No. ________

IN THE UNITED STATES COURT OF APPEALS
FOR THE FOURTH CIRCUIT

APPALACHIAN VOICES; WILD VIRGINIA; WEST VIRGINIA RIVERS COALITION; PRESERVE GILES COUNTY; PRESERVE BENT MOUNTAIN, a chapter of Blue Ridge Environmental Defense League; WEST VIRGINIA HIGHLANDS CONSERVANCY; INDIAN CREEK WATERSHED ASSOCIATION; SIERRA CLUB; CHESAPEAKE CLIMATE ACTION NETWORK; and CENTER FOR BIOLOGICAL DIVERSITY

Petitioners,

v.

UNITED STATES DEPARTMENT OF THE INTERIOR; DEB HAALAND, in her official capacity as Secretary of the U.S. Department of the Interior; UNITED STATES FISH AND WILDLIFE SERVICE, an agency of the U.S. Department of Interior; MARTHA WILLIAMS, in her official capacity as Director of the U.S. Fish and Wildlife Service; and CINDY SCHULZ, in her official capacity as Field Supervisor, Virginia Ecological Services, Responsible Official

Respondents.

JOINT PETITION FOR REVIEW

Pursuant to the Administrative Procedure Act, 5 U.S.C. §702, Section 19(d)(1) of the Natural Gas Act, 15 U.S.C. §717r(d)(1), and Federal Rule of Appellate Procedure 15(a), Appalachian Voices, Wild Virginia, West Virginia Rivers Coalition, Preserve Giles County, Preserve Bent Mountain (a chapter of Blue Ridge Environmental Defense League), West Virginia Highlands Conservancy, Indian

Creek Watershed Association, Sierra Club, Chesapeake Climate Action Network, and Center for Biological Diversity hereby petition this Court for review of the United States Fish and Wildlife Service's Biological Opinion and Incidental Take Statement, dated February 28, 2023, for the Mountain Valley Pipeline. In accordance with Local Rule 15(b), a copy of the Biological Opinion and Incidental Take Statement is attached hereto as Exhibit A.

In accordance with Rule 15(c) of the Federal Rules of Appellate Procedure, parties that may have been admitted to participate in the underlying procedure have been served with a copy of this Petition. Pursuant to Local Rule 15(b), attached hereto is a list of Respondents specifically identifying the Respondents' names and addresses.

In accordance with the Natural Gas Act, 15 U.S.C. §717r(d)(5), this matter "shall [be] set … for expedited consideration."

DATED: April 10, 2023

Respectfully submitted,

/s/ Elizabeth F. Benson

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LIST OF RESPONDENTS

Pursuant to Local Rule 15(b), Petitioners hereby provide a list of Respondents, specifically identifying the Respondents' names and the addresses where Respondents may be served with copies of the Joint Petition for Review:

United States Department of the Interior
1849 C Street, NW
Washington, D.C. 20240

Deb Haaland
Secretary
U.S. Department of the Interior
1849 C Street, NW
Washington D.C. 20240

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1849 C Street, NW
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Director
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1849 C Street, NW
Room 3331
Washington, D.C. 20240-0001

Cindy Schulz
Field Supervisor
Virginia Ecological Services
United States Fish and Wildlife Service
6669 Short Lane
Gloucester, VA 23061

CERTIFICATE OF SERVICE

In accordance with Federal Rules of Appellate Procedure 15(c)(1) & (2), the undersigned hereby certifies that a true copy of this Petition for Review was served on each of the following entities that may have been admitted to participate in the agency proceedings and/or their counsel:

Mountain Valley Pipeline, LLC
c/o CT Corporation System
Registered Agent
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Glen Allen, VA 23060

Todd Normane
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Equitrans Midstream Corporation
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Kimberly Bose
Secretary
Federal Energy Regulatory Commission
888 First Street NE, Room 1A
Washington, D.C. 20426

DATED: April 10, 2023

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Exhibit A

Note to: FERC Docket No. CP16-10-000

Note from: James Martin, Chief, Gas Branch 3

Date: March 1, 2023

Subject: Biological Opinion-United States Fish and Wildlife Service

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Attached is the Biological Opinion for the Mountain Valley Pipeline Project issued by the United States Fish and Wildlife Service (FWS) on February 28, 2023. This document was provided to the Federal Energy Regulatory Commission via email from the FWS on February 28, 2023.

United States Department of the Interior

FISH AND WILDLIFE SERVICE

Virginia Field Office
6669 Short Lane
Gloucester, VA 23061

February 28, 2023

Kimberly Bose, Secretary
Federal Energy Regulatory Commission
888 First Street NE, Room 1A
Washington, D.C. 20426

Attn: James Martin, Branch Chief

Re: Mountain Valley Pipeline, LLC;
Docket Number CP16-10-000;
Project #05E2VA00-2016-F-0880
and #05E2WV00-2015-F-0046

Dear Secretary Bose:

On November 21, 2017, the U.S. Fish and Wildlife Service (Service or USFWS) provided the Federal Energy Regulatory Commission (FERC) with a non-jeopardy biological opinion (Opinion) based on our review of the referenced project and its effects on the federally listed species in Table 1 in accordance with Section 7 of the Endangered Species Act (16 U.S.C. 1531-1544, 87 Stat. 884), as amended (ESA). On August 28, 2019, FERC reinitiated consultation with the Service due to the listing of the candy darter and new information regarding potential effects of the Mountain Valley Pipeline (MVP) project on certain species (Roanoke logperch, Indiana bat, and northern long-eared bat). As part of the reinitiation, on July 2, 2020, Mountain Valley Pipeline, LLC (Mountain Valley) submitted a final draft of its supplement to the 2017 Biological Assessment, which included revised effect analyses for all federally listed species (including the candy darter) affected by the MVP project.

On September 4, 2020, the Service provided FERC with a non-jeopardy biological and conference opinion that replaced in its entirety the Service's 2017 Opinion based on our review of the referenced project and its effects on the federally listed species and proposed critical habitat in Table 1. On May 14, 2021, the Service provided FERC with a letter confirming the September 4, 2020, conference opinion as the biological opinion for candy darter critical habitat.

On February 3, 2022, the U.S. Court of Appeals for the Fourth Circuit issued a vacatur and remand of the Service's September 4, 2020, Opinion (*Appalachian Voices v. U.S. Dep't of the Interior*, 25 F.4th 259 (4th Cir. 2022)). On June 24, 2022, FERC sent a letter to the Service regarding reinitiation of Section 7 consultation on the MVP project. On July 29, 2022, Mountain

Valley submitted to the Service and FERC its Updated Supplement to the Biological Assessment, marking the official reinitiation of formal consultation between the agencies, as clarified by the Service on September 28, 2022. On December 9, 2022, Mountain Valley submitted a revised Updated Supplement to the Biological Assessment (SBA2) addressing comments and requests provided by the Service and FERC. On December 12, 2022, the Service sent FERC a letter documenting the agreement between the Service and FERC, with the consent of the project applicant, in accordance with 50 C.F.R. § 402.14(e) to extend the consultation period by 60 days to February 10, 2023. On February 10, 2023, the Service sent FERC a letter documenting the agreement between the Service and FERC, with the consent of the project applicant, in accordance with 50 C.F.R. § 402.14(e) to extend the consultation period to February 28, 2023.

We have drafted a new Opinion and incidental take statement (ITS) to address new data and to ensure that we continue using the best scientific and commercial data available. This revised Opinion replaces in its entirety the Service's 2020 biological and conference opinion (2020 Opinion). This document transmits the Service's Opinion based on our review of the MVP project and its effects on the federally listed species and designated critical habitat in Table 1 in accordance with Section 7.

Table 1. Listed species and critical habitat considered in the 2017, 2020, and current Opinions.

Species Name	ESA Status	State	Included in Opinion		
			2017	2020	Current
Small whorled pogonia (*Isotria medeoloides*)	Threatened	West Virginia (WV)	X	-[1]	-[1]
Virginia spiraea (*Spiraea virginiana*) (VASP)	Threatened	WV	X	X	X
Indiana bat (*Myotis sodalis*) (Ibat)	Endangered	Virginia (VA), WV	X	X	X
Northern long-eared bat (*Myotis septentrionalis*) (NLEB)	Threatened[2]	VA, WV	X	X	X
Roanoke logperch (*Percina rex*) (RLP)	Endangered	VA	X	X	X
Candy darter (*Etheostoma osburni*) (CD)	Endangered	VA, WV	-	X[3]	X
CD critical habitat	Proposed critical habitat	VA, WV	-	X[4]	-
CD critical habitat	Critical habitat	VA, WV	-	-	X[4]

[1] Based on additional species-specific information, in a July 9, 2020, letter the Service concurred with FERC's may affect, not likely to adversely affect determination for small whorled pogonia. There are no new occurrences of the species within or near any portion of the action area since the 2020 consultation (Updated Supplement to the BA [SBA2]).
[2] On November 30, 2022, the Service published a final rule reclassifying the NLEB from threatened to endangered (87 FR 73488). The reclassification will be effective March 31, 2023 (88 FR 4908). See the Environmental Baseline section below for an explanation of treatment of NLEB in this Opinion.
[3] The Service listed the CD as endangered on December 21, 2018 (83 FR 58747), after issuance of the 2017 Opinion.
[4] The Service proposed critical habitat for the CD on November 21, 2018 (83 FR 59232) and designated critical habitat for the CD on May 7, 2021 (86 FR 17956).

