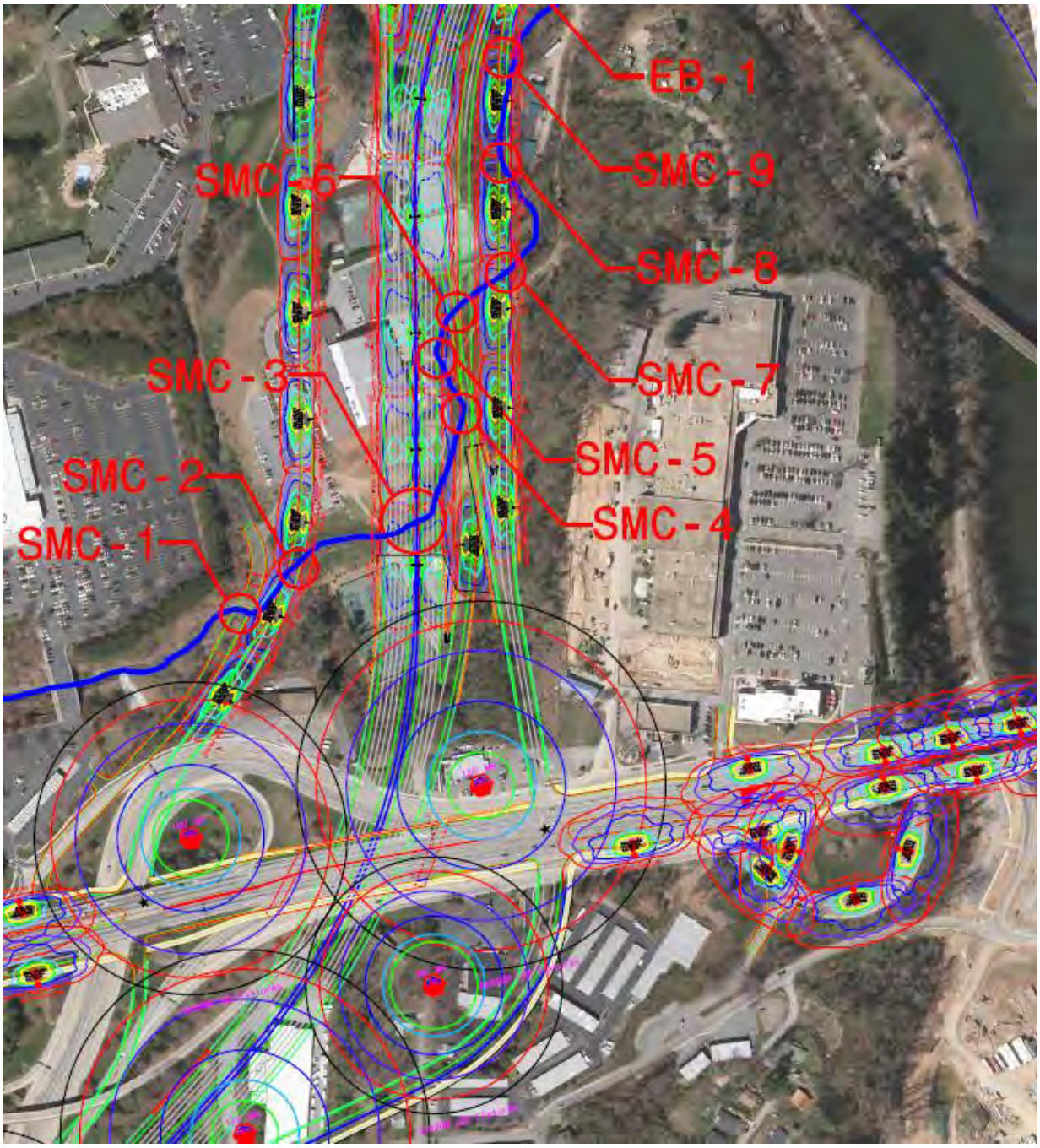


Figure 20: Mitigation lighting layout at Smith Mill Creek and Emma Branch crossings.

I-26/I-240/Patton Avenue Connector

This 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 as shown below. Since there were no stream crossings identified in this area, there were no lighting mitigation efforts.

Figure 21: I-26/I-240/Patton Avenue Connector lighting layout.

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. These high masts flooded the mainline, Hill Street and the surrounding area with light.

Figure 22: Original lighting layout at Hill Street culvert inlet.

To address mitigation efforts and better align with the NCDOT Roadway Lighting Policy of NCDOT owned lighting inside of the controlled access (C/A) area, the high mast poles were removed and were replaced with GE light fixtures installed on twin arm poles on the mainline median barrier.

Currently the city has installed LED lighting on Houston Street north of the culvert inlet, as well on the unnamed road that leads to the back entrance of Isaac Dickson Elementary School just south of the culvert opening.

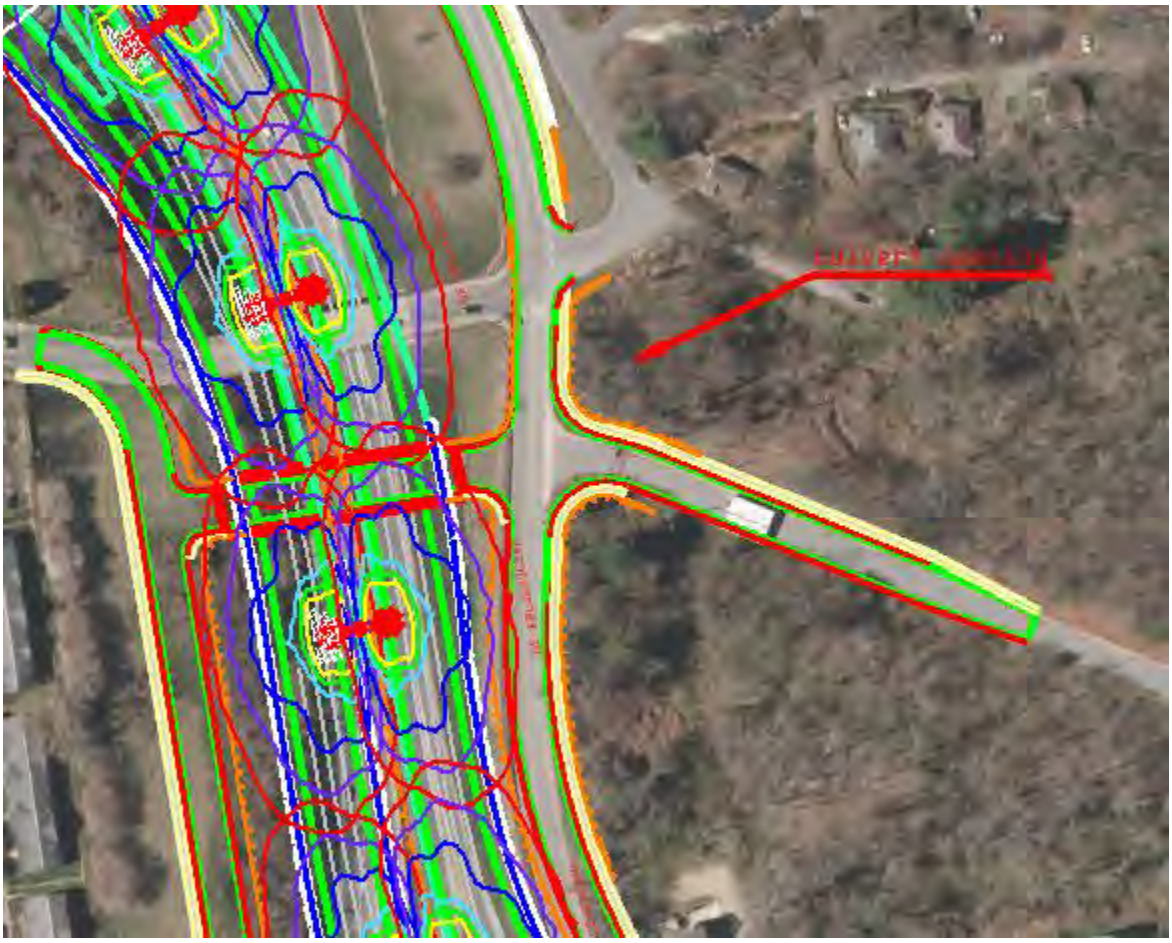


Figure 23: Mitigation lighting layout at Hill Street culvert inlet.

Smith Mill Creek Culvert at I-26/Patton Avenue Interchange

There is a culvert entrance approximately 40' from the existing overhead sign structure crossing the ramp from Patton Avenue to I-26 East. In the current configuration, the last roadway lighting pole on the ramp is approximately 300' from the overhead sign structure. Additionally, there is also a high mast pole in the center of the loop from I-26 East to Patton Avenue. 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 lighting system is currently not operational and is under repair, with full functionality expected by the end of 2019.

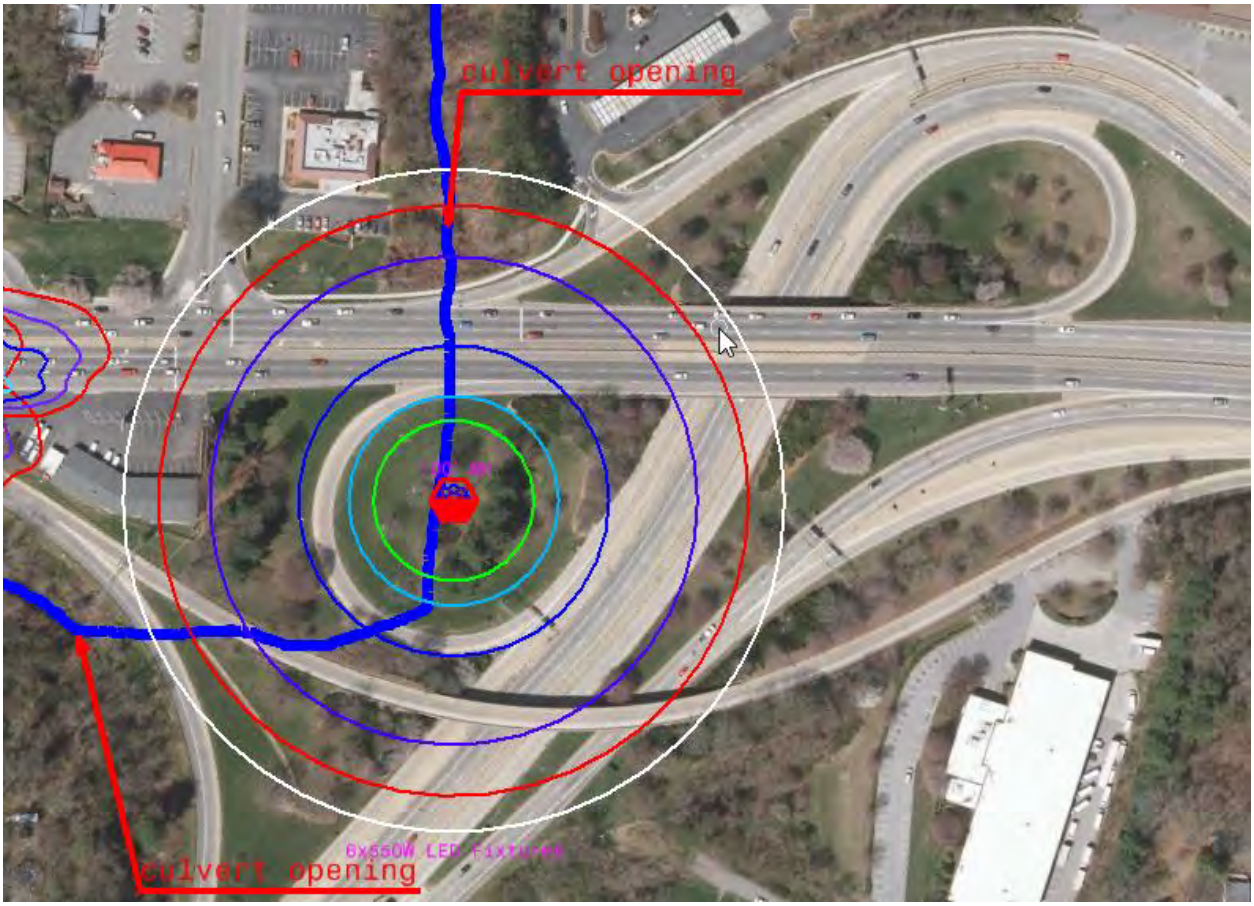


Figure 24: Existing lighting layout at Smith Mill Creek culvert at I-26/Patton Avenue Interchange.

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 opening.

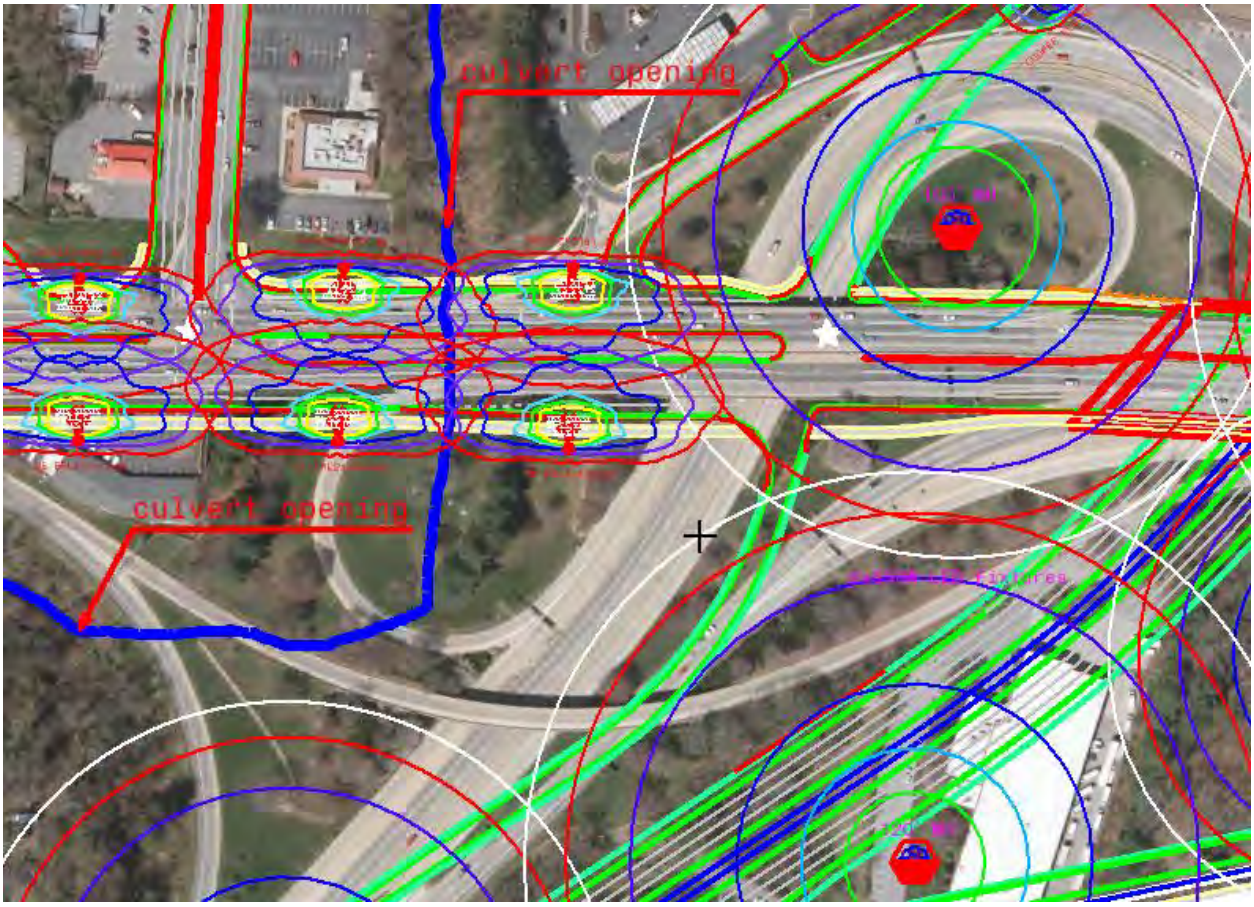


Figure 25: Proposed lighting layout at Smith Mill Creek culvert after interchange reconfiguration.

Appendix K. Light and Noise at bridge construction/demolition

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:

Anticipated light from activities is listed in red, noise is listed in blue.

- 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.
    - 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.
    - 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.
    - 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.
    - 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.
    - 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.

    - 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.
    - 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. 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.
    - 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.
- 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

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.
- 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.

Appendix L. Summary of events at the Hill Street Culvert

Timeline of notable events associated with the Hill Street culvert roost

- 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 10 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, 27 adult male, and 7 juvenile MYGR
- August 6, 2018: Trapping yielded 2 adult female, 17 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 1, 2018: Trapping yielded 4 adult female and 33 adult male MYGR
- October 8, 2018: Trapping yielded 12 adult male MYGR
- October 10, 2018: Trapping yielded 1 adult female and 20 adult male MYGR
- October 11, 2018: Substantial flooding; backwater from French Broad River
- October 19, 2018: Trapping yielded 4 adult male MYGR
- October 25, 2018: Trapping yielded 1 recapture adult male MYGR
- 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, NCWRC & USFWS 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.

Biological Opinion and Conference Opinion

Addendum to the June 19, 2020 Biological Opinion for I-26 Connector from I-40 to US 19/23/70 North of Asheville, Buncombe County, North Carolina

Service Log #02-252
NCDOT STIP I-2513; WBS Element #34165.1.1

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Consultation History

June 19, 2020:	U.S. Fish and Wildlife Service (Service) issued a Biological Opinion (2020 BO) for the subject project and provided the signed document to the North Carolina Department of Transportation (NCDOT).
November 10, 2022:	NCDOT requested modification to language in select lighting commitments in the 2020 BO.
December 21, 2022:	Service issued a Modification and Clarification to the 2020 BO regarding lighting commitments.
May 2, 2023:	NCDOT requested to use the Federal Highway Administration (FHWA) programmatic framework for northern long-eared bat (*Myotis septentrionalis,* MYSE) consultation.
May 31, 2023:	Service provided NCDOT with issue list regarding use of FHWA programmatic consultation for MYSE consultation, resulting in the programmatic not being used.
June 20, 2023:	Meeting with NCDOT and Service to review conservation measures associated with the 2020 BO.
June 22, 2023:	NCDOT provided Service with lighting design draft and requested comments within15 days.
July 5, 2023:	Service provided NCDOT list of topics regarding listed and proposed bat species in relation to the subject project consultation and regarding handling of acoustic records.
July 5, 2023:	Service responded to NCDOT with lighting comments and additional questions.
July 24, 2023:	NCDOT provided the Service a draft addendum Biological Assessment (BA) for the subject project to address tree-roosting bat species within the action area.
July 25, 2023:	Service provided receipt verification to NCDOT.
August 10, 2023:	Service provided NCDOT with request for additional information.
August 15, 2023:	NCDOT provided Service with updated addendum BA.
August 23, 2023:	Service and NCDOT met virtually to discuss monitoring commitments and fund contribution amount.
October 10, 2023:	Service attended a virtual meeting with NCDOT to review lighting and tree clearing depictions on project figures.
October 11, 2023:	NCDOT provided Service with document compiling current consultation topics.
October 30, 2023:	Service provided NCDOT with comments on selected conservation measures, including the proposed telemetry study. NCDOT provided a response on the same date.
November 1, 2023:	NCDOT provided complete figures depicting lighting, tree clearing, and hydrography within action area, completing the updated addendum BA.
November 6, 2023:	NCDOT provided request to amend a conservation measure from original 2020 BO to edit language regarding causeway configuration.
November 9, 2023:	Service responded to NCDOT that we accept the proposed language edit.

Biological Opinion and Conference Opinion

1. Introduction

A biological opinion is the document that states the opinion of the Service in accordance with section 7 of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531-1543) (ESA), as to whether a Federal action is likely to jeopardize the continued existence of species listed as endangered or threatened; or result in the destruction or adverse modification of designated critical habitat. A conference opinion is the document that states the opinion of the Service in accordance with section 7 of the ESA, as to whether a Federal action is likely to jeopardize the continued existence of species proposed for listing. A conference opinion (CO) is equivalent to a biological opinion but addresses species that are not yet listed under the ESA and/or proposed critical habitats not yet designated. Therefore, the ESA prohibitions against jeopardy, adverse modification, and taking do not yet apply. The Service may adopt a CO as a biological opinion if the evaluated species/critical habitat are eventually listed/designated and while the action agency maintains discretion and involvement in the action.

This document transmits the Service's biological opinion and conference opinion (Opinion) based on our review of the proposed improvements and upgrades to 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, and its effects on the Federally endangered Indiana bat (*Myotis sodalis*, MYSO), Federally endangered northern long-eared bat (*Myotis septentrionalis*, MYSE), proposed endangered tricolored bat (*Perimyotis subflavus*, PESU), and at-risk little brown bat (*Myotis lucifugus*, MYLU). This Opinion is based on information provided in the addendum BA submitted to the Service by the NCDOT, field investigations, email communications between NCDOT and the Service, communications with experts on the affected species, and other sources of information as cited. The FHWA is the lead Federal action agency for this project, with authority delegated to the NCDOT.

Formal consultation occurred for this project during 2019-2020 and a biological opinion was issued for Federally endangered Appalachian elktoe (*Alasmidonta raveneliana*) and Federally endangered gray bat (*Myotis grisescens,* MYGR) on June 19, 2020. The project is expected to begin construction in 2024. In the time since the 2020 BO was issued, the Service has implemented several listing changes and species data for the project area has been updated. Those updates are as follows:

Acoustic data obtained from surveys conducted during a study on MYGR within the action area indicates potential presence of MYSO. Those acoustic records will be manually vetted, though that process is not yet complete at the time of this document. NCDOT assumes presence of MYSO within the action area and includes it in this consultation reinitiation to address impacts to the species.

MYSE was reclassified from threatened to endangered, as published in the *Federal Register* on November 30, 2022; effective on March 31, 2023. At the time of the 2020 BO, the proposed action was determined to be consistent with the final Section 4(d) rule for MYSE, codified at 50 C.F.R. § 17.40(o) and effective February 16, 2016. The reclassification removed the 4(d) rule and, given the reclassification of MYSE as Federally endangered, NCDOT reinitiated consultation to address impacts to this species.

On September 13, 2022, the Service announced a proposal to list PESU as endangered. Given the listing proposal and associated decision timeline, NCDOT requested to conference on PESU in the reinitiation to address impacts to the species.

In April 2023, the Service published an update to its National Listing Workplan (Workplan), which projects the anticipated timeline for listing-related decisions over the next five years (2023-2027). The

Workplan indicates a proposed listing determination for MYLU in 2024. Given the potential listing of MYLU, NCDOT included it in the consultation reinitiation to address potential impacts to the species.

Presence is assumed for these four species within the action area.

2. Proposed Action

As defined in the Service's section 7 regulations (50 CFR 402.02), "*action*" means "*all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by Federal agencies in the United States or upon the high seas*." The "*action area*" is defined as "*all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action*." The direct and indirect effects of the actions and activities must be considered in conjunction with the effects of other past and present Federal, state, or private activities, as well as the cumulative effects of reasonably certain future state or private activities within the action area.

2.1 Action Area

No changes from 2020 BO. See Appendix A, Figure 3.

2.2 Project Description

No changes from 2020 BO, with the exception of the following:

NCDOT incorporated additional lighting minimization measures on behalf of bat species. Those measures are discussed below in the Conservation Measures section 2.3.2.5.

Additional information on tree clearing is shared here given its relevance to the biology of MYSO, MYSE, PESU, and MYLU. Based on the most circuitous alternative and widest slope stakes, the total limits of tree clearing are estimated at 211 acres for the entire project. The addendum BA states that actual tree-clearing will be much less in total as design plans are developed and refined. Forested areas to be cleared include riparian, upland, fragmented, and portions of intact swaths of forest (Appendix B, Figures 1-19). Tree clearing may occur during any time of year.

The project's proposed lighting and clearing areas as they relate to the surrounding landscape and hydrology features are displayed in Appendix B, Figures 1-19.

2.3 Conservation Measures

Conservation measures (CMs) represent actions, pledged in the project description, that the action agency will implement to minimize the effects of the proposed action and further the recovery of the species under review. Such measures should be closely related to the action and should be achievable within the authority of the action agency. We consider the beneficial effects of conservation measures in making our determination of whether the project will jeopardize the species.

The Service and NCDOT developed CMs and avoidance and minimization measures (AMMs) for MYGR which were included in the 2020 BO to minimize impacts from project construction and further species recovery. The effects of project actions discussed in the 2019 BA/2020 BO on MYGR are similar to the effects on MYSO, MYSE, PESU, and MYLU. Because of these similarities in effects, many of the CMs included for MYGR in the 2020 BO are expected to be protective of these four species as well. Therefore, the CMs and AMMs for MYGR in the 2020 BO are also considered applicable to MYSO,

MYSE, PESU, and MYLU. The CMs in the 2020 BO remain valid and are included as Appendix D in this document.

2.3.1 Modified Conservation Measures and Commitments

Modifications to commitments made in the 2020 BO are as follows:

2.3.1.1 Causeway Language Update

The original measure in the 2020 BO, *2.3.4.2 Causeways – French Broad River, Hominy Creek, and Smith Mill Creek* states:

- 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 U.S. Army Corps of Engineers and Service prior to permitting.

The updated *2.3.4.2 Causeways – French Broad River, Hominy Creek, and Smith Mill Creek* states:

- Causeways will not restrict more than 50% of the river or stream flow 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.

This adjustment was made given the understanding that "river or stream flow" is considered a more accurate measure than "river or channel width" by the NCDOT Assistant State Hydraulics Engineer.

2.3.1.2 Monitoring of Bat Activity Updates

Previous work conducted by NCDOT and Indiana State University has greatly advanced our knowledge of the MYGR population in the French Broad River watershed since the 2020 BO measures were written. For this reason, as well as a lack of ideal sites at which to conduct some of the agreed-upon measures (e.g. acoustics and night-vision video recording that would provide new information), several of the commitments have been adjusted or removed in order to better focus resources on current research questions and conservation efforts. Those changes are listed below.

CM *2.3.1.1 Timing of Construction* describes monitoring commitments that are updated below based on data obtained in the years since the 2020 BO.

- Original Measure: NCDOT will monitor bat activity at the [Hill Street] culvert before, during, and after construction. Acoustic monitoring and/or emergence surveys will be conducted between March and November.
- Update: Based on recent data, the Service, North Carolina Wildlife Resources Commission (NCWRC), and NCDOT decided the best approach to monitoring the culvert would be through a combination of daytime visual surveys within the culvert and acoustic surveys. Visual surveys will be conducted two times per year during the active season (pre- and post-volancy) before, during, and after construction. If visual surveys discover large numbers of roosting bats, counts will switch to emergence surveys. Acoustic monitoring should occur throughout the active season (March 1 – November 15) at the culvert before, during, and post construction with detectors placed at the inlet and outlet. NCDOT will coordinate these monitoring efforts, including the preferred points of ingress and egress, ahead of time with the Service and NCWRC.

CM *2.3.7.1 Monitoring for MYGR Return and Activity* and Term & Condition 10 in the 2020 BO present monitoring activities that can now be adjusted due to species information gained on MYGR over the past several years since the original consultation took place.

- Original Measure: 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.

- Update: The above measure is no longer necessary, as described above.
- Original Measure: To help determine whether MYGR avoid active construction zones [including bridges and the Hill Street culvert roost] 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.
- Update: The use of night vision recording at active construction zones (including bridges and the Hill Street culvert) is no longer necessary. The original commitment was to see if MYGR avoid active construction zones at night. This was investigated via the night vision work conducted by NCDOT at the I-26 bridge over the French Broad River (NCDOT project I-4400/I-4700) and additional work on this is not needed. It was also determined that there weren't other locations like the (I-4400/I-4700) I-26 bridge that lend themselves to successfully doing this type of work.
- Original Measure: (As stated in T&C 10) NCDOT will conduct additional monitoring/research to include telemetry, coordinated monitoring of roosts, monitoring of new panels, basin-wide acoustics to be conducted at key points during and after construction. The details of additional monitoring will be decided by a committee to include USFWS, NCWRC and NCDOT. Information gathered will be used to increase our knowledge of impacts to bats to help inform future consultation, to learn more about gray bats in the project area, to better conserve the species, and to track movements of [MYGR] bats and hopefully determine where bats go if they abandon the culvert roost and/or the area.
- Update: Only the coordinated monitoring of roosts and roost panel monitoring aspects of this measure remain valid. As stated above, information gained on MYGR in the French Broad River basin over the past several years obviates the need to pursue additional monitoring as described in the original measure. Coordinated monitoring in the form of emergence surveys will be conducted at primary bridge roosts. Survey methods will be coordinated with the Service, NCWRC and NCDOT. Surveys will occur two times per summer and will take place in 2024 and 2025 (pre-construction), then four times every other year during project construction, then two years after construction.

2.3.2 Added Conservation Measures

Additional CMs specific to the four bat species addressed in this Opinion are numbered below. The following AMMs and CMs (listed generally as CMs) shall be applied in addition to the measures in the 2020 BO:

2.3.2.1 Tree Clearing Minimization

The wooded buffer along Hominy Creek between the existing right-of-way and Hominy Creek will remain intact. Two locations will have stone rip rap installed at the outlets of two pipes (-RPD- Sta. 23+25.27). Some trees may be trimmed or removed to create an entrance point for the rip rap installation, however, the clearing for the two rip rap installations will be minimal and temporary, and vegetation will return. These two locations are adjacent to a maintained clearing for overhead electric transmission lines. An additional two areas involve clearing within the existing right-of-way to install ditches. The wooded area between the existing right-of-way and Hominy Creek will remain unaffected, which is expected to block lighting from the roadway. Clearing at this location is depicted via pink dashed lines in Appendix B, Figures 12 and 13.

2.3.2.2 Bat Telemetry Study

NCDOT, in coordination with FHWA, shall manage a contract funding a research institution to conduct a 2-year-minimum telemetry study focused on the subject bat species within a 30-mile radius of the I-26 Connector project, with the goal of finding roosting locations and gaining information about commuting

and foraging areas and habitat use. The research will include work to capture focal species (MYSO, MYSE, PESU, MYLU) to transmitter/track. Work may involve using acoustics to identify areas of high focal species activity and netting those locations, searching bridges and culverts, and netting nearby known occupied areas as well as Hominy Creek. Additionally, bats could be captured at nearby hibernacula in early spring to track where they go in the summer. Active ground telemetry, aerial telemetry, and fixed tower telemetry may be utilized. The structure and details of the study design and research decisions will be decided by a committee to include the Service, NCWRC, NCDOT, and the contracted researcher(s).

2.3.2.3 Structure Surveys

a) NCDOT shall survey bridges and culverts that meet the criteria detailed in the Standard Operating Procedures: NCDOT Preliminary Bat Habitat Assessments (Structures, Caves, and Mines) (NCDOT 2015), within 2 years of construction for each phase of the project. This measure applies to structures that are proposed for modification or replacement. CM 2.3.3.3 *Pre-Demolition Check for Bats* in the 2020 BO remains valid.
b) NCDOT shall conduct a 2023/2024 winter survey within the 15 originally surveyed culverts most suitable for winter roosting by PESUs and five smaller culverts that have features of high thermal stability that could support cold weather PESU roosting (e.g., concrete with longer lengths). NCDOT will involve the Service in deciding which five smaller culverts to survey.

2.3.2.4 Roost Panel Monitoring

NCDOT's monitoring plan of the Modern Bat Modular Roost Panels as described in the Terms and Conditions outlined in the 2020 BO shall include the Pratt-Whitney roost panels placed on the Biltmore Farms bridge (E. Frederick Law Olmsted Way) over the French Broad River.

2.3.2.5 Bat Conservation Funding

NCDOT shall contribute $150,000 to the NCWRC's North Carolina Non-Game and Aquatics Project Fund (NCNGAPF) to support conservation and recovery efforts for MYSO, MYSE, PESU, and MYLU. This fund and its dispensation will be managed by the Service and NCWRC. At the time of this document, the NCNGAPF has not yet been officially approved, though that approval is expected in 2024.

2.3.2.5 Lighting

a) Smokey Park Highway Interchange:
    - Lighting at Ragsdale Creek shall not change from baseline condition. The current lighting will remain and the project will not result in changes or increases to the amount of light reaching Ragsdale Creek.
    - All new low level and high mast lighting installed by NCDOT for I-2513 A, B, C, and D sections shall be 3,000K color temperature, with the exception of the new ramp along Smokey Park Highway.
b) I-26/I-40 Interchange Ramp East of Sand Hill Road:
    - The lighting fixtures installed at this location shall be 3,000K. This is a reduction from the existing lighting of 4000K.
    - At Trent Branch, high mast poles shall be reduced from existing conditions. At least four high mast poles shall be removed at this location. Replacement lighting shall be on single arm poles to the west of Trent Branch. This updated lighting configuration is designed to reduce lighting on Trent Branch.
c) I-26/I-40 Interchange North of Pond Road:
    - Lighting adjacent to Hominy Creek shall be decreased from existing conditions. The existing lighting at this location is 400-watt high pressure sodium (HPS) with dropped glass lenses. Such fixtures typically produce 50,000 lumens of light each. The light-emitting diode (LED)

replacement fixtures will produce less than 35,000 each. The LED fixtures have directional optics which enable light to be directed toward the road, as opposed to the HPS in dropped glass lens fixtures which result in more scattered light.

3. Status of the Species

3.1 Indiana Bat

Scientific Name: *Myotis sodalis*
Status: Endangered
Date of Listing: March 11, 1967
Critical Habitat: September 24, 1967

3.1.1 Description and Life History

MYSO is a medium-sized bat that closely resembles the MYLU but has a chestnut brown to dark gray pelage. MYSO average life span is 5-10 years, but recapture of banded individuals has documented MYSO up to 15 years old (Humphrey and Cope 1977). Hall (1962), Myers (1964), and LaVal and LaVal (1980) report sex ratios of 1:1 for the MYSO. MYSO is an insectivorous migratory species that hibernates in caves and mines during winter and forages in wooded areas, particularly riparian areas (LaVal *et al*. 1977), during summer. Foraging activity and travel is mostly nocturnal. The key phases in the MYSO annual life cycle, with dates applicable to western North Carolina (Susan Cameron, personal communication, 2023) are: Hibernation, inactive season: Oct 15 to April 1; Spring staging and migration, active season: April 1 to May 15; Pregnancy and lactation, maternity season: May 15 to August 15; Pup volancy (able to fly), maternity season: July; Fall migration and mating (swarming), active season: August 15 to October 15.

MYSO generally hibernates from mid-fall to mid-spring each year in caves and mines, though timing varies with latitude and weather conditions. Upon emerging from hibernation, bats forage for a few days or weeks near their hibernaculum (spring staging). During spring staging, MYSO roost in trees and forage in habitats that are similar to their summer habitats, within five miles of their hibernaculum. Female MYSO commonly migrate hundreds of miles from their hibernacula and are pregnant when they reach summer areas (Service 2007). Males tend to stay closer to hibernacula during summer. Spring migration occurs when fat reserves are depleted from hibernation, prey abundance is low, and females are pregnant; therefore, spring migration is possibly the most stressful period in the MYSO's life cycle.

Most MYSO maternity colonies contain fewer than 100 adult females (Service 2007). A MYSO maternity colony in Indiana averaged 50 to 80 adult females (Whitaker and Brack 2002). A study by O'Keefe and Loeb (2017) suggests maternity roosts in the Appalachian Mountains may be smaller, typically less than 25 bats (range 1-126 bats), with an average of 18.4 bats emerging from a maternity roost each night. Adult females give birth to a single pup in late May to early June (Humphrey *et al*. 1977). Pups are weaned from nursing shortly after, becoming volant in mid- to late-July.

In summer, most reproductive females occupy roost sites under the exfoliating bark of dead trees that retain large, thick slabs of peeling bark. Primary roosts usually receive direct sunlight for more than half the day. Roost trees are typically within canopy gaps in a forest, on a fence line, or along a wooded edge (Service 2007). MYSO maternity colonies have been reported to switch between roosts every two to three days (Foster and Kurta 1999; Kurta et al. 2002; Carter and Feldhamer 2005; Kurta 2005; O'Keefe and Loeb 2017). The species exhibits a high degree of inter-annual fidelity to particular roost trees, maternity areas, or both (Humphrey *et al.* 1977; Gardner *et al.* 1991a, 1991b, 1996; Callahan *et al.* 1997). Males are rarely found roosting with females in MYSO maternity colonies.

Summer habitats for the MYSO consists of a wide variety of forested areas where they roost, forage, and travel. These habitats may include portions of adjacent and interspersed non-forested areas such as wetlands, the edges of agricultural fields, old fields, and pastures. Areas containing potential roosts include forests and woodlots, as well as linear features such as fencerows, riparian forests, and other wooded corridors. Tree density and canopy cover in areas used for roosting or foraging is variable. MYSOs are known to use a wide variety of tree species ≥ 5 inches diameter at breast height (DBH) that have cracks, crevices, or peeling bark for roost trees. A typical MYSO primary roost is located under the exfoliating bark of a dead ash (*Fraxinus* spp.), elm (*Ulmus* spp.), hickory (*Carya* spp.), maple (*Acer* spp.), oak, or poplar (*Populus* spp.), but any tree that retains large, thick slabs of peeling bark is potentially suitable. MYSOs in a study located in the Appalachians primarily used yellow pine snags O'Keefe et al. 2017), which is a departure from what has been observed for MYSO maternity colonies in the Midwest and Northeast . Primary roosts are usually in trees that are in early-to-mid stages of decay (Gardner *et al*. 1991a).

Adult and juvenile MYSOs have been found roosting in human-made structures including bridges (Joey Weber, personal communication, 2019; Service 2007), buildings, utility poles, bat houses (Service 2007), and culverts (Service 2022). Use of only two culverts has been documented. MYSO were found in an Indiana culvert in September 2014 and were more recently found winter roosting in a triple box culvert in Georgia (Service 2022).

While wing morphology of the MYSO suggests that the species is adapted to moving in and tolerating some cluttered habitats (Norberg and Rayner 1987), it is more often detected along forest edges, forest openings, and corridors (Sparks *et al*. 2005). Many species of bats, including the MYSO, consistently avoid crossing or foraging in large open areas, choosing instead to use tree-lined pathways or small openings (Patriquin and Barclay 2003; Yates and Muzika 2006).

Fall migration occurs following summer months spent foraging and building up fat reserves. Upon arriving at their winter hibernaculum from summer habitats, the species exhibits swarming behavior in the vicinity of the hibernaculum. MYSOs roost in trees and forage in habitats that are similar to their summer habitats, typically within five miles of their hibernaculum. Fall swarming continues for several weeks and mating occurs during the latter part of the period. After mating, females enter hibernation, but not necessarily at the same hibernaculum where mating occurred.

Home range, the area in which an MYSO forages, commutes, and roosts, may vary in size between seasons, sexes, and reproductive status of the females (Lacki *et al*. 2009). Observed home ranges from studies tracking individual MYSOs associated with maternity colonies vary widely (205.1 to 827.8 ac) (Menzel et al. 2005; Sparks et al. 2005; Watrous et al. 2006; Jachowski et al. 2014; Kniowski and Gehrt 2014). Colonies have larger home ranges than individual bats with areas of overlapping core roosting and foraging areas and areas that do not overlap. Since early radio-tracking studies in Illinois, it has become standard practice for Service Field Offices to assume that a MYSO maternity colony will utilize suitable habitat within about 2.5 miles of its primary roost tree(s)/focal roosting area (Service 2020), an area of 12,563 acres. Based on data provided in the MYSO draft revised recovery plan (Service 2007), a maternity colony needs at least 10 percent suitable habitat (*i.e*., forested habitat that provides adequate roost sites and foraging areas) to exist at a given point on the landscape.

3.1.2 Population Size

The 2019 (most current) range-wide MYSO population estimate was approximately 537,297 bats with 71% of these bats hibernating in sites located in Missouri and Indiana (36.3% and 34.4%, respectively). The 2019 range-wide population declined an additional 4% from the 2017 estimate and represented a 19% decline since the arrival of WNS in New York in 2007. As of 2022, the population in the

Appalachian Mountain Recovery Unit was 1,464 individuals. As of 2022, the Service estimates the winter range-wide population at 596,431 MYSO. MYSO are concentrated in relatively few hibernacula during the winter. Biennial winter surveys in 2019 estimated MYSO in 223 hibernacula in 16 states, which decreased in 2022, to 166 hibernacula in 15 states. Four states accounted for over 95% of the total population estimate: Missouri, Indiana, Illinois, and Kentucky (Service 2019a, Service, unpublished data, February 2, 2023).

Using a 1:1 female to male sex ratio and an average maternity colony size of 50 adult females, the 2019 winter survey population estimate yields an estimate of 5,370 maternity colonies (Service 2019b). The 269 MYSO maternity colonies known as of 2007 represent only five percent of the possible total. While additional maternity colonies have been found since that time, known colonies still represents a small percentage of what exists.

Range-wide population data based on winter hibernacula counts are completed every two years. The biennial population estimates increased from 2001 to 2007, suggesting that the species' long-term decline had been reversed (Service 2017). The decline since 2007 is likely attributable to WNS. The estimated population in the Appalachian Mountain Recovery Unit decreased by 26.7% from 2019 estimates and has declined by 93.4% since 2007. The most dramatic declines in the number of occupied hibernacula have occurred in the Northeast and Appalachia Mountain Recovery Units (Service 2019b, Service, unpublished data, February 2, 2023).

3.1.3 Distribution

The overall geographic range and distribution of winter habitat has changed relatively little since the MYSO was first listed. "Extant" winter populations presently occur in 18 states (Service 2019a, Service 2019b). The species has shown some expansion in its winter range beyond its historical winter limits as a result of occupying human-made hibernacula (for example, mines, tunnels, and a dam) (Service 2019b). There are five priority four hibernacula in North Carolina though several are historic and only one has been used by MYSO since the arrival of WNS in the winter of 2010 and 2011 in Western North Carolina (Service, unpublished data, February 2, 2023).

Because maternity colonies are widely dispersed during the summer and difficult to locate, all the combined summer survey efforts have found only a fraction of the colonies presumed to exist (based on range-wide population estimates derived from winter hibernacula surveys). Surveys continue to discover maternity colonies. Biologists in North Carolina documented two adult and one juvenile MYSO under a bridge in Haywood County, North Carolina in July 2021 (Mary Frazer, personal communication, July 16, 2021). However, the Service has not compiled a range-wide estimate of maternity colonies or summer populations since 2007.

The 2007 recovery plan established four Recovery Units for the species: Ozark Central, Midwest, Appalachian Mountains, and Northeast. The proposed delineation of the Appalachian Mountain Recovery Unit is based on Bailey's Central Appalachian Broadleaf Forest Province with some exceptions in the eastern-most counties in Tennessee (Service 2007). All of the MYSO's current range in Western North Carolina is part of the Appalachian Mountain Recovery Unit.

3.1.4 Threats

The conservation needs of and threats to the MYSO are discussed in detail in the 2007 Draft Recovery Plan (Service 2007) and the most recent 5-year review (Service 2019b). These documents describe WNS, forest fragmentation, habitat modification, habitat loss and degradation, hibernacula disturbance and alteration, environmental contaminants, and collisions with wind turbines as threats to MYSOs. While those threats related to or having the potential to occur as a result of the proposed project are the focus of the review, the threats of WNS and climate change are also briefly discussed. All of these threats are

described in the 2020 Opinion *Threats section* for the MYGR and are similar for MYSO except for the threats from WNS and forest modifications and some species-specific information, further discussed below.

White-nose Syndrome

In recent years, no other threat is more severe and immediate for the MYSO than WNS. WNS was first documented in North Carolina in 2010-2011 in multiple counties. Since first observed in New York in 2006, WNS has spread rapidly in bat populations. As of winter 2023, the causative WNS fungal pathogen, *Pseudogymnoascus destructans* (Pd), has spread to 43 states and eight Canadian provinces. WNS currently affects 12 species of bat (Service 2019b). The range-wide MYSO population has decreased by 19.2 percent from 2007 (that is, since arrival of WNS in New York State) to 2019 (Service 2019b).

WNS is the clear cause of the recent declines in MYSO numbers. In areas with WNS, there are additional energetic demands for MYSOs. For example, WNS-affected bats arouse more frequently than normal and, as a result, have fewer fat reserves than non-WNS-affected bats when they emerge from hibernation (Reeder et al. 2012, Warnecke et al. 2012) and have wing damage (Meteyer et al. 2009; Reichard and Kunz 2009) that makes flight (migration and foraging) more challenging. Females that survive the migration to their summer habitat must partition energy resources between foraging, keeping warm, successful pregnancy, pup-rearing, and healing.

Other stressors that had no discernable population-level impacts previously, combined with the impact of this disease, could become factors influencing MYSO probability of persistence in particular areas or regions. In general, smaller populations are more vulnerable to extirpation resulting from direct impacts or adverse habitat changes than larger populations, especially those that rely on colonial behaviors for critical life history functions. A single bat maternity colony, for example, reduced in size by WNS-related mortality and with the remaining individuals weakened by the disease, is much less likely to adapt to the loss or reduction of suitable roosting trees and foraging habitat in its traditional home range than a larger and healthier colony. Repeating this scenario with multiple colonies across a landscape could accelerate the population-level declines caused by WNS alone (Service 2019b).

Across the range of MYSO, it is critical to protect all WNS survivors. Surviving MYSO are emerging from hibernation in very poor condition and need every opportunity to clear themselves of infection to be able to survive and reproduce.

Forest Fragmentation and Habitat Modification

Forests used by foraging and roosting MYSO during spring, summer, and autumn have changed dramatically from pre-settlement conditions (Service 1999). The U.S. Forest Service summary of forest trends (USFS 2014) reported a decline in forest acreage from 1850 to the early 1900s, when forests were converted to other land cover types or many native plant communities were altered. Over the next century, other land cover types (mostly cropland) were converted to forest through tree planting or pioneer-field succession. From 2001 to 2006, the U.S. lost 1.2 percent of its total forest acreage, mostly in the Southeast and West. Interior forest (40-acre parcels comprised of at least 90 percent forest cover) experienced a net loss of 4.3 percent. Although it is difficult to quantify the resultant impacts, this forest fragmentation has resulted in modifications to MYSO habitat, especially summer habitat, and is suspected in contributing to the decline of MYSO populations (Service 1999).

Summer habitat can include extensive forests or small woodlots connected by hedgerows. The removal of such habitats is occurring rapidly in some portions of the MYSO's range due to residential and commercial development, mining, oil and gas development, and infrastructure development, including roadways and utility corridors. Even in areas of relatively abundant habitat, permanent and temporary

impacts to forest habitat pose mortality risks to MYSOs during tree felling activities. Furthermore, the ongoing, permanent loss of forests and woodlots may have a significant cumulative effect on the species, as habitat is lost, fragmented, or degraded and as maternity colonies are displaced from habitat to which they exhibit fidelity (Service 2012).

Climate Change

The capacity of climate change to result in shifts in the range and distribution of wildlife species is recognized, but detailed assessments of how climate change may affect specific species, including MYSO, are limited. Bats are sensitive to changes in temperature, humidity, and precipitation (Adams and Hayes 2008). During winter, for example, only a small proportion of caves provide the right conditions for hibernating MYSO because of the species' very specific temperature and humidity requirements.

Climate change may affect bats through changes in food availability, timing of hibernation and reproductive cycles, frequency and duration of torpor, rates of energy expenditure, and rates of juvenile bat development (Sherwin *et al.* 2013). Surface temperature is directly related to cave temperature, so climate change that involves increased surface temperatures may affect the suitability of hibernacula. Climate change may, therefore, shift MYSO from southern to northern hibernacula (Clawson 2002). Loeb and Winters (2013) noted that while areas suitable for MYSO summer maternity colonies have been forecasted to decline significantly due to climate change, the northeastern and Appalachian regions of the U.S. have the potential to serve as climate refugia for MYSO and are predicted to continue to support the species. Impacts on the availability and timing of insect prey are also likely. Currently, however, the Service has no evidence demonstrating climate change impacts at a population-level to MYSOs. However, the rapid spread of WNS across the range of the species is likely to mask any effects of climate change on their status.

Lighting

The 5-Year Review (Service 2019b) lists light pollution as an emerging man-made threat to the MYSO.

Noise and Vibration

While noise and vibration are not mentioned in the 5-Year Review (Service 2019b) as threats to the MYSO, significant changes in noise levels in an area may result in temporary to permanent alteration of bat behaviors and their use of certain areas. Bats are also believed to habituate to noise (Service 2002, Service 2018). While roosts are typically located further from paved highways than from non-paved roads (Garner and Gardener 1992), MYSO tree roosts have been found within 213 feet (Service 2008) and 81 feet (Matthew Mangan and Catherine Liller, personal communication, July 27, 2022) of multi-lane paved interstates. Additionally, MYSO can continue to roost and forage in areas with active timber harvest operations (Gardner et al. 1991), and continue to occupy Fort Drum in areas located 400 to 800 m from multi-year construction projects (Service 2018).

3.2 Northern Long-eared Bat

Scientific Name: *Myotis septentrionalis*
Status: Endangered
Date of Listing: Listed Threatened: May 4, 2015; Listed Endangered: November 29, 2022
Critical Habitat: None Designated

3.2.1 Description and Life History

MYSE typically overwinters in caves or mines and spends the remainder of the year in forested habitats. The active season for MYSE in Western North Carolina is April 1 through October 15. While information is lacking, short regional migratory movements between seasonal habitats (summer roosts and winter hibernacula) of 35-55 miles have been documented (Griffin 1940, Caire et al. 1979, Nagorsen and Brigham 1993) and occur during the first part and last part of the active season outside of the

maternity season. The maternity season is May 15 through August 15 in Western North Carolina (Susan Cameron, personal communication). Adult females give birth to a single pup. Parturition (birth) may occur as early as late May or early June (Easterla 1968, Caire et al. 1979, Whitaker and Mumford 2009) and may occur as late as mid-July (Whitaker and Mumford 2009). Juvenile volancy (flight) often occurs 21 days after birth (Kunz 1971; Krochmal and Sparks 2007).

MYSE typically roost singly or in maternity colonies underneath bark or more often in cavities or crevices of both live trees and snags (Sasse and Pekins 1996, Foster and Kurta 1999, Owen et al. 2002, Carter and Feldhamer 2005, Perry and Thill 2007, Timpone et al. 2010). Males' and non-reproductive females' summer roost sites may also include cooler locations, including caves and mines (Barbour and Davis 1969, Amelon and Burhans 2006). MYSEs switch tree roosts often (Sasse and Pekins 1996), typically every two to three days (Foster and Kurta 1999, Owen et al. 2002, Carter and Feldhamer 2005, Timpone et al. 2010). Suitable summer habitat is extensively defined in the *Range-wide MYSO and MYSE Survey Guidelines*, which is updated annually (https://www.fws.gov/library/collections/range-wide-indiana-bat-and-northern-long-eared-bat-survey-guidelines).

Maternity colonies, consisting of females and young, are generally small, numbering from about 30 (Whitaker and Mumford 2009, p. 212) to 60 individuals (Caceres and Barclay 2000, p. 3); however, larger colonies of up to 100 adult females have been observed (Whitaker and Mumford 2009, p. 212). Summer home range includes both roosting and foraging areas, and range size may vary by sex). Minimum summer roosting areas range from 13-65 acres (Service 2022). Foraging areas are six or more times larger (Broders et al. 2006; Henderson and Broders 2008). The distance traveled between alternate roosts varies widely from 20 ft (Foster and Kurta 1999) to 2.4 mi (Timpone et al. 2010). Likewise, the distance traveled between roost trees and foraging areas in telemetry studies varies widely, e.g., a mean of 1,975 feet (Sasse and Perkins 1996) and a mean of 3,609 feet (Henderson and Broders 2008). Circles with a radius of these distances have an area of 281 and 939 ac, respectively.

MYSEs are nocturnal foragers and use hawking (catching insects in flight) and gleaning (picking insects from surfaces) behaviors in conjunction with passive acoustic cues (Nagorsen and Brigham 1993, Ratcliffe and Dawson 2003). The MYSE has a diverse diet including moths, flies, leafhoppers, caddisflies, and beetles (Griffith and Gates 1985, Nagorsen and Brigham 1993, Brack and Whitaker 2001), with diet composition differing geographically and seasonally (Brack and Whitaker 2001). Most foraging occurs above the understory, one to three m (3 to 10 ft) above the ground, but under the canopy (Nagorsen and Brigham 1993) on forested hillsides and ridges, rather than along riparian areas (LaVal et al. 1977, Brack and Whitaker 2001). This coincides with data indicating that mature forests are an important habitat type for foraging MYSEs (Caceres and Pybus 1997, White et al. 2017). Foraging also takes place over small forest clearings and water and along roads (van Zyll de Jong 1985). MYSEs seem to prefer intact mixed-type forests with small gaps (that is, forest trails, small roads, or forest-covered creeks) in forests with sparse or medium vegetation for forage and travel rather than fragmented habitat or areas that have been clear cut (Service 2015).

Artificial Roosts

MYSE have been observed roosting in human-made structures, such as buildings, barns, utility poles, , bridges, culverts, and bat houses (Mumford and Cope 1964, Barbour and Davis 1969, Cope and Humphrey 1972, Burke 1999, Sparks et al. 2004, Amelon and Burhans 2006, Whitaker and Mumford 2009, Timpone et al. 2010, Bohrman and Fecske 2013, Feldhamer et al. 2003, Sasse et al. 2014, Service 2015, Dowling ad O'Dell 2018). It has been hypothesized that use of human-made structures may occur in areas with fewer suitable roost trees (Henderson and Broders 2008, Dowling and O'Dell 2018). In northcentral West Virginia, MYSEs were found to more readily use artificial roosts as distance from large forests (greater than 494 acres) increased, suggesting that artificial roosts are less likely to be selected when there is greater availability of suitable roost trees (De La Cruz et al. 2018).

A July 2014 survey in Missouri found two MYSE in a culvert with an entrance measuring approximately 9 ft in diameter and 250 ft long (Droppelman 2014, L. Droppelman, personal communication, February 24, 2022). Winter 2014 surveys in Louisiana documented MYSE in seven concrete tube and box culverts ranging in size from 4.5 ft to 10.5 ft tall and 131 ft to 476 ft long. MYSE co-occurred in these culverts with southeastern myotis, PESUs, Rafinesque's big-eared bat, and big brown bats (Nikki Anderson, unpublished data, March 23, 2022). The species has not been found in culverts in Georgia (Emily Ferrall, personal communication, April 7, 2022), North Carolina (NCDOT 2022b), or Mississippi (Katelin Cross, personal communication, March 23, 2022). Published culvert records are limited for this species.

3.2.2 Population Size

Prior to 2006 (that is, before WNS was first documented), MYSE was abundant and widespread throughout much of its range (despite having low winter detectability) with 737 occupied hibernacula and a maximum count of 38,181 individuals (Table 1; Service 2022c). According to the SSA (Service 2022c), in 2020, the MYSE was projected to be detected in 139 hibernacula, with a median winter abundance of 19,356 individuals (Table 1; Service 2022c).

Available evidence, including both winter and summer data, indicates MYSE abundance has and will continue to decline substantially over the next ten years under current demographic conditions. Winter abundance (from known hibernacula) has declined range-wide (49%) and across most Representation Units (RPUs) (0–90%). In addition, the number of extant winter colonies declined range-wide (81%) and across all RPUs (40–88%). There has also been a noticeable shift towards smaller colony sizes, with a 96–100% decline in the number of large hibernacula (≥100 individuals). Declining trends in abundance and occurrence are also evident across much of the MYSE's summer range. Range-wide summer occupancy declined by 80% from 2010–2019. Data collected from mobile acoustic transects found a 79% decline in range-wide relative abundance from 2009–2019 and summer mist-net captures declined by 43–77% compared to pre-WNS capture rates (Service 2022c).

Table 1. Numbers of MYSE Adapted from Service (2022c)

Year	Range	# States	Spatial Extent	# Hibernacula	Winter Abundance
Prior to 2006 (Historical Condition)	Range-wide	29	1.2 billion acres	737	38,131 (max)
2020 (Projected)	Range-wide	18	644 million acres	139	19,356 (median)
Prior to 2006 (Historical Condition)	Southeast Unit			50	393 (max)
2020 (Projected)	Southeast Unit			1	Probability of population growth = 0

3.2.3 Distribution

MYSEs occur over much of the eastern and north-central U.S., and all Canadian provinces west to the southern Yukon Territory and eastern British Columbia (Nagorsen and Brigham 1993, Caceres and Pybus 1997, Environment Yukon 2011). In the U.S., the species' range reaches from Maine west to Montana, south to eastern Kansas, eastern Oklahoma, Arkansas, and east to South Carolina (Whitaker and Hamilton 1998, Caceres and Barclay 2000, Simmons 2005, Amelon and Burhans 2006). The species' range includes all or portions of 37 states and the District of Columbia. The species' range extends into the mountains of Western North Carolina but does not appear to include most of the Piedmont Ecoregion in

the state. The SSA splits the MYSE range-wide population into five representation units (RPUs), three of which occur in North Carolina: 1) Eastern Hardwoods RPU, 2) Southeast RPU, and 3) East Coast RPU. A population of MYSE was discovered in coastal North Carolina (East Coast RPU) in 2007 and has since been documented to extend into at least 27 coastal North Carolina counties.

3.2.4 Threats

Although there are countless stressors affecting MYSE, the primary factor influencing the viability of the species is WNS. Other primary factors that influence MYSE viability include wind energy mortality, effects from climate change, and habitat loss. Additional concerns relate to development and include roads, lighting, noise, and vibration (Rowse et al. 2016, Ramalho and Aguiar 2020). Lighting is increasingly being associated with negative outcomes for many species, including bats (Rowse et al. 2016), and has been "acknowledged as a threat to biodiversity" (Rowse et al. 2016 citing Hölker et al. 2010). These threats are discussed in the 2020 BO for MYGR and above for MYSO and can similarly apply to MYSE.

3.3 Tricolored bat

Scientific Name: *Perimyotis subflavus*
Status: Proposed Endangered
Date Proposed for Listing: September 14, 2022
Critical Habitat: None Proposed

A petition to list the PESU as threatened was received by the Service on June 16, 2016. On December 20, 2017, the Service found that the petition presented substantial scientific or commercial information indicating that the petitioned action may be warranted. The Service commenced a review (known as a 12-month finding) to determine if listing of the PESU is warranted. The Service proposed to list the species at endangered under the Endangered Species Act on 14 September 2022. The Service completed an SSA (Service 2021) but no conservation or recovery plans yet exist for this species.

3.3.1 Description and Life History

Migration

PESU have been documented to migrate between 13 and 149 miles (21 and 240 km) between winter and summer habitat (Griffin 1940; Griffin 1945; Cockrum 1956; Barbour and Davis 1969; Samoray et al. 2019; Wisconsin DNR 2017a). Species engaging in regional migration travel annually from hibernaculum to summer roosting sites, and then move among swarming locations in the autumn (Fenton 1969; Fraser et al. 2012; Hitchcock 1965). Recent research has led to some speculations that some individuals migrate farther distances than previously suspected, and that migratory behavior may differ between males and females (Davis 1959; Fraser et al. 2012). Fraser et al. (2012) investigated PESU migration by conducting stable hydrogen isotope analyses of 184 museum specimen fur samples and compared the results to published values of collection site growing season precipitation. Their results suggested that 33% of males and 16% of females collected during the postulated non-molt period were south of their location of fur growth. Fraser et al. (2012) also noted that if PESUs only engaged in regional migration, then evidence would be expected to show equal numbers of bats migrating north and south during the non-molt period. Respectively, Fraser et al. (2012) concluded that at least some PESUs, of both sexes, engage in latitudinal migration.

Hibernation

As cited in SSA (Service 2021), PESU are one of the first cave-hibernating species to enter hibernation in the fall and one of the last to leave in the spring in Missouri and Pennsylvania (LaVal and LaVal 1980, p. 29; Merritt 1987, p. 102). In the southern U.S., hibernation length is shorter compared to northern portions of the range and some PESU exhibit shorter torpor bouts and remain active and feed during the

winter (Layne 1992, pp. 43–44; Grider et al. 2016, p. 8; Limon et al. 2018, p. 219; Newman 2020, pp. 13–17; Stevens et al. 2020, p. 528). In addition to caves, PESUs use a wide variety of other hibernacula including mines (Whitaker and Stacy 1996, Brack 2007), storm sewers (Goehring 1954), box culverts (Sandel et al. 2001, Lutsch et al. 2022), and surge tunnels at quarries (Slider and Kurta 2011). Recent evidence indicates that PESUs also hibernate in rock faces in Nebraska (Lemen et al. 2016) and suggests that the species may have a wider winter range than previously suspected. Hibernating PESUs roost mostly singly but will form small clusters and often select a roost on the walls as opposed to the ceiling of the hibernaculum (Brack 1979, Kurta 2008). During hibernation, individuals arose every 15-25 days on average (Brack and Twente 1985). Throughout most of the range, they select relatively warm, stable sites often located further from the hibernaculum entrance than other bat species (Brack 2007).

Summer Habitat Use

PESUs primarily roost in trees during the active season, considered to be April 1 to October 15 in Western North Carolina. Maternity colonies are most likely to be found roosting in umbrella-shaped clusters of dead leaves, but may also be found in live leaf foliage, lichens, patches of pine needles caught in tree limbs, buildings, caves, bridges, culverts, and rock crevices (Humphrey 1975, Veilleux et al. 2003, Veilleux and Veilleux 2004a; b, Veilleux et al. 2004, Perry and Thill 2007, Newman et al. 2021). Perry and Thill (2007) suggest that PESU's yellow-brown coloration allows them to blend in with brown, dead leaf clusters imparting protection from visual predators. Oak (genus *Quercus*) and maple (*Acer*) trees are preferred by maternity colonies of PESUs presumably because the ends of the branches tend to have many leaves (Veilleux et al. 2003; 2004, Perry and Thill 2007), and thus maternity colonies are more often associated with uplands than bottomland forest. O'Keefe (2009) found male PESUs primarily in hickories, maples, and birches and not oaks. Veilleux et al. (2003) found 27% of PESU roosts in oak trees when oaks compromised only 3% of the available trees; others found at least 80% of PESU roosts in oaks (Leput 2004, Perry and Thill 2007). PESUs are known to forage near trees, as well as forest perimeters, and along waterways (Fujita and Kunz 1984).

Use of trees by PESU may occur in a relatively small area. One study found that the average distance between roost trees was 86 meters (m) (range 5-482 m) and between capture locations and roost trees was 2.5 kilometers (km) (range 165 to 2,290 m) (Schaefer 2016). "Roosting range" was between 0.005 acres (ac) and 10.9 ac for seven individuals (average=1.95 acres) (Schaefer 2016, p. 49). "Roost habitat area" or "minimum roost area" was 0.25 to 5.7 ac for four individuals (Veilleux and Veilleux 2004b). In Indiana, Veilleux and Veilleux (2004b) radio-tracked four PESUs to their respective roost trees and found that the minimum and maximum distances between roosts trees was 13 m and 926 m. A study in Nova Scotia found that the "roost area" for five maternity colonies using more than five trees (12 to 31 trees) varied from 4 - 191 ac, with a mean of 67.5 ac (Table 4 in Poissant 2009). In summary, a PESU maternity colony could have a roost area between 0.005 and 191 acres (Schaefer 2016, Veilleux and Veilleux 2004, Poissant 2009).

A study conducted in Arkansas radio-tagged 28 male and nine female PESUs and found that roost trees varied from one to three roost trees for males and one to five roost trees for females (Perry and Thill 2007b). Seven of 14 female roosts were colonies and based on exit counts and visible pups; the estimated number of bats (adults and pups) in colonies was three to 13, with an average of 6.9 bats (±1.5) (Perry and Thill 2007b). Other studies report maternity colony sizes of 3.7 individuals (Veillieux and Veillieux 2004b), 15 individuals (Whitaker and Hamilton 1998), and 18 individuals with an average of ten individuals (Poissant 2009). Perry and Thill (2007b) found males roosting in forested habitats also occupied by females, but primarily in solitary roosts. One study found that individuals within a roosting area or colony did not switch or overlap other roost areas or colonies though all individuals from all colonies shared foraging space (Poissant 2009).

In Indiana, female PESU maternity roosts occurred mostly in upland habitats (9.4%) as opposed to riparian (0.8%) and bottomland (0.2%) habitats (Veilleux et al. 2003). Preferred upland habitat by this species could be related to the greater availability of preferred roost tree species: white oak (Quercus alba), bur oak (*Quercus macrocarpa*), and red oak (*Quercus rubra*) (Veilleux et al. 2003). O'Keefe (2009) found that non-reproductive PESUs in North Carolina only roosted in forest stands older than 72 years, and preferentially roosted at lower elevations, closer to non-linear openings, and closer to streams than expected by random chance. Other researchers have found that at the stand level or greater, PESUs seem to roost selectively in more mature forest within riparian buffers or corridors (Perry and Thill 2007, O'Keefe 2009), within a diversity of patch types, farther than expected from roads (Perry et al. 2008), and in unharvested pine or pine-hardwood stands greater than or equal to 50 years old (94% of female roosts and 52% of male roosts, Perry and Thill 2007b). One small study in the Nantahala National Forest in Macon County, North Carolina found male PESU roosts were on average 136 m from roads or trails, and while the distance ranged from 4 to 285 m, 75% of the roads in the study area were gated grass-covered U.S. Forest Service roads with virtually no vehicular traffic (O'Keefe 2009). Other studies found PESU roosts on average 70 m and 52 m from edges (Leput 2004, Veilleux et al. 2003, respectively).

PESUs vary their roost position in the canopy and landscape depending on reproductive conditions. Reproductive female bats roost lower in the canopy and farther from forest edges than non-reproductive females. Veilleux and Veilleux (2004b) speculated that lower position in the canopy and greater distances from the forest edge may reduce wind exposure and allow for more stable temperatures. Gestation is typically 44 days (Wimsatt 1945), and females produce twin pups whose mass is approximately 44-54% of the size of the mother, a higher ratio than most Vespertilionid bats (Kurta and Kunz 1987). Young are volant at 3 weeks and act as adults around 4 weeks old (Hoying and Kunz 1998). Post-natal growth rates slow during cold snaps because the mothers cannot eat, and available energy is used for thermoregulation (Hoying and Kunz 1998). As with other species of bats, some male PESUs remain at hibernacula year-round (Whitaker and Rissler 1992). Most males roost in the same types of leaf clusters used by female PESUs (Veilleux and Veilleux 2004a), although they return to the same roost for multiple days, with one individual in Arkansas roosting in the same cluster for 33 days (Perry and Thill 2007). Male bats also select roosts in the same species of trees, although males tend to use thinner and shorter trees (Veilleux and Veilleux 2004a). Males also tend to roost at lower heights than females; often 16.4 feet (ft) (5 m) from the ground (Perry and Thill 2007).

Structures

There are numerous culvert records for this species across multiple states (NCDOT 2022b, Walker et al., 1996; Martin et al., 2005; Katzenmeyer, 2016, L. Smith, personal communication, 2022, Nikki Anderson, unpublished data, March 24, 2022). Katzenmeyer (2016), conducting winter surveys in Mississippi over five years, found PESUs in culverts as small as 2 ft tall and 30 ft long. PESUs use culverts in Florida as small as 3 ft tall by 60 ft long though smaller culverts are not surveyed. Preliminary analysis did not find an effect of culvert height or length on PESU presence in Florida (Smith, L. personal communication, March 9, 2022). The Louisiana Department of Wildlife and Fisheries has surveyed more than 1,000 culverts over three winters and found PESUs in 21% of them. Summer surveys of a much smaller number of culverts found the species in about 4% of surveyed culverts. The smallest culvert used by the species in Georgia is a 3 ft tall pipe culvert that is 388 ft long (Emily Ferrall, personal communication, April 7, 2022).

As of January 2023, NCDOT had 23 records of PESUs using 20 bridges and 7 culverts in western NC during the active season (April 1 to October 15). Of these 23 records, one was a maternity roost (1 female and 1 pup at a bridge between May 15 to Aug 15). The average roost size was 1.6 bats though 75% of the roost checks recorded just one PESU. The maximum summer roost size detected in North Carolina is seven PESUs. NCDOT had 17 records of PESU using 2 bridges and 11 culverts in western NC during the inactive season (October 16 – March 31). The maximum winter roost size detected was 12 in a culvert

(Sue Cameron, personal communication, January 10, 2023). In North Carolina, PESUs have been found in culverts with an opening as small as 29 inches tall (36-inch diameter culvert with 7 inches of fill and water; winter record) (Katherine Etchison, personal communication, January 24, 2023) by 46.4 ft long (winter record; Lauren Wilson, personal communication, February 23,2023).

3.3.2 Population Size

WNS has recently decimated PESU populations in several states. Before the onset of WNS, PESU was generally believed to be common and secure throughout most of its range in the eastern US (Benedict et al. 2000, Sparks and Choate 2000, Geluso et al. 2004). Prior to 2006, PESU was highly abundant and widespread, with over 140,000 bats observed hibernating in 1,951 known hibernacula spread across > 1 billion acres in 34 states and 1 Canadian province (Service 2021). Since the arrival of WNS, Cheng et al. (2021) estimates range-wide declines of 93% from 1995 to 2018 and a 59% overlap of species and WNS occurrence ranges. The range-wide population of PESUs is estimated to be 67,898 individuals as of 2020 (Service 2022b).

3.3.3 Distribution

PESUs are known from 39 States (from New Mexico north to Wyoming and all states to the east), Washington D.C., 4 Canadian Provinces (Ontario, Quebec, New Brunswick, Nova Scotia), and Guatemala, Honduras, Belize, Nicaragua, and Mexico. The species current distribution in New Mexico, Colorado, Wyoming, South Dakota, and Texas is the result of westward range expansion in recent decades (Geluso et al. 2005, Adams et al. 2018, Hanttula and Valdez 2021). They have also expanded into the Great Lakes Basin (Kurta et al. 2007; Slider and Kurta 2011). This expansion is largely attributed to increases in trees along rivers and increases in suitable winter roosting sites, such as abandoned mines and other human-made structures (Benedict et al. 2000, Geluso et al. 2005, Slider and Kurta 2011).

3.3.4 Threats

WNS is a threat to many bat species throughout North America. While WNS has been assumed to be the primary driver of bat population declines for many species in recent years, new research indicates that many factors are likely acting synergistically (Ingersoll et al. 2016). Bats are subject to a suite of severe threats (Mickleburgh et al. 1992, Hutson et al. 2001, Pierson 1998), including disturbance and altered microclimates of critical hibernacula and day roosts (Tuttle 1979, Neilson and Fenton 1994, Thomas 1995), loss and modification of foraging areas (Pierson 1998, Hein 2012, Jones et al. 2009), toxicity and changed prey composition and abundances from pesticide use and other chemical compounds (Shore and Rattner 2001, Clark 1988), direct or indirect chemical exposure leading to lethal or sublethal effects that eventually lead to death or reduced reproduction (Clark et al. 1978, Clark et al. 1980, Clark et al. 1982, Eidels et al. 2016), climate change primarily because temperature is an essential feature of both hibernacula and maternity roosts (Frick et al. 2010, Rodenhouse et al. 2009), and in-flight collisions with vehicles, buildings, and wind turbines (Russell et al. 2009, Arnett et al. 2008, Kunz et al. 2007). Bats are often subject to more than one of these threats simultaneously; such co-occurring threats may result in synergistic or interacting effects, with impacts more severe than from any single threat in isolation (Crain et al. 2008, Kannan et al. 2010, Laurance and Useche 2009, Harvell et al. 2002). Additional concerns relate to development and include roads, lighting, noise, and vibration (Rowse et al. 2016, Ramalho and Aguiar 2020). Lighting is increasingly being associated with negative outcomes for many species, including bats (Rowse et al. 2016), and has been “acknowledged as a threat to biodiversity” (Rowse et al. 2016 citing Hölker et al. 2010). These threats are discussed in the 2020 BO for MYGR and above for MYSO and can similarly apply to PESU.

