United States Department of the Interior

FISH AND WILDLIFE SERVICE
Ecological Services
P.O. Box 33726
Raleigh, NC 27636-3726

April 10, 2018

Edward T. Parker
Assistant Division Administrator
Federal Highway Administration
310 New Bern Avenue, Suite 410
Raleigh, NC 27601

Subject: Biological Opinion – Complete 540, Triangle Expressway Southeast Extension in Wake and Johnston Counties, North Carolina (STIP Numbers R-2721, R-2828, R-2829)
FWS Log #: 42420-2010-F-0383

Dear Mr. Parker:

This letter transmits the enclosed Biological Opinion (BO) of the U.S. Fish and Wildlife Service (Service) for the Complete 540, Triangle Expressway Southeast Extension (the Action). The North Carolina Department of Transportation, in cooperation with the Federal Highway Administration, proposes to construct an approximately 27 mile long controlled-access toll road (NC 540) in Wake and Johnston Counties, North Carolina. The Service received on December 6, 2017 your letter requesting formal consultation and conference for the Action described in *Biological Assessment, An Assessment of Potential Effects to Federally Listed Species for Complete 540, Triangle Expressway Southeast Extension.* You determined that the Action is likely to adversely affect Dwarf Wedgemussel and Yellow Lance. At the time of your letter, the Yellow Lance was only a proposed species. However, the Yellow Lance was subsequently listed as a threatened species on April 3, 2018. Therefore, both species are hereby addressed through formal consultation.

You also determined that the Action is not likely to adversely affect Michaux's Sumac and Cape Fear Shiner. The Service concurs with these determinations for reasons we explain in Section 3 of the BO.

The enclosed BO answers your request for formal consultation, and concludes that the Action is not likely to jeopardize the continued existence of the species listed above. This finding fulfills the requirements applicable to the Action for completing consultation under §7(a)(2) of the Endangered Species Act (ESA) of 1973, as amended.

The BO includes an Incidental Take Statement that requires the Federal Highway Administration to implement reasonable and prudent measures that the Service considers necessary or

appropriate to minimize the impacts of anticipated taking on the listed wildlife species. Incidental taking of listed wildlife species that is in compliance with the terms and conditions of this statement is exempted from the prohibitions against taking under the ESA.

Reinitiating consultation is required if the Federal Highway Administration retains discretionary involvement or control over the Action (or is authorized by law) when:

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

A complete administrative record of this consultation/conference is on file in our office at the letter-head address. If you have any questions about the BO, please contact me by phone at 919-856-4520 x.11 or by email at pete_benjamin@fws.gov.

Sincerely,

Pete Benjamin
Field Office Supervisor

Enclosure

Electronic copy provided to:

Donnie Brew, FHWA, Raleigh, NC
Eric Alsmeyer, USACE, Wake Forest, NC
Chris Murray, NCDOT, Durham, NC
Chad Coggins, NCDOT, Wilson, NC
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Rob Ridings, NCDEQ, Raleigh, NC
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Biological Opinion

Complete 540, Triangle Expressway Southeast Extension in Wake and Johnston Counties, North Carolina (STIP Numbers R-2721, R-2828, R-2829)

FWS Log #: 42420-2010-F-0383

Prepared by:

U.S. Fish and Wildlife Service
Raleigh Field Office
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Field Supervisor — April 10, 2016

[NAME, TITLE] Date

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CONSULTATION HISTORY

This section lists key events and correspondence during the course of this consultation. A complete administrative record of this consultation is on file in the U.S. Fish and Wildlife Service's (Service) Raleigh Field Office.

2009-12-08 to **2017-07-12** – Service staff attended multiple agency coordination meetings with North Carolina Department of Transportation (NCDOT) and Federal Highway Administration (FHWA).

2010-02-03 – The Service submitted a letter to NCDOT expressing concerns about potential adverse effects to Dwarf Wedgemussel (DWM).

2011-02-17 – The Service submitted a letter to NCDOT detailing specific concerns about effects to DWM and requesting NCDOT to fund additional studies of the species and its habitat within the Swift Creek Watershed.

2011-03-14 – The Service met with NCDOT, FHWA, and North Carolina Wildlife Resources Commission to discuss DWM issues.

2011-03-16 – NCDOT agreed to conduct additional studies of DWM within Swift Creek Watershed.

2012-01-25 – The Service submitted a letter to NCDOT commenting on alternatives being studied and reiterated concerns for adverse effects to DWM.

2012-06-11 – The Service met with consultants to discuss additional DWM studies.

2015-02-03 – The Service met with FHWA and NCDOT to discuss DWM issues and strategy to improve viability of the species in Swift Creek Watershed via captive propagation.

2015-11-25 – The Service submitted a letter to NCDOT commenting on the Federal Draft Environmental Impact Statement and reiterated concerns about adverse effects on federally listed mussels and the need for captive propagation as part of strategy to maintain viability of species.

2016-05-16 – The Service met with NCDOT to discuss Endangered Species Act Section 7 consultation and captive propagation facility as a conservation measure.

2016-05-17 – DWM Viability Study for Swift Creek Watershed final report completed and reviewed by Service.

2016-08-02 – NCDOT and FHWA agree to fund mussel captive propagation facility as conservation measure.

2017-01-19 – The Service met with NCDOT to discuss captive propagation facility as conservation measure.

2017-05-10 – The Service met with NCDOT and FHWA to discuss development of Biological Assessment (BA).

2017-07-12 – North Carolina State University provides budget proposal to operate mussel propagation facility.

2017-09-13 – The Service provided comments to NCDOT and FHWA on draft BA.

2017-09-28 – The Service met with NCDOT and other stakeholders to discuss mussel propagation facility.

2017-10-04 – The Service met with NCDOT and FHWA to discuss issues with draft BA.

2017-12-06 – The Service received the final BA and a letter from the FHWA requesting initiation of formal Section 7 consultation for DWM and formal Section 7 conference for the Yellow Lance.

2017-12-21 – The Service provided a letter to the FHWA stating that all information required for initiation of formal consultation and formal conference was either included with their 2017-12-06 letter or was otherwise available.

2018-01-18 – The Service provided the FHWA and NCDOT with a draft Biological and Conference Opinion.

2018-04-03 – The Yellow Lance was listed as a federally threatened species.

BIOLOGICAL OPINION

1. INTRODUCTION

A Biological Opinion (BO) is the document that states the opinion of the U.S. Fish and Wildlife Service (Service) under the Endangered Species Act of 1973, as amended (ESA), as to whether a federal action is likely to:

- jeopardize the continued existence of species listed as endangered or threatened; or
- result in the destruction or adverse modification of designated critical habitat.

The federal action addressed in this BO is the Federal Highway Administration (FHWA) proposed Complete 540, Triangle Expressway Southeast Extension in Wake and Johnston Counties, North Carolina (the Action). The BO considers the effects of the Action on Dwarf Wedgemussel (*Alasmidonta heterodon*, DWM) and Yellow Lance (*Elliptio lanceolata*, YL). The Action does not affect designated critical habitat; therefore, this BO does not further address critical habitat.

The FHWA determined that the Action is not likely to adversely affect Michaux's sumac (*Rhus michauxii*) and Cape Fear Shiner (*Notropis mekistocholas*). The Service concurs with these determinations, for reasons we explain in Section 3 of the BO.

A BO evaluates the effects of a federal action along with those resulting from interrelated and interdependent actions, and from non-federal actions unrelated to the proposed Action (cumulative effects), relative to the status of listed species and the status of designated critical habitat. A Service opinion that concludes a proposed federal action is *not* likely to jeopardize species and is *not* likely to destroy or adversely modify critical habitat fulfills the federal agency's responsibilities under §7(a)(2) of the ESA.

"*Jeopardize the continued existence*" means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species (50 CFR §402.02). "*Destruction or adverse modification*" means a direct or indirect alteration that appreciably diminishes the value of designated critical habitat for the conservation of a listed species. Such alterations may include, but are not limited to, those that alter the physical or biological features essential to the conservation of a species or that preclude or significantly delay development of such features (50 CFR §402.02).

This BO uses hierarchical numeric section headings. Primary (level-1) sections are labeled sequentially with a single digit (e.g., 2. PROPOSED ACTION). Secondary (level-2) sections within each primary section are labeled with two digits (e.g., 2.1. Action Area), and so on for level-3 sections. The basis of our opinion for DWM and YL is wholly contained in separate level-1 sections that address the status, environmental baseline, effects of the Action, cumulative effects, and conclusion.

2. PROPOSED ACTION

The North Carolina Department of Transportation (NCDOT), in cooperation with the FHWA, proposes improvements to NC 540 in Wake and Johnston Counties, North Carolina. An approximately 27 mile long controlled-access toll road is proposed to be constructed. The two primary purposes of the Action are to 1) improve mobility within or through the Action Area during peak travel periods and 2) to reduce forecast congestion on the existing roadway network within the Action Area. A secondary purpose of the Action is to improve system linkage in the regional roadway network by completing the NC 540 outer loop around the greater Raleigh area. The Action is comprised of three projects in the NCDOT 2016-2025 State Transportation Improvement Program (TIP R- 2721, R-2828, and R-2829) combined together for analysis. The Action will likely be constructed in phases with initial construction tentatively scheduled for fiscal year 2020. The Action will be evaluated here in three components: 1) construction of roadway and stream crossings, 2) operation of roadway facility, and 3) conservation measures.