This Opinion is based on information provided in the June 23, 2017, Final Environmental Impact Statement (FEIS) (FERC 2017a); July 10, 2017, Biological Assessment (BA) (FERC 2017b); May 28, 2020, second revised Supplement to the Biological Assessment (SBA) prepared by Mountain Valley (Mountain Valley 2020); July 29, 2022, updated Supplement to the Biological Assessment (SBA2) revised on December 9, 2022, prepared by Mountain Valley (Mountain Valley 2022); multiple responses to Service requests for data and information from FERC and

Mountain Valley; telephone conversations; field investigations; and other sources of information. In several instances we relied on and adopted the findings of FERC and Mountain Valley after determining that those findings were reasonable, the product of sound methodological choices, and consistent with the best scientific data available. The consultation history is in Appendix A after the Literature Cited. Because the project traverses 2 states under the geographic jurisdiction of the 2 Service Field Offices in Gloucester, VA (VAFO), and Davis, WV (WVFO), each maintain their geographic portion of the administrative record in their respective Field Office. As noted at the end of this Opinion, as we were in the process of finalizing the Opinion, the petitioners in the Fourth Circuit litigation submitted voluminous materials to the Service, including new materials that had not previously been submitted. These materials came too late to be meaningfully considered during consultation and addressed in this Opinion. As a result, FERC and the other action agencies will need to assess whether the materials contain any new information that might prevent them from relying on this Opinion to meet their obligations under Section 7 of the ESA. See City of Tacoma v. FERC, 460 F.3d 53, 76 (D.C. Cir. 2006); Pyramid Lake Paiute Tribe of Indians v. U.S. Dept of the Navy, 898 F.2d 1410, 1415 (9th Cir.1990). We will also consider whether the materials contain any new information that might require reinitiation of consultation under 50 CFR 402.16. Some of the new materials have already been provided to FERC. We will forward the remainder by separate correspondence and request FERC's initial assessment as to whether the materials affect any of the methodologies employed or findings made in the SBA2.

TABLE OF CONTENTS

DESCRIPTION OF PROPOSED ACTION 5
- ACTION AREA 48

STATUS OF THE SPECIES 56
- Climate Change 56
- Virginia spiraea (VASP) 58
- Indiana bat (Ibat) 64
- Northern long-eared Bat (NLEB) 72
- Roanoke logperch (RLP) 81
- Candy darter (CD) 85

STATUS OF CRITICAL HABITAT 91
- Candy darter (CD) critical habitat 91

ENVIRONMENTAL BASELINE 94
- Virginia spiraea (VASP) 96
- Indiana bat (Ibat) 100
- Northern long-eared bat (NLEB) 118
- Roanoke logperch (RLP) 128
- Candy darter (CD) 139
- Candy darter (CD) critical habitat 148

EFFECTS OF THE ACTION 150

Non-jurisdictional facilities (NJFs) 150
Virginia spiraea (VASP)..152
Indiana bat (Ibat) 153
Northern long-eared bat (NLEB)..174
Roanoke logperch (RLP) 189
Candy darter (CD) 207
Candy darter (CD) critical habitat 217
CUMULATIVE EFFECTS...220
JEOPARDY AND ADVERSE MODIFICATION ANALYSIS...236
Virginia spiraea (VASP)..238
Indiana bat (Ibat) 241
Northern long-eared bat (NLEB)..248
Roanoke logperch (RLP) 254
Candy darter (CD) 258
Candy darter (CD) critical habitat 268
CONCLUSION 269
Virginia spiraea (VASP)..269
Indiana bat (Ibat) 270
Northern long-eared bat (NLEB)..270
Roanoke logperch (RLP) 270
Candy darter (CD) 270
INCIDENTAL TAKE STATEMENT 271
Indiana bat (Ibat) 272
Northern long-eared bat (NLEB)..275
Roanoke logperch (RLP) 278
Candy darter (CD) 281
REASONABLE AND PRUDENT MEASURES..285
Indiana bat (Ibat) 285
Northern long-eared bat (NLEB)..285
Roanoke logperch (RLP) 286
Candy darter (CD) 286
TERMS AND CONDITIONS..286
Indiana bat (Ibat) 286
Northern long-eared bat (NLEB)..287
Roanoke logperch (RLP) 287
Candy darter (CD) 288
MONITORING AND REPORTING REQUIREMENTS...289
Indiana bat (Ibat) 289
Northern long-eared bat (NLEB)..290

Roanoke logperch (RLP) 291
Candy darter (CD) 292
CONSERVATION RECOMMENDATIONS 293
Virginia spiraea (VASP) 293
Indiana bat (Ibat) 293
Northern long-eared bat (NLEB) 293
Roanoke logperch (RLP) 294
Candy darter (CD) 294
REINITIATION NOTICE 295
LITERATURE CITED 298
Appendix A. Consultation History 335
Appendix B. Species-Specific and Critical Habitat Effects Tables. 341
Appendix C. Biological Effects of Sediment on Bull Trout and Their Habitat – Guidance for Evaluating Effects (Muck 2010). 342
Appendix D. Table 1 and 2 and Maps. RLP and CD Mixing Zone Impact. 343
Appendix E. Table 1 and 2. MVP project FERC-approved variances. 344
Appendix F. Monitoring Plan. 345
Appendix G. Non-jurisdictional Facilities. 346
Appendix H. Acronyms used in Opinion. 347

BIOLOGICAL OPINION

DESCRIPTION OF PROPOSED ACTION

As defined in the ESA Section 7 regulations (50 CFR 402.02), "action" means "all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by federal agencies in the United States or upon the high seas."[1]

The following is a summary of the proposed action[2] and a detailed description can be found in FERC's MVP and Equitrans Expansion Project FEIS (FERC 2017a) and BA (FERC 2017b), the SBA (Mountain Valley 2020), and the SBA2 (Mountain Valley 2022). Mountain Valley is proposing to construct a 304-mile natural gas pipeline in WV and VA (Figure 1), which requires

[1] In August 2019, the Service revised various regulations implementing the ESA, including those relating to Section 7 consultation. 84 Federal Register (FR) 44976. In so doing, the Service made it clear that the 2019 regulations were made solely to clarify and streamline existing interagency consultation practices without altering the standards applicable to Section 7 consultations. 84 FR at 45012, 45015. The 2019 regulations were challenged shortly after issuance. On November 16, 2022, the U.S. District Court for the Northern District of California granted the Service's motion for remand without vacatur. Without confessing error on any aspect of the 2019 regulations, the Service has announced its intent to revise the regulations applicable to Section 7. Accordingly, the 2019 regulations currently govern this consultation. Nevertheless, based on the history of this project, the analyses set forth in this Opinion have been conducted so as to be consistent with both the 2019 regulations and the prior iteration.
[2] Although portions of the project have already been completed as discussed in more detail below, this Opinion analyzes the effects of the entire project, including activities that have already been completed and those that have yet to occur.

state and federal approvals, including a Certificate of Public Convenience and Necessity from FERC and a right-of-way (ROW) grant from the Bureau of Land Management (BLM) (Mountain Valley 2020, 2022).

Note that throughout this Opinion, numbers in rows and columns of tables may not sum to exact totals due to rounding. Additionally, numbers in the text, tables, or figures may not match to the tenths and/or hundredths place due to rounding.

Project Route – As proposed, the 42-inch diameter natural gas pipeline will cross 17 counties within WV and VA. The pipeline route begins at an interconnection with Equitrans, L.P.'s existing H-302 pipeline at the Mobley Interconnect and Tap in Wetzel County, WV, and proceeds to the Transcontinental Gas Pipeline Company's existing compressor station 165 in Pittsylvania County, VA. Additional components include 3 new compressor stations, 4 meter and regulation (M&R) stations (i.e., interconnects), 3 taps, 8 pig launchers and receivers at 5 locations, 36 new mainline valves (MLVs), and 31 cathodic protection beds. The MVP project will deliver up to 2 billion cubic feet (ft) per day of natural gas from the Appalachian Basin to markets in the Mid-Atlantic and Southeastern U.S.

Per the SBA (Mountain Valley 2020) and the SBA2 (Mountain Valley 2022), the project route and facilities remain largely unchanged from what was presented in the BA (FERC 2017b). The route was approximately 303.4 miles and since 2017 is approximately 304.2 miles. The additional 0.8 mile of ROW is primarily a result of shifts to avoid impacts to sensitive resources or accommodate landowner requests. Original tree clearing for the MVP project was estimated at 4,459.37 acres. An estimate of approximately 4,714.87 acres of tree clearing was provided in 2020 (Mountain Valley 2020). This increase was a result of ROW alignment shifts, changes to access roads (AR), additions to the work area, and responses to landslides. All route changes were approved by FERC via the variance process and underwent ESA Section 7 review by FERC, in consultation with the Service as appropriate. Total tree clearing is currently estimated at approximately 4,694.73 acres, approximately 2,732.85 acres of which will be allowed to regenerate over time (Mountain Valley 2022). The 4,694.73 acres of tree clearing includes the following (P. Moore, Beveridge & Diamond PC, email to C. Schulz, Service, November 30, 2022):

- 4,443.60 acres felled. This includes the acres of trees felled as provided in the 2020 Opinion (including felling associated with variances accounted for in the 2020 Opinion; felling associated with slips accounted for in the 2020 Opinion; and felling associated with slips that occurred after the issuance of the 2020 Opinion which were analyzed as "future" clearing under the 2020 Opinion).
- 3.45 acres future felling for project locations (i.e., areas of planned clearing associated with the original MVP project plan) and known variances and slips. After issuance of the 2020 Opinion, FERC approved 5 variances for Mountain Valley to undertake slip remediation work, including the felling of 3.27 acres of trees in compliance with the USFWS-prescribed protocol in the 2020 Opinion for future slip-related tree clearing. Due to the vacatur of the 2020 Opinion, 3 of these variances still have trees that need to be felled.
- 247.68 acres future felling for unknown future slips. As described below and in Mountain Valley (2020) additional tree felling may be necessary to remediate unknown future slips

(i.e., slips that cannot be predicted based on numerous factors including site conditions, rainfall amounts, and rainfall intensity). Using the values that were established for purposes of the 2020 Opinion, Mountain Valley estimates the amount of tree removal for unknown future slips, including future felling both within the slip areas and necessary to access the slip areas to complete remediation activities.

Construction Timeline (Mountain Valley 2022) – As of December 2022, Mountain Valley completed construction along approximately 272 miles of the MVP project, with approximately 169 miles fully restored. As of December 2022, an estimated 56% of the alignment is permanently restored and the remaining 44% is temporarily stabilized (M. Neylon, Mountain Valley, email to C. Schulz, Service, December 10, 2022). Following FERC approval and receipt of necessary permits, Mountain Valley is targeting the resumption of construction in spring 2023 and completing construction by the end of 2023. Mountain Valley estimates the final ROW restoration will be complete by the end of 2023 (M. Neylon, Mountain Valley, email to C. Schulz, Service, December 10, 2022).

