

Supplemental Information in Support of the Biological Opinion

CONSULTATION HISTORY

- 10-13-14 The U.S. Fish and Wildlife Service (Service) received an introduction to the Mountain Valley Pipeline Project (Project) from Mountain Valley Pipeline LLC (MVP).
- 10-30-14 MVP mailed endangered species coordination letter to the Service (Elkins).
- 11-03-14 MVP submitted a Bat Study Plan to the Service.
- 11-10-14 MVP met with the Service in Elkins, West Virginia (WV) to formally introduce the Project.
- 11-13-14 MVP requested a Service review of Information for Planning and Conservation (IPAC) species list.
- 11-14-14 The Service (Gloucester) requested an official Project review packet.
- 11-14-14 MVP requested clarification from the Service (Gloucester) regarding the Project review packet.
- 11-18-14 The Service (Gloucester) concurred with MVP's Project review packet procedure and requested that MVP complete the packet and coordinate with Virginia Department of Game and Inland Fisheries (VDGIF).
- 11-19-14 The Service (Elkins) provided a list of federal species potentially impacted by the Project.
- 11-19-14 MVP requested clarification from the Service (Elkins) regarding required surveys for each listed species on the previously provided list.
- 11-20-14 MVP requested additional comments from the Service (Gloucester) on the Bat Study Plan.
- 11-25-14 The Service (Elkins) provided federally listed species occurrences in the vicinity of the Project.
- 11-26-14 The Service (Gloucester) provided MVP with comments on the Bat Study Plan.
- 03-06-15 MVP requested concurrence from the Service (Elkins) regarding the list of federally listed plant species and proposed survey methods.
- 03-06-15 MVP submitted the Project Review Package to the Service (Gloucester).

03-06-15 MVP submitted revised the Bat Study Plan to the Service.

04-03-15 The Service (Gloucester) provided formal comments on the Project.

04-06-15 The Service (Elkins) and MVP discussed the Bat Study Plan and past northern long-eared bat (*Myotis septentrionalis*) captures.

04-08-15 The Service (Elkins) and MVP discussed plant surveys.

04-16-15 The Service (Elkins) and MVP discussed distribution of northern long-eared bat buffers and guidance.

04-24-15 MVP submitted a copy of the revised Bat Study Plan to the Service (Gloucester).

04-27-15 The Service (Elkins) provided formal comments to MVP regarding the Bat Study Plan.

04-29-15 The Service (Elkins) requested that MVP coordinate with West Virginia Division of Natural Resource (WVDNR) botanist regarding the Project.

05-05-15 The Service (Elkins) and MVP discussed additional surveys for bald (*Haliaeetus leucocephalus*) and golden (*Aquila chrysaetos*) eagles.

05-08-15 The Service (Gloucester) concurred with the Bat Study Plan.

05-21-15 MVP requested site-specific bat mist-net authorization from the Service (Elkins) and additional information on locations where eagle nest surveys are required.

06-02-15 The Service (Elkins) requested specifics regarding survey level of efforts for bats.

06-02-15 MVP submitted the bat survey level of effort information to the Service (Elkins).

06-02-15 The Service (Elkins) provided guidance on eagle nest surveys.

06-03-15 MVP submitted the Plant Study Plan to the Service.

06-04-15 The Service (Elkins) concurred with the Bat Study Plan.

06-17-15 The Service (Gloucester) concurred with the Plant Study Plan.

06-29-15 The Service (Elkins) concurred with the Plant Study Plan.

07-13-15 The Service (Elkins) concurred with the Mussel Study Plan.

09-09-15 The Service (Gloucester) met with MVP and VDGIF in Richmond, Virginia (VA) regarding the overall project scope and consultation with that agency to date.

09-10-15	The Service (Elkins) met with MVP in Elkins, WV regarding the overall project scope and consultation with that agency to date.
09-17-15	The Service (Gloucester) and MVP discussed Roanoke logperch and butterflies.
10-02-15	ESI provided the Service (Gloucester) with satyr butterfly occurrence records from the Virginia Department of Conservation and Recreation (VDCR) indicating that surveys not required.
10-13-15	MVP submitted its proposed eagle nest survey methods to the Service (Elkins).
11-03-15	The Service (Elkins) concurred with the proposed eagle nest survey methods.
11-13-15	MVP submitted WV-specific bat, plant, and mussel reports to the Service (Elkins).
11-13-15	MVP submitted VA-specific bat, plant, fish, and mussel reports to the Service (Gloucester).
11-13-15	MVP submitted official notification of intent to initiate formal consultation to the Service.
11-23-15	The Service (Elkins) met with MVP to discuss the biological assessment (BA).
12-09-15	The Service (Gloucester) requested updated Project shapefiles and IPAC species list.
12-17-15	MVP provided the Service (Elkins) updated shapefiles.
12-17-15	MVP provided the Service (Gloucester) updated shapefiles and an IPAC species list.
12-30-15	The Service (Elkins) completed reviews of submitted survey reports.
01-08-16	ESI submitted a Listed Bat Detailed Habitat Assessment Report to the Service.
01-08-16	ESI submitted an Eagle Nest Survey Report to the Service (Elkins).
01-11-16	The Service (Elkins) commented on the Eagle Nest Survey Report.
01-11-16	MVP submitted a Bat Portal Search Report to the Service (Elkins).
01-11-16	MVP submitted a draft aquatic species take model to Service (Gloucester) for comment.
01-13-16	MVP submitted a Bat Portal Search Report to the Service (Gloucester).

01-21-16	MVP and the Service (Elkins) discussed report confidentiality.
02-04-16	MVP submitted a Migratory Bird Conservation Plan (MBCP) to the Service.
02-18-16	MVP and the Service (Elkins) discussed review status of the MBCP and other submitted reports.
02-18-16	MVP submitted draft BA to the Service.
03-08-16	The Service (Gloucester) commented on completed listed species surveys.
03-09-16	MVP submitted a Spring Portal Trapping Study Plan to the Service (Elkins).
03-16-16	The Service (Gloucester) and MVP discussed comments regarding completed listed species surveys.
03-21-16	The Service (Elkins) denied spring portal trapping in WV.
03-24-16	The Service (Gloucester) commented on the MBCP.
04-07-16	The Service met with MVP to discuss the draft BA.
04-07-16	The Service (Elkins) commented on the draft BA.
04-22-16	MVP submitted the Little Kanawha River Mussel Survey Study Plan to the Service (Elkins).
05-19-16	MVP requested guidance from the Service (Gloucester) on methods to estimate Roanoke logperch abundance.
05-30-16	The Service (Elkins) concurred with the Little Kanawha River Mussel Survey Study Plan.
06-13-16	MVP submitted a Bat Mist-Net Report Addendum and an Eagle Nest Survey Report to the Service (Gloucester).
06-24-16	MVP submitted the updated BA to the Service.
07-28-16	MVP submitted the Little Kanawha River Mussel Report to the Service (Elkins).
08-29-16	MVP submitted the Little Kanawha River (Access Road 2) Mussel Survey Study Plan to the Service (Elkins).
09-08-16	The Service (Elkins) concurred with the Little Kanawha (Access Road 2) Mussel Survey Study Plan.

09-12-16	MVP submitted the Little Kanawha River Water Withdrawal Study Plan to the Service (Elkins).
09-22-16	The Service (Elkins) commented on the Little Kanawha River Water Withdrawal Study Plan.
10-14-16	MVP submitted the 2016 VA Mussel Survey Report to the Service (Gloucester).
10-17-16	MVP submitted the 2016 VA Roanoke Logperch Survey Report to the Service (Gloucester).
10-20-16	MVP submitted the updated MBCP to the Service.
10-25-16	MVP submitted the updated BA to the Service.
10-28-16	MVP submitted the Little Kanawha River (Access Road 2) Mussel Survey Report to the Service (Elkins).
11-03-16	The Service (Gloucester) requested Project shapefiles be sent to The Nature Conservancy (TNC).
11-09-16	MVP submitted the 2016 Plant Survey Report to the Service (Elkins).
11-14-16	MVP provided TNC with the Project shapefiles per Service (Gloucester) request.
11-15-16	MVP submitted a Bog Turtle Phase I Habitat Assessment Report to the Service (Gloucester).
11-21-16	MVP submitted the 2016 Plant Survey Report to the Service (Gloucester).
12-02-16	MVP submitted Virginia Project shapefiles to the Service (Gloucester).
12-02-16	ESI submitted the Bat Portal Search and Harp Trap Report to the Service.
12-05-16	MVP submitted West Virginia Project shapefiles to the Service (Gloucester).
12-08-16	The Service met with MVP and ESI to discuss the BA.
12-14-16	MVP sent email to the Service (Gloucester and Elkins) to confirm that the Service would compile comments on the draft BA by December 23 and then those would be provided to MVP. MVP also indicated they were soliciting input for a date that would work to have a meeting regarding the MBCP.
12-19-16	The Service (Gloucester) emailed MVP requesting copies of the Project's Draft Spill Plan, Karst Plan, and Blasting Plan; additional information about stream crossings and associated listed species, if applicable; hydro-testing, water

withdrawal, and discharge plans; and GIS shapefiles of action area, which should include the buffer areas.

- 12-20-16 MVP sent the Service (Gloucester) an email confirming that the gray bat would be included in the BA and requesting guidance on the necessity of including the Virginia big-eared bat.
- 12-21-16 MVP submitted action area shapefiles to the Service (Gloucester).
- 12-21-16 The Service discussed the MBCP with MVP.
- 12-22-16 The Service (Gloucester) provided MVP with biological opinion (BO) format.
- 12-22-16 MVP submitted draft Appendix C (Estimate of Take for Federally Listed Species) to the Service (Elkins).
- 12-22-16 The Service discussed potential mitigation strategies under the Endangered Species Act (ESA) with MVP.
- 12-23-16 MVP requested input regarding the value of completing aquatic habitat assessments along a stretch of Craig Creek within the Action Area potentially impacted by sediment.
- 01-04-17 The Service (Gloucester) provided MVP notice of the publishing of the Service's Final Compensatory Mitigation Policy.
- 01-05-17 MVP requested information from the Service regarding mitigation.
- 01-06-17 MVP provided the Service with copies of the Draft Spill Plan, Karst Plan, Blasting Plan, Karst Hazards Assessment, and hydrostatic testing water withdrawal and discharge plans. MVP also provided additional information regarding stream crossings and associated listed species.
- 01-06-17 MVP and the Service (Gloucester) discussed additional stream analysis, mitigation updates, Virginia big-eared bats, and the status of comments on the BA, and the BO format.
- 01-06-17 The Service (Gloucester) emailed MVP regarding rusty patched bumble bee area of influence for Project review in Virginia.
- 01-10-17 The Service (Gloucester) requested the inclusion of the Virginia big-eared bat in the BA.
- 01-10-17 The Service (Gloucester) informed MVP it was not ready to discuss mitigation for the Project.

01-11-17 The Service (Gloucester) and MVP discussed the general approach to mitigation, the fact that the Service expected mitigation for bats and Roanoke logperch in the BA, and the fact that the Service (Gloucester) was deferring to the Commonwealth of Virginia for migratory birds.

01-12-17 The Service (Gloucester) and MVP discussed the rusty patched bumble bee and how to address the species for the Project.

01-17-17 The Service (Elkins) provided information regarding rusty patched bumble bee surveys for 2017 and proactive conservation measures.

01-18-17 The Service provided comments on the draft BA.

01-19-17 MVP notified the Service (Elkins) of reaching out to regional office for clarification on the rusty patched bumble bee and mitigation.

01-19-17 MVP requested a meeting with the Service (Gloucester) to discuss rusty patched bumble bee and mitigation.

01-23-17 MVP and the Service (Gloucester) discussed meeting topics for scheduled conference call.

01-24-17 MVP and the Service (Gloucester) discussed rusty patched bumble bee mitigation, Agency comments on the BA, and schedule for submission of revised BA to Federal Energy Regulatory Commission (FERC).

01-25-17 The Service (Gloucester) and MVP discussed James spinymussel occurrence record in Craig Creek.

01-25-17 MVP requested clarification from the Service (Gloucester) regarding shapefiles requested in 01-18-17 comments on the BA.

01-26-17 MVP and the Service (Gloucester) discussed rusty patched bumble bee, mitigation, and request for third-party monitors.

01-26-17 MVP requested clarification regarding protective buffers for Indiana and northern long-eared bat hibernacula.

01-26-17 The Service (Gloucester) requested a hydrologic and geologic analysis report.

01-27-17 The Service (Gloucester) provided a response regarding protective buffers for Indiana and northern long-eared bat hibernacula.

02-02-17 MVP notified the Service (Gloucester) that the comment matrix issued by the Service to MVP on 01-18-17 will be filed as part of FERC data response.

02-07-17	MVP submitted a draft report regarding hydrologic and geologic analysis of Canoe and Tawney's caves.
02-09-17	MVP requested clarification from the Service (Elkins) regarding ESA mitigation to be addressed in BA.
02-09-17	MVP and the Service (Gloucester) discussed the hydrologic and geologic analysis, Craig Creek, and ESA mitigation to be addressed in the BA.
02-14-17	MVP presented a hydrologic and geologic analysis for Canoe and Tawney's caves and updated sedimentation information for Craig Creek to the Service (Gloucester).
02-15-17	The Service (Gloucester) notified MVP of the rusty patched bumble bee listing rule extension.
02-16-17	MVP requested information from the Service (Gloucester) regarding the rusty patched bumble bee.
02-21-17	The Service (Gloucester) informed MVP that information regarding the rusty patched bumble bee is not yet available.
02-21-17	MVP requested information from the Service (Elkins) regarding gray and Virginia big-eared bat records in proximity to the Project.
02-22-17	MVP submitted Project Limits of Disturbance (LOD) shapefiles to the Service (Elkins).
02-23-17	MVP requested information from the Service regarding non-Project bat captures in proximity to Project that may need to be included in the impacts analysis.
02-24-17	The Service (Gloucester) provided an update to the IPaC area of influence for the rusty patched bumble bee.
02-24-17	MVP requested input from the Service (Gloucester) regarding tree-clearing windows and bat mist-net survey expirations.
02-27-17	MVP and the Service (Elkins) discussed mitigation strategies for the Project.
02-28-17	MVP and the Service (Gloucester) discussed bat mist-net survey expirations in Virginia.
03-06-17	MVP requested input from the Service (Elkins) on how to address remaining plant surveys in West Virginia within the BA.
03-08-17	MVP and the Service (Elkins) discussed remaining plant surveys within West Virginia. The Agency (Elkins) suggested assuming presence of plants in question

within the BA until more information can be provided by the Regional Director.

- 03-09-17 The Service (Elkins) requested a meeting with the MVP to discuss migratory bird and forest mitigation.
- 03-13-17 The Service (Gloucester) discussed supplemental information in support of the BO and setting up a meeting to discuss migratory bird and forest mitigation.
- 03-14-17 The Service (Gloucester) requested a meeting to discuss MVP's mitigation model.
- 03-14-17 MVP confirmed a meeting to discuss MVP's mitigation model.
- 03-14-17 MVP submitted BA to FERC and the Service.
- 03-16-17 The Service (Gloucester) requested information about the buffer around Canoe Cave.
- 03-16-17 MVP confirmed the agenda for upcoming meeting to discuss the MBCP and MVP's mitigation model.
- 03-17-17 The Service (Gloucester) requested a copy of the revised BA, responses to comments, candy darter, and request to include Elkins and The TNC in meeting scheduled for 03-23-17.
- 03-20-17 The Service (Gloucester) provided contact information for TNC.
- 03-20-17 MVP provided track changes version of revised BA, responses to comments in matrix, shapefiles of areas not surveyed, shapefiles of mainline valve locations, update on supplemental information in support of the BO, update on hydrologic and geologic analysis information, Karst Specialist Team list, Water Resources Identification and Testing Plan, update on alternatives analysis for stream crossing methods, and update on candy darter.
- 03-20-17 MVP requested clarification regarding question about buffer around Canoe Cave.
- 03-23-17 MVP, the Service, and TNC met to discuss MVP's mitigation model, summary of revisions in BA, and updates to MBCP.
- 03-23-17 The Service (Gloucester) requested coordination with landowner regarding buffer around Canoe Cave.
- 03-30-17 The Service (Gloucester) requested copy of presentation from 03-23-17 meeting.
- 03-30-17 The Service (Gloucester) stated that MVP should coordinate migratory bird mitigation with the Commonwealth of Virginia.

03-31-17	MVP provided the Service with a copy of presentation from 03-23-17 meeting.
03-31-17	MVP provided the Service (Gloucester) with shapefiles for proposed route.
04-03-17	MVP requested the landowner accommodate a site visit to confirm entrance location of Canoe Cave.
04-03-17	The Service (Gloucester) requested updates on information provided in January.
04-05-17	MVP provided the Service (Gloucester) with updates to information provided in January, including WV Spill Prevention, Control, and Countermeasure (SPCC) Plan, VA SPCC Plan, Karst Mitigation Plan, Draft Blasting Plan, stream crossing table, and hydrostatic testing plans.
04-13-17	MVP provided update on request for landowner to accommodate a site visit to confirm the entrance location of Canoe Cave.
04-19-17	MVP requested an update on the BA schedule and requested a meeting to discuss avian surveys.
04-19-17	MVP provided specific questions regarding avian surveys.
04-26-17	MVP and the Service (Gloucester) discussed the BA schedule and avian surveys.
04-27-17	MVP and the Service discussed mitigation.
05-02-17	MVP provided an update on the entrance location of Canoe Cave.
05-08-17	MVP and the Service (Gloucester and Elkins) discussed the Service's comments on the BA.
05-08-17	MVP requested additional information regarding site-specific blasting plans.
05-10-17	MVP filed the updated MBCP.
05-18-17	MVP filed responses to comments received on the BA.
05-22-17	MVP provided electronic copies of the MBCP and responses to comments received on the BA.

DESCRIPTION OF PROPOSED ACTION

MVP is proposing to construct a 488.3-kilometer (303.4-mi), 42-inch-diameter natural gas pipeline from Wetzel County, West Virginia to the town of Chatham in Pittsylvania County, Virginia. A more detailed description of the Project is provided below. The Project will cross 17 counties and require authorization from a number of federal agencies. A description of federal agency

involvement in this Project is provided below.

Federal Agencies

Federal Energy Regulatory Commission (FERC)

Under the Natural Gas Act (15 United States Code [U.S.C.] 717f) and its implementing regulations (18 Code of Federal Regulations [CFR] Part 157), the FERC reviews and approves interstate natural gas pipeline projects. The FERC is also responsible for fulfilling the requirements of the National Environmental Policy Act (42 U.S.C. 4321-4347) to analyze the environmental impacts of the projects it authorizes. For this Project, the FERC prepared and circulated an Environmental Impact Statement (EIS), issuing the final version in June 2017. Upon completion of the EIS public review, the FERC will issue a Certificate of Public Convenience and Necessity authorizing the Project construction and operation. MVP cannot commence construction of the Project until the FERC issues a notice to proceed. This is anticipated in late 2017 upon completion of ESA consultation and issuance of pending state and federal permits. The Army Corps of Engineers (Corps), U.S. Forest Service (USFS), and Bureau of Land Management (BLM) are cooperating agencies.

Army Corps of Engineers

The Corps may issue a federal permit pursuant to Section 404 of the Clean Water Act (33 U.S.C. 1344) and may use the biological opinion in its consideration of permit approval.

U.S. Forest Service

Since pipeline construction would not be in compliance with the existing Forest Plan for the Jefferson National Forest, USFS will decide whether to amend the Forest Plan so that the Project may proceed.

Bureau of Land Management

The BLM may issue a right-of-way (ROW) grant for the Project to cross federal lands associated with the Corps and USFS, pursuant to the Mineral Leasing Act, and may use the biological opinion in consideration of its decision whether to issue the ROW grant.

National Park Service

The NPS may issue a ROW grant for the Project to cross the Blue Ridge Parkway and may use the biological opinion in consideration of its decision whether to issue the ROW grant.

In accordance with 50 CFR § 402.07, the FERC is the lead agency for ESA Section 7 consultation with the Service for this Project. This consultation is being conducted with the Service's Gloucester and Elkins Field Offices.

The following Project description is summarized from the BA.

Project Description

The Mountain Valley Pipeline Project will transport up to 2.0 million dekatherms per day of natural gas from the Appalachian Basin to growing markets in the Mid-Atlantic and southeastern United States.

The 488.3-kilometer (303.4-mi) pipeline will extend from an interconnection with Equitrans' existing H-302 pipeline in Wetzel County, West Virginia and traverse south-southeast to the town of Chatham, Pittsylvania County, Virginia where the pipeline will terminate at Transco's compressor station 165. Mileposts and length (miles) of the Project in each county crossed are summarized in Table 1.

Table 1. Length of proposed pipeline by county.

County, State	Milepost Range	Length (miles)
Wetzel, West Virginia	0.0 – 9.5	9.5
	9.5 – 31.5	
Harrison, West Virginia	32.6 – 33.7	23.7
	37.4 – 38.0	
Doddridge, West Virginia	31.5 – 32.6	4.8
	33.7 – 37.4	
Lewis, West Virginia	38.0 – 65.5	27.5
Braxton, West Virginia	65.5 – 80.2	14.7
Webster, West Virginia	80.2 – 110.8	30.4
Nicholas, West Virginia	110.8 – 135.3	24.8
	135.3 – 154.2	
Greenbrier, West Virginia	154.7 – 157.1	21.3
	154.2 – 154.7	0.5
Fayette, West Virginia	157.1 – 174.3	17.1
Summers, West Virginia	174.3 – 196.3	22.1
Monroe, West Virginia	196.3 – 216.8	20.4
Giles, Virginia	216.8 – 218.5	1.7
Craig, Virginia	218.5 – 238.1	19.6
Montgomery, Virginia	238.1 – 246.5	8.4
Roanoke, Virginia	246.5 – 283.9	37.4
Franklin, Virginia	283.9 – 303.4	19.5
Pittsylvania, Virginia		
Total		303.4

The Project Area consists of the temporary and permanent ROW established for construction, operation, and maintenance of the pipeline, access roads, and aboveground facilities. The pipeline will require a 38.1-meter (125-ft) construction ROW (for the majority of the Project; some areas have been reduced to 75 feet wide) and a 15.2-meter (50-ft) permanent, operational ROW. Three compressor stations (Bradshaw, Harris, and Stallworth stations) and four meter (interconnect) stations will be constructed for the receipt and delivery of natural gas with other pipelines (Table 2). Additional ancillary aboveground facilities will include pig launcher and receiver sites at the compressor stations and the beginning and end of the pipeline and meter stations, along with mainline block valve sites within the permanent pipeline ROW. The Project will use a combination of both temporary and permanent access roads to provide access to the pipeline facilities. MVP will maintain permanent access roads throughout construction, and once the Project is completed, the permanent access roads will be used during typical operational activities. Temporary access roads will be restored to pre-construction conditions. Areas of additional temporary workspace (ATWS) will be necessary for construction activities requiring space beyond the 38.1-meter (125-ft) construction ROW. Land required for the Project is summarized in Table 2.

Table 2. Land requirements for the Mountain Valley Pipeline Project.

Project Component	Land Affected During Construction	Land Affected During Operation
	Acres	
Pipeline Facilities		
Pipeline Right-of-Way	4,458.3	1,844.1
Additional Temporary Workspaces	659.4	0.00
Above Ground Facilities		
Mobley Interconnect	3.21	1.1
Bradshaw Compressor Station	36.5	6.3
Sherwood Interconnect	12.0	1.1
Harris Compressor Station	16.5	5.6
WB Interconnect	9.9	1.2
Stallworth Compressor Station	29.9	7.2
Transco Interconnect	41.0	2.7
Yards	170.4	0.0
Access Roads	905.8	237.6
Cathodic Protection Beds	17.7	9.6
Total	6,360.6	2,116.5

Construction

This section provides an overview of the typical and specialized construction methods that will be implemented on this Project. Per USFS's request, some methodologies vary slightly on the Jefferson National Forest (JNF). The Plan of Development describes how the Project will be constructed on the USFS-managed lands. Construction of the pipeline and associated facilities will occur within one construction season and will be undertaken in 11 construction spreads using conventional open-cut methods during the majority of the process.

Those portions of the Project primarily in upland terrain will employ conventional overland construction scenario where the construction contractor will construct the pipeline along the ROW using sequential construction techniques, including survey, staking, and fence crossing; clearing and grading; trenching; pipe stringing, bending and welding; lowering-in and backfilling; hydrostatic testing; clean-up and restoration; and commissioning.

Engineers and land survey crews will stake the outside limits of the construction ROW, the centerline of the proposed trench, ATWS, and other approved work areas. Any identified environmentally sensitive areas (e.g., waterbodies and wetlands, special status species habitat, and historic properties) will be fenced off to constrict the construction ROW as necessary to avoid these features.

The FERC 2013 Upland Erosion Control, Revegetation, and Maintenance Plan as well as site-specific erosion and sedimentation control plans will be implemented along the construction ROW. Temporary erosion controls (e.g., rock construction entrances, silt fences, compost filter socks) will be installed prior to disturbance to the soil and will be maintained throughout construction phases of the Project until permanent erosion controls (e.g., waterbars, slope breakers) are installed or restoration is completed. Environmental Inspectors (EIs) will be present at each construction spread and will aid in determining if erosion controls are properly installed, maintained, or if additional measures are necessary.

