APPENDIX D
AGENCY COORDINATION

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
1650 Arch Street
Philadelphia, Pennsylvania 19103-2029

April 25, 2018

Mr. Mack Frost
Environment Specialist
Federal Highway Administration, Virginia Division
400 North 8th Street, Suite 750
Richmond, Virginia 23219-4825

RE: Martinsville Southern Connector Study, Environmental Impact Statement (EIS) scoping

Dear Mr. Frost:

EPA has reviewed your letter dated March 13, 2018 regarding the Martinsville Southern Connector Study. The proposed Environmental Impact Statement (EIS) will evaluate potential transportation improvements along the Route 220 corridor between the North Carolina state line and the U.S. Route 58 Bypass in Henry County, Virginia. We understand that the study is being done in compliance with the National Environmental Policy Act (NEPA) and CEQ regulations implementing NEPA. Please find below recommendations for the scope of analysis for the proposed study.

- The EIS should include a clear and robust justification of the underlying purpose and need for the proposed action. The purpose and need statement is important to explain why the proposed action is being undertaken and what objectives the project intends to achieve. The purpose of the proposed action is typically the specific objective of the activity. The need should explain the underlying problem for why the project is necessary.
- We suggest that updated mapping of community and environmental features be shared with the cooperating agencies prior to the development of purpose and need and refined as additional data is obtained.
- We suggest the EIS clearly explain this project in relation to the previous I-73 corridor project.
- Alternatives analysis should include the suite of activities or solutions that were considered and the rationale for not carrying these alternatives forward for detailed study.
- The document should describe potential impacts to the natural and human environment. Existing resources should be identified and EPA encourages that adverse impacts to natural resources, especially wetlands and other aquatic resources, be avoided and minimized.
- A robust narrative describing aquatic resources and functions should be included in the EIS. We suggest at a minimum, a narrative should be provided that includes: a discussion of hydrology, including sources and direction of flow; the vegetative communities in the impact area, including size of trees (dbh), percent canopy cover, understory and other components such as woody debris and snags, and presence of invasive species; soil type(s); and an assessment of expected functions based on the HGM type, ecological community, and surrounding land-use. Photos

should be included. The Route 460 EIS study methodology should be considered a template. Some information on resources may be gained from public websites including:

  - EnviroMapper[1]: https://www.epa.gov/waterdata/waters-watershed-assessment-tracking-environmental-results-system
  - Envirofacts[2]: https://www3.epa.gov/enviro/
  - NEPAssist[3]: https://www.epa.gov/nepa/nepassist
  - 303(d) Listed Impaired Waters: https://www.epa.gov/exposure-assessment-models/303d-listed-impaired-waters
  - Watershed Resources Registry: https://watershedresourcesregistry.org/index.html. This newly released mapping and screening tool prioritizes areas for preservation and restoration of wetlands, riparian zones, terrestrial areas, and stormwater management across several states in the mid-Atlantic region, including Pennsylvania. This tool is useful for planners to access environmental data to avoid impacting natural areas and identify optimal mitigation areas.

- Stormwater ponds, best management practices (BMPs) and construction staging areas should not be located in wetlands and streams. Stormwater management alternatives that address the existing and new construction should be considered and are encouraged.
- For this or future projects, please consider the following: to reduce runoff volume and improve water quality, EPA recommends where possible the incorporation of Low Impact Development (LID) design features. Technical guidance in implementing green infrastructure (GI) practices and LID can be found at: https://19january2017snapshot.epa.gov/sites/production/files/2015-09/documents/eisa-438.pdf and www.epa.gov/greeninfrastructure. We suggest LID options be considered for design of features such as parking, paving, and landscaping. Other information can be found at www.epa.gov/nps/lid ; U.S. EPA's Smart Growth Website: www.epa.gov/smartgrowth ; and the International Stormwater BMP Database: http://www.bmpdatabase.org
- EPA suggests coordinating with other appropriate federal, state and local resource agencies on possible impacts to wetlands, streams and/or rare, threatened and endangered species. As needed, assessment of aquatic resources functions should be provided. We would be pleased to coordinate with VDOT and the U.S. Army Corps of Engineers on this work.
- An evaluation of air quality and community impacts, including noise, light and possible traffic impacts, should be included in the document. General conformity status should be included in the document.
- The EIS should include an analysis of any hazardous sites or materials, and the status of any ongoing or past remediation efforts in the project area. This includes any groundwater contamination.
- We recommend the EIS include consideration of extreme weather events in particular in association with resiliency design.
- The document should address potential indirect and cumulative effects in the project areas; the cumulative impact analysis should evaluate impacts to environmental resources that have the potential to be impacted by the project (i.e. wetlands, surface water, etc). Analysis may aid in the identification of resources that are likely to be adversely affected by multiple projects, and sensitive resources that could require additional avoidance or mitigation measures. It is suggested that a secondary and cumulative effects analysis begin with defining the geographic

and temporal limits of the study; this is generally broader than the study area of the project. EPA recommends that methodology be discussed with the interagency team early in EIS development.

- The EIS should discuss how the project will tie in to the transportation system in North Carolina and analyze potential impacts.

Thank you for coordinating with EPA on this project. We look forward to working with you as more information becomes available. Please let me know if you have any questions on the recommended topics above.

Sincerely,

Barbara Rudnick
NEPA Program Manager
Office of Environmental Programs

1 The Watershed Assessment, Tracking & Environmental Results System (WATERS) unites water quality information previously available only from several independent and unconnected databases

2 Includes enforcement and compliance information

3 NEPAssist is a tool that facilitates the environmental review process and project planning in relation to environmental considerations. The web-based application draws environmental data dynamically from EPA Geographic Information System databases and web services and provides immediate screening of environmental assessment indicators for a user-defined area of interest. These features contribute to a streamlined review process that potentially raises important environmental issues at the earlier stages of project development.

DEPARTMENT OF THE ARMY
US ARMY CORPS OF ENGINEERS
NORFOLK DISTRICT
FORT NORFOLK
803 FRONT STREET
NORFOLK VA 23510-1011

Reply to
Attention of

April 24, 2018

Special Projects Virginia Regulatory Section
NAO-2007-00380, Martinsville Southern Connector Study
Federal Project Number: STP-044-2(059)
State Project Number: 0220-044-052, P101; UPC: 110916

Mr. Mack Frost
Environmental Specialist
Federal Highway Administration, Virginia Division
400 North 8th Street, Suite 750
Richmond, Virginia 23219-4825

Dear Mr. Frost:

This letter is in response to your letter dated March 27, 2018 soliciting scoping comments for a study you have undertaken to evaluate transportation improvements along the U.S. Route 220 corridor between the North Carolina state line to the U.S. Route 58 Bypass. The area for study is anticipated to generally encompass a portion of Henry County southeast to the City of Martinsville, roughly following Greensboro Road (U.S. Route 220) to William F. Stone Highway (U.S. Route 58/U.S. Route 220 Bypass). In accordance with the National Environmental Policy Act (NEPA), an Environmental Impact Statement (EIS) is being prepared with the Federal Highway Administration (FHWA) as the lead federal agency and the Virginia Department of Transportation (VDOT) as the Joint Lead Agency to FHWA.

It is likely the project will impact waters and/or wetlands regulated by the Norfolk District Army Corps of Engineers (USACE) under Section 10 of the Rivers and Harbors Act of 1899 and Section 404 of the Clean Water Act (33 U.S.C. 1344), and a permit or permits will likely be required. The Smith River, adjacent to the study area, is a Section 10 navigable waterway pursuant to the Rivers and Harbors Act of 1899. USACE cannot agree to the evaluation of only one alternative for the proposed project if wetlands and/or waters of the U.S. are expected to be impacted. USACE recommends the evaluation and study of additional alternatives as detailed in the itemized responses below.

USACE will participate as a cooperating agency in the preparation of the EIS and as a concurring agency as part of the merged process. We recommend coordination with the Cooperating Agencies of draft sections of the EIS prior to publishing the document. Such coordination will help to minimze future delays or

problems that can be addressed earlier in the process. We wish to participate in any interagency meetings and field reviews for this project to the extent possible.

Before you develop and evaluate alternatives, waters and wetlands should be identified and mapped, and you should document how impacts to aquatic resources are avoided and minimized by the alternatives you identify. We request regular coordination with the appropriate state and Federal agencies prior to making any decisions regarding the range and elimination of alternatives. While USACE recommends a jurisidictional determination, you should consider, at a minimum, all available information such as aerial photography, U.S.G.S. quad sheets, National Wetland Inventory (NWI) maps, and soil mapping of the study area, as well as review of aerial photography (including color infrared aerials) by a qualified reviewer. Should FHWA and/or VDOT perform the assessment of jurisdictional areas through remote sensing, USACE recommends field verification of any areas which FHWA and/or VDOT notes need further evaluation. The more accurate the delineation, the better for the purposes of alternative analysis and project development that incorporates avoidance and minimization of aquatic resources. USACE understands that due to the purpose of improving an existing roadway, alternative options may be constrained. However additional alternatives must be developed and examined to include options that are in accordance with the Virginia Access Management Regulations (24 VAC 30-73).

Our records indicate an older VDOT mitigation site in the vicinity of the project, further to the west on Route 58 (VMRC # 90-0699). We recommend coordination with local VDOT district offices to insure identification of any VDOT mitigation sites and/or preservation sites within the study area. Measures to avoid and minimize impacts to streams and wetlands, such as bridging and alignment shifts, should be incorporated wherever practicable, and the environmental document should discuss avoidance and minimization measures considered. Relocation of streams should be avoided as should all impacts to any prior mitigation areas. All stormwater facilities should be located outside of jurisdictional areas.

Our regulations require that we consider a full range of public interest factors and conduct an alternatives analysis in order to identify the least environmentally damaging practicable alternative (LEDPA), which is the only alternative we can authorize.

In addition to wetland and waters impacts, we must consider factors such as land use (including displacements of homes and businesses), floodplain hazards and values, water supply and conservation, water quality, safety, cost, economics, threatened and endangered species, historic and cultural resources, and environmental justice.

Identifying potential compensation for stream and wetland impacts early in the process of project development is critical. Wetland impacts are typically compensated at 2:1 for forested, 1:5:1 for scrub/shrub, and 1:1 for emergent. Typically, we require stream compensation for unavoidable stream impacts to greater than 300 linear feet of stream at a crossing. However, we also consider the cumulative impacts to streams from a given project, and may require compensation for shorter lengths of stream if there are many impacts at close proximity, or if there are multiple impacts to the same stream and/or its direct tributaries. We encourage natural channel design to the extent practicable for streams that must be relocated. We utilize the Unified Stream Methodology for determining how much stream compensation is required for projects. The use of mitigation bank credits or Virginia Aquatic Resources Trust Fund released credits within the watershed are the preferred methods for providing compensation for stream and wetland impacts. This proposed study area encompasses one watershed, Upper Dan, HUC 03010103.

The proposed project encompasses both Norfolk District's boundaries as well as the Wilmington District (if any alternatives extend south of the state line). To avoid multiple USACE responses for this project to the extent possible, Norfolk District anticipates it will be the lead within USACE.

As part of the Corps of Engineers designation of lead federal agency authority, please note the following:

The proposed project may affect historic and cultural resources. Many projects funded by the Federal Highway Administration (FHWA) require permits from the Corps of Engineers. These projects are subject to compliance with Section 106 of the National Historic Preservation Act of 1966.

According to 36 CFR 800.2(a)(2):

"…If more than one Federal agency is involved in an undertaking, some or all [of] the agencies may designate a lead Federal agency, which shall identify the appropriate official to serve as the agency official who shall act on their behalf, fulfilling their collective responsibilities under section 106. Those Federal agencies that do not designate a lead Federal agency remain individually responsible for their compliance with this part."

Pursuant to the above provision, FHWA is hereby designated as the lead federal agency to fulfill the collective Federal responsibilities under Section 106 for the following undertaking:

Martinsville Southern Connector Study (UPC: 110916)

The Corps authorizes FHWA to conduct Section 106 coordination on its behalf, including all required tribal coordination. Any Memorandum of Agreement

prepared by FHWA under 36 CFR 800.6 should include the following clause in the introductory text:

> *"WHEREAS, pursuant to Section 10 and/or Section 404 of the Clean Water Act, a Department of the Army permit will likely be required from the Corps of Engineers for this project, and the Corps has designated FHWA as the lead federal agency to fulfill federal responsibilities under Section 106; and*

In accordance with 50 CFR 401.07, FHWA is also designated as the lead Federal agency for consultation with the U. S. Fish and Wildlife Service concerning potential effects to Federally-listed threatened and endangered species.

We appreciate your consideration including USACE in the early planning stages of this study and look forward to working with you.

Should you have any questions, you may contact Ms. Lee Fuerst at 757-201-7832 or lee.fuerst@usace.army.mil.

Sincerely,

Kimberly A. Prisco-Baggett

Kimberly A. Prisco-Baggett, MBA
Chief, Special Projects Section

cc:
Mr. Michael W. Gray, Virginia Department of Transportation, Salem District
Ms. Jennifer Salyers, Virginia Department of Transportation
Mr. Caleb Parks, Virginia Department of Transportation
Mr. Mark Holma, Virginia Department of Historic Resources
Ms. Barbara Okorn, U.S. Environmental Protection Agency
Ms. Alison Whitlock, U.S. Fish and Wildlife Service
Mr. Cody Boggs, Virginia Department of Environmental Quality

U.S. Department of Homeland Security

United States Coast Guard

Commander
United States Coast Guard
Fifth Coast Guard District

431 Crawford Street
Portsmouth, VA 23704-5004
Staff Symbol: dpb
Phone: (757) 398-6422
Fax: (757) 398-6334
Email: Martin.A.Bridges@uscg.mil
or CGDFiveBridges@uscg.mil

16593
20 JUL 2018

Mr. Caleb Parks
Virginia Department of Transportation
Environmental Division
1401 East Broad Street
Richmond, VA 23219

Dear Mr. Parks:

This is in response to your request for review of the Coast Guard jurisdiction regarding the Environmental Impact Statement (EIS), to evaluate potential transportation improvements along the U.S. Route 220 corridor. The corridor consists of approximately seven miles between the North Carolina State Line at Greensboro Road (U.S. Route 220), east of Martinsville, Virginia, to the William F. Stone Highway (U.S. Route 58/U.S. Route 220 bypass), at Henry County, VA. A navigable determination and comments are unnecessary because the project area does not cross a navigable waterway.

The fact that a Coast Guard bridge permit is not required does not relieve you of the responsibility for compliance with the requirements of any other Federal, State, or local agency who may have jurisdiction over any aspect of the project.

If you have any further questions, please contact Mr. Martin Bridges at the above listed address or telephone number.

Sincerely,

HAL R. PITTS
Bridge Program Manager
By direction

Copy: CG Sector Hampton Roads, Waterways Management

Matthew J. Strickler
Secretary of Natural Resources

Clyde E. Cristman
Director

COMMONWEALTH of VIRGINIA
DEPARTMENT OF CONSERVATION AND RECREATION

Rochelle Altholz
Deputy Director of Administration and Finance

Russell W. Baxter
Deputy Director of Dam Safety & Floodplain Management and Soil & Water Conservation

Thomas L. Smith
Deputy Director of Operations

MEMORANDUM

DATE: April 29, 2019

TO: Angel Aymond, VDOT

FROM: Roberta Rhur, Environmental Impact Review Coordinator

SUBJECT: VDOT 19-014, Martinsville Southern Connector Study, Route 220 EIS

Division of Natural Heritage

The Department of Conservation and Recreation (DCR) has searched its Biotics Data System for occurrences of natural heritage resources from the area outlined on the submitted map. Natural heritage resources are defined as the habitat of rare, threatened, or endangered plant and animal species, unique or exemplary natural communities, and significant geologic formations.

Biotics documents the presence of natural heritage resources within two miles of the project area. However, due to the scope of the activity and the distance to the resources, we do not anticipate that this project will adversely impact these natural heritage resources.

There are no State Natural Area Preserves under DCR's jurisdiction in the project vicinity.

Many invasive plant species are adapted to take advantage of soil disturbances and poor soil conditions. These adaptations are part of what enable certain species to be invasive. Non-native invasive plants are found through Virginia. Therefore, the potential exists for some VDOT projects to further the establishment of invasive species. To minimize the potential for invasive species infestation, projects should be conducted to minimize the area of disturbance, and disturbed sites should be revegetated with desirable species at the earliest opportunity following disturbance. Equally as important, species used for revegetation should not include the highly invasive species that have traditionally been used for revegetating disturbed sites. We recommend VDOT avoid using crown vetch, tall fescue, and autumn olive if at all possible.

For more information on invasive alien plants and native plants, see the DCR-Division of Natural Heritage website http://www.dcr.virginia.gov/natural-heritage/invspinfo.shtml. For sources of native plant material, see the Virginia Native Plant Society's website (http://vnps.org) or the U.S. Fish and Wildlife Service nursery list for Virginia (http://www.fws.gov/ChesapeakeBay/BayScapes/bsresources/bs-nurseries.html).

Under a Memorandum of Agreement established between the Virginia Department of Agriculture and Consumer Services (VDACS) and the DCR, DCR represents VDACS in comments regarding potential impacts on state-listed threatened and endangered plant and insect species. The current activity will not affect any documented state-listed plants or insects.

New and updated information is continually added to Biotics. Please re-submit project information and map for an update on this natural heritage information if the scope of the project changes and/or six months has passed before it is utilized.

All VDOT projects on state-owned lands must comply with the Virginia Erosion & Sediment Control (ESC) Law and Regulations, the Virginia Stormwater Management (SWM) Law and Regulations, the most current version of the DCR approved VDOT Annual ESC and SWM Specifications and Standards, and the project-specific ESC and SWM plans. [Reference: VESCL §10.1-560, §10.1-564; VESCR §4VAC50-30 et al; VSWML §10.1-603 et al; VSWMR §4VAC-3-20 et al].

The VDGIF maintains a database of wildlife locations, including threatened and endangered species, trout streams, and anadromous fish waters that may contain information not documented in this letter. Their database may be accessed from http://vafwis.org/fwis, or contact Ernie Aschenbach at 804-367-2733 or Ernie.Aschenbach@dgif.virginia.gov. According to the information currently in our files, the Smith River, which has been designated by the Virginia Department of Game and Inland Fisheries (VDGIF) as a "Threatened and Endangered Species Water" for the Roanoke logperch is within 2 miles of the project area. Therefore, DCR recommends coordination with the U.S. Fish and Wildlife Service (USFWS) and Virginia's regulatory authority for the management and protection of this species, the VDGIF, to ensure compliance with protected species legislation.

The remaining DCR divisions have no comments regarding the scope of this project. Thank you for the opportunity to comment.

Cc: Ernie Aschenbach, VDGIF
Troy Andersen, USFWS

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Virginia Ecological Services Field Office
6669 Short Lane
Gloucester, VA 23061-4410
Phone: (804) 693-6694 Fax: (804) 693-9032
http://www.fws.gov/northeast/virginiafield/

In Reply Refer To: October 03, 2019
Consultation Code: 05E2VA00-2020-SLI-0063
Event Code: 05E2VA00-2020-E-00206
Project Name: Route 220 Martinsville Southern Connector Natural Resources Study

Subject: List of threatened and endangered species that may occur in your proposed project location, and/or may be affected by your proposed project

To Whom It May Concern:

The enclosed species list identifies threatened, endangered, proposed and candidate species, as well as proposed and final designated critical habitat, that may occur within the boundary of your proposed project and/or may be affected by your proposed project. The species list fulfills the requirements of the U.S. Fish and Wildlife Service (Service) under section 7(c) of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 *et seq.*). Any activity proposed on National Wildlife Refuge lands must undergo a 'Compatibility Determination' conducted by the Refuge. Please contact the individual Refuges to discuss any questions or concerns.

New information based on updated surveys, changes in the abundance and distribution of species, changed habitat conditions, or other factors could change this list. Please feel free to contact us if you need more current information or assistance regarding the potential impacts to federally proposed, listed, and candidate species and federally designated and proposed critical habitat. Please note that under 50 CFR 402.12(e) of the regulations implementing section 7 of the Act, the accuracy of this species list should be verified after 90 days. This verification can be completed formally or informally as desired. The Service recommends that verification be completed by visiting the ECOS-IPaC website at regular intervals during project planning and implementation for updates to species lists and information. An updated list may be requested through the ECOS-IPaC system by completing the same process used to receive the enclosed list.

The purpose of the Act is to provide a means whereby threatened and endangered species and the ecosystems upon which they depend may be conserved. Under sections 7(a)(1) and 7(a)(2) of the Act and its implementing regulations (50 CFR 402 *et seq.*), Federal agencies are required to utilize their authorities to carry out programs for the conservation of threatened and endangered

species and to determine whether projects may affect threatened and endangered species and/or designated critical habitat.

A Biological Assessment is required for construction projects (or other undertakings having similar physical impacts) that are major Federal actions significantly affecting the quality of the human environment as defined in the National Environmental Policy Act (42 U.S.C. 4332(2)(c)). For projects other than major construction activities, the Service suggests that a biological evaluation similar to a Biological Assessment be prepared to determine whether the project may affect listed or proposed species and/or designated or proposed critical habitat. Recommended contents of a Biological Assessment are described at 50 CFR 402.12.

If a Federal agency determines, based on the Biological Assessment or biological evaluation, that listed species and/or designated critical habitat may be affected by the proposed project, the agency is required to consult with the Service pursuant to 50 CFR 402. In addition, the Service recommends that candidate species, proposed species and proposed critical habitat be addressed within the consultation. More information on the regulations and procedures for section 7 consultation, including the role of permit or license applicants, can be found in the "Endangered Species Consultation Handbook" at:

http://www.fws.gov/endangered/esa-library/pdf/TOC-GLOS.PDF

Please be aware that bald and golden eagles are protected under the Bald and Golden Eagle Protection Act (16 U.S.C. 668 *et seq.*), and projects affecting these species may require development of an eagle conservation plan (http://www.fws.gov/windenergy/eagle_guidance.html). Additionally, wind energy projects should follow the wind energy guidelines (http://www.fws.gov/windenergy/) for minimizing impacts to migratory birds and bats.

Guidance for minimizing impacts to migratory birds for projects including communications towers (e.g., cellular, digital television, radio, and emergency broadcast) can be found at: http://www.fws.gov/migratorybirds/CurrentBirdIssues/Hazards/towers/towers.htm; http://www.towerkill.com; and http://www.fws.gov/migratorybirds/CurrentBirdIssues/Hazards/towers/comtow.html.

We appreciate your concern for threatened and endangered species. The Service encourages Federal agencies to include conservation of threatened and endangered species into their project planning to further the purposes of the Act. Please include the Consultation Tracking Number in the header of this letter with any request for consultation or correspondence about your project that you submit to our office.

Attachment(s):

- Official Species List
- USFWS National Wildlife Refuges and Fish Hatcheries

Official Species List

This list is provided pursuant to Section 7 of the Endangered Species Act, and fulfills the requirement for Federal agencies to "request of the Secretary of the Interior information whether any species which is listed or proposed to be listed may be present in the area of a proposed action".

This species list is provided by:

Virginia Ecological Services Field Office
6669 Short Lane
Gloucester, VA 23061-4410
(804) 693-6694

This project's location is within the jurisdiction of multiple offices. Expect additional species list documents from the following office, and expect that the species and critical habitats in each document reflect only those that fall in the office's jurisdiction:

Raleigh Ecological Services Field Office
Post Office Box 33726
Raleigh, NC 27636-3726
(919) 856-4520

Project Summary

Consultation Code: 05E2VA00-2020-SLI-0063

Event Code: 05E2VA00-2020-E-00206

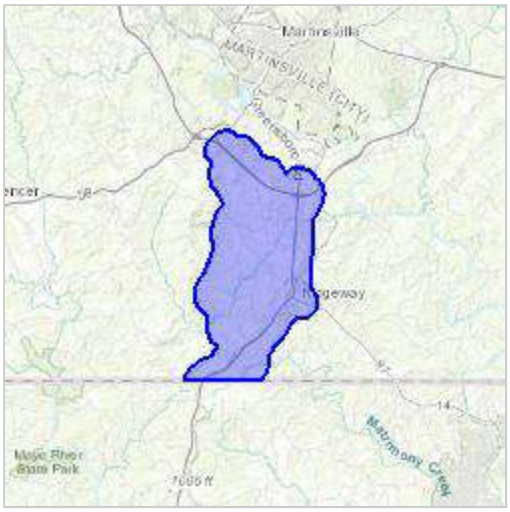
Project Name: Route 220 Martinsville Southern Connector Natural Resources Study

Project Type: TRANSPORTATION

Project Description: The Virginia Department of Transportation (VDOT), in coordination with the Federal Highway Administration (FHWA) as the Federal Lead Agency, is evaluating potential transportation improvements along the U.S. Route 220 corridor between the North Carolina state line and U.S. Route 58 near the City of Martinsville, Virginia.

Project Location:

Approximate location of the project can be viewed in Google Maps: https://www.google.com/maps/place/36.5966933129267N79.8801339340492W



Counties: Rockingham, NC | Henry, VA

Endangered Species Act Species

There is a total of 1 threatened, endangered, or candidate species on this species list.

Species on this list should be considered in an effects analysis for your project and could include species that exist in another geographic area. For example, certain fish may appear on the species list because a project could affect downstream species.

IPaC does not display listed species or critical habitats under the sole jurisdiction of NOAA Fisheries[1], as USFWS does not have the authority to speak on behalf of NOAA and the Department of Commerce.

See the "Critical habitats" section below for those critical habitats that lie wholly or partially within your project area under this office's jurisdiction. Please contact the designated FWS office if you have questions.

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1. NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

Mammals

NAME	STATUS
Northern Long-eared Bat *Myotis septentrionalis* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/9045	Threatened

Critical habitats

THERE ARE NO CRITICAL HABITATS WITHIN YOUR PROJECT AREA UNDER THIS OFFICE'S JURISDICTION.

USFWS National Wildlife Refuge Lands And Fish Hatcheries

Any activity proposed on lands managed by the National Wildlife Refuge system must undergo a 'Compatibility Determination' conducted by the Refuge. Please contact the individual Refuges to discuss any questions or concerns.

THERE ARE NO REFUGE LANDS OR FISH HATCHERIES WITHIN YOUR PROJECT AREA.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Raleigh Ecological Services Field Office
Post Office Box 33726
Raleigh, NC 27636-3726
Phone: (919) 856-4520 Fax: (919) 856-4556

In Reply Refer To: October 03, 2019
Consultation Code: 04EN2000-2020-SLI-0015
Event Code: 04EN2000-2020-E-00048
Project Name: Route 220 Martinsville Southern Connector Natural Resources Study

Subject: List of threatened and endangered species that may occur in your proposed project location, and/or may be affected by your proposed project

To Whom It May Concern:

The species list generated pursuant to the information you provided identifies threatened, endangered, proposed and candidate species, as well as proposed and final designated critical habitat, that may occur within the boundary of your proposed project and/or may be affected by your proposed project. The species list fulfills the requirements of the U.S. Fish and Wildlife Service (Service) under section 7(c) of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 *et seq.*).

New information based on updated surveys, changes in the abundance and distribution of species, changed habitat conditions, or other factors could change this list. Please feel free to contact us if you need more current information or assistance regarding the potential impacts to federally proposed, listed, and candidate species and federally designated and proposed critical habitat. Please note that under 50 CFR 402.12(e) of the regulations implementing section 7 of the Act, the accuracy of this species list should be verified after 90 days. This verification can be completed formally or informally as desired. The Service recommends that verification be completed by visiting the ECOS-IPaC website at regular intervals during project planning and implementation for updates to species lists and information. An updated list may be requested through the ECOS-IPaC system by completing the same process used to receive the enclosed list.

Section 7 of the Act requires that all federal agencies (or their designated non-federal representative), in consultation with the Service, insure that any action federally authorized, funded, or carried out by such agencies is not likely to jeopardize the continued existence of any federally-listed endangered or threatened species. A biological assessment or evaluation may be prepared to fulfill that requirement and in determining whether additional consultation with the Service is necessary. In addition to the federally-protected species list, information on the species' life histories and habitats and information on completing a biological assessment or

evaluation and can be found on our web page at http://www.fws.gov/raleigh. Please check the web site often for updated information or changes

If your project contains suitable habitat for any of the federally-listed species known to be present within the county where your project occurs, the proposed action has the potential to adversely affect those species. As such, we recommend that surveys be conducted to determine the species' presence or absence within the project area. The use of North Carolina Natural Heritage program data should not be substituted for actual field surveys.