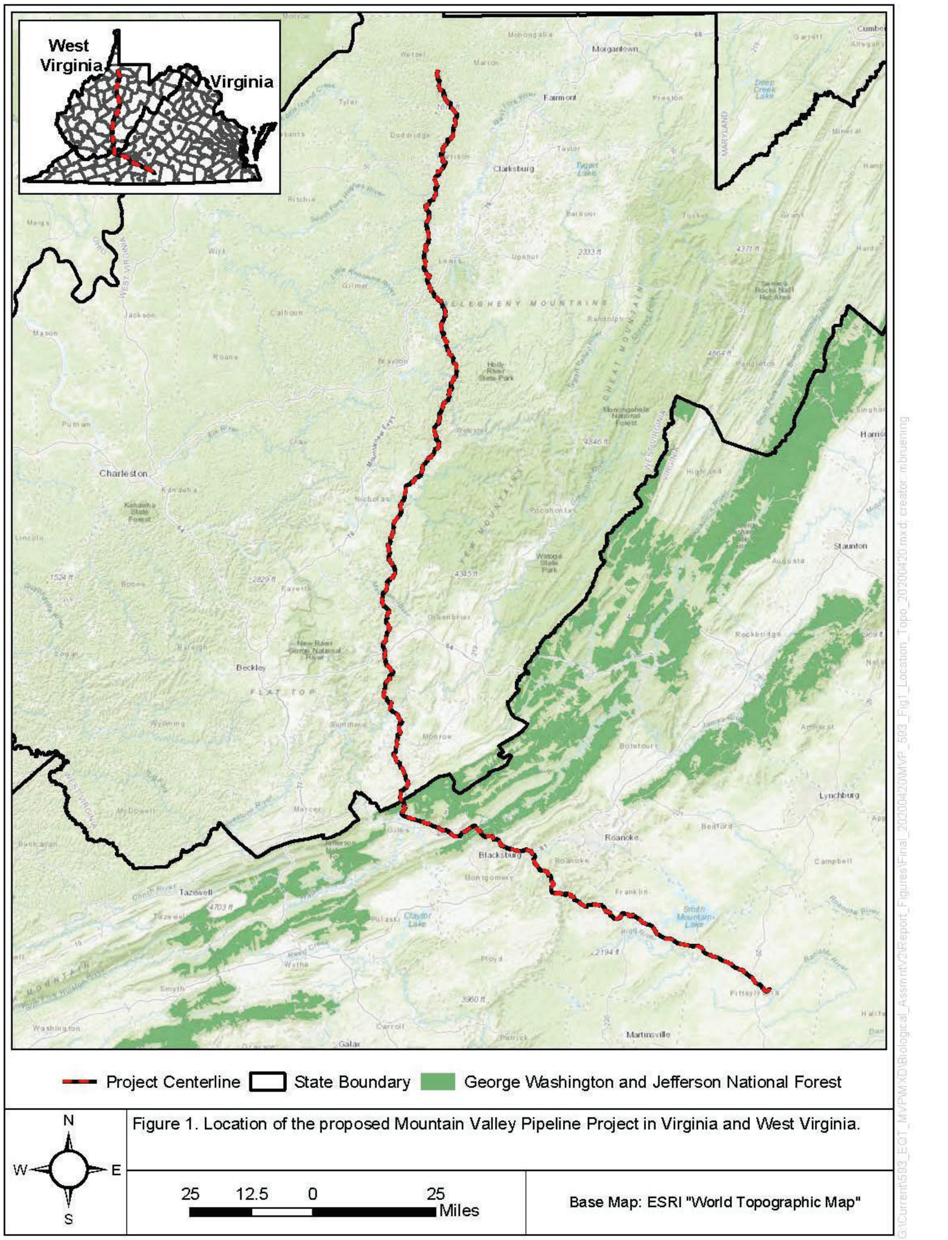

Figure 1. Location of the proposed MVP project in VA and WV.

Proposed Facilities – A brief description of the 7 types of above-ground facilities is included below. Additional details describing the facilities are included in Section 2.1 of the FEIS (FERC 2017a) and Section 3.1 of the BA (FERC 2017b).

1. Compressor stations – utilize engines to maintain pressure within the pipeline to deliver the contracted volumes of natural gas to specific points at specific pressures. Designed to attenuate noise and allow for operation and maintenance (O&M) activities.
2. M&R stations – measure the volume of gas removed from or added to a pipeline system at receipt and delivery interconnects. Consist of a small, graveled area with a small building(s) that enclose the measurement equipment.
3. Taps – connect the MVP project with other natural gas systems operated by other companies.
4. MLVs – consist of a small system of aboveground and underground piping and valves that control the flow of gas within the pipeline and can also be used to vacate, or blowoff, the gas within a pipeline segment, if necessary.
5. Pig launchers and receivers – facilities where internal pipeline cleaning and inspection tools, referred to as "pigs," can be inserted or retrieved from the pipeline. Generally consist of a segment of aboveground piping.
6. Cathodic protection systems – systems that help prevent corrosion of underground pipeline facilities. Typically include a small, aboveground transformer-rectifier unit and an associated anode ground bed located underground.
7. Very small aperture terminal equipment – provides telecommunication services at all compressor stations, M&R stations, and MLV sites.

Land Requirements – Construction of the pipeline will disturb approximately 6,656 acres of land (M. Hoover, Mountain Valley, email to C. Schulz, Service, January 12, 2023). Following construction, approximately 2,210 acres of disturbed land will be maintained for O&M of the pipeline and the remaining approximately 4,446 acres of disturbed land will be restored and will revert to former use (M. Hoover, Mountain Valley, email to C. Schulz, Service, December 28, 2022). A brief description of the 6 types of land requirements is included below. Additional details describing the land requirements are included in Section 2.3 of the FEIS (FERC 2017a) and Section 3.2.3 of the BA (FERC 2017b).

1. Pipeline ROW – the construction ROW consists of 2 portions, the temporary construction ROW and the permanent ROW. The temporary construction ROW will be restored or will revert to former use; a 50-ft permanent ROW (i.e., operational easement) will be maintained and utilized for O&M purposes. Mountain Valley will generally use a 125-ft construction ROW to install the pipeline in uplands and a 75-ft construction ROW through wetlands.
2. Additional temporary workspace (ATWS) – additional space necessary to complete construction of the pipeline. Examples include, but are not limited to, areas adjacent to crossings of roadways, railroads, waterbodies, wetlands, or other utilities; areas requiring

extra trench depth; certain pipe bend locations; truck turnarounds or equipment passing lanes; and staging and fabrication areas. ATWS will be used only during construction; after pipeline installation, all ATWS will be restored to their pre-construction condition and use.

3. Aboveground facilities – includes compressor stations, M&R stations and interconnects, taps, MLVs, and pig launcher and receivers. Temporary work areas used during construction of the aboveground facilities will be restored to their pre-construction condition and use after the facilities are built.
4. Contractor and storage yards (yards) – used to temporarily store pipe, materials, and equipment; set up offices; and mobilize workers. After pipeline installation, all yards will be restored to their pre-construction conditions and use.
5. Cathodic protection areas – used for installing cathodic protection rectifiers and groundbeds.
6. Access road (AR) – necessary to gain access to the construction ROW and aboveground facilities. Many of the proposed ARs are existing roads and virtually all existing ARs will require improvements for pipeline construction traffic.

Construction Procedures – Mountain Valley will design, construct, operate, and maintain the MVP project pipeline and facilities in accordance with U.S. Department of Transportation (USDOT) regulations under 49 CFR 192 and other applicable federal and state requirements. Mountain Valley will comply with siting and maintenance requirements under 18 CFR 380.15 and other applicable federal and state regulations and implement various forms of mitigations as defined in 40 CFR 1508.20. They will adopt FERC's general construction, restoration, and operational mitigation measures as outlined in FERC's Upland Erosion Control Revegetation and Maintenance Plan (FERC Plan) (FERC 2013a) and Wetland and Waterbody Construction and Mitigation Procedures (FERC Procedures) (FERC 2013b). Construction plans include some modifications to FERC Procedures and more details can be found in Section 2.4.1.1 of the FEIS (FERC 2017a). Specific mitigation plans for National Forest lands have been determined in consultation with the U.S. Forest Service (USFS).

A brief description of the 8 types of typical construction procedures associated with the project is included below. Also provided below, where appropriate, is a description of significant work that has been completed to date and new information regarding certain construction procedures. Additional details describing the typical construction procedures are included in Section 2.4.2 of the FEIS (FERC 2017a). The typical construction procedures described below have proceeded and will generally continue to proceed in an assembly line fashion with construction crews moving down the construction ROW as work progresses. After tree-clearing, construction and restoration at any point along the pipeline route takes about 3 weeks to complete; although progress can be delayed by topography, weather, or other factors (FERC 2017a, 2017b). Within 20 days of backfilling the trench (10 days in residential areas) all work areas are graded.

Typical construction procedure 1 of 8. Surveying and staking – marking of the limits of the construction ROW, centerline, ATWS, other approved work areas, and environmentally sensitive areas using temporary flagging or tape.

Typical construction procedure 2 of 8. Clearing and grading – removal of trees, shrubs, brush, roots, and large rocks from the construction work area and leveling of the construction ROW to allow for operation of construction equipment.

The action area (described below) contains approximately 1,002,627.71 acres (Mountain Valley 2022; M. Hoover, Mountain Valley, email to C. Schulz, Service, December 28, 2022):

- 765,806.97 acres are forested,
- 4,694.73 forested acres have been or will be cleared (0.61% of forested acres in the action area),
- 1,694.60 of the cleared forest acres along the permanent ROW will remain in an herbaceous state (this represents a permanent loss of 0.22% of forested acres in the action area following construction),
- 3,000.13 of the cleared forest acres within the temporary workspace will be allowed to regenerate following construction but may take up to 25 years to become suitable bat roosting habitat (this represents a temporary forest loss of 0.39% of forested acres in the action area following construction).

Tree Removal – Most of the tree clearing required for the MVP project has been completed and approximately 3.45 acres of planned tree removal has yet to occur (Mountain Valley 2022). Tree removal in each bat habitat category that has occurred since issuance of the 2017 Opinion and is yet to be completed is provided in Tables 2 and 3.

