BIOLOGICAL ASSESSMENT

AN ASSESSMENT OF POTENTIAL IMPACTS TO CAROLINA HEELSPLITTER (*Lasmigona decorata*) and DESIGNATED CRITICAL HABITAT, SCHWEINITZ'S SUNFLOWER (*Helianthus schweinitzii*), MICHAUX'S SUMAC (*Rhus michauxii*), and SMOOTH CONEFLOWER (*Echinacea laevigata*)

MONROE CONNECTOR/BYPASS

MECKLENBURG and UNION COUNTIES, NORTH CAROLINA

FEDERAL AID PROJECT NUMBER STP-NHF-74(90)
WBS ELEMENT 34533.1.TA1
STIP PROJECT NUMBER R-3329/R-2559

PREPARED FOR:

Federal Highway Administration
Raleigh, North Carolina

AND

North Carolina Turnpike Authority
A Division of North Carolina Department of Transportation
Raleigh, North Carolina

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1.0 INTRODUCTION

The North Carolina Turnpike Authority (NCTA), a division of the North Carolina Department of Transportation (NCDOT), in cooperation with the Federal Highway Administration (FHWA), proposes to construct a project known as the "Monroe Connector/Bypass" in Mecklenburg and Union Counties, North Carolina. The purpose of this Biological Assessment (BA) is to review the project and determine whether the proposed action may affect federally listed species that occur in the Action Area (Figure 1).

The proposed roadway is included in the NCDOT's *2013-2023 State Transportation Improvement Project* (STIP), project numbers R-3329 (Monroe Connector) and R-2559 (Monroe Bypass), as a controlled-access toll road extending from US 74 near I-485 in Mecklenburg County to US 74 between the towns of Wingate and Marshville in Union County, a distance of approximately 20 miles. NCDOT previously studied these as two separate projects; however, the two projects are now being advanced by NCTA as a single project at the request of the Mecklenburg-Union Metropolitan Planning Organization (MUMPO).

This Biological Assessment (BA) is based upon information provided in the Draft Technical Report on Direct, Indirect and Cumulative Impacts to Federally Listed Species *Response to FWS Letter dated December 20, 2012* (DTR), the Responses To USFWS September 30, 2013 Comments on the Draft Technical Report, and analyses detailed in this report.

This BA addresses likely effects to federally protected species associated with the proposed Monroe Connector/Bypass. This BA is prepared in accordance with legal requirements established under Section 7 of the Endangered Species Act (ESA) (16 U.S.C. 1536 (c)), and is consistent with the standards established in U.S. Fish and Wildlife Service (USFWS) Region 4 guidance (USFWS 2005), FHWA guidelines (USDOT 2002), and NCDOT guidance (NCDOT 2002).

The species evaluated in this BA are:

- Carolina heelsplitter (*Lasmigona decorata*) and its designated Critical Habitat
- Schweinitz's sunflower (*Helianthus schweinitzii*)
- Michaux's sumac (*Rhus michauxii*)
- Smooth coneflower (*Echinacea laevigata*).

1.1 Statutory Authority of Action

Section 7(a)(2) of the ESA (16 USC 1531-1544 and Section 1536) requires that each Federal agency shall, in consultation with USFWS, insure that any action authorized, funded, or carried out by such agency, is not likely to jeopardize the continued existence of an endangered or threatened species, or result in the destruction or adverse modification of critical habitat.

NCDOT derives their statutory authority via North Carolina General Statutes (NCGS) 143B-345 and 346 and FHWA derives their statutory authority via 49 US Code (USC) 104.

As defined in 50 Code of Federal Regulations (CFR) Part 402.02, "actions" include 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. Since the proposed project includes both funding by FHWA and approval by the U.S. Army Corps of Engineers (USACE) pursuant to the Clean Water Act, it is subject to consultation under Section 7 of the ESA.

1.2 Summary of Consultation History

The section describes the consultation history of this project, beginning with the two projects separately and then as single project as it is currently proposed.

Monroe Bypass (R-2559)

An Environmental Assessment (EA) was issued on March 14, 1996, and a Finding of No Significant Impact (FONSI) was completed on June 20, 1997 for the Monroe Bypass (a new location freeway facility from US 601 to US 74 near Marshville in Union County). As part of that FONSI, comments concerning the Monroe Bypass were solicited from various agencies, including the USFWS. In letter dated April 18, 1997 the USFWS issued a concurrence that the project is "not likely to adversely affect" the federally endangered Carolina heelsplitter or Schweinitz's sunflower. However, the USFWS subsequently rescinded their "not likely to adversely affect" concurrence for the USACE's determination of effect. In a letter dated August 8, 2002, written in response to the public notice issued for the Section 404 Permit Application, the USFWS stated that based on "new information and a changed condition" their previous concurrence was no longer valid.

Monroe Connector (R-3329)

NCDOT began the planning process in 1999 for the Monroe Connector (from near I-485 in Mecklenburg County to US 601 in Union County). A Draft EIS was issued on October 17, 2003, and released for review and comment by the public and environmental resource and regulatory agencies in November 2003. Based on comments received from the various federal and state agencies and the public, and due to concerns regarding logical termini of the Monroe Connector and Monroe Bypass projects, the 2003 Draft EIS was rescinded on January 30, 2006 by notice in the Federal Register (Vol. 71, No. 19, page 4958). The notice stated that FHWA, NCDOT and NCTA plan to prepare a new Draft EIS for the combined Monroe Connector/Bypass project.

2005 Draft BA

A Draft BA was originally prepared on October 28, 2005 which assessed effects from both the Monroe Bypass (R-2559) and the Monroe Connector (R-3329) on the Carolina heelsplitter and Schweinitz's sunflower. Consultation with USFWS was not initiated due to the rescission of the Monroe Connector Draft EIS.

Monroe Connector/Bypass Draft EIS

A Draft EIS, prepared by PBS&J (2009) was issued for the Monroe Connector/Bypass on March 31, 2009. It included discussion of federally-protected species in the project area, including biological conclusions for potential effects to these species as follows:

- Carolina heelsplitter (*Lasmigona decorata*) and its designated Critical Habitat – Unresolved
- Schweinitz's sunflower (*Helianthus schweinitzii*) – May Affect/Not Likely to Adversely Affect
- Michaux's sumac (*Rhus michauxii*) – No Effect
- Smooth coneflower (*Echinacea laevigata*) – No Effect

USFWS commented on the Draft EIS via letter dated June 12, 2009. USFWS comments relating to the ESA and NCTA responses to those comments follow:

Schweinitz's sunflower

- USFWS stated, "…*it is premature to determine that there will be no impacts to the Schweinitz's sunflower (Helianthus schweinitzii) from this project. Until more specifics about design and any changes that may result from public comment or other information are available we believe the appropriate conclusion for this species is 'unresolved.'*"
- NCTA responded that two populations of Schweinitz's sunflower were identified near Interchange 3 and per Draft EIS comments; a subsequent interchange redesign changed the configuration to a compressed urban diamond. FHWA and NCTA are coordinating with USFWS in accordance with Section 7 of the ESA in the preparation of this BA.

Goose Creek

- USFWS stated, "*We remain concerned about the overall impacts to streams and wetlands and wildlife habitat…in particular, the potential for impacts to the Goose Creek watershed, which is occupied by and designated critical habitat for the federally endangered Carolina heelsplitter.*"
- NCTA responded with reference to Section 2.3.3 of the Final EIS which includes measures to avoid and minimize impacts to streams and wetlands as well as a Section PC, which includes a special project commitment to implement BMPs based on NCDOT's *Design Standards in Sensitive Watersheds*. NCTA further stated that the DSAs would

not be located within the Goose Creek watershed and that indirect and cumulative land use and impervious surface changes were analyzed in the Quantitative ICE.

Forest / Habitat Fragmentation

- USFWS stated, "*Forest fragmentation is described as an indirect effect of highway projects, but we believe that the impacts of fragmentation are direct effects that should be quantified.*"
- NCTA responded that habitat fragmentation has been addressed in the Quantitative ICE.

Indirect and Cumulative Impacts

- USFWS stated, "*Indirect and cumulative impacts continue to be a great concern for this project. … This is a significant omission in determining environmental impacts from the project, especially regarding potential impacts to the Carolina heelsplitter and its critical habitat.*"
- NCTA responded, stating that the USFWS comment refers to the Qualitative ICE. Subsequently, a Quantitative ICE Analysis and a Quantitative Water Quality ICE Analysis were prepared to quantify indirect and cumulative impacts. These reports are summarized in Section 2.5.5 of the Final EIS.

Habitat Protection

- USFWS stated, "*Any new development that occurs without measures adequate to protect the species and its habitat is likely to result in extirpation of the species and adverse impacts to its designated critical habitat.*"
- NCTA responded by referencing Section 7 coordination and the development of this BA. They also referenced the Quantitative ICE which found no measurable differences in percent impervious surface between the Preferred Alternative and the No Build Alternative for the FLUSA as a whole, and no change in the Goose Creek Watershed.

On July 22, 2009, representatives of NCTA, FHWA, and USFWS met to discuss design revisions incorporated into the Preferred Alternative as a result of public comments on the Draft EIS. This included revising the proposed interchange configuration at Unionville-Indian Trail Road to reduce the footprint of the design. Two populations of Schweinitz's sunflower were identified along Secrest Shortcut Road in the vicinity of this proposed interchange. USFWS indicated that based on the design change, which would increase the potential for future development adjacent to the interchange, it would be highly likely that the populations would be lost due to indirect impacts of this project, either related to future road improvements along Secrest Shortcut Road or to future development. USFWS recommended formal Section 7 consultation for these impacts to Schweinitz's sunflower.

Additional coordination with USFWS occurred during Turnpike Environmental Agency Coordination (TEAC) meetings and various other meetings and types of correspondence regarding the ESA and protected species. This information is summarized below.

- May 17, 2007, TEAC meeting: In identifying potential corridors/study alternatives, the study area was developed to avoid direct impacts to Goose Creek basin in an effort to minimize impacts to Carolina heelsplitter. It was suggested that impacts to Stewarts Creek be minimized as it feeds Lake Twitty and the Goose Creek watershed. Additionally, USFWS planned to provide information about the Schweinitz's sunflower population near Secrest Shortcut Road. USFWS suggested the team consider a new approach to indirect and cumulative impacts which may be useful. NCTA planned to follow up with USFWS.
- June 29, 2007, Meeting: FHWA and NCTA met with USFWS and WRC to discuss the scope of work, study area, and methodologies for the ICE study. USFWS stated that previous ICE studies have used a standard five to seven mile distance from interchanges as an assumed study area for induced growth. NCTA stated that the assumption would be revisited as part of this study. FHWA and NCTA asked USFWS to provide input on which indicators should be used for analyzing impacts to the mussels. USFWS noted that impact analysis will be influenced by NPDES permit decisions. USFWS also suggested NCTA determine the current status of land use controls and regulations in the project area. WRC requested analysis of impervious surface increase for the land use analysis. WRC also stated that stormwater and 303(d) streams may be issues. NCTA addressed these comments and incorporated these suggestions into the project documents.
- December 5, 2007, TEAC Meeting: USFWS suggested that NCTA consider eliminating the interchange at US 601 with new location alternatives to reduce potential indirect impacts on the Goose Creek watershed. NCTA has moved forward with the project considering both with the US 601 option and without the US 601 option in the quantitative ICE analyses.
- September 23, 2008, TEAC Meeting: NCTA noted that two populations of Schweinitz's sunflower were identified near the proposed Unionville Indian Trail Road interchange. No direct impacts are anticipated; however, the biological conclusion in the Draft Natural Resources Technical Report will be "unresolved" until NCTA/FHWA and USFWS coordinate on this issue.
- August 12, 2009, TEAC Meeting: NCTA noted that formal Section 7 consultation for Carolina heelsplitter and its designated critical habitat and Schweinitz's sunflower is anticipated. USFWS clarified that a decision to enter formal consultation has not yet been made and a final decision will be based on results of the quantitative land use studies / ICE analyses. It was noted that the FLUSA would be expanded to include the entire Goose Creek watershed. USFWS suggested that localities should be asked specifically about how the *Site Specific Water Quality Management Plan for the Goose Creek Watershed* will be implemented. NCDWQ responded that their agency will be implementing the plan initially and that training will be provided to the local governments. USFWS also stressed the importance of documentation of assumptions and rationale regarding future land use. USFWS suggested that the water quality component of the ICE may be useful for Section 7 consultation. The agencies will identify which parameters they will require in the final water quality analysis.
- September 8, 2009, TEAC Meeting: Per USFWS request, NCTA agreed to evaluate ICE with and without the US 601 interchange in the Quantitative ICE study. (US 601 is the

closest major interchange to the Goose Creek watershed.) USFWS requested more information about the water quality ICE model (i.e. input parameters, adaption to suburban landscapes, groundwater, etc.). Sixmile Creek watershed was suggested to be included in the modeling efforts.

- October 31, 2009, TEAC Meeting: The Generalized Water Loading Function (GWLF) model was presented to describe water quality modeling and analysis. Agencies were requested to identify and provide stressors in addition to those presented. USFWS suggested NCTA review the Goose Creek watershed management plan for other sources of impairment. NCTA will proceed with the study area as identified for water quality modeling. If the Quantitative ICE indicates indirect impacts in Sixmile Creek watershed, NCTA will reevaluate whether to include more of the watershed in the analysis and/or perform additional analysis.

- November 11, 2009, TEAC Meeting: Preliminary results of the Quantitative ICE were presented at this meeting. Several agency representatives expressed uncertainty as to the accuracy of the projections and NCTA asked if there were any suggestions for another method to determine future growth that would be defensible. None were offered. Agencies were requested to provide opinions / recommendations regarding methodologies throughout the planning process (see June 29, 2007 meeting, above). USFWS requested a discussion on how the Hartgen method was used to perform validation. NCTA hosted additional meetings to discuss and explain methodologies and associated reports also included detailed discussions regarding chosen methodologies.

- February 2, 18, 22, 2010, Telephone Correspondence: USFWS provided updated data from the Draft 5-year Status Reviews for smooth coneflower and Michaux's sumac (Suiter 2010a and 2010b, USFWS, pers. comm.).

- February 10, 2010, Email Correspondence: USFWS provided updated data (narrative from a recent Biological Opinion) for Schweinitz's sunflower (Wells 2010, USFWS, pers. comm.).

- February 10-11, 2010, Email Correspondence: USFWS stated that a previous relocation of Schweinitz's sunflower from Secrest Shortcut Road (Natural Heritage Program Element Occurrence #77) to Cane Creek Preserve was associated with a NCDOT Division level project with no federal nexus to trigger Section 7 consultation (Buncick 2010a, USFWS, pers. comm.).

- March 30-April 1, 2010, Email Correspondence: USFWS provided details about other Section 7 consultations in the Action Area (Buncick, 2010b, pers. comm.) (Section 1.3).

- May 25, 2010, Draft Biological Assessment completed by Catena and submitted to NCTA
- July 26, 2010, completed BA package prepared by FHWA and NCDOT received by USFWS.
- July 29, 2010 USFWS concurred with FHWA's determination of "Not Likely to Adversely Affect" regarding construction of the subject project and associated impacts to

federally listed Carolina heelsplitter and its designated critical habitat and the Schweinitz's Sunflower, and "no effect" to Michaux Sumac and Smooth Coneflower.

- September 1, 2010 the Record of Decision (ROD) issued.
- In November, 2010, the Southern Environmental Law Center (SELC) on behalf of the North Carolina Wildlife Federation, Clean Air Carolina and Yadkin Riverkeeper, filed suit against NCTA and FHWA, alleging failures to correctly follow procedures for studying the environmental effects of the proposed project.
- April 2011 USACE issued 404 permit.
- In October 2011, a US District Court Judge ruled in favor of NCTA and FHWA regarding the environmental study.
- On October 31, 2012, SELC filed an appeal of the U.S. District judge's decision.
- On May 3, 2012, the Fourth Circuit Court of Appeals overturned the ruling of the lower court and found that the agencies failed to disclose the underlying assumptions of their analysis and falsely responded to public concerns. The Court remanded the matter so the agencies could publically and fully evaluate the "no-build" data.
- Design on the project was halted in May 2012.
- On June 15, 2012, NCDOT filed a petition to the Fourth Circuit Court of Appeals for rehearing of the case to address technical data and other facts that the state believes the higher court misunderstood.
- On June 29, 2012, the Fourth Circuit denied the petition for rehearing.
- Subsequent to the Fourth Circuit Court's decision, the FHWA rescinded the ROD on July 3, 2012.
- NCTA and FHWA commenced work to address the issues raised by the Fourth Circuit Court of Appeals.
- July 18, 2012, TEAC Meeting: USFWS asked if a merger type process to review the new data and provide comments had been considered. NCTA and FHWA agreed to discuss this and determine some key points for agency involvement and input in this process. Agencies will be asked to provide input and comments on all documents. USFWS noted that depending on the outcome of NCTA's current studies, they may need to revisit consultations under Section 7 of the Endangered Species Act. At that time, no modifications appear to be needed. NCTA and FHWA agreed to continue to coordinate with USFWS to determine an appropriate course of action.
- November 7, 2012, NCDOT and USFWS met in preparation of the TEAC meeting taking place the following day (see below).
- November 8, 2012, TEAC Meeting: USFWS requested verification that since there are no changes in the land use, the water quality impacts will not be remodeled. Ms. Harris explained that pursuant to the meeting that took place between NCDOT and USFWS on 11/7, this issue needs further discussion in regards to if and where additional water quality modeling needs to be completed. FHWA feels that additional modeling is not

necessary and once a thorough explanation of the differences found in the most recent study is provided to the agencies, stakeholders, and the public, then sufficient information will have been provided to show that no additional water quality analysis would be necessary.

- On December 20, 2012, the USFWS sent NCTA a letter that among other items, recommended a re-initiation of Section 7.
- July 10, 2013; FHWA met with USFWS in Atlanta, GA to discuss the project's status and findings from new ICE Analysis
- August 28, 2013, FHWA submitted the following draft ESA information to USFWS:
    - Report on Effect to Species for FWS_DRAFT_082613 MW_toFHWA_rev.docx
    - Copy of FWS_Monroe_Maps 081913.pdf
    - Appendix A Interview Summaries.pdf
    - Appendix B Union_County_Growth_Memo_091112_Final.pdf
    - Appendix C Reports of Independent Economist.pdf
- September 30, 2013, the USFWS provided a letter with comments to the FHWA August 28, 2013 draft ESA information submittal.

<u>Other Consultations in Action Area</u>

There have been several previous consultations within the Action Area (as defined in Section 3.0) of the project:

- B-2647 (Carolina heelsplitter): Bridge No. 3 on SR 1547 over Goose Creek in Union County (TIP B-2647) was replaced during 1998. The findings of an informal consultation were transmitted to the USFWS in a letter dated May 14, 1998.
- R-2123 (Carolina heelsplitter): During the 1990s and early part of the present decade, the Charlotte Outer Loop (TIP R-2123) was designed and constructed within the Goose Creek Subbasin. There were several consultations and re-initiations throughout the development and construction of the project.
- <u>(Carolina heelsplitter)</u>: Wal-Mart Real Estate Business Trust development of a commercial center (Wal-Mart Supercenter) on an approximately 50-acre site near the intersection of US Hwy 521 and SC 160, within the Sixmile Creek watershed in Lancaster County, South Carolina. The project site drains into the North Carolina portion of Sixmile Creek, and the entire Sixmile Creek watershed was evaluated in the Biological Assessment (TCG 2007) that concluded that the project was "Not Likely to Adversely Affect" the Carolina heelsplitter.
- U-2506 (Carolina heelsplitter): Involved the extension of Rea Road (SR 3624) on new alignment from its former terminus at the then proposed Charlotte Outer Loop (I-485) in Mecklenburg County, NC to NC 16 in Union County, NC. The roadway extension involved a new crossing of Sixmile Creek in between the NC 16 and SR 3635 (Marvin

Road) crossings. Although the project itself is located outside of the Action Area, the Sixmile Creek watershed as a whole was evaluated in the consultation. Freshwater mussel surveys were conducted in 1999 prior to the authorization of the USACE 404 permit, for a standard distance of 1,312 feet below and 328 feet above the proposed crossing. A large number of mussels, primarily the eastern elliptio, were found during this survey effort; however, typical Carolina heelsplitter habitat is not present in this reach of the stream. Based on the survey results, and the lack of typical habitat, it was concluded that the project was "Not Likely to Adversely Affect" the Carolina heelsplitter. The USFWS concurred with these findings, and the project was let for construction later that year and completed the following year. NOTE: Schweinitz's sunflower was also addressed as part of this project, but its occurrence was outside of the Action Area.

- U-2510 (Carolina heelsplitter): Involved the widening of NC 16 from the intersection with the Rea Road Extension in Union County, NC north to I-485. The widening of the roadway involved replacing the existing culvert over Sixmile Creek with a bridge. As with the Rea Road Extension project, mussel surveys were completed for this project in August 2004, with similar results and a concurrence of "Not Likely to Adversely Affect" was issued by USFWS. As a result of the discovery of Carolina heelsplitter in Sixmile Creek, the USFWS asked NCDOT to reinitiate consultation in April 2006, and perform additional surveys. These surveys were conducted later that month, with similar results to the previous surveys. Again a "Not Likely to Adversely Affect" conclusion was reached and concurred with by USFWS.
- R-5114 (Carolina heelsplitter): Involved the rehabilitation of NC 218 in Mecklenburg, Union, and Anson Counties. This was an American Recovery and Reinvestment Act (ARRA) project which involved repairing deteriorated sections of the existing roadway, overlaying with asphalt and several culvert replacements (Duck Creek).
- (Carolina heelsplitter): USFWS consulted on a natural gas pipeline project that involved crossings of Goose and Duck Creeks. Based on results of surveys for listed plants and measures incorporated into the project to avoid impacts to the Carolina heelsplitter, USFWS concurred with the determination of a "Not Likely to Adversely Affect" conclusion.
- (Carolina heelsplitter): USFWS consulted with NCWRC in the past on several restoration projects in the Goose Creek watershed. A "Not Likely to Adversely Affect" conclusion was reached and concurred with by USFWS.
- B-5109 (Carolina heelsplitter): Bridge No. 29 on NC 218 over Goose Creek. A BA was submitted on April 5, 2013 with the determination of a "May Affect, Likely to Adversely Affect" conclusion. A BO was issued on May 20, 2013 which concurred that "implementing this project is not likely to jeopardize the continued existence of the Carolina heelsplitter or adversely modify its critical habitat" (USFWS 2013).
- Carolina heelsplitter: Bridge No. 6 on SR 1600 over Duck Creek in Union County. Biological Assessment concluded the project "May Affect, Likely to Adversely Affect"

the Carolina heelsplitter. The BA was submitted in May 2012. A concurrence has not been issued as of the writing of this document.

1.3 Habitat Conservation Plans In Action Area

There have been no Habitat Conservation Plans developed for any listed species within the Action Area.

2.0 PROJECT DESCRIPTION

The Monroe Connector/Bypass is proposed to be a controlled-access toll road extending from US 74 near I-485 in Mecklenburg County to US 74 between the towns of Wingate and Marshville in Union County, a distance of approximately 20 miles. The project will occupy approximately 1,240 acres within the proposed right of way (ROW). The proposed action will improve mobility and capacity within the project study area by providing a facility for the US 74 corridor that allows for high-speed regional travel consistent with the designations of the North Carolina Strategic Highway Corridor (SHC) program and the North Carolina Intrastate System, while maintaining access to properties along existing US 74.