To bury the pipeline underground, it will be necessary to excavate a trench by removing all soil and bedrock using a track-mounted excavator/backhoe or similar equipment. Generally, the trench will be excavated at least 30.5 centimeters (12 in) wider than the pipe diameter. The trench will be excavated to a depth of 1.7 to 2.7 meters (5.5 to 9.0 ft) to allow a minimum of 0.9 meter (3 ft) of soil cover between the top of the pipe and final land surface after backfilling. At waterbody crossings, the pipe will be buried deeper with a minimum of 1.2 meters (4 ft) of cover at navigable waterways and a minimum of 0.6 meter (2 ft) of cover at waterbodies with consolidated rock. Under railroads, uncased pipeline will be installed with a minimum of 3.0 meters (10 ft) of cover and cased pipe with a minimum of 1.7 meters (5.5 ft) of cover.

After the pipe is lowered into the trench, the trench will be backfilled. Clean fill free of rocks will be used in the first 30.5 centimeters (12 in) above the top of the pipe. Clean fill will include limestone dust or sand, which is typically basic and will often aid in cathodic protection of the pipeline. The remainder of the trench will be filled using an aggregate of material removed during the time of excavation. In wetlands, a crown will not be left in order to restore the hydrology to pre-construction conditions.

Following backfilling of the trench, the pipeline will be hydrostatically tested to ensure it is capable of safe operation at the designated pressure. Hydrostatic testing involves filling the pipeline with water to a designated test pressure and maintaining that pressure for approximately 8 hours (Table 3). Water for hydrostatic testing will be obtained from surface waterbodies (only in West Virginia outside the JNF) and municipal water sources. Water will not be withdrawn or discharged into streams containing federally listed aquatic species. Baseline water samples will be taken at the withdrawal source prior to water withdrawal and prior to discharge.

Water withdrawals for hydrostatic testing will follow established best management practices (BMPs) in West Virginia and will be implemented in coordination with the West Virginia Department of Environmental Protection (WVDEP). To minimize potential adverse impacts to aquatic plants and wildlife near water withdrawal areas, temporary, floating, screened intake pumps will be used with a screen size no larger than 4.7625 millimeters (0.1875 in) and preferably placed in water depths of 0.9 meter (3 ft) or greater. Intakes are designed to limit the through-screen approach velocity to 0.1524 meter per second (0.5 ft/sec) or less. The test water will be discharged to the ground (not directly to surface waters) in an upland, well-vegetated area through an energy-dissipating device in compliance with National Pollutant Discharge Elimination System permit conditions.

All disturbed areas will be regraded and re-contoured in order to reestablish natural drainage patterns, except at those locations where permanent changes in drainage will be required to prevent erosion, scour, and possible exposure of the pipeline. Cleanup (including final grading and installation of permanent erosion control structures) will be completed within 20 days after backfilling the trench (10 days in residential areas). All construction debris (e.g., mats, garbage, etc.) will be cleared from the construction area and disposed of in accordance with state and local regulations. All non-merchantable brush and slash will be windrowed to the edge of the ROW, utilized in downslope areas of the ROW and access roads, or removed from the area in accordance with local, state, or federal requirements.

Following final cleanup and re-contouring, the temporary and permanent ROWs will be mulched and reseeded using tailored mixes composed entirely of native, non-invasive species. The 50-foot-wide permanent ROW will be maintained in a grassland/low-shrub state above the pipeline by periodic mechanical mowing, cutting, and trimming. Mechanical removal of vegetation will not occur more frequently than every three years (per standard FERC procedures) and not during the period of April 15 to August 1 in order to avoid impacts to ground-nesting migratory birds. In addition to the herbaceous seed mix prescribed for the corresponding section of the permanent ROW, temporary workspaces within wooded areas will receive a woody seed mix in order to promote forest regeneration. To further avoid and minimize impacts to habitat, temporary workspaces within forested wetlands and at select stream crossings are proposed to be hand planted with bare-root live shrubs and tree saplings in addition to receiving a prescribed herbaceous seed mix.

MVP will inspect disturbed areas where seed mixes were applied after the first and second growing seasons to determine the success of revegetation and if any areas will require subsequent seeding and/or fertilizer. MVP will utilize approved techniques to control invasive plant species along the ROW, which will include mechanical methods (e.g., pulling, mowing, disking, etc.) as well as chemical treatments (e.g., herbicides). Success criteria will differ within the permanently maintained ROW, as these areas will not be allowed to achieve a distribution and diversity similar to adjacent undisturbed areas (e.g., they will be maintained in a grassland/low-shrub condition). The permanently maintained ROW will be considered successfully restored when the soils have been stabilized and a native vegetation community is established that is consistent and compatible with the pipeline's permanent ROW (i.e., native low grasses and shallow-rooted shrubs). In agricultural areas, revegetation will be considered successful when the area has been revegetated and is similar to adjacent undisturbed areas within the same field.

Specialized Construction Methods and Crossings

Special construction methods and crossings are likely to occur throughout the construction phases. Impacts at aquatic resource crossings are minimized by reducing the LOD and establishing setbacks where feasible. ROW crossing widths are reduced from 38.1 meters (125 ft) to 22.9 meters (75 ft) at most stream and wetland crossings. Exceptions preventing the appropriate neck-down at resource crossings are discussed within the BA.

Waterbody Crossings

The Project will require 1,269 waterbody crossings. Construction across waterbodies will be performed to minimize the time trenches for pipeline crossings are left open. The typical trenching operation, as described above, will skip the waterbody crossing, stopping on each side near the top of the bank. Where feasible, a 30.5-meter (100-ft) buffer will be maintained between the aquatic resource and LOD immediately prior to stream crossings. Where a 30.5-meter (100-ft) buffer is not possible, a 15.2-meter (50-ft) buffer will be maintained.

Temporary equipment bridges will be installed to prevent sedimentation caused by construction equipment traffic crossing the waterbodies. Bridges will be maintained throughout construction, and types may include clean-rock fill over culverts, equipment pads, wooden mats, and free-

spanning bridges. Each bridge will be designed to accommodate normal to high streamflow (storm events), prevent soil from entering the waterbody, and prevent restriction of flow when in use.

Sediment barriers, such as silt fence and straw/hay bales, will be installed prior to initial disturbance to the waterbody and adjacent upland area. Sediment barriers will be properly maintained throughout construction until replaced with permanent erosion controls (e.g., waterbars, slope breakers) or restoration of adjacent upland areas is complete and revegetation has stabilized the disturbed areas. Trench plugs, consisting of compacted earth or similar low-permeability material, will be installed at the entry and exit points of the waterbodies to prevent water from the stream from moving along the trench. After backfilling, streambanks will be re-established to approximate pre-construction contours and stabilized.

All stream crossings will involve dry-ditch crossing methods using flume pipe, dam and pump, or cofferdams, with the exception of four rivers in West Virginia: the Elk, Gauley, Greenbrier, and Meadow. These four crossings are planned to be traversed via specialized dry-ditch crossing techniques using Portadam structures. Dry-ditch stream crossings require the use of pumps to remove water from within an isolated, instream workspace and trench de-watering. In Virginia, fish relocations will be completed prior to the dewatering of workspaces.

Waterbody Crossing Method Evaluation

For crossings with federally listed species, the open-cut crossing method is the currently proposed method for crossings due to the controlled, visible work site and short duration of the crossing. However, MVP is finalizing an analysis of alternative crossing methods to identify the crossing methods that will best avoid and minimize temporary and permanent adverse effects on the most environmentally sensitive waterbodies. This evaluation includes waterbodies meeting one or more of the following criteria: top of bank width greater than 3.05 meters (10 ft), a listed flow regime of perennial, a FERC classification of intermediate or major, and a fishery type of cold water, trout waters (West Virginia only), coldwater, threatened and endangered species stream, wild trout (Virginia only), or stocked trout (Virginia only). MVP will adjust crossing methods where necessary once the analysis is complete.

Wetland Crossings

The crossings of jurisdictional wetlands will be completed in accordance with state and federal permits and the FERC 2013 Wetland and Waterbody Construction and Mitigation Procedures (Procedures). However, specific-site conditions may require MVP to request variances from the Procedures that will require approval by FERC (and USFS in the JNF) prior to construction in these areas. As proposed, the pipeline is expected to cross 300 wetlands and other project components (e.g., access roads) would cross 265 wetlands.

A maximum construction ROW width of 22.9 meters (75 ft) in wetlands will be utilized, and operation of construction equipment will be limited to that which is needed to clear the ROW, dig the trench, fabricate the pipe, install the pipe, backfill the trench, and restore the ROW. Exceptions to the maximum construction ROW of 22.9 meters (75 ft) are required at seven wetlands (six in West Virginia and one in Virginia). Fuel will not be stored within 30.5 meters (100 ft) of wetlands

or waterbodies. Topsoil will be segregated up to 0.3 meter (1 ft) in depth within wetlands where hydrologic conditions permit and placed into the trench following subsoil backfilling. The restoration and monitoring of wetland crossings will be conducted in accordance with FERC Procedures.

Rugged Terrain

Construction techniques in mountainous areas where the pipeline will encounter slopes exceeding 30 to 35 percent will require expanded workspace areas. The dimensions of these ATWS will vary depending on the degree and length of the slope. On steep slopes, various measures will be taken in order to properly control erosion and sedimentation on the ROW. Spoil piles from trenching operations will be staged along the side of the ROW and will be compacted via rolling with dozers on site as additional material is added. Once a soil pile is completed, it will be temporarily mulched to control washouts. Additionally, spoil piles will be separated at intervals of 15.2 meters (50 ft) by temporary water bars, which will serve to slow the flow of runoff down the ROW and divert it into straw bales or No. 3 aggregate. Silt fence and super silt fence will be used to stop rocks from rolling off the ROW. Other measures such as erosion control blankets, temporary mulching, hydroseed, and sock filtration may be used.

Topsoils are not commonly found on slopes that are greater than 50 percent, as soils in these areas will naturally wash away; therefore, topsoil will not be placed on slopes that are greater than 50 percent during restoration activities. However, these areas will be treated as soon as possible to minimize erosion potential. This may be accomplished by hydro-seeding the slope or covering the slope with jute erosion-control matting.

Karst Areas

Portions of the Project will cross areas with potential to contain karst and karst-related features. After consultations with karst experts and numerous governmental agencies, MVP has made route adjustments to avoid areas containing dense concentrations of features, such as sinkholes, which are indicative of karst development; however, the route may encounter areas of karst geology not detectable until construction activity begins.

MVP developed a Karst Mitigation Plan (KMP) that addresses the assessment and mitigation of potential karst hazards associated with construction activities along the proposed route. Construction activities will be conducted in a manner to limit potential impact to karst features and related water resources.

Blasting

All blasting will be conducted in accordance with the Project Blasting Plan. At this time, the extent of blasting for the Project is unknown. MVP will minimize the amount of blasting required to the extent practicable. Where unrippable subsurface rock is encountered, blasting for ditch excavation may be necessary. Where competent sandstone bedrock occurs in the stream bed, blasting may be used to reduce bedrock so that the trench can be excavated.

Operation and Maintenance

Operational activity on the pipeline will be limited to maintenance of the permanent ROW and inspection, repair, and cleaning of the pipeline. Regular cleaning will be conducted at established pig launcher/receiver sites. Emergency spill kits will be on site and accessible during pigging operations. Temporary containment will be installed prior to pig removal. All contaminated material will be collected and disposed of by a qualified vendor and temporary containment will be removed when all work is complete.

The permanent ROW will be allowed to revegetate and will be maintained by periodic mechanical mowing, cutting, and trimming. Permanent mowing in the ROW will not occur more frequently than every three years (per standard FERC procedures) and not during the period of April 15 to August 1. Large brush and trees will not be permitted to grow within the permanent ROW.

Site personnel at aboveground facilities will perform routine checks of the facilities, including calibration of equipment and instrumentation, inspection of critical components, and scheduled and preventative maintenance of equipment.

Conservation Measures

Conservation measures are actions taken to benefit or promote the recovery of the species. These actions are taken by the federal agency or the applicant that serve to minimize or compensate for project effects on the species under review and are included as an integral portion of the proposed action.

Conservation measures designed to avoid and minimize impacts to a variety of terrestrial and aquatic resources are included in the BA. In addition, specific measures are outlined for the Indiana bat (*Myotis sodalis*), northern long-eared bat, Roanoke logperch (*Percina rex*), clubshell (*Pleurobema calva*), snuffbox (*Epioblasma triquetra*), James spinymussel (*Pleurobema collina*), and rusty patch bumble bee (*Bombus affinis*). The analysis of the effects of the Project in the BA assumes that the Project will be implemented as proposed (including all conservation measures).

General Measures

- Implement sediment and erosion control measures, ensure restoration of pre-existing topographic contours after any ground disturbance, and restore native vegetation (where possible).
- Control erosion and sediment by using appropriate BMPs. EIs will be present onsite during construction and until stabilization after construction. Erosion and sedimentation issues will be addressed immediately.
- Maintain areas that must be kept open for pipeline operation and safety by mowing at the maximum time interval required to prevent wood encroachment (e.g., every 3 years) and late in the growing season of any year (not during the period of April 15 to August 1).
- Reduce the construction ROW width from 38.1 to 23 meters (125 to 75 ft) at stream and wetland crossings.

- Expedite construction within any waterbody, effectively reducing disturbance to the streambed and adjacent soils and the quantity of suspended sediments.
- Clearly mark wetland boundaries and buffers to be avoided in the field with signs and/or highly visible flagging until construction-related ground-disturbing activities are complete.
- Conduct pipeline assembly in upland areas unless the wetland is dry enough to adequately support skids and pipe. Timber mats are used to cross wetlands.
- Minimize the length of time that the trench is open, to the maximum extent practicable, especially within wetlands.
- Minimize the amount of necessary construction equipment traffic to that which is needed to clear and grade the ROW, excavate the trench, install the pipeline, backfill the trench, and restore the construction ROW.
- Prohibit construction equipment, vehicles, hazardous materials, chemicals, fuels, lubricating oils, and petroleum products from being parked, stored, or serviced within a 30.5-meter (100-ft) radius of any wetland or waterbody. All equipment will be inspected for leaks by an inspector at the beginning of the day. Operation will not commence or will cease until the spill is contained, cleaned up, and collected before operations continue. Leaking equipment will be removed or repaired the same day.
- Locate as many ATWS as possible at least 15.2 meters (50 ft) away from the water's edge.
- Store trench spoil excavated from within a stream at least 3 meters (10 ft) from the top of the bank to minimize turbidity caused by erosion.
- Avoid the use of herbicides and pesticides to maintain any portion of the Project ROW or aboveground facilities, unless requested by a land-management agency.
- Install temporary equipment bridges within the ROW to reduce turbidity and sedimentation caused by construction and vehicular traffic.
- Minimize crossing of the pipeline through forested wetlands to the maximum extent practicable. When forested wetlands are crossed, MVP will maintain no more than a 3-meter (10-ft) wide, herbaceous strip centered over the pipeline and will only remove woody vegetation within a 9.1-meter (30-ft) wide strip centered over the pipeline.
- Allow vegetation in wetlands to recover more rapidly by removing tree stumps only located directly over the trench line or where safety is a concern.

Indiana and northern long-eared bats:

- Avoid felling of known roosts to the maximum extent practicable.
 - A juvenile female northern long-eared bat was tracked to a water oak (*Quercus nigra*) in Lewis County, West Virginia (Roost 116-1) near milepost 48.4. The work area has been reduced to 15 meters (50 ft) in this area to avoid impacts to the identified roost tree.
 - A post-lactating adult female northern long-eared bat was tracked to a shagbark hickory (*Carya ovata*) in Lewis County, West Virginia (Roost 084-2) near milepost 51.0. The work area was shifted 43 meters (141 ft) to the east to avoid impacts to the identified roost tree.
 - A juvenile male northern long-eared bat was tracked to a black locust

(*Robinia pseudoacacia*) in Greenbrier County, West Virginia (Roost 044-1) near milepost 150.6. A proposed Access Road (MVP-GB-190) was shifted to avoid impacts to the identified roost tree.

- A juvenile male northern long-eared bat was tracked to a tulip tree (*Liriodendron tulipifera*) in Braxton County, West Virginia (Roost 791-1) near milepost 74.6. The construction ROW was shifted 6 meters (19.7 ft) to the west to avoid impacts to the identified roost.
- Avoid impacts to potentially suitable hibernacula in the Project vicinity to the maximum extent practicable.
 - A proposed access road (MVP-MN-264) in Montgomery County, Virginia was abandoned to avoid impacts to Old Mill Cave.
 - A proposed access road (MVP-WB-120) in Webster County, West Virginia was abandoned to avoid impacts to an identified portal (CRA-PO-00001) near milepost 88.4.
 - The pipeline route was moved to the east to avoid impacts to an identified portal (SJTB-PO-00002) in Greenbrier County, West Virginia near milepost 140.5.
 - The pipeline route was moved to the north of Canoe Cave in Giles County, Virginia to avoid removing forested habitat within 0.4 kilometer (0.25 mi) of the cave's entrance.
- Suspend tree-clearing operations from April 1 to November 15 within 8 kilometers (5 mi) of entrances to known Indiana bat hibernacula and within 0.4 kilometer (0.25 mi) of entrances to known northern long-eared bat hibernacula to prevent mortality to individuals engaging in autumn swarming or spring staging activities.
- Suspend tree-clearing operations from June 1 through July 31 to prevent mortality to non-volant young.
- Clearly mark the Project construction ROW to help ensure contractors do not accidentally remove more trees than anticipated to maintain the maximum amount of suitable summer maternity habitat.
- Prepare and distribute information to construction personnel that provides information about biology of Indiana and northern long-eared bats, activities that may affect bat behavior, ways to avoid and minimize these effects, and appropriate procedures to follow as they relate to Project-specific conservation measures.
- Minimize lighting impacts on bats by instituting a 7:00 a.m. to 7:00 p.m. work day, except as mandated by safety standards. The directional luminous intensity of lighting structures used during construction will be proportional to work area required to complete the task. Permanent outdoor lighting will be photocell controlled at compressor stations to only be on at night. MVP will utilize fully shielded, "full cut-off" type lighting fixtures to minimize objectionable light from each station. "Full cut-off" lighting means no direct upward lighting will be emitted above horizontal, which therefore provides the maximum possible shielding to prevent unintentional lighting of surrounding areas. Further, outdoor lighting will be located on each station perimeter and pointed inward toward the station.
- Allow natural woodland regeneration of temporary and additional work spaces.
- Use water trucks to dampen the area and control fugitive dust when construction causes dust that affects wooded lands when roosting bats may be present (most

frequently in summer, but also in spring and autumn).

- Conduct future maintenance activities that involve tree removal, limb trimming, or pruning between November 15 and March 31 to avoid disturbance to bats, except in cases of human safety. When the season restriction cannot be met, a qualified bat biologist will investigate trees for the presence of bats to avoid a take. Prior to conducting these investigations, coordination will be undertaken with the Service and other agencies as necessary to ensure the suitability of such a survey.

Rusty patched bumble bee

- Use pollinator seed mixes targeted for rusty patched bumble bee.
 - Use native plant species known to be visited by the species.
 - Use a mix of flowering plant species with continual floral availability through the entire active season (March – October).
 - Consider foraging needs of pollinators when creating subcanopy, shrub, and riparian mixes.
- Restrict use of pesticides and herbicides.
 - Prohibit use of insecticides, including systemic insecticides.
 - Use herbicides only for invasive species control. All attempts will be made to apply when flowers are not open.
- Control invasive species on edges to encourage ephemeral spring wildflowers.
- Minimize disturbances to vegetation and create a dispersal corridor for insects by mowing open ROW on a rotating schedule with multiple-year cycles.

Plants

- Avoid introducing exotic/invasive species in organic materials brought onsite during construction by thoroughly cleaning equipment prior to mobilization to the Project.
- Establish equipment cleaning stations to thoroughly wash all equipment before transporting it to the next construction spread.
- Implement selective spot treatment or eradication of exotic/invasive plant species encountered during construction and operation of the Project.
- In wetlands, agricultural, and residential areas, strip topsoil from the full width of the construction ROW and store it separately from other soils in areas identified as containing higher than usual concentrations of exotic/invasive plant species.
- Commit to using native seed mixes, as developed by the Wildlife Habitat Council, during restoration efforts.
- Minimize amount of time bare soil is exposed during construction to reduce opportunity for exotic/invasive plants to become established.

Aquatic Species

- Avoid removal of riparian canopy or stabilizing vegetation, if possible. Crushing or shearing streamside woody vegetation is preferable to complete removal.
- Stabilize waterbody banks and install permanent sediment barriers (i.e., silt fence, silt logs) within 24 hours of completing in-stream construction activities. Sediment barriers will be left in place until the site has been stabilized with perennial vegetation (typically one full growing season after construction).

- Align crossings as close to perpendicular to the axis of the waterbody channel as engineering and routing conditions allow.
- Attempt to maintain, at minimum, a 4.6-meter (15-ft) section of undisturbed vegetation between the waterbody and construction ROW where the pipeline parallels a waterbody.
- Conduct construction at stream crossings during low-flow conditions, to the maximum extent possible.
- Cross streams using dry crossing methods by pumping or fluming water around if water is flowing at the time of construction.
- Restore each waterbody to its original configuration and contour to the maximum extent possible. Permanent stabilization of the banks of the waterbody and adjacent areas using erosion control measures and vegetative cover will occur as soon as possible after construction.
- Use native stone to the extent possible during stream bed restoration and stabilization.
- Promptly remove construction materials and related crossing structures from each waterbody after construction.
- Avoid the use of surface-water sources in Virginia for hydrostatic testing. Municipal source waters will be used instead.
- Avoid the use of waterbodies supporting federally listed species as surface-water sources in West Virginia for hydrostatic testing to avoid potential impacts to federally listed aquatic species.
- Implement sustainable water-use practices to ensure water resources and environmentally responsible stream flows are maintained. All water withdrawals in West Virginia will be performed in accordance with local, state, and/or federal regulations to prevent the localized and downstream dewatering of streams. To prevent crushing, entrainment, or entrapment of mussels and fishes, floating intakes will be used. The intake end of the pump will contain an appropriately sized screen (i.e., less than 4.7625 millimeters [0.1875 in] mesh size), and withdrawal rates will be reduced (i.e., screen approach velocity will be 0.1524 meter per second [0.5 ft/sec] or less).
- Discharge hydrostatic test water to the ground in an upland, well-vegetated area and not directly to surface waters.
- Avoid or minimize impacts to waterbodies potentially supporting federally listed aquatic species.
 - The Little Kanawha River in Braxton County, West Virginia is listed as a Group 2 stream. Avoidance and minimization measures have been implemented in this river including the following:
 - The pipeline crossing location avoids known occurrences of federally endangered mussels in the Little Kanawha River by traversing upstream of Burnsville Lake and Burnsville Dam. No known populations of federally endangered mussels occur upstream of the dam, and the dam will likely arrest the majority of any sediments introduced by the Project.
 - The Little Kanawha River was originally proposed as a water source for hydrostatic testing, but the temporary, water withdrawal location

has been abandoned.

- MVP proposes to use two existing public-use roads (i.e., Gregory Road, Gregory Lake Lane) that currently traverse the Little Kanawha River via ford crossings. MVP plans to improve the existing ford crossings by installing bridges across the river.
- The pipeline route traverses the Elk River upstream of Sutton Lake and in Webster County, West Virginia where the river is listed as a Group 1 waterbody and federally endangered mussels are not expected. The pipeline crossing avoids known occurrences of federally endangered mussels in the Elk River.
- Craig Creek (Montgomery County, Virginia) avoidance and minimization measures include the following:
 - Former Project routes included the potential crossing of Craig Creek in Montgomery County, Virginia four times, including three pipeline crossings and use of an existing access road ford crossing. The pipeline route was adjusted to eliminate two pipeline crossings. Use of the existing access road remains, and the access road will be improved to include a bridge spanning the stream, thereby minimizing instream disturbances.
 - MVP conducted an alternatives analysis of the proposed pipeline crossing of Craig Creek, which confirmed the open-cut dry-ditch method is preferable due to the controlled, visible work site and short duration for the crossing. Conventional bore was eliminated due to the lack of additional work area currently available on the east side of Craig Creek to site drill support and bore pit spoil material storage areas. In addition, the proximity of the west bore pit to the creek and its depth below the stream could create a construction safety issue due to the presence of groundwater that must be continually pumped out during boring. HDD was eliminated due to the risk of an inadvertent return and a horizontal break in the alignment near the proposed crossing.
 - MVP will adhere to standards established in Virginia Department of Environmental Quality's Virginia Erosion & Sediment Control Field Manual (1995) and implement enhanced erosion and sediment control BMPs in sensitive areas and/or high water-energy areas (yet to be determined).
 - Most of the Craig Creek valley traversed by the Project is part of the JNF. MVP is coordinating with the USFS to minimize potential impacts of sedimentation on Craig Creek. An alternatives analysis was completed to assess various alignments near the Craig Creek crossing that produce the least amount of potential sedimentation impacts.
 - MVP is committed to minimizing the duration of bare-soil exposure during construction and restoration. The time elapsed between vegetation clearing and grubbing/grading/trenching in the Craig Creek valley will be minimized to the maximum extent. The

construction timeline will immediately follow tree clearing within the Craig Creek watershed.