The action area (described below) includes 6 categories of Ibat habitat:

- Known use summer habitat – defined as areas within a 5-mile radius of a pregnant female or juvenile capture or within 2.5 miles of a known roost tree. Areas within these distances are generally considered the likely Ibat home range.
- Unknown use summer habitat – defined as unsurveyed areas where Ibats are reasonably likely to occur based on their location and presence of suitable habitat. Suitable forested/wooded habitat contains potential roosts (i.e., live trees and/or snags ≥5 inches dbh that have exfoliating bark, cracks, crevices, and/or cavities), as well as forested linear features such as wooded fencerows, riparian forests, and other wooded corridors.
- Known occupied hibernacula – defined as caves/mine portals which are currently occupied, or were historically occupied, by hibernating Ibats.
- Assumed occupied hibernacula[3] – defined as suitable caves and their associated

[3] Caves and other features are conservatively assumed to be occupied when the cave/feature is located within the range of the species, the cave/feature was determined to be suitable in accordance with the Service's protocol (Service 2017a) at the time of the assessment, and occupancy surveys were not completed to determine

sinkholes, fissures, and other karst features, as well as anthropogenic features such as mines and tunnels, which are reasonably certain to be occupied by hibernating Ibats.
- Known use spring staging/fall swarming habitat – defined as roosting and foraging habitat within a 5-mile radius of priority 3 and 4 hibernacula or a 10-mile radius of Priority 1 and 2 hibernacula.
- Unknown use spring staging/fall swarming habitat – defined as roosting and foraging habitat within a 5-mile radius of a potentially suitable hibernaculum that has not been surveyed for Ibats.

The action area (described below) includes 6 categories of NLEB habitat:
- Known use summer habitat – defined as areas within a 3-mile radius of a NLEB capture or within 1.5 miles of a known roost tree. Areas within these distances are generally considered the likely NLEB home range.
- Unknown use summer habitat – defined as unsurveyed areas where NLEB are reasonably likely to occur based on presence of suitable habitat. Suitable forested/wooded habitat contains potential roosts (i.e., live trees and/or snags ≥3 inches dbh that have exfoliating bark, cracks, crevices, and/or cavities), as well as forested linear features such as wooded fencerows, riparian forests, and other wooded corridors.
- Known occupied hibernacula – defined as caves/mine portals which are currently occupied, or were historically occupied, by hibernating NLEBs.
- Assumed occupied hibernacula[4] – defined as suitable caves and their associated sinkholes, fissures, and other karst features, as well as anthropogenic features such as mines and tunnels.
- Known use spring staging/fall swarming habitat – defined as roosting and foraging habitat within a 5-mile radius of known hibernacula openings.
- Unknown use spring staging/fall swarming habitat – defined as roosting and foraging habitat within a 5-mile radius of a potentially suitable hibernaculum that has not been surveyed for NLEBs.

In addition to the categories described above, 1,234.85 acres of previously surveyed suitable summer habitat for Ibats have been cleared (i.e., trees felled) (P. Moore, Beveridge & Diamond PC, email to C. Schulz, Service, December 9, 2022). These areas included forested/wooded

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presence/probable absence. However, the best available science indicates that all of these features are not reasonably certain to be occupied, post-WNS. As a result, USFWS applies the best available science in the Environmental Baseline section below to estimate the number of unsurveyed features within the action area that may be occupied for purposes of analysis in the Opinion.

[4] Caves and other features are conservatively assumed to be occupied when the cave/feature is located within the range of the species, the cave/feature was determined to be suitable in accordance with the Service's protocol (Service 2017a) at the time of the assessment, and occupancy surveys were not completed to determine presence/probable absence. However, the best available science indicates that all of these features are not reasonably certain to be occupied, post-WNS. As a result, USFWS applies the best available science in the Environmental Baseline section below to estimate the number of unsurveyed features within the action area that may be occupied for purposes of analysis in the Opinion.

habitats in an Ibat recovery unit. However, because the level of effort outlined in the Range-wide Indiana bat Summer Survey Guidelines (Service 2017a) was met and no Ibats were captured, these survey results suggested probable absence for Ibats during the summer months on the 1,234.85 acres.

Similarly, no NLEBs were captured during survey efforts, meeting the required level of effort on 603.06 acres of suitable forested/wooded habitat within the action area, suggesting probable absence of NLEBs on those surveyed acres. Ten NLEB roosts are known (or have been known) within the action area (A. Silvis, WVDNR, pers. comm., December 9, 2022); 2 of these were within the project's LOD (limits of disturbance) and were identified in the Service's 2017 and 2020 Opinions. The additional 8 maternity NLEB colonies were not mentioned in previous Opinions as they fell outside the area previously analyzed for impacts to the NLEB (see discussion below).

Potentially suitable habitat where summer surveys were conducted in accordance with the Service's guidance (as discussed further below) for Ibat and NLEB and surveys were negative for these species was considered its own habitat category in the 2017 Opinion (*suitable unoccupied habitat*). Additionally, portions of the action area that are not within 5 miles of known or assumed occupied Ibat and/or NLEB hibernacula are not expected to be used by Ibats and/or NLEBs during spring staging, fall swarming, or winter hibernation. As explained below, because no Ibats or NLEB are expected to occur in these areas during the summer, and the presence of the cleared areas within the project ROW and LOD are not expected to adversely affect any bats that may migrate through or adjacent to those areas in non-summer months, we are no longer considering these suitable unoccupied habitat areas to be a separate habitat category for purposes of evaluating likely effects on individuals of the species. For more detailed information on these areas and the survey effort refer to the Ibat Environmental Baseline section.

Bat Survey Efforts – As stated on page 1 of the Range-wide Indiana Bat and Northern Long-Eared Bat Summer Survey Guidance, "The following guidance is designed to determine whether IBAT and/or NLEB are present[5] or probably absent (P/A)[6] at a given site during the summer (May 15 to August 15)...." These guidelines have been in use for many years and have been periodically updated based on new scientific information and public feedback[7]. The Service accepts the results of surveys if they were conducted in accordance with the guidelines. The exception to this is when there is new information or a better understanding of other existing site-specific information that warrants resurveying a location.

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[5] The guidance is not intended to be rigorous enough to provide sufficient data to fully determine population size or structure.
[6] Recognizing protocols are not 100% certain to detect Ibat and NLEB when present and identification errors may occur.
[7] https://www.fws.gov/library/collections/range-wide-indiana-bat-and-northern-long-eared-bat-survey-guidelines

Since 2018, the Service has accepted negative surveys rangewide for a *minimum* of 5 years, unless new information (e.g., new nearby surveys) suggests otherwise (Service 2018d); prior to 2018, survey results were accepted for a *minimum* of 2 years. There is no automatic expiration of survey results after that time, as these are minimums. Through discussions with the local Service field office, applicants and action agencies may consider conducting additional surveys or continue to use prior survey results, particularly where (as in this case) there is no new information to suggest the results are no longer valid. Coordination consistent with this approach occurred between Mountain Valley and the Service and resulted in the determination that no new bat surveys were needed, as discussed below. This approach has been applied across the ranges of the 2 species and is consistent with the use of these guidelines.

To determine the presence or probable absence of potential Ibat and NLEB maternity colonies, summer mist-net surveys were conducted in 2015 and 2016. Surveys followed the Range-wide Indiana Bat Summer Survey Guidance current at that time (Service 2015, 2016). Mist-net surveys were not conducted along approximately 128.9 miles (42.4%) of the construction ROW and 102.3 miles (50%) of ARs in WV and VA (ESI 2015c, 2015d, 2016b). In these areas, Mountain Valley chose to assume presence for Ibats and NLEBs because these parts of the ROW and ARs were within designated known use bat buffers (i.e., summer and/or spring staging/fall swarming buffers) (FERC 2017b).

The Service accepted the results of the 2015 and 2016 bat mist net surveys as valid for the 2020 Opinion as there was no new information to suggest that the survey results were no longer valid. The Service recommended that no additional bat surveys be completed for the current reinitiation, because the previously surveyed areas have been cleared of trees and the areas are no longer considered to be suitable summer habitat for the species (Mountain Valley 2022). New surveys would not be useful or informative in those areas. Surveys valid as of the commencement of construction in 2018, when tree clearing occurred, provide the best snapshot of bat activity in the area pre-project. Surveys conducted in 2022 in areas where trees were cleared for the project previously would not inform an assessment of the effects of tree clearing conducted in 2018. Thus, the best available data on the presence or probable absence of Ibats and NLEBs within the surveyed sections of the action area continues to be the results of the 2015-2016 survey efforts, which are described in more detail in the Environmental Baseline section.

Travel/commuting habitat is used by bats during the summer months in occupied areas and may include forested areas between foraging and roosting habitat. Because Ibats and NLEBs have strong site fidelity to their summer habitat, standardized surveys conducted during the summer are used to determine presence or probable absence of the species. Due to the strong site fidelity to summer habitat, if bats are not present during summer surveys, they are not expected to use the habitat during the summer season in the foreseeable future. Mountain Valley conducted the appropriate pre-construction surveys using the Service's survey guidance and determined probable absence of Ibat in these areas (i.e., suitable unoccupied summer habitat) and presence for portions of these areas for NLEB. The "probable absence" determination means that the best available data indicates that Ibats are unlikely to use the surveyed areas as summer foraging, roosting, or traveling/commuting habitat.

The SBA2 (Mountain Valley 2022) correctly acknowledges that negative survey results are used by USFWS to demonstrate that bats are unlikely to be in the area and therefore unlikely to be affected by a given activity. Service statements regarding impacts to bats in suitable unoccupied summer habitat in its 2017 Opinion for the Atlantic Coast Pipeline project (Service 2017b) project were in error. The potential effects described in that analysis are the type of effects that may occur as the result of tree clearing in occupied or unknown use summer habitat. In unoccupied summer habitat (which has been determined unoccupied by standardized surveys), these effects are unlikely to occur because bats are not expected to be present in the habitat or use the habitat in the foreseeable future.