If you determine that the proposed action may affect (i.e., likely to adversely affect or not likely to adversely affect) a federally-protected species, you should notify this office with your determination, the results of your surveys, survey methodologies, and an analysis of the effects of the action on listed species, including consideration of direct, indirect, and cumulative effects, before conducting any activities that might affect the species. If you determine that the proposed action will have no effect (i.e., no beneficial or adverse, direct or indirect effect) on federally listed species, then you are not required to contact our office for concurrence (unless an Environmental Impact Statement is prepared). However, you should maintain a complete record of the assessment, including steps leading to your determination of effect, the qualified personnel conducting the assessment, habitat conditions, site photographs, and any other related articles.

Please be aware that bald and golden eagles are protected under the Bald and Golden Eagle Protection Act (16 U.S.C. 668 *et seq.*), and projects affecting these species may require development of an eagle conservation plan (http://www.fws.gov/windenergy/eagle_guidance.html). Additionally, wind energy projects should follow the wind energy guidelines (http://www.fws.gov/windenergy/) for minimizing impacts to migratory birds and bats.

Guidance for minimizing impacts to migratory birds for projects including communications towers (e.g., cellular, digital television, radio, and emergency broadcast) can be found at: http://www.fws.gov/migratorybirds/CurrentBirdIssues/Hazards/towers/towers.htm; http://www.towerkill.com; and http://www.fws.gov/migratorybirds/CurrentBirdIssues/Hazards/towers/comtow.html.

Not all Threatened and Endangered Species that occur in North Carolina are subject to section 7 consultation with the U.S Fish and Wildlife Service. Atlantic and shortnose sturgeon, sea turtles,when in the water, and certain marine mammals are under purview of the National Marine Fisheries Service. If your project occurs in marine, estuarine, or coastal river systems you should also contact the National Marine Fisheries Service, http://www.nmfs.noaa.gov/

We appreciate your concern for threatened and endangered species. The Service encourages Federal agencies to include conservation of threatened and endangered species into their project planning to further the purposes of the Act. Please include the Consultation Tracking Number in the header of this letter with any request for consultation or correspondence about your project that you submit to our office. If you have any questions or comments, please contact John Ellis of this office at john_ellis@fws.gov.

Attachment(s):

- Official Species List

Official Species List

This list is provided pursuant to Section 7 of the Endangered Species Act, and fulfills the requirement for Federal agencies to "request of the Secretary of the Interior information whether any species which is listed or proposed to be listed may be present in the area of a proposed action".

This species list is provided by:

Raleigh Ecological Services Field Office
Post Office Box 33726
Raleigh, NC 27636-3726
(919) 856-4520

This project's location is within the jurisdiction of multiple offices. Expect additional species list documents from the following office, and expect that the species and critical habitats in each document reflect only those that fall in the office's jurisdiction:

Virginia Ecological Services Field Office
6669 Short Lane
Gloucester, VA 23061-4410
(804) 693-6694

Project Summary

Consultation Code: 04EN2000-2020-SLI-0015

Event Code: 04EN2000-2020-E-00048

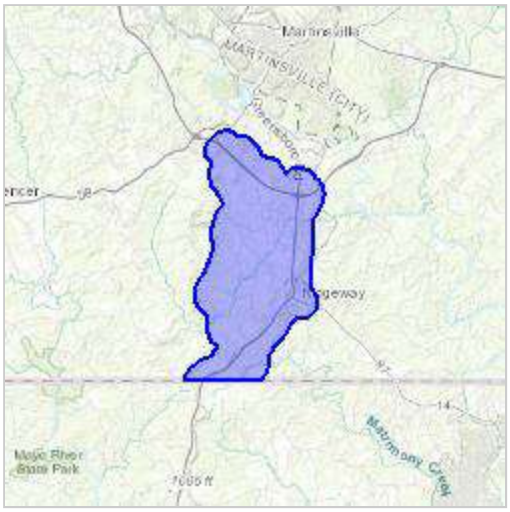
Project Name: Route 220 Martinsville Southern Connector Natural Resources Study

Project Type: TRANSPORTATION

Project Description: The Virginia Department of Transportation (VDOT), in coordination with the Federal Highway Administration (FHWA) as the Federal Lead Agency, is evaluating potential transportation improvements along the U.S. Route 220 corridor between the North Carolina state line and U.S. Route 58 near the City of Martinsville, Virginia.

Project Location:

Approximate location of the project can be viewed in Google Maps: https://www.google.com/maps/place/36.5966933129267N79.8801339340492W



Counties: Rockingham, NC | Henry, VA

Endangered Species Act Species

There is a total of 3 threatened, endangered, or candidate species on this species list.

Species on this list should be considered in an effects analysis for your project and could include species that exist in another geographic area. For example, certain fish may appear on the species list because a project could affect downstream species.

IPaC does not display listed species or critical habitats under the sole jurisdiction of NOAA Fisheries[1], as USFWS does not have the authority to speak on behalf of NOAA and the Department of Commerce.

See the "Critical habitats" section below for those critical habitats that lie wholly or partially within your project area under this office's jurisdiction. Please contact the designated FWS office if you have questions.

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1. NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

Fishes

NAME	STATUS
Roanoke Logperch *Percina rex* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/1134	Endangered

Clams

NAME	STATUS
James Spinymussel *Pleurobema collina* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/2212	Endangered

Flowering Plants

NAME	STATUS
Smooth Coneflower *Echinacea laevigata* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/3473	Endangered

Critical habitats

THERE ARE NO CRITICAL HABITATS WITHIN YOUR PROJECT AREA UNDER THIS OFFICE'S JURISDICTION.

VaFWIS Search Report Compiled on 10/3/2019, 3:27:18 PM

Help

Known or likely to occur within a **6 mile radius around point 36,34,48.8 -79,51,40.4** in **089 Henry County, 690 Martinsville City, VA**

View Map of Site Location

391 Known or Likely Species ordered by Status Concern for Conservation (displaying first 20) (18 species with Status* or Tier I** or Tier II**)

BOVA Code	Status*	Tier**	Common Name	Scientific Name	Confirmed	Database(s)
060017	FESE	Ia	Spinymussel, James	Parvaspina collina		BOVA
010214	FESE	IIa	Logperch, Roanoke	Percina rex	Yes	BOVA,TEWaters,Habitat,SppObs,HU6
050022	FTST	Ia	Bat, northern long-eared	Myotis septentrionalis		BOVA
050020	SE	Ia	Bat, little brown	Myotis lucifugus		BOVA,HU6
050027	SE	Ia	Bat, tri-colored	Perimyotis subflavus		BOVA
040293	ST	Ia	Shrike, loggerhead	Lanius ludovicianus		BOVA
060081	ST	IIa	Floater, green	Lasmigona subviridis		HU6
010127	ST	IIb	Madtom, orangefin	Noturus gilberti	Yes	BOVA,TEWaters,HU6
040292	ST		Shrike, migrant loggerhead	Lanius ludovicianus migrans		BOVA
030012	CC	IVa	Rattlesnake, timber	Crotalus horridus		BOVA,HU6
010174		Ia	Bass, Roanoke	Ambloplites cavifrons	Yes	BOVA,Habitat,SppObs,HU6
100248		Ia	Fritillary, regal	Speyeria idalia idalia		HU6
040052		IIa	Duck, American black	Anas rubripes	Potential	BOVA,BBA,HU6
040320		IIa	Warbler, cerulean	Setophaga cerulea		BOVA,HU6
040140		IIa	Woodcock, American	Scolopax minor	Potential	BOVA,BBA,HU6
040203		IIb	Cuckoo, black-billed	Coccyzus erythropthalmus		BOVA

040105		IIb	Rail, king	Rallus elegans		BOVA
040304		IIc	Warbler, Swainson's	Limnothlypis swainsonii		HU6
010131		IIIa	Eel, American	Anguilla rostrata		BOVA
030068		IIIa	Turtle, woodland box	Terrapene carolina carolina		BOVA,HU6

To view **All 391 species** View 391

*FE=Federal Endangered; FT=Federal Threatened; SE=State Endangered; ST=State Threatened; FP=Federal Proposed; FC=Federal Candidate; CC=Collection Concern

**I=VA Wildlife Action Plan - Tier I - Critical Conservation Need; II=VA Wildlife Action Plan - Tier II - Very High Conservation Need; III=VA Wildlife Action Plan - Tier III - High Conservation Need;
IV=VA Wildlife Action Plan - Tier IV - Moderate Conservation Need
Virginia Widlife Action Plan Conservation Opportunity Ranking:
a - On the ground management strategies/actions exist and can be feasibly implemented.;
b - On the ground actions or research needs have been identified but cannot feasibly be implemented at this time.;
c - No on the ground actions or research needs have been identified or all identified conservation opportunities have been exhausted.

View Map of All Query Results from All Observation Tables

Bat Colonies or Hibernacula: **Not Known**

Anadromous Fish Use Streams

N/A

Impediments to Fish Passage

N/A

Colonial Water Bird Survey

N/A

Threatened and Endangered Waters

(43 Reaches - displaying first 20)

View Map of All Threatened and Endangered Waters

Stream Name	T&E Waters Species					View Map
	Highest TE*	BOVA Code, Status*, Tier**, Common & Scientific Name				
Smith River (0329763)	FESE	010127	ST	IIb	Madtom, orangefin	Noturus gilberti	Yes
		010214	FESE	IIa	Logperch,	Percina rex	

					Roanoke		
Smith River (0329782)	FESE	010127	ST	IIb	Madtom, orangefin	Noturus gilberti	Yes
		010214	FESE	IIa	Logperch, Roanoke	Percina rex	
Smith River (0329845)	FESE	010127	ST	IIb	Madtom, orangefin	Noturus gilberti	Yes
		010214	FESE	IIa	Logperch, Roanoke	Percina rex	
Smith River (0329953)	FESE	010127	ST	IIb	Madtom, orangefin	Noturus gilberti	Yes
		010214	FESE	IIa	Logperch, Roanoke	Percina rex	
Smith River (0329964)	FESE	010127	ST	IIb	Madtom, orangefin	Noturus gilberti	Yes
		010214	FESE	IIa	Logperch, Roanoke	Percina rex	
Smith River (0329986)	FESE	010127	ST	IIb	Madtom, orangefin	Noturus gilberti	Yes
		010214	FESE	IIa	Logperch, Roanoke	Percina rex	
Smith River (0330010)	FESE	010127	ST	IIb	Madtom, orangefin	Noturus gilberti	Yes
		010214	FESE	IIa	Logperch, Roanoke	Percina rex	
Smith River (0330185)	FESE	010127	ST	IIb	Madtom, orangefin	Noturus gilberti	Yes
		010214	FESE	IIa	Logperch, Roanoke	Percina rex	
Smith River (0330192)	FESE	010127	ST	IIb	Madtom, orangefin	Noturus gilberti	Yes
		010214	FESE	IIa	Logperch, Roanoke	Percina rex	
Smith River (0331179)	FESE	010127	ST	IIb	Madtom, orangefin	Noturus gilberti	Yes
		010214	FESE	IIa	Logperch, Roanoke	Percina rex	
Smith River (0331215)	FESE	010127	ST	IIb	Madtom, orangefin	Noturus gilberti	Yes
		010214	FESE	IIa	Logperch, Roanoke	Percina rex	

Smith River (0331216)	FESE	010127	ST	IIb	Madtom, orangefin	Noturus gilberti	Yes
		010214	FESE	IIa	Logperch, Roanoke	Percina rex	
Smith River (0331231)	FESE	010127	ST	IIb	Madtom, orangefin	Noturus gilberti	Yes
		010214	FESE	IIa	Logperch, Roanoke	Percina rex	
Smith River (0331245)	FESE	010127	ST	IIb	Madtom, orangefin	Noturus gilberti	Yes
		010214	FESE	IIa	Logperch, Roanoke	Percina rex	
Smith River (0331339)	FESE	010127	ST	IIb	Madtom, orangefin	Noturus gilberti	Yes
		010214	FESE	IIa	Logperch, Roanoke	Percina rex	
Smith River (0331357)	FESE	010127	ST	IIb	Madtom, orangefin	Noturus gilberti	Yes
		010214	FESE	IIa	Logperch, Roanoke	Percina rex	
Smith River (0331460)	FESE	010127	ST	IIb	Madtom, orangefin	Noturus gilberti	Yes
		010214	FESE	IIa	Logperch, Roanoke	Percina rex	
Smith River (0332489)	FESE	010127	ST	IIb	Madtom, orangefin	Noturus gilberti	Yes
		010214	FESE	IIa	Logperch, Roanoke	Percina rex	
Smith River (0332495)	FESE	010127	ST	IIb	Madtom, orangefin	Noturus gilberti	Yes
		010214	FESE	IIa	Logperch, Roanoke	Percina rex	
Smith River (0332596)	FESE	010127	ST	IIb	Madtom, orangefin	Noturus gilberti	Yes
		010214	FESE	IIa	Logperch, Roanoke	Percina rex	
Smith River (0332607)	FESE	010127	ST	IIb	Madtom, orangefin	Noturus gilberti	Yes
		010214	FESE	IIa	Logperch, Roanoke	Percina rex	

Smith River (0332617)	FESE	010127	ST	IIb	Madtom, orangefin	Noturus gilberti	Yes
		010214	FESE	IIa	Logperch, Roanoke	Percina rex	
Smith River (0332619)	FESE	010127	ST	IIb	Madtom, orangefin	Noturus gilberti	Yes

To view **All 43 Threatened and Endangered Waters records** View 43

Managed Trout Streams (1 records) (Click on Stream Name to view complete reach history)

View Map of All Trout Stream Surveys

Reach ID	Stream Name	Class	Brook Trout	Brown Trout	Rainbow Trout	View Map
05SRE-01	Smith River	Wild trout		Y		Yes

Bald Eagle Concentration Areas and Roosts

N/A

Bald Eagle Nests

N/A

Species Observations (121 records - displaying first 20 , 5 Observations with Threatened or Endangered species)

View Map of All Query Results Species Observations

obsID	class	Date Observed	Observer	N Species			View Map
				Different Species	Highest TE*	Highest Tier**	
622501	SppObs	Oct 13 2014	Greg; Anderson| Brandon; Plunkett| AJ; Barnard| Zoey; Car	16	FESE	II	Yes
315307	SppObs	Jul 1 1999	DEQ	25	FESE	II	Yes
315308	SppObs	Jul 1 1999	DEQ	21	FESE	II	Yes
55294	SppObs	Sep 21 1998	Scott Smith, VDGIF	1	FESE	II	Yes
55295	SppObs	Sep 21 1998	Scott Smith, VDGIF	1	FESE	II	Yes
621262	SppObs	Sep 3 2013	Jamie; Roberts	1		I	Yes
315309	SppObs	Jul 1 1999	DEQ	25		I	Yes
315310	SppObs	Jul 1 1999	DEQ	22		I	Yes

337084	SppObs	Jan 1 1981	REJ-B-JENKINS	22		I	Yes
613951	SppObs	Sep 20 2011	Christopher; Plummer| Brock; Reggi	24		IV	Yes
600325	SppObs	Aug 26 2009	Jason; Hill| Drew; Miller	29		IV	Yes
601913	SppObs	Oct 23 2008	Jason Hill and Mike Hutch	13		IV	Yes
67342	SppObs	Jun 4 2002	RICHARD NEVES AND MELLISSA PETTY, VA COOPERATIVE FISH AND WILDLIFE RESEARCH UNIT	9		IV	Yes
65923	SppObs	Jun 4 2002	Aaron Liberty, Brett Ostby, and Melissa Petty (collectors)	8		IV	Yes
67341	SppObs	Jun 4 2002	RICHARD NEVES AND MELLISSA PETTY, VA COOPERATIVE FISH AND WILDLIFE RESEARCH UNIT	7		IV	Yes
67387	SppObs	May 24 2002	RICHARD J. NEVES AND MELISSA PETTY, VA COOPERATIVE FISH AND WILDLIFE RESEARCH UNIT	10		IV	Yes
58211	SppObs	Aug 18 1999	Ryan W. Boggs and Louis Seivard (principle permittee), Dept. of Environmental Quality	2		IV	Yes
10520	SppObs	Jul 29 1977	Frankensteen	7		IV	Yes
10517	SppObs	Jul 27 1977	Frankensteen	11		IV	Yes
10516	SppObs	Jul 27 1977	Frankensteen	7		IV	Yes

Displayed 20 Species Observations

Selected 121 Observations View all 121 Species Observations

Habitat Predicted for Aquatic WAP Tier I & II Species (24 Reaches - displaying first 20)

View Map Combined Reaches from Below of Habitat Predicted for WAP Tier I & II Aquatic Species

Stream Name	Tier Species						View Map
	Highest TE*	BOVA Code, Status*, Tier**, Common & Scientific Name					
Cobbs Creek (30101031)	FESE	010214	FESE	IIa	Logperch, Roanoke	Percina rex	Yes
Drag Creek (30101031)	FESE	010214	FESE	IIa	Logperch, Roanoke	Percina rex	Yes
Fall Creek (30101031)	FESE	010214	FESE	IIa	Logperch, Roanoke	Percina rex	Yes
Fall Creek (30101032)	FESE	010214	FESE	IIa	Logperch,	Percina	Yes

					Roanoke	rex	
Leatherwood Creek (30101031)	FESE	010174		Ia	Bass, Roanoke	Ambloplites cavifrons	Yes
		010214	FESE	IIa	Logperch, Roanoke	Percina rex	
Leatherwood Creek (30101031)	FESE	010214	FESE	IIa	Logperch, Roanoke	Percina rex	Yes
Leatherwood Creek (30101032)	FESE	010174		Ia	Bass, Roanoke	Ambloplites cavifrons	Yes
		010214	FESE	IIa	Logperch, Roanoke	Percina rex	
Little Marrowbone Creek (30101031)	FESE	010214	FESE	IIa	Logperch, Roanoke	Percina rex	Yes
		010432			Madtom, spotted-margin	Noturus insignis ssp 1	
Marrowbone Creek (30101031)	FESE	010214	FESE	IIa	Logperch, Roanoke	Percina rex	Yes
		010432			Madtom, spotted-margin	Noturus insignis ssp 1	
Marrowbone Creek (30101031)		010432			Madtom, spotted-margin	Noturus insignis ssp 1	Yes
Marrowbone Creek (30101032)	FESE	010174		Ia	Bass, Roanoke	Ambloplites cavifrons	Yes
		010214	FESE	IIa	Logperch, Roanoke	Percina rex	
Marrowbone Creek (30101032)	FESE	010214	FESE	IIa	Logperch, Roanoke	Percina rex	Yes
		010432			Madtom, spotted-margin	Noturus insignis ssp 1	
Marrowbone Creek (30101032)		010432			Madtom, spotted-margin	Noturus insignis ssp 1	Yes
Matrimony Creek (30101031)	FESE	010214	FESE	IIa	Logperch, Roanoke	Percina rex	Yes
Middle Creek (30101031)	FESE	010214	FESE	IIa	Logperch, Roanoke	Percina rex	Yes
Mulberry Creek (30101031)	FESE	010214	FESE	IIa	Logperch, Roanoke	Percina rex	Yes
		010432			Madtom, spotted-margin	Noturus insignis ssp 1	
Mulberry Creek (30101031)		010432			Madtom,	Noturus	Yes

					spotted-margin	insignis ssp 1	
Smith River (30101031)	FESE	010174		Ia	Bass, Roanoke	Ambloplites cavifrons	Yes
		010214	FESE	IIa	Logperch, Roanoke	Percina rex	
		010432			Madtom, spotted-margin	Noturus insignis ssp 1	
Smith River (30101031)	FESE	010174		Ia	Bass, Roanoke	Ambloplites cavifrons	Yes
		010214	FESE	IIa	Logperch, Roanoke	Percina rex	
Smith River (30101031)		010174		Ia	Bass, Roanoke	Ambloplites cavifrons	Yes
Smith River (30101032)	FESE	010174		Ia	Bass, Roanoke	Ambloplites cavifrons	Yes
		010214	FESE	IIa	Logperch, Roanoke	Percina rex	
		010432			Madtom, spotted-margin	Noturus insignis ssp 1	
Smith River (30101032)	FESE	010174		Ia	Bass, Roanoke	Ambloplites cavifrons	Yes
		010214	FESE	IIa	Logperch, Roanoke	Percina rex	
Smith River (30101032)	FESE	010174		Ia	Bass, Roanoke	Ambloplites cavifrons	Yes

To view **All 24 Tier Reaches records records** View 24

Habitat Predicted for Terrestrial WAP Tier I & II Species

N/A

Virginia Breeding Bird Atlas Blocks (5 records)

View Map of All Query Results
Virginia Breeding Bird Atlas Blocks

BBA ID	Atlas Quadrangle Block Name	Breeding Bird Atlas Species			View Map
		Different Species	Highest TE*	Highest Tier**	
32026	Martinsville East, SE	60		III	Yes
32025	Martinsville East, SW	1			Yes
31026	Martinsville West, SE	65		II	Yes
32014	Northwest Eden, CE	48		III	Yes
31014	Price, CE	50		III	Yes

Public Holdings:

N/A

Summary of BOVA Species Associated with Cities and Counties of the Commonwealth of Virginia:

FIPS Code	City and County Name	Different Species	Highest TE	Highest Tier
089	Henry	329	FESE	I
690	Martinsville City	285	FTSE	I

USGS 7.5' Quadrangles:
Price
Martinsville West
Northwest Eden
Martinsville East

USGS NRCS Watersheds in Virginia:

N/A

USGS National 6th Order Watersheds Summary of Wildlife Action Plan Tier I, II, III, and IV Species:

HU6 Code	USGS 6th Order Hydrologic Unit	Different Species	Highest TE	Highest Tier
RD11	Horse Pasture Creek	50	FESE	I
RD12	North Mayo River-Koger Creek	57	FESE	I
RD13	Mayo River-Pawpaw Creek	45	FESE	I
RD14	Dan River-Matrimony Creek	46	FESE	I
RD24	Smith River-Beaver Creek	56	FESE	I
RD25	Marrowbone Creek	47	FESE	I
RD26	Smith River-Mulberry Creek	48	FESE	I
RD29	Lower Leatherwood Creek	46	FESE	I
RD30	Smith River-Fall Creek	47	FESE	I

Compiled on 10/3/2019, 3:27:18 PM I995621.0 report=all searchType= R dist= 9654 poi= 36,34,48.8 -79,51,40.4

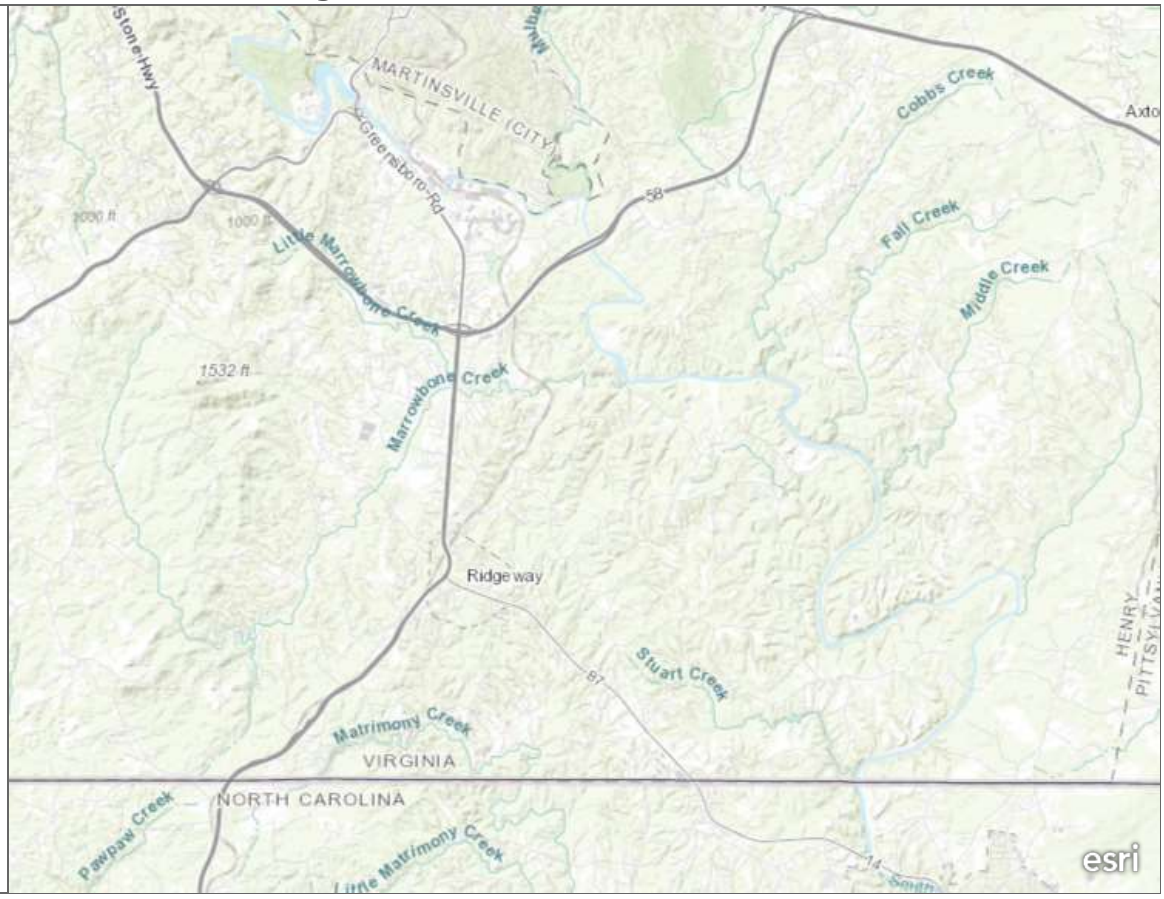
PixelSize=64; Anadromous=0.036035; BBA=0.091425; BECAR=0.032772; Bats=0.033044; Buffer=1.055917; County=0.112366; HU6=0.151999; Impediments=0.034569; Init=1.167105; PublicLands=0.045956; Quad=0.115413; SppObs=0.491544; TEWaters=0.077319; TierReaches=0.122627; TierTerrestrial=0.290207; Total=3.139664; Tracking_BOVA=0.167667; Trout=0.075477; huva=0.083453

USFWS Bald Eagle Concentration Areas - Virginia

Eagle Concentration Areas

- December 15 to March 15
- May 15 to August 31 and December 15 to March 15

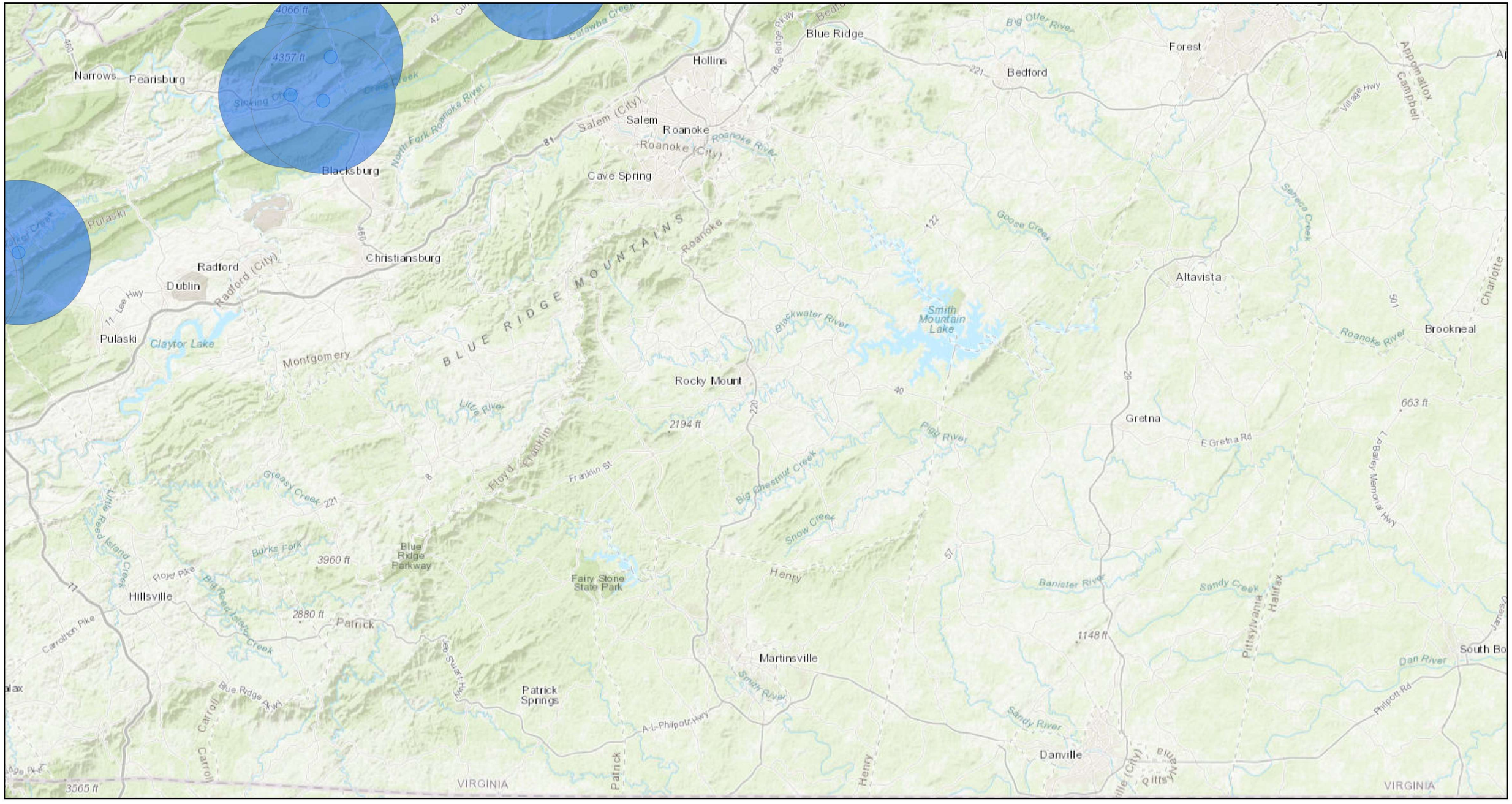
USFWS Northeast Region States



This map depicts designated Bald Eagle Concentration Areas in the State of Virginia. The Intent of this map is to provide information to the public about shoreline areas that ar ...