- MVP will apply temporary seed/mulch to topsoil piles at the end of each day.
 - Disturbed ROW areas will be temporarily mulched/seeded if the areas are to remain undisturbed for more than four days. This includes following installation of the pipeline and backfill to rough grade. Once it is returned to rough grade, if the area is to remain undisturbed for more than four days, MVP will apply temporary seed/mulch to stabilize the area until full restoration is complete.
 - Backfilled areas of the trench will be mulched within four days.
 - Temporary sediment control measures will remain in place for one year after seeding.
 - In the area of Craig Creek, MVP is committed to implementation of restoration efforts within eight weeks of ROW stabilization (e.g., backfill, mulching).
 - MVP will reduce the ROW width at the Craig Creek crossing to less than 22.9 meters (75 ft).
 - Riparian timber and vegetation will remain within 15.2 meters (50 ft) from each streambank, and clearing activities will occur immediately prior to instream construction.
 - Instream construction activities will not occur during time-of-year restrictions (TOYRs) for James spinymussel (i.e., May 15 to July 31) in Craig Creek because of known populations downstream of the Action Area.
- The pipeline route was adjusted to the north to eliminate two crossings of the Blackwater River in Franklin County, Virginia, thereby avoiding suitable habitats to Roanoke logperch.
 - MVP has located the ROW and as many ATWS as possible at least 30.5 meters (100 ft) away from the edge of waterbodies potentially supporting federally listed aquatic species. Exceptions are provided in Table 8 in the BA.
 - The Project Area includes using Reese Mountain Road (MN-276.03) as an access road during construction efforts. Reese Mountain Road traverses North Fork Roanoke River via an existing, paved bridge that spans the river, and because no instream construction activities are anticipated, instream impacts are avoided. The crossing of the river by this access road is referred to as North Fork Roanoke River AR2.
 - BMPs that will be used along the Project include (and may not be limited to) compost filter sock (e.g., single and triple stack), silt fence, super silt fence, belted silt fence, waterbars, temporary diversion berms, cross-culverts, broad-based dips, rock checkdams, rock construction entrances, cofferdams, timbermats, seeding/mulching, erosion control blanketing, hydro-seed, hydro-mulch, dewatering structures, and sediment filter bags. Construction will minimize work in rain conditions, perform frequent inspections, and ensure appropriate grading.

- Adhere to applicable state or federal required TOYRs for in-stream construction including.
 - Snuffbox – April 1 to June 30
 - Clubshell – April 1 to June 30
 - Roanoke logperch – March 15 to June 30
 - James spinymussel – May 15 to July 31
- Remove non-federally listed freshwater mussels (by qualified and approved surveyors) from the stream bed and relocate them upstream outside of the impact area prior to construction. These efforts are proposed to occur at two crossings in West Virginia (Sand Fork and Greenbrier River) and eight crossings in Virginia (Sinking Creek², North Fork Roanoke River¹, North Fork Roanoke AR1 [MN-268.01], North Fork Roanoke River AR2 [MN-276.03], Roanoke River, Little Creek², Blackwater River³, and Pigg River).
- Remove all fish from work areas within waterbodies crossed within Virginia per VDGIF's request.

Action Area

The Action Area is defined as all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action. The Action Area includes the geographic extent of environmental changes (i.e., physical, chemical, and biotic effects) that result directly and indirectly from the action. The Action Area is defined by measurable or detectable changes in land, air, and water quantity or other measurable factors that may elicit a response in the species or critical habitat. As such, in addition to the immediate area of disturbance, the Action Area should include any location where impacts can occur, even outside of the Project Area, that impair essential behavior patterns or the health and survival of an individual, whether associated with the visual spectrum (i.e., nighttime lights or recognition/perception of distinctive changes or patterns in habitat), airborne or substrate-borne sound or vibration, water, or movement of an element from within to outside the Project Area (e.g., a tree felled in the wrong direction). Accordingly, MVP has determined that the Action Area for this Project is defined as the Project construction ROW plus the distance where:

- Meaningful concentrations of dust and airborne vehicle emissions will travel outside the Project Area, estimated at 106.7 meters (350 ft);
- Nighttime lights might stimulate a response by active bats, estimated at 365.8 meters (1,200 ft);
- Airborne or substrate-borne sound or vibration will travel, estimated at 0.97 kilometer (0.6 mi or 3,168 ft);
- Water will carry deleterious concentrations of sediments (greater than 10 percent increase over baseline) downstream of the Project Area.

When combined, the majority of these metrics lie within the 0.97-kilometer (0.6-mi) buffer associated within the distance that sound from the Project will remain noticeable, with the exception of where a 10 percent increase in sediment loads will be detectable in streams extending beyond the 0.97-kilometer (0.6-mi) noise buffer. As such, the Action Area for this Project consists of all lands within 0.97 kilometer (0.6 mi) of the boundaries of the Project Area and approximately

1,135.13 kilometers (705.34 mi) of potentially impacted streams.

STATUS OF THE SPECIES AND CRITICAL HABITAT RANGEWIDE

Indiana Bat

Information about the species description, life history, population dynamics, status, and distribution is in the proposed/final rules, recovery plans, 5-year status reviews, species surveys, habitat assessments, journal articles, etc. that are listed in the Literature Cited section. Critical habitat for this species has been designated at 11 caves (Bat Cave [Carter County, Kentucky], Coach Cave [Edmonson County, Kentucky], White Oak Blowhole Cave [Blount County, Tennessee], Big Wyandotte Cave [Crawford County, Indiana], Rays Cave [Greene County, Indiana], Cave 021 [Crawford County, Missouri], Cave 009 [Franklin County, Missouri], Cave 017 [Franklin County, Missouri], Bat Cave [Shannon County, Missouri], Cave 029 [Washington County, Missouri], and Hellhole Cave [Pendleton County, West Virginia]) and two abandoned mines (Blackball Mine [LaSalle County, Illinois] and Pilot Knob Mine [Iron County, Missouri]). However, the Project does not affect those areas.

Species Description

The Indiana bat is a medium-sized bat in the genus *Myotis*. The forearm length has a range of 3.6 to 4.1 centimeters (1.4 to 1.6 in). The head and body length range from 4.1 to 4.8 centimeters (1.6 to 1.9 in). Its appearance most closely resembles that of congeners little brown bat (*Myotis lucifugus*) and northern long-eared bat. Indiana bats differ from similar *Myotis* species in that they have a distinctly keeled calcar (cartilage that extends from the ankle to support the tail membrane). Other minor differences include smaller and more delicate hind feet, shorter hairs on the feet that do not extend past the toenails, and a pink nose. The fur lacks luster, and the wing and ear membranes have a dull, flat coloration that does not contrast with the fur (USFWS 2007a). Fur on the chest and belly is lighter than fur on the back, but is not as strongly contrasting as that of similar *Myotis* species. Overall color is slightly grayer, while the little brown bat and northern bat are browner. The skull has a crest and tends to be smaller, flatter, and narrower than that of the little brown bat (USFWS 2007a).

Life History

The Indiana bat is a “tree bat” in summer and a “cave bat” in winter. There are four ecologically distinct components of the annual life cycle: winter hibernation, spring staging and autumn swarming, spring and autumn migration, and the summer season of reproduction.

Some males remain near hibernacula throughout summer while others migrate varying distances (Whitaker and Brack 2002). Males can be caught at hibernacula on most nights during summer (Brack 1983, Brack and LaVal 1985), although there may be a large turnover of individuals between nights (Brack 1983). Woodland roosts appear similar to maternity roosts (Kiser and Elliott 1996, Schultes and Elliott 2002, Brack and Whitaker 2004, Brack et al. 2004), although smaller-diameter trees may be used. Less space may be required for a single bat than a colony of bats, or

thermal requirements may differ. Males appear somewhat nomadic; over time, the number of roosts and the size of an area used increases.

When female Indiana bats emerge from hibernation, they migrate to maternity colonies that may be located up to several hundred miles away (Kurta and Murray 2002). Females form nursery colonies under exfoliating bark of dead, dying, and living trees in a variety of habitat types, including uplands and riparian habitats. A wide variety of tree species, including occasional pines (Britzke et al. 2003), are used as nursery colonies indicating that it is tree form, not species, that is important for roosts. Since many roosts are in dead or dying trees, they are often ephemeral.

Roost trees may be habitable for one to several years, depending on the species and condition of the tree (Callahan et al. 1997). Indiana bats exhibit strong site fidelity to summer roosting and foraging areas (Kurta and Murray 2002, Kurta et al. 2002). Females are pregnant when they arrive at maternity roosts. Parturition typically occurs between late June and early July. A maternity colony typically consists of 25 to 325 adult females. Nursery colonies often use several roost trees (Kurta et al. 1993, Foster and Kurta 1999, Kurta and Murray 2002), moving among roosts within a season. Most members of a colony coalesce into a single roost tree about the time of parturition, which begins to break up again as soon as young are volant.

Roosts that contain large numbers of bats (more than 20 bats) are often called primary roosts, while secondary roosts hold fewer bats. Primary roost trees are often greater than 46 centimeters (18 in) diameter at breast height (dbh) and secondary roost trees are often greater than 23 centimeters (9 in) dbh (Gardner et al. 1991, Callahan et al. 1997, Kurta et al. 2002, Carter 2003). Numerous suitable roosts may be required to support a single nursery colony, possibly about 45 stems per hectare (20/acre) (Gardner et al. 1991, Kurta et al. 2002, Carter 2003). Roost trees are often located where they have solar exposure, with 20 to 80 percent canopy closure (Humphrey et al. 1977, Gardner et al. 1991, Kurta et al. 1993, Kurta et al. 1996, Kurta et al. 2002, Carter 2003). They are often exposed to 10 or more hours of solar radiation per day (Kurta et al. 2002). The need for solar exposure may vary with latitude.

Indiana bats live on anthropogenic landscapes, and recent research indicates females do include roads in their active area. Although bats do cross roads, the studies that document this behavior were not designed to gauge a graded response (Gardner et al. 1991, Brown et al. 2001, Kiser et al. 2002, Kurta et al. 2002, Brack 2006).

Like many other species of microchiropterans, the Indiana bat often uses travel corridors that consist of open flyways such as streams, woodland trails, small infrequently used roads, and possibly utility corridors, regardless of suitability for foraging or roosting (Brown and Brack 2003). Members of maternity colonies forage in a variety of woodland settings, including upland and floodplain forest (Humphrey et al. 1977, Brack 1983, Gardner et al. 1991). Foraging activity is concentrated above and around foliage surfaces, such as over the canopy in upland and riparian woods, around crowns of individual or widely spaced trees, and along edges. They forage less frequently over old fields and occasionally over bushes in open pastures. Forest edges, small openings, and woodlands with patchy trees provide more foraging opportunities than dense woodlands. Most species of woodland bats forage prominently along edges, less in openings, and

least within forests (Grindal 1996). Openings also provide a better supply of insects than do wooded areas (Tibbels and Kurta 2003).

Status and Distribution

The Agency listed the Indiana bat as endangered on March 11, 1967 (USFWS 1967). Critical winter habitat was proposed December 16, 1975, and designated September 24, 1976 (USFWS 1976). A recovery plan for the species was completed on October 14, 1983 (USFWS 1983). In October 1996, the Indiana Bat Recovery Team released a Technical Draft Indiana Bat Recovery Plan. In October 1997, a preliminary version of the “Agency Draft of the Indiana Bat Recovery Plan,” which incorporated changes from the 1996 Technical Draft, was released. Subsequently, the draft “Indiana Bat (*Myotis sodalis*) Revised Recovery Plan” was distributed publicly for comments in March 1999. In April 2007, the Agency released the “Indiana Bat (*Myotis sodalis*) Draft Recovery Plan: First Revision” (USFWS 2007a).

Populations are estimated using inventories of winter hibernacula, and the most current range-wide estimate of the population is 523,636 individuals, which represents about 60 percent of the estimated population of 1960 (USFWS 2015a). Long-term, detailed documentation of population changes are lacking across most of its range, with the exception of the state of Indiana (Brack et al. 1984, Johnson et al. 2002, Whitaker and Gummer 2003), although such information is now being acquired in most states. It is probable that habitat loss during summer (USFWS 2007b) and winter disturbances during hibernation (Johnson et al. 1998) both contributed to the overall decline of the species that lead to listing. With the advent of White-nose Syndrome (WNS), this species has undergone significant population declines.

The summer range of the Indiana bat is large and includes much of the eastern deciduous forestlands between the Appalachian Mountains and Midwest prairies. Distribution throughout the range is not uniform and summer occurrences are more frequent in southern Iowa and Michigan, northern Missouri, Illinois, and Indiana. Greater tree densities do not equate to more bats (Brack et al. 2002). Cooler summer temperatures associated with latitude or altitude likely affect reproductive success and the summer distribution of the species (Brack et al. 2002).

Status in Virginia

Indiana bats are known to summer and winter in Virginia. As such, the species should also be expected to occur when migrating between habitat types.

Virginia harbors 597 Indiana bats (0.1% of the total Indiana bat population) and does not contain designated critical habitat (USFWS 2015a). WNS was first detected in Virginia in 2009, and the population has declined 17 percent from 723 bats in 2007, likely as a result.

The most recent draft recovery plan recognized recovery goals for four recovery units based on both biological and logistic connections among winter hibernacula. Indiana bats that hibernate in Lee County, Virginia are assigned to the Midwest Recovery Unit. Conversely, winter hibernacula in Wise, Bath, Bland, Craig, Giles, Dickenson, Montgomery, and Tazewell counties (USFWS 2007a) are part of the Appalachian Mountains Recovery Unit. Prior to the arrival of WNS, the

known hibernaculum in Bland County contained approximately 230 individuals and thus was designated a Priority 3 hibernaculum (i.e., one containing 100 to 999 bats at any given time). Tazewell County contained a Priority 2 hibernaculum (1000 to 9,999 bats) that contained an estimated 4,000 Indiana bats (USFWS 2007a). These populations have likely declined in response to WNS. Approximately 11.78 miles of the Project traverses a buffer associated with Tawney's Cave, a Priority 4 (less than 100 Indiana bats) hibernaculum in Giles County, Virginia, which had a maximum population of 14 Indiana bats (USFWS 2007a), but more recent in-cave winter surveys conducted in 2009, 2011, and 2013 yielded zero hibernating Indiana bats (Powers et al. 2015).

Prior to the arrival of WNS, there was evidence of summer maternity colonies in Lee County, Virginia. Summer non-reproductive records are also known from Bath, Bland, Dickenson, Highland, Lee, Tazewell and Wise counties, Virginia.

Status in West Virginia

Indiana bats in West Virginia are present in both summer and winter, and they are also expected to occur during migration between habitats.

Indiana bats in West Virginia are associated with the Appalachian Mountains Recovery Unit, and totaled an estimated 2,373 bats in 2015 (0.5% of the entire population) (USFWS 2007a; 2015a). These bats are spread among 18 caves in Greenbrier, Mercer, Monroe, Pendleton, Preston, Randolph, and Tucker counties, West Virginia. The population has decreased 84 percent from 14,745 in 2007, likely as a result of the introduction of WNS in 2009. Hellhole Cave in Pendleton County is designated critical habitat and contained approximately 2,172 bats in 2015.

Maternity colonies are known from Boone and Tucker counties (USFWS 2007b), and summer captures are known along the proposed route of the Project in Tyler and Wetzel counties. The Wetzel County record is associated with the capture of a pregnant female on June 10, 2010, and considered evidence of a maternity colony although the bat was not radio-tracked to a roost and subsequent capture efforts were unsuccessful.

Threats to the Species

At the time of listing, the greatest threats to Indiana bats were associated with the winter hibernacula (USFWS 2007a). Documented threats to winter habitats, caused by humans, include: (1) disturbance and vandalism, (2) improper cave gates and structures, (3) indiscriminate collecting, and (4) flooding of caves from reservoir construction. Natural hazards included flash flooding of hibernacula (Brack et al. 2005), ceiling collapse of mines and caves (Elliot 2007), and colder or warmer than average winters. Natural and/or human-caused changes in the microclimate of caves and mines used as hibernacula adversely affected the species (Richter et al. 1993).

In 2006, WNS became the greatest threat to hibernating bats in the eastern half of North America. The fungal pathogen WNS was first observed on bats hibernating in caves and mines near Albany, New York and was responsible for dramatic declines in bats throughout the northeast (Blehert et al. 2008, Gargas et al. 2009). Since then, WNS has rapidly spread to hibernacula across the entire range of the Indiana bat. Researchers associate WNS with a recently identified fungus

(*Pseudogymnoascus destructans*) that thrives in cold and humid conditions characteristic of the caves and mines used by hibernating bats (Gargas et al. 2009). Bats apparently have a reduced immune responses during hibernation torpor (Carey et al. 2003), which may predispose them to infection by *P. destructans*. Indiana bats are among the species known to be killed by the fungus, and mortality due to WNS has likely caused rapid declines of the species across the Appalachians and in the Northeast (Thogmartin et al. 2012).

Hellhole Cave has been decimated by WNS since infection became apparent in 2010. A record high population of 18,557 bats was recorded in 2010 (WVDNR 2013); it has since precipitously declined to 2,172 in 2015, an 84.5 percent decline in population over five years. Future declines are expected in this designated critical habitat.

Wind energy is also a relatively novel threat to the species, although mortality is minimal compared to migratory tree bats (USFWS 2012, WEST 2013, Arnett et al. 2016). Bats flying around wind turbines either impact the blades or are killed by barotrauma caused by the extreme low air pressure within the rotor-swept zone (Baerwald et al. 2008). Multiple wind-energy-related habitat conservation plans have either been completed or are currently in development that minimize and mitigate the mortality of Indiana bats at wind farms, although no wind-related habitat conservation plans are currently approved for Virginia or West Virginia.

Recovery Goals and Accomplishments

In 2007, the Service established four recovery units to manage this species: Ozark-Central, Midwest, Appalachian Mountains, and Northeast. These units work to protect and promote population separation and genetic differentiation across the species range. Each unit must be protected sufficiently to recover the species (USFWS 2007a).

There are two recovery goals for Indiana bats: reclassification and delisting. The criteria for reclassification of the species to threatened are defined by the Service's recovery plan (USFWS 2007a).

1. Permanent protection at 80 percent of all Priority 1 hibernacula, with a minimum of one Priority 1 hibernaculum protected in each unit;
2. A minimum overall population estimate equal to the 2005 population estimate of 457,000; and
3. Documentation using statistically reliable information that indicates important hibernacula within each Recovery Unit, on average, have positive annual population growth rates and minimum risk of population declines over five sequential survey periods.

The criteria for delisting the species as defined by the Service recovery plan (USFWS 2007a):

1. Protection of a minimum of 50 percent of Priority 2 hibernacula in each Recovery Unit;
2. A minimum overall population estimate equal to the 2005 population estimate of 457,000; and
3. Documentation using statistically reliable information that shows a positive population growth rate over an additional five sequential survey periods over reclassification.

Note that the population estimate for 2005 has been increased to 592,781, after the discovery of a Priority 1 hibernaculum in 2012 and revision of past estimates (USFWS 2015a).

While reclassification criterion 2 and delisting criteria 2 and 3 were achieved or provisionally achieved when the 5-year review was published (USFWS 2009), after the spread of WNS and subsequent population decline, the species no longer meets these criteria.

Northern Long-Eared Bat

Information about the species description, life history, population dynamics, status, and distribution is in the proposed/final rules, recovery plans, 5 year status reviews, species surveys, habitat assessments, journal articles, etc. listed in the Literature Cited section. No critical habitat has been designated for this species.

Species Description

The northern long-eared bat weighs approximately 5 to 8 grams (0.17 to 0.28 ounces) at maturity, and its right forearm measures about 3.3 to 3.8 centimeters (1.3 to 1.5 in). The wing membrane connects to the foot at the base of the first toe. The northern long-eared bat is most easily characterized by the long ears (1.8 centimeters [0.7 in]), which extend past the muzzle when laid forward, as well as a long and thin tragus (1.02 centimeters [0.4 in]) (Whitaker and Mumford 2009). The northern long-eared bat's pelage is typically colored a light to dark brown on the dorsal side and a light brown on the ventral side (Caceres and Barclay 2000, Whitaker and Mumford 2009). Ears and wing membranes are usually a dark brown.

Life History

The northern long-eared bat is a "tree bat" in summer and a "cave bat" in winter. During the summer, the species is forest dependent. As with the Indiana bat, there are four ecologically distinct components of the annual life cycle: winter hibernation, spring staging and autumn swarming, spring and autumn migration, and the summer season of reproduction.

When female northern long-eared bats emerge from hibernation, they migrate to maternity colonies. The distance traveled from winter hibernacula to summer roosting areas is not known. Maternity colonies are typically found in hollow trees and under bark although they also use bat-houses, buildings, and other anthropogenic structures (Amelon and Burhans 2006). After parturition, pups usually achieve volancy by 21 days (Kunz 1971, Krochmal and Sparks 2007). As the offspring become volant, average number of bats using a maternity roost declines (Lacki and Schwierjohann 2001, Sparks 2003).

A wide variety of deciduous tree species, as well as occasional coniferous species, are used as nursery colonies indicating that it is tree form, not species, that is important for roosts (Caceres and Barclay 2000, Carter and Feldhamer 2005). This species regularly uses both live and dead trees (Sasse and Pekins 1996, Foster and Kurta 1999, Lacki and Schwierjohann 2001, Sparks 2003, Timpone 2004, Whitaker et al. 2004, Carter and Feldhamer 2005, Ford et al. 2006, Timpone et al. 2010, Johnson et al. 2012, Silvis et al. 2012, Johnson et al. 2013, Silvis et al. 2014).

The northern long-eared bat may choose either live or dead trees, depending on the presence or availability within an area or possibly due to competition with or predation from other wildlife

(Perry and Thill 2007, Perry et al. 2007). Roost trees may be habitable for one to several years, depending on the species and condition of the tree. The species may also use several other structures as summer roost sites. These can be natural or human-made (e.g., bridges, barns/homes, rocky cracks or crevices). Northern long-eared bats make extensive use of bat-houses when these structures are available (Whitaker et al. 2006).

Some males and non-reproductive females remain near their winter hibernacula throughout summer while others migrate varying distances. This may be due to a preference for cooler environments in the absence of pups (Barbour and Davis 1969, Amelon and Burhans 2006).

Structurally, summer roosts used by males are similar to those used by maternity colonies. Trees used by males of the species are often smaller than those used by maternity colonies, perhaps because males are often solitary or form small groups, and thus need less space, or they may have different thermal requirements than females.

Status and Distribution

On October 2, 2013, the northern long-eared bat was proposed for listing by the Service as endangered. On January 16, 2015, the Service proposed listing the northern long-eared bat as threatened with a 4(d) rule. On April 2, 2015, the Service published notice in the Federal Register of its final decision to list the species as threatened and issued an interim 4(d) rule exempting certain activities from the ESA's take prohibition. The listing decision and interim 4(d) rule took effect May 4, 2015. The Service issued a final 4(d) rule on January 14, 2016, which took effect on February 16, 2016. On April 27, 2016, the Service determined that designation of critical habitat was not prudent. Based on hibernacula studies, the northern long-eared bat has suffered estimated losses of up to 99 percent in certain areas of the Northeastern U.S. since 2005, which led to its status under the ESA as threatened (USFWS 2013). As of 2016, the range-wide population is estimated to be 6,546,718 adults, using 1,508 hibernacula in the winter and occupying 1,744 known maternity roost trees in the summer (USFWS 2016).

The summer range of the northern long-eared bat is large and includes much of the eastern deciduous forestlands from the northern border of Florida north and west to Saskatchewan and east to Labrador (Caceres and Barclay 2000, Whitaker and Mumford 2009). This bat is common to a variety of forest types ranging from intact to small remnants. Although primarily an eastern species, the northern long-eared bat can be found as far west as Montana and onto the High Plains.

Distribution throughout the range is not uniform, and summer occurrences are more common in the northern and northeastern portions of the species' range than in southern and western portions (Caceres and Barclay 2000, Amelon and Burhans 2006). Historically, these areas were primarily forested. Through the southern portions of their range, northern long-eared bats appear to be less abundant and are thought of as rare in Alabama, South Carolina, and Georgia (Mumford and Cope 1964, Barbour and Davis 1969, Amelon and Burhans 2006, Whitaker and Mumford 2009, Timpone et al. 2010). Although occasionally captured/recorded in western portions of their range, they are uncommon when records are compared to eastern areas and may now occupy this area as a result of range expansion following settlement (Sparks et al. 2011).

Prior to the arrival of WNS, the northern long-eared bat was widespread and common in forested landscapes of the eastern United States and Canada. There are hundreds of capture records within 80.5 kilometers (50 mi) of the Project, and the species remains relatively common throughout the region.

Status in Virginia

The northern long-eared bat is rarely found in large numbers during winter cave surveys in Virginia; however, it is frequently captured during the fall swarming period at cave entrances. The northern long-eared bat is assumed to occur throughout Virginia during summer months. An estimated population of 277,920 adults occurs in Virginia (USFWS 2016). According to data maintained in VDGIF's Wildlife Environmental Review Map Agency, summer capture records are reported from Craig, Giles, Montgomery, and Roanoke counties. One northern long-eared bat was captured for this Project in Montgomery County.