3.4 Little Brown Bat

Scientific Name: *Myotis lucifugus*

Status: Under Review
Date Petitioned for Listing: Not Applicable
Critical Habitat: Not Applicable

This section summarizes best available data about the life history, population size, and distribution of and threats to the MYLU throughout its range that are relevant to formulating an opinion about the action. MYLU is currently undergoing a discretionary status review by the Service as listed on the Service's National Listing Workplan (Workplan). The Service anticipates determining if the species warrants listing under the Act in fiscal year 2024. Currently, no conservation or recovery plans exist for this species. Given the Workplan's information on a listing proposal timeline for MYLU, and considering the proposed multi-year timeline for construction of the subject project, NCDOT requested to include MYLU in this formal consultation.

3.4.1 Description and Life History

Migration

MYLUs migrate between subterranean habitats in winter to trees, anthropogenic structures (for example, buildings and woodpiles) (Humphrey and Cope 1976), and natural structures (for example, under rocks, in caves) during summer (Fenton and Barclay 1980). Spring migration occurs in parallel with staging with most bats moving from the hibernacula to the summer range in April and May. In the late summer and fall, individual MYLUs depart from summer roosts and migrate to a variety of transient roosts (Fenton and Barclay 1980) before arriving at winter hibernacula, between September and October (Saunders 1988).

As summarized in Kuntz and Reichard (2010), MYLU travel up to 186.4 miles from summer roosts (Davis and Hitchcock 1965; Fenton 1970; Griffin 1970; Humphrey and Cope 1976) or perhaps as far as 621.4 miles (Wilson and Ruff 1999). LaVal and LaVal (1980) found that of approximately 1,600 banded MYLUs, six bats made short migrations of approximately 25 miles (40.23 km), but two migrated approximately 150 miles (241.40 km). Myers (1964) banded 4,427 MYLUs in Missouri and adjacent states, 20 of which provided information on migration. Average migration distance was 94.3 miles (151.76 Km) with extremes of 18 (28.97 km) and 240 miles (386.24 km). Several other studies found hibernacula located up to 186 miles from summer roosts (Davis and Hitchcock 1965, Fenton 1970, Griffin 1970, Humphrey and Cope 1976) or perhaps as far as 621 miles (Wilson and Ruff 1999).

Summer Habitat

Most MYLUs roost in buildings, other anthropogenic structures such as bridges and bat boxes, tree cavities, and under exfoliating bark (Boyles et al. 2009). Maternity colonies typically contain 300 to 1,200 individuals (adults and offspring) (Wisconsin DNR 2013 citing Humphrey and Cope 1976), though a colony of 6,700 MYLUs was found in a barn in Indiana (Whitaker and Hamilton 1998). No records of MYLUs using culverts are known at this time. The ability to use a variety of summer habitats is also key to understanding a large and diverse geographic range (Bergeson et al. 2015). Bats using the interface between developed lands (that provide roosts) and undeveloped lands and water (that provide foraging habitat) tend to be healthier and have higher reproductive rates (Coleman and Barclay 2011). Female MYLUs use warm roosts (Burnett and August 1981). MYLUs select roost trees that are large, dead, or dying and that have substantial solar exposure (Crampton and Barclay 1998, Bergeson et al. 2015). MYLUs make frequent use of cracks and hollows in trees as well as sloughing bark (Crampton and Barclay 1998, Bergeson et al. 2015). Randall (2014) found that data collected during their telemetry study in 2007 agreed with Broders and Forbes (2004), who reported that all female MYLUs captured in forests were found to roost in nearby buildings, whereas the males roosted in nearby trees. Minimum roosting areas for MYLUs have a mean of 9.6 acres; minimum foraging areas have a mean of 129 acres (Broders et al. 2006). Other home range estimates differ by life stage, with pregnant MYLU home ranges

averaging 74 acres and lactating MYLU home ranges averaging 44 acres (Henry et al. 2002). Coleman et al. (2014) estimated mean home range at 353 acres.

Barbour and Davis (1969) noted that females are pregnant when they arrive at maternity roosts in early- to mid-April, with individuals arriving throughout May and into June. In Indiana (Krochmal and Sparks 2007), females in one colony gave birth to a single pup between 3 June and 15 July. These pups began fluttering at two days of age, could complete coordinated wing strokes by 15 days and could fly by 21 days. Most pups are likely volant by the end of July or mid-August in North Carolina. Maternity colonies begin to break up as soon as the young are weaned; few remain by September (Barbour and Davis 1969).

3.4.2 Population Size

Long-term monitoring of 22 prominent MYLU hibernacula in the core of their range provided the basis for cave survey data from 1985 to predict a population of 6.5 million MYLUs as of 2006 (Frick et al. 2010b). This estimate was presumed to account for the vast majority of the species' overall population at the time. As of 2006, regional mean growth suggested that the northeastern core population of this species was stable or slightly increasing (Frick et al. 2010b). Thus, the pre-WNS population of this species – both throughout its range and within its core northeastern range – was viable and did not face imminent risk of extinction.

The appearance of WNS in 2006 dramatically altered the population balance, which in turn has substantially impaired the ability of MYLUs to adapt to other cumulative threats looming against a rapidly declining species baseline. In four years, this lethal fungal pathogen summarily killed at least one million MYLUs in the northeastern core range, and all efforts undertaken thus far to contain its south and westward spread and rate of infection have proven ineffective. As the disease spreads geographically and regionally, population collapse has been observed and, in some cases, local species extinction has been predicted, suggesting that even limited take may have the potential for population-level effects (MidAmerican Energy Company [MEC] 2019, Frick et al. 2010, Ingersoll et al. 2013). Of winter hibernacula examined where WNS has been confirmed or suspected for two or more years, survey data indicates that winter populations at 36 of 38 sites had declined compared to their 10-year pre-WNS average estimates (Kuntz and Reichard 2010). Of hibernaculum that averaged greater than 50 MYLUs prior to the discovery of WNS, four hibernacula (North Carolina [3], Tennessee [1]) declined to zero MYLUs in the most recent post-WNS surveys (Kuntz and Reichard 2010). Die-offs of MYLUs at hibernacula have been associated with declines in summer activity (Dzal et al. 2011). Cheng et al. (2021) estimates a 98% decline at hibernacula with WNS establishment from 1995 to 2018 and a 36% overlap of species and WNS occurrence ranges for MYLU.

4.4.3 Distribution

The MYLU is widely distributed across North America. Their geographic distribution ranges from central Alaska to northern Florida and into southern California and central Mexico (Harvey et al. 1999). They are absent from the middle plains region (for example, New Mexico, Texas, and southern Florida). Prior to the arrival of WNS, the largest colonies were found in the Northeastern and Midwestern U.S. where some hibernacula contained tens to hundreds of thousands of individuals (Kunz and Reichard 2010). The southern edge of their distribution is limited by the lack of suitable caves and mines, whereas the northern edge of the range is likely defined by a limited number of suitable hibernacula and the longer length of the hibernation season (Humphries et al. 2002, Humphries et al. 2006).

3.4.4 Threats

Tinsley (2016) reviewed potential threats to the MYLU and determined WNS as the greatest threat faced by the species; without WNS it is unlikely the MYLU would be a conservation priority. Other stressors

of importance include deaths from other diseases, losses at wind energy sites, environmental contaminants, climate change, and loss and adverse modification of both summer and winter habitat. Like other bats, the MYLU is frequently the subject of persecution by people. Because MYLUs can form large maternity colonies in man-made structures, they are often the target of exclusion efforts (Cope et al. 1991). Additional concerns relate to development and construction and include roads, lighting, and noise and vibration (Rowse et al. 2016, Ramalho and Aguiar 2020). Lighting is increasingly being associated with negative outcomes for many species, including bats (Rowse et al. 2016), and has been "acknowledged as a threat to biodiversity" (Rowse et al. 2016 citing Hölker et al. 2010). These threats are discussed in the 2020 BO for MYGR and above for MYSO and can similarly apply to PESU.

4. Environmental Baseline in the Action Area

In accordance with 50 CFR 402.02, the environmental baseline "*refers to the condition of the listed species or its designated critical habitat in the action area, without the consequences to the listed species or designated critical habitat caused by the proposed action. The environmental baseline includes the past and present impacts of all Federal, State, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of State or private actions which are contemporaneous with the consultation in process. The consequences to listed species or designated critical habitat from ongoing agency activities or existing agency facilities that are not within the agency's discretion to modify are part of the environmental baseline*."

The four bat species addressed in this Opinion, MYSO, MYSE, PESU, and MYLU, are all assumed to be present within the action area. While no known caves or mines, which could be used as winter hibernacula, are present within the action area, forested habitat (for roosting, foraging, and commuting), riverine and riparian habitat (for commuting and foraging), and man-made structure habitat (for roosting) are present within the action area. Additionally, acoustic records obtained during a study on MYGR indicated presence of PESU and possible presence of MYSO in the action area. As of the time of this Opinion, the manual vetting of MYSO and MYSE acoustic records is ongoing but has not yet been completed. These species are considered likely within the action area.

Structure surveys on bridges and culverts within the action area have been conducted to identify evidence of bat use. A survey history from the 2019 BA (July 2017-August 2018) is included in Appendix B of the 2020 BO. A summary of the structure surveys in the action area that have been conducted and or submitted to NCDOT after the original 2020 BA was completed are summarized in Appendix C. No evidence of bat use was found on the surveyed bridges. Surveys of the culvert at Hill Street and Riverside Drive near the French Broad River and the culvert that carries Smith Mill Creek under Patton Avenue revealed bats or evidence of bat use.

4.1 Indiana Bat Environmental Baseline

MYSO are known to roost in man-made structures, and several records exist for the species roosting in NC bridges (NCDOT, 2022a), though no records exist in NC for culvert roosts. It is difficult to estimate population numbers for MYSO in the action area as summer maternity colonies are widely dispersed, with most locations unknown (USFWS 2019). There are 20 element occurrences of MYSO in western NC based on NC Natural Heritage Program (NCNHP) records (April 2023). Five of the records are considered historical and most of the records are of tree-roosting individuals or of mist-net captures. The closest known roosting occurrences of MYSO are multiple records of a single hibernating bat at locations approximately 19 miles east of the project site and a 2021 summer survey location at a bridge site 25 miles west of the project site. Summer maternity colonies are difficult to locate and not widely known, especially in the southernmost portion of the MYSO's range. The first documented maternity colony in NC was found by Britzke et al. (2003) in the Nantahala National Forest, though researchers were unable

to re-locate it in subsequent years. MYSO maternity colonies were also documented during studies in the Nantahala National Forest by O'Keefe and Loeb (2017). The closest active hibernaculum to NC is found in the Tennessee portion of the Great Smoky Mountains National Park (GSMP), with the most recent population estimate being 736 bats (USFWS 2019).

4.2 Northern Long-eared Bat Environmental Baseline

MYSE are also known to roost in NCDOT bridges (NCDOT, 2022a). There are no records in NC of MYSE roosting in culverts (NCDOT 2022b). According to the NCNHP Biotics Database and the NCDOT Bat Structure Survey Databases, most recently updated in April 2023 and February 2023 (respectively), the closest known winter roosting occurrence of MYSE is in a cave site approximately 16.75 miles southeast of the project site. The closest summer capture occurrences of MYSE are a 2018 mist net location approximately 6 miles southwest of the project location and a 2022 mist net location 12 miles southeast of the project location.

Reliable numbers of MYSE in the action area are not available. There are approximately 171 occurrences of MYSE in western NC based on NCNHP element occurrence records, 19 of which are considered historical; most observations are from mist-netting efforts, as well as individuals roosting in caves. The number of bats found at each occurrence range from 1 to over 80 bats (note that some sites have multiple data collection events). According to NCNHP data (April 2023), evidence of MYSE reproduction in western NC, including capture/tracking of pregnant or lactating bats, or discovery of maternity trees, has been found in 11 western NC counties. Work has not been conducted to track MYSE in Buncombe County, but a lactating female was captured in the county in 2022. There have been 22 documented MYSE hibernacula in western NC, all in caves or mines. There are no known MYSE hibernacula in Buncombe County. MYSE have not been observed using hibernacula in North Carolina since 2014 (NCWRC email comm. November 17, 2022). However, the species is hard to detect given its use of small cracks and crevices in hibernacula.

4.3 Tricolored Bat Environmental Baseline

PESU are also known to roost in NCDOT structures, both bridges (NCDOT, 2022a) and culverts (NCDOT, 2022b). All records are associated with a water crossing. According to the NCNHP Biotics Database and the NCDOT Bat Structure Survey Databases, most recently updated in April 2023 and February 2023 (respectively), the closest known roosting occurrence of PESU is in a bridge site approximately 3 miles south of the project location. The closest summer capture record of PESU is a 2015 mist net location 6 miles southwest of the project site.

Reliable numbers of PESUs in the Action Area are not available. There are 163 element occurrences of the PESU in western NC based on NCNHP records, 7 of which are considered historical; most observations are from mist-netting, as well as cave/mine and bridge/culvert roosting individuals. The number of bats found at each occurrence range from 1 to 70 to several thousand bats (note that some sites have multiple data collection events). Maternity and other summer roosts are mainly in dead or live tree foliage (Carter and Menzel 2007, Poissant et al. 2010) but can also be found in human-made structures such as bridges (Ferrara and Leberg 2005). PESU are present in western NC during pupping season and are reproducing, but work has not been done to locate maternity colonies. There have been 79 PESU hibernacula documented in western NC, including caves (50), mines (22), root cellars (4), and culverts (3). While there are no known PESU hibernacula in Buncombe County (WRC email comm. November 17, 2022), swarming/staging areas from hibernacula in Henderson, Yancey, and Rutherford Counties fall within Buncombe County.

4.4 Little Brown Bat Environmental Baseline

MYLU are also known to roost in bridge structures (NCDOT 2022a). Current records, with the exception of one bridge, are associated with a water crossing. There are no records in NC of MYLU roosting in culverts (NCDOT 2022b). According to the NCNHP Biotics Database and the NCDOT Bat Structure Survey Databases, most recently updated in April 2023 and February 2023 (respectively), the closest known roosting occurrence of MYLU is in a barn site approximately 9 miles north of the project location. The closest summer capture record of MYLU is from a 2011 mist net survey 6 miles southwest of the project location.

Reliable numbers of MYLU in the action area are not available. There are 136 element occurrences of MYLU in western NC based on NCNHP records, 10 of which are considered historical. Most observations are from mist-netting, as well as from bats roosting in small caves, bridges, and other human-made structures. The number of bats found at each occurrence range from 1 to 350 bats. Maternity colonies of MYLU have been found in 11 western NC counties including Buncombe County. Six maternity colonies were found under NCDOT bridges while others were found in buildings, artificial roosts, and caves. MYLU hibernacula (caves/mines) have been found in 9 NC counties. While there are no known MYLU hibernacula in Buncombe County (WRC email comm. November 17, 2022), swarming/staging areas from hibernacula in Henderson, Yancey, and Rutherford Counties fall within Buncombe County.

4.5 Factors Affecting MYSO, MYSE, PESU, and MYLU in the Action Area

The main factors that could adversely affect the four subject species in the action area are similar to those discussed in the 2020 BO for MYGR. That is, increasing urbanization and development directly adjacent to the French Broad River. Activities associated with residential, commercial, and industrial development and the supporting infrastructure result in the fragmentation of intact portions of forested riparian habitat and increased lighting and noise on the landscape. For the subject bats within the action area, these conditions can be expected to negatively impact necessary roosting, foraging, and commuting conditions.

5. Effects of the Action

In accordance with 50 CFR 402.02, the 2019 regulatory definition of effects of the action is "*all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action. A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action*."

This section analyzes the direct and indirect effects of the Action on MYSO, MYSE, PESU, and MYLU. Direct effects are caused by the action and occur at the same time and place. Indirect effects are caused by the action but are later in time and reasonably certain to occur. The effects of the action are added to the environmental baseline and, after taking into consideration the status of the species and cumulative effects, serve as the basis for the determinations in this Opinion (50 CFR 402.14(g)(4)).

5.1 Stressors

Based on the description of the Action and the species' biology, the following stressor to the MYSO, MYSE, PESU, MYLU has been identified that may result from the Action: tree removal. The ways in which lighting (temporary and permanent), noise and vibration, changes to hydrology and water quality impacts, and highway operation activities are understood to affect MYGR are also understood to affect MYSO, MYSE, PESU, and MYLU based on current knowledge of species life histories and are addressed in the 2020 BO for MYGR, therefore, those stressors are not further addressed here but can be

referenced in the 2020 BO and applied to these four species. Below, tree removal is described and associated responses and rationale for the determination of effects are provided.

5.1.1 Stressor: Tree Removal

Tree-clearing activities are anticipated to take place any time of year within the action area, with up to 211 acres cleared. Clearing will occur in riparian and upland, fragmented and intact swaths of forest (Appendix B, Figures 1-19). MYSO, MYSE, PESU, and MYLU are active on the landscape from April 1 to October 15, meaning that tree clearing activities are expected to occur when these species are utilizing forested portions of the action area for roosting, foraging, and commuting.

The 2020 BO, specifically section 5.1.2.2.1.3, addresses tree clearing effects on MYGR foraging and commuting habitat. While MYGR, MYSO, MYSE, PESU, and MYSE all have species-specific variations in foraging and commuting habitat and associated behavior, the analysis of impacts from tree removal on these species' foraging and commuting habitat throughout the action area, as discussed in the 2020 BO, is applicable for the four subject species covered in this Opinion. Therefore, the stressors of tree removal on foraging and commuting are not discussed further here other than to reiterate the following: These stressors are expected to result in increased energy expenditure and reduced fitness, which equates to harm; as well as increased risk of exposure to predators, which equates to wounding and death.

Unlike MYGR, which is generally not considered a tree-roosting species, MYSO, MYSE, PESU, and MYLU roost in trees during the active season and are expected to be adversely affected by the loss of roosting habitat through the project's tree clearing activities. Direct and indirect effects from the loss of forested roosting habitat are expected.

While bats can flee during tree removal, removal of occupied roosts (spring through fall) is likely to result in direct injury or mortality to some percentage of bats. This percentage would be expected to be greater if flightless pups or inexperienced flying juveniles were also present. Felling roost trees during the active season may result in adverse effects to any of the four subject bat species. If a bat is in the tree and a tree is cut down, the bat may either stay in the tree and potentially be crushed or fly out (adults or volant pups) during the day and be more susceptible to predation (e.g., by raptors) and have to expend energy to find a new roost. The risk is also greater to adults during cooler weather when bats periodically enter torpor and would be unable to arouse quickly enough to respond.

The removal of roost trees, even while unoccupied, is expected to indirectly affect MYSO, MYSE, PESU, and MYLU. Removal of roost trees would likely result in increased energy expenditures for affected bats. Increased flight distances or smaller colonies are expected to result in some percentage of bats having reduced pregnancy success, and/or reduced pup survival. The impact of shifting flight patterns and foraging areas on individual bats varies. Recovery from the stress of hibernation, WNS, and migration may be slower as a result of the added energy demands of searching for new roosting habitat, especially in an already fragmented landscape where forested habitat is limited. Pregnant females, known to exhibit roost site fidelity, displaced from preferred roosting areas will have to expend additional energy to search for alternative habitat; which would likely result in reduced reproductive success (failure to carry to full term or failure to raise pup to volancy) for some females. Females that do give birth may have pups with lower birth weights given the increased energy demands associated with longer flights, or their pups may experience delayed development. These longer flights would also be experienced by pups once they become volant which could affect the survival of these pups as they enter hibernation with potentially reduced fat reserves. Overall, the removal of roost trees from the landscape could cause varying degrees of harm depending on individual bats' conditions and the habitat provided in the surrounding landscape.

5.1.2 Summary of Stressors and Effects Determinations

In summary, the anticipated stressor and effects discussed above are expected to adversely affect MYSO, MYSE, PESU, and MYLU. The felling of occupied roost trees could result in the death, wounding, and harm of the subject bats, while the loss of roost trees in general could result in harm via increased energy expenditures from the search for alternative roosts and subsequent reduced fitness and/or maternity success.

5.2 Beneficial Effects

Beneficial effects have contemporaneous positive effects without any adverse effects to the species or habitat.

No changes from 2020 BO.

5.3 Cumulative Effects

Cumulative effects include the "*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, 2019 Regulations). Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Endangered Species Act.

No changes from 2020 BO.

6. Conclusion

After reviewing the current status of MYSO, MYSE, PESU, and MYLU, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is the Service's biological opinion that the proposed action is not likely to jeopardize the continued existence of the four considered species. No critical habitat has been designated for these species; therefore, none will be affected. This opinion is based on the following:

1. Although the proposed action is expected to result in adverse effects to MYSO, MYSE, PESU, and MYLU from year-round tree removal, lighting (temporary and permanent), noise and vibration, alterations to hydrology, water quality impacts, and highway operation; we have determined that the species' reproduction, numbers, and distribution will not be appreciably reduced as a result of the proposed action. We do not know how many MYSO, MYSE, PESU, or MYLU may be using the action area but are able to produce estimations based on existing data.
    a. The projected range-wide MYSO population is 596,431 as of 2022. Assuming one maternity colony of up to 126 bats within the action area, a maximum expected number as a worst-case scenario, the project will impact 0.02% of the estimated range-wide population.
    b. The Service projected the range-wide MYSE population to be 19,356 individuals in 2020. Based on mean home-range sizes (21 – 179 acres), distances between roosts (20 feet to 2.4 miles), and the typical foraging range of MYSE maternity colony (1.5 miles = 4,522 acres), if we assume the presence of one maternity roost of up to 60 individuals within the action area, the project will impact less than 0.31% of the range-wide population.
    c. The PESU range-wide population is estimated to be 67,898 individuals (Service 2022b). If a maternity colony will occupy an area of 5 acres, and each colony has a mean of 7 bats, we estimate the presence of 42 maternity colonies. This is based on an estimate that approximately 211 acres within the action area may be suitable for supporting several maternity colonies, a maximum expected number as a worst-case scenario. At 211 acres /

5 = 42 colonies, and at a mean of 7 bats per colony, that equates to 295 bats. Following this estimate, the project could impact 0.4% (= 295/ 67,898) of the range-wide population.

d. While the current range-wide population of MYLU is unknown, populations within WNS-impacted areas (36% of the little brown population) have declined 98% (Cheng et al. 2021). Assuming the range-wide population of MYLU is evenly distributed across its range, thirty-six percent of the 2006 estimated population of 6.5 million bats is 2.34 million individuals. If the 2.34 million bats declined by 98%, that leaves 46,800 bats in WNS-impacted areas. Based on home range sizes, if we assume that one maternity colony with 1,200 MYLU occurs within the action area, 2.6% of the WNS-impacted portion of the population (=1,200/46,800) and a much smaller fraction of the range-wide population would be impacted.

7. Incidental Take Statement

Section 9 of the Endangered Species Act and Federal regulations pursuant to section 4(d) of the Endangered Species Act prohibit the take of endangered and threatened species, respectively, without special exemption. Take "*means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct*" (16 U.S.C §1532). Harm is further defined by the Service as "*an act which actually kills or injures wildlife. Such act may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding or sheltering*" (50 CFR 17.3). Incidental taking "*means any taking otherwise prohibited, if such taking is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity*" (50 CFR 17.3). Harass is defined by the Service as "*an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding or sheltering*" (50 CFR 17.3). Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to, and not intended as part of, the agency action is not considered to be prohibited under the Endangered Species Act, provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

7.1 Amount or Extent of Take

The Service anticipates incidental take of MYSO, MYSE, PESU, and MYLU may occur as a result of the proposed action. Specifically, take of the species may occur as a result of tree removal (year round), lighting (temporary and permanent), noise and vibration, changes to hydrology, water quality impacts, and highway operation. During these activities, individual bats may be crushed, flushed, struck, exposed to higher energy expenditure and/or predation, or experience reduced quality of foraging habitat and prey base.

The Service anticipates the incidental taking of MYSO, MYSE, PESU, and MYLU associated with this project will be difficult to detect because: 1) the individuals are small, mostly nocturnal, and occupy trees or structures where they are difficult to observe, 2) finding dead or injured bats during or following project implementation is unlikely, and 3) most incidental take is in the form of non-lethal harm and not directly observable. Also, there is no data from the action area that estimates the numbers of the four subject species in the action area, and bat populations are known to fluctuate seasonally and annually in a given area, therefore, it is difficult to base the amount of incidental take on numbers of individual bats for these species. Given this, the extent of take will be monitored for MYSO, MYSE, PESU, and MYLU using three surrogate measures:

1. Construction operations and project disturbance, which will not occur outside of the established action area (Appendix A, Figure 3).
2. Tree clearing acreage, which will not exceed 211 acres.
3. The duration of activities, which will not exceed five maternity seasons (May 15 – August 15).

These surrogate measures are appropriate because the anticipated taking will result from the removal of forested habitat, noise and vibration effects to suitable roosting trees and structures in the action area, and the timing of these activities. These surrogate measures serve to set a clear limit for determining when take has been exceeded for MYSO, MYSE, PESU, and MYLU. In this Opinion, the Service determined that this level of anticipated take is not likely to result in jeopardy to these four species.

Therefore, the incidental take exempted by the Opinion would be exceeded if:

1. The construction footprint and associated activities exceed the establish boundaries of the action area.
2. Tree clearing acreage exceeds 211 acres.
3. Project construction exceeds five maternity seasons from start to completion.

Exceedance of take as defined by 1 – 3 above will represent new information that was not considered in this Opinion and shall result in reinitiation of this consultation. The incidental take of MYSO, MYSE, PESU, and MYLU is expected to be in the form of harm, wounding, or death. In this Opinion, the Service determined that this level of anticipated take is not likely to result in jeopardy to the species.

7.2 Reasonable and Prudent Measures

The Service believes the following reasonable and prudent measure(s) are necessary and appropriate to minimize take of MYSE, MYSO, and PESU. These non-discretionary measures reduce the level of take associated with project activities and include only actions that occur within the action area.

1. NCDOT shall ensure that the contractor(s) understands and follows the measures listed in the "Conservation Measures", "Reasonable and Prudent Measures," and "Terms and Conditions" sections of this Opinion.
2. NCDOT shall monitor and document any take numbers and the surrogate measures of take and report those to the Service.

7.3 Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the Act, the Applicant must comply with the following terms and conditions, which implement the reasonable and prudent measures described above and outline required reporting and/or monitoring requirements. When incidental take is anticipated, the terms and conditions must include provisions for monitoring project activities to determine the actual project effects on listed fish or wildlife species (50 CFR §402.14(i)(3)). These terms and conditions are nondiscretionary.

1. Ensure that the procedures listed in the "Conservation Measures", "Reasonable and Prudent Measures", and "Terms and Conditions" sections of this Opinion are being implemented and that all project plans are being implemented in a manner that ensures the conditions of this Opinion are met.
2. NCDOT shall ensure that the Service and NCWRC are fully involved and in agreement with the design of the telemetry study. The study design process and subsequent data sharing shall be inclusive of and transparent to the involved agencies. Language will be included in any agreement requiring group consensus on any changes or contract and funding extensions, data sharing, and about following WNS decontamination protocols when working in western NC. Prior to funding approval, the study shall be approved by the Service and NCWRC.

3. Ensure that the telemetry study project description includes a specified minimum level of effort, e.g. minimum number of nights of netting, and/or number and size of culverts/bridges to check, and/or number of acoustic stations.
4. NCDOT shall provide oversight and monitoring to ensure that construction contractors abide by all design plans.
5. NCDOT shall monitor the surrogate measures of take to ensure that any exceedances are detected in a timely manner.
6. NCDOT shall immediately notify the Service's Asheville Field Office should live or deceased MYSO, MYSE, PESU, or MYLU be discovered during project work.

8. Conservation Recommendations

Section 7(a)(l) of the Endangered Species Act directs Federal agencies to use their authorities to further the purposes of the Endangered Species Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information.

1. **Tree Clearing**: Avoid tree clearing activities during the most sensitive bat seasons, notably the pup season of May 15 – July 31. During this time, pups are non-volant and unable to fly away from clearing activities.
2. **Habitat Protection**: Continue pursuit of property acquisition adjacent to the Hill Street culvert.
3. **Lighting**: Implement additional reductions in high mast poles throughout the action area, especially near waterbodies and riparian areas.
4. **Canton Bridge**: Investigate the light that is illuminating one side of the Pigeon River where bats historically traveled and emerged from the bridge, but are now avoiding. The goal of this is to remove or modify the light in a way that removes illumination from the river and riparian corridor.
5. **Riparian Planting**: Replant disturbed riparian areas with native, fast-growing trees and shrubs that would serve to stabilize the stream bank, filter runoff and reduce erosion and sedimentation, block light pollution, and generally improve the quality of the habitat for bats and aquatic species. Examples of potential native tree species to plant include: sycamore, tulip poplar, black cherry and river birch. Planting with established (e.g. containerized) young trees can increase the survival rate of plantings and contribute to faster improvement of riparian habitat.
6. **Noise Considerations for Bats**: If suitable roost trees are present near high-decibel activity (81 – 162 dBA) and would experience noise above background levels (41 – 70 dBA), avoid conducting those high-decibel activities during the bat maternity season (May 15 – August 15). Alternatively, activity could avoid the pup season (May 15 - July 31). To minimize noise levels, incorporate sound-dampening devices such as noise shrouds for pile driving.

For the Service to be kept informed of actions minimizing or avoiding adverse effects or benefitting listed species or their habitats, we request notification of the implementation of any conservation recommendations.

9. Monitoring and Reporting

No changes from 2020 BO, with the exception of the following which provides further specifics:

- Yearly monitoring summaries will be cumulative. That is, take the first year's report and add data from year two. In year three, add data to the report that has years 1 and 2. Update the methods, results, and discussion each year as needed. In this way, the subsequent reports add to and supersede the older reports and provide updated context. The last report will serve as the

final report.
- Include annual updates on the amount of tree clearing throughout the construction project in each year's report.

10. Reinitiation Notice

This concludes formal consultation on the action(s) outlined in the consultation request dated July 24, 2023. As provided in 50 CFR §402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation.

Literature Cited

Adams, R.A., and M.A. Hayes. 2008. Water availability and successful lactation by bats as related to climate change in arid regions of western North America. J. Animal Ecology **77**:1115-1121.

Adams, R.A., B. Stoner, D. Nespoli, and S. M. Bexell. 2018. New records of tricolored bats (*Perimyotis subflavus*) in Colorado, with first evidence of reproduction. *Western North American Naturalist*, 78(2), 212-215.

Amelon, S., and D. Burhans. 2006. Conservation assessment: Myotis septentrionalis (MYSE) in the eastern United States. Pages 69–82 in Conservation assessments for five forest bat species in the eastern United States, Thompson, F. R., III, editor. U.S. Department of Agriculture, Forest Service, North Central Research Station, General Technical Report NC-260. St. Paul, Minnesota. 82pp

Arnett, E.B., Brown, W.K., Erickson, W.P., Fiedler, J.K., Hamilton, B.L., Henry, T.H., Jain, A., Johnson, G.D., Kerns, J., Koford, R.R. and Nicholson, C.P., 2008. Patterns of bat fatalities at wind energy facilities in North America. The Journal of Wildlife Management, 72(1), pp.61-78.

Barbour, R.W., and W.H. Davis. 1969. Bats of America. The University of Kentucky Press, Lexington, Kentucky. 311pp.

Benedict, R. A., H. H. Genoways, and P. W. Freeman. 2000. Shifting distributional patterns of mammals of Nebraska. *Proceedings of the Nebraska Academy of Science*. 26:55-84.

Bergeson, S. M., T. C. Carter, and M. D. Whitby. 2015. Adaptive roosting gives MYLUs an advantage over endangered MYSOs. *American Midland Naturalist.* 174:321–330.

Bernard, R. F., E. V. Willcox, K. L. Parise, J. T. Foster, and G. F. McCracken. 2017. Whitenose syndrome fungus, *Pseudogymnoascus destructans*, on bats captured emerging from caves during winter in the southeastern United States. *BMC Zoology*, 2(1):12.

Bohrman, J., and D. Fecske. 2013. White-Nose Syndrome Surveillance and Summer Monitoring of Bats at Great Swamp National Wildlife Refuge, Morris County, New Jersey. A final report prepared for United States Fish and Wildlife Service, 115pp.

Boyles, J., J. Timpone, and L. W. Robbins. 2009. Bats of Missouri. Indiana State University, Center for North American Bat Research and Conservation, Publication number 3. 60 pp.

Brack, V., Jr. 1979. The duration of the period of hibernation in *Eptesicus fuscus*, *Myotis lucifugus*, and *Pipistrellus subflavus* under natural conditions. Unpublished M.S. thesis. University of Missouri, Columbia, Missouri. 50 pp.

Brack V. Jr. 2007. Temperatures and Locations Used by Hibernating Bats, Including *Myotis sodalis* (MYSO), in a Limestone Mine: Implications for Conservation and Management. *Journal of Environmental Management*. 40:739–746.

Brack, V., Jr. and J. W. Twente. 1985. The duration of the period of hibernation in three species of vespertilionid bats. I. Field studies. *Canadian Journal of Zoology*. 63:2952-2954.

Brack, V., Jr. 1985. The foraging ecology of some bats in Indiana. *Indiana Academy of Sciences*. 94:231-237.

consistency, opportunism, and selectivity. *Journal of Mammalogy*. 87:7- 18.

Brack V. Jr., and J.O. Whitaker. 2001. Foods of the northern myotis, Myotis septentrionalis, from Missouri and Indiana, with notes on foraging. Acta Chiropterologica, 3(2):203–210.

Britzke, E.R., M.J. Harvey, and S.C. Loeb. 2003. Indiana bat, *Myotis sodalis*, maternity roosts in the southern United States. Southeastern Naturalist 2(2): 235-242.

Broders, H.G. and Forbes, G.J., 2004. Interspecific and intersexual variation in roost-site selection of northern long-eared and MYLUs in the Greater Fundy National Park ecosystem. The Journal of Wildlife Management, 68(3), pp.602-610.

Broders, H., G. J. Forbes, S. Woodley, and I. D. Thompson. 2006. Range Extent and Stand Selection for Roosting and Foraging in Forest-Dwelling MYSEs and MYLUs in the Greater Fundy Ecosystem, New Brunswick. Journal of Wildlife Management. 70 (5): 1174-1184.

Burke, H.S. Jr. 1999. Maternity colony formation in *Myotis septentrionalis* using artificial roosts: the rocket box, a habitat enhancement for woodland bats? Bat Research News, 40:77–78.
Butchkoski, C. M. and S. Bearer. 2016. Summer bat netting trends in Pennsylvania. Chapter 9, pages 137-151. in *Conservation and ecology of Pennsylvania's bats* (C.M. Butchkoski, D.M. Reeder, G.G. Turner, and H.P. Whidden, eds.). Pennsylvania Academy of Science, East Stroudsburg, Pennsylvania. 267 pp.
Center for Biological Diversity and Defenders of Wildlife. 2016. Petition to list the Tricolored bat (Perimyotis subflavus) as threatened or endangered under the Endangered Species Act. Petition submitted to the U.S. Secretary of the Interior, acting through the U.S. Fish and Wildlife Service. The Center for Biological Diversity, Tucson, Arizona and Defenders of Wildlife, Washington D.C. 76pp.
Caceres, M.C., and M.J. Pybus. 1997. Status of the MYSE (*Myotis septentrionalis*) in Alberta. Alberta Environmental Protection, Wildlife Management Division, Wildlife Status Report No. 3, Edmonton, AB, 19pp.
Caceres, M.C., and R.M.R. Barclay. 2000. Myotis septentrionalis. Mammalian Species, 634:1–4.
Caire, W., R.K. LaVal, M.L. LaVal, and R. Clawson. 1979. Notes on the ecology of Myotis keenii (Chiroptera, Vespertilionidae) in Eastern Missouri. American Midland Naturalist, 102(2): 404–407.
Callahan, E.V., R.D. Drobney, and R.L. Clawson. 1997. Selection of summer roosting sites by Indiana bats (*Myotis sodalis*) in Missouri. J. Mamnmalogy. 78:818-825.
Carter, T.C., and G. Feldhamer. 2005. Roost tree use by maternity colonies of MYSOs and MYSEs in southern Illinois. Forest Ecology and Management, 219:259– 268.
Carter, T. C., and J. M. Menzel. 2007. Behavior and day-roosting ecology of North American foliage-roosting bats. Pages 61-81 in M. J. Lacki et al., editors. Bats in forests. Johns Hopkins University Press, Baltimore
Cheng, T.L., Reichard, J.D., Coleman, J.T., Weller, T.J., Thogmartin, W.E., Reichert, B.E., Bennett, A.B., Broders, H.G., Campbell, J., Etchison, K. and Feller, D.J., 2021. The scope and severity of white-nose syndrome on hibernating bats in North America. Conservation Biology, 35(5), pp.1586-1597. Available at: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8518069/.
Clark, D.R., 1988. How sensitive are bats to insecticides? Wildlife Society Bulletin (1973-2006), 16(4), pp.399-403.
Clawson, R. L. 1984. Investigations of endangered MYSO and MYGR summer ecology, distribution and status. Missouri Department of Conservation Surveys and Investigation Projects, Study Number 66.
Clawson, R.L. 2002. Trends in population size and current status. Pp. 2-8 in A. Kurta and J. Kennedy (eds.), The Indiana bat: biology and management of an endangered species. Bat Conservation International, Austin, TX.
Colatskie, S. 2017. Missouri bat hibernacula survey results from 2011-2017, following white-nose syndrome arrival. Missouri Department of Conservation, Jefferson City, Missouri. 14 pp.
Coleman, J.L. and R. M. Barclay. 2011. Influence of urbanization on demography of MYLUs (*Myotis lucifugus*) in the prairies of North America. PLoS One, 6(5), p.e20483.
Coleman, L. S., Ford, W. M., Dobony, C. A., & Britzke, E. R. 2014. Comparison of radio-telemetric home-range analysis and acoustic detection for MYLU habitat evaluation. *Northeastern Naturalist*, *21*(3), 431-445. Available at: https://bioone.org/journals/northeastern-naturalist/volume-21/issue-3/045.021.0309/Comparison-of-Radio-Telemetric-Home-Range-Analysis-and-Acoustic-Detection/10.1656/045.021.0309.full
Cope, J.B., and S.R. Humphrey. 1972. Reproduction of the bats Myotis Keenii and Pipistrellus subflavus in Indiana. Bat Research News, 13:9–10.
Cope, J. B., J. O. Whitaker, Jr., and S. L. Gummer. 1991. Duration of bat colonies in Indiana. *Proceedings of the Indiana Academy of Science*. 99:199-201.
Crain, C.M., Kroeker, K. and Halpern, B.S., 2008. Interactive and cumulative effects of multiple human stressors in marine systems. Ecology letters, 11(12), pp.1304-1315.

Crampton, L. H. and M. R. Barclay. 1998. Selection of roosting and foraging habitat by bats in different-aged aspen mixedwood stands. *Conservation Biology*. 12:1347-1358.
Cryan, P. M., C. U. Meteyer, J. G. Boyles, and D. Blehert. 2013. White-nose syndrome in bats: illuminating the darkness. *BMC Biology*. 11:47.
Davis, W.H., 1959. Disproportionate sex ratios in hibernating bats. *Journal of Mammalogy*. 40(1):16-19.
Davis, W.H., and H.B. Hitchcock. 1965. Biology and Migration of the Bat, *Myotis lucifugus*, in New England. *Journal of Mammalogy*. 46(2):296–313
De la Cruz, J.L., R.L. Ward, and E.S. Schroder. 2018. Landscape characteristics related to use of artificial roosts by MYSEs in north-central West Virginia. Northeastern Naturalist, 25(3):487–501.
Dowling, Z.R., and D.I. O'Dell. 2018. Bat use of an island off the coast of Massachusetts. Northeastern Naturalist, 25(3):362–382.
Downs, N. C., V. B., J. Guest., J. Polanski., S. L. Robinson., and P. A. Racey. 2003. The effects of illuminating the roost entrance on the emergence behavior of *Pipistrellus pygmaeus*. *Biological Conservation*, 111, 247-252.
Droppelman, P. L. 2014. Bat Survey Report for *Myotis sodalis* MYSO, *Myotis grisescens* MYGR, *Myotis septentrionalis* MYSE, Mine Tailings Impoundment Brushy Creek Mine Doe Run Company Reynolds County, Missouri. Eco-Tech Consultants, Inc. 73p.
Dzal, Y.A., 2011. Thermoregulatory and foraging strategies of the MYLU (*Myotis lucifugus*) during the reproductive season. Faculty of Graduate Studies and Research, University of Regina.
Easterla, D.A. 1968. Parturition of Keen's Myotis in Southwestern Missouri. Journal of Mammalogy, 49(4):770.
Environment Yukon. 2011. Yukon Bats. Government of Yukon, Environment Yukon, Whitehorse, Yukon. 22p
Eidels, R. R., D. W. Sparks, J. Whitaker J O, and C. A. Sprague. 2016. Sub-lethal effects of chlorpyrifos on big brown bats (*Eptesicus fuscus*). *Archives of Environmental Contaminants and Toxicology*. 2016:322-335.
Feldhamer, G.A., T.C. Carter, A.T. Morzillo, and E.H. Nicholson. 2003. Use of bridges as day roosts by bats in southern Illinois. Transactions of the Illinois State Academy of Science, 96(2): 107–112
Fenton, M.B. 1969. Summer activity of *Myotis lucifugus* (Chiroptera:Vespertilionidae) at hibernacula in Ontario and Quebec. *Canadian Journal of Zoology*. 47(4)597–602.
Fenton, M. B. 1970. Population studies of *Myotis lucifugus*: (Chiroptera: Vespertilionidae) in Ontario. Life sciences contributions no. 77. Royal Ontario Museum, Ontario, Canada. 34 pp.
Fenton, M.B., and R.M.R. Barclay. 1980. *Myotis lucifugus*. 142 Mammalian Species, pp. 1-8.
Ferrara, F. J., and P. L. Leberg. 2005. Characterisitcs of positions selected by day-roosting bats under bridges in Louisiana. Journal of Mammalogy 86:729-735.
Foster, R.W., and A. Kurta. 1999. Roosting ecology of the Northern bat (Myotis septentrionalis) and comparisons with the endangered MYSO (*Myotis sodalis*). Journal of Mammalogy, 80(2):659–672.
Fraser, E. E., L. P. McGuire, J L Eger, F. J. Longstaffe, and M. B. Fenton. 2012. Evidence of latitudinal migration in tri-colored bats, *perimyotis subflavus*. PLoS ONE 7:e31419.
Frick, W.F., D.S. Reynolds, and T.H. Kunz. 2010. Influence of climate and reproductive timing on demography of little brown myotis *Myotis lucifugus*. *Journal of Animal Ecology*. 79:128–136.
Frick, W.F., J.F. Pollock, A. Hicks, K. Langwig, D.S. Reynolds, G.G. Turner, C. Butchowski, T.H. Kunz. 2010b. A once common bat faces rapid extinction in the northeastern United States from a fungal pathogen. Science, 329:679-682.
Fujita, M.S. and T. H. Kunz. 1984. *Pipistrellus subflavus*. Mammalian species, (228), pp.1-6.
Fuller, N.W., J. D. Reichard, M. L. Nabhan, S. R. Fellows, L.C. Pepin, and T. H. Kunz. 2011. Free-ranging little brown myotis (*Myotis lucifugus*) heal from wing damage associated with white-nose syndrome. *EcoHealth.* 8(2):154-162.
Gardner, J.E., J.D. Garner, and J. Hofmann. 1991. Summer roost selection and roosting behavior of Myotis sodalis (Indiana bat) in Illinois. Final Report. 66p. Available at: https://www.ideals.illinois.edu/items/10423.

Gardner, J.E., J.D. Garner, and J.E. Hofmann. 1991a. Summary of *Myotis sodalis* summer habitat studies in Illinois: with recommendations for impact assessment. Report prepared for Indiana/Gray bat Recovery Team Meeting, Columbia, MO 28 pp.

Gardner, J.E., J.D. Garner, and J.E. Hofmann. 1991b. Summer roost selection and roosting behavior of *Myotis sodalis* (Indiana bat) in Illinois. Unpublished report to Region-3 U.S.

Garner, J.D., and J.E. Gardner. 1992. Determination of summer distribution and habitat utilization of the Indiana bat (*Myotis sodalis*) in Illinois. Illinois Department of Conservation. Final Project Report No. E-3. Springfield, Illinois.

Geluso, K. N., R. A. Benedict, and F. L. Kock. 2004. Seasonal activity and reproduction in bats of east-central Nebraska. *Transactions of the Nebraska Academy of Sciences and Affiliated Societies.* 29:33-44.

Geluso, K., T. R. Mollhagen, J. M. Tigner, and M. A. Bogan. 2005. Westward expansion of the eastern pipistrelle (*Pipistrellus subflavus*) in the United States, including new records from New Mexico, South Dakota, and Texas. *Western North American Naturalist*. 65:405-409.

Goehring, H. H. 1954. *Pipistrellus subflavus obscurus*, *Myotis keenii*, and *Eptesicus fuscus fuscus* hibernating in a storm sewer in central Minnesota. *Journal of Mammalogy*. 35:434-435.

Griffin, D. R. 1940. Migration of New England bats. *Bulletin of the Museum of Comparative Zoology at Harvard College*. 86:217-246.

Griffin, D. R. 1945. Travels of banded cave bats. *Journal of Mammalogy*. 26:15-23.

Griffin, D.R. 1970. Migration and homing in bats. Pp. 233-264, In Biology of Bats, Vol. 2 (W.A. Wimsatt, ed.). Academic Press, New York, 477 pp.

Griffith, L.A., and J.E. Gates. 1985. Food habits of cave-dwelling bats in the central Appalachians. Journal of Mammalogy, 66(3):451–460.

Hall, J.S. 1962. A life history and taxonomic study of the Indiana bat, *Myotis sodalis*. Reading Publ. Mus. Art., Gallery Publ. 12:1-68.

Hanttula, M.K. and E.W. Valdez. 2021. First record and diet of the tri-colored bat (*Perimyotis subflavus*) from Guadalupe Mountains National Park and Culberson County, Texas. *Western North American Naturalist.* 81(1): 31-134.

Harvell, C.D., Mitchell, C.E., Ward, J.R., Altizer, S., Dobson, A.P., Ostfeld, R.S. and Samuel, M.D., 2002. Climate warming and disease risks for terrestrial and marine biota. Science, 296(5576), pp.2158-2162.

Harvey, M. J., J. S. Altenbach, and T. L. Best. 1999. *Bats of the United States*. Arkansas Game and Fish Commission, Little Rock, Arkansas, 64 pp.

Hein, C.D. 2012. Potential impacts of shale gas development on bat populations in the northeastern United States. Austin, Texas: Bat Conservation International. 33 p.

Henderson, L.E., and H.G. Broders. 2008. Movements and resource selection of the northern long-eared myotis (*Myotis septentrionalis*) in a forest-agriculture landscape. Journal of Mammalogy, 89(4):952–963.

Henry, M., Thomas, D.W., Vaudry, R., and Carrier, M. 2002. Foraging Distances and Home Range of Pregnant and Lactating MYLUs (*Myotis lucifugus*). *Journal of Mammalogy*, 83 (3)L 767-774. Available at: https://academic.oup.com/jmammal/article/83/3/767/2373247

Hitchcock, H.B., 1965. Biology and migration of the bat, *Myotis lucifugus*, in New England. *Journal of Mammalogy.* 46(2): 296-313.

Hoying, K. M. and T. H. Kunz. 1998. Variation in size at birth and post-natal growth in the insectivorous bat *Pipistrellus subflavus* (Chiroptera: Vespertilionidae). *Journal of Zoology*. 245:15-27.

Humphrey, S. R. 1975. Nursery roosts and community diversity on Nearctic bats. *Journal of Mammalogy.* 56:321-346.

Humphrey, S. R. and J. B. Cope. 1976. Population ecology of the MYLU, *Myotis lucifugus*, in Indiana and north-central Kentucky. *Special Publication of the American Society of Mammalogists*. 4:1-81.

Humphrey, S.R., and J.B. Cope. 1977. Survival rates of the endangered Indiana bat, Myotis sodalis. J. Mammalogy 58:32-36.

Humphrey, S.R., A.S. Richter and J.B. Cope. 1977. Summer habitat and ecology of the endangered Indiana bat, *Myotis sodalis*. J. Mammalogy 58(3):334-346.
Humphries, M. H., D. W. Thomas, and J. R. Speakman. 2002. Climate-mediated energetic constraints on the distribution of hibernating mammals. *Nature*. 418:313-316.
Humphries, M. M., J. R. Speakman, and D. W. Thomas. 2006. Temperature, hibernation energetics, and the cave and continental distributions of little brown myotis. Pages 23-37 in *Functional and Evolutionary Ecology of Bats* (A. Zubaid, G. F. McCracken, and T. Kunz, eds.). Oxford University Press, Oxford, United Kingdom. 360 pp.
Hutson, A.M. and Mickleburgh, S.P. eds., 2001. Microchiropteran bats: global status survey and conservation action plan (Vol. 56). IUCN.
Ingersoll, T.E., B.J. Sewall, and S.K. Amelon. 2013. Improved analysis of long-term monitoring data demonstrates marked regional declines of bat populations in the eastern United States. PLoS One, 8(6), p.e65907.
Ingersoll, T.E., B.J. Sewall, and S.K. Amelon. 2016. Effects of white-nose syndrome on regional population patterns of 3 hibernating bat species. Conservation Biology 30(5): 1048- 1059.
Jachowski, D.S., J.B. Johnson, C.A. Dobony, J.W. Edwards, and W.M. Ford. 2014. Space use and resource selection by foraging Indiana bats at the northern edge of their distribution. Endangered Species Research 24:149-157.
Jones, G., Jacobs, D.S., Kunz, T.H., Willig, M.R. and Racey, P.A., 2009. Carpe noctem: the importance of bats as bioindicators. Endangered species research, 8(1-2), pp.93-115.
Kniowski, A. B., and S. D. Gehrt. 2014. Home range and habitat selection of the Indiana bat in an agricultural landscape. The Journal of Wildlife Management 78:503-512.
Kannan, K., Yun, S.H., Rudd, R.J. and Behr, M., 2010. High concentrations of persistent organic pollutants including PCBs, DDT, PBDEs and PFOS in MYLUs with white-nose syndrome in New York, USA. Chemosphere, 80(6), pp.613-618.
Katzenmeyer, J.B. (2016). Use of highway culverts, box bridges, and caves by winter-roosting bats in Mississippi. Masters Thesis, Mississippi State University. University Libraries Theses and Dissertations. https://scholarsjunction.msstate.edu/td/4869/
Krochmal, A. R. and D. W. Sparks. 2007. Timing of birth and estimation of age of juvenile *Myotis septentrionalis* and *Myotis lucifugus* in west-central Indiana. *Journal of Mammalogy*. 88:649-656.
Kunz, T.H. 1971. Reproduction of Some Vespertilionid Bats in Central Iowa. American Midland Naturalist, 86(2):477–486.
Kunz, T.H., Arnett, E.B., Cooper, B.M., Erickson, W.P., Larkin, R.P., Mabee, T., Morrison, M.L., Strickland, M.D. and Szewczak, J.M., 2007. Assessing impacts of wind-energy development on nocturnally active birds and bats: a guidance document. The Journal of Wildlife Management, 71(8), pp.2449-2486.
Kunz T. H. and J. D. Reichard. 2010. Status review of the little brown myotis (*Myotis lucifugus*) and determination that immediate listing under the Endangered Species Act is scientifically and legally warranted. Status Review prepared for US Fish and Wildlife Service.
Kurta, A. 2005. Roosting ecology and behavior of Indiana bats (*Myotis sodalis*) in summer. Pp. 29-42 *in* K.C. Vories and A. Harrington (eds.), Proceedings of the Indiana bat and coal mining: a technical interactive forum. Office of Surface Mining, U.S. Department of the Interior, Alton, IL.
Kurta, A., S.W. Murray, and D.H. Miller. 2002. Roost selection and movements across the summer landscape. Pp. 118-129 *in* A. Kurta and J. Kennedy (eds.), The Indiana bat: biology and management of an endangered species. Bat Conservation International, Austin, TX.
Kurta, A. 2008. *Bats of Michigan*. Indiana State Center for North American Bat Research and Conservation, Publication 2. Indiana State University, Terre Haute, Indiana. 72 pp.
Kurta A., G.P. Bell, K.A. Nagy, and T.H. Kunz. 1989. Energetics of pregnancy and lactation in free-ranging MYLU (*Myotis lucifugus*). *Physiological Zoology* 62: 804–818.
Kurta, A. and T. H. Kunz. 1987. Size of bats at birth and maternal investment during pregnancy. *Symposia of the Zoological Society of London.* 57:79-106.

Kurta, A., J.P. Hayes, and M.J. Lacki. 2007. *Bats in forests: conservation and management*. Johns Hopkins University Press.
Lacki, M. J., L. S. Burford, and J. O. Whittaker, Jr. 1995. Food habits of MYGRs in Kentucky. *Journal of Mammalogy*. 76:1256-1259.
Lacki, M. J., D. R. Cox, and M. B. Dickinson. 2009. Meta-analysis of summer roosting characteristics of two species of *Myotis* bats. American Midland Naturalist. 162: 318-26.
Laurance, W.F. and Useche, D.C., 2009. Environmental synergisms and extinctions of tropical species. Conservation biology, 23(6), pp.1427-1437.
LaVal, R. K. and M. L. LaVal. 1980. Ecological studies and management of Missouri bats, with emphasis on cave-dwelling species. *Missouri Department of Conservation: Terrestrial Series*. 8:1-53.
LaVal, R. K., R. L. Clawson, M. L. La Val, and W. Caire. 1977. Foraging behavior and nocturnal activity patterns of Missouri bats, with emphasis on the endangered species *Myotis grisescens* and *Myotis sodalis*. *Journal of Mammalogy*. 58:592-599.
Lemen, C. A., P. W. Freeman, and J. A. White. 2016. Acoustic evidence of bats using rock crevices in winter: A call for more research on winter roosts in North America. *Transactions of the Nebraska Academy of Sciences and Affiliated Societies*. 36:9-13.
Loeb, S.C. and Winters, E.A. 2013. Indiana bat summer maternity distribution: effects of current and future climates. *Ecol Evol*. 2012;3(1):103-114. doi:10.1002/ece3.440
Lorch, J.M., Meteyer, C.U., Behr, M.J., Boyles, J.G., Cryan, P.M., Hicks, A.C., Ballmann, A.E., Coleman, J.T., Redell, D.N., Reeder, D.M. and Blehert, D.S., 2011. Experimental infection of bats with *Geomyces destructans* causes white-nose syndrome. Nature, 480(7377), pp.376-378.
Lutsch K. E., A.G. McDonald, K.T. Gabriel, and C.T. Cornelison. 2022. Roadway-associated culverts may serve as a transmission corridor for *Pseudogymnoascus destructans* and white-nose syndrome in the coastal plains and coastal region of Georgia, USA. *Journal of Wildlife Diseases.* 58(2): 322–332.
Martin, C. O., R.F. Lance, C.H. Bucciantini. 2005. Collisions with aircraft and use of culverts under runways by bats at U.S. Naval Air Station Meridian, Meridian, Mississippi. *Bat Research News*. 46: 51-54.
McNab, B. K. 1974. The behavior of temperate cave bats in a subtropical environment. *Ecology*. 55:943-958.
Meteyer, C.U., E.L. Buckles, D.S. Blehert, A.C. Hicks, D.E. Green, V. Shearn-Bochsler, N.J. Thomas, A. Gargas, and M.J. Behr. 2009. Histopathologic criteria to confirm white-nose syndrome in bats. Journal of Veterinary Diagnostic Investigation 21:411-414.
MidAmerican Energy Company. 2019. Final Habitat Conservation Plan; MidAmerican Energy Company Iowa Wind Project Portfolio. Prepared by MidAmerican Energy Company. 193 pp (plus appendices and addenda).
Mikula, P., F. Morelli, R.K. Lucan, D.N. Jones, P. Tryjanowski. 2016. Bats as prey of diurnal birds: a global perspective. *Mammal Review* 46: 160-174.
Mumford R.E., and J.B. Cope. 1964. Distribution and status of the chiroptera of Indiana. American Midland Naturalist, 72(2):473–489.
Myers, R. F. 1964. Ecology of three species of myotine bats in the Ozark Plateau. Unpublished Ph.D. dissertation, University of Missouri, Columbia, Missouri. 210 pp.
Nagorsen, D.W. and R.M. Brigham. 1993. Bats of British Columbia. Royal British Columbia Museum, Victoria, and the University of British Columbia Press, Vancouver. 164 pp
Newman, B.A., S.C. Loeb, and D.S. Jachowski. 2021. Winter roosting ecology of PESUs (*Perimyotis subflavus*) in trees and bridges, *Journal of Mammalogy.* 105(5): 1331–1341.
Norberg, U.M., and J.M.V. Rayner. 1987. Ecological Morphology and Flight in Bats (Mammalia; Chiroptera): Wing Adaptations, Flight Performance, Foraging Strategy and Echolocation. *Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences*, Vol. 316, No. 1179, pp. 335-427.

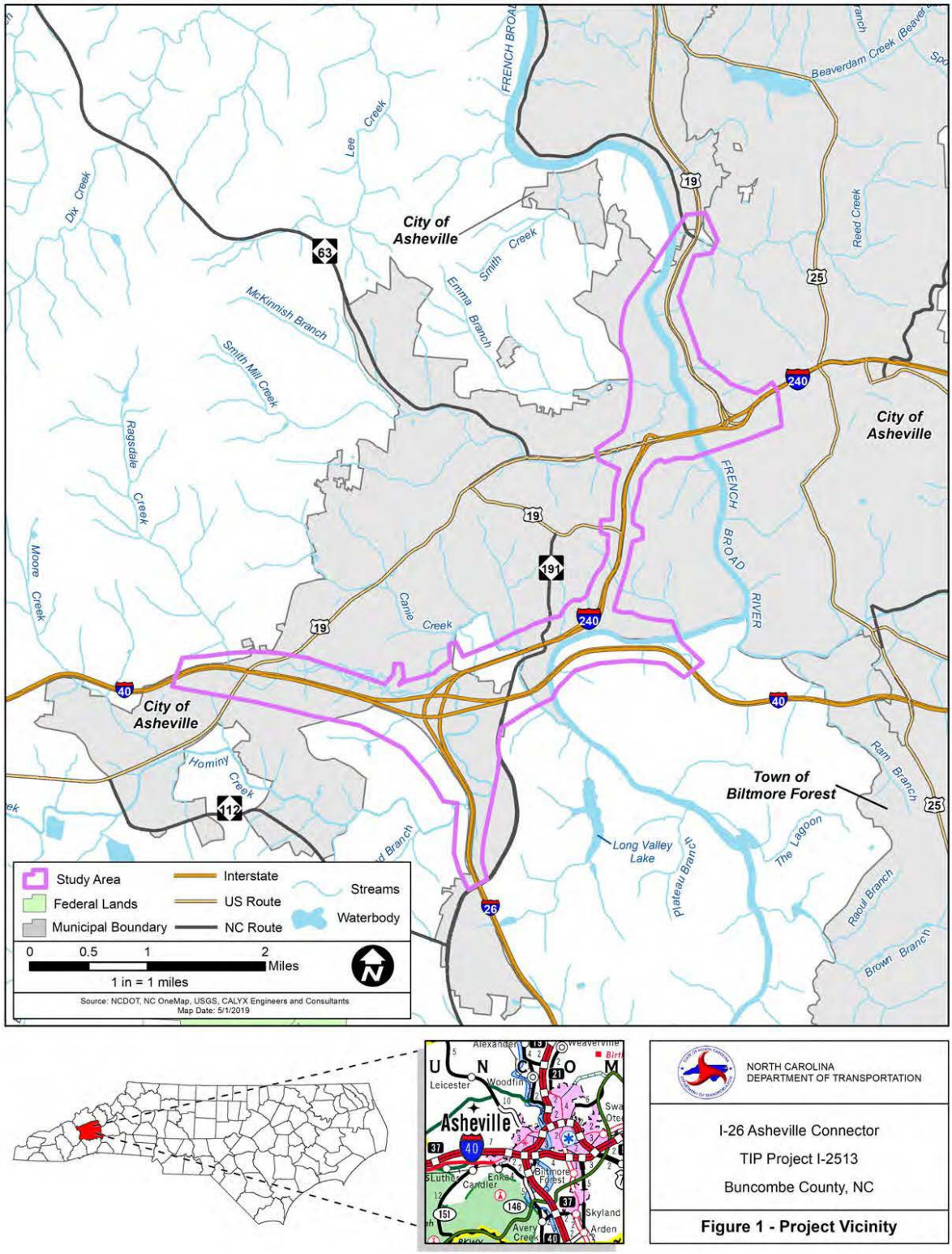
North Carolina Bat Working Group. 2013. Bats of North Carolina: Tri-colored Bat (*Perimyotis subflavus*). https://www.ncbwg.org/tri-colored-bat-perimyotis-subflavus/
North Carolina Department of Transportation (NCDOT). 2019. STIP Project I-2315 Biological Assessment, I-26 Connector.
North Carolina Department of Transportation (NCDOT). 2022a. Combined Bridge Inspection Database. Accessed July 19, 2023. Last updated February 2023.
North Carolina Department of Transportation (NCDOT). 2022b. Combined Culvert Inspection Database. Accessed July 19, 2023. Last updated February 2023.
North Carolina Natural Heritage Program (NCNHP) Online Data Search. 2022. Accessed February 08, 2022. Last updated January 20, 2022. www.ncnhp.org.
O'Keefe, J.M. 2009. Roosting and Foraging Ecology of Forest Bats in the Southern Appalachian Mountains. (PhD diss., Clemson University). Available from: https://tigerprints.clemson.edu/cgi/viewcontent.cgi?article=1333&context=all_dissertations
O'Keefe, J.M., and S.C. Loeb. 2017. Indiana bats roost in ephemeral, fire-dependent pine snags in the southern Appalachian Mountains, USA. Forest Ecology and Management 391:264-274.
Owen, S.F., M.A. Menzel, W.M. Ford, J.W. Edwards, B.R. Chapman, K.V. Miller, and P.B. Wood. 2002. Roost tree selection by maternal colonies of Northern long-eared Myotis in an intensively managed forest. USDA Forest Service. Newtown Square, Pennsylvania. 10 pp.
Owen, S. F., M. A. Menzel, W. M. Ford, B. R. Chapman, K. V. Miller, J. W. Edwards, P. B. Wood. 2003. Home-range size and habitat used by the northern Myotis (*Myotis septentrionalis*). American Midland Naturalist 150:352-359.
Patriquin, K.J. and R.M. Barclay. 2003. Foraging by bats in cleared, thinned, and unharvested boreal forest. J. Applied Ecology, 40:646-657.
Perry, R. W. and R. E. Thill. 2007. Roost selection by male and female MYSEs in a pine-dominated landscape. *Forest Ecology and Management*. 247:220-226.
Perry, R.W., and R.E. Thill. 2007b. Tree roosting by male and female eastern pipistrelles in a forested landscape. Journal of Mammalogy 88(4):974-981.
Perry, R.W., R.E. Thill, and D.M. Leslie Jr. 2008. Scale-dependent effects of landscape structure and composition on diurnal roost selection by forest bats. J. Wildlife. Manage. 72(4): 913-925.
Pierson, E.D., 1998. Tall trees, deep holes, and scarred landscapes: conservation biology of North American bats. Bat biology and conservation. Smithsonian Institution Press, Washington, DC, USA, pp.309-325.
Poissant, J. A. 2009. Roosting and Social Ecology of the PESU, Perimyotis subflavus, in Nova Scotia. Thesis for Master of Science. Saint Mary's University, Halifax, Nova Scotia. 85 pp. Available at: https://t.library2.smu.ca/bitstream/handle/01/25150/poissant_joseph_a_masters_2009.PDF?sequence=2&isAllowed=y
Poissant, J. A., H. G. Broders, and G. M. Quinn. 2010. Use of lichen as a roosting substrate by *Perimyotis subflavus*, the tricolored bat, in Nova Scotia. Ecoscience 17:372-378.
Ratcliffe, J.M. and J.W. Dawson. 2003. Behavioral flexibility: the MYLU, Myotis lucifugus, and the MYSE, M. septentrionalis, both glean and hawk prey. Animal Behaviour, 66:847–856.
Randall, L.A., 2014. Roost-site selection and movements of little brown myotis (*Myotis lucifugus*) in southwestern Yukon. *Northwestern Naturalist*, 95(3), pp.312-317.
Reeder, D.M., C.L. Frank, G.G. Turner, C.U. Meteyer, A. Kurta, E.R. Britzke, M.E. Vodzak, S.R. Darling, C.W. Stihler, A.C. Hicks, R. Jacob, L.E. Grieneisen, S.A. Brownlee, L.K. Muller, and D.S. Blehert. 2012. Frequent arousal from hibernation linked to severity of infection and mortality in bats with white-nose syndrome. Plos One 7:e38920. http://dx.doi.org/10.1371%2Fjournal.pone.0038920.
Reichard, J.D. and T.H. Kunz. 2009. White-nose syndrome inflicts lasting injuries to the wings of little brown myotis (*Myotis lucifugus*). Acta Chiropterologica, 11(2):457-464.
Rodenhouse, N.L., Christenson, L.M., Parry, D. and Green, L.E., 2009. Climate change effects on native fauna of northeastern forests. Canadian Journal of Forest Research, 39(2), pp.249-263.