VITA, Esri, HERE, Garmin, USGS, NGA, EPA, USDA, NPS

NLEB Locations and Roost Trees



10/19/2018, 2:52:20 PM

NLEB Hibernaculum 5.5 Mile Buffer

NLEB Hibernaculum Half Mile Buffer

1:577,791

0 5 10 20 mi

0 5 10 20 km

Esri, HERE, Garmin, USGS, NGA, EPA, USDA, NPS

VA Dept. Game & Inland Fisheries

Esri, HERE, Garmin, USGS, NGA, EPA, USDA, NPS |

Parks, Caleb

From: Aymond, Angel <angel.aymond@vdot.virginia.gov>
Sent: Friday, October 4, 2019 2:26 PM
To: Parks, Caleb
Subject: Fwd: current Martinsville alignment map

---------- Forwarded message ---------
From: **Alexander, Susan** <susan.alexander@vdot.virginia.gov>
Date: Fri, Apr 5, 2019 at 9:41 AM
Subject: RE: current Martinsville alignment map
To: Angel Aymond <angel.aymond@vdot.virginia.gov>, Amy Golden <amy.golden@vdot.virginia.gov>

Thanks Angel.

I see there has been some adjustment to the proposed alignments. Can you tell me if Route D is a viable option (the dark-blue line on the map)? From what I can see, it looks like Routes D & E will mostly follow the existing Rt. 220 alignment, and D will head west to follow the same alignment as Route C and then B & C up to the northern termini. I want to be sure that I give the correct information and locations where Dr. Angermeier and Dr. Neves can expect to conduct the habitat assessments/surveys for fish and mussels. I have contacted Dr. Angermeier about a cost proposal, but I have not heard from him. I am going to send a follow up and include the current map information as well. I will send the same information to Dr. Neves regarding the mussels. Brian Watson at DGIF recommends at least assessments of the reaches in Marrowbone Creek to see if any protected mussels are there. He does not have any information or data of mussels in this area. There is a chance that Green floater and/or Atlantic pigtoe can be in the Marrowbone drainage.

Thanks for your help on this. Any information you can provide that give a better description of which alignments are most likely to be considered would be great. I see at least 3 for Routes A, B & C, and possibly a 4th crossing of Marrowbone Creek for Option D. Let me know if you have questions.

Susan

From: Aymond, Angel <angel.aymond@vdot.virginia.gov>
Sent: Tuesday, April 2, 2019 9:28 AM
To: Golden, Amy <amy.golden@vdot.virginia.gov>
Cc: Mary Alexander <susan.alexander@vdot.virginia.gov>
Subject: Re: current Martinsville alignment map

Here you go!

On Tue, Apr 2, 2019 at 9:22 AM Golden, Amy <amy.golden@vdot.virginia.gov> wrote:

> Hi Angel,
>
> Susan is working with our subs to get cost proposals for both fish and mussel surveys lined up for this project. Is there an updated alignment map for M-220 and can you please email it?
>
> Thanks,
>
> **Amy Golden**
>
> Endangered Species Program Manager | Virginia Department of Transportation | 1201 E. Broad Street Richmond VA 23219 | Phone: 804-786-0705 | amy.golden@vdot.virginia.gov

--

Angel E. Aymond

Senior Location Studies Specialist

Virginia Department of Transportation | Environmental Division

Desk: 804.786.5344 | **Cell**: 254.592.7912

Angel.Aymond@vdot.virginia.gov

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Angel E. Aymond
Senior Location Studies Specialist
Virginia Department of Transportation | Environmental Division
Desk: 804.786.5344 | **Cell**: 254.592.7912
Angel.Aymond@vdot.virginia.gov

Parks, Caleb

From: Aymond, Angel <angel.aymond@vdot.virginia.gov>
Sent: Wednesday, October 2, 2019 7:33 AM
To: Parks, Caleb
Subject: Fwd: Martinsville 220 EIS - black rail

Please add this email to the documentation for coordination on the black rail. Need to add a sentence to the NRTR explaining this new information that became available in fall 2019.

Angel

---------- Forwarded message ---------
From: **Golden, Amy** <amy.golden@vdot.virginia.gov>
Date: Tue, Oct 1, 2019 at 2:21 PM
Subject: Fwd: Martinsville 220 EIS - black rail
To: Angel Aymond <angel.aymond@vdot.virginia.gov>

For the project file.

---------- Forwarded message ---------
From: **Argo, Emily** <emily_argo@fws.gov>
Date: Tue, Oct 1, 2019 at 1:52 PM
Subject: Martinsville 220 EIS - black rail
To: <Amy.Golden@vdot.virginia.gov>
Cc: Troy Andersen <troy_andersen@fws.gov>

Hi Amy,

Based on the location of the subject project and known occurrences of the proposed threatened black rail in Virginia, this project does not intersect potential suitable habitat and will have no effect on the black rail. Should project plans change or if additional information on the distribution of the proposed threatened black rail or critical habitat becomes available, this determination may be reconsidered. If you have any questions, please contact me at (804) 824-2405, or via email at emily_argo@fws.gov.

Emily

--
Emily E. Argo

Fish and Wildlife Biologist
Virginia Field Office
U.S. Fish and Wildlife Service
6669 Short Lane
Gloucester, VA 23061

Parks, Caleb

From: Aymond, Angel <angel.aymond@vdot.virginia.gov>
Sent: Friday, October 4, 2019 2:25 PM
To: Parks, Caleb
Subject: Fwd: FW: Review for mussels: Rt. 220 Martinsville connector study, Henry Co. VA
Attachments: WilliamsEtAl_UpdatedMusselTaxonomy_FMBC_Vol20-2_2017October.pdf

As discussed.

From: Brian Watson <brian.watson@dgif.virginia.gov>
Sent: Monday, April 1, 2019 4:09 PM
To: Susan Alexander <susan.alexander@vdot.virginia.gov>
Cc: Amy Golden <amy.golden@vdot.virginia.gov>
Subject: RE: Review for mussels: Rt. 220 Martinsville connector study, Henry Co. VA

Susan,

Since JSM was not known from the Dan River watershed until 2001 and Marrowbone Creek is in the adjacent subwatershed, DGIF would not rule out JSM as being a possibility. Smith River models as potential habitat for JSM as do portions of Leatherwood Creek, which is a tributary on the east side of Smith River and the next major tributary downstream of Marrowbone Creek. Other possibilities could be Green Floater and Atlantic Pigtoe since they have turned up in the Dan River, which were new records for Atlantic pigtoe, and the Smith River and portions of Leatherwood Creek model as potential habitat for Atlantic Pigtoe.

Parvaspina is the genus for collina, no more Pleurobema. Official taxonomic name changes came out in October 2017, paper attached.

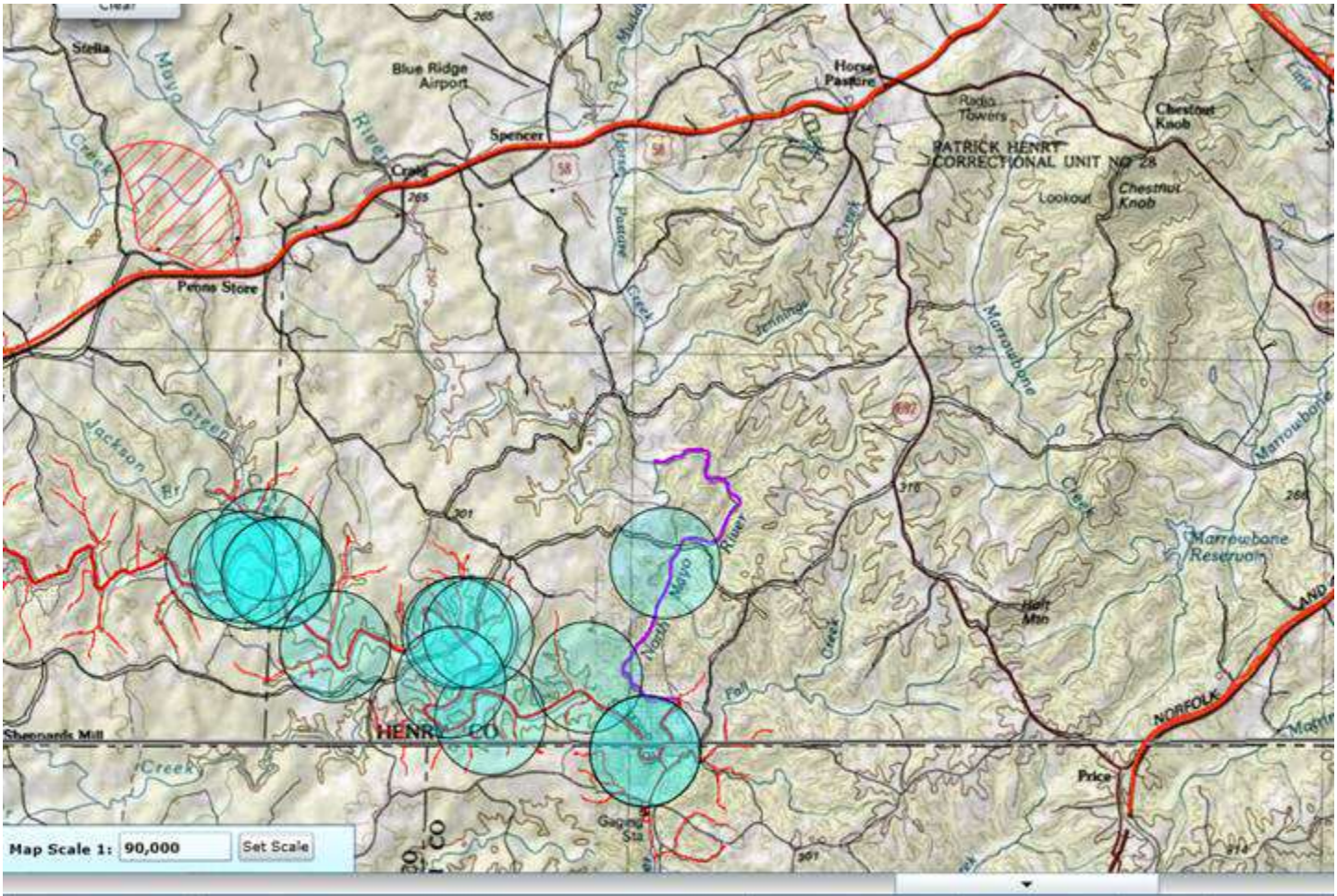
Brian

From: Alexander, Susan <susan.alexander@vdot.virginia.gov>
Sent: Monday, April 1, 2019 3:57 PM
To: Brian Watson <brian.watson@dgif.virginia.gov>
Cc: Amy Golden <amy.golden@vdot.virginia.gov>
Subject: RE: Review for mussels: Rt. 220 Martinsville connector study, Henry Co. VA

Brian,

Just a note… Marrowbone Creek is a tributary to the Smith River, which is in the Roanoke drainage. The Mayo River system appears to be on the other side of the ridge (Rt. 692). We are coordinating with Paul Angermeier regarding habitat assessments for the Roanoke logperch, as well as Orangefin madtom. I had planned to contact Dr. Neves about mussel assessments or surveys along Marrowbone Creek – to ensure all is clear in the event instream work is necessary (i.e. cofferdams or to construct bridge abutments below ordinary high water). If you have any recommendations (I think we can exclude JSM), please let me/us know. Thanks again.

PS: the red/blue circles below are the collection records for JSM (*Parvaspina collina* …not familiar with that genus; is that the NC species). Dates range in 2002 and 2012.



OBSERVATION_DATE	DESCRIPTION	SOURCE_DATABASE_ID	BOVA	GENUS	SPECIES	SUBSPECIES
5/29/2002 12:00:00 AM	VDGIF Scientific Collections, TE, and Salvage permit data		060017	Parvaspina	collina	
5/29/2002 12:00:00 AM	VDGIF Scientific Collections, TE, and Salvage permit data		060017	Parvaspina	collina	
6/7/2012 12:00:00 AM	VDGIF Scientific Collections, TE, and Salvage permit data from application		060017	Parvaspina	collina	
6/27/2005 12:00:00 AM	VDGIF Scientific Collections, TE, and Salvage permit data		010127	Noturus	gilberti	

Record: << < 0 > >> Records (0 out of 16 Selected) Options...

Susan

From: Brian Watson <brian.watson@dgif.virginia.gov>
Sent: Monday, April 1, 2019 2:57 PM
To: Susan Alexander <susan.alexander@vdot.virginia.gov>
Cc: Amy Golden <amy.golden@vdot.virginia.gov>
Subject: RE: Review for mussels: Rt. 220 Martinsville connector study, Henry Co. VA

Susan,

Checking the survey records, that area is kind of an unknown. I am showing no positive or null records Marrowbone Creek and just a handful of survey records in streams nearby like Leatherwood Creek and Matrimony Creek. Given the proximity to JSM in the South Mayo, DGIF would likely recommend abbreviated surveys in Marrowbone Creek if there are instream impacts. Little Marrowbone Creek likely would not need surveys unless something turned up in Marrowbone Creek. Any unnamed tributaries smaller than Little Marrowbone Creek, DGIF likely would not recommend surveys and photos of the sites would probably suffice for the review. Little Marrowbone might suffice using photos as well.

Brian

Brian T. Watson

Aquatic Resources Biologist/State Malacologist

P 434.525-7522, x114 / M 434.941.5990

Virginia Department of Game & Inland Fisheries

CONSERVE. CONNECT. PROTECT.

A 1132 Thomas Jefferson Road, Forest, VA 24551

www.dgif.virginia.gov

From: Alexander, Susan <susan.alexander@vdot.virginia.gov>
Sent: Wednesday, February 20, 2019 3:53 PM
To: Brian Watson <brian.watson@dgif.virginia.gov>
Cc: Amy Golden <amy.golden@vdot.virginia.gov>
Subject: Review for mussels: Rt. 220 Martinsville connector study, Henry Co. VA

Brian,

We are currently working on the NEPA document that proposes new alignment alternatives of Route 220 that will connect Rt. 58 with Rt. 220 at the Virginia/North Carolina Stateline, (Rt. 220 Martinsville Southern Connector Study) . The southernmost end of the new route begins off the existing Rt. 220, just southeast of the Marrowbone Reservoir in Henry County, VA. The northern terminus will be at Rt. 58, south of Martinsville, VA (near Little Marrowbone Creek). At this time, all alternatives are being considered (see attached map), and the final decision will be determined in mid-March. It is likely, however, that options 4C, 4B or 4A will be in the final analysis for the new route. The eastern routes will potentially be eliminated to avoid the Smith River and protected natural resources.

We are reviewing the T&E species that may be associated with the project. There are no collections records of T&E mussels or fish along the immediate alignments west of Rt. 220 (options 4C, 4B, 4A). The streams that are of concern include: Marrowbone Creek, Little Marrowbone Creek, and tributaries in area (unnamed). In efforts to avoid or minimized potential impacts to protected natural resources, we would appreciate your input regarding protected mussels that may be in this area . We would greatly appreciate any information you may have on occurrences, or your thoughts on whether a habitat assessments should be performed. From what we understand, the final road crossings will span many/most of the streams.

FYI: the maps attached are drafts and are not to scale. These are for reference only. The alignments are approximate.

Please let me know if you have questions or need additional information. Thank you for your time and consideration regarding protected mussels in this region of the state.

Susan

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Angel E. Aymond
Location Studies Project Manager
Virginia Department of Transportation **|** Environmental Division
Desk: 804.786.5344 **| Cell**: 254.592.7912
Angel.Aymond@vdot.virginia.gov

Freshwater Mollusk Biology and Conservation 20:33–58, 2017

REGULAR ARTICLE

A REVISED LIST OF THE FRESHWATER MUSSELS (MOLLUSCA: BIVALVIA: UNIONIDA) OF THE UNITED STATES AND CANADA

James D. Williams[1]*, Arthur E. Bogan[2], Robert S. Butler[3,4], Kevin S. Cummings[5], Jeffrey T. Garner[6], John L. Harris[7], Nathan A. Johnson[8], and G. Thomas Watters[9]

[1] *Florida Museum of Natural History, Museum Road and Newell Drive, Gainesville, FL 32611 USA*
[2] *North Carolina Museum of Natural Sciences, MSC 1626, Raleigh, NC 27699 USA*
[3] *U.S. Fish and Wildlife Service, 212 Mills Gap Road, Asheville, NC 28803 USA*
[4] *Retired.*
[5] *Illinois Natural History Survey, 607 East Peabody Drive, Champaign, IL 61820 USA*
[6] *Alabama Division of Wildlife and Freshwater Fisheries, 350 County Road 275, Florence, AL 35633 USA*
[7] *Department of Biological Sciences, Arkansas State University, State University, AR 71753 USA*
[8] *U.S. Geological Survey, Wetland and Aquatic Research Center, 7920 NW 71st Street, Gainesville, FL 32653 USA*
[9] *Museum of Biological Diversity, The Ohio State University, 1315 Kinnear Road, Columbus, OH 43212 USA*

ABSTRACT

We present a revised list of freshwater mussels (order Unionida, families Margaritiferidae and Unionidae) of the United States and Canada, incorporating changes in nomenclature and systematic taxonomy since publication of the most recent checklist in 1998. We recognize a total of 298 species in 55 genera in the families Margaritiferidae (one genus, five species) and Unionidae (54 genera, 293 species). We propose one change in the Margaritiferidae: the placement of the formerly monotypic genus *Cumberlandia* in the synonymy of *Margaritifera*. In the Unionidae, we recognize three new genera, elevate four genera from synonymy, and place three previously recognized genera in synonymy. We recognize for the first time two species (one native and one nonindigenous) in the Asian genus *Sinanodonta* as occurring in North America. We recognize four new species and one subspecies and elevate 21 species from synonymy. We elevate 10 subspecies to species status and no longer recognize four subspecies. We change common names for five taxa, correct spelling for eight species, and correct the date of publication of original descriptions for four species.

KEY WORDS: Unionidae, Margaritiferidae, taxonomy, systematics, nomenclature, mussel scientific names, mussel common names

INTRODUCTION

During the past 50 yr, there has been considerable interest in freshwater mussels (order Unionida) in the United States and Canada. Much of this interest was brought about by passage of the U.S. Endangered Species Acts of 1966, 1969, and 1973 and the Canadian Species at Risk Act of 2002. These legislative actions and the environmental movement that accompanied them focused conservation attention on all animals and plants, as well as their habitats. This in turn led

*Corresponding Author: fishwilliams@gmail.com

to assessment of species conservation status and the development of faunal lists for many states and provinces. The task of developing species lists was difficult for most invertebrates, including mussels, because so little attention had been given to the study of their biology, ecology, and systematics. In 1970, only six U.S. states had recent lists or books covering their mussel fauna. The first modern attempt to provide a comprehensive list of freshwater mussels of North America was published by Burch (1973, 1975).

The first comprehensive list of freshwater mussels of the United States and Canada was compiled in Turgeon et al. (1988) and revised a decade later (Turgeon et al. 1998). Williams et al. (1993) was another important resource during this period; although mainly an assessment of species conservation status, this paper also provided a comprehensive and widely used species list similar to those of Turgeon et al. (1988, 1998). These lists standardized and provided taxonomic stability to mussel common and scientific names to an extent that was previously unavailable. However, systematic taxonomy of mussels was poorly known at that time, and classifications at all taxonomic levels were based largely on concepts from the early 1900s.

Since publication of Turgeon et al. (1988, 1998) and Williams et al. (1993), many studies have refined our understanding of mussel systematic taxonomy. Several major publications have addressed systematic relationships within the class Bivalvia, including the order Unionida (Bieler et al. 2010; Carter et al. 2011; Bolotov et al. 2016; Araujo et al. 2017; Combosch et al. 2017). Major studies specific to the Unionida include Graf and Ó Foighil (2000), Hoeh et al. (2001, 2002, 2009), Roe and Hoeh (2003), Campbell et al. (2005), Walker et al. (2006), Graf and Cummings (2007, 2017), Cummings and Graf (2010), and Campbell and Lydeard (2012a, 2012b). In addition, many studies have examined systematic relationships at lower taxonomic levels (e.g., Serb et al. 2003; Jones et al. 2006; Lane et al. 2016). Together, this body of work depicts a view of mussel taxonomy that differs substantially from that of previous lists of the North American fauna.

We present a revised classification and list of the freshwater mussels of the United States and Canada (Tables 1 and 2). The primary purpose of this revision is to provide in a single resource a comprehensive list and taxonomic classification that reflects recent refinement of mussel systematics.

METHODS

We used as a starting point the list of Turgeon et al. (1998). We revised this list and its taxonomic classification based on a review of peer-reviewed mussel taxonomic and nomenclatural literature produced since 1998, unpublished research by the authors, and discussions with other experts on mussel systematics. We also corrected the spelling of specific epithets and publication dates of original descriptions based on the International Code of Zoological Nomenclature (http://www.iczn.org/iczn/index.jsp). Species mentioned in the text, but not included in Table 2, have author and date of publication following the name. Author and date of publication for all other species are given in Table 2.

Mussel common names follow Turgeon et al. (1998) with minor exceptions, but they are capitalized as is now the practice for many other animal groups (e.g., birds, reptiles, amphibians, fishes). Capitalization of common names helps avoid confusion by identifying standardized common names. For example, reference to a "fragile papershell" could apply to several thin-shelled species, but the capitalized "Fragile Papershell" is unambiguously recognized as the common name for *Leptodea fragilis*. We note and explain other instances where we changed common names from those of Turgeon et al. (1998) or where recognition of previously unrecognized species necessitated creation of a new common name.

We provide a rationale for and discussion of all taxonomic changes in the following accounts for each family and genus and in Table 2. There is a degree of uncertainty and subjectivity in our revised list that is unavoidable given our still imperfect understanding of mussel systematics. We attempted to reconcile divergent views regarding mussel systematics based on our assessment of the strength of evidence for these views. In cases where evidence did not allow reconciliation, we attempted to provide a plausible conclusion based on our professional judgment and experience; these conclusions were based on consensus among the authors to the extent possible.

Subspecies is a taxonomic category applied to populations that are morphologically distinct and geographically separated but that exhibit intergradation in contact zones (Mayr et al. 1953; Gilbert 1961). We evaluated morphological and molecular evidence relating to the status of subspecies recognized by Turgeon et al. (1998) and subsequent workers (Jones and Neves 2010). In most cases, recent evidence did not support recognition of subspecies but supported either subsuming subspecies under the nominal species or elevating subspecies to species status; we discuss this evidence for each case. However, strong evidence with which to evaluate their status was lacking for several, mostly extinct, subspecies (see *Epioblasma*). The designation of subspecies versus species is arbitrary and inconsistent for many animal groups (Huang and Knowles 2016), and this has historically been the case for mussels (e.g., Ortmann 1918, 1920). For subspecies that lacked strong evidence for synonymization or elevation, we recognize all as species to provide more consistent null hypotheses regarding potential diversity in these groups.

This work has been registered with ZooBank and a copy has been archived at Zenodo.org.

RESULTS

Freshwater bivalve higher classification continues to evolve as more data are generated and new techniques are developed. Fossil and modern bivalve higher classification has

Table 1. Higher classification of the Unionoidea present in the United States and Canada.

CLASS Bivalvia Linnaeus, 1758
INFRACLASS Heteroconchia Hertwig, 1895
COHORT Uniomorphi Gray, 1854 [=Paleoheterodonta]
ORDER Unionida Gray, 1854
SUPERFAMILY Unionoidea Rafinesque, 1820
MARGARITIFERIDAE Henderson, 1929
Margaritifera Schumacher, 1816
UNIONIDAE Rafinesque, 1820
ANODONTINAE Rafinesque, 1820
Anodontini Rafinesque, 1820
Alasmidonta Say, 1818
Anodonta Lamarck, 1799
Anodontoides Simpson in Baker, 1898
Arcidens Simpson, 1900
Lasmigona Rafinesque, 1831
Pegias Simpson, 1900
Pyganodon Crosse and Fischer, 1894
Simpsonaias Frierson, 1914
Strophitus Rafinesque, 1820
Utterbackia Baker, 1927
Utterbackiana Frierson, 1927
Cristariini Lopes-Lima, Bogan, and Froufe, 2017
Sinanodonta Modell, 1945
GONIDEINAE Ortmann, 1916
Gonideini Ortmann, 1916
Gonidea Conrad, 1857
AMBLEMINAE Rafinesque, 1820
Amblemini Rafinesque, 1820
Amblema Rafinesque, 1820
Lampsilini Ihering, 1901
Actinonaias Crosse and Fischer, 1894
Cyprogenia Agassiz, 1852
Cyrtonaias Crosse and Fischer, 1894
Dromus Simpson, 1900
Ellipsaria Rafinesque, 1820
Epioblasma Rafinesque, 1831
Glebula Conrad, 1853
Hamiota Roe and Hartfield, 2005
Lampsilis Rafinesque, 1820
Lemiox Rafinesque, 1831
Leptodea Rafinesque, 1820
Ligumia Swainson, 1840
Medionidus Simpson, 1900
Obliquaria Rafinesque, 1820
Obovaria Rafinesque, 1819
Plectomerus Conrad, 1853
Potamilus Rafinesque, 1818
Ptychobranchus Simpson, 1900
Toxolasma Rafinesque, 1831
Truncilla Rafinesque, 1819
Venustaconcha Frierson, 1927
Villosa Frierson, 1927

Table 1, continued.

Pleurobemini Hannibal, 1912
Elliptio Rafinesque, 1819
Elliptoideus Frierson, 1927
Eurynia Rafinesque, 1820
Fusconaia Simpson, 1900
Hemistena Rafinesque, 1820
Parvaspina Perkins, Gangloff, and Johnson, 2017
Plethobasus Simpson, 1900
Pleurobema Rafinesque, 1819
Pleuronaia Frierson, 1927
Quadrulini Ihering, 1901
Cyclonaias Pilsbry in Ortmann and Walker, 1922
Megalonaias Utterback, 1915
Quadrula Rafinesque, 1820
Theliderma Swainson, 1840
Tritogonia Agassiz, 1852
Uniomerus Conrad, 1853
AMBLEMINAE (*incertae sedis*)
Disconaias Crosse and Fischer, 1894
Popenaias Frierson, 1927
Reginaia Campbell and Lydeard, 2012

recently been summarized by Carter et al. (2011), with standardized endings for higher taxa within Bivalvia. Recent evidence supports the order Unionida as a monophyletic clade (Combosch et al. 2017). There have been two recent assessments of the taxonomy for Margaritiferidae (Bolotov et al. 2016; Araujo et al. 2017). Higher level relationships within the Unionidae have recently been reviewed by Lopes-Lima et al. (2017). Based on these publications, we provide our assessment of higher classification of the Unionida and its position in the class Bivalvia (Table 1).