2.1. Action Area

For purposes of consultation under ESA §7, the action area is defined as "all areas to be affected directly or indirectly by the federal action and not merely the immediate area involved in the action" (50 CFR §402.02). The "Action Area" for this consultation consists of the Future Land

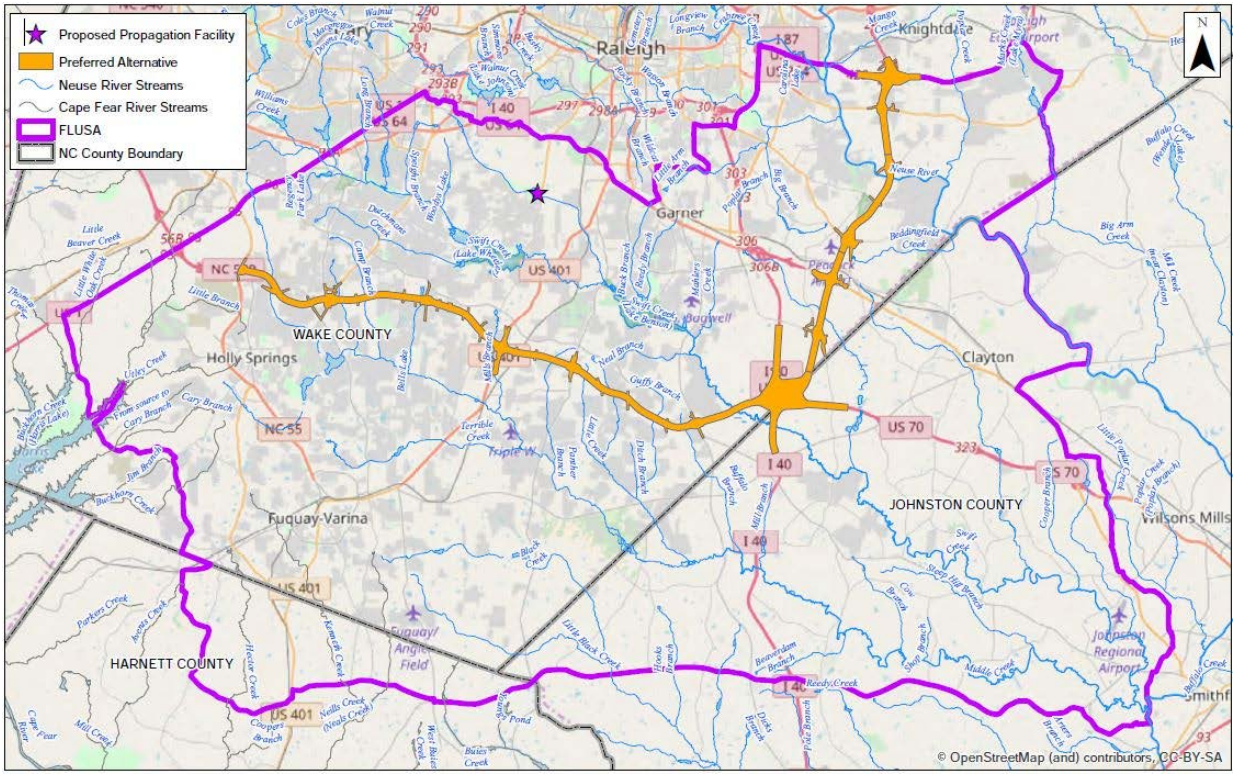

Figure 2.1 Action Area boundaries depicted in purple.

Use Study Area (FLUSA) as defined in the Qualitative Indirect and Cumulative Effects Report (H.W. Lochner 2014). Portions of Wake, Johnston, and Harnett Counties occur within the Action Area (Figure 2-1). The Action Area includes the entire Swift Creek Watershed below Lake

Benson to its confluence with the Neuse River. The FLUSA was chosen as the Action Area because of the Action's potential to induce land development.

2.2. Construction of Roadway and Stream Crossings

An approximately 27 mile long controlled-access toll road is proposed to be constructed on new location to extend the existing NC 540 (Triangle Expressway) from its current terminus at NC 55 Bypass in Apex to US 64/US 264 (I-495) in Knightdale. The new road will consist of six lanes, with three 12-foot lanes in each direction of travel, separated by a 70-foot median. The new facility will occupy approximately 1,240 acres within the proposed right-of-way. Interchanges are proposed at the following locations: NC 55 Bypass, Holly Springs Road, Bells Lake Road, US 401, Old Stage Road, NC 50, White Oak Road, I-40, US 70 Bypass, US 70 Business, Old Baucom Road, Auburn Knightdale Road, Poole Road, and US 64/US 264. The Neuse River, Swift Creek, some tributaries to Swift Creek, and other major streams will be crossed utilizing bridges. Smaller streams will be crossed using culverts. The dual bridges over Swift Creek will be 825 feet long and will completely span the channel (i.e. no bents in the water) and much of the floodplain. The Action will likely be implemented in phases over several years, depending upon availability of funding. Construction is tentatively scheduled to begin in fiscal year 2020. The estimated construction duration for each TIP is approximately:

- R-2721 – 3.0 years
- R-2828 – 3.5 years
- R-2829 – 2.5 years

2.3. Operation of Roadway Facility

Operation of the new roadway facility includes daily vehicular use and routine maintenance activities. Routine maintenance includes, but is not limited to, the following common practices: mowing, tree trimming, bridge painting, minor bridge repair, culvert cleaning/repair, ditch cleaning/reshaping, detention/retention basin cleaning, guardrail replacement, pavement rehabilitation/resurfacing, and right-of-way fence repair.

2.4. Conservation Measures

The following measures will be implemented by NCDOT to minimize and partially offset potential adverse effects to Dwarf Wedgemussel (DWM) and Yellow Lance (YL).

Erosion Control Measures

NCDOT will require Design Standards in Sensitive Watersheds [15A NCAC 04B .0124 (b) – (e)], which are erosion control measures that exceed the standard best management practices (BMPs) (e.g. measures are designed to provide protection from runoff of 25-year storm event). The areas within the Swift Creek Watershed and Lower Middle Creek will be identified as "Environmentally Sensitive Areas" on the Sedimentation and Erosion Control Plans. By definition, the Environmentally Sensitive Areas will be identified as a 50-foot buffer zone on both sides of the stream measured from top of streambank. Within the identified 50-foot Environmentally Sensitive Areas, the following shall apply:

1. The contractor may perform clearing operations, but not grubbing operations until immediately prior to beginning grading operations.
2. Once grading operations begin in identified Environmentally Sensitive Areas, work shall progress in a continuous manner until complete.
3. Erosion control devices shall be installed immediately following the clearing operation.
4. Seeding and mulching shall be performed on the areas disturbed by construction immediately following final grade establishment.
5. Seeding and mulching shall be done in stages on cut and fill slopes that are greater than 20 feet in height measured along the slope, or greater than 2 acres in area, whichever is less.

All sedimentation and erosion control measures will be appropriately maintained following NCDOT standards, to ensure proper function of the measures.

Bridge Deck Drainage

The design for all bridges within the Swift Creek Watershed and Middle Creek will eliminate deck drains into the water bodies they cross. Deck drainage is routed back to the land, thus allowing for some filtering of runoff prior to entering the stream.

Agency Coordination

NCDOT will invite representatives from the Service, North Carolina Wildlife Resources Commission (NCWRC), and other agency personnel to preconstruction meetings for the Action, as well as to preconstruction meetings associated with installation of structures within 0.25 mile of the Swift Creek crossing to ensure compliance with special project commitments.

Stream Crossing Review

During the development of the alternatives for the Action, an interagency field review was held to review stream crossings and determine if the minimum required structure type should be altered to minimize environmental effects. Within Swift Creek Watershed, the crossings of three tributaries to Swift Creek were identified as particularly high-value that warranted larger structures to minimize direct effects. Two proposed culverts were changed to bridges and one proposed bridge was lengthened (to span more of the stream banks and floodplain rather than fill them), resulting in the following net reduction of impacts: 3153 linear feet of stream, 7.56 acres of stream buffers, and 18.57 acres of wetlands (see Table 12 and Figure 12 in Biological Assessment).

Bridging of Swift Creek

The bridges that cross Swift Creek will not have any part of the structure in the stream channel or within 10 feet of the top of either bank. Also, no permanent structures or temporary structures required to build the bridge will be placed within Swift Creek. All permanent and temporary structures will be designed and installed such that they should not result in bank instability or cause significant sediment runoff into Swift Creek.

Hazardous Spill Basins (HSBs)

NCDOT will require construction of permanent HSB(s) on the crossing of Swift Creek. Barring any final design constraints, NCDOT will also require that final design direct road runoff

through a HSB before being discharged to the Swift Creek tributaries (SCY, SDF, SDH, SDJ and SDK as labeled in NCDOT 2014) that are within 0.25 mile of Swift Creek. The HSB(s) will be designed to contain a spill from a typical tanker truck that may have otherwise flowed directly into these water bodies. NCDOT will implement their standard protocols for upkeep and use of these HSB(s).

Preconstruction Survey and Potential Mussel Relocation

NCDOT will conduct a preconstruction survey (just prior to construction) at the Swift Creek crossing and remove mussels from a defined area (salvage area) and relocate them to appropriate habitat within Swift Creek outside of the salvage area (relocation site), or if deemed appropriate after coordination with the Service and NCWRC, DWM and YL individuals may be taken into captivity to use as brood stock for propagation efforts. The preconstruction survey will be incorporated into a Mussel Relocation Plan, which will identify the salvage area and relocation site, and be developed in coordination with the Service and NCWRC.

DWM Viability Study

NCDOT, in cooperation with the Service, commissioned the DWM Viability Study (Three Oaks 2016) to update the baseline conditions for the DWM. The results obtained were used in the development of this BO and are discussed below. The specific purpose of the DWM Viability Study was threefold:

1. Characterize existing conditions of the Swift Creek Watershed
2. Summarize conservation measures that have been implemented to protect DWM in the Swift Creek Watershed
3. Assess historical trends and future viability of the DWM population and habitat conditions

The study concluded that suitable habitat still exists in Swift Creek and the DWM population there is viable but vulnerable (see Section 4, below).

Propagation Facility

An ongoing commitment by several entities in developing the Yates Mill Aquatic Conservation Center (YMACC) has been underway concurrent to the development of the Action. Since 1997, state and federal agencies in North Carolina have worked with local universities and others to develop Atlantic Slope freshwater mussel captive propagation techniques, steadily growing the expertise but lacking full production capacity. Hence, the Service, NCDOT, and the FHWA have been in coordination regarding the logistics of developing a mussel propagation facility in the Raleigh, North Carolina area as a conservation measure to expand current capabilities, apply local expertise, and help offset potential effects to DWM and YL resulting from the Action.

NCDOT will provide funding to be utilized for the retrofit and upgrade of the existing research facility in the A.E. Finley Center, at the Historic Yates Mill County Park, owned by Wake County and leased and operated by North Carolina State University (NCSU), for the purpose of research and propagation of DWM, YL, and other aquatic species. The retrofitted/upgraded facility will then become the YMACC. The goal of the YMACC is to promote the long-term survival of rare aquatic species in streams throughout eastern North Carolina by producing individuals for population augmentation and/or reintroduction. Wake County will be provided

with approximately $2 million in funding for the construction of the retrofit and upgrade to the existing facility in the A.E. Finley Center. Wake County and NCSU will oversee and manage the construction of the new YMACC. In addition, approximately $3 million in funding will be provided to NCWRC's Non-Game Aquatic Project Fund. These funds will be used for NCSU's detailed proposal to provide a facility manager and an assistant at the YMACC to oversee the propagation, research, restoration, outreach, and other expenses needed to operate and maintain the facility for a minimum of five years.