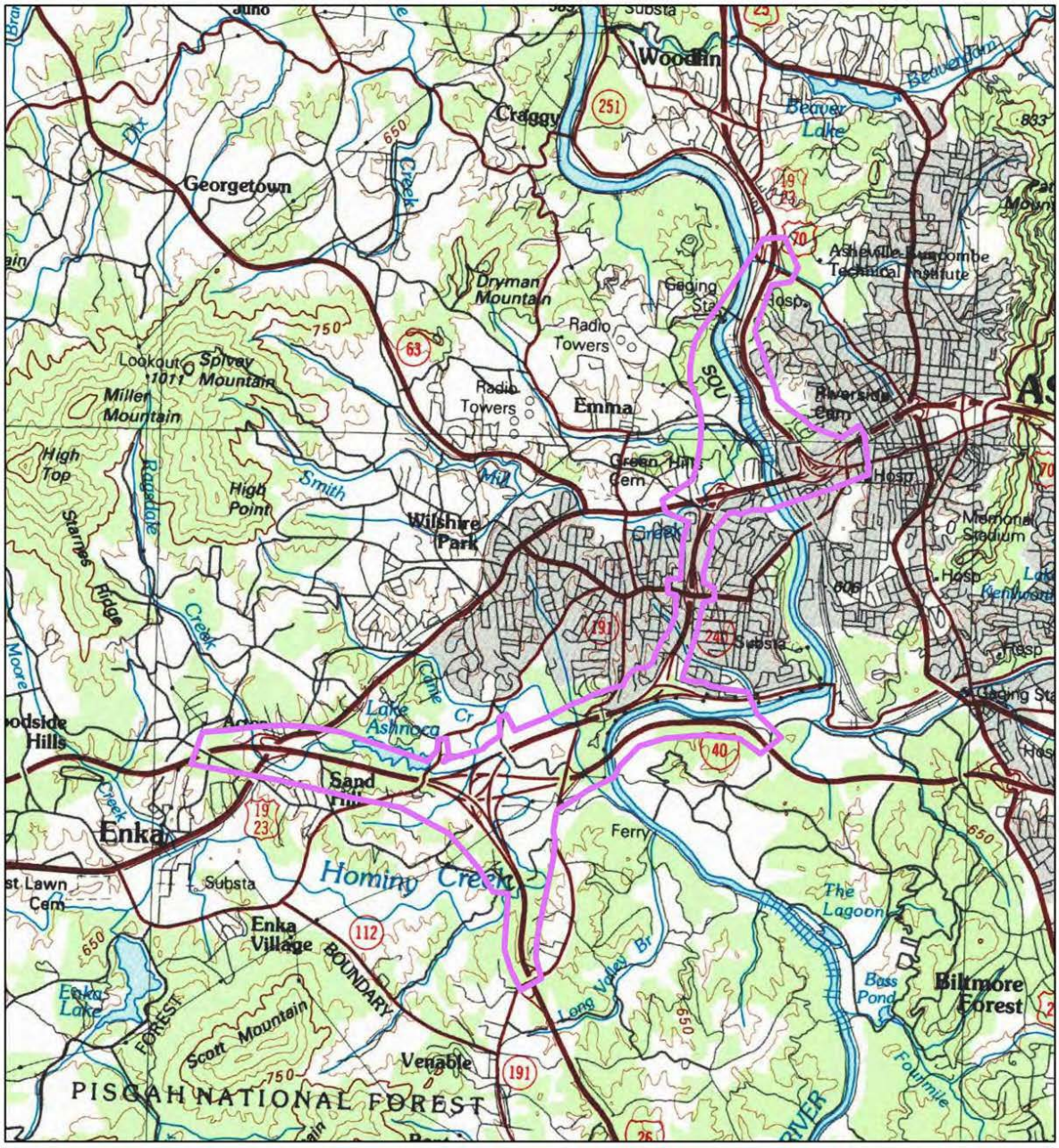
Russell A.L., C.M. Butchkoski, L. Saidak, and G.F. McCracken. 2009. Road-killed bats, highway design, and the commuting ecology of bats. *Endangered Species Research*. 8:49-60.
Sandel, J. K., G. R. Benatar, K. M. Burke, C. W. Walker, T. E. Lacher, Jr., and R. L. Honeycutt. 2001. Use and selection of winter hibernacula by the eastern pipistrelle (*Pipistrellus subflavus*) in Texas. *Journal of Mammalogy*. 82:173-178.
Sasse, D.B., and P.J. Pekins. 1996. Summer roosting ecology of MYSEs (Myotis septentrionalis) in the white mountain national forest. Bats and Forests Symposium October 1995, Victoria, British Columbia, Canada, pp. 91–101.
Sasse, D.B., M. L. Caviness, M. J. Harvey, J. L. Jackson, and P. N. Jordan. 2014. Journal of the Arkansas Academy of Science 68(32):170–173.
Saunders, D.A. [online]. 1988. MYLU (*Myotis lucifugus*). P. 216 in Adirondack Mammals. State University of New York, College of Environmental Science and Forestry.
Schaefer, K. 2016. Habitat Usage of Tri-colored Bats (*Perimyotis subflavus*) in Western Kentucky and Tennessee Post-White Nose Syndrome. Murray State Theses and Dissertations. https://digitalcommons.murraystate.edu/etd/33.
Sherwin, H.A., W.I. Montgomery, and M.G. Lundy. 2013. The impact and implications of climate change for bats. Mammal Review 43(3):171-182.
Shore, R.F. and Rattner, B.A. eds., 2001. Ecotoxicology of wild mammals. Chichester: Wiley.
Simmons, N.B. 2005. Order Chiroptera: Subfamily Myotinae. p. 516 in Mammal species of the world: a taxonomic and geographic reference, D.E. Wilson and D.M. Reeder, editors. The John Hopkins University Press, Baltimore, Maryland. 2000 pp
Slider, R. M. and A. Kurta. 2011. Surge tunnels in quarries as potential hibernacula for bats. *Notes of the Northeastern Naturalist*. 18:378-381.
Sparks, D. W. and J. R. Choate. 2000. Distribution, natural history, conservation status, and biogeography of bats in Kansas. Pages 173-228 in *Reflections of a naturalist: Papers honoring professor Eugene D. Fleharty* (J. R. Choate, ed.). *Fort Hays Studies, Special Issue*. 1:1-241.
Sparks, J.K., B.J. Foster, and D.W. Sparks. 2004. Utility pole used as a roost by a northern myotis, Myotis septentrionalis. Bat Research News, 45:94.
Timpone, J.C., J.G. Boyles, K.L. Murray, D.P. Aubrey, and L.W. Robbins. 2010. Overlap in roosting habits of MYSOs (*Myotis sodalis*) and northern bats (*Myotis septentrionalis*). American Midland Naturalist 163:115–123.
Timpone, J., K.E. Francl, V. Brack Jr., and J. Beverly. 2011. Bats of the Cumberland Plateau and Ridge and Valley provinces, Virginia. *Southeastern Naturalist*. 10(3): 515–528.
Tinsley, K. 2016. Status review for the eastern subspecies of the MYLU (*Myotis lucifugus lucifugus*). Prepared for U.S. Department of Interior, U.S. Fish and Wildlife Service, Region 3, Bloomington, Minnesota. 150 pp.
U.S. Fish and Wildlife Service (Service). 1983. Recovery Plan for the Indiana Bat. Twin Cities, MN.
U.S. Fish and Wildlife Service (Service). 1999. Agency Draft Indiana Bat (*Myotis sodalis*) Revised Recovery Plan. Fort Snelling, MN. 53 pp.
U.S. Fish and Wildlife Service. 2009. Indiana Bat 5-Year Review: Summary and Evaluation. USFWS Region 3. Available at http://www.fws.gov/midwest/endangered/recovery/5yr_rev/pdf/INBA5Yr30Sept2009.pdf
U.S. Fish and Wildlife Service (Service). 2019a. 2019 Indiana bat (*Myotis sodalis*) Population Status Update. Indiana Ecological Services Field Office. 9 pp.
U.S. Fish and Wildlife Service (Service). 2019b. Indiana Bat (*Myotis sodalis*) 5-Year Review: Summary and Evaluation. Indiana Ecological Services Office, Bloomington Indiana. 68 pp and an appendix. Available at : https://ecos.fws.gov/docs/tess/species_nonpublish/2918.pdf
U.S. Fish and Wildlife Service (Service). 2020. Range-wide Indiana Bat Survey Guidelines. 14 pp with appendices.
U.S Fish and Wildlife Service (Service) and National Marine Fisheries Service (NMFS). 1998. Consultation Handbook: Procedures for Conducting Consultation and Conference Activities Under

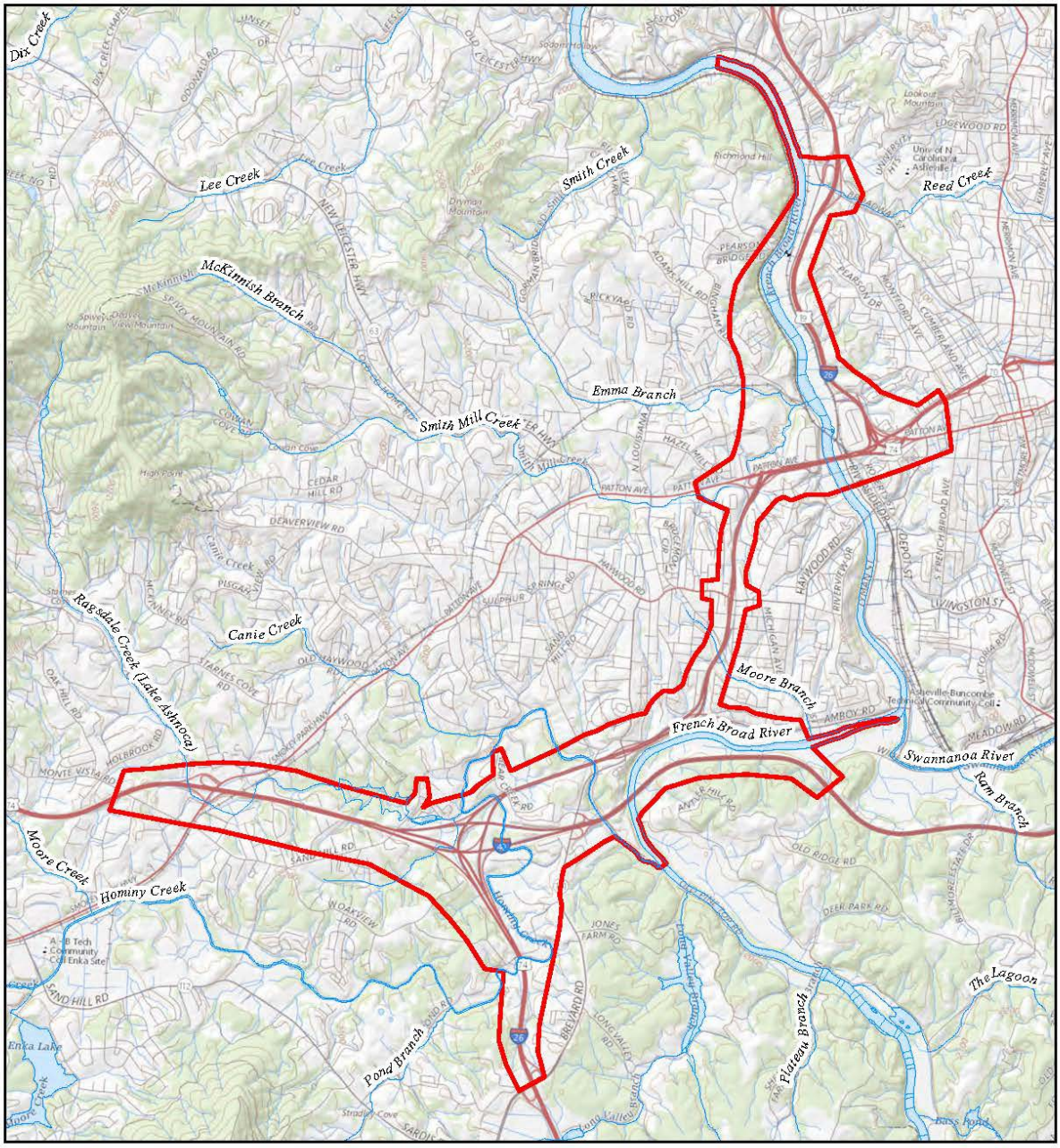
Section 7 of the Endangered Species Act. March. Final. 315 pp. Available at: https://www.fws.gov/sites/default/files/documents/endangered-species-consultation-handbook.pdf
U.S. Fish and Wildlife Service (Service). 2007. Indiana bat (*Myotis sodalis*) Draft Recovery Plan: First Revision. Fort Snelling, MN.
U.S Fish and Wildlife Service (Service). 2014. MYSE Interim Conference and Planning Guidance. USFWS Regions 2, 3, 4, 5, & 6. Available at http://www.fws.gov/midwest/endangered/mammals/nlba/pdf/MYSEinterimGuidance6Jan2014.pdf.
U.S. Fish and Wildlife Service (Service). 2015. Endangered and Threatened Wildlife and Plants; Threatened Species Status for the MYSE With 4(d) Rule; Final Rule and Interim Rule. Federal Register 80(63): 17974–18033.
U.S. Fish and Wildlife Service. 2021. Species Status Assessment Report for the PESU (*Perimyotis subflavus*), Version 1.1. December 2021. Hadley, Massachusetts. Available at: https://ecos.fws.gov/ServCat/DownloadFile/221212.
U.S. Fish and Wildlife Service (Service). 2022a. Information for Planning and Consultation (IPaC). Accessed January 6, 2022. https://ecos.fws.gov/ipac/location/BBKWYJI6HNE7JHOKGB2JHODMFI/resources
U.S. Fish and Wildlife Service (Service). 2022b. Biological opinion and conference opinion for the issuance of an incidental take permit for the MYGR, MYSO, MYSE, MYLU, and PESU, Associated with the Habitat Conservation Plan for the Missouri Department of Conservation's habitat and public access management activities across the state of Missouri. Columbia, Missouri. https://ecos.fws.gov/docs/plan_documents/bobs/bobs_3468.pdf
U.S. Fish and Wildlife Service. Service 2022c. Species Status Assessment Report for the MYSE (*Myotis septentrionalis*), Version 1.1. March 22, 2022. Bloomington, MN. https://ecos.fws.gov/ServCat/DownloadFile/215290
U.S. Fish and Wildlife Service. Service 2022d. Programmatic Biological Opinion on the Revised Forest Plan for the Pisgah and Nantahala National Forests. FWS Log Number 22-399. Asheville Ecological Services Field Office. June 02, 2022.
Nan Zyll de Jong, C.G. 1985. Handbook of Canadian mammals. National Museums of Canada, Ottawa, Canada. 212pp.
Veilleux, J. P. and S. L. Veilleux. 2004a. Colonies and reproductive patterns of tree-roosting female eastern pipistrelle bats in Indiana. *Proceedings of the Indiana Academy of Science*. 113:60-65.
Veilleux, J. P. and S. L. Veilleux. 2004b. Intra-annual and interannual fidelity to summer roost areas by female eastern pipistrelles, *Pipistrellus subflavus*. *The American Midland Naturalist*. 152:196-200.
Veilleux, J. P., J. O. Whitaker, Jr., and S. L. Veilleux. 2003. Tree-roosting ecology of reproductive female eastern Pipistrelles, *Pipistrellus subflavus*, in Indiana. *Journal of Mammalogy*. 84:1068-1075.
Veilleux, J. P., J. O. Whitaker, Jr., and S. L. Veilleux. 2004. Reproductive stage influences roost use by tree roosting female eastern pipistrelles, *Pipistrellus suflavus*. *Ecoscience*. 11:249-256.
Walker, C. W., J.K Sandel, R.L. Honeycutt, and C. Adams. 1996. Winter utilization of box culverts by vespertilionid bats in southeast Texas. *The Texas Journal of Science*. 48:166–168.
Watrous, K.S., T.M. Donovan, R.M. Mickey, S.R. Darling, A.C. Hicks, and S.L. Von Oettingen. 2006. Predicting minimum habitat characteristics for the Indiana bat in the Champlain Valley. J. Wildlife Management 70:1128-1237.
Warnecke, L., J.M. Turner, T.K. Bollinger, J.M. Lorch, V. Misra, P.M. Cryan, G. Wibbelt, D.S.Blehert, and C.K.R. Willis. 2012. Inoculation of bats with European *Geomyces destructans* supports the novel pathogen hypothesis for the origin of white-nose syndrome. PNAS 109(18):6999-7003.
Weber, J and B. Walters. 2022. Monitoring MYGRs in Western North Carolina, Report to Biltmore Farms and U.S. Fish and Wildlife Service. Indiana State University, Terre Haute, IN.
Weber, J., J. O'Keefe, and B. Walters. 2018. Activity Report: Distribution, Roosting, and Foraging Ecology, and Migration Pathways for MYGRs in Western NC. Indiana State University, Terre Haute, IN.

Weber, J., J. O'Keefe, and B. Walters. 2018. Activity Report: Distribution, Roosting, and Foraging Ecology, and Migration Pathways for MYGRs in Western NC. Indiana State University, Terre Haute, IN.
Weber, J., J. O'Keefe, B. Walters, F. Tillman, and C. Nicolay. 2020. Distribution, Roosting and Foraging Ecology, and Migration Pathways for MYGRs in Western North Carolina. NCDOT Project 2018-36, FHWA/NC/2018-36.
West, E.W. 2016. Technical Guidance for Assessment and Mitigation of the Effects of Traffic Noise and Road Construction Noise on Bats. Division of Environmental Analysis, California Department of Transportation, 1120 N Street, MS-27, Sacramento CA 95814.
Whitaker, J.O., Jr. and V. Brack, Jr. 2002. Distribution and summer ecology in Indiana. Pp. 48- 54 *in* A. Kurta and J. Kennedy (eds.), The Indiana bat: biology and management of an endangered species. Bat Conservation International, Austin, TX.
Whitaker, J.O., and W.J. Hamilton. 1998. Order Chiroptera: Bats. Chapter 3: pp.89–102 in Mammals of the eastern United States, Third Edition, Comstock Publishing Associates, a Division of Cornell University Press, Ithaca, New York, 608pp.
Whitaker, J.O., and R.E. Mumford. 2009. Northern Myotis. pp. 207–214. In Mammals of Indiana. Indiana University Press, Bloomington, Indiana. 688pp.
Whitaker, J. O., Jr. and L. J. Rissler. 1992. Seasonal activity of bats at Copperhead Cave. *Proceedings of the Indiana Academy of Science*. 101:127-134.
Whitaker, J. O., Jr and M. Stacy. 1996. Bats of abandoned coal mines in southwestern Indiana. *Proceedings of the Indiana Academy of Science*. 105:277-280.
White, J.W., P. Freeman, C. A. Lemen. 2017. Habitat selection by the Northern Long-eared Myotis (Myotis septentrionalis) in the Midwestern United States: Life in a shredded farmscape. Transactions of the Nebraska Academy of Sciences and Affiliated Societies 37: 1–10.
Wilson, D.E., and S. Ruff. 1999. The Smithsonian Book of North American Mammals. The Smithsonian Institution Press, Washington, D.C.
Wimsatt, W. A. 1945. Notes on breeding behavior, pregnancy, and parturition in some vespertilionid bats of the eastern United States. *Journal of Mammalogy*. 26:23-33.
Wisconsin Department of Natural Resources. 2013. Wisconsin MYLU Species Guidance. Bureau of Natural Heritage Conservation, Wisconsin Department of Natural Resources, Madison, Wisconsin. PUB-ER-705. Available at: https://dnr.wi.gov/files/pdf/pubs/er/er0705.pdf
Yates, M.D., and R.M. Muzika. 2006. Effect of forest structure and fragmentation on site occupancy of bat species in Missouri Ozark Forests. J. Wildlife Management 70(5):1238-1248.

Appendix A. Vicinity and Project Areas




Woodfin
Craggy
Beaver Lake
Georgetown
Dryman Mountain
Radio Towers
Emma
Asheville-Buncombe Technical Institute
Riverside Cem
Memorial Stadium
Wilshire Park
Green Hill Cem
Lookout 1011
Spivey Mountain
Miller Mountain
High Top
High Point
Ragsdale
Starnes Ridge
Smith
Mill
Creek
Lake Ashnoca
Moore
Hills
Sand Hill
Enka
Homing Creek
Enka Village
BOUNDARY
FOREST
Enka Lake
Scott Mountain
Venable
PISGAH NATIONAL FOREST
Ferry
The Lagoon
Bass Pond
Long Valley Br
Biltmore Forest
Substa
Hosp
Cem
Lawn
Leading Sta
Gaging Sta
Beaverdam
Foulmile
RIVER
Legend
Study Area
N
0 0.5 1 2 Miles
1 in = 1 mile
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
I-26 Asheville Connector
TIP Project I-2513
Buncombe County, NC
Figure 2 - Landscape Position
Source: NC OneMap, CALYX Engineers and Consultants
Map Date: 1/14/2019



NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

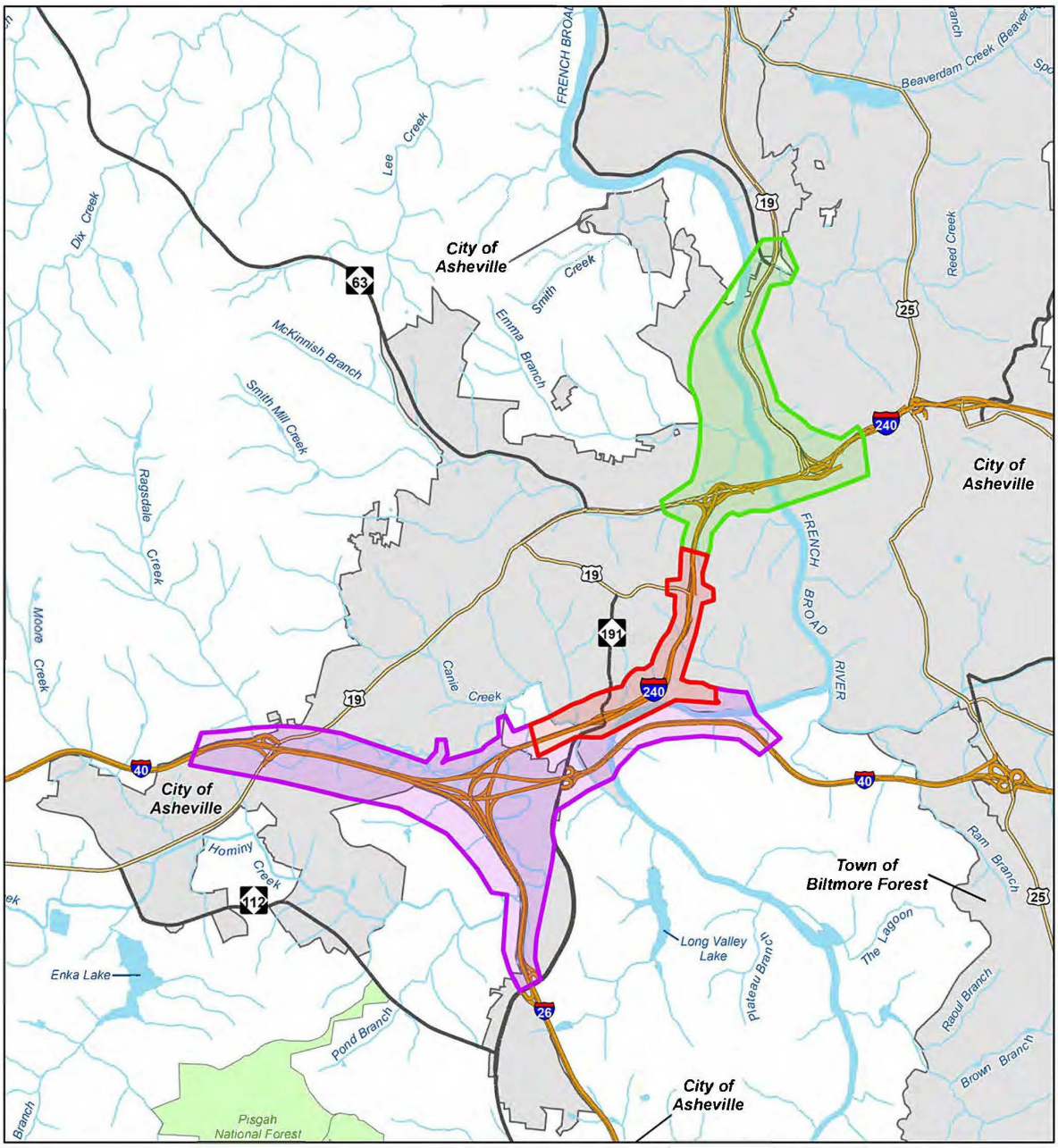
I-26 Asheville Connector

TIP Project I-2513

Buncombe County, NC

Figure 3 - Action Area Streams

Source: Three Oaks Engineering
Map Date: 3/6/2019



NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

I-26 Asheville Connector
TIP Project I-2513
Buncombe County, NC

Legend

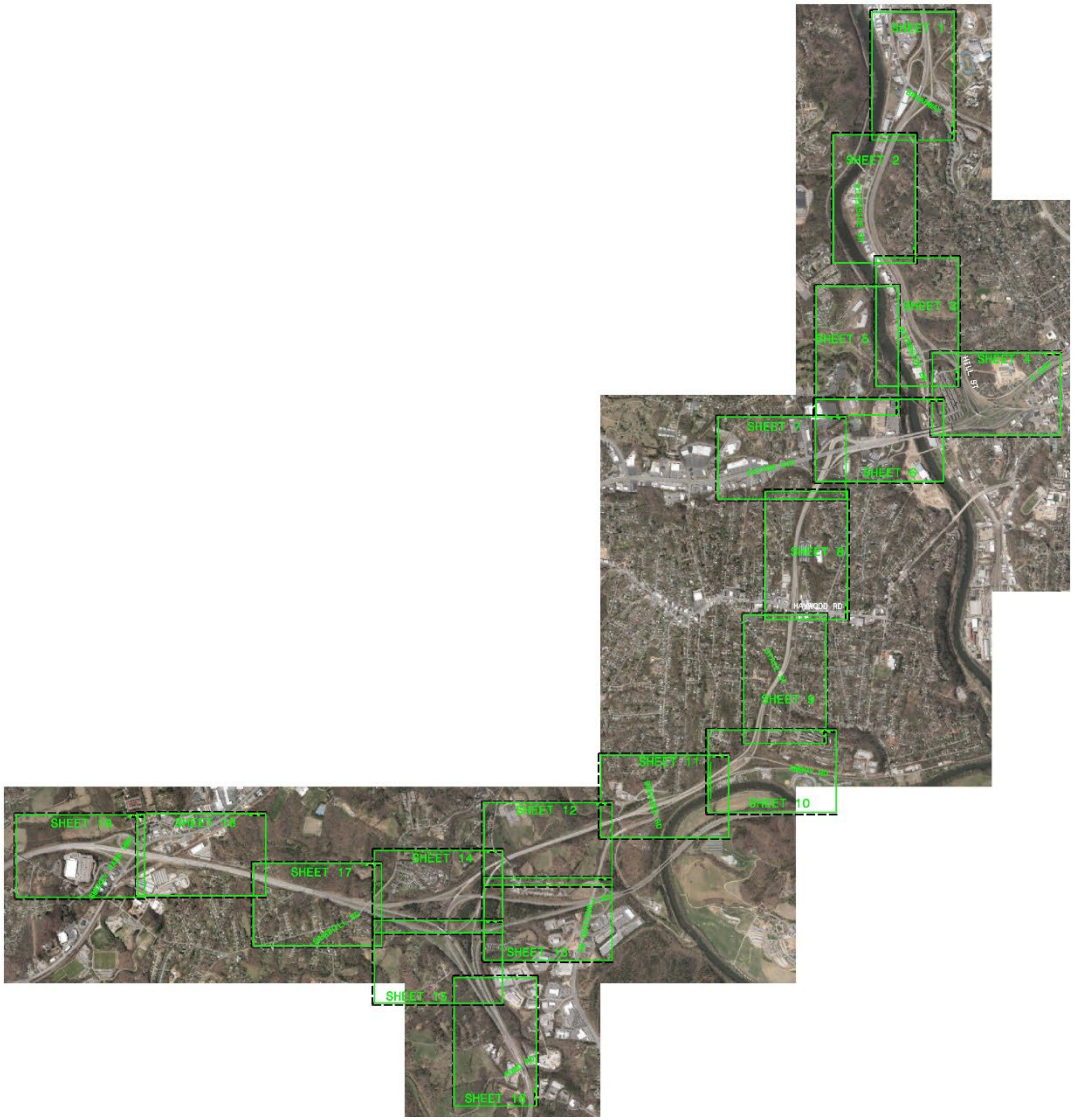
- Section A
- Section B
- Section C
- Interstate
- US Route
- NC Route
- Federal Lands
- Streams
- Waterbody

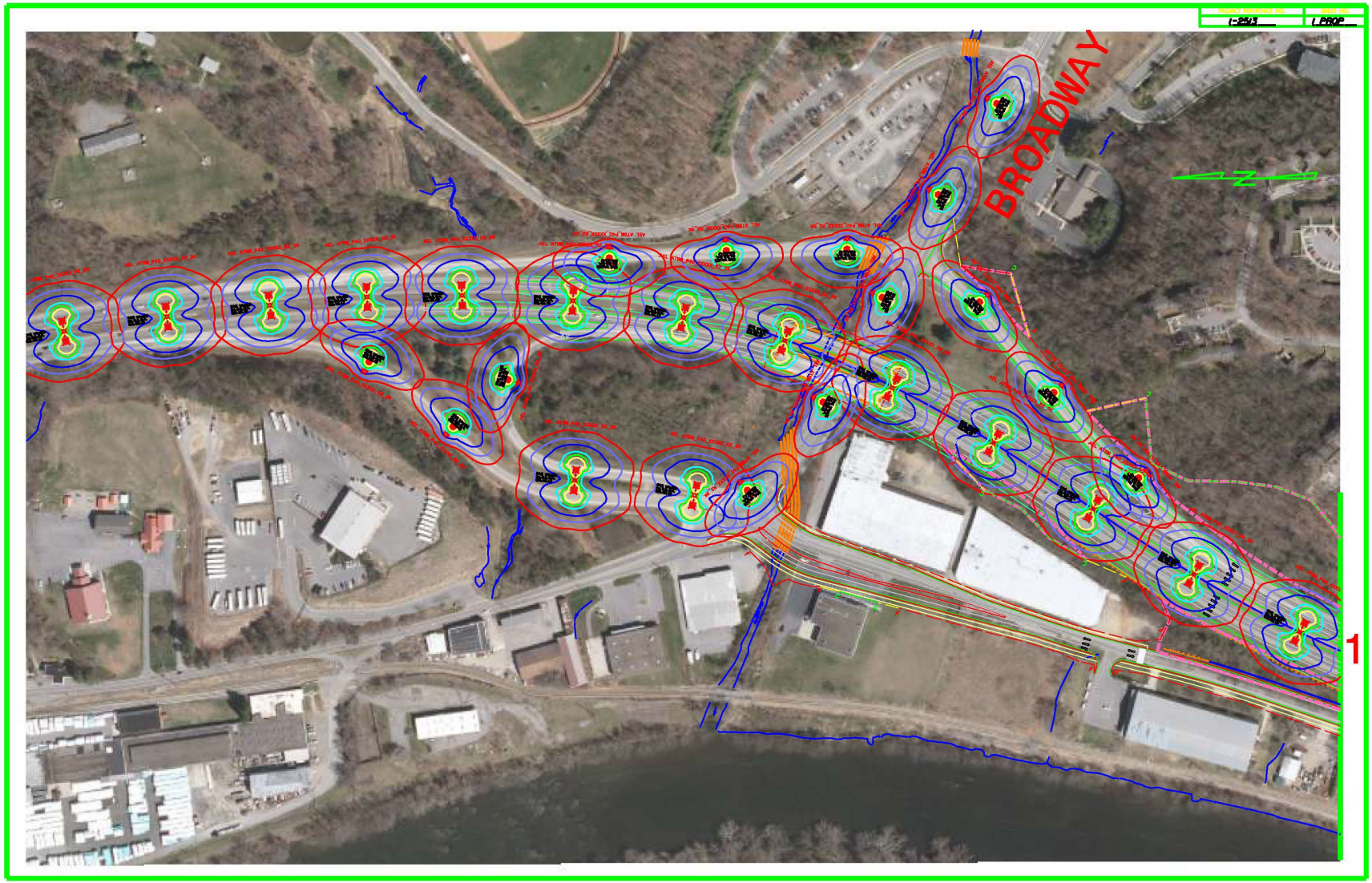
0 0.5 1 2 Miles
1 in = 1 mile

Figure 4
Project Study Area and Sections

Source: NCDOT, NC OneMap, USGS, CALYX Engineers and Consultants
Map Date: 1/14/2019

Appendix B. Proposed Lighting and Clearing

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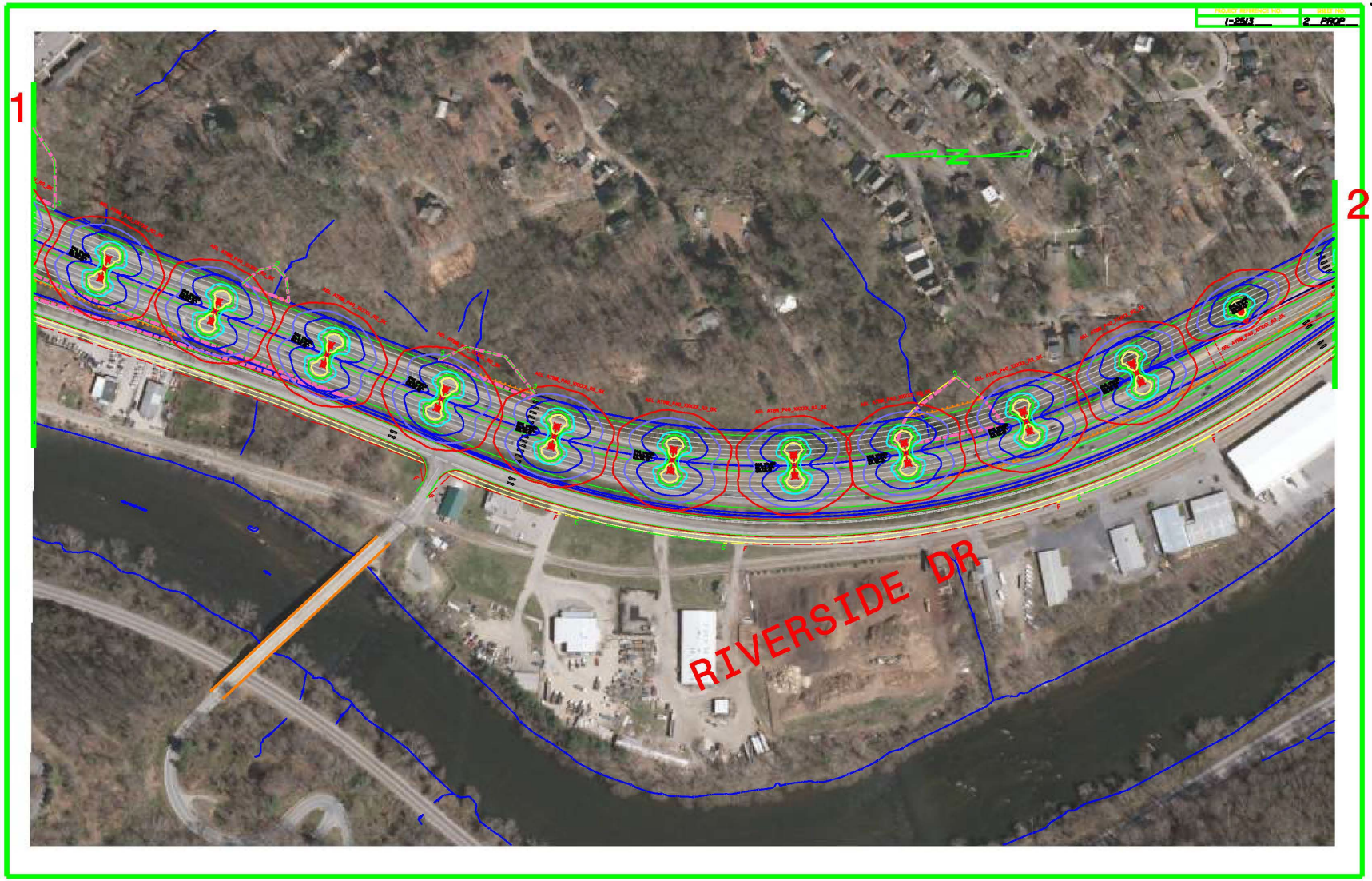
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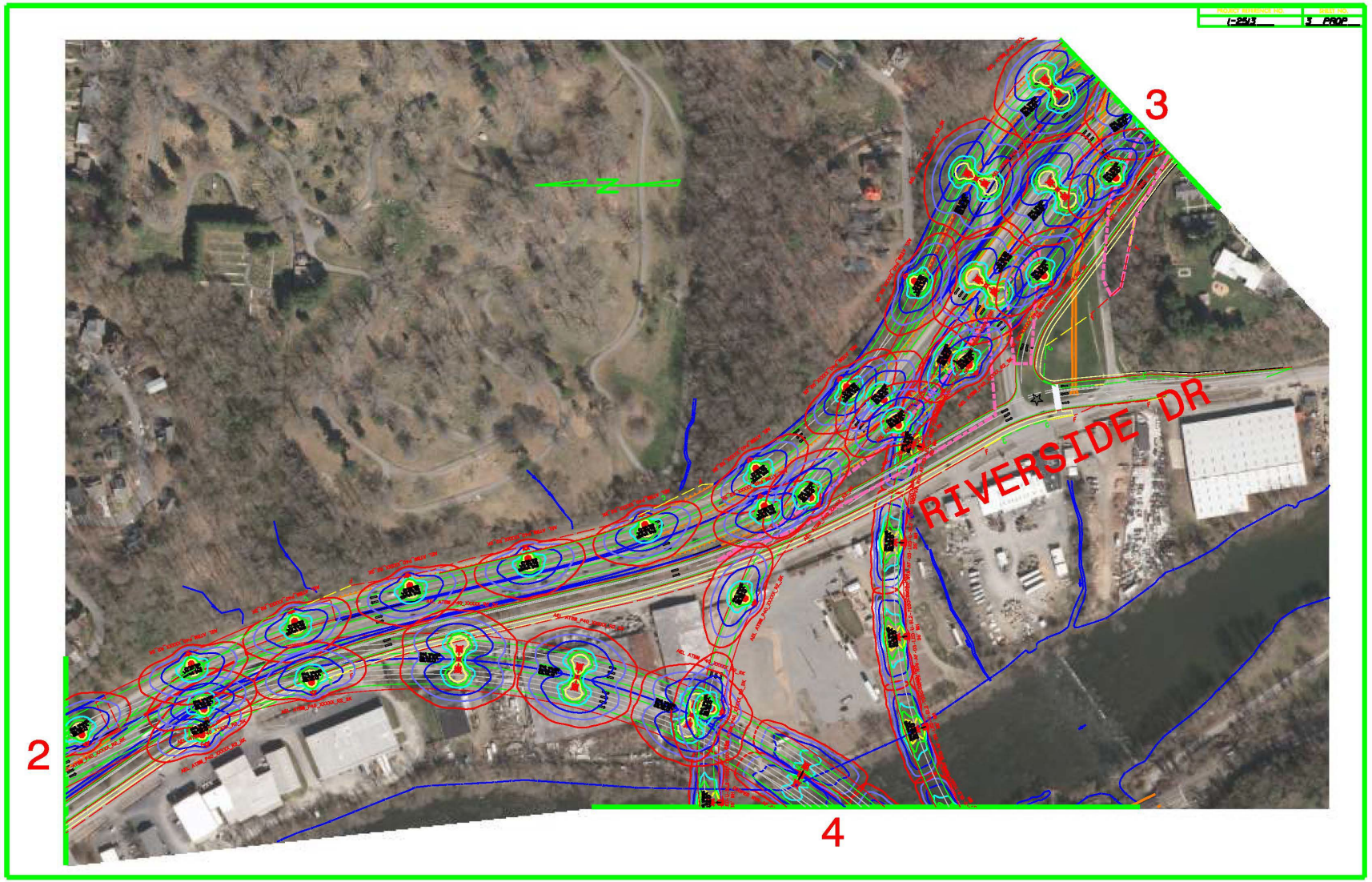
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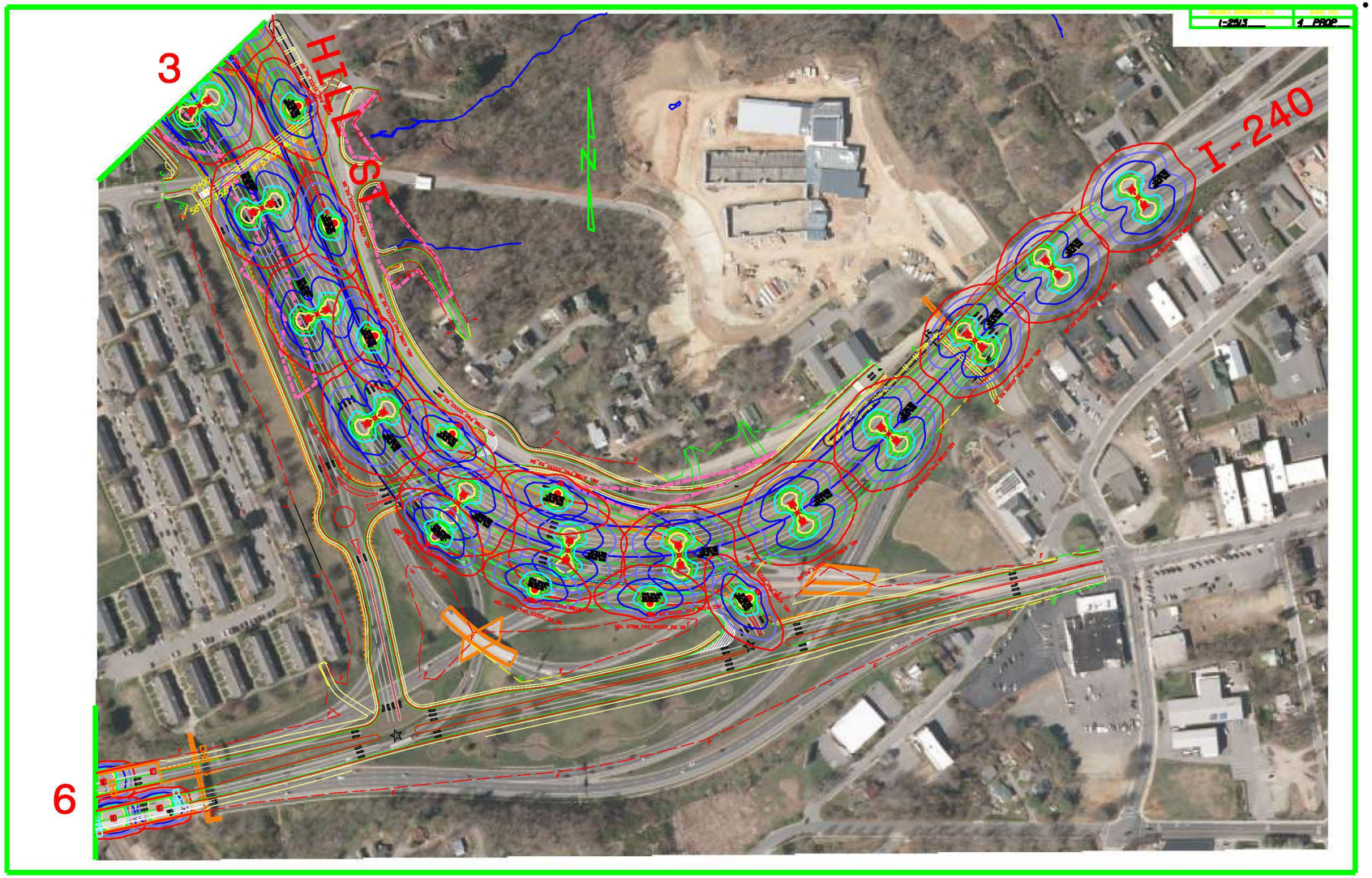
RIVERSIDE DR
2
4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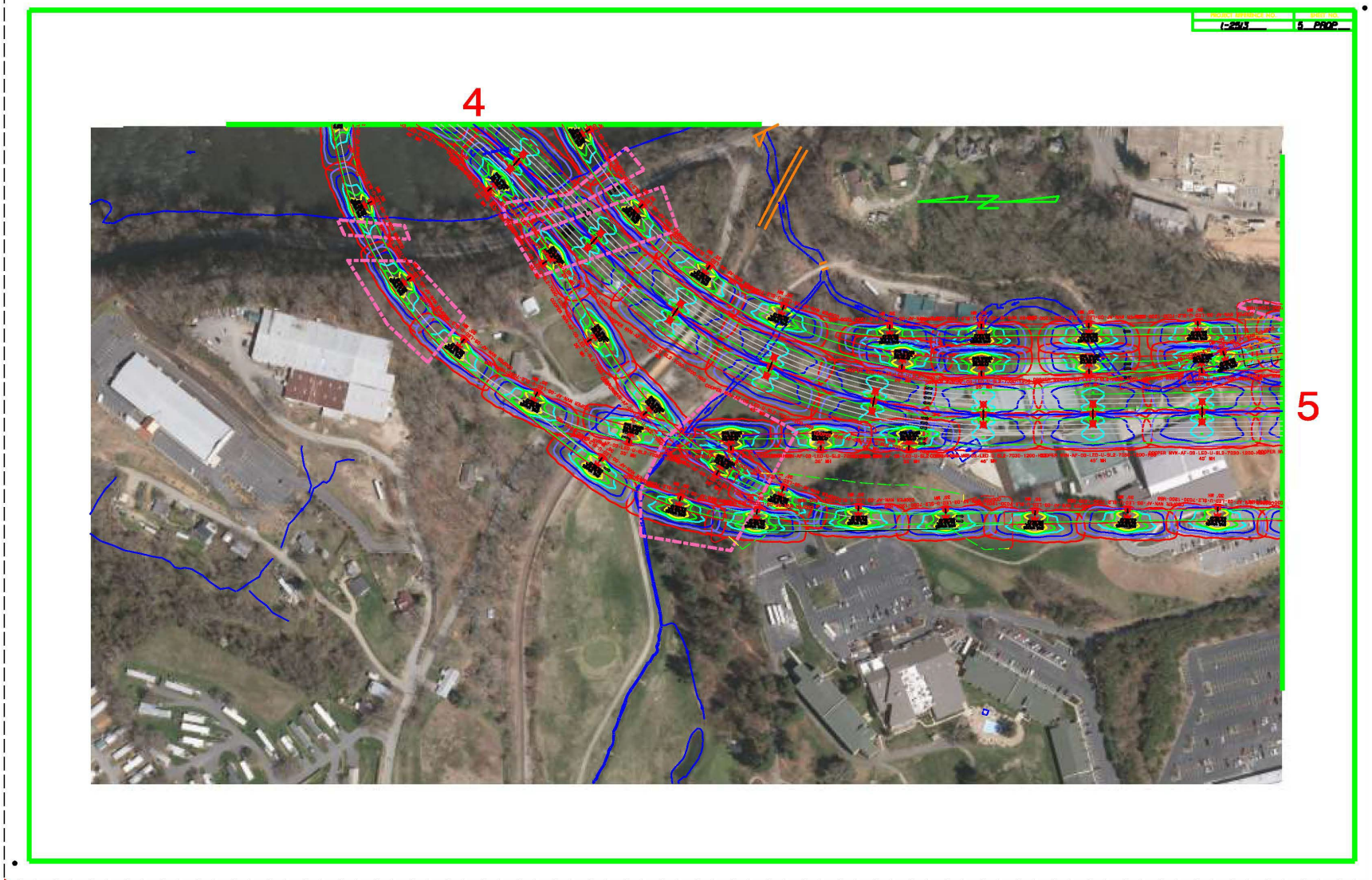
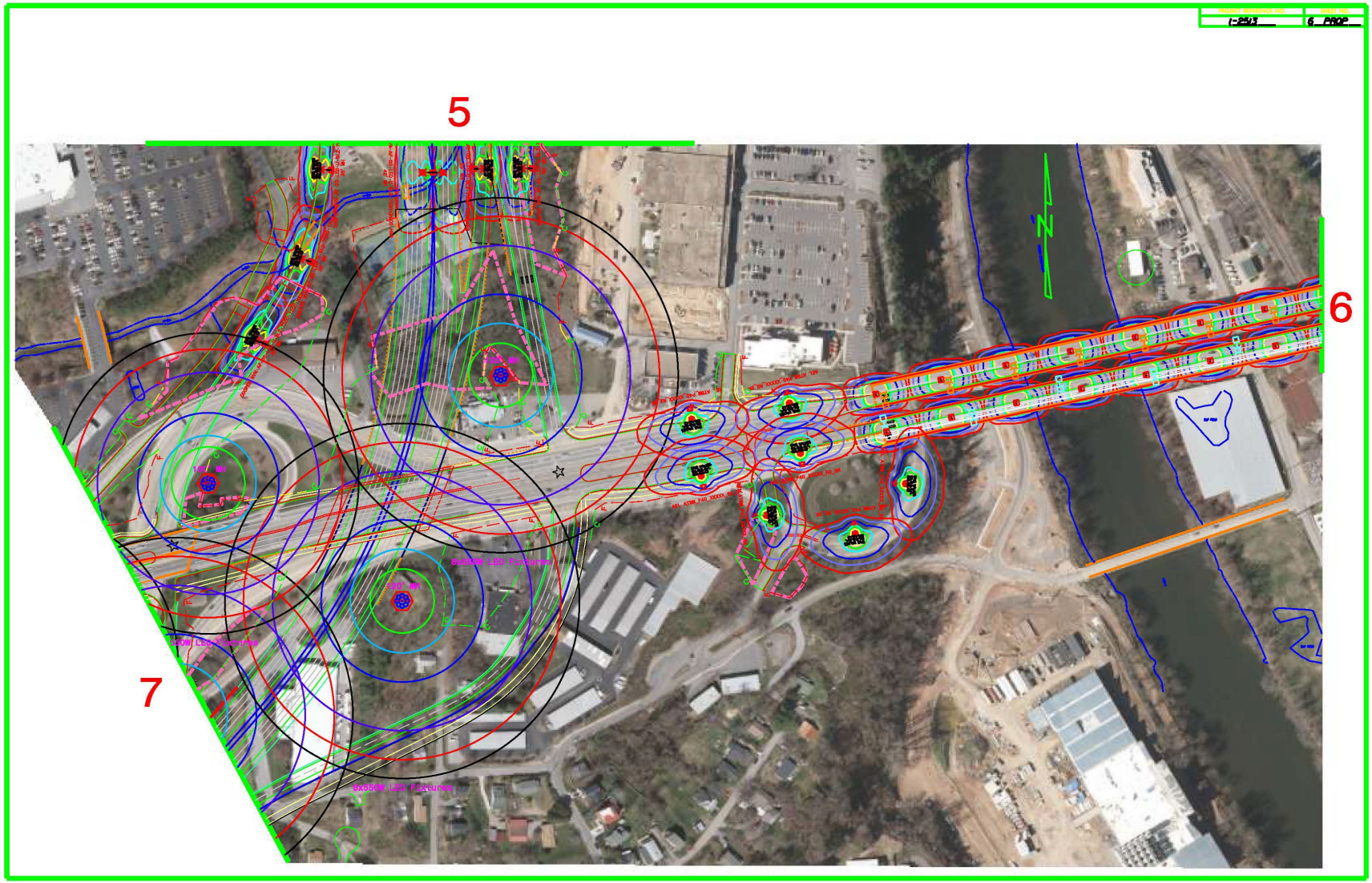
I-240
6


I-295
5 PROP
4
5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PATTON AVE
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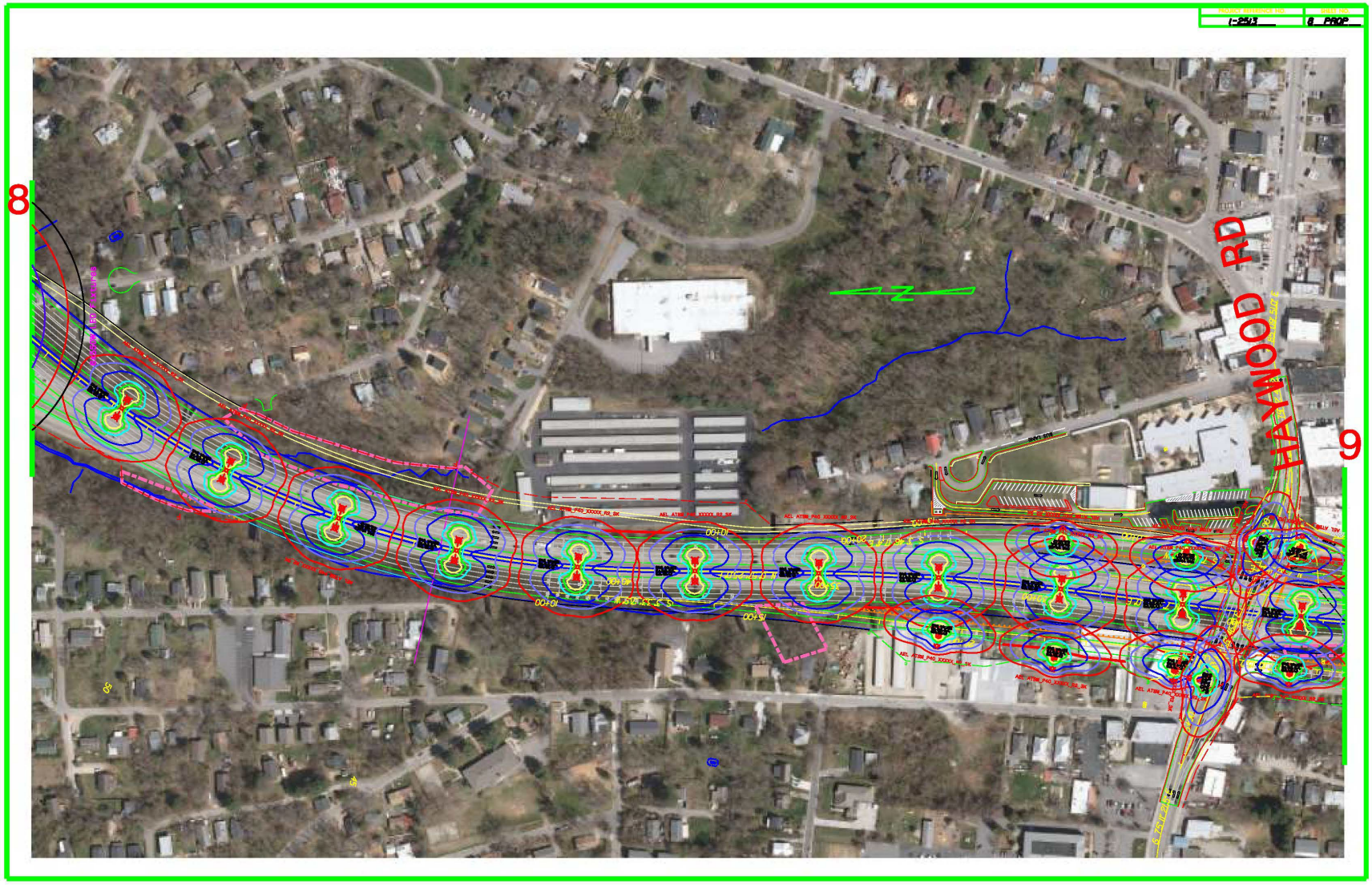
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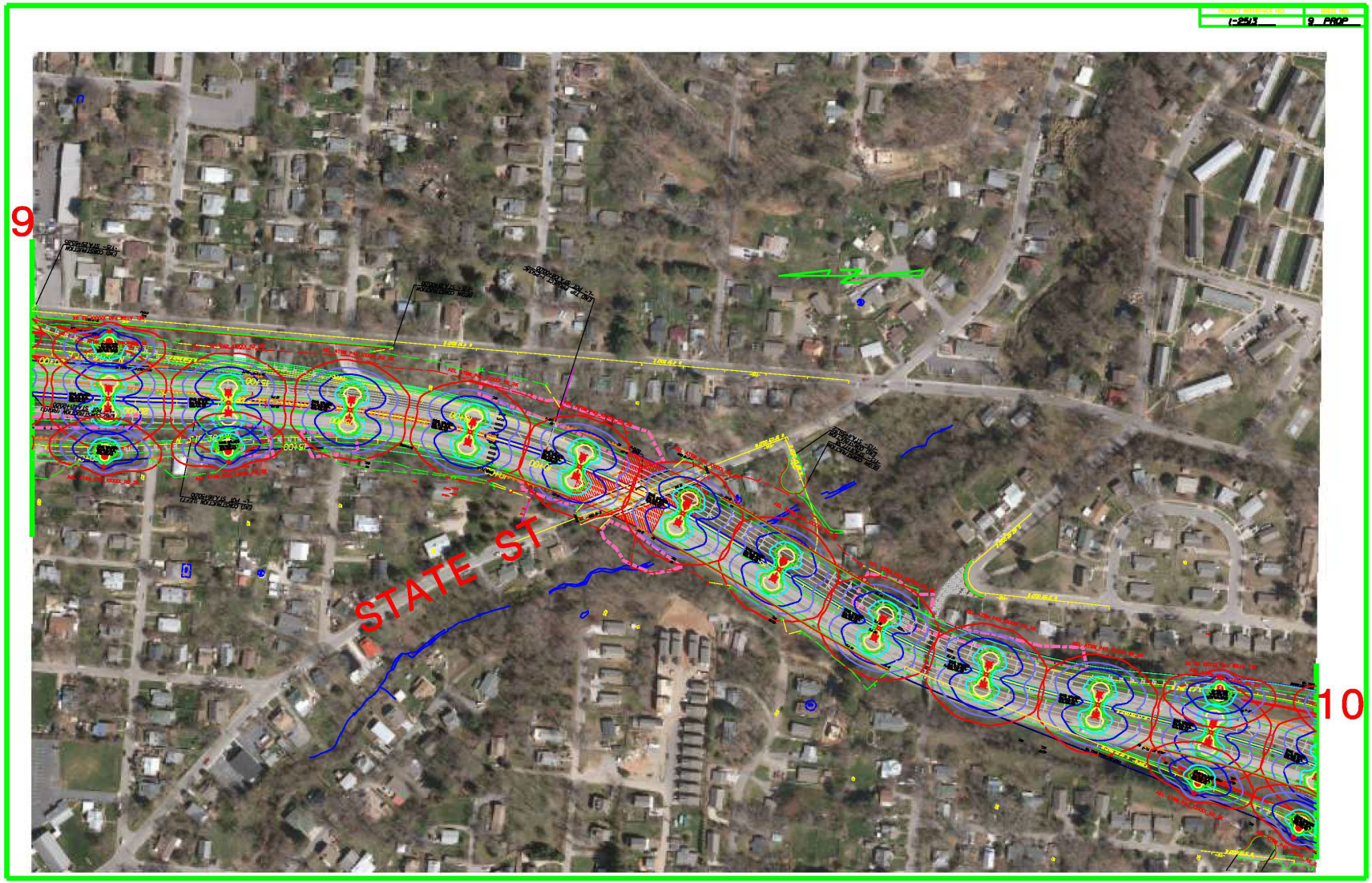
HAYWOOD RD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STATE ST
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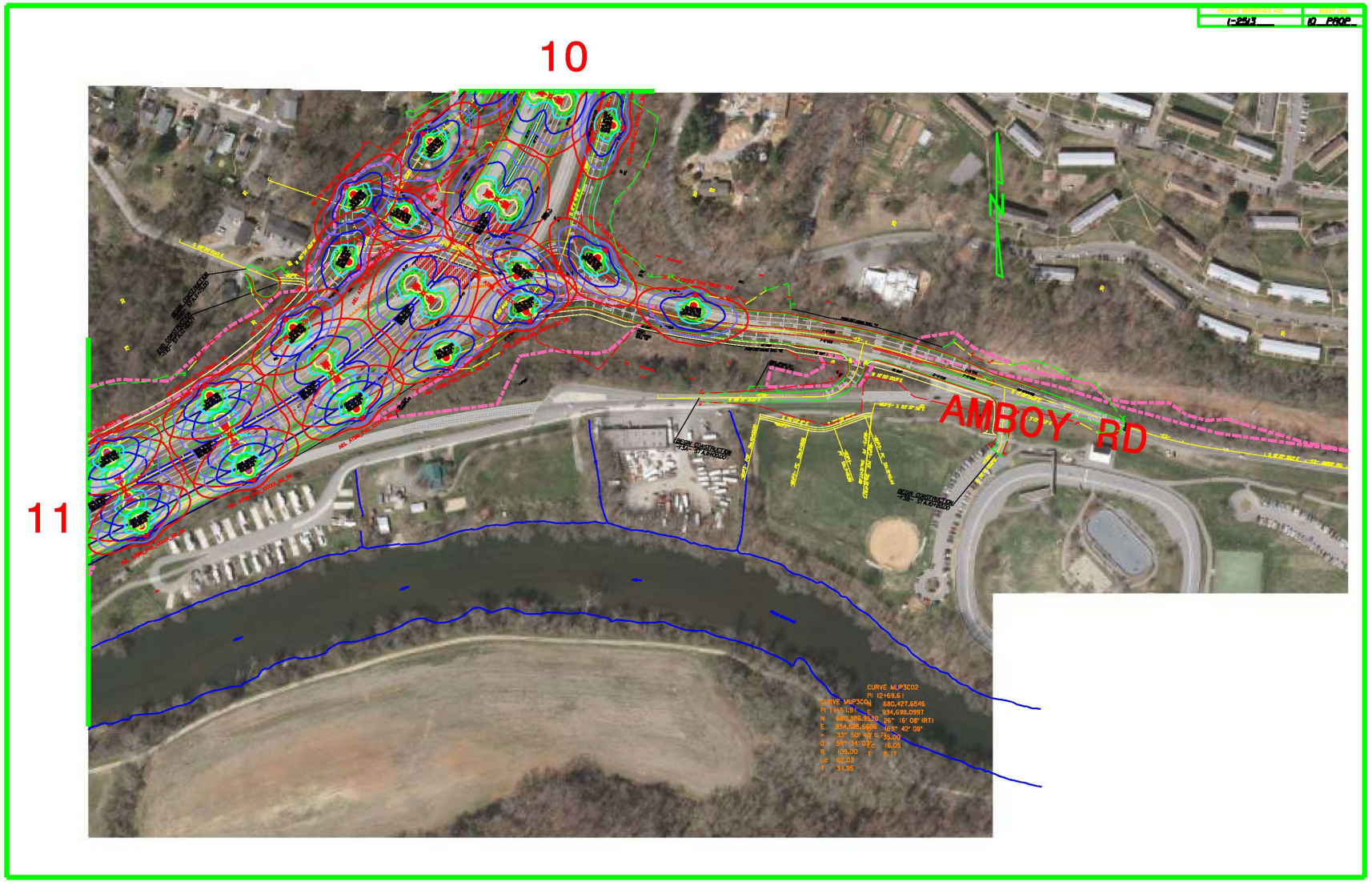
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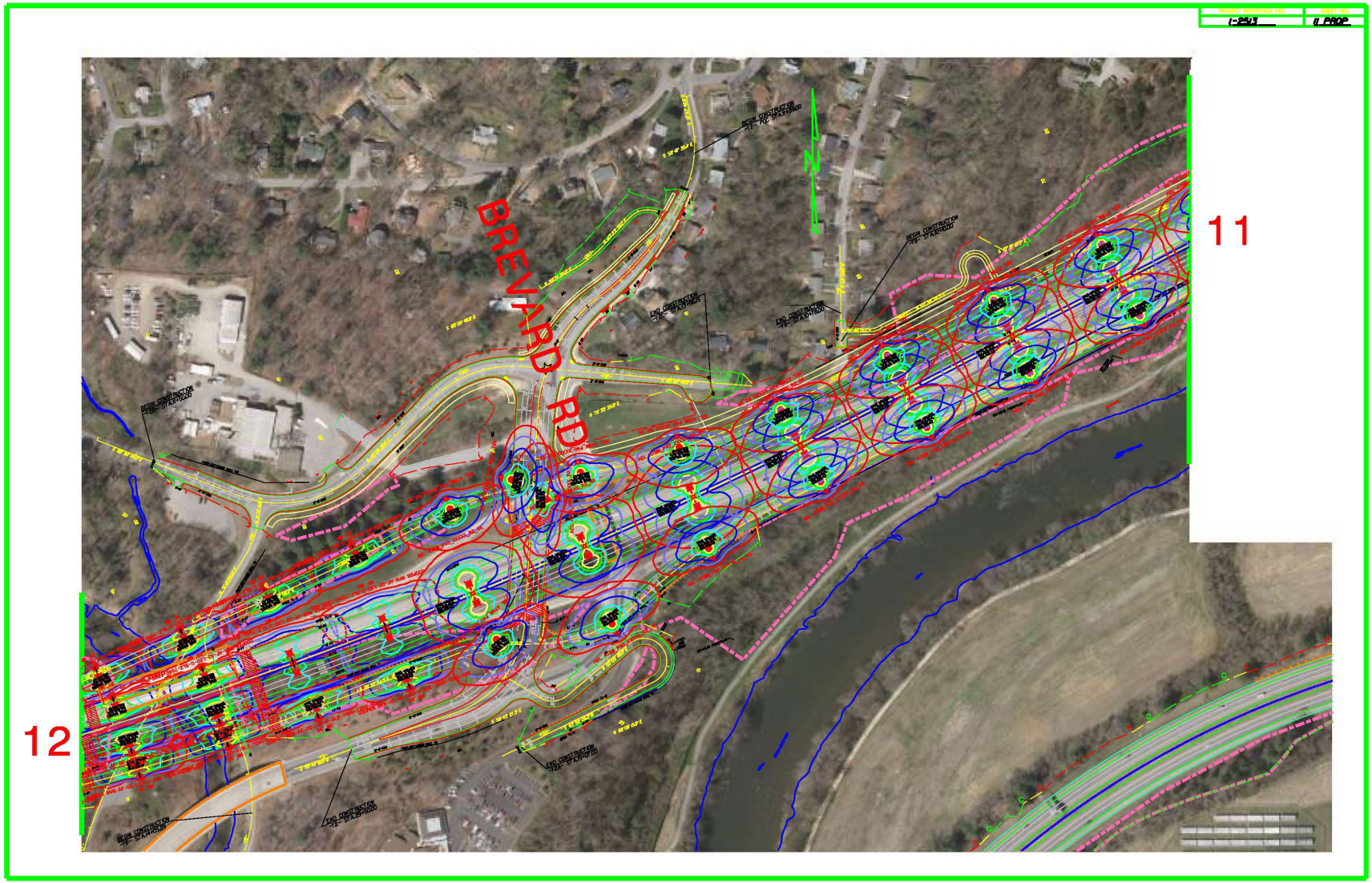
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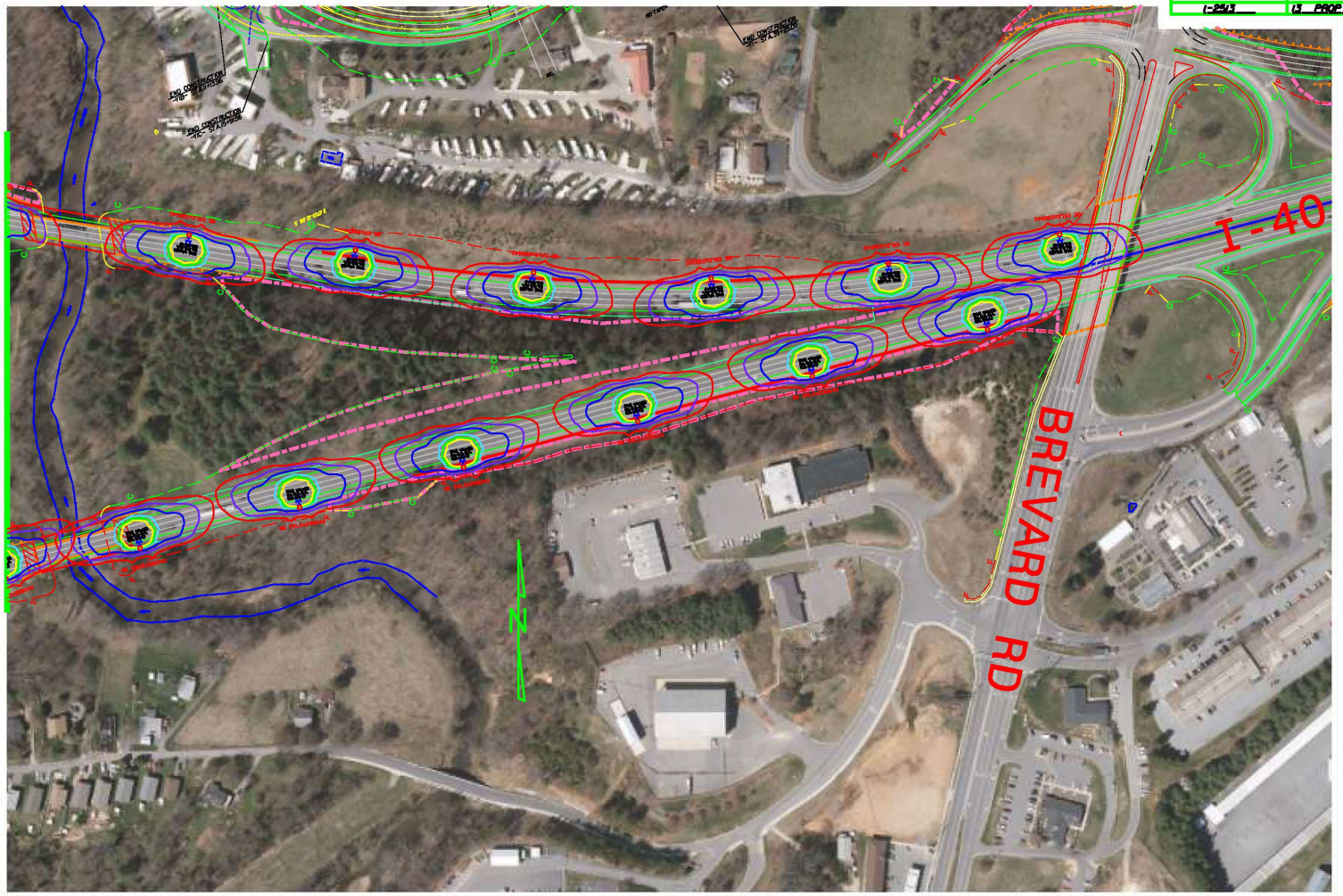