There is general agreement on the three subfamily divisions within the Unionidae in North America and seven subfamilies worldwide, but there remains some uncertainty regarding classification at lower levels. We adopted a subfamily-, tribe-, and generic-level classification for the United States and Canada based on recent phylogenetic research (Table 1). We recognize the Anodontinae as a subfamily with two tribes in the United States and Canada. We recognize the subfamily Gonideinae, containing the genus *Gonidea*. We recognize the subfamily Ambleminae as consisting of four tribes: Amblemini, Lampsilini, Pleurobemini, and Quadrulini. The placement of many genera within tribes in the Ambleminae is well supported and consistent among studies, but the placement of others is less certain and varies among studies (e.g., *Plectomerus*, Campbell et al. 2005). The Mexican and Central American genera *Disconaias* and *Popenaias* and North American *Reginaia* lack sufficient phylogenetic information to be confidently assigned to a classification, and we placed them in Ambleminae incertae sedis (Table 1).

Our revised list includes many taxonomic changes at the

Table 2. List of Margaritiferidae and Unionidae of the United States and Canada. Currently recognized taxa are bolded. Taxa preceded by an asterisk and not bolded appeared in Turgeon et al. (1998) but are no longer recognized or reassigned to other genera.

Scientific Name	Common Name	Changes in Scientific and Common Names
MARGARITIFERIDAE Henderson, 1929		
**Cumberlandia* Ortmann, 1912		Synonym of *Margaritifera*
**Cumberlandia monodonta* (Say, 1829)	Spectaclecase	Reassigned to *Margaritifera*
***Margaritifera* Schumacher, 1816**		
***Margaritifera falcata* (Gould, 1850)**	Western Pearlshell	
***Margaritifera hembeli* (Conrad, 1838)**	Louisiana Pearlshell	
***Margaritifera margaritifera* (Linnaeus, 1758)**	Eastern Pearlshell	
***Margaritifera marrianae* Johnson, 1983**	Alabama Pearlshell	
***Margaritifera monodonta* (Say, 1829)**	Spectaclecase	Reassigned from *Cumberlandia*
UNIONIDAE Rafinesque, 1820		
***Actinonaias* Crosse and Fischer, 1894**		
***Actinonaias ligamentina* (Lamarck, 1819)**	Mucket	
***Actinonaias pectorosa* (Conrad, 1834)**	Pheasantshell	
***Alasmidonta* Say, 1818**		
***Alasmidonta arcula* (Lea, 1838)**	Altamaha Arcmussel	
***Alasmidonta atropurpurea* (Rafinesque, 1831)**	Cumberland Elktoe	
***Alasmidonta heterodon* (Lea, 1829)**	Dwarf Wedgemussel	Publication date corrected
***Alasmidonta marginata* Say, 1818**	Elktoe	
***Alasmidonta mccordi* Athearn, 1964**	Coosa Elktoe	
***Alasmidonta raveneliana* (Lea, 1834)**	Appalachian Elktoe	
***Alasmidonta robusta* Clarke, 1981**	Carolina Elktoe	
***Alasmidonta triangulata* (Lea, 1858)**	Southern Elktoe	
***Alasmidonta undulata* (Say, 1817)**	Triangle Floater	
***Alasmidonta varicosa* (Lamarck, 1819)**	Brook Floater	
***Alasmidonta viridis* (Rafinesque, 1820)**	Slippershell Mussel	
***Alasmidonta wrightiana* (Walker, 1901)**	Ochlockonee Arcmussel	
***Amblema* Rafinesque, 1820**		
***Amblema elliottii* (Lea, 1856)**	Coosa Fiveridge	
***Amblema neislerii* (Lea, 1858)**	Fat Threeridge	
***Amblema plicata* (Say, 1817)**	Threeridge	
***Anodonta* Lamarck, 1799**		
**Anodonta beringiana* Middendorff, 1851	Yukon Floater	Reassigned to *Sinanodonta*
***Anodonta californiensis* Lea, 1852**	California Floater	
**Anodonta couperiana* Lea, 1840	Barrel Floater	Reassigned to *Utterbackiana*
**Anodonta dejecta* Lewis, 1875	Woebegone Floater	Synonym of *Anodonta californiensis*
**Anodonta heardi* Gordon and Hoeh, 1995	Apalachicola Floater	Reassigned to *Utterbackiana*
**Anodonta implicata* Say, 1829	Alewife Floater	Reassigned to *Utterbackiana*
***Anodonta kennerlyi* Lea, 1860**	Western Floater	
***Anodonta nuttalliana* Lea, 1838**	Winged Floater	
***Anodonta oregonensis* Lea, 1838**	Oregon Floater	
**Anodonta suborbiculata* Say, 1831	Flat Floater	Reassigned to *Utterbackiana*
***Anodontoides* Simpson in Baker, 1898**		
***Anodontoides denigrata* (Lea, 1852)**	Cumberland Papershell	Elevated from synonymy
***Anodontoides ferussacianus* (Lea, 1834)**	Cylindrical Papershell	
***Anodontoides radiatus* (Conrad, 1834)**	Rayed Creekshell	
***Arcidens* Simpson, 1900**		
***Arcidens confragosus* (Say, 1829)**	Rock Pocketbook	
***Arcidens wheeleri* (Ortmann and Walker, 1912)**	Ouachita Rock Pocketbook	Reassigned from *Arkansia*
**Arkansia* Ortmann and Walker, 1912		Synonym of *Arcidens*
**Arkansia wheeleri* Ortmann and Walker, 1912	Ouachita Rock Pocketbook	Reassigned to *Arcidens*

Table 2, continued.

Scientific Name	Common Name	Changes in Scientific and Common Names
***Cyclonaias* Pilsbry in Ortmann and Walker, 1922**		
***Cyclonaias archeri* (Frierson, 1905)**	Tallapoosa Orb	Elevated from synonymy
***Cyclonaias asperata* (Lea, 1861)**	Alabama Orb	Reassigned from *Quadrula*
***Cyclonaias aurea* (Lea, 1859)**	Golden Orb	Reassigned from *Quadrula*
***Cyclonaias houstonensis* (Lea, 1859)**	Smooth Pimpleback	Reassigned from *Quadrula*
***Cyclonaias infucata* (Conrad, 1834)**	Sculptured Pigtoe	Reassigned from *Quincuncina*
***Cyclonaias kieneriana* (Lea, 1852)**	Coosa Orb	Elevated from synonymy
***Cyclonaias kleiniana* (Lea, 1852)**	Florida Mapleleaf	Elevated from synonymy
***Cyclonaias mortoni* (Conrad, 1835)**	Western Pimpleback	Species elevated from subspecies; reassigned from *Quadrula*
***Cyclonaias nodulata* (Rafinesque, 1820)**	Wartyback	Reassigned from *Quadrula*
***Cyclonaias petrina* (Gould, 1855)**	Texas Pimpleback	Reassigned from *Quadrula*
***Cyclonaias pustulosa* (Lea, 1831)**	Pimpleback	Reassigned from *Quadrula*
***Cyclonaias refulgens* (Lea, 1868)**	Purple Pimpleback	Reassigned from *Quadrula*
***Cyclonaias succissa* (Lea, 1852)**	Purple Pigtoe	Reassigned from *Fusconaia*
***Cyclonaias tuberculata* (Rafinesque, 1820)**	Purple Wartyback	
***Cyprogenia* Agassiz, 1852**		
***Cyprogenia aberti* (Conrad, 1850)**	Western Fanshell	
***Cyprogenia stegaria* (Rafinesque, 1820)**	Fanshell	
***Cyrtonaias* Crosse and Fischer, 1894**		
***Cyrtonaias tampicoensis* (Lea, 1838)**	Tampico Pearlymussel	
***Disconaias* Crosse and Fischer, 1894**		
***Disconaias fimbriata* (Frierson, 1907)**	Fringed Mucket	Elevated from synonymy
**Disconaias salinasensis* (Simpson, 1908)	Salina Mucket	Synonym of *Disconaias fimbriata*
***Dromus* Simpson, 1900**		
***Dromus dromas* (Lea, 1834)**	Dromedary Pearlymussel	
***Ellipsaria* Rafinesque, 1820**		
***Ellipsaria lineolata* (Rafinesque, 1820)**	Butterfly	
***Elliptio* Rafinesque, 1819**		
***Elliptio ahenea* (Lea, 1843)**	Southern Lance	
***Elliptio angustata* (Lea, 1831)**	Carolina Lance	
***Elliptio arca* (Conrad, 1834)**	Alabama Spike	
***Elliptio arctata* (Conrad, 1834)**	Delicate Spike	
**Elliptio buckleyi* (Lea, 1843)	Florida Shiny Spike	Synonym of *Elliptio jayensis*
***Elliptio chipolaensis* (Walker, 1905)**	Chipola Slabshell	
***Elliptio cistellaeformis* (Lea, 1863)**	Box Spike	
***Elliptio complanata* (Lightfoot, 1786)**	Eastern Elliptio	
***Elliptio congaraea* (Lea, 1831)**	Carolina Slabshell	
***Elliptio crassidens* (Lamarck, 1819)**	Elephantear	
***Elliptio dariensis* (Lea, 1842)**	Georgia Elephantear	
**Elliptio dilatata* (Rafinesque, 1820)	Spike	Reassigned to *Eurynia*
***Elliptio downiei* (Lea, 1858)**	Satilla Elephantear	
**Elliptio errans* (Lea, 1856)	Oval Elliptio	Synonym of *Elliptio icterina*; publication date corrected
***Elliptio fisheriana* (Lea, 1838)**	Northern Lance	
***Elliptio folliculata* (Lea, 1838)**	Pod Lance	
***Elliptio fraterna* (Lea, 1852)**	Brother Spike	
***Elliptio fumata* (Lea, 1857)**	Gulf Slabshell	Elevated from synonymy
**Elliptio hepatica* (Lea, 1859)	Brown Elliptio	Synonym of *Elliptio icterina*
***Elliptio hopetonensis* (Lea, 1838)**	Altamaha Slabshell	
***Elliptio icterina* (Conrad, 1834)**	Variable Spike	

Table 2, continued.

Scientific Name	Common Name	Changes in Scientific and Common Names
***Elliptio jayensis* (Lea, 1838)**	Florida Spike	Common name changed from Flat Spike
**Elliptio judithae* Clarke, 1986	Plicate Spike	Synonym of *Elliptio roanokensis*
***Elliptio lanceolata* (Lea, 1828)**	Yellow Lance	
**Elliptio lugubris* (Lea, 1834)	Sad Elliptio	Synonym of *Elliptio icterina*
***Elliptio marsupiobesa* Fuller, 1972**	Cape Fear Spike	
***Elliptio mcmichaeli* Clench and Turner, 1956**	Fluted Elephantear	
***Elliptio monroensis* (Lea, 1843)**	St. Johns Elephantear	
***Elliptio nigella* (Lea, 1852)**	Winged Spike	
***Elliptio occulta* (Lea, 1843)**	Hidden Spike	Elevated from synonymy
***Elliptio producta* (Conrad, 1836)**	Atlantic Spike	
***Elliptio pullata* (Lea, 1856)**	Gulf Spike	Elevated from synonymy
***Elliptio purpurella* (Lea, 1857)**	Inflated Spike	Elevated from synonymy
**Elliptio raveneli* (Conrad, 1834)	Carolina Spike	Synonym of *Elliptio icterina*
***Elliptio roanokensis* (Lea, 1838)**	Roanoke Slabshell	
***Elliptio shepardiana* (Lea, 1834)**	Altamaha Lance	
***Elliptio spinosa* (Lea, 1836)**	Altamaha Spinymussel	
**Elliptio steinstansana* Johnson and Clarke, 1983	Tar River Spinymussel	Reassigned to *Parvaspina*
**Elliptio waccamawensis* (Lea, 1863)	Waccamaw Spike	Synonym of *Elliptio congaraea*
**Elliptio waltoni* (Wright, 1888)	Florida Lance	Synonym of *Elliptio ahenea*
***Elliptoideus* Frierson, 1927**		
***Elliptoideus sloatianus* (Lea, 1840)**	Purple Bankclimber	
***Epioblasma* Rafinesque, 1831**		
***Epioblasma ahlstedti* Jones and Neves, 2010**	Duck River Dartersnapper	Described as new species
***Epioblasma arcaeformis* (Lea, 1831)**	Sugarspoon	
***Epioblasma aureola* Jones and Neves, 2010**	Golden Riffleshell	Species elevated from subspecies
***Epioblasma biemarginata* (Lea, 1857)**	Angled Riffleshell	
***Epioblasma brevidens* (Lea, 1831)**	Cumberlandian Combshell	
***Epioblasma capsaeformis* (Lea, 1834)**	Oyster Mussel	
***Epioblasma cincinnatiensis* (Lea, 1840)**	Ohio Riffleshell	Elevated from synonymy
***Epioblasma curtisii* (Frierson and Utterback, 1916)**	Curtis Pearlymussel	Species elevated from subspecies
***Epioblasma flexuosa* (Rafinesque, 1820)**	Leafshell	
***Epioblasma florentina* (Lea, 1857)**	Yellow Blossom	
**Epioblasma florentina aureola* Jones and Neves, 2010	Golden Riffleshell	Described as new subspecies; elevated to species
**Epioblasma florentina curtisii* (Frierson and Utterback, 1916)	Curtis Pearlymussel	Subspecies elevated to species
**Epioblasma florentina florentina* (Lea, 1857)	Yellow Blossom	Nominotypical subspecies not required
**Epioblasma florentina walkeri* (Wilson and Clark, 1914)	Tan Riffleshell	Subspecies elevated to species
***Epioblasma gubernaculum* (Reeve, 1865)**	Green Blossom	Species elevated from subspecies
***Epioblasma haysiana* (Lea, 1834)**	Acornshell	
***Epioblasma lenior* (Lea, 1842)**	Narrow Catspaw	
***Epioblasma lewisii* (Walker, 1910)**	Forkshell	
***Epioblasma metastriata* (Conrad, 1838)**	Upland Combshell	
***Epioblasma obliquata* (Rafinesque, 1820)**	Catspaw	
**Epioblasma obliquata obliquata* (Rafinesque, 1820)	Catspaw	Nominotypical subspecies not required
**Epioblasma obliquata perobliqua* (Conrad, 1836)	White Catspaw	Subspecies elevated to species
***Epioblasma othcaloogensis* (Lea, 1857)**	Southern Acornshell	
***Epioblasma penita* (Conrad, 1834)**	Southern Combshell	
***Epioblasma perobliqua* (Conrad, 1836)**	White Catspaw	Species elevated from subspecies
***Epioblasma personata* (Say, 1829)**	Round Combshell	
***Epioblasma propinqua* (Lea, 1857)**	Tennessee Riffleshell	
***Epioblasma rangiana* (Lea, 1838)**	Northern Riffleshell	Species elevated from subspecies

Table 2, continued.

Scientific Name	Common Name	Changes in Scientific and Common Names
***Epioblasma sampsonii* (Lea, 1861)**	Wabash Riffleshell	
***Epioblasma stewardsonii* (Lea, 1852)**	Cumberland Leafshell	
***Epioblasma torulosa* (Rafinesque, 1820)**	Tubercled Blossom	
**Epioblasma torulosa gubernaculum* (Reeve, 1865)	Green Blossom	Subspecies elevated to species
**Epioblasma torulosa rangiana* (Lea, 1838)	Northern Riffleshell	Subspecies elevated to species
**Epioblasma torulosa torulosa* (Rafinesque, 1820)	Tubercled Blossom	Nominotypical subspecies not required
***Epioblasma triquetra* (Rafinesque, 1820)**	Snuffbox	
***Epioblasma turgidula* (Lea, 1858)**	Turgid Blossom	
***Epioblasma walkeri* (Wilson and Clark, 1914)**	Tan Riffleshell	Species elevated from subspecies
***Eurynia* Rafinesque, 1820**		Elevated from synonymy
***Eurynia dilatata* Rafinesque, 1820**	Spike	Reassigned from *Elliptio*
***Fusconaia* Simpson, 1900**		
**Fusconaia askewi* (Marsh, 1896)	Texas Pigtoe	Synonym of *Fusconaia chunii*
**Fusconaia barnesiana* (Lea, 1838)	Tennessee Pigtoe	Reassigned to *Pleuronaia*
***Fusconaia burkei* (Walker, 1922)**	Tapered Pigtoe	Reassigned from *Quincuncina*
***Fusconaia cerina* (Conrad, 1838)**	Gulf Pigtoe	Common name changed from Southern Pigtoe
***Fusconaia chunii* (Lea, 1861)**	Texas Pigtoe	Elevated from synonymy
***Fusconaia cor* (Conrad, 1834)**	Shiny Pigtoe	
***Fusconaia cuneolus* (Lea, 1840)**	Finerayed Pigtoe	
**Fusconaia ebena* (Lea, 1831)	Ebonyshell	Reassigned to *Reginaia*
***Fusconaia escambia* Clench and Turner, 1956**	Narrow Pigtoe	
***Fusconaia flava* (Rafinesque, 1820)**	Wabash Pigtoe	
**Fusconaia lananensis* (Frierson, 1901)	Triangle Pigtoe	Synonym of *Fusconaia chunii*
***Fusconaia masoni* (Conrad, 1834)**	Atlantic Pigtoe	
***Fusconaia mitchelli* (Simpson, 1895)**	False Spike	Reassigned from *Quincuncina*
***Fusconaia ozarkensis* (Call, 1887)**	Ozark Pigtoe	
***Fusconaia subrotunda* (Lea, 1831)**	Longsolid	
**Fusconaia succissa* (Lea, 1852)	Purple Pigtoe	Reassigned to *Cyclonaias*
***Glebula* Conrad, 1853**		
***Glebula rotundata* (Lamarck, 1819)**	Round Pearlshell	
***Gonidea* Conrad, 1857**		
***Gonidea angulata* (Lea, 1838)**	Western Ridged Mussel	
***Hamiota* Roe and Hartfield, 2005**		Described as new genus
***Hamiota altilis* (Conrad, 1834)**	Finelined Pocketbook	Reassigned from *Lampsilis*
***Hamiota australis* (Simpson, 1900)**	Southern Sandshell	Reassigned from *Lampsilis*
***Hamiota perovalis* (Conrad, 1834)**	Orangenacre Mucket	Reassigned from *Lampsilis*
***Hamiota subangulata* (Lea, 1840)**	Shinyrayed Pocketbook	Reassigned from *Lampsilis*
***Hemistena* Rafinesque, 1820**		
***Hemistena lata* (Rafinesque, 1820)**	Cracking Pearlymussel	
***Lampsilis* Rafinesque, 1820**		
***Lampsilis abrupta* (Say, 1831)**	Pink Mucket	
**Lampsilis altilis* (Conrad, 1834)	Finelined Pocketbook	Reassigned to *Hamiota*
**Lampsilis australis* Simpson, 1900	Southern Sandshell	Reassigned to *Hamiota*
***Lampsilis binominata* Simpson, 1900**	Lined Pocketbook	
***Lampsilis bracteata* (Gould, 1855)**	Texas Fatmucket	
***Lampsilis brittsi* Simpson, 1900**	Northern Brokenray	Species elevated from subspecies
***Lampsilis cardium* Rafinesque, 1820**	Plain Pocketbook	
***Lampsilis cariosa* (Say,1817)**	Yellow Lampmussel	
***Lampsilis dolabraeformis* (Lea, 1838)**	Altamaha Pocketbook	
***Lampsilis fasciola* Rafinesque, 1820**	Wavyrayed Lampmussel	

Table 2, continued.

Scientific Name	Common Name	Changes in Scientific and Common Names
***Lampsilis floridensis* (Lea, 1852)**	Florida Sandshell	Elevated from synonymy
**Lampsilis fullerkati* Johnson, 1984*	Waccamaw Fatmucket	Synonym of *Lampsilis radiata*
**Lampsilis haddletoni* Athearn, 1964*	Haddleton Lampmussel	Reassigned to *Obovaria*
***Lampsilis higginsii* (Lea, 1857)**	Higgins Eye	
***Lampsilis hydiana* (Lea, 1838)**	Louisiana Fatmucket	
***Lampsilis ornata* (Conrad, 1835)**	Southern Pocketbook	
***Lampsilis ovata* (Say, 1817)**	Pocketbook	
**Lampsilis perovalis* (Conrad, 1834)*	Orangenacre Mucket	Reassigned to *Hamiota*
***Lampsilis powellii* (Lea, 1852)**	Arkansas Fatmucket	
***Lampsilis radiata* (Gmelin, 1791)**	Eastern Lampmussel	
**Lampsilis radiata conspicua* (Lea, 1872)*	Carolina Fatmucket	Subspecies no longer recognized
**Lampsilis radiata radiata* (Gmelin, 1791)*	Eastern Lampmussel	Nominotypical subspecies not required
***Lampsilis rafinesqueana* Frierson, 1927**	Neosho Mucket	
***Lampsilis reeveiana* (Lea, 1852)**	Arkansas Brokenray	
**Lampsilis reeveiana brevicula* (Call, 1887)*	Ozark Brokenray	Subspecies no longer recognized
**Lampsilis reeveiana brittsi* Simpson, 1900*	Northern Brokenray	Subspecies elevated to species
**Lampsilis reeveiana reeviana* (Lea, 1852)*	Arkansas Brokenray	Nominotypical subspecies not required
***Lampsilis satura* (Lea, 1852)**	Sandbank Pocketbook	
***Lampsilis siliquoidea* (Barnes, 1823)**	Fatmucket	
***Lampsilis splendida* (Lea, 1838)**	Rayed Pink Fatmucket	
***Lampsilis straminea* (Conrad, 1834)**	Rough Fatmucket	
**Lampsilis straminea claibornensis* (Lea, 1838)*	Southern Fatmucket	Subspecies no longer recognized
**Lampsilis straminea straminea* (Conrad, 1834)*	Rough Fatmucket	Nominotypical subspecies not required
***Lampsilis streckeri* Frierson, 1927**	Speckled Pocketbook	
**Lampsilis subangulata* (Lea, 1840)*	Shinyrayed Pocketbook	Reassigned to *Hamiota*
***Lampsilis teres* (Rafinesque, 1820)**	Yellow Sandshell	
***Lampsilis virescens* (Lea, 1858)**	Alabama Lampmussel	
***Lasmigona* Rafinesque, 1831**		
***Lasmigona alabamensis* Clarke, 1985**	Alabama Heelsplitter	Species elevated from subspecies
***Lasmigona complanata* (Barnes, 1823)**	White Heelsplitter	
**Lasmigona complanata alabamensis* Clarke, 1985*	Alabama Heelsplitter	Subspecies elevated to species
**Lasmigona complanata complanata* (Barnes, 1823)*	White Heelsplitter	Nominotypical subspecies not required
***Lasmigona compressa* (Lea, 1829)**	Creek Heelsplitter	
***Lasmigona costata* (Rafinesque, 1820)**	Flutedshell	
***Lasmigona decorata* (Lea, 1852)**	Carolina Heelsplitter	
***Lasmigona etowaensis* (Conrad, 1849)**	Etowah Heelsplitter	Elevated from synonymy
***Lasmigona holstonia* (Lea, 1838)**	Tennessee Heelsplitter	
***Lasmigona subviridis* (Conrad, 1835)**	Green Floater	
***Lemiox* Rafinesque, 1831**		
***Lemiox rimosus* (Rafinesque, 1831)**	Birdwing Pearlymussel	
***Leptodea* Rafinesque, 1820**		
***Leptodea fragilis* (Rafinesque, 1820)**	Fragile Papershell	
***Leptodea leptodon* (Rafinesque, 1820)**	Scaleshell	
***Leptodea ochracea* (Say, 1817)**	Tidewater Mucket	
**Lexingtonia* Ortmann, 1914*		Synonym of *Fusconaia*
**Lexingtonia dolabelloides* (Lea, 1840)*	Slabside Pearlymussel	Reassigned to *Pleuronaia*
**Lexingtonia subplana* (Conrad, 1837)*	Virginia Pigtoe	Synonym of *Fusconaia masoni*
***Ligumia* Swainson, 1840**		
***Ligumia nasuta* (Say, 1817)**	Eastern Pondmussel	
***Ligumia recta* (Lamarck, 1819)**	Black Sandshell	
***Ligumia subrostrata* (Say, 1831)**	Pondmussel	

Table 2, continued.

Scientific Name	Common Name	Changes in Scientific and Common Names
***Medionidus* Simpson, 1900**		
***Medionidus acutissimus* (Lea, 1831)**	Alabama Moccasinshell	
***Medionidus conradicus* (Lea, 1834)**	Cumberland Moccasinshell	
**Medionidus mcglameriae* van der Schalie, 1939*	Tombigbee Moccasinshell	Synonym of *Leptodea fragilis*
***Medionidus parvulus* (Lea, 1860)**	Coosa Moccasinshell	
***Medionidus penicillatus* (Lea, 1857)**	Gulf Moccasinshell	
***Medionidus simpsonianus* Walker, 1905**	Ochlockonee Moccasinshell	
***Medionidus walkeri* (Wright, 1897)**	Suwannee Moccasinshell	
***Megalonaias* Utterback, 1915**		
***Megalonaias nervosa* (Rafinesque, 1820)**	Washboard	
***Obliquaria* Rafinesque, 1820**		
***Obliquaria reflexa* Rafinesque, 1820**	Threehorn Wartyback	
***Obovaria* Rafinesque, 1819**		
***Obovaria arkansasensis* (Lea, 1862)**	Southern Hickorynut	Reassigned from *Villosa*
***Obovaria choctawensis* (Athearn, 1964)**	Choctaw Bean	Reassigned from *Villosa*
***Obovaria haddletoni* (Athearn, 1964)**	Haddleton Lampmussel	Reassigned from *Lampsilis*
**Obovaria jacksoniana* (Frierson, 1912)*	Southern Hickorynut	Synonym of *Obovaria arkansasensis*
***Obovaria olivaria* (Rafinesque, 1820)**	Hickorynut	
***Obovaria retusa* (Lamarck, 1819)**	Ring Pink	
**Obovaria rotulata* (Wright, 1899)*	Round Ebonyshell	Reassigned to *Reginaia*
***Obovaria subrotunda* (Rafinesque, 1820)**	Round Hickorynut	
***Obovaria unicolor* (Lea, 1845)**	Alabama Hickorynut	
***Parvaspina* Perkins, Gangloff, and Johnson, 2017**		Described as new genus
***Parvaspina collina* (Conrad, 1836)**	James Spinymussel	Reassigned from *Pleurobema*; publication date corrected
***Parvaspina steinstansana* (Johnson and Clarke, 1983)**	Tar River Spinymussel	Reassigned from *Elliptio*
***Pegias* Simpson, 1900**		
***Pegias fabula* (Lea, 1838)**	Littlewing Pearlymussel	
***Plectomerus* Conrad, 1853**		
***Plectomerus dombeyanus* (Valenciennes, 1827)**	Bankclimber	
***Plethobasus* Simpson, 1900**		
***Plethobasus cicatricosus* (Say, 1829)**	White Wartyback	
***Plethobasus cooperianus* (Lea, 1834)**	Orangefoot Pimpleback	
***Plethobasus cyphyus* (Rafinesque, 1820)**	Sheepnose	
***Pleurobema* Rafinesque, 1819**		
**Pleurobema altum* (Conrad, 1854)*	Highnut	Considered a *nomen dubium*
***Pleurobema athearni* Gangloff, Williams, and Feminella, 2006**	Canoe Creek Clubshell	Described as new species
**Pleurobema avellanum* Simpson, 1900*	Hazel Pigtoe	Synonym of *Pleurobema rubellum*
***Pleurobema beadleianum* (Lea, 1861)**	Mississippi Pigtoe	
**Pleurobema bournianum* (Lea, 1840)*	Scioto Pigtoe	Synonym of *Pleurobema clava*
**Pleurobema chattanoogaense* (Lea, 1858)*	Painted Clubshell	Synonym of *Pleurobema decisum*
***Pleurobema clava* (Lamarck, 1819)**	Clubshell	
**Pleurobema collina* (Conrad, 1836)*	James Spinymussel	Reassigned to *Parvaspina*
***Pleurobema cordatum* (Rafinesque, 1820)**	Ohio Pigtoe	
***Pleurobema curtum* (Lea, 1859)**	Black Clubshell	
***Pleurobema decisum* (Lea, 1831)**	Southern Clubshell	
***Pleurobema fibuloides* (Lea, 1859)**	Kusha Pigtoe	Elevated from synonymy
**Pleurobema flavidulum* (Lea, 1861)*	Yellow Pigtoe	Synonym of *Pleurobema perovatum*
**Pleurobema furvum* (Conrad, 1834)*	Dark Pigtoe	Synonym of *Pleurobema rubellum*
***Pleurobema georgianum* (Lea, 1841)**	Southern Pigtoe	

Table 2, continued.