NCDOT is not responsible for the construction, management, or success of the facility or its propagation goals. NCDOT has committed to provide funding which is based on the design and construction needs for the facility (through Wake County) and the operations leading to the ability to do mussel restorations (via the Non-game Aquatic Species Program). This program is intended to benefit federally threatened, endangered, and at-risk aquatic species, and may fund projects such as NCSU's proposal for operation of the YMACC, restocking efforts, surveys, monitoring, land acquisition, or habitat enhancement work by NCSU, NCWRC, and other conservation partners. These funding agreements are being prepared and will be in place prior to permitting for the Action.

2.5. Interrelated and Interdependent Actions

A BO evaluates the effects of a proposed federal action. For purposes of consultation under ESA §7, the effects of a federal action on listed species or critical habitat include the direct and indirect effects of the action, plus the effects of interrelated or interdependent actions. "Indirect effects are those that are caused by the proposed action and are later in time, but still are reasonably certain to occur. Interrelated actions are those that are part of a larger action and depend on the larger action for their justification. Interdependent actions are those that have no independent utility apart from the action under consideration" (50 CFR §402.02).

Although there are currently no designs for borrow pits, haul roads, or staging areas, the Action will invariably require such. These common construction features are generally left to the contractor to determine the need and location. NCDOT will strongly discourage the contractor from choosing borrow/waste site locations, staging areas, equipment storage areas, and refueling areas within 0.25 mile of Swift Creek by putting such language in the project commitments. However, if the contractor opts to pursue borrow or waste sites in these locations, the NCDOT Division Environmental Officer will coordinate with the Service during the approval process of any borrow or waste sites. It is the Service's experience that such sites are generally located so as to avoid additional adverse effects to listed species. The contractor must follow provisions in the Standard Specifications for Roads and Structures (January 2012) for borrow excavation (Section 230) and disposal of waste and debris (Section 802).

At this time there are no identified utilities which must be relocated due to the Action. However, after additional detailed design, it is possible that limited utility relocation may be necessary.

3. CONCURRENCE

The FHWA determined that the Action is not likely to adversely affect Michaux's sumac and Cape Fear Shiner. The Service concurs with these determinations for the following reasons.

There are only two known occurrences of Michaux's sumac within the Action Area, and these two populations will not be directly affected by the Action. Surveys for Michaux's sumac were performed within the footprint of the proposed road in 2013 and 2017. No specimens were observed. Also, several past surveys for other actions within the Action Area have failed to find the species. Although the Action is expected to slightly contribute to induced land development, the probability of Michaux's sumac occurring within such an area is discountable.

The Cape Fear Shiner only occurs within the Cape Fear River Basin. Given that the alignment of the Action occurs within the Neuse River Basin only, there will be no construction related or operational effects to the Cape Fear Shiner. The only known occurrence of Cape Fear Shiner within the Action Area is from Neills Creek. The species has not been observed from this location since 1986 (USFWS 2017a), and a 2003 survey failed to find the species in Neills Creek (Pottern 2009).

This concurrence concludes consultation for the listed species named in this section, and these are not further addressed in this BO. The circumstances described in the Reinitiation Notice of this BO that require reinitiating consultation for the Action, except for exceeding the amount or extent of incidental take, also apply to these species.

4. DWARF WEDGEMUSSEL

4.1. Status of Dwarf Wedgemussel

This section summarizes best available data about the biology and current condition of DWM throughout its range that are relevant to formulating an opinion about the Action. The Service published its decision to list DWM as endangered on March 14, 1990 (55 FR 9447- 9451).

4.1.1. Description of DWM

The DWM is a small bivalve, rarely exceeding 45 mm in length. Clean young shells are usually greenish-brown with green rays. As it ages, the shell color becomes obscured by diatoms or mineral deposits and appears black or brown. The shell is thin but does thicken somewhat with age, especially toward the anterior end. The anterior end is rounded while the posterior end is angular forming a point near the posterio-ventral margin (USFWS 2017b).

4.1.2. Life History of DWM

The DWM occurs in small creeks to deep rivers in stable habitat with substrates ranging from mixed sand, pebble and gravel, to clay and silty sand. In the southern portion of its range, it is often found buried under logs or root mats in shallow water (USFWS 1993); whereas in the northern portion of its range, it may be found in firm substrates of mixed sand, gravel or cobble,

or embedded in clay banks in water depths of a few inches to greater than 20 feet (Fichtel and Smith 1995, Gabriel 1995 and 1996, Nedeau and Werle 2003, Nedeau 2004a and 2004b, Nedeau 2006).

The DWM's reproductive cycle is typical of other freshwater mussels, requiring a host fish on which its larvae (glochidia) parasitize and metamorphose into juvenile mussels. The following species have been confirmed as host fish for the DWM: tessellated darter (*Etheostoma olmstedi*), Johnny darter (*E. nigrum*), fantail darter (*E. flabellare*), chainback darter (*Percina nevisense*), Roanoke darter (*P. roanoka*), mottled sculpin (*Cottus bairdi*), slimy sculpin (*C. cognatus*), Atlantic salmon (*Salmo salar*), pirate perch (*Aphredoderus sayanus*), redbreast sunfish (*Lepomis auritus*), green sunfish (*L. cyanellus*), bluegill (*L. macrochirus*), bluehead chub (*Nocomis leptocephalus*), highfin shiner (*Notropis altipinnis*), swallowtail shiner (*Notropis procne*), white shiner (*Luxilus albeolus*), and pinewoods shiner (*Lythrurus matutinus*) (Michaelson and Neves 1995, White 2007, Levine *et al*. 2011). The DWM is not a long-lived species as compared to other freshwater mussels; life expectancy is estimated at 10 to 12 years (Michaelson and Neves 1995).

4.1.3. Numbers, Reproduction, and Distribution of DWM

The DWM is found in Atlantic Coast drainage streams and rivers of various sizes and moderate current. It currently ranges from New Hampshire to North Carolina. Historically, the DWM range extended north to New Brunswick, Canada. North Carolina's Neuse River Basin tributaries have apparently always represented the southern range of the species. The DWM has been documented in 16 major drainages (Table 4.1.3), comprising approximately 70 sites. However, at least 45 of these sites are based on less than five individuals or solely on relic shells (USFWS 2007, USFWS 2013).

Viable populations (i.e. containing a sufficient number of reproducing adults to maintain genetic variability and in which annual recruitment is adequate to sustain a stable population, USFWS 1993) in the northeastern United States include the Ashuelot River in New Hampshire and the Flat Brook in New Jersey. The Connecticut River in New Hampshire and Vermont, the Farmington River in Connecticut, Paulins Kill in New Jersey, and the Neversink River in New York may harbor viable populations, but more survey work is needed (USFWS 2013). Because of the qualitative survey methods used to assess the populations, it is not possible to estimate the number of individuals in these populations at this time. However, recent surveys indicate that DWM numbers may be declining at some locations in the Connecticut River and Ashuelot River (Biodrawversity LLC 2013, Biodrawversity LLC et al. 2014).

Although remaining populations from New Jersey south to North Carolina are much smaller, the Upper Tar River and Upper Fishing Creek in North Carolina are thought to harbor viable populations. Other populations in North Carolina, Virginia, and Maryland appear to be declining as evidenced by low densities, lack of reproduction, or inability to relocate any DWM in follow-up surveys (USFWS 2013). While discussed in more detail below, the DWM population in Swift Creek appears viable (Three Oaks 2016) but with a high risk of local extirpation due to low population abundance and lack of dispersal (Smith et al. 2015).

Table 4.1.3 DWM major drainages.

State	Major Drainage	County
NH	Upper Connecticut River	Coos, Grafton, Sullivan, Cheshire
VT	Upper Connecticut River	Essex, Orange, Windsor, Windham
MA	Middle Connecticut River	Hampshire, Hampden
CT	Lower Connecticut River	Hartford
NY	Housatonic River	Dutchess
NY	Middle Delaware	Orange, Sullivan, Delaware
NJ	Middle Delaware	Warren, Sussex
PA	Upper Delaware River	Wayne
MD	Choptank River	Queen Anne's, Caroline
MD	Lower Potomac River	St. Mary's, Charles
MD	Upper Chesapeake Bay	Queen Anne's
VA	Middle Potomac River	Stafford
VA	York River	Louisa, Spotsylvania
VA	Chowan River	Sussex, Nottoway, Lunenburg
NC	Upper Tar River	Granville, Vance, Franklin, Nash
NC	Upper Fishing Creek	Warren, Franklin, Nash, Halifax
NC	Upper Contentnea Creek	Wilson, Nash, Johnston
NC	Upper Neuse River (including Swift Creek)	Johnston, Wake, Orange

* The 16 major drainages identified in Table 4.1.3 do not necessarily correspond to the original drainages identified in the Recovery Plan (USFWS 1993), although there is considerable overlap.

4.1.4. Conservation Needs of and Threats to DWM

Human activity has significantly degraded DWM habitat causing a general decline in populations and a reduction in distribution of the species. Some factors responsible for the decline of the DWM include: 1) impoundment of river systems, 2) pollution, 3) alteration of riverbanks, 4) siltation, and 5) extreme weather events (e.g. floods and drought) (USFWS 1993, USFWS 2013).

Damming and channelization of rivers throughout the DWM's range have resulted in the elimination or alteration of much mussel habitat (Watters 2001). Domestic and industrial pollution was the primary cause for mussel extirpation at many historical sites. Mussels are known to be sensitive to a variety of heavy metals, inorganic salts, and ammonia (Wang et al. 2017). Mussel die-offs have been attributed to chemical spills, agricultural waste run-off, and low dissolved oxygen levels.

Because freshwater mussels are relatively sedentary and cannot move quickly or for long distances, they cannot easily escape when silt is deposited over their habitat. Siltation has been documented to be extremely detrimental to mussel populations by degrading substrate and water quality, increasing exposure to other pollutants, and by direct smothering of mussels (Ellis 1936, Marking and Bills 1980). In Massachusetts, a bridge construction project decimated a population of DWM by accelerated sedimentation and erosion (Smith 1981).

Extreme weather events like flooding and drought have had an impact on DWM. Surveys in 2006 indicated that the DWM population in the Neversink River (formerly one of the most robust populations of DWM) was adversely affected by flood events, and it remains to be seen if this population can rebound. Drought also appears to have adverse effects on DWM populations. This is evident in the upper Tar River watershed in North Carolina, where severe population declines followed a substantial drought in 2007 (USFWS 2013).