Migration – The Fourth Circuit understood the statements in the 2017 Atlantic Coast Pipeline Opinion (Service 2017b) to mean that Ibats would be adversely affected by the presence of the cleared areas when they attempted to travel through those areas "in non-summer months." Understood this way, the statements in the 2017 Atlantic Coast Pipeline Opinion remain in error because they reflect a misunderstanding of the nature of bat migration and erroneously assume that the presence of cleared areas will harm migrating bats. USFWS defines migration habitat for NLEBs to include the safe space to migrate between spring/fall habitat and summer roost sites (modified from USFWS 2022); this definition of migration habitat would also apply for Ibats. Migration habitat sometimes includes forested stop-over areas (where bats may stop to roost temporarily) if travelling longer distances. The term "migration habitat" is not interchangeable with the terms "travel corridor" or "commuting habitat," which are sometimes used to describe uses of habitat by bats during summer months in occupied areas. Migration habitat is inaccurately described in the Fourth Circuit's 2022 MVP Opinion (see footnote 4 of the Court's Opinion) and in the Service's 2017 Opinion for the Atlantic Coast Pipeline project, p. 34 (Service 2017b), as "a travel corridor between hibernacula and roost trees" in non-summer months[8]. USFWS considers the former definition (USFWS 2022) to be a more accurate description of migration habitat, as the term "corridor" inaccurately implies restricted passageways only. The best available information indicates Ibats will broadly use forested habitat during migration and are not restricted to narrow, straight-line travel corridors (Roby et al. 2019). They move along a general trajectory during migration, using any forested landscape as they forage, fly through, or sometimes roost overnight as they migrate. Research also suggests that NLEBs may cross narrow open habitats (e.g., a pipeline corridor) when necessary to continue in their migration trajectory, but typically will travel along or within forested habitat (White et al. 2017). In general, Ibats and NLEBs are known to use similar habitat and exhibit similar behavior; thus, it is reasonable to assume that they will also behave and use habitats in a similar manner when migrating.

[8] While the Fourth Circuit's discussion of this issue centered on Ibats, we note that Ibats and NLEBs rely on similar migration habitat.

Because ample forest habitat exists within the action area, it is the Service's opinion that if stop-over habitat is removed, the species will adjust and seek new (nearby) stop-over locations. Ibats and NLEBs do not appear to show site fidelity during migration, and are flexible with selecting roosts (e.g., they change roosts based on weather conditions encountered). Thus, we may also expect that Ibats and NLEBs moving through the project area may fly over the disturbed area without stopping since it has been cleared or is close to an on-going work area, and instead would continue traveling along and to forest habitat. Given the lack of forest cover in the ROW, bats are not able to roost in this cleared area during migration. Therefore, migrating bats that are moving through/across the cleared ROW, or that may have used these areas as stop-over habitat prior to clearing, are not expected to experience adverse impacts because, as stated above, they broadly use the landscape during migration and thus, are not always selecting the same travel route or stop-over temporary roost trees year after year. Furthermore, their use of migration or stop-over habitat is typically influenced by weather and other changing landscape features. Some bats can fly to maternity areas within 1 night, depending on where they are migrating from, which greatly decreases the potential for the MVP action area to provide stop-over habitat. Finally, because they will cross narrow open habitat (White et al. 2017), such as a pipeline ROW, we expect that any bats migrating through the linear ROW would simply fly across it while passing through the area without expending significant additional energy. Thus, we do not expect migrating Ibats and NLEBs that pass through or temporarily stop over in the action area of this project to experience any adverse effects. Nor do we expect that crossing the pipeline corridor or loss of potential stop-over habitat in the pipeline corridor would measurably reduce an individual bat's fitness during migration. Any suggestions to the contrary in the 2017 Atlantic Coast Pipeline Opinion (Service 2017b) are erroneous and inconsistent with the best available data.

When no adverse effects are expected to occur, the Service typically does not discuss them in its biological opinions. However, we discuss the above issues in detail here in response to the Fourth Circuit's direction in footnote 4 of the Court's Opinion and because this issue was raised in the SBA2 (Mountain Valley 2022). In summary, for the reasons discussed above, no effects to migrating individual Ibats and NLEBs are expected from project implementation, including from clearing of unoccupied suitable habitat, which will not be addressed further in this Opinion. Any statements in the 2017 Atlantic Coast Pipeline Opinion (Service 2017b) regarding impacts to bats in suitable unoccupied summer habitat and migration habitat, which the Fourth Circuit referenced in its 2022 MVP opinion, were incorrect and are not supported by the best available science.

Ibat – Most tree clearing required for the MVP project has been completed. Tree removal in each Ibat habitat category that has occurred since the issuance of the 2017 Opinion and 2020 Opinion is provided in Table 2a. Table 2b shows the tree removal that has occurred to date in each bat habitat category, by month. A total of 3.45 acres of planned tree felling in known project locations and/or tree removal associated with known variances and slips has yet to be cleared within the action area (Mountain Valley 2022). However, only 3.4 acres of this clearing occurs in known or unknown use Ibat habitat; 0.05 acres of tree removal will occur in suitable, but unoccupied Ibat habitat and will not have an effect on the species (Table 2a). Up to an additional 247.68 acres of tree removal associated with future slips is anticipated to occur; future slips and slip repairs could occur in any Ibat habitat category. The location and amount/area per unknown slip where tree removal will occur in the future are unknown at this time (see *Tree Removal for Slips and Other Variances* discussion below). However, Mountain Valley will complete the tree clearing for all planned tree removal (i.e., known project locations, variances, and slips) and future slip repairs between November 15 and March 31 whenever possible. Additionally, no tree cutting will occur during the bat pup season (June 1 to July 31). However, should an emergency arise, that would require tree clearing from June 1 to July 31, Mountain Valley will consult with the Service and FERC regarding the need for emergency consultation (Mountain Valley 2022).

Table 2a. Acres of tree removal in Ibat habitat categories to date (P. Moore, Beveridge & Diamond PC, email to C. Schulz, Service, December 9, 2022; M. Hoover, Mountain Valley, email to C. Schulz, Service, December 14, 2022). Numbers in rows and columns may not sum to exact totals due to rounding.

Habitat Category	Felled Before 2020 Opinion Issued – WV	Felled Before 2020 Opinion Issued – VA	Downed Before 2020 Opinion due to Slips – WV (none in VA)	Removed since 2020 Opinion – WV	Removed since 2020 Opinion – VA	Total Cleared to Date	Not Yet Cleared for Planned Project Locations-VA (none in WV)[1]	Not Yet Cleared for Approved Variances – WV (none in VA)[2]	Not Yet Cleared for Approved Slip Variances – WV (none in VA)[2]	Not Yet Cleared for Slips Pending Variance Approval – WV (none in VA)	Total to be Cleared for Project Locations and Variances and Slips	Not Yet Cleared for Future Slip Repair[3]
Known Use Summer	226.29	0.00	10.14	2.04	0.00	238.47	0.00	0.00	0.06	0.00	0.06	N/A
Unknown Use Summer	1,748.98	74.78	4.82	4.75	0.00	1,833.33	0.00	1.84	0.29	1.05	3.18	N/A
Unknown Use Spring Staging / Fall Swarming[4]	303.67	521.51	0.00	0.24	3.05	828.47	0.13	0.00	0.03	0.00	0.16	N/A
Known Use Spring Staging / Fall Swarming	176.76	131.43	0.00	0.00	0.29	308.48	0.00	0.00	0.00	0.00	0.00	N/A
Total	**2,455.70**	**727.72**	**14.96**	**7.03**	**3.34**	**3,208.75**	**0.13**	**1.84**	**0.38**	**1.05**	**3.4[5]**	**247.68**

[1] This refers to areas of planned clearing associated with the original project plan, not associated with any variance or slip that has occurred.

[2] After issuance of the 2020 Opinion, FERC approved 5 variances for Mountain Valley to undertake slip remediation work in compliance with the USFWS-prescribed protocol in the 2020 Opinion for future slip-related tree clearing. Due to the vacatur of the 2020 Opinion, 3 of these variances still have trees that need to be felled.

[3] As described below and in Mountain Valley (2020) additional tree felling may be necessary to remediate unknown future slips (i.e., slips that cannot be predicted based on numerous factors including site conditions, rainfall amounts, and rainfall intensity). Using the values that were established for purposes of the 2020 Opinion, Mountain Valley estimates the amount of tree removal to remediate unknown future slips. Location for future slips totaling 247.68 acres is unknown and the total is not assigned to a habitat category. The total is over the life of the project, and not more than a few acres are expected to occur at a time in any given habitat type.

[4] Approximately 1.74 acres that were included in the 2020 Opinion totals (Spread D area [WV] and Tree Sit area [VA]) were not felled until after 2020 Opinion approval but were included in the 2020 Opinion totals. To avoid double counting of the felling, this 1.74 acres is not included in the Felled Before 2020 Opinion Issued – WV (0.24 acre) and Felled Before 2020 Opinion Issued – VA (1.5 acres) columns for Unknown Use Spring Staging/Fall Swarming habitat. These acres are included in the Total Cleared to Date column under the for Unknown Use Spring Staging/Fall Swarming habitat.

[5] While a total of 3.45 acres of planned tree removal has yet to occur, 0.05 acres of this will occur in suitable but unoccupied bat habitat, as determined by appropriate level of bat survey efforts. Therefore, only 3.4 acres of planned tree removal will occur in known or unknown use bat habitat.

Table 2b. Acres of tree removal that has occurred to date in Ibat habitat categories, by month (M. Hoover, Mountain Valley, email to C. Schulz, Service, February 24, 2023).

IBat Habitat Category	2018								2019					2020		2021					Total Acres
	Feb	Mar	Apr	May	Jun	Aug	Sep	Nov	Mar	Apr	May	Aug	Sep	Nov	Dec	Jan	Mar	Apr	Aug	Sep	
Known use summer habitat (acres cleared)	135.05	80.68	0	0	0	0	0	0	8.09	1.93	0	0.55	0	0	0	0	2.04	0	0	0	228.34[1]
Known use spring staging and fall swarming	15.49	292.7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.29	0	0	0	308.48
Unknown use spring staging and fall swarming habitat (acres cleared)	53.45	194.67	431.05	105.86	0.31	0	39.73	0	0.08	0.01	0	0	0	0.24	0.20	0	2.88	0	0	0	828.48
Unknown use summer habitat (acres cleared)	0	268.31	893.89	630.67	0	3.5	5.73	0.34	0.64	4.87	15.24	0.26	0.31	0	1.05	0.41	0.46	1.32	0.4	1.11	1828.51[2]
Total Acres[3]	**203.99**	**836.36**	**1324.94**	**736.53**	**0.31**	**3.5**	**45.46**	**0.34**	**8.81**	**6.81**	**15.24**	**0.81**	**0.31**	**0.24**	**1.25**	**0.41**	**5.68**	**1.32**	**0.4**	**1.11**	**3193.82**

[1] This total does not include 10.14 acres of downed trees as a result of slips.
[2] This total does not include 4.82 acres of downed trees as a result of slips.
[3] Numbers in rows and columns may not sum to exact totals due to rounding.