Status in West Virginia

Although this species is never abundant in winter intra-cave/hibernaculum surveys, it is one of the most common bats captured during summer mist-net surveys in wooded areas of West Virginia and portions of nearby Ohio. It can also be common in the capture at cave entrances during autumn swarming. More information is needed to understand where this species hibernates within the state (Stihler 2013). The population estimate for West Virginia is approximately 235,680 adults (USFWS 2016).

Seventy-four northern long-eared bats were captured for this Project in Braxton (10), Doddridge (4), Fayette (1), Greenbrier (3), Harrison (3), Lewis (15), Monroe (1), Nicholas (7), Summers (3), and Webster (26) counties.

Threats to the Species

WNS is the single largest threat to the northern long-eared bat and is the primary reason for listing. Observations in regularly monitored northern long-eared bat hibernacula in the northeast showed declines of 98 percent in the five years following the arrival of WNS (Turner et al. 2011), the worst decline of all species studied. Similarly, Francel et al. (2012) documented a 77 percent decline in summer capture rates of northern long-eared bats in West Virginia and adjacent areas of Pennsylvania in the two years following the arrival of WNS. In Virginia, summer mist-netting studies documented a decline of 95 percent (Reynolds et al. 2016), and winter studies documented a decline of greater than 90 percent (Powers et al. 2015) between 2009 and 2013. Data from cave surveys conducted across multiple states (New York, Pennsylvania, West Virginia, and Tennessee) between 1999 and 2011 indicate that population declines average 31 percent among all four states and are attributable to WNS and other factors (Ingersoll et al. 2013). A more recent paper described current extirpation of 69 percent in 468 winter colonies (Frick et al. 2015). As stated in the 12-month finding on the petition to list the northern long-eared bat as an endangered species, "no other threat is as severe and immediate to the northern long-eared bat's persistence as the disease, white-nose syndrome" (78 Federal Register 61046–61080).

Additional threats to the species are similar in nature to those impacting the Indiana bat and include anthropogenic disturbance and destruction of hibernacula, removal and alteration of summer forested habitat, chemical contamination, and mortality at wind energy facilities. Other than removal of occupied maternity colony roost trees and hibernacula disturbance, these threats are not considered detrimental to the species as a whole (USFWS 2015b; 2016). These threats are being mitigated by gating and protection of habitat surrounding hibernacula and protection of known occupied maternity roost trees (USFWS 2015b).

Recovery Goals and Accomplishments

A recovery plan for this species has not been completed as of the writing of this assessment. Based on the primary threats to the species, the major recovery goals for delisting are likely to include reduction of mortality caused by WNS and significant WNS-zone population increases. These goals may be accomplished in the future through continued monitoring of northern long-eared bat hibernacula and prevention, treatment, and/or natural recovery of WNS-infected populations.

Roanoke Logperch

Information about the species description, life history, population dynamics, status, and distribution is in the proposed/final rules, recovery plans, 5 year status reviews, species surveys, habitat assessments, journal articles, etc. listed in the Literature Cited section. No critical habitat has been designated for this species.

Species Description

The Roanoke logperch is a relatively large darter within the genus and subgenus, *Percina*. Members of the subgenus *Percina* are referred to as “logperches” and are known for their distinctive behavior of overturning substrates (e.g., gravel, pebbles) during foraging (Jenkins and Burkhead 1994). The Roanoke logperch has a long, conical snout, inferior mouth, and a moderate to robust body form (Rosenberger 2007) and grows to an adult length of approximately 15 centimeters (6 in) (Page and Burr 1991). Its dorsal is dark green, and its sides are greenish to yellowish, both with dark, blotched markings; the ventral side is white to yellowish (USFWS 2003). Fins are patterned with dark pigment, and the caudal fin is emarginate or truncate (Jenkins and Burkhead 1994).

Life History

Roanoke logperch generally live five to six years and mature after two to three years (Simonson and Neves 1986). The species is benthic and occupies medium to large warm-water streams and rivers in lotic habitats. Shifts in habitat occur by age classes, reproductive cycles, and seasons (Burkhead 1983, Rosenberger and Angermeier 2003). Adults (i.e., Age 1+ individuals) use riffle and run mesohabitats, whereas young of year (YOY) usually occur in pools, slow runs, or backwater areas alongside riffles with sandy bottoms. During spring months, adult males are typically found in shallow riffles, while females often occupy deep runs exhibiting gravel and small cobble substrates, which is also the preferred habitat for spawning. Logperch typically spawn in April or May in scoured, deep riffles and runs (Rosenberger and Angermeier 2002, USFWS

2003). Eggs are typically buried in fine, un-silted gravel, and little to no nest preparation is performed. Once the larval forms hatch, individuals drift to areas of low flow such as pools or back waters (Burkhead 1983).

Status and Distribution

The Service listed the Roanoke logperch as endangered on August 18, 1989 (U.S. 54 Federal Register 34468-34472) and completed a recovery plan on March 20, 1992. The species is endemic to the Roanoke-Chowan river basin of Virginia and North Carolina and is known to occur within the mainstems and select tributaries of the Roanoke, Pigg, Smith, and Dan rivers of the Roanoke River Basin and the mainstem and select tributaries of the Nottoway River of the Chowan River Basin.

The population structure of the species is divided into several small, genetically disparate populations that are separated by dams or large segments of river presumed to be unsuitable for the species (USFWS 2003, Roberts et al. 2013). Since the Roanoke logperch was first listed under the ESA, the information regarding the distribution and occurrence of the species has increased; however, the range of the species is small and, when present, the species is often rare (Simonson and Neves 1986, Jenkins and Burkhead 1994, Lahey and Angermeier 2007, Rosenberger 2007).

Roanoke logperch demonstrate complex preferences for habitat that vary over multiple scales. This, combined with the difficulty of detecting the species when present, makes estimating population sizes difficult. Using data available for long-term survey of the species, Roberts (2012) estimated the total number of Roanoke logperch to be 52,491 individuals distributed among eight populations with a total range extent of 637 stream kilometers. However, detailed occurrence of the species across its range is lacking (Lahey and Angermeier 2007), and thus, this estimate may underrepresent the total number of Roanoke logperch and the total extent of its range.

Eight fragmented populations of Roanoke logperch are known: (1) the upper Roanoke river drainage downstream to Niagara Dam, (2) the middle Roanoke River drainage downstream of Leesville Lake, (3) the Upper Pigg River Drainage upstream of Power Dam, (4) the Middle Pigg River drainage downstream of Power Dam, (5) the Smith River drainage upstream of Philpott Reservoir, (6) the Smith River drainage downstream of Philpott Reservoir to the headwaters of Martinsville Dam, (7) the Smith River drainage below Martinsville Dam, and (8) the Nottoway River drainage (USFWS 2007c).

Status in Virginia

The majority of the Roanoke logperch distribution resides within Virginia with portions of the range extending into North Carolina. Within the upper Roanoke, the species is known within the mainstems of the North Fork and South Fork Roanoke River, Roanoke River, Goose Creek, Big Otter River, and Pigg River as well as several tributaries draining into these waterbodies. Within the upper Smith, the species is known within the Smith River and several tributaries, including Rock Castle Creek and Town Creek. Within the Nottoway drainage, Roanoke logperch are known to occur within the mainstem of the Nottoway River and several direct tributaries to the mainstem, including Stony, Butterwood, and Waqua creeks.

Status in West Virginia

The Roanoke logperch is not known to occur in the state of West Virginia.

Threats to the Species

Main threats to Roanoke logperch populations include dams, toxic spills, channelization, roads, and sedimentation/siltation due to upland land disturbances and urban developments. Fragmented populations face different threats of varying degrees. For example, whereas the upper Roanoke River population is largely threatened by urbanization, agricultural/forestry practices, and road building, the Pigg River population is largely threatened by road building and toxic spills (USFWS 2007c).

Recovery Goals and Accomplishments

A recovery plan for Roanoke logperch was issued on March 20, 1992. Two recovery goals were established in the plan that aim to maintain and restore populations of Roanoke logperch and ultimately delist the species (Moser 1992). The recovery objectives include reclassification and delisting:

1. Reclassify the Roanoke logperch from endangered to threatened status when the likelihood of extinction in the foreseeable future has been eliminated by meeting the following criteria.
 - A. Populations of *Percina rex* are shown to be stable or expanding and reproducing (as evidenced by sustained recruitment) in each of the following river systems: upper Roanoke River, Pigg River, Smith River, and Nottoway River. Achievement of this criterion will be determined by population monitoring over at least a ten-year period.
 - B. Each of the known populations is protected from present and foreseeable threats that may interfere with the species' survival.
2. Remove *Percina rex* from the Federal list of endangered and threatened species when the following criterion has been met in addition to A and B above:
 - C. Habitat improvement measures have been developed and successfully implemented, as evidenced by a sustained increase in logperch population size and/or length of river reach inhabited within the upper Roanoke River drainage and a similar increase in at least two of the other three populations (Pigg River, Smith River, or Nottoway River).

Since the listing of the species, the known range for Roanoke logperch has been expanded (Rosenberger and Angermeier 2002, Lahey and Angermeier 2007), and the number of known populations of logperch has increased (Roberts et al. 2013). However, many of the watersheds within the Roanoke-Chowan remain undersampled (e.g., Blackwater River system), and the few fish collections that do exist were conducted prior to 1980. Several occurrence models have recently been developed by Virginia Tech, and these models suggest that logperch may occur within (1) many more waterbodies within watersheds with known documented occurrences, and (2) waterbodies in watersheds with no known occurrences. Increased occurrence monitoring

within these areas may lead to large gains in the known range for the species and perhaps the discovery of new populations.

The majority of threats that Roanoke logperch faced at the time of its listing remain present (Moser 1992, USFWS 2007c). The degree of risks associated with each threat may vary over time but are present nonetheless.

Criteria (A and B) for the reclassification of the species have not been met; therefore, reclassification is not probable in the foreseeable future. Habitat restoration activities have occurred within the known distribution of Roanoke logperch; however, any resultant recovery effects to existing populations have not been quantified (USFWS 2007c). Sustained increases in any known population size have not been reported, with the exception of the population in the Pigg River after the chemical spill in 1975 (Rosenberger 2002, Lahey and Angermeier 2007). In summary, the most recent 5-year review (USFWS 2007c), determined that “Roanoke logperch faces a moderate degree of threat with low recovery potential.”

Running Buffalo Clover

Information about the species description, life history, population dynamics, status, and distribution is in the proposed/final rules, recovery plans, 5-year status reviews, species surveys, habitat assessments, journal articles, etc. listed in the Literature Cited section. No critical habitat has been designated for this species.

Species Description

Running buffalo clover (*Trifolium stoloniferum*) is a stoloniferous, perennial herb. This species is characterized by and differentiated from white clover (*Trifolium repens* L.) by having erect peduncles (flowering stalks) that have two large trifoliate leaves at their summit. White clover lacks these leaves on the peduncle. Running buffalo clover’s erect flowering stems are typically 7.6 to 15.2 centimeters (3 to 6 in) tall. The round flowering heads occur in mid-April to June with wilted flowering heads persisting for a short time thereafter. It reproduces by both seeds and stolons.

Life History

Running buffalo clover is known to occur in relatively moist, fertile soils in calcareous regions. There does not appear to be any correlation between running buffalo clover and any particular soil type. It has been encountered in semi-shaded conditions along footpaths, logging trails, lawns of older homes and cemeteries, and grazed, semi-wooded terraces along stream corridors. In Ohio, it clearly inhabits open to semi-open, moist ground with grazing, trampling, or mowing, and it is generally near streams or rivers. Running buffalo clover may be found in semi-shaded, moist openings and edge habitats maintained by some form of long-term disturbance. Disturbance must be moderate in intensity; minimal or excessive disturbance is considered detrimental. Disturbances that may be helpful when moderate (or detrimental when excessive) include grazing, trampling, and mowing. Moderate amounts of disturbance, at a level conducive for establishment and maintenance of healthy populations, are infrequently encountered.

A canopy closure of 50 to 80 percent has been noted at some sites in Kentucky. Modern-day woody associates at those sites include bitternut hickory (*Carya cordiformis*), tulip tree (*Liriodendron tulipifera*), white ash (*Fraxinus americana*), boxelder (*Acer negundo*), white oak (*Quercus alba*), black cherry (*Prunus serotina*), red bud (*Cercis canadensis*), spicebush (*Lindera benzoin*), and sassafras (*Sassafras albidum*). Herbaceous components of the community include pale touch-me-not (*Impatiens pallida*), rich-weed, white grass (*Leersia virginica*), path rush (*Juncus tenuis*), white snakeroot (*Eupatorium rugosum*), honewort (*Cryptotaenia canadensis*), wild rye (*Elymus sp.*), and garlic mustard (*Alliaria officinalis*) (Campbell et al. 1989).

Status and Distribution

Running buffalo clover was listed as federally endangered on June 5, 1987. A recovery plan was prepared and released on August 12, 2005. As recently as 1983, this species was considered to possibly be extinct, as it had not been encountered in the field since 1937 in Preston County, West Virginia and 1940 in Webster County, West Virginia. Brooks (1983) considered the species endangered (with a few undiscovered populations) or extinct. In 1983, the Service placed the species under review for listing, noting that the species was probably extinct. The plant was rediscovered in 1985 at two sites in West Virginia (Bartgis 1985) and federally listed as endangered in 1987. These finds spurred a continued search for the species, and additional populations have been found in West Virginia, Ohio, Indiana, and Kentucky. These sites vary in size from a few individuals covering a few square feet to hundreds of individuals over a quarter of an acre.

Historically, the range of this species was across the central eastern United States. Brooks (1983) included eight states within the range: Arkansas, Illinois, Indiana, Kansas, Kentucky, Missouri, Ohio, and West Virginia. The earliest dated collection of the species was in 1830 near St. Louis, Missouri, with scattered collections throughout its range during the latter part of the 1800s and early 1900s. In Ohio, running buffalo clover is known from Hamilton, Warren, and Clermont counties, and most recently from Lawrence County.

Status in Virginia

Running buffalo clover is not currently known in Virginia

Status in West Virginia

Running buffalo clover is known to occur or has occurred in Barbour, Brooke, Fayette, Greenbrier, Monongalia, Pendleton, Pocahontas, Preston, Randolph, Tucker, and Webster counties, West Virginia. Greenbrier and Webster counties, West Virginia have the closest known populations to the Project Area.

Threats to the Species

Threats to running buffalo clover include anthropomorphic influences such as permanent habitat loss (e.g., road construction), elimination of grazing animals for dispersal, increased consumption from cattle and rabbit populations, and competition from introduced, exotic plants (Jacobs and

Bartgis 1987). Without large, hooved mammals acting as dispersal agents and the reduction of other natural disturbances, the habitat became closed and has led to a reduction in populations (Cusick 1989).

Recovery Goals and Accomplishments

A revision to the Running Buffalo Clover Recovery Plan was issued by the Service on June 27, 2007. This plan identifies three criteria for downlisting and delisting of the species. These include (1) having 17 A (1,000 or more naturally occurring rooted crowns), B (100-199 naturally occurring rooted crowns), C (30-99 naturally occurring rooted crowns), or D (1-29 naturally occurring rooted crowns) ranked populations (1 A, 3 B, 3 C, and 10 D) in at least two of the three regions in which running buffalo clover occurs, (2) achieving 95 percent probability of persistence or establishing viability within the next 20 years for A and B populations, and (3) maintaining and conserving these populations on government or private conservation agency land to ensure threats to running buffalo clover habitats have been addressed. For delisting, the final criterion must be met for all populations. Additionally, land-management strategies have been developed to enhance and maintain suitable habitat for running buffalo clover. Monitoring of known populations and surveys for new populations have continued since the species' listing in 1987, and new species occurrences have been found, resulting in 101 total known populations. The information collected from these efforts has been critical in the increased understanding of the species and its habitat.

Shale Barren Rock Cress

Information about the species description, life history, population dynamics, status, and distribution is in the proposed/final rules, recovery plans, 5-year status reviews, species surveys, habitat assessments, journal articles, etc. listed in the Literature Cited section. No critical habitat has been designated for this species.

Species Description

The shale barren rock cress (*Arabis serotina*) is a biennial plant species within the mustard family. Young, non-reproductive individuals have leaves in a basal rosette that range in size from 1.6 to 3.5 centimeters (0.6 to 1.4 in) in diameter. Potentially reproductive individuals are erect (41 to 97 centimeters [16.1 to 38.2 in]) and are flowering plants that lack the basal rosette. The flowering stalks are highly branched with 3 to 41 branches measuring 20 to 40 centimeters (7.9 to 15.7 in) wide with many flowers. The flowers are small and white with calyxes (20.2 to 0.3 centimeter [0.08 to 0.13 in] long) that bear silique fruits ranging from 4.3 to 7.9 centimeters (1.7 to 3.1 in) long (USFWS 1991). It flowers from mid-July to October.

A similar species (*Arabis laevigata* var. *burkii*) is often confused with shale barren rock cress as it is also found on shale barrens. However, it occupies a variety of habitats; flowers in April and May; and has broader leaves that are auricled at the base, less branched inflorescences, and larger flowers than shale barren rock cress (Wieboldt 1987).

Life History

The shale barren rock cress is very habitat restricted and is endemic to and occurs at low densities among scattered mid-Appalachian shale barrens in West Virginia and Virginia (USFWS 2002, Catrow et al. 2009). It is believed there may be fewer than 4,000 individuals in existence, with known populations having fewer than fifty individuals each.

Status and Distribution

The plant was listed as federally endangered on August 8, 1989, and only 34 extant and 1 historical populations were known at the time of listing (USFWS 1989). It is believed there may be fewer than 4,000 individuals in existence. If known populations, most have fewer than fifty individuals. No published critical habitat exists for the shale barren rock cress.

Status in Virginia

Shale barren rock cress has been documented in six Virginia counties (Bath, Alleghany, Augusta, Highland, Page, and Rockbridge).

Status in West Virginia

Shale barren rock cress has been documented in three West Virginia counties (Pendleton, Greenbrier, and Hardy). For this Project, the closest known populations occur in Greenbrier County.

Threats to the Species

Threats to the species include habitat loss, reproductive failure due to drought and lack of pollinators, herbivory by large mammals and insects, competition from exotic plants, and over collection by botanists. Populations of shale barren rock cress may be negatively influenced by construction and maintenance of roads and other pathways that cause landscape fragmentation (Nott 2006). Over-browsing (particularly in late summer) by white-tailed deer (*Odocoileus virginianus*) has also been documented as a cause of decline for shale barren rock cress (USFWS 1989). Pollinators of the species are significantly threatened by spraying of insecticides, and, due to the open habitat preferred by shale barren rock cress, insect pollinators are highly exposed to insecticides (Nott 2006).

Recovery Goals and Accomplishments

The Shale Barren Rock Cress Recovery Plan was released in 1991 and details the recovery objectives for downlisting and delisting the species. Three criteria have been established for downlisting: (1) maintaining 20 populations throughout its range, (2) permanently protecting the habitat of these 20 populations, and (3) storing of seeds to ensure against extinction of natural populations (USFWS 1991). In addition to these criteria, the addition of 15 self-maintaining populations with permanently protected habitat would warrant delisting (USFWS 1991). Furthermore, land-management strategies have been developed to enhance and maintain suitable habitat for the shale barren rock cress. Monitoring of known populations and surveys for new

populations have continued since the species listing, and the information collected from these efforts has been critical in the increased understanding of the species and its habitat.

Small Whorled Pogonia

Information about the species description, life history, population dynamics, status, and distribution is in the proposed/final rules, recovery plans, 5-year status reviews, species surveys, habitat assessments, journal articles, etc. listed in the Literature Cited section. No critical habitat has been designated for this species.

Species Description

The small whorled pogonia (*Isotria medeoloides*) is a member of the orchid family and is characterized by a single gray-green stem up to 30 centimeters (11.8 in) tall and the whorl of five to six leaves at the top of the stem. The leaves are gray-green and oblong and reach 4 to 8 centimeters (1.6 to 3.1 in) in length. A single or pair of green-yellow flowers appears in May or June. Pollinators are unknown. Fruits are capsules that mature in the autumn.

Large whorled pogonia (*Isotria verticillata*) is a similar species and can be differentiated by its reddish stem, differently colored flowers, and sepal characteristics. Small whorled pogonia also resembles young plants of Indian cucumber-root (*Medeola virginiana*) and is distinguished from it because small whorled pogonia has a hollow stout stem whereas Indian cucumber-root has a solid, more slender stem (USFWS 2008).

Life History

The small whorled pogonia is found in mature or secondary hardwood or mixed stands composed of beech (*Fagus spp.*), birch (*Betula spp.*), maple (*Acer spp.*), oak (*Quercus spp.*), hickory (*Carya spp.*), and pine (*Pinus strobus*) that have an open understory. However, it has been found that vegetative cover does not necessarily limit this species as it has been found in up to 60 percent cover (Mehrhoff 1980). In fact, one indicator community used to find this species is paper birch (*Betula papyrifera*) on steep slopes with dense fern understory. Witch hazel (*Hamamelis virginiana*) is almost always associated with it as a shrub species. Associated herbaceous cover includes Indian cucumber-root, club mosses (*Lycopodium spp.*), eastern teaberry (*Gaultheria procumbens*), trailing arbutus (*Epigaea repens*), striped prince's pine (*Chimaphila maculata*), partridgeberry (*Mitchella repens*), wintergreens (*Pyrola spp.*) and orchids such as moccasin flower (*Cypripedium acaule*), checkered rattlesnake plantain (*Goodyera tessellata*), downy rattlesnake plantain (*G. pubescens*), summer coralroot (*Corallorhiza maculata*), autumn coralroot (*C. odontorhiza*), and threebirds (*Triphora trianthophora*). Eight other orchids have been listed associated with a population in Ontario (Brownell and Bowman 1981). In Virginia, green adder's-mouth orchid (*Malaxis unifolia*) and brown widelip orchid (*Liparis liliifolia*) have been listed as associated orchids (Grimes 1921). The species typically occurs in acidic soils (Mehrhoff 1989).

Status and Distribution

The Service listed the species as endangered in 1982 due to a population size of only 466 individuals (USFWS 1982), but was subsequently reclassified as threatened in 1994 when 61 percent of the plant's viable sites were permanently protected (USFWS 1994). Most small whorled pogonia populations remain small and are not considered viable (USFWS 2008). Overall, its range is from Ontario to Maine down the Eastern United States coast to Georgia and possible as far west as Missouri, although it is thought to be extirpated there.

Status in Virginia

Small whorled pogonia is known from 20 counties in Virginia and two cities (Petersburg and Williamsburg). It is thought to be extirpated in four of these counties (Appomattox, Buckingham, New Kent, and York) and the city of Petersburg.

Status in West Virginia

Small whorled pogonia is known from two counties in West Virginia (Greenbrier and Randolph). The closest known populations to the Project Area are in Greenbrier County, West Virginia.

Threats to the Species

Habitat loss due to forestry or residential or commercial construction is the primary threat to small whorled pogonia (USFWS 1992a, McConnell 2007). This species may also be negatively affected by recreational use by hikers and off-road vehicles (McConnell 2007).

Recovery Goals and Accomplishments

The Small Whorled Pogonia Recovery Plan was released in 1985 and then revised in 1992 (USFWS 1985; 1992a). It details the recovery criteria for downlisting and three criteria for delisting the species. For downlisting these include (1) protection of at least 25 percent of populations equally distributed throughout the range, (2) demonstration of site or population viability over a three-year period, and (3) protection of sufficient buffer zones around populations. For delisting, the criteria include (1) protection of at least 61 sites equally distributed throughout its range, (2) self-sustainment of 75 percent of these sites over a ten-year period, and (3) establishment of appropriate management programs or protection of adjacent habitat for existing colonies to expand. As noted above, the species was initially listed as endangered in 1982, but was downlisted to threatened in 1994 (USFWS 1982; 1994), because the criteria for downlisting had been satisfied. Land-management strategies have been developed to enhance and maintain suitable habitat for the small whorled pogonia, which include maintaining open understories in forests with appropriate habitat. Monitoring of known populations and surveys for new populations have continued since the species listing in 1987. The information collected from these efforts has been critical in the increased understanding of the species and its habitat.

Virginia Spiraea

Information about the species description, life history, population dynamics, status, and distribution is in the proposed/final rules, recovery plans, 5-year status reviews, species surveys,

habitat assessments, journal articles, etc. listed in the Literature Cited section. No critical habitat has been designated for this species.

Species Description

Virginia spiraea (*Spiraea virginiana*) is a clonal, often profusely branched shrub that grows 1 to 3 meters (3.3 to 9.8 ft) in height. Its leaves are oblong-lanceolate or oblanceolate, 3 to 6 centimeters (1.2 to 2.4 in) by 1.0 to 1.8 centimeters (0.4 to 0.7 in), acute and mucronate, entire or with a few low teeth near the tip, and somewhat glaucous beneath. The inflorescence is a short, broad, terminal corymb, 5 to 22 centimeters wide (2.0 to 8.7 in), with glabrous or villous branches. The flowers are white and 0.5 to 0.6 centimeter (0.19 to 0.24 in) wide, with 0.08- to 0.11-centimeter (0.03- to 0.04-) sepals. The fruits are small follicles, at 0.15 centimeter (0.06 in) long. This species flowers in late May to late July (Gleason and Cronquist 1991, USFWS 1992b).