2.1 Avoidance and Minimization

Consideration was given to the location of endangered species throughout the alternatives development and design process, based on the best available information regarding the known locations of the protected species populations. As stated in Section 2.3.1 in the Draft EIS (excerpt below), all alternatives were purposely kept from encroaching on the Goose Creek watershed in an effort to avoid direct effects to the Carolina heelsplitter and its designated critical habitat (PBS&J 2009).

> *To the north, the boundary does not encroach on either the Goose Creek watershed or on Lake Twitty (a water supply). Previous studies included these areas, but because of concerns surrounding the presence of the federally-endangered Carolina heelsplitter mussel in Goose Creek and because Lake Twitty is a critical watershed, these areas were eliminated from the current project study area. Previously identified corridors for the Monroe Connector and Monroe Bypass that would result in direct impacts to the Goose Creek watershed or Lake Twitty are not included in this analysis.*

Additionally, alternatives were kept outside of the Waxhaw Creek watershed, known Carolina heelsplitter habitat, as stated in Section 2.3.1 in the Draft EIS (PBS&J 2009):

A corridor south of the Lake Lee critical watershed would not be reasonable or practical due to substantially greater length and potential impacts to the Waxhaw Creek watershed, which is also a known Carolina heelsplitter habitat.

3.0 DESCRIPTION OF ACTION AREA

The action area, as defined in 50 CFR 402.02, means areas to be affected directly or indirectly by the federal action and not merely the immediate area involved in the action. The defined Action Area for the proposed project includes several area types: those directly impacted by construction activities; those potentially impacted by indirect effects or cumulative effects; and those in which conservation measures are utilized to offset any impacts are proposed outside of the construction areas and the identified zone of indirect impacts. The Action Area for this BA is also referred to as the Future Land Use Study Area (FLUSA) in this and other associated NEPA documents.

Defining the Action Area / FLUSA was coordinated with the environmental regulatory agencies at the January 25, 2007 TEAC meeting. The limits of the FLUSA was also discussed at the February 14, 2007 TEAC meeting, with discussions concluding at the March 22, 2007 TEAC meeting. The FLUSA was expanded to include the entire Goose Creek Watershed.

3.1 Areas of Direct Effects

Direct effects are caused by the proposed action and generally occur at the same time and place as the project. Areas of direct effects will include, but are not limited to: the footprint or ROW of the facility, construction areas, or any other activity that causes ground disturbing activities that can be directly associated with the project. Direct effects of the proposed action are documented in the Final EIS Section S-8 (Table S-2) (PBS&J 2010a).

Direct effects also refer to other activities that are interrelated or interdependent with the proposed action. Interrelated actions are defined as federal actions that are part of a larger action and depend on the larger action for their justification [50 CFR 402.02]. Interrelated action areas include project-associated utility relocations, as well as construction borrow pits, haul roads, and staging areas. Interdependent actions, defined as federal actions having no independent utility apart from the proposed action [50 CFR 402.02], were evaluated with regard to direct effects to endangered species and critical habitat. No direct interdependent actions are anticipated.

3.2 Areas of Indirect Effects

Areas of indirect effects include, but are not limited to, those areas that are impacted by, or will result from, the proposed action and are later in time, but are still reasonably certain to occur [50 CFR 402.02]. These types of impacts can include natural responses to the proposed action’s direct impacts, or can include human induced impacts associated with the proposed action. The indirect impacts are assessed in the DTR. Indirect effects also refer to activities that are interrelated or interdependent with the proposed action. These actions were evaluated with regard to indirect effects to endangered species and critical habitat.

3.3 Conservation Measures

Conservation measures are those measures that facilitate conservation of the species and offer some level of protection to the population.

4.0 ENVIRONMENTAL BASELINE – CAROLINA HEELSPLITTER

4.1 Species Description: Carolina Heelsplitter

4.1.1 Designation (Legal Status)

The Carolina heelsplitter, of the family Unionidae, was listed as Endangered on June 30, 1993, under provisions of the Endangered Species Act of 1973 (as amended) (58 FR 34926-34932) (USFWS 1993a). Critical habitat was designated for Carolina heelsplitter on September 2, 2002, (67 FR 44501-44522), described in detail in Section 4.2.

4.1.1 Characteristics

The Carolina heelsplitter (*Lasmigona decorata*), originally described as *Unio decoratus* by (Lea 1852), synonymized with *Lasmigona subviridis* (Conrad 1835, Johnson 1970), and later separated as a distinct species (Clarke 1985), is a federally Endangered freshwater mussel, historically known from several locations within the Catawba and Pee Dee River systems in North Carolina and the Pee Dee, Savannah, and possibly the Saluda River systems in South Carolina.

The Carolina heelsplitter is characterized as having an ovate, trapezoid-shaped, unsculptured shell. The outer surface of the shell ranges from greenish brown to dark brown in color, with younger specimens often having faint greenish brown or black rays. The shell's nacre is often pearly white to bluish white, grading to orange in the area of the umbo (Keferl 1991). The hinge teeth are well developed and heavy and the beak sculpture is double looped (Keferl and Shelly 1988). Morphologically, the shell of the Carolina heelsplitter is very similar to the shell of the green floater (Clarke 1985), with the exception of a much larger size and thickness in the Carolina heelsplitter (Keferl and Shelly 1988).

Prior to collections in 1987 and 1990 by Keferl (1991), the Carolina heelsplitter had not been collected in the 20th century and was known only from shell characteristics. Because of its rarity, very little information of this species' biology, life history, and habitat requirements was known until very recently. Feeding strategy and reproductive cycle of the Carolina heelsplitter have not been documented, but are likely similar to other native freshwater mussels (USFWS 1996).

The feeding processes of freshwater mussels are specialized for the removal (filtering) of suspended microscopic food particles from the water column (Pennak 1989). Documented food sources for freshwater mussels include detritus, diatoms, phytoplankton, and zooplankton (USFWS 1996).

McMahon and Bogan (2001) and Pennak (1989) should be consulted for a general overview of freshwater mussel reproductive biology. Freshwater mussels have complex reproductive cycles, which usually include a larval stage (glochidium) that is an obligatory parasite on a fish. The glochidia develop into juvenile mussels and detach from the "fish host" and sink to the stream bottom where they continue to develop, provided suitable substrate and water conditions are available (USFWS 1996). Often, this relationship is quite species-specific with a mussel being able to infect only one species of fish or a small group of closely related species. Many of the fish host associations have been documented by direct evidence on wild-caught fishes or implicated in laboratory infestation experiments (Watters 1994).

Until recently, nothing was known about the host species(s) for the Carolina heelsplitter (USFWS 1996, Bogan 2002). Starnes and Hogue (2005) identified the most likely fish host candidates (15 species) based on fish community surveys in occupied streams throughout the range of the Carolina heelsplitter.

Captive propagation efforts for this species had not been attempted in the past; however, due to the critical level of imperilment of the North Carolina populations, acting on recommendations from the NC Scientific Council on Mollusks, the NC Wildlife Resources Commission (NCWRC) funded a life history/captive propagation study, which allowed for salvage of individuals from the Goose/Duck and Sixmile Creek populations to be used in the study. A total of nine minnow species (Cyprinidae) were identified as suitable, and two sunfish species (*Lepomis* spp.) were identified as marginally suitable host species (Eads et al. 2010). All of these species may occur in habitat types known to be occupied by the Carolina heelsplitter; however, "it is always possible that it may use a combination of fish host species and some may not be native to all streams inhabited by this mussel" (Starnes and Hogue 2005).

Another member of the genus *Lasmigona*, the green floater (*Lasmigona subviridis*), perhaps a close relative to the Carolina heelsplitter, has been documented to be capable of in situ early development with glochidia developing within the marsupium of the female (Barfield and Watters 1998), thus it is possible that the Carolina heelsplitter may also be able to propagate by direct transformation.

4.1.2 Distribution and Habitat Requirements

Currently the Carolina heelsplitter has a very fragmented, relict distribution. At the time of listing, it was known to be surviving in only six streams and one small river (USFWS 1996); however, subsequent discoveries have increased the number of known populations to eleven.

Pee Dee River Basin:

1. Duck Creek/Goose Creek – Mecklenburg/Union Counties, NC
2. Flat Creek/Lynches River – Lancaster/Chesterfield/Kershaw Counties, SC

Catawba River Basin:

3. Sixmile Creek (Twelvemile Creek Subbasin) – Union/Mecklenburg Counties, NC and Lancaster County, SC
4. Waxhaw Creek – Union County, NC and Lancaster County, SC
5. Cane Creek/Gills Creek – Lancaster County, SC
6. Fishing Creek Subbasin – Chester County, SC
7. Rocky Creek Subbasin (Bull Run Creek/UT Bull Run Creek/Beaverdam Creek – Chester County, SC

Saluda River Basin:

8. Redbank Creek – Saluda County, SC
9. Halfway Swamp Creek – Greenwood/Saluda Counties, SC

Savannah River Basin:

10. Little Stevens Creek/Mountain Creek/Sleepy Creek /Turkey Creek (Stevens Creek Subbasin) – Edgefield/McCormick Counties, SC.
11. Cuffytown Creek (Stevens Creek Subbasin) – Greenwood/McCormick Counties, SC

All of these populations occur in stream reaches within the Piedmont Physiographic Province, particularly within two northeast trending lithostratigraphic belts of the Carolina Terrane, the Carolina Slate Belt and the Charlotte Belt. The Carolina Slate Belt is a band of greenschist faces metavolcanic rock formations positioned in the central and lower Piedmont province extending from south-central Virginia to extreme eastern Georgia (Howell 2005, Butler and Secor 1991). The Charlotte Belt extends from north central North Carolina to eastern Georgia and is comprised of amphibolite faces metavolcanic and metaplutonic rock (Howell 2005, Butler and Secor 1991). These hard formations strongly dictate the channel morphology and character of stream substrates where they intersect. Starnes and Hogue (2005) describe such reaches as "generally characterized by dark, often tilted, bedrock stream bottom with associated large and small rock rubble interspersed with pockets of sand, silt, and gravel."

Habitat for this species has been reported from small to large streams and rivers as well as ponds. The ponds are believed to be millponds on some of the smaller streams within the species' historic range (Keferl 1991). Keferl and Shelly (1988) and Keferl (1991) reported that most individuals have been found along well-shaded streambanks with mud, muddy sand, or muddy gravel substrates; however, numerous individuals in several of the populations have been found in cobble and gravel dominated substrate in stream reaches intersecting the hard rock formations described above (TCG personal observations). The stability of stream banks appears to be very important to this species (Keferl 1991).

4.1.3 Threats to Species (Particularly Goose/Duck Creek and Sixmile Creek Populations)

Habitat degradation, water quality degradation, and changes in stream flow (water quantity) are the primary identified threats to the Carolina heelsplitter. Specific types of activities that lead to these threats have been documented by the USFWS in the Recovery Plan, Federal Register and other publications (USFWS 1996, 2002a, 2003). These specific threats include the following:

- Siltation resulting from poorly implemented agricultural, forestry and developmental activities;
- Golf course construction;
- Road construction and maintenance;
- Runoff and discharge of municipal, industrial and agricultural pollutants;
- Habitat alterations associated with impoundments, channelization, dredging, and sand mining operations; and
- Other natural and human-related factors that adversely modify the aquatic environment.

These threats, alone and collectively, have contributed to the loss of the Carolina heelsplitter in streams previously known to support the species (USFWS 2002a). In addition, many of the remaining populations occur in areas experiencing high rates of urbanization, such as the Charlotte, NC and Augusta, GA greater metropolitan areas. The low numbers of individuals and the restricted range of each of the surviving populations make them extremely vulnerable to extirpation from a single catastrophic event or activity (USFWS 1996). The cumulative effects of several factors, including sedimentation, water quality degradation, habitat modification (impoundments, channelization, etc.), urbanization and associated alteration of natural stream discharge, invasive species, and other causes of habitat degradation have contributed to the decline of this species throughout its range (USFWS 1996).

Extensive threats to the species, including sedimentation, toxic contaminants, habitat alterations, urbanization/impervious surface area, thermal pollution, invasive species, and other causes of habitat degradation, are discussed in further detail below.

4.1.3.1 Sedimentation

Sedimentation resulting from improper erosion control of various land usage practices, including agriculture, forestry, and development activities, has been recognized as a major contributing factor to the degradation of mussel populations (USFWS 1996, Brim Box and Mossa 1999, Chapman and Smith 2008). Siltation has been documented to be extremely detrimental to mussel populations by degrading substrate and water quality, increasing potential exposure to other pollutants, and by direct smothering of mussels (Ellis 1936, Markings and Bills 1979). Sediment accumulations of less than one inch have been shown to cause high mortality in most mussel species (Ellis 1936). Accelerated sedimentation and erosion resulting from a bridge construction project in Massachusetts lead to the extirpation of a population of the dwarf wedgemussel (*Alasmidonta heterodon*), a federally endangered freshwater mussel (Smith 1981).

4.1.3.2 Toxic Contaminants

The presence of toxic contaminants has been attributed as a contributor to widespread declines of freshwater mussel populations (Havlik and Marking 1987; Bogan 1993; Neves et al. 1997). Toxic contaminants can produce lethal or sub-lethal responses to freshwater mussels. The sensitivities of freshwater mussels to toxic contaminants is variable based on species, life stage (glochidium, juvenile, or adult), and environmental conditions, as well as concentration and exposure route (water column, sediments, etc.), frequency, and duration. Several studies have indicated that freshwater mussels are among the most sensitive aquatic organisms to various toxicants, particularly cadmium, copper and ammonia (Grabarkiewicz and Davis 2008).

Freshwater mussels are extremely sensitive to ammonia, a form of nitrogen (Goudreau et al. 1993; Augspurger et al. 2003, Bartsch et al. 2003, Newton et al. 2003; Wang et al. 2007a; 2007b). Anthropogenic sources of ammonia in surface waters include sewage treatment effluent, industrial wastewater effluent, and runoff and ground water contamination from lawn/turf management, livestock operations and faulty septic systems. 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 two miles below discharges of chlorinated sewage effluent. Similarly, surveys in the Goose Creek watershed show a dramatic absence of mussel fauna below the Oxford Glen WWTP on Stevens Creek for a considerable distance (approximately 1.6 km/1mi) below the discharge point (NCWRC 2010). A study conducted in the Goose Creek watershed documented that baseflow concentrations of chlorine nearly double directly downstream of the Hunley Creek WWTP located on Goose Creek (Allan 2004).

Recent studies indicate that current federal and state water quality standards for many pollutants commonly found in wastewater discharges and stormwater runoff are likely not protective of freshwater mussels and current regulations controlling the discharge or runoff of these pollutants are not protective (Augspurger et al. 2003). The U.S. Environmental Protection Agency (EPA) has been evaluating potential revision of the current federal standards (acute and chronic standards) for ammonia, but has yet to revise them to a protective level (USFWS 2007). Water quality monitoring by the North Carolina Division of Water Quality [Note: North Carolina Division of Water Quality changed its name to North Carolina Division of Water Resources in 2013] (NCDWQ 2002) identified average and maximum concentrations of ammonia in Goose Creek as being among the highest of any monitored sites in the Yadkin/Pee Dee River Basin.

In addition to ammonia, several other pollutants have been identified as exceeding levels of concern in Goose Creek, including, but not limited to, sediment/suspended solids (NCDWQ 2000; Chen et al. 2001; Allan 2005), copper (NCDWQ 2002), chlorine (NCDWQ 1998), and phosphate, a form of phosphorus (Chen et al. 2001; NCDWQ 2002, 2003; Allan 2005). While phosphate itself is not toxic, concerns with extremely high concentrations of phosphate pertain to increased biological production, such as algal blooms, which can result in lowering of dissolved oxygen (Binkley et al. 1999).

Concentrations of several of these pollutants in Goose Creek, including ammonia, appear to be on an increasing trend (Chen et al. 2001; Service et al. 2005). Currently there are no water quality standards, or monitoring requirements for ammonia, copper and phosphorus in North Carolina (USFWS 2007); however, the Goose Creek Site Specific Management Plan (NCDENR 2009) requires that any direct or indirect discharge that may cause ammonia toxicity to the Carolina heelsplitter, action shall be taken to reduce ammonia (NH3-N) inputs to achieve 0.5 milligrams per liter or less of total ammonia based on chronic toxicity defined in 15A NCAC 02B .0202. This level of total ammonia is based on ambient water temperature equal to or greater than 25 degrees Celsius (NCDENR 2009).

In addition, recent studies indicate other toxicants present in wastewater effluent such as pharmaceuticals and personal care products (fluoxitine, estrogenic compounds, opiate derivatives etc.) cause a wide array of neurotoxicological (Gagné et al 2007a), reproductive (Bringolf et al. 2007, Gagné et al 2007b) and behavioral (Heltsley et al. 2006) impacts to freshwater mussels.

Other sources of toxic contaminants in surface waters arise from highway and urban runoff. Numerous pollutants have been identified in highway runoff, including various metals (lead, zinc, iron, etc.), sediment, pesticides, deicing salts, nutrients (nitrogen, phosphorus), and petroleum hydrocarbons (Yousef et al. 1985, Gupta et al. 1981). The sources of these runoff constituents range from construction and maintenance activities to daily vehicular use. Hoffman et al. (1984) concluded that highway runoff can contribute up to 80% of the total pollutant loadings to receiving water bodies. Petroleum hydrocarbons, polycyclic aromatic hydrocarbons, lead, and zinc were some of the pollutants identified in this study.

The toxicity of highway runoff to aquatic ecosystems is poorly understood. A major reason for this poor understanding is a lack of studies focusing solely on highway runoff. Potential impacts of highway runoff have often been inferred from studies conducted on urban runoff; however, the relative loadings of pollutants are often much greater in urban runoff, because of a larger drainage area and lower receiving water dilution ratios (Dupuis et al. 1985). The negative effects of urban runoff inputs on benthic macroinvertebrate communities have been well documented (Garie and McIntosh 1986; Jones and Clark 1987; Field and Pitt 1990). Lied (1998) found the macroinvertebrate community of a headwater stream in Pennsylvania to be highly degraded by urban runoff via a detention pond. Improvements were observed at continual distances downstream from the discharge point, however all sites examined were still impaired compared to a reference community.

The few studies that examined actual highway runoff show that some species demonstrate little sensitivity to highway runoff exposure, while others are much more sensitive (Dupuis et al. 1985). Maltby et al. (1995) found elevated levels of hydrocarbons and metals in both stream sediments and the water column below a heavily traveled British motorway. They demonstrated that the benthic amphipod (*Gammarus pulex*) experienced a decrease in survival when exposed to sediments contaminated with roadway runoff. However, this species showed no increase in mortality when exposed to water contaminated with roadway runoff. Unfortunately, most of these studies only measured acute toxicity to runoff and did not examine long-term effects.

The effects of highway runoff on freshwater bivalves have not been studied extensively. Augspurger (1992) compared sediment samples and soft tissues of three eastern elliptio (*Elliptio complanata*), a relatively common species upstream and downstream of the I-95 crossing of Swift Creek in Nash County, North Carolina. The sediment samples as well as the mussels exhibited higher levels of aliphatic hydrocarbons, arsenic, lead, zinc, and other heavy metal contaminants in the downstream samples. Because of the small sample size, the effect on the health of these mussels was not studied. In another study, contaminant analysis of stream sediments showed an increase of polycyclic aromatic hydrocarbons and some metals downstream of road crossings, although there was no direct correlation found between increasing contaminant levels and decreasing mussel abundance at these crossings (Levine et al. 2005). The eastern elliptio was the only mussel species that was found in large enough numbers for statistically valid comparisons. The eastern elliptio is generally considered more tolerant of water quality degradation than many other mussel species. Further research is needed before the effects of highway runoff on sensitive mussel species such as the Carolina heelsplitter can be determined.

In addition, contamination of surface water from toxic spills along roadways is known to have significant impacts to aquatic communities. A toxic spill resulting from a tanker truck accident that was carrying Octocure 554 (a chemical liquid used in the rubber making process), killed several miles of mussel populations in the Clinch River near Cedar Bluff, Virginia. The spill killed thousands of fish and mussels, including three federally protected species. The Clinch River contains one of the most diverse mussel faunas in the United States. The stretch of the river affected by the spill was one of the few remaining areas that contained a reproducing population of the Endangered tan riffleshell (*Epioblasma florentina walkeri*). The toxic spill is believed to have eliminated this population (Richmond Times Dispatch 1998).

4.1.4 Habitat Alterations

The impact of impoundments on freshwater mussels has been well-documented (USFWS 1992a, Neves 1993). Dam construction transforms lotic habitats into lentic habitats, which results in changes within aquatic community composition. Muscle Shoals on the Tennessee River in northern Alabama, once the richest site for mussels) in the world, is now at the bottom of Wilson Reservoir, covered with 19 feet of muck (USFWS 1992b). Large portions of all of the river basins within the Carolina heelsplitter's range have been impounded; this is believed to be a major factor contributing to the species decline (USFWS 1996). This is especially true in the larger river habitats within the species historic range, such as the Catawba and Savannah Rivers, where impoundments have significantly altered habitat. The two extant populations in the Savannah River Basin are functionally isolated from each other by an impoundment on Stevens Creek, as such, there are considered two separate units for management (USFWS 1996).

4.1.4.1 Urbanization/Impervious Surface Area

The correlation of increasing development within a watershed and decreasing water quality is well documented (Lieb 1998, Crawford and Lenat 1989, Garie and McIntosh 1986, Lenat et al. 1979), and is largely associated with increases in impervious surface area. These increases in impervious surface area can indirectly affect water quality in a variety of ways, particularly with regard to changes to stream flow, water temperature, total suspended sediment, and pollutant loadings.

Multiple studies have demonstrated that water quality and stream ecosystem degradation begins to occur in watersheds that have approximately 10% coverage by impervious surfaces (Stewart et al. 2000, Schueler 1994, Arnold and Gibbons 1996). The NCWRC recommendations for management of protected aquatic species watersheds are to limit imperviousness to 6% of the watershed (NCWRC 2002). These impacts are examined in Section 6.5 of the DTR.

Increases in impervious surface area within a watershed can result in extremes in peak discharge, runoff volume and base flow conditions. The Carolina heelsplitter may inherently be more susceptible to the consequences of these extremes than other mussels. While most mussels will usually dig into the substrate such that only the siphons are exposed or the very top of the shell, the Carolina heelsplitter is usually found with about 1/3 of its shell lodged in the substrate (Catena personal observations). As a result, it is much more prone to dislodgement during high base flows and less able to bury itself in the substrate during low flow conditions. This factor likely makes the Carolina heelsplitter more prone to predation and desiccation, even during periods of normal precipitation, than other freshwater mussels.

- *Peak Discharge*

Peak discharge is the maximum rate of stormwater flow expected from a storm event, measured in cubic feet per second (cfs). Peak discharge is often one metric used in analyzing impacts from development. Peak discharge affects channel stability (or instability), which is one of the identified constituent elements. Increases in peak discharge equates to higher velocity, which in turn increases the scouring effect (surface erodibility) of the runoff. Accordingly, sedimentation will increase as erosion rates increase. Allan (2005) documented dramatic increases in sediment and nutrient concentrations during high flow events in the Goose Creek subbasin.