NLEB[9] – There are 66 features known or considered to be potentially suitable NLEB hibernacula within the action area (described below) (Mountain Valley 2022). The project will not directly impact any of the known or potentially suitable NLEB hibernacula. Approximately 436,337.3 acres of forested habitat occur within 5 miles of those features. To date, 3,840.54 acres of occupied or unknown NLEB habitat have been cleared and 3.40 acres remain to be cleared (Table 3).

Within 5 miles of known NLEB hibernacula, 0 acres of planned tree clearing remains in WV and VA (M. Hoover, Mountain Valley, email to C. Schulz et al., Service, January 11, 2023); therefore, within known use and unknown use spring staging/fall swarming habitat, no planned future tree clearing is expected. Mountain Valley may need to maintain vegetation (including clearing of regrowth) in areas where trees have already been removed, but USFWS has indicated that these locations would not support roosting habitat for bats prior to completion of the project (A. Bossie, Department of the Interior [DOI], email to P. Moore, Beveridge & Diamond PC, July 14, 2022).

There are 6 known NLEB hibernacula in the action area (described below). Approximately 488.73 acres of forested habitat occurred within 0.25 miles of the 3 previously known hibernacula. Within this 488.73-acre area, project construction reduced forested spring staging/fall swarming habitat by 15.64 acres.

The MVP project will not directly impact any currently known NLEB hibernacula (Mountain Valley 2022). All tree removal within 0.25 miles of Tawney's Cave, Canoe Cave, and PS-WV3-Y-P1 occurred in 2018. Mountain Valley performed tree removal during April 1–November 15 in 2018 within 5 miles of known NLEB hibernacula. There are several other activities proposed within 5 miles of the 6 known NLEB hibernacula. Activities planned within 5 miles of Canoe Cave and Tawney's Cave include trenching, pipe installation, restoration activities, vegetation maintenance and AR maintenance/upgrades. Activities planned within 5 miles of PS-WV3-Y-P1 include trenching, pipe installation, vegetation maintenance, AR maintenance, and restoration activities (no AR upgrades). Tree clearing associated with addressing past slips and variances of 3.40 acres is expected within 5 miles of these known hibernacula (Table 3). However, the location and amount/area per unknown slip where tree removal will occur in the future are unknown at this time (see *Tree Removal for Slips and Other Variances* discussion below).

[9] See the Environmental Baseline section below for an explanation of the NLEB analysis area and treatment of NLEB in this Opinion.

Table 3. Acres of tree removal in NLEB habitat categories; all acres were accounted for in 2020 Opinion (M. Hoover, Mountain Valley, email to C. Schulz, Service, January 11, 2023). Numbers in rows and columns may not sum to exact totals due to rounding.

Habitat Category	Felled Before 2020 Opinion Issued – WV	Felled Before 2020 Opinion Issued - VA	Downed Before 2020 Opinion due to Slips - WV (none in VA)	Removed since 2020 Opinion - WV	Removed since 2020 Opinion - VA	Total Cleared to Date	Not Yet Cleared for Approved Slips Variances - WV[1]	Not Yet Cleared for Approved Slip Variances - VA[1]	Total to be Cleared for Variances and Slips	Not Yet Cleared for Future Slip Repair[2]
Known Use Summer	2620.04	243.55	15.16	7.54	3.05	2889.34	3.27	0.13	3.40	N/A
Unknown Use Summer	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	N/A
Unknown Use Spring Staging/Fall Swarming	95.24	240.69	0.00	0.00	0.00	335.93	0.00	0.00	0.00	N/A
Known Use Spring Staging/Fall Swarming	419.20	194.79	0.99	0.00	0.29	615.27	0.00	0.00	0.00	N/A
Total	**3134.48**	**679.03**	**16.15**	**7.54**	**3.34**	**3840.54**	**3.27**	**0.13**	**3.40**	**247.68**

[1] After issuance of the 2020 Opinion, FERC approved 5 variances for Mountain Valley to undertake slip remediation work in compliance with the USFWS-prescribed protocol in the 2020 Opinion for future slip-related tree clearing. Due to the vacatur of the 2020 Opinion, trees associated with 3 of these variances still need to be felled.

[2] As described below and in Mountain Valley (2020) additional tree felling may be necessary to remediate unknown future slips (i.e., slips that cannot be predicted based on numerous factors including site conditions, rainfall amounts, and rainfall intensity). Using the values that were established for purposes of the 2020 Opinion, Mountain Valley estimates the amount of tree removal to remediate unknown future slips. Location for future slips totaling 247.68 acres is unknown and the total is not assigned to a habitat category. The total is over the life of the project, and not more than a few acres are expected to occur at a time in any given habitat type.

Tree Removal for Slips and Other Variances – Slips are a type of slope failure that result in a downward falling or sliding of a mass of soil, rock, trees, and other debris from a steep slope onto an area below (M. Hoover, Mountain Valley, email to C. Schulz, Service, July 1, 2020). Slips can be caused by a variety of factors, such as long duration or high-intensity rainfall events, rapid snowmelt, freeze/thaw conditions, slope height and steepness, vegetation, and underlying geology. A total of 14.96 acres of downed trees as a result of slips has occurred on the MVP project route in known and unknown use Ibat habitat (P. Moore, Beveridge & Diamond PC, email to C. Schulz, Service, December 9, 2022; and see Table 2a). This acreage was included in the 2020 Opinion. A total of 10.14 acres fell during slips in the non-active bat season in known use summer habitat. A total of 4.82 acres fell as a result of slips in unknown use summer Ibat habitat; 3.31 acres of slips occurred during the active bat season and 1.51 acres fell during the inactive bat season in this habitat category. To date, no slips have occurred in known or unknown use spring and fall Ibat habitat. A total of 16.15 acres of downed trees as a result of slips have occurred within the MVP project area within known NLEB habitat (M. Hoover, Mountain Valley, email to C. Schulz, B. Smrekar, and J. Utrup, Service, February 13, 2023). However, the location and timing of slips are unpredictable; therefore, future slips could occur in all Ibat and NLEB habitat categories during the inactive or active seasons. Additionally, after issuance of the 2020 Opinion, FERC approved 5 variances for Mountain Valley to undertake slip remediation work, including the felling of 2.35 acres of trees within Ibat and NLEB known or unknown habitat (Mountain Valley 2022) (Tables 2a and 3). Due to the vacatur of the 2020 Opinion, 1.05 acres of trees associated with 3 of these variances still need to be felled (Mountain Valley 2022); an additional 0.05 acres of this will occur in suitable but unoccupied bat habitat, as determined by appropriate level of bat survey efforts).

As described in Mountain Valley (2022), additional tree felling may be necessary to remediate unknown future slips (i.e., slips in locations that cannot be predicted based on numerous factors, including site conditions, rainfall amounts, and rainfall intensity). Using the values established for purposes of the 2020 Opinion, Mountain Valley (2022) estimates the amount of tree removal to remediate unknown future slips is approximately 247.68 acres. In general, slips are often related to site-specific natural factors that are difficult to predict in advance of an occurrence. Due to the unpredictable nature of slips (when and where they may occur), the exact type of site restoration cannot be predicted. However, the overall restoration goal is to restore the area to a stable condition, reestablish original contours, and allow the area to naturally revegetate.

Mountain Valley provided the following (M. Neylon, Mountain Valley, letter to J. Martin, FERC, July 2, 2019) explanation regarding uncertainty and additional slips. The northern approximately 60 miles of the MVP project occur within the Upper Pennsylvanian-aged Connemaugh Formation and Monongahela Formation as well as the Upper Pennsylvanian/Permian-aged Dunkard Group. These formations consist mainly of cyclic sequences of sandstone, siltstone, red and gray shale, limestone, and coal. These formations contain landslide-prone shale formations which are frequently associated with landslides that occur in the area. As these shales are exposed to water and oxygen near the surface, they weather into a thick mud. In addition, impervious layers located beneath the shale may trap water and cause the weathered shale to become saturated. Steep slopes that are often present in these areas, along with the weathered shale and mud, produce conditions that increase the likelihood for landslides.

Mountain Valley provided the following (M. Neylon, Mountain Valley, letter to J. Martin, FERC, November 27, 2019) further explanation regarding uncertainty and additional slips. In general, landslide susceptibility is higher in the northern and mountainous portions of the MVP project due to regional geology and topography. Figure 2 demonstrates this trend. While this map shows only the relative incidence of landslide occurrence and does not consider the effects of pipeline construction, the same trend is expected to occur along the pipeline alignment. The likelihood of additional slip-related tree clearing is increased in areas where the pipeline is aligned with the contours of the slope (i.e., sidehills or ridgelines) as landslides tend to damage trees above and below the movement. Usually, slips and slides occurring on planar slopes (perpendicular to contours) along the pipeline alignment affect areas already cleared of trees to facilitate pipeline construction.

Mountain Valley provided the following (M. Neylon, Mountain Valley, letter to J. Martin, FERC, November 27, 2019) additional explanation regarding uncertainty and additional slips. It is difficult to obtain a meaningful estimate of required acreage per month as it will be highly dependent upon precipitation. Generally, more slips are expected during the wetter months of the year (generally November through April) with fewer slips occurring during the dry summer months. Landslide occurrence is influenced by many factors that cannot be readily predicted, including precipitation. For example, while typically slip incidence is decreased during the dry summer months, intense rainfall such as that derived from a tropical storm could trigger landslides regionally, not limited to the pipeline corridor. Slips may occur during a relatively dry time of year, but a period of very intense rainfall may initiate numerous slips regionally. Many slips continue to grow over time. When the initial movement occurs, the slip repair may be minimally invasive and require a relatively small amount of tree clearing. Timely remediation is critical to minimizing the tree acreage and other resources affected by slips.