Virginia spiraea can be differentiated from other spiraeas mainly by its creamy white flower color and leaves, which have an acute apex (Weakley 2015). It most closely resembles shinyleaf meadowsweet (*Spiraea betulifolia* var. *corymbosa*) (Weakley). Virginia spiraea is distinguished from shinyleaf meadowsweet by its leaves, which are more than twice as long as wide (shinyleaf meadowsweet's leaves are less than twice as long as wide) and cuneate base (Weakley 2015). The introduced Japanese meadowsweet (*Spiraea japonica*) occurs in similar habitats but has pink flowers and leaves with long-acuminate tips (Patrick et al. 1995).

Life History

Virginia spiraea occurs along scoured banks of second and third order streams (small, intermittent or perennial streams), or on meander scrolls, point bars, natural levees, and other braided features of lower reaches. Virginia spiraea is somewhat different in that its life history requirements are strongly tied to high-gradient streams on larger creeks and rivers. In Virginia, Virginia spiraea plants are along flood scour zones in crevices of sandstone cobbles, boulders, and massive rock outcrop, and quartzite/feldspar boulders. It occurs in soils that are sandy, silty, or clay. The elevation range is 304.8 to 731.5 meters (1,000 to 2,400 ft). In West Virginia, it occurs among large boulders, flatrock, and flood debris along scoured stream-sides. Soils are silt and sand and elevation for populations ranges from 304.8 to 548.6 meters (1,000 to 1,800 ft).

Associated plants in Virginia include trees, shrubs and forbs such as hazel alder (*Alnus serrulata*), American hogpeanut (*Amphicarpaea bracteata*), sweet birch (*Betula lenta*), river birch (*B. nigra*), trumpet creeper (*Campsis radicans*), American hornbeam (*Carpinus caroliniana*), common buttonbush (*Cephalanthus sp.*), silky dogwood (*Cornus amomum*), leatherwood (*Dirca sp.*), scouringrush horsetail (*Equisetum hyemale*), ash (*Fraxinus sp.*), common winterberry (*Ilex verticillata*), cardinalflower (*Lobelia cardinalis*), royal fern (*Osmunda regalis*), ninebark (*Physocarpus sp.*), American sycamore (*Platanus occidentalis*), dotted smartweed (*Polygonum punctatum*), Japanese meadowsweet, steplebush (*S. tomentosa*), eastern poison ivy (*Toxicodendron radicans*), bluejacket (*Tradescantia ohiensis*), hemlock (*Tsuga sp.*), wingstem (*Verbesina alternifolia*), and yellowroot (*Xanthorhiza simplicissima*). In West Virginia, associated plants are red maple (*Acer rubrum*), hazel alder (*Alnus serrulata*), river birch, common buttonbush, silky dogwood, leatherwood, common winterberry (*Ilex verticillata*), royal fern (*Osmunda*

regalis), creeper (*Parthenocissus sp.*), ninebark, American sycamore, Japanese meadowsweet, eastern poison ivy (*Toxicodendron radicans*), bluejacket, hemlock, and yellowroot.

Status and Distribution

Virginia spiraea was listed as federally threatened in 1990. Reasons include the fact that it is endemic to the southern Appalachians (although it occurs from Pennsylvania, where it is presumed extirpated, to Ohio south to Alabama and Georgia), sexual reproduction is rare, very little population expansion is reported, and majority of populations are poor quality and have low viability. In addition, less than thirty genotypes are thought to occur range wide, and few mature seed or seedlings have been sighted. Virginia is known to have five known occurrences, and West Virginia has six (of 31 known). There are approximately 31 populations in seven states, down from 39 populations in eight states (USFWS 1992b).

Status in Virginia

Virginia contains five known occurrences out of the 31 known populations across seven states.

Status in West Virginia

West Virginia contains six known occurrences, with the closest known populations to the Project Area in Summers and Nicholas counties.

Threats to the Species

Virginia spiraea is threatened by a number of factors, including limited range, small number of known populations, and limited evidence of sexual reproduction. This species is particularly vulnerable to habitat fragmentation and land-use conversion (USFWS 1992b). Other threats caused by human activities include creation of impoundments near waterbodies, rising water from erosion controls near dams, and uncontrolled development of rivers (USFWS 1992b).

Many known Virginia spiraea sites are threatened by changes in hydrology by impoundment and impact from recreational use, hydroelectric facilities, and run-off debris. Small populations may be threatened by severe flooding that results in washouts of the streambank. Other threats include exotic species, such as multiflora rose (*Rosa multiflora*) and Japanese honeysuckle (*Lonicera japonica*), that compete with Virginia spiraea; roadside maintenance; damage by mammals; all-terrain vehicle use; and upslope timbering.

Recovery Goals and Accomplishments

The Virginia spiraea recovery plan was released in 1992 (USFWS 1992b). It details four recovery criteria for delisting the species. These include (1) having three stable populations in each drainage where populations are currently known, (2) protecting stable populations in each drainage in which it occurs, (3) searching all potential in states with present or past collections, and (4) cultivating representatives of each genetic group in a permanent collection. Land-management strategies have been developed to enhance and maintain suitable habitat for Virginia spiraea. Monitoring of known

populations and surveys for new populations have continued since the species listing in 1990. The information collected during these survey efforts has been critical in the increased understanding of the species and its habitat. Programs to collect genetic material and cuttings to propagate *Virginia spiraea* have been started. Cuttings from *Virginia spiraea* in 1993 by George Sanko in Cloudland Canyon, Georgia have been successfully propagated at Georgia Perimeter College Native Plant Botanical Garden and are in sufficient numbers to sell and trade.

ENVIRONMENTAL BASELINE

Regulations implementing the ESA (50 CFR 402.02) define the environmental baseline as the past and present impacts of all Federal, state, or private actions and other human activities in the action area. Also included in the environmental baseline are the anticipated impacts of all proposed Federal projects in the action area that have undergone or are in the process of Section 7 consultation.

Indiana Bat

Status of the Species/Critical Habitat within the Action Area

In West Virginia, maternity colonies are known from Boone and Tucker counties (USFWS 2007a), and summer captures are documented near the proposed route of the Project in Tyler and Wetzel counties. A pregnant female was captured in Wetzel County on June 10, 2010, indicative of the potential existence of maternity colonies in the area. Summer non-reproductive records are also known from Bath, Bland, Dickenson, Highland, Lee, Tazewell and Wise counties, Virginia.

ESI sampled 338 net sites (1,953 complete and 426 partial net nights) within the Project Area from May 15 to August 15, 2015, and 3 net sites (6 complete and 6 partial net nights) from May 15 to May 26, 2016. No Indiana bats were captured on this Project during the 2015 and 2016 mist-net surveys. At the time of the 2015 mist net survey, the interim 4(d) rule for the northern long-eared bat was in place. Based on the Service's Northern Long-Eared Bat Interim Conference and Planning Guidance (USFWS 2014), all lands within 2.4 kilometers (1.5 mi) of a northern long-eared bat roost location and within 4.0 kilometers (3.0 mi) of a capture with no associated roost location were considered "known, occupied" habitat for the threatened bat species. Thus, when northern long-eared bats were captured during mist-net surveys for the Project, further mist-net surveys were suspended within the appropriate radius of a capture or roost location. As a result, mist-net surveys were not conducted along approximately 42.4 percent (207.47 kilometers [128.92 mi]) of the proposed route and 50 percent (164.67 kilometers [102.32 mi]) of access roads because these Project features fell within the designated buffers surrounding northern long-eared bat captures and/or roost locations. Northern long-eared and Indiana bats are assumed present within all unsurveyed areas for the purposes of this document.

Detailed habitat assessments were completed for portions of the Project intersecting protective buffers associated with Indiana and northern long-eared bat captures, roosts, and hibernacula. A total of 917 habitat patches and 10,978 potential roost trees was identified. Of these 917 habitat patches, 343 had no roosting potential for Indiana bats. Fifty-five habitat patches were ranked as high roosting potential, 175 as moderate roosting potential, and 344 as low roosting potential for

the Indiana bat. Of the 10,978 potential roost trees, 5,084 (46.3%) were ranked as low, 4,908 (44.7%) were ranked as moderate, and 986 (9.0%) were ranked as high potential for the Indiana bat. With respect to foraging potential, 200 (21.8%) of the habitat patches had high foraging potential for the Indiana bat.

Portal searches for potential Indiana and northern long-eared bat hibernacula were conducted along the proposed route of the Project in Virginia and West Virginia between November 2014 and January 2017. Before initiating field studies, a Global Information System (GIS) desktop analysis was completed to locate known underground features near (within 1 kilometer [0.6 mi]) the Project that could potentially serve as winter hibernacula (mines and caves). Where land access was granted, any underground features identified near the Project were visited by permitted bat biologists to confirm presence and determine potential suitability.

Field searches were conducted within a 91.4-meter (300-ft) wide environmental survey corridor. In addition, following the Northern Long-eared Bat Interim Conference and Planning Guidance, ESI biologists searched for and evaluated any underground features encountered incidental to other field surveys up to 0.5 kilometer (0.3 mi) on either side of the Project centerline. Searches along the Project ROW, access roads, and aboveground and ancillary facilities were completed by walking along the proposed path. Biologists searched not only for holes in the ground, but also tailings, slag, benches, high-walls, seams, vents, drainage, abandoned structures, and areas of auger activity that could indicate the potential presence of open mine portals. To the degree that property access was provided, mine or cave features on the ROW were followed until they ended to locate any void openings near the proposed Project.

If voids were found, biologists recorded locations using a GPS unit, completed a potential hibernaculum description data sheet, and took photographs. All voids were assessed for their potential to serve as suitable Indiana and northern long-eared bat hibernacula based on the Agency's Draft Protocol for Assessing Abandoned Mines/Caves for Bat Use (Updated June 2011). In general, portals were deemed unsuitable for bat use and did not require subsequent sampling when:

- Only one opening could be found, and it was <15.2 centimeters (6 in) in diameter with little to no outward air flow;
- Vertical shafts were <0.3 meter (1 ft) in diameter;
- Passage continued <15.2 meters (50 ft) and terminated with no fissures available for bats to access;
- Openings were prone to flooding, collapse, heavy predation, or otherwise inaccessible to bats;
- The opening(s) had occurred recently due to creation or subsidence.

Biologists also noted the presence/absence of guano, outside temperature at void, temperature inside the void, percent canopy closure at void, approximate distance to nearest water source, and whether the void was obstructed by vegetation or spider webs.

Portal searches yielded a total of 44 previously undocumented underground features and eight known caves, including Tawney's and Canoe caves. Twenty-four of the 52 features were

determined to be potentially suitable for hibernating bats, of which three suitable features (Crooks Crevise, PS-WV5-B-P2, and PS-WV5-B-P3) are in the construction ROW. However, all three features were surveyed using harp traps, and no bats were captured. An additional ten features were harp trapped in fall 2015 and 2016, but no Indiana bats were captured. Canoe Cave was not surveyed for this Project, but was recently surveyed by the VDCR Department of Natural History (DNH), and no Indiana bats were observed (K. Powers, pers. Comm. April 1, 2016). Thus, the feature is considered unoccupied by the Indiana bat.

Four of the potentially suitable portals (BJD-PO-00001 through BJD-PO-00004) occur on an active surface mining site and were destroyed before harp trap surveys could occur for the Project. One potentially suitable portal (CRA-PO-00001) discovered during Project surveys is no longer within the Action Area. In addition to these features, Fred Bull's Cave was encountered during Project surveys but was well outside the Project Area (although still within the Action Area), and land access could not be obtained to conduct field surveys beyond the initial assessment of the opening. Tawney's Cave, a known Indiana bat hibernacula, is also within the Action Area of the Project but not the Project Area, and thus, presence is assumed. Three additional features were discovered in January 2017 in the Action Area that are suitable but remain unsurveyed: Kimballton Mine Cave and two undocumented underground features (MKM-PO-002 and MKM-PO-003). Because these features remain unsurveyed, presence of Indiana bat is assumed. In total, presence is assumed at three caves (Tawney's Cave, Kimballton Mine Cave, and Fred Bull's Cave) and two undocumented underground features (MKM-PO-002 and MKM-PO-003).

Factors Affecting Species Environment within the Action Area

The effects of both past and current natural and anthropogenic factors have shaped the occurrence and abundance of Indiana bat within the Action Area. Currently, the most influential factors governing the Indiana bat within the Action Area include: (1) loss or alteration of forest habitats surrounding wintering and summering areas and (2) WNS.

Timber harvest and forest fragmentation within the Action Area have altered the habitat and ecosystem of the Action Area. Past trends in forestry suggest that the Action Area may have been heavily harvested between 1880 and 1920 and again during the World War II era (USDA 2004). However, forest impacts within the Action Area are not as prevalent compared to other areas states the eastern United States. West Virginia, at 78 percent forest cover, is the third most heavily forested state in the United States, and the amount of forest cover increased between 1949 and 1989, remaining stable through 2007. Furthermore, reductions in population within the state have led to widespread abandonment of farm lands, many of which have and continue to revert to forest cover. Tree size in West Virginia forests has also increased, and there are now more large trees than at any point in the past century. The first decade of the 21st century saw a marked increase in the amount of timber cut in the state, but tree growth continued to exceed tree removal. These data pre-date the explosive development in the Marcellus Shale, which has led to a wide variety of developments associated with some timber removal and will likely continue to contribute to timber removal in the state. Similar increases in forest cover occurred in Virginia between the 1940s and 2007, and these trends are evident across both softwood and hardwood systems. In 2007, hardwood systems added 1.47 units of forest for every one unit removed, indicating that over time, both forest acreage and the size of trees increased; a trend that does not show a sign of reversal. However,

most of the current increase is driven by increasing size-classes of trees, as landscape conversion is a primary concern for foresters in Virginia and may be negatively impacting the species within the Action Area.

The fungal pathogen WNS was first observed near the Action Area in 2009 and has since reduced both the wintering and summering populations of Indiana Bat in and/or around the Action Area. The Action Area includes Tawney's Cave, a Priority 4 (less than 100 Indiana bats) hibernaculum in Giles County, Virginia, which had a maximum population of 14 Indiana bats (USFWS 2007a), but more recent in-cave winter surveys conducted in 2009, 2011, and 2013 yielded zero hibernating Indiana bats (Powers et al. 2015), and evidence suggests WNS is likely the cause for this observed reduction. Although only limited information is available regarding summering Indiana bats within the Action Area, WNS has reduced capture rates of the species in areas nearby the Action Area suggesting a reduced population size, and therefore, it is likely that similar trends exist within the Action Area itself.

Within the Action Area, additional potential human-caused threats to winter habitat include disturbance during hibernation, vandalism to suitable hibernacula due to the lack of or the improper installation of cave gates, and alterations to caves, mines, and surrounding landscapes that could lead to changes in the hibernacula's microclimate. Such vandalism has been previously documented within Tawney's, and the cave is currently gated at the roadside entrances. In general, disturbance during winter hibernation can lead to mortality by arousing a bat, causing it to unnecessarily deplete fat reserves needed to sustain it through winter.

Northern Long-Eared Bat

Status of the Species/Critical Habitat within the Action Area

Prior to the arrival of WNS, the northern long-eared bat was widespread and common in forested landscapes of the eastern United States and Canada. There are hundreds of capture records within 80.5 kilometers (50 mi) of the Project, and the species remains relatively common throughout the region.

ESI sampled 338 net sites (1,953 complete and 426 partial net nights) within the Project Area from May 15 to August 15, 2015, and 3 net sites (6 complete and 6 partial net nights) from May 15 to May 26, 2016. A total of 74 northern long-eared bats was captured during the 2015 survey efforts with all but one individual captured in West Virginia. No northern long-eared bats were captured in 2016. Radio transmitters were attached to 56 northern long-eared bats, and 43 of those bats were tracked to 70 diurnal roosts. Emergence counts were conducted on each roost tree for a minimum of two nights and yielded a total of 267 bats over 145 observation nights with the greatest number of bats emerging from a single roost on a single night (40 individuals; July 9, 2015).

Detailed habitat assessments were completed for portions of the Project intersecting protective buffers associated with Indiana and northern long-eared bat captures, roosts, and hibernacula. A total of 917 habitat patches and 10,978 potential roost trees were identified. Of these 917 habitat patches, 314 had no roosting potential for the northern long-eared bat, 137 patches were ranked as high roosting potential, 188 were ranked as moderate roosting potential, and 278 were ranked as

low roosting potential. Of the 10,978 potential roost trees, 2,431 (22.1%) potential roost trees were ranked as low, 5,344 (48.7%) were ranked as moderate, and 3,203 (29.2%) were ranked as high potential. With respect to foraging potential, 265 (28.9%) of the habitat patches identified had high foraging potential for the northern long-eared bat.

Portal searches yielded a total of 44 previously undocumented underground features and eight known caves. Twenty-four of the 52 features were determined to be potentially suitable for hibernating bats. As previously mentioned for Indiana bats, 13 suitable portals were sampled using harp traps: 6 within West Virginia and 7 within Virginia. One northern long-eared bat was captured at a portal (PS-WV3-Y-P1) in Braxton County, West Virginia during these efforts. After the discovery of one suitable portal (CRA-PO-00001), the Project Area was altered, and the feature is no longer within the Action Area of the Project. Additionally, four of the suitable portals (BJD-PO-00001 through BJD-PO-00004) occur on an active surface mining site and were destroyed before harp trap surveys could occur for the Project. Four features remain unsampled (using harp traps) for hibernating bats: two known caves (Fred Bull's and Kimballton Mine caves) and two suitable features discovered during Project surveys (MKM-PO-002 and MKM-PO-003). Presence is assumed at these four features as well as two previously document hibernacula (Canoe and Tawney's caves) and one feature determined occupied during Project surveys (PS-WV3-Y-P1) .

Factors Affecting Species Environment within the Action Area

The factors past and current impacts to the northern long-eared bat within the Action Area include WNS and the loss or alteration of suitable habitat from past and current management activities that reduce forest cover (including increased urbanization and timber harvesting). Similar to the Indiana bat, the northern long-eared bat shows strong susceptibility to WNS in areas near the Action Area (Francl et al. 2012, Powers et al. 2015, Reynolds et al. 2016), and similar trends are likely within the Action Area, including in hibernacula and in summer roosting areas.

Forests within the Action Area were likely heavily harvested between 1880 and 1920 and again during the World War II era. However, reduced harvesting activity and reductions in population with the Action Area in West Virginia have led to widespread abandonment of farm lands, and many of these areas have reverted back to a forested land cover. Tree size in West Virginia forests has also increased since the last major period of harvesting. These data, however, pre-date the explosive development in the Marcellus Shale, which has led to a wide variety of developments associated with some timber removal and will likely continue to contribute to timber removal in the state. Increases in forest cover occurred in Virginia between the 1940s and 2007. In 2007, hardwood systems added 1.47 units of forest for every one unit removed, indicating that over time, both forest acreage and the size of trees increased; a trend that does not show a sign of reversal. However, most of the current increase is driven by increasing size-classes of trees. Landscape conversion is a primary concern for foresters in Virginia and may be negatively impacting the species within the Action Area. Forest removal, especially when near hibernacula, can directly and indirectly impact the species. When forest is removed within proximity to a hibernaculum's entrance, available habitat needed during swarming or staging periods is reduced, and the action can potentially change the microclimate at the cave's entrance.

In addition to these changes due to WNS and forest health, the species is impacted by human

disturbance within the Action Area during winter hibernation. Occurrences of vandalism in known hibernacula within the Action Area have been documented, particularly in Tawney's Cave; however, in 2003 the roadside entrances to the cave were gated. Such disturbance can lead to direct mortality by arousing bats and cause them to burn fat reserves otherwise needed to sustain them through winter.

Roanoke Logperch

Status of the Species/Critical Habitat within the Action Area

The Project traverses both the upper Roanoke River and the Pigg River (a tributary of the Roanoke) watersheds, and each of these watersheds contain a distinct population of Roanoke logperch (Roberts et al. 2013). In addition to these two watersheds, the Project also crosses the Blackwater River system that contains suitable habitat for the species, but no individuals have been collected or observed.

The Project intersects 38 crossings with the potential to host Roanoke logperch (based on preliminary, desktop analysis), including 5 stream crossings where the species is known to occur. During surveys for the Project, several stream crossings were excluded on the justification that they do not exhibit habitat suitable for use by the species. Based on the results of suitable habitat surveys, it was determined that in addition to the 5 stream crossings where the species is known to occur, nine crossings have the potential to host Roanoke logperch.

Within the Action Area intersecting the upper Roanoke River watershed, the species is known from Bottom Creek, North Fork Roanoke River, South Fork Roanoke River, and Roanoke River; however, the species or suitable habitat for the species may also occur in Bradshaw Creek and Flatwoods Branch as well as unnamed tributaries to the waterbodies listed above. Within the Action Area intersecting the Blackwater river watershed, suitable habitat for the species occurs or may occur in portions of the Blackwater River, Foul Ground Creek, Little Creek, Maggodee Creek, North Fork Blackwater River, and Teels Creek. Within the Action Area within the Pigg River, the species is known only from the Pigg River; however, the species or suitable habitat may also occur portions of Harpen Creek, Jacks Creek, Jonnikin Creek, Parrot Branch, and Tomahawk Creek.

Factors Affecting Species Environment within the Action Area

The factors affecting the Roanoke logperch within the Action Area mirror those listed as the current threats to the species. These include dams, toxic spills, channelization, roads, and sedimentation/siltation. Land use within the Action Area is largely forest; however, a variety of land use types, including industrial, agricultural, and municipal, are also present. Within the North Fork and South Fork Roanoke watersheds, forest cover has remained fairly stable since 1992; however, there has been a small increase in municipal land use (Jin et al. 2013). Runoff from these areas likely contributes both sediments and potential containments into waterbodies hosting the species, degrading habitat quality for the logperch. Rosenberger (2007) identified the primary threats to the species to include road projects, urbanization, catastrophic spill events, and siltation from agricultural runoff. All of these activities have occur within the Action Area.

Running Buffalo Clover

Status of the Species/Critical Habitat within the Action Area

Running buffalo clover habitat was initially determined based on consultation with the Service and GIS desktop analyses. The desktop habitat analysis was completed to identify potentially suitable habitat and was used to determine the specific survey areas. Field surveys were completed by a Service-Certified Plant Surveyor using a pedestrian-meander search technique across the 91.4-meter (300-ft) wide environmental study corridor. In areas where habitat conditions were designated as highly suitable, more intensive searches were employed. Potential suitable habitat was identified within Greenbrier and Webster counties, West Virginia.

Surveys for running buffalo clover were performed July 16 – 23, 2015, in Webster and Nicholas counties, West Virginia yielding no individuals. Due to route modifications, additional surveys were performed May 2 – 3, August 5 – 7, August 23 – 26, and September 16 – 17, 2016, in Greenbrier and Webster counties, West Virginia. Again, no individuals were identified. Collectively, a total of 177.45 hectares (438.49 ac) along 39.28 kilometers (24.41 mi) was surveyed during these efforts.

Due to restricted land access, approximately 0.23 kilometer (0.14 mi) in Webster County remains to be surveyed. However, for the purposes of this analysis, presence is assumed within the unsurveyed area.

Factors Affecting Species Environment within the Action Area

Habitat alteration is the largest threat to running buffalo within the Action Area. The factors contributing to this threat include habitat destruction, habitat succession, and invasive species competition. This species may be found in open areas (such as along roads and trails) that receive moderate disturbance from recreational and other purposes. Mowing, as well as occurrences of grazing and trampling, may benefit the species; however, use of herbicides may result in detrimental impacts. Additionally, habitat destruction and modification due to increased residential and commercial developments have reduced the amount of potentially suitable habitat for running buffalo clover within the Action Area.

Shale Barren Rock Cress

Status of the Species/Critical Habitat within the Action Area

Shale barren rock cress habitat was initially determined based on consultation with the Service and GIS desktop analyses. The desktop habitat analysis was completed to identify potentially suitable habitat and was used to determine the specific survey areas. Field surveys were completed by a Service-Certified Plant Surveyor using a pedestrian-meander search technique across the 91.4-meter (300-ft) wide environmental study corridor. Potentially suitable habitat in Greenbrier and Fayette counties, West Virginia was assessed from August 5 – 12, 2015, but no potential habitat or individuals of shale barren rock cress were confirmed. Due to route modifications, additional surveys were performed August 5 – 7, August 23 – 26, and September 16 – 17, 2016, in Greenbrier and Fayette counties, West Virginia. Again, no potential habitat or individuals were identified.

Collectively, a total of 110.40 hectares (272.81 ac) along 17.03 kilometers (10.58 mi) was surveyed during these efforts.

Due to restricted land access, 0.19 kilometer (0.12 mi) remains to be surveyed. However, for the purposes of this analysis, presence is assumed in the unsurveyed areas.

Factors Affecting Species Environment within the Action Area

No potentially suitable habitat or individuals were identified during field surveys; therefore, there are currently no known factors affecting the species' environment within the Action Area.