Increases of peak discharge rates, coupled with deforestation, have been shown to result in stream narrowing and incision and subsequent loss of ecosystem function (Sweeney et al. 2004). Increased runoff volume and peak discharge (from typical and atypical storm events) destabilize the stream channel.

- *Runoff Volume*

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

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

- *Decreased Base Flow*

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

- During periods of reduced base flow, there is less water to cover the stream bottom.

- Widened streams have less overhanging tree cover and are exposed to more sunlight, resulting in increased water evaporation and temperature, especially in areas with shallower water.
- If base flow is reduced, yet WWTP discharge remains constant or increases, it takes longer for the stream to dilute the nutrients and other toxins in the effluent, thereby extending the WWTP effluent "plume" further downstream.
- Permitted and un-permitted water withdrawals for crop and turf/lawn irrigation further exacerbate this effect. Currently, there is an irrigation withdrawal from Goose Creek at approximately mid-length of its course for a golf course at approximately mid-length of its course. During summer months withdrawals of up to 188 gallons per minute (gpm), or 0.42 cfs can significantly affect the available dilution for downstream dischargers (Belnick, 2001).

4.1.4.2 Thermal Pollution

Concerns over effects of thermal pollution from urban runoff on aquatic systems have increased in recent years. Elevation of stream temperature can raise Biochemical Oxygen Demand (BOD), lower dissolved oxygen (DO), and alter faunal composition (Roa-Espinosa et al. 2003, Poole et al. 2001). Typically, runoff from a developed impervious area will have a temperature similar to the temperature of the impervious area. During the hot summer months, this could potentially make the stormwater runoff reach temperatures up to and above 90°F, which could be detrimental to the aquatic life. Traditional structural stormwater controls, such as open storm-water detention ponds/basins that do not allow for infiltration, do not protect receiving water bodies against adverse temperature effects. For these and other reasons, the USFWS feels that the Goose Creek Site Specific Management Plan (NCDENR 2009), will not provide adequate protection to the Carolina heelsplitter, because the plan states that although measures to promote infiltration and groundwater recharge are to be "considered," such measures will not be required (USFWS 2008). Various stormwater BMPs have been shown to be effective in ameliorating temperature effects (NC State Cooperative Extension 2006a). Bioretention devices were shown to reduce runoff temperature by 5-10°F in Greensboro, NC (NC State Cooperative Extension 2006b).

The loss of riparian buffers as well as peak discharge-related channel widening can also contribute to stream temperature increases, by increasing sunlight exposure and decreasing water depth.

4.1.4.3 Invasive Species

The introduction of exotic species such as the Asian clam (*Corbicula fluminea*) and zebra mussel (*Dreissena polymorpha*) has also been shown to pose significant threats to native freshwater mussels. The zebra mussel is not known from any waterbodies supporting the Carolina heelsplitter (USFWS 1996); however, the Asian clam is established in most of the major river systems in the United States (Fuller and Powell 1973), including those streams still supporting surviving populations of the Carolina heelsplitter (USFWS 1996).

Concern has been raised over competitive interactions for space, food, and oxygen with the Asian clam and native mussels, possibly at the juvenile stages (Neves and Widlack 1987, Alderman 1997). In addition, under high densities, Asian clam beds are subject to large die-offs, which have been shown to dramatically increase porewater ammonia, and reduce DO during low-flow summer months (Cooper et al. 2005).

4.1.4.4 Other Causes of Habitat Degradation

Loss of riparian buffers can lead to degradation of adjacent aquatic habitats. The role of forested riparian buffers in protecting aquatic habitats is well documented (NCWRC 2002). The Recovery Plan for the Carolina heelsplitter (USFWS 1996) identifies the establishment of stream buffer zones as a major Recovery Objective (Task 1.4). Riparian buffers provide many functions including pollutant reduction and filtration, a primary source of carbon for aquatic food web, stream channel stability, and maintenance of water and air temperatures. Numerous studies have recommended a range of buffer widths needed to maintain these functions. Recommended widths vary greatly depending on the parameter or function evaluated. Wide contiguous buffers of 100-300 feet (30-91 meters) are recommended to adequately perform all functions (NCWRC 2002). The NCWRC recommends a minimum of 200 foot (61 meter) native, forested buffer on perennial streams and a 100 foot (30 meter) forested buffer on intermittent streams in watersheds that support federally endangered and threatened aquatic species (NCWRC 2002). Although not officially adopted, the USFWS uses the NCWRC recommendations as guidance when addressing federally protected aquatic species in North Carolina. The Site Specific Water Quality Management Plan for the Goose Creek Watershed (NCDWQ 2009) requires undisturbed riparian buffers within 200 feet of waterbodies within the 100-year floodplain and within 100 feet of waterbodies not within the 100-year floodplain. The USFWS feels that this level of protection is not sufficient to protect the Carolina heelsplitter, as Rule 15A NCAC 02B.0607 exempts or potentially allows (with NCDWQ approval) numerous activities within the “undisturbed” buffers, with no requirement for mitigation (USFWS 2008).

Another human-related factor adversely impacting habitat of the Carolina heelsplitter is recreational all-terrain vehicle (ATV) use. ATV tracks have been noted crossing streams as well as traveling stream channels within Carolina heelsplitter habitat, in particular in several segments of Goose Creek. In addition to directly running over mussels, ATVs destabilize stream banks and floodplains, causing sedimentation and buffer degradation. While there is no quantitative data available on ATV use, locally, this can have significant impacts.

4.1.4.5 Identified Action Area Threats

The Goose Creek and Sixmile Creek populations of the Carolina heelsplitter are threatened by numerous sources of degradation. Both of these watersheds have experienced rapid urbanization in recent years (TCG 2007, HNTB 2009, Baker Engineering 2013), which have contributed to, or exacerbated these threats. Specific threats to Carolina heelsplitter populations in these two watersheds are listed in Table 1.

Table 1. Threats to Carolina heelsplitter in the Goose Creek Basin and Action Area

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

Threat/Concern	Specific Problems	Potential Sources
Invasive Species	Competitive interactions, water quality effects	Asian clam

4.2 Designated Critical Habitat

In accordance of Section 4 of the ESA, Critical Habitat for listed species consists of:

(1) The specific areas within the geographical area occupied by the species at the time it is listed in which are found those physical or biological features (constituent elements) that are:
  a. essential to the conservation of the species, and
  b. which may require special management considerations or protection

(2) Specific areas outside the geographical area occupied by the species at the time it is listed in accordance with the provisions of Section 4 of the Act, upon a determination by the Secretary that such areas are "essential for the conservation of the species."

When designating Critical Habitat, the USFWS identifies physical and biological features (primary constituent elements) that are essential to the conservation of the species and that may require special management considerations or protection. The primary constituent elements essential for the conservation of the Carolina heelsplitter (USFWS 2002a) include:

1. permanent flowing, cool, clean water
2. geomorphically stable stream and river channels and banks
3. pool, riffle, and run sequences within the channel
4. stable substrates with no more than low amounts of fine sediment
5. moderate stream gradient
6. periodic natural flooding
7. fish hosts, with adequate living, foraging, and spawning areas for them.

Critical Habitat for the Carolina heelsplitter was designated in 2002 (USFWS 2002a). The designated area totals approximately 148 kilometers (92 miles) of nine creeks and one river in North and South Carolina (Figures 2 and 3). Six areas (Units) have been designated as critical habitat and a description of each follows.

<u>Unit 1. Goose Creek and Duck Creek (Pee Dee River system), Union County, NC</u>

Unit 1 encompasses approximately 7.2 km (4.5 mi) of the main stem of Goose Creek, Union County, NC, from the N.C. Highway 218 Bridge, downstream to its confluence with the Rocky River, and approximately 8.8 km (5.5 mi) of the main stem of Duck Creek, Union County, NC, from the Mecklenburg/Union County line downstream to its confluence with Goose Creek.

Details regarding recent surveys in Goose/Duck Creeks, and conditions within the Critical Habitat Unit are discussed in Section 4.4.

Unit 2. Waxhaw Creek (Catawba River system), Union County, NC

Unit 2 encompasses approximately 19.6 km (12.2 mi) of the main stem of Waxhaw Creek, Union County, NC, from the N.C. Highway 200 Bridge, downstream to the North Carolina/South Carolina state line. Very few Carolina heelsplitter individuals have been found in Waxhaw Creek since they were first discovered in 1987. Keferl (1991) found one live individual in 1987 and two in 1990. Subsequent surveys failed to find any individuals until one weathered shell was found in 1996, followed by one live individual in 1998, one weathered shell in 2005, three live individuals at three separate sites in 2006 (NCWRC Database) and no live individuals in 2011 (USFWS 2012a). Surveys of Waxhaw Creek in South Carolina, conducted in 2004, documented only two live individuals at a single site – one of only a couple of sites in the stream below the North Carolina/South Carolina state line that appeared to provide suitable substrate for the heelsplitter (USFWS 2007). The population level in Waxhaw Creek is therefore very low, making it extremely vulnerable to extirpation.

Unit 3. Gills Creek (Catawba River system), Lancaster County, SC

Unit 3 encompasses approximately 9.6 km (6.0 mi) of the main stem of Gills Creek, Lancaster County, SC, from the County Route S-29-875, downstream to the SC Route 51 Bridge, east of the City of Lancaster. One 88.0 mm fresh shell and one 67.0 mm live individual discovered in 1998 represent this population (Alderman 1998). No additional surveys have been completed in this section of Gills Creek since 1998. In 2006 Catena discovered the species (two live and one shell) at three sites in Cane Creek, a tributary to Gills Creek (USFWS 2007). While Cane Creek is not within the boundaries of Unit 3, Gills Creek and Cane Creek are considered a single population from a management perspective, as there are no physical barriers that would isolate the two areas. The discovery of the Carolina heelsplitter in Cane Creek demonstrates that this population has been reduced to small pockets of habitat in the watershed. Additional surveys in 2011 in Gills Creek from the South Carolina Highway 9 Bridge upstream to the Langley Road crossing resulted in the discovery of one live individual (USFWS 2012a). This population is very small, consisting of a few individuals, and increasingly at risk of being extirpated.

Unit 4. Flat Creek (Pee Dee River system), Lancaster County, SC, and the Lynches River (Pee Dee River system), Lancaster, Chesterfield, and Kershaw Counties, SC

Unit 4 encompasses approximately 18.4 km (11.4 mi) of the main stem of Flat Creek, Lancaster County, SC, from the SC Route 204 Bridge, downstream to its confluence with the Lynches River. Additionally, Unit 4 encompasses approximately 23.6 km (14.6 mi) of the main stem of the Lynches River, in Lancaster and Chesterfield Counties, SC, from the confluence of Belk

Branch, Lancaster County, northeast (upstream) of the U.S. Highway 601 Bridge, downstream to the SC Highway 903 Bridge in Kershaw County, SC.

Within this unit in 2005 to 2007, the Lynches River local population was represented by 14 live and two fresh dead shells (54-87mm) found above SC 265 in Chesterfield/Lancaster Counties, SC (USFWS 2012a). In 2011, 13 live and one shell were found in this area (Catena 2011). Between 1994 and 1997, the Flat Creek local population was represented by 28 live individuals ranging in length from 54.15 to 94.1 mm and by four shells ranging in length from 41.0 to 86.1 mm (Alderman 1998). In 2007, Alderman conducted surveys of two reaches of Flat Creek, one in upper Flat Creek and one in middle-lower Flat Creek, and documented 16 live Carolina heelsplitters, including several age classes, some likely less than five years of age based on shell measurements (USFWS 2007). In 2010, Alderman and USFWS found 50 live and one weathered shell in Flat Creek, with a large number of size classes represented (USFWS 2012a). The population in Flat/Lynches Creek exists in relatively low numbers, and in Lynches Creek has a highly fragmented distribution (USFWS 2012a).

Unit 5. Mountain and Beaverdam Creeks (Savannah River system), Edgefield County, South Carolina, and Turkey Creek (Savannah River system), Edgefield and McCormick Counties, SC

Unit 5 encompasses approximately 11.2 km (7.0 mi) of the main stem of Mountain Creek, Edgefield County, SC, from the SC Route 36 Bridge, downstream to its confluence with Turkey Creek; approximately 10.8 km (6.7 mi) of Beaverdam Creek, Edgefield County, from the SC Route 51 Bridge, downstream to its confluence with Turkey Creek; and approximately 18.4 km (11.4 mi) of Turkey Creek, from the SC Route 36 Bridge, Edgefield County, downstream to the SC Route 68 Bridge, Edgefield and McCormick Counties, SC. Within this unit, only a single shell of the Carolina heelsplitter had been found in Beaverdam Creek since its discovery there (Alderman 1995). Additional surveys of the Beaverdam Creek between 1995 and 2007 failed to locate any individuals (USFWS 2007). Extensive surveys of the creek in 2010, however, resulted in the discovery of one live heelsplitter and one shell (USFWS 2012a).

Until recently, the Turkey Creek local population was represented by a few shells discovered in 1995 and by one live individual discovered in 1997 (Mcdougal 1997). Subsequent surveys have yielded several more live individuals: two in 2006, two in 2007, one in 2010 (USFWS 2012a), and 10 individuals in 2012 (1) and 2013 (9) (Catena 2013). The Mountain Creek local population is represented by 15 live individuals ranging in length from 38.7 to 84.9 mm and by 15 shells ranging in length from 53.0 to 98.0 mm (Alderman 1998, 2002). During surveys conducted in 2009 and 2010, USFWS biologists recorded nine live heelsplitters at sites scattered throughout the stream (USFWS 2012a). During 2002, two additional local populations of Carolina heelsplitter were discovered within the Turkey Creek Subbasin, one in Little Stevens Creek represented by a shell fragment, and one in Sleepy Creek represented by seven live individuals ranging in length from 51.1 to 73.0 mm and by three shells ranging in length from 61.4 to 71.0 mm (Alderman 2002). Most recently, seven live and one moribund individuals were documented in Little Stevens Creek in 2007 (USFWS 2007). A survey in 2011 of Little Stevens Creek yielded just one live individual. Additionally, during surveys conducted in Sleepy Creek in 2011, USFWS biologists recorded a total of 18 live individuals in a ~6.63-km (~4.12-mi) reach of the stream (USFWS 2012a). Overall, this population of Carolina heelsplitter consists of several small populations that are fragmented throughout the watershed. This distribution of individuals makes the population highly vulnerable to extirpation, though it appears that a few of these pockets may be rebounding.

Unit 6. Cuffytown Creek (Savannah River system), Greenwood and McCormick Counties, SC

Unit 6 encompasses approximately 20.8 km (12.9 mi) of the main stem of Cuffytown Creek, from the confluence of Horsepen Creek, northeast (upstream) of the SC Route 62 Bridge in Greenwood County, SC, downstream to the U.S. Highway 378 Bridge in McCormick County. Within this unit, three live individuals were discovered in 1998 and two live individuals were discovered in 2001, with lengths ranging from 53.5 to 71.5 mm. One shell was discovered in 1998 with a length of 63.0 mm (Alderman 1998, 2002). Biologists conducting surveys in 2010 found two live individuals at two separate sites. This appears to be a very small population and highly vulnerable to extirpation (USFWS 2012a).

Five of the eleven Carolina heelsplitter populations listed in Section 4.1.3: Sixmile Creek, Fishing Creek, Rocky Creek, Redbank Creek, and Halfway Swamp Creek, were discovered after Critical Habitat was designated. These populations are all limited in size and distribution.

4.3 Potential Effects of Roadway Projects on Freshwater Mussels and Habitat

A number of potential direct and indirect effects to the freshwater mussels and their habitat, which could result from roadway projects, are identified here. Potential cumulative effects are also discussed in this section. While several threats to the Carolina heelsplitter are recognized (Section 4.1.4), potential roadway-related threats fall into three main categories:

1) physical effects (habitat degradation , direct mortality of individuals),
2) water quality effects (chemical, temperature, and biological pollutants),
3) water quantity effects (changes in peak and base flows).

4.3.1 Potential Direct Effects

Direct effects refer to consequences that can be directly attributed to the project. Direct impacts associated with road construction include, but are not limited to, land-clearing, loss of habitat, stream re-channelization, hydrologic modification, and erosion associated with construction in the project corridor as well as within fill/borrow areas, and construction staging/access areas outside of the project corridor. The potential effects of these activities on aquatic species, especially freshwater mussels, include degradation of habitat due to siltation, substrate disturbance (resulting in physical injury to individual mussels, and reduced habitat suitability), temporary, and permanent alteration of flows (temporary dewatering, causeway construction, channel restriction etc.), and runoff of pollutants, that originate from the project corridor during construction, and once in operation, that result in mortality, or harm (stress, adverse behavioral responses, or limited viability etc.) to individual mussels. Potential impacts to mussel habitat include channel and stream bank scouring, erosion, and runoff of pollutants that originate from the project corridor during construction, and once in operation.

4.3.2 Potential Indirect Effects

Indirect effects are those effects that are caused by, or will result from, the proposed action and are later in time, but are still reasonably certain to occur [50 CFR 402.02]. These types of impacts can include natural responses to the proposed action's direct impacts, or can include human induced impacts associated with the proposed action.

4.3.1.1 Indirect Effects on Land Use

Project-induced changes in land use are also considered part of the indirect impacts of a proposed action. These types of land use changes are not direct consequences of the road construction, but result from modifications in access to parcels of land and from modifications in travel time between various areas (Mulligan and Horowitz 1986). Indirect land use impacts of highway projects include residential, commercial, and industrial developments and linear urban sprawl along a highway corridor or in the vicinity of interchanges.

Economic development is often used as a criterion in highway funding (Eagle and Stephanedes 1987). Historically, transportation has been viewed as a necessary precursor to economic development (Anderson et al. 1992), and transportation infrastructure is "one of the principle policy levers that state and local governments can use to increase their attractiveness to business investors" (Forkenbrock 1990).

Depending upon local land development regulations, development demand, water/sewer availability, and other factors, roadway improvements can also result in encouragement of additional unintended development and sprawl. Improvements to levels of service, better accommodation of merging and exiting traffic, and reductions in travel times can have land development impacts outside of the direct project area. Any induced growth and development within this area has the potential to degrade water quality, scenic values, and recreational opportunities unless proper planning and development regulations are utilized. This potential increases in areas with minimal or no planning programs and virtually non-existent development controls

4.3.1.2 Indirect Changes in Traffic Patterns

Project-induced development has the potential to effect traffic patterns on the existing road network within the action area of roadway construction projects. Increased traffic volumes on the road networks traversing the watersheds could potentially affect the associated aquatic communities, including freshwater mussels, by causing water quality degradation, while decreases in traffic volume could have a potential beneficial effect, by decreasing concentrations of toxicants originating from roadway runoff, and/or toxic spills along roadways.

4.3.2 Potential Cumulative Effects

Cumulative effects are those effects of future state or private activities, not involving federal actions, which are reasonably certain to occur within the action area of the proposed federal action. Cumulative effects to mussels and their habitat include continued non-federal development pressures, and their subsequent environmental consequences in the watersheds that are independent of the federal action.

4.4 Presence within Action Area

The Action Area / FLUSA encompasses streams within two major River Basins, the Catawba and Yadkin/Pee Dee. This includes portions of the subbasins within the project alignment, as well as others that are not, including McAlpine Creek (Irvins Creek, Campbell Creek, and Fourmile Creek), Goose Creek (Stevens Creek, Duck Creek, and Paddle Branch), Sixmile Creek, Twelvemile Creek (West Fork, Davis Mine Creek and East Fork), Bearskin Creek, (Horsepen Creek, Camp Branch and Lick Fork), and Lanes Creek (Henry Branch and Barkers Branch). These watersheds are depicted in Figure 4. As the Carolina heelsplitter is known to occur in water bodies ranging in size from large rivers to headwater streams, all perennial streams within the action area were evaluated for presence of this species

4.4.1 Project Alignment

The 31 perennial streams within the project alignment were evaluated for the presence of this species (Catena 2009). The streams are within the following subbasins: Crooked Creek (North and South Forks), Stewarts Creek, and Richardson Creek (includes Ray Fork, Salem Branch and Meadow Branch). The Carolina heelsplitter was not found in any of these water bodies (Catena 2009). Surveys conducted in 2009 were updated in 2012. In order to determine the location for the 2012 mussel surveys, the location of potential effects and/or impacts within the Project Study Area (PSA) were overlaid with streams identified during the 2009 surveys that contain a robust freshwater mussel population that could potentially support the Carolina heelsplitter. Accordingly, South Fork Crooked Creek and Stewarts Creek in the vicinity of the project alignment, and portions of Crooked Creek and Richardson Creek were surveyed.

Overall the results of the 2012 survey efforts are very similar to the 2009 surveys, and as was the case in 2009, the Carolina heelsplitter was not found in any of the surveyed streams. In addition, the Savannah Lilliput remains extant in South Fork Crooked Creek, and like in 2009, a concentration of individuals was found within the proposed roadway crossing. The survey report is included as Appendix A.

The difference in results between the two surveys are likely a result of differences in time of year, survey conditions, and level of effort, rather than an indication of changes in mussel abundances. For example, while the Savannah Lilliput was found in low numbers (3 individuals) in Richardson Creek in 2009, it was not located in 2012, but is likely still present. There was a large amount of leaf pack covering the substrate in 2012 generally making surveying difficult. This coupled with the very small size of the Savannah Lilliput (< 2 inches) is likely the reason it was not detected. The fact that most of the other species occurring in Richardson Creek were found in similar numbers further supports this assumption. Furthermore, the difficulty of detecting a species that is present in low numbers during a one-time survey is highlighted by the fact that the Paper Pondshell was found (one individual) in Richardson Creek in 2012, but not in 2009, although it was known from the stream prior to 2009 (NCWRC Unpublished Aquatic Species Database).

4.4.2 Mussel Fauna in Project Footprint

Existing mussel survey data within the project footprint were reviewed by Catena. Data sources consulted included the NCWRC Unpublished Aquatic Species Database, which was reviewed in October 2013, the NC Natural Heritage Program (NCNHP) database (NCNHP 2013), reviewed in February 2010, and Johnson (1970), and surveys conducted by Catena. Habitat evaluations/ mussel surveys were conducted in the perennial streams within the project alignment in 2009 (Catena 2009). Catena also conducted surveys in the streams that were outside of the project alignment but needed updated survey information to determine the presence/absence of the Carolina heelsplitter: Lanes Creek, Richardson Creek upstream of the project alignment, and Crooked Creek downstream of the project alignment (Catena 2009, 2010).

A total of 15 freshwater mussel species have been recorded in the action area watersheds (Table 2). In addition to the Carolina heelsplitter, other rare freshwater mussel species known from Action Area streams include the Federal Species of Concern (FSC) and State Endangered (E) Atlantic Pigtoe (*Fusconaia masoni*), Brook Floater (*Alasmidonta varicosa*), Carolina Creekshell (*Villosa vaughnaniana*), and Savannah Liliput (*Toxolasma pullus*); the state Threatened (T) Creeper (*Strophitus undulatus*); the State Special Concern (SC) Notched Rainbow (*Villosa constricta*); and the State Significantly Rare (SR) Eastern Creekshell (*Villosa delumbis*).