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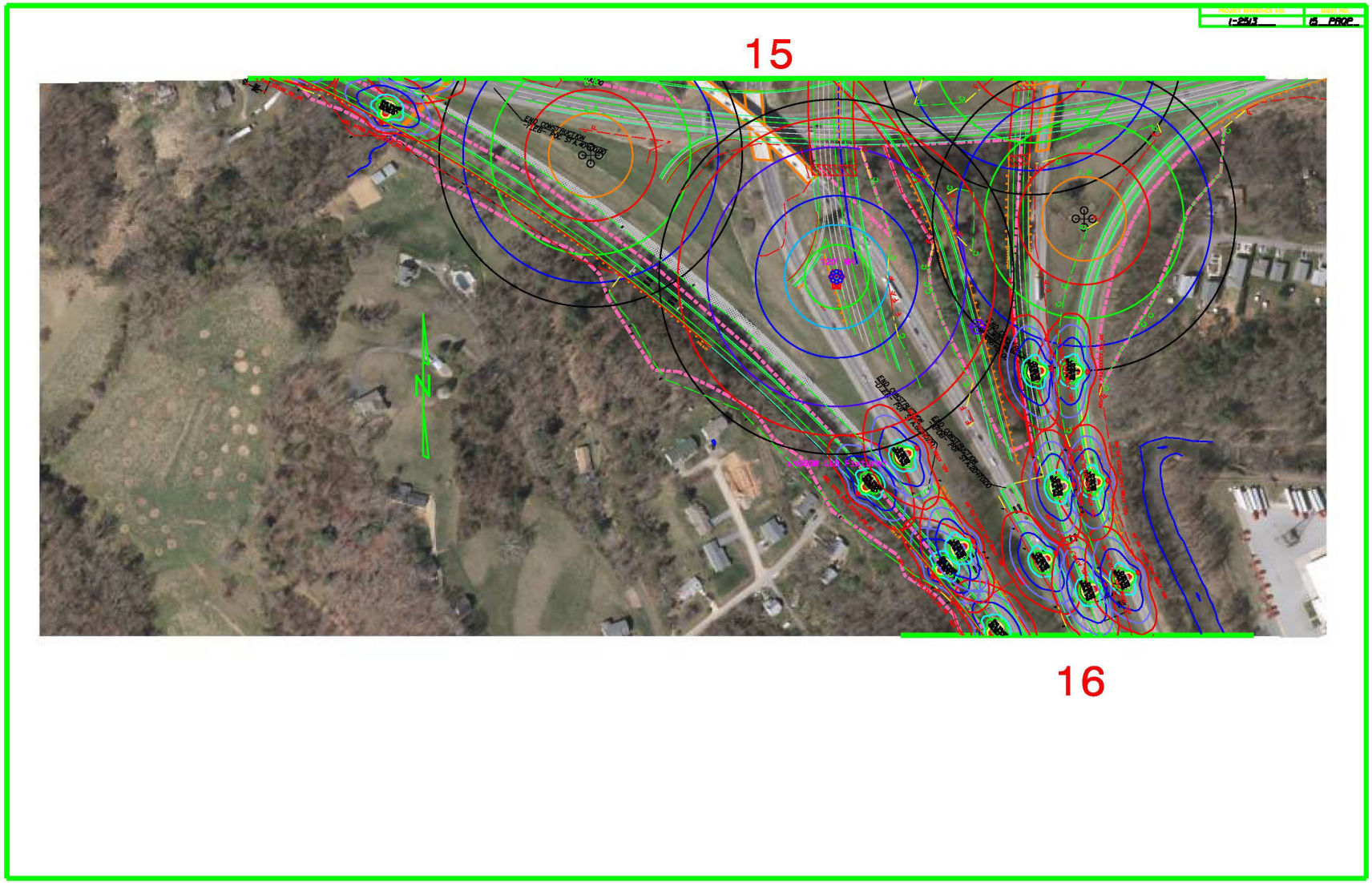
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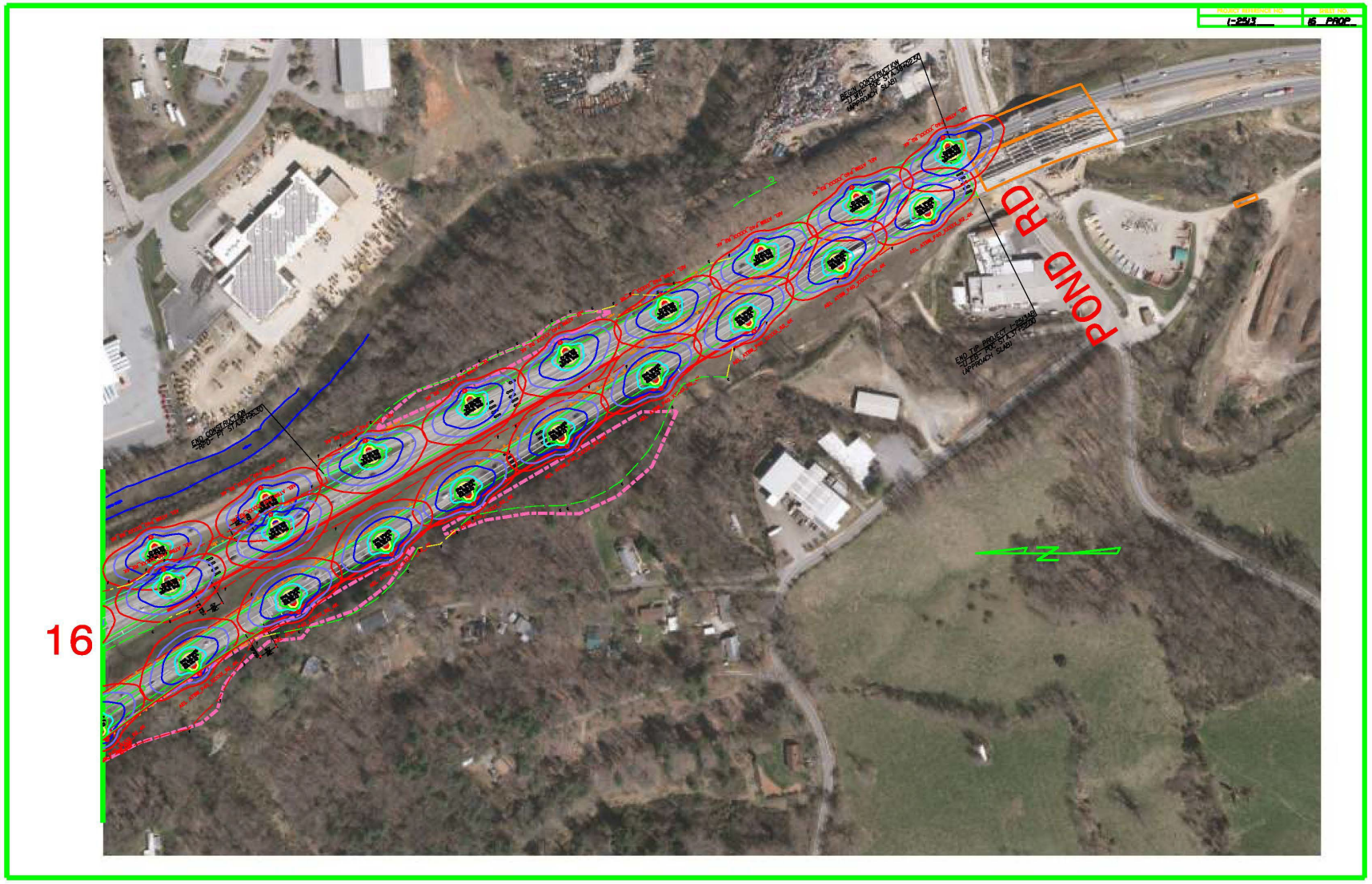
POND RD
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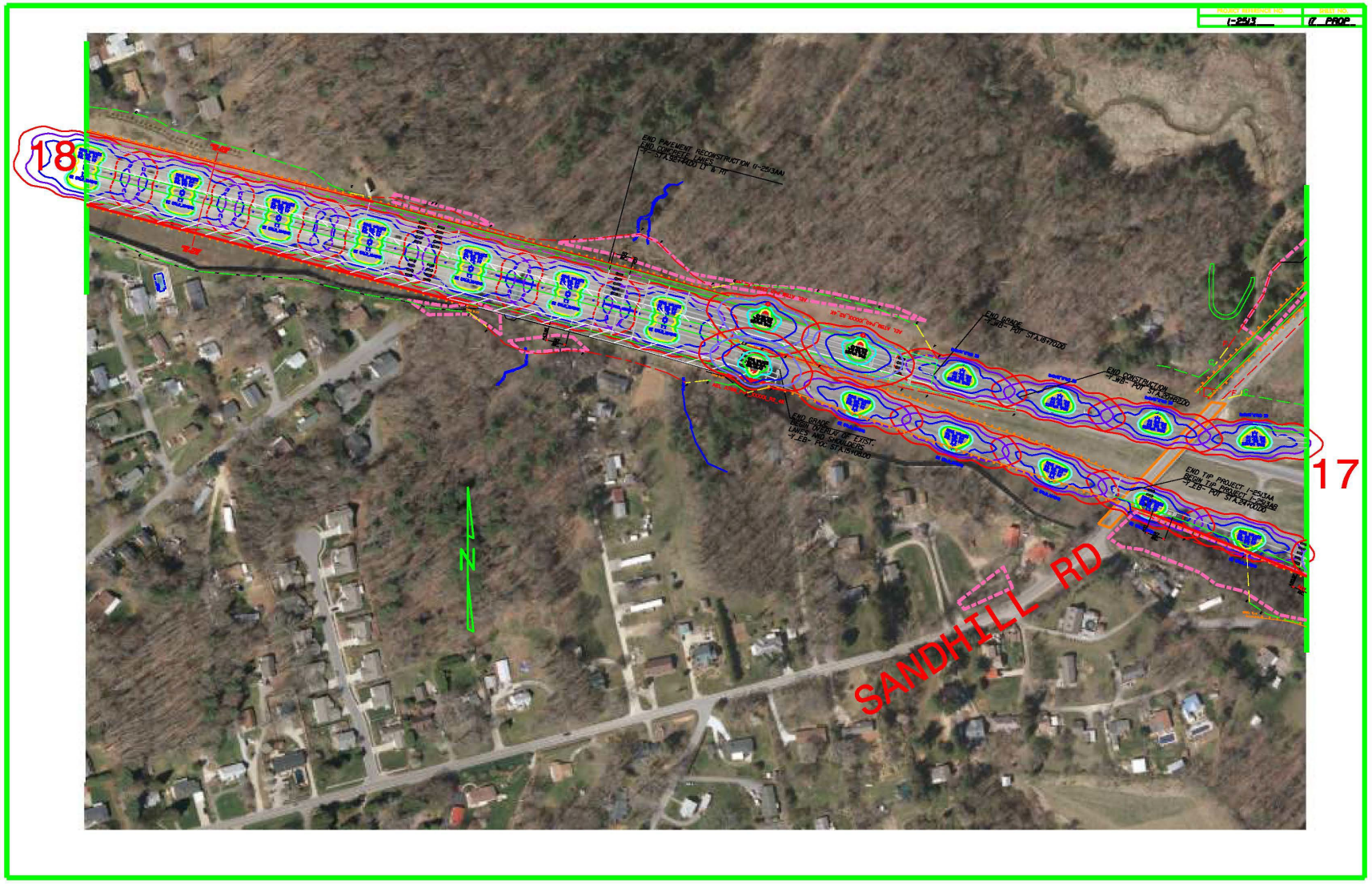
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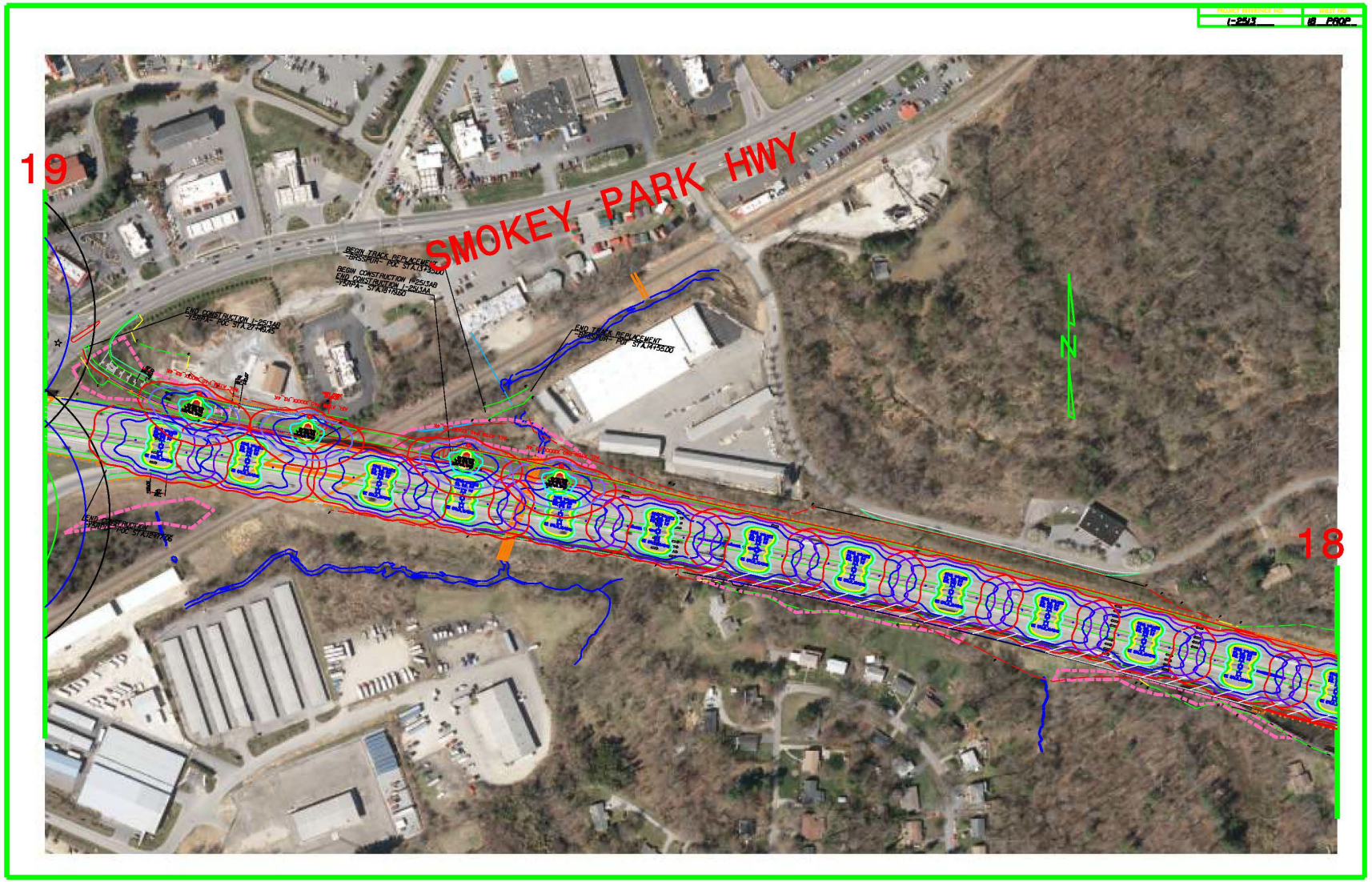
17
SANDHILL RD
N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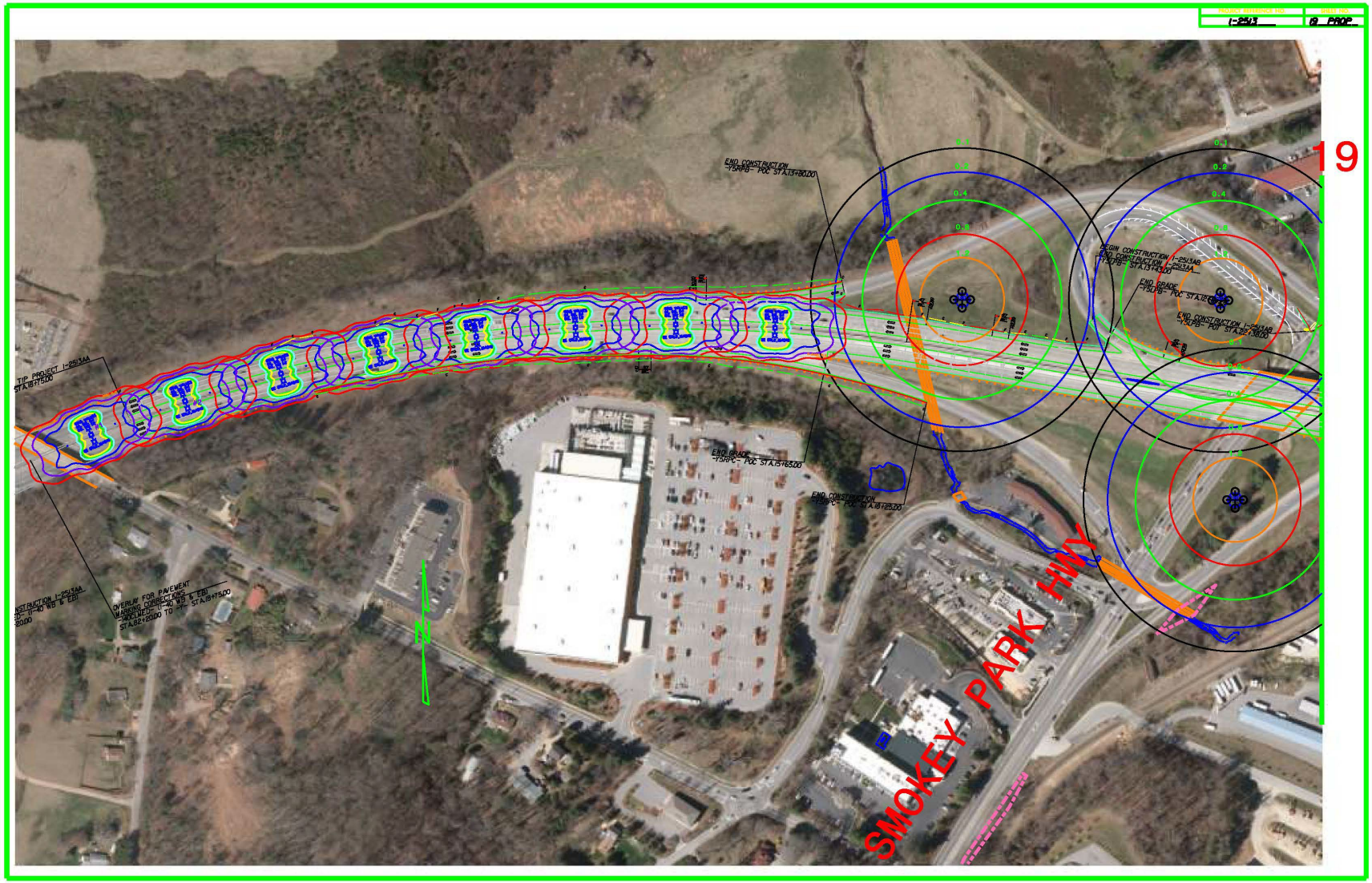
SMOKEY PARK HWY
18
N


19
SMOKEY PARK HWY

Appendix C. Structure Survey Post 2020 BA Submittal

Survey history of bridges in the I-2513 Action Area obtained after original BA submittal

Structure Number	Type (Culvert/Bridge)	Description	Survey date(s)	Results	Survey Reason
100334	Bridge	Hominy Creek and I-40 Bifurcated EBL	6/26/2019	No evidence	ISU*
100339	Bridge	Hominy Creek and I-40 Bifurcated WBL	6/26/2019	No evidence	ISU
100352	Bridge	FBR and I-40 EBL	6/27/2019	No evidence	ISU
None	Culvert	UT FBR and I-26 (near Burnsville Hill Rd.)	5/30/2019	No evidence	A-0010 Action Area overlap
100302	Bridge	Lookout Rd and I-26 WBL	5/27/2019	No evidence	A-0010 Action Area overlap
100303	Bridge	Lookout Rd and I-26 EBL	5/27/2019, 6/18/2019, 5/15/2020	No evidence	A-0010 Action Area overlap & ISU
100314	Bridge	Burnsville Hill Rd and I-26 WBL	5/27/2019, 6/18/2019	No evidence	A-0010 Action Area overlap & ISU
100316	Bridge	Burnsville Hill Rd and I-26 EBL	5/27/2019	No evidence	A-0010 Action Area overlap
100774	Culvert	Reed Creek and Broadway/ NC 251	6/1/2018, 5/27/2019	No evidence	ISU & A-0010 Action Area overlap
100284	Bridge	Reed Creek Broadway and I-26 WBL	5/27/2019	No evidence	A-0010 Action Area overlap
100289	Bridge	Reed Creek Broadway and I-26 EBL	5/27/2019	No evidence	A-0010 Action Area overlap
100278	Bridge	FBR and SR1348/Pearson Bridge Rd.	7/13/2019	No evidence	ISU
100769	Culvert	Smith Mill Creek and US19/23/Patton Ave	6/1/2019	5 MYGR	ISU, NCDOT BSG survey
None	Culvert	UT FBR and Hill St. at Southern States	6/1/2018, 8/28/2019, 3/9/2021, 2/24/2022, 9/22/2022	1-35 MYGR, except the 2/24/2022 survey-no bats	ISU, WRC winter culvert blitz, NCDOT BSG guano research
100771	Culvert	Ragsdale Creek and US19/23	6/1/2018	No evidence	ISU
100297	Culvert	Ragsdale Creek and I-40	6/1/2018	No evidence	ISU
100066	Bridge	Hominy Creek and I-240E	4/14/2019	No evidence	ISU
100182	Bridge	S. Bear Creek Rd. and I-240	6/25/2018	No evidence	ISU

Structure Number	Type (Culvert/Bridge)	Description	Survey date(s)	Results	Survey Reason
100194	Bridge	NC191/Brevard Rd and I-40	7/8/2019	No evidence	ISU
100206	Bridge	Hominy Creek and I-240 EBL	7/8/2019	No evidence	ISU
100208	Bridge	Hominy Creek and I-240 WBL	7/8/2019	No evidence	ISU
None	Bridge	Hominy Creek pedestrian walkway and I-240 WBL	7/8/2019	No evidence	ISU
100242	Bridge	NC191/Brevard Rd and I-240	6/27/2019	No evidence	ISU
100248	Bridge	Amboy Rd. ramp and I-240	6/25/2018, 5/15/2020	No evidence	ISU
100253	Bridge	I-240 ramp and I-26	7/14/2018, 6/26/2019	No evidence	ISU
100273	Bridge	I-240/I-40 ramp and I-26 WBL Smokey Park	6/26/2019	No evidence	ISU
100051	Bridge	Hominy Creek and Pond Rd. SR 3431	7/8/2019	No Evidence	ISU
100521	Bridge	FBR and Amboy Rd (just outside Action Area)	7/8/2019	No Evidence	ISU

*ISU – Indiana State University, contracted by NCDOT to conduct research on MYGRs in the French Broad River Basin as part of conservation measures for area NCDOT roadway projects.

Appendix D. Conservation Measures for MYGR from 2020 BO

2.3.1 Measures to Avoid/Minimize Effects to Gray Bat during Hill Street Culvert Roost Construction

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

2.3.1.1 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.

2.3.1.2 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.

2.3.1.3 Additional Commitments

- An equipment staging area will 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 baseflow to the RCBC and CMAP portion of 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 (from here referred to as a 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.

2.3.2 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

2.3.2.1 Preservation of Riparian Vegetation

- NCDOT will ensure the Contractor preserves riparian buffer trees where practicable and feasible.

2.3.2.2 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.

2.3.3. 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

2.3.3.1 Access Roads

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

2.3.3.2 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 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 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.

2.3.3.3 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. See Term and Condition 12 for checks specific to culverts.
- 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.

2.3.3.4 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.

2.3.4 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.

2.3.4.1 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.

2.3.4.2 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.
- 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 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.

2.3.4.3 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 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.

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

2.3.5.1 Erosion Control Measures

- The Soil and Erosion Control (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).

2.3.5.2 Agency Coordination (Post-Biological Opinion Checkpoints)

NCDOT Requirements

- 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.
- NCDOT will provide USFWS with the final roadway lighting plans and allow 15 days for review upon acknowledgement of receipt of notice.
- 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.
- 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.
- Once ROW plans are developed where vegetation will be removed in riparian areas, NCDOT will meet with USFWS and NCWRC to discuss re-vegetation plans with the goal of establishing native forested buffers in all impacted areas (Hominy Creek, Smith Mill Creek, Emma Branch, and the French Broad River). NCDOT, USFWS and NCWRC will also discuss re-vegetation for acquired riparian ROW that was not forested when purchased. Additionally, NCDOT will coordinate with USFWS and NCWRC to develop a revegetation and invasive species management plan for these areas.

Bid Build Contractor Requirements

- The Bid Build Contractor shall meet with NCDOT personnel and USFWS and regulatory agency representatives immediately after contract execution to review the project and project commitments. At this time, the USFWS shall be afforded the opportunity to meet with key Bid Build Contractor members and NCDOT employees to provide education on the effects of artificial lighting, noise, and construction on nearby wildlife habitat and behavior. The Bid Build Contractor shall coordinate with the NCDOT Environmental Analysis Unit to schedule these meetings. This meeting shall be made prior to submitting any required permit modification application.
- The Bid Build Contractor shall provide USFWS with the construction phasing plan for each bridge.
- The Bid Build Contractor and / or NCDOT shall contact USFWS if new information about MYGR is discovered, as it relates to the project.
- The Bid Build Contractor shall report any dead bats found on the construction sites to USFWS.
- The Bid Build Contractor shall adhere to project commitments within the ROD and the Biological Opinion relating to Section 7 of the Endangered Species Act.

Design-Build Team Requirements

- NCDOT will arrange a meeting between each shortlisted DBT, representatives of the USFWS, and other 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 (DBT) to provide an opportunity for USFWS to convey their concern about potential effects to protected species. The DBT shall meet with NCDOT personnel and USFWS and regulatory agency representatives immediately after contract execution to review the project and project commitments. At this time, the USFWS shall be afforded the opportunity to meet with key DBT 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 Unit shall coordinate with the DBT and the NCDOT Environmental Analysis Unit to schedule this meeting. This meeting shall be made prior to submitting the permit application. This is prior to the standard pre-con environmental meeting.
- The DBT shall adhere to project commitments within the ROD and the Biological Opinion relating to Section 7 of the Endangered Species Act. The DBT will be required to prepare information 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 DBT 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 DBT shall 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 DBT shall provide USFWS with the sediment and erosion control plan and allow 15 days for review upon acknowledgement of receipt of notice.
- The DBT shall 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 DBT shall provide USFWS with the construction phasing plan for each bridge.
- The DBT and / or NCDOT shall contact USFWS if new information about MYGR is discovered, as it relates to the project.
- The DBT shall report any dead bats found on the construction sites to USFWS.
- The DBT shall include an Environmental Coordinator as a member of their Team who will be required to attend all design, merger, and preconstruction meetings, and who will consult bat and mussel experts, as needed.
- Once ROW plans are developed where vegetation will be removed in riparian areas, NCDOT will meet with USFWS and NCWRC to discuss re-vegetation plans with the goal of establishing native forested buffers in all impacted areas (Hominy Creek, Smith Mill Creek, Emma Branch, and the French Broad River). NCDOT, USFWS and NCWRC will also discuss re-vegetation for acquired riparian ROW that was not forested when purchased. Additionally, NCDOT will coordinate with USFWS and NCWRC to develop a revegetation and invasive species management plan for these areas. Certain ROW areas will not be forested because they must be mowed or maintained at a low height for safety purposes.

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

2.3.6.1 Stormwater Control Measures

- NCDOT's stormwater commitment guidance, will apply at crossings of the French Broad River and its tributaries, and any portion of the NCDOT stormwater conveyance system draining to those waters within the right-of-way.
- NCDOT will prepare a stormwater management plan (SMP) to implement post-construction stormwater best management practices (BMPs) to the maximum extent practical, 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, 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 a feasible BMP.
- NCDOT will commit to evaluating the use of emerging BMP technologies that the Department has not yet published in its BMP Toolbox:
  - 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.

2.3.6.2 Permanent Lighting

(Crossing numbers in this section refer to Table 1 in Section 2.2.4 and Figures 4A-4D in Appendix A).

- General CM's for the entire project:

- Use shorter poles, providing an overall LED light fixture mounting height of 35' above the pavement surface.
- Use LED light fixtures with a more rectangular light pattern as well as house side shields to minimize lighting outside of the pavement area.
- Use LED light fixtures with a BUG rating of 1-0-3 or less
- Change the design standards to meet the AASHTO minimum requirements of an average 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 design near Southern States property results in zero calculated change to 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 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. The crossing is still centered between the Cooper fixtures, as it was for the GE 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 - Cooper fixtures located so the crossings are centered as best as possible between fixtures where the light level is the lowest.
- SMC culvert area – Existing high mast pole located within the interchange ramps will be removed.

2.3.7 Conservation Measures to Benefit Gray Bat

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

2.3.7.1 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 help 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 at a minimum 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. Please refer to Term and Condition 10 for clarification.

2.3.7.2 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 roostiwillng 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.

2.3.7.3 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 fund Indiana State University $900,000 to conduct the research project, 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.

2.3.7.4 Protection of Hill Street 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.

2.3.7.5 Gray Bat Conservation Funding

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

2.3.7.6 Installation of Temporary Bat Roost Panels on Bridges

- In their BA, NCDOT committed to temporarily installing modern bat roost panels or comparable structures on four bridges within the French Broad River basin that were currently or had recently been used by

roosting bats. **However, NCDOT, FHWA, and USFWS have come to a new agreement, described below.**

- NCDOT will provide modern bat roost panels or comparable structures that could serve as a temporary alternate roost for bats potentially disturbed by work on the culvert roost for the duration of construction of the I-2513 project. This will be in the place of the panels on four bridges NCDOT has committed to in the BA, which were to be placed on bridges with documented signs of bat use. These bridges are all relatively far from the Hill Street Culvert roost. The USFWS believes that panels placed on one bridge close to the Hill Street Culvert roost has greater potential to minimize take than panels placed on four bridges farther away (Reasonable and Prudent Measure 3). Refer to Term and Condition 9 for more details.

Modified Biological Opinion

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

Service Log #02-252
NCDOT #I-2513
Original Biological Opinion Issued June 19, 2020

Prepared by:

U.S. Fish and Wildlife Service
Asheville Ecological Services Office
160 Zillicoa Street
Asheville, North Carolina 28801

_____

Gary Peeples
Acting Field Supervisor
Asheville Ecological Services Field Office
Asheville, North Carolina

INTRODUCTION

This constitutes an amendment to the June 19, 2020 Biological Opinion (Opinion) for effects of the I-26 Connector from I-40 to US 19/23/70 North of Asheville in Buncombe County, North Carolina on Appalachian elktoe (*Alasmidonta raveneliana*). That Opinion also addresses project impacts on gray bat (*Myotis grisescens*). Additionally, an addendum Biological and Conference Opinion, issued for the project on December 14, 2023, addresses impacts on Indiana bat (*Myotis sodalis*), northern long-eared bat (*Myotis septentrionalis*), tricolored bat (*Perimyotis subflavus*), and little brown bat (*Myotis lucifugus*). This modification specifically addresses changes to a portion of the project description with impacts on Appalachian elktoe. The U.S. Fish and Wildlife Service (Service) received a request for modification to the 2020 Opinion from North Carolina Department of Transportation (NCDOT) Biological Surveys Group on April 17, 2025. The modification request addresses needed changes to the portion of the project description (Section 2.2.5.4 in the 2020 Opinion) on Investigative Drilling. As provided in 50 CFR §402.16, reinitiation of formal consultation is required when new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in the 2020 Opinion. We have reviewed the request and provide the following in accordance with section 7 of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 - 1543) (Act).

CONSULTATION HISTORY

No changes to the 2020 or subsequent Opinions. Additions follow:

- June 19, 2020 – Original Opinion issued by the Service.
- December 14, 2023 – Addendum Biological and Conference Opinion issued by the Service.
- April 15, 2025 – In-person and phone discussions between the Service and NCDOT on the need for a modification on the Investigative Drilling portion of the project description.
- April 17, 2025 – The NCDOT submitted (via email) a request to the Service to modify the project description in the 2020 Opinion.
- April 17, 2025 – The Service responded, providing confirmation of receipt and submitting questions.
- April 27, 2025– NCDOT provided responses to the Service's questions.
- May 09, 2025 – Service submitted draft Opinion modification to NCDOT for review prior to finalization.

DESCRIPTION OF THE PROPOSED ACTION

This section describes the portion of the proposed project action that differs from that described in the 2020 Opinion. Outside of the changes discussed here, there are no changes to the 2020 Opinion for this section. In the original project description, as described in the BA and as written in the 2020 Opinion, Section 2.2.5.4 Investigative Drilling, the below was stated. The key elements to change are underlined:

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. <u>The drill rig will sit on a 15 by 20 ft. (approximate) barge</u> that is surrounded by a containment boom to minimize turbidity. <u>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</u>.

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.

It has since been determined that the relatively low normal water level (less than two feet) in the French Broad River (FBR) does not allow for proper draft of the barge- mounted equipment and has the potential to disturb/damage the riverbed and geotechnical equipment. Additionally, the causeway language is not accurate, as the causeways will not be constructed until the bridge is ready to be constructed. The updated description is as follows, with the key difference of drill rig mobilization underlined:

Investigative Drilling

Drilled shafts will be used for bridge construction and investigative drilling for the bridge foundations will require a vertical boring with an area of approximately 0.5 square foot at each of the drilled shaft locations. The investigative drilling occurs well in advance of the bridge shaft drilling and bridge construction. Each boring will reach a depth of 25 to 30 ft. Roughly 30 borings may be needed in the FBR, covering about 15 square feet in total. The borings will be performed with <u>drill rigs mounted to large diameter rubber tire all terrain carriers</u>. Riverbed disturbance will occur along the routes that will be established for the carriers through repeated use, though it is noted that the low-pressure tires serve to minimize contact pressures with the riverbed. Drilling will be performed during low water levels within the river (approximately 2 feet). The drill rigs will be in the river during the day and then moved, whenever possible, to the adjacent floodplain during the night. When parked on the floodplain, rigs will be secured to heavy equipment with cables. During rain events, water levels will be monitored, and the drilling equipment will be mobilized to the banks when water levels are elevated above 2 feet. Drilling will resume when the water level recedes to normal.

Investigative drilling will be conducted approximately eight to ten hours/day, resulting in approximately two borings per day. It will take approximately two months to complete the geotechnical investigative drilling which includes mobilization to the project location and weather delays that result in elevated water levels in the river. To expedite the borings, there will be two rigs in the river which will be the only pieces of equipment driving back and forth. Personnel will be in waders in the river by the machinery while doing work.

The noise will be equivalent to or quieter than baseline bridge traffic (70-80 decibels). Water from the river will be used as drilling fluid and the output from the drilling operations will consist of silt-sized rock dust, approximately one pound per hole which is the direct sediment output from the hole.

Conservation Measures:

The conservation measures provided in the 2020 Opinion remain the same and are applicable to the updated investigative drilling procedures. Notably, section 2.3.4 “Measures to Avoid/Minimize Effects to Gray Bat and Appalachian Elktoe during Bridge Construction” outlines commitments with direct application such as containment and erosion control measures. No additional measures are included in relation to the updated project description.

STATUS OF THE SPECIES – Appalachian Elktoe

Due to impacts from Tropical Storm (TS) Helene, which hit Western NC on September 27, 2024 and resulted in widespread and catastrophic flooding throughout much of the region including the FBR, the information presented in the 2020 Opinion is assumed to have changed. At the time of this document; however, measurable impacts to Appalachian elktoe from TS Helene remain largely unknown. Extreme flooding and scour in many of the rivers occupied by the species are believed to have resulted in reduced abundance in several locations, while other areas likely lost fewer individuals. While we assume the status of Appalachian elktoe has changed and been reduced by impacts precipitated by TS Helene, we lack comprehensive data at the time of this consultation to base any stated changes in species numbers or status. The Service’s ability to make informed statements on species status will evolve over time once

recovery efforts are completed and biologists have the time and capacity to conduct comprehensive surveys and compile that data.

In general, natural flooding events combined with alteration of watersheds can lead to large fluctuations in abundance observed in Appalachian elktoe populations. Record catastrophic flooding in the species range occurred during TS Helene, with many areas inhabited by Appalachian elktoe being severely damaged by erosive flooding, bedload scour, and bank failures. Observations immediately after the flooding in October 2024 revealed that despite severe flooding, certain portions of Appalachian elktoe occurrences in North Carolina, such as the upper Pigeon River, were relatively intact. Those observations indicate that the species is likely to remain in most of the affected areas, though individual numbers were likely greatly reduced in many inhabited locations. Portions of the FBR basin also experienced catastrophic flooding in late summer 2021 due to the remnants of TS Fred. The flooding likely resulted in loss of Appalachian elktoe individuals within populations in the hardest-hit portions of the Pigeon, Mills and FBRs.

While there are unknowns regarding the current status of Appalachian elktoe within the action area in the FBR, observations of the intact bedload and of mussel presence upstream at the confluence of Bent Creek and the FBR indicate that the species remains within the action area.

ENVIRONMENTAL BASELINE – Appalachian Elktoe

Flooding and scour from TS Helene impacted the portion of the FBR included in this consultation, resulting in an assumed shift in baseline. Post-storm in-water species surveys have not been conducted within the action area at this time, given the scale of post-storm efforts and the constraints associated with the TS Helene response. Discussions regarding site conditions as observed by the Service's Asheville Field Office aquatics recovery lead and NCDOT's Biological Surveys Group have occurred and there is consensus that the bedload remains intact. While the major flood event and requisite response work in the form of heavy machinery and in-water work damaged aquatic habitat within the FBR, the potential for individual Appalachian elktoe to still occur within the action area remains. At the time of this consultation, those individual numbers are believed to be reduced from pre-Helene conditions but are not believed to be zero.

EFFECTS OF THE ACTION

Effects analyzed in the 2020 Opinion are still relevant and valid. Additional effects on Appalachian elktoe from the all-terrain carrier vehicles that will transport the drill rigs in the FBR are examined below.

Impacts expected to occur from the use of the all-terrain carrier vehicles are: crushing/wounding/killing of Appalachian elktoe which could be present in the substrate where the vehicles drive; and/or degraded habitat quality in the form of disturbed sediment and/or leakage of vehicle fluids while in use in the river.

Within the Effects on Appalachian Elktoe - Section 5.2.3.2.1.1 Investigative Drilling in the 2020 Opinion, the below is stated and is expected to remain the same even with the updated drill rig transportation plan:

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. 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…

CONCLUSION

In the 2020 Opinion, we determined that the estimated level of take associated with the project is unlikely to result in jeopardy to Appalachian elktoe. That estimated number is based on the species density model as explained in the 2020 Opinion. Restating the above discussion, we do not currently have data to support a change in that density model. Given that the footprint of impacts associated with the updated

investigative drilling process will = 12,000 square feet (1,115 square meters) x 0.0005 estimated density per square meter = estimated 0.6 Appalachian elktoe within that 12,000 square foot area. Based on that calculation, the new estimated amount of take for Appalachian elktoe adds one additional individual for a total estimate of 13 individuals expected to be harmed during the FBR bridge construction portion of the project. While the change to the proposed action is expected to result in a slightly higher amount of take, the analysis of "no jeopardy" remains the same. This conclusion was reached through consideration of the scale of the additional impact in combination with what is currently known regarding post-TS Helene status of Appalachian elktoe throughout its range and within the FBR.

INCIDENTAL TAKE STATEMENT – Appalachian Elktoe

Amount of Take Anticipated

In addition to the amount of take described in the 2020 Opinion, the following is now included:
As explained in the previous section, the amount of take is expected to increase by 1 individual given the 12,000 square foot additional area of impact. Because impact area (i.e. square footage) serves as a surrogate measure of take for the purposes of this analysis for Appalahcian elktoe, the amount of incidental take will be exceeded if the impact area is exceeded.

Reasonable and Prudent Measures

No changes from the 2020 Opinion.

Terms and Conditions

No changes from the 2020 Opinion.

CONSERVATION RECOMMENDATIONS

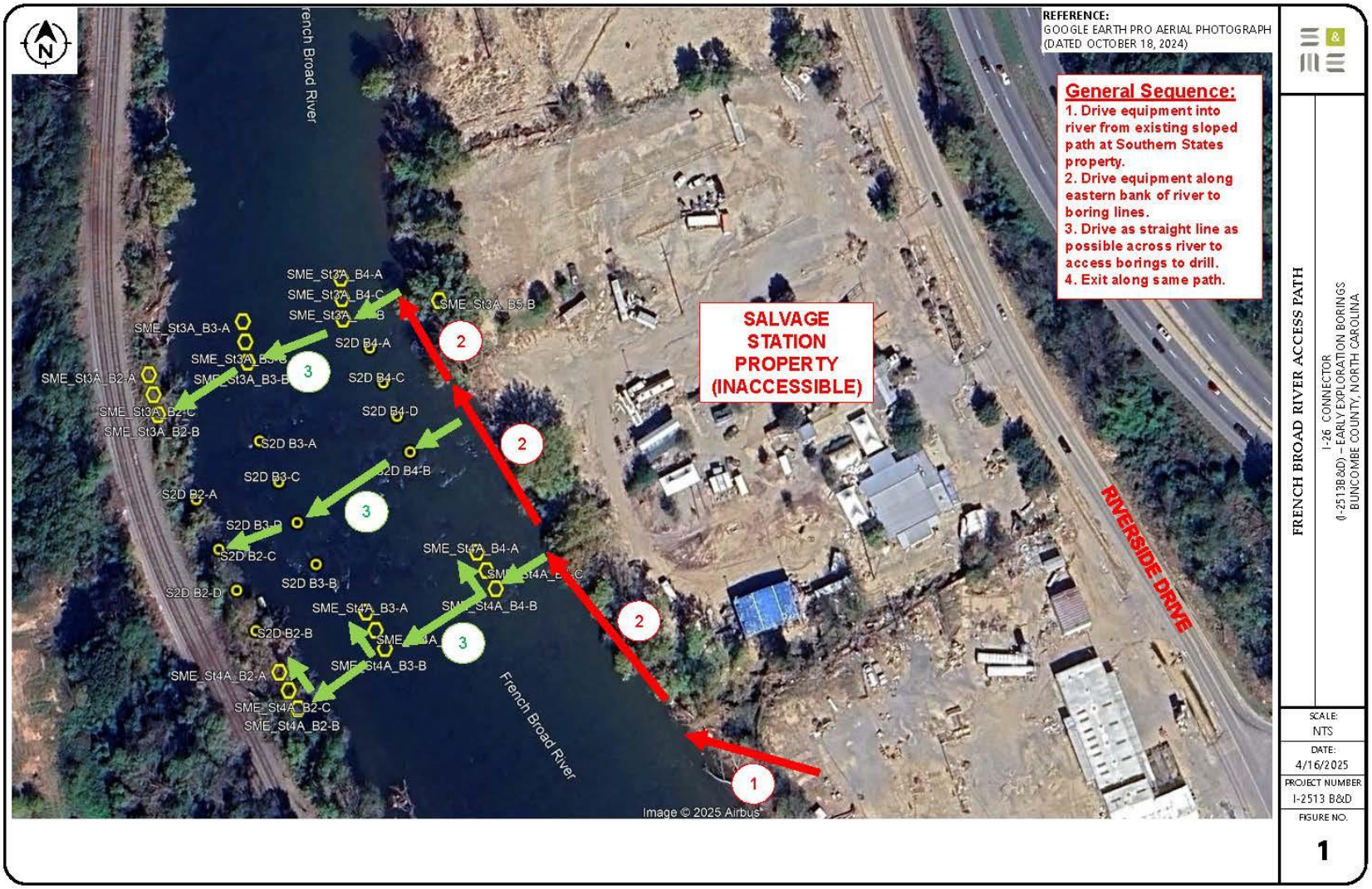
In addition to the recommendations provided in the 2020 Opinion:

- Reduce the area of riverbed impact from large diameter rubber tire all terrain carriers and all other drilling-related equipment to the maximum extent possible.
- Conduct thorough and regular maintenance investigations on all machinery that will operate in the river to ensure avoidance of fluid leaks and spills.
- Stabilize, restore, and revegetate the area of riverbank used for access once work is completed. Utilize native riparian species.

REINITIATION AND CLOSING STATEMENT

This concludes reinitiation of formal consultation on the actions outlined in your project description last updated April 27, 2025. As provided in 50 CFR 402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded, (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this BO, (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this BO, or (4) a new species is listed or critical habitat is designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operation causing such take must cease, pending reinitiation.

Figure


REFERENCE:
GOOGLE EARTH PRO AERIAL PHOTOGRAPH
(DATED OCTOBER 18, 2024)
General Sequence:
1. Drive equipment into river from existing sloped path at Southern States property.
2. Drive equipment along eastern bank of river to boring lines.
3. Drive as straight line as possible across river to access borings to drill.
4. Exit along same path.
SALVAGE STATION PROPERTY (INACCESSIBLE)
RIVERSIDE DRIVE
French Broad River
French Broad River
Image © 2025 Airbus
SME_St3A_B4-A
SME_St3A_B4-C
SME_St3A_B5-B
SME_St3A_B3-A
S2D B4-A
SME_St3A_B2-A
SME_St3A_B3-B
S2D B4-C
SME_St3A_B2-C
SME_St3A_B2-B
S2D B4-D
S2D B3-A
S2D B4-B
S2D B3-C
S2D B2-A
S2D B3-D
S2D B2-C
S2D B3-B
S2D B2-D
SME_St4A_B4-A
SME_St4A_B4-B
SME_St4A_B3-A
S2D B2-B
SME_St4A_B3-B
SME_St4A_B2-A
SME_St4A_B2-C
SME_St4A_B2-B
1
2
3
FRENCH BROAD RIVER ACCESS PATH
I-26 CONNECTOR
(I-2513B&D) – EARLY EXPLORATION BORINGS
BUNCOMBE COUNTY, NORTH CAROLINA
SCALE:
NTS
DATE:
4/16/2025
PROJECT NUMBER
I-2513 B&D
FIGURE NO.
1

North Carolina Department of Transportation

Highway Stormwater Program

STORMWATER MANAGEMENT PLAN

FOR NCDOT PROJECTS

(Version 3.00; Released August 2021)

General Project Information

WBS Element:	34165.1.11/34165.1.12	**TIP Number:**	I-2513AA/AB	**Project Type:**	Roadway Widening	**Date:**	12/12/2022
NCDOT Contact:	Kevin E Moore, PE			**Contractor / Designer:**	Matthew Harvey, PE		
Address:	NCDOT PMU 1000 Birch Ridge Drive Raleigh, NC 27610, USA			**Address:**	Wetherill Engineering, Inc. 1223 Jones Franklin Road Raleigh, NC 27606		
Phone:	919-707-6287			**Phone:**	919-851-8077		
Email:	kemoore2@ncdot.gov			**Email:**	MHarvey@wetherilleng.com		
City/Town:	Asheville, NC			**County(ies):**	Buncombe		
River Basin(s):	French Broad			**CAMA County?**	No		
Wetlands within Project Limits?	Yes						

Project Description

Project Length (lin. miles or feet):	2.656 Miles	**Surrounding Land Use:**	Residential/Commercial		
	Proposed Project			**Existing Site**	
Project Built-Upon Area (ac.)	41.7	ac.		35.9	ac.
Typical Cross Section Description:	Variable - See Project Typical Sections			Variable - See Project Typical Sections	
Annual Avg Daily Traffic (veh/hr/day):	Design/Future: 118,800	Year:	2040	Existing: 95,100	Year: 2024

General Project Narrative: (Description of Minimization of Water Quality Impacts)

The project consists of roadway improvements on I-40 from east of SR 1224 (Monte Vista Road) to pavement joint west of SR 3412 (Sand Hill Road) and I-26 from Pond Road bridge to I-26/I-40/I-240 interchange. The project will also include initial improvements at I-40EB, to I-26EB Ramp and US 19/23 (Smokey Park Highway). The proposed stormwater runoff from the roadway widening has been conveyed to roadside ditches and storm drainage systems that drain to existing outfalls.

Potential areas for placing Stormwater Control Measures (SCM) were looked at within the project corridor. Below is a list of the locations and reason why or why not a device was proposed at the location:

Plan Sheet 4/5:

---Since this portion of the project is almost entirely a pavement overlay with no new built upon area, no SCMs were proposed here.

Plan Sheet 6:

---The gore area between -Y5LPB- and -Y- was looked for a potential SCM. This area was mentioned by the aesthetics committee and will likely be facilitated with plantings. Since this is not a new built upon area, a SCM will not be pursued.

---The area to the right of -Y5RPA- at Station 24+00 +/- was investigated for a SCM. A SCM was designed at the location to treat the water quality volume (WQV). It was found that the headwater from the crosspipe will back up the basin, even in smaller storm events. This will decrease the functionality of the basin and cause long term maintenance concerns. NCDOT maintenance personnel voiced concern with the basin interfering with their daily operations which would hinder their public safety operations. Since this facility serves one of the larger more vital locations in the area during icing/winter storm events, it was determined that a device could not be installed at this location without negatively impacting the community's safety.

---The area right of -Y5RPA- at Station 17+00 +/- at the outlet of the Ragsdale Creek culvert was investigated for an SCM and found to not be feasible. Railroads do not typically allow SCMs in their right of way and accessibility for long term maintenance would be difficult. For this reason, a SCM will not be pursued at this location.

Plan Sheet 7:

---The 5' base ditch left of -Y- 67+50 +/- along Montgomery Street was looked at, but disturbance to the Asheville School property will need to be limited since the property is a 4F property. For this reason a SCM will not be pursued.

---The outlet at drainage structure 0721 is a JS upstream and non-JS on the downstream side. The outfall is designed for larger storm events due to the large drainage area coming to this location. A SCM is not feasible at this location.

---There are no opportunities available right of -Y- on this plan sheet due to access issues. For this reason a SCM will not be pursued.

Plan Sheet 8:

---All outlets on this sheet are not easily accessible due to their existing locations in steep ravines. For this reason a SCM will not be pursued.

Plan Sheet 9:

---A SCM cannot be placed at the outlet of 0914 due to the steepness of the existing banks and the stream having a JS designation, as well as the site not being easily accessible.

---All outlets on this sheet are not easily accessible. The SCMs would have to be placed behind the proposed noise wall. For this reason an SCM will not be pursued.

---Energy Dissipator Basins were added at the outlets of Permit Sites 4 and 5. The basins will reduce the discharge velocity and minimize the stream degradation that is currently occurring under the existing conditions.

Plan Sheet 10:

---An SCM was looked at for the existing outlet at -Y_WB- 30+50 +/-, but the basin would be in the floodplain of Ragsdale Creek and not easily accessible. For this reason an SCM will not be pursued.

---The drainage structure 1014 outlet is not easily accessible and adjacent to a residential property. For this reason an SCM will not be pursued.

Additional General Project Information

General Project Narrative: (Description of Minimization of Water Quality Impacts)

Plan Sheet 11:
---The concrete ditches will be removed between -RPC- and -L1_EB- and be replaced with a step down infiltration SCM. This is one of the few options at this location due to the steep grade.

Plan Sheet 12:
---The 4' base outlet right of -RPC- 46+00 +/- is very steep and near an existing utility tower access. This site is not easily accessible. For this reason an SCM will not be pursued.
---Drainage outlet e1204 is within a floodplain. For this reason an SCM will not be pursued.

Plan Sheet 13:
---The outlet of drainage structure 1308 is a large drainage area. An SCM is not feasible here due to topography restrictions. For this reason an SCM will not be pursued.

Impact and Minimization Efforts: The project has been designed to minimize wetland and stream impacts along the corridor. Drainage has been designed so that outlets discharging into wetlands have non-erosive velocities to minimize disturbance to the wetlands. 2:1 fill slopes have been used throughout the project in order to minimize impacts in areas with wetlands and streams. Box culverts in the project area that convey jurisdictional streams have been buried a minimum of 1 foot and circular culverts have been buried 20% of their diameter so that they provide aquatic passage where applicable. Grassed shoulders and ditches with vegetated liner were used throughout the project where possible. Factors that prevented grass lined ditches from being used throughout the entire project include velocities in the ditch exceeding 4 fps and permissible shear stress in the ditch greater than 3.36 (shear stress = depth x slope x specific weight of water). The slope factor in the permissible shear stress equation was the main driver of ditches requiring rip rap or PSRM on the project, the steep ditch slopes are due to the natural topography in this area. The few instances where PSRM was used to line ditches was driven by the ditch slopes being so steep the shear stress in the ditch exceeded the limits for rip rap liner. Existing flow patterns and outfalls were maintained to the maximum extent practical to limit discharge increases to any particular area. While there was a 5.8 acre increase in impervious area for the entire project this increase was divided up among the 15 outfall locations. The existing outfalls consisted of buried pipe ends, undersized outfall channels/pipes, and little to no rip rap at pipe outlets. When the project is complete the outfalls will be upgraded to have rip rap outlet pads, energy dissipator basins, and improved outfall channels. These measures will help offset the lack of SCMs by reducing the discharge velocities which will mitigate watercourse erosion and damage to riparian ecology. The project is not expected to have a significant impact on water quality or quantity downstream of the project.

North Carolina Department of Transportation

Highway Stormwater Program

STORMWATER MANAGEMENT PLAN

FOR NCDOT PROJECTS

(Version 3.00; Released August 2021)

General Project Information

Waterbody Information

Surface Water Body (1):	Ragsdale Creek		**NCDWR Stream Index No.:**	6-76-11		
NCDWR Surface Water Classification for Water Body		**Primary Classification:**	Class C			
		Supplemental Classification:	None			
Other Stream Classification:	None					
Impairments:	None					
Aquatic T&E Species?	No	Comments:	This portion of the project contributes stormwater about 3.5 river miles from occupied app elktoe habitat in the French Broad River			
NRTR Stream ID:	SV			**Buffer Rules in Effect:**	N/A	
Project Includes Bridge Spanning Water Body?	No	**Deck Drains Discharge Over Buffer?**	No	**Dissipator Pads Provided in Buffer?**	No	
Deck Drains Discharge Over Water Body?	No	(If yes, provide justification in the General Project Narrative)		(If yes, describe in the General Project Narrative; if no, justify in the General Project Narrative)		
(If yes, provide justification in the General Project Narrative)						

Surface Water Body (2):	Trent Branch		**NCDWR Stream Index No.:**	6-76-10		
NCDWR Surface Water Classification for Water Body		**Primary Classification:**	Class C			
		Supplemental Classification:	None			
Other Stream Classification:	None					
Impairments:	None					
Aquatic T&E Species?	No	Comments:				
NRTR Stream ID:	SW			**Buffer Rules in Effect:**	N/A	
Project Includes Bridge Spanning Water Body?	No	**Deck Drains Discharge Over Buffer?**	N/A	**Dissipator Pads Provided in Buffer?**	N/A	
Deck Drains Discharge Over Water Body?	N/A	(If yes, provide justification in the General Project Narrative)		(If yes, describe in the General Project Narrative; if no, justify in the General Project Narrative)		
(If yes, provide justification in the General Project Narrative)						

Surface Water Body (3):	Hominy Creek		**NCDWR Stream Index No.:**	6-76d		
NCDWR Surface Water Classification for Water Body		**Primary Classification:**	Class C			
		Supplemental Classification:	None			
Other Stream Classification:	None					
Impairments:	fecal coliform					
Aquatic T&E Species?	No	Comments:				
NRTR Stream ID:	SX			**Buffer Rules in Effect:**	N/A	
Project Includes Bridge Spanning Water Body?	No	**Deck Drains Discharge Over Buffer?**	N/A	**Dissipator Pads Provided in Buffer?**	N/A	
Deck Drains Discharge Over Water Body?	N/A	(If yes, provide justification in the General Project Narrative)		(If yes, describe in the General Project Narrative; if no, justify in the General Project Narrative)		
(If yes, provide justification in the General Project Narrative)						

WBS Element: **TIP/Proj No.:** I-2513AA/AB **County(ies):** Buncombe

Preformed Scour Holes and Energy Dissipators

Sheet No.	Line	Station	Location (LT,RT,CL)	Latitude	Longitude	Surface Water Body	Energy Dissipator Type	Riprap Type	Drainage Area (ac)	Conveyance Structure	Pipe (in) / Structure Dimensions (ft)	Q10 (cfs)	V10 (fps)	BMP Associated w/ Buffer Rules?
9	L	92+94	LT	35.557278	-82.622985	UT3 to Ragsdale Creek	Riprap Energy Dissipator Basin	Class 'B'	36.7	Pipe	48"	71.0	2.9	N/A
9	L	93+22	LT	35.557277	-82.622970	UT6 to Ragsdale Creek	Riprap Energy Dissipator Basin	Class 'B'	11.4	Pipe	30"	21.0	3.1	N/A

Additional Comments

* Refer to the NCDOT Best Management Practices Toolbox (2014), NCDOT Standards, the Federal Highway Administration (FHWA) Hydraulic Engineering Circular No. 14 (HEC-14), Third Edition, Hydraulic Design of Energy Dissipators for Culverts and Channels (July 2006), as applicable, for design guidance and criteria.

North Carolina Department of Transportation

Highway Stormwater Program

STORMWATER MANAGEMENT PLAN

FOR NCDOT PROJECTS

(Version 3.00; Released August 2021)

WBS Element: 34165.1.11/34165.1.12 **TIP/Proj No.:** I-2513AA/AB **County(ies):** Buncombe

Other Non-Toolbox Best Management Practices

Sheet No.	Line	Station	Location (LT,RT,CL)	Latitude	Longitude	Surface Water Body	BMP Type	Drainage Area (ac)	New Built-Upon Area (ac)	BMP Associated w/ Buffer Rules?
11	RPC	30+85	LT	35.55418	-82.61198	(1)Ragsdale Creek	Bio-filtration Conveyance	3.7	0.6	No

Additional Comments

STATE OF NORTH CAROLINA
DIVISION OF HIGHWAYS

BUNCOMBE COUNTY

STATE	STATE PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
N.C.	I-2513AA/AB	1	

STATE PROJ. NO.	F. A. PROJ. NO.	DESCRIPTION
34165.1.11/34165.1.12	0026024 /0026025	P.E.
34165.2.14/34165.2.16	0026024 /0026025	R/W
34165.2.15/34165.2.17	0026024 /0026025	UTIL.
34165.3.6/34165.3.7	0026024 /0026025	CONST.

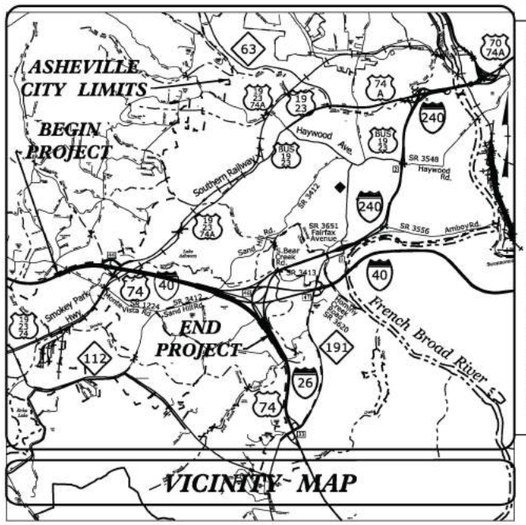
LOCATION: ***I–40 FROM EAST OF SR 1224 (MONTE VISTA RD) TO PAVEMENT JOINT WEST OF SR 3412 (SAND HILL RD). I–26 FROM POND ROAD BRIDGE TO I–26/I–40/I–240 INTERCHANGE. INCLUDES INITIAL IMPROVEMENTS AT I–40EB TO I–26EB RAMP AND US 19/23 (SMOKEY PARK HIGHWAY)***

TYPE OF WORK: ***GRADING, DRAINAGE, PAVING, STRUCTURES, RETAINING WALLS, SOUND WALLS, AND ITS***

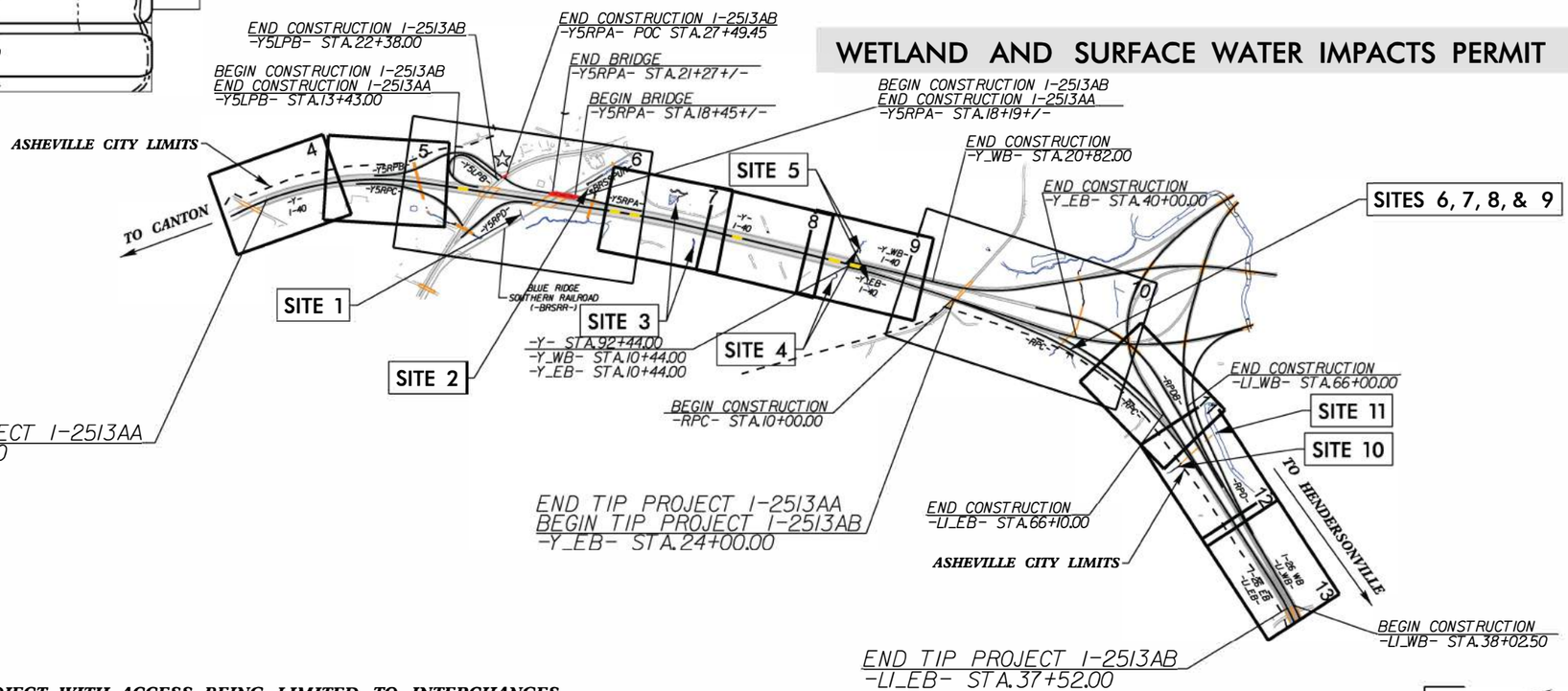
PERMIT DRAWING
SHEET 1 OF 26

TIP PROJECT: I–2513AA/AB

RIGHT–OF–WAY PLANS



VICINITY MAP



WETLAND AND SURFACE WATER IMPACTS PERMIT

THIS IS A CONTROLLED–ACCESS PROJECT WITH ACCESS BEING LIMITED TO INTERCHANGES

THIS PROJECT IS LOCATED WITHIN THE CITY LIMITS OF THE CITY OF ASHEVILLE

CLEARING ON THIS PROJECT WILL BE PERFORMED TO THE LIMITS ESTABLISHED BY METHOD III

☆ REVISED SIGNAL

ETHERILL ENGINEERING
1223 Jones Franklin Rd.
Raleigh, N.C. 27606
License No. F-0377
Bus: 919 851 8077
Fax: 919 851 8107
TRANSPORTATION PLANNING/DESIGN - BRIDGE/STRUCTURE DESIGN
CIVIL/SITE DESIGN - GIS/GPS - CONSTRUCTION OBSERVATION

CONTRACT:

GRAPHIC SCALES

50 25 0 50 100 PLANS

50 25 0 50 100 PROFILE (HORIZONTAL)

10 5 0 10 20 PROFILE (VERTICAL)

DESIGN DATA

ADT 2024 = 95,100
ADT 2040 = 118,800
K = 9 %
D = 55 %
T = 11 % *
V = 60 MPH
* TTST = 8% DUAL 3%
FUNC CLASS = INTERSTATE

STATEWIDE TIER

PROJECT LENGTH

LENGTH ROADWAY TIP PROJECT I–2513AA/AB = ***2.656 MI***

TOTAL LENGTH TIP PROJECT I–2513AA/AB = ***2.656 MI***

KCI ASSOCIATES OF N.C., P.A.
4505 Falls of Neuse Road, Suite 400
Raleigh, NC 27609
Phone (919) 783-9214
NC Firm License No: C-0764
http://www.kci.com

20 18 STANDARD SPE CIFI CATIONS

RIGHT OF WAY DATE:
NOVEMBER 18, 2022

LETTING DATE:
NOVEMBER 21, 2023

CHARLES L. FLOWE, P.E.
PROJECT ENGINEER

BARRY C. SMITH, P.E.
PROJECT DESIGN ENGINEER

KEVIN E. MOORE, P.E.
NCDOT CONTACT

HYDRAULICS ENGINEER

P.E.
SIGNATURE:

ROADWAY DESIGN ENGINEER

P.E.
SIGNATURE:

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

STATE OF NORTH CAROLINA · DEPARTMENT OF TRANSPORTATION

09/28/99
1/17/2023
C:\pwworking\ecom_ds2_na_2020\d0244737\I2513AA_hyd_prm_tsh.dgn
MHarvey

5/14/99

PROJECT REFERENCE NO.	SHEET NO.
I-2513AA/AB	2D-1
R/W SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

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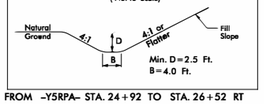
TRANSPORTATION PLANNING/DESIGN - BRIDGE/STRUCTURE DESIGN
CIVIL/SITE DESIGN - GIS/GPS - CONSTRUCTION OBSERVATION

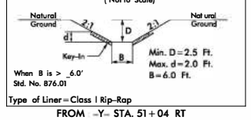
PERMIT DRAWING SHEET 2 OF 26

DETAIL A
SPECIAL LATERAL BASE DITCH (Not to Scale)



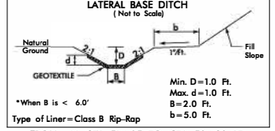
FROM –Y5RPA– STA. 24+92 TO STA. 26+52 RT

DETAIL B
STANDARD BASE DITCH (Not to Scale)



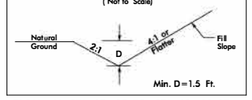
FROM –Y– STA. 51+04 RT

DETAIL C
LATERAL BASE DITCH (Not to Scale)



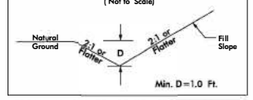
FROM –Y– STA. 51+05 TO STA. 50+90 LT
FROM –Y– STA. 59+35 TO STA. 60+02 LT

DETAIL D
SPECIAL LATERAL 'V' DITCH (Not to Scale)



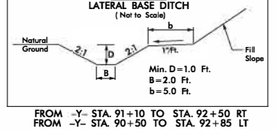
FROM –Y– STA. 67+25 TO STA. 69+00 RT

DETAIL E
SPECIAL LATERAL 'V' DITCH (Not to Scale)



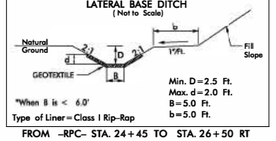
FROM –Y– STA. 75+25 TO STA. 76+55 RT
FROM –RPC– STA. 23+00 TO STA. 32+50 LT

DETAIL F
LATERAL BASE DITCH (Not to Scale)



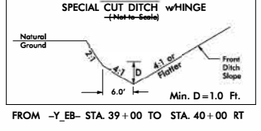
FROM –Y– STA. 91+10 TO STA. 92+50 RT
FROM –Y– STA. 90+50 TO STA. 92+85 LT

DETAIL G
LATERAL BASE DITCH (Not to Scale)



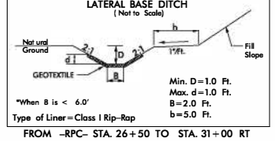
FROM –RPC– STA. 24+45 TO STA. 26+50 RT

DETAIL H
SPECIAL CUT DITCH wHINGE (Not to Scale)



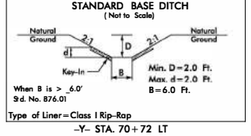
FROM –Y_EB– STA. 39+00 TO STA. 40+00 RT

DETAIL I
LATERAL BASE DITCH (Not to Scale)



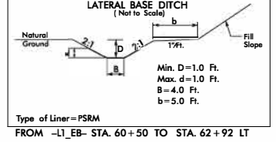
FROM –RPC– STA. 26+50 TO STA. 31+00 RT

DETAIL J
STANDARD BASE DITCH (Not to Scale)



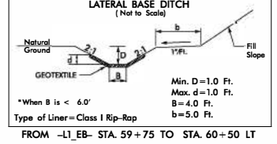
–Y– STA. 70+72 LT

DETAIL K
LATERAL BASE DITCH (Not to Scale)



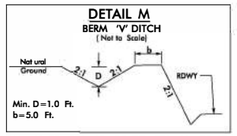
FROM –L1_EB– STA. 60+50 TO STA. 62+92 LT

DETAIL L
LATERAL BASE DITCH (Not to Scale)



FROM –L1_EB– STA. 59+75 TO STA. 60+50 LT

DETAIL M
BERM 'V' DITCH (Not to Scale)

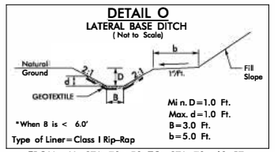


FROM –L1 EB– STA. 45+25 TO STA. 46+25 LT
FROM –L1_EB– STA. 52+13 TO STA. 52+98 LT

DETAIL N
SPECIAL CUT DITCH (Not to Scale)

FROM –RPC– STA. 31+00 TO STA. 33+50 RT
FROM –L1_WB– STA. 51+00 TO STA. 53+70 RT

DETAIL O
LATERAL BASE DITCH (Not to Scale)

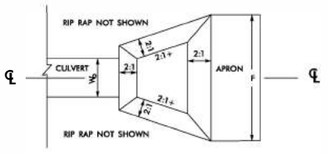


FROM –Y– STA. 70+50 TO STA. 72+60 RT

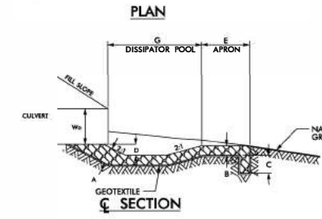
DETAIL P
RIP–RAPPED ENERGY DISSIPATOR BASIN

DIM. (ft)	RIP RAP BASIN # 1	2	?
A	2.5	2.0	?
B	1.7	1.4	?
C	1.4	0.5	?
D	1.4	0.5	?
E	7.0	2.5	?
F	18.0	9.0	?
G	14.0	7.5	?

ALL DIMENSIONS APPROXIMATE



PLAN

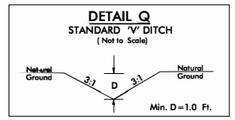


℄ SECTION

BASIN #	LOCATION (AT OUTLET)
1	–Y– 92+94 LT
2	–Y– 93+22 LT
–	–

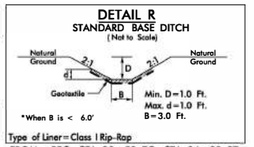
7/08

DETAIL Q
STANDARD 'V' DITCH (Not to Scale)



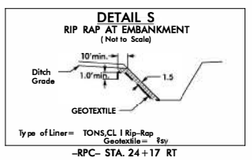
FROM STA. –Y19– 11+00 LT TO STA. –Y– 88+55 RT

DETAIL R
STANDARD BASE DITCH (Not to Scale)



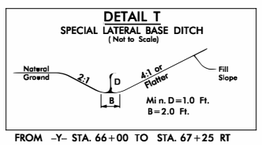
FROM –RPC– STA. 23+58 TO STA. 24+08 RT

DETAIL S
RIP RAP AT EMBANKMENT (Not to Scale)



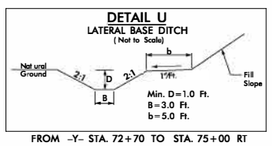
–RPC– STA. 24+17 RT

DETAIL T
SPECIAL LATERAL BASE DITCH (Not to Scale)



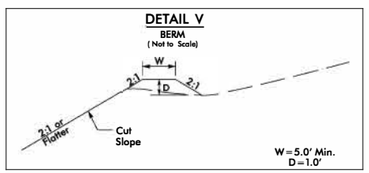
FROM –Y– STA. 66+00 TO STA. 67+25 RT

DETAIL U
LATERAL BASE DITCH (Not to Scale)



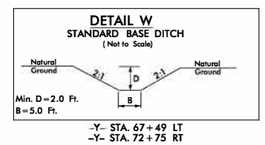
FROM –Y– STA. 72+70 TO STA. 75+00 RT

DETAIL V
BERM (Not to Scale)



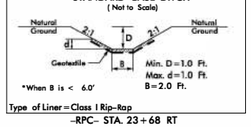
FROM –RPC– STA. 36+25 TO STA. 37+50 RT

DETAIL W
STANDARD BASE DITCH (Not to Scale)



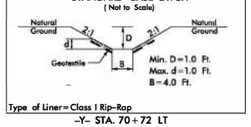
–Y– STA. 67+49 LT
–Y– STA. 72+75 RT

DETAIL X
STANDARD BASE DITCH (Not to Scale)



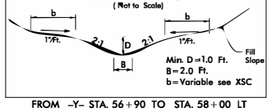
–RPC– STA. 23+68 RT

DETAIL Y
STANDARD BASE DITCH (Not to Scale)



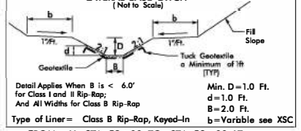
–Y– STA. 70+72 LT

DETAIL Z
LATERAL BASE DITCH (Not to Scale)



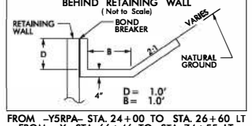
FROM –Y– STA. 56+90 TO STA. 58+00 LT

DETAIL AA
LATERAL BASE DITCH (Not to Scale)



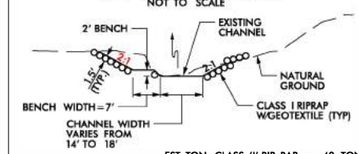
FROM –Y– STA. 58+00 TO STA. 59+00 LT

DETAIL AB
CONCRETE DITCH BEHIND RETAINING WALL (Not to Scale)



FROM –Y5RPA– STA. 24+00 TO STA. 26+60 LT
FROM –Y– STA. 66+46 TO STA. 74+55 LT
FROM –RPC– STA. 18+13 TO STA. 74+55 RT
FROM –RPC– STA. 23+69 TO STA. 28+33 RT
FROM –RPC– STA. 33+78 TO STA. 39+95 RT

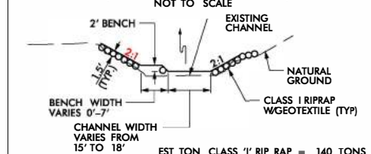
DETAIL AC
OUTLET TYPICAL (LT TO RT LOOKING DOWNSTREAM) NOT TO SCALE



EST TON CLASS 'I' RIP RAP = 40 TONS
EST GEOTEXTILE = 53 SY

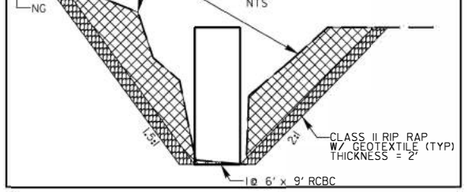
NOTE: THIS DETAIL IS ALSO THE INLET TYPICAL FOR CSR UNDER THE –BRSSPUR–

DETAIL AD
OUTLET TYPICAL (LT TO RT LOOKING DOWNSTREAM) NOT TO SCALE

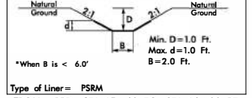


EST TON CLASS 'I' RIP RAP = 140 TONS
EST GEOTEXTILE = 182 SY

DETAIL AE
INLET DETAIL NTS

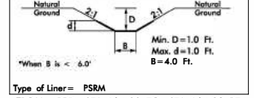


DETAIL AF
STANDARD BASE DITCH (Not to Scale)



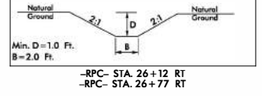
FROM –RPD– STA. 15+60 TO STA. 16+00 RT

DETAIL AG
STANDARD BASE DITCH (Not to Scale)



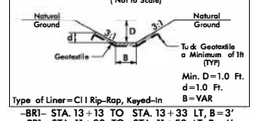
FROM –RPD– STA. 16+00 TO STA. 16+38 RT

DETAIL AH
STANDARD BASE DITCH (Not to Scale)



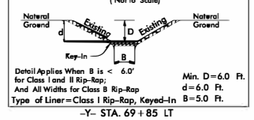
–RPC– STA. 26+12 RT
–RPC– STA. 26+77 RT

DETAIL AI
STANDARD BASE DITCH (Not to Scale)



–BR1– STA. 13+13 TO STA. 13+33 LT, B=3'
–BR1– STA. 11+30 TO STA. 11+50 LT, B=4'
–BR1– STA. 13+13 TO STA. 13+76, B=5'
–JR1– STA. 11+25 TO STA. 12+15, B=6'

DETAIL AJ
STANDARD BASE DITCH (Not to Scale)



–Y– STA. 69+85 LT

2/27/2023
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USER: Matthew

FILTRATION BASIN DETAILS (BASIN 2A)

WETHERILL ENGINEERING
1223 Jones Franklin Road
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License No. F-0377
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Fax: 919 851 8107
TRANSPORTATION PLANNING/DESIGN - BRIDGE/STRUCTURE DESIGN
CIVIL/SITE DESIGN - GIS/GPS - CONSTRUCTION OBSERVATION

PROJECT REFERENCE NO.	SHEET NO.
I-2513 AA/AB	2D-7
R/W SHEET NO.	