Small Whorled Pogonia

Status of the Species/Critical Habitat within the Action Area

Small whorled pogonia potentially suitable habitat was initially determined based on consultation with the Service and GIS desktop analyses. Field surveys were completed by a Service-Certified Plant Surveyor using a pedestrian-meander search technique across the 91.4-meter (300-ft) wide environmental study corridor. In areas where habitat conditions were designated as highly suitable, more intensive searches were employed. A survey for small whorled pogonia was performed August 5 – 12, 2015, in Greenbrier and Fayette counties, West Virginia yielding no individuals. Due to route modifications, additional surveys were performed May 2 – 3, August 5 – 7, August 23 – 26, and September 16 – 17, 2016, in Greenbrier and Fayette counties, West Virginia, but the species was not observed. A total of 135.68 hectares (335.26 ac) along 20.63 kilometers (12.82 mi) were surveyed during these efforts.

Due to restricted land access, 0.19 kilometer (0.12 mi) remains to be surveyed. However, for the purposes of this analysis, presence is assumed in the unsurveyed areas.

Factors Affecting Species Environment within the Action Area

Habitat loss and degradation are the primary factors affecting small whorled pogonia within the Action Area. Increased residential and commercial developments contribute to the loss of potentially suitable habitat for the species. Forestry practices within the Action Area may also result in detrimental impacts as the species prefers older hardwood stands. Additionally, portions of the Action Area are known for recreational activities (such as camping and hiking), which makes the species' habitat susceptible to trampling or clearing.

Virginia Spiraea

Status of the Species/Critical Habitat within the Action Area

Virginia spiraea potentially suitable habitat was initially determined based on consultation with the Service and GIS desktop analyses. Field surveys were completed by a Service-Certified Plant Surveyor using a pedestrian-meander search technique across the 91.4-meter (300-ft) wide environmental study corridor. In areas where habitat conditions were designated as highly suitable, more intensive searches were employed. A survey for Virginia spiraea was performed August 5 –

12, 2015, in Summers and Nicholas counties, West Virginia yielding no individuals. A total of 1.47 hectare (3.64 ac) along 0.23 kilometer (0.14 mi) were surveyed during these efforts.

Due to restricted land access, 0.14 kilometer (0.09 mi) in Summers County remains to be surveyed. However, for the purposes of this analysis, presence is assumed in the unsurveyed areas.

Factors Affecting Species Environment within the Action Area

Although the occurrence within the Action Area has not been confirmed, if present, there are several factors that may affect the Virginia spiraea within the Action Area. Changes in hydrology (such as run-off debris and impoundments) can impact potentially suitable habitat for the species along the streambanks. Construction of boat docks or other streambank modifications may affect the species' environment.

EFFECTS OF THE ACTION

Direct effects are the direct or immediate effects of the Project on the species, its habitat, or designated critical habitat. Indirect effects are defined as those that are caused by the proposed action and are later in time, but still are reasonably certain to occur (50 CFR 402.02). Potential effects of Project activities on individuals and habitat are addressed below.

Indiana Bats

Indiana bats may be subjected to direct and indirect effects during construction, operation, and maintenance of the Project. Effects, by season, to individuals and associated habitat are addressed in the sections below.

Direct Effects

Winter Season of Hibernation

The Project will not directly impact any Indiana bat proposed or designated critical habitat or potentially suitable or occupied hibernacula. Therefore, harm from directly impacting winter habitat is not likely. However, noise produced during construction of the Project is estimated to harass 63 hibernating individuals. No documented hibernacula (known or potentially occupied) occur within 0.97 kilometer (0.6 mi) of a compressor station location. Based on these data, the risk of harassing hibernating Indiana bats by operational noise is insignificant and discountable.

Autumn Swarming and Spring Staging

Within 8 kilometers (5 mi) of known or potentially occupied winter habitat, Project development will temporarily reduce forested habitat used by swarming or staging Indiana bats by 0.21 percent (325.49 hectares [804.31 ac]) and permanently reduce it by 0.12 percent (188.1 hectares [464.8 ac]). An estimated 56 Indiana bats have potential to be disturbed and 1 Indiana bat has potential to be killed during spring staging. The same level of potential harassment and harm may also be applicable to bats during autumn swarming, thus resulting in the potential harassment and harm of 56 and 1 Indiana bats, respectively.

Summer Season of Reproduction

As a whole, the Project will permanently decrease forest within the Action Area by 0.72 percent and by 0.162 percent within the known, occupied Indiana bat summer habitat. This loss is a tiny fraction of the summer habitat available on the landscape that can sustain roosting bats. The Project crosses an area of occupied Indiana bat summer habitat from milepost 0.0 to 10.3. In addition, Indiana bat presence is assumed along the length of the ROW and access roads where summer mist-net surveys were not completed. Because timber will be removed during April (except for near Greenville Salt Peter and Tawney's Cave), a portion of the Indiana bat population may be present within the Action Area during habitat removal, resulting in approximately 1 individual being harmed. Construction will occur during summer months, and the number of individuals estimated to be harassed by noise and dust as well as tree clearing along the Project is 31. Likewise, the number of bats expected to be harassed during the first year of operations at the compressor station facilities is 1.

Spring and Autumn Migration/Transient Period

Approximately 0.72 percent (647.85 hectares [1,600.87 ac]) of the available forest within the Action Area will be permanently lost following Project development. This loss is a tiny fraction of the migration/transient habitat available on the landscape that sustains bats as they traverse between summer and winter habitats. Because there is the potential to remove forested habitat during portions of April and September (except around Tawney's Cave and Greenville Salt Peter), the expected number of migrant Indiana bats killed or disturbed due to tree clearing is 1 and 1, respectively.

Indirect Effects

Indirect effects from Project construction and operation are reviewed in detail within the BA. Detrimental indirect effects considered include clearing of roost trees during winter, light pollution, and water quality. Based on the best scientifically available data, MVP concludes that detrimental indirect effects associated with Project development are not likely to rise to the level of take for Indiana bats.

Interrelated and Interdependent Actions

An interrelated action is an action that is part of a larger action and depends on the larger action for its justification. Interdependent actions are those that have no independent utility apart from the proposed action. MVP is not aware of any actions that are interrelated to or interdependent with the proposed action at this time.

Beneficial Actions

A variety of actions will be undertaken to benefit the Indiana bat. The Project will avoid affecting known roosts to the maximum extent practicable. Four changes to the proposed Project alignment were implemented based on northern long-eared bat captures (northern long-eared bat roosts may provide some varying degree of potential roosting suitability for Indiana bats):

- Reduction of work area in Lewis County, West Virginia to avoid impacting Roost 116-1 near milepost 48.4;
- Shift in work area in Lewis County, West Virginia to avoid impacting Roost 084-2 near milepost 51.0;
- Shift in access road (MVP-GB-190) in Greenbrier County, West Virginia to avoid impacting Roost 044-1 near milepost 150.6;
- Shift in the construction ROW in Braxton County, West Virginia to avoid affecting Roost 791-1 near milepost 74.6.

Additionally, tree-clearing operations will be suspended from June 1 through July 31 to prevent mortality to non-volant young. Prior to commencement of tree-clearing activities, the Project construction ROW will be clearly marked to help ensure contractors do not accidentally remove more trees than anticipated. Some trees along the edges of the Project Area are likely to be damaged during clearing activities, potentially increasing the number of roost sites. Most damaged trees will survive, but will be more prone to insect infestations and diseases that result in senescence, which in turn produces potential roosts for Indiana bats. Over time, some damaged trees will die and, with significant solar exposure along the forest edge, provide high-quality roosts. Upon completion of Project construction, natural woodland regeneration will be allowed in the temporary and additional workspaces.

The Project will also avoid affecting potentially suitable hibernacula in the Project vicinity to the maximum extent practicable. Four changes to the proposed Project alignment were implemented based on the presence of potentially suitable hibernacula:

- Abandonment of proposed access road (MVP-MN-264) in Montgomery County, Virginia due to Old Mill Cave;
- Abandonment of proposed access road (MVP-WB-120) in Webster County, West Virginia due to identified portal (CRA-PO-00001);
- Pipeline route shift in Greenbrier County, West Virginia to avoid identified portal (SJTB-PO-00002);
- Pipeline route shift in Giles County, Virginia to avoid removal of forested habitat within 0.4 kilometer (0.25 mi) of the entrance of Canoe Cave.

Tree-clearing operations will be suspended from April 1 to November 15 within 8 kilometers (5 mi) of entrances to known Indiana bat hibernacula to prevent mortality to individuals engaging in autumn swarming or spring staging activities.

Prior to construction, information about the biology of the Indiana bat, activities that may affect bat behavior, ways to avoid and minimize these effects, and appropriate procedures to follow with respect to Project-specific conservation measures will be prepared and distributed to construction personnel. During construction, water trucks will be used to dampen the Project Area and control fugitive dust. Lighting impacts will also be minimized by instituting a 7:00 a.m. to 7:00 p.m. work day (except as mandated by safety standards). Permanent outdoor lighting at compressor stations will be full-shielded, “full cut-off” type lighting fixtures to minimize objectionable light from each station.

Restoration activities will include planting native seed mixes within temporary work areas and

then subsequently allowing forest regeneration. Initially these areas will provide foraging habitat and, over time, roosting habitat. Woodland edges provide high-quality foraging and commuting habitat. Restoration using native herbaceous species in the permanent ROW and continuous maintenance will provide suitable foraging and commuting habitat for Indiana bats.

Future maintenance activities that involve tree removal, limb trimming, or pruning will be conducted between November 15 and March 31 to avoid disturbance to bats, except in cases of human safety. If the seasonal restriction cannot be met, a qualified bat biologist will investigate the trees for the presence of bats to avoid a take (agency coordination will occur prior to this effort).

In addition to the aforementioned beneficial actions, MVP acquired a 121-acre property crossed by the Project in Braxton County, West Virginia. The property has a small stream on the southern end and is in proximity to Falls Mill, Millstone Run, Barbecue Run, and McChord Run and is approximately 2.82 kilometers (1.75 mi) east of Burnsville Lake. The parcel straddles three ridges. It is a mature, upland deciduous forest dominated by mostly oak, hickory, and red maple. There are numerous ATV/hunting trails throughout the property, providing excellent travel/foraging corridors for bats. There are numerous existing snags throughout the property. Approximately 262 meters (860 ft) of the Project crosses the eastern portion of the property. After construction, approximately 42.90 hectares (106 ac) will remain as interior forest as classified by the state of West Virginia and will be maintained as such in perpetuity (if requested, a conservation easement will be placed on the property). There are a variety of options for habitat enhancement on this property, including but not limited to, erection of artificial roost structures and establishment of a permanent water source. This acquisition is in addition to the forest mitigation described below.

As part of MVP's efforts to complete the Project with "no net loss" to the environment and in collaboration with the Virginia and West Virginia state environmental agencies, a mitigation model is being developed. This analysis utilizes interior forest as the benchmark to which habitat impacts are compared. Once complete, this analysis will identify the quantity of service acres required to fully offset forest impacts from the Project. Thus, funding for bat mitigation will be derived from the quantity of service acres translated into dollars, with inclusion of a typical land-management multiplier.

Northern Long-eared Bats

Analyses of effects to northern long-eared bats as a result of Project construction and operation are restricted to areas of known or potentially occupied habitat where the species is presumed to be present. Effects, by season, to individuals and associated habitat are addressed in the sections below.

Direct Effects

Winter Season of Hibernation

The Project will not directly impact any potentially suitable or occupied northern long-eared bat hibernacula. Based on the expected number of northern long-eared bats in known or potentially occupied hibernacula within the Project's Action Area and the Project's proposed tree-clearing

schedule, an estimated 222 individuals have potential to be harassed due to clearing and construction noise.

Autumn Swarming and Spring Staging

Within 0.4 kilometer (0.25 mi) of known or potentially occupied northern long-eared bat winter habitat, Project development will temporarily reduce forested habitat by 3.56 percent (24.57 hectares [60.71 ac]) and permanently reduce forested habitat by 1.25 percent (8.62 hectares [21.3 ac]). Based on the location of known and potentially occupied hibernacula, the proposed Project tree-clearing schedule, and estimated number of bats in each hibernaculum, it is estimated that 1 bat will be harmed and 1 bat will be harassed during spring staging. No individuals are expected to be harmed or harassed during autumn swarming.

Summer Season of Reproduction

Studies conducted in support of this analysis provided evidence of occupation of the Project Area by the northern long-eared bat during the summer season of reproduction. The final 4(d) rule published on January 14, 2016, prohibits incidental take of northern long-eared bats through removal of known maternity roosts and any trees within 45.7 meters (150 ft) from June 1 through July 31, when non-volant young may be present within the roosts.

Approximately 0.72 percent (647.85 hectares [1,600.87 ac]) of the available forest within the Action Area, including four documented maternity roosts, will be permanently lost following Project development. This loss is a tiny fraction of the forested habitat available on the landscape that supports summer roosting and foraging bats. No forest habitat will be removed during June or July, and therefore a direct take via harm to individuals will not occur when maternity colonies are most vulnerable.

Spring and Autumn Migration/Transient Period

Approximately 0.72 percent (647.85 hectares [1,600.87 ac]) of the available forest within the Action Area will be permanently lost following Project development. It is estimated that 1 migrant individual may be harmed and 1 individual may be harassed from Project construction.

Indirect Effects

Indirect effects from Project construction and operation are reviewed in detail within the BA. Detrimental indirect effects considered include clearing of roost trees during winter, light pollution, and water quality. Based on the best scientifically available data, MVP concludes that detrimental indirect effects associated with Project development are not likely to rise to the level of take for northern long-eared bats.

Interrelated and Interdependent Actions

MVP is not aware of any actions that are interrelated to or interdependent with the proposed action at this time.

Beneficial Actions

A variety of actions will be undertaken to benefit the northern long-eared bat. The Project will avoid affecting known roosts to the maximum extent practicable. Four changes to the proposed Project alignment were implemented based on northern long-eared bat captures:

- Reduction of work area in Lewis County, West Virginia to avoid impacting Roost 116-1 near milepost 48.4;
- Shift in work area in Lewis County, West Virginia to avoid impacting Roost 084-2 near milepost 51.0;
- Shift in access road (MVP-GB-190) in Greenbrier County, West Virginia to avoid impacting Roost 044-1 near milepost 150.6;
- Shift in the construction ROW in Braxton County, West Virginia to avoid impacting Roost 791-1 near milepost 74.6.

Additionally, tree-clearing operations will be suspended from June 1 through July 31 to prevent mortality to non-volant young. Prior to commencement of tree-clearing activities, the Project construction ROW will be clearly marked to help ensure contractors do not accidentally remove more trees than anticipated. Some trees along the edges of the Project Area are likely to be damaged during clearing activities, potentially increasing the number of roost sites. Most damaged trees will survive, but will be more prone to insect infestations and diseases that result in senescence, which in turn produces potential roosts for northern long-eared bats. Over time, some damaged trees will die and, with significant solar exposure along the forest edge, provide high-quality roosts. Upon completion of Project construction, natural woodland regeneration will be allowed in the temporary and additional workspaces.

The Project will also avoid impacting potentially suitable hibernacula in the Project vicinity to the maximum extent practicable. Four changes to the proposed Project alignment were implemented based on the presence of potentially suitable hibernacula:

- Abandonment of proposed access road (MVP-MN-264) in Montgomery County, Virginia due to Old Mill Cave;
- Abandonment of proposed access road (MVP-WB-120) in Webster County, West Virginia due to identified portal (CRA-PO-00001);
- Pipeline route shift in Greenbrier County, West Virginia to avoid identified portal (SJTB-PO-00002);
- Pipeline route shift in Giles County, Virginia to avoid removal of forested habitat within 0.4 kilometer (0.25 mi) of the entrance of Canoe Cave.

Tree-clearing operations will be suspended from April 1 to November 15 within 0.4 kilometer (0.25 mi) of entrances to known northern long-eared bat hibernacula to prevent mortality to individuals engaging in autumn swarming or spring staging activities.

Prior to construction, information about the biology of the northern long-eared bat, activities that may affect bat behavior, ways to avoid and minimize these effects, and appropriate procedures to follow with respect to Project-specific conservation measures will be prepared and distributed to construction personnel. During construction, water trucks will be used to dampen the Project Area

and control fugitive dust. Lighting impacts will also be minimized by instituting a 7:00 a.m. to 7:00 p.m. work day (except as mandated by safety standards). Permanent outdoor lighting at compressor stations will be full-shielded, “full cut-off” type lighting fixtures to minimize objectionable light from each station.

Restoration activities will include planting native seed mixes within temporary work areas and then subsequently allowing forest regeneration. Initially these areas will provide foraging habitat and, over time, roosting habitat. Woodland edges provide high-quality foraging and commuting habitat. Restoration using native herbaceous species in the permanent ROW and continuous maintenance will provide suitable foraging and commuting habitat for northern long-eared bats.

Future maintenance activities that involve tree removal, limb trimming, or pruning will be conducted between November 15 and March 31 to avoid disturbance to bats, except in cases of human safety. If the seasonal restriction cannot be met, a qualified bat biologist will investigate the trees for the presence of bats to avoid a take (agency coordination will occur prior to this effort).

MVP acquired a 121-acre property crossed by the Project in Braxton County, West Virginia. There are six northern long-eared bat captures in the vicinity of the property (five approximately 6.43 kilometers [4.0 mi] north and one approximately 4.83 kilometers [3.0 mi] south). The property has a small stream on the southern end and is in proximity to Falls Mill, Millstone Run, Barbecue Run, and McChord Run and is approximately 2.82 kilometers (1.75 mi) east of Burnsville Lake. The parcel straddles three ridges. It is a mature, upland deciduous forest dominated by mostly oak, hickory, and red maple. There are numerous ATV/hunting trails throughout the property, providing excellent travel/foraging corridors for bats. There are numerous existing snags throughout the property. Approximately 262 meters (860 ft) of the Project crosses the eastern portion of the property. After construction, approximately 42.90 hectares (106 ac) will remain as interior forest as classified by West Virginia and will be maintained as such in perpetuity. There are a variety of options for habitat enhancement on this property, including but not limited to, erection of artificial roost structures and establishment of a permanent water source.

As part of MVP’s efforts to complete the Project with “no net loss” to the environment and in collaboration with the Virginia and West Virginia state environmental agencies, a mitigation model is being developed. This analysis utilizes interior forest as the benchmark to which habitat impacts are compared. Once complete, this analysis will identify the quantity of service acres required to fully offset forest impacts from the Project. Thus, funding for bat mitigation will be derived from the quantity of service acres translated into dollars, with inclusion of a typical land-management multiplier.

Roanoke Logperch

Project activities with the potential to affect Roanoke logperch include instream, benthic disturbances; upland disturbances (e.g., erosion and sedimentation); noise; and artificial lighting. Occupied habitats where Project activities may impact Roanoke logperch include the North Fork Roanoke, Roanoke, and Pigg rivers. Suitable habitats (and assumed occupation) also occur in the North Fork Blackwater River, Blackwater River, Little Creek, and portions of Bradshaw, Teels, Maggodee, and Harpen creeks. Potential effects of Project activities on individuals and habitat are

summarized below.

Direct Effects

At Project waterbody crossings where Roanoke logperch occur or have the potential occur, harm and harassment of individuals may occur from instream construction activities. MVP will remove all fishes at these crossings immediately prior to construction, including Roanoke logperch (where present). Removals will occur in all instream disturbance areas (including but not limited to coffer dams, dewatered areas, and pipeline construction footprint). All collected fishes will be translocated downstream of the construction area. All Roanoke logperch encountered during depletion fish surveys are considered harassed under the ESA; however, some individuals encountered could sustain harm during the relocation process.

In addition to the effects within the construction footprint, harassment may occur immediately downstream of each proposed crossing where Roanoke logperch may be present. Such disturbance is the result of heightened sediment loads from instream activities and altered hydrology when the construction footprint is isolated. Upland disturbances may also impact the species downstream of Project construction where increased erosion and sedimentation may occur.

Instream and upland construction activities may temporarily and cumulatively affect 49.63 stream kilometers (30.84 mi) of occupied or suitable Roanoke logperch habitats; however, critical habitat has not been designated for the species. Within this area, it is estimated that Project activities could potentially harass 3,618 individuals and harm 29 individuals of all age classes (YOY and Age 1+ individuals). Harm estimates are calculated at 13 crossings where instream construction activities are needed, with expected harm rates for YOY and Age-1+ Roanoke logperch of 1 individual for each age class at each crossing with the exception of the Roanoke River where 4 adult individuals are expected to be harmed. Thus, the combined number of YOY and Age-1+ individuals that may be harmed is 29.

Indirect Effects

Roanoke logperch may potentially experience lasting effects from sedimentation after Project completion. Roanoke logperch heavily rely on interstitial space availability for foraging, and sedimentation can alter food web interactions for fishes, particularly those that rely on interstitial spaces for foraging (Henley et al. 2000). Sediments that enter streams are anticipated to occur at a relatively short temporal scale and are primarily limited to a short construction duration. It is anticipated that sediments will be flushed out or transported downstream during high-water events. However, introduced sediment, and any associated contaminants or nutrients, can be sequestered in streams and impart a legacy effect to future generations in the form of altered fish assemblages or macroinvertebrate (i.e., prey) communities or a reduction in sheltering, feeding, or breeding habitats.

Riparian vegetation removal at the Project LOD could potentially result in the future harassment of individuals via resultant changes in localized ecological processes. Removal of riparian vegetation decreases bank stability, increases erosion rates, and subjects individuals to augmented turbidity and suspended sediments. Allowing more sunlight to reach the stream may also expose

fishes, including Roanoke logperch, to increased predation rates via aerial predators. Additionally, increased sun exposure may alter the instream primary productivity. This, in combination with potential influx of nutrients via sediments, can encourage algal growth on substrates. These alterations can have cascading effects that modify food web dynamics, trophic interactions, and aquatic community structure.

All of these effects are likely to occur at a localized scale, and the temporary reduction of the ROW width to 22.9 meters (75 ft) may minimize the spatial extent and overall potential of effects. To further minimize potential adverse effects along riparian corridors, MVP plans to allow a 3.3-meter-wide (10-ft-wide) strip of herbaceous cover centered on the pipeline (for potential maintenance purposes) and trees will be allowed to grow within 4.6 meters (15 ft) of the pipeline.

Any potential reduction in water or habitat quality could invite the potential colonization and/or proliferation of aquatic invasive species (e.g., Asian clam, zebra mussels) because these species are opportunistic in nature and are habitat generalists. The presence of aquatic invasive species increases the potential for competitive or predatory interactions. However, Project activities are not anticipated to introduce aquatic invasive species nor augment existing populations of aquatic invasive species within occupied streams.

Interrelated and Interdependent Actions

MVP is not aware of any actions that are interrelated to or interdependent with the proposed action at this time.

Beneficial Actions

All fish will be removed from work areas within waterbodies crossed within Virginia (per VDGF's request). In addition, the Project will adhere to the TOYR for in-stream construction (March 15 to June 30) for the Roanoke logperch. A variety of other aquatic actions will be undertaken, including:

- Avoiding removal of riparian canopy or stabilizing vegetation (where possible);
- Stabilizing waterbody banks and installation of permanent sediment barriers within 24 hours of completing in-stream construction activities;
- Aligning crossings as close to perpendicular to the axis of the waterbody channel as engineering and routing conditions allow;
- Attempting to maintain, at minimum, a 4.6-meter (15-ft) section of undisturbed vegetation between the waterbody and construction ROW where the pipeline parallels a waterbody;
- Conducting construction at stream crossings during low-flow conditions, to the maximum extent possible;
- Crossing streams using dry crossing methods by pumping or fluming water around if water is flowing at the time of construction;
- Restoring each waterbody to its original configuration and contour to the maximum extent possible;
- Using native stone to the extent possible during stream bed restoration and stabilization;
- Promptly removing construction materials and related crossing structures from each

waterbody after construction;

- Avoiding the use of surface-water sources in Virginia for hydrostatic testing;
- Implementing sustainable water-use practices to ensure water resources and environmentally responsible stream flows are maintained;
- Discharging hydrostatic test water to the ground in an upland, well-vegetated area and not directly to surface waters.

BMPs to protect aquatic resources will also be used along the Project, including, but not limited to, compost filter sock (e.g., single and triple stack), silt fence, super silt fence, belted silt fence, waterbars, temporary diversion berms, cross-culverts, broad-based dips, rock checkdams, rock construction entrances, cofferdams, timbermats, seeding/mulching, erosion control blanketing, hydro-seed, hydro-mulch, dewatering structures, and sediment filter bags. Construction will minimize work in rain conditions, perform frequent inspections, and ensure appropriate grading. MVP has located the ROW and as many ATWS as possible at least 30.5 meters (100 ft) away from the edge of waterbodies potentially supporting federally listed aquatic species (exceptions in Table 8 in the BA). The Project was also shifted north to avoid suitable habitats to Roanoke logperch (thus eliminating two crossings of the Blackwater River in Franklin County, Virginia).