Table 2. Freshwater Mussel Species in Action Area Streams

Scientific Name	Common Name	Federal Status	State Status	Action Area Streams*
Alasmidonta varicosa	Brook Floater	FSC	E	RC
Elliptio angustata	Carolina Lance	~	~	CC,GC
Elliptio complanata	Eastern Elliptio	~	~	All
Elliptio icterina	Variable Spike	~	~	BC,GC,LC,RC,XC,TC
Elliptio producta	Carolina Spike	~	W	GC,XC,TC
Fusconaia masoni	Atlantic Pigtoe	FSC	E	GC,LC
Lasmigona decorata	Carolina heelsplitter	E	E	GC,XC,TC**
Pyganodon cataracta	Eastern Floater	~	~	BC,CC,LC,RC,SC,XC,TC
Strophitus undulatus	Creeper	~	T	GC,BC,LC
Toxolasma pullus	Savannah Lilliput	FSC	E	CC, LC, RC
Uniomerus carolinianus	Florida Pondhorn	~	~	BC,CC,LC,RC,TC
Utterbackia imbecillis	Paper Pondshell	~	~	CC,RC,SC
Villosa constricta	Notched Rainbow	~	SC	GC,TC
Villosa delumbis	Eastern Creekshell	~	SR	All
Villosa vaughaniana	Carolina Creekshell	FSC	E	CC,GC,LC,RC,XC,TC

*BC, CC, GC, LC, MC, RC, SC, XC, and TC denote Bearskin Creek, Crooked Creek, Goose Creek, Lanes Creek, McAlpine Creek, Richardson Creek, Stewarts Creek, Sixmile Creek and Twelvemile Creek subbasins, respectively.

**Historic Record

Based on location, geology, life history and distribution, it is likely that the Carolina heelsplitter occurred in portions of most, if not all, of the subbasins in the surveyed area at one point in time. However, it is currently limited to the Goose Creek and Sixmile Creek subbasins.

4.4.2.1 Distribution in Goose/Duck Creek

The Carolina heelsplitter was first discovered in Goose Creek in 1987 (Keferl 1991) and in Duck Creek in 2000 (NCWRC Database). Between 1993 and 1999 a total of 15 live individuals had been recorded in Goose Creek. NCWRC surveys in early 2002 found 16 live individuals in Duck Creek (NCWRC Database); however, following extreme drought conditions in late 2002, where much of the streambed in both creeks was dry, status surveys in Duck Creek yielded only four live and more than 40 fresh dead. One fresh-dead shell was also found in Goose Creek during the 2002 drought surveys just below US 601. Pools and wet streambeds were much more common in lower Goose Creek, apparently providing refuge from desiccation during the drought.

Between 2004 and 2005, four live individuals were found at two locations within Goose Creek, and 12 live individuals were found at six locations within Duck Creek. Prolonged severe drought conditions persisted in the Goose Creek watershed in 2006 through 2007. A total of nine individuals have been found in Duck Creek between 2006 and 2009. Three of the individuals were found on more than one occasion. Four of these individuals were taken into captivity, as much of the stream channel was dry when they were found. A survey conducted in 2011 of the critical habitat portion of Goose Creek, from the Rocky River confluence to the NC 218 crossing, located a total of 12 live individuals, and one fresh dead shell (TCG 2007). All of the live individuals were taken into captivity for a joint propagation effort between North Carolina State University and the North Carolina Wildlife Resources Commission. The majority of the individuals were estimated to be <5 years of age based on shell condition and growth rests, indicating relatively recent reproduction. Repeated survey efforts in Duck Creek in 2011 and 2012 have not located any live individuals post drought.

Distribution and relative abundances (based on Catch Per Unit Effort) of freshwater mussel species known to occur in the Goose Creek watershed have generally declined since 2003, to the extent that mussels are increasingly rare in the subbasin. Species like the Atlantic Pigtoe (*Fusconaia masoni*) and Notched Rainbow (*Villosa constricta*) may be extirpated (NCWRC Database).

4.4.2.2 Distribution in Sixmile Creek

The Carolina heelsplitter was first discovered in Sixmile Creek in 2006 (Catena 2007). A total of 16 live individuals and 3 dead shells were found in the creek extending from near the confluence with Twelvemile Creek in Lancaster County, SC, upstream to the vicinity of the Marvin Road (SR 1312) crossing on the Mecklenburg/Union County line. In 2009, two live individuals were found between the SC/NC state line and the Marvin Road crossing (NCWRC Database), and in 2011 one live individual was found in the same area in 2011 (USFWS 2012a).

4.5 Watershed Conditions

Characteristics and conditions of the two watersheds within the Action Area supporting the Carolina heelsplitter, Goose Creek and Sixmile Creek are discussed below.

4.5.1 Goose Creek Subbasin (03-07-12)

The Goose Creek subbasin occupies an area of 29 square miles in Union and Mecklenburg Counties. There are 163 miles of identified perennial streams within the subbasin. From the headwaters in Mecklenburg County approximately 7.5 km (4.7 mi) east of the town of Matthews to the confluence with the Rocky River 5.2 km (3.2 mi) south of Midland on the Union/Stanly County line, Goose Creek is approximately 25 km (15.5 mi) in length. Major tributaries include Stevens Creek, Paddle Branch and Duck Creek.

4.5.2 Water Quality

4.5.2.1 Best Usage Classification

The NCDENR assigns a best usage classification to all waters of North Carolina. These classifications, which are the responsibility of the NCDWR, provide a level of water quality protection to ensure that the designated usage of that water body is maintained. Class C imposes a minimum standard of protection for all waters of North Carolina. Table 3 lists the streams in the Action Area within the Goose Creek Subbasin and their Usage Classification and NCDWR Index number (#).

Table 3. Streams Within Goose Creek Subbasin

Steam Name	Usage Classification	DWQ Index #
Stevens Creek	C	13-17-18-1
Paddle Branch*	C	13-17-18-2
Duck Creek	C	13-17-18-3
Goose Creek	C	13-17-18

* Paddle Branch is a tributary to Duck Creek

Class C waters are protected for secondary recreation, fishing, wildlife, fish and aquatic life propagation and survival, agriculture, and other uses suitable for Class C. There are no restrictions on watershed development or types of discharges.

4.5.2.2 Impaired 303(d) Listing

As mandated in Section 303(d) of the Clean Water Act., states, territories, and authorized tribes are required to develop lists of impaired waters, which are defined as water bodies that do not meet water quality standards that states, territories, and authorized tribes have set for them, even after point sources of pollution have installed the minimum required levels of pollution control technology. These water quality standards include designated uses, numeric and narrative criteria, and anti-degradation requirements as defined in 40 CFR 131. Failures to meet standards may be due to an individual pollutant, multiple pollutants, or unknown causes of impairment, originating from point and non-point sources and/or atmospheric deposition. The law requires that these jurisdictions establish priority rankings for waters on the lists and develop Total Maximum Daily Load limits (TMDLs) of identified pollutants for these waters.

In recent years, both Goose (from SR 1524 to the Rocky River) and Duck Creek (from its source to Goose Creek) in Union County had been on the NCDWQ's Section 303(d) Category 5 list of impaired streams. However, the 2012 303(d) List, which only includes Category 5 waters, does not list Goose or Duck Creek. Category 5 waters are those impaired for one or more designated uses by a pollutant(s), and require a TMDL for the pollutant(s).

Since 1998, Goose Creek had been on the 303(d) for various impairments, such as fecal coliform. Currently, it is listed as a Category 4b for turbidity and ecological/biological integrity benthos, indicating that, while the stream is still impaired, a management strategy is in place to address exceedances (NCDWR 2013). Goose Creek from SR 1524 to Rocky River is categorized as 4t for fecal coliform, indicating that the stream is impaired, but that a TMDL has been approved (NCDWR, 2013). Duck Creek, which was included on the 2008 draft list for the first time, has also been downgraded to a Category 4b for ecological/biological integrity benthos.

The 303(d) Category 5 streams in the FLUSA are listed in Tables 4 and 5 along with details of the impairments, and shown in Figure 4.

Table 4. Catawba River Basin Impaired (Category 5) Streams 2012. Use of listed streams is "Aquatic Life".

Stream	AU Number	Length/Area	Reason for Rating	Parameter (Year)
Sixmile Creek (030501030203)	11-138-3	8.8 FW Miles	Fair Bioclassification	Ecological/Bio Int, Fish Comm (2006)
McAlpine Creek (030501030107)	11-137-9b	6.3 FW Miles	Fair Bioclassification	Ecological/Bio Int. Benthos (1998)
McAlpine Creek (030501030107)	11-137-9a	8.2 FW Miles	Fair Bioclassification	Ecological/Bio Int. Benthos (1998)

Table 5. Yadkin-Pee Dee River Basin Impaired (Category 5) Streams 2012. Use of listed streams is "Aquatic Life".

Stream	AU Number	Length/Area	Reason for Rating	Parameter (Year)
Little Richardson Creek (030401050504)	13-17-36-4-(0.5)	77.1 FW Acres	Standard Violation	Chlorophyll a (2008)
Little Richardson Creek (030401050504)	13-17-36-4-(2)	38.7 FW Acres	Standard Violation	Chlorophyll a (2008)
Richardson Creek (030401050504)	13-17-36-(3.5)b	106.4 FW Acres	Standard Violation	Chlr a (2008), pH (2008)
Richardson Creek (030401050506)	13-17-36-(5)a1a	8.2 FW Miles	Fair Bioclassification	Eco/Bio Int. Benthos (1998)
Stewarts Creek (030401050503)	13-17-36-9-(1)	8.3 FW Miles	Fair Bioclassification	Eco/Bio Int. Benthos (2008)
Stewarts Creek (030401050503)	13-17-36-9-(4.5)	131.1 FW Acres	Standard Violation	DO (2012), Copper (2008), Chlr. a (2008)
Richardson Creek (030401050501)	13-17-36-(5)a1b	3.9 FW Miles	Standard Violation	Copper (2008)
Richardson Creek (030401050501)	13-17-36-(5)a2	4.7 FW Miles	Standard Violation	Copper (2008)
Beaverdam Creek (030401050602)	13-17-40-11	12.1 FW Miles	Standard Violation	Copper (2008), DO (2008)

Stream	AU Number	Length/Area	Reason for Rating	Parameter (Year)
Crooked Creek (030401050702)	13-17-20-2a	5.6 FW Miles	Fair/Poor Bioclassification	Eco/Bio Int. Fish Comm/Benthos (1998)
Crooked Creek (030401050702)	13-17-20-2b	8.8 FW Miles	Fair Bioclassification	Eco/Bio Int. Benthos (1998)
Crooked Creek (030401050702)	13-17-20-1	12.0 FW Miles	Standard Violation	Turbidity (2004)
Crooked Creek (030401050702)	13-17-20	12.9 FW Miles	Standard Violation/Fair Bioclassification	Turbidity (2010), Eco/Bio Int. Benthos (2012)

4.5.2.3 Nonpoint Source Pollution

Nonpoint source (NPS) pollution refers to runoff that enters surface waters through stormwater or snowmelt. There are many types of land use activities that are sources of NPS pollution including land development, construction activity, animal waste disposal, mining, agriculture and forestry operations, and impervious surfaces such as roadways and parking lots. Various nonpoint source management programs have been developed by a number of agencies to control specific types of nonpoint source pollution (e.g. forestry, pesticide, urban, and construction-related pollution etc.). Each of these management programs develops Best Management Practices (BMPs) to control the specific type of NPS pollution.

The Nonpoint Discharge Elimination System (NPDES) Stormwater Permitting program institutes permitting requirements for municipal separate storm sewer systems (MS4) and also established post-construction stormwater management requirements in both incorporated and unincorporated areas for development activities outside of the permitted MS4s (NPDES Phase II). Development activities in these areas must meet post-construction requirements. Within the Action Area, Mecklenburg County enforces the Phase II and post-construction requirements within the county while NCDWR currently enforces the same regulations within Union County and any communities which do not have Phase II permits. The post-construction ordinance allows NCDWR to implement undisturbed riparian buffer rules within the Goose Creek, Sixmile Creek, and Waxhaw Creek watersheds, which are habitat to the Carolina heelsplitter. These buffer requirements are only implemented when NCDWR receives a permit application, whether stormwater or Section 401 (Randall 2010, pers. comm.). The NCDWR requires that permits in the Goose Creek watershed include post-construction requirements of 200 foot undisturbed riparian buffers on perennial streams, 100 foot riparian buffers on intermittent streams, and a ten percent impervious surface threshold for engineered stormwater controls (NCDWQ 2009).

NCDWR also implements the buffer requirements from the Goose Creek Site Specific Management Plan (NCDENR 2009), which requires all projects disturbing more than one acre of land to control stormwater as described in Rule .0602 of the plan (see Section 4.5.2.7 of this report).

4.5.2.4 Point Source Pollution

Point source discharges of pollution are defined as pollutants that enter surface waters through a pipe, ditch, or other well-defined point of discharge. These include municipal and industrial wastewater treatment facilities, small domestic discharging treatment systems (schools, commercial offices, subdivisions and individual residents), and stormwater systems from large urban areas and industrial sites. The primary pollutants associated with point source discharges include nutrients, solids/sediments, oxygen demanding wastes, and toxic substances such as chlorine, ammonia and metals.

There are five permitted wastewater discharges in the Goose Creek subbasin (Table 6), two of which have been decommissioned (Figure 5). These facilities currently fall under the Goose Creek Site Specific Management Plan (NCDENR 2009b) NPDES Permitting Policy, which was implemented by NCDWR (formerly NCDWQ) in conjunction with other resource agencies.

Table 6. Permitted Wastewater Treatment Plants (WWTP) in the Goose Creek Watershed

Permit	Facility	Receiving Stream	Flow (GPD)	Owner
NC0063584	Oxford Glen	Stevens Creek	75,000	Aqua NC
NC0065749	Ashe Plantation	Duck Creek	100,000	Aqua NC
NC0072508	Hunley Creek	Goose Creek	Decommissioned (2006)	Union County
NC0034762	Fairfield Plantation	Goose Creek	Decommissioned (2011)	Goose Creek Utility Co
NC0065684	Country Wood	Goose Creek	670,000	Aqua NC

The NPDES Permitting Policy includes limits on various parameters, including, but not limited to chlorine (since October 2002), ammonia, fecal coliform, BOD, DO, flow, and temperature, for the existing facilities. Compliance reports from the 2005-2010 review period show routine problems with several parameter limits exceeded at the Fairfield Plantation and Hunley Creek WWTPs, which have since been decommissioned. A summary of violations obtained from NCDENR Central Files on April 6, 2010, October 17, 2012 and November 2, 2012 is provided below.

<u>Oxford Glen (Aqua North Carolina)</u>

- No records available for 2005
- No violations recorded for 2006-2009

- A notice of violation (NOV) was documented on September 22, 2010 due to failing to report dissolved oxygen, temperature and pH during the May 2010 self-monitoring period. No civil penalties were issued.

Ashe Plantation (Aqua North Carolina)

- A NOV from DWQ was documented on March 1, 2010 due to exceeding the daily maximum of total suspended solids (TSS) in the November 2009 self-monitoring report. No civil penalties were assessed.

Hunley Creek (Union County)

- Numerous NOVs and civil penalties were documented throughout 2005-2006 monitoring period due primarily to exceedences of BOD, with occasional exceedences of flow, fecal coliform, TSS, and total suspended residue (TSR). Civil penalties assessed included approximately $30,510.11 while receipts of payment received included $24,436.08.
- In May 2006, this facility was decommissioned. Wastewater previously directed to the Hunley Creek WWTP was redirected to the Crooked Creek watershed for treatment. No NOVs were identified for this WWTP throughout 2007-2010 due to decommission (Union County 2006).

Fairfield Plantation (Goose Creek Utility Company)

- DWQ sent a memorandum to the Attorney General's Office on January 13, 2010, requesting Injunctive Relief with regard to the Fairfield Plantation WWTP. DWQ described how the WWTP is in a "state of disrepair" with questionable structural integrity and a history of deteriorating conditions. Improvements to the structure were not made due to the fact that connection to the Union County Public Works sewer system was imminent. In February 2011, NCDWQ terminated the NPDES permit for this facility, and Union County Public Works commenced treating the wastewater previously treated by the Goose Creek Utility Company (Black & Veatch Holding Co 2011).
- DWQ sent a letter to NC Utilities Commission dated February 4, 2010, requesting its advice, counsel and assistance in addressing the situation with this WWTP:

> "This WWTP currently operates under the terms of a NPDES permit issued in 1994. As such, effluent limitations and monitoring requirements are not as stringent as those found in contemporary permits for facilities discharging to Goose Creek. This WWTP has deteriorated to the point that its structural integrity is questionable and its owners attest that it cannot consistently meet currently applicable (1994) permit limits."

- Numerous NOVs and civil penalties were documented throughout 2009-2010 monitoring period due primarily to exceedences of flow, with occasional exceedences of fecal coliform, DO, and ammonia. Civil penalties assessed included approximately $12,899.37 for this period. No receipts of payment were documented for these penalties.

Country Wood (Aqua North Carolina)

- There are no documented violations at this facility between 2006 and September 2011; though there were no records for 2005.
- Ammonia violations were recorded in September and November 2011, for which civil penalties totaling $1,289.34 were issued and $894.67 in payment was received.

In addition to chlorine limits, a moratorium on new facilities or expansion of existing facilities within the Goose Creek watershed was instituted under the Goose Creek Site Specific Management Plan (NCDENR 2009b), but was subsequently lifted in May 9, 2013.

4.5.2.5 Ecological Significance

The NCNHP maintains a database of rare plant and animal species, as well as significant natural areas, for the state of North Carolina. The NCNHP compiles the NCDENR priority list of "Natural Heritage Areas" as required by the Nature Preserves Act (NCGS 113A-164 of Article 9). Natural areas (sites) are inventoried and evaluated on the basis of rare plant and animal species, rare or high quality natural communities, and geologic features occurring in the particular site. These sites are rated with regard to national, state, and regional significance. This list contains those areas which should be given priority for protection; however, it does not imply that all of the areas currently receive protection (NCDENR 2009). The Goose Creek Subbasin Aquatic Habitat is considered to be of "National Significance".

The Goose Creek Subbasin supports several other rare aquatic species besides the Carolina heelsplitter. They are listed Table 7 along with their state and federal status.

Table 7. Rare Aquatic Species in Goose Creek Subbasin

Scientific Name	Common Name	NC Status	Federal Status	Species Type
Etheostoma collis collis	Carolina darter	SC	FSC	Fish
Fuscanaia masoni	Atlantic pigtoe	E	FSC	Mussel
Lasmigona decorata	Carolina heelsplitter	E	E	Mussel
Strophitus undulatus	Creeper	T	~	Mussel
Villosa vaughaniana	Carolina creekshell	E	FSC	Mussel
Villosa delumbus	Eastern creekshell	SR	~	Mussel
Villosa constricta	notched rainbow	SC	~	Mussel

E = Endangered, T = Threatened, FSC = Federal Species of Concern, SC = Special Concern, SR = Significantly Rare, ~ = no rating (NCNHP 2010)

The Goose Creek watershed is considered to be a globally significant ecosystem; as such several efforts have been undertaken by USFWS, NCDOT and NCWRC to preserve this ecosystem. NCWRC has acquired 23 conservation easements on 156 acres along Goose Creek and Duck Creek, using a $1.8 million NC Clean Water Management Trust Fund grant specifically awarded to address Goose Creek's water pollution problems. In addition to buying conservation easements, NCWRC has used grants to fund other projects, including the stream restoration and stabilization of five streams and ditches in the watershed (PBS&J 2010b). NCDOT has acquired, or funded stream mitigation projects in the Goose Creek watershed; however, those projects were utilized towards mitigation requirements associated with other NCDOT projects.

4.5.2.6 Conditions within Critical Habitat Unit 1

Water quality and stream habitat conditions within the Goose Creek have deteriorated significantly in recent years, to the level that several of the Constituent Elements have been significantly altered to the extent that they may no longer be present. The habitat degradation has coincided with the rapid urbanization of the watershed, which was discussed in Section 4.1.5.1. Each of the Constituent Elements of Unit 1 and the way they have been compromised are discussed below:

1) permanent flowing, cool, clean water: The mainstems of both Goose and Duck Creeks have experienced several prolonged periods of interrupted flow (TCG personal observations, John Fridell, pers. comm.). This has resulted in mortality of several individuals (John Fridell, pers. comm.). In addition, various toxic contaminants have been reported in the watershed (Section 4.1.4.2), and both Goose and Duck Creeks are listed as impaired (Section 4.5.4.2).

2) geomorphically stable stream and river channels and banks: The effects of urbanization on peak discharge and channel stability were discussed in Section 4.1.5.1. Channel inscision,

headcutting, and numerous streambank failures leading to new channel cuts have occurred in the Goose Creek watershed in recent years, especially in the mainstem of Goose Creek (TCG personal observations, John Alderman and John Fridell, pers. comm., Allen 2005).

3) pool, riffle, and run sequences within the channel: While these habitat sequences are still present within the Critical Habitat Unit, large accumulations of fine sediments occur in many of these areas (see below).

4) stable substrates with no more than low amounts of fine sediment: As a result of channel instability, and erosion from the landscape, large accumulations of fine sediment occur throughout the channel of Goose Creek, and to a lesser extent Duck Creek (TCG personal observations, John Alderman and John Fridell, pers. comm., Allen 2005). As stated above, Allan (2005) documented dramatic increases in sediment concentrations during high flow events in the Goose Creek subbasin.

5) moderate stream gradient: This constituent element is generally still present; however significant channel incision has occurred throughout much of the Goose Creek channel (see below).

6) periodic natural flooding: The effects of urbanization on stream channel scour, and the subsequent effects on freshwater mussels and mussel habitat are discussed in Section 4.1.5.1. The mainstem of Goose Creek has incised significantly in recent years to the level that in many areas the floodplain is inaccessible from the channel except during extremely high flows (TCG personal observations, John Alderman and John Fridell, pers. comm.), which further contributes to channel instability and habitat degradation.

7) fish hosts, with adequate living, foraging, and spawning areas for them: There have been no documented extirpations of any fish species within the Goose Creek watershed, and Starnes and Hogue (2005), found several of the species of cyprinids (minnows) in the watershed, which have been identified as fish hosts for the Carolina heelsplitter (Eads et al. 2010). However, the habitat degradation (high levels of silt, channel scour etc.) discussed above may be compromising spawning habitat for the host species.