Scientific Name	Common Name	Changes in Scientific and Common Names
**Pleurobema gibberum* (Lea, 1838)	Cumberland Pigtoe	Reassigned to *Pleuronaia*
**Pleurobema hagleri* (Frierson, 1900)	Brown Pigtoe	Synonym of *Pleurobema rubellum*
***Pleurobema hanleyianum* (Lea, 1852)**	Georgia Pigtoe	
***Pleurobema hartmanianum* (Lea, 1860)**	Cherokee Pigtoe	Elevated from synonymy
**Pleurobema johannis* (Lea, 1859)	Alabama Pigtoe	Synonym of *Pleurobema perovatum*
***Pleurobema marshalli* Frierson, 1927**	Flat Pigtoe	
**Pleurobema murrayense* (Lea, 1868)	Coosa Pigtoe	Synonym of *Pleurobema stabile*
**Pleurobema nucleopsis* (Conrad, 1849)	Longnut	Synonym of *Pleurobema georgianum*
***Pleurobema oviforme* (Conrad, 1834)**	Tennessee Clubshell	
***Pleurobema perovatum* (Conrad, 1834)**	Ovate Clubshell	
***Pleurobema plenum* (Lea, 1840)**	Rough Pigtoe	
***Pleurobema pyriforme* (Lea, 1857)**	Oval Pigtoe	
***Pleurobema riddellii* (Lea, 1861)**	Louisiana Pigtoe	
***Pleurobema rubellum* (Conrad, 1834)**	Warrior Pigtoe	
***Pleurobema rubrum* (Rafinesque, 1820)**	Pyramid Pigtoe	
***Pleurobema sintoxia* (Rafinesque, 1820)**	Round Pigtoe	
***Pleurobema stabile* (Lea, 1861)**	Coosa Pigtoe	Elevated from synonymy
***Pleurobema strodeanum* (Wright, 1898)**	Fuzzy Pigtoe	
***Pleurobema taitianum* (Lea, 1834)**	Heavy Pigtoe	
**Pleurobema troschelianum* (Lea, 1852)	Alabama Clubshell	Synonym of *Pleurobema georgianum*
***Pleurobema verum* (Lea, 1861)**	True Pigtoe	
***Pleuronaia* Frierson, 1927**		Elevated from synonymy
***Pleuronaia barnesiana* (Lea, 1838)**	Tennessee Pigtoe	Reassigned from *Fusconaia*
***Pleuronaia dolabelloides* (Lea, 1840)**	Slabside Pearlymussel	Reassigned from *Lexingtonia*
***Pleuronaia gibber* (Lea, 1838)**	Cumberland Pigtoe	Reassigned from *Pleurobema*; spelling correction of species name
***Popenais* Frierson, 1927**		
***Popenais popeii* (Lea, 1857)**	Texas Hornshell	
***Potamilus* Rafinesque, 1818**		
***Potamilus alatus* (Say, 1817)**	Pink Heelsplitter	
***Potamilus amphichaenus* (Frierson, 1898)**	Texas Heelsplitter	
***Potamilus capax* (Green, 1832)**	Fat Pocketbook	
***Potamilus inflatus* (Lea, 1831)**	Inflated Heelsplitter	Common name changed from Alabama Heelsplitter
***Potamilus metnecktayi* Johnson, 1998**	Salina Mucket	Described as new species
***Potamilus ohiensis* (Rafinesque, 1820)**	Pink Papershell	
***Potamilus purpuratus* (Lamarck, 1819)**	Bleufer	
***Ptychobranchus* Simpson, 1900**		
***Ptychobranchus fasciolaris* (Rafinesque, 1820)**	Kidneyshell	
***Ptychobranchus foremanianus* (Lea, 1842)**	Rayed Kidneyshell	Elevated from synonymy
***Ptychobranchus greenii* (Conrad, 1834)**	Triangular Kidneyshell	
***Ptychobranchus jonesi* (van der Schalie, 1934)**	Southern Kidneyshell	
***Ptychobranchus occidentalis* (Conrad, 1836)**	Ouachita Kidneyshell	
**Ptychobranchus subtentum* (Say, 1825)	Fluted Kidneyshell	Incorrect spelling of species name
***Ptychobranchus subtentus* (Say, 1825)**	Fluted Kidneyshell	Spelling correction of species name
***Pyganodon* Crosse and Fischer, 1894**		
***Pyganodon cataracta* (Say, 1817)**	Eastern Floater	
***Pyganodon fragilis* (Lamarck, 1819)**	Newfoundland Floater	
***Pyganodon gibbosa* (Say, 1824)**	Inflated Floater	
***Pyganodon grandis* (Say, 1829)**	Giant Floater	
***Pyganodon lacustris* (Lea, 1857)**	Lake Floater	Publication date corrected

Table 2, continued.

Scientific Name	Common Name	Changes in Scientific and Common Names
***Quadrula* Rafinesque, 1820**		
***Quadrula apiculata* (Say, 1829)**	Southern Mapleleaf	
**Quadrula asperata* (Lea, 1861)	Alabama Orb	Reassigned to *Cyclonaias*
**Quadrula aurea* (Lea, 1859)	Golden Orb	Reassigned to *Cyclonaias*
***Quadrula couchiana* (Lea, 1860)**	Rio Grande Monkeyface	
**Quadrula cylindrica cylindrica* (Say, 1817)	Rabbitsfoot	Nominotypical subspecies not required; reassigned to *Theliderma*
**Quadrula cylindrica strigillata* (Wright, 1898)	Rough Rabbitsfoot	Subspecies no longer recognized
***Quadrula fragosa* (Conrad, 1835)**	Winged Mapleleaf	
**Quadrula houstonensis* (Lea, 1859)	Smooth Pimpleback	Reassigned to *Cyclonaias*
**Quadrula intermedia* (Conrad, 1836)	Cumberland Monkeyface	Reassigned to *Theliderma*
**Quadrula kieneriana* (Lea, 1852)	Coosa Orb	Reassigned to *Cyclonaias*
**Quadrula metanevra* (Rafinesque, 1820)	Monkeyface	Reassigned to *Theliderma*
***Quadrula nobilis* (Conrad, 1854)**	Gulf Mapleleaf	Elevated from synonymy
**Quadrula nodulata* (Rafinesque, 1820)	Wartyback	Reassigned to *Cyclonaias*
**Quadrula petrina* (Gould, 1855)	Texas Pimpleback	Reassigned to *Cyclonaias*
**Quadrula pustulosa mortoni* (Conrad, 1835)	Western Pimpleback	Subspecies elevated to species; reassigned to *Cyclonaias*
**Quadrula pustulosa pustulosa* (Lea, 1831)	Pimpleback	Nominotypical subspecies not required; reassigned to *Cyclonaias*
***Quadrula quadrula* (Rafinesque, 1820)**	Mapleleaf	
**Quadrula refulgens* (Lea, 1868)	Purple Pimpleback	Reassigned to *Cyclonaias*
***Quadrula rumphiana* (Lea, 1852)**	Ridged Mapleleaf	
**Quadrula sparsa* (Lea, 1841)	Appalachian Monkeyface	Reassigned to *Theliderma*
**Quadrula stapes* (Lea, 1831)	Stirrupshell	Reassigned to *Theliderma*
**Quadrula tuberosa* (Lea, 1840)	Rough Rockshell	Synonym of *Theliderma metanevra*
**Quincuncina* Ortmann, 1922		Synonym of *Fusconaia*
**Quincuncina burkei* Walker, 1922	Tapered Pigtoe	Reassigned to *Fusconaia*
**Quincuncina infucata* (Conrad, 1834)	Sculptured Pigtoe	Reassigned to *Cyclonaias*
**Quincuncina mitchelli* (Simpson, 1895)	False Spike	Reassigned to *Fusconaia*
***Reginaia* Campbell and Lydeard, 2012**		Described as new genus
***Reginaia apalachicola* (Williams and Fradkin, 1999)**	Apalachicola Ebonyshell	Described as new species; reassigned from *Fusconaia*
***Reginaia ebenus* (Lea, 1831)**	Ebonyshell	Reassigned from *Fusconaia*; spelling correction of species name
***Reginaia rotulata* (Wright, 1899)**	Round Ebonyshell	Reassigned from *Obovaria*
***Simpsonaias* Frierson, 1914**		
***Simpsonaias ambigua* (Say, 1825)**	Salamander Mussel	
***Sinanodonta* Modell, 1945**		Not previously reported from North America
***Sinanodonta beringiana* (Middendorff, 1851)**	Yukon Floater	Reassigned from *Anodonta*
***Sinanodonta woodiana* (Lea, 1834)**	Chinese Pondmussel	Introduced and established in New Jersey
***Strophitus* Rafinesque, 1820**		
***Strophitus connasaugaensis* (Lea, 1858)**	Alabama Creekmussel	
***Strophitus subvexus* (Conrad, 1834)**	Southern Creekmussel	
***Strophitus undulatus* (Say, 1817)**	Creeper	
***Theliderma* Swainson, 1840**		Elevated from synonymy
***Theliderma cylindrica* (Say, 1817)**	Rabbitsfoot	Reassigned from *Quadrula*
***Theliderma intermedia* (Conrad, 1836)**	Cumberland Monkeyface	Reassigned from *Quadrula*
***Theliderma metanevra* (Rafinesque, 1820)**	Monkeyface	Reassigned from *Quadrula*
***Theliderma sparsa* (Lea, 1841)**	Appalachian Monkeyface	Reassigned from *Quadrula*
***Theliderma stapes* (Lea, 1831)**	Stirrupshell	Reassigned from *Quadrula*

Table 2, continued.

Scientific Name	Common Name	Changes in Scientific and Common Names
***Toxolasma* Rafinesque, 1831**		
***Toxolasma corvunculus* (Lea, 1868)**	Southern Purple Lilliput	
***Toxolasma cylindrellus* (Lea, 1868)**	Pale Lilliput	
***Toxolasma lividum* Rafinesque, 1831**	Purple Lilliput	Spelling correction of species name; parentheses unnecessary
**Toxolasma lividus* (Rafinesque, 1831)	Purple Lilliput	Incorrect spelling of species name
**Toxolasma mearnsi* (Simpson, 1900)	Western Lilliput	Synonym of *Toxolasma texasiense*
***Toxolasma parvum* (Barnes, 1823)**	Lilliput	Spelling correction of species name
**Toxolasma parvus* (Barnes, 1823)	Lilliput	Incorrect spelling of species name
***Toxolasma paulum* (Lea, 1840)**	Iridescent Lilliput	Spelling correction of species name
**Toxolasma paulus* (Lea, 1840)	Iridescent Lilliput	Incorrect spelling of species name
***Toxolasma pullus* (Conrad, 1838)**	Savannah Lilliput	
***Toxolasma texasiense* (Lea, 1857)**	Texas Lilliput	Spelling correction of species name
**Toxolasma texasiensis* (Lea, 1857)	Texas Lilliput	Incorrect spelling of species name
***Tritogonia* Agassiz, 1852**		
***Tritogonia verrucosa* (Rafinesque, 1820)**	Pistolgrip	
***Truncilla* Rafinesque, 1819**		
***Truncilla cognata* (Lea, 1860)**	Mexican Fawnsfoot	
***Truncilla donaciformis* (Lea, 1828)**	Fawnsfoot	
***Truncilla macrodon* (Lea, 1859)**	Texas Fawnsfoot	
***Truncilla truncata* Rafinesque, 1820**	Deertoe	
***Uniomerus* Conrad, 1853**		
***Uniomerus carolinianus* (Bosc, 1801)**	Eastern Pondhorn	Common name changed from Florida Pondhorn
***Uniomerus columbensis* (Lea, 1857)**	Apalachicola Pondhorn	Elevated from synonymy
***Uniomerus declivis* (Say, 1831)**	Tapered Pondhorn	
***Uniomerus tetralasmus* (Say, 1831)**	Pondhorn	
***Utterbackia* Baker, 1927**		
***Utterbackia imbecillis* (Say, 1829)**	Paper Pondshell	
***Utterbackia peggyae* (Johnson, 1965)**	Florida Floater	
***Utterbackia peninsularis* Bogan and Hoeh, 1995**	Peninsular Floater	
***Utterbackiana* Frierson, 1927**		Elevated from synonymy
***Utterbackiana couperiana* (Lea, 1840)**	Barrel Floater	Reassigned from *Anodonta*
***Utterbackiana hartfieldorum* (Williams, Bogan, and Garner, 2009)**	Cypress Floater	Described as new species; reassigned from *Anodonta*
***Utterbackiana heardi* (Gordon and Hoeh, 1995)**	Apalachicola Floater	Reassigned from *Anodonta*
***Utterbackiana implicata* (Say, 1829)**	Alewife Floater	Reassigned from *Anodonta*
***Utterbackiana suborbiculata* (Say, 1831)**	Flat Floater	Reassigned from *Anodonta*
***Venustaconcha* Frierson, 1927**		
***Venustaconcha ellipsiformis* (Conrad, 1836)**	Ellipse	
***Venustaconcha pleasii* (Marsh, 1891)**	Bleedingtooth Mussel	
***Venustaconcha trabalis* (Conrad, 1834)**	Tennessee Bean	Reassigned from *Villosa*; common name changed from Cumberland Bean
***Venustaconcha troostensis* (Lea, 1834)**	Cumberland Bean	Elevated from synonymy
***Villosa* Frierson, 1927**		
**Villosa amygdala* (Lea, 1843)	Florida Rainbow	Incorrect spelling of species name
***Villosa amygdalum* (Lea, 1843)**	Florida Rainbow	Spelling correction of species name
**Villosa arkansasensis* (Lea, 1862)	Ouachita Creekshell	Reassigned to *Obovaria*
**Villosa choctawensis* Athearn, 1964	Choctaw Bean	Reassigned to *Obovaria*
***Villosa constricta* (Conrad, 1838)**	Notched Rainbow	
***Villosa delumbis* (Conrad, 1834)**	Eastern Creekshell	
***Villosa fabalis* (Lea, 1831)**	Rayed Bean	

Table 2, continued.

Scientific Name	Common Name	Changes in Scientific and Common Names
***Villosa iris* (Lea, 1829)**	Rainbow	
***Villosa lienosa* (Conrad, 1834)**	Little Spectaclecase	
***Villosa nebulosa* (Conrad, 1834)**	Alabama Rainbow	
***Villosa ortmanni* (Walker, 1925)**	Kentucky Creekshell	
**Villosa perpurpurea* (Lea, 1861)	Purple Bean	Synonym of *Venustaconcha trabalis*
***Villosa sima* (Lea, 1838)**	Caney Fork Rainbow	Elevated from synonymy
***Villosa taeniata* (Conrad, 1834)**	Painted Creekshell	
**Villosa trabalis* (Conrad, 1834)	Cumberland Bean	Reassigned to *Venustaconcha*
***Villosa umbrans* (Lea, 1857)**	Coosa Creekshell	Species elevated from subspecies
**Villosa vanuxemensis umbrans* (Lea, 1857)	Coosa Creekshell	Subspecies elevated to species
***Villosa vanuxemensis* (Lea, 1838)**	Mountain Creekshell	
**Villosa vanuxemensis vanuxemensis* (Lea, 1838)	Mountain Creekshell	Nominotypical subspecies not required
***Villosa vaughaniana* (Lea, 1838)**	Carolina Creekshell	
***Villosa vibex* (Conrad, 1834)**	Southern Rainbow	
***Villosa villosa* (Wright, 1898)**	Downy Rainbow	

genus, species, and subspecies levels relative to previous lists. We recognize in total 298 freshwater mussel species from the United States and Canada. These comprise the families Margaritiferidae with one genus and five species and Unionidae with 54 genera and 293 species (Table 2). Turgeon et al. (1998) recognized in total 304 taxa: Margaritiferidae with two genera and five species and Unionidae with 49 genera, 286 species, and 13 subspecies. We summarize our changes to Turgeon et al. (1998) as follows. We recognize eight additional genera, including three recently described (*Hamiota*, *Parvaspina*, and *Reginaia*), four elevated from synonymy (*Eurynia*, *Pleuronaia*, *Theliderma*, and *Utterbackiana*), and one newly reported from North America (*Sinanodonta*). We place in synonymy four genera, including one in the Margaritiferidae (*Cumberlandia*) and three in the Unionidae (*Arkansia*, *Lexingtonia*, and *Quincuncina*). We recognize 25 additional species (all Unionidae), including four newly described species and 21 species elevated from synonymy. We place in synonymy 29 species and consider *Pleurobema altum* a nomen dubium, and we reassigned 41 species to other genera. We corrected the specific epithet spelling for eight species, corrected the date of publication for four, and changed the common names of five. Last, we recognized no subspecies, elevating 10 subspecies to species status and subsuming four subspecies into their nominal species (see Methods).

Margaritiferidae Henderson, 1929

Turgeon et al. (1998) recognized two genera in Margaritiferidae, *Cumberlandia* (one species) and *Margaritifera* (four species). On the basis of shell morphology and soft anatomy, Smith (2001) placed *Cumberlandia* in *Margaritanopsis* and *Margaritifera* (in part) in *Pseudunio*, but this classification was not widely accepted. In a molecular phylogenetic analysis, Huff et al. (2004) considered *Cumberlandia* a junior synonym of *Margaritifera*, and this classification was followed by some subsequent authors (e.g., Graf and Cummings 2007, 2017; Cummings and Graf 2010), but others continued to recognize the genus as valid (e.g., Williams et al. 2008; Watters et al. 2009; Haag 2012). A more comprehensive phylogeny of the Margaritiferidae that included eight of 13 currently recognized species (three from North America) retained the use of *Cumberlandia* (Bolotov et al. 2015). However, based on more recent evidence (Bolotov et al. 2016; Araujo et al. 2017), we consider *Cumberlandia* a junior synonym of *Margaritifera*.

Cumberlandia *Ortmann, 1912*.—Turgeon et al. (1998) recognized one species, *Cumberlandia monodonta*. We place *Cumberlandia* in the synonymy of *Margaritifera* (see Margaritiferidae).

Margaritifera *Schumacher, 1816*.—Turgeon et al. (1998) recognized four species of *Margaritifera*. Placement of *Cumberlandia* in the synonymy of *Margaritifera* brings the number of recognized species to five (see Margaritiferidae).

Unionidae Rafinesque, 1820

Turgeon et al. (1998) recognized 49 genera, 286 species, and 13 subspecies in Unionidae. We recognize 54 genera, 293 species, and no subspecies. We provide support for and discussion of these changes in the following assessments of genera.

Actinonaias *Crosse and Fischer, 1894*.—Turgeon et al. (1998) recognized two species, *Actinonaias ligamentina* and *Actinonaias pectorosa*. Molecular analyses (e.g., Campbell et al. 2005; Zanatta and Murphy 2006) found that the two species of *Actinonaias* together did not represent a monophyletic grouping, but the position of each of these lineages within the Lampsilini was unresolved. The type locality for *Actinonaias* is central Mexico, and 10 recognized species are restricted to this region (Graf and Cummings 2017), but no species

attributable to *Actinonaias* occur between Mexico and the range of *ligamentina* and *pectorosa* in the central United States and southern Canada. No phylogenetic research has examined relationships among Mexican *Actinonaias* and *ligamentina* and *pectorosa*, but it is unlikely they are closely related considering the disjunct distribution and lack of precedent for such a geographical pattern in other freshwater taxa (e.g., Miller et al. 2005). *Actinonaias ligamentina* and *pectorosa* require placement in two different genera, but at this time we retain these two species in the genus *Actinonaias* pending the outcome of further phylogenetic research.

Alasmidonta *Say, 1818*.—Turgeon et al. (1998) recognized 12 species, and recent evidence supports no changes to this classification.

Amblema *Rafinesque, 1820*.—Turgeon et al. (1998) recognized three species, and recent evidence supports no changes to this classification.

Anodonta *Lamarck, 1799*.—Turgeon et al. (1998) recognized 10 species. Mock et al. (2004) and Zanatta et al. (2007) found *Anodonta* to be polyphyletic, with eastern North American species forming a monophyletic clade distinct from the one that includes the type species (*Anodonta cygnea*, which occurs in Eurasia) and western North American *Anodonta*. Without discussion, Graf and Cummings (2007) and Cummings and Graf (2010) placed *Anodonta couperiana*, *A. heardi*, and *A. suborbiculata* in *Utterbackia*, and *A. implicata* in *Pyganodon*. Because no supporting evidence was provided, we do not recognize these changes. The next available genus for the eastern North American clade (*A. couperiana*, *A. heardi*, *A. suborbiculata*, and *A. implicata*) identified as distinct by Mock et al. (2004) is *Utterbackiana*. *Anodonta hartfieldorum* Williams, Bogan, and Garner, 2009, was described subsequently and also belongs to *Utterbackiana* (see *Utterbackiana*).

In a phylogenetic analysis of western North American *Anodonta*, Chong et al. (2008) found *A. beringiana* to be more closely related to the Asian species *Sinanodonta woodiana* than to North American species. Based on this evidence, we reassign *beringiana* to *Sinanodonta* (see *Sinanodonta*).

We retain the remaining four western North American species within *Anodonta* (*A. californiensis*, *A. kennerlyi*, *A. nuttalliana*, and *A. oregonensis*) based on their phylogenetic affinity to Eurasian *Anodonta* (Mock et al. 2004; Zanatta et al. 2007; Chong et al. 2008). *Anodonta dejecta* was recognized by Turgeon et al. (1998), Graf and Cummings (2007), and Cummings and Graf (2010). This species is treated as a synonym of *A. californiensis* by Bequaert and Miller (1973) and the Arizona Game and Fish Department (2017). We do not recognize *A. dejecta*, which is here placed in synonymy of *A. californiensis*.

Anodontoides *Simpson in Baker, 1898*.—Turgeon et al. (1998) recognized two species. One additional species, *Anodontoides denigrata*, was recognized without discussion by Neves et al. (1997) and Cicerello and Schuster (2003). Haag and Cicerello (2016) recognized *A. denigrata* on the basis of molecular data showing that upper Cumberland River drainage populations were distinct from *A. ferussacianus* (Bogan and Raley 2013), and we recognize this species for the same reason. Bogan and Raley (2013) referred to *A. denigrata* as *A. argenteus* (Lea, 1840), for which the type locality is Stones River, Tennessee. The Stones River is a tributary of the middle Cumberland River and well downstream of the putative distribution of *A. denigrata* and other species considered endemic to the upper Cumberland River drainage upstream of the hypothesized original location of Cumberland Falls (Haag and Cicerello 2016). Until further research delineates this species' distribution more precisely, we use *A. denigrata*, for which the type locality is in the upper Cumberland River drainage (Clear Fork, Campbell County, Tennessee; see Ortmann 1918). Ahlstedt et al. (2016) reported a possibly distinct *Anodontoides* species from the Powell River, Virginia, but further work is needed to determine its validity and taxonomy.

Arcidens *Simpson, 1900*.—Turgeon et al. (1998) recognized one species, *Arcidens confragosus*. Clarke (1981) considered *Arkansia* (see *Arkansia*) a junior synonym of *Arcidens* (see also Graf and Cummings 2007), and this classification was supported by morphological and molecular data (Inoue et al. 2014). We recognize two species of *Arcidens*.

Arkansia *Ortmann and Walker, 1912*.—*Arkansia* was described as a monotypic genus including *A. wheeleri*, which was recognized by Turgeon et al. (1998). We place *Arkansia* in the synonymy of *Arcidens* (see *Arcidens*).

Cyclonaias *Pilsbry in Ortmann and Walker, 1922*.—Turgeon et al. (1998) recognized *Cyclonaias*, which has long been considered a monotypic genus for *C. tuberculata*. *Cyclonaias tuberculata* has been aligned with the Quadrulini based on morphological (e.g., Frierson 1927; Modell 1964) and protein polymorphism data (Davis and Fuller 1981). Heard and Guckert (1971) placed *Cyclonaias* in the Pleurobemini based on its ectobranchous brooding (see also Graf and Cummings 2007). However, it appears that ectobranchy arose multiple times (Davis and Fuller 1981; Graf 2002; Roe and Hoeh 2003), meaning that this trait does not necessarily exclude *Cyclonaias* from the Quadrulini, and some female *C. tuberculata* brood glochidia in all four gills (Frierson 1927).

Recent molecular studies consistently supported inclusion of *Cyclonaias* in the Quadrulini, but they further show that it is a member of a monophyletic clade including *Q. pustulosa* and related species (Campbell et al. 2005; Campbell and Lydeard 2012b). Serb et al. (2003) did not support this relationship, but these results were later attributed to an error in sample labeling (Campbell and Lydeard 2012b). However, Serb et al. (2003) as well as Campbell et al. (2005) and Campbell and Lydeard (2012b) support the monophyly of the *Quadrula pustulosa* clade and its distinctiveness from other species of *Quadrula* (see *Quadrula* and *Theliderma*). In addition to *Cyclonaias tuberculata*, the *Quadrula pustulosa* clade identified by these studies includes the following species recognized by Turgeon et al. (1998): *Q. asperata*, *Q. aurea*, *Q. houstonensis*, *Q. nodulata*, *Q. petrina*, *Q. pustulosa*, and *Q. refulgens*, as well

as *Fusconaia succissa* and *Quincuncina infucata* (see *Fusconaia* and *Quincuncina*).

The name *Quadrula* is not available for the *Q. pustulosa* clade because the type species, *Q. quadrula*, is a member of another distinct, monophyletic clade (see *Quadrula*). Graf and Cummings (2007) elevated the generic name *Amphinaias* Crosse and Fischer, 1894, for the *Q. pustulosa* clade. The type species for *Amphinaias* (by original designation) is *Unio couchianus* Lea, 1860, which has a quadrate shell and sulcus (but lacks pustules) similar to the *Q. quadrula* clade. This morphology is very different from the rounded, pustulose shells of the *Q. pustulosa* clade. *Quadrula couchiana* is considered extinct and genetic data are unavailable; however, we do not consider *Amphinaias* an available name for the *Q. pustulosa* clade because of the strongly divergent morphology of the type species. Campbell and Lydeard (2012b) proposed *Rotundaria* Rafinesque, 1820, as a name for the *Q. pustulosa* clade, presuming its availability based on statements in Valenciennes (1827). However, Valenciennes noted that Rafinesque had confused two species, one for which he kept Rafinesque's name *Unio verrucosa* and named the other *Unio tuberculosa* [sic]. As such, Valenciennes's statement cannot be accepted as a subsequent designation of *Obliquaria tuberculata* Rafinesque, 1820, as the type species of *Rotundaria* (P. Bouchet, Muséum National d'Histoire Naturelle, Paris, personal communication), and Herrmannsen (1848) later designated *Obliquaria subrotunda* Rafinesque, 1820, as the type species of *Rotundaria*. Rafinesque did not select a type species for *Rotundaria* and because more than one species was included by him in the genus, the type species cannot be fixed by monotypy. Therefore, *Rotundaria* is not available for the *Q. pustulosa* clade. Frierson (1927) erected the subgenus *Bullata* for *Q. pustulosa* but realized this was preoccupied and created the replacement name *Pustulosa* with the same type species. Thus, *Cyclonaias* becomes the oldest available name for this group.