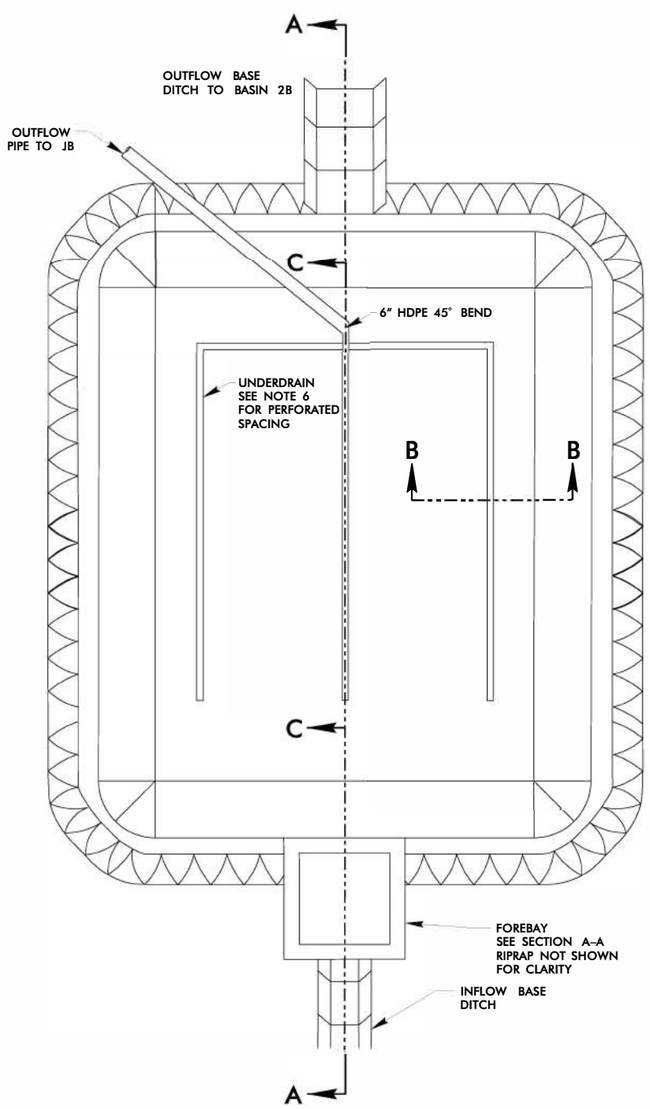
HYDRAULICS ENGINEER

NOT TO SCALE

PERMIT DRAWING
SHEET 2A OF 26

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

PLAN



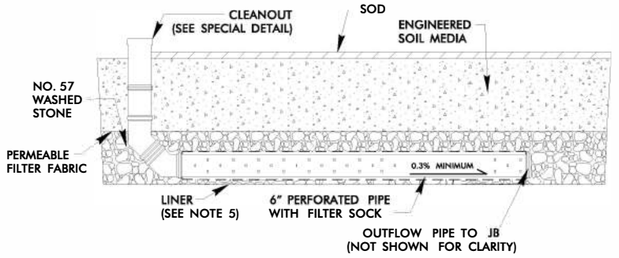
NOTES

1. THE 6-INCH UNDERDRAIN IS THE PRIMARY DRAWDOWN DEVICE.
4. UNDERDRAIN PIPES SHOULD BE PLACED A MAXIMUM OF 10 FEET FROM THE EDGE OF THE BASIN AND MUST HAVE A MAXIMUM OF 10 FEET BETWEEN THE PERFORATED UNDERDRAIN PIPES.
5. UNDERDRAIN SHOULD BE BEDDED ON A THIN LAYER OF NO.57 WASHED STONE AND BACKFILLED TO A TOTAL MINIMUM STONE DEPTH OF 12 INCHES.
6. UNDERDRAIN PERFORATED PIPE HOLES ARE 3/8 INCH IN DIAMETER AND LONGITUDINALLY SPACED 6 INCHES ON CENTER ALONG 4 ROWS.
7. TOP OF MEDIA FILTER MUST BE LEVEL.

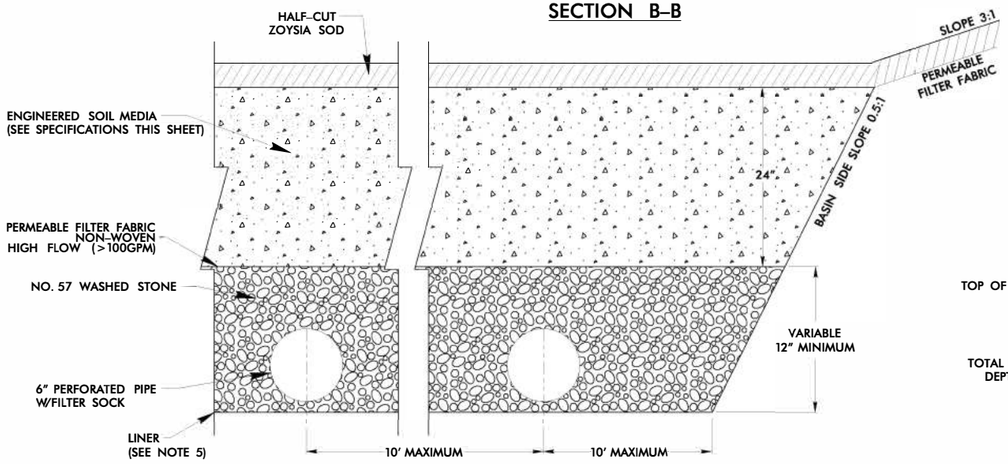
SPECIFICATIONS

ENGINEERED SOIL MEDIA SHALL CONSIST OF:
(1) HOMOGENOUS SOIL MIX OF 85-88 PERCENT BY WEIGHT SAND (USDA SOIL TEXTURAL CLASSIFICATION), 8 TO 12 PERCENT FINES (SILT AND CLAY), AND 2 TO 5 PERCENT ORGANIC MATTER (ORGANIC MATTER SHALL BE LEAF OR BARK COMPOST, OR SIMILAR, AND SHALL NOT BE ANIMAL MANURE).
(2) P-INDEX BETWEEN 10 AND 30
(3) PH VALUE BETWEEN 5.5 – 7.5
(4) PERMEABILITY BETWEEN 1 AND 2 INCHES/HOUR MINIMUM
(5) BE UNIFORM AND FREE OF STONES, STUMPS, ROOTS OR OTHER SIMILAR MATERIAL GREATER THAN 2 INCHES

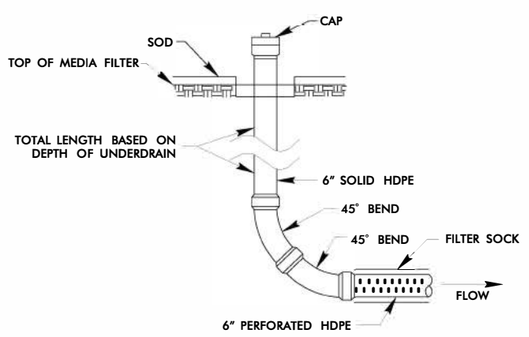
SECTION C–C



SECTION B–B

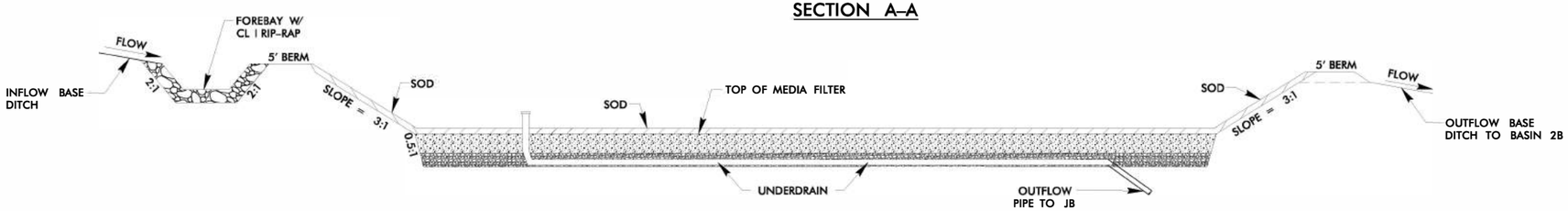


CLEANOUT



CLEANOUT NOTES:
1. ONLY UNDERDRAIN PIPE THAT IS LOCATED BENEATH ENGINEERED SOIL MEDIA SHOULD BE PERFORATED.
2. PROVIDE THREADED SCREW CAP.

PROFILE
SECTION A–A



NOT TO SCALE

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USER:mgreen

FILTRATION BASIN DETAILS (BASIN 2B)

WETHERILL ENGINEERING
1223 Jones Franklin Road
Raleigh, N.C. 27606
License No. F-0377
Bus: 919 851 8077
Fax: 919 851 8107
TRANSPORTATION PLANNING/DESIGN - BRIDGE/STRUCTURE DESIGN
CIVIL/SITE DESIGN - GIS/GPS - CONSTRUCTION OBSERVATION

PROJECT REFERENCE NO.	SHEET NO.
I-2513 AA/AB	2D-8
R/W SHEET NO.	
	HYDRAULICS ENGINEER

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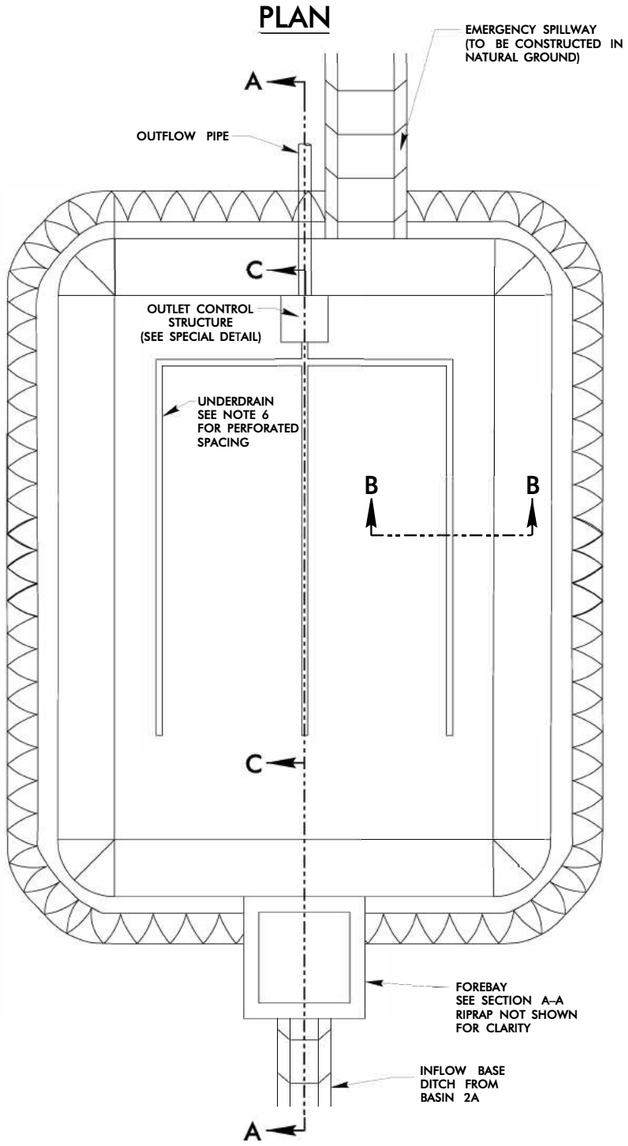
PERMIT DRAWING
SHEET 2B OF 26

PLAN



NOTES

1. AN EMERGENCY SPILLWAY SHOULD BE INCORPORATED WHERE SITE PERMITS.
2. AN ACCESS BERM SHOULD BE PROVIDED FOR MAINTENANCE.
3. THE 6-INCH UNDERDRAIN IS THE PRIMARY DRAWDOWN DEVICE.
4. UNDERDRAIN PIPES SHOULD BE PLACED A MAXIMUM OF 10 FEET FROM THE EDGE OF THE BASIN AND MUST HAVE A MAXIMUM OF 10 FEET BETWEEN THE PERFORATED UNDERDRAIN PIPES.
5. UNDERDRAIN SHOULD BE BEDDED ON A THIN LAYER OF NO.57 WASHED STONE AND BACKFILLED TO A TOTAL MINIMUM STONE DEPTH OF 12 INCHES.
6. UNDERDRAIN PERFORATED PIPE HOLES ARE 3/8 INCH IN DIAMETER AND LONGITUDINALLY SPACED 6 INCHES ON CENTER ALONG 4 ROWS.
7. TOP OF MEDIA FILTER MUST BE LEVEL.

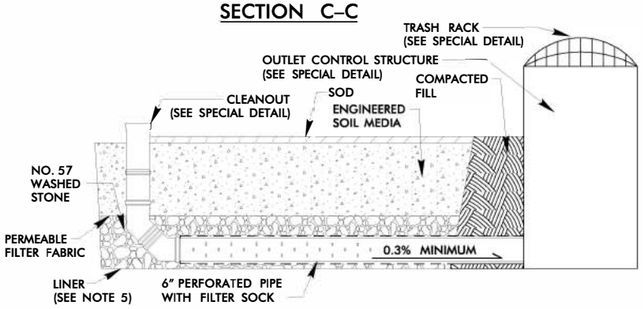
REFERENCED SPECIAL DETAILS

FOR "OUTLET CONTROL STRUCTURE DETAILS" SEE SHEET 2D-8
FOR "TRASH RACKS DETAIL" SEE SHEET 2D-9

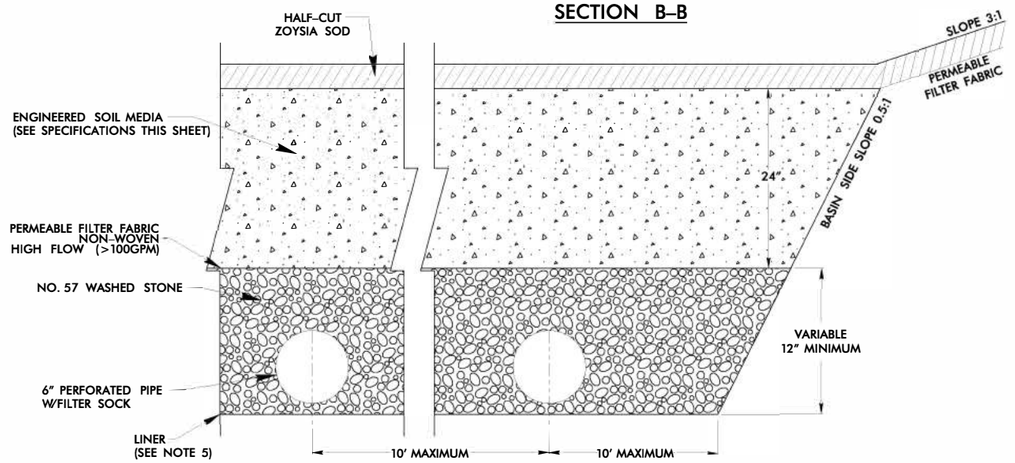
SPECIFICATIONS

ENGINEERED SOIL MEDIA SHALL CONSIST OF:
(1) HOMOGENOUS SOIL MIX OF 85-88 PERCENT BY WEIGHT SAND (USDA SOIL TEXTURAL CLASSIFICATION), 8 TO 12 PERCENT FINES (SILT AND CLAY), AND 2 TO 5 PERCENT ORGANIC MATTER (ORGANIC MATTER SHALL BE LEAF OR BARK COMPOST, OR SIMILAR, AND SHALL NOT BE ANIMAL MANURE).
(2) P-INDEX BETWEEN 10 AND 30
(3) PH VALUE BETWEEN 5.5 – 7.5
(4) PERMEABILITY BETWEEN 1 AND 2 INCHES/HOUR MINIMUM
(5) BE UNIFORM AND FREE OF STONES, STUMPS, ROOTS OR OTHER SIMILAR MATERIAL GREATER THAN 2 INCHES

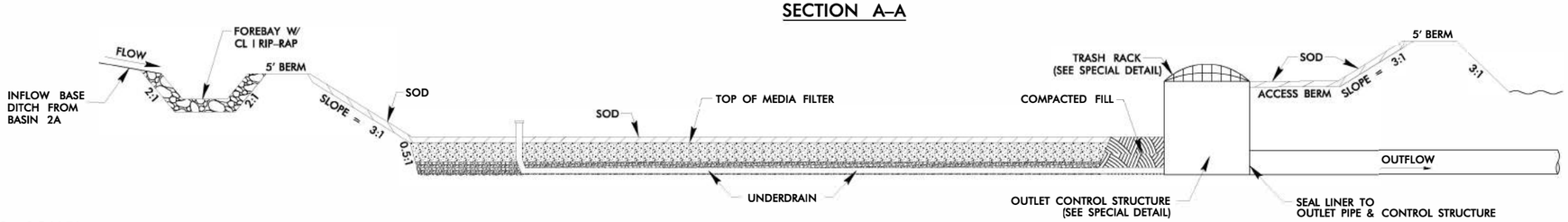
SECTION C–C



SECTION B–B



PROFILE
SECTION A–A



NOT TO SCALE

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USER:Mdrexel

6/17/99

OUTLET CONTROL STRUCTURE DETAILS

WETHERILL ENGINEERING
1223 Jones Franklin Road
Raleigh, N.C. 27606
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Bus: 919 851 8077
Fax: 919 851 8107
TRANSPORTATION PLANNING/DESIGN - BRIDGE/STRUCTURE DESIGN
CIVIL/SITE DESIGN - GIS/GPS - CONSTRUCTION OBSERVATION

PROJECT REFERENCE NO.	SHEET NO.
I-2513 AA/AB	2D-9
R/W SHEET NO.	
	HYDRAULICS ENGINEER

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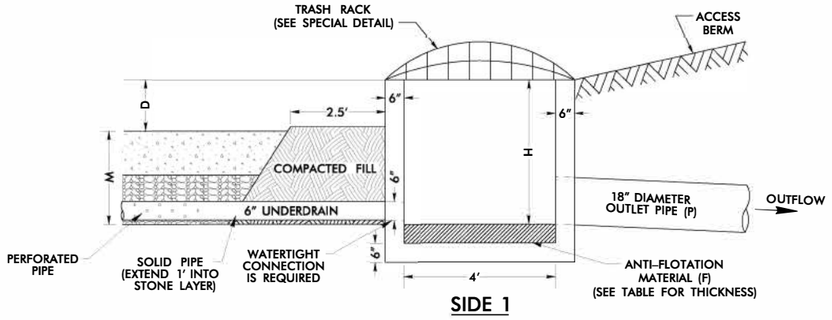
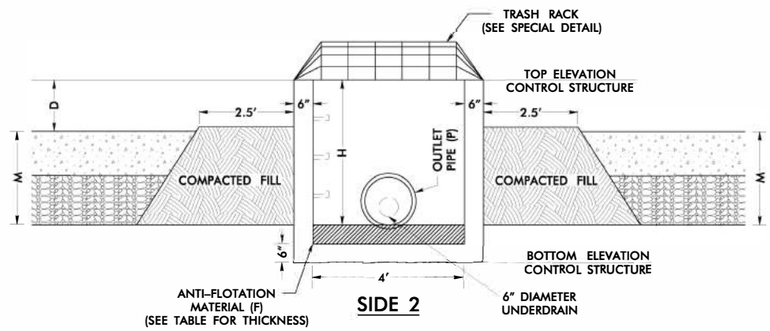
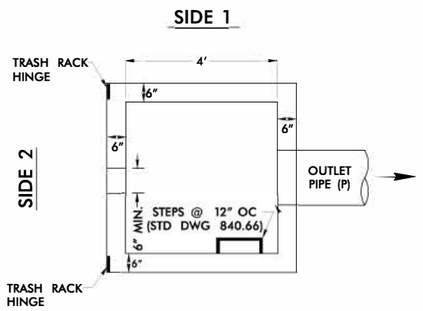
PERMIT DRAWING SHEET 2C OF 26



SIDE 1

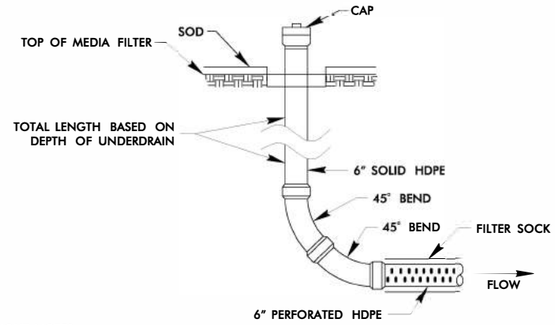


SIDE 2



PLAN VIEW

TRASH RACK NOT SHOWN FOR CLARITY



CLEANOUT NOTES:

1. ONLY UNDERDRAIN PIPE THAT IS LOCATED BENEATH ENGINEERED SOIL MEDIA SHOULD BE PERFORATED.
2. PROVIDE THREADED SCREW CAP.

CLEANOUT

DIMENSIONS

D = PONDING DEPTH
M = MEDIA FILTER + AGGREGATE THICKNESS
F = ANTI-FLOTATION MATERIAL THICKNESS
SLAB THICKESS IS 0.5'
MINIMUM H = D + M

NOTES

1. BEDDING MATERIAL SHALL NOT TO BE USED. DO NOT FOLLOW STANDARD DRAWINGS FOR METHOD OF PIPE INSTALLATION FOR OUTLET PIPE THROUGH EMBANKMENT.
2. ANTI-FLOTATION MATRIAL IS REQUIRED AND SHALL BE CONCRETE.

REFERENCED SPECIAL DETAILS

FOR "FILTRATION BASIN DETAILS (BASIN 2B)" SEE SHEET 2D-8
FOR "TRASH RACKS DETAIL" SEE SHEET 2D-10

MINIMUM DIMENSIONS FOR MEDIA FILTER BASIN DRAWDOWN STRUCTURES

BASIN	STATION	STRUCTURE NUMBER	TOP ELEVATION MEDIA FILTER	TOP ELEVATION CONTROL STRUCTURE	BASIN DEPTH (D)	MEDIA FILTER + AGGREGATE DEPTH (M)	ANTI-FLOTATION MATERIAL (F) THICKNESS	BOTTOM ELEVATION CONTROL STRUCTURE	DIMENSIONS CONTROL STRUCTURE (W x L x H)	DIAMETER OUTLET PIPE (P) (SEE NOTE 5)	INVERT ELEVATION OUTLET PIPE (P)
2B	-L- 348+38 (RT)	1096	2032.00	2033.50	2.0'	3.0'	1.1'	2027.4	4' x 4' x 4.5'	18"	2029.25

NOT TO SCALE

3/12/2023
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USER:Mdarvell

6/17/99

TRASH RACKS DETAIL

WETHERILL ENGINEERING
1223 Jones Franklin Road
Raleigh, N.C. 27606
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Fax: 919 851 8107

TRANSPORTATION PLANNING/DESIGN - BRIDGE/STRUCTURE DESIGN
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PROJECT REFERENCE NO.	SHEET NO.
I-2513 AA/AB	2D-10
R/W SHEET NO.	

HYDRAULICS ENGINEER

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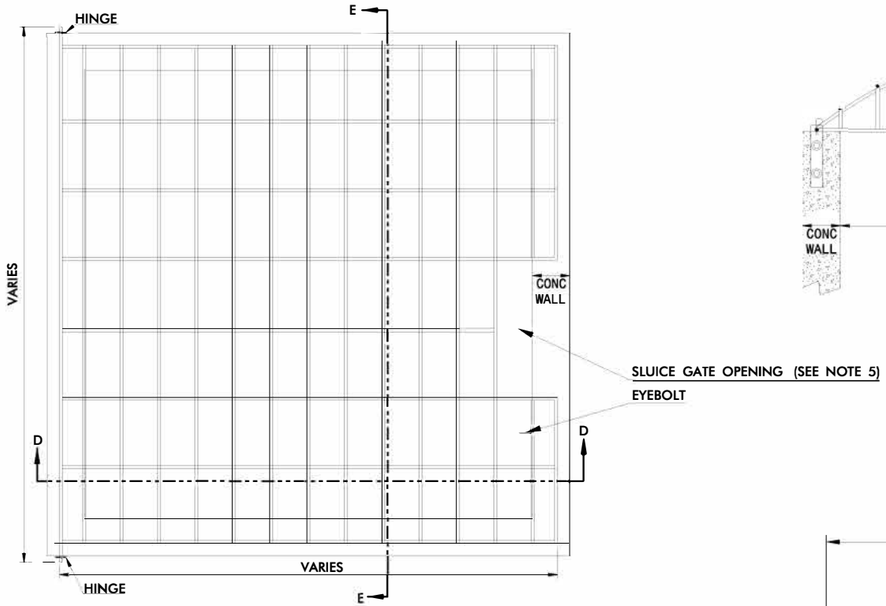
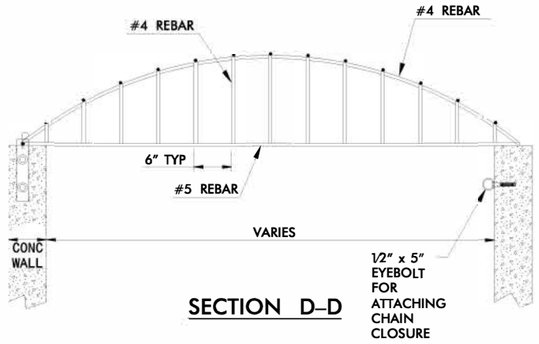
PERMIT DRAWING
SHEET 2D OF 26

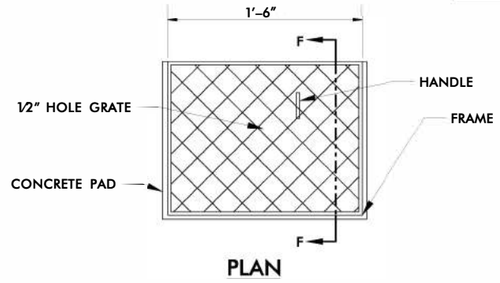
NOT TO SCALE



PLAN



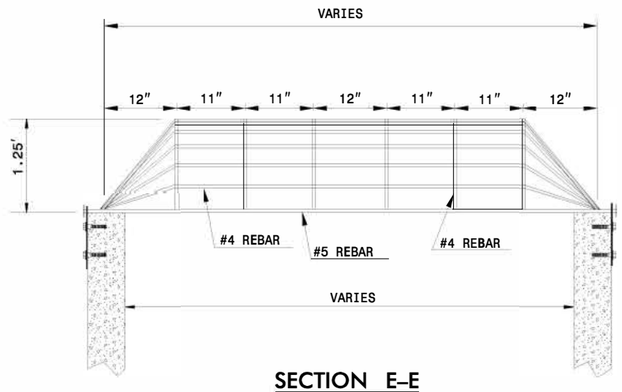
SECTION D–D



PLAN

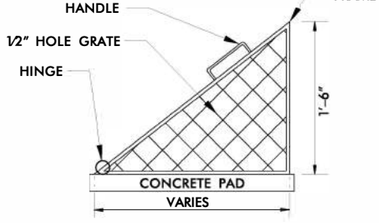
RISER TRASH RACK NOTES:

1. ALL JOINTS SHALL BE FULLY WELDED AROUND JOINT WITH A MINIMUM OF A 1/4" BEAD.
2. IF BOLTS ARE ANCHORED IN CONCRETE, FOLLOW STD. DWG. 862.03 AND 862.04 FOR ANCHORING PROCEDURE.
3. EYEBOLT FOR CHAIN CLOSURE SHALL BE INSTALLED BY THE SAME METHOD AS THE HINGE PLATE BOLTS.
4. RACK AND HARDWARE SHALL BE REBAR AND GALVANIZED IN ACCORDANCE WITH ASTM A-153.
5. PROVIDE OPENING IN TRASH RACK TO ACCOMODATE SLUICE GATE ON THE OUTLET PIPE.



SECTION E–E

REBAR TRASH RACK



SECTION F–F

ORIFICE TRASH RACK NOTES:

1. ALL JOINTS SHALL BE FULLY WELDED AROUND JOINT WITH A MINIMUM OF A 1/4" BEAD.
2. IF BOLTS ARE ANCHORED IN CONCRETE, FOLLOW STD. DWG. 862.03 AND 862.04 FOR ANCHORING PROCEDURE.
3. REMOVEABLE ORIFICE TRASH RACK SHALL BE ATTACHED TO CONCRETE BOX BY HINGE OR SLIDE RAIL SYSTEM.
4. RACK AND HARDWARE SHALL BE ALUMINUM OR GALVANIZED IN ACCORDANCE WITH ASTM A-153.

REMOVEABLE ORIFICE TRASH RACK

3/2/2023
R:\Projects\PERMITS_Environmental\Drawings\I2513AA_hyd_prm_basin_details.dgn
USER:Mgreen

MEDIA FILTRATION BASIN PLAN & PROFILE
ALIGNMENT –BR1–

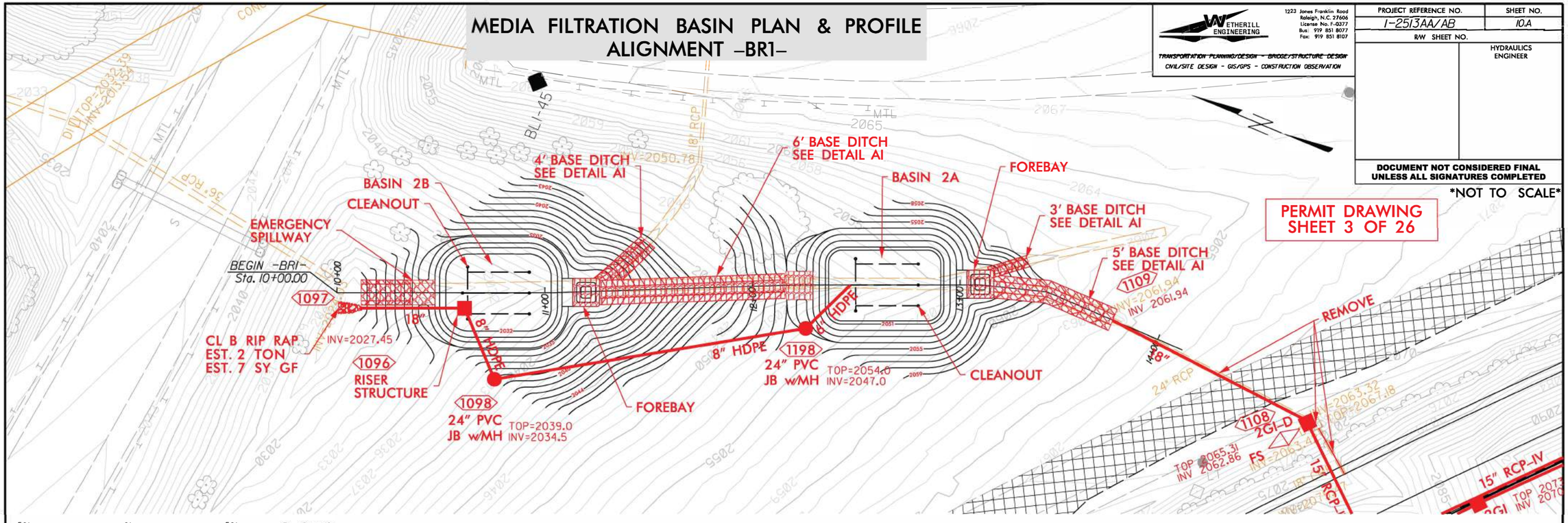
WETHERILL ENGINEERING
1223 Jones Franklin Road
Raleigh, N.C. 27606
License No. F-0377
Bus: 919 851 8077
Fax: 919 851 8107
TRANSPORTATION PLANNING/DESIGN - BRIDGE/STRUCTURE DESIGN
CIVIL/SITE DESIGN - GIS/GPS - CONSTRUCTION OBSERVATION

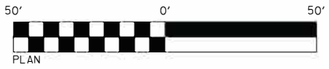
PROJECT REFERENCE NO.	SHEET NO.
I-2513AA/AB	10.A
R/W SHEET NO.	
	HYDRAULICS ENGINEER

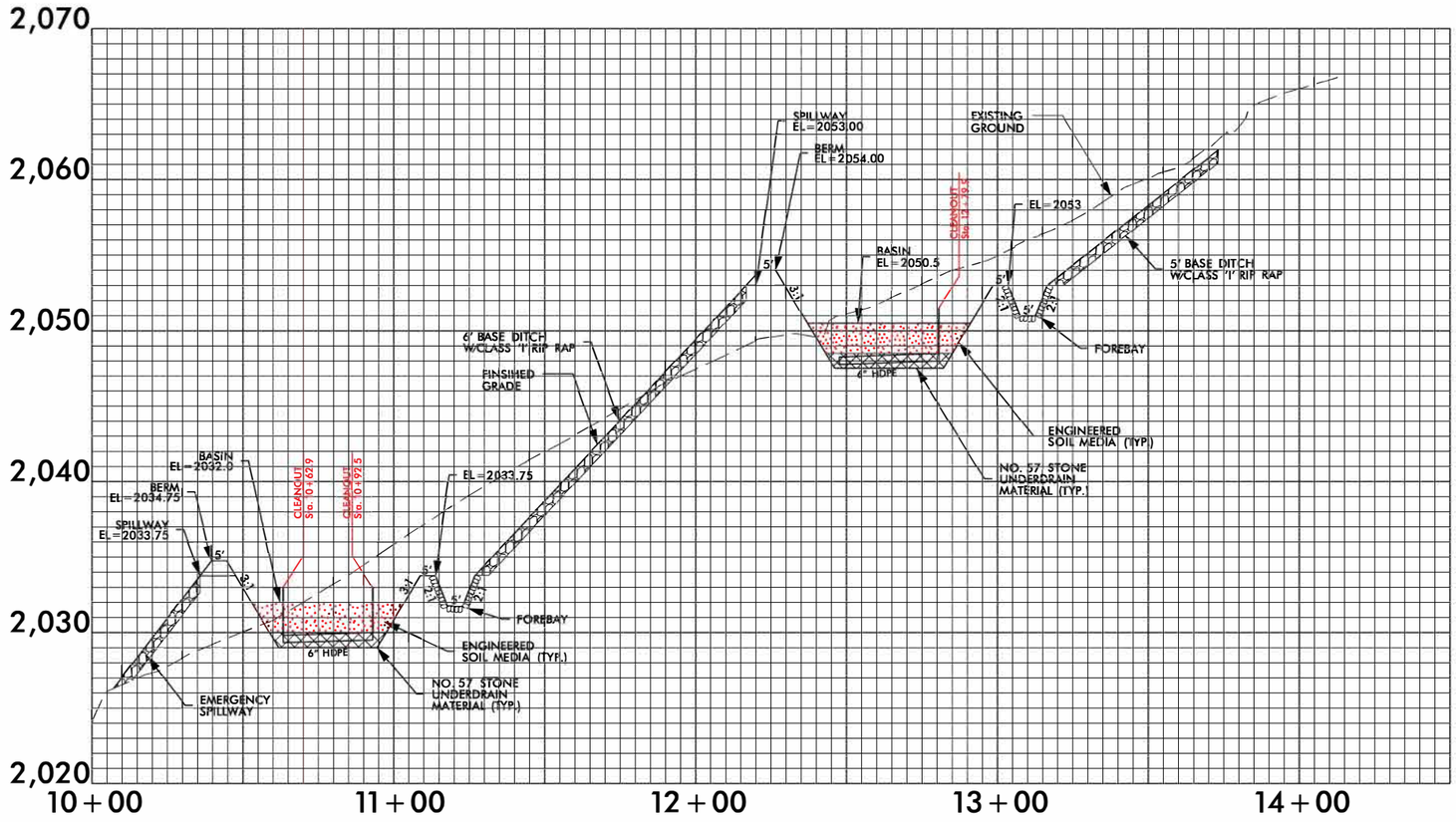
DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

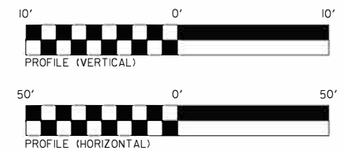
NOT TO SCALE

PERMIT DRAWING
SHEET 3 OF 26









MEDIA FILTRATION BASIN PLAN & PROFILE
ALIGNMENT –BR2–

WETHERILL ENGINEERING
1223 Jones Franklin Road
Raleigh, N.C. 27606
License No. F-0377
Bus: 919 851 8077
Fax: 919 851 8107
TRANSPORTATION PLANNING/DESIGN - BRIDGE/STRUCTURE DESIGN
CIVIL/SITE DESIGN - GIS/GPS - CONSTRUCTION OBSERVATION

PROJECT REFERENCE NO.	SHEET NO.
I-2513AA/AB	10B
R/W SHEET NO.	
	HYDRAULICS ENGINEER

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

NOT TO SCALE

PERMIT DRAWING
SHEET 4 OF 26

BL I-45

BEGIN –BR2–
Sta. 10+00.00
CL B RIP RAP
EST. 2 TON
EST. 7 SY GF

1097
INV=2027.45

EMERGENCY SPILLWAY

BASIN 2B

CLEANOUT

1096
RISER STRUCTURE

4' BASE DITCH
SEE DETAIL AI

1098
24" PVC
JB w/MH
TOP=2039.0
INV=2034.5

18"

8" HDPE

FOREBAY

6' BASE DITCH
SEE DETAIL AI

END –BR2–
Sta. 12+80.37

8" HDPE

1198
24" PVC
JB w/MH
TOP=2054.0
INV=2047.0

6" HDPE

BASIN 2A

CLEANOUT

FOREBAY

3' BASE DITCH
SEE DETAIL AI

5' BASE DITCH
SEE DETAIL AI

1109
INV=2061.94
INV 2061.94

REMOVE

18"

24" RCP

1108
2GI-D
TOP 2065.31
INV 2062.86
FS
INV=2063.32
TOP=2067.18

15" RCP-IV

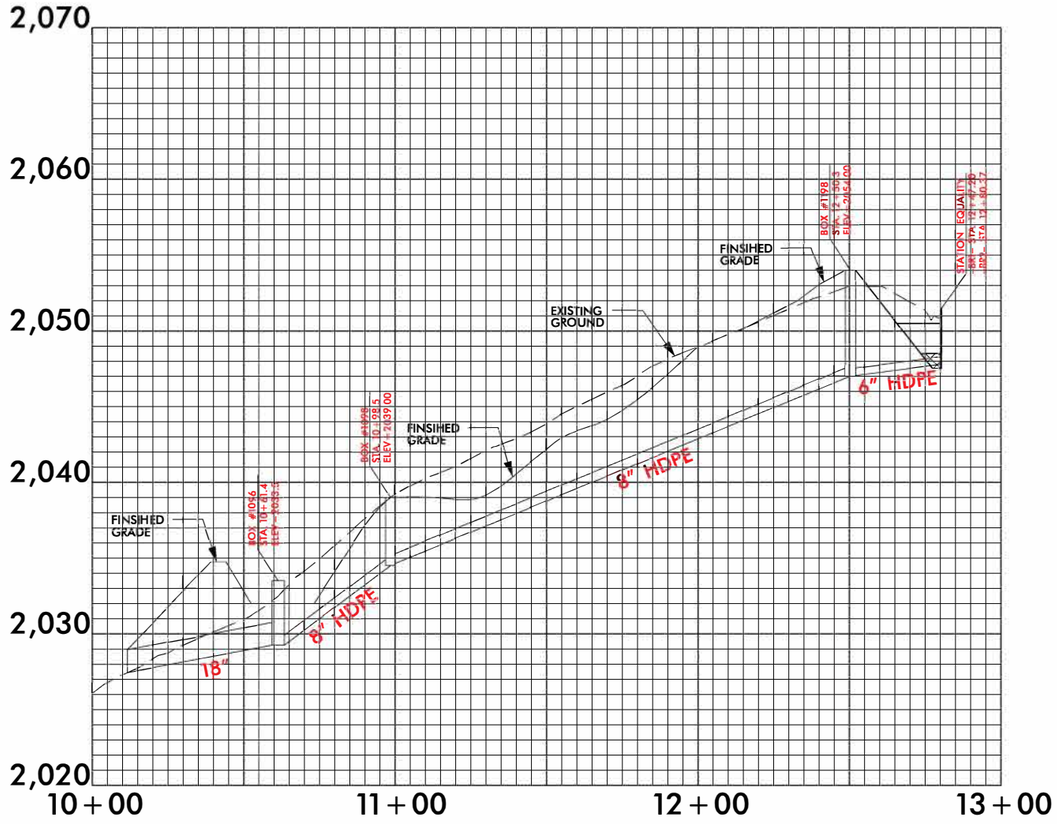
15" RCP-I

TOP 2073
INV 2070

36" RCP

8" RCP

50' 0' 50'
PLAN



10' 0' 10'
PROFILE (VERTICAL)

50' 0' 50'
PROFILE (HORIZONTAL)

REVISIONS

PROJECT REFERENCE NO. I-2514A/B | SHEET NO. 6

STATE PROJECT NO. | ROADWAY DESIGN ENGINEER | HYDRAULICS ENGINEER

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

KCI TECHNOLOGIES

PERMIT DRAWING SHEET 5 OF 26

GRAPHIC SCALE 200' 0' 200'

MATCHLINE -YSRPB- STA 17+00 SEE SHEET 5

MATCHLINE -Y- STA 39+50 SEE SHEET 5

MATCHLINE -YSRPC- STA 19+20 SEE SHEET 5

MATCHLINE -Y- STA 63+00 – SEE SHEET 7

SITE 1

SITE 2

See Permit Drawing Sheet 10 of 30 for Enlargement

See Permit Drawing Sheet 11 of 30 for Enlargement

S-SR2447

SURFACE WATER IMPACTS

TS TS TEMPORARY SURFACE WATER IMPACTS

REVISED SIGNAL

FOR -Y-, -L-, -L1-, -L2- PROFILES SEE SHEETS 16 & 17
FOR -YSRPA- PROFILE SEE SHEET 13
FOR -YSRPC- PROFILE SEE SHEET 15
FOR -SRSUPER- PROFILE SEE SHEET 30
FOR DRAINAGE DETAILS SEE SHEET 26-1

LOCATION:

TIP NO.: COUNTY:

DESIGNED BY:

CHECKED BY: DATE:

GRAPHIC SCALE 50 25 0 50 100 PLANS

PROJECT REFERENCE NO.	SHEET NO.
I-25I3AA/AB	6
R/W SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

INCOMPLETE PLANS
DO NOT USE FOR R/W ACQUISITION

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

PERMIT DRAWING SHEET 6 OF 26

SITE 1

FLOWABLE FILL

TRENCHLESS INSTALLATION 66" WELDED ST (NOT BURIED)

RETAIN

6' STANDARD BASE DITCH
CLASS I RIP RAP
EST. 18 TON
KEY-IN
DDE = 125 CY
SEE DETAIL B

BL2-269

I-40 WBL BST

I-40 EBL BST

50+00

10+00

20+00

0° 18' 40.1" E

-Y-

CONC BARRIER

(FULL OF DEBRIS)
TOP=2129.95' DI
FLOOR=2123.78'
TOP=2130.05' DI
FLOOR=2123.48'
(FULL OF DEBRIS)

TOP=2127.99'
FLOOR=2121.40'
(FULL OF DEBRIS)

TOP=2128.07'
FLOOR=2121.50'
(FULL OF DEBRIS)

APPROX. DIRECTION

48" RCP

15" RCP

15" CMP

24" DIP

36" RCP

72" CHL W/3SBW

48" CHL & 3SBW

72" CHL & 3SBW

CB

DI

LT

BST

CONC

MTL

R/W MON

CAN

S S SURFACE WATER IMPACTS

TS TS TEMPORARY SURFACE WATER IMPACTS

40' 0' 40'
GRAPHIC SCALE

REVISIONS

8/17/99

1/17/2023
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kring

PERMIT DRAWING
SHEET 7 OF 26

PROJECT REFERENCE NO.	SHEET NO.
I-2513AA/AB	6
RW SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

INCOMPLETE PLANS
DO NOT USE FOR R/W ACQUISITION

DOCUMENT NOT CONSIDERED FINAL
UNLESS ALL SIGNATURES COMPLETED

REVISIONS 8/17/99

SITE 2

OUTLET TYPICAL
SEE DETAIL AD

2' LATERAL
BASE DITCH
SEE DETAIL Z

2' LATERAL
BASE DITCH
SEE DETAIL AA

OUTLET TYPICAL
SEE DETAIL AC

2' LATERAL BASE DITCH
SEE DETAIL C

BEG. FENCE

END FENCE

HIGH FLOW BENCH

84" CMP

15" w/ELBOWS

15" RCP-IV

TB 2GI

IA-MASH TL-3

RETAIN

REMOVE 99 LF
OF 15" RCP

REMOVE

15" CSP

COLLAR AND EXTEND

15+00

60+00

-Y5RPA-

-Y-

TOP=2084.24'

TOP=2075.49'

TOP=2094.91'

TOP=2107.70'
FLOOR=2101.33'
(FULL OF DEBRIS)

84 PROPERTIES LLC

BLUE RIDGE SOUTHERN

ISMTLBUS

S S SURFACE WATER IMPACTS

TS TS TEMPORARY SURFACE WATER IMPACTS

40' 0' 40'
GRAPHIC SCALE

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1/17/2023

REVISIONS

PROJECT REFERENCE NO.	SHEET NO.
I-2513A/B	6
R/W SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

KCI TECHNOLOGIES

PERMIT DRAWING
SHEET 8 OF 26

GRAPHIC SCALE 200' 0' 200'

MATCHLINE -YSRPB- STA 17+00
SEE SHEET 5

MATCHLINE -Y- STA 39+50
SEE SHEET 5

MATCHLINE -YSRPC- STA 19+20
SEE SHEET 5

MATCHLINE -Y- STA 63+00 – SEE SHEET 7

SITE 2

SITE 1

See Permit Drawing Sheet 11 of 30 for Enlargement

See Permit Drawing Sheet 10 of 30 for Enlargement

S 80° W 407.2'

S 80° W 407.2'

SURFACE WATER IMPACTS

TEMPORARY SURFACE WATER IMPACTS

REVISED SIGNAL

FOR -FJT- & -FJR- PROFILES SEE SHEETS 16 & 17
FOR -YSRPA- PROFILE SEE SHEET 23
FOR -YSRPC- PROFILE SEE SHEET 29
FOR -RPBSGR- PROFILE SEE SHEET 30
FOR DRAINAGE DETAILS SEE SHEET 30-1

LOCATION:
TIP NO.: COUNTY:
DESIGNED BY:
CHECKED BY: DATE:

GRAPHIC SCALE
50 25 0 50 100
PLANS

5/14/99

PROJECT REFERENCE NO.	SHEET NO.
I-2513AA/AB	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

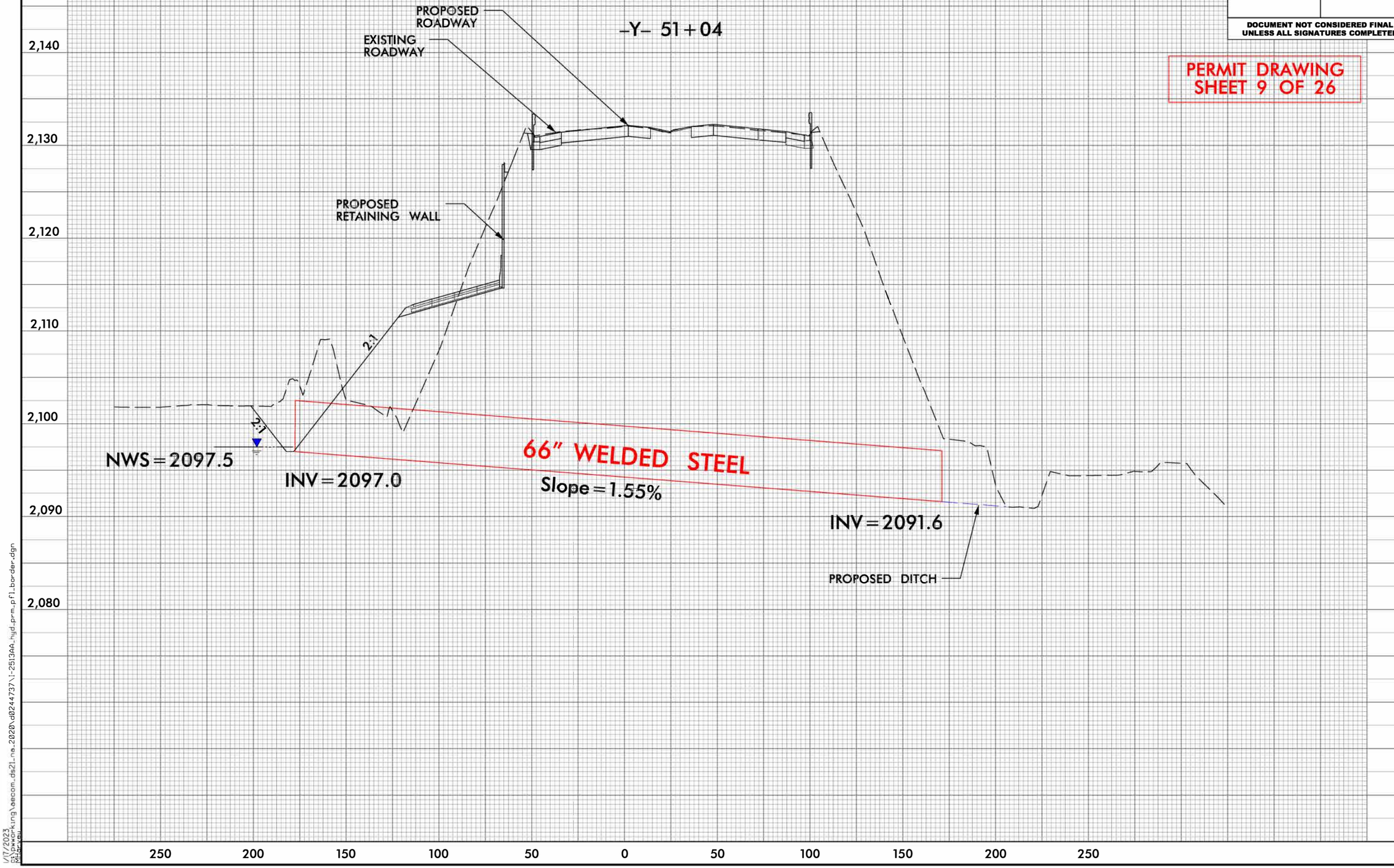
INCOMPLETE PLANS
DO NOT USE FOR R/W ACQUISITION

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

PERMIT DRAWING
SHEET 9 OF 26

SITE 1

-Y- 51+04



1/7/2023
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PROJECT REFERENCE NO.	SHEET NO.
I-2513AA/AB	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

INCOMPLETE PLANS
DO NOT USE FOR R/W ACQUISITION

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

PERMIT DRAWING
SHEET 10 OF 26

SITE 2

℄ STA. 59+50 –Y–
SKEW: 99°55'
–YLT– ELEV = 2111.85'
–YRT– ELEV = 2111.97'
EXTEND EXISTING CULVERT
3 @ 7' x 9' RCBC

EXISTING ROADWAY

PROPOSED ROADWAY

PROPOSED NOISE WALL

3:1 (2:1 NORMAL)

℄ STA. 13+94 –BRSSPUR–
SKEW: 87°55'
ELEV = 2084.7'
SUPPLEMENT EXISTING
2 @ 84" CMP (WITH HEADWALL)
WITH AN ADDITIONAL
84" WELDED STEEL PIPE
W/HEADWALL AND SILLS

NWS ELEV=2068.5'

WATER SURFACE
DATE OF SURVEY
EL. =2067.7 (6/09/22)

PROPOSED SLOPE=0.6%

SLOPE=0.6%

℄ ELEV=2063.9'

EXISTING SLOPE=0.6%

EXISTING RCBC INVERT= 2065.2'

EXISTING RCBC INVERT= 2066.9'

EXISTING RCBC INVERT= 2066.8'

EXISTING STREAM BED

EXISTING 2@84" CMP SUPPLEMENT WITH ADDITIONAL 84" CMP

EXTEND EXISTING 3 X 7' x 9' RCBC AT OUTLET

2,130
2,120
2,110
2,100
2,090
2,080
2,070
2,060
2,050

400 350 300 250 200 150 100 50 0 50 100 150 200 250

5/14/99

1/17/2023
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PROJECT REFERENCE NO.	SHEET NO.
I-2513AA/AB	7
R/W SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

KCI ASSOCIATES OF N.C., P.A.
4505 Falls of Neuse Road, Suite 400
Raleigh, NC 27609-6270
Phone (919) 783-9214
NC Firm License No: C-0764

ETHERIDGE ENGINEERING
1223 Jones Franklin Rd.
Raleigh, N.C. 27606
License No. F-0377
Bus: 919 851 8077
Fax: 919 851 8107

TRANSPORTATION PLANNING/DESIGN - BRIDGE/STRUCTURE DESIGN
CIVIL/SITE DESIGN - GIS/GPS - CONSTRUCTION OBSERVATION

PERMIT DRAWING SHEET 11 OF 26

FILL IN WETLAND
SURFACE WATER IMPACTS
TEMPORARY SURFACE WATER IMPACTS
WETLAND EXCAVATION
HAND CLEARING (NON-GRUBBING)

100' 0' 100'
GRAPHIC SCALE

NAD 83

REVISIONS 5/14/99

MATCHLINE -Y- STA 63+00 – SEE SHEET 6

MATCHLINE -Y- STA 75+00 – SEE SHEET 8

5 84 PROPERTIES LLC

6 THE ASHEVILLE SCHOOL INC

7 HAYES & LEDFORD LLC

8 AUTOSTAR PROPERTY GROUP LLC

SITE 3

6' STANDARD BASE DITCH w/CL I RIP RAP EST 41 TON KEY-IN SEE DETAIL J SLOPE=3.4% L=100 FT DDE=560 CY

5' STANDARD BASE DITCH SEE DETAIL W SLOPE=0.4% L=135 FT DDE=140 CY

CL I RIP RAP EST. 20 TONS SEE DETAIL AJ

BEG PROP. RET.WALL W701 -Y- STA.66+46.00, OS=129' LT

BEG.PAVED SHOULDER -Y- STA.67+50.00, OS=147.20' LT

BEG.PROP.2'-6" C&G -Y- STA.68+05.00, OS=131.50' LT

END PROP. RET.WALL W701 -Y- STA.74+55.00, OS=129' LT

END PAVED SHOULDER -Y- STA.74+38.00, OS=157.80' LT

END PROP.2'-6" C&G -Y- STA.73+57.00, OS=131.50' LT

BEG. FENCE -Y- +55.00 129' +/- LT

END FENCE (TIE TO EXIST) -Y- +90 +/- 135' +/- LT

TIE FENCE TO EXIST. AND PROP. RET. WALL -Y- +46.00

BEGIN PROP. NOISE WALL NWC-1A -Y- STA.63+70.00, OS=86.50' RT

BEG FENCE (TIE TO EXIST) -Y- +70+/- 111' +/- RT

END FENCE (TIE TO EXIST) -Y- +06 +/- 110' +/- RT

BEG FENCE (TIE TO EXIST) -Y- +78 +/- 139' +/- RT

END FENCE (TIE TO EXIST) KATHY RENA BRANCH

REMOVE 6 LF OF 30" RCP R=165'

REMOVE 7 LF OF 30" RCP

CONCRETE DITCH SEE DETAIL AB

FLOWABLE FILL

TRENCHLESS INSTALLATION OF 30" WELDED STEEL

SPECIAL LATERAL DITCH SEE DETAIL D

REMOVE EXIST. NOISE WALL -Y- 64+00.00 TO 76+11.00 RT

3' LATERAL BASE DITCH w/CLASS I RIP RAP SEE DETAIL O

3' LATERAL BASE DITCH SEE DETAIL U

REMOVE STANDARD BASE DITCH SEE DETAIL W

DAVID D & SHIRLEY R BAKER

PHYLLIS DUCKETT MORGAN

RONNI & CARMON D O'BRIEN

LUIS A & MARIA ARROYO

ZELMA PERKINS ET

HARVEY G & RUTH M BUCKNER

BRUCE R & JUDY V DILLS

THOMAS JAMES HEY REVOCABLE TRUST

GARNET JOHN BUDD III & CYNTHIA BUDD

HEATHER A PERRY

See Permit Drawing Sheet 16 of 30 for Enlargement

FOR -Y_LT- & -Y_RT- PROFILES SEE SHEET 18
FOR -Y5RPA- PROFILE SEE SHEET 23
FOR DRAINAGE DETAILS SEE SHEET 2D-1

2/27/2023
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PROJECT REFERENCE NO.	SHEET NO.
I-2513AA/AB	7
RW SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

INCOMPLETE PLANS
DO NOT USE FOR R/W ACQUISITION

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

PERMIT DRAWING SHEET 12 OF 26

REVISIONS

8/17/99

TOP=2098.39'
FLOOR=2092.00'
(FULL OF DEBRIS)
TOP=2097.95'
FLOOR=20902.19'
(FULL OF DEBRIS)

70+00

RETAIN

FLOWABLE FILL

60" WELDED STEEL (NOT BURIED) INSTALLATION

-Y-

S 75° 19' 51.7" E

CONC SOUND BARRIER

TB 2GI

REMOVE

14' PS

BL2-21A

2-273

3' LATERAL BASE DITCH w/CLASS I RIP RAP SEE DETAIL O

15" w/ELBOWS

HW

48" WW & ISBW

8" PVC

R/W MON

SS

MH

TOP=2098.69'

RW CA

PUE

E

PROP. 48" WW

LUIS A & MARIA ARROYO

JEFFREY A CLARK & TAMMY G CLARK

ZELMA PERKINS ET AL

KATHY RENA BRANCH

3' LATERAL BASE DITCH SEE DETAIL

REMOVE STANDARD BASE DITCH SEE DETAIL W

DUE

TS

HC

SITE 3

13

14

15

17

48" CHL

18" CMP

TOP=2093.86'

TOP=2105.27'

SSMH

ISFD

CONC

10' BST

DK

BST

BRUCE R & JUDY V DILLS

40' 0' 40'
GRAPHIC SCALE

F F	FILL IN WETLAND
S S	SURFACE WATER IMPACTS
TS TS	TEMPORARY SURFACE WATER IMPACTS
E E	WETLAND EXCAVATION
HC HC	HAND CLEARING (NON-GRUBBING)

1/17/2023
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Mike.vel

REVISIONS

5/14/99

FF	FILL IN WETLAND
SS	SURFACE WATER IMPACTS
TS TS	TEMPORARY SURFACE WATER IMPACTS
EE	WETLAND EXCAVATION
HC HC	HAND CLEARING (NON-GRUBBING)

PERMIT DRAWING SHEET 13 OF 26

100' 0' 100'
GRAPHIC SCALE

NAD 83

PROJECT REFERENCE NO.	SHEET NO.
I-2513AA/AB	7
R/W SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

KCI ASSOCIATES OF N.C., P.A.
4505 Falls of Neuse Road, Suite 400
Raleigh, NC 27609-6270
Phone (919) 783-9214
NC Firm License No: C-0764

ETHERIDGE ENGINEERING
1223 Jones Franklin Rd.
Raleigh, N.C. 27606
License No. F-0377
Bus: 919 851 8077
Fax: 919 851 8107
TRANSPORTATION PLANNING/DESIGN - BRIDGE/STRUCTURE DESIGN
CIVIL/SITE DESIGN - GIS/GPS - CONSTRUCTION OBSERVATION

MATCHLINE -Y- STA 63+00 – SEE SHEET 6

MATCHLINE -Y- STA 75+00 – SEE SHEET 8

5 84 PROPERTIES LLC

6 THE ASHEVILLE SCHOOL INC

7 HAYES & LEDFORD LLC

8 AUTOSTAR PROPERTY GROUP I LLC

SITE 3

5' STANDARD BASE DITCH SEE DETAIL W SLOPE=0.4% L=135 FT DDE=140 CY

6' STANDARD BASE DITCH w/CL I RIP RAP EST. 41 TON KEY-IN SEE DETAIL J SLOPE=3.4% L=100 FT DDE=560 CY

CL I RIP RAP EST. 20 TONS SEE DETAIL AJ

BEG PROP. RET.WALL W701 -Y- STA.66+46.00, OS=129' LT

BEG.PAVED SHOULDER -Y- STA.67+50.00, OS=147.20' LT

BEG.PROP.2'-6" C&G -Y- STA.68+05.00, OS=131.50' LT

END PROP. RET.WALL W701 -Y- STA.74+55.00, OS=129' LT

END PAVED SHOULDER -Y- STA.74+38.00, OS=157.80' LT

END PROP.2'-6" C&G -Y- STA.73+57.00, OS=131.50' LT

END FENCE (TIE TO EXIST) -Y- +90 +/- 135' +/- LT

BEG. FENCE -Y- +55.00 129' +/- LT

TIE FENCE TO EXIST. AND PROP. RET. WALL -Y- +46.00

BEGIN PROP. NOISE WALL NWC-1A -Y- STA.63+70.00, OS=86.50' RT

BEG. FENCE (TIE TO EXIST) -Y- +70 +/- 111' +/- RT

END FENCE (TIE TO EXIST) -Y- +06 +/- 110' +/- RT

BEG. FENCE (TIE TO EXIST) -Y- +78 +/- 139' +/- RT

END FENCE (TIE TO EXIST)

REMOVE 6 LF OF 30" RCP R=165'

REMOVE 7 LF OF 30" RCP

REMOVE 24" w/ELBOWS

CONCRETE DITCH SEE DETAIL AB

FLOWABLE FILL

TRENCHLESS INSTALLATION OF WELDED STEEL

SPECIAL LATERAL DITCH SEE DETAIL D

3' LATERAL BASE DITCH w/CLASS I RIP RAP SEE DETAIL O

3' LATERAL BASE DITCH SEE DETAIL U

REMOVE STANDARD BASE DITCH SEE DETAIL W

REMOVE EXIST. NOISE WALL -Y- 64+00.00 TO 76+11.00 RT

11.67' PS

14' PS

-Y5RPA-

-Y- S 75° 19' 51.7" E

See Permit Drawing Sheet 16 of 30 for Enlargement

FOR -Y_LT- & -Y_RT- PROFILES SEE SHEET 18
FOR -Y5RPA- PROFILE SEE SHEET 23
FOR DRAINAGE DETAILS SEE SHEET 2D-1

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Mike.Kelly

5/14/99

PROJECT REFERENCE NO.	SHEET NO.
I-2513AA/AB	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

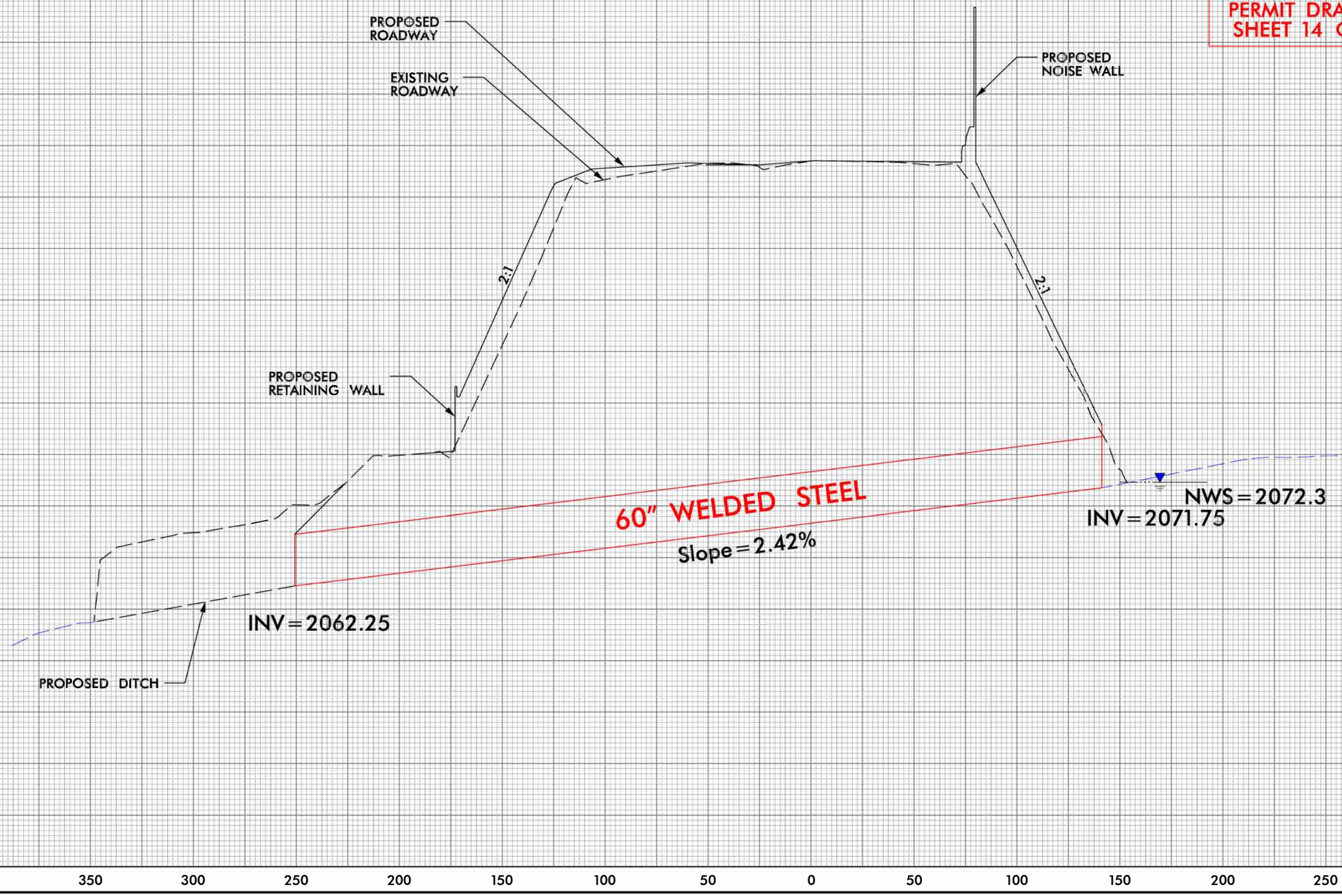
INCOMPLETE PLANS
DO NOT USE FOR R/W ACQUISITION

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

PERMIT DRAWING
SHEET 14 OF 26

SITE 3

-Y- 71+74



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Michael Ki

6/23/16

0 5 10	PROJ. REFERENCE NO.	SHEET NO.
	I-2513AA/AB	X-YRT50

PERMIT DRAWING
SHEET 15 OF 26

SITE 3

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PERMIT DRAWING
SHEET 16 OF 26

PROJECT REFERENCE NO.	SHEET NO.
I-2513AA/AB	9
R/W SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

100' 0' 100'
GRAPHIC SCALE

NAD 83

SURFACE WATER IMPACTS

TEMPORARY SURFACE WATER IMPACTS

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

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Fax: 919 851 8107
TRANSPORTATION PLANNING/DESIGN - BRIDGE/STRUCTURE DESIGN
CIVIL/SITE DESIGN - GIS/GPS - CONSTRUCTION OBSERVATION

REVISIONS 5/14/99

MATCHLINE -Y- STA 88+00 – SEE SHEET 8

MATCHLINE -Y_WB- STA 18+50 – SEE SHEET 10

See Permit Drawing Sheet 22 of 30 for Enlargement

See Permit Drawing Sheet 21 of 30 for Enlargement

22 CLYDE S. TRAVIS SR & JANE TRAVIS

6 THE ASHEVILLE SCHOOL, INC.

23 BENNIE NORMAN

24 THE ASHEVILLE SCHOOL, INC.

25 CHARLES M & CONNIE W CATHEY

26 GAIL D YOUNG & CHARLES S DOWIS

27 BEG. FENCE GARY & CAROL HENSLEY

28 RENEE M BARGER LIVING TRUST & RENEE M BARGER TRUSTEE

MICHAEL D & PATRICIA RIDDLE

ROBERT E & SUSIE V BAKER

ROBERT N DEMPSEY III

JEREMY M VALONE SHANNON N VALONE

REGINA BAKER-HARDIN

MICHAEL A KUTYANA

SITE 4

SITE 5

-Y- S 75°19'51.7" E

-Y_WB- S 75°19'51.7" E

-Y_EB-

90+00

15+00

BEARING BK = S 75°19'51.7" E

PROP. 48" WW

2' LATERAL BASE DITCH SEE DETAIL E

2' LATERAL BASE DITCH SEE DETAIL F

STANDARD V DITCH SEE DETAIL Q DDE=11 CY L=42.5 S=1.6%

STANDARD BASE DITCH EST 9 TONS EST 15 SY GSI SLOPE=0.5% L=25 FT DDE=11 CY SEE DETAIL Y

BEGIN FENCE (TIE TO EXIST)

END FENCE (TIE TO EXIST)

END FENCE (TIE TO EXIST) -Y_WB- +67 +/- 113' +/- LT

ENERGY DISSIPATOR BASIN CL B RIP RAP SEE DETAIL P

ENERGY DISSIPATOR BASIN CL B RIP RAP SEE DETAIL P

JB wMH

TB 2GI

15" CSP

18" RCP-IV

15" RCP-IV

30" RCP-III

COLLAR

COLLAR AND EXTEND 15" RCP-III

REMOVE

RETAIN

15" RCP

15" w/ ELBOWS

30" w/ELBOWS

48" HW

CONC SOUND BARRIER

8" PVC

SSMH

TOP=2068.20'

TOP=2077.41'

TOP=2087.26'

TOP=2097.97' FLOOR=2097.47' (FULL OF DEBRIS)

TOP=2068.75'

TOP=2096.55'

FOR -Y_LT- & -Y_RT_ PROFILES SEE SHEET 20
FOR -Y_WB- PROFILE SEE SHEET 21
FOR -Y_EB- PROFILE SEE SHEET 21
FOR DRAINAGE DETAILS,SEE SHEET 2D-1

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PROJECT REFERENCE NO.	SHEET NO.
I-2513AA/AB	9
R/W SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

INCOMPLETE PLANS
DO NOT USE FOR R/W ACQUISITION

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

PERMIT DRAWING SHEET 17 OF 26

REVISIONS 8/17/99

90+00

RETAIN

RETAIN

REMOVE

TB 2GI

15" w/ELBOWS

RETAIN

REMOVE

COLLAR 15"

15" w/ ELBOWS

15" CMP

48" RCP APPROX DIRECTION

30" RCP

15" RCP

8" PVC

CONC BST

CONC SOUND BARRIER

TOP=2110.32' (FULL OF DEBRIS)

PROP. 48" WW

JB w/MH 8" CONC HW

48" HW

JB w/MH 30" RCP-III

STANDARD BASE DITCH
EST 9 TONE
EST 15 SY GF
SLOPE=0.5%
L=25 FT
DDE=11 CY
SEE DETAIL Y

2' LATERAL BASE DITCH
SEE DETAIL F

26

GAIL D YOUNG & CHARLES S DOWIS

SITE 4

SITE 5

BEG. FENCE

27

GARY & CAROL HENSLEY

END FENCE
(TIE TO EXIST)

ISBLK G

ISFD

CONC

ROBERT N DEMPSEY III

BEARING-BK = S 75° 19' 51.7" E

SSMH

8" DIP

TOP=2088.15'

TOP=2068.75'

TOP=2075.6

TOP=2077.47'

W/LT

EIP

S/S SURFACE WATER IMPACTS

TS/TS TEMPORARY SURFACE WATER IMPACTS

40' 0' 40'

GRAPHIC SCALE

1/7/2023
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S S SURFACE WATER IMPACTS

TS TS TEMPORARY SURFACE WATER IMPACTS

40′ 0′ 40′

GRAPHIC SCALE

PERMIT DRAWING
SHEET 18 OF 26

PROJECT REFERENCE NO.	SHEET NO.
I-2513AA/AB	9
R/W SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

INCOMPLETE PLANS
DO NOT USE FOR R/W ACQUISITION

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

REVISIONS 8/17/99

6

THE ASHEVILLE SCHOOL, INC.