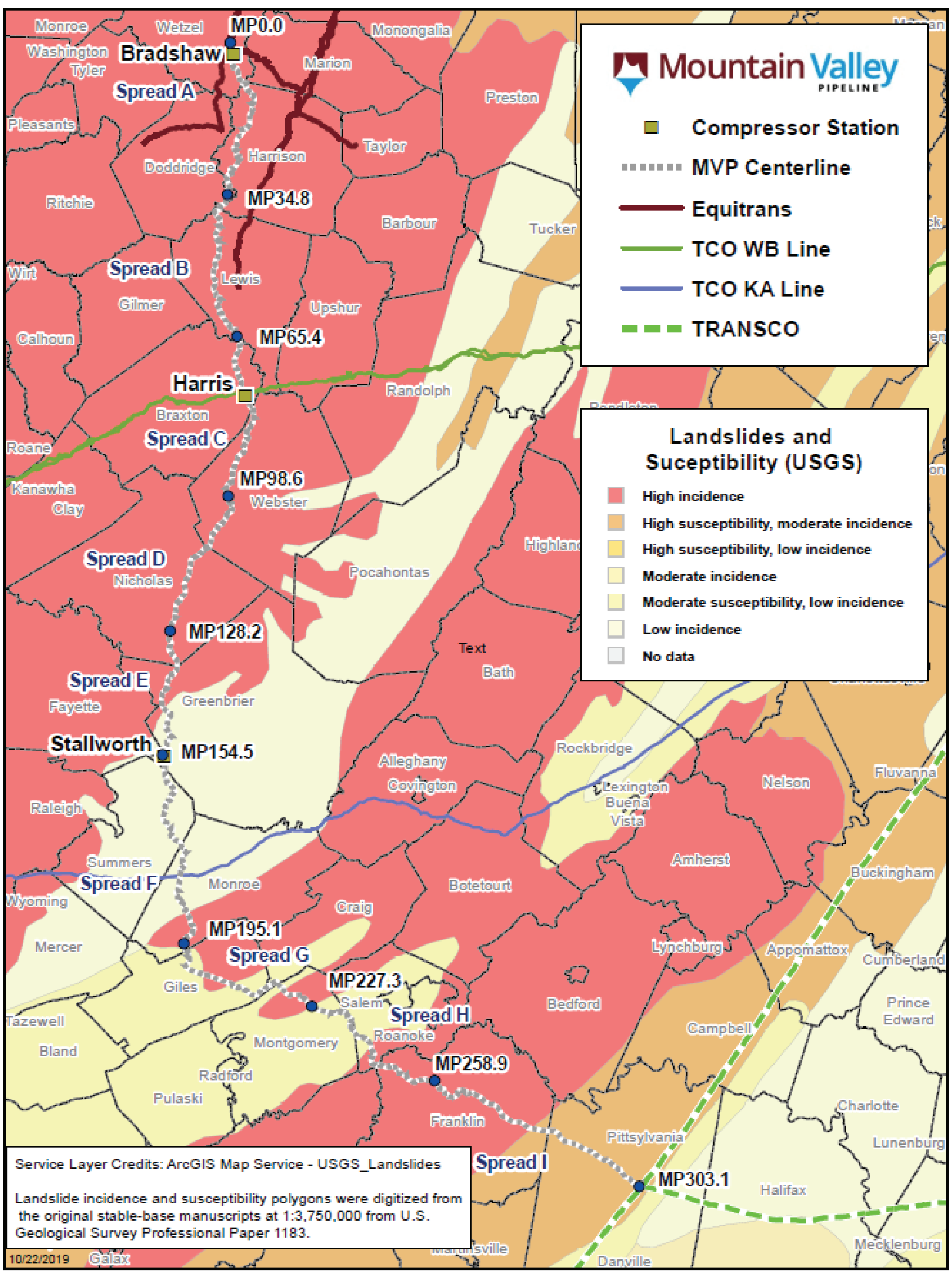

Figure 2. Landslides and susceptibility (U.S. Geological Survey [USGS]). This map was digitized from USGS manuscripts and is unsuitable for local planning due to scale (M. Neylon, Mountain Valley, letter to J. Martin, FERC, November 27, 2019).

Mountain Valley has adhered to all bat time-of-year restrictions (TOYRs) for tree clearing related to slips and variances to date, except for the tree clearing associated with slip variances for which emergency Section 7 consultation was requested by FERC. Trees were cleared in Ibat habitat during the Ibat tree clearing TOYRs after consultation with the Service as detailed in Table 4 (Mountain Valley 2020). No tree clearing has occurred during the Ibat tree clearing TOYRs since the 2020 Opinion (P. Moore, Beveridge & Diamond PC, email to C. Schulz, Service, December 9, 2022). However, as discussed above, the locations and timing of future slips and any required tree clearing to remediate the slip areas are unpredictable. Therefore, Mountain Valley will implement the following protocol before cutting any trees in those areas to avoid and minimize adverse effects to bats (Mountain Valley 2022):

(1) Complete the tree clearing between November 15 and March 31 of any given year whenever possible.
(2) No tree cutting from June 1 through July 31 (to avoid pup season when pups cannot yet fly) to address future slips, barring an unforeseen emergency arising.
(3) Should an emergency arise, that would require tree clearing from June 1 through July 31, Mountain Valley will consult with the Service and FERC regarding the need for emergency consultation.

Tables 2a and 3 provide the acreage of trees cleared due to past, ongoing, and future slips. Any slip-associated tree clearing beyond that included in Tables 2a and 3 would constitute a change in the action that could require reinitiation of Section 7 consultation. FERC and Mountain Valley should contact the Service prior to engaging in any tree-clearing beyond that anticipated in Tables 2a and 3.

Table 4. Acres of trees cleared during Ibat tree clearing TOYRs (Mountain Valley 2020).

Ibat Habitat Category	Month Cleared	Acreage Cleared	Justification	Type and Date of Section 7 Consultation
Unknown use spring staging/fall swarming	June 2018	0.31	Protestors occupied trees on top of Peters Mountain in WV near MP 196 for several months. Mountain Valley obtained approval under Variance G-4 to clear the trees following the end of the occupation.	Effects to Ibats included in 2017 Opinion (C. Schulz, Service, letter to K. Bose, FERC, June 6, 2018).
Known use summer	April 2019	1.92	This tree felling was required to remediate a safety hazard caused by slips and was approved through Variances A-21 (MP 5.71), A-47 (MP 5.52), and A-55 (MP 1.2).	Emergency consultation on effects to Ibats initiated in 2019 (T. Lennon, Service, email to A. Mardiney, FERC, April 2, 2019) and after-the-fact consultation completed via the 2020 Opinion.
Known use summer	August 2019	0.55	This tree felling was required near MP 1.5 to remediate a safety hazard caused by slips and was approved in Variance A-78.	Effects to Ibats included in 2017 Opinion (P. Friedman, FERC, letter to M. Eggerding, Mountain Valley, August 13, 2019).

Failed Erosion and Sediment (E&S) Controls – E&S control failures occurred due to excessive precipitation or other factors that were not analyzed in the 2017 Opinion (M. Neylon, Mountain Valley, letter to J. Martin, FERC, July 2, 2019). In certain instances, sediment traveled beyond the MVP project LOD and into listed species potential habitat (Table 5). When sediment leaves the MVP project LOD, due to an E&S control failure, Mountain Valley immediately repaired or replaced those E&S controls (M. Neylon, Mountain Valley, letter to J. Martin, FERC, July 2, 2019). In many instances, additional E&S controls were added to reinforce protection of resources and to keep material within the LOD. In some instances, Mountain Valley worked with the applicable state to redesign the controls in a particular area to reduce off ROW events (M. Neylon, Mountain Valley, letter to J. Martin, FERC, July 2, 2019). For listed plants, the failed E&S controls occurred in areas where Mountain Valley had previously conducted plant surveys and found none (M. Neylon, Mountain Valley, letter to J. Martin, FERC, July 2, 2019).

Table 5. Instances of sedimentation beyond the MVP project LOD that potentially impacted listed species (P. Moore, Beveridge & Diamond PC, email to C. Schulz, Service, November 10, 2022). The species column indicates the listed species with potential habitat at event location.

Species	Stream Name	Stream ID	MP	County, State	Approximate Amount of Sediment (ft^3)	Approximate Length Sediment Traveled from LOD (ft)	Date of Occurrence	Date Cleaned Up
RLP	North Fork Roanoke River	S-G36	227.2	Montgomery, VA	2	Unknown	8/15/2018	8/15/2018
RLP	North Fork Roanoke River	S-G36	227.2	Montgomery, VA	2[a]	Unable to be retrieved	9/16/2018	Washed Away
RLP	North Fork Roanoke River	S-G36	227.2	Montgomery, VA	10[a]	Unable to be retrieved	10/11/2018	Washed Away
RLP	Harpen Creek	S-C3	289.8	Pittsylvania, VA	2	Unable to be retrieved	10/14/2018	10/17/2018

[a] Amount is estimated following hurricane-level storm event (M. Neylon, Mountain Valley, letter to J. Martin, FERC, July 2, 2019).

Typical construction procedure 3 of 8. Trenching – digging of pipeline trench by removal of soil and rock by track-mounted excavator/backhoe or similar equipment. Tractor-mounted mechanical rippers or rock trenchers may be used to fracture rock prior to removal. Blasting may be used in specific areas where hard bedrock is close to the surface.

<u>*Trenching*</u> – Table 6 reflects the amount of completed and remaining trenching within 1,060 ft of each bat portal. The 1,060-ft is a screening distance based on the maximum charge weight used to evaluate the potential vibration and noise effects associated with blasting (Appendix G in Mountain Valley 2020, 2022). The maximum charge weight to date on the MVP project has been 30 pounds (aside from the compressor stations, which are located over 2 miles from the closest portal), so an analysis (Appendix G in Mountain Valley 2020, 2022) was performed for all bat habitats within the 1,060-ft screening distance for this charge weight. The 1,060 ft distance is more fully explained in Mountain Valley (2020).

Table 6. Amount of trenching completed and remaining within 1,060 ft of each bat portal ((P. Moore, Beveridge & Diamond PC, email to C. Schulz, Service, December 9, 2022).