Of the 10 species discussed above as members of *Cyclonaias*, three were not recognized by Turgeon et al. (1998) (*C. archeri*, *C. kieneriana*, and *C. kleiniana*), and one was considered a subspecies (*C. mortoni*, as *Quadrula pustulosa mortoni*). Graf and Cummings (2007) elevated *Q. archeri* from synonymy with *Q. asperata*, but they provided no justification for this change. The distinctiveness of *C. archeri* was recognized by Williams et al. (2008) based on its morphology, absence of intergrades, and isolated and restricted distribution. We recognize *C. archeri*. The distinctiveness of *C. kieneriana* was recognized by Williams et al. (2008) based on shell morphology; however, it was not supported by molecular data (Serb et al. 2003), but that study included only one specimen of this putative taxon. We recognize *C. kieneriana* until additional information becomes available (see Williams et al. 2008). *Cyclonaias kleiniana* was synonymized under *Quincuncina infucata* by Clench and Turner (1956), but molecular studies supported the distinctiveness of these species and their inclusion in *Cyclonaias* (Lydeard et al. 2000; Campbell and Lydeard 2012b). Molecular data supported the distinctiveness of *C. mortoni* from *C. pustulosa* (Serb et al. 2003). In summary, we recognize *Cyclonaias* as including 14 species: *C. tuberculata*, seven species recognized by Turgeon et al. (1998) under *Quadrula*, one subspecies recognized by Turgeon et al. (1998) but now elevated to species status (*C. mortoni*), two species recognized by Turgeon et al. (1998) in different genera (*C. infucata* and *C. succissa*), and three species elevated from synonymy (*C. archeri*, *C. kieneriana*, and *C. kleiniana*).

Cyprogenia *Agassiz, 1852*.—Turgeon et al. (1998) recognized two species. Subsequent molecular data suggested cryptic species diversity in the genus (Serb and Barnhart 2008; Grobler et al. 2011). The most recent molecular analysis of *Cyprogenia* identified three independent evolutionary lineages: *C. aberti* in the Ozark drainages of Arkansas, Missouri, and Kansas; *C. stegaria* in the Ohio River Basin; and a third lineage in the Ouachita River drainage in Arkansas (Chong et al. 2016). Confusion regarding the type locality of *Unio lamarckianus* Lea, 1852, requires resolution to determine whether that name is available for the Ouachita River drainage population. We recognize the distinctiveness of this species but defer including it in our list until a specific epithet can be designated.

Cyrtonaias *Crosse and Fischer, 1894*.—Turgeon et al. (1998) recognized one species, *Cyrtonaias tampicoensis*, and recent evidence supports no changes to this classification. Five other species are recognized, all of which occur in Mexico or Central America (Graf and Cummings 2017).

Disconaias *Crosse and Fischer, 1894*.—Turgeon et al. (1998) recognized one species, *Disconaias salinasensis* Simpson in Dall, 1908, which was subsequently placed in the synonymy of *Disconaias fimbriata* by Graf and Cummings (2007). Five other species are recognized, all of which occur in Mexico (Graf and Cummings 2017). We recognize *Disconaias fimbriata* as the only species of the genus occurring in the United States (Rio Grande drainage).

Dromus *Simpson, 1900*.—Turgeon et al. (1998) recognized one species, *Dromus dromas*, and recent evidence supports no changes to this classification.

Ellipsaria *Rafinesque, 1820*.—Turgeon et al. (1998) recognized one species, *Ellipsaria lineolata*, and recent evidence supports no changes to this classification.

Elliptio *Rafinesque, 1819*.—Turgeon et al. (1998) recognized 36 species, making it the largest unionid genus in the United States and Canada, but species concepts within this group remain mostly untested, and their highly variable shell morphology precludes traditional approaches for species diagnosis. Recent molecular studies have largely supported the monophyly of *Elliptio* with two exceptions (Campbell et al. 2005; Campbell and Lydeard 2012b; Perkins et al. 2017). *Elliptio dilatata*, which is morphologically and anatomically similar to many *Elliptio*, is not a member of this group; we recognize reassignment of this species to *Eurynia* (Campbell and Lydeard 2012b). We also recognize reassignment of *Elliptio steinstansana* to *Parvaspina* based on molecular data (Perkins et al. 2017). It is important to note that phylogenetic

affinities remain unknown for most species that we currently recognize under *Elliptio* and some may prove to be members of other genera (e.g., *Eurynia*; Elderkin et al. 2008; Campbell and Lydeard 2012b).

Because of our poor understanding of species diversity within *Elliptio*, we largely retain the classification of Turgeon et al. (1998) with the following exceptions. We stress that this classification is provisional and meant to provide a stable, working hypothesis for diversity within the genus. We elevate from synonymy four species of *Elliptio*: *E. fumata* (from *E. complanata*), *E. occulta* and *E. pullata* (from *E. icterina*), and *E. purpurella* (from *E. arctata* and *E. strigosa*); these changes are based primarily on differences in shell morphology (Brim Box and Williams 2000; Williams et al. 2008, 2011, 2014). We place eight species into synonymy. Four Atlantic Slope species (*E. errans*, *E. hepatica*, *E. lugubris*, and *E. raveneli*) were recognized by Turgeon et al. (1998) based on Davis and Mulvey (1993). The research by Davis and Mulvey (1993) was confined almost exclusively to the Savannah River drainage and has no context within the greater Atlantic Coast region. The validity of these species has not been evaluated further. We return these species to synonymy following Johnson (1970) as follows: *E. errans* is synonymized under *E. complanata*; and *E. hepatica*, *E. lugubris*, and *E. raveneli* are synonymized under *E. icterina*. We place *Elliptio waccamawensis* into the synonymy of *E. congaraea* based on molecular data (McCartney et al. 2016). We place the following species into synonymy based on examination of shell type material by Clarke (1992) and Williams et al. (2011, 2014): *E. waltoni* (synonymized under *E. ahenea*), *E. judithae* (synonymized under *E. roanokensis*), and *E. buckleyi* (synonymized under *E. jayensis*). After these changes, we recognize 30 species of *Elliptio*, and it remains the largest unionid genus in the United States and Canada.

Turgeon et al. (1998) listed the common names Flat Spike and Florida Shiny Spike for *Elliptio jayensis* and *E. buckleyi*, respectively. We follow the recommendation of Williams et al. (2014) that the common name of *E. jayensis* be changed to Florida Spike because the species is largely endemic to that state and is neither consistently flat nor shiny.

Elliptoideus *Frierson, 1927*.—Turgeon et al. (1998) recognized one species, *Elliptoideus sloatianus*, and recent evidence supports no changes to this classification.

Epioblasma *Rafinesque, 1831*.—Turgeon et al. (1998) recognized 20 species and five subspecies. Our changes to this classification involve recognition of two newly described cryptic species, elevating one species from synonymy, and elevating subspecies to species status. We recognize *Epioblasma ahlstedti* Jones and Neves, 2010, a cryptic species formerly included within *E. capsaeformis*, and we recognize and elevate to species status *Epioblasma aureola* Jones and Neves, 2010, formerly identified as *E. florentina walkeri* but described as *E. florentina aureola* Jones and Neves, 2010.

Epioblasma cincinnatiensis was not recognized by Turgeon et al. (1998), and it has been considered a synonym (e.g., Parmalee and Bogan 1998) or a subspecies (e.g., Morrison 1942) of *Epioblasma torulosa*. Williams et al. (2008) elevated this species from synonymy based on examination of shell type material. Watters et al. (2009) also recognized this taxon but placed it in the synonymy of *Epioblasma phillipsii* (Conrad, 1835). However, *E. phillipsii* is considered a synonym of *Obliquaria reflexa* (see Williams et al. 2008). We follow Williams et al. (2008) in recognizing *E. cincinnatiensis*.

Turgeon et al. (1998) recognized eight subspecies of *Epioblasma* in three nominal species: *florentina* (three), *obliquata* (two), and *torulosa* (three). A conclusive assessment of the taxonomic status of these taxa may be impossible at this time because half are considered extinct (*E. florentina florentina*, *E. f. curtisii*, *E. torulosa torulosa*, and *E. t. gubernaculum*). Cummings and Berlocher (1990) found no evidence of intergradation between *E. t. torulosa* and *E. t. rangiana* and both taxa co-occurred at many sites; based on this evidence, we elevate these subspecies to species status. *Epioblasma aureola* and *E. walkeri* represent morphologically and genetically distinct sister taxa (Jones and Neves 2010, as *E. florentina aureola* and *E. florentina walkeri*). These taxa appear to be restricted to two different river systems (Tennessee and Cumberland, respectively); based on the low probability of exchange between these populations and their distinctiveness, we recognize and elevate to full species status *E. aureola* and *E. walkeri*. There is little information with which to assess the taxonomic status of *E. florentina florentina*, *E. florentina curtisii*, *E. obliquata obliquata*, *E. obliquata perobliqua*, and *E. torulosa gubernaculum*, but all have distinctive shell morphology or occupy distinct geographical regions and we recognize all these taxa as distinct species (see Methods).

We recognize 28 *Epioblasma* species, making it the second largest unionid genus in the United States and Canada.

Eurynia *Rafinesque, 1820*.—*Eurynia* was not recognized in Turgeon et al. (1998). *Eurynia* was elevated from synonymy by Campbell and Lydeard (2012b) to accommodate *Elliptio dilatata*, which consistently falls outside the *Elliptio* clade in molecular analyses (see also Perkins et al. 2017). We consider *Eurynia* monotypic at this time, but more inclusive molecular studies may identify other species that belong to this genus, including some now assigned to *Elliptio* (Elderkin et al. 2008; Campbell and Lydeard 2012b).

Fusconaia *Simpson, 1900*.—Turgeon et al. (1998) recognized 13 species. Several studies showed that the genus *Fusconaia* as portrayed by Turgeon et al. (1998) was polyphyletic (Lydeard et al. 2000; Serb et al. 2003; Campbell et al. 2005; Campbell and Lydeard 2012a, 2012b; Pfeiffer et al. 2016). Based on these results, we reassign three species recognized by Turgeon et al. (1998) to other genera: *F. succissa* to *Cyclonaias*, *F. barnesiana* to *Pleuronaia*, and *F. ebenus* to *Reginaia*. *Pleuronaia* was resurrected to accommodate *F. barnesiana*, along with two other species in the clade (Williams et al. 2008; Campbell and Lydeard 2012a, 2012b; see *Pleuronaia*). *Reginaia* was described to accommodate *F.*

ebenus and two other species (Campbell and Lydeard 2012a; see *Reginaia*).

These studies also showed that several species assigned to other genera belonged in *Fusconaia*. Based on these results, *Quincuncina* is a junior synonym of *Fusconaia*, and we reassign *Q. burkei* and *Q. mitchelli* to *Fusconaia* (Lydeard et al. 2000; Serb et al. 2003; Campbell et al. 2005; Pfeiffer et al. 2016; see *Cyclonaias*, *Quadrula*, and *Quincuncina*). *Lexingtonia* was placed in the synonymy of *Fusconaia* when its type species, *L. subplana*, was determined a junior synonym of *Fusconaia masoni* based on molecular data (Bogan et al. 2003).

Fusconaia chunii was not recognized by Turgeon et al. (1998), but they recognized two other *Fusconaia* from Texas: *F. askewi* and *F. lananensis*. Subsequent molecular data showed that all *Fusconaia* in Texas drainages from the Sabine River west belonged to a single species (Burlakova et al. 2012). However, *Unio chunii* Lea, 1861, has priority over *Unio askewi* Marsh, 1896, and *Quadrula lananensis* Frierson, 1901, so we place *F. askewi* and *F. lananensis* in the synonymy of *F. chunii*.

We adopt the former common name for *F. askewi*, Texas Pigtoe, for *F. chunii* because it is descriptive of the species' range. Turgeon et al. (1988) listed the common name Gulf Pigtoe for *Fusconaia cerina*, but it was changed to Southern Pigtoe in Turgeon et al. (1998) without comment. However, Turgeon et al. (1998) also used Southern Pigtoe as the common name of *Pleurobema georgianum*. We designate the common name Gulf Pigtoe for *F. cerina*.

In summary, we recognize 11 species of *Fusconaia*, including eight species recognized by Turgeon et al. (1998) under *Fusconaia*, two species recognized by Turgeon et al. (1998) in other genera, and one species elevated from synonymy.

Glebula *Conrad, 1853*.—Turgeon et al. (1998) recognized one species, *Glebula rotundata*, and recent evidence supports no changes to this classification.

Gonidea *Conrad, 1857*.—Turgeon et al. (1998) recognized one species, *Gonidea angulata*, and recent evidence supports no changes to this classification.

Hamiota *Roe and Hartfield, 2005*.—*Hamiota* was described subsequent to Turgeon et al. (1998) to accommodate a monophyletic clade of four species that produce superconglutinates (Roe et al. 2001). They were previously recognized under *Lampsilis*: *L. altilis*, *L. australis*, *L. perovalis*, and *L. subangulata* (Roe and Hartfield 2005). We recognize all four of these species under *Hamiota*.

Hemistena *Rafinesque, 1820*.—Turgeon et al. (1998) recognized one species, *Hemistena lata*, and recent evidence supports no changes to this classification.

Lampsilis *Rafinesque, 1820*.—Turgeon et al. (1998) recognized 28 species and four subspecies. Molecular data indicated that *Lampsilis*, as presented by Turgeon et al. (1998), is polyphyletic (Graf and Ó Foighil 2000; Campbell et al. 2005). There are likely unrecognized taxa in the genus *Lampsilis* (e.g., in Arkansas; Harris et al. 2009). The genus *Hamiota* was described to accommodate a monophyletic clade of four species, *Lampsilis altilis*, *L. australis*, *L. perovalis*, and *L. subangulata* (Roe and Hartfield 2005), and we recognize reassignment of these species from *Lampsilis* to *Hamiota*. We also recognize reassignment of *Lampsilis haddletoni* to *Obovaria* (Williams et al. 2008; see *Obovaria*). In addition to *Hamiota*, molecular data suggested the existence of at least two other paraphyletic clades within *Lampsilis* as recognized by Turgeon et al. (1998). *Lampsilis cardium*, *L. ornata*, and *L. ovata* formed a monophyletic clade sister to *Hamiota*, and *L. siliquoidea* and *L. teres* were members of a clade sister to the latter two groups; however, these groupings were not consistently or strongly supported, and the analyses did not include other species of putative *Lampsilis* (Campbell et al. 2005). Additional generic-level changes regarding *Lampsilis* will likely occur in the future, but we retain traditional use of this genus for all species except those reassigned to *Hamiota* and *Obovaria*.

Lampsilis floridensis was not recognized by Turgeon et al. (1998), and formerly it was recognized as a subspecies (Clench and Turner 1956) or synonym (Burch 1975) of *Lampsilis teres*. We recognize *L. floridensis* as a full species based on shell morphology, unpublished molecular data, and its allopatric distribution (Williams et al. 2008).

Turgeon et al. (1998) recognized nominal *Lampsilis reeveiana* along with two subspecies, *L. r. brevicula* and *L. r. brittsi*. Molecular data showed that *brittsi* populations from the Missouri River drainage formed a well-supported monophyletic clade separate from nominal *reeveiana*, but there was no morphological or genetic distinction between nominal *L. reeveiana* and *L. r. brevicula* (Harris et al. 2004). Based on these data, we follow McMurray et al. (2012) in recognizing *L. brittsi* and *L. reeveiana* as species and placing *L. reeveiana brevicula* into the synonymy of *L. reeveiana*.

Turgeon et al. (1998) recognized nominal *Lampsilis radiata* and one subspecies, *L. r. conspicua*. However, molecular and shell morphology data did not support the distinctiveness of *L. r. conspicua* (Stiven and Alderman 1992), and we place this taxon into the synonymy of *Lampsilis radiata*. Turgeon et al. (1998) also recognized *Lampsilis fullerkati*, but we recognize placement of that species into the synonymy of *L. radiata* based on molecular data (McCartney et al. 2016).

Turgeon et al. (1998) recognized nominal *Lampsilis straminea* and one subspecies, *L. s. claibornensis*. *Lampsilis straminea straminea* is restricted to the Black Belt Prairie region of Alabama and Mississippi and is characterized by a profusion of fine, concentric ridges on the shell, which are absent in *L. s. claibornensis*. However, concentric ridges are present in some other mussels inhabiting streams in the Black Belt Prairie region and are most likely environmentally induced and not due to genetic differences (Williams et al. 2008). We do not recognize the taxonomic validity of these shell forms and place *L. s. claibornensis* in the synonymy of *Lampsilis straminea*. The common name of *Lampsilis s. straminea*, Rough Fatmucket (Turgeon et al. 1998), is

descriptive of individuals in only a small portion of its range (i.e., the Black Belt Prairie). Therefore, we retain the common name for *L. straminea claibornensis*, Southern Fatmucket, for *L. straminea*.

In summary, we recognize 24 species of *Lampsilis* including one species elevated from synonymy and two species elevated from subspecies. *Lampsilis* is the third largest genus in the family Unionidae following *Elliptio* (30) and *Epioblasma* (28).

Lasmigona *Rafinesque, 1831*.—Turgeon et al. (1998) recognized six species and one subspecies. Williams et al. (2008) elevated *Lasmigona complanata alabamensis* to species status based on examination of museum shell material, and molecular data supported the distinctiveness of this taxon (King et al. 1999). Williams et al. (2008) also recognized Mobile Basin populations of *Lasmigona holstonia* as a distinct species based on unpublished molecular data and the occurrence of these populations in two different river systems. They resurrected from synonymy *Lasmigona etowaensis* to refer to Mobile Basin populations and retained *L. holstonia* to refer to Tennessee and Ohio River drainage populations. We recognize all three of these species.

Molecular studies showed that *Lasmigona* is polyphyletic: *L. alabamensis*, *L. complanata*, and *L. costata* formed a monophyletic clade, and *L. compressa* and *L. subviridis* represented another monophyletic clade more closely related to *Alasmidonta* (King et al. 1999). However, this study did not include all species of *Lasmigona*, and a broader study within the context of the tribe Anodontini is needed to clarify these relationships. Populations of *Lasmigona costata* in the Ozark Highlands represented a monophyletic clade strongly differentiated from populations east of the Mississippi River, suggesting the presence of at least one cryptic species within this taxon; additional investigation across the range of *L. costata* is needed to better understand these patterns (Hewitt et al. 2016). An endemic form of *Lasmigona* in the Barrens region of the upper Caney Fork drainage in Tennessee was recognized by Layzer et al. (1993), but the status of this putative taxon has not been evaluated further.

Lemiox *Rafinesque, 1831*.—Turgeon et al. (1998) recognized one species, *Lemiox rimosus*, and recent evidence supports no changes to this classification.

Leptodea *Rafinesque, 1820*.—Turgeon et al. (1998) recognized three species, and recent evidence supports no changes to this classification. Smith (2000) proposed moving *Leptodea ochracea* into the genus *Ligumia* based on mantle margin pigment and size of glochidia. We do not accept this proposal due to the limited number of taxa (four species in two genera) in that analysis, and we retain *ochracea* in *Leptodea*.

Lexingtonia *Ortmann, 1914*.—Turgeon et al. (1998) recognized two species. However, the type species, *Lexingtonia subplana*, was subsequently relegated to the synonymy of *Fusconaia masoni* based on Johnson (1970) and Bogan et al. (2003). As such, *Lexingtonia* is a junior synonym of *Fusconaia*. The other species recognized by Turgeon et al. (1998), *Lexingtonia dolabelloides*, did not group with *Fusconaia* in molecular analyses but formed a monophyletic clade with two other species (Campbell et al. 2005; Campbell and Lydeard 2012a, 2012b). *Pleuronaia* was resurrected by Williams et al. (2008) to accommodate this clade (see *Pleuronaia*).

Ligumia *Swainson, 1840*.—Turgeon et al. (1998) recognized three species. Subsequent molecular studies indicated the genus is not monophyletic, but further research is needed to fully elucidate these patterns (Campbell et al. 2005; Kuehnl 2009). We retain the classification of Turgeon et al. (1998), but as additional information becomes available taxa assigned to this genus will likely change (see Raley et al. 2007). Gangloff et al. (2013) identified a genetically divergent clade of *Ligumia recta* from the Mobile Basin that may warrant recognition as a distinct taxon.

Medionidus *Simpson, 1900*.—Turgeon et al. (1998) recognized seven species. We no longer recognize *Medionidus mcglameriae*, which was placed in the synonymy of *Leptodea fragilis* based on examination of the type specimen (Williams et al. 2008). Campbell et al. (2005) found some evidence for polyphyly of *Medionidus*, but this evidence was not conclusive and we make no other changes to this genus.

Megalonaias *Utterback, 1915*.—Turgeon et al. (1998) recognized one species, *Megalonaias nervosa*, and recent evidence supports no changes to this classification.

Obliquaria *Rafinesque, 1820*.—Turgeon et al. (1998) recognized one species, *Obliquaria reflexa*, and recent evidence supports no changes to this classification.

Obovaria *Rafinesque, 1819*.—Turgeon et al. (1998) recognized six species. Molecular data showed that *Obovaria* as depicted by Turgeon et al. (1998) is polyphyletic (Campbell et al. 2005). Notably, *Obovaria rotulata* was not a member of this group, and it was later reassigned to *Reginaia* (Campbell and Lydeard 2012b); we recognize this reassignment. In an analysis by Campbell et al. (2005), *O. olivaria* fell outside the clade containing other *Obovaria* and *Epioblasma*, but this conclusion was not consistently supported. We retain *olivaria* within *Obovaria*, but further work on this species is needed to resolve its generic assignment.

Evidence also supports reassignment to *Obovaria* of species recognized by Turgeon et al. (1998) under other genera. We reassign *Villosa arkansasensis* and *V. choctawensis* to *Obovaria* based on molecular data (Kuehnl 2009; Inoue et al. 2013) and marsupial morphology (Williams et al. 2011, for *choctawensis*). We also recognize reassignment of *Lampsilis haddletoni* to *Obovaria* based on shell morphology of the type lot (Williams et al. 2008, 2011), but this species is considered extinct and there are no available soft parts for anatomical or molecular study. *Obovaria jacksoniana* was recognized in Turgeon et al. (1998) but is synonymous with *Villosa arkansasensis* (Inoue et al. 2013). *Unio jacksoniana* Frierson, 1912, is a junior synonym of *Unio arkansasensis* Lea, 1862, and we place *O. jacksoniana* in the synonymy of *Obovaria arkansasensis*. There is also potential for unrecognized taxa within *O. arkansasensis* in central Gulf Slope drainages (Inoue et al. 2013).

In summary, we recognize seven species of *Obovaria*, including four species recognized by Turgeon et al. (1998) and three species reassigned from other genera, one from *Lampsilis* and two from *Villosa*.

Parvaspina *Perkins, Gangloff, and Johnson, 2017*.—*Parvaspina* was described subsequent to Turgeon et al. (1998) to accommodate a monophyletic clade of two species previously recognized as *Elliptio steinstansana* and *Pleurobema collina* (Perkins et al. 2017). We recognize these species as *Parvaspina steinstansana* and *Parvaspina collina*.

Pegias *Simpson, 1900*.—Turgeon et al. (1998) recognized one species, *Pegias fabula*, and recent evidence supports no changes to this classification.

Plectomerus *Conrad, 1853*.—Turgeon et al. (1998) recognized one species, *Plectomerus dombeyanus*, and recent evidence supports no changes to this classification.

Plethobasus *Simpson, 1900*.—Turgeon et al. (1998) recognized three species, and recent evidence supports no changes to this classification.

Pleurobema *Rafinesque, 1819*.—Turgeon et al. (1998) recognized 32 species, making it one of the largest unionid genera. Molecular data largely support the monophyly of *Pleurobema* as depicted by Turgeon et al. (1998) with two exceptions (Campbell et al. 2005, 2008; Campbell and Lydeard 2012b). These studies support reassignment of *P. collina* to *Parvaspina* and *P. gibberum* to *Pleuronaia* (Campbell et al. 2005, 2008; Campbell and Lydeard 2012b; see *Parvaspina* and *Pleuronaia*). However, Campbell et al. (2008) and Campbell and Lydeard (2012b) provided evidence that *Pleurobema* includes two distinct lineages, one including *P. sintoxia*, *P. cordatum*, *P. plenum*, *P. riddellii*, and *P. rubrum* and the other including all other species. Further research is needed to elucidate these relationships; we retain traditional use of *Pleurobema*.

Pleurobema rivals *Elliptio* in its large number of described species and the intractability of many species concepts, particularly in the Mobile Basin, but these problems are compounded for *Pleurobema* because many putative taxa are considered extinct. Based on a comprehensive comparison of shell type specimens and other available material, Williams et al. (2008) placed into synonymy nine species of Mobile Basin *Pleurobema* recognized by Turgeon et al. (1998): *P. chattanoogaense* (into *P. decisum*); *P. murrayense* (into *P. stabile*); *P. nucleopsis* and *P. troschelianum* (into *P. georgianum*); *P. flavidulum* and *P. johannis* (into *P. perovatum*); and *P. avellanum*, *P. furvum*, and *P. hagleri* (into *P. rubellum*). Some of these synonyms are further supported by molecular data (e.g., *P. chattanoogaense*, *P. furvum*; Campbell et al. 2008), and we recognize all of these changes. We do not recognize *Pleurobema altum* since it was deemed a nomen dubium because it is not identifiable due to incomplete description, vague type locality, and lack of type material (Williams et al. 2008). One Ohio River drainage species, *Pleurobema bournianum*, was placed into the synonymy of *Pleurobema clava* based on shell morphology (Watters et al. 2009), and we recognize this change.

We recognize four additional Mobile Basin species of *Pleurobema* not recognized by Turgeon et al. (1998). Williams et al. (2008) recognized three species based on examination of shell type specimens: *P. fibuloides*, *P. hartmanianum*, and *P. stabile*. We correct the spelling of *P. stabilis* as used by Williams et al. (2008) to *stabile* based on Lee (2008). *Pleurobema athearni* Gangloff, Williams, and Feminella, 2006, was described subsequent to Turgeon et al. (1998) based on morphological data (Gangloff et al. 2006). In addition, preliminary findings identified an undescribed species in the upper Tennessee River drainage (Schilling 2015).

In summary, we recognize 23 species of *Pleurobema*, including 19 species recognized by Turgeon et al. (1998), three species elevated from synonymy, and one newly described species.

Pleuronaia *Frierson, 1927*.—*Pleuronaia* was not included in Turgeon et al. (1998). This was the senior available name for a monophyletic clade of three species—*Fusconaia barnesiana*, *Lexingtonia dolabelloides*, and *Pleurobema gibberum*—identified in a molecular study by Campbell et al. (2005). We recognize resurrection of *Pleuronaia* to accommodate this group and reassignment of these three species to *Pleuronaia* as proposed previously (Williams et al. 2008; Campbell and Lydeard 2012a, 2012b). There are likely cryptic taxa of *Pleuronaia* in the upper Tennessee River drainage (Schilling 2015). We correct the gender agreement of the specific name of *Pleuronaia gibberum* to *gibber* (H. Lee, Jacksonville, Florida, personal communication).

Popenais *Frierson, 1927*.—Turgeon et al. (1998) recognized one species, *Popenais popeii*, and recent evidence supports no changes to this classification.

Potamilus *Rafinesque, 1818*.—Turgeon et al. (1998) recognized six species. One additional species, *Potamilus metnecktayi* Johnson, 1998, was described subsequently, and we recognize this species. *Potamilus inflatus* was referred to as the Inflated Heelsplitter by Turgeon et al. (1988) but was changed to Alabama Heelsplitter by Turgeon et al. (1998) without comment. Alabama Heelsplitter is the established common name for *Lasmigona alabamensis*, and we adopt the original common name Inflated Heelsplitter for *P. inflatus*. Roe and Lydeard (1998) found the Amite River population of *P. inflatus* to be genetically divergent, and it may warrant recognition as a distinct taxon.

Ptychobranchus *Simpson, 1900*.—Turgeon et al. (1998) recognized five species. *Ptychobranchus foremanianus* was elevated from the synonymy of *Ptychobranchus greenii* (in part) by Williams et al. (2008) based on shell morphology and periostracum color. A molecular analysis of this genus included insufficient material to resolve the relationship between these two taxa (Roe 2013), but we recognize both species. We correct the gender agreement of *Ptychobranchus subtentum* to *P. subtentus* following Lee (2008).

Pyganodon *Crosse and Fischer, 1894*.—Turgeon et al. (1998) recognized five species. Graf and Cummings (2007) without comment moved *Anodonta implicata* to *Pyganodon*

and omitted *P. fragilis* and *P. lacustris*. However, molecular data demonstrated the validity of *P. fragilis* and *P. lacustris* (Doucet-Beaupré et al. 2012). Based on these results and the lack of justification for movement of *A. implicata* to *Pyganodon*, we retain the classification of Turgeon et al. (1998) for *Pyganodon*.