4.5.2.7 Goose Creek Watershed Site Specific Water Quality Management Plan

In 2009, a Site Specific Management Plan for the Goose Creek Watershed was adopted to protect the Carolina heelsplitter (NCDENR 2009). The purpose of the actions required by this site-specific management strategy that comprises the site-specific water quality management plan (Plan) is for the maintenance and recovery of the water quality conditions required to sustain and recover the Carolina heelsplitter population in the Goose Creek Watershed. The site-specific management strategies shall be implemented to:

(1) Control stormwater for projects disturbing one acre or more of land
(2) Control wastewater discharges
(3) Control toxicity to streams supporting the Carolina heelsplitter
(4) Maintain riparian buffers

Charlotte-Mecklenburg Storm Water Services began administering the Plan in October, 2009. This Plan stemmed from the Water Quality Recovery Plan (WQRP) for the Goose Creek Watershed, required as part of Charlotte-Mecklenburg's Phase II Storm Water Permit application. The required WQRP was implemented to comply with the pollutant load limitations set forth in the 2007 Goose Creek total maximum daily load (TMDL) for Fecal Coliform. In the NC 2010 Integrated Report, 303(d) List, the Mecklenburg County reach of Goose Creek was changed from a 4a to a 1t designation because that part of the water body was compliant with the TMDL. In 2011, the County was informed that it was no longer required to implement the WQRP, but it must continue to implement six expanded and/or tailored BMP's, that were identified in the WQRP. These have been included in the Charlotte-Mecklenburg Storm Water Management Plan and implementation is ongoing.

As part of the Goose Creek TMDL (Section C.2.), Mecklenburg County collects water quality samples, including Fecal Coliform, from Goose Creek at Steven's Mill Road, in Union County. In the most recent sample year, FY2013, sixteen samples were collected and analyzed for Fecal Coliform. Based on the results of these analyses, when compared with data collected during the last five years, Fecal Coliform concentrations for this reach of Goose Creek have remained essentially unchanged. This reach of Goose Creek remains as a Category 4t stream in the 2012 Integrated Report, 303(d) List.

Additionally, during FY2013, Mecklenburg County completed a specialized sampling effort in order to characterize Fecal Coliform distribution in five catchment areas of the Goose Creek watershed, for a variety of land covers, as well as during regular base flow and storm impacted events. Sampling results indicated that sediment is a primary source of elevated Fecal Coliform levels in Goose Creek. It was concluded that while enhanced erosion control measures required in Goose Creek were proving effective at controlling development related sediment run off, stream bed and bank stability were also a contributor elevated Fecal Coliform levels and that Stream Restoration projects are an effective tool for reducing this sediment source.

The specifics of the Plan are contained in North Carolina Administration Cods: 15A NCAC 2B .0600-.0609.

During the drafting of the Management Plan, the USFWS noted that they believed the management plan is insufficient to protect the Carolina heelsplitter, and does not allow for recovery of the species in the creek, as was stated as the purpose of the plan (USFWS 2008). Specifically, the USFWS stated that "the subject rules: (1) affect primarily only certain future development activities within the Goose Creek watershed, and, it is the Service's belief, are inadequate to prevent further decline of water quality and the Carolina heelsplitter from the effects of the future development activities subject to the rules; (2) fail to address the likely detrimental effects to water quality associated with numerous other potential future land use activities within the watershed; and, (3) do practically nothing to address the affects of existing landuse activities affecting water quality within the watershed which have contributed the decline of the Carolina heelsplitter within the Goose Creek watershed" (USFWS 2008).

4.5.3 Goose Creek TMDL

TMDLs were established for fecal coliforms in Goose Creek (MCWQP, 2005). Fecal coliform load reductions of 92.5 percent would be required for water quality in Goose Creek to be considered no longer impaired and removed from the 303(d) list.

4.5.4 Summary of regulatory effects

a) Responsible entities for enforcement of Site Specific Water Quality Management Plan

In Union County, the NCDWR maintains enforcement of the Plan. Requests for variances to allow an activity not allowed by the Plan must be submitted to the NCDWR and eventually proposed to the Environmental Management Commission for approval.

Enforcement of the Plan in Mecklenburg County has been designated by the NCDWR to the Charlotte-Mecklenburg Stormwater Services. Requests for variances must proceed through Charlotte-Mecklenburg Stormwater Services to the Charlotte-Mecklenburg Storm Water Advisory Committee. If approved, it goes to NCDWR and the EMC for final approval.

b) Issuance of Variances to the Plan

According to Rusty Rozzelle with Charlotte-Mecklenburg Stormwater Services, since the implementation of the rule, no variances have been requested to use or develop riparian buffer areas within Goose Creek in Mecklenburg County. Likewise, according to Jennifer Burdette with the NCDWR, no variances have been requested to use or develop riparian buffer areas within Union County.

c) Removal of the Inter-basin Transfer Restrictions

On May 9, 2013, the March 14, 2002 ban on transferring water from the Catawba River Basin to the Goose Creek River Basin was eliminated, the effects of which are considered in the Environmental Assessment (EA) for the Addition of the Goose Creek Watershed to the IBT Certificate under the Provisions of G.S 143-215.22I (CH2M Hill, 2013). The EA concludes that the direct, indirect, and secondary and cumulative impacts of removing the ban from the IBT

Certificate on Goose Creek Watershed would be insignificant given the watershed mitigation measures that have been implemented by the Town of Mint Hill through its post construction ordinance.

To date, no transfers have taken place since the ban on interbasin transfers was eliminated. Infrastructure is typically installed either via citizen requests for service through the City of Charlotte’s Street Main policy or extensions by developers that are donated. The City of Charlotte did have one water line on Thompson Road that was incomplete, and there are plans to finish it, though no construction date has been set. There are no other plans for extensions by Charlotte-Mecklenburg Utility Department (Barry Shearin, City of Charlotte, personal communication, July 22, 2013 and July 24, 2013).

4.5.5 Sixmile Creek Subbasin (03-08-38)

Sixmile Creek arises in Mecklenburg County, approximately three miles west of Stallings, and flows in a general southwest direction for approximately 8.8 miles before entering Lancaster County, SC. The stream then flows approximately 10 miles before entering Twelvemile Creek near Hancock, SC, which in turn flows approximately six more miles before entering the Catawba River near Van Wyck, SC. Sixmile Creek and Twelvemile Creek are included in North Carolina Catawba River Subbasin 03-08-38 (NCDWQ 2004) and are located within Union and Mecklenburg Counties, NC. Sixmile Creek forms the boundary between these two counties for much of its course. The Sixmile Creek watershed drains the southeastern and southwestern portions of Mecklenburg and Union Counties, respectively, while Twelvemile Creek drains southwestern Union County (NCDWQ 2004). Both streams have very low flows during the summer months and may stop flowing during periods of drought (NCDWQ 2004).

The Sixmile Creek watershed has undergone a significant amount of economic development, including residential, commercial and office space has occurred along the US 521 corridor between I-485 in Mecklenburg County, NC and US 160 in Lancaster County, SC. Over the eight-year period between 1998 and 2006, developed land use increased by approximately 18 percent. Agricultural lands decreased by a total of 1,996 acres and forested lands decreased by 2,579 acres between 1998 and 2006 (TCG 2007). The agricultural and forested lands were replaced with residential properties, industrial / commercial properties and paved roads. The residential land use category increased by 4,017 acres and the industrial / commercial and paved roads categories increased by 400 acres and 200 acres, respectively (TCG 2007). High density residential areas increased by approximately 6.6 percent whereas moderate and low density residential areas increased by almost 5 and 3 percent, respectively from 1998 to 2006 (TCG 2007). The population of Stallings and Weddington, which occur within the Sixmile Creek watershed increased 287% and 117% respectively between the year 2000 and 2008 (Baker Engineering 2010) Continued growth is projected in this area to year 2030 (Baker Engineering 2010).

4.5.6 Water Quality

4.5.6.1 Best Usage Classification

In North Carolina, Sixmile Creek is assigned a Best Usage Classification of C from its source to the NC/SC state line. The South Carolina portion of Sixmile Creek is contained within the Twelvemile Creek subbasin (classification 03050103-030). Water quality standards are assigned and assessed using basically similar methods to those described in North Carolina (SCDHEC 2005).

4.5.6.2 Impaired 303(d) Listing

Currently the 8.8-mile segment of Sixmile Creek from its headwaters to the South Carolina border is classified as "Impaired for Aquatic Life" due to Fair bioclassification (NCDENR 2010) (Figure 4). In the mid 1990's, the South Carolina portion of Sixmile Creek was place on the 303(d) list for several years. In the mid 1990's, zinc levels exceeded impairment thresholds and the creek was placed on the 303(d) list of impaired waters. By 2002, the zinc level was sufficiently reduced and the stream was fully supporting of aquatic life; however, the recreational use was not supported due to fecal coliform levels. Additionally, trends of decreasing DO, decreasing pH, increasing BOD, increasing turbidity, and increasing total phosphorus and total nitrogen were identified (SCDHEC 2005).

4.5.6.3 Nonpoint Source Pollution

Nonpoint source pollution, runoff that enters surface waters through stormwater or snowmelt, is identified as a major source of water quality degradation in this subbasin (NCDENR 2004, NCDENR 2008). Land development, construction activities, animal waste disposal, mining, forestry operations, agriculture, and impervious surfaces (urban runoff) are examples of land uses that contribute to NPS pollution. Many NPS management programs have been developed to control runoff with BMPs for stormwater management.

The naturally low flow of Sixmile Creek increases stream sensitivity to nonpoint source runoff (NCDENR 2004).

4.5.6.4 Point Source Pollution

Point source pollution includes discharges of pollutants directly to surface waters through a pipe, ditch, or other well-defined point of discharge. Point sources include municipal and industrial WWTPs, small domestic discharging treatment systems, and stormwater systems from municipal areas and industrial sites.

One major municipal NPDES facility was located on Sixmile Creek (NPDES Permit NC0066559/001). Between 1997 and 2003 in Union County, this site failed two effluent toxicity tests. Since that time the NPDES point source has been removed from Sixmile Creek (NCDENR 2004). However, despite the removal of the NDPES point source, Sixmile Creek received the highest conductivity rating (185 µmhos/cm) of any stream in the basin during the 2004 sampling effort (NCDENR 2004), indicating the likely presence of pollutants such as chloride, phosphate, or nitrate.

4.5.6.5 Point Source and NPS Pollution Control

Stormwater management to control point and nonpoint source pollution is implemented by NCDWR under the NPDES stormwater permitting Phase II requirements [Session Law 2006-246]. These requirements are implemented in the Sixmile Creek watershed through the City of Charlotte's NPDES municipal separate storm sewer system (MS4) permit in Mecklenburg County and through the NCDWR's post-construction stormwater permitting in Union County and the Village of Marvin (NCDWQ 2009).

Projects that disturb an acre or more of land within Union County and the Village of Marvin are subject to NCDWR stormwater review under the post-construction stormwater permitting program (NCDWQ 2009). NCDWQ requires that projects meet not only the post-construction requirements but also the more stringent buffer and stormwater requirements for the protection of the Carolina heelsplitter within the Sixmile Creek watershed, similar to the Goose Creek Site Specific Management Plan (Randall 2010, NCDWQ Stormwater, pers. comm.). These buffer requirements are only implemented when NCDWR receives a permit application, whether stormwater or Section 401 (Randall 2010, pers. comm.). The NCDWQ requires that permits in the Sixmile Creek watershed include post-construction requirements of 200 foot undisturbed riparian buffers on perennial streams, 100 foot riparian buffers on intermittent streams, and a ten percent impervious surface threshold for engineered stormwater controls (NCDWQ 2009).

4.5.6.6 Ecological Significance

The Sixmile Creek Subbasin supports several other rare aquatic species besides the Carolina heelsplitter. They are listed Table 8 along with their state and federal status.

Table 8. Rare Aquatic Species in Sixmile Creek Subbasin

Scientific Name	Common Name	NC Status	Federal Status	Species Type
Etheostoma collis collis	Carolina darter	SC	FSC	Fish
Lasmigona decorata	Carolina heelsplitter	E	E	Mussel
Strophitus undulatus	Creeper	T	~	Mussel
Villosa vaughaniana	Carolina creekshell	E	FSC	Mussel
Villosa delumbus	Eastern creekshell	SR	~	Mussel

E = Endangered, T = Threatened, FSC = Federal Species of Concern, SC = Special Concern, SR = Significantly Rare, ~ = no rating (NCNHP 2010)

5.0 ENVIRONMENTAL BASELINE – SCHWEINITZ'S SUNFLOWER

This section discusses the characteristics and current status of the Schweinitz's sunflower throughout its range and within the proposed action area. There have been no 5-year status reviews completed for this species as of the date of this report; therefore, most of the following text has referenced personal communication with USFWS and older documents, including the 1994 USFWS Recovery Plan for Schweinitz's sunflower.

5.1 Species Description

A detailed description of characteristics, habitat requirements, legal status, and primary threats to the species are summarized below.

5.1.1 Designation (Legal Status)

Schweinitz's sunflower was listed as Endangered on May 7, 1991, under provisions of the Endangered Species Act of 1973 (as amended) (FR 56(88): 21087-21091) (USFWS 1991). Currently there is no critical habitat designated for Schweinitz's sunflower.

5.1.2 Characteristics

Schweinitz's sunflower is a rhizomatous perennial herb described from North Carolina by Torrey and Gray (1841) that grows 1 to 2 meters tall from a cluster of carrot-like tuberous roots (USFWS 1994, Radford et al. 1968). Stems are usually solitary, branching only at or above mid-stem, with the branches departing from the stem at about a 45-degree angle. The stem is usually pubescent but can be nearly glabrous and is often purple in color.

The leaves are opposite on the lower portion of the stem, changing to alternate above. In shape, the leaves are lanceolate, wider near their bases, but variable in size, being generally larger on the lower portion of the stem, and gradually reduced upwards. Lower stem leaves average 10 to 20 centimeters long and 1.5 to 2.5 centimeters wide (about 5 to 10 times as long as wide). Upper stem leaves (subtending branches of the inflorescence) average about 5 centimeters long and 1 centimeter wide. Leaf margins are entire with a few obscure serrations and are generally also somewhat revolute.

Texture of the leaves is rather thick and stiff and the pubescence of the leaves is distinctive. The upper surface of the leaves is rough, with the broad-based spinose hairs directed toward the tip of the leaf. The lower surface is more or less densely pubescent, with soft white hairs obscuring the leaf surface. From September to frost, Schweinitz's sunflower blooms with comparatively small heads of yellow flowers. The nutlets are 3.3 to 3.5 millimeters long and are glabrous with rounded tips. (NC-ES 2010, USFWS 1994)

The pubescence of the leaves is distinctive and is one of the best characteristics to distinguish Schweinitz's sunflower from its relatives. Additionally, the following characteristics separates Schweinitz's sunflower from all other eastern North American species in the genus: the heads are generally small (the involucre is less than 1 centimeter across), stems are generally sparsely strigose or hirsute below the inflorescence, the leaves are typically sessile to short-petiolate (petiole less than 1.5 centimeter long, very rarely to 3 cm long), scabrous above with dense soft white hairs below, lanceolate, and broadest near the base (USFWS 1994).

5.1.3 Distribution and Habitat Requirements

Schweinitz's sunflower is endemic to the Piedmont physiographic region of North and South Carolina. At the time of its listing in 1991, Schweinitz's sunflower was distributed across five counties in NC and one county in SC. As of 2006, the global range of Schweinitz's sunflower included more than 85 populations distributed across Anson, Cabarrus, Davidson, Gaston, Mecklenburg, Montgomery, Randolph, Richmond, Rowan, Stanly, Stokes, Surry, and Union Counties, NC, and Lancaster and York Counties, SC (Wells 2010, pers. comm.). There are currently 75 extant populations in NC (NCNHP 2010) and 41 extant populations in SC (Holling 2010, SCDNR pers. comm.), all known from the aforementioned counties.

Historically, it is believed that Schweinitz's sunflower occupied open prairie and Post Oak-Blackjack Oak Savannas that were maintained by relatively frequent fire (USFWS 1994). Current habitats include roadsides, periodically disturbed or maintained utility rights of way, old pastures, and sunny or semi-sunny woodland openings. While the plant occurs on a variety of soils, it is generally found on shallow, poor, clayey or rocky soils, especially those derived from mafic rock. Where Schweinitz's sunflower occurs in relatively natural (undisturbed) areas, the natural community is considered a Xeric Hardpan Forest (Schafale and Weakley 1990).

NatureServe (2010) characterizes Schweinitz's sunflower habitat as "clearings in, and edges of, upland oak-pine-hickory woods and piedmont longleaf pine forests in moist to dryish sandy loams." In addition, Schweinitz's sunflower requires the "full to partial sun of an open habitat, which was formerly maintained over the species' range by wildfires and grazing by herds of bison and elk" (NatureServe 2010). Now most occurrences are confined to roadsides and utility rights of way that are periodically maintained or disturbed and/or managed for the species.

5.1.4 General Threats to Species

Schweinitz's sunflower is endangered by the loss of historic levels of natural disturbance (i.e. fire, grazing by herbivores), development, mining and encroachment by exotic species (USFWS 1994). The species requires fire or other vegetation management to maintain an open canopy (NatureServe 2010). Primary threats to this species occur from direct habitat loss, degradation, and fragmentation due to residential, commercial, and industrial development, highway construction and improvement, and intensive maintenance of roadsides and utility rights of way (USFWS 1994).

5.1.5 Roadway-Related Threats to Species

A number of potential direct and indirect effects to plant species resulting from road construction projects were evaluated for this BA. These potential effects are discussed within their respective sections below.

5.1.5.1 Potential Direct Effects

Direct effects refer to consequences that can be directly attributed to a project. Direct effects associated with roadway projects include, but are not limited to, land clearing and loss, degradation, and/or modification of habitat in the project corridor, in fill/borrow/spoil areas, and in construction staging/access areas outside of the project corridor. Potential direct effects to plant species associated with transportation projects include habitat modification and/or destruction resulting from highway construction and improvement, utility relocation, and intensive maintenance of roadside and utility ROWs. Intensive maintenance includes herbicidal treatments, mowing, and ground disturbing activities, particularly during critical growth periods of the species.

5.1.5.2 Potential Indirect Effects

Indirect effects, together with the effects of other activities that are interrelated or interdependent with the action, have been evaluated in this assessment and DTR. Indirect effects are those that are caused by the proposed action and are later in time, but are still reasonably certain to occur [50 CFR 402.02]. Interrelated actions are those that are part of a larger action and depend on the larger action for their justification while interdependent actions are those that have no independent utility apart from the action under consideration [50 CFR 402.02]. These types of indirect effects can include natural responses to the direct effects of the proposed action, or can include human-induced effects associated with the proposed action.

Potential indirect effects to plant species associated with transportation projects include the loss, degradation, destruction, fragmentation, or modification of habitat resulting from land conversion induced by roadway construction. Land conversion (changes in land use) includes residential, commercial, and industrial development as well as linear urban sprawl along the highway corridor or in the vicinity of interchanges. Also included as indirect effects are reasonably foreseeable local roadway improvements (e.g. widening) necessitated by increased traffic associated with the proposed action. These types of land use changes are not direct consequences of road construction, but rather a result of modifications in access to parcels of land and modifications in travel time between different areas (Mulligan and Horowitz 1986).

Economic development is often used as a criterion in highway funding (Eagle and Stephanedes 1987). Historically, transportation has been viewed as a necessary precursor to economic development (Anderson et al. 1992), and transportation infrastructure is "one of the principle policy levers that state and local governments can use to increase their attractiveness to business investors" (Forkenbrock 1990). Thus, planned or forecasted project-induced changes in land use are considered to be indirect effects of a proposed action.

Alternatively, depending on the extent of local land development regulations, development demand, and water/sewer availability, among other factors, roadway improvements may result in unintentional development and sprawl. These unintended land use changes are also project-induced and therefore are considered to be indirect effects of the proposed action. Improvements to levels of service, better accommodation of traffic, and reductions in travel times may encourage changes in land development outside of the direct project area. This induced growth and development with limited or no proper planning programs along with unchecked development controls, has the potential to degrade suitable habitat for endangered plant species as a result of a proposed action.

5.1.5.3 Potential Cumulative Effects

Cumulative effects are those effects of future state or private activities, not involving federal activities, which are reasonably certain to occur within the action area of the proposed federal action [50 CFR 402.02]. Cumulative effects within an action area may include foreseeable infrastructure projects independent of the federal action, such as water and sewer service expansion, which have the potential to stimulate land development and associated roadway improvements. Other small-scale adverse effects to plant species may also occur within the project action area. Though difficult to predict or quantify, other potential cumulative effects may also include mismanagement of the species or its habitat by private landowners (i.e. poor conservation maintenance or herbicide use), habitat degradation caused by traffic accidents occurring within roadside populations, private harvesting of the species for medicinal or otherwise personal use, or habitat impairment caused by emergency repair efforts within utility ROW.

5.2 Presence in Action Area

In order to determine presence of the species within the Action Area, the NCNHP natural heritage database was searched for known populations (Element Occurrence), suitable habitat was evaluated, and presence/absence surveys were conducted. Species surveys were conducted within the preferred alignment and vicinity (ESI 2007, Atkins 2012).

The NCNHP identified six Element Occurrences (EO) of Schweinitz's sunflower within the FLUSA (Figure 2) in July 2013 (NCNHP 2013) within the Action Area. Table 9 summarizes the location within the project alignment, FLUSA, or Conservation Area.

Table 9. NCNHP Schweinitz's sunflower EO populations within Action Area (NCNHP 2013)

EO #	EO Rank*	Population	Status	Last Observed	Details/Comments
5	X	0 stems	Destroyed	Sept. 1957	No suitable habitat identified in 1982 and 1990. Presumed extirpated.
18	C	183 stems	Extant	Oct. 21, 2008	North Fork Crooked Creek Site: Located within utility and roadway ROWs along south side Indian Trail-Fairview Road. Union Electric mows the utility ROW on a 5-yr rotation. NCDOT mows roadside ROW.
31	X	0 stems	Destroyed	July 31, 1995	In 1998, 210 stems transplanted to McDowell Prairie Site.
77	CD	192 stems	Extant	Oct. 11, 2003	South Fork Crooked Creek Site: Located along roadside, southwest bank of Secrest Shortcut Road. "Do Not Mow" sign marks population.
78	D	62 stems	Extant	Nov. 4, 2003	Bearskin Creek Site: Located along south side of Gold Mine Road within utility and NCDOT ROWs.
230	D	12 stems	Current	Sep, 2009	South Fork Crooked Creek, Secrest Shortcut Road West of Unionville-Indian Trail Road

* EO Rank description: X = extirpated; C = Fair estimated viability/ecological integrity; CD = Fair or poor estimated viability/ecological integrity; D = Poor estimated viability/ecological integrity

Atkins performed field survey within the footprint of the Monroe Bypass / Connector in 2012. The footprint was based upon the final design, including utility relocations, from the Design-Build team. Prior to performing the surveys, Atkins reviewed aerial photos of the affected area to identify suitable habitat, which consists of roadsides, utility right-of-ways, field edges, and other areas that receive abundant sunlight and are infrequently but regularly maintained. A total of approximately 35 acres, or 13.5 miles of linear transects, were targeted for field surveys. Surveys were performed visually using systematic overlapping transects to cover suitable habitat areas. Atkins scientists visited the known locations of Schweinitz's sunflower along Secrest Shortcut Road to determine the local phenology of the species and to establish a search image. The two populations on the east side of the road appeared to be declining due to encroachment of shrubs and saplings. Four plants with eight stems were found at the more northerly location, while three plants with six stems were seen at the more southerly location. In the powerline population east of Secrest Shortcut Road, an estimated 17 plants with 60 stems were found. Maintenance in this right-of-way area appears to be more regular and timed to ensure survival and increase of Schweinitz's sunflower. Atkins scientists visited a known location along

Highway 601 just north of the project corridor, but did not find any plants (Atkins 2012). The report is appended (Appendix B).