Most DWM populations are small and geographically isolated from each other. This isolation restricts exchange of genetic material among populations and reduces genetic variability within populations (USFWS 1993). Recent studies investigating the range-wide phylogeographic structure of DWM indicate that the low degree (or absence) of gene flow between and within drainages suggests that individual host fish do not move between drainages, nor do they exhibit effective movement (resulting in gene flow) within drainages (USFWS 2013).

4.2. Environmental Baseline for DWM

This section is an analysis of the effects of past and ongoing human and natural factors leading to the current status of the DWM, its habitat, and ecosystem within the Action Area. The environmental baseline is a "snapshot" of the species' condition in the Action Area at the time of the consultation, and does not include the effects of the Action under review.

4.2.1. Action Area Numbers, Reproduction, and Distribution of DWM

The DWM was first discovered in Swift Creek in 1991. Due to the low detection rate of DWM and the inherent nature of sampling methods, it is not possible to know the exact number of DWM within the Action Area. However, between 1991 and 2016, a total of 54 live individuals and 12 relict shells have been found at 34 distinct sites over 21 stream miles in Swift Creek downstream of Lake Benson, including six live individuals in 2016. The lower 10 miles, however, are represented by only one individual observation, and the species has not been found in this 10-mile section since 1991. Two individuals have also been recorded in Little Creek and one in White Oak Creek; both streams are tributaries to Swift Creek. Additionally, two DWM individuals were found in Middle Creek in 1992. Subsequent surveys, including extensive survey efforts undertaken in 2010, 2011, 2012 and 2016 did not detect any live individuals in Middle Creek (Three Oaks 2016, NCWRC 2017). The general consensus is that the DWM is likely extirpated from Middle Creek. Recent surveys have failed to find DWM in any other stream within the Action Area (Three Oaks 2017).

The DWM Viability Study (Three Oaks 2016) provides further details on the history of mussel surveys and mussel fauna population trends in Swift Creek. The results of this study showed that there are several stressors to DWM in the Swift Creek Watershed, directly and indirectly related to urbanization of the watershed. While the DWM population has declined (as indicated by a declining catch per unit effort) since rapid urbanization began approximately two decades ago, the decline appears to have leveled off, and there is some indication that DWM recruitment has increased within the past few years. The DWM population in Swift Creek currently appears viable (Three Oaks 2016) but with a high risk of local extirpation due to low population abundance and lack of dispersal (Smith et al. 2015).

4.2.2. Action Area Conservation Needs of and Threats to DWM

In order to reclassify the DWM to threatened status, the DWM Recovery Plan (USFWS 1993) requires a viable population be present in Swift Creek. Smith et al. (2015) concluded that the top three factors limiting the persistence of DWM in Swift Creek are:

1. Unsuitable physical habitat
2. Allee effect (high risk of demographic extirpation due to low population abundance and lack of dispersal)
3. Low water quality because of contaminants

Unsuitable physical habitat within the Action Area can arise from several sources including alterations in stream flow, channel instability, loss of riparian buffers, and degradation from all-terrain vehicle use within the channel (Three Oaks 2016). The Swift Creek Watershed has experienced rapid urbanization in recent years with an associated increase in impervious surface. The correlation of increasing urbanization within a watershed and decreasing water quality is well documented (Garie and McIntosh 1986, Crawford and Lenat 1989, Kemp and Spotila 1997, Paul and Meyer 2001). An increase in impervious surface leads to higher stormwater peak discharges which, in turn, lead to channel instability and scouring of the channel and banks. As erosion rates increase, sedimentation of DWM habitat increases. Increased impervious surface also leads to decreases in infiltration and base flow (groundwater flow), thus lowering water levels within streams. Periods of drought also contribute to lower water levels within Swift Creek. Stream gauge data on Swift Creek indicates that the stream has experienced periodic episodes of low flow throughout the period of record (Three Oaks 2016).

The DWM Viability Study (Three Oaks 2016) concluded that the mussel fauna of the Swift Creek Watershed is subject to multiple stressors which may threaten future viability. While further analysis of population and habitat trends would allow for a more definitive conclusion, the results of this study point to a population that is vulnerable to extirpation. Changes in the watershed have happened in a relatively short period of time, and the overall mussel fauna appears to have declined in conjunction with these changes. However, through the Neuse 01 Regional Watershed Plan, the Swift Creek Watershed is being targeted for conservation/ mitigation efforts (NCDEQ 2016a). Three Oaks (2016) attempted to assess the effectiveness of past conservation measures that were applied to the Swift Creek Watershed in response to urbanization, but due to a variety of reasons, the results were inconclusive.

In terms of habitat viability, there are a number of indicators of degradation within the Action Area. For example, the bioclassification ratings for a major portion of Swift Creek have declined to the point where it has been listed as 303(d) impaired since 2009 (NCDEQ 2016b). Sedimentation and erosion were identified as sources of degradation in this portion of the stream. Additionally, in the upper portion of the DWM range in Swift Creek at some of the sites where DWM is now considered to no longer be present, habitats are dominated by shifting sand, scour pools, and unstable streambanks. These sites were described as riffle/run/pool sites with a heterogeneous substrate in previous years when DWM was found (Three Oaks 2016).

While it is apparent that habitat has been degraded in some of the Action Area, relatively stable areas with heterogeneous substrate still exist within Swift Creek. In general, the Swift Creek Watershed is a dynamic stream system where hydrogeomorphic changes have occurred. The channel dimensions and substrate composition in any given area have been adjusting to this change and will continue to do so until a dynamic equilibrium has been reached. As long as areas of suitable habitat continue to be present within the stream, and there are sufficient dispersal mechanisms to facilitate recruitment, the DWM has a realistic chance of persisting in the stream. However, the lack of long-term quantitative habitat monitoring over time makes it difficult to predict future habitat viability (Three Oaks 2016). Accordingly, efforts to increase the resiliency of this population are prudent.

The water quality component of habitat viability as it pertains to DWM population viability is somewhat unclear. Copper may be a source of habitat degradation that could affect long term viability, as four of the 24 water quality samples collected during the DWM Viability Study (Three Oaks 2016) had copper levels that exceeded North Carolina water quality standards. These exceedances occurred during periods of low flow. With the limited dataset (one year of monitoring), and not knowing the source of copper, it is unclear if this is a chronic problem in Swift Creek or an irregular occurrence. We note that the U.S. Environmental Protection Agency has more recent water quality criteria for copper (2007) than the standard being used in North Carolina (1995); the newer federal approach recognizes that copper is often less toxic in natural waters due to complexation with organic matter. Ammonia and other heavy metals do not appear to be a major concern in Swift Creek at this time (Three Oaks 2015, Three Oaks 2016).

The North Carolina DWM Work Group concluded that population augmentation through captive propagation is an essential component of management strategies to ensure DWM persistence in North Carolina (Smith et al. 2015). This is especially true with the population in Swift Creek where the Allee effect (high risk of demographic extirpation due to low population abundance and lack of dispersal) is one of the major limiting factors of population viability. Though a cooperative program between the NCWRC and NCSU is actively propagating some imperiled mussel species, the current capacity is insufficient to meet the needs. There is an ongoing commitment in developing a Swift Creek DWM population augmentation plan and acquiring the capacity or funds needed to implement this plan (Three Oaks 2016).

In summary, there is still some high quality stream habitat present within the Action Area, yet there are also some water quality concerns. Despite an urbanizing watershed, the DWM still persists within Swift Creek at a low population level. There appears to have been a levelling off in the decline of DWM, and the population appears to have some level of recent recruitment. When considering this information, and with active management, it can be concluded that the DWM will likely persist into the future within the Swift Creek Watershed. Captive propagation and population augmentation, along with increased habitat protection, is vital to this future persistence.

4.3. Effects of the Action on DWM

This section analyzes the direct and indirect effects of the Action on the DWM, which includes the direct and indirect effects of interrelated and interdependent actions. Direct effects are caused

by the Action and occur at the same time and place. Indirect effects are caused by the Action, but are later in time and reasonably certain to occur. Our analyses are organized according to the description of the Action in section 2 of this BO.

4.3.1. Effects of Construction of Roadway and Stream Crossings on DWM

The alignment of the new section of NC 540 traverses Swift Creek and some of its smaller tributaries. Swift Creek will be completely spanned by a bridge with no permanent or temporary in-stream fill-related impacts. Larger tributaries will also be bridged, while smaller tributaries will be crossed using culverts and pipes. While there is potential for construction related harm or harassment to DWM from any stream crossing within the Swift Creek Watershed, the likelihood diminishes the further the crossing is from occupied habitat. Other than Swift Creek itself, there are two crossings of tributaries that occur within 0.25 mile of occupied habitat. The largest of these will occur on a bridge, although temporary causeways and/or a temporary work bridge may be required for construction. The smaller crossing within 0.25 mile of occupied habitat will be crossed utilizing a box culvert, impacting an estimated 443 linear feet of stream channel. Additionally, a small intermittent stream within 0.25 mile of occupied habitat may have minor fill impacts.

Since the dual bridges over Swift Creek will not involve any permanent or temporary fill in the channel, there is no anticipated DWM habitat loss or disturbance associated with fill for this crossing. However, there is always the possibility that small amounts of bridge debris could inadvertently fall into the channel, thus degrading DWM habitat. While none of the other streams crossed within the Action Area are currently considered to be occupied by DWM, there is the slight possibility that DWM could expand its range into the lower sections of one or more of these tributaries. More likely is the potential for the fish hosts of DWM to be present in these tributaries. Stream fill associated with culverts and bridge bents on some of these tributaries could degrade habitat for DWM (if future colonization occurs) or for DWM host fish by eliminating the substrate, altering stream flows, or by destabilizing banks.

There is the potential for fish infested with DWM glochidia to be present in the tributary streams while the crossing structures are being constructed. Host fish could be crushed during causeway placement or while pile driving for temporary work bridges. Causeway construction may also strand individuals in areas that are dewatered, or congregate them into ponded areas where temperature and dissolved oxygen levels may affect their health and/or survival. Dispersal of host fish from the areas being affected by construction may increase their susceptibility to predation while they seek alternate habitats. Host fish may also be harmed or harassed by noise from pile driving and causeway placement. Underwater sound waves emitting from these actions can cause tissue damage to fish. If culverts are not properly placed or constructed, they can also serve as impediments to host fish movements upstream. All of these effects to host fish could in turn harm or harass DWM glochidia by affecting their ability to successfully transform into juveniles. However, due to their high mobility under normal conditions, the probability of mortality of host fish occurring from these potential effects is low.