SITE 4

SITE 5

TOP=2064.20′

ENERGY DISSIPATOR BASIN
CL. I RIP RAP
SEE DETAIL P

SSMH

8" VCP SS

ENERGY DISSIPATOR BASIN
CL. B RIP RAP
SEE DETAIL P

TOP=2063.80′

TB

TS

S

RETAIN

PROP. 48" WW

EXISTING R/W

JB w/MH

2′ LATERAL
BASE DITCH
SEE DETAIL F

EIP

F

C

A

48" RCP

APPROX. DIRECTION

APPROX. JB

18" w/ELBOWS

15" CMP

TB 2GI

15" CSP

18" RCP-IV

BL3-260

CB

15" RCP

COLLAR

REMOVE

15" F

15" RCP-IV

-Y_WB-
S 75° 19′ 51.7" E

CONC

DST

30" RCP

TOP=2097.97′
FLOOR=2097.75′
(FULL OF DEBRIS)

DI

SS

I/17/2023
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mikeyel

PERMIT DRAWING
SHEET 19 OF 26

PROJECT REFERENCE NO.	SHEET NO.
I-2513AA/AB	9
RW SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

100' 0' 100'
GRAPHIC SCALE

NAD 83

SURFACE WATER IMPACTS

TEMPORARY SURFACE WATER IMPACTS

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

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TRANSPORTATION PLANNING/DESIGN - BRIDGE/STRUCTURE DESIGN
CIVIL/SITE DESIGN - GIS/GPS - CONSTRUCTION OBSERVATION

See Permit Drawing Sheet 22 of 30 for Enlargement

See Permit Drawing Sheet 21 of 30 for Enlargement

MATCHLINE -Y- STA 88+00 - SEE SHEET 8

MATCHLINE -Y_WB- STA 18+50 - SEE SHEET 10

SITE 4

SITE 5

22 CLYDE S. TRAVIS SR & JANE TRAVIS

6 THE ASHEVILLE SCHOOL, INC.

24 THE ASHEVILLE SCHOOL, INC.

23 BENNIE NORMAN

26 GAIL D YOUNG & CHARLES S DAVIS

25 CHARLES M & CONNIE M CATHEY

27 GARY & CAROL BENSLEY

28 RENEE M BARGER LIVING TRUST & RENEE M BARGER, TRUSTEE

JEREMY M VALONE
SHANNON N VALONE

MICHAEL D & PATRICIA RIDDLE

ROBERT E & SUSIE V BAKER

REGINA BAKER HARDIN

MICHAEL A SULLIVAN

ROBERT N DEMPSEY III

90+00

15+00

-Y- S 75°19'51" E

-Y_WB- S 75°19'51" E

-Y_EB-

BEARING BK = S 75°19'51" E

BEGIN FENCE (TIE TO EXIST)

END FENCE (TIE TO EXIST)

END FENCE (TIE TO EXIST) -Y_WB- +67+/- 113'+/- LT

BEG. FENCE

END FENCE

STANDARD V DITCH SEE DETAIL Q DDE=31 CY L=60.5 S=1.6%

STANDARD BASE DITCH EST 9 TONS EST 15 SY GF SLOPE=0.5% L=25 FT DDE=11 CY SEE DETAIL Y

2' LATERAL BASE DITCH SEE DETAIL F

ENERGY DISSIPATOR BASIN CL-B 'G' RAP SEE DETAIL P

RETAIN

REMOVE

COLLAR

COLLAR AND EXTEND 15" RCP-III

TB 2GI

JB wMH

15" CSP

18" RCP-IV

15" RCP

30" RCP-III

48" RCP

15" w ELBOWS

PROP. 48' WW

PROP. 28' WW

FOR -Y_LT- & -Y_RT_ PROFILES SEE SHEET 20
FOR -Y_WB- PROFILE SEE SHEET 21
FOR -Y_EB- PROFILE SEE SHEET 21
FOR DRAINAGE DETAILS, SEE SHEET 20-1

REVISIONS

5/14/99

1/17/2023
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REVISIONS

SURFACE WATER IMPACTS

TEMPORARY SURFACE WATER IMPACTS

GRAPHIC SCALE

PROJECT REFERENCE NO.	SHEET NO.
I-2514A/B	10
R-4 SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

KCI TECHNOLOGIES

PERMIT DRAWING SHEET 20 OF 26

NORTH

MATCHLINE -Y WB- STA 18+50 - SEE SHEET 9

MATCHLINE -RPC- STA 32+00 - SEE SHEET 11

SITE 6

SITE 7

SITE 8

SITE 9

See Permit Drawing Sheet 25 of 30 for Enlargement

PAVEMENT REMOVAL

FOR -Y-WB- PROFILE SEE SHEET 21
FOR -RPC- PROFILE SEE SHEET 23 & 25
FOR DRAINAGE DETAILS SEE SHEET 32-1

LOCATION:

TIP NO.: COUNTY:

DESIGNED BY:

CHECKED BY: DATE:

GRAPHIC SCALE
50 25 0 50 100
PLANS

PROJECT REFERENCE NO.	SHEET NO.
I-2513AA/AB	6
R/W SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

INCOMPLETE PLANS
DO NOT USE FOR R/W ACQUISITION

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

PERMIT DRAWING SHEET 21 OF 26

REVISIONS

8/17/99

40+00

-Y_EB-

RETAIN

SP CUT DITCH w/HINGE
SEE DETAIL H

C

2GI

SITE 7

25+00

2GI

15" RCP-IV

TB 2GI

EXTEND EXISTING
1@6'x9' RCBC

18" RCP-IV

WING WALLS
BURIED

1-6X9 BARREL

15" RCP-IV

SITE 9

BANK STABILIZATION

INTLET TYPICAL
DDE=100 CY
SEE DETAIL AE

TB 2GI

18" w/ELBOWS

12" Sf

DI

JS

S

Sf

RW
CA

. FENCE

CREASMAN

TS

SITE 6

PROP. 48" WW

SITE 8

MTL
CANOPY

48" CHL & 3SB.

3' STANDARD BASE DITCH
CLASS I RIP RAP
SEE DETAIL R

5' LATERAL BASE DITCH
CLASS I RIP RAP
SEE DETAIL G

34

2' STANDARD BASE DITCH
DDE=43 CY
SEE DETAIL AH

2' STANDARD
BASE DITCH
DDE=44 CY
SEE DETAIL AH

2' LATERAL BASE DITCH
CLASS I RIP RAP
SEE DETAIL I

EIP

40' 0' 40'

GRAPHIC SCALE

S S SURFACE WATER IMPACTS

TS TS TEMPORARY SURFACE WATER IMPACTS

1/17/2023
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REVISIONS

SURFACE WATER IMPACTS

TEMPORARY SURFACE WATER IMPACTS

200' 0' 200'
GRAPHIC SCALE

PROJECT REFERENCE NO. I-2514AN/B
SHEET NO. 10
ROADWAY DESIGN ENGINEER
HYDRAULICS ENGINEER

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KCI TECHNOLOGIES

PERMIT DRAWING SHEET 22 OF 26

NORTH

MATCHLINE -Y WB- STA 18+50 – SEE SHEET 9

MATCHLINE -RPC- STA 32+00 – SEE SHEET 11

SITE 6

SITE 7

SITE 8

SITE 9

See Permit Drawing Sheet 23 of 30 for Enlargement

PAVEMENT REMOVAL

FOR -Y-WB- PROFILE SEE SHEET 18
FOR -RPC- PROFILE SEE SHEET 23 & 25
FOR DRAINAGE DETAILS SEE SHEET 20-1

LOCATION:
TIP NO.: COUNTY:
DESIGNED BY:
CHECKED BY: DATE:

GRAPHIC SCALE
50 25 0 50 100
PLANS

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PROJECT REFERENCE NO.	SHEET NO.
I-2513AA/AB	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

INCOMPLETE PLANS
DO NOT USE FOR R/W ACQUISITION

DOCUMENT NOT CONSIDERED FINAL
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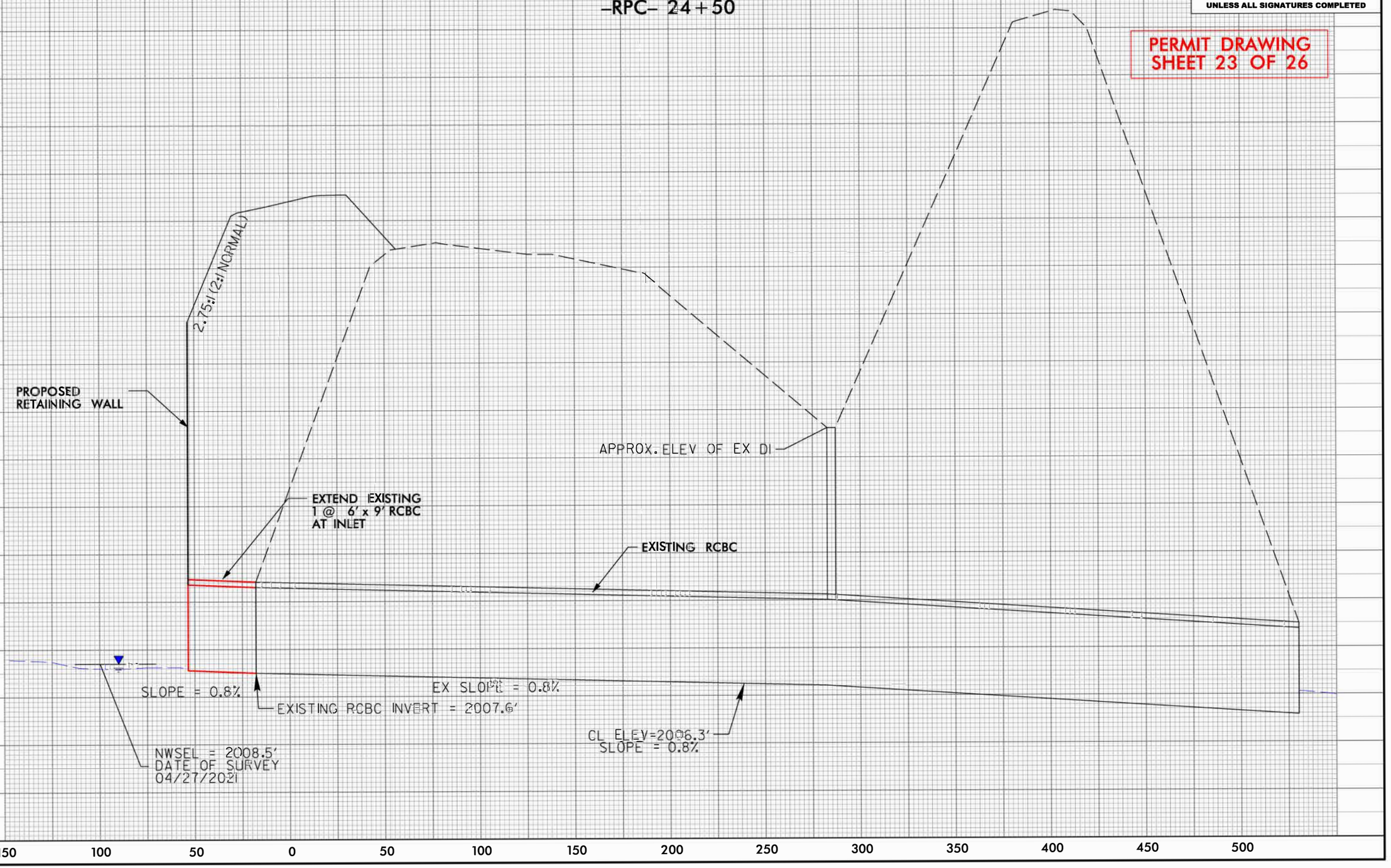
PERMIT DRAWING
SHEET 23 OF 26

SITE 6

–RPC– 24+50



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PROJECT REFERENCE NO.	SHEET NO.
I-2513AA/AB	12
R/W SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

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TRANSPORTATION PLANNING/DESIGN - BRIDGE/STRUCTURE DESIGN
CIVIL/SITE DESIGN - GIS/GPS - CONSTRUCTION OBSERVATION

PERMIT DRAWING SHEET 24 OF 26

REVISIONS

5/14/99

GRAPHIC SCALE 100' 0' 100'

NAD 83

SURFACE WATER IMPACTS

TEMPORARY SURFACE WATER IMPACTS

MATCHLINE -L1_WB- STA 64+50 SEE SHEET 11

MATCHLINE -L1_EB- STA 64+00 SEE SHEET 11

MATCHLINE -RPC- STA 41+85 SEE SHEET 11

MATCHLINE -L1_EB- STA 50+00 – SEE SHEET 13

AVERITT PROPERTIES INC

CTE ASHEVILLE LLC

SITE 11

SITE 10

HOMINY CREEK

CL I RIP RAP EST 40 TON EST 75 SY GF

CL I RIP RAP EST 7 TON EST 15 SY GF

RUBBLIZE CONCRETE DITCH AND UTILIZE CONCRETE REMNANTS TO FILL ERODED DITCHLINE THAT BEGINS AT END OF EXISTING CONCRETE DITCH

STANDARD BASE DITCH SEE DETAIL AF

STANDARD BASE DITCH SEE DETAIL AG

SPECIAL CUT DITCH SEE DETAIL N

BERM V DITCH SEE DETAIL M

4' LATERAL BASE DITCH PSRM SEE DETAIL K

4' LATERAL BASE DITCH CLASS I RIP RAP SEE DETAIL L

CL I RIP RAP EST 3 TON EST 7 SY GF

END FENCE

BEG. FENCE

JB wMH

15" w/ELBOWS

18" RCP-IV COLLAR

COLLAR REMOVE

RETAIN

TB 2GI

15" RCP-IV

18" RCP-IV

25+00 20+00 15+00 50+00 55+00 60+00 45+00

N 23° 48' 11.1" W -L1_WB-

N 29° 18' 11.1" W -RPDB-

N 29° 18' 11.1" W -L1_WB-

N 31° 35' 05.2" W -L1_EB-

-RPD-

-RPC-

GREU TL-3

CAT-1

BL-78

BL1-44

43 JOSEPH E GIBSON

41 ROGER DALE EDMONDS JR

42 EDWIN & DEBORAH L SHELTON

40 APRIL BURGESS-JOHNSON FRANCES WILLOWBROOK BURGESS-JOHNSON

39 YAIR M AMBROCIO

DIRK D HILLEGASS

RICK BARRETT

REBECCA B MOSES IRREVOCABLE TRUST MICHAEL RAUCHWARG (TRUSTEE)

BETTY L BLANKENSHIP & JUANITA M MOELLER & MARTHA WARREN

BRIAN DAVID BLANKENSHIP

C D & BETTY L BLANKENSHIP

ASHEVILLE CITY LIMITS

FOR -L1_EB- PROFILE SEE SHEET 27 & 28
FOR -L1_WB- PROFILE SEE SHEET 28 & 29
FOR -RPC- PROFILE SEE SHEET 26
FOR -RPD- PROFILE SEE SHEET 29
FOR -RPDB- PROFILE SEE SHEET 30
FOR DRAINAGE DETAILS, SEE SHEET 2D-1

1/17/2023
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PROJECT REFERENCE NO.	SHEET NO.
I-2513AA/AB	12
R/W SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

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License No. F-0377
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Fax: 919 851 8107
TRANSPORTATION PLANNING/DESIGN - BRIDGE/STRUCTURE DESIGN
CIVIL/SITE DESIGN - SURVEYING - CONSTRUCTION INSPECTION

PERMIT DRAWING SHEET 25 OF 26

REVISIONS 5/14/99

MATCHLINE -L1_WB- STA 64+50 SEE SHEET 11

MATCHLINE -L1_EB- STA 64+00 SEE SHEET 11

MATCHLINE -RPC- STA 41+85 SEE SHEET 11

MATCHLINE -L1_EB- STA 50+00 – SEE SHEET 13

GRAPHIC SCALE 100' 0' 100'

NAD 83

SURFACE WATER IMPACTS

TEMPORARY SURFACE WATER IMPACTS

AVERITT PROPERTIES INC

HOMINY CREEK

CTE ASHEVILLE SVC

SITE 11

SITE 10

CL I RIP RAP EST 40 TON EST 75 SY GF

CL I RIP RAP EST 7 TON EST 15 SY GF

RUBBLIZE CONCRETE DITCH AND UTILIZE CONCRETE REMNANTS TO FILL ERODED DITCHLINE THAT BEGINS AT END OF EXISTING CONCRETE DITCH

STANDARD BASE DITCH SEE DETAIL AF

STANDARD BASE DITCH SEE DETAIL AG

SPECIAL CUT DITCH SEE DETAIL N

BERM V DITCH SEE DETAIL M

4' LATERAL BASE DITCH PSRM SEE DETAIL K

4' LATERAL BASE DITCH CLASS I RIP RAP SEE DETAIL L

CL I RIP RAP EST 3 TON EST 7 SY GF

END FENCE

BEG. FENCE

RETAIN

REMOVE

COLLAR

TB 2GI

15" RCP-IV

18" RCP-IV

15" w/ELBOWS

JB w/MH

PROP. 48" RR

CAT-1

GREU TL-3

-L1_WB-

-L1_EB-

-RPC-

-RPD-

-RPDB-

N 23° 48' 11.1" W

N 29° 18' 11.1" W

N 31° 35' 05.2" W

25+00 20+00 15+00 60+00 55+00 50+00 45+00

43 41 40 39 42

APRIL BURGESS-JOHNSON
FRANCES WILLOWBROOK BURGESS-JOHNSON

REBECCA B MOSES IRREVOCABLE TRUST
C/O MICHAEL RAINCHWARG (TRUSTEE)

ROGER DALE EDMONDS JR

EDWIN & DEBORAH L SHELTON

BETTY L. BLANKENSHIP & JUANITA M. MOELLER & MARTHA WARREN

BRIAN DAVID BLANKENSHIP

YAIR M AMBROCHI

DEAN D HILLEGASS

RICK BARRETT

FOR -L1_EB- PROFILE SEE SHEET 27 & 28
FOR -L1_WB- PROFILE SEE SHEET 28 & 29
FOR -RPC- PROFILE SEE SHEET 26
FOR -RPD- PROFILE SEE SHEET 29
FOR -RPDB- PROFILE SEE SHEET 30
FOR DRAINAGE DETAILS, SEE SHEET 20-1

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WETLAND AND SURFACE WATER IMPACTS SUMMARY

			WETLAND IMPACTS					SURFACE WATER IMPACTS				
Site No.	Station (From/To)	Structure Size / Type	Permanent Fill In Wetlands (ac)	Temp. Fill In Wetlands (ac)	Excavation in Wetlands (ac)	Mechanized Clearing in Wetlands (ac)	Hand Clearing in Wetlands (ac)	Permanent SW impacts (ac)	Temp. SW impacts (ac)	Existing Channel Impacts Permanent (ft)	Existing Channel Impacts Temp. (ft)	Natural Stream Design (ft)
1	-Y- 50+95 Rt	Existing 48" Pipe						< 0.01		11		
	-Y- 50+95 Rt	Base Ditch						< 0.01	< 0.01	39	15	
2	-Y- 59+50 Lt	3@7x9 RCBC Extention						0.04		147		
	-Y- 58+70 Lt	84"CMP *						0.02	< 0.01	44	10	
3	-Y- 69+85 Lt / -Y- 72+95 Rt	Channel Relocation	< 0.01		< 0.01		< 0.01	0.02	< 0.01	89	17	
4	-Y- 91+05 Rt	Channel Relocation						< 0.01	< 0.01	24	5	
	-Y- 91+05 Rt	48" Pipe						< 0.01		8		
	-Y- 92+92 Lt	48" Pipe						0.01		19		
	-Y- 92+92 Lt	Energy Dissipator						0.01	< 0.01	19	14	
5	-Y- 93+44 Rt	30' Pipe						< 0.01	< 0.01	10	11	
	-Y- 93+20 Lt	30' Pipe						< 0.01		17		
	-Y- 93+20 Lt	Energy Dissipator						< 0.01	< 0.01	10	12	
6	-RPC- 24+24 to 26+90 Rt	1@6'X9' RCBC Extension						< 0.01	< 0.01	58	8	
	-RPC- 24+24 to 26+90 Rt	Bank Stabilzation						< 0.01		40		
7	-RPC- 25+50 Rt	Base Ditch						0.01	< 0.01	246	9	
8	-RPC- 26+05 Rt	Base Ditch						< 0.01	< 0.01	60	5	
9	-RPC- 26+50 Rt	Base Ditch						< 0.01		34	9	
10	-RPC- 46+05 Rt	Base Ditch						< 0.01	< 0.01	19	24	
11	-RPD- 23+30 Rt	Outfall Protection						< 0.01	< 0.01	26	32	
TOTALS*:			< 0.01		< 0.01		< 0.01	0.14	0.02	920	171	0

*Rounded totals are sum of actual impacts

NOTES:

*** HIGH FLOW BENCH**

NC DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
2/27/2023
Buncombe County
I-2513 AA/AB
34165.1.11/34165.1.12

REVISIONS

PROJECT REFERENCE NO. I-2513AA/AB — SHEET NO. 6
R/W SHEET NO.
ROADWAY DESIGN ENGINEER — HYDRAULICS ENGINEER

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NORTH

PERMIT DRAWING
SHEET 5 OF 26

200' 0' 200'
GRAPHIC SCALE

MATCHLINE -Y5RPB- STA 17+00
SEE SHEET 5

MATCHLINE -Y- STA 39+50
SEE SHEET 5

MATCHLINE -Y5RPC- STA 19+20
SEE SHEET 5

MATCHLINE -Y- STA 63+00 – SEE SHEET 7

SITE 1

SITE 2

See Permit Drawing Sheet 10 of 30 for Enlargement

See Permit Drawing Sheet 11 of 30 for Enlargement

UTILITY PERMIT MOD

S/S SURFACE WATER IMPACTS

TS/TS TEMPORARY SURFACE WATER IMPACTS

☆ REVISED SIGNAL

FOR -Y-,-L- & -Y,M- PROFILES SEE SHEETS 16 & 17
FOR -Y5RPA- PROFILE SEE SHEET 23
FOR -Y5RPD- PROFILE SEE SHEET 29
FOR -Y5RSPUR- PROFILE SEE SHEET 30
FOR DRAINAGE DETAILS SEE SHEET 26-1

LOCATION:
TIP NO.: COUNTY:
DESIGNED BY:
CHECKED BY: DATE:

GRAPHIC SCALE
50 25 0 50 100
PLANS

i-2513AA/AB UTILITY PERMIT DRAWINGS
SHEET 1

DocuSign Envelope ID: 191C3A20-3BC5-4C3E-A8E6-C57BC5D54A03

SEE SHEET UC-10
FOR SEWER LINE 2 PROFILE
SEE SHEET UC-11
FOR SEWER LINE 3 PROFILE

140′ OF 24″ ENCASEMENT PIPE
140′ BORE AND JACK OF 24″ STEEL
(STEEL ENCASEMENT, 0.375″ THICK)

163′ OF 8″ SANITARY GRAVITY SEWER
(DI RJ, PC 350)

4′ DIA. UTILTIY MANHOLE D3
STA. 4+17.28, LINE 3
200.62′ RT OF LINE -Y5RPA-, STA. 18+75.65
8′ OF UTILITY MANHOLE WALL
4′ DIA

134′ OF 8″ SANITARY GRAVITY SEWER
(DI, PC 350)

140′ OF 8″ SANITARY GRAVITY SEWER
(DI RJ, PC 350)

67′ OF SEWER SERVICE LINE, 2 SEWER CLEANOUTS
(4″ DI RJ, CLASS 51)

4′ DIA. UTILTIY MANHOLE E3
STA. 5+57.77, LINE 3
125.89′ RT OF LINE -Y5RPA-, STA. 19+91.88
2′ OF UTILITY MANHOLE WALL
4′ DIA

4′ DIA. UTILTIY MANHOLE B3
STA. 1+20, LINE 3
151.10′ RT OF LINE -Y5RPA-, STA. 16+58.82
3′ OF UTILITY MANHOLE WALL
4′ DIA

120′ OF 8″ SANITARY GRAVITY SEWER
(DI, PC 350)

72′ OF SEWER SERVICE LINE, 1 SEWER CLEANOUT
(4″ DI RJ, CLASS 51)

SEWER LINE 3

SEWER LINE 2

4′ DIA. UTILTIY MANHOLE C3
STA. 2+54, LINE 3
77.97′ RT OF LINE -Y5RPA-, STA. 17+69.61
7′ OF UTILITY MANHOLE WALL
4′ DIA

UTILITY PERMIT MOD

455′ OF ABANDON 18″ UTILTIY PIPE
(REMOVE THE PORTION OF SEWER LINE INSIDE CULVERT)
ABANDON 1 UTILITY MANHOLE

5′ DIA. UTILTIY MANHOLE C2
STA. 4+49.01, LINE 2
259.01′ RT OF LINE -Y-, STA. 59+14.72
5′ OF UTILITY MANHOLE WALL
4′ DIA
REMOVE 1 MANHOLE

46′ OF 18″ SANITARY GRAVITY SEWER
(DI, PC 250)

5′ DIA. UTILTIY MANHOLE EQ1
STA. 0+00, SEWER LINE 2
STA. 0+00, SEWER LINE 3
79.01′ RT OF LINE -Y5RPA-, STA. 15+64.16
11′ OF UTILITY MANHOLE WALL
4′ DIA

300′ OF 36″ ENCASEMENT PIPE
300′ BORE AND JACK OF 36″ STEEL
(STEEL ENCASEMENT, 0.500″ THICK)

23 CY CLASS B CONCRETE FOR ENCASING UTILITY LINES

403′ OF 18″ SANITARY GRAVITY SEWER
(DI RJ, CLASS 52)

5′ DIA. UTILTIY MANHOLE B2
STA. 4+03.00, LINE 2
230.21′ RT OF LINE -Y-, STA. 59+50.59
5′ OF UTILITY MANHOLE WALL
4′ DIA

594′ OF ABANDON 8″ UTILTIY PIPE
142′ OF ABANDON 4″ UTILTIY PIPE
ABANDON 3 UTILITY MANHOLES
87′ OF ABANDON 16″ UTILTIY PIPE

16″ UTILTIY PIPE IS THE PAY ITEM USED TO FILL THE EXISTING 16″ STEEL ENCASMENT UNDER THE RAILROAD

MATCHLINE -Y5RPB- STA 17+00
SEE SHEET UC-4

MATCHLINE -Y- STA 40+50 SEE SHEET UC-4

MATCHLINE -Y5RPC- STA 20+50
SEE SHEET UC-4

MATCHLINE -Y- STA 63+00 – SEE SHEET UC-6

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PROJECT REFERENCE NO.	SHEET NO.
I-2513 AA/AB	UC-5
DESIGNED BY: JKC	
DRAWN BY: JKC	
CHECKED BY: CLS	
APPROVED BY: CDB	
REVISED:	

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
UTILITIES ENGINEERING SEC.
PHONE:(919)707-6690
FAX:(919)250-4151

NORTH CAROLINA PROFESSIONAL ENGINEER SEAL
DocuSigned by: Corey D. Bousquet, P.E.
COREY D. BOUSQUET
1/11/2024

UTILITY CONSTRUCTION PLANS ONLY

UTILITY CONSTRUCTION

i-2513AA/AB UTILITY PERMIT DRAWINGS
SHEET 2

S:\Server Files\PROJECTS\2020\A0020908\AR\Design\Utilities\Engineering\UC\Proj\I2513AA_ut_cplx_UC01.dgn

SEWER LINE 2

Existing 18" DIP Sanitary Sewer
Remove from Culvert Barrel

36" Encasement Pipe Trenchless Installation
18" DIP Sanitary Sewer

MATCHLINE –Y– STA 63+(

LTIY MANHOLE C3
LINE 3

F LINE -Y5RPA-,
61

TY MANHOLE WALL

' UTILTIY PIPE
N OF SEWER LINE

MANHOLE

LTIY MANHOLE C2
01, LINE 2

5' DIA. UTILTIY MA
STA. 0+00, SEWER

Summary of Impacts

UT to Ragsdale Creek:
Temp SW (ac): < 0.01
Temp Channel (LF) 30

Ragsdale Creek:
Temp SW (ac): < 0.01
Temp Channel (LF) 50

ADAN M TINAJERO
DB 5786 PG 1455
PB 159 PG 61

FARM EQUIPMENT CO
OF ASHEVILLE INC
DB 1743 PG 570

North Carolina Department of Transportation

Highway Stormwater Program

STORMWATER MANAGEMENT PLAN

FOR NCDOT PROJECTS

(Version 3.00; Released August 2021)

General Project Information

WBS Element:	34165.1.13	**TIP Number:**	I-2513AC	**Project Type:**	Roadway Widening	**Date:**	3/15/2023
NCDOT Contact:	Kevin E. Moore, P.E.			**Contractor / Designer:**	Brandon Barham, PE - VHB		
Address:	1000 Birch Ridge Drive Raleigh, NC 27610, USA			**Address:**	940 Main Campus Drive, Suite 500 Raleigh, NC 27606		
Phone:	919-707-6210			**Phone:**	919-741-5779		
Email:	kemoore2@ncdot.gov			**Email:**	bbarham@vhb.com		
City/Town:	Asheville, NC			**County(ies):**	Buncombe		
River Basin(s):	French Broad			**CAMA County?**	No		
Wetlands within Project Limits?	Yes						

Project Description

Project Length (lin. miles or feet):	1.74	**Surrounding Land Use:**	Residentail/Commercial				
	Proposed Project			**Existing Site**			
Project Built-Upon Area (ac.)	79.2	ac.		33.3	ac.		
Typical Cross Section Description:	Variable - See Project Typical Sections			Variable - See Project Typical Sections			
Annual Avg Daily Traffic (veh/hr/day):	Design/Future:	101,400	Year: 2040	Existing:	NA	Year:	2024

General Project Narrative: (Description of Minimization of Water Quality Impacts)

The project consists of roadway improvements on the I-26/I-40/I-240 Interchange starting just east of the I-26/Bear Creek Rd intersection to SR 3548 (Haywood Rd). The proposed stormwater runoff from the roadway widening has been conveyed to roadside ditches and storm drainage systems that drain to existing outfalls.
Potential areas for placing Stormwater Control Measures (SCM) were looked at within the project corridor. Below is a list of the locations and reason why or why not a device was proposed at the location:

Plan Sheet 4

--- Ditches ending at -L-15+50 Left and -L-15+51 Left were found to meet swale criteria.
--- Ditch ending at -L- 18+50 Left could not meet swale criteria without additional ROW.
--- A preformed scour hole was investigated for the network outfall at -L- 19+60 Left, however the resulting dimensions were less than a standard NCDOT rip rap pad. Maintenance and access would be challenging given the natural landscape. The drainage was reworked to use a 2GI and false sump to result in a pipe that discharges velocities to the maximum extent practicable.
---The area downsream of -L- Station 20+25 Right was investigated for a SCM, however construction would result in existing utility impacts, additional ROW and wetland impacts
--- The area right of -L- at Station 26+07 +/- was investigated for a SCM and found to not be feasible. The area is too steep and unstable, and would impact the wetlands. Maintenance / access issues would be challenging.
---The network outlet at -Y1- Station 21+72 Right was investigated for a SCM, however the existing landscape would create challenges for access and maintenance and result in addtional ROW.

Plan Sheet 5

--- Typical ditches ending at stations -L- 30+50, 35+50, 37+19, 39+25, 41+00 Right meet swale criteria. All other ditches on this sheet could not meet swale criteria without additional ROW.

Plan Sheet 6

--- The network that discharges at -L- Station 42+72 Right was investigated for a SCM but would require additional ROW. Maintenance and access would be challenging due to the existing landscape.
--- The area right of -Y7- at Station 14+00 +/- was investigated for a SCM and found to not be feasible. The area would require safety fence, additional ROW, utility relocations. Infiltration would not be ideal next to bridge foundations. Establishing vegetation under the bridge where the sun doesn't penetrate would be challenging.
--- The area at -Y8- Station 18+82 Left was investigated for a SCM, however this area is within the Hominy Creek Floodplain. No SCMs were pursued. The preferred alternative was proposed at Y8 19+61 as noted below.
--- The area left of -Y8- at Station 21+50 +/- was investigated for a SCM and found to not be feasible. This area would require additional ROW and is currently a popular parking facitility for the Hominy Creek Greenway.
---The area left of -Y8- at Station 19+61 +/- was investigated for a SCM and a dry detention basin is being proposed.
---The area right of -Y2B- at Station 16+52 +/- was investigated for a SCM and a filtration basin is being proposed.
---Ditch ending at -Y2RPC Station 31+30 Right was investigated for a SCM. Upstream portions of the ditch utilized a forebay and rip rap lined channel to facilite a swale before outletting to the closed storm network.
---The ditch ending at -Y2C- 12+50 Right was investigated for a SCM, however a ditch that meets swale criteria would result in over 12' of excavation at the upstream end. A detention basin was investigated but would require 20' of excavation based on the existing landscape constraints.
---The ditch ending at -RP32- Station 14+27 Right results in ditch depths of 12' and would treat a drainage area less than 1 acre if converted to a swale.

General Project Narrative: (Description of Minimization of Water Quality Impacts)

Sheet 6 (Cont.):
---Ditches ending at-RP23-Station 11+66 RT could not meet swale criteria due to the proposed roadway geometry constraints.
---The ditch ending at -Y2B- 19+84 LT could not meet swale criteria due to the steep existing landscape, a swale would require sigificant ROW aquisition.
---The ditch ending at -Y2- 17+30LT could not meet swale criteria without additional ROW.

Sheet 7:
--There is proposed pavement removal along the east bound ramp of I-26/I-240 from Sta. 33+10 to 35+22 RP23 RT just east of the proposed outfall at Sta. 31+18 RP23 (SN 7108). This area was considered for a potentail bio-swale or bioretention SCM that would treat the water draining to outfall 7108 and ultimatly connect with the proposed junction box at 7017. Geotech took multiple core samples in this area and it was determined that this would not be a suitable site for a bio-swale or bioretention SCM due to bedrock in tihs area.
--There is proposed pavement removal along the east bound ramp of I-26/I-240 from Sta. 35+22 to 39+40 RP23 RT just east of the proposed junction box at 0717. This area was considered for a potentail bio-swale or bioretention SCM that would treat the water that outfalls 7033. Geotech took multiple core samples in this area and it was determined that this would not be a suitable site for a bio-swale or bioretention SCM due to bedrock in tihs area.

Sheet 8/9:
--The project team worked to identify any potential SCM locations on these two sheets but no feasable SCM locations were identified due to steep topography, tight right-of-way and location of residentail properties adjacent to the roadway.

Sheet 10/10A:
-- A proposed wet swale will be installed near the intersection of Y3B and Y3 (Amboy Rd) and drain from west to east running parallel with Amboy Rd (Sta. 28+95 to 37+75 Y3 RT) for approximately 925 ft. This swale will utilize a vegetated bench to obtain treatment in the Amboy Rd area. Swale criteria was unable to be met at this location due to the large drainage area, existing topo constraints (flat slope) and limited space constraints (not enought room to uitlize flatter slopes).

Plan Sheet 11
---The network that outlets at -Y1- Station 19+39 Right was investigated for a SCM, however it would require additional ROW. The existing landscape would make maintenance and access challenging.
---The ditches -Y1- Stations 10+84 Left and 12+80 Right were investigated for a SCM, however it would require additional ROW.

Plan Sheet 12
---All outfalls on this sheet were investigated for SCMs, but would require additional ROW. The existing landscape would also make maintenance and access challenging.

Minimization Efforts:
In addition the the proposed SCMs; the project team strived to incorporate avoidance and minimization practices into the design. When possible, the project team utilized grass shoulders, 2:1 slopes near/adjacent to stream and wetland areas and utilized vegetated ditch linings where possible. Grass lined ditches were used unless the resulting calculations demonstrated that a grass lined ditch would not be stable.

Due to the topography, ground water elevations, and the nature of the project, it was not possible to incorporate many of the features that were investigated. Large SCMs would also further increase impacts to surrounding areas resulting in more clearing and land disturbance which we are trying to minimize. However, existing flow patterns and outfalls were maintained to the maximum extent practical to limit discharge increases to any particular area. Pre/post analyses were completed at areas where concentrated runoff leaves the project and rip rap outlet pads, energy dissipators, and other measures were incorporated to ensure areas downstream of the project remain stable. The project is not expected to have a significant impact on water quality or quantity downstream of the project. It should also be noted that the total added impervious area was divided among multiple outfalls across the project. All outlets were evaluated for stability and the project is not expected to cause or worsen erosion.

Looking at the big picture with regard to the French Broad River and overall impacts from this project, the project team pulled together a drainage area comparision for the I-2513AC proposed project area and compared it to the French Broad watershed just downstream of the proposed project site. The I-2513AC proposed project drainage area (excluding offsite drainage areas from major structures such as Hominy Creek, Moore Branch, etc.) is 0.4 square miles and the French Broad River drainage area is 800 square miles. Overall, the I-2513AC proposed project drainage area is less than 0.1% of the overall drainage area of the French Broad River. Even though this project will increase the built upon area from 33.3 acres to 79.2 acres, it will have a negligble impact on the environmental health of the French Broad River due to the scale of the proposed project watershed in comparision to the size of the French Broad River.

North Carolina Department of Transportation

Highway Stormwater Program

STORMWATER MANAGEMENT PLAN

FOR NCDOT PROJECTS

(Version 3.00; Released August 2021)

General Project Information

Waterbody Information

Surface Water Body (1):	French Broad River		**NCDWR Stream Index No.:**	6-(54.5)		
NCDWR Surface Water Classification for Water Body		**Primary Classification:**	Class B			
		Supplemental Classification:	None			
Other Stream Classification:	None					
Impairments:	None					
Aquatic T&E Species?	Yes	Comments:	The French Broad River is occupied by the endangered Appalachian elktoe.			
NRTR Stream ID:	SA			**Buffer Rules in Effect:**	N/A	
Project Includes Bridge Spanning Water Body?	No	**Deck Drains Discharge Over Buffer?**	N/A	**Dissipator Pads Provided in Buffer?**	N/A	
Deck Drains Discharge Over Water Body?	N/A	(If yes, provide justification in the General Project Narrative)		(If yes, describe in the General Project Narrative; if no, justify in the General Project Narrative)		
(If yes, provide justification in the General Project Narrative)						

Surface Water Body (2):	Hominy Creek		**NCDWR Stream Index No.:**	6-76d		
NCDWR Surface Water Classification for Water Body		**Primary Classification:**	Class C			
		Supplemental Classification:	None			
Other Stream Classification:	None					
Impairments:	None					
Aquatic T&E Species?	No	Comments:	Hominy Creek flows into the French Broad River 0.85 miles downstream, where aquatic listed species occur.			
NRTR Stream ID:	SB/SX			**Buffer Rules in Effect:**	N/A	
Project Includes Bridge Spanning Water Body?	Yes	**Deck Drains Discharge Over Buffer?**	No	**Dissipator Pads Provided in Buffer?**	N/A	
Deck Drains Discharge Over Water Body?	No	(If yes, provide justification in the General Project Narrative)		(If yes, describe in the General Project Narrative; if no, justify in the General Project Narrative)		
(If yes, provide justification in the General Project Narrative)						

Surface Water Body (3):	Moore Branch		**NCDWR Stream Index No.:**	6-77		
NCDWR Surface Water Classification for Water Body		**Primary Classification:**	Class C			
		Supplemental Classification:	None			
Other Stream Classification:	None					
Impairments:	None					
Aquatic T&E Species?	Yes	Comments:	Moore Branch flows into the French Broad River 0.85 miles downstream, where aquatic listed species occur.			
NRTR Stream ID:	SC			**Buffer Rules in Effect:**	N/A	
Project Includes Bridge Spanning Water Body?	No	**Deck Drains Discharge Over Buffer?**	N/A	**Dissipator Pads Provided in Buffer?**	N/A	
Deck Drains Discharge Over Water Body?	N/A	(If yes, provide justification in the General Project Narrative)		(If yes, describe in the General Project Narrative; if no, justify in the General Project Narrative)		
(If yes, provide justification in the General Project Narrative)						

North Carolina Department of Transportation

Highway Stormwater Program

STORMWATER MANAGEMENT PLAN

FOR NCDOT PROJECTS

(Version 3.00; Released August 2021)

WBS Element: 34165.1.13 **TIP/Proj No.:** I-2513AC **County(ies):** Buncombe

Swale

Sheet No.	Line	Station	Location (LT,RT,CL)	Latitude	Longitude	Surface Water Body	Base Width (ft)	Front Slope (H:1)	Back Slope (H:1)	Drainage Area (ac)	Recommended Treatm't Length (ft)	Actual Length (ft)	Longitudinal Slope (%)	Q2 (cfs)	V2 (fps)	Q10 (cfs)	V10 (fps)	Rock Checks Used	BMP Associated w/ Buffer Rules?
4	L	15+50	LT	35.55996	-82.606950	(1)Hominy Creek	0.0	6.0	4.0	0.2	23	100	1.50%	0.5	1.1	0.7	1.2	No	No
4	L	15+51	LT	35.55996	-82.606950	(1)Hominy Creek	0.0	6.0	4.0	0.1	7	89	1.70%	0.1	0.9	0.2	0.9	No	No
5	L	35+50	RT	35.5614944	-82.6004235	(1)Hominy Creek	0.0	6.0	4.0	0.8	83	164	1.10%	1.9	1.4	2.5	1.5	No	No
5	L	37+19	RT	35.5616113	-82.5998723	(1)Hominy Creek	0.0	6.0	4.0	0.8	82	169	1.90%	2.0	1.7	2.7	1.9	No	No
5	L	39+25	RT	35.5617534	-82.5992003	(1)Hominy Creek	0.0	6.0	4.0	0.9	89	206	1.90%	2.1	1.7	2.8	1.9	No	No
5	L	41+00	RT	35.5618779	-82.5986292	(1)Hominy Creek	0.0	6.0	4.0	0.6	55	175	1.80%	1.2	1.5	1.7	1.6	No	No
6	Y2RPC	31+30	RT	35.5625391	-82.5963428	(1)Hominy Creek	3.0	4.0	4.0	1.5	154	150	1.50%	4.5	2.0	6.1	2.1	No	No
6	L	48+10	LT	35.56316	-82.59664	(1)Hominy Creek	3.0	6.0	4.0	0.9	88	316	2.86%	2.1	1.9	2.9	2.1	No	No
6	L	51+50	LT	35.56351	-82.59560	(1)Hominy Creek	3.0	6.0	4.0	1.9	189	250	1.10%	5.3	1.8	7.2	1.9	No	No
10A	Y3	38+11	RT	35.5663319	-82.5787205	Wetland WM	4.0	2.0	2.0	20.9	2094	924	0.20%	38.7	1.9	53.4	2.4	No	No

Additional Comments

In addition the the proposed SCMs; the project team strived to incorporate avoidance and minimization practices into the design. When possible, the project team utilized grass shoulders, 2:1 slopes near/adjacent to stream and wetland areas and utilized vegetated ditch linings where possible. Grass lined ditches were used unless the resulting calculations demonstrated that a grass lined ditch would not be stable.

Due to the topography, ground water elevations, and the nature of the project, it was not possible to incorporate many of the features that were investigated. Large SCMs would also further increase impacts to surrounding areas resulting in more clearing and land disturbance which we are trying to minimize. However, existing flow patterns and outfalls were maintained to the maximum extent practical to limit discharge increases to any particular area. Pre/post analyses were completed at areas where concentrated runoff leaves the project and rip rap outlet pads, energy dissipators, and other measures were incorporated to ensure areas downstream of the project remain stable. The project is not expected to have a significant impact on water quality or quantity downstream of the project. It should also be noted that the total added impervious area was divided among multiple outfalls across the project.

North Carolina Department of Transportation

Highway Stormwater Program

STORMWATER MANAGEMENT PLAN

FOR NCDOT PROJECTS

(Version 3.00; Released August 2021)

WBS Element: 34165.1.13 **TIP/Proj No.:** I-2513AC **County(ies):** Buncombe

Other Toolbox Best Management Practices

Sheet No.	Line	Station	Location (LT,RT,CL)	Latitude	Longitude	Surface Water Body	BMP Type	Drainage Area (ac)	New Built-Upon Area (ac)	Volume Treated (ac-ft)	Precipitation Depth Treated over NBUA (in)	BMP Associated w/ Buffer Rules?
6	Y8	19+60	LT	35.56350	-82.59715	(1)Hominy Creek	Dry Detention Basin	2.4	0.7	0.022	0.40	No
6	Y2B	16+40	RT	35.56406	-82.59588	(1)Hominy Creek	Filtration Basin	3.7	0.3	0.0975	4.24	No

Additional Comments

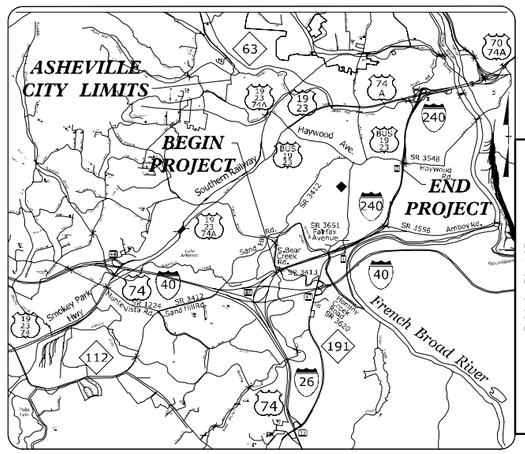
09/08/99

TIP PROJECT: I-2513AC

CONTRACT:

$$$$$$$$SYSTIME$$$$$$$$DGN$$$$$$$$USERNAME$$$$$$$$

See Sheet 1A For Index of Sheets
See Sheet 1B For Conventional Symbols



VICINITY MAP

STATE OF NORTH CAROLINA
DIVISION OF HIGHWAYS

PERMIT DRAWING
SHEET 1 OF 36

STATE	STATE PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
N.C.	I-2513AC	1	

STATE PROJ. NO.	F. A. PROJ. NO.	DESCRIPTION
34165.1.13		P.E.
34165.2.18		R/W
34165.2.19		UTIL.
34165.3.8		CONST.

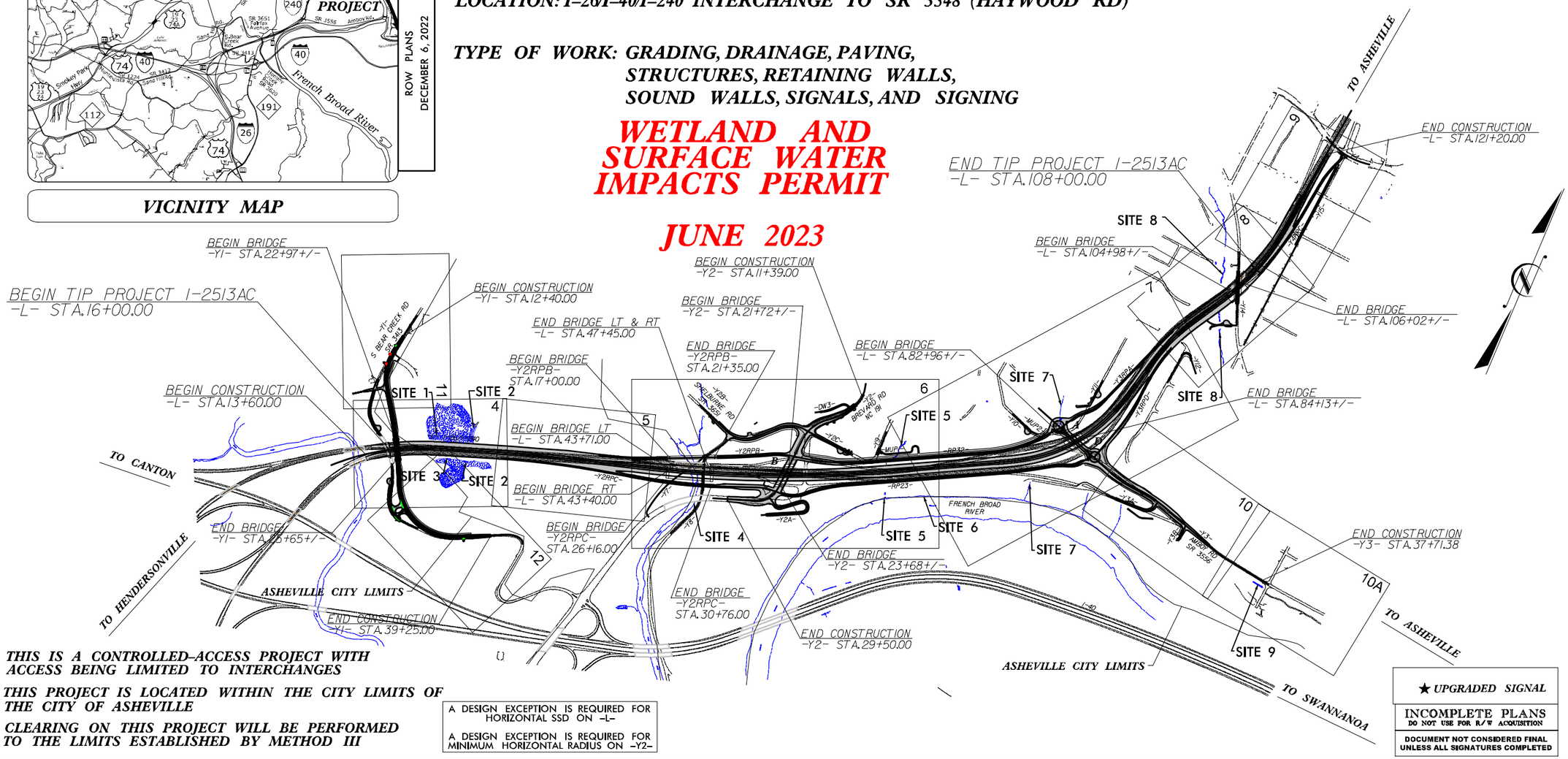
BUNCOMBE COUNTY

LOCATION: I-26/I-40/I-240 INTERCHANGE TO SR 3548 (HAYWOOD RD)

TYPE OF WORK: GRADING, DRAINAGE, PAVING, STRUCTURES, RETAINING WALLS, SOUND WALLS, SIGNALS, AND SIGNING

WETLAND AND SURFACE WATER IMPACTS PERMIT

JUNE 2023



THIS IS A CONTROLLED-ACCESS PROJECT WITH ACCESS BEING LIMITED TO INTERCHANGES

THIS PROJECT IS LOCATED WITHIN THE CITY LIMITS OF THE CITY OF ASHEVILLE

CLEARING ON THIS PROJECT WILL BE PERFORMED TO THE LIMITS ESTABLISHED BY METHOD III

A DESIGN EXCEPTION IS REQUIRED FOR HORIZONTAL SSD ON -L-

A DESIGN EXCEPTION IS REQUIRED FOR MINIMUM HORIZONTAL RADIUS ON -Y2-

★ *UPGRADED SIGNAL*

INCOMPLETE PLANS
DO NOT USE FOR R/W ACQUISITION

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

GRAPHIC SCALES

PLANS: 50 25 0 50 100

PROFILE (HORIZONTAL): 50 25 0 50 100

PROFILE (VERTICAL): 5 2 0 5 10

DESIGN DATA

ADT 2024 = NA
ADT 2040 = 101,400
K = 9 %
D = 55 %
T = 10 % *
V = 60 MPH
* TTST =5% DUAL 5%
FUNC CLASS=INTERSTATE

STATEWIDE TIER

PROJECT LENGTH

LENGTH ROADWAY TIP PROJECT I-2513AC = 1.623 MI

LENGTH STRUCTURE TIP PROJECT I-2513AC = 0.119 MI

TOTAL LENGTH TIP PROJECT I-2513AC = 1.742 MI

AECOM
NC FIRM LICENSE No: F-0342
5438 Wade Park Blvd, Suite 200
Raleigh, NC 27607
(919) 854-6200 - (919) 854-6259(FAX)

2018 STANDARD SPECIFICATIONS

RIGHT OF WAY DATE:
NOVEMBER 15, 2022

LETTING DATE:
FEBRUARY 20, 2024

JOHN SLOAN, P.E.
PROJECT ENGINEER

ED EDENS, P.E.
PROJECT DESIGN ENGINEER

KEVIN E. MOORE, P.E.
NCDOT CONTACT

HYDRAULICS ENGINEER

SIGNATURE: *P.E.*

ROADWAY DESIGN ENGINEER

SIGNATURE: *P.E.*

STATE OF NORTH CAROLINA • DEPARTMENT OF TRANSPORTATION •

5/14/99

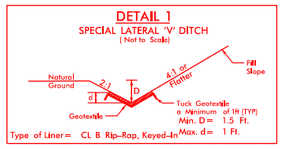
PROJECT REFERENCE NO.	SHEET NO.
I-2513AC	2D-1
R/W SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

INCOMPLETE PLANS
DO NOT USE FOR R/W ACQUISITION

Prepared in the Office of: AECOM
NC FIRM LICENSE No: F-0342
5438 Wade Park Boulevard, Suite 200
Raleigh, NC 27607
(919) 854-6200 - (919) 854-6259(FAX)

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

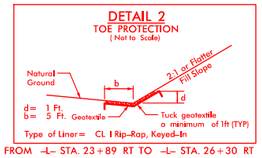
DETAIL 1
SPECIAL LATERAL 'V' DITCH
(Not to Scale)



Type of Liner= CL B Rip-Rap, Keyed-In

FROM –Y1– STA. 12+50 RT TO –Y1– STA. 17+69 RT

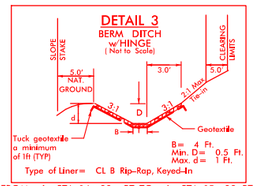
DETAIL 2
TOE PROTECTION
(Not to Scale)



Type of Liner= CL I Rip-Rap, Keyed-In

FROM –L– STA. 23+89 RT TO –L– STA. 26+30 RT

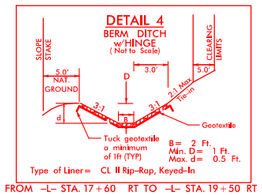
DETAIL 3
BERM DITCH w/HINGE
(Not to Scale)



Type of Liner= CL B Rip-Rap, Keyed-In

FROM –L– STA. 14+00 RT TO –L– STA. 15+00 RT
FROM –L– STA. 37+87 RT TO –L– STA. 39+25 RT

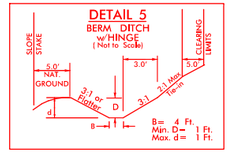
DETAIL 4
BERM DITCH w/HINGE
(Not to Scale)



Type of Liner= CL II Rip-Rap, Keyed-In

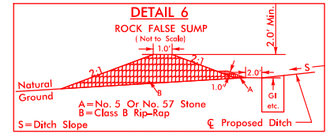
FROM –L– STA. 17+60 RT TO –L– STA. 19+50 RT

DETAIL 5
BERM DITCH w/HINGE
(Not to Scale)



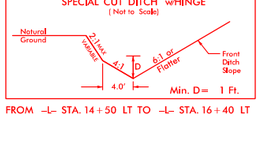
FROM –L– STA. 15+10 RT TO –L– STA. 16+16 RT
FROM –L– STA. 35+50 RT TO –L– STA. 36+14 RT
FROM –L– STA. 36+14 RT TO –L– STA. 37+19 RT
FROM –L– STA. 37+20 RT TO –L– STA. 37+87 RT
FROM –L– STA. 39+25 RT TO –L– STA. 42+00 RT

DETAIL 6
ROCK FALSE SUMP
(Not to Scale)



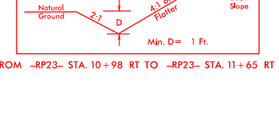
–L– STA. 15+08 RT

DETAIL 7
CONCRETE DITCH BEHIND RETAINING WALL
(Not to Scale)



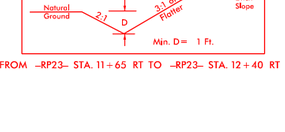
FROM –Y2– STA. 25+50 LT TO –Y2– STA. 26+62 LT
FROM –Y2– STA. 26+62 LT TO –Y2– STA. 28+96 LT
FROM –Y2B– STA. 11+78 LT TO –Y2B– STA. 15+75 LT
FROM –Y2RPB– STA. 21+28 LT TO –Y2B– STA. 14+44 RT
FROM –L– STA. 54+78 TO –L– STA. 55+33 RT
FROM –L– STA. 55+59 TO –L– STA. 63+75 LT
FROM –L– STA. 60+17 TO –L– STA. 80+86 RT
FROM –L– STA. 85+57 TO –L– STA. 98+25 LT
FROM –L– STA. 88+32 TO –L– STA. 97+50 RT
FROM –L– STA. 115+50 RT TO –L– STA. 121+00 RT

DETAIL 8
SPECIAL CUT BASE DITCH
(Not to Scale)



–L– STA. 44+87 LT
FROM –Y2B– STA. 21+65 LT TO –Y2B– STA. 19+84 LT

DETAIL 9
LATERAL 'V' DITCH
(Not to Scale)

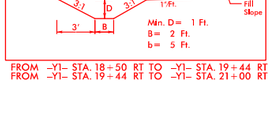


FROM –Y2C– STA. 11+50 RT TO –Y2C– STA. 12+50 RT
FROM –L– STA. 18+50 LT TO –L– STA. 19+40 LT

DETAIL 10
STANDARD BASE DITCH
(Not to Scale)

FROM –Y2B– STA. 18+33 RT TO –Y2B– STA. 17+59 RT

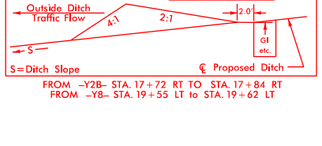
DETAIL 11
SPECIAL BASE DITCH
(Not to Scale)



Type of Liner= CLASS I Rip-Rap, Keyed-In

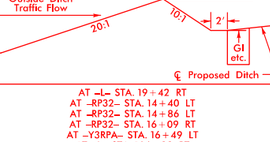
FROM –Y2B– STA. 16+00 RT TO –Y2B– STA. 15+00 RT

DETAIL 12
SPECIAL LATERAL BASE DITCH
(Not to Scale)



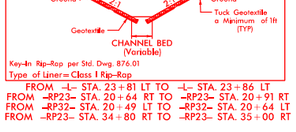
FROM –Y2B– STA. 21+65 LT TO –Y2B– STA. 19+84 LT

DETAIL 13
SPECIAL CUT BASE DITCH w/HINGE
(Not to Scale)



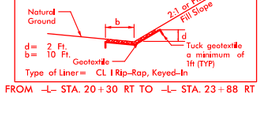
FROM –Y2RPC– STA. 31+30 RT TO –Y2RPC– STA. 32+81 RT

DETAIL 14
LATERAL BASE DITCH
(Not to Scale)



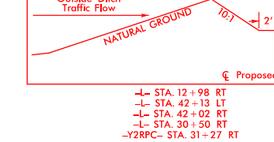
FROM –Y2C– STA. 11+50 RT TO –Y2C– STA. 12+50 RT

DETAIL 15
SPECIAL LATERAL BASE DITCH



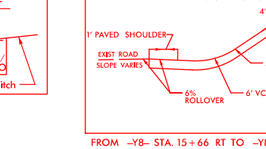
FROM –RP32– STA. 11+23 LT TO –RP32– STA. 14+26 LT

DETAIL 16
SPECIAL BACK OF CURB CUT DITCH
(NOT TO SCALE)



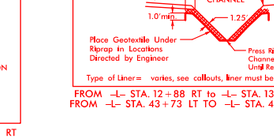
FROM –Y1B– STA. 10+32 LT TO –Y1– STA. 31+00 RT
FROM –Y1– STA. 31+00 RT TO –Y1– STA. 32+24 RT
FROM –Y1– STA. 32+24 RT TO –Y1– STA. 34+97 RT
FROM –Y1– STA. 34+97 RT TO –Y1– STA. 36+50 RT

DETAIL 17
HEAD DITCH
(Not to Scale)



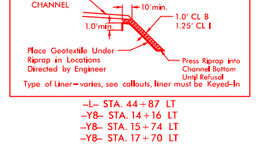
FROM –Y1– STA. 39+00 RT TO –Y1– STA. 40+30 RT

DETAIL 18
SPECIAL LATERAL BASE DITCH
(Not to Scale)



FROM –Y1– STA. 36+50 RT TO –Y1– STA. 39+00 RT

DETAIL 19
BERM DITCH w/HINGE
(Not to Scale)



Type of Liner= CL II Rip-Rap, Keyed-In

FROM –L– STA. 33+50 RT TO –L– STA. 35+00 RT

DETAIL 20
SPECIAL CUT DITCH w/HINGE
(Not to Scale)

FROM –Y2RPC– STA. 31+23 RT TO –Y2RPC– STA. 34+83 RT
FROM –L– STA. 41+00 RT TO –L– STA. 42+00 RT
FROM –L– STA. 42+00 RT TO –L– STA. 42+50 RT
FROM –L– STA. 14+50 RT TO –L– STA. 15+64 RT
FROM –L– STA. 15+64 RT TO –L– STA. 16+40 RT
FROM –L– STA. 17+00 LT TO –L– STA. 18+50 LT

DETAIL 21
FALSE SUMP
(Not to Scale)

FROM –L– STA. 23+97 RT TO –L– STA. 24+47 RT
FROM –L– STA. 37+21 RT TO –L– STA. 37+71 RT
FROM –L– STA. 39+27 RT TO –L– STA. 39+77 RT
FROM –L– STA. 35+52 RT TO –L– STA. 36+02 RT
FROM –L– STA. 48+10 LT TO –L– STA. 48+60 LT
FROM –L– STA. 17+07 RT TO –L– STA. 17+57 RT
AT –L– STA. 51+48 LT
AT –Y3RPD– STA. 15+78 RT
AT –Y3RPD– STA. 19+93 LT
AT –Y3RPD– STA.21+05 LT
AT –L– STA. 108+87 LT
AT –L– STA. 111+37 LT
AT –L– STA. 113+98 LT

DETAIL 22
BERM DITCH w/HINGE
(Not to Scale)

FROM –L– STA. 32+68 LT TO –L– STA. 35+00 LT
FROM –L– STA. 30+50 RT TO –L– STA. 33+50 RT

DETAIL 23
LATERAL BASE DITCH
(Not to Scale)

Type of Liner= CL I Rip-Rap, Keyed-In

FROM –L– STA. 26+35 RT TO –L– STA. 28+50 RT

DETAIL 24
TOE PROTECTION
(Not to Scale)

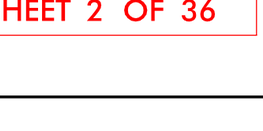
Type of Liner= CL B Rip-Rap, Keyed-In

FROM –L– STA. 26+00 LT TO –L– STA. 27+50 LT
FROM –Y1– STA. 21+38 RT TO –Y1– STA. 22+38 RT

DETAIL 25
SPECIAL CUT BASE DITCH
(Not to Scale)

FROM –L– STA. 17+00 RT TO –L– STA. 19+00 RT

DETAIL 26
SPECIAL LATERAL BASE DITCH w/HINGE
(Not to Scale)



FROM –L– STA. 19+00 RT TO –L– STA. 20+25 RT

DETAIL 27
SPECIAL CUT DITCH w/HINGE
(Not to Scale)

FROM –L– STA. 14+50 LT TO –L– STA. 16+40 LT

DETAIL 28
CUT DITCH
(Not to Scale)

FROM –RP23– STA. 10+98 RT TO –RP23– STA. 11+65 RT

DETAIL 29
CUT DITCH
(Not to Scale)

FROM –RP23– STA. 11+65 RT TO –RP23– STA. 12+40 RT

DETAIL 30
SPECIAL LATERAL 'V' DITCH
(Not to Scale)

FROM –DW3– STA. 10+53 LT TO –DW3– STA. 11+46 LT

DETAIL 31
LATERAL BASE DITCH
(Not to Scale)

FROM –Y1– STA. 18+50 RT TO –Y1– STA. 19+44 RT
FROM –Y1– STA. 19+44 RT TO –Y1– STA. 21+00 RT

DETAIL 32
FALSE SUMP
(Not to Scale)

FROM –Y2B– STA. 17+72 RT TO STA. 17+84 RT
FROM –Y8– STA. 19+55 LT to STA. 19+62 LT

DETAIL 33
CUT DITCH
(Not to Scale)

FROM –Y2– STA. 16+00 RT TO –Y2– STA. 17+30 RT

DETAIL 34
FALSE SUMP
(Not to Scale)

AT –L– STA. 19+42 RT
AT –RP32– STA. 14+40 LT
AT –RP32– STA. 14+86 LT
AT –RP32– STA. 16+09 RT
AT –Y3RPA– STA. 16+49 LT
AT –L– STA. 106+38 RT
AT –L– STA. 108+38 RT
AT –L– STA. 111+97 RT
AT –L– STA. 115+87 RT
AT –L– STA. 117+85 RT

DETAIL 35
BANK STABILIZATION
(Not to Scale)

Key-In Rip-Rap per Std. Dwg. 876.01
Type of Liner= Class I Rip-Rap

FROM –L– STA. 23+81 LT TO –L– STA. 23+86 LT
FROM –RP23– STA. 20+64 RT TO –RP23– STA. 20+91 RT
FROM –RP32– STA. 20+49 LT TO –RP32– STA. 20+64 LT
FROM –RP23– STA. 34+80 RT TO –RP23– STA. 35+00 RT

DETAIL 36
TOE PROTECTION
(Not to Scale)

Type of Liner= CL I Rip-Rap, Keyed-In

FROM –L– STA. 20+30 RT TO –L– STA. 23+88 RT

DETAIL 37
FALSE SUMP
(Not to Scale)

–L– STA. 12+98 RT
–L– STA. 42+13 LT
–L– STA. 42+02 RT
–L– STA. 30+50 RT
–Y2RPC– STA. 31+27 RT

DETAIL 38
CONCRETE DITCH
(END BENT SLOPE PROTECTION)
(Not to Scale)

FROM –Y8– STA. 15+66 RT TO –Y8– STA. 18+33 RT

DETAIL 39
BANK STABILIZATION
(Not to Scale)

Type of Liner= varies, see callouts, liner must be Keyed-In

FROM –L– STA. 12+88 RT to –L– STA. 13+15 RT
FROM –L– STA. 43+73 LT TO –L– STA. 44+12 LT

DETAIL 40
BANK STABILIZATION
(Not to Scale)

Type of Liner= varies, see callouts, liner must be Keyed-In

–L– STA. 44+87 LT
–Y8– STA. 14+16 LT
–Y8– STA. 15+74 LT
–Y8– STA. 17+70 LT
–Y8– STA. 18+54 LT

PERMIT DRAWING
SHEET 2 OF 36

jlb2123 AM
Documents\60646756\12513A\900-CAD GIS\910-CAD\70-NCDOT TIP\Hydraulics\VHB_Design\PSH\I-2513A_Hyd_Details.dgn

pw:\\aecom-na-pw.bentley.com:AECOM_DS21_NA_2021\Documents\60646756\1-2513A_NA_900-CAD_GIS\910_CAD\70_NCDOT_TIP\Hydraulics\VHB_Design\PSH\I-2513A_Hyd_Details.dgn
JL5224, AM
5/1/2024

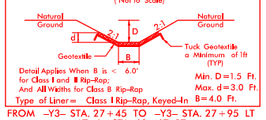
PROJECT REFERENCE NO.	SHEET NO.
I-2513AC	2D-2
R/W SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

INCOMPLETE PLANS
DO NOT USE FOR R/W ACQUISITION

Prepared in the Office of: AECOM
NC FIRM LICENSE No: F-0342
5438 Wade Park Boulevard, Suite 200
Raleigh, NC 27607
(919) 854-6200 - (919) 854-6259(FAX)

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

DETAIL 41
STANDARD BASE DITCH
(Not to Scale)



Detail Applies When B is < 6.0' for Class I and II Rip-Rap; And All Widths for Class B Rip-Rap
Min. D=1.5 Ft.
Max. d=3.0 Ft.
Type of Liner= Class I Rip-Rap, Keyed-In B=4.0 Ft.

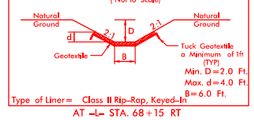
FROM –Y3– STA. 27+45 TO –Y3– STA. 27+95 LT
AT –L– STA. 63+67 RT

DETAIL 42
STANDARD BASE DITCH
(Not to Scale)

Detail Applies When B is < 6.0' for Class I and II Rip-Rap; And All Widths for Class B Rip-Rap
Min. D=1.5 Ft.
Max. d=1.5 Ft.
Type of Liner= Class I Rip-Rap, Keyed-In B=2.0 Ft.

AT –L– STA. 65+54 RT
FROM –L– STA. 101+07 TO –L– STA. 101+53 RT

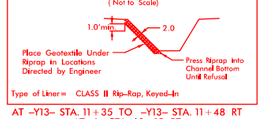
DETAIL 43
STANDARD BASE DITCH
(Not to Scale)



Min. D=2.0 Ft.
Max. d=4.0 Ft.
B=6.0 Ft.
Type of Liner= Class II Rip-Rap, Keyed-In

AT –L– STA. 68+15 RT

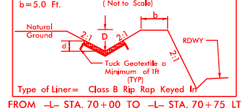
DETAIL 44
BANK STABILIZATION
(Not to Scale)



Type of Liner= CLASS II Rip-Rap, Keyed-In

AT –Y13– STA. 11+35 TO –Y13– STA. 11+48 RT
AT –L– STA. 68+13 RT

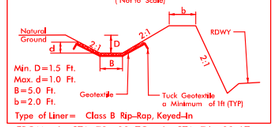
DETAIL 45
Max d=1.0 Ft.
Min. D=1.5 Ft.
b=5.0 Ft.
BERM 'V' DITCH
(Not to Scale)



Type of Liner= Class B Rip Rap Keyed In

FROM –L– STA. 70+00 TO –L– STA. 70+75 LT

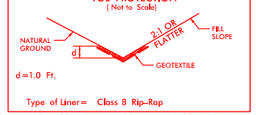
DETAIL 46
BERM BASE DITCH
(Not to Scale)



Min. D=1.5 Ft.
Max. d=1.0 Ft.
B=5.0 Ft.
b=2.0 Ft.
Type of Liner= Class B Rip-Rap, Keyed-In

FROM –L– STA. 73+00 TO –L– STA. 76+00 LT

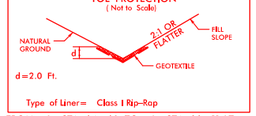
DETAIL 47
TOE PROTECTION
(Not to Scale)



d=1.0 Ft.
Type of Liner= Class B Rip-Rap

FROM –RP32– STA. 34+29 TO –RP32– STA. 35+68 LT
FROM –RA81– STA. 11+11 TO –RA81– STA. 11+78 RT
FROM –Y3A– STA. 11+55 TO –Y3A– STA. 12+00 LT
FROM –Y3A– STA. 13+00 TO –Y3A– STA. 14+50 LT

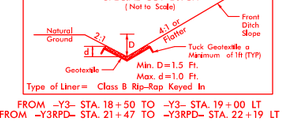
DETAIL 48
TOE PROTECTION
(Not to Scale)



d=2.0 Ft.
Type of Liner= Class I Rip-Rap

FROM –L– STA. 64+60 TO –L– STA. 66+11 LT
FROM –RP32– STA. 31+21 TO –RP32– STA. 32+99 LT

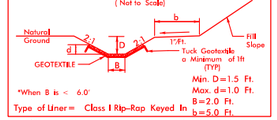
DETAIL 49
SPECIAL CUT DITCH
(Not to Scale)



Min. D=1.5 Ft.
Max. d=1.0 Ft.
Type of Liner= Class B Rip-Rap Keyed In

FROM –Y3– STA. 18+50 TO –Y3– STA. 19+00 LT
FROM –Y3RPD– STA. 21+47 TO –Y3RPD– STA. 22+19 LT

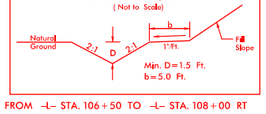
DETAIL 50
LATERAL BASE DITCH
(Not to Scale)



*When B is < 6.0'
Min. D=1.5 Ft.
Max. d=1.0 Ft.
B=2.0 Ft.
Type of Liner= Class I Rip-Rap Keyed In b=5.0 Ft.