EO# 230

EO# 230 is located on Secrest Shortcut Road (SR 1501), approximately 600 feet west of the intersection with Unionville-Indian Trail Road along the southern side of the road near GPS location 35.0759^{o} N, -80.6136^{o} W (ESI 2007). It is noted in Figure 7 and labeled as ESI 1. It was located by ESI in 2007 and is a very small population (12 stems) that occurs primarily between the roadside swale and the power line adjacent to Secrest Shortcut Road (Petitgout 2010b, pers. comm.). Due to its small size and its location in and along a roadside ditch swale (also within the distribution power line ROW), this population has a poor chance of persisting for an extended period of time, unless specific management actions are undertaken.

EO# 77

EO# 77 is located on Secrest Shortcut Road (SR 1501) between Unionville-Indian Trail Road (SR 1367) and the crossing of the South Fork Crooked Creek near GPS location 35.0721^{o}N, -80.6097^{o}W (Figure 7). This roadside population was located in 2003 by Larry Thompson (NCDOT Div. 10) with a total count of 192 stems and a NCNHP element occurrence rank of CD (NCNHP 2010). This 2003 survey is the only survey event NCNHP currently has on record in their database (see Table 6 in Section 5.2).

NCDOT Division-level road improvements on Secrest Shortcut Road associated with a NCDOT "Moving Ahead" project led to subsequent monitoring of EO# 77. A total of 314 stems were counted by NCDOT, all of which were on the southwestern side of the road in 2004 (Frazer 2010, NCDOT-NEU, pers. comm.), earning it an NCNHP EO rank of B. Due to the proximity of the population to the roadway, NCDOT consulted USFWS regarding efforts to protect this population from a combination of impacts during the planned roadway resurfacing and shoulder widening (Buncick 2010a, pers. comm.; Thompson 2010a, NCDOT Div. 10, pers. comm.). Ultimately, in October 2006, NCDOT relocated a total of 418 plants from EO# 77 to the newly developed Cane Creek Park Piedmont Prairie Restoration Area (Cane Creek Park), a five acre conservation easement which serves as a permanent refuge for protected plant species (NCDOT et al. 2006, HARP 2009). NCDOT arranged the creation of the Cane Creek Park conservation / management area with Union County and provided the funds for initial site preparation, maintenance, and monitoring.

Although the EO# 77 population was transplanted from the southwestern bank of Secrest Shortcut Road to Cane Creek Park in October 2006 (HARP 2009), the species was able to re-colonize this area from either germination of remaining seeds, or by vegetative propagation from remaining underground rhizomes as was noted by ESI in the 2009 surveys. The remnant population of EO# 77 includes 103 stems on the northern side and 31 stems on the southwestern side of Secrest Shortcut Road (Petitgout 2010b, pers. comm.). This population is located within NCDOT ROW and within Union Power ROW.

5.2.1 FLUSA

In addition to the two aforementioned occurrences of Schweinitz's sunflower in the Project Alignment Section 5.2.1, a review of NCNHP (2013) database records indicated an additional four EOs. Two of the four EOs are extant populations (EO# 18, EO# 78), one population had been relocated (EO #31), and one is considered extirpated (EO# 5).

EO# 18

EO# 18 is the most northern population in the FLUSA and is referred to as the "North Fork Crooked Creek Sunflower Site" by NCNHP. It is located mostly along the southern side of Indian Trail-Fairview Road (SR 1520) approximately halfway between Rocky River Road (SR 1514) and Cunningham Lane (SR 1526) near GPS location 35.1014^{o} N, -80.5985^{o} W. A total of 183 plants were last observed within the utility easement on October 21, 2008 during a survey conducted by J. R. Siler, of Environmental Resources of the Carolinas (NCNHP 2010). This population has a current element occurrence rating of C. Union Power (2010) mows and/or hand clears the utility line ROW as needed, per their agreement with USFWS regarding access to Schweinitz's sunflower restricted sites.

EO# 78

EO#78 is the most southern population within the FLUSA and is referred to as the "Bearskin Creek Sunflower Site" by NCNHP. It is located along the south side of Gold Mine Road (SR 1162) near GPS location 35.1184^{o} N, -80.7790^{o} W (NCNHP 2010). According to NCNHP (2010), the most recent survey was conducted by Larry Thompson (NCDOT Div. 10) on November 4, 2003. A total of 62 stems were observed mostly on the back side of a ditch maintained by the NCDOT; however, some plants are also within Union Power's right-of-way. This population has an element occurrence rating of D. As a management commitment, NCDOT installed "Do Not Mow" signs marking the boundaries of the population and Union Power was notified of the population within their right-of-way (NCNHP 2010, Union Power 2010).

EO# 31

EO# 31 is located along the western end of the FLUSA and is referred to as the Rea Road Sunflower Site by NCNHP. This EO is located along NC 16, approximately 0.05 mile north of the intersection with Rea Road (SR 3624). NCNHP's (2010) current status for this population is “destroyed” since the population (210 stems) was transplanted to McDowell Prairie in 1998. According to NCNHP (2010), this population was reported by NCDOT as having been sprayed with herbicide in September 1993. This population was recognized as extirpated in 2005 (NCNHP 2010), and as such, will not be further discussed in the effects section of this report.

EO# 5

EO#5 is located in the central portion of the FLUSA, just west of US 601, south of its intersection with Sikes Mill Road (SR 1001) and north of the US 601 crossing of Stumplick Branch. It was originally located in 1957 by H. E. Ahles; however, additional surveys by Matthews and Creel in 1982 and Weakley in 1990 failed to confirm an extant population. NCNHP (2010) considers this an extirpated population and as such, this population will not be further discussed in the effects section of this report.

5.2.2 Conservation Areas

Proposed conservation areas do not occur outside of the alignment or the FLUSA. Conservation measures for Schweinitz’s sunflower are discussed in Section 9.5.

6.0 ENVIRONMENTAL BASELINE – MICHAUX’S SUMAC

This section discusses the characteristics and current status of the Michaux’s sumac throughout its range and within the proposed action area. Most of the following text references data from the draft 5-year status review, obtained through personal communication with Mr. Dale Suiter, USFWS, in addition to the 1993 USFWS Recovery Plan for Michaux’s sumac.

6.1 Species Description

A detailed description of characteristics and habitat requirements, as well as the legal status for Michaux’s sumac is provided below. In addition, primary threats to the species are also summarized below.

6.1.1 Designation (Legal Status)

Michaux’s sumac was listed as Endangered on September 28, 1989, under provisions of the Endangered Species Act of 1973 (as amended) (FR 54(187): 39853-39857) (USFWS 1989). Currently there is no critical habitat designated for Michaux’s sumac.

6.1.2 Characteristics

Michaux's sumac is a rhizomatous shrub that grows 0.2 to 1.0 meter in height. Although it is usually dioecious, monoecious individuals have been reported in some populations (USFWS 1993b). The entire plant is densely pubescent. The narrowly winged or wingless rachis supports 9 to 13 sessile, oblong to oblong-lanceolate leaflets that are each four to nine centimeters long, two to five centimeters wide, and acute to acuminate (USFWS 1993b, NatureServe 2010). The bases of the leaflets are rounded, and their edges are simply or doubly serrate. Flowering occurs in June and the small flowers are borne in a terminal, erect, dense cluster, with each one being four- to five-parted and greenish-yellow to white (USFWS 1993b). The fruit is a red, densely short-pubescent drupe, five to six millimeters broad, and is visible on female plants from August to October (USFWS 1993b). Michaux's sumac can generally be distinguished from other species in the genus due to its small stature, dense pubescence, and evenly serrate leaflets. Michaux's sumac, also called false poison sumac, is quite harmless compared to poison sumacs of superficial resemblance.

Little information is available on the population biology and reproductive requirements of Michaux's sumac. Most of the surviving populations appear to contain plants of only one sex and therefore reproduce only vegetatively, if at all (USFWS 1993b). Due to the rhizomatous nature of the species, this may mean that the single-sex populations may be clones of one or a few individuals. Limited genetic variation within populations may also contribute to the observed low rates of seed production and seed viability has been shown to be extremely low (Suiter 2010a, pers. comm.).

6.1.3 Distribution and Habitat Requirements

Michaux's sumac was originally described from "Mecklenburg County, North Carolina" as *Rhus pumula* by André Michaux in 1803, but later changed to *R. michauxii* by Sargent in 1895, to correct Michaux's use of a homonym (pullus) and to honor its discoverer (Barden and Matthews 2004). Historically, Michaux's sumac has been documented in Davie, Durham, Franklin, Hoke, Johnston, Lincoln, Mecklenburg, Moore, Orange, Richmond, Robeson, Scotland, Wake, and Wilson Counties in North Carolina; Florence, Kershaw, and Oconee Counties in South Carolina; Columbia, Elbert, Gwinnett, Muscogee, Newton, and Rabun Counties in Georgia; and Alachua County, Florida (USFWS 1993b). Many of theses populations have been extirpated. As of 2009, there are 40 populations range-wide (Suiter 2010a, pers. comm.). The NCNHP currently lists 32 extant populations in NC known from Cumberland, Davie, Durham, Franklin, Hoke, Moore, Nash, Richmond, Robeson, Scotland, Union, and Wake Counties (NCNHP 2010). Four extant occurrences are known in Georgia and four extant occurrences are known in Virginia (Suiter 2010a, pers. comm.). All previously known populations in South Carolina and Florida are currently considered extinct (Suiter 2010a, pers. comm.; Holling 2012, pers. comm.).

Michaux's sumac grows in sandy or rocky open woods on sandy or sandy loam soils with low cation exchange capacities and appears to depend upon some form of disturbance to maintain the open quality of its habitat (USFWS 1993b, Suiter 2010a, pers. comm.). Michaux's sumac can occur on circumneutral soils, loamy swales, or on clayey soils derived from mafic rocks, depending on the physiographic province where it occurs (NatureServe 2010). Most extant populations can be found on open disturbed areas, such as railroad, road, and utility rights-of-way that are periodically maintained and/or managed for the species.

Not much is known about the population dynamics of Michaux's sumac. Fire or some other forms of disturbance, such as mowing or hand clearing (outside the normal flowering and fruiting time), appears to be essential for maintaining the open habitat preferred by Michaux's sumac (USFWS 1993b). Without periodic disturbance, this type of habitat is overgrown by woody vegetation. As this overgrowth occurs, Michaux's sumac begins to decline due to its intolerance of shade. The current distribution of Michaux's sumac demonstrates its dependence on disturbance. Of the remaining populations, most are located in areas that receive significant disturbance through periodic clearing or maintenance by fire.

6.1.4 General Threats to Species

Michaux's sumac is threatened by fire suppression and ecological succession (competition/shading by woody species) that occurs in areas not burned on a regular basis (Suiter 2010a, pers. comm.). Additionally, forested populations are threatened by timber and utility rights of way populations are threatened by herbicide use, ground disturbing activities, and mowing during critical growth periods (Suiter 2010a, pers. comm.). Multiple observations also suggest that limited seed production continues to be a problem at most populations (Suiter 2010a, pers. comm.).

The greatest threat to Michaux's sumac comes from the loss/degradation or modification of habitat from activities such as development (residential, commercial, or industrial), highway construction and improvement, and intensive and/or untimely maintenance of existing utility and roadside rights of way (USFWS 1993b, USFWS 2010). Other threats include low genetic diversity within the existing populations and hybridization with other species of Rhus.

6.1.5 Roadway-Related Threats to Species

A number of potential direct and indirect effects to plant species resulting from road construction projects were evaluated for this BA. These potential effects are discussed in Section 5.1.6 for Schweinitz's sunflower, and are applicable to Michaux's sumac as well.

6.2 Presence in Action Area

A review of NCNHP (2013) natural heritage database records indicated one known occurrence (EO# 40) of Michaux's sumac within the FLUSA and none in the Conservation Areas (Figure 6)

<u>EO# 40</u>

EO# 40 is actually the type locality of Michaux's sumac, as André Michaux discovered it here on July 21, 1794 (Barden and Matthews 2004). This site is located along the southwestern portion of the FLUSA, "probably…no more than a mile or two north of New Town Road (SR 1315), probably along Providence Road (NC 16) or Antioch Church Road (SR 1338)" (Barden and Matthews 2004). Although Michaux described the type locality as Mecklenburg County, this location is now in Union County, which was formed in 1842 from portions of Mecklenburg County and Anson County. As such, the type locality for this species occurs in Union County (Barden and Matthews 2004). The EO is mapped by NCNHP as an area rather than an exact location due to difficulty in determining the exact location of the population based on the original survey (Buchanan 2010a, pers. comm.). Barden and Matthews (2004) spent two days searching along Michaux's route for the population, but did not find the species as little suitable habitat remains. NCNHP (2010) currently ranks this population as "historical", which indicates a lack of recent field information verifying the existence of the EO; this EO is based only on historical collections data.

Surveys for federally threatened and endangered plant species were conducted by ESI within the project study area (PSA). At the time of the surveys in 2007, the PSA included several detailed study alternatives and was therefore much larger than the final selected alternative, but much smaller than the FLUSA (Figure 8). Survey methodologies and results are included in a Nov. 15, 2007 Endangered Plant Survey Update letter (ESI 2007).

Atkins (2012) performed updated field survey within the final footprint of the Monroe Bypass / Connector in 2012. Prior to performing the surveys, Atkins reviewed aerial photos of the affected area to identify suitable habitat, which consists of roadsides, utility right-of-ways, field edges, and other areas that receive abundant sunlight and are infrequently but regularly maintained. A total of approximately 35 acres, or 13.5 miles of linear transects, were targeted for field surveys. Surveys were performed visually using systematic overlapping transects to cover suitable habitat areas. No Michaux's Sumac populations were identified during the 2012 field surveys.

Based on the results of these surveys and the NCNHP natural heritage database search, there are no known documented occurrences of Michaux's sumac within the proposed project alignment.

7.0 ENVIRONMNETAL BASELINE – SMOOTH CONEFLOWER

This section discusses the characteristics and current status of the smooth coneflower throughout its range and within the proposed action area. Most of the following text references data from the draft 5-year status review, obtained through personal communication with Mr. Dale Suiter, USFWS, in addition to the 1993 USFWS Recovery Plan for smooth coneflower.

7.1 Species Description

A detailed description of characteristics, habitat requirements, legal status, and primary threats to the species are summarized below.

7.1.1 Designation (Legal Status)

Smooth coneflower was federally listed as endangered on October 8, 1992, under provisions of the Endangered Species Act of 1973 (as amended) (FR 57(196):46340-46344) (USFWS 1992c). Currently there is no critical habitat designated for smooth coneflower.

7.1.2 Characteristics

Smooth coneflower was described from material collected in South Carolina by Boynton and Beadle (1903). It is a rhizomatus perennial herb that grows up to 1.5 meters tall from a vertical root stock and the stems are typically smooth, with few leaves (USFWS 1995). The largest leaves are the basal leaves, reaching 20 cm long and 7.5 cm wide, with long petioles, an elliptical to broadly lanceolate shape, tapering to the base. Texture of the basal leaves is smooth to slightly rough. The midstem leaves, if present, have shorter petioles and are smaller than the basal leaves. Flower heads are usually solitary, consisting of light pink to purplish ray flowers, usually drooping at a length of 5 to 8 cm (USFWS 1995). Disk flowers are approximately 5 mm long and have tubular purple corollas and with generally erect, short, triangular teeth (USFWS 1995, NatureServe 2010).

Information is limited on the life history and species biology of smooth coneflower. Flowering occurs from May through July, and fruits develop from late June to September (USFWS 1995). The fruit is a gray-brown, oblong-prismatic achene, usually four-angled, and 4 to 4.5 mm long (USFWS 1995). Seeds are 0.5 cm long. Reproduction is generally only by sexual means; however, vegetative reproduction has been reported from some of the southern National Forest populations (USFWS 1995).

The smooth coneflower can be distinguished from its most similar relative, the purple coneflower (*Echinacea purpurea*), by its leaves (USFWS 1995). Smooth coneflower leaves are never cordate (heart-shaped) like those of the purple coneflower. In addition, the chaffy scales at the base of the fruit in the smooth coneflower are incurved, while those of the purple coneflower are straight. The vertical rootstock of smooth coneflower also distinguishes itself from purple coneflower, which typically has a horizontal rootstock (USFWS 1995).

7.1.3 Distribution and Habitat Requirements

Smooth coneflower is endemic to the Piedmont or Mountain physiographic provinces. At the time of its listing in 1995, 24 known populations of smooth coneflower was distributed across Virginia, North Carolina, South Carolina, and Georgia (USFWS 1995). Currently there are 11 extant populations in Georgia, eight in North Carolina (USFWS 2011), 34 in South Carolina (Holling 2012), and 16 in Virginia (Suiter 2010b, pers. comm.). Extant populations of Smooth Coneflower in the Carolinas are located in Durham, Granville, and Mecklenburg Counties, North Carolina (Buchanan 2010b, pers. comm.) and Allendale, Anderson, Barnwell, Oconee, Pickens, and Richland Counties, South Carolina (Holling 2012, pers. comm.).

Smooth coneflower populations naturally occur in xeric hardpan forests and diabase glades natural communities in North Carolina (as described by Schafale and Weakley 1990), in dolomite woodlands or glades natural communities in Virginia (as described by Rawinski 1994) (USFWS 1995) and in distinct physiographic provinces / habitats in open woodlands over marble, sandy loams, chert, and amphibolites in South Carolina (Suiter 2010b, pers. comm.). Smooth coneflower is typically found in open woods, cedar barrens, roadsides, clear cuts, dry limestone bluffs, and periodically maintained utility ROWs (USFWS 1995, Suiter 2010b pers. comm.). The species is usually found on soils rich in magnesium and/or calcium, associated with amphibolite, dolomite, or limestone, gabbro, diabase, and marble (USFWS 1995).

Optimal sites for smooth coneflower include areas with abundant sunlight and little competition in the herbaceous layer, with periodic disturbance (historically by natural fires and large herbivores) to reduce the shade and competition of woody plants (USFWS 1995).

7.1.4 General Threats to Species

Smooth coneflower is threatened range-wide by the suppression of fire and ecological succession (competition/shading by woody species) that occurs in areas not burned on a regular basis (USFWS 1995; Suiter 2010b, pers. comm.). Additional threats include timber operations as well as intensive maintenance of utility ROW populations (herbicide use and/or mowing during critical growth periods). Also a threat to this species, but to a lesser degree, is habitat modification and/or destruction resulting from land conversion or highway construction and residential, commercial, and industrial development (Suiter 2010b, pers. comm.).

7.1.5 Roadway-Related Threats to Species

A number of potential direct and indirect effects to plant species resulting from road construction projects were evaluated for this BA. These potential effects are discussed in Section 5.1.6 for Schweinitz's sunflower, and are applicable to smooth coneflower as well.

7.2 Presence in Action Area

A review of NCNHP (2013) natural heritage database indicated no documented occurrences of Smooth Coneflower within the FLUSA or Conservation Areas. Plant surveys conducted by Environmental Services, Inc. (ESI) within what was termed the PSA, or "project study area" in 2007 did not find locate any species. Survey methodologies and results are included in a Nov. 15, 2007 Endangered Plant Survey Update letter (ESI 2007). The footprint of the Monroe Bypass / Connector is entirely within Union County. Since smooth coneflower is only listed for Mecklenburg County, it was not included in the Atkins 2012 field surveys (Atkins 2012). Based on the results of this survey and the NCNHP natural heritage database search, there are no known documented occurrences of smooth coneflower within the proposed project alignment.

8.0 EFFECTS OF PROPOSED ACTION– CAROLINA HEELSPLITTER AND CRITICAL HABITAT

Potential effects to the freshwater mussels (i.e. Carolina heelsplitter) and mussel habitat discussed in Sections 4.1 and 4.3 were thoroughly evaluated with regard to this project. In order to determine the project effects on the Carolina heelsplitter and its designated Critical Habitat, effects with and without the proposed project (Build vs. No-Build scenarios) were evaluated.

While it is documented that both populations of this species in the Action Area are critically imperiled, adverse effects to these populations associated with the proposed project are unlikely to occur.

8.1 Direct Effects

Based on mussel survey data and habitat evaluations, the Carolina heelsplitter does not occur in any of the waterbodies within the project corridor of the proposed action. However, because of proximity to the project corridor, the contractor may use areas within the Goose Creek and Sixmile Creek watersheds for staging, storage, refueling, borrow pit or spoil areas. Although buffer areas of intermittent or perennial streams within these watersheds would be excluded from being used for borrow/spoil per the Goose Creek Watershed Site Specific Management Plan and the similar post construction ordinance requirements for the Sixmile Creek watershed, borrow/spoil areas outside of the buffers still have the potential to affect water quality and in turn the Carolina heelsplitter from sedimentation,/erosion and introduction of toxic compounds from entering streams via storm-water channels, ditches, and overland runoff. The potential for these effects to occur can be eliminated, or minimized by developing measures to control sedimentation, erosion and introduction of toxic compounds from entering streams in these areas.

The NCDOT will strongly discourage the location of borrow sites, staging areas, equipment storage areas, and refueling areas within Goose Creek or Sixmile Creek watersheds in association with this project. As such, the likelihood of the contractor choosing such a site is remote. However, if it is decided that such a site is ultimately the best way to move the project forward, the NCDOT Division Environmental Officer will coordinate with the NCTA, USFWS, and the contractor to develop BMPs for each site to avoid/minimize the potential for adverse effects.

8.2 Indirect Effects

Potential project related indirect effects to the Carolina heelsplitter and Critical Habitat are assessed at a detailed, Goose and Sixmile Creek watersheds scale, the results of which are provided in Section 6.0 of the DTR. The assessment found that the indirect land use differences between the Updated No-Build and Updated Build scenarios for Goose Creek watershed have no measurable differences in effect on the amount of developed land, water quality, water quantity, and changes in traffic patterns in the Goose Creek or Sixmile Creek watersheds.

8.3 Cumulative Effects

Although the cumulative definition under ESA differs from that under NEPA, the cumulative analysis was performed using the NEPA definition. Therefore, the cumulative effects discussed in this BA, as defined per ESA, may be somewhat overestimated since the Quantitative ICE analysis included the effects of future federal actions *as well as* non-federal actions.

Potential project related cumulative effects to the Carolina heelsplitter and Critical Habitat are assessed at a focused, Goose and Sixmile Creek watersheds scaled detail, the results of which are provided in Sections 6.8 and 6.9 of the DTR. Future state and private activities, including federal actions, are reasonably certain to occur within the Goose Creek and Sixmile Creek watersheds that will continue to impact the Carolina heelsplitter. However, these impacts are expected to occur with or without (Build vs. No-build) the proposed action. As there are no anticipated direct, or indirect effects, the project is not expected to contribute an incremental effect that would yield potential cumulative effects. .

8.4 Conclusions of Effects – Carolina ***heelsplitter***

While it is documented that both the Goose Creek and Sixmile Creek populations of the Carolina heelsplitter are imperiled and continue to be threatened by future adverse impacts, direct and indirect effects to these populations are very unlikely to occur as a result of the proposed project.