Quadrula *Rafinesque, 1820*.—Turgeon et al. (1998) recognized 18 species and two subspecies. Molecular studies generally supported the monophyly of *Quadrula* as depicted by Turgeon et al. (1998), but they also showed that it is composed of three deeply divergent monophyletic clades plus *Tritogonia verrucosa*, each of which warranted generic recognition (Serb et al. 2003; Campbell et al. 2005; Campbell and Lydeard 2012b). The type species for *Quadrula* is *Q. quadrula*, and the clade containing this species also includes *Q. apiculata*, *Q. fragosa*, *Q. nobilis*, and *Q. rumphiana*. *Quadrula nobilis* was elevated from synonymy based on shell morphology and unspecified genetic data (Howells et al. 1996) but not recognized by Turgeon et al. (1998). Relationships among species in the *Q. quadrula* group were not clearly resolved by Serb et al. (2003), but we recognize all five species. We also recognize within this group *Q. couchiana* on the basis of its shell morphology, which is similar to that of *Q. quadrula* (see *Cyclonaias*).

Based on molecular data, we reassign to *Cyclonaias* 10 taxa recognized by Turgeon et al. (1998) under *Quadrula*, and we reassign 5 species to *Theliderma* (Serb et al. 2003; Campbell et al. 2005; Campbell and Lydeard 2012b; see also Graf and Cummings 2007). We also synonymize two taxa recognized by Turgeon et al. (1998) under *Quadrula* (see *Theliderma*). In summary, we recognize six species of *Quadrula*, including five recognized under this genus by Turgeon et al. (1998) and one elevated from synonymy (*Q. nobilis*).

Quincuncina *Ortmann, 1922*.—Turgeon et al. (1998) recognized three species. Molecular data showed that the type species, *Quincuncina burkei*, belongs in *Fusconaia* (Lydeard et al. 2000; Serb et al. 2003; Campbell et al. 2005). As such, *Quincuncina* is a junior synonym of *Fusconaia*, and we reassign to this genus *Q. burkei* and *Q. mitchelli* (see also Pfeiffer et al. 2016). Based on these findings, we also reassign *Q. infucata* to *Cyclonaias* (see *Cyclonaias*).

Reginaia *Campbell and Lydeard, 2012*.—*Reginaia* was described subsequent to Turgeon et al. (1998) to accommodate a monophyletic clade of two species identified in a phylogenetic analysis of Ambleminae (Campbell and Lydeard 2012b). The two *Reginaia* species were included in Turgeon et al. (1998) as *Fusconaia ebena* and *Obovaria rotulata* (Campbell and Lydeard 2012b); we recognize assignment of these species to *Reginaia*. We follow Watters et al. (2009) in correcting the spelling of the species name *ebena* to *ebenus*. A third species, *Fusconaia apalachicola* Williams and Fradkin, 1999, was described subsequent to Turgeon et al. (1998) from archaeological material; we reassign this species to *Reginaia* based on its shell characters, which are similar to those of *R. ebenus* and *R. rotulata*.

Simpsonaias *Frierson, 1914*.—Turgeon et al. (1998) recognized one species, *Simpsonaias ambigua*, and recent evidence supports no changes to this classification.

Sinanodonta *Modell, 1945*.—*Sinanodonta* was not included in Turgeon et al. (1998). This genus was previously considered to be confined to Asia and not part of the North America fauna. Molecular data showed that *A. beringiana* is more closely related to the Asian species *Sinanodonta woodiana* than to other western North American *Anodonta* (Chong et al. 2008; see *Anodonta*). Based on this evidence, we reassign *beringiana* to *Sinanodonta*. In 2010 *S. woodiana*, Chinese Pondmussel, was found in Wickecheoke Creek, a tributary of the Delaware River, New Jersey (Bogan et al. 2011a). Several known glochidial host fishes, native and introduced species, occur in the watershed (Bogan et al. 2011b). The species appears to have become established in that stream despite eradication efforts (J. Bowers-Altman, New Jersey Division of Fish and Wildlife, personal communication). We recognize *S. woodiana* as established in New Jersey (Table 2). This is the only nonindigenous unionid mussel known to have become established in the United States or Canada.

Strophitus *Rafinesque, 1820*.—Turgeon et al. (1998) recognized three species, and recent evidence supports no changes to this classification. *Strophitus undulatus*, one of the most wide-ranging species in the United States and Canada, likely contains unrecognized cryptic taxa (Watters et al. 2009).

Theliderma *Swainson, 1840*.—*Theliderma* was not recognized by Turgeon et al. (1998). This genus was resurrected from synonymy by Graf and Cummings (2007) to accommodate a monophyletic clade of five species recognized by Turgeon et al. (1998) under *Quadrula* (*Q. cylindrica*, *Q. intermedia*, *Q. metanevra*, *Q. sparsa*, and *Q. stapes*; see Serb et al. 2003). *Theliderma* is the oldest available name for this clade and has *T. metanevra* as its type species. We recognize placement of all five of these species in *Theliderma*. No molecular data are available for *Theliderma stapes*, but its shell morphology is very similar to that of other *Theliderma*, and we include it in this genus following Graf and Cummings (2007).

Turgeon et al. (1998) recognized *Quadrula tuberosa*, but we place this taxon in the synonymy of *Theliderma metanevra* following Parmalee and Bogan (1998, as *Q. metanevra*). However, the relationship of *tuberosa* to other species is uncertain, and if it represents a valid species, it is considered extinct (see Haag and Cicerello 2016). *Quadrula cylindrica* was recognized in Turgeon et al. (1998) as containing two subspecies, *Theliderma cylindrica cylindrica* and *T. cylindrica strigillata*. These subspecies traditionally were distinguished from each other based on shell morphology and distribution, with *strigillata* being confined mainly to the upper Tennessee River system in Tennessee and Virginia (Parmalee and Bogan 1998). However, the distributional limits of *strigillata* have never been clearly defined as it grades into typical *T. c. cylindrica* in larger streams, suggesting that the shell forms represent ecophenotypic variation (Ortmann 1920), and

molecular data provide no support for recognition of *T. c. strigillata* (Serb et al. 2003; Sproules et al. 2006). Based on this evidence, we do not recognize subspecies within *T. cylindrica*. Both *T. c. cylindrica* (threatened) and *T. c. strigillata* (endangered) are federally protected taxa. Synonymizing *strigillata* under *T. cylindrica* will not remove the protection provided by the Endangered Species Act but may impact the status of populations formerly recognized as *strigillata*.

Toxolasma *Rafinesque, 1831*.—Turgeon et al. (1998) recognized eight species. Recent evidence supports no changes at the genus level, but species boundaries within *Toxolasma* remain uncertain. Howells et al. (1996) placed *Toxolasma mearnsi* in the synonymy of *Toxolasma texasiense* based on electrophoretic analysis, a change overlooked by Turgeon et al. (1998); we recognize placement of *T. mearnsi* in the synonymy of *T. texasiense*. Undescribed species of *Toxolasma* have been recognized (e.g., Gulf Lilliput) but have yet to be formerly described (Williams et al. 2008, 2014).

Lee (2006) concluded that *Toxolasma* has a neuter gender, which necessitates correction of spellings from *lividus* to *lividum*, *parvus* to *parvum*, and *paulus* to *paulum*, without change to *corvunculus*, *cylindrellus*, or *pullus*; we recognize these spelling changes. Lee (2006) provided an incorrect spelling of *Toxolasma texasiense* (as *texasense*), but we correct it based on the spelling presented in the original description.

Tritogonia *Agassiz, 1852*.—Turgeon et al. (1998) recognized one species, *Tritogonia verrucosa*. Molecular data clearly supported inclusion of *T. verrucosa* within the tribe Quadrulini, but its placement within that group was unresolved, and Serb et al. (2003) recommended its placement within *Quadrula* (*sensu lato*) until relationships were better understood (e.g., see Williams et al. 2008; Haag and Cicerello 2016). Regardless of its relationship to other clades within the Quadrulini, *Tritogonia* represents a deeply divergent lineage (Serb et al. 2003; Campbell et al. 2012b), and our recognition of three other genera within this tribe (*Cyclonaias*, *Theliderma*, and *Quadrula* sensu stricto) warrants retention of *Tritogonia* as a monotypic genus (e.g., see Watters et al. 2009; Sietman et al. 2012).

Truncilla *Rafinesque, 1819*.—Turgeon et al. (1998) recognized four species, and recent evidence supports no changes to this classification.

Uniomerus *Conrad, 1853*.—Turgeon et al. (1998) recognized three species. Recent evidence supports no changes at the genus level, but species concepts within *Uniomerus* are uncertain (see Williams et al. 2008). *Uniomerus columbensis* was not recognized by Turgeon et al. (1998) but was elevated from synonymy by Williams et al. (2008) based on unpublished molecular data and shell morphology; we recognize this change. Species boundaries for other taxa (e.g., *Uniomerus declivis*) remain unresolved.

The inappropriate and misleading common name for *Uniomerus carolinianus*, Florida Pondhorn, was changed to Eastern Pondhorn by Williams et al. (2014) because the species occurs not only in Florida but northward along the Atlantic Coast; we recognize this change.

Utterbackia *Baker, 1927*.—Turgeon et al. (1998) recognized three species and recent evidence supports no changes to this classification.

Utterbackiana *Frierson, 1927*.—*Utterbackiana* was not recognized by Turgeon et al. (1998). We resurrect this genus as the senior available name for a monophyletic clade of four eastern North American species included in Turgeon et al. (1998) under *Anodonta* (*A. couperiana*, *A. heardi*, *A. implicata*, and *A. suborbiculata*; Mock et al. 2004; Zanatta et al. 2007; see *Anodonta*). The type species for the genus is *Anodonta suborbiculata* Say, 1831. In addition to the four taxa mentioned above, a new species was described subsequent to Turgeon et al. (1998), *Anodonta hartfieldorum* (Williams et al. 2009). We also place this species in *Utterbackiana* because it appears closely related to *U. suborbiculata* and was formerly associated with that species.

Venustaconcha *Frierson, 1927*.—Turgeon et al. (1998) recognized two species. Molecular data showed that *Villosa perpurpurea* and *Villosa trabalis* also are members of *Venustaconcha* (Kuehnl 2009; Lane et al. 2016). Molecular data further showed that *Venustaconcha perpurpurea* is a junior synonym of *Venustaconcha trabalis*, and populations of this species in the Tennessee River drainage are genetically and morphologically distinct from those in the Cumberland River drainage (Lane et al. 2016). Based on the type locality of *trabalis*, Flint River, Alabama, this name is applicable to the Tennessee River drainage species. *Unio troostensis* Lea, 1834, is the oldest available name for the Cumberland drainage species (type locality is Stones River, Tennessee), and we recognize this species as *Venustaconcha troostensis* (see Haag and Cicerello 2016; Lane et al. 2016). Cumberland Bean was the common name used for *V. trabalis* by Turgeon et al. (1998), but Lane et al. (2016) proposed Tennessee Bean for *Venustaconcha trabalis* and Cumberland Bean for *Venustaconcha troostensis*; we follow this use. *Venustaconcha sima* was not included in Turgeon et al. (1998) but was elevated from synonymy by Gordon (1995) based on shell coloration and conchological characters, and its distinctiveness is supported by molecular data (Kuehnl 2009). This species was synonymized under *Villosa iris* by Parmalee and Bogan (1998), and molecular data support its relationship to *Villosa* (Kuehnl 2009). We recognize *sima* as a species of *Villosa*.

Villosa *Frierson, 1927*.—Turgeon et al. (1998) recognized 17 species and one subspecies. Molecular data show that *Villosa*, as depicted by Turgeon et al. (1998), is wildly polyphyletic, with species occurring in as many as seven different clades within the Lampsilini (Kuehnl 2009). These and other data support reassignment of *Villosa trabalis* to *Venustaconcha*, synonymization of *Villosa perpurpurea* under *Venustachoncha trabalis* (see *Venustaconcha*), and reassignment of *Villosa choctawensis* and *V. arkansasensis* to *Obovaria* (see *Obovaria*). Most other species will require reassignment to existing genera (e.g., *V. vaughniana* to *Ligumia*; Raley et al. 2007; Kuehnl 2009) or resurrected or newly described genera, potentially with only *Villosa amygdala*

and *V. villosa* remaining in *Villosa* (Kuehnl 2009). However, these relationships are not fully understood, and currently synonymized or newly described generic names have not been proposed. With the exception of *Villosa trabalis*, *V. perpurpurea*, *V. choctawensis*, and *V. arkansasensis*, we retain all other species recognized by Turgeon et al. (1998) in *Villosa*.

Villosa vanuxemensis umbrans was elevated to species status by Williams et al. (2008) based on shell characters and preliminary molecular data, and subsequent molecular data support this change (Kuehnl 2009); based on this evidence, we recognize *V. umbrans*. There are several undescribed taxa within *Villosa* (Kuehnl 2009; Harris et al. 2009). We recognize correction of gender agreement for *Villosa amygdala*, as given by Turgeon et al. (1998), to *Villosa amygdalum* following Williams et al. (2011, 2014). We recognize fifteen species of *Villosa*.

DISCUSSION

Changes in mussel taxonomy compared to Turgeon et al. (1998) reflect our better understanding of mussel phylogenetic relationships obtained mainly from molecular genetic data (e.g., Serb et al. 2003; Campbell and Lydeard 2012a, 2012b; Inoue et al. 2013, 2014; Pfeiffer et al. 2016). Molecular genetics continues to be one of the most important tools for understanding unionoid relationships and taxonomy, but other data sets (e.g., life history, host use, soft anatomy, shell morphology, zoogeography) are informative and should not be overlooked when constructing phylogenies and conducting taxonomic studies (e.g., Roe et al. 2001; Jones and Neves 2010; Lane et al. 2016).

We recognize a larger number of genera than Turgeon et al. (1998; 56 vs. 49), but the number of currently recognized species is similar. However, recent studies show that considerable cryptic biodiversity exists in the Unionidae (e.g., *Cyprogenia*, *Lampsilis*, *Villosa*). Most of this biodiversity remains to be discovered, and its future recognition may result in increased numbers of species in the United States and Canada (see Haag 2012). Currently unrecognized species may be narrowly distributed (e.g., one river system) and in need of conservation measures. Development of additional molecular markers, more inclusive taxon sampling, advancements in phylogenetic analyses, and other techniques for species delineation are facilitating taxonomic recognition of species. More thorough understanding of life histories with improved husbandry techniques should also help facilitate species recognition.

Future research will most likely reveal unrecognized taxa. Conversely, additional synonymy may be warranted for some currently recognized species. Much more research is needed to delineate true diversity of the mussels of the United States and Canada.

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United States Department of the Interior

FISH AND WILDLIFE SERVICE
Assistant Regional Director-Ecological Services
5600 American Blvd. West
Bloomington, MN 55437-1458
Phone: (612) 713-5350 Fax: (612) 713-5292

In Reply Refer To: December 19, 2019
Consultation Code: 05E2VA00-2020-TA-1148
Consultation Code: 04EN2000-2020-TA-0386
Event Code: 04EN2000-2020-E-00877
Project Name: Martinsville Southern Connector Study

Subject: Verification letter for the 'Martinsville Southern Connector Study' project under the January 5, 2016, Programmatic Biological Opinion on Final 4(d) Rule for the Northern Long-eared Bat and Activities Excepted from Take Prohibitions.

Dear Justin Weiser:

The U.S. Fish and Wildlife Service (Service) received on December 19, 2019 your effects determination for the 'Martinsville Southern Connector Study' (the Action) using the northern long-eared bat (*Myotis septentrionalis*) key within the Information for Planning and Consultation (IPaC) system. This IPaC key assists users in determining whether a Federal action is consistent with the activities analyzed in the Service's January 5, 2016, Programmatic Biological Opinion (PBO). The PBO addresses activities excepted from "take"[1] prohibitions applicable to the northern long-eared bat under the Endangered Species Act of 1973 (ESA) (87 Stat.884, as amended; 16 U.S.C. 1531 et seq.).

Based upon your IPaC submission, the Action is consistent with activities analyzed in the PBO. The Action may affect the northern long-eared bat; however, any take that may occur as a result of the Action is not prohibited under the ESA Section 4(d) rule adopted for this species at 50 CFR §17.40(o). Unless the Service advises you within 30 days of the date of this letter that your IPaC-assisted determination was incorrect, this letter verifies that the PBO satisfies and concludes your responsibilities for this Action under ESA Section 7(a)(2) with respect to the northern long-eared bat.

Please report to our office any changes to the information about the Action that you submitted in IPaC, the results of any bat surveys conducted in the Action area, and any dead, injured, or sick northern long-eared bats that are found during Action implementation. If the Action is not completed within one year of the date of this letter, you must update and resubmit the information required in the IPaC key.

This IPaC-assisted determination allows you to rely on the PBO for compliance with ESA Section 7(a)(2) only for the northern long-eared bat. It **does not** apply to the following ESA-protected species that also may occur in the Action area:

- James Spinymussel, *Pleurobema collina* (Endangered)
- Roanoke Logperch, *Percina rex* (Endangered)
- Smooth Coneflower, *Echinacea laevigata* (Endangered)

If the Action may affect other federally listed species besides the northern long-eared bat, a proposed species, and/or designated critical habitat, additional consultation between you and this Service office is required. If the Action may disturb bald or golden eagles, additional coordination with the Service under the Bald and Golden Eagle Protection Act is recommended.

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[1]Take means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct [ESA Section 3(19)].

Action Description
You provided to IPaC the following name and description for the subject Action.

1. Name

Martinsville Southern Connector Study

2. Description

The following description was provided for the project 'Martinsville Southern Connector Study':

> The Virginia Department of Transportation (VDOT), in coordination with the Federal Highway Administration (FHWA), have initiated the environmental review process for an Environmental Impact Statement (EIS) to evaluate transportation improvements along the U. S. Route 220 corridor between the North Carolina state line to the U. S. Route 58 Bypass. The area for study is anticipated to generally encompass a portion of Henry County southeast of the City of Martinsville, roughly following Greensboro Road (U.S. Route 220) and William F. Stone Highway (U.S. Route 58/U.S. Route 220 Bypass).

Approximate location of the project can be viewed in Google Maps: https://www.google.com/maps/place/36.593109583195144N79.87739835869424W

Determination Key Result

This Federal Action may affect the northern long-eared bat in a manner consistent with the description of activities addressed by the Service’s PBO dated January 5, 2016. Any taking that may occur incidental to this Action is not prohibited under the final 4(d) rule at 50 CFR

§17.40(o). Therefore, the PBO satisfies your responsibilities for this Action under ESA Section 7(a)(2) relative to the northern long-eared bat.

Determination Key Description: Northern Long-eared Bat 4(d) Rule

This key was last updated in IPaC on May 15, 2017. Keys are subject to periodic revision.

This key is intended for actions that may affect the threatened northern long-eared bat.

The purpose of the key for Federal actions is to assist determinations as to whether proposed actions are consistent with those analyzed in the Service's PBO dated January 5, 2016.

Federal actions that may cause prohibited take of northern long-eared bats, affect ESA-listed species other than the northern long-eared bat, or affect any designated critical habitat, require ESA Section 7(a)(2) consultation in addition to the use of this key. Federal actions that may affect species proposed for listing or critical habitat proposed for designation may require a conference under ESA Section 7(a)(4).

Determination Key Result

This project may affect the threatened Northern long-eared bat; therefore, consultation with the Service pursuant to Section 7(a)(2) of the Endangered Species Act of 1973 (87 Stat.884, as amended; 16 U.S.C. 1531 et seq.) is required. However, based on the information you provided, this project may rely on the Service's January 5, 2016, *Programmatic Biological Opinion on Final 4(d) Rule for the Northern Long-Eared Bat and Activities Excepted from Take Prohibitions* to fulfill its Section 7(a)(2) consultation obligation.

Qualification Interview

1. Is the action authorized, funded, or being carried out by a Federal agency?

   Yes

2. Have you determined that the proposed action will have "no effect" on the northern long-eared bat? (If you are unsure select "No")

   No

3. Will your activity purposefully **Take** northern long-eared bats?

   No

4. Is the project action area located wholly outside the White-nose Syndrome Zone?

   Automatically answered
   No

5. Have you contacted the appropriate agency to determine if your project is near a known hibernaculum or maternity roost tree?

   Location information for northern long-eared bat hibernacula is generally kept in state Natural Heritage Inventory databases – the availability of this data varies state-by-state. Many states provide online access to their data, either directly by providing maps or by providing the opportunity to make a data request. In some cases, to protect those resources, access to the information may be limited. A web page with links to state Natural Heritage Inventory databases is available at www.fws.gov/midwest/endangered/mammals/nleb/nhisites.html.

   Yes

6. Will the action affect a cave or mine where northern long-eared bats are known to hibernate (i.e., hibernaculum) or could it alter the entrance or the environment (physical or other alteration) of a hibernaculum?

   No

7. Will the action involve Tree Removal?

   Yes

8. Will the action only remove hazardous trees for the protection of human life or property?

   No

9. Will the action remove trees within 0.25 miles of a known northern long-eared bat hibernaculum at any time of year?

   No

10. Will the action remove a known occupied northern long-eared bat maternity roost tree or any trees within 150 feet of a known occupied maternity roost tree from June 1 through July 31?

    No

Project Questionnaire

If the project includes forest conversion, report the appropriate acreages below. Otherwise, type ‘0’ in questions 1-3.

1. Estimated total acres of forest conversion:

318

2. If known, estimated acres of forest conversion from April 1 to October 31

0

3. If known, estimated acres of forest conversion from June 1 to July 31

0

If the project includes timber harvest, report the appropriate acreages below. Otherwise, type ‘0’ in questions 4-6.

4. Estimated total acres of timber harvest

0

5. If known, estimated acres of timber harvest from April 1 to October 31

0

6. If known, estimated acres of timber harvest from June 1 to July 31

0

If the project includes prescribed fire, report the appropriate acreages below. Otherwise, type ‘0’ in questions 7-9.

7. Estimated total acres of prescribed fire

0

8. If known, estimated acres of prescribed fire from April 1 to October 31

0

9. If known, estimated acres of prescribed fire from June 1 to July 31

0

If the project includes new wind turbines, report the megawatts of wind capacity below. Otherwise, type ‘0’ in question 10.

10. What is the estimated wind capacity (in megawatts) of the new turbine(s)?

0

Species Conclusions Table

Project Name: Martinsville Southern Connector Study

Date: February 14, 2020

Species / Resource Name	Conclusion	ESA Section 7 / Eagle Act Determination	Notes / Documentation
Northern Long-Eared Bat	Suitable habitat present	May affect	Based on the information you provided, this project may rely on the Service's January 5, 2016, Programmatic Biological Opinion on Final 4(d) Rule for the Northern Long-Eared Bat and Activities Excepted from Take Prohibitions to fulfill its Section 7(a)(2) consultation obligation.
Roanoke Logperch	No known occurrences or potential habitat.	No Effect	Full report and mapping available in Appendix E.
James Spinymussel	No known occurrences or potential habitat.	No Effect	Full report and mapping available in Appendix E.
Atlantic Pigtoe	No known occurrences or potential habitat.	No Effect	Full report and mapping available in Appendix E.
Eastern Black Rail	No known occurrences or potential habitat.	No Effect	Through coordination with USFWS, it was determined in October 2019 that the project does not intersect potential suitable habitat and will have no effect on the black rail (see email dated October 1, 2019).
Green Floater	No known occurrences or potential habitat.	No Effect	Full report and mapping available in Appendix E.
Orangefin Madtom	No known occurrences or potential habitat.	No Effect	Full report and mapping available in Appendix E.
Critical Habitat	No critical habitat present	No effect	
Bald Eagle	Unlikely to disturb nesting bald eagles; does not intersect with an eagle concentration area	No Eagle Act permit required	

U.S. DEPARTMENT OF AGRICULTURE
Natural Resources Conservation Service

NRCS-CPA-106
(Rev. 1-91)

FARMLAND CONVERSION IMPACT RATING FOR CORRIDOR TYPE PROJECTS

PART I *(To be completed by Federal Agency)*	3. Date of Land Evaluation Request **6/12/19**	4. Sheet 1 of **1**
1. Name of Project **Martinsville Southern Connector Study**	5. Federal Agency Involved **FHWA**	
2. Type of Project **Corridor**	6. County and State **Henry County, VA**	

PART II *(To be completed by NRCS)*	1. Date Request Received by NRCS **6/26/19**	2. Person Completing Form **M. Louise Jacques**
3. Does the corridor contain prime, unique statewide or local important farmland? (If no, the FPPA does not apply - Do not complete additional parts of this form). YES ☑ NO ☐		4. Acres Irrigated **0** / Average Farm Size **148 acres**
5. Major Crop(s) **Corn**	6. Farmable Land in Government Jurisdiction Acres: **171,205** % **67.8**	7. Amount of Farmland As Defined in FPPA Acres: **6,640** % **47.3**
8. Name Of Land Evaluation System Used **LESA**	9. Name of Local Site Assessment System **N/A**	10. Date Land Evaluation Returned by NRCS **7/15/19**

PART III *(To be completed by Federal Agency)*	Alternative Corridor For Segment Corridor A			
	Corridor A	**Corridor B**	**Corridor C**	**Corridor D**
A. Total Acres To Be Converted Directly	**93**			
B. Total Acres To Be Converted Indirectly, Or To Receive Services				
C. Total Acres In Corridor	**492**			
PART IV *(To be completed by NRCS) Land Evaluation Information*				
A. Total Acres Prime And Unique Farmland	**9.71**			
B. Total Acres Statewide And Local Important Farmland	**258**			
C. Percentage Of Farmland in County Or Local Govt. Unit To Be Converted	**0.0**			
D. Percentage Of Farmland in Govt. Jurisdiction With Same Or Higher Relative Value	**65.1**			
PART V *(To be completed by NRCS) Land Evaluation Information Criterion Relative value of Farmland to Be Serviced or Converted (Scale of 0 - 100 Points)*	55			

PART VI *(To be completed by Federal Agency) Corridor Assessment Criteria (These criteria are explained in 7 CFR 658.5(c))*	**Maximum Points**				
1. Area in Nonurban Use	15	**15**			
2. Perimeter in Nonurban Use	10	**10**			
3. Percent Of Corridor Being Farmed	20	**0**			
4. Protection Provided By State And Local Government	20	**0**			
5. Size of Present Farm Unit Compared To Average	10	**10**			
6. Creation Of Nonfarmable Farmland	25	**0**			
7. Availablility Of Farm Support Services	5	**5**			
8. On-Farm Investments	20	**0**			
9. Effects Of Conversion On Farm Support Services	25	**0**			
10. Compatibility With Existing Agricultural Use	10	**0**			
TOTAL CORRIDOR ASSESSMENT POINTS	160	**40**	**0**	**0**	**0**
PART VII *(To be completed by Federal Agency)*					
Relative Value Of Farmland (From Part V)	100	**55**	**0**	**0**	**0**
Total Corridor Assessment (From Part VI above or a local site assessment)	160	**40**	**0**	**0**	**0**
TOTAL POINTS *(Total of above 2 lines)*	260	**95**	**0**	**0**	**0**

1. Corridor Selected:	2. Total Acres of Farmlands to be Converted by Project:	3. Date Of Selection:	4. Was A Local Site Assessment Used?
A preferred Alt. has not been selected.			YES ☐ NO ☐

5. Reason For Selection:

Signature of Person Completing this Part: | DATE

NOTE: Complete a form for each segment with more than one Alternate Corridor

CORRIDOR - TYPE SITE ASSESSMENT CRITERIA

The following criteria are to be used for projects that have a linear or corridor - type site configuration connecting two distant points, and crossing several different tracts of land. These include utility lines, highways, railroads, stream improvements, and flood control systems. Federal agencies are to assess the suitability of each corridor - type site or design alternative for protection as farmland along with the land evaluation information.