FROM –L– STA. 100+00 TO –L– STA. 100+90 RT

DETAIL 51
LATERAL 'V' DITCH
(Not to Scale)



Min. D=1.5 Ft.
b=5.0 Ft.

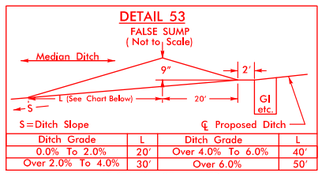
FROM –L– STA. 106+50 TO –L– STA. 108+00 RT

DETAIL 52
SPECIAL CUT DITCH
(Not to Scale)

Min. D=1.5 Ft.

FROM –Y3– STA. 30+00 TO –Y3– STA. 31+00 LT
FROM –L– STA. 108+50 TO –L– STA. 112+50 RT

DETAIL 53
FALSE SUMP
(Not to Scale)

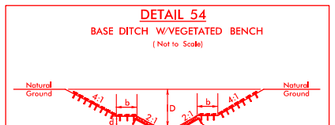


S=Ditch Slope

Ditch Grade	L	Ditch Grade	L
0.0% To 2.0%	20'	Over 4.0% To 6.0%	40'
Over 2.0% To 4.0%	30'	Over 6.0%	50'

AT STA. 111+37 –L– MED
AT STA. 113+98 –L– MED
AT STA. 115+33 –L– MED
AT STA. 116+99 –L– MED

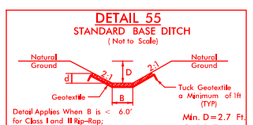
DETAIL 54
BASE DITCH W/VEGETATED BENCH
(Not to Scale)



Establish wetland vegetation along benches and 4:1 backslopes up to natural ground
Min. D=2.5 Ft.
d=1.0 Ft.
B=4.0 Ft.
b=2.0 Ft.
Type of Liner= Class B Rip-Rap, Keyed-In

FROM –Y3– STA. 28+98 TO –Y3– 30+52 RT

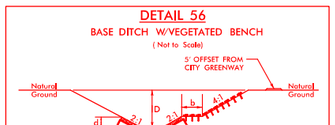
DETAIL 55
STANDARD BASE DITCH
(Not to Scale)



Detail Applies When B is < 6.0' for Class I and II Rip-Rap; And All Widths for Class B Rip-Rap
Min. D=2.7 Ft.
d=1.0 Ft.
Type of Liner=Class B Rip-Rap, Keyed-In B=4.0 Ft.

FROM –L– STA. 30+52 TO –L– STA. 31+39 RT

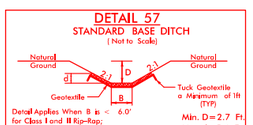
DETAIL 56
BASE DITCH W/VEGETATED BENCH
(Not to Scale)



Establish wetland vegetation along benches and 4:1 backslopes up to natural ground
Min. D=2.5 Ft.
d=1.0 Ft.
B=4.0 Ft.
Type of Liner= Class B Rip-Rap, Keyed-In b=VARIES 0–30 Ft.

FROM –L– STA. 31+39 TO –L– STA. 34+10 RT

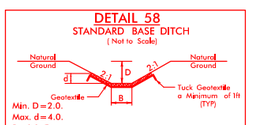
DETAIL 57
STANDARD BASE DITCH
(Not to Scale)



Detail Applies When B is < 6.0' for Class I and II Rip-Rap; And All Widths for Class B Rip-Rap
Min. D=2.7 Ft.
Max d=5.4 Ft.
Type of Liner=Class B Rip-Rap, Keyed-In B=4.0 Ft.

FROM –L– STA. 34+10 TO –L– STA. 37+71 RT

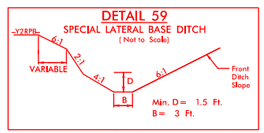
DETAIL 58
STANDARD BASE DITCH
(Not to Scale)



Min. D=2.0.
Max. d=4.0.
B=6.0 Ft.
Type of Liner= Class II Rip-Rap, Keyed-In

AT –L– STA. 104+83 LT

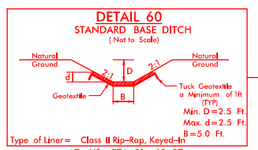
DETAIL 59
SPECIAL LATERAL BASE DITCH
(Not to Scale)



Min. D= 1.5 Ft.
B= 3 Ft.

FROM –L– STA. 48+10 TO STA. 54+00 LT

DETAIL 60
STANDARD BASE DITCH
(Not to Scale)



Min. D=2.5 Ft.
Max. d=2.5 Ft.
B=5.0 Ft.
Type of Liner= Class II Rip-Rap, Keyed-In

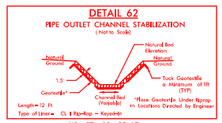
AT –Y3– STA. 21+62 RT

DETAIL 61
SPECIAL CUT BASE DITCH w/HINGE
(Not to Scale)

Min. D= 1 Ft.
d= 1 Ft.
B= 3 Ft.
Type of Liner= B Rip-Rap, Keyed-In

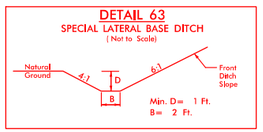
FROM –Y2RPC– STA. 32+81 RT TO –Y2RPC– STA. 34+67 RT

DETAIL 62
PIPE OUTLET CHANNEL STABILIZATION
(Not to Scale)



–Y8– STA. 19+32 LT

DETAIL 63
SPECIAL LATERAL BASE DITCH
(Not to Scale)



Min. D= 1 Ft.
B= 2 Ft.

FROM –Y1– STA. 12+78 LT TO –Y1– STA. 14+00 LT

PERMIT DRAWING
SHEET 3 OF 36

PERMIT DRAWING
SHEET 4 OF 36

PROJECT REFERENCE NO.	SHEET NO.
I-2513AC	XX
R/W SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

INCOMPLETE PLANS
DO NOT USE FOR R/W ACQUISITION

Prepared in the Office of: AECOM
NC FIRM LICENSE No: F-0342
5438 Wade Park Boulevard Suite 200
Raleigh, NC 27607
(919) 854-6200 - (919) 854-6259 (FAX)

DOCUMENT NOT CONSIDERED FINAL
UNLESS ALL SIGNATURES COMPLETED

10' 0' 10' 20' 30'
GRAPHIC SCALE

PIPE OUTLET CHANNEL STABILIZATION
EST. 22 TON CL II RIP RAP
EST. 30 SY GEOTEXTILE
SEE DETAIL 62

DO NOT OBSTRUCT DITCH
BASE WITH PROPOSED PIPE

PDE

PDE

PDE

PDE

PUE

36" RCP-IV

6103

OTCB

FS
SEE DETAIL 32

RW
CA

6103

TB

TB

TB

REMOVE 15" RC

JB w/MH

6054

RETAIN

18" RCP-IV

OUTLET
STRUCTURE
SEE DETAIL C

6142

18" RCP-IV

6143

JB w/MH

WELL GRADED CLASS II
RIP RAP MIXED WITH
CLASS B RIP RAP

GRADE TO
DRAIN

DRY DETENTION
BASIN LINED WITH
CLASS B RIP RAP

6067

GRADE
TO
DRAIN

18"
RCP-IV

6066

JB w/MH

18"
RCP-IV

GRADE TO
DRAIN

GRADE TO
DRAIN

6062

TB 2GI

15" RCP-IV

2GI-D

6065

6141

RETAIN

PROP. RETAINING WALL (A)

-Y8-

-Y2RPB-

B-77

EXISTING R/W

EXISTING R/W

HOMINY CREEK RD

SR 3620

TH-4

N 31° 40' 100.0"

S 54° 16" E 30

N 65° 5

025

02

REVISIONS

5/14/99

3/3/2023
I:\2513A\900-CAD\910-CAD\70-NCDOT_TIP\Hydraulics\Permits_Environmental\AECOM\I-2513_AC\Drawings\04_Dry_Detention_Plan
Karen Sloan

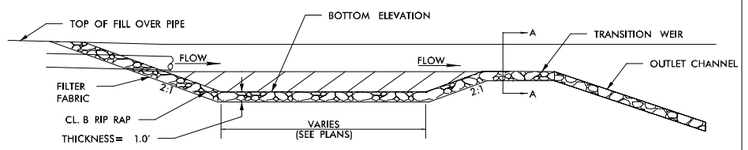
5/14/99

REVISIONS

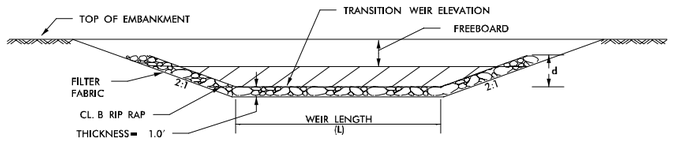
DETAIL A

DRY DETENTION POND

(Not to Scale)



PROFILE VIEW



SECTION A–A
"TRANSITION BERM CROSS-SECTION"

MINIMUM DIMENSIONS FOR DRY DETENTION POND

LOCATION	BOTTOM ELEV.	TRANSITION WEIR ELEV.	TRANSITION WEIR LENGTH (L)	WEIR SIDE SLOPES (X:1)	d
–Y8– 19+60	2003.0	2006.50	8.5'	2:1	1.0'

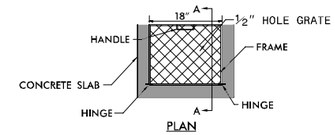
PERMIT DRAWING
SHEET 5 OF 36

DETAIL B

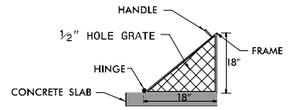
ORIFICE TRASH RACK

(N.T.S.)

ORIFICE TRASH RACK NOTES:
1) ALL JOINTS SHALL BE FULLY WELDED AROUND JOINT WITH A MINIMUM OF A , 1/4" BEAD.
2) IF BOLTS ARE ANCHORED IN CONCRETE, FOLLOW STD. DWG. 862.03 AND 862.04 FOR ANCHORING PROCEDURE.
3) REMOVEABLE ORIFICE TRASH RACK SHALL BE ATTACHED TO CONCRETE BOX BY HINGE OR SLIDE RAIL SYSTEM.
4) RACK AND HARDWARE SHALL BE ALUMINUM OR GALVANIZED IN ACCORDANCE WITH ASTM A-153.



PLAN



SECTION A–A

PROJECT REFERENCE NO.	SHEET NO.
I-2513AC	2D-4
R/W SHEET NO.	

ROADWAY DESIGN ENGINEER | HYDRAULICS ENGINEER

INCOMPLETE PLANS
DO NOT USE FOR R/W ACQUISITION

Prepared in the Office of: AECOM
NC FIRM LICENSE Nos: F-0342
5438 Wade Park Boulevard Suite 200
Raleigh, NC 27607
(919) 854-6200 - (919) 854-6259(FAX)

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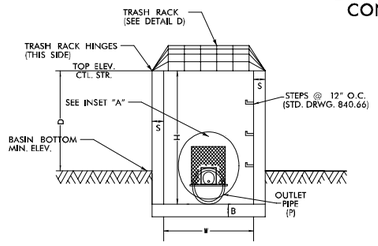
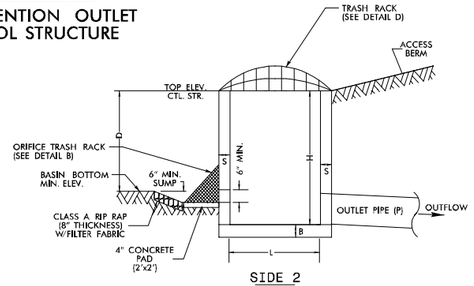
DETAIL C

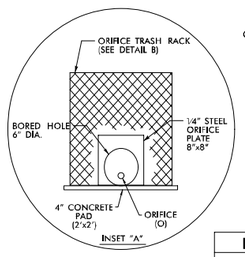
DRY DETENTION OUTLET CONTROL STRUCTURE



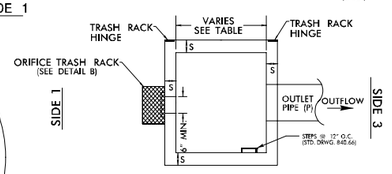
SIDE 1



SIDE 2



INSET "A"



SIDE 2

PLAN VIEW
TRASH RACK NOT SHOWN FOR CLARITY

MINIMUM DIMENSIONS FOR DRY DETENTION BASIN DRAWDOWN STRUCTURE

STATION	STRUCTURE NUMBER	S (INCHES)	B (INCHES)	TOP ELEVATION CONTROL STRUCTURE	CTL. STR. DIMENSIONS W	L	H	ORIFICE DIAMETER (O) INCHES	ORIFICE INV. ELEV.	OUTLET PIPE INV.	OUTLET PIPE DIAMETER(P) INCHES	OUTLET PIPE MATERIAL
–Y8– 19+80	6142	6	6	2005.50	3	3	5.5	2.0	2002.50	2000.00	18	RCP

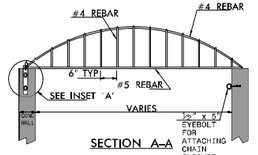
NOT TO SCALE

DETAIL D

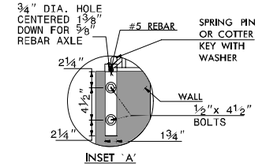
REBAR TRASH RACK

(N.T.S.)

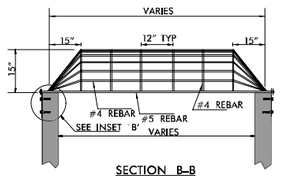
RISER TRASH RACK NOTES:
1) ALL JOINTS SHALL BE FULLY WELDED AROUND JOINT WITH A MINIMUM OF A "" BEAD.
2) IF BOLTS ARE ANCHORED IN CONCRETE, FOLLOW STD. DWG. 862.03 AND 862.04 FOR ANCHORING PROCEDURE.
3) EYEBOLT FOR CHAIN CLOSURE SHALL BE INSTALLED BY THE SAME METHOD AS THE HINGE PLATE BOLTS.
4) RACK AND HARDWARE SHALL BE ALUMINUM OR REBAR AND GALVANIZED IN ACCORDANCE WITH ASTM A-153.
5) PROVIDE OPENING IN TRASH RACK TO ACCOMODATE SLUICE GATE, IF APPLICABLE, ON THE OUTLET PIPE. ENSURE TRASH RACK OPENS FREELY AND WITHOUT INTERFERENCE WITH SLUICE GATES.



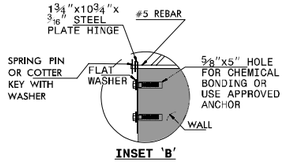
SECTION A–A



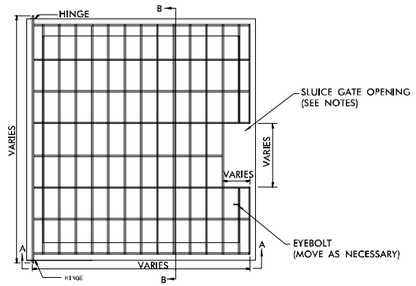
INSET 'A'



SECTION B–B



INSET 'B'



PLAN

J:\I-2513\900-CAD\Civil\2513_CAD\70.NCDOT_TIP\Hydraulics\Permits_Environmental\AECOM\I-2513_AC\Drawings\05_I-2513A_hyd_det-2D-4
3/13/2013
kenneth.sloan

PERMIT DRAWING
SHEET 6 OF 36

PROJECT REFERENCE NO.	SHEET NO.
I-2513AC	2D-5
R/W SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

INCOMPLETE PLANS
DO NOT USE FOR R/W ACQUISITION

Prepared in the Office of: AECOM
NC FIRM LICENSE No: F-0342
5438 Wade Park Boulevard Suite 200
Raleigh, NC 27607
(919) 854-6200 - (919) 854-6259 (FAX)

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UNLESS ALL SIGNATURES COMPLETED

10 5 0 10 20
PLANS

REVISIONS
5/14/99

REMOVE
6047
CB
6049
REMOVE
CB
15" RCP-IV
6048
15" RCP-IV
CB
TB JB
w/MH
15" RCP-IV
REMOVE
15" RCP-IV
6045
CB
N 45° 09' 30.6" E
CB
6044
18" RCP-IV
18" RCP-IV
15" RCP-IV
CB
6040
HEAD DITCH
SEE DETAIL 10
GRADE
TO DRAIN
18" RCP-IV
2GI
6036
18" RCP-IV
FS
SEE DETAIL 32
FOREBAY WITH
CLASS I RIP RAP
OUTLET 6147
STRUCTURE
SEE DETAIL J
18" RCP-IV
6146
24" RCP-IV
6037 JB w/MH
2GI
6145
FS
SEE DETAIL 32
WELL GRADED CLASS II
RIP RAP MIXED WITH
CLASS B RIP RAP
TRANSITION
EST. 40 TONS
EST. 65 SY GEOTEXTILE
6149 JB w/MH
24"
24"
EMERGENCY
SPILLWAY
2' SPECIAL LATERAL
BASE DITCH
SEE DETAIL 11
EST. 54 TONS CL B RIP RAP
EST. 84 SY GEOTEXTILE
WEIR
UNDERDRAIN
CLEANOUT (TYP.)
FILTRATION
BASIN
REMOVE
DIRECTIONAL
ONLY
C
A

3/13/2023
...\I-2513A\900-CAD\I-2513A_hyd_det-2D-5.dgn
kmeadows

FILTRATION BASIN DETAILS (ALIGNMENT –Y2B–)

PERMIT DRAWING
SHEET 7 OF 36

PROJECT REFERENCE NO.	SHEET NO.
I-2513AC	2D-6
R/W SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

INCOMPLETE PLANS
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GENERAL NOTES:

① ENGINEERED SOIL MEDIA

Filtration Basin Soil Mix Blend

The Engineered Soil Mix shall consist of the following blend:

Recycled Expanded Slate Fines	80%
Approved Compost Organic Component	20%

Mechanically mix 1 part compost with 4 parts of the expanded slate fines until a uniform distribution of the components is achieved. The slate aggregate fines and organic component consist of the following:

Recycled Expanded Slate Fines

The recycled expanded slate aggregate fines shall conform to the following screening operation:

Sieve Size	% Retained
#4	4–8%
#8	28–38%
#16	46–58%
#30	63–75%
#50	74–84%
#100	82–90%
Fine Material	2.79–3.53% passing #100

Organic Component

The compost or organic component shall conform to the following specifications:

1. Humus material shall have an ash content of no less than 8 percent and no more than 40 percent.
2. The pH of the organic matter shall be between 5.5 and 8.5.
3. The salt consent shall be less than 10 millimho/cm at 25 degrees C, (Ece<10) on a saturated past extract.
4. Types of acceptable composted products can be derived from yard wastes, low in salts, low in phosphorus (P2O5 below 1% wet wt. bas us), free from weed seeds, free of pathogens and other deleterious materials.
5. Composted pine bark products are conditionally acceptable (stable humus must be present).
6. Sludge- based materials are not acceptable including municipal swage sludge bio –solids.
7. The organic amendment must have a Carbon/Nitrogen ratio of <25:1.
8. The compost shall be aerobic without malodorous presence of decomposition products.
9. From 75 to 100 percent organic amendment particles shall pass the 4.0 mm sieve size,
10. From 45 to 65 percent moisture measure via wet –weight basis.
11. Free of stones, debris, plant material.
12. Organic content must be above 50% on a dry weight basis.
13. Metals and contaminants must meet or exceed US EPA Standard 40.

② WASHED GRAVEL (NO. 57 STONE), LIMESTONE BASED AGGREGATES SHOULD NOT BE USED

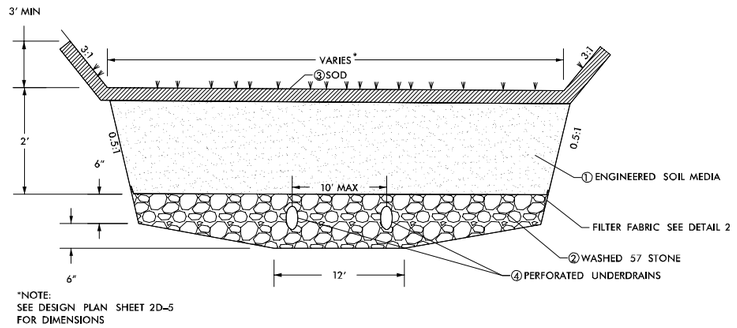
③ FESCUE/BLUEGRASS BLEND SOD; THE SOD SOIL LAYER SHALL CONTAIN MINIMAL CLAY CONTENT IN ORDER TO FACILITATE FILTRATION. THE SOD SHALL BE APPROVED BY THE ENGINEER PRIOR TO INSTALLATION (TOP OF SOD IS FINISHED GRADE)

④ THE UNDERDRAIN PIPES SHALL HAVE A MINIMUM SLOPE OF 0.005 FT./FT.

⑤ FOR FURTHER FILTRATION BASIN DETAIL, SEE PROJECT SPECIAL PROVISIONS.

ESTIMATED BILL OF MATERIALS FOR BASIN ALIGNMENT –Y2B–

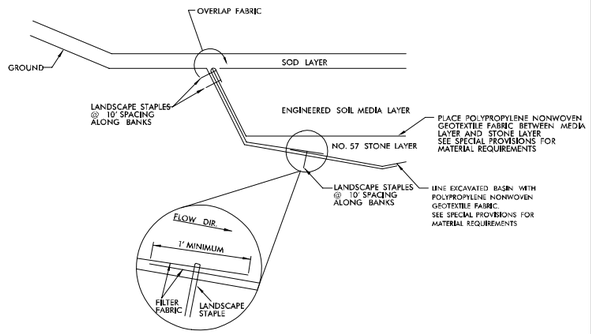
SOD – 80 SY
6" HDPE PERFORATED UNDERDRAINS – 68 LF
CLEANOUTS – 4 EA
SOIL MEDIA, WASHED STONE – SEE SHEET 2D–5
6" HDPE – 15 LF



DETAIL E TYPICAL FILTRATION CROSS SECTION

NOT TO SCALE

DETAIL F
FILTRATION BASIN
FABRIC INSTALLATION
N.T.S.

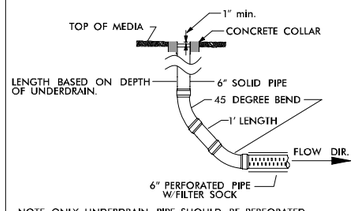


NOTES:
1) LINING FABRIC SHOULD BE FOLDED BACK TO OVERLAP DIVIDING FABRIC AND SECURED WITH LANDSCAPE STAPLES TO ENSURE SEALING THE STONE FROM SOIL.
2) FABRIC SHOULD BE LAYED IN A WAY TO PREVENT WATER FROM FLOWING BETWEEN OVERLAPPED PIECES. (SEE BLOWUP)
3) FABRIC SHOULD BE OVERLAPPED A MINIMUM OF 12 INCHES AND SECURED WITH STAPLES.
4) NO OVERLAPPING SHOULD OCCUR UNDER DRAIN PIPES.

DETAIL G
UNDERDRAIN CLEANOUTS

END CLEANOUT

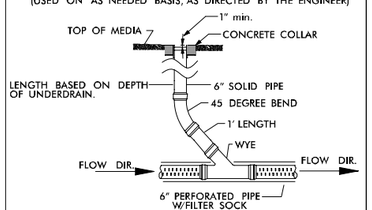
*NOT TO SCALE



NOTE: ONLY UNDERDRAIN PIPE SHOULD BE PERFORATED

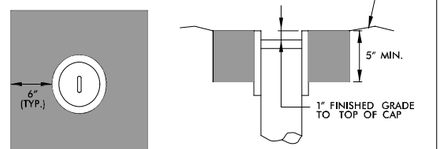
MIDWAY CLEANOUT

(USED ON AS NEEDED BASIS, AS DIRECTED BY THE ENGINEER)



NOTE: ONLY UNDERDRAIN PIPE SHOULD BE PERFORATED *NOT TO SCALE

RECESSED CLEANOUT W/CONCRETE COLLAR



TOP VIEW SIDE VIEW

NOTES:
1. CLEANOUT CAP SHALL BE RECESSED 1" MIN. BELOW GROUND, REMOVABLE, WATER TIGHT, AND CLOSED UNDER NORMAL CONDITIONS.
2. CONCRETE SHALL BE 3,000 PSI.
3. THIS CONCRETE COLLAR DETAIL SHALL BE APPLIED TO ALL CLEANOUTS ON PROJECT.
4. USE 45 DEG ELBOWS AT ALL BENDS IN PIPE CLEANOUTS.

*NOT TO SCALE

REVISIONS

8/17/99

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kerens.logan

FILTRATION BASIN DETAILS (ALIGNMENT –Y2B–)

PERMIT DRAWING
SHEET 7A OF 36

PROJECT REFERENCE NO.	SHEET NO.
I-2513AC	2D-7
R/W SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

INCOMPLETE PLANS
DO NOT USE FOR R/W ACQUISITION

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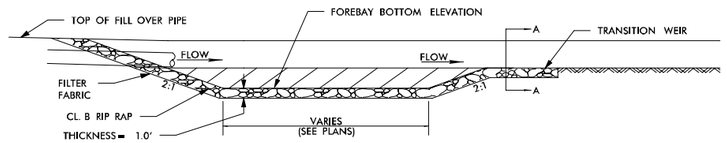
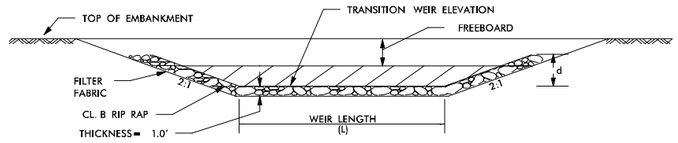
DETAIL H

FOREBAY

(Not to Scale)



PROFILE VIEW



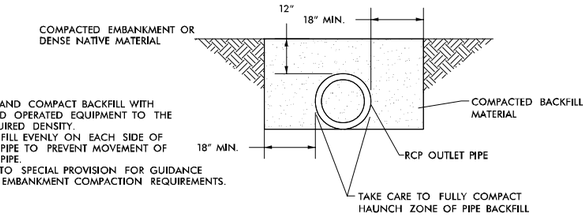
SECTION A–A
"TRANSITION BERM CROSS–SECTION"

MINIMUM DIMENSIONS FOR FOREBAY

LOCATION	FOREBAY BOTTOM ELEV.	TRANSITION WEIR ELEV.	TRANSITION WEIR LENGTH (L)	WEIR SIDE SLOPES (X:1)	d
–Y2B– 16+93	2038	2041	34	2	1
–Y2C– 34+70	2065.99	2068.99	15	2	1

DETAIL I

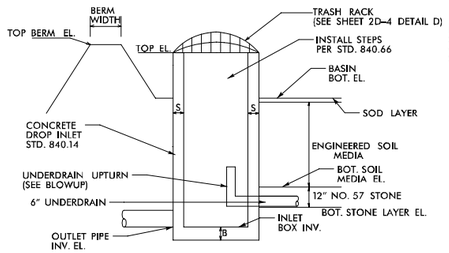
OUTLET PIPE INSTALLATION THROUGH EMBANKMENT
(N.T.S.)



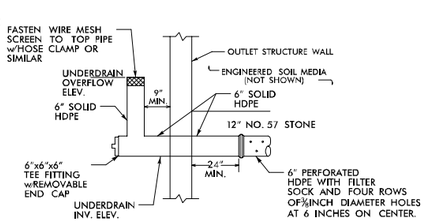
NOTES:
1) PLACE AND COMPACT BACKFILL WITH HAND OPERATED EQUIPMENT TO THE REQUIRED DENSITY.
2) PLACE FILL EVENLY ON EACH SIDE OF THE PIPE TO PREVENT MOVEMENT OF THE PIPE.
3) REFER TO SPECIAL PROVISION FOR GUIDANCE ON EMBANKMENT COMPACTION REQUIREMENTS.

DETAIL J

FILTRATION BASIN
OUTLET CONTROL STRUCTURE



BIORETENTION BASIN OUTLET STRUCTURE DETAIL
N.T.S.



UNDERDRAIN UPTURN BLOWUP
N.T.S.

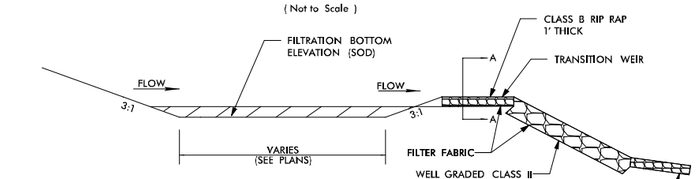
NOTES:
1) PROVIDE WATER TIGHT CONNECTIONS USING WATERSTOP OR COMPRESSION GASKET APPROVED BY ENGINEER ON ALL OUTLET STRUCTURE PENETRATIONS.
2) INSTALL STEPS IN ACCORDANCE WITH STD. 840.66
3) FOR UNDERDRAIN, USE SOLID (NON–PERFORATED) PIPE THROUGH STRUCTURE WALL AND EXTEND 2 FT. MIN. INTO NO. 57 STONE LAYER.
4) SEE ENGINEERED SOIL MEDIA DETAIL SHEET 2–A.
5) SEE DETAIL THIS SHEET FOR UNDERDRAIN UPTURNED ELBOW/OVERFLOW.
6) NO BEDDING MATERIAL TO BE USED. THEREFORE, DO NOT FOLLOW STANDARD DRAWINGS FOR METHOD OF PIPE INSTALLATION FOR OUTLET PIPE THROUGH EMBANKMENT. SEE DETAIL FOR PIPE INSTALLATION THROUGH EMBANKMENT.
7) ENSURE TRASH RACK OPENS FREELY AND WITHOUT INTERFERENCE.

STATION	STR. #	S (Inches)	B (Inches)	TOP BOX EL.	CTL. STR. DIMENSIONS W	L	H	TOP BERM EL.	TOP BERM WIDTH	BASIN BOTTOM EL.	BOTTOM SOIL MEDIA EL.	BOTTOM STONE EL.	UNDERDRAIN INVERT	UNDERDRAIN OVERFLOW EL.	BOX / OUTLET PIPE INVERT
–Y2B– 16+40	6147	6	6	2040.5	3	3	4.5	2044.0	10	2039	2037	2036	2036.25	2037.50	2036.00

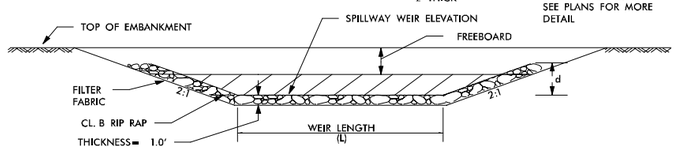
DETAIL K

FILTRATION SPILLWAY WEIR

(Not to Scale)



PROFILE VIEW



SECTION A–A
"TRANSITION BERM CROSS–SECTION"

MINIMUM DIMENSIONS FOR FOREBAY SPILLWAY WEIR

LOCATION	FILTRATION BOTTOM ELEV.	TRANSITION WEIR ELEV.	TRANSITION WEIR LENGTH (L)	WEIR SIDE SLOPES (X:1)	d	TOP OF EMBANKMENT ELEV.
–Y2B– 16+27	2038	2042	9	2	1	2044

REVISIONS

8/17/99

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PERMIT DRAWING
SHEET 8 OF 36

PROJECT REFERENCE NO.	SHEET NO.
I-2513AC	4
R/W SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

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Prepared in the Office of: PINECONE — NC FIRM LICENSE No: P-1804, 205 E. Spring St #61, Fuquay-Varina, NC 27526, (919) 636-6514

5/14/99

REVISIONS

MATCHLINE -Y1- STA 20+00 - SEE SHEET 11

MATCHLINE -L- STA 27+00 - SEE SHEET 5

MATCHLINE -Y1- STA 28+50 - SEE SHEET 12

SITE 1

SITE 2

SITE 3

SEE PERMIT DRAWING 9 OF 36 FOR ENLARGEMENT

BEGIN CONSTRUCTION -YIC- STA.11+43.50

END CONSTRUCTION -YID- STA.14+43.12

END SBG +82 REMOVE EXIST BRIDGE

BEG.SBG +94

BEG.SBG +60

START SBG +60

END SBG +78

JOLENE E WOODY

1 BILTMORE AVE, LLC

HARRY LEE COATES REVOCABLE LIVING TRUST

JESSE CALLOWAY JR

ROGERS LAND COMPANY LLC

ANDERSON BEAR CREEK LLC

ASHEVILLE HOMINY RIVERBLUE LLC (PHASE 1)

CROSSROADS ASSEMBLY EAST ASHEVILLE ASSEMBLY OF GOD

ASHEVILLE CITY LIMITS

I-26 NB 47' CONC

I-240 EBL 23" CONC

I-240 WBL 23" CONC

N 70° 44' 00.0" E

-L-

-Y1-

-YIC-

-YID-

-Y2-

-Y3-

-Y4-

-Y5-

-Y6-

-Y7-

-Y8-

-Y9-

-Y10-

-Y11-

-Y12-

-Y13-

-Y14-

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-Y32-

-Y33-

-Y34-

-Y35-

-Y36-

-Y37-

-Y38-

-Y39-

-Y40-

-Y41-

PROJECT REFERENCE NO.	SHEET NO.
I-2513AC	
RW SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

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PERMIT DRAWING
SHEET 9 OF 36

SITE 1

SITE 2

SITE 3

TEMPORARY SURFACE WATER IMPACTS

ASHEVI

BANK STABILIZATION
SEE DETAIL 35
LENGTH= 16LF MIN.
EST. 25 TONS OF CLASS I RIP-RAP
EST. 50 SY GEOTEXTILE

SURFACE WATER IMPACTS

SURFACE WATER IMPACTS

NOTE: OUTLETTING TO EAST NETWORK TO AVOID OUTLETTING DIRECTLY INTO WETLANDS

TRENCHLESS INSTALLATION 48" WELDED STEEL NOT BURIED

COLLAR AND EXTEND

CLEAN OUT SEDIMENT & SLIPLINE EXISTING CMP

NOTE: 48" SUPPLEMENTAL INVERT TO MATCH NORMAL WATER ELEVATION. CONTRACTOR TO CLEAN OUT EXISTING 48" PRIOR TO SLIPLINE

SEE DETAIL 34

ROW CHORD

N 70° 44' 00.0" E

I-240 EBL 23' CONC

I-240 WBL 23' CONC

F F	FILL IN WETLAND	S S	SURFACE WATER IMPACTS
* * *	MECHANIZED CLEARING (GRUBBING)	TS TS	TEMPORARY SURFACE WATER IMPACTS

50' 0' 50' 100' 150'
GRAPHIC SCALE

REVISIONS

8/17/99

$$$$$$SYSTIME$$$$$$
$$$$$$

PERMIT DRAWING
SHEET 10 OF 36

PROJECT REFERENCE NO.	SHEET NO.
I-2513AC	4
R/W SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

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REVISIONS 5/14/99

MATCHLINE -Y1- STA 20+00 – SEE SHEET 11

MATCHLINE -L- STA 27+00 – SEE SHEET 5

MATCHLINE -Y1- STA 28+50 – SEE SHEET 12

SITE 1

SITE 2

SITE 3

END CONSTRUCTION -Y1D- STA.14+43.12

BEGIN CONSTRUCTION -Y1C- STA.11+43.50

-L_TIE_WB- PCC Sta. 13+99.30

-L_TIE_WB- PT Sta. 14+76.15

-L_TIE_WB- PCC Sta. 11+92.99

JOLENE E WOODY

1 BILTMORE AVE, LLC

CROSSROADS ASSEMBLY FKA BEST ASHEVILLE ASSEMBLY OF GOD

ASHEVILLE HOMNY RIVERBLUE LLC (PHASE 1)

JESSE CALLOWAY JR

ROGERS LAND COMPANY LLC

ANDERSON BEAR CREEK LLC

HARRY LEE COATES REVOCABLE LIVING TRUST

REMOVE EXIST BRIDGE

2' LATERAL BASE DITCH SEE DETAIL 31

7' LATERAL BASE DITCH SEE DETAIL 23 EST. 260 TONS CL I RIP RAP EST. 370 SY GEOTEXTILE

7' SPECIAL LATERAL BASE DITCH W/HINGE SEE DETAIL 26

2' BASE BERM DITCH W/HINGE SEE DETAIL 4 EST. 90 TON CL II RIP RAP EST. 120 SY GEOTEXTILE

4' BASE BERM DITCH W/HINGE SEE DETAIL 5

4' BASE BERM DITCH W/HINGE SEE DETAIL 20 EST. 60 TONS CL II RIP RAP EST. 85 SY GEOTEXTILE

SPECIAL CUT DITCH W/HINGE SEE DETAIL 20

SPECIAL CUT 7' BASE DITCH SEE DETAIL 25

SPECIAL DITCH W/HINGE SEE DETAIL 27

LATERAL V DITCH SEE DETAIL 9

ROCK FS SEE DETAIL 6

TEMPORARY SURFACE WATER IMPACTS

BANK STABILIZATION SEE DETAIL 35 LENGTH= 16LF MIN EST. 25 TONS OF CLASS I RIP-RAP EST. 50 SY GEOTEXTILE

SURFACE WATER IMPACTS

CLEAN OUT SEDIMENT & SLIPLINE EXISTING CMP

COLLAR AND EXTEND

NOTE: 48" SUPPLEMENTAL INVERT TO MATCH NORMAL WATER ELEVATION. CONTRACTOR TO CLEAN OUT EXISTING 48" PRIOR TO SLIPLINE

OUTFALL ANALYSIS

FILL IN WETLAND

MECHANIZED CLEARING (GRUBBING)

SURFACE WATER IMPACTS

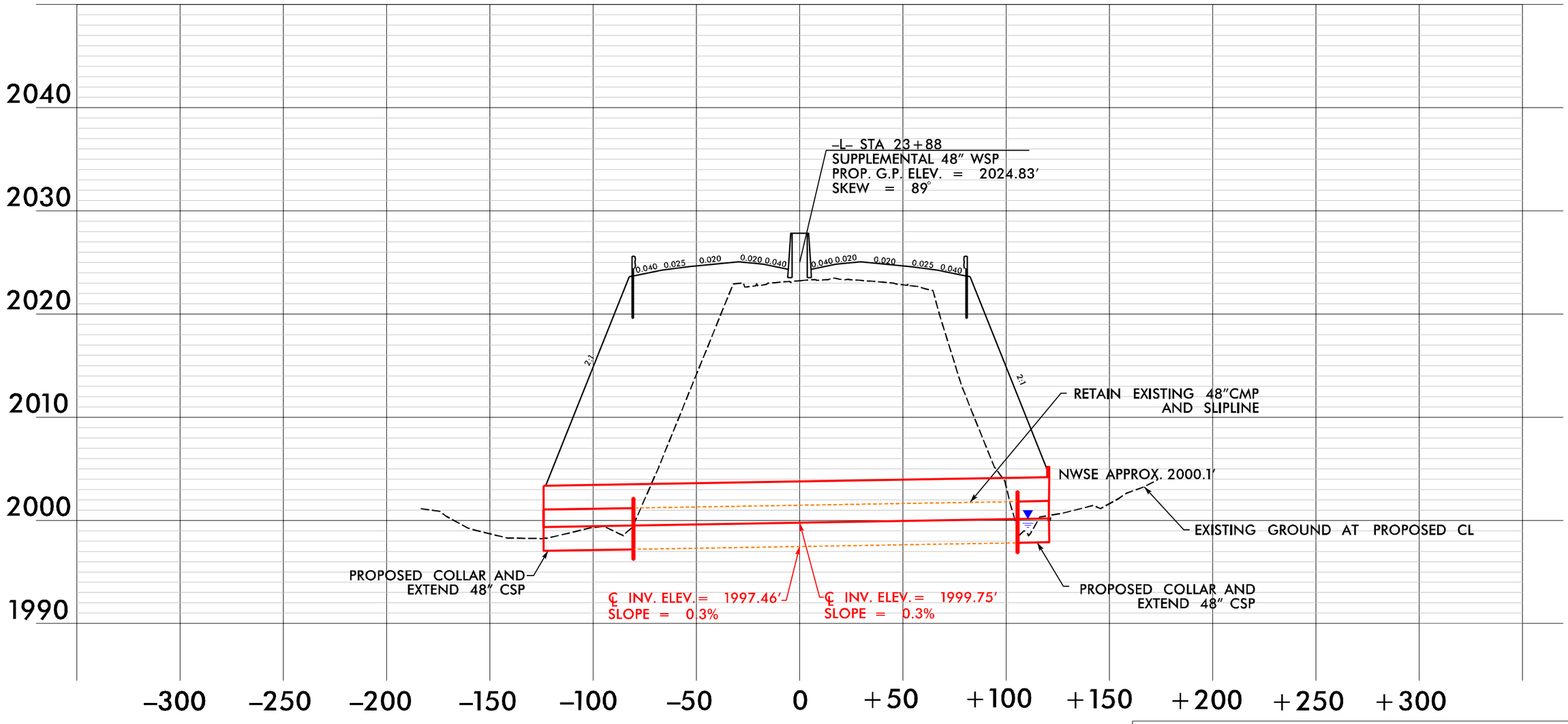
TEMPORARY SURFACE WATER IMPACTS

PAVEMENT REMOVAL

GRAPHIC SCALE 100' 0' 100' 200' 300'

FOR -L- PROFILE SEE SHEET 13
FOR -Y1- PROFILE SEE SHEET 17
FOR -Y1C- PROFILE SEE SHEET 18
FOR -Y1D- PROFILE SEE SHEET 18

SITES 2 – PROFILE VIEW ALONG STRUCTURE



PROFILE

SCALE
VERT. 1"=10'
HORIZ. 1"=50'

PERMIT DRAWING
SHEET 11 OF 36

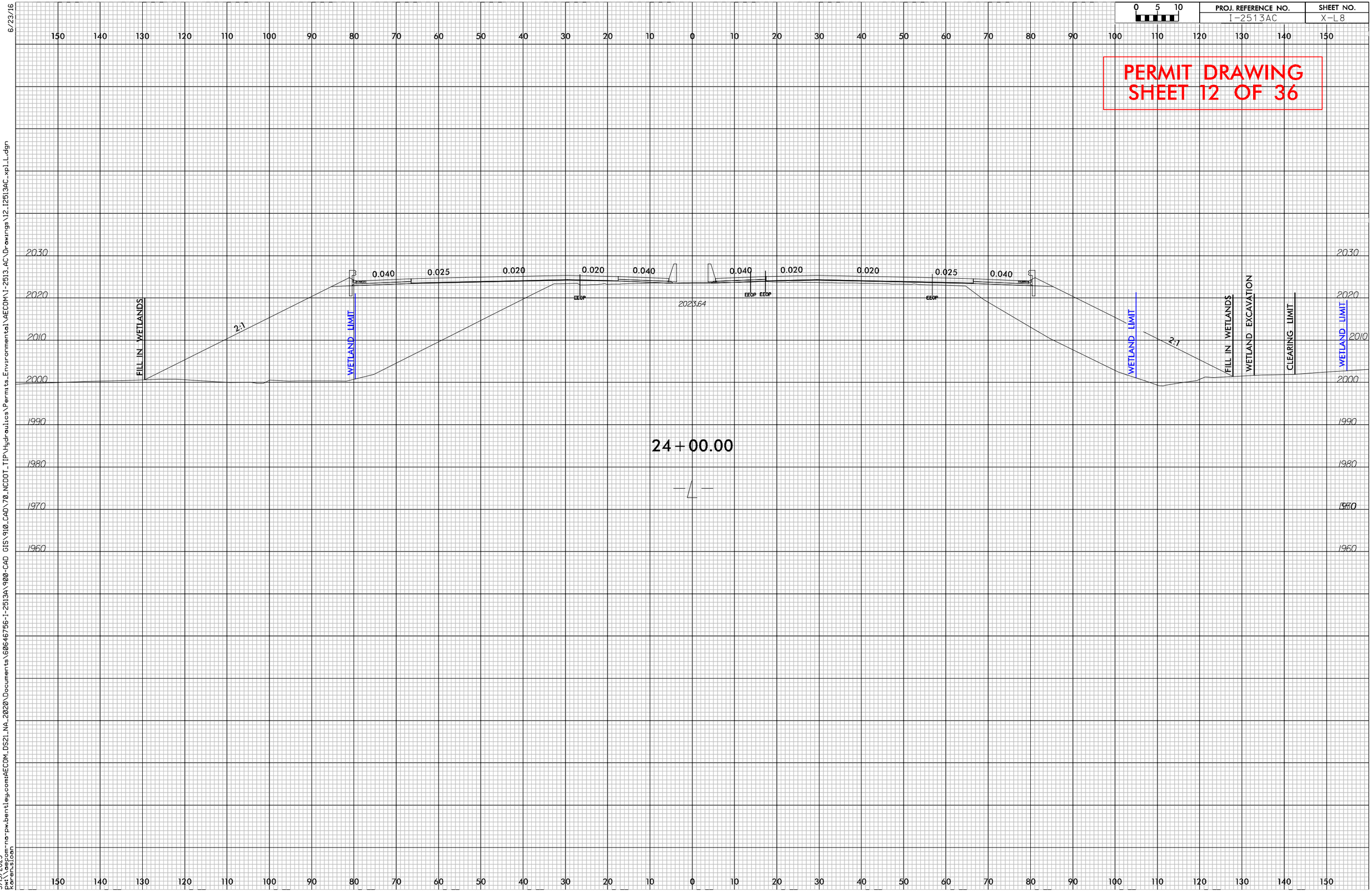
NCDOT

DIVISION OF HIGHWAYS
BUNCOMBE COUNTY

PROJECT: 34165.1.3 (I-2513AC)
I-26 / I-40 / I-240 INTERCHANGE TO
SR 3548 (HAYWOOD RD)

0 5 10	PROJ. REFERENCE NO.	SHEET NO.
	I-2513AC	X-L8

PERMIT DRAWING
SHEET 12 OF 36



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karen.sloan

PERMIT DRAWING
SHEET 13 OF 36

PROJECT REFERENCE NO.	SHEET NO.
I-2513AC	5
R/W SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

INCOMPLETE PLANS
DO NOT USE FOR R/W ACQUISITION

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NC FIRM LICENSE No: F-0342
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REVISIONS 5/14/99

MATCHLINE -Y- STA 27+00 – SEE SHEET 4

MATCHLINE -Y- STA 41+00 – SEE SHEET 6

ASHEVILLE HOMINY RIVERBLUE LLC (PHASE 1)

AREA UNDER CONSTRUCTION

ANDERSON BEAR CREEK LLC

BERM DITCH w/HINGE SEE DETAIL 22

TOE OF SLOPE

EXISTING R/W

60' CHL

NOTE: GORE AREAS RESTRICTED TO 5% ROLLOVER

TIE TO EXIST. FENCE

-Y2RPB-

-L-

-Y2RPC-

N 77° 46' 34.5" E

N 77° 32' 06.9" E

I-26 SB 40.8' CONC

I-26 NB 41' CONC

I-26 NB 40.5' CONC

I-26 SB 40' CONC

I-240 WBL 23' CONC

I-240 EBL 23' CONC

15" RCP-IV

18" RCP-IV

24" RCP-IV

TB 2GI

FS SEE DETAIL 21

FS SEE DETAIL 37 BDO

BDO

BEG. FENCE

END FENCE

TIE INTO EXISTING GROUND

TIE TO EXIST. FENCE

7' LATERAL BASE DITCH
SEE DETAIL 23
EST. 260 TONS CL I RIP RAP
EST. 370 SY GEOTEXTILE

2' BASE BERM DITCH w/HINGE SEE DETAIL 22

4' BASE BERM DITCH w/HINGE SEE DETAIL 19
EST. 170 TONS CL II RIP RAP
EST. 230 SY GEOTEXTILE

4' BASE BERM DITCH w/HINGE SEE DETAIL 5

4' BASE BERM DITCH w/HINGE SEE DETAIL 3
EST. 70 TONS CL B RIP RAP
EST. 160 SY GEOTEXTILE

4' BASE BERM DITCH w/HINGE SEE DETAIL 5

100' 0' 100' 200' 300'
GRAPHIC SCALE

FOR -L- PROFILE SEE SHEET 13
FOR -Y2RPB- PROFILE SEE SHEET 21
FOR -Y2RPC- PROFILE SEE SHEET 22

3/13/2023
C:\900-CAD\13A\900-CAD\70_NCDOT_TIP\Hydraulics\Permits_Environmental\AECOM\I-2513_AC\Drawings\13_I2513AC_rdy_psh_05.dgn
karen.sloan

PROJECT REFERENCE NO.	SHEET NO.
I-2513AC	5
R/W SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

INCOMPLETE PLANS
DO NOT USE FOR R/W ACQUISITION

Prepared in the Office of: AECOM
NC FIRM LICENSE No: F-0342
5438 Wade Park Boulevard Suite 200
Raleigh, NC 27607
(919) 854-6200 - (919) 854-6259(FAX)

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

PERMIT DRAWING
SHEET 14 OF 36

MATCHLINE -Y- STA 27+00 – SEE SHEET 4

MATCHLINE -Y- STA 41+00 – SEE SHEET 6

ASHEVILLE HOMINY RIVERBLUE LLC
(PHASE II)

AREA UNDER CONSTRUCTION

ANDERSON BEAR CREEK LLC

-L-

-Y2RPB-

-Y2RPC-

N 77° 46' 34.5" E

N 77° 32' 06.9" E

BEG. FENCE

END FENCE

TIE INTO EXISTING GROUND

TIE TO EXIST. FENCE

7' LATERAL BASE DITCH
SEE DETAIL 23
EST. 260 TONS CL I RIP RAP
EST. 370 SY GEOTEXTILE

2' BASE BERM DITCH w/HINGE
SEE DETAIL 22

4' BASE BERM DITCH w/HINGE
SEE DETAIL 19
EST. 170 TONS CL II RIP RAP
EST. 230 SY GEOTEXTILE

4' BASE BERM DITCH w/HINGE
SEE DETAIL 5

4' BASE BERM DITCH w/HINGE
SEE DETAIL 3
EST. 70 TONS CL B RIP RAP
EST. 160 SY GEOTEXTILE

BERM DITCH w/HINGE SEE DETAIL 22

NOTE: GORE AREAS RESTRICTED TO 5% ROLLOVER

FS SEE DETAIL 37 BDO

FS SEE DETAIL 21

FS SEE DETAIL 20

BDO

15" RCP-IV

18" RCP-IV

24" RCP-IV

TB 2GI

2GI

I-26 SB 40.8' CONC

I-26 NB 41' CONC

I-26 SB 40' CONC

I-26 NB 40.5' CONC

I-240 WBL 23' CONC

I-240 EBL 80' CONC

10' BST

9' BST

BST

5' CURB

EXISTING R/W

60' CHL

TOE OF SLOPE

100' 0' 100' 200' 300'
GRAPHIC SCALE

FOR -L- PROFILE SEE SHEET 13
FOR -Y2RPB- PROFILE SEE SHEET 21
FOR -Y2RPC- PROFILE SEE SHEET 22

REVISIONS

5/14/99

3/13/2023
C:\Users\karen.sloan\AppData\Local\Temp\900-CAD\13A\900-CAD\13A\CAD\70_NCDOT_TIP\Hydraulics\Permits_Environmental\AECOM\I-2513_AC\Drawings\14_I2513AC_rdy_psh_05.dgn
karen.sloan

REVISIONS

PROJECT REFERENCE NO.	SHEET NO.
I-2513C	6
R/W SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

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DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

PERMIT DRAWING SHEET 15 OF 36

TRAFFIC DIAGRAM
-Y2- BREVARD RD 13,344 16,800 ADT 2014 ADT 2040
-Y2RPA- 12,484 15,900
-RP22- 11,280 13,700
-L- I-26 (TO I-40) 58,400 101,400
-Y2RPC- 12,484 15,900
-RP23- 11,280 13,700
-L- I-26 (TO ASHEVILLE) 60,332 73,000
17,216 20,800
-Y2- BREVARD RD

TRAFFIC DIAGRAM
-Y2- BREVARD RD 17,216 20,800 ADT 2014 ADT 2040
408 600
-Y12A- HEALTHCARE COMPLEX DR 850 1,700
408 600
17,216 20,800
-Y2- BREVARD RD

TRAFFIC DIAGRAM
ADT 2014 ADT 2040 -Y2- BREVARD RD 11,472 15,900
725 400
-Y13B- SHELBURN RD 2,104 2,400 2,104 2,300
15,344 18,800
-Y2- BREVARD RD

SITE 5 (SEE PERMIT SHEET 17)

MAG 6°06'

S 58° 41' 35.4" E

S 12° 29' 48.2" E

S 85° 06' 48.8" E

N 50° 54' 26.0" E

S 45° 09' 30.8" E

N 68° 54' 09.2" E

S 58° 38' 40.5" E

N 67° 40' 10.7" E

N 65° 54' 09.2" E

N 68° 54' 54.9" E

S 10° 44' 51.0" W

S 58° 43' 27.3" E

N 82° 47' 54.9" W

N 37° 04' 00.7" E

S 63° 52' 06.3" W

N 88° 08' 15.8" E

N 78° 35' 35.8" E

S 85° 06' 48.8" E

N 82° 58' 32.3" E

S 87° 21' 27.7" E

N 62° 58' 32.3" E

SEE PERMIT DRAWING 16 OF 36 FOR ENLARGEMENT

SITE 4 (SEE PERMIT SHEET 16)

SITE 5 (SEE PERMIT SHEET 18)

SITE 6 (SEE PERMIT SHEET 18)

MATCHLINE -Y- STA 41+00 – SEE SHEET 5

MATCHLINE -Y- STA 69+00 – SEE SHEET 7

REED FAMILY REVOCABLE TRUST LORA N. DIETZ TYRUSTEED ETAL

DANIEL & EMILY E SCHURING

CITY OF ASHEVILLE

ASHEVILLE CITY LIMITS

ASHEVILLE-HOMINY RIVERBLUE LLC

MICHAEL CARPENTER

PATRICK BOLAND

MATTHEW & KATHLEEN LITTLEFIELD

TINA G. WOOD

TONY & ELLEN BRANT

TOMMIE & CAROLYN TRANTHAM

JOHN & ROSMARY KAST

MARGARET SHAW

MANDY SCEPANIAK

SARAH S & DANIEL R SALAZAR

DAVID ZARITSKY

DAVID LINDSAY SMITH & CARLA SMITH HALE

SAMUEL C. & ELIZABETH W. WEAVER JR.

IMPERIAL CONSTRUCTION & DEVELOPMENT INC

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

STATE HIGHWAY COMMISSIONS

ASTON PARK HEALTH CARE CENTER

NCDOT

HERON BEAR CREEK

S/S SURFACE WATER IMPACTS

TS/TS TEMPORARY SURFACE WATER IMPACTS

50′ 0′ 100′
GRAPHIC SCALE

PAVEMENT REMOVAL ★ PROPOSED SIGNAL

FOR -Y2- PROFILE SEE SHEET 19
FOR -Y2A- PROFILE SEE SHEET 20
FOR -Y2B PROFILE SEE SHEET 20
FOR -Y2C PROFILE SEE SHEET 21
FOR -Y2- PROFILE SEE SHEET 29
FOR -DW2- PROFILE SEE SHEET 33

FOR -L- PROFILE SEE SHEETS 14-15
FOR -Y2RPB- PROFILE SEE SHEET 21
FOR -Y2RPC- PROFILE SEE SHEET 22
FOR -RP23- PROFILE SEE SHEET 23
FOR -RP32- PROFILE SEE SHEETS 24-25
FOR -DW3- PROFILE SEE SHEET 33

LOCATION:
TIP NO.: COUNTY:
DESIGNED BY:
CHECKED BY: DATE:

GRAPHIC SCALE
50 25 0 50 100
PLANS

PLOTTED BY: jwilson DateTime:8/2/2024 10:05:21 AM File Name:C:\Users\jwilson\Desktop\WORK\I-2513C_NA_20220\Documents\ROADWAY\I-2513C_TIP\Hydraulics\Permits_Environmental\I-2513C_sht_plan_ovr.sht

SITE 4

PROJECT REFERENCE NO.	SHEET NO.
R/W SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

INCOMPLETE PLANS
DO NOT USE FOR R/W ACQUISITION

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

REVISIONS 8/17/99

PERMIT DRAWING
SHEET 16 OF 36

S S SURFACE WATER IMPACTS

30' 0' 30' 60' 90'
GRAPHIC SCALE

3/14/2023
pw:\\aecom-na-pwbentley.com:AECOM_DS21_NA_2020\Documents\60646756-I-2513A\900-CAD_GIS\910_CADD\70_NCDOT_TIP\Hydraulics\Permits_Environmental\AECOM\I-2513A_AC\Drawings\16_I2513AC_perm_wet_Site 4.dgn

SITE 5

S S SURFACE WATER IMPACTS

TS TS TEMPORARY SURFACE WATER IMPACTS

NAD 83/95

PROJECT REFERENCE NO.	SHEET NO.
I-2513AC	
R/W SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

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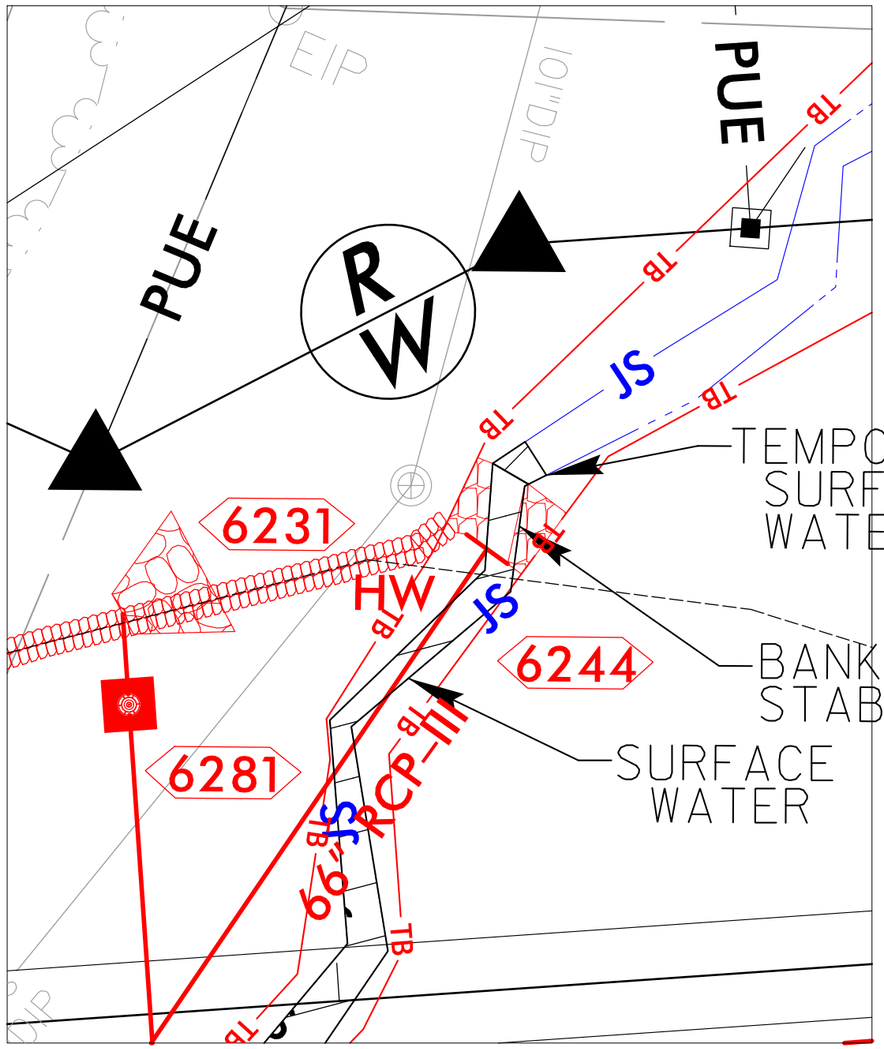
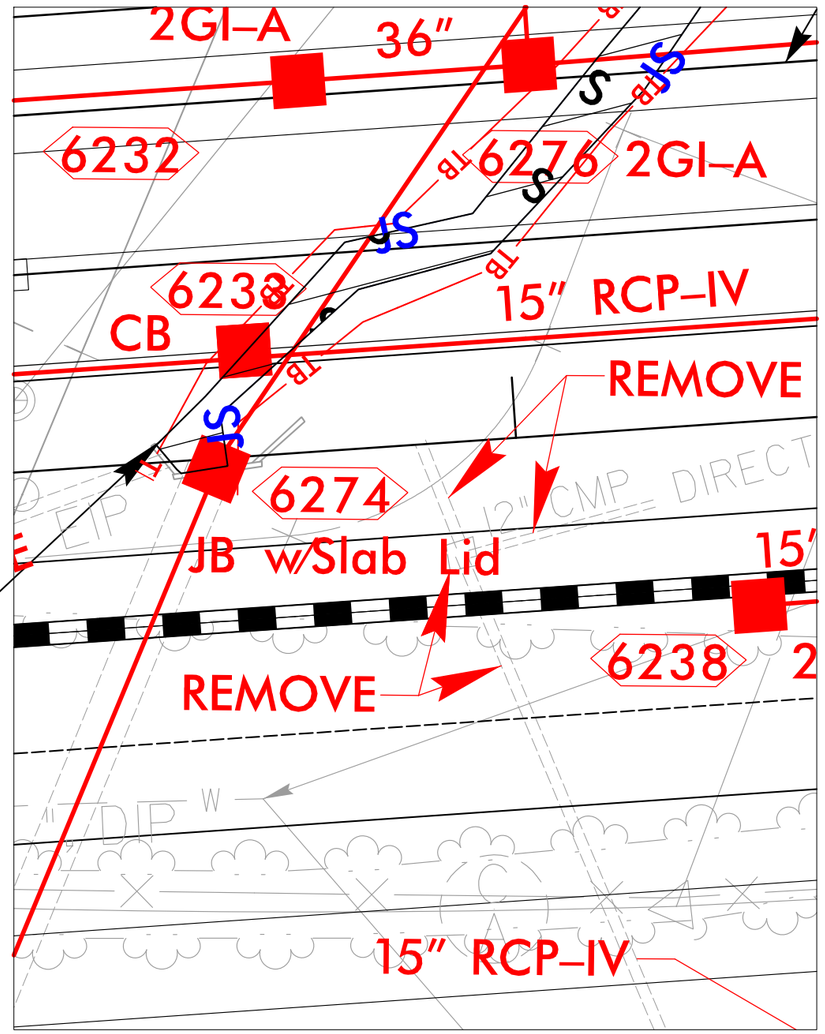
PERMIT DRAWING
SHEET 17 OF 36



SITE 5 BLOWUP MATCHLINE



10' 0' 20'
INSET GRAPHIC SCALE

PAVEMENT REMOVAL

FOR -L- PROFILE SEE SHEET 16
FOR -Y4- PROFILE SEE SHEET 28
FOR -Y4RPC- PROFILE SEE SHEET 29

REVISIONS 5/14/99

Plotted: 11:17 AM
Design Data
Project Manager
Project Engineer
Drawn By
Checked By
Project Engineer
Project Manager
Designed By
Project Engineer
Project Manager
Checked By
Project Engineer
Project Manager
Drawn

PROJECT REFERENCE NO.	SHEET NO.
I-2513AC	
R/W SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

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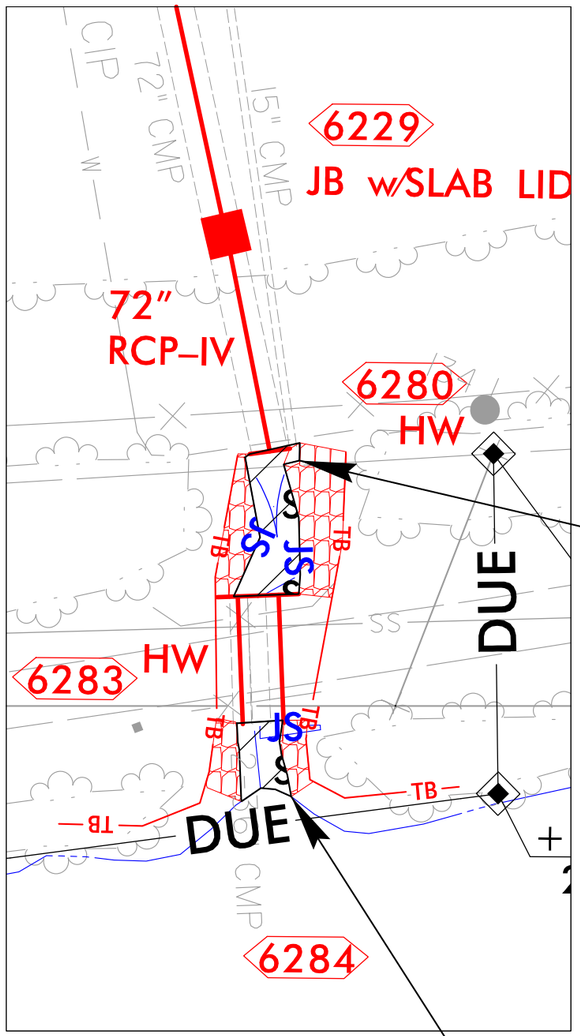
PERMIT DRAWING SHEET 18 OF 36

TS TS TEMPORARY SURFACE WATER IMPACTS

S S SURFACE WATER IMPACTS

NAD 83/95

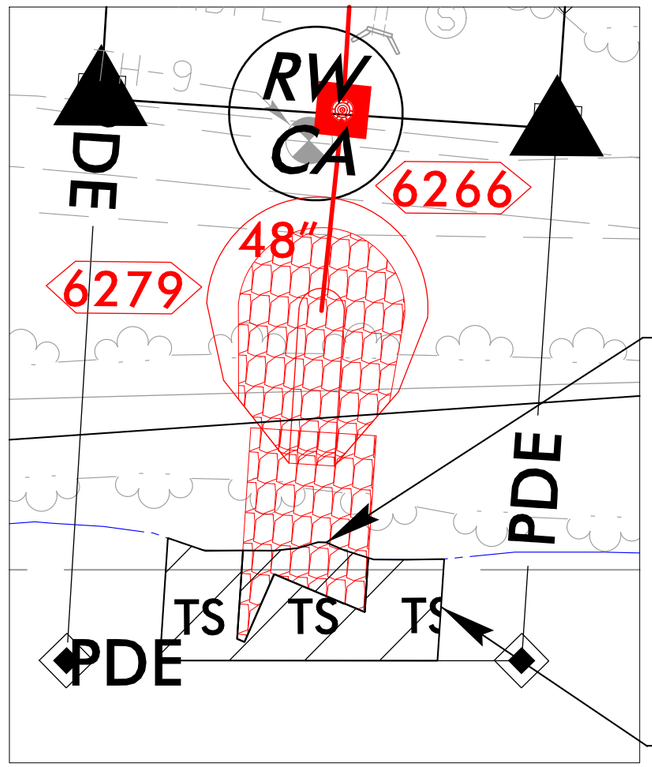
SITE 5



25′ 0′ 50′

INSET GRAPHIC SCALE

SITE 6



10′ 0′ 20′

INSET GRAPHIC SCALE

PAVEMENT REMOVAL

FOR -L- PROFILE SEE SHEET 16
FOR -Y4- PROFILE SEE SHEET 28
FOR -Y4RPC- PROFILE SEE SHEET 29

REVISIONS 5/14/99

W:\56-I-2513A\GIS\910_CAD\70_NCDOT_TIP\Hydraulics\Permits_Environmental\VHB\I2513A_hyd_prm_wet_blowups_2.dgn
11/19/2015 11:44:40 AM

REVISIONS

TRAFFIC DIAGRAM
-Y3- BREVARD RD
13,344 / 12,500 ADT 2024 / ADT 2045
-Y2RPA- 12,484 / 13,900
-RP2A- 13,700 / 13,700
-Y2RPC- 12,484 / 13,900
-RP2C- 13,700 / 13,700
-L- I-26 (TO ASHEVILLE) 88,400 / 107,400
-L- I-26 (TO ASHEVILLE) 69,200 / 77,500
-Y2- HEALTHCARE COMPLEX DR 500 / 1,100
17,216 / 20,800 -Y2- BREVARD RD
-Y2- BREVARD RD 17,216 / 20,800 ADT 2024 / ADT 2045
538 / 600
486 / 600
-Y2- BREVARD RD
ADT 2024 / ADT 2045 -Y2- BREVARD RD 11,472 / 13,600
-Y3B- SHELBURN RD 2,524 / 2,400
726 / 650
2,168 / 2,300
15,344 / 16,900 -Y2- BREVARD RD

SITE 5 (SEE PERMIT SHEET 17)

SITE 6 (SEE PERMIT SHEET 18)

SITE 5 (SEE PERMIT SHEET 18)

SITE 4 (SEE PERMIT SHEET 16)

SEE PERMIT DRAWING 16 OF 36 FOR ENLARGEMENT

MATCHLINE -Y- STA 41+00 – SEE SHEET 5

MATCHLINE -Y- STA 69+00 – SEE SHEET 7

PROJECT REFERENCE NO. I-2513C
R/W SHEET NO.
SHEET NO. 6
ROADWAY DESIGN ENGINEER
HYDRAULICS ENGINEER
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PERMIT DRAWING SHEET 19 OF 36

S / S SURFACE WATER IMPACTS
TS / TS TEMPORARY SURFACE WATER IMPACTS
50' 0' 100'
GRAPHIC SCALE

PAVEMENT REMOVAL ★ PROPOSED SIGNAL

FOR -Y2- PROFILE SEE SHEET 19
FOR -Y2A- PROFILE SEE SHEET 20
FOR -Y2B PROFILE SEE SHEET 20
FOR -Y2C PROFILE SEE SHEET 21
FOR -Y3- PROFILE SEE SHEET 29
FOR -DW2- PROFILE SEE SHEET 33
FOR -L- PROFILE SEE SHEETS 14-15
FOR -Y2RPB- PROFILE SEE SHEET 21
FOR -Y2RPC- PROFILE SEE SHEET 22
FOR -RP23- PROFILE SEE SHEET 23
FOR -RP32- PROFILE SEE SHEETS 24-25
FOR -DW3- PROFILE SEE SHEET 33

LOCATION:
TIP NO.: COUNTY:
DESIGNED BY:
CHECKED BY: DATE:
GRAPHIC SCALE 50 25 0 50 100
PLANS

C:\Users\dmcfall\Desktop\MICDM_25C2L_MA_20289\Documents\68f46796-1-2513A_MA_20289_Curve_wet_ash_RK.dgn

PROJECT REFERENCE NO.	SHEET NO.
I-2513AC	
R/W SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