The greatest construction related concern is prolonged erosion/sedimentation from construction areas in close proximity to Swift Creek and the tributaries that are closer to occupied DWM

habitat. A major storm event could erode soil from within these disturbed areas and wash it into streams (or farther down streams), causing harassment or harm by interfering with respiration, feeding, or spawning and otherwise degrading habitat for DWM and their host fish. However, to avoid or minimize the potential siltation effects, NCDOT has developed stringent erosion control measures (see Section 2.4) which greatly minimize sediment entering the streams. Assuming the proper installation and maintenance of these erosion control measures and full implementation of all conservation measures, the probability of effects from siltation leading to mortality is low. Except in the most extreme and rare circumstances, it is the Service's experience that the modern erosion control methods employed by NCDOT are effective at minimizing sediment entering a stream. Only in a catastrophic failure of erosion control measures would effects be expected to be lethal. However, given the small size and cryptic nature of DWM, any effects would be difficult to detect and measure. It would not be possible to determine the number of individuals affected, especially for juveniles and glochidia.

4.3.2. Effects of Operation of Roadway Facility on DWM

With the exception of Swift Creek, none of the other stream crossings occur over occupied DWM habitat. However, for a few crossings which occur on tributaries closer to Swift Creek, the continued presence of culverts and bridge bents may modify stream flows and channel stability which could produce downstream effects to occupied DWM habitat. However, these effects would likely not rise to the level of harming or harassing DWM.

The presence of new roadway surface will expose the DWM population to increased roadway runoff, primarily originating from all the crossings of tributaries draining to Swift Creek. The most common contaminants in highway runoff are heavy metals, inorganic salts, hydrocarbons, and suspended solids that accumulate on the road surface as a result of regular highway operation and maintenance activities (FHWA 2016). Mussels are known to be among the most sensitive forms of aquatic life to toxicity from some heavy metals and inorganic salts (Wang et al. 2017). However, NCDOT has committed to eliminating deck drainage directly into any waterbody within the Action Area and to maintain the local discharge to pre-construction conditions. These actions will reduce the potential for adverse effects to DWM. Furthermore, the new road facility will draw traffic away from some other existing roadways within the Action Area, thus reducing the exposure to roadway runoff at some existing stream crossings that drain into Swift Creek.

Over time there is the potential for a traffic accident involving toxic chemicals to occur. Toxic chemical spills can be devastating to mussels (USFWS 2017c). It is not possible to accurately predict when or where toxic spills may occur. However, NCDOT has committed to constructing one or two hazardous spill basins adjacent to the Swift Creek crossing (see Section 2.4) to minimize the potential for adverse effects to DWM. In addition, in the event of a toxic spill that adversely affected the DWM population, NCDOT's funding for the captive propagation facility would help provide the potential for restocking of the population after clean up occurred.

<u>Induced Land Development</u>
Roadway construction can influence land use and result in development that would not occur without the road (induced development). The resultant increases in sediment loads and various

pollutants, alterations in flow regime (base flow and peak discharge), and loss of riparian buffers are consequences of development that lead to water quality degradation. The correlation of increasing urbanization within a watershed and decreasing water quality is well documented (Garie and McIntosh 1986, Crawford and Lenat 1989, Kemp and Spotila 1997, Paul and Meyer 2001). As discussed in the DWM Viability Study (Three Oaks 2016) and Michael Baker Engineering (2017a,b,c,d), there are a number of development restrictions in place within the Action Area, such as Neuse Buffer Rules and designated Environmentally Sensitive Areas, which would reduce the potential for Action induced development. However, there are some areas that drain into Swift Creek that are exempt from the current Environmentally Sensitive Areas, such as some properties in the I-40/NC-42 interchange area.

Michael Baker Engineering (2017a,b,c,d) completed a Quantitative Indirect and Cumulative Effects (ICE) Report for the Action using a methodology to forecast land use changes between the base year of 2010 and design year 2040. The report determined that development will occur throughout the Action Area with or without the Action occurring. When comparing the No-Build to the Build scenario, the primary difference in land use occurs at the proposed interchanges where the Action "is anticipated to encourage higher land use densities, more commercial and industrial development, and a greater mix of uses…" However, overall, Michael Baker Engineering (2017d) concluded that the "projected differences in land use between the 2040 No-Build and 2040 Build scenarios are relatively small".

For the purpose of analyzing the effects of induced development on federally listed mussels, three factors were chosen to quantify induced land use effects: impervious surface, total suspended solids (TSS), and copper (see Table 4.3.2). These factors were chosen as they either directly or indirectly can be correlated with, or serve as surrogates for, threats to mussels. Six subwatersheds within the Action Area where federally listed mussels currently occur or have recently occurred were selected for analysis. These six subwatersheds are White Oak Creek (Lower), Piney Grove Cemetery-Swift Creek, Mahlers-Swift Creek, Reed Branch, Little Creek (Lower), and Middle Creek (Lower) (see Figure 4.3.2).

It is important to note that the Quantitative ICE Report (Michael Baker Engineering 2017a,b,c,d) comprehensively addresses all future development under the Build and No-Build scenarios, but which include actions both with and without a federal nexus (e.g. Section 404 Clean Water Act permit). Those future actions with a federal nexus would normally have their own separate consultation under §7 of the ESA. However, due to the scale of the Quantitative ICE analysis, it is not possible to differentiate between future federal and non-federal actions induced by the Action. Therefore, the following relative percent increases (Table 4.3.2) between the No-Build and Build scenarios are to some extent overestimates for purposes of this BO, but are the best available information.

In Table 4.3.2, the percent increases are shown as a range due to two separate runs of the model used in the analysis. One run of the model used default settings based on national averages (typically the high number in the range), whereas the other run of the model utilized settings based on locally observed data (typically the low number in the range)(Michael Baker Engineering 2017b and 2017d).

Figure 4.3.2 Sub-watersheds in Action Area (adapted from Michael Baker Engineering 2017d)

Table 4.3.2. Percent Increases from 2010 Baseline to 2040 No-Build and from 2040 No-Build to 2040 Build[1]

Sub-watershed	Impervious Surface (%)			TSS (metric tons/year/acre)			Copper (grams/year/acre)		
	Baseline % coverage	Baseline to No-Build % increase[2]	No-Build to Build % increase[3]	Baseline	Baseline to No-Build % increase	No-Build to Build % increase	Baseline	Baseline to No-Build % increase	No-Build to Build % increase
White Oak Creek	4-10	5-18	≤1	0.08	26-38	≤1	0.69-0.70	26-38	≤1
Piney Grove Cemetery-Swift Creek	4-7	1-5	<1	0.20	18-20	3-4	1.36-1.40	18-20	3-4
Little Creek (Lower)	4-9	3-13	<1	0.11	21-27	<1	0.74	21-27	<1
Mahlers-Swift Creek	5-14	5-15	<1-6	0.26	88-94	<1-2	2.27-2.29	88-94	<1-2
Reed Branch	4-12	2-10	<1	0.17	34-38	2	1.17	34-38	2
Middle Creek (Lower)	3-8	1-5	≤1	0.33-0.34	29-30	3	2.26-2.34	29-30	3

[1] Note: Adapted from Michael Baker Engineering (2017d)
[2] Note: % increase is the difference between % impervious surface coverage at Baseline 2010 and % impervious surface coverage at No-Build 2040 (No-Build 2040 % - Baseline 2010 % = % increase)
[3] Note: % increase is the difference between % impervious surface coverage of No-Build 2040 and % impervious surface coverage of Build 2040 (Build 2040 % - No-Build 2040 % = % increase)

Induced Impervious Surface Effects
Impervious surface was chosen as one of the three factors since it directly relates to loss of pervious surfaces and indirectly to water flow in receiving surface waters, and is used as a proxy to represent anticipated indirect physical habitat effects (channel instability, channel scour, etc.), indirect water quality effects (thermal pollution), and indirect water quantity effects (changes in peak and base flows). As shown in Table 4.3.2, the percentage increase in five of the six sub-watersheds from the 2040 No-Build to Build is $\leq$ 1 %, with the exception being the Mahlers-Swift Creek sub-watershed, where the range is < 1-6 %. However, as previously noted, this range of increase is due to two separate runs of a model. The 6% figure was obtained using nationally derived default settings, whereas the <1% figure was obtained using locally derived settings. Michael Baker Engineering (2017b) states that using the nationally derived default settings "may overestimate impervious cover percentages for land use types and land cover categories." After reviewing existing land cover, with one exception, Michael Baker Engineering determined that the existing impervious surface percentages for each land cover type were lower than nationally derived default settings (see Table 7 in Michael Baker Engineering 2017b).

Induced TSS Effects
TSS was chosen as one of the three factors as a proxy to represent anticipated indirect water quality and physical habitat effects since it directly relates to sedimentation, which degrades water quality and habitat suitability. As shown in Table 4.3.2, the highest potential increase is the Piney Grove Cemetery-Swift Creek sub-watershed, where there is a 3-4 % increase attributable to the Action, followed by 3 % in Middle Creek.

Induced Copper Effects
Copper was chosen as one of the three factors as a proxy to represent anticipated indirect water quality effects since it is among the pollutants to which freshwater mussels are known to be sensitive, is found in runoff directly relatable to increased development, and has been addressed in the Lower Swift Creek Water Quality Report (Three Oaks 2015). Because the transport method for copper is directly related to TSS, the same percent increases in the six sub-watersheds that were noted for TSS are also reflected for copper. The highest potential increase is the Piney Grove Cemetery-Swift Creek sub-watershed, where there is a 3-4 % increase attributable to the Action, followed by 3 % in Middle Creek.

Overall, the Quantitative ICE analysis (Michael Baker Engineering 2017a,b,c,d) demonstrates that the Action Area will develop with or without implementation of the Action. However, implementation of the Action will lead to a relatively small incremental increase in this development. Based on the analysis of the three chosen factors that correlate with, or serve as surrogates for, threats to federally listed mussels, induced development attributed to the Action is likely to indirectly adversely affect DWM as harm or harassment. However, these effects on DWM are likely not discernable or measureable above and beyond the effects that would be attributed to the No-Build scenario if the Action is not implemented since they represent such a small percentage of the overall change from the Baseline to the Build 2040 scenario. Any additional effects are of concern however given the precarious status of the species in Swift Creek.

Induced changes in land use also have the potential to affect traffic patterns on the existing road network within the Action Area, which in turn could result in changes of pollutant concentration of roadway runoff exposure within occupied DWM habitat. Some existing roads may see increased traffic volumes, while others may see reduced traffic volumes. Increased traffic volumes on the road networks traversing the Swift Creek Watershed could potentially cause water quality degradation via an increase in runoff contaminants attributable to the additional traffic. Decreases in traffic volumes could have a localized beneficial effect by decreasing concentrations of toxicants originating from roadway runoff or from toxic spills along roadways.