(1) How much land is in nonurban use within a radius of 1.0 mile from where the project is intended?
More than 90 percent - 15 points
90 to 20 percent - 14 to 1 point(s)
Less than 20 percent - 0 points

(2) How much of the perimeter of the site borders on land in nonurban use?
More than 90 percent - 10 points
90 to 20 percent - 9 to 1 point(s)
Less than 20 percent - 0 points

(3) How much of the site has been farmed (managed for a scheduled harvest or timber activity) more than five of the last 10 years?
More than 90 percent - 20 points
90 to 20 percent - 19 to 1 point(s)
Less than 20 percent - 0 points

(4) Is the site subject to state or unit of local government policies or programs to protect farmland or covered by private programs to protect farmland?
Site is protected - 20 points
Site is not protected - 0 points

(5) Is the farm unit(s) containing the site (before the project) as large as the average - size farming unit in the County ? (Average farm sizes in each county are available from the NRCS field offices in each state. Data are from the latest available Census of Agriculture, Acreage or Farm Units in Operation with $1,000 or more in sales.)
As large or larger - 10 points
Below average - deduct 1 point for each 5 percent below the average, down to 0 points if 50 percent or more below average - 9 to 0 points

(6) If the site is chosen for the project, how much of the remaining land on the farm will become non-farmable because of interference with land patterns?
Acreage equal to more than 25 percent of acres directly converted by the project - 25 points
Acreage equal to between 25 and 5 percent of the acres directly converted by the project - 1 to 24 point(s)
Acreage equal to less than 5 percent of the acres directly converted by the project - 0 points

(7) Does the site have available adequate supply of farm support services and markets, i.e., farm suppliers, equipment dealers, processing and storage facilities and farmer's markets?
All required services are available - 5 points
Some required services are available - 4 to 1 point(s)
No required services are available - 0 points

(8) Does the site have substantial and well-maintained on-farm investments such as barns, other storage building, fruit trees and vines, field terraces, drainage, irrigation, waterways, or other soil and water conservation measures?
High amount of on-farm investment - 20 points
Moderate amount of on-farm investment - 19 to 1 point(s)
No on-farm investment - 0 points

(9) Would the project at this site, by converting farmland to nonagricultural use, reduce the demand for farm support services so as to jeopardize the continued existence of these support services and thus, the viability of the farms remaining in the area?
Substantial reduction in demand for support services if the site is converted - 25 points
Some reduction in demand for support services if the site is converted - 1 to 24 point(s)
No significant reduction in demand for support services if the site is converted - 0 points

(10) Is the kind and intensity of the proposed use of the site sufficiently incompatible with agriculture that it is likely to contribute to the eventual conversion of surrounding farmland to nonagricultural use?
Proposed project is incompatible to existing agricultural use of surrounding farmland - 10 points
Proposed project is tolerable to existing agricultural use of surrounding farmland - 9 to 1 point(s)
Proposed project is fully compatible with existing agricultural use of surrounding farmland - 0 points

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FARMLAND CONVERSION IMPACT RATING FOR CORRIDOR TYPE PROJECTS

PART I *(To be completed by Federal Agency)*	3. Date of Land Evaluation Request 6/12/19	4. Sheet 1 of 1
1. Name of Project **Martinsville Southern Connector Study**	5. Federal Agency Involved **FHWA**	
2. Type of Project **Corridor**	6. County and State **Henry County, VA**	

PART II *(To be completed by NRCS)*	1. Date Request Received by NRCS 6/26/19	2. Person Completing Form **M. Louise Jacques**
3. Does the corridor contain prime, unique statewide or local important farmland? (If no, the FPPA does not apply - Do not complete additional parts of this form). YES ☑ NO ☐		4. Acres Irrigated **0** / Average Farm Size **149 acres**
5. Major Crop(s) **Corn**	6. Farmable Land in Government Jurisdiction Acres: **171,205** % **67.8**	7. Amount of Farmland As Defined in FPPA Acres: **6,640** % **47.3**
8. Name Of Land Evaluation System Used **LESA**	9. Name of Local Site Assessment System **N/A**	10. Date Land Evaluation Returned by NRCS **7/15/19**

PART III *(To be completed by Federal Agency)*	Alternative Corridor For Segment Corridor B			
	Corridor A	Corridor B	Corridor C	Corridor D
A. Total Acres To Be Converted Directly		39.5		
B. Total Acres To Be Converted Indirectly, Or To Receive Services				
C. Total Acres In Corridor		480		
PART IV *(To be completed by NRCS) Land Evaluation Information*				
A. Total Acres Prime And Unique Farmland		66		
B. Total Acres Statewide And Local Important Farmland		336.4		
C. Percentage Of Farmland in County Or Local Govt. Unit To Be Converted		0.0		
D. Percentage Of Farmland in Govt. Jurisdiction With Same Or Higher Relative Value		63.4		
PART V *(To be completed by NRCS) Land Evaluation Information Criterion Relative value of Farmland to Be Serviced or Converted (Scale of 0 - 100 Points)*		59		

PART VI *(To be completed by Federal Agency) Corridor Assessment Criteria (These criteria are explained in 7 CFR 658.5(c))*	Maximum Points				
1. Area in Nonurban Use	15		15		
2. Perimeter in Nonurban Use	10		10		
3. Percent Of Corridor Being Farmed	20		0		
4. Protection Provided By State And Local Government	20		0		
5. Size of Present Farm Unit Compared To Average	10		10		
6. Creation Of Nonfarmable Farmland	25		0		
7. Availablility Of Farm Support Services	5		5		
8. On-Farm Investments	20		0		
9. Effects Of Conversion On Farm Support Services	25		0		
10. Compatibility With Existing Agricultural Use	10		0		
TOTAL CORRIDOR ASSESSMENT POINTS	160	0	40	0	0
PART VII *(To be completed by Federal Agency)*					
Relative Value Of Farmland (From Part V)	100	0	59	0	0
Total Corridor Assessment (From Part VI above or a local site assessment)	160	0	40	0	0
TOTAL POINTS *(Total of above 2 lines)*	260	0	99	0	0

1. Corridor Selected:	2. Total Acres of Farmlands to be Converted by Project:	3. Date Of Selection:	4. Was A Local Site Assessment Used?
A preferred Alt. has not been selected.			YES ☐ NO ☐

5. Reason For Selection:

Signature of Person Completing this Part: | DATE

NOTE: Complete a form for each segment with more than one Alternate Corridor

CORRIDOR - TYPE SITE ASSESSMENT CRITERIA

The following criteria are to be used for projects that have a linear or corridor - type site configuration connecting two distant points, and crossing several different tracts of land. These include utility lines, highways, railroads, stream improvements, and flood control systems. Federal agencies are to assess the suitability of each corridor - type site or design alternative for protection as farmland along with the land evaluation information.

(1) How much land is in nonurban use within a radius of 1.0 mile from where the project is intended?
More than 90 percent - 15 points
90 to 20 percent - 14 to 1 point(s)
Less than 20 percent - 0 points

(2) How much of the perimeter of the site borders on land in nonurban use?
More than 90 percent - 10 points
90 to 20 percent - 9 to 1 point(s)
Less than 20 percent - 0 points

(3) How much of the site has been farmed (managed for a scheduled harvest or timber activity) more than five of the last 10 years?
More than 90 percent - 20 points
90 to 20 percent - 19 to 1 point(s)
Less than 20 percent - 0 points

(4) Is the site subject to state or unit of local government policies or programs to protect farmland or covered by private programs to protect farmland?
Site is protected - 20 points
Site is not protected - 0 points

(5) Is the farm unit(s) containing the site (before the project) as large as the average - size farming unit in the County ? (Average farm sizes in each county are available from the NRCS field offices in each state. Data are from the latest available Census of Agriculture, Acreage or Farm Units in Operation with $1,000 or more in sales.)
As large or larger - 10 points
Below average - deduct 1 point for each 5 percent below the average, down to 0 points if 50 percent or more below average - 9 to 0 points

(6) If the site is chosen for the project, how much of the remaining land on the farm will become non-farmable because of interference with land patterns?
Acreage equal to more than 25 percent of acres directly converted by the project - 25 points
Acreage equal to between 25 and 5 percent of the acres directly converted by the project - 1 to 24 point(s)
Acreage equal to less than 5 percent of the acres directly converted by the project - 0 points

(7) Does the site have available adequate supply of farm support services and markets, i.e., farm suppliers, equipment dealers, processing and storage facilities and farmer's markets?
All required services are available - 5 points
Some required services are available - 4 to 1 point(s)
No required services are available - 0 points

(8) Does the site have substantial and well-maintained on-farm investments such as barns, other storage building, fruit trees and vines, field terraces, drainage, irrigation, waterways, or other soil and water conservation measures?
High amount of on-farm investment - 20 points
Moderate amount of on-farm investment - 19 to 1 point(s)
No on-farm investment - 0 points

(9) Would the project at this site, by converting farmland to nonagricultural use, reduce the demand for farm support services so as to jeopardize the continued existence of these support services and thus, the viability of the farms remaining in the area?
Substantial reduction in demand for support services if the site is converted - 25 points
Some reduction in demand for support services if the site is converted - 1 to 24 point(s)
No significant reduction in demand for support services if the site is converted - 0 points

(10) Is the kind and intensity of the proposed use of the site sufficiently incompatible with agriculture that it is likely to contribute to the eventual conversion of surrounding farmland to nonagricultural use?
Proposed project is incompatible to existing agricultural use of surrounding farmland - 10 points
Proposed project is tolerable to existing agricultural use of surrounding farmland - 9 to 1 point(s)
Proposed project is fully compatible with existing agricultural use of surrounding farmland - 0 points

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FARMLAND CONVERSION IMPACT RATING FOR CORRIDOR TYPE PROJECTS

PART I *(To be completed by Federal Agency)*	3. Date of Land Evaluation Request 6/12/19	4. Sheet 1 of 1
1. Name of Project **Martinsville Southern Connector Study**	5. Federal Agency Involved **FHWA**	
2. Type of Project **Corridor**	6. County and State **Henry County, VA**	

PART II *(To be completed by NRCS)*	1. Date Request Received by NRCS 6/26/19	2. Person Completing Form M. Louise Jacques
3. Does the corridor contain prime, unique statewide or local important farmland? (If no, the FPPA does not apply - Do not complete additional parts of this form). YES ☑ NO ☐		4. Acres Irrigated 0 / Average Farm Size 148 acres
5. Major Crop(s) Corn	6. Farmable Land in Government Jurisdiction Acres: 171,205 % 67.8	7. Amount of Farmland As Defined in FPPA Acres: 6,640 % 47.3
8. Name Of Land Evaluation System Used LESA	9. Name of Local Site Assessment System N/A	10. Date Land Evaluation Returned by NRCS 7/15/19

PART III *(To be completed by Federal Agency)*	Alternative Corridor For Segment Corridor C			
	Corridor A	Corridor B	Corridor C	Corridor D
A. Total Acres To Be Converted Directly			49	
B. Total Acres To Be Converted Indirectly, Or To Receive Services				
C. Total Acres In Corridor			447	
PART IV *(To be completed by NRCS) Land Evaluation Information*				
A. Total Acres Prime And Unique Farmland			52.7	
B. Total Acres Statewide And Local Important Farmland			302	
C. Percentage Of Farmland in County Or Local Govt. Unit To Be Converted			0.0	
D. Percentage Of Farmland in Govt. Jurisdiction With Same Or Higher Relative Value			63.4	
PART V *(To be completed by NRCS) Land Evaluation Information Criterion Relative value of Farmland to Be Serviced or Converted (Scale of 0 - 100 Points)*			58	
PART VI *(To be completed by Federal Agency) Corridor Assessment Criteria (These criteria are explained in 7 CFR 658.5(c))* — Maximum Points				
1. Area in Nonurban Use — 15			15	
2. Perimeter in Nonurban Use — 10			10	
3. Percent Of Corridor Being Farmed — 20			0	
4. Protection Provided By State And Local Government — 20			0	
5. Size of Present Farm Unit Compared To Average — 10			10	
6. Creation Of Nonfarmable Farmland — 25			0	
7. Availablility Of Farm Support Services — 5			5	
8. On-Farm Investments — 20			0	
9. Effects Of Conversion On Farm Support Services — 25			0	
10. Compatibility With Existing Agricultural Use — 10			0	
TOTAL CORRIDOR ASSESSMENT POINTS — 160	0	0	40	0
PART VII *(To be completed by Federal Agency)*				
Relative Value Of Farmland (From Part V) — 100	0	0	58	0
Total Corridor Assessment (From Part VI above or a local site assessment) — 160	0	0	40	0
TOTAL POINTS *(Total of above 2 lines)* — 260	0	0	98	0

1. Corridor Selected:	2. Total Acres of Farmlands to be Converted by Project:	3. Date Of Selection:	4. Was A Local Site Assessment Used?
A preferred Alt. has not been selected.			YES ☐ NO ☐

5. Reason For Selection:

Signature of Person Completing this Part: | DATE

NOTE: Complete a form for each segment with more than one Alternate Corridor

CORRIDOR - TYPE SITE ASSESSMENT CRITERIA

The following criteria are to be used for projects that have a linear or corridor - type site configuration connecting two distant points, and crossing several different tracts of land. These include utility lines, highways, railroads, stream improvements, and flood control systems. Federal agencies are to assess the suitability of each corridor - type site or design alternative for protection as farmland along with the land evaluation information.

(1) How much land is in nonurban use within a radius of 1.0 mile from where the project is intended?
More than 90 percent - 15 points
90 to 20 percent - 14 to 1 point(s)
Less than 20 percent - 0 points

(2) How much of the perimeter of the site borders on land in nonurban use?
More than 90 percent - 10 points
90 to 20 percent - 9 to 1 point(s)
Less than 20 percent - 0 points

(3) How much of the site has been farmed (managed for a scheduled harvest or timber activity) more than five of the last 10 years?
More than 90 percent - 20 points
90 to 20 percent - 19 to 1 point(s)
Less than 20 percent - 0 points

(4) Is the site subject to state or unit of local government policies or programs to protect farmland or covered by private programs to protect farmland?
Site is protected - 20 points
Site is not protected - 0 points

(5) Is the farm unit(s) containing the site (before the project) as large as the average - size farming unit in the County ? (Average farm sizes in each county are available from the NRCS field offices in each state. Data are from the latest available Census of Agriculture, Acreage or Farm Units in Operation with $1,000 or more in sales.)
As large or larger - 10 points
Below average - deduct 1 point for each 5 percent below the average, down to 0 points if 50 percent or more below average - 9 to 0 points

(6) If the site is chosen for the project, how much of the remaining land on the farm will become non-farmable because of interference with land patterns?
Acreage equal to more than 25 percent of acres directly converted by the project - 25 points
Acreage equal to between 25 and 5 percent of the acres directly converted by the project - 1 to 24 point(s)
Acreage equal to less than 5 percent of the acres directly converted by the project - 0 points

(7) Does the site have available adequate supply of farm support services and markets, i.e., farm suppliers, equipment dealers, processing and storage facilities and farmer's markets?
All required services are available - 5 points
Some required services are available - 4 to 1 point(s)
No required services are available - 0 points

(8) Does the site have substantial and well-maintained on-farm investments such as barns, other storage building, fruit trees and vines, field terraces, drainage, irrigation, waterways, or other soil and water conservation measures?
High amount of on-farm investment - 20 points
Moderate amount of on-farm investment - 19 to 1 point(s)
No on-farm investment - 0 points

(9) Would the project at this site, by converting farmland to nonagricultural use, reduce the demand for farm support services so as to jeopardize the continued existence of these support services and thus, the viability of the farms remaining in the area?
Substantial reduction in demand for support services if the site is converted - 25 points
Some reduction in demand for support services if the site is converted - 1 to 24 point(s)
No significant reduction in demand for support services if the site is converted - 0 points

(10) Is the kind and intensity of the proposed use of the site sufficiently incompatible with agriculture that it is likely to contribute to the eventual conversion of surrounding farmland to nonagricultural use?
Proposed project is incompatible to existing agricultural use of surrounding farmland - 10 points
Proposed project is tolerable to existing agricultural use of surrounding farmland - 9 to 1 point(s)
Proposed project is fully compatible with existing agricultural use of surrounding farmland - 0 points

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FARMLAND CONVERSION IMPACT RATING FOR CORRIDOR TYPE PROJECTS

PART I *(To be completed by Federal Agency)*	3. Date of Land Evaluation Request 6/12/19	4. Sheet 1 of 1
1. Name of Project **Martinsville Southern Connector Study**	5. Federal Agency Involved **FHWA**	
2. Type of Project **Corridor**	6. County and State **Henry County, VA**	

PART II *(To be completed by NRCS)*	1. Date Request Received by NRCS 6/26/19	2. Person Completing Form M. Louise Jacques
3. Does the corridor contain prime, unique statewide or local important farmland? (If no, the FPPA does not apply - Do not complete additional parts of this form). YES ☑ NO ☐		4. Acres Irrigated 0 / Average Farm Size 148 acres
5. Major Crop(s) Corn	6. Farmable Land in Government Jurisdiction Acres: 171,205 % 67.8	7. Amount of Farmland As Defined in FPPA Acres: 6,640 % 47.3
8. Name Of Land Evaluation System Used LESA	9. Name of Local Site Assessment System N/A	10. Date Land Evaluation Returned by NRCS 7/15/19

PART III *(To be completed by Federal Agency)*	Alternative Corridor For Segment Corridor D			
	Corridor A	Corridor B	Corridor C	Corridor D
A. Total Acres To Be Converted Directly				41
B. Total Acres To Be Converted Indirectly, Or To Receive Services				
C. Total Acres In Corridor				497
PART IV *(To be completed by NRCS) Land Evaluation Information*				
A. Total Acres Prime And Unique Farmland				37.4
B. Total Acres Statewide And Local Important Farmland				385.7
C. Percentage Of Farmland in County Or Local Govt. Unit To Be Converted				0.0
D. Percentage Of Farmland in Govt. Jurisdiction With Same Or Higher Relative Value				63.4
PART V *(To be completed by NRCS) Land Evaluation Information Criterion Relative value of Farmland to Be Serviced or Converted (Scale of 0 - 100 Points)*				58

PART VI *(To be completed by Federal Agency) Corridor Assessment Criteria (These criteria are explained in 7 CFR 658.5(c))*	Maximum Points				
1. Area in Nonurban Use	15				15
2. Perimeter in Nonurban Use	10				10
3. Percent Of Corridor Being Farmed	20				0
4. Protection Provided By State And Local Government	20				0
5. Size of Present Farm Unit Compared To Average	10				0
6. Creation Of Nonfarmable Farmland	25				0
7. Availablility Of Farm Support Services	5				5
8. On-Farm Investments	20				0
9. Effects Of Conversion On Farm Support Services	25				0
10. Compatibility With Existing Agricultural Use	10				0
TOTAL CORRIDOR ASSESSMENT POINTS	160	0	0	0	30
PART VII *(To be completed by Federal Agency)*					
Relative Value Of Farmland (From Part V)	100	0	0	0	58
Total Corridor Assessment (From Part VI above or a local site assessment)	160	0	0	0	30
TOTAL POINTS *(Total of above 2 lines)*	260	0	0	0	88

1. Corridor Selected:	2. Total Acres of Farmlands to be Converted by Project:	3. Date Of Selection:	4. Was A Local Site Assessment Used?
A preferred Alt. has not been selected.			YES ☐ NO ☐

5. Reason For Selection:

Signature of Person Completing this Part: | DATE

NOTE: Complete a form for each segment with more than one Alternate Corridor

CORRIDOR - TYPE SITE ASSESSMENT CRITERIA

The following criteria are to be used for projects that have a linear or corridor - type site configuration connecting two distant points, and crossing several different tracts of land. These include utility lines, highways, railroads, stream improvements, and flood control systems. Federal agencies are to assess the suitability of each corridor - type site or design alternative for protection as farmland along with the land evaluation information.

(1) How much land is in nonurban use within a radius of 1.0 mile from where the project is intended?
More than 90 percent - 15 points
90 to 20 percent - 14 to 1 point(s)
Less than 20 percent - 0 points

(2) How much of the perimeter of the site borders on land in nonurban use?
More than 90 percent - 10 points
90 to 20 percent - 9 to 1 point(s)
Less than 20 percent - 0 points

(3) How much of the site has been farmed (managed for a scheduled harvest or timber activity) more than five of the last 10 years?
More than 90 percent - 20 points
90 to 20 percent - 19 to 1 point(s)
Less than 20 percent - 0 points

(4) Is the site subject to state or unit of local government policies or programs to protect farmland or covered by private programs to protect farmland?
Site is protected - 20 points
Site is not protected - 0 points

(5) Is the farm unit(s) containing the site (before the project) as large as the average - size farming unit in the County ? (Average farm sizes in each county are available from the NRCS field offices in each state. Data are from the latest available Census of Agriculture, Acreage or Farm Units in Operation with $1,000 or more in sales.)
As large or larger - 10 points
Below average - deduct 1 point for each 5 percent below the average, down to 0 points if 50 percent or more below average - 9 to 0 points

(6) If the site is chosen for the project, how much of the remaining land on the farm will become non-farmable because of interference with land patterns?
Acreage equal to more than 25 percent of acres directly converted by the project - 25 points
Acreage equal to between 25 and 5 percent of the acres directly converted by the project - 1 to 24 point(s)
Acreage equal to less than 5 percent of the acres directly converted by the project - 0 points

(7) Does the site have available adequate supply of farm support services and markets, i.e., farm suppliers, equipment dealers, processing and storage facilities and farmer's markets?
All required services are available - 5 points
Some required services are available - 4 to 1 point(s)
No required services are available - 0 points

(8) Does the site have substantial and well-maintained on-farm investments such as barns, other storage building, fruit trees and vines, field terraces, drainage, irrigation, waterways, or other soil and water conservation measures?
High amount of on-farm investment - 20 points
Moderate amount of on-farm investment - 19 to 1 point(s)
No on-farm investment - 0 points

(9) Would the project at this site, by converting farmland to nonagricultural use, reduce the demand for farm support services so as to jeopardize the continued existence of these support services and thus, the viability of the farms remaining in the area?
Substantial reduction in demand for support services if the site is converted - 25 points
Some reduction in demand for support services if the site is converted - 1 to 24 point(s)
No significant reduction in demand for support services if the site is converted - 0 points

(10) Is the kind and intensity of the proposed use of the site sufficiently incompatible with agriculture that it is likely to contribute to the eventual conversion of surrounding farmland to nonagricultural use?
Proposed project is incompatible to existing agricultural use of surrounding farmland - 10 points
Proposed project is tolerable to existing agricultural use of surrounding farmland - 9 to 1 point(s)
Proposed project is fully compatible with existing agricultural use of surrounding farmland - 0 points

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FARMLAND CONVERSION IMPACT RATING FOR CORRIDOR TYPE PROJECTS

PART I *(To be completed by Federal Agency)*	3. Date of Land Evaluation Request 6/12/19	4. Sheet 1 of 1
1. Name of Project **Martinsville Southern Connector Study**	5. Federal Agency Involved **FHWA**	
2. Type of Project **Corridor**	6. County and State **Henry County, VA**	

PART II *(To be completed by NRCS)*	1. Date Request Received by NRCS 6/26/19	2. Person Completing Form **M. Louise Jacques**
3. Does the corridor contain prime, unique statewide or local important farmland? (If no, the FPPA does not apply - Do not complete additional parts of this form). YES ☑ NO ☐		4. Acres Irrigated **0** / Average Farm Size **148 acres**
5. Major Crop(s) **Corn**	6. Farmable Land in Government Jurisdiction Acres: **171,205** % **67.8**	7. Amount of Farmland As Defined in FPPA Acres: **6,640** % **47.3**
8. Name Of Land Evaluation System Used **LESA**	9. Name of Local Site Assessment System **N/A**	10. Date Land Evaluation Returned by NRCS **7/15/19**

PART III *(To be completed by Federal Agency)*	Alternative Corridor For Segment Corridor E			
	Corridor E			
A. Total Acres To Be Converted Directly	14			
B. Total Acres To Be Converted Indirectly, Or To Receive Services				
C. Total Acres In Corridor	401			
PART IV *(To be completed by NRCS) Land Evaluation Information*				
A. Total Acres Prime And Unique Farmland	4.6			
B. Total Acres Statewide And Local Important Farmland	338.5			
C. Percentage Of Farmland in County Or Local Govt. Unit To Be Converted	0.0			
D. Percentage Of Farmland in Govt. Jurisdiction With Same Or Higher Relative Value	65.1			
PART V *(To be completed by NRCS) Land Evaluation Information Criterion Relative value of Farmland to Be Serviced or Converted (Scale of 0 - 100 Points)*	57			
PART VI *(To be completed by Federal Agency) Corridor Assessment Criteria (These criteria are explained in 7 CFR 658.5(c))* — Maximum Points				
1. Area in Nonurban Use — 15	15			
2. Perimeter in Nonurban Use — 10	10			
3. Percent Of Corridor Being Farmed — 20	0			
4. Protection Provided By State And Local Government — 20	0			
5. Size of Present Farm Unit Compared To Average — 10	0			
6. Creation Of Nonfarmable Farmland — 25	0			
7. Availablility Of Farm Support Services — 5	5			
8. On-Farm Investments — 20	0			
9. Effects Of Conversion On Farm Support Services — 25	0			
10. Compatibility With Existing Agricultural Use — 10	0			
TOTAL CORRIDOR ASSESSMENT POINTS — 160	30	0	0	0
PART VII *(To be completed by Federal Agency)*				
Relative Value Of Farmland (From Part V) — 100	57	0	0	0
Total Corridor Assessment (From Part VI above or a local site assessment) — 160	30	0	0	0
TOTAL POINTS *(Total of above 2 lines)* — 260	87	0	0	0

1. Corridor Selected:	2. Total Acres of Farmlands to be Converted by Project:	3. Date Of Selection:	4. Was A Local Site Assessment Used?
A preferred Alt. has not been selected.			YES ☐ NO ☐

5. Reason For Selection:

Signature of Person Completing this Part: | DATE

NOTE: Complete a form for each segment with more than one Alternate Corridor

CORRIDOR - TYPE SITE ASSESSMENT CRITERIA

The following criteria are to be used for projects that have a linear or corridor - type site configuration connecting two distant points, and crossing several different tracts of land. These include utility lines, highways, railroads, stream improvements, and flood control systems. Federal agencies are to assess the suitability of each corridor - type site or design alternative for protection as farmland along with the land evaluation information.

(1) How much land is in nonurban use within a radius of 1.0 mile from where the project is intended?
More than 90 percent - 15 points
90 to 20 percent - 14 to 1 point(s)
Less than 20 percent - 0 points

(2) How much of the perimeter of the site borders on land in nonurban use?
More than 90 percent - 10 points
90 to 20 percent - 9 to 1 point(s)
Less than 20 percent - 0 points

(3) How much of the site has been farmed (managed for a scheduled harvest or timber activity) more than five of the last 10 years?
More than 90 percent - 20 points
90 to 20 percent - 19 to 1 point(s)
Less than 20 percent - 0 points

(4) Is the site subject to state or unit of local government policies or programs to protect farmland or covered by private programs to protect farmland?
Site is protected - 20 points
Site is not protected - 0 points

(5) Is the farm unit(s) containing the site (before the project) as large as the average - size farming unit in the County ? (Average farm sizes in each county are available from the NRCS field offices in each state. Data are from the latest available Census of Agriculture, Acreage or Farm Units in Operation with $1,000 or more in sales.)
As large or larger - 10 points
Below average - deduct 1 point for each 5 percent below the average, down to 0 points if 50 percent or more below average - 9 to 0 points

(6) If the site is chosen for the project, how much of the remaining land on the farm will become non-farmable because of interference with land patterns?
Acreage equal to more than 25 percent of acres directly converted by the project - 25 points
Acreage equal to between 25 and 5 percent of the acres directly converted by the project - 1 to 24 point(s)
Acreage equal to less than 5 percent of the acres directly converted by the project - 0 points

(7) Does the site have available adequate supply of farm support services and markets, i.e., farm suppliers, equipment dealers, processing and storage facilities and farmer's markets?
All required services are available - 5 points
Some required services are available - 4 to 1 point(s)
No required services are available - 0 points

(8) Does the site have substantial and well-maintained on-farm investments such as barns, other storage building, fruit trees and vines, field terraces, drainage, irrigation, waterways, or other soil and water conservation measures?
High amount of on-farm investment - 20 points
Moderate amount of on-farm investment - 19 to 1 point(s)
No on-farm investment - 0 points

(9) Would the project at this site, by converting farmland to nonagricultural use, reduce the demand for farm support services so as to jeopardize the continued existence of these support services and thus, the viability of the farms remaining in the area?
Substantial reduction in demand for support services if the site is converted - 25 points
Some reduction in demand for support services if the site is converted - 1 to 24 point(s)
No significant reduction in demand for support services if the site is converted - 0 points

(10) Is the kind and intensity of the proposed use of the site sufficiently incompatible with agriculture that it is likely to contribute to the eventual conversion of surrounding farmland to nonagricultural use?
Proposed project is incompatible to existing agricultural use of surrounding farmland - 10 points
Proposed project is tolerable to existing agricultural use of surrounding farmland - 9 to 1 point(s)
Proposed project is fully compatible with existing agricultural use of surrounding farmland - 0 points