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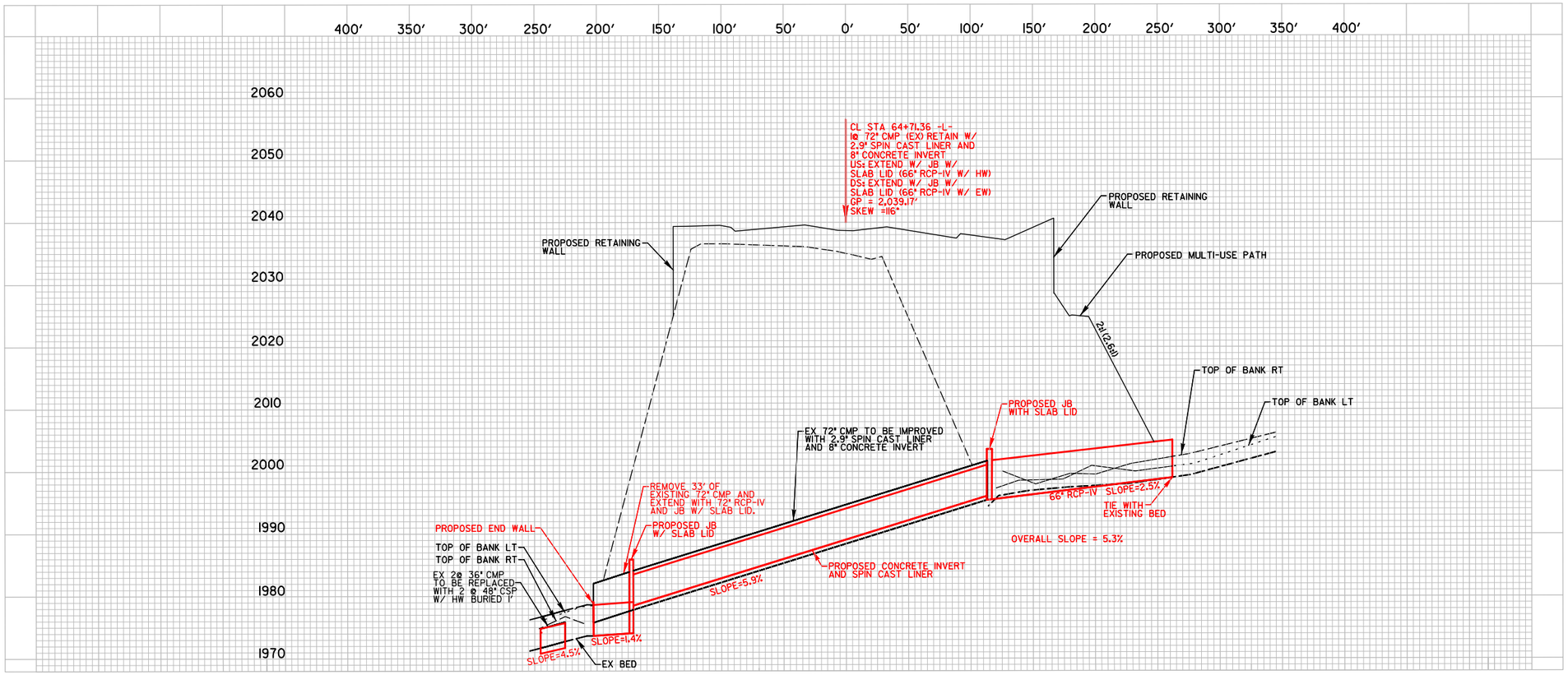
PERMIT DRAWING SHEET 20 OF 36

NAD 83/95

SITE 5 - PROFILE VIEW ALONG STRUCTURE



PAVEMENT REMOVAL

FOR -Y3- PROFILE SEE SHEET 25-26
FOR -Y3A- PROFILE SEE SHEET 26
FOR -Y3B- PROFILE SEE SHEET 26

REVISIONS
5/14/99

J:\2513AC_NCDOT_TIP\900-CAD Group\910-CAD\70_NCDOT_TIP\Hydraulics\Permits_Environmental\VHB\I2513A_hyd_prm_wet_pipe_profile_UT_to_FrenchBroad.dgn
10:37:45 AM
Gustafson, Peter

REVISIONS

PROJECT REFERENCE NO.	SHEET NO.
I-2513C	7
R/W SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

PERMIT DRAWING
SHEET 21 OF 36

S / S	SURFACE WATER IMPACTS
TS / TS	TEMPORARY SURFACE WATER IMPACTS
F / F	FILL IN WETLAND

50' 0' 100'
GRAPHIC SCALE

SITE 7
(SEE PERMIT
SHEET 22)

SITE 7
(SEE PERMIT
SHEET 23)

MATCHLINE -L- STA 69+00 - SEE SHEET 6

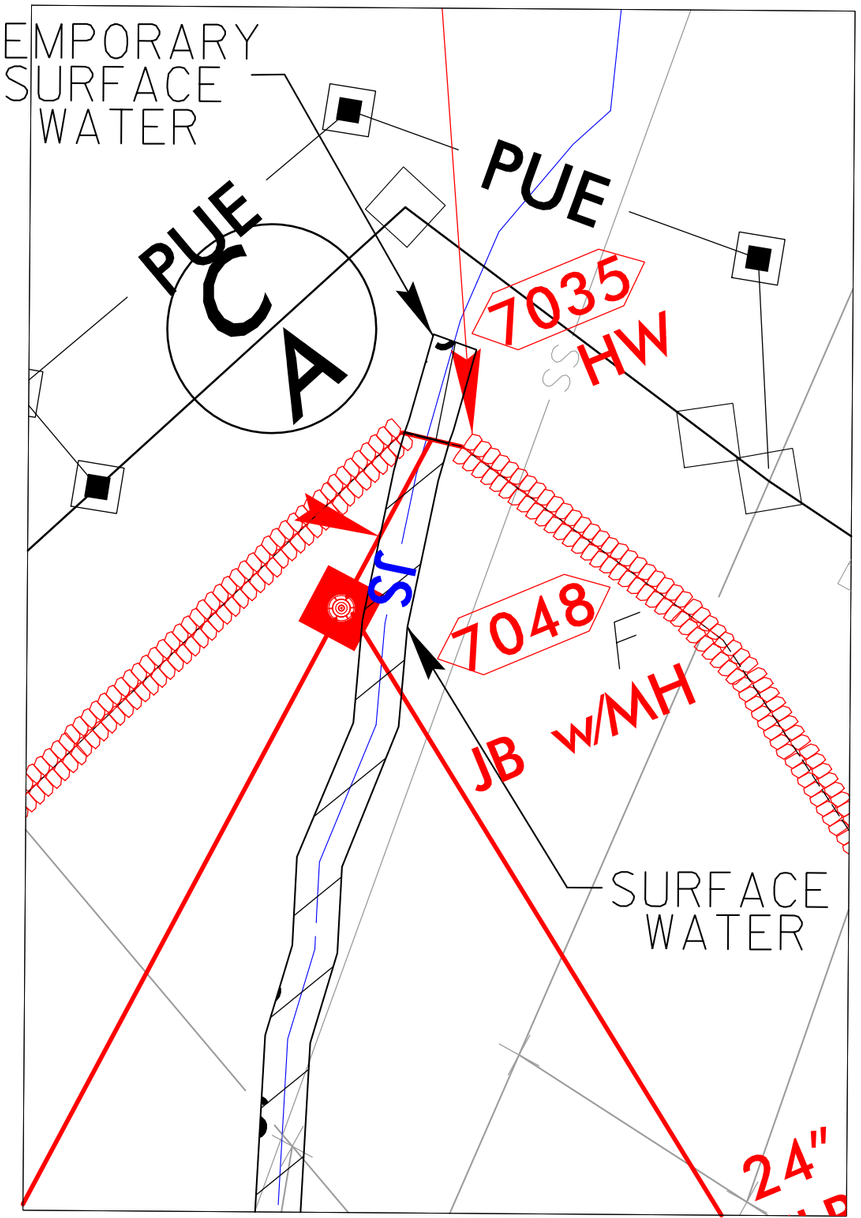
MATCHLINE -L- STA 98+00 - SEE SHEET 8

MATCHLINE -Y3- STA 20+00
SEE SHEET 10

LOCATION:	
TIP NO.:	COUNTY:
DESIGNED BY:	
CHECKED BY:	DATE:

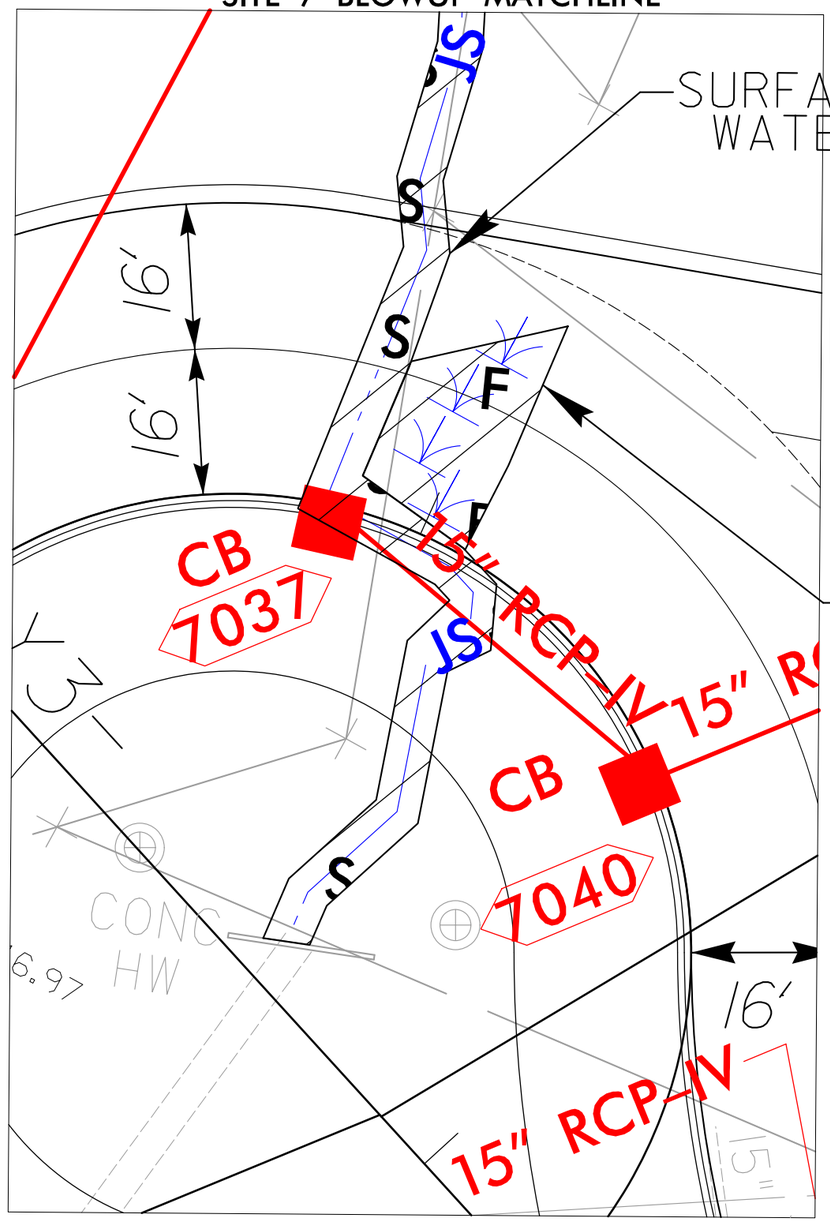
GRAPHIC SCALE
50 25 0 50 100
PLANS

SITE 7



SITE 7 BLOWUP MATCHLINE

SITE 7 BLOWUP MATCHLINE



25' 0' 50'

INSET GRAPHIC SCALE

PROJECT REFERENCE NO.	SHEET NO.
I-2513AC	
R/W SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

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PERMIT DRAWING SHEET 22 OF 36

S / S	SURFACE WATER IMPACTS
F / F	FILL IN WETLAND
TS / TS	TEMPORARY SURFACE WATER IMPACTS

PAVEMENT REMOVAL

FOR -L- PROFILE SEE SHEET 16
FOR -Y4- PROFILE SEE SHEET 28
FOR -Y4RPC- PROFILE SEE SHEET 29

REVISIONS 5/14/99

56-I-2513a_9-30-06.dgn
GIS\910_CAD\70_NCDOT_TIP\Hydraulics\Permits_Environmental\VHB\I2513a_hyd_prm_wet_blowups_3.dgn
9-30-06 AM

PROJECT REFERENCE NO.	SHEET NO.
I-2513AC	
R/W SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

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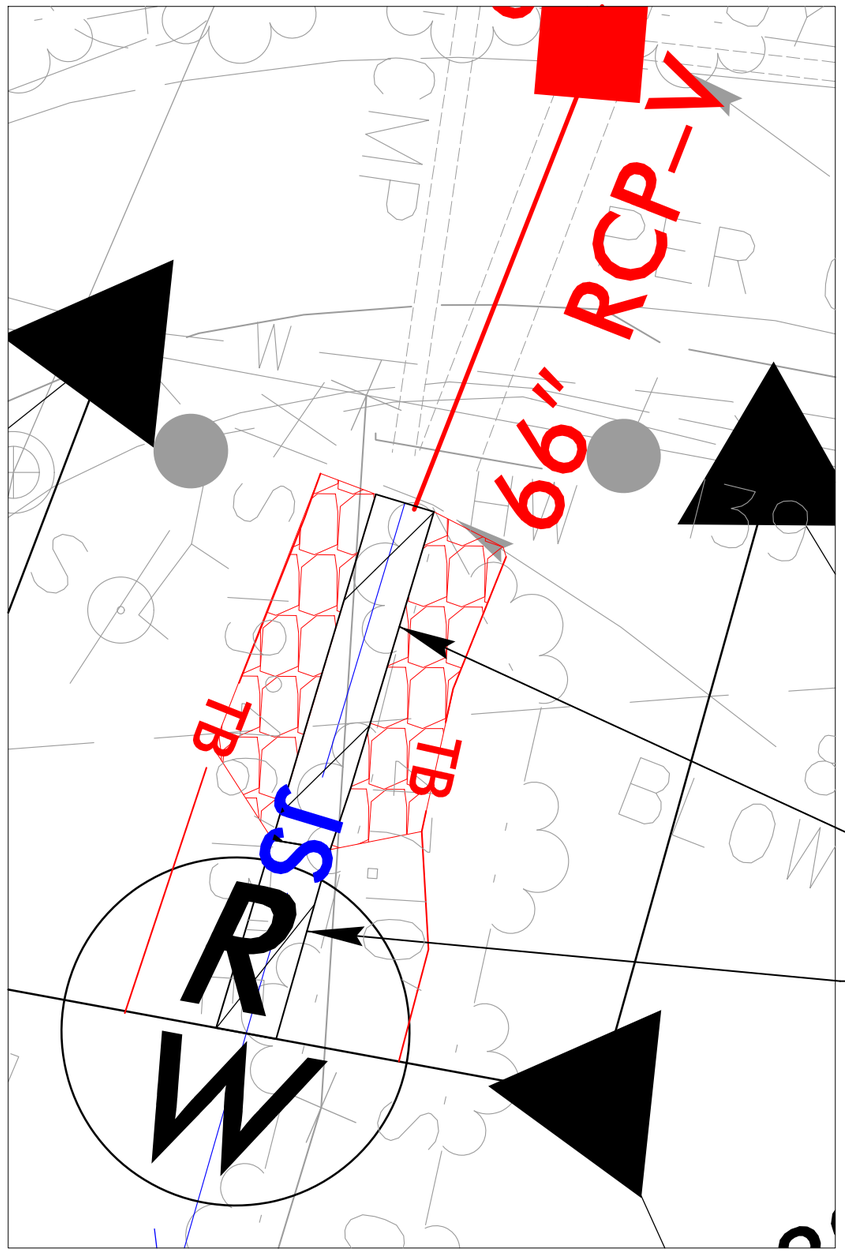
PERMIT DRAWING SHEET 23 OF 36

SITE 7



10' 0' 20'
INSET GRAPHIC SCALE

TS TS TEMPORARY SURFACE WATER IMPACTS

S S SURFACE WATER IMPACTS

PAVEMENT REMOVAL

FOR -L- PROFILE SEE SHEET 16
FOR -Y4- PROFILE SEE SHEET 28
FOR -Y4RPC- PROFILE SEE SHEET 29

REVISIONS 5/14/99

W:\56-I-2513A\WBG\GIS\910_CAD\70_NCDOT_TIP\Hydraulics\Permits_Environmental\VHB\I2513A_hyd_prm_wet_blowups_4.dgn 11/8/2018 8:58:58 AM

REVISIONS

PROJECT REFERENCE NO.	SHEET NO.
I-2513C	7
R/W SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

PERMIT DRAWING
SHEET 24 OF 36

50' 0' 100'
GRAPHIC SCALE

S S SURFACE WATER IMPACTS

TS TS TEMPORARY SURFACE WATER IMPACTS

F F FILL IN WETLAND

SITE 7
(SEE PERMIT
SHEET 22)

SITE 7
(SEE PERMIT
SHEET 23)

MATCHLINE -L- STA 69+00 - SEE SHEET 6

MATCHLINE -L- STA 98+00 - SEE SHEET 8

MATCHLINE -Y3- STA 20+00
SEE SHEET 10

LOCATION:	
TIP NO.	COUNTY:
DESIGNED BY:	
CHECKED BY:	DATE:

GRAPHIC SCALE
50 25 0 50 100
PLANS

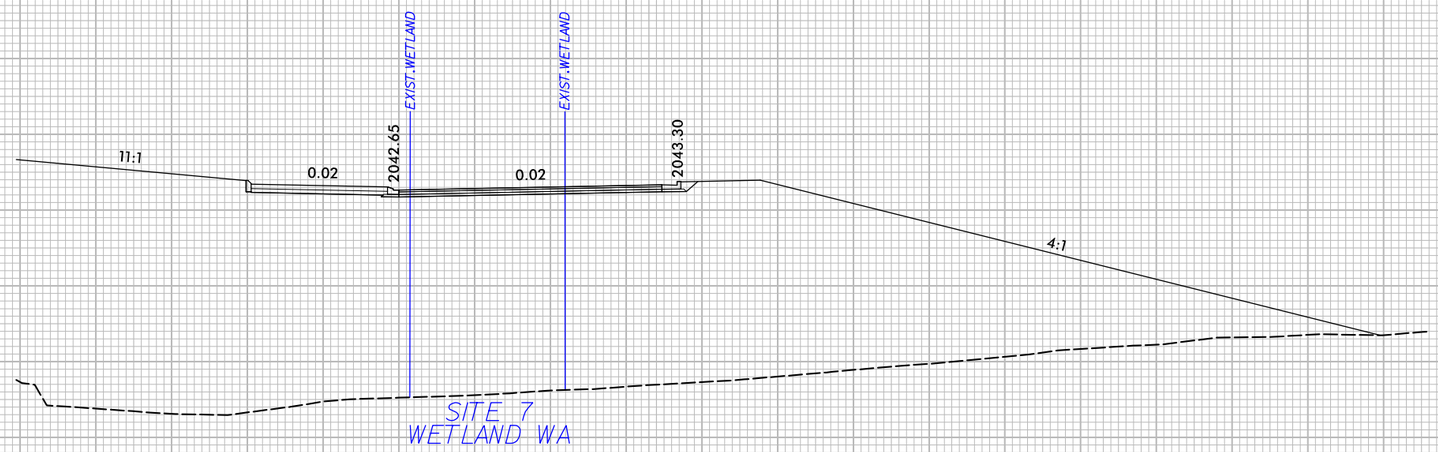
-RABI-

0 5 10	PROJECT REFERENCE	SHEET NO.
	BP6.R017 – HARNETT 54	X-1

PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION

INCOMPLETE PLANS
DO NOT USE FOR R/W ACQUISITION

PERMIT DRAWING
SHEET 25 OF 36



11+00.00

-RABI-

11/11/2022 9:39:54 AM
javerette
pw:\\aecom-na-pw.bentley.com:AECOM_DS21_NA_2020_Documents\60646756-I-2513A\900-CAD GIS\910_CAD\70_NCDOT_TIP\Hydraulics\Permits_Environmental\VHB\12513A_hyd_prm_wet_wetland_xsc.dgn

PROJECT REFERENCE NO.	SHEET NO.
I-2513AC	8
R/W SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

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5438 Wade Park Boulevard, Suite 200
Raleigh, NC 27607
(919) 854-6200 - (919) 854-6259(FAX)

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PERMIT DRAWING SHEET 26 OF 36

S S SURFACE WATER IMPACTS

TS TS TEMPORARY SURFACE WATER IMPACTS

NAD 83/95

MATCHLINE -L- STA 98+00 – SEE SHEET 7

MATCHLINE -L- STA 110+00 – SEE SHEET 9

SITE 8 (SEE PERMIT SHEET 27)

SITE 8 (SEE PERMIT SHEETS 27 THROUGH 28)

CONCRETE DITCH BEHIND RETAINING WALL SEE DETAIL 7

STANDARD BASE DITCH W/CLASS I RIP RAP EST 100 TONS EST 30 CY DDE SLOPE=1:1–5.0% SEE DETAIL 58

TIE TO EXIST. FENCE

TRENCHLESS INSTALLATION 72" WELDED STEEL BURIED

FILL WITH FLOWABLE FILL

REMOVE

LATERAL BASE DITCH W/CLASS I RIP RAP SEE DETAIL 50 STANDARD BASE DITCH W/CLASS I RIP RAP EST 80 TONS EST 144 SY GEOTEXTILE EST 25 CY DDE SLOPE=8.6% SEE DETAIL 42

BANK STABILIZATION CLASS II RIP RAP EST 5 TONS EST 7 SY GEOTEXTILE SEE DETAIL 44

FILL SCOUR HOLE AND ARMOR EXISTING BANKS W/CLASS II RIP RAP EST 135 TONS EST 150 SY GEOTEXTILE DDE=150 CY

FALSE SUMP SEE DETAIL 21

FALSE SUMP SEE DETAIL 34

LATERAL 'V' DITCH SEE DETAIL 51

SPECIAL CUT 'V' DITCH SEE DETAIL 52

RETAIN

N 68° 51' 00.00" E

N 21° 03' 00.00" W

N 4° 51' 20.00" E

-Y13-

-Y14-

-Y15-

50' 0' 100'
GRAPHIC SCALE

FOR -L- PROFILE SEE SHEET 16
FOR -Y3RPA- PROFILE SEE SHEET 27
FOR -Y4RPC- PROFILE SEE SHEET 29
FOR -Y13- PROFILE SEE SHEET 31
FOR -Y14- PROFILE SEE SHEET 31

REVISIONS

5/14/99

ROW REV. APRIL 5, 2023 PARCEL 93 AND 94 CHANGED TO TOTAL TAKE
ROW REV. APRIL 5, 2023 PUE ADDED TO PARCEL 95 FOR OH UTILITY
ROW REV. APRIL 5, 2023 PARCEL NUMBER 85 ADDED TO PARCEL

I:\I3756\I-2513AC\PRODUCTION\ROADWAY\GIS\910_CADD\70_NCDOT_TIP\Hydraulics\I-2513AC_H_GIS_PERMIT_SHEET_8.dgn
11/15/2023 11:53:53 AM
User:jcovington

S/S SURFACE WATER IMPACTS

TS/TS TEMPORARY SURFACE WATER IMPACTS

PROJECT REFERENCE NO.	SHEET NO.
I-2513AC	
R/W SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

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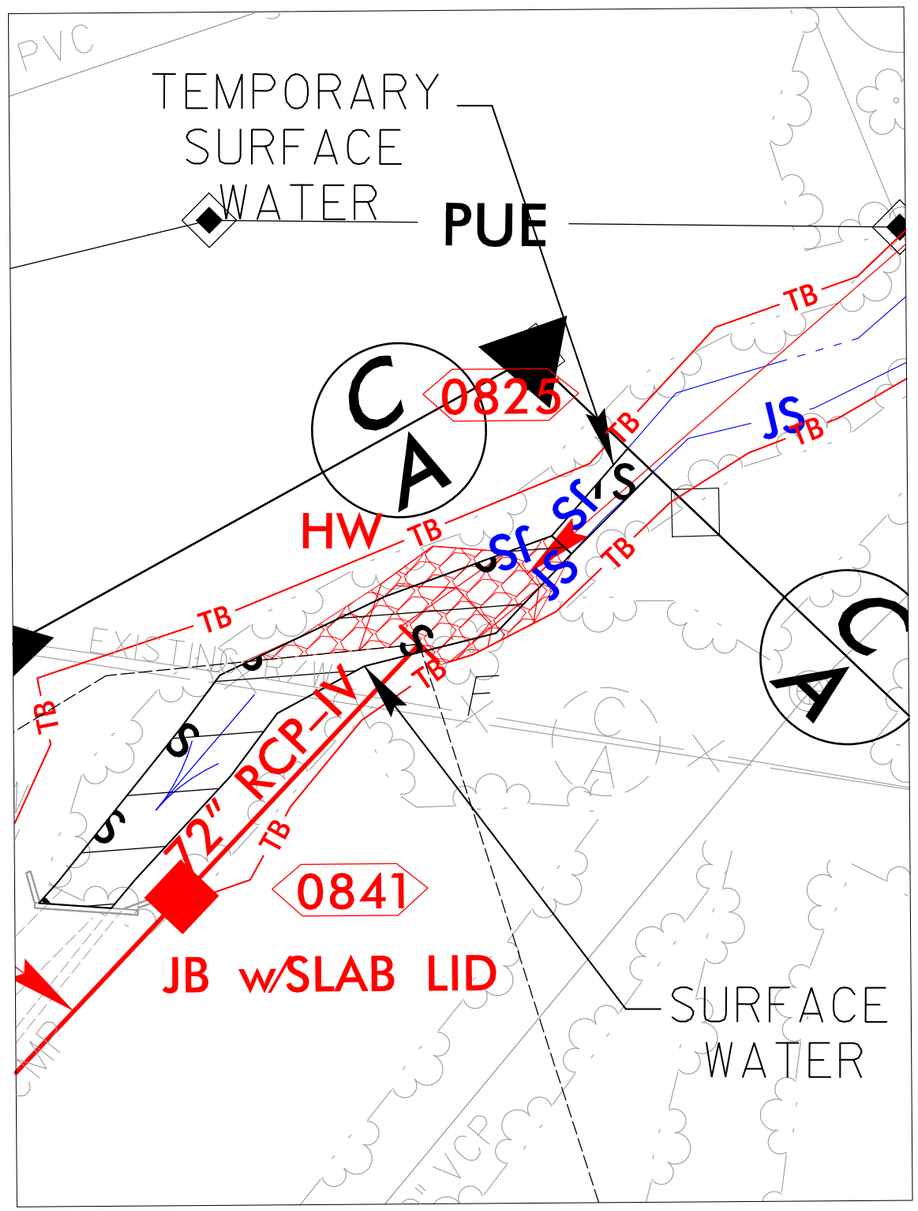
NC FIRM LICENSE No: F-0342
5438 Wade Park Boulevard, Suite 200
Raleigh, NC 27607
(919) 854-6200 - (919) 854-6259(FAX)

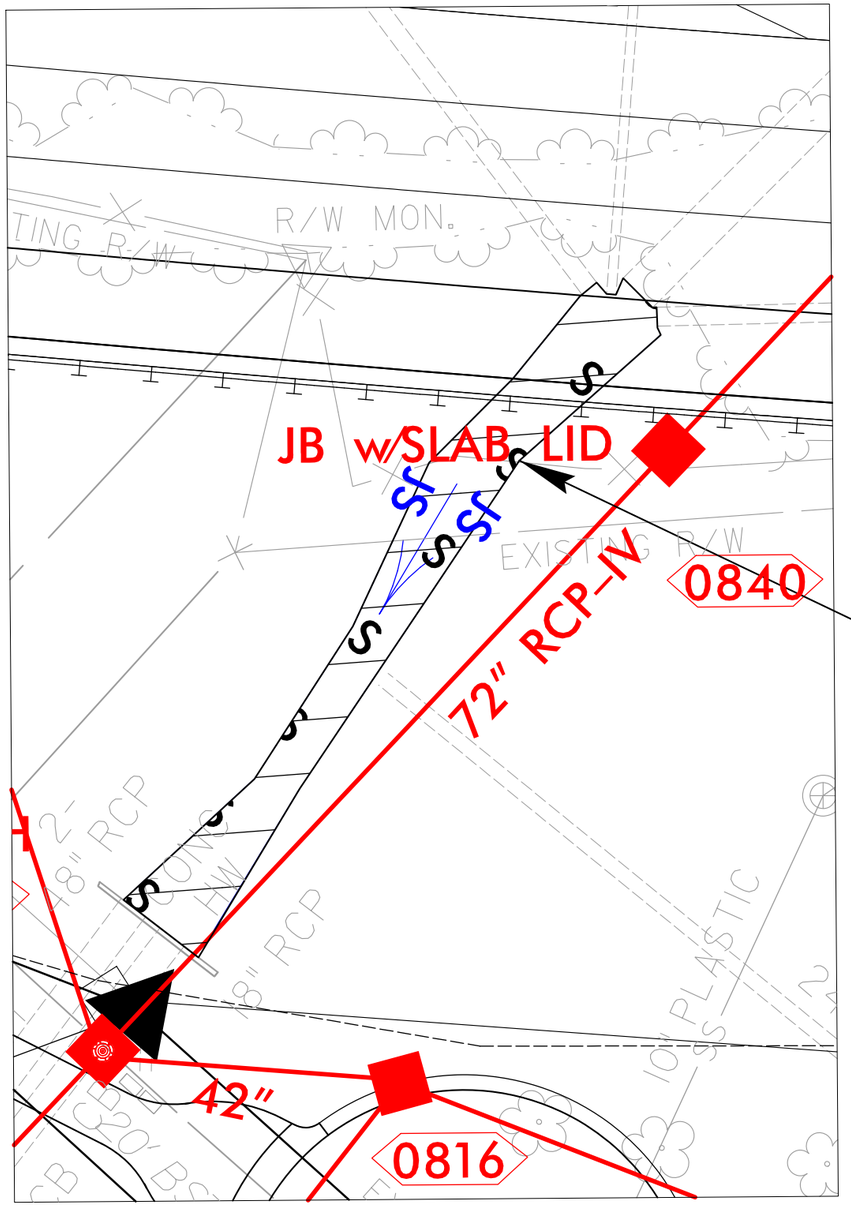
DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

PERMIT DRAWING
SHEET 27 OF 36

SITE 8



SITE 8



PAVEMENT REMOVAL

FOR -Y3- PROFILE SEE SHEET 25-26
FOR -Y3A- PROFILE SEE SHEET 26
FOR -Y3B- PROFILE SEE SHEET 26

REVISIONS 5/14/99

9:46:25 AM
C:\Projects\56-I-2513A\GIS\910_CADV\70_NCDOT_TIP\Hydraulics\Permits_Environmental\VHB\I2513A_hyd_prm_wet_blowups_5.dgn
pgreene

PROJECT REFERENCE NO.	SHEET NO.
I-2513AC	
R/W SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

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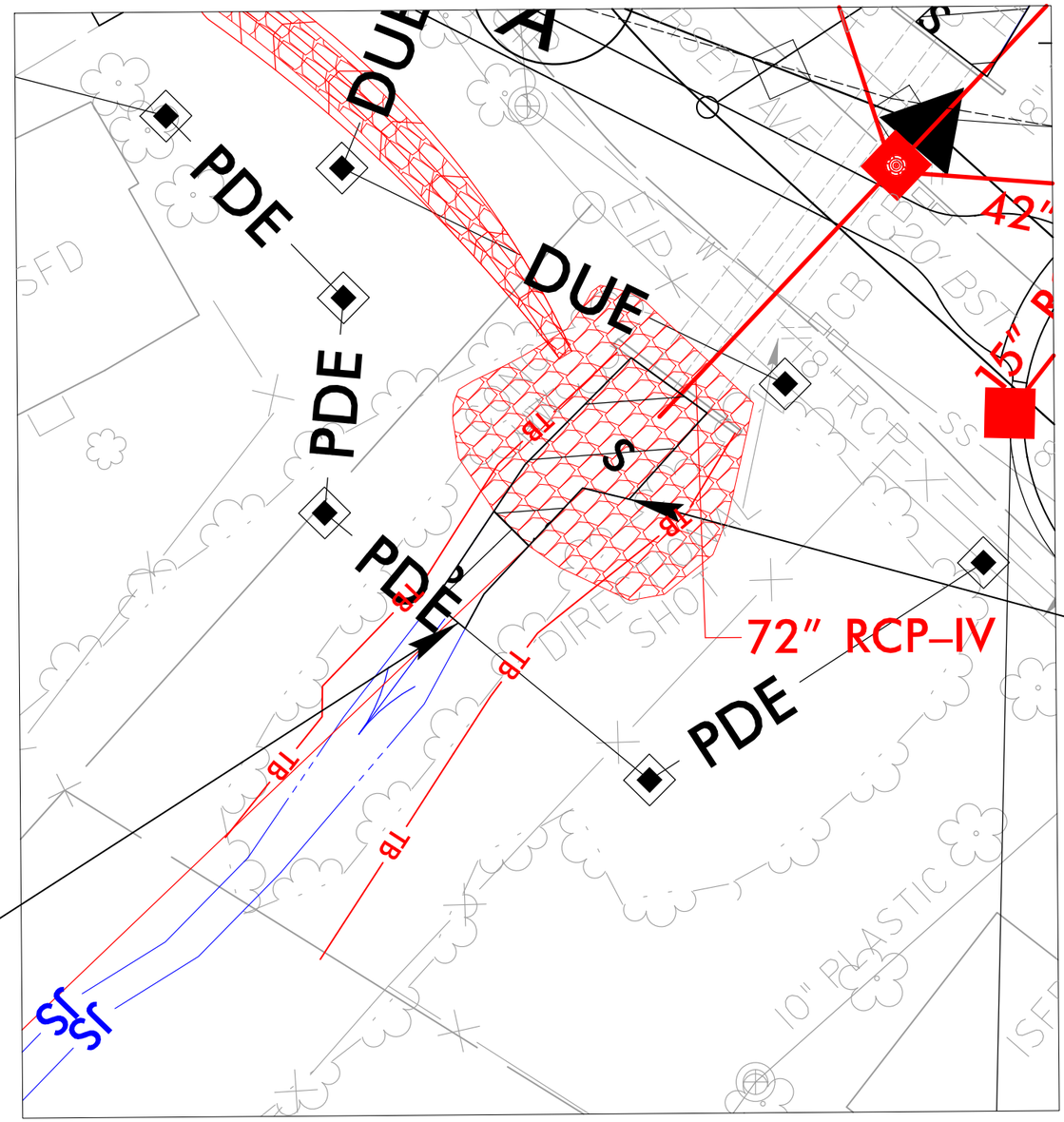
PERMIT DRAWING SHEET 28 OF 36

SITE 8



10′ 0′ 20′
INSET GRAPHIC SCALE

S S SURFACE WATER IMPACTS

TS TS TEMPORARY SURFACE WATER IMPACTS

PAVEMENT REMOVAL

FOR -Y3- PROFILE SEE SHEET 25-26
FOR -Y3A- PROFILE SEE SHEET 26
FOR -Y3B- PROFILE SEE SHEET 26

REVISIONS

5/14/99

9:58:01 AM
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User:ALAN
Default
'56-I-2513A

PROJECT REFERENCE NO.	SHEET NO.
I-2513AC	8
R/W SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

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PERMIT DRAWING SHEET 29 OF 36

S S SURFACE WATER IMPACTS

TS TS TEMPORARY SURFACE WATER IMPACTS

NAD 83/95

50' 0' 100'
GRAPHIC SCALE

MATCHLINE –L– STA 98+00 – SEE SHEET 7

MATCHLINE –L– STA 110+00 – SEE SHEET 9

SITE 8 (SEE PERMIT SHEET 27)

SITE 8 (SEE PERMIT SHEETS 27 THROUGH 28)

CONCRETE DITCH BEHIND RETAINING WALL SEE DETAIL 7

TIE TO EXIST. FENCE

TRENCHLESS INSTALLATION 72" WELDED STEEL BURIED

STANDARD BASE DITCH W/CLASS I RIP RAP EST 100 TONS EST 30 CY DDE SLOPE=5:1 SEE DETAIL 58

JB w/SLAB LID

FILL WITH FLOWABLE FILL

REMOVE

LATERAL BASE DITCH W/CLASS I RIP RAP SEE DETAIL 50

STANDARD BASE DITCH W/CLASS I RIP RAP EST 80 TONS EST 144 SY GEOTEXTILE EST 25 CY DDE SLOPE=3:1 SEE DETAIL 42

BANK STABILIZATION CLASS II RIP RAP EST 5 TONS EST 7 SY GEOTEXTILE SEE DETAIL 44

FILL SCOUR HOLE AND ARMOR EXISTING BANKS W/CLASS II RIP RAP EST 135 TONS EST 150 SY GEOTEXTILE DDE=150 CY

FALSE SUMP SEE DETAIL 21

FALSE SUMP SEE DETAIL 34

LATERAL 'V' DITCH SEE DETAIL 51

SPECIAL CUT 'V' DITCH SEE DETAIL 52

FOR –L– PROFILE SEE SHEET 16
FOR –Y3RPA– PROFILE SEE SHEET 27
FOR –Y4RPC– PROFILE SEE SHEET 29
FOR –Y13– PROFILE SEE SHEET 31
FOR –Y14– PROFILE SEE SHEET 31

REVISIONS

ROW REV. APRIL 5, 2023 PARCEL 93 AND 94 CHANGED TO TOTAL TAKE
ROW REV. APRIL 5, 2023 PUE ADDED TO PARCEL 95 FOR OH UTILITY
ROW REV. APRIL 5, 2023 PARCEL NUMBER 85 ADDED TO PARCEL

5/14/99

36-I-2513A\910_GIS\910_CADD\70_NCDOT_TIP\Hydraulics\Design
USER: AM
DGN: ORIGINAL

PROJECT REFERENCE NO.	SHEET NO.
I-2513AC	
R/W SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

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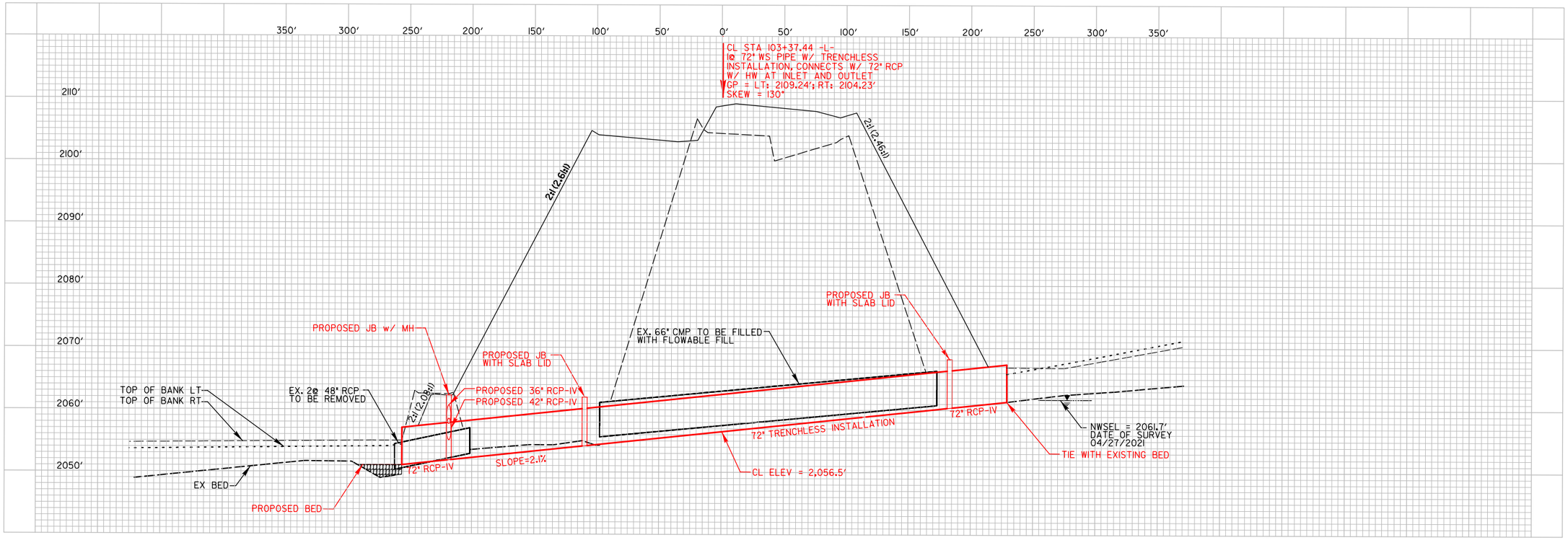
PERMIT DRAWING SHEET 30 OF 36

SITE 8 - PROFILE VIEW ALONG STRUCTURE



PAVEMENT REMOVAL
PAVEMENT REMOVAL

FOR -Y3- PROFILE SEE SHEET 25-26
FOR -Y3A- PROFILE SEE SHEET 26
FOR -Y3B- PROFILE SEE SHEET 26

REVISIONS
5/14/99

I:\WBA\900-CAD\Hydraulics\ADV70_NCDOT_TIP\Hydraulics\Permits_Environmental\WHB\I2513A_hyd_prm_wet_pipe_profile_Moore_Branch_2.dgn
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overcite

PROJECT REFERENCE NO.	SHEET NO.
I-2513AC	10
R/W SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

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PERMIT DRAWING SHEET 31 OF 36

REVISIONS 5/14/99

NAD 83/95

MATCHLINE –Y3– STA 20+00 – SEE SHEET 7

MATCHLINE –Y3– STA 34+00.00 – SEE SHEET 10A

FRED F & ALICE B CAUDLE DB 5084 PG 1187 PB 142 PG 78

HOUSING AUTHORITY OF THE CITY OF ASHEVILLE DB 700 PG 543 PB 14 PG 73

RIVERVIEW WEST COMPANY LLC DB 4532 PG 788 PB 14 PG 73

PROGRESS ENERGY OF THE CAROLINAS FKA CAROLINA POWER & LIGHT DB 681 PG 37 PB 14 PG 73

CAROLINA POWER & LIGHT CO DB 681 PG 37

CITY OF ASHEVILLE DB 2053 PG 438 DB 72 PG 53

–Y3– POT Sta. 24+93.50 = –Y3A– POT Sta.15+73.18

–Y3– PRC Sta. 22+65.34

–Y3– PT Sta. 26+18.07

–Y3– POT Sta. 28+50.37 = –Y3B– POT Sta.11+82.21

–Y3– PC Sta. 31+90.02

–Y3– PT Sta. 33+80.01

BEGIN CONSTRUCTION –Y3A– STA.11+00.00

BEGIN CONSTRUCTION –Y3B– STA.10+20.00

–Y3A– POT Sta.10+00.00

–Y3A– PC Sta.11+19.96

–Y3A– PT Sta. 15+20.70

–Y3B– PC Sta.10+23.39

–Y3B– POT Sta. 10+00.00

–MUP3– POT Sta.10+00.00

–MUP3– PC Sta.12+61.44

–MUP3– POT Sta.12+77.49

–MUP3– PT Sta.11+81.99

–MUP3– PT Sta.12+78.73

PROP. RETAINING WALL #14

PROP. RETAINING WALL #15

PROP. RETAINING WALL #18

STANDARD BASE DITCH W/CLASS I RIP RAP
EST 88 TONS
EST 155 SY GEOTEXTILE
EST 30 CY DDE
SLOPE=10.9%
SEE DETAIL 41

290' SHIFT (LT)

155' SHIFT (RT)

STANDARD BASE DITCH W/CLASS II RIP RAP
EST 35 TONS
EST 65 SY GEOTEXTILE
EST 105 CY DDE
SLOPE=15.2%
SEE DETAIL 60

TOE PROTECTION SEE DETAIL 47

BASE DITCH W/ VEGETATED BENCH AND CLASS B RIP RAP
EST 100 TONS
EST 265 SY GEOTEXTILE
EST 195 CY DDE
SLOPE=0.2%
SEE DETAIL 54

CLASS B RIP RAP
EST 8 TONS
EST 21 SY GEOTEXTILE

STANDARD BASE DITCH W/CLASS B RIP RAP
EST 50 TONS
EST 115 SY GEOTEXTILE
EST 60 CY DDE
SLOPE=0.2%
SEE DETAIL 55

CLASS I RIP RAP
EST 15 TONS
EST 29 SY GEOTEXTILE

BASE DITCH W/ VEGETATED BENCH AND CLASS B RIP RAP
EST 130 TONS
EST 345 SY GEOTEXTILE
EST 405 CY DDE
SLOPE=0.2%
SEE DETAIL 56

SPECIAL CUT DITCH SEE DETAIL 52

100' TAPER

150' TAPER

90' TAPER

217.06' TAPER

50' STORAGE

S 71° 52' 04.4" E

N 12° 50' 20.5" E

N 3° 13' 55.7" E

N 39° 41' 05.8" E

S 76° 03' 11" E

N 70° 05' 56" E

N 89° 27' 00.0" E

–MUP3– S 83° 37' 56" E

PAVEMENT REMOVAL

FOR –Y3– PROFILE SEE SHEET 25–26
FOR –Y3A– PROFILE SEE SHEET 26
FOR –Y3B– PROFILE SEE SHEET 26

I:\2513AC\GIS\MAPS\I-2513AC_MAP_GIS\910_CADV\70_NCDOT_TIP\Hydraulics\Permits_Environmental\VHB\I2513A_hyd_prm_wet_psh_10.dgn
jkinard 3:00:00 AM
pwerstle
I-2513AC 35756-I-2513AC

PROJECT REFERENCE NO.	SHEET NO.
I-2513AC	10
R/W SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

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PERMIT DRAWING SHEET 32 OF 36

REVISIONS 5/14/99

NAD 83/95

MATCHLINE -Y3- STA 20+00 – SEE SHEET 7

MATCHLINE -Y3- STA 34+00.00 – SEE SHEET 10A

FRED F & ALICE B CAUDLE DB 5084 PG 187 PB 142 PG 78

HOUSING AUTHORITY OF THE CITY OF ASHEVILLE DB 700 PG 543 PB 14 PG 73

RIVERVIEW WEST COMPANY LLC DB 4532 PG 758 PB 14 PG 73

PROGRESS ENERGY OF THE CAROLINAS FKA CAROLINA POWER & LIGHT DB 681 PG 37 PB 14 PG 73

CAROLINA POWER & LIGHT CO DB 681 PG 37

CITY OF ASHEVILLE DB 2053 PG 438 DB 72 PG 53

-Y3- POT Sta. 24+93.50 = -Y3A- POT Sta.15+73.18

-Y3- PRC Sta. 22+65.34

-Y3- PT Sta. 26+18.07

-Y3- POT Sta. 28+50.37 = -Y3B- POT Sta.11+82.21

-Y3- PC Sta.31+90.02

-Y3- PT Sta. 33+80.01

STANDARD BASE DITCH W/CLASS I RIP RAP EST 88 TONS EST 155 SY GEOTEXTILE EST 30 CY DDE SLOPE=10.9% SEE DETAIL 41

290' SHIFT (LT)

155' SHIFT (RT)

STANDARD BASE DITCH W/CLASS II RIP RAP EST 35 TONS EST 65 SY GEOTEXTILE EST 105 CY DDE SLOPE=2.3% SEE DETAIL 60

PROP. RETAINING WALL #14

PROP. RETAINING WALL #15

PROP. RETAINING WALL #16

CONC. APRON W/ 60' BREAK IN CA 75' TAPER

REMOVE EXIST. CONCRETE DITCH

TOE PROTECTION SEE DETAIL 47

SPECIAL CUT DITCH SEE DETAIL 52

BASE DITCH W/ VEGETATED BENCH AND CLASS B RIP RAP EST 100 TONS EST 265 SY GEOTEXTILE EST 195 CY DDE SLOPE=0.2% SEE DETAIL 54

CLASS B RIP RAP EST 8 TONS EST 21 SY GEOTEXTILE

STANDARD BASE DITCH W/CLASS B RIP RAP EST 50 TONS EST 115 SY GEOTEXTILE EST 60 CY DDE SLOPE=0.2% SEE DETAIL 55

CLASS I RIP RAP EST 15 TONS EST 29 SY GEOTEXTILE

BASE DITCH W/ VEGETATED BENCH AND CLASS B RIP RAP EST 130 TONS EST 345 SY GEOTEXTILE EST 405 CY DDE SLOPE=0.2% SEE DETAIL 56

BEGIN CONSTRUCTION -Y3A- STA.11+00.00

BEGIN CONSTRUCTION -Y3B- STA.10+20.00

-Y3A- POT Sta.10+00.00

-Y3A- PC Sta.13+86.99

-Y3A- PT Sta. 15+20.70

-MUP3- POT Sta.10+00.00

-MUP3- PC Sta.11+96.11

-MUP3- PT Sta.11+81.99

-MUP3- POT Sta.12+78.73

-MUP3- PC Sta.12+61.44

-Y3B- PC Sta.10+23.39

-Y3B- POT Sta.10+00.00

-Y3B- PT Sta.10+53.54

PAVEMENT REMOVAL

FOR -Y3- PROFILE SEE SHEET 25-26
FOR -Y3A- PROFILE SEE SHEET 26
FOR -Y3B- PROFILE SEE SHEET 26

I:\2513AC\GIS\910_CAD\70_NCDOT_TIP\Hydraulics\Permits_Environmental\VHB\I2513A_hyd_prm_wet_psh_10_con.dgn
10/27/2011 11:32:27 AM
jgarrett

PROJECT REFERENCE NO.	SHEET NO.
I-2513AC	10A
R/W SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

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PERMIT DRAWING SHEET 33 OF 36

NAD 83/95

E E WETLAND EXCAVATION

50' 0' 100'
GRAPHIC SCALE

REVISIONS
5/14/99

MATCHLINE -Y3- STA 33+98.56 - SEE SHEET 10

DEBORAH A GERHARDT
WEST ASHEVILLE HOUSE OF PRAYER INC
CADOVA STREET LLC
FRANK E GOODSON CHRIST FELLOWSHIP CENTER
HOUSING AUTHORITY OF THE CITY OF ASHEVILLE
CAROLINA POWER & LIGHT CO.
PROGRESS ENERGY OF THE CAROLINAS FKA CAROLINA POWER & LIGHT
CITY OF ASHEVILLE
RIVER FRONT STUDIO LLC
HARRINS SAND AND GRAVEL LLC
CITY LIMITS = EDGE OF RIVER

END CONSTRUCTION -Y3- STA.37+71.38

-Y3- AMBOY RD.
S 81° 27' 30.0" E
-AMB- EXTND

SITE 9 (SEE PERMIT SHEET 34)

BASE DITCH W/ VEGETATED BENCH AND CLASS B RIP RAP
EST 130 TONS
EST 345 SY GEOTEXTILE
EST 405 CY DDE
SLOPE= 0.2%
SEE DETAIL 56

STANDARD BASE DITCH W/CLASS B RIP RAP
EST 625 TONS
EST 1490 SY GEOTEXTILE
EST 910 CY DDE
SLOPE= 0.2%
SEE DETAIL 57

PAVEMENT REMOVAL

FOR -Y3- PROFILE SEE SHEET 25-26
FOR -Y3A- PROFILE SEE SHEET 26
FOR -Y3B- PROFILE SEE SHEET 26

10:52 AM
C:\Projects\I-2513A 90% PS&E Submittal\PS&E\910_CAD\70_NCDOT_TIP\Hydraulics\Permits_Environmental\VHB_I2513A_hyd_prm_wet_psh_10A_Ditch.dgn
overette

PROJECT REFERENCE NO.	SHEET NO.
I-2513AC	
R/W SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

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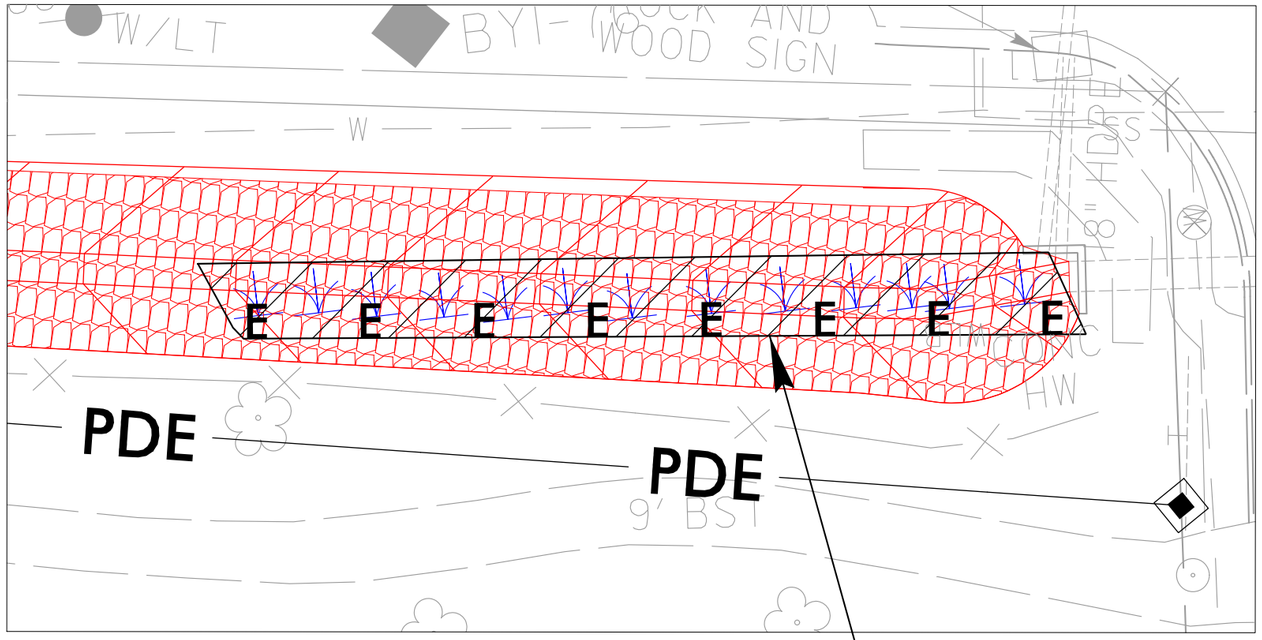
PERMIT DRAWING SHEET 34 OF 36

SITE 9



10' 0' 20'
INSET GRAPHIC SCALE

E E WETLAND EXCAVATION

PAVEMENT REMOVAL

FOR -L- PROFILE SEE SHEET 16
FOR -Y4- PROFILE SEE SHEET 28
FOR -Y4RPC- PROFILE SEE SHEET 29

REVISIONS 5/14/99

56-I-2513A\Hydraulics GIS\910.CAD\70.NCDOT_TIP\Hydraulics\Permits_Environmental\VHB\I2513A_hyd_prm_wet_blowups_7.dgn 10:53:53 AM

PROJECT REFERENCE NO.	SHEET NO.
I-2513AC	10A
R/W SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

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PERMIT DRAWING SHEET 35 OF 36

E E WETLAND EXCAVATION

NAD 83/95

50' 0' 100'
GRAPHIC SCALE

REVISIONS
5/14/99

MATCHLINE -Y3- STA 33+98.56 - SEE SHEET 10

DEBORAH A GERHARDT
WEST ASHEVILLE HOUSE OF PRAYER INC
CADOVA STREET LLC
FRANK E GOODSON CHRIST FELLOWSHIP CENTER
HOUSING AUTHORITY OF THE CITY OF ASHEVILLE
CAROLINA POWER & LIGHT CO.
PROGRESS ENERGY OF THE CAROLINAS FKA CAROLINA POWER & LIGHT
CITY OF ASHEVILLE
RIVER FRONT STUDIO LLC
HARRINS SAND AND GRAVEL LLC
CITY LIMITS = EDGE OF RIVER

NEW SHORM-

END CONSTRUCTION
-Y3- STA 37+71.38

S 81° 27' 30.0" E -Y3- AMBOY RD.

-AMB- EXTND

PDE PDE PDE 60' WD RAP PDE PDE

BASE DITCH W/ VEGETATED BENCH AND CLASS B RIP RAP
EST 130 TONS
EST 345 SY GEOTEXTILE
EST 405 CY DDE
SLOPE= 0.2%
SEE DETAIL 56

STANDARD BASE DITCH W/CLASS B RIP RAP
EST 625 TONS
EST 1490 SY GEOTEXTILE
EST 910 CY DDE
SLOPE= 0.2%
SEE DETAIL 57

SITE 9
(SEE PERMIT SHEET 34)

PAVEMENT REMOVAL

FOR -Y3- PROFILE SEE SHEET 25-26
FOR -Y3A- PROFILE SEE SHEET 26
FOR -Y3B- PROFILE SEE SHEET 26

I-2513A\900_ROADWAY\910_CAD\70_NCDOT_TIP\Hydraulics\Permits_Environmental\VHB\I2513A_hyd_prm_wet_psh_10A_Ditch_con.dgn
11:28:18 AM
overdale

WETLAND AND SURFACE WATER IMPACTS SUMMARY

			WETLAND IMPACTS					SURFACE WATER IMPACTS				
Site No.	Station (From/To)	Structure Size / Type	Permanent Fill In Wetlands (ac)	Temp. Fill In Wetlands (ac)	Excavation in Wetlands (ac)	Mechanized Clearing in Wetlands (ac)	Hand Clearing in Wetlands (ac)	Permanent SW impacts (ac)	Temp. SW impacts (ac)	Existing Channel Impacts Permanent (ft)	Existing Channel Impacts Temp. (ft)	Natural Stream Design (ft)
1	19+73 to 24+09 -L- LT	Roadway Fill	0.45			0.14						
2	23+23 to 24+04 L RT/LT	Roadway Fill						0.03		148		
		(2) 48" CMP/WSP							0.01		36	
		Bank Stabilization	< 0.01									
3	20+56 to 26+05 -L- LT	Roadway Fill	0.24			0.17						
		Toe Protection	0.06									
4	43+90 to 46+71 -L- RT/LT	Bank Stabilization							0.02	32	93	
5	64+23 to 66+24 -L- RT/LT	2 @ 48" CSP						< 0.01		11		
		1 @ 72" / 2 @ 48" CSP						< 0.01		24		
		Roadway Fill						0.02		168		
		Bank Stabilization						< 0.01	< 0.01	11	4	
6	67+91 to 68+29 -L- RT	Bank Stabilization							0.01	17	37	
7	82+92 to 84+13 -L- LT	Roadway FIll	< 0.01					0.02	< 0.01	208	11	
	78+23 to 78+35 -L- RT	Bank Stabilization						< 0.01	< 0.01	24	13	
8	101+43 to 105+28 -L- RT/LT	Roadway Fill						0.04	< 0.01	217	30	
9	36+97 to 37+71 -Y3- RT	Ditch Excavation			0.03							
TOTALS*:			0.76		0.03	0.31		0.12	0.05	860	224	0

*Rounded totals are sum of actual impacts

NOTES:

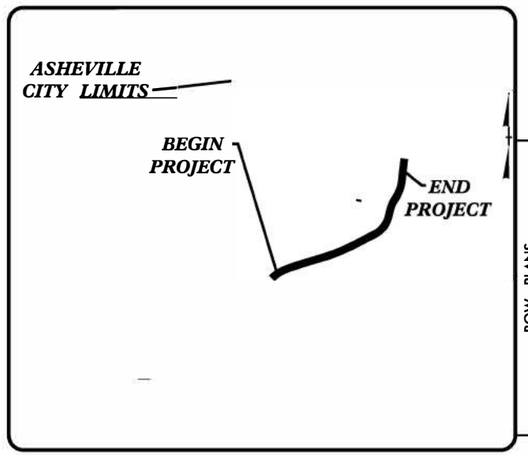
NC DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
06/02/2023
BUNCOMBE
I-2513
34165.1.2

09/08/99

TIP PROJECT: I-2513AC

CONTRACT:

See Sheet 1A For Index of Sheets
See Sheet 1B For Conventional Symbols



VICINITY MAP

ROW PLANS
DECEMBER 6, 2022

STATE OF NORTH CAROLINA
DIVISION OF HIGHWAYS

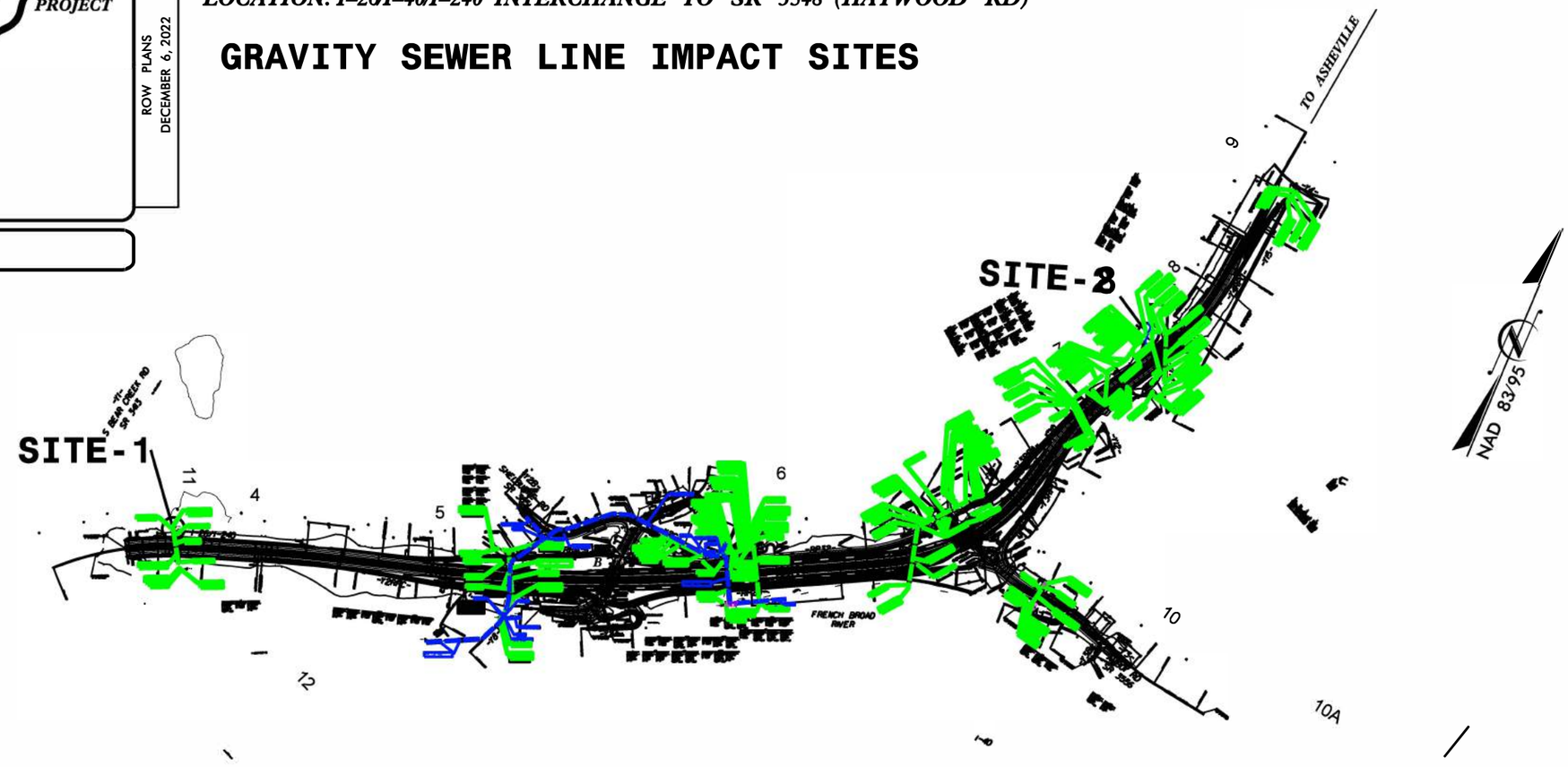
BUNCOMBE COUNTY

STATE	STATE PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
N.C.	I-2513AC	1	

STATE PROJ. NO.	F. A. PROJ. NO.	DESCRIPTION
34165.1.13		P.E.
34165.2.18		R/W
34165.2.19		UTIL.
34165.3.8		CONST.

LOCATION: I-26/I-40/I-240 INTERCHANGE TO SR 3548 (HAYWOOD RD)

GRAVITY SEWER LINE IMPACT SITES



THIS IS A CONTROLLED-ACCESS PROJECT WITH ACCESS BEING LIMITED TO INTERCHANGES

THIS PROJECT IS LOCATED WITHIN THE CITY LIMITS OF THE CITY OF ASHEVILLE

CLEARING ON THIS PROJECT WILL BE PERFORMED TO THE LIMITS ESTABLISHED BY METHOD III

A DESIGN EXCEPTION IS REQUIRED FOR HORIZONTAL SSD ON -L-

A DESIGN EXCEPTION IS REQUIRED FOR MINIMUM HORIZONTAL RADIUS ON -Y2-

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

GRAPHIC SCALES

50 25 0 50 100
PLANS

50 25 0 50 100
PROFILE (HORIZONTAL)

10 5 0 10 20
PROFILE (VERTICAL)

DESIGN DATA

ADT 2024 = NA
ADT 2040 = 101,400
K = 9 %
D = 55 %
T = 10 % *
V = 60 MPH
* TTST = 5% DUAL 5%
FUNC CLASS = INTERSTATE

STATEWIDE TIER

PROJECT LENGTH

LENGTH ROADWAY TIP PROJECT I-2513AC = 1.623 MI

LENGTH STRUCTURE TIP PROJECT I-2513AC = 0.119 MI

TOTAL LENGTH TIP PROJECT I-2513AC = 1.742 MI

AECOM
NC FIRM LICENSE No: F-0342
5438 Wade Park Blvd., Suite 200
Raleigh, NC 27607
(919) 854-6200 - (919) 854-6259(FAX)

2018 STANDARD SPECIFICATIONS

RIGHT OF WAY DATE: DECEMBER 6, 2022

LETTING DATE: FEBRUARY 20, 2024

JOHN SLOAN, P.E.
PROJECT ENGINEER

ED EDENS, PE
PROJECT DESIGN ENGINEER

KEVIN E. MOORE, P.E.
NCDOT CONTACT

HYDRAULICS ENGINEER

SIGNATURE: P.E.

ROADWAY DESIGN ENGINEER

SIGNATURE: P.E.

STATE OF NORTH CAROLINA · DEPARTMENT OF TRANSPORTATION

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PROJECT REFERENCE NO.	SHEET NO.
I-2513AC	UC- 4
R/W SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

Prepared in the Office of: AECOM 5438 Wade Park Boulevard, Suite 200 Raleigh, NC 27607 (919) 854-6200 - (919) 854-6259 (FAX) — NC FIRM LICENSE No: F-0342

Prepared in the Office of: PINECONE 205 E. Spring Street Fuquay-Varina, NC 27526 (919) 656-8574 — NC FIRM LICENSE No: P-1804

REVISIONS

5/14/99

MATCHLINE -Y1- STA 20+00 - SEE SHEET 11

SITE-1

335 LF OF 8" SANITARY GRAVITY SEWER (DB 83 PG 350)

4' DIA UTILITY MANHOLE A1 STA. 0+00 158.26' LT OF LINE -L-, STA. 19+68.79

ABANDON UTILITY MANHOLE

ABANDON 365 LF 8" UTILITY PIPE

4' DIA UTILITY MANHOLE C1 STA. 3+75 192.10' RT OF LINE -L-, STA. 20+66.77

ABANDON UTILITY MANHOLE

ABANDON 24" CMP PIPE (JACK) AND JACK OF 24"

4' DIA UTILITY MANHOLE B1 STA. 1+54 139.15' LT OF LINE -L-

ABANDON 8" SANITARY UTILITY SEWER

BEGIN TIP PROJECT I-2513AC -L- STA. 16+00.00

MATCHLINE -Y1- STA 28+50 - SEE SHEET 12

MATCHLINE -Y- STA 27+00 - SEE SHEET 5

WILSON, GENE & BETTY (128) DB 1180 PG 147 PB 193 PG 132

JOLENE E MOODY (127) DB 3886 PG 264

JESSE CALLOWAY JR (3) DB 1849 PG 92

ROGERS LAND COMPANY LLC (130) DB 5441 PG 1850

BEAR CREEK REAL ESTATE LLC (4) DB 5291 PG 1656

CROSSROADS ASSEMBLY FKA WEST ASHEVILLE ASSEMBLY OF GOD DB 1679 PG 748

GATEWAY AVL LLC (2) DB 5453 PG 963 PB 162 PG 82

ROGERS LAND COMPANY LLC DB 5756 PG 1578

D COMPANY LLC 41 PG 1850

ASHEVILLE CITY LIMITS

PROP. RETAINING WALL

-L-

PI Sta 14+32.09
Δ = 21° 06' 01.2" (RT)
D = 2° 28' 10.7"
L = 854.39'
T = 432.09'
R = 2,320.00'
e = 6.0%
RUNOFF = 122.0'

Pls Sta 19+76.46
Θs = 4° 31' 10.0"
Ls = 366.00'
LT = 244.08'
ST = 122.07'

PI Sta 29+74.15
Δ = 3° 02' 34.5" (RT)
D = 0° 28' 38.9"
L = 637.31'
T = 318.73'
R = 12,000.00'
e = NC

-Y2RPC- POT Sta. 10+00.00 = -L- PT Sta. 26+88.21 53.50'

-L- PC Sta. 26+55.42

FOR -L- PROFILE SEE SHEET 13
FOR -Y1- PROFILE SEE SHEET 17
FOR -Y1C- PROFILE SEE SHEET 18
FOR -Y1D- PROFILE SEE SHEET 18

SITE-1

8" DIP

STA. L 19+67
L 19+76

WETLAND EXCAVATION : 0.0047 ACRE

PAVEMENT REMOVAL

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PROJECT REFERENCE NO.	SHEET NO.
I-2513AC	UC- 8
R/W SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

REVISIONS

5/14/99

NAD 83/95

SITE-8

MATCHLINE -L- STA 98+00 – SEE SHEET 7

MATCHLINE -L- STA 110+00 – SEE SHEET 9

-L- SRS Sta. 101+42.08

-L- SC Sta. 104+30.08

-Y14- POT Sta. 7+30.60

TIE TO EXIST. FENCE

PROP. RETAINING WALL #5 BEG. SBG +25

45.79' INC.

48" INC.

END SBG +83

END FENCE +90.31 -L- 78.79' LT

BEG. FENCE +69.28 -L- 78.79' RT

END SBG +87

BEG. FENCE EX. R/W +69.28 -L- 78.79' RT

BEG. SBG +04

T20' LANE DROP (WB LANES)

300' TAPER

+99 -L- 120' LT

GREU TL-3

NO CLAIM

EXIST. 42" CMP

SKEW 135°57'11"

PROP. RETAINING WALL

-L- Sta. 105+49.43 = -Y14- Sta. 13+76.06

2'-6" CBG

N 27° 03' 00.00" E

N 4° 51' 20.0" E

-Y14RPC- ST Sta. 10+00.00

END TIP PROJECT I-2513AC
-L- POT STA. 108+00.00

+64 -L- 227' LT

+65 -L- EX. R/W

+67 -L- 217' LT

+11 -L- 209' LT

+35 EX. R/W

+69 -L- EX. R/W

STA. L 105+22, -189.27
L 105+44, -192.14

TS TS TEMPORARY SURFACE WATER IMPACTS : 0.0022 ACRE

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WETLAND PERMIT IMPACT SUMMARY

			WETLAND IMPACTS							SURFACE WATER IMPACTS				
Site No.	Station (From/To)	Structure Size / Type	404 Permanent Fill In Wetlands (ac)	CAMA Permanent Fill In Wetlands (ac)	Temp. Fill In Wetlands (ac)	Excavation in Wetlands (ac)	Mechanized Clearing in Wetlands (ac)	404 Hand Clearing in Wetlands (ac)	CAMA Hand Clearing in Wetlands (ac)	Permanent SW impacts (ac)	Temp. SW impacts (ac)	Existing Channel Impacts Permanent (ft)	Temporary Channel Impacts (ft)	Temporary Wetland Impacts *** (ac)
1	-L-19+67~L19+76	Prop. Sewer Pipe 8"				<0.01*								
8	-L-105+22~L105+44	Prop. Sewer Pipe 8"									<0.01**		10	