North Fork Roanoke River is crossed by the Project and is known to support populations of a wide variety of native fish, including the Roanoke logperch. The Service is engaged in public-private partnership for restoration activities along the North Fork Roanoke River. Previous restoration efforts by the partnership have taken place both up and downstream of the Project's crossing of the river. These activities include constructing instream features, planting riparian buffers with native vegetation to stabilize the streambank and floodplain, excluding cattle access to streams, grading streambanks, and reestablishing channel morphology. MVP will provide funds to continue and expand these restoration activities in the watershed, and expand on an existing, successful, landscape approach that tangibly benefits the Roanoke logperch within its known, occupied range.

MVP will also support proper stream restoration activities within the distributional range of the Roanoke logperch and other sensitive riparian areas within the Project corridor. Proper stream restoration activities can provide a multitude of environmental and economic benefits including (but not limited to) improved water quality, augmentation of habitat diversity, reestablishment of critical watershed functions, increases in property and aesthetic values, reduction of flood damages, and riparian property loss. Targeted restoration activities in or near waterbodies would take place at 55 stream crossing locations along the Project.

Funding will be provided for Roanoke logperch mitigation. The amount will be derived directly from the number of linear stream feet of Roanoke logperch habitat impacts, as identified within the BA.

Running Buffalo Clover

Direct and Indirect Effects

The Project will not directly impact known-occupied habitats of running buffalo clover. Critical habitat has not been designated for the species, and the nearest known populations of running

buffalo clover occur outside of the Action Area in Greenbrier County, West Virginia. To date, running buffalo clover has not been identified in the Project Area during Service-approved plant surveys.

Remaining surveys for running buffalo clover will be conducted prior to construction if land access timing coincides with the survey window. If the species is located, it will be fenced off and avoided if possible. If it occurs within the LOD such that it cannot be avoided, it will be transplanted. If the timing of land access does not coincide with the survey window, it will not be feasible to identify whether running buffalo clover is present within the LOD for the unsurveyed area. In that instance, it is possible that up to 2.1 acres of running buffalo clover may be cleared during ROW clearing. However, it is unlikely that any running buffalo clover individuals are present in the 2.1 acres of unsurveyed areas in light of the negative results in the areas that were surveyed. Even if running buffalo clover were present in the unsurveyed areas, and could not be identified (and thus avoided or transplanted) prior to ROW clearing, it is unlikely that the entire unsurveyed 2.1 acres would contain running buffalo clover in light of the existing information about the location of known populations and the negative results for the surveyed portions of the ROW.

No indirect effects to individuals or habitat is expected as such effects (e.g., noise or dust) are not expected to impact plant species.

Interrelated and Interdependent Actions

MVP is not aware of any actions that are interrelated to or interdependent with the proposed action at this time.

Beneficial Actions

A variety of actions will be undertaken to benefit listed plant species along the Project, including:

- Thoroughly cleaning equipment prior to mobilization to avoid introducing exotic/invasive species in organic materials brought onsite during construction;
- Establishing cleaning stations to thoroughly wash all equipment prior to transporting it to the next construction spread;
- Implementing selective spot treatment or eradication of exotic/invasive plant species encountered during construction and operation of the Project;
- Stripping of topsoil from the full width of the construction ROW and storing it separately from other soils in areas identified as containing higher than usual concentrations of exotic/invasive plant species (in wetlands, agricultural, and residential areas);
- Committing to use native seed mixes, as developed by the Wildlife Habitat Council, during restoration efforts;
- Minimizing the amount of time bare soil is exposed during construction to reduce opportunity for exotic/invasive plants to become established.

Maintenance of the Project ROW and access roads may provide potentially suitable habitat for running buffalo clover. This species may be found in semi-shaded, moist openings and edge habitats maintained by some form of long-term disturbance. Disturbance must be moderate in

intensity; minimal or excessive disturbance is detrimental. Disturbances that may be helpful when moderate (or detrimental when excessive) include grazing, trampling, and mowing. Additionally, increases in light regimes from clearing may benefit running buffalo clover (as long as the light intensity is not too intense).

Shale Barren Rock Cress

Direct and Indirect Effects

The Project will not directly impact known-occupied habitats of shale barren rock cress. To date, shale barren rock cress has not been identified in the Project Area during Service-approved plant surveys.

Remaining surveys for shale barren rock cress will be conducted prior to construction if land access timing coincides with the survey window. If the species is located, it will be fenced off and avoided if possible. If it occurs within the LOD such that it cannot be avoided, it will be transplanted. If the timing of land access does not coincide with the survey window, it will not be feasible to identify whether shale barren rock cress is present within the LOD for the unsurveyed area. In that instance, it is possible that up to 1.8 acres of shale barren rock cress may be cleared during ROW clearing. However, it is unlikely that any shale barren rock cress individuals are present in the 1.8 acres of unsurveyed areas in light of the negative results in the areas that were surveyed. Even if shale barren rock cress were present in the unsurveyed areas, and could not be identified (and thus avoided or transplanted) prior to ROW clearing, it is unlikely that the entire unsurveyed 1.8 acres would contain shale barren rock cress in light of the existing information about the location of known populations and the negative results for the surveyed portions of the ROW.

No indirect effects to individuals or habitat is expected as such effects (e.g., noise or dust) are not expected to impact plant species.

Interrelated and Interdependent Actions

MVP is not aware of any actions that are interrelated to or interdependent with the proposed action at this time.

Beneficial Actions

A variety of actions will be undertaken to benefit listed plant species along the Project, including:

- Thoroughly cleaning equipment prior to mobilization to avoid introducing exotic/invasive species in organic materials brought onsite during construction;
- Establishing cleaning stations to thoroughly wash all equipment prior to transporting it to the next construction spread;
- Implementing selective spot treatment or eradication of exotic/invasive plant species encountered during construction and operation of the Project;
- Stripping of topsoil from the full width of the construction ROW and storing it separately from other soils in areas identified as containing higher than usual concentrations of

- exotic/invasive plant species (in wetlands, agricultural, and residential areas);
- Committing to use native seed mixes, as developed by the Wildlife Habitat Council, during restoration efforts;
- Minimizing the amount of time bare soil is exposed during construction to reduce opportunity for exotic/invasive plants to become established.

Eradication of exotic/invasive plant species encountered during construction and operation of the Project may decrease competition for this species.

Small Whorled Pogonia

Direct and Indirect Effects

The Project will not directly impact known-occupied habitats of small whorled pogonia. Critical habitat has not been designated for the species, and the nearest known populations of small whorled pogonia occur outside of the Action Area in Greenbrier County, West Virginia. To date, small whorled pogonia has not been found in the Project Area during Service-approved plant surveys.

Remaining surveys for small whorled pogonia will be conducted prior to construction if land access timing coincides with the survey window. If the species is located, it will be fenced off and avoided if possible. If it occurs within the LOD such that it cannot be avoided, it will be transplanted. If the timing of land access does not coincide with the survey window, it will not be feasible to identify whether small whorled pogonia is present within the LOD for the unsurveyed area. In that instance, it is possible that up to 1.8 acres of small whorled pogonia may be cleared during ROW clearing. However, it is unlikely that any small whorled pogonia individuals are present in the 1.8 acres of unsurveyed areas in light of the negative results in the areas that were surveyed. Even if small whorled pogonia were present in the unsurveyed areas, and could not be identified (and thus avoided or transplanted) prior to ROW clearing, it is unlikely that the entire unsurveyed 1.8 acres would contain small whorled pogonia in light of the existing information about the location of known populations and the negative results for the surveyed portions of the ROW.

No indirect effects to individuals or habitat is expected as such effects (e.g., noise or dust) are not expected to impact plant species.

Interrelated and Interdependent Actions

MVP is not aware of any actions that are interrelated to or interdependent with the proposed action at this time.

Beneficial Actions

Removal of brush and opening of edges associated with construction of the Project may increase habitat for small whorled pogonia. Additionally, increases in light regimes from clearing may benefit small whorled pogonia (as long as the light intensity is not too intense).

Virginia Spiraea

Direct and Indirect Effects

The Project will not directly impact known-occupied habitats of Virginia spiraea. Critical habitat has not been designated for the species, and the nearest known populations of Virginia spiraea occur outside of the Action Area in Nicholas County, West Virginia. To date, Virginia spiraea has not been found in the Project Area during Service-approved plant surveys.

Remaining surveys for Virginia spiraea will be conducted prior to construction if land access timing coincides with the survey window. If the species is located, it will be fenced off and avoided if possible. If it occurs within the LOD such that it cannot be avoided, it will be transplanted. If the timing of land access does not coincide with the survey window, it will not be feasible to identify whether Virginia spiraea is present within the LOD for the unsurveyed area. In that instance, it is possible that up to 1.4 acres of Virginia spiraea may be cleared during ROW clearing. However, it is unlikely that any Virginia spiraea individuals are present in the 1.4 acres of unsurveyed areas in light of the negative results in the areas that were surveyed. Even if Virginia spiraea were present in the unsurveyed areas, and could not be identified (and thus avoided or transplanted) prior to ROW clearing, it is unlikely that the entire unsurveyed 1.4 acres would contain Virginia spiraea in light of the existing information about the location of known populations and the negative results for the surveyed portions of the ROW.

No indirect effects to individuals or habitat is expected as such effects (e.g., noise or dust) are not expected to impact plant species.

Interrelated and Interdependent Actions

MVP is not aware of any actions that are interrelated to or interdependent with the proposed action at this time.

Beneficial Actions

A variety of actions will be undertaken to benefit listed plant species along the Project, including:

- Thoroughly cleaning equipment prior to mobilization to avoid introducing exotic/invasive species in organic materials brought onsite during construction;
- Establishing cleaning stations to thoroughly wash all equipment prior to transporting it to the next construction spread;
- Implementing selective spot treatment or eradication of exotic/invasive plant species encountered during construction and operation of the Project;
- Stripping of topsoil from the full width of the construction ROW and storing it separately from other soils in areas identified as containing higher than usual concentrations of exotic/invasive plant species (in wetlands, agricultural, and residential areas);
- Committing to use native seed mixes, as developed by the Wildlife Habitat Council, during restoration efforts;
- Minimizing the amount of time bare soil is exposed during construction to reduce

opportunity for exotic/invasive plants to become established.

Eradication of exotic/invasive plant species encountered during construction and operation of the Project may decrease competition for this species. Clearing could increase light regimes, which may actually benefit Virginia spiraea habitat as long as hydrology patterns are maintained.

CUMULATIVE EFFECTS

Cumulative effects include the effects of future State, tribal, local, or private actions that are reasonably certain to occur in the Action Area considered in this analysis. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to Section 7 of the ESA.

Cumulative effects can result from specific, usually large-scale, developments and from future activities that incrementally contribute (increasing or decreasing) to overall changes in the quantity or quality of habitat in the Action Area.

Natural Gas and Oil Projects

The Project is associated with exploitation of the Marcellus and Utica Shales. These shales contain marketable quantities of gaseous and liquid petroleum products. The clearing and construction of these well pads within the Action Area will result in additional loss of forested habitat. These well pads are not typically large. For example, Drohan et al. (2012) investigated oil and gas impacts on forest ecosystems in Pennsylvania and found that the average size was 5.5 acres serving 3 different wells. However, Drohan et al. (2012) also demonstrated that disturbance of well pads extends beyond the pad itself, including associated access roads, grading, installation of gathering lines, and creation of impoundments to contain water used for each well. These disturbances averaged 29.65 acres for each well pad.

Once oil or gas is obtained from a well site, it is typically shipped to market via transmission pipelines, although liquid products are also shipped by rail and sometimes in trucks. Midstream and transmission lines are often require interstate travel, and thus are regulated by FERC and subject to a separate Section 7 analysis by the Service. Projects that are intrastate often have a federal nexus due to federal Clean Water Act permits required from the U.S. Army Corps of Engineers to cross wetlands or waterbodies. As such, these also require Section 7 consultation. Eleven natural gas development or improvement projects are expected to occur in the vicinity of the Project. All these projects have either already undergone a review by the Service or have commenced the application process with FERC. As such, these all represent federal actions that are not considered part of the cumulative effects under the ESA.

Coal Mining

The Project traverses the Appalachian coal-producing region, where coal mining has been ongoing since the 1800s. In this region, coal is extracted through surface strip mining (e.g., mountaintop removal) and underground (e.g., longwall mining) operations. Coal mining causes disturbances to land and can cause soil erosion, dust, noise, and water pollution. Although several coal mining operations are already present near the Project, future mining projects are also expected and may

contribute to cumulative effects.

State-wide Forest Trends

The amount of forest cover in West Virginia increased between 1949 and 1989 and remained stable through 2007. Reductions in population have led to widespread abandonment of farm lands, and these farms will likely revert to forest cover in the future. In addition, tree size in West Virginia forests has also increased, and there are now more large trees than at any point in the past century. The first decade of the 21st century saw a marked increase in the amount of timber cut in the state, but tree growth continued to exceed tree removal. These trends suggest that forested habitat will likely remain plentiful in the reasonably foreseeable future. It should be noted, however, that these data pre-date explosive development in the Marcellus Shale, which has led to a wide variety of developments associated with some timber removal and will likely continue to contribute to timber removal in the state.

Forest cover in Virginia increased markedly between the 1940s and 2007 and will likely continue to increase. In 2007, hardwood systems added 1.47 units of forest for every one unit removed, indicating that over time, both forest acreage and the size of trees increased, a trend that does not show a sign of reversal. However, most of the current increase is driven by increasing size-classes of trees, and landscape conversion to non-forest is likely to occur in portions of the Action Area within Virginia.

Agricultural Land Use Changes

In both West Virginia and Virginia, the use of pesticides and herbicides steadily increased from 2007 to 2012 in the majority of counties crossed by the Project (USDA 2014a; b) and will likely continue to increase. The number of farms in West Virginia decreased between 2007 and 2012, but the acreages of farms have changed with decreases in the northern part of West Virginia but increases in southern West Virginia, suggesting more potential changes in the future. In Virginia, numbers of farms and total farmland acres increased in all counties along the alignment.

Based on county-wide agricultural reports, future increases in agricultural practices are foreseeable. Trends indicate further increases in harvested cropland and farmland values. As mentioned above, this is often correlated with increases in the use of pesticides and herbicides.

Local Demographic Trends

Although population estimates in West Virginia have not shown increases since 2010 according to the U.S. Census Bureau (available at <http://www.census.gov/quickfacts/>), between 2010 and 2016, the Virginia population increased by 5.1 percent. Within counties crossed by the Project in Virginia, population increases occurred in Floyd (2.9% increase) and Montgomery (4.4% increase) and the nearby cities of Roanoke (2.8% increase) and Salem (2.8% increase). Most counties crossed by the Project in West Virginia demonstrate stagnant or declines in population size with the exception of Doddridge, which demonstrated a 2.6 percent increase in population between 2010 and 2016. Collectively, these trends suggest that urbanization and suburbanization may be occurring and will likely continue to occur within the Action Area for the Project, particularly

within Virginia. Associated within this process is the increase in roads, waterbody crossings, deforestation, and increases in sediment and silt.

Cumulative Effects on Indiana Bats

Before the threat of WNS, declines in populations of Indiana bats were primarily attributed to loss of summer habitat and winter disturbances during hibernation. The Project will not destroy known, occupied Indiana bat hibernacula, but some individuals are likely to be harassed during construction. The amount of forest removed during Project construction is a fraction of what will remain available on the landscape, and other non-federal actions, as identified above, will not significantly reduce the amount of available habitat in the Action Area. More specifically, approximately 89,623 hectares (221,463 ac) of forest within the Project's Action Area currently provides suitable roosting and foraging habitat for Indiana bats. Project construction will reduce the amount of forest within the Action Area by approximately 2.01 percent and operation will permanently reduce the amount of forest by approximately 0.72 percent. Cumulatively, anticipated losses of suitable forested habitat from nearby energy projects (e.g., well pads), regional population growth, and increases in agriculture in the immediate area are minimal.

Cumulative Effects on Northern Long-eared Bats

As with the Indiana bat, WNS is the primary threat to northern long-eared bats. The northern long-eared bat is not habitat limited within the Action Area, and the level of take associated with anticipated non-federal energy projects (e.g., well pads), regional population growth, and increases in agriculture in the immediate area are minimal.

Cumulative Effects on Roanoke Logperch

Rosenberger (2007) identified road projects, urbanization, and siltation from agricultural runoff as the primary threats to Roanoke logperch within the upper Roanoke and Pigg river drainages. All of these activities are reasonably certain to occur within the region. Associated impacts of these activities are similar to those identified for the effects of the proposed action and primarily include disturbance from instream activities and increases in sediment loading. In addition to these effects, urbanization and agricultural runoff may lead to the addition of pesticides and herbicides into adjacent waterbodies along with other potential pollutants (e.g., petrochemicals), leading to disturbance and potential lethal level effects. Given these reasonably, foreseeable effects and the potential for the proposed Project to augment sediment loading rates (at a limited time scale) during construction, the Project is likely to contribute to cumulative effects on Roanoke logperch. However, the cumulative effects to the species are likely to be limited (temporally and spatially) relative to the magnitude of aforementioned impacts and trends within the upper Roanoke subbasin.

Cumulative Effects on Running Buffalo Clover

The loss of suitable habitat is one of the greatest threats to running buffalo clover. The Project will remove suitable habitat for this species; however, it will also create potentially suitable habitat as this species is commonly found along slightly disturbed roadsides and ROWs. No individuals

have been observed to date; however, unless land access can be obtained within the survey window for this species, it is unknown whether it is present within the remaining 2.1 acres. Even if the species is present within the remaining survey area, it is unlikely to cover its entirety. If present, these individuals will be avoided or transplanted. If surveys cannot be completed, any effects are expected to be minor. Cumulatively, potential effects to this species are minimal.

Cumulative Effects on Shale Barren Rock Cress

The shale barren rock cress is highly habitat restricted, only occurring in low densities in West Virginia and Virginia shale barrens. No individuals or suitable habitat for this species has been identified during surveys up to this point; however, 1.8 acres remain unsurveyed. Unless land access can be obtained within the survey window for this species, it is unknown whether it, or its habitat, is present within the unsurveyed area. Even if the species, or its habitat, is present within the remaining survey area, it is unlikely to cover its entirety. If present, these individuals will be avoided or transplanted. If surveys cannot be completed, any effects are expected to be minor. Cumulatively, potential effects to this species are minimal.

Cumulative Effects on Small Whorled Pogonia

The loss of suitable habitat is the primary threat to small whorled pogonia; however, an abundance of potentially suitable habitat exists in the vicinity of the Project. No individuals of this species have been identified during surveys up to this point; however, 1.8 acres remain unsurveyed. Unless land access can be obtained within the survey window for this species, it is unknown whether it is present within the unsurveyed area. Even if the species is present within the remaining survey area, it is unlikely to cover its entirety. If present, these individuals will be avoided or transplanted. If surveys cannot be completed, any effects are expected to be minor. Cumulatively, potential effects to this species are minimal.

Cumulative Effects on Virginia Spiraea

Virginia spiraea is threatened by a number of factors; however, habitat loss and fragmentation are of greatest concern. No individuals of this species have been identified during surveys up to this point; however, 1.4 acres remain unsurveyed. Unless land access can be obtained within the survey window for this species, it is unknown whether it is present within the unsurveyed area. Even if the species is present within the remaining survey area, it is unlikely to cover its entirety. If present, these individuals will be avoided or transplanted. If surveys cannot be completed, any effects are expected to be minor. Cumulatively, potential effects to this species are minimal.

AMOUNT OR EXTENT OF TAKE ANTICIPATED

Based on the expected number of Indiana bats in known or potentially occupied hibernacula within the Project's Action Area, an estimated 63 Indiana bats have potential to be harassed by construction noise during the winter season of hibernation. During spring staging, an estimated 56 Indiana bats have potential to be harassed from noise and activities associated with tree clearing, and 1 Indiana bat has potential to be harmed from tree clearing. The same level of potential harassment and harm may also be applicable to bats during autumn swarming, thus resulting in the

potential harassment and harm of an additional 56 and 1 Indiana bats, respectively. Because timber will be removed during April, May, and August through November, there is the potential to harass and harm any Indiana bat population that may be present on summer grounds within the Project Area, resulting in the potential for 1 individual being harassed and 1 individual being harmed. Construction will occur during summer months, and the number of individuals estimated to be harassed by noise and dust as well as tree clearing along the Project is 30; an additional 1 bat is expected to be harassed during the first year of operations at the compressor station facilities. Because there is the potential to remove forested habitat during portions of April and September, one migrant Indiana bat is expected to be harmed and one migrant Indiana bat is expected to be harassed due to tree clearing. MVP anticipates a total take of 208 Indiana bats in the form of harassment, and an additional 4 Indiana bats are expected to be harmed.

Based on the expected number of northern long-eared bats in known or potentially occupied hibernacula within the Project's Action Area and the proposed tree-clearing schedule, an estimated 222 individuals have potential to be harassed due to clearing and construction noise during the winter season of hibernation. Based on the location of known and potentially occupied hibernacula, the proposed MVP tree-clearing schedule, and estimated number of bats in each hibernaculum, it is estimated that one bat will be harassed and one bat will be harmed from sounds and activities associated with tree clearing during spring staging and autumn swarming, cumulatively. No forest habitat will be removed during June or July, and therefore a direct take via harm to individuals during the summer season is highly unlikely. It is estimated that one migrant individual may be harmed and one individual may be harassed from Project construction. MVP anticipates a total take of 224 northern long-eared bats in the form of harassment, and an additional 2 northern long-eared bats are expected to be harmed.

Sixteen adult/subadult and 13 young-of-the-year Roanoke logperch are estimated to be harmed during collection and translocation activities at 13 stream crossings. Sediment disturbance/introduction during construction at stream crossings is expected to result in harassment of 2,118 adults/subadults and 1,500 YOY individuals. Collectively throughout the Roanoke River basin, MVP anticipates that Project activities could potentially harass 3,618 individuals and harm 29 individual Roanoke logperch of all age classes (YOY and Age 1+ individuals).