Direct Effects

As discussed in Section 8.1, the project alignment does not occur within either the Goose Creek or Sixmile Creek watersheds; thus, the only potential direct effects associated with project construction would be sedimentation/erosion and introduction of toxic compounds originating from borrow/spoil areas, staging areas, equipment storage areas, and refueling areas and entering Goose Creek or Sixmile Creek via unregulated stormwater channels, ditches, and overland runoff. At this time, the locations of potential borrow/spoil sites staging areas, equipment storage areas, and refueling areas have not been chosen. In the event that any of these sites are selected within either the Goose Creek or Sixmile Creek watersheds, existing regulations excluding stream buffer areas from being used for these purposes, and the commitment of NCDOT to adopt measures to avoid/minimize the potential for adverse effects in non-regulated areas within the respective watersheds, make it extremely unlikely (discountable) that project-related direct effects could occur.

Indirect Effects

The DTR found that the indirect land use differences between the Updated No-Build and Updated Build scenarios for Goose Creek watershed have no measurable differences in effect on the amount of developed land, the water quality, and changes in traffic patterns in the Goose Creek or Sixmile Creek watersheds.

Cumulative Effects

Direct effects are extremely unlikely, though cannot be unquestionably discounted. The DTR analysis found that there are no anticipated indirect effects. Accordingly, cumulative effects to the Carolina heelsplitter, however unlikely, could occur.

Biological Conclusion

Construction of the Monroe Bypass/ Connector is not anticipated to have any direct, indirect, or cumulative effect on the Carolina heelsplitter populations in Goose Creek and Sixmile Creek. However, as noted in Section 6.9 of the DTR, there are limitations to the accuracy and certainty of the results of any analysis that attempts to project future growth or development. As such, given the inherent level of uncertainty in the forecasting models for this project and the proximity of these two watersheds to the project corridor, a "No Effect" determination cannot be concluded. Therefore, it is concluded that the proposed action **"May Affect, Not Likely to Adversely Affect"** the Carolina heelsplitter.

8.5 Conclusions of Effects-Critical Habitat

Construction of the Monroe Bypass/ Connector is not anticipated to have any direct, indirect, or cumulative effect on the Carolina heelsplitter Critical Habitat Unit 1. However, as noted in Section 6.9 of the DTR, there are limitations to the accuracy and certainty of the results of any analysis that attempts to project future growth or development. As such, given the inherent level of uncertainty and the proximity of these two watersheds to the project corridor, a "No Effect" determination cannot be concluded. Therefore, it is concluded that the proposed action **"May Affect, Not Likely to Adversely Affect"** Critical Habitat Unit 1.

8.6 Conservation Measures –Carolina Heelsplitter & Critical Habitat

In an effort to off-set potential impacts from some unanticipated event associated with construction of the Monroe Bypass/ Connector, NCDOT has either completed, or proposes, the following:

- IF any construction staging, storage, refueling, borrow pit or spoil areas are to occur in the Goose Creek and Sixmile Creek watersheds, the NCTA will coordinate with the NCDOT DEO, USFWS, and the contractor to develop BMPs for each site to avoid and minimize the potential for adverse effects. Additionally, NCTA will follow NCDOT's *Design Standards in Sensitive Watersheds* for implementing erosion and sediment control BMPs along the entire project.
- In collaboration with, and at the request of, the USFWS, a payment in the amount of $150,000 was provided to the Carolina heelsplitter Conservation Bank in the Flat Creek watershed in Lancaster County on August 4, 2010. The details of the transaction are in Appendix C.
- In collaboration with, and at the request of, the USFWS, NCDOT continued its funding of the USGS stream gauges on the US 601 crossing of Goose Creek and the SR 1103 crossing of Waxhaw Creek. A payment of $150,200 was provided on September 14, 2010 to fund operation through June 2015 (Appendix C).

9.0 EFFECTS OF PROPOSED ACTION – SCHWEINITZ'S SUNFLOWER

9.1 Direct Effects

There is suitable habitat for Schweinitz's Sunflower in the project alignment; however, there are no known populations within the proposed project alignment, right-of-way (ROW), or clearing limits. Based on NCNHP (2013) EO data as well as project study area surveys (ATKINS 2012), there are two populations of this species (EO# 230 and EO# 77) within approximately 500 feet of the proposed project alignment in the vicinity of the proposed interchange at Indian Trail-Fairview Road. The interchange has been specifically designed to avoid encroachment on these two populations. NCDOT has further committed to preserving and managing these populations during construction as noted in Section PC (Special Project Commitments) of the Final EIS (PBS&J 2010a).

The two populations are located partially within the Union Power utility ROW. As part of the proposed roadway construction, the power lines above EO #77 will be raised, but kept in the same location (Shumate 2010, NCTA, pers. comm.). Union Power agreed to manage the populations in their utility easement per their agreement with USFWS: Union Power's Schweinitz's Sunflower Restricted Sites Plan (Union Power 2010) (Appendix D). The project will not require utility coordination near EO #230.

Therefore, direct effects to Schweinitz's Sunflower are not anticipated to occur as a result of the proposed project.

9.2 Indirect Effects

Section 6.6 of the DTR performs a detailed, magnified assessment of the specific land use changes in the vicinity of the Elemental Occurrences. While there is expected to be induced land use changes near EO#77 and EO# 230 (Figure 22 in DTR), it is not expected to impact these populations. Likewise, the analysis found that the four percent loss of potentially suitable is not expected to impact the species. However, given the proximity of the construction project coupled with the inherent uncertainty of forecasting models, indirect effects, while not anticipated, cannot be unquestionably discounted.

9.3 Cumulative Effects

Although the cumulative definition under ESA differs from that under NEPA, the cumulative analysis was performed using the NEPA definition. Therefore, the cumulative effects discussed in this BA, as defined per ESA, may be somewhat overestimated since the Quantitative ICE analysis included the effects of future federal actions *as well as* non-federal actions.

Future state and private activities, not involving federal actions, are reasonably certain to occur throughout the FLUSA, specifically in the vicinity of EO# 18 and EO# 78, which could affect these populations (Figure 21 in DTR). The area around EO# 18 is expected to incur a change in land use from Undeveloped to Residential and the area around EO# 78 is expected to incur a change in land use from undeveloped to Non-Residential, independent of the proposed Monroe Connector/Bypass. The anticipated growth will likely affect these populations by degrading potentially suitable habitat through the expansion of residential and industrial development in areas currently undeveloped. Additional development in the vicinity of EO# 78 may include future infrastructure projects (i.e. sewer and water expansion) associated with the anticipated land use changes since this area is currently slated for future County sewer service. This future growth is expected to occur through future state, local, and private actions, not requiring federal permits or funds to complete.

Reasonably foreseeable small-scale adverse effects to Schweinitz's Sunflower may also occur within the Action Area; however, they are difficult to predict or quantify. Poor conservation management of the species at EO# 77 by the landowner has occurred in the past, namely excessive mowing (Thompson 2010b, pers. comm.). In addition, a past traffic accident caused habitat degradation in the vicinity of EO# 77 (Thompson 2010b, pers. comm.). The NCDOT has since widened Secrest Shortcut Road, which will likely aid in minimizing minor traffic accidents.

9.4 Conclusion of Effects

Direct and indirect effects to these populations of Schweinitz's Sunflower are unlikely to occur as a result of the proposed project.

9.4.1 Direct Effects

The project alignment does not occur within the bounds of any known Schweinitz's Sunflower populations; therefore, the only potential direct effects associated with the proposed project include the raising of the utility lines above EO# 77, which is not anticipated to adversely affect this population. Given the proximity of these two populations to the project corridor, NCDOT has committed to taking extra precautions, such as installing construction fencing around these populations, to ensure construction activities (e.g. worker parking, etc.) do not affect these populations. The Special Project Commitments of the Final EIS (Section PC; PBS&J 2010a) further detail NCDOT's commitment to avoid/minimize the potential for project-related adverse direct effects to Schweinitz's Sunflower.

9.4.2 Indirect Effects

As summarized in Section 6.6 of the DTR, no indirect effects to Schweinitz's Sunflower are anticipated.

9.4.3 Cumulative Effects

Direct, indirect effects are not anticipated, but as detailed above cannot be unquestionably discounted for various reasons. Further, cumulative effects, independent of the proposed action, in the form of loss of potential habitat is expected, though not anticipated to effect the viability of the species.

9.4.4 Biological Conclusion

Project-related direct and indirect effects to Schweinitz's Sunflower are extremely unlikely to occur (or are discountable). Potential direct and indirect effects are anticipated to be avoided by on-site preservation and management, the details of which are provided in Section 9.5. Cumulative effects independent of the proposed action are expected, though not anticipated to effect the viability of the species. Therefore, it can be concluded that the proposed action "**May Affect, Not Likely To Adversely Affect"** Schweinitz's Sunflower.

9.5 Schweinitz's Sunflower Conservation Measures

The Recovery Plan for Schweinitz's Sunflower lists several actions needed for the conservation of the species. This includes surveying suitable habitat for additional populations and potential reintroduction sites, protecting known remnant populations and viable populations through various protective management tools (i.e. management and cooperative agreements, acquisition of parcels containing preferred habitat, etc.), monitoring existing populations, conducting research, and implementing management plans on protected populations (USFWS 1994).

Conservation measures are those measures that can be taken to offset potential adverse effects to a protected species. Conservation measures for plant species typically fall into two categories: (1) Protection of extant populations through the use of management / cooperative agreements, and (2) relocation of extant populations to areas where they can be preserved and maintained. Conservation, relocation, or preservation of known populations may help alleviate potential direct, indirect, and cumulative effects to plant species within the Action Area.

The conservation measure of preference is most always to preserve the species in place, with relocation / transplanting being a viable alternate option if on site preservation is not feasible. After evaluating the potential effects, NCTA and FHWA determined on site preservation of EO# 230 and EO# 77 to be a feasible, preferable option, which conserves the species in its present habitat within the Action Area. This population has flourished at its current location, despite the past instances of excessive maintenance by the local landowner, a traffic accident, and even removal and relocation of the original population. The impressive re-growth of EO# 77 leads to the determination of on site preservation as the preferred conservation measure for this population.

9.5.1 On Site Preservation

NCDOT has been protecting roadside populations of rare plants since 1989, marking these populations in order to prevent them from being mowed (AASHTO 2009). NCDOT signed a Memorandum of Understanding (MOU) with NCDENR in 1990 that committed NCDOT to protect populations of threatened and endangered species that occur within NCDOT ROW. Working to protect roadside populations of federal and state-listed endangered and threatened species, NCDOT established general statewide management guidelines for areas marked for rare species; "NCDOT Roadside Vegetation Management Guidelines in Marked Areas" (Appendix E).

On site preservation of EO# 230 and EO# 77 will be the responsibility of NCDOT. Funds will be designated for the resources and labor to mark the extent of both populations with "Do Not Mow" signs. Additionally, NCDOT Division personnel and field maintenance crews will conduct vegetation management and maintenance activities per "NCDOT Roadside Vegetation Management Guidelines in Marked Areas". NCDOT did not immediately install signage since it was anticipated that they could conflict with construction of the Monroe Bypass/ Connector Project and other protective measures (fencing, other signs) would be used during construction. Nonetheless, NCDOT Division 10 personnel are aware of the populations and will continue to follow aforementioned vegetation management guidelines. NCDOT Division 10 has committed to preserving the species in place (NCTA 2010a).

NCTA has also notified Union Power of these populations (NCTA 2010b) and Union Power has committed to including these sites in their Schweinitz's Sunflower Restricted Sites plan (Ortiz 2010, Union Power, pers. comm.). Letters from NCTA to Division 10 and Union Power requesting onsite preservation are included in Appendix F. The commitments from both NCDOT and Union Power will be adhered to for as long as the respective conservation areas are under their ownership. While this can't necessarily be considered "in perpetuity", ownership of such areas are very rarely relinquished. As such, there is no reason to assume these sites will not continue to be managed for Schweinitz's sunflowers for the foreseeable future.

In addition, continued NCDOT management of EO# 78 and EO# 18 within the ROW, per "NCDOT Roadside Vegetation Management Guidelines in Marked Areas" as well as continued Union Power management of these populations, would lessen the likelihood of the anticipated impacts to these populations. Union Power currently manages these populations under their Schweinitz's Sunflower Restricted Sites plan.

10.0 EFFECTS OF PROPOSED ACTION – MICHAUX'S SUMAC

10.1 Direct Effects

Based on NCNHP (2013) Natural Heritage EO data as well as project study area surveys (ATKINS 2012), Michaux's Sumac is not currently known within the proposed project alignment, ROW, or clearing limits. As such, direct effects to Michaux's sumac are not anticipated.

10.2 Indirect Effects

Based on NCNHP (2013) Natural Heritage EO data as well as project study area surveys (ATKINS 2012), Michaux's Sumac is not currently known within the FLUSA. Therefore, indirect effects to Michaux's Sumac are not anticipated.

10.3 Cumulative Effects

Cumulative effects to Michaux's Sumac are not anticipated as neither direct nor indirect effects are anticipated to occur to this species as a result of the proposed action.

10.4 Conclusion of Effects

Based on NCNHP (2013) Natural Heritage EO data as well as project study area surveys (ESI 2007), Michaux's sumac is not known within the Action Area, and therefore the project will have **No Effect** on this species.

11.0 EFFECTS OF PROPOSED ACTION – SMOOTH CONEFLOWER

11.1 Direct Effects

Smooth Coneflower is not listed by the USFWS as occurring in Union County nor are there NCNHP (2013) Natural Heritage EO records near the proposed project alignment, ROW, or clearing limits. As such, direct effects to Smooth Coneflower are not anticipated.

11.2 Indirect Effects

Based on the DTR, there are no indirect effects anticipated in Mecklenburg County. Further, there are no known NCNHP (2013) Natural Heritage EOs of this species within the FLUSA. Therefore, indirect effects to Smooth Coneflower are not anticipated.

11.3 Cumulative Effects

Cumulative effects to Smooth Coneflower are not anticipated as neither direct nor indirect effects are anticipated to occur to this species as a result of the proposed action.

11.4 Conclusion of Effects

Since there will be no direct or indirect effects within Mecklenburg County and the lack of EO records within or near the FLUSA, the project will have **No Effect** on this species.

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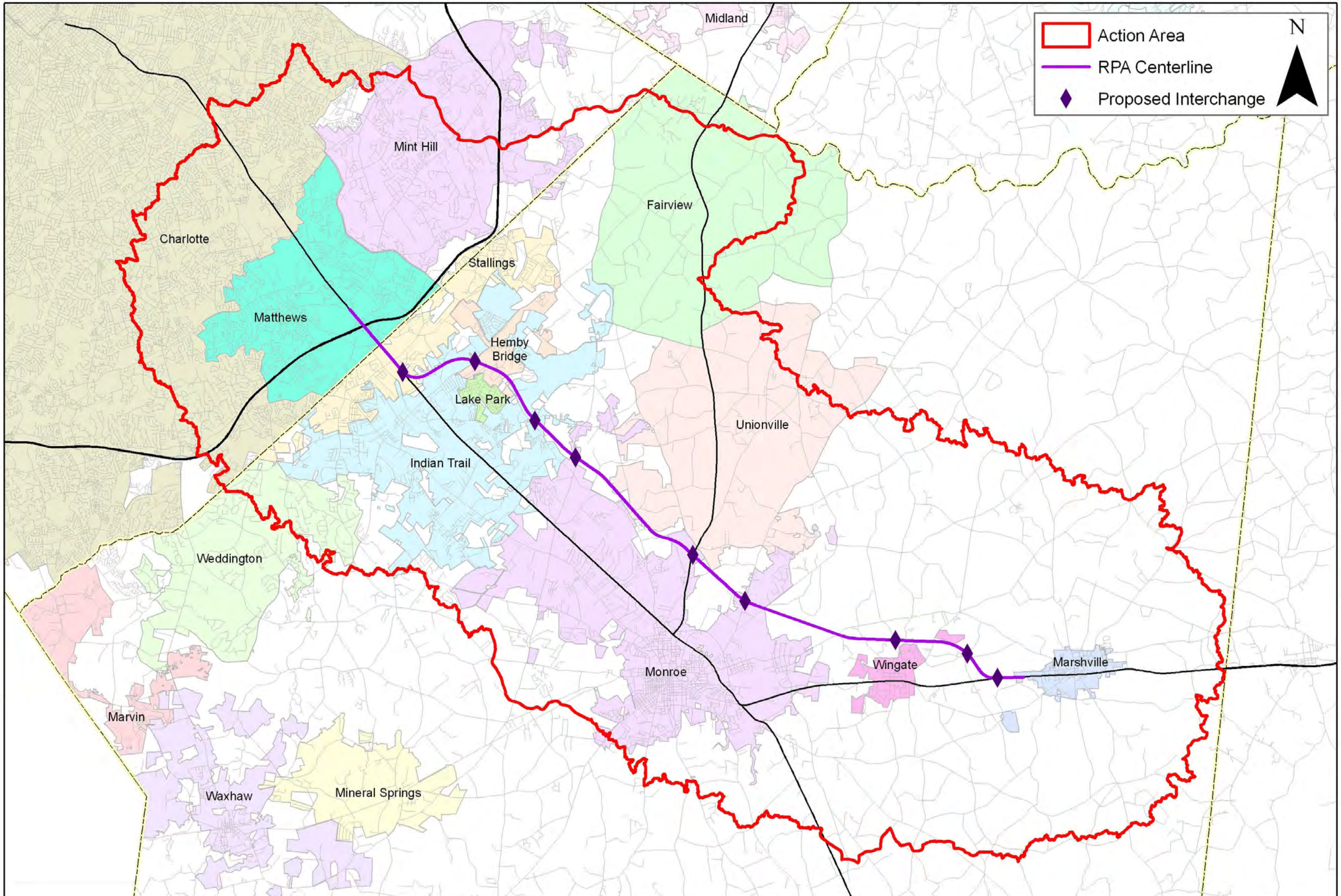


The Catena Group

Date: February 2010

Scale: 0 1 2 Miles

Job No.: 1125

Title:

Monroe Connector/Bypass (R-3329/R-2559)

Action Area

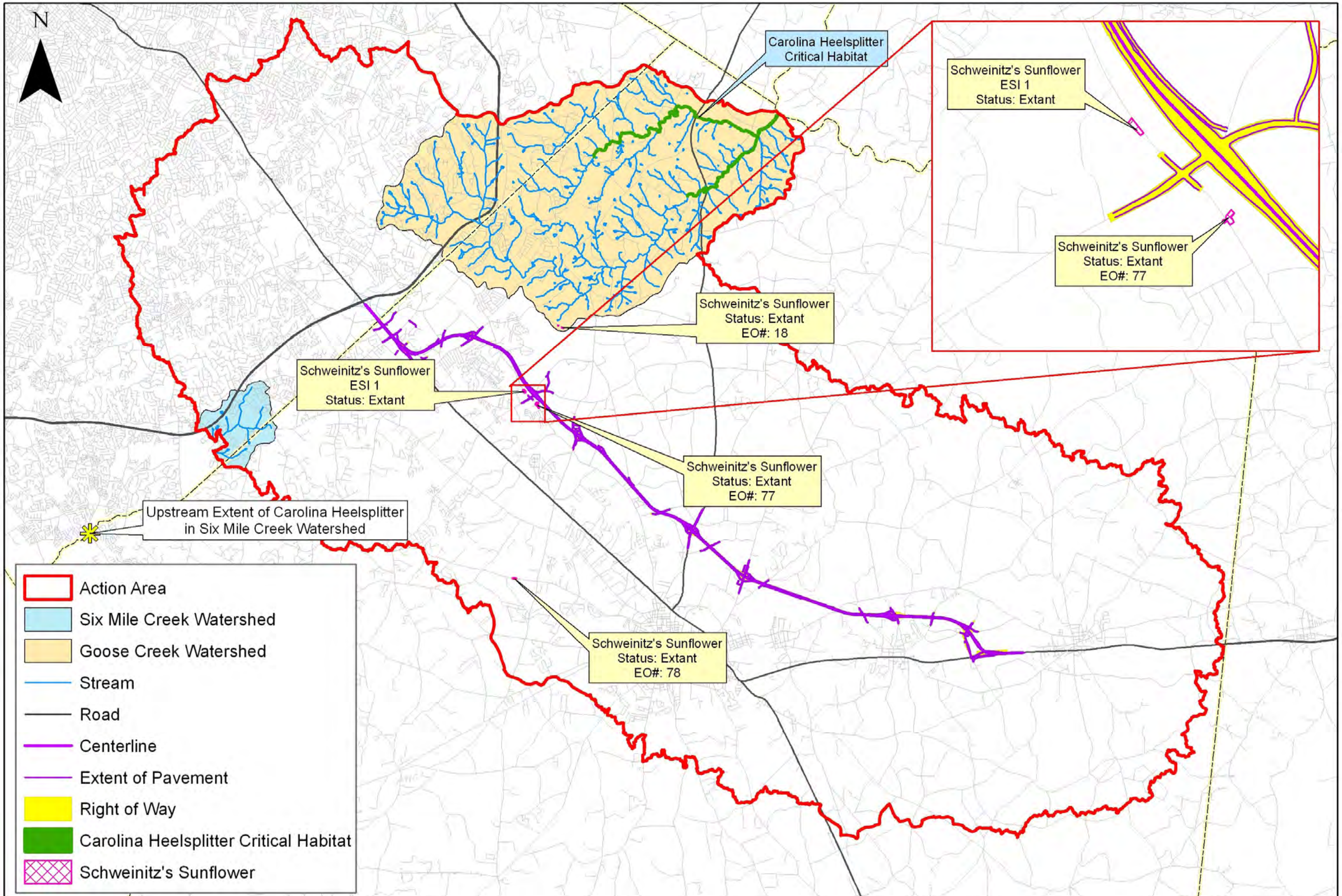
Mecklenburg and Union Counties, North Carolina

Client:

North Carolina Turnpike Authority

Figure

1



The Catena Group

Date: March 2010

Scale: 0 1 2 Miles

Job No.: 1125

Title:

Monroe Connector/Bypass (R-3329/R-2559)