4.3.3. Effects of Conservation Measures on DWM

While most of the conservation measures described in Section 2.4 are designed to minimize adverse effects to DWM, the captive propagation facility is a substantial and proactive measure that would not only partially offset adverse effects to the DWM within the Action Area, but would be a significant tool in furthering the recovery of the species.

Propagation Facility

Captive propagation of freshwater mussels is becoming an increasingly useful tool in the management and restoration of freshwater mussel populations, building upon recommendations to pursue augmentation and reintroduction as management strategies for these imperiled animals (National Native Mussel Conservation Committee 1998, Neves 2004). The Allee effect (high risk of demographic extirpation due to low population abundance and lack of dispersal) has been recognized as one of the major limiting factors of DWM population viability in the Swift Creek Watershed (Smith et al. 2015). If the Allee effect is causing unsustainable recruitment for the DWM, the release of propagated individuals to augment the existing population may increase viability given the apparent leveling off in population declines for DWM and other mussel species (Three Oaks 2016). Propagated DWM would be placed into suitable habitat within the Action Area where conditions would allow the likelihood of success.

Numerous imperiled freshwater mussel species have been successfully propagated and released into the wild for various projects in the United States (Virginia Tech News 2010, Kentucky Department of Fish and Wildlife Resources 2013, USFWS 2015a, USFWS 2015b, Clinch-Powell Clean Rivers Initiative 2016, USFWS 2016a, USFWS 2016b). Several freshwater mussel species have been propagated (Eads et al. 2007, Levine et al. 2011, Levine 2012) and successfully released in North Carolina (NCWRC 2015, Tar River Land Conservancy 2015, Fraley et al. 2017, Hoch et al. 2017). To date there have not been any DWM population augmentation or reintroduction efforts using captive propagation in North Carolina, but the species has successfully been propagated, and the methodology is currently being refined at NCSU (Beck and Neves 2001, Levine et al. 2011).

As stated in the DWM Viability Report (Three Oaks 2016), the DWM Workgroup for North Carolina concluded that propagation/augmentation was the highest priority management action for the Swift Creek population. Also, the long-term maintenance of captive held “ark” populations is a vital conservation strategy for critically imperiled mussels (Rachael Hoch, Conservation Aquaculture Coordinator for NCWRC, Marion, NC. Personal email communication on December 28, 2017). Thus, in addition to augmenting the Swift Creek

Watershed DWM population, developing the propagation facility will allow for the establishment of an "ark" population of the DWM for the Neuse River Basin, and ultimately for other North Carolina streams in the species range, to maintain the genetic stock.

Although a mussel propagation facility currently exists in western North Carolina, there is no eastern North Carolina analogue. Due to limitations in capacity, and given the distance from DWM habitats, the mussel propagation facility in western North Carolina is unable to meet the needs for propagation of DWM and other eastern North Carolina mussels. Therefore, the beneficial effect of NCDOT's commitment to fund the propagation facility fulfills an urgent need in the conservation and recovery of DWM in the Swift Creek Watershed and beyond.

Potential Mussel Relocation

NCDOT has committed to conduct a preconstruction survey (just prior to construction) at the Swift Creek crossing and remove mussels from a defined area (where they could potentially be affected by sedimentation). The removed mussels would then either be relocated to appropriate habitat within Swift Creek or taken into captivity to use as brood stock for propagation. The extent of this survey and potential relocation has yet to be determined, but it will likely be very limited in scope. Based on past survey history, the probability of encountering DWM within such a survey is low. However, if DWM are collected, the relocation or taking into captivity would qualify as harassment to the species.

4.3.4. Effects of Interrelated and Interdependent Actions on DWM

At this time, the locations of potential borrow/waste sites, staging areas, equipment storage areas, and refueling areas have not been selected. Activities at these locations have the potential to adversely affect DWM through sedimentation/erosion and introduction of toxic compounds into streams within the Swift Creek Watershed. As discussed in Section 2.5, NCDOT will strongly discourage the contractor from choosing borrow/waste site locations, staging areas, equipment storage areas, and refueling areas within 0.25 mile of Swift Creek. However, if the contractor opts to pursue borrow or waste sites in these locations, the NCDOT Division Environmental Officer will coordinate with the Service during the approval process of any borrow or waste sites. In addition, NCDOT standard guidance for borrow/fill sites provide another layer of environmental protection for waterbodies. These sites will also be reviewed prior to project permitting through interagency meetings. Staging areas are required to be identified by the contractor and reviewed by NCDOT, the Service, and other regulatory agencies prior to permitting. Therefore, adverse effects to DWM from the use of borrow/waste sites, staging areas, equipment storage areas, and refueling areas are extremely unlikely to occur (discountable).

4.4. Cumulative Effects on DWM

For purposes of consultation under ESA §7, cumulative effects are those caused by future state, tribal, local, or private actions that are reasonably certain to occur in the Action Area. Future federal actions that are unrelated to the proposed action are not considered, because they require separate consultation under §7 of the ESA.

4.4.1. Effects of Future Development on DWM

Michael Baker Engineering (2017a,b,c,d) completed a Quantitative Indirect and Cumulative Effects (ICE) Report for the Action using a methodology to forecast land use changes between the base year of 2010 and design year 2040. However, the analysis was conducted using the cumulative effects definition under the National Environmental Policy Act (NEPA, 42 U.S.C. 4321, et seq.) rather than ESA. The rationale for using the NEPA definition is due to the impracticality of determining which future developments will require federal authorization, such as a Section 404 Clean Water Act permit. Therefore, the potential cumulative effects discussed in this section are likely overestimates due to many future developments requiring federal authorization, and thus not meeting the ESA definition of cumulative effects.

For the six subwatersheds in which federally listed mussels occur, Table 4.3.2 depicts the percent change from the Baseline to the No-Build Scenario for three factors chosen to quantify land use changes from 2010 to the design year of 2040. These factors can be correlated with, or serve as surrogates for, threats to mussels. As previously discussed, nearly all of the change in land use will occur irrespective of the Action. The minimum and maximum percent changes from Baseline to No-Build in 2040 for impervious surface, TSS, and copper are 1-18%, 18-94%, and 18-94%, respectively. The portion of these percent increases in which no federal authorization is required would be the cumulative effects under the ESA definition, but again it is impracticable to determine what that portion is.

Given the projected development in the watershed with or without the Action, the effect of the development on the viability of the DWM in the Action Area is unclear. As detailed in the DWM Viability Study (Three Oaks 2016), aggressive management, particularly through captive propagation and thereby providing the potential to augment the existing population in the future, is considered to be the best practice to enable DWM persistence in light of the cumulative effects of future development. NCDOT's commitment to fund the mussel propagation facility fulfills an urgent need in the conservation and recovery of DWM in the Action Area and beyond.

4.5. Conclusion for DWM

In this section, we summarize and interpret the findings of the previous sections for the DWM (status, baseline, effects, and cumulative effects) relative to the purpose of a BO under §7(a)(2) of the ESA, which is to determine whether a federal action is likely to:

a) jeopardize the continued existence of species listed as endangered or threatened; or
b) result in the destruction or adverse modification of designated critical habitat.

"Jeopardize the continued existence" means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species (50 CFR §402.02).

Viable and relatively larger populations of DWM occur in portions of the northeastern United States. Other populations from New Jersey south to North Carolina are smaller and appear to be declining. The DWM Recovery Plan (USFWS 1993) requires a viable population be present in Swift Creek in order for the species to be reclassified to threatened status.

Smith et al. (2015) concluded that the top three factors limiting the persistence of DWM in Swift Creek are 1) unsuitable physical habitat, 2) Allee effect (high risk of demographic extirpation due to low population abundance and lack of dispersal), and 3) low water quality from contaminants. The DWM Viability Study (Three Oaks 2016) concluded that there are several stressors to DWM in the Swift Creek Watershed, directly and indirectly related to urbanization of the watershed. While the DWM population has declined since urbanization began, the decline appears to have leveled off, and there is some indication that DWM recruitment has increased within the past few years. While it is apparent that habitat has been degraded in some of the Action Area, relatively stable areas with suitable habitat still exist within Swift Creek.

Since the Action's new road alignment traverses Swift Creek and some of its smaller tributaries, there is the potential for direct effects associated with construction. However, Swift Creek will be completely spanned by a bridge with no permanent or temporary in-stream fill-related impacts. No other streams currently occupied by DWM will be directly affected by construction. While there is potential for construction related erosion/siltation effects from any stream crossing within the Swift Creek Watershed, the likelihood of adverse effects to occur diminishes the further the crossing is from occupied habitat. Other than Swift Creek, there are only two crossings of tributaries that occur within 0.25 mile of occupied habitat. To minimize potential erosion/siltation effects, NCDOT has developed stringent erosion control measures which greatly minimize sediment entering the streams. Assuming the proper installation and maintenance of these erosion control measures, the probability of effects from siltation leading to mortality is low. There is the potential for fish infested with DWM glochidia to be present in streams while crossing structures are being constructed. There is a low probability that these host fish could be harmed or harassed by such construction activities, which in turn could affect the attached DWM glochidia. None of these potential direct effects are expected to have a meaningful impact on DWM reproduction, numbers, or distribution within its overall range or within the Action Area. Therefore, these direct effects will not reduce appreciably the likelihood of the survival and recovery of the DWM.

The indirect effects and cumulative effects from future land development (from Action-induced and from that independent of the Action) are the greatest concern for DWM in the Action Area. The Quantitative ICE Report (Michael Baker Engineering 2017a,b,c,d) concluded that the Action Area will develop with or without the implementation of the Action. However, implementation of the Action will lead to a relatively small incremental increase in this development. The Action will undoubtedly incrementally contribute to the adverse effects, but these small additional effects are likely not discernable or measureable above and beyond the effects that would be attributed to the No-Build scenario if the Action is not implemented. The adverse effect of small incremental increases in impervious surface and associated impacts on water quality and sediment stability are of concern, but can be offset by the project benefits of enhanced DWM captive propagation capacity and augmentation. As such, the indirect effects from induced development attributed to the Action are not likely to reduce appreciably the likelihood of the survival and recovery of the DWM by reducing the reproduction, numbers, or distribution of the species.

Given the projected development in the Action Area with or without implementation of the Action, the effect of the development on the viability of the DWM in the Action Area is unclear. However, the DWM Viability Study and the North Carolina DWM Work Group (Three Oaks 2016) concluded that aggressive management, particularly through captive propagation and the ability to augment the existing population in the future, is considered to be the best practice to improve the viability of the DWM population in the Swift Creek Watershed. Therefore, the commitment of NCDOT to fund the propagation facility fulfills an urgent need in the conservation and recovery of DWM in the Action Area and beyond. This conservation measure will help to alleviate some of the indirect and cumulative effects of future land development within the Action Area. Without this important conservation measure, the viability of DWM in the Action Area is less certain.