LITERATURE CITED

- Amelon, S. and D. Burhans. 2006. Conservation assessment: *Myotis septentrionalis* (northern long-eared bat) in the Eastern United States. U.S. Department of Agriculture, Forest Service, General Technical Report NC-260: Conservation Assessments for Five Forest Bat Species in the Eastern United States.
- Arnett, E. B., E. F. Baerwald, F. Mathews, L. Rodrigues, A. Rodríguez-Durán, J. Rydell, R. Villegas-Patraca, and C. C. Voigt. 2016. Impacts of wind energy development on bats: a global perspective. Chapter 11. *in* Bats in the Anthropocene: conservation of bats in a changing world (C.C. Voigt and T. Kingston, eds.). Springer International Publishing AG, Cham, Switzerland. 606 pp.
- Baerwald, E. F., G. H. D'Amours, B. J. Klug, and R. M. R. Barclay. 2008. Barotrauma is a significant cause of bat fatalities at wind turbines. *Current Biology* 18:695-696.
- Barbour, R. W. and W. H. Davis. 1969. Bats of America. University Press of Kentucky, Lexington, Kentucky.
- Bartgis, R. L. 1985. Rediscovery of *Trifolium stoloniferum*. *Rhodora* 87:425-429.
- Bleher, D. S., A. C. Hicks, M. Behr, C. U. Meteyer, B. M. Berlowski-Zier, E. L. Buckles, J. T. H. Coleman, S. R. Darling, A. Gargas, R. Niver, J. C. Okoniewski, R. J. Rudd, and W. B. Stone. 2008. Bat white-nose syndrome: An emerging fungal pathogen? *Science* 323:227.
- Brack, V., Jr. 1983. The nonhibernating ecology of bats in Indiana with emphasis on the endangered Indiana bat,

- Myotis sodalis*. Unpublished Ph.D. dissertation, Purdue University, West Lafayette, Indiana.
- Brack, V., Jr. 2006. Autumn activity of *Myotis sodalis* (Indiana bat) in Bland County, Virginia. *Northeastern Naturalist* 13:421-434.
- Brack, V., Jr., J. A. Duffey, R. K. Dunlap, and S. A. Johnson. 2005. Flooding of hibernacula in Indiana: are some caves population sinks. *Bat Research News* 46:71-74.
- Brack, V., Jr. and R. K. LaVal. 1985. Food habits of the Indiana bat in Missouri. *Journal of Mammalogy* 66:308-315.
- Brack, V., Jr., C. W. Stihler, R. J. Reynolds, C. M. Butchkoski, and C. S. Hobson. 2002. Effect of climate and elevation on distribution and abundance in the mid-eastern United States. Pages 21-28 in *The Indiana Bat: Biology and Management of an Endangered Species* (A. Kurta and J. Kennedy, eds.). Bat Conservation International, Austin, Texas.
- Brack, V., Jr. and J. O. Whitaker, Jr. 2004. Bats of the Naval Surface Warfare Center at Crane, Indiana. *Proceedings of the Indiana Academy of Science* 113:66-75.
- Brack, V., Jr., J. O. Whitaker, Jr., and S. E. Pruitt. 2004. Bats of Hoosier National Forest. *Proceedings of the Indiana Academy of Science* 113:78-86.
- Brack, V., Jr., A. M. Wilkinson, and R. E. Mumford. 1984. Hibernacula of the endangered Indiana bat in Indiana. *Proceedings of the Indiana Academy of Science* 93:463-468.
- Britzke, E. R., M. J. Harvey, and S. C. Loeb. 2003. Indiana bat, *Myotis sodalis*, maternity roosts in the southern United States. *Southeastern Naturalist* 2:235-242.
- Brooks, R. E. 1983. *Trifolium stoloniferum*, running buffalo clover: description, distribution, and current status. *Rhodora* 85:343-354.
- Brown, R. J. and V. Brack, Jr. 2003. An unusually productive net site over an upland road used as a travel corridor. *Bat Research News* 44:187-188.
- Brown, R. J., R. A. King, and R. Rommé. 2001. First documented maternity colony of the Indiana bat in Greene County, Ohio (Abstract). *Bat Research News* 42:27.
- Brownell, V. R. and I. Bowman. 1981. The small whorled pogonia (*Isotria medeoloides* (Pursh.) Raf.): A status report. Volume 3. Committee on the status of endangered wildlife in Canada, Ottawa, Canada.
- Burkhead, N. M. 1983. Ecological studies of two potentially threatened fishes (the orangefin madtom, *Noturus gilberti* and the Roanoke logperch, *Percina rex*) endemic to the Roanoke River drainage. Report to the Wilmington District of the Army Corps of Engineers, Wilmington, North Carolina.
- Caceres, M. C. and R. M. R. Barclay. 2000. *Myotis septentrionalis*. *Mammalian Species* 634:1-4.
- Callahan, E. V., R. D. Drobney, and R. L. Clawson. 1997. Selection of summer roosting sites by Indiana bats (*Myotis sodalis*) in Missouri. *Journal of Mammalogy* 78:818-825.
- Campbell, J. J. N., M. Evans, M. E. Medley, and N. L. Taylor. 1989. Buffalo clovers in Kentucky (*Trifolium stoloniferum* and *T. reflexum*): historical records, presettlement environment, rediscovery, endangered status, cultivation, and chromosome number. *Rhodora* 90:399-418.
- Carey, H. V., M. T. Andrews, and S. L. Martin. 2003. Mammalian hibernation: cellular and molecular responses to depressed metabolism and low temperature. *Physiological Reviews* 83:1153-1181.
- Carter, T. C. 2003. Summer habitat use of roost trees by the endangered Indiana bat (*Myotis sodalis*) in the Shawnee National Forest of Southern Illinois. Ph.D. dissertation. Southern Illinois University, Carbondale, Illinois.
- Carter, T. C. and G. A. Feldhamer. 2005. Roost tree use by maternity colonies of the Indiana bats and the northern long-eared bats in southern Illinois. *Forest Ecology and Management* 219:259-268.
- Catrow, J. L., D. Wing, D. DiLella, and E. Volker. 2009. Gas chromatography and mass spectroscopy of cuticular and epicuticular waxes of *Arabis serotina*. *SUJUR* 1:27-35.
- Cusick, A. W. 1989. *Trifolium stoloniferum* (Fabaceae) in Ohio: history, habitats, decline and rediscovery. *SIDA* 13:467-480.
- Drohan, P. J., J. C. Finley, P. Roth, T. M. Schuler, S. L. Stout, M. C. Brittingham, and N. C. Johnson. 2012. Oil and gas impacts on forest ecosystems: findings gleaned from the 2012 Goddard Forum at Penn State University. *Environmental Practice*:1-6.
- Elliot, W. 2007. Gray and Indiana bat population trends in Missouri. Pages 46-61 in *Proceedings of 2007 National Cave & Karst Management Symposium*, October 8-12, 2007, St. Louis, Missouri. 46-61.
- Ford, W. M., S. F. Owen, J. W. Edwards, and J. L. Rodrigue. 2006. *Robinia pseudoacacia* (Black Locust) as day-roosts of male *Myotis septentrionalis* (Northern Bats) on the Fernow Experimental Forest, West Virginia. *Northeastern Naturalist* 13:15-24.
- Foster, R. W. and A. Kurta. 1999. Roosting ecology of the northern bat (*Myotis septentrionalis*) and comparisons with the endangered Indiana bat (*Myotis sodalis*). *Journal of Mammalogy* 80:659-672.
- Francl, K. E., W. M. Ford, D. W. Sparks, and V. Brack, Jr. 2012. Capture and reproductive trends of summer bat

- communities in West Virginia: assessing the impact of white nose syndrome. *Journal of Fish and Wildlife Management* 3:33-42.
- Frick, W. F., S. Puechmaille, J. R. Hoyt, B. A. Nickel, K. E. Langwig, J. T. Foster, K. E. Barlow, T. Bartonicka, D. Feller, A. Haarsma, C. Herzog, I. Horacek, J. Van der Kooij, B. Mulkens, B. Petrov, R. Reynolds, L. Rodrigues, C. W. Stihler, G. G. Turner, and A. M. Kilpatrick. 2015. Disease alters macroecological patterns of North American bats. *Global Ecology & Biogeography* 24:741-749.
- Gardner, J. E., J. D. Garner, and J. E. Hofmann. 1991. Summer roost selection and roosting behavior of *Myotis sodalis* (Indiana bat) in Illinois. Unpublished report. Illinois Natural History Survey, Illinois Department of Conservation, Section of Faunistic Surveys and Insect Identification. Champaign, Illinois. 56 pp.
- Gargas, A., M. T. Trest, M. Christensen, T. J. Volk, and D. S. Blehert. 2009. *Geomyces destructans* sp. nov. associated with bat white-nose syndrome. *MYCOTAXON* 108:147-154.
- Gleason, H. A. and A. Cronquist. 1991. Manual of vascular plants of northeastern United States and adjacent Canada. 2nd edition. The New York Botanical Garden. Bronx, New York. 910 pp.
- Grimes, E. J. 1921. A new station for *Pogonia affinis*. *Rhodora*:195-197.
- Grindal, S. D. 1996. Habitat use by bats in fragmented forests. Pages 260-272 in *Bats and Forests Symposium* (R. M. R. Barclay and R. M. Brigham, eds.), October 19-21, 1995. Research Branch, British Columbia Minister of Forests Research Program. Victoria, British Columbia, Canada.
- Henley, W. F., M. A. Patterson, R. J. Neves, and A. D. Lemly. 2000. Effects of sedimentation and turbidity on lotic food webs: a concise review for natural resource managers. *Reviews in Fisheries Science* 8:125-139.
- Humphrey, S. R., A. R. Richter, and J. B. Cope. 1977. Summer habitat and ecology of the endangered Indiana bat, *Myotis sodalis*. *Journal of Mammalogy* 58:334-346.
- Ingersoll, T. E., B. Sewall, and S. Amelon. 2013. Improved analysis of long-term monitoring data demonstrates marked regional declines of bat populations in the eastern United States. *PLoS ONE* 8:1-12.
- Jacobs, J. F. and R. L. Bartgis. 1987. The running buffalo clover. in *Audubon Wildlife Report* (R.L. Di Silvestro, ed.), The National Audubon Society, Academic Press, New York, New York. 612 pp.
- Jenkins, R. E. and N. M. Burkhead. 1994. The freshwater fishes of Virginia. American Fisheries Society, Bethesda, Maryland. 1079 pp.
- Jin, S., L. Yang, P. Danielson, Homer, J. Fry, and G. Xian. 2013. A comprehensive change detection method for updating the National Land Cover Database to circa 2011. U.S. Geologic Survey, Published Research. Paper 711.
- Johnson, J. B., W. M. Ford, and J. W. Edwards. 2012. Roost networks of northern myotis (*Myotis septentrionalis*) in a managed landscape. *Forest Ecology and Management* 266:223-231.
- Johnson, J. B., J. H. Roberts, T. L. King, J. W. Edwards, W. M. Ford, and D. A. Ray. 2013. Genetic structuring of northern myotis (*Myotis septentrionalis*) at multiple spatial scales. *Acta Theriologica* 59:223-231.
- Johnson, S. A., V. Brack, Jr., and R. K. Dunlap. 2002. Management of hibernacula in the state of Indiana. Pages 100-109 in *The Indiana Bat: Biology and Management of an Endangered Species* (A. Kurta and J. Kennedy, eds.). Bat Conservation International, Austin, Texas.
- Johnson, S. A., V. Brack, Jr., and R. E. Rolley. 1998. Overwinter weight loss of Indiana bats (*Myotis sodalis*) from hibernacula subject to human visitation. *American Midland Naturalist* 139:255-261.
- Kiser, J. D. and C. L. Elliott. 1996. Foraging habitat, food habits, and roost tree characteristics of the Indiana Bat (*Myotis sodalis*) during autumn in Jackson County, Kentucky. Unpublished report to Kentucky Department of Fish and Wildlife Resources. Frankfort, Kentucky. 75 pp.
- Kiser, J. D., J. R. MacGregor, H. D. Bryan, and A. Howard. 2002. Use of concrete bridges as night roosts. Pages 208-215 in *The Indiana Bat: Biology and Management of an Endangered Species* (A. Kurta and J. Kennedy, eds.). Bat Conservation International. Austin, Texas.
- Krochmal, A. R. and D. W. Sparks. 2007. Timing of birth and estimation of age of juvenile *Myotis septentrionalis* and *Myotis lucifugus* in west-central Indiana. *Journal of Mammalogy* 88:649-656.
- Kunz, T. H. 1971. Reproduction of some vespertilionid bats in central Iowa. *American Midland Naturalist* 86:477-486.
- Kurta, A., D. King, J. A. Teramino, J. M. Stribley, and K. J. Williams. 1993. Summer roosts of the endangered Indiana bat (*Myotis sodalis*) on the northern edge of its range. *American Midland Naturalist* 129:132-138.
- Kurta, A. and S. W. Murray. 2002. Philopatry and migration of banded Indiana bats (*Myotis sodalis*) and effects of radio transmitters. *Journal of Mammalogy* 83:585-589.
- Kurta, A., S. W. Murray, and D. H. Miller. 2002. Roost selection and movements across the summer landscape. Pages 118-129 in *The Indiana Bat: Biology and Management of an Endangered Species* (A. Kurta and J. Kennedy, eds.). Bat Conservation International, Austin, Texas.

- Kurta, A., K. J. Williams, and R. Mies. 1996. Ecological, behavioral, and thermal observations of a peripheral population of Indiana bats (*Myotis sodalis*). Pages 102-117 in *Bats and Forests Symposium* (R. M. R. Barclay and R. M. Brigham, eds.), October 19-21, 1995. Research Branch, British Columbia Minister of Forests Research Program. Victoria, British Columbia, Canada.
- Lacki, M. J. and J. H. Schwierjohann. 2001. Day-roost characteristics of northern bats in mixed mesophytic forests. *The Journal of Wildlife Management* 65:482-488.
- Lahey, A. M. and P. L. Angermeier. 2007. Range-wide assessment of habitat suitability for Roanoke logperch (*Percina rex*). Final report VTRC 07-CR8 prepared for Virginia Transportation Research Council, in Cooperation with the U.S. Department of Transportation, Federal Highway Administration, Charlottesville, Virginia. 58 pp.
- McConnell, A. 2007. recovery strategy for the small whorled pogonia (*Isotria medeoloides*) in Canada. Candian Wildlife Service.
- Mehrhoff, L. A. 1980. The reproductive biology of the genus *Isotria* (Orchidaceae) and the ecology of *Isotria medeoloides*. M. A. Thesis, University of North Carolina, Chapel Hill, North Carolina. 65 pp.
- Mehrhoff, L. A. 1989. Reproductive vigor and environmental factors in populations of an endangered North American orchid, *Isotria medeoloides* (Pursh) Rafinesque. *Biological Conservation* 47:281-296.
- Moser, G. A. 1992. Roanoke logperch recovery plan. U.S. Department of Interior, Fish and Wildlife Service, Newton Corner, Massachusetts. .
- Mumford, R. E. and J. B. Cope. 1964. Distribution and status of the Chiroptera of Indiana. *American Midland Naturalist* 72:473-489.
- Nott, M. P. 2006. shale barren rock cress (*Arabis serotina*): a literature review and analysis of vegetation data. Navy Information and Operations Command.
- Page, L. M. and B. M. Burr. 1991. A field guide to freshwater fishes: North America north of Mexico. Peterson Field Guide Series, Houghton Mifflin Company, Boston, Massachusetts. 432 pp.
- Patrick, T. S., J. R. Allison, and G. A. Krakow. 1995. Protected Plants of Georgia, An Information Manual on Plants Designated by the State of Georgia as Endangered, Threatened, Rare or Unusual. Georgia Department of Natural Resources, Wildlife Resources Division, Georgia Natural Heritage Program. 246 pp.
- Perry, R. W. and R. E. Thill. 2007. Roost selection by male and female northern long-eared bats in a pine-dominated landscape. *Forest Ecology and Management* 247:220-226.
- Perry, R. W., R. E. Thill, and D. M. Leslie, Jr. 2007. Selection of roosting habitat by forest bats in a diverse forested landscape. *Forest Ecology and Management* 238:156-166.
- Powers, K. E., R. J. Reynolds, W. Orndorff, W. M. Ford, and C. S. Hobson. 2015. Post-white-nose syndrome trends in Virginia's cave bats, 2008-2013. *Journal of Ecology and the Natural Environment* 7:113-123.
- Reynolds, R. J., K. E. Powers, W. Orndorff, W. M. Ford, and C. S. Hobson. 2016. Changes in rates of capture and demographics of *Myotis septentrionalis* (northern long-eared bat) in western Virginia before and after onset of white-nose syndrome. *Northeastern Naturalist* 23:195-204.
- Richter, A. R., S. T. Humphrey, J. B. Cope, and V. Brack, Jr. 1993. Modified cave entrances: Thermal effect on body mass and resulting decline of endangered Indiana bats (*Myotis sodalis*). *Conservation Biology* 7:407-415.
- Roberts, J. H. 2012. Using genetic tools to understand the population ecology of stream fishes. Virginia Polytechnic Institute and State University.
- Roberts, J. H., P. L. Angermeier, and E. M. Hallerman. 2013. Distance, dams and drift: what structures populations of an endangered, benthic stream fish? *Freshwater Biology* 58:2050-2064.
- Rosenberger, A. 2002. Multi-scale patterns of habitat use by Roanoke logperch (*Percina rex*) in Virginia rivers: a comparison among populations and life stages. Virginia Polytechnic Institute and State University.
- Rosenberger, A. and P. L. Angermeier. 2003. Ontogenetic shifts in habitat use by the endangered Roanoke logperch (*Percina rex*). *Freshwater Biology* 48:1563-1577.
- Rosenberger, A. E. 2007. An update to the Roanoke logperch recovery plan. Prepared for U.S. Department of Interior, Fish and Wildlife Service, Virginia Field Office, Gloucester, Virginia.
- Rosenberger, A. E. and P. L. Angermeier. 2002. Roanoke logperch (*Percina rex*) population structure and habitat use. Final report prepared by Virginia Cooperative Fish and Wildlife Research Unit, Department of Fisheries and Wildlife Sciences, Virginia Tech for Virginia Department of Game and Inland Fisheries, Blacksburg, Virginia.
- Sasse, D. B. and P. J. Pekins. 1996. Summer roosting ecology of northern long-eared bats (*Myotis septentrionalis*) in the White Mountain National Forest. Pages 91-101 in *Bats and Forests Symposium* (R. M. R. Barclay and R. M. Brigham, eds.), October 19-21, 1995. Research Branch, British Columbia Minister of Forests Research Program. Victoria, British Columbia, Canada.
- Schultes, K. L. and C. L. Elliott. 2002. Roost tree selection by Indiana bats and northern bats on the Wayne National

- Forest, Ohio. Unpublished report to U.S. Fish & Wildlife Service, Reynoldsburg, Ohio Field Office and U.S. Department of Agriculture, Forest Service, Wayne National Forest.
- Silvis, A., W. M. Ford, E. R. Britzke, N. R. Beane, and J. B. Johnson. 2012. Forest succession and maternity day roost selection by *Myotis septentrionalis* in a mesophytic hardwood forest. *International Journal of Forestry Research*. 8p.
- Silvis, A., W. M. Ford, E. R. Britzke, and J. B. Johnson. 2014. Association, roost use and simulated disruption of *Myotis septentrionalis* maternity colonies. *Behavioural Processes* 103:283–290.
- Simonson, T. D. and R. J. Neves. 1986. A status survey of the orangefin madtom (*Noturus gilberti*) and Roanoke logperch (*Percina rex*). Virginia Commission of Game and Inland Fisheries, Richmond, Virginia. 101 pp.
- Sparks, D. W. 2003. How does urbanization impact bats? Ph.D. Dissertation. Indiana State University, Terre Haute, Indiana. 121 pp.
- Sparks, D. W., C. J. Schmidt, and J. R. Choate. 2011. Bats of Kansas. Publication Number 5, Indiana State University Center for North American Bat Research and Conservation. 62 pp.
- Stihler, C. W. 2013. Shedding light on West Virginia's cave-dwelling bats. *West Virginia Wildlife Magazine*.
- Thogmartin, W. E., R. A. King, P. C. McKann, J. A. Szymanski, and L. Pruitt. 2012. Population-level impact of white-nose syndrome on the endangered Indiana bat. *Journal of Mammalogy* 93:1086–1098.
- Tibbels, A. E. and A. Kurta. 2003. Bat activity is low in thinned and unthinned stands of red pine. *Canadian Journal of Forest Research* 33 (12):2436–2442.
- Timpone, J. C. 2004. Roost-site selection of bats in the northeast Missouri with emphasis on the endangered Indiana bat (*Myotis sodalis*). Masters thesis, Southwest Missouri State University. 71pp.
- Timpone, J. C., J. G. Boyles, K. L. Murray, D. P. Aubrey, and L. W. Robbins. 2010. Overlap in roosting habits of Indiana bats (*Myotis sodalis*) and northern bats (*Myotis septentrionalis*). *American Midland Naturalist* 163:115–123.
- Turner, G. O., D. M. Reeder, and J. T. H. Coleman. 2011. A five-year assessment of mortality and geographic spread of white-nose syndrome in North American bats and a look to the future. *Bat Research News* 52:13–27.
- USDA. 2004. The mountain state's forests- trends in the resource. U.S. Department of Agriculture, Forest Service.
- USDA. 2014a. 2012 Census of agriculture- Virginia state and county data. U.S. Department of Agriculture, National Agricultural Statistics Service.
- USDA. 2014b. 2012 Census of agriculture- West Virginia state and county data. U.S. Department of Agriculture, National Agricultural Statistics Service.
- USFWS. 1967. Notice by Office of the Secretary of native fish and wildlife threatened with extinction. Pages 4001 *in* Federal Register 32(48) U.S. Department of the Interior, Fish & Wildlife Service.
- USFWS. 1976. Determination of critical habitat for American crocodile, California condor, Indiana bat, and Florida manatee. Pages 41914–41918 *in* Federal Register 41(187) U.S. Department of Interior, Fish & Wildlife Service.
- USFWS. 1982. *Isotria medeoloides* (small whorled pogonia) determined to be an endangered species. Pages 39827–39831 *in* Federal Register, Volume 47 (176). U.S. Department of Interior, Fish & Wildlife Service.
- USFWS. 1983. Indiana bat recovery plan, draft. U.S. Department of Interior, Fish and Wildlife Service. 85 pp.
- USFWS. 1985. Endangered and threatened wildlife and plants: endangered status for Short's goldenrod (*Solidago shortii*). Pages 36085–36089 *in* Federal Register 50(172) U.S. Department of Interior, Fish and Wildlife Service.
- USFWS. 1989. *Arabis serotina* (shale barren rock cress) determined to be an endangered species. Federal Register Vol. 54, No. 133. U.S. Department of Interior, Fish and Wildlife Service.
- USFWS. 1991. Shale barren rock-cress (*Arabis serotina*) recovery plan. U.S. Department of Interior, Fish and Wildlife Service, Region Five, Newton Corner, Massachusetts. 40 pp.
- USFWS. 1992a. Small whorled pogonia (*Isotria medeoloides*) recovery plan, first revision. U.S. Department of Interior, Fish and Wildlife Service, Region Five, Newton Corner, Massachusetts. 77pp.
- USFWS. 1992b. Virginia spiraea (*Spiraea virginiana Britton*) recovery plan. U.S. Department of Interior, Fish and Wildlife Service, Region Five, Newton Corner, Massachusetts. 47 pp.
- USFWS. 1994. Endangered and threatened wildlife and plants; Final rule to reclassify the plant *Isotria medeoloides* (small whorled pogonia) from endangered to threatened. *in* 50 CFR Part 17, RIN 1018-AC11. U.S. Department of the Interior, Fish and Wildlife Service. 14 pp.
- USFWS. 2002. Shale barren rock cress (*Arabis serotina*) recovery plan, first revision. U.S. Department of Interior, Fish and Wildlife Service, Newton Corner, Massachusetts. 40pp.
- USFWS. 2003. Roanoke Logperch (*Percina rex*) fact sheet. U.S. Department of Interior, Fish and Wildlife Service, Virginia Field Office. Gloucester, Virginia.

- USFWS. 2007a. Indiana bat (*Myotis sodalis*) draft recovery plan: First revision. U.S. Department of Interior, Fish and Wildlife Service, Fort Snelling, Minnesota. 258 pp.
- USFWS. 2007b. Indiana bat survey guidance for the commonwealth of Kentucky. Developed by U.S. Fish and Wildlife Service, Kentucky Field Office and Kentucky Department for Fish & Wildlife Resources.
- USFWS. 2007c. Roanoke logperch (*Percina rex*) 5-year review: summary and evaluation. Prepared By W. Hester and K. Smith, U.S. Department of Interior, U.S. Fish and Wildlife Service, Virginia Field Office, Gloucester, Virginia. 24 pp.
- USFWS. 2008. Species accounts, small whorled pogonia. U.S. Department of Interior, Fish and Wildlife Service, Division of Endangered Species.
- USFWS. 2009. Indiana bat (*Myotis sodalis*) 5-year review: summary and evaluation. U.S. Department of the Interior, Fish and Wildlife Service, Midwest Region, Bloomington Ecological Services Office, Bloomington, Indiana.
- USFWS. 2012. Land-Based Wind Energy Guidelines. U.S. Department of Interior, Fish and Wildlife Service, Arlington, Virginia.
- USFWS. 2013. Northern long-eared bat (*Myotis septentrionalis*) fact sheet. U.S. Department of Interior, Fish and Wildlife Service.
- USFWS. 2014. Northern long-eared bat interim conference and planning guidance: USFWS Regions 2, 3, 4, 5, & 6. U.S. Department of Interior, Fish and Wildlife Service. 67 pp.
- USFWS. 2015a. 2015 Rangewide population estimate for the Indiana bat (*Myotis sodalis*) by USFWS region. U.S. Department of Interior, Fish and Wildlife Service, Ecological Services Field Office, Bloomington, Indiana.
- USFWS. 2015b. Endangered and threatened wildlife and plants; threatened species status for the northern long-eared bat with 4(d) rule. U.S. Department of the Interior, Fish and Wildlife Service, *in* Federal Register, Volume 80, No. 63, Thursday, April 2, 2015.
- USFWS. 2016. Programmatic biological opinion on final 4(d) rule for the northern long-eared bat and activities excepted from take prohibitions. U.S. Department of the Interior, Fish and Wildlife Service, Midwest Regional Office, Bloomington, Minnesota. 103 pp.
- Weakley, A. S. 2015. Flora of the southern and mid-atlantic states (working draft of 21 May, 2015). University of North Carolina Herbarium, Chapel Hill, North Carolina. 1320 pp.
- WEST. 2013. Fowler Ridge Wind Farm, Benton County, Indiana Indiana Bat Habitat Conservation Plan. Prepared by: Fowler Ridge Wind Farm LLC, Fowler Ridge II Wind Farm LLC, Fowler Ridge III Wind Farm LLC, Fowler Ridge IV Wind Farm LLC in consultation with: Western EcoSystems Technology, Inc. Cheyenne, Wyoming, and Bloomington, Indiana. 165 pp.
- Whitaker, J. O., Jr and S. L. Gummer. 2003. Current status of the evening bat, *Nycticeius humeralis*, in Indiana. *Proceedings of the Indiana Academy of Science* 112:55-60.
- Whitaker, J. O., Jr. and V. Brack, Jr. 2002. Distribution and summer ecology in Indiana. Pages 48-54 *in* The Indiana Bat: Biology and Management of an Endangered Species (A. Kurta and J. Kennedy, eds.). Bat Conservation International, Austin, Texas.
- Whitaker, J. O., Jr. and R. E. Mumford. 2009. *Mammals of Indiana*. Indiana University Press. Bloomington, Indiana, 661 pp.
- Whitaker, J. O., Jr., D. W. Sparks, and V. Brack, Jr. 2004. Bats of the Indianapolis International airport area, 1991–2001. *Proceedings of the Indiana Academy of Science* 113:151-161.
- Whitaker, J. O., Jr., D. W. Sparks, and V. Brack, Jr. 2006. Use of artificial roost structures by bats at the Indianapolis International Airport. *Environmental Management* 38:28-36.
- Wieboldt, T. F. 1987. The shale barren endemic, *Arabis serotina* (Brassicaceae). *SIDA* 12:381-389.
- WVDNR. 2013. Hellhole, Pendleton County, West Virginia. Results of the winter bat survey conducted on 23 February 2013. West Virginia Division of Natural Resources, Wildlife Resources Section, Wildlife Diversity Unit, South Charleston, West Virginia. 27 pp.