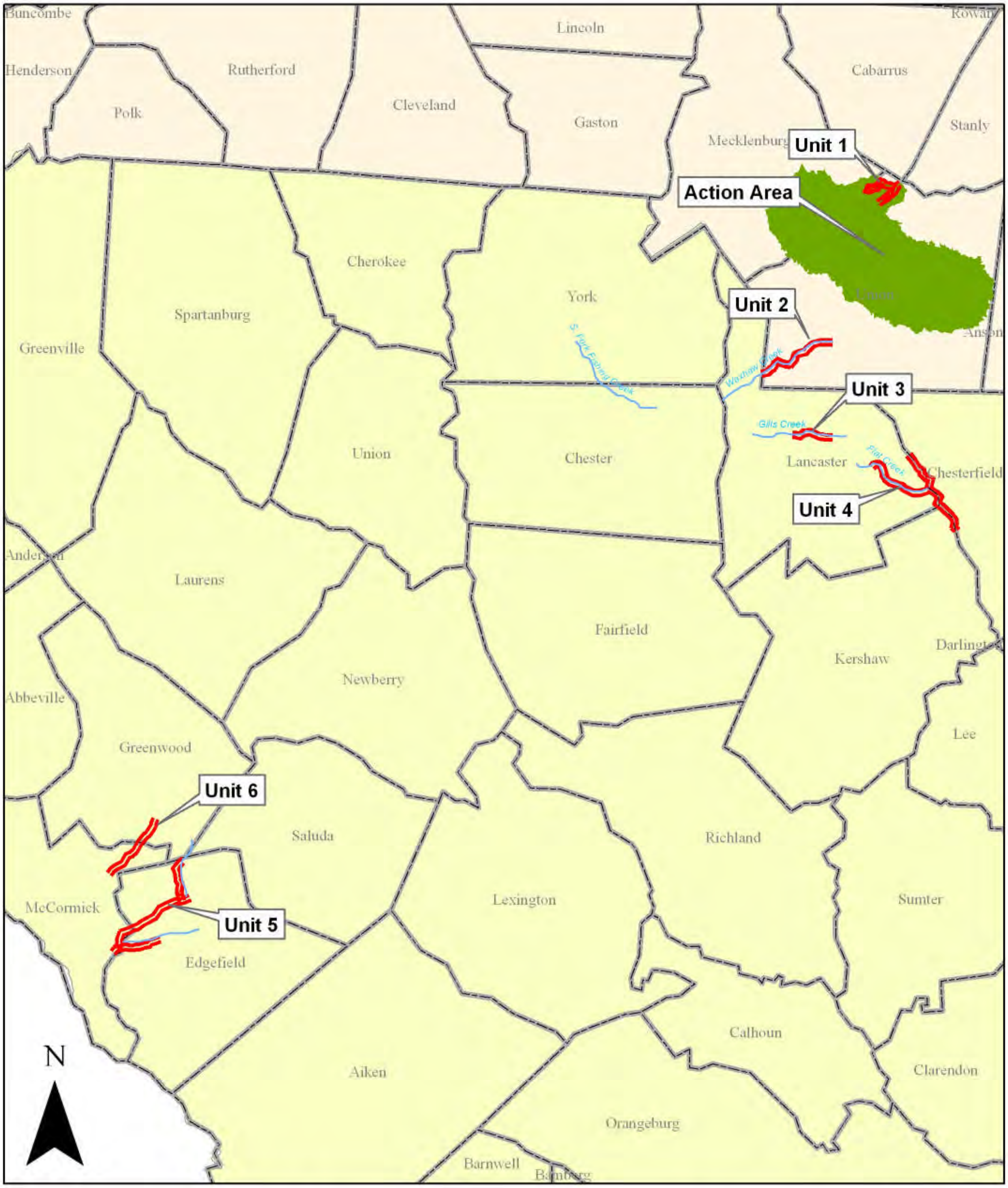
Project Proximity to Endangered Species and Critical Habitat

Mecklenburg and Union Counties, North Carolina

Client:

North Carolina Turnpike Authority

Figure 2



The Catena Group

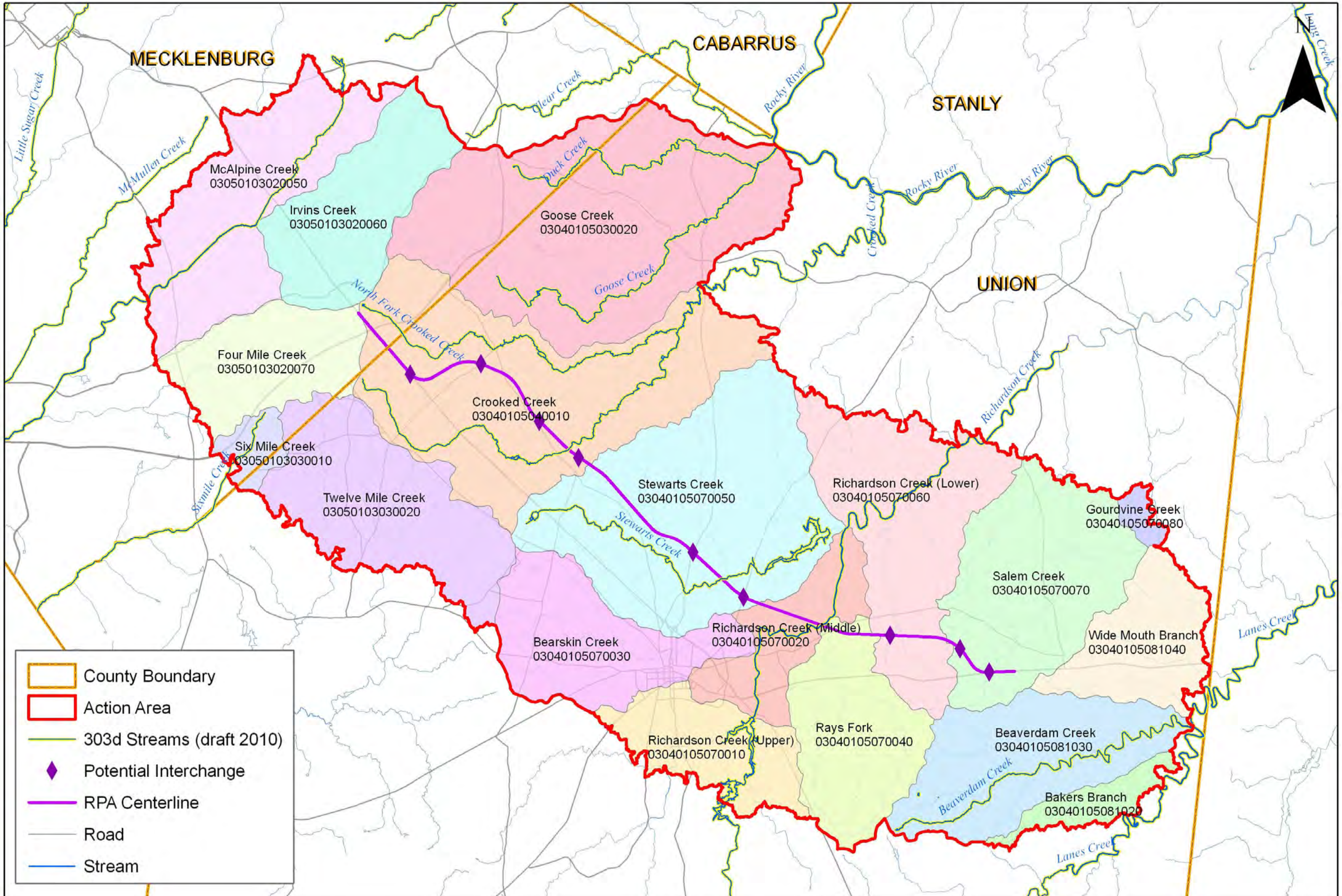
Monroe Connector/Bypass
(R-2239/R-2559)
Carolina Heelsplitter
USFWS Critical Habitat Units
North and South Carolina

Date: March 2010

Scale: 0 5 10 Miles

Job No.: 1125

Figure 3



The Catena Group

Date: February 2010

Scale: 0 1 2 Miles

Job No.: 1125

Title:

Monroe Connector/Bypass (R-3329/R-2559)

Watersheds and 303(d) Streams

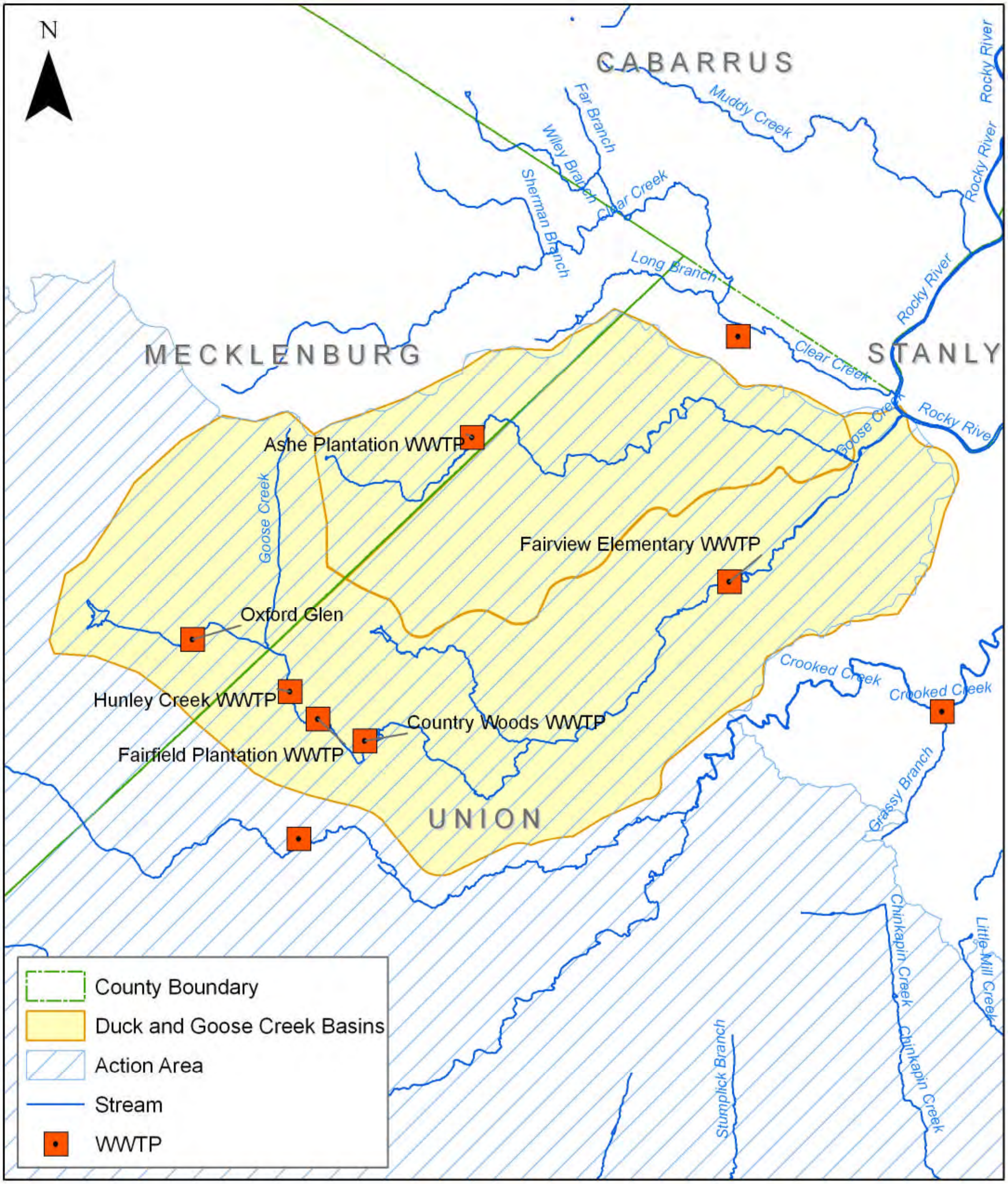
Mecklenburg and Union Counties, North Carolina

Client:

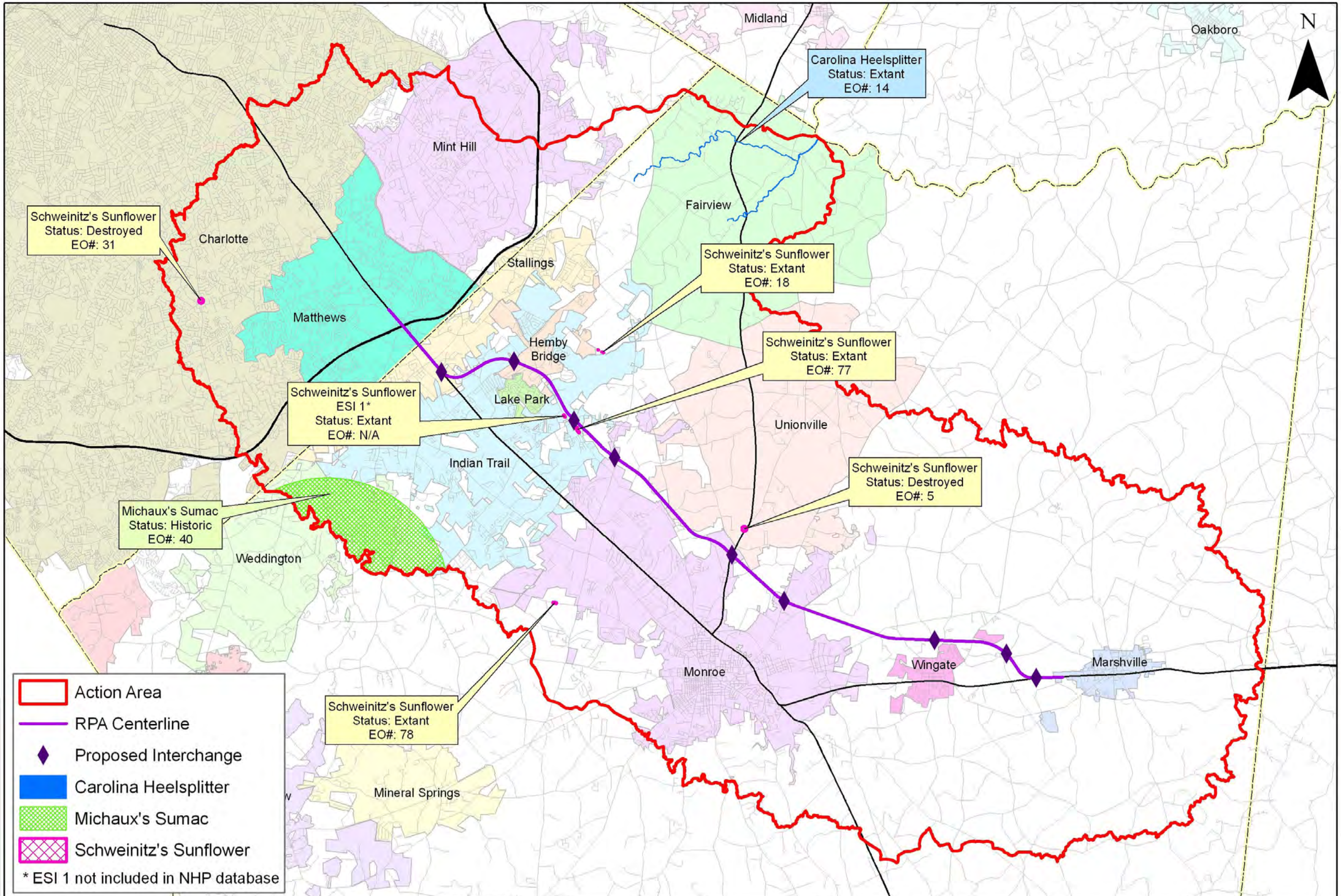
North Carolina Turnpike Authority

Figure

4



The Catena Group	Monroe Bypass/Connector (R-3329/R-2559) WWTP Locations Goose and Duck Creek Basins Union and Mecklenburg Counties, North Carolina	Date: March 2010 Scale: 0 0.5 1 Miles Job No.: 1125	Figure 5



The Catena Group

Date: February 2010

Scale: 0 1 2 Miles

Job No.: 1125

Title:

Monroe Connector/Bypass (R-3329/R-2559)

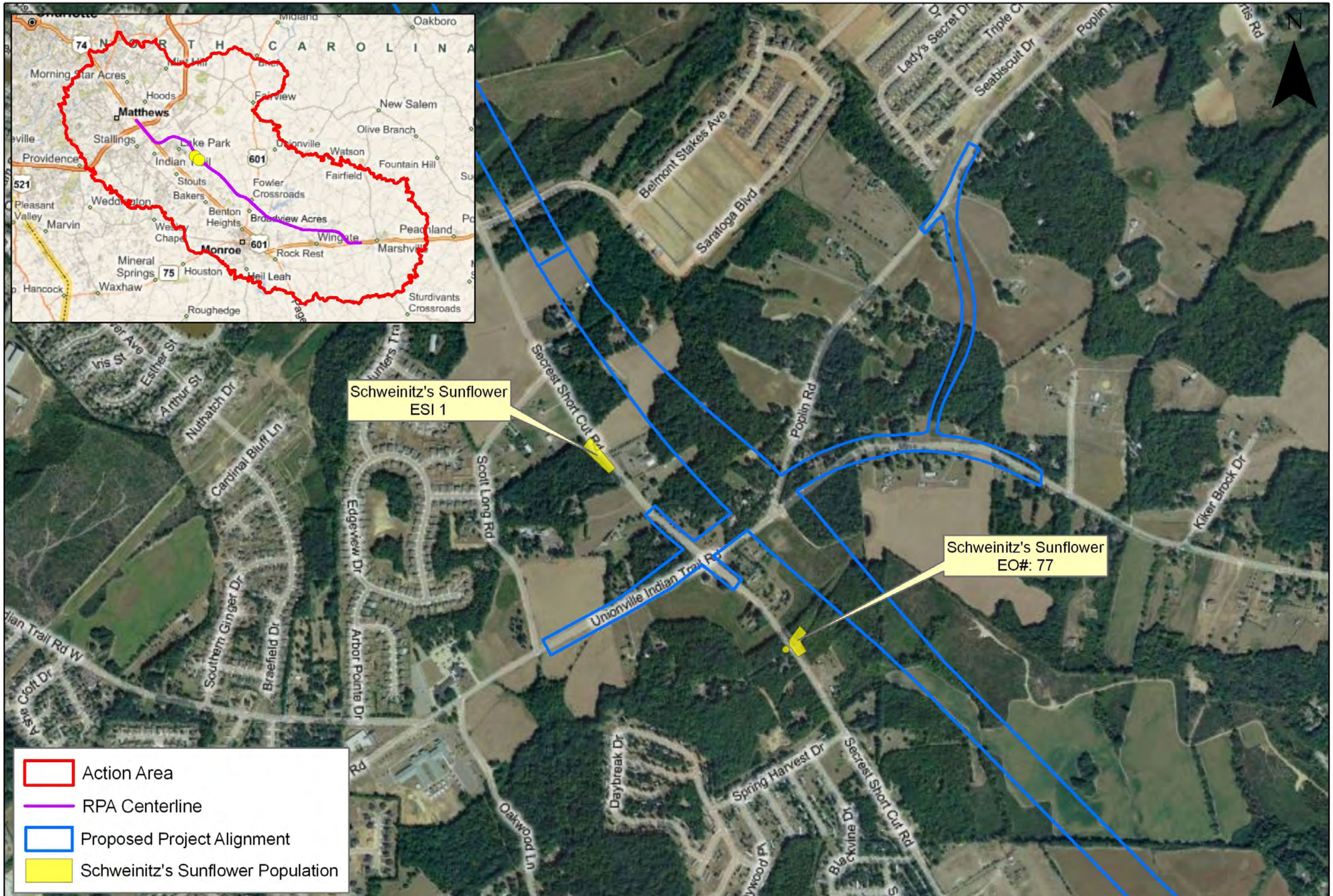
NCNHP Element Occurrences

Mecklenburg and Union Counties, North Carolina

Client:

North Carolina Turnpike Authority

Figure 6



The Catena Group

Date: February 2010

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Job No.: 1125

Title:
Monroe Connector/Bypass (R-3329/R-2559)

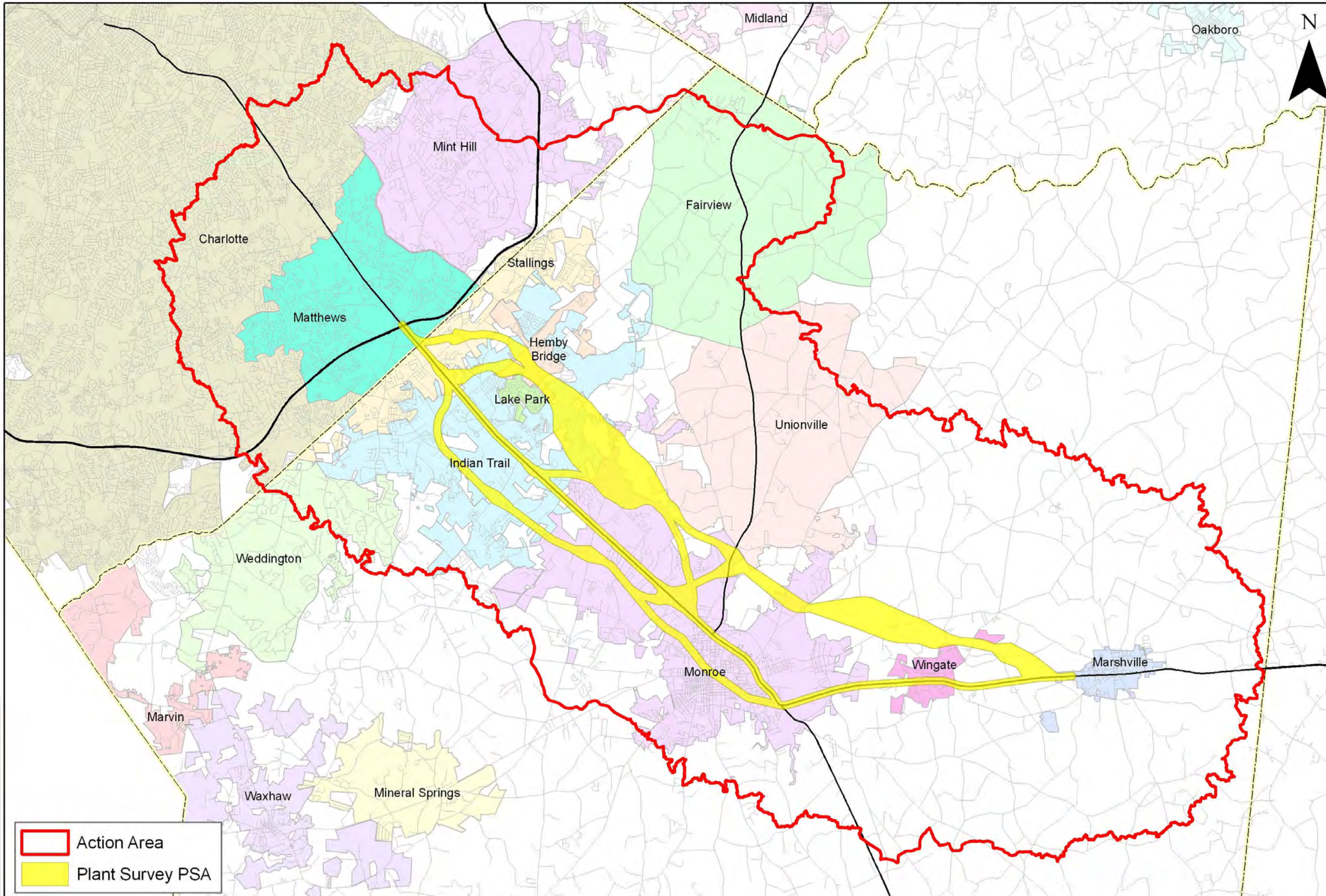
Potential Impact Schweinitz's Sunflower Populations

Mecklenburg and Union Counties, North Carolina

Aerial Photography: www.bingmaps.com

Client:
North Carolina Turnpike Authority

Figure 7



The Catena Group

Date: February 2010

Scale: 0 1 2 Miles

Job No.: 1125

Title:

Monroe Connector/Bypass (R-3329/R-2559)

Plant Survey Project Study Area

Mecklenburg and Union Counties, North Carolina

Client:

North Carolina Turnpike Authority

Figure 8