After reviewing the current status of the species, the environmental baseline for the Action Area, the effects of the Action and the cumulative effects, it is the Service's biological opinion that the Action is not likely to jeopardize the continued existence of the DWM.

5. YELLOW LANCE

5.1. Status of Yellow Lance

This section summarizes best available data about the biology and current condition of YL throughout its range that are relevant to formulating an opinion about the Action. The Service published its decision to list YL as threatened on April 3, 2018 (83 FR 14189-14198). The Service also recently completed a Species Status Assessment Report for the YL (USFWS 2017d), and much of the information contained in that document is incorporated by reference into this BO.

5.1.1. Description of YL

The YL is a bright yellow mussel with a shell more than twice as long as it is tall, usually not more than 86mm (3.4 inches) in length. Its shell is composed of two hinged valves which are joined by a ligament. The outermost layer of the shell has a waxy appearance with brownish ridges known as "growth rests" that formed during an intermediate stage of growth when the ridge area was the edge of the shell. The lustrous inner layer is usually an iridescent blue color, and sometimes has white or salmon color on the shorter end of the shell from where the foot extends (the anterior). The longer end of the shell from where the siphons extend (the posterior) is distinctly rounded. YL has interlocking hinge "teeth" on the inside of the shell to help keep the two valves in proper alignment (USFWS 2017e)

5.1.2. Life History of YL

The YL is a sand-loving species often found buried deep in clean, coarse to medium sand, although it can sometimes be found in gravel substrates. The YL often are moved with shifting sand and eventually settle in sand at the downstream end of stable sand and gravel bars. This species depends on clean, moderate flowing water with high dissolved oxygen and is found in medium-sized rivers to smaller streams.

The life cycle of the YL, like most freshwater mussels, is complex, relying on host fish for successful reproduction. Their eggs develop into microscopic larvae (glochidia) within the gills of the female mussel. The female expels glochidia into the water where they must attach to gills or fins of a fish to continue developing. Each mussel species has specific host fish species that are needed by the glochidia to keep growing and transform into juveniles. After a few weeks, they drop off and land on the river bottom where they grow into adults.

Like many freshwater mussels, the YL grows rapidly during the first few years of life and slows down with age. In the laboratory, the YL reaches sexual maturity around three years old. Once the YL reaches maturity, the females release stringy clumps of glochidia in mucous. The clumps are likely eaten by minnows so the glochidia can attach to the minnow's gills and fin scales. At least two species of minnow are confirmed to host YL development in a laboratory setting, the white shiner (*Luxilus albeolus*) and pinewoods shiner (*Lythrurus matuntinus*). Biologists have developed ways to propagate YL under controlled laboratory conditions.

Like other freshwater mussels, YL are suspension feeders that eat algae and other tiny particles, such as leaf debris, that they filter out of the water. Juveniles likely pedal-feed in the sediment, whereas adults filter-feed from the water column. For more detailed information on the life history of YL, see USFWS (2017d).

5.1.3. Numbers, Reproduction, and Distribution of YL

The YL has a historical range from the Patuxent River Basin in Maryland to the Neuse River Basin in North Carolina. For the current range, the YL Species Status Assessment Report (USFWS 2017d) delineates populations by using the eight river basins that YL has historically occupied. This includes the Patuxent, Potomac, Rappahannock, York, James, Chowan, Tar, and Neuse River basins in Maryland, Virginia, and North Carolina. Because the river basin level is at a very coarse scale, populations were further delineated using management units (MUs). MUs were defined as one or more HUC10 watersheds that species experts identified as most appropriate for assessing population-level resiliency. Of eight historical populations, six are known to have had a YL occurrence in the last 10 years, though the majority of those occurrences were limited to a single location within the river basin.

Patuxent River Basin in Maryland – This population contains one MU, the Patuxent MU. Very few YL have been documented from this MU; five were collected prior to 1965, one individual was collected in 2015, and one relic shell was collected in 2016.

Potomac River Basin in Maryland/Virginia – This population contains one MU, the Potomac MU. One specimen has been documented from a pre-1970 survey.

Rappahannock River Basin in Virginia – This population contains one MU, the Rappahannock River Subbasin MU. Many surveys have documented the presence of YL in this MU, with an occasional observation of upwards of 50 individuals. The species was first seen in the late 1980s, and it has been observed most recently in 2011 in the Rappahannock River, although very few (3) individuals were seen during that survey.

York River Basin in Virginia – This population contains one MU, the York MU. Several surveys document the presence of YL in this MU – presumably first seen in 1973, and as recent as 2007 in the South Anna River, although only one individual was observed during that survey.

James River Basin in Virginia – This population contains one MU, the Johns Creek MU. YL was first seen in this MU in 1984, and last observed in 2004, where one effort observed 31 individuals. YL is assumed to still be present despite the lack of recent surveys.

Chowan River Basin in Virginia – This population contains two MUs, the Nottoway River Subbasin MU and the Meherrin River MU. Several surveys in the Nottoway River Subbasin have noted the presence of YL (one with as many as 781 individuals, although the identity of some specimens is in question). The species has been seen as recently as 2011 in the Nottoway River, albeit in extremely low (5) numbers.

Tar River Basin in North Carolina – This population contains four MUs; the Upper/Middle Tar River MU, the Lower Tar River MU, the Sandy-Swift Creek MU, and the Fishing Creek Subbasin MU. Many survey efforts have documented the presence of YL over the years; the species was first seen in 1966 in the Tar River, and it has been documented as recently as 2017 in Shocco Creek (RK&K 2017). Surveys in the mainstem Tar in 1990 documented upwards of 100 live individuals; most other surveys have documented between 25 and 31 individuals, and the most seen in recent (2014) surveys has been 25 live individuals. Similarly, in the late 1980s and early 1990s, Swift Creek surveys documented hundreds (342 in one instance) of shells, and recent surveys in 2015 and 2016 documented 53 and 45 live individuals, respectively.

Neuse River Basin in North Carolina – This population contains one MU, the Middle Neuse Tributaries MU. The YL was first seen in 1991, and most recently one individual was seen in 2015. Most surveys report very low numbers observed (usually only one live individual or just shell material), although one effort in 1994 (Swift Creek) documented 18 live individuals. There have been recent (2014-2016) intensive surveys in the Swift Creek watershed, and only one YL has been observed.

For more detailed information regarding the current condition of YL populations across its range, see USFWS (2017d).

5.1.4. Conservation Needs of and Threats to YL

The conservation needs of and threats to YL are very similar to those of the DWM described in Section 4.1.4. However, for additional detailed information, see USFWS (2017d).

5.2. Environmental Baseline for YL

This section is an analysis of the effects of past and ongoing human and natural factors leading to the current status of the YL, its habitat, and ecosystem within the Action Area. The environmental baseline is a “snapshot” of the species’ health in the Action Area at the time of the consultation, and does not include the effects of the Action under review.

5.2.1. Action Area Numbers, Reproduction, and Distribution of YL

Due to the inherent nature of sampling methods, it is not possible to know the exact number of YL within the Action Area. The YL was first discovered in Swift Creek in 1991. A population trend analysis (utilizing catch per unit effort) for Swift Creek demonstrates that YL was much more common during the timeframe of 1992-1996 than in later years and has become extremely rare since then (Three Oaks 2016). The species was last identified in Swift Creek in 2015 (a single specimen), and was not detected during 2016 and 2017 surveys (USFWS 2017d). The YL has been observed in Middle Creek in 1992 (2 shells), 1995 (2 live), 1999 (1 live), and 2011 (1 live). The species was not observed in Middle Creek during extensive surveys in 2016; nor was it observed in any other stream surveyed within the Action Area in 2016 (Three Oaks 2017).

5.2.2. Action Area Conservation Needs of and Threats to YL

The Action Area conservation needs of and threats to the YL are very similar to those of the DWM described in Section 4.2.2.

5.3. Effects of the Action on YL

This section analyzes the direct and indirect effects of the Action on the YL, which includes the direct and indirect effects of interrelated and interdependent actions. Direct effects are caused by the Action and occur at the same time and place. Indirect effects are caused by the Action, but are later in time and reasonably certain to occur. Our analyses are organized according to the description of the Action in section 2 of this BO.

5.3.1. Effects of Construction of Roadway and Stream Crossings on YL

The direct construction related effects of the Action on YL in Swift Creek are very similar to those of the DWM described in Section 4.3.1. There are no crossings of the lower portion of Middle Creek where YL records occur, and all crossings of tributaries to lower Middle Creek are relatively distant (>1.0 mile) from the mainstem of Lower Middle Creek. Therefore, direct construction related effects to YL in Middle Creek are unlikely.

5.3.2. Effects of Operation of Roadway Facility on YL

The effects of the operation of the roadway facility on YL are very similar to those of the DWM described in Section 4.3.2.

5.3.3. Effects of Conservation Measures on YL

The effects of the conservations measures on YL are very similar to those of the DWM described in Section 4.3.3.

5.3.4. Effects of Interrelated and Interdependent Actions on YL

The effects of interrelated and interdependent actions on YL are very similar to those of the DWM described in Section 4.3.4.

5.4. Cumulative Effects on YL

For purposes of consultation under ESA §7, cumulative effects are those caused by future state, tribal, local, or private actions that are reasonably certain to occur in the Action Area. Future federal actions that are unrelated to the proposed action are not considered, because they require separate consultation under §7 of the ESA.

5.4.1. Effects of Future Development on YL

The cumulative effects of future development on YL are very similar to those of the DWM described in Section 4.4.1.

5.5. Conclusion for YL

In this section, we summarize and interpret the findings of the previous sections for the YL (status, baseline, effects, and cumulative effects) relative to the purpose of a BO under §7(a)(2) of the ESA, which is to determine whether a federal action is likely to:

c) jeopardize the continued existence of species listed as endangered or threatened; or
d) result in the destruction or adverse modification of designated critical habitat.

"Jeopardize the continued existence" means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species (50 CFR §402.02).

Of eight historical populations of YL occurring in Maryland, Virginia, and North Carolina, six are known to have had records in the last 10 years (USFWS 2017d). Although the catch per unit effort has declined since the 1990s, the YL is thought to still be present within the Action Area in very low numbers (Three Oaks 2016).

The conclusion for YL is very similar to that of the DWM described in Section 4.5. The adverse effect of small incremental increases in impervious surfaces and associated impacts on water quality and sediment stability are of concern, but can be offset by the project benefits of enhanced captive propagation capacity. After reviewing the current status of the species, the environmental baseline for the Action Area, the effects of the Action and the cumulative effects, it is the Service's biological opinion that the Action is not likely to jeopardize the continued existence of the YL.

6. INCIDENTAL TAKE STATEMENT

ESA §9(a)(1) and regulations issued under §4(d) prohibit the take of endangered and threatened fish and wildlife species without special exemption. The term "take" in the ESA means "to

harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct" (ESA §3). In regulations at 50 CFR §17.3, the Service further defines:

- "harass" as "an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering;"
- "harm" as "an act which actually kills or injures wildlife. Such act may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding or sheltering;" and
- "incidental take" as "any taking otherwise prohibited, if such taking is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity."

Under the terms of ESA §7(b)(4) and §7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered prohibited, provided that such taking is in compliance with the terms and conditions of an incidental take statement (ITS).

The Action considered in this BO includes a conservation measure to potentially collect and then either relocate or take into captivity for propagation efforts DWM and YL specimens in the vicinity of the crossing of Swift Creek as described in Section 2.4. Through this statement, the Service authorizes this conservation measure as an exception to the prohibitions against trapping, capturing, or collecting listed species. This conservation measure is referenced in a Reasonable and Prudent Measure below, and we provide Terms and Conditions for its implementation.

For the exemption in ESA §7(o)(2) to apply to the Action considered in this BO, the FHWA must undertake the non-discretionary measures described in this ITS, and these measures must become binding conditions of any permit, contract, or grant issued for implementing the Action. The FHWA has a continuing duty to regulate the activity covered by this ITS. The protective coverage of §7(o)(2) may lapse if the FHWA fails to:

- assume and implement the terms and conditions; or
- require a permittee, contractor, or grantee to adhere to the terms and conditions of the ITS through enforceable terms that are added to the permit, contract, or grant document.

In order to monitor the impact of incidental take, the FHWA must report the progress of the Action and its impact on the species to the Service as specified in this ITS.

6.1. Amount or Extent of Take

This section specifies the amount or extent of take of listed wildlife species that the Action is reasonably certain to cause, which we estimated in the "Effects of the Action" section(s) of this BO. We reference, but do not repeat, these analyses here.

6.1.1. DWM

The Service anticipates that the Action is reasonably certain to cause incidental take of individual DWM consistent with the definition of harass resulting from the construction of the roadway and stream crossings, operation of the roadway facility, and from the conservation measures (see Sections 4.3.1, 4.3.2, and 4.3.3). The Service anticipates that the Action is reasonably certain to

cause incidental take of individual DWM consistent with the definition of harm resulting from the construction of the roadway and stream crossings and from the operation of the roadway facility (see Sections 4.3.1 and 4.3.2). However, we believe that incidental take for this species is difficult to determine. Incidental take that occurs as harassment due to sub-lethal levels of siltation or water quality degradation which temporarily disrupt movement, breeding, feeding, or sheltering of adult and juvenile DWM or larval glochidia are likely not detectable or measureable. Incidental take that occurs as harm resulting in injury or death from larger amounts of siltation or water quality degradation would be difficult to determine. Actual habitat degradation may be detectable, but knowing whether a specific degradation actually affected the species would be difficult to determine. Spent shells may be collected, but attributing the cause of mortality would be very difficult. Incidental take of DWM due to effects to host fish would likely not be detectable or measureable. Also, there is no practical way to know the number of DWM (adult, juveniles, and the much smaller glochidia) that may be present within the Action Area at any given time. Therefore, it is not possible to base the overall amount of incidental take on numbers of animals.

Due to the difficulty of detecting take of DWM caused by the Action, the amount or extent of take will be defined by using miles of DWM stream habitat as a surrogate measure. The Action Area contains approximately 53 miles of potentially occupied stream habitat for DWM. This includes 21 miles of Swift Creek, approximately 26 miles of Middle Creek (included in case the stream is recolonized by DWM), approximately 1 mile of White Oak Creek, and approximately 5 miles of Little Creek. Therefore, the amount or extent of take of DWM caused by the Action is all DWM (including adults, juveniles, and glochidia) harassed and/or harmed within the approximately 53 miles of stream habitat contained in the Action Area. Although take in the form of harassment could potentially occur anywhere within the approximate 53 miles of potentially occupied stream habitat, we anticipate potential take in the form of harm would likely be limited to the area at and immediately downstream of the NC 540 crossing of Swift Creek.

6.1.2. YL

The Service anticipates that the Action is reasonably certain to cause incidental take of individual YL consistent with the definition of harass resulting from the construction of the roadway and stream crossings, operation of the roadway facility, and from the conservation measures (see Sections 4.3.1, 4.3.2, and 4.3.3). The Service anticipates that the Action is reasonably certain to cause incidental take of individual YL consistent with the definition of harm resulting from the construction of the roadway and stream crossings and from the operation of the roadway facility (see Sections 4.3.1 and 4.3.2). However, we believe that incidental take for this species is difficult to determine. Incidental take that occurs as harassment due to sub-lethal levels of siltation or water quality degradation which temporarily disrupt movement, breeding, feeding, or sheltering of adult and juvenile YL or larval glochidia are likely not detectable or measureable. Incidental take that occurs as harm resulting in injury or death from larger amounts of siltation or water quality degradation would be difficult to determine. Actual habitat degradation may be detectable, but knowing whether a specific degradation actually affected the species would be difficult to determine. Spent shells may be collected, but attributing the cause of mortality would be very difficult. Incidental take of YL due to effects to host fish would likely not be detectable or measureable. Also, there is no practical way to know the number of YL (adult, juveniles, and

the much smaller glochidia) that may be present within the Action Area at any given time. Therefore, it is not possible to base the overall amount of incidental take on numbers of animals.

Due to the difficulty of detecting take of YL caused by the Action, the amount or extent of take will be defined by using miles of YL stream habitat as a surrogate measure. The Action Area contains approximately 47 miles of potentially occupied habitat for YL. This includes 21 miles of Swift Creek and approximately 26 miles of Middle Creek. Therefore, the amount or extent of take of YL caused by the Action is all YL (including adults, juveniles, and glochidia) harassed and/or harmed within the approximately 47 miles of stream habitat contained in the Action Area. Although take in the form of harassment could potentially occur anywhere within the approximate 47 miles of potentially occupied stream habitat, we anticipate potential take in the form of harm would likely be limited to the area at and immediately downstream of the NC 540 crossing of Swift Creek.

6.2. Reasonable and Prudent Measures

The Service believes the following reasonable and prudent measures (RPMs) are necessary or appropriate to minimize the impact of incidental take caused by the Action on DWM and YL.

RPM 1. Funding Propagation Facility. After receiving Section 404 Clean Water Permit for the Action, NCDOT will transfer necessary funding for the propagation facility described in Section 2.4.

RPM 2. Mussel Relocation. NCDOT will conduct a preconstruction mussel survey at the Swift Creek crossing (just prior to construction) and potentially relocate or take into captivity DWM and/or YL. This measure is part of the proposed Action described in Section 2.4.

6.3. Terms and Conditions

In order for the exemption from the take prohibitions of §9(a)(1) and of regulations issued under §4(d) of the ESA to apply to the Action, the FHWA must comply with the terms and conditions (T&Cs) of this statement, provided below, which carry out the RPMs described in the previous section. These T&Cs are mandatory. As necessary and appropriate to fulfill this responsibility, the FHWA must require any permittee, contractor, or grantee to implement these T&Cs through enforceable terms that are added to the permit, contract, or grant document.

T&C 1. Funding to Wake County (RPM 1). Within 30 days of receiving a Section 404 Clean Water Act permit for the Action from the US Army Corps of Engineers, NCDOT will transfer approximately $1,958,936 to Wake County for the construction of the Yates Mill Aquatic Conservation Center.

T&C 2. Funding to NCWRC (RPM 1). Within 30 days of receiving a Section 404 Clean Water Act permit for the Action from the US Army Corps of Engineers, NCDOT will transfer approximately $3,041,064 to the NCWRC Non-Game Aquatic Project Fund. These funds will be used for North Carolina State University's detailed proposal to operate the facility, including a facility manager and assistant at the Yates Mill Aquatic Conservation

Center to oversee the operation of the facility for propagation of DWM, YL, and other mussels.

T&C 3. Mussel Relocation and/or Captivity (RPM 2). Prior to conducting the preconstruction survey, NCDOT must coordinate with the Service regarding the extent of the survey and to determine whether DWM and YL will be relocated or taken into captivity for propagation purposes. If DWM and/or YL are to be relocated, a relocation plan must be submitted to and approved by the Service.

6.4. Monitoring and Reporting Requirements

In order to monitor the impacts of incidental take, the FHWA must report the progress of the Action and its impact on the species to the Service as specified in the incidental take statement (50 CFR §402.14(i)(3)). However, we are not able to provide specific instructions for such monitoring and reporting. This is due to the fact that the Action Area is very large, and the amount or extent of incidental take is necessarily broadly defined using the surrogate measure of stream miles. Furthermore, the incidental take described in this BO for DWM and YL is very difficult to determine and likely not measureable in any practical way. Although surveys can be conducted to determine population trends of mussels over many years, there is no conclusive way to determine whether changes in population trends are attributable to the Action. Therefore, monitoring the amount or extent of incidental take for DWM or YL is not practicable.

7. CONSERVATION RECOMMENDATIONS

§7(a)(1) of the ESA directs federal agencies to use their authorities to further the purposes of the ESA by conducting conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary activities that an action agency may undertake to avoid or minimize the adverse effects of a proposed action, implement recovery plans, or develop information that is useful for the conservation of listed species. The Service offers the following recommendations that are relevant to the listed species addressed in this BO and that we believe are consistent with the authorities of the FHWA.

1. Prioritize Section 404 Clean Water Act mitigation projects that will help conserve habitat for DWM and YL populations.
2. Provide funding for additional surveys for DWM and YL outside of the Action Area.
3. After the mussel propagation facility is functional, provide additional funding for DWM and/or YL augmentations throughout their range in North Carolina.

8. REINITIATION NOTICE

Formal consultation for the Action considered in this BO is concluded. Reinitiating consultation is required if the FHWA retains discretionary involvement or control over the Action (or is authorized by law) when:

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

critical habitat not considered in this BO; or

d. a new species is listed or critical habitat designated that the Action may affect.

In instances where the amount or extent of incidental take is exceeded, the FHWA is required to immediately request a reinitiation of formal consultation.

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