Portal ID	Completed Trenching (ft)	Remaining Trenching (ft)
86_02	867.96	857.02
86_03	1040.4	857.02
PS-WV3-Y-P1	2346.77	0
44_01	661.73	756.27
43_01	1639.4	65.52
23_01	2930.49	0
12_01	824.23	868.5

Blasting – Blasting for grade, trench, and bore-pit excavation is short in duration, utilized only after all other reasonable means of excavation are determined to be unlikely to achieve required results or in areas of shallow bedrock where unrippable subsurface rock is encountered (Mountain Valley 2020). Blasting has occurred along approximately 127 miles of the project (M. Hoover, Mountain Valley, email to C. Schulz et al., Service, January 19, 2023). The miles of blasting that have occurred in Ibat or NLEB habitat are provided in Table 7a and Table 7b.

Table 7a. Summary of blasting within Ibat habitat 2018-2021 (P. Moore, Beveridge & Diamond PC, email to C. Schulz, Service, December 9, 2022).

Bat Habitat Category	Number of Miles Blasted				
	May-December 2018	April-September 2019	November 2020	April-September 2021	Total
Known summer use	5.28	0	0	0	5.28
Known use spring staging/fall swarming	9.05	0	0	1.92	10.97
Unknown use spring staging/fall swarming	14.39	3.75	0.17	2.47	20.77
Unknown use summer	29.16	27.98	0	0.58	57.73
Total	57.88	31.73	0.17	4.97	94.75

Table 7b. Summary of blasting within NLEB habitat 2018-2021 (M. Hoover, Mountain Valley, email to C. Schulz, Service, February 23, 2023).

Bat Habitat Category	Number of Miles Blasted				
	May-December 2018	April-September 2019	November 2020	April-September 2021	Total
Known use spring staging/fall swarming	14.79	0.29	0.00	1.92	17.00
Known use summer	48.30	43.52	0.17	2.00	93.99
Unknown use spring staging/fall swarming	6.63	0.40	0.00	1.05	8.08
Total	69.72	44.21	0.17	4.97	119.07

In areas where blasting occurs, Mountain Valley will continue to incorporate measures designed to avoid impacts to natural and human-made features and structures, including potential hibernacula and special aquatic resources, and develop site-specific plans if needed for any future blasting (Mountain Valley 2022). Blasting mats or padding, restricted charge sizes, and/or charge delays are used to minimize air blast, peak sound pressure levels, and ground vibration. The 2017 Project General Blasting Plan (revised March 2018) and 2018 Site-Specific Plan for Braxton County Mine Portals describe the procedures and safety measures adhered to while implementing blasting activities (Mountain Valley 2020).

Mountain Valley will avoid blasting during the bat hibernating season within the distances specified in Table 2 of Appendix G in Mountain Valley (2020) that would exceed the overpressure criterion of 115 dBA (0.0016 psi) (M. Eggerding, Mountain Valley, letter to J. Martin, FERC, May 13, 2020; Mountain Valley 2022). If blasting activities are required within 0.5 miles of known/assumed occupied hibernacula for Ibat or NLEB, Mountain Valley will prepare a site-specific blasting plan to minimize impacts to the features (Mountain Valley 2022; P. Moore, Beveridge & Diamond PC, email to C. Schulz, Service, November 30, 2022). As noted in Mountain Valley's Pipeline General Blasting Plan, the site-specific blasting plan will be developed based on the conditions of that location at the time directly prior to the blasting event and will include monitoring details (P. Moore, Beveridge & Diamond PC, email to C. Schulz, Service, May 18, 2020). Specifically, as noted in Section 7.6 of the General Blasting Plan, in karst terrain, the site-specific plan will be provided to the appropriate federal, state, and local authorities for review and approval 5 working days prior to conducting the blasting.

A site-specific plan for blasting within 0.5 mile of any known or assumed Ibat hibernacula was prepared for the Braxton County Mine Portal (Mountain Valley 2022). Additionally, 18 blasting shots were performed within 0.5 mile of 5 known or assumed occupied Ibat hibernacula in late 2020 and 2021: Tawneys Cave, Pighole Cave, Eight Point Cave, Links Cave, and MVP-NI-151-P0001/.02. Two blasting shots were performed within 0.5 mile of Canoe Cave, a known NLEB hibernaculum (M. Hoover, Mountain Valley, email to C. Schulz et al., Service, January 18, 2023). Mountain Valley developed site-specific plans for these blasting events, and these plans incorporated the same AMMs that were approved for the Braxton County portals, including blasting outside of the hibernation period, reducing the charge weight, and using blasting mats when necessary (M. Hoover, Mountain Valley, email to C. Schulz et al., Service, January 19, 2023).

Using the maximum charge weight to date on the MVP project (approximately 30 pounds), Mountain Valley's consultants determined that any portal beyond 1,000 ft from the blasting location would not experience vibrations greater than 0.06 inches per second. Six known or assumed occupied Ibat portals are located within the 1,000-ft buffer and blasting has occurred within this buffer around 3 of those portals (PS-WV3-Y-P1, Tawney's Cave, Eight Point Cave). All blasting near these portals was outside the hibernation season. Blasting near 3 other Ibat portals located beyond the 1,000-ft buffer occurred outside the hibernation season. No blasting vibration impacts to any Ibat portals are anticipated.

Mountain Valley's consultants also evaluated overpressure levels from blasting events (Appendix G in Mountain Valley 2020). Due to the short-term, low frequency nature of the overpressure, it is not expected that bats would be more sensitive to overpressure than humans. Accordingly, the human annoyance level of 115 dB linear was used as the evaluation criterion for bats. The West Virginia Department of Environmental Protection (WVDEP) study (Appendix G in Mountain Valley 2020) also indicated that there is a significant reduction in overpressure levels from the mouth of caves to the interior, so higher criteria levels would be reasonable for caves as compared to trees or bridges. Thus, the use of 115 dB is conservative for the caves and other features being evaluated. Based on the largest charge weight used during construction of the MVP project, no portals beyond 1,060 ft from the blasting location would experience overpressure greater than 115 dB. There are 7 Ibat portals within 1,060 ft of the LOD, and blasting has occurred within 1,060 ft at 5 of the portals. Each of those blasting events occurred outside the hibernation season.

Mountain Valley prepared a site-specific blasting plan for PS-WV3-Y-P1 (M. Hoover, Mountain Valley, email to C. Schulz et al., Service, January 19, 2023). The blasting plan indicated that shot designs would be based on site-specific parameters including distance to the portal entrance and maximum peak particle velocity of 0.50 inches per second. Seismic readings taken at PS-WV3-Y-P1during blasting indicated that all blasts except 1 were below a peak particle velocity of 0.5 inches per second. One blast on September 21, 2018, resulted in a reading of 0.72 inches per second at PS-WV3-Y-P1 . Mountain Valley does not anticipate that this blast resulted in any structural impacts to the feature, and the Service is relying on the expertise of Mountain Valley and Mountain Valley's consultants. The maximum peak particle velocity of 0.5 inches per second was selected to be conservative based on statements in the 2006 report by the WVDEP Office of Explosives and Blasting (Mountain Valley 2022). That report includes information indicating that threshold peak particle velocity for damage would be in the vicinity of 2.0 inches/second and low-level vibrations below 1.0 inch per second would be harmless to underground workings, as well as its entrance and environment.

Mountain Valley prepared a site-specific plan for blasting activities near Canoe Cave, a known NLEB hibernaculum (M. Hoover, Mountain Valley, email to C. Schulz et al., Service, January 19, 2023). The plans were developed with the same avoidance and minimizations measures approved for the Braxton County portals, including blasting outside of the hibernation period, reducing charge weight, and using blasting mats when necessary. The blasting occurred in April 2021, outside of the hibernating season. The maximum peak particle velocity was calculated to be 0.03 inches per second at the nearest opening.

Typical construction procedure 4 of 8. Pipe stringing, bending, welding, and coating – transportation of pipe segments to the construction ROW or yards and bending of pipes to fit contours of the trench. Pipeline segments are aligned and welded together. Welds are inspected and covered with protective coating.

Typical construction procedure 5 of 8. Lowering-in and backfilling – lowering of pipe using side-boom tractors and backfill of trench with suitable excavated material using track-hoes, bulldozers, graders, or backfilling machines. In rocky areas, protective materials may be placed in trench to protect pipe. Trench breakers (sandbags or foam) will be installed in the trench on slopes prior to backfilling to prevent subsurface water movement along pipeline.

Typical construction procedure 6 of 8. Hydrostatic testing and pipe cleaning – hydrostatic testing to ensure the system is capable of withstanding the operating pressure for which is it designed. Additional details describing hydrostatic testing are included in Section 3.1.6 of the BA (FERC 2017b). Afterwards, the pipeline will be cleaned and dried with pressurized air.

Temporary Water Withdrawals – Surface waterbodies planned for temporary water withdrawals for use in hydrostatic testing, dust control, and hydroseeding are listed in Table 8 if listed species may be affected (Mountain Valley 2020). Water withdrawals are conducted in compliance with conditions in the WVDEP Division of Water and Waste Management's Water Withdrawal Guidance Tool to avoid and minimize adverse impacts to aquatic organisms and ensure maintenance of existing instream physical, chemical, and biological characteristics.

To reduce the potential impacts of withdrawing water from these streams, in any streams containing listed or proposed species or their critical habitat Mountain Valley will install holding tanks near the withdrawal points to pull water over a longer period, instead of a more acute withdrawal (Mountain Valley 2022). Mountain Valley commits to placing temporary water intakes within pools rather than riffles in the Gauley River (M. Eggerding, Mountain Valley, letter to J. Martin, FERC, May 27, 2020). Mountain Valley is committed to limiting surface water withdrawals to 10% of a stream's instantaneous flow, installing temporary water intakes situated above the instream substrates with screened openings not to exceed 3/16-inch mesh, and ensuring through-screen approach velocities less than 0.5 ft per second (Mountain Valley 2022).

Mountain Valley has renewed its commitment to refrain from withdrawing water during low flows and drought conditions by adhering to the restrictions identified in the WVDEP Division of Water and Waste Management's Water Withdrawal Guidance Tool (Mountain Valley 2022). The WVDEP Water Withdrawal Guidance Tool information is based on annual flow statistics using USGS stream gauges in nearby streams. The historical information is used to determine when water can be withdrawn and still provide appropriate flow to protect the aquatic habitat. Using this tool will identify periods of low flow and drought conditions, which in turn will indicate when water can or cannot be withdrawn from the resource. Mountain Valley will use the tool each day a withdrawal is required and will adhere to any identified restrictions (M. Eggerding, Mountain Valley, letter to J. Martin, FERC, May 27, 2020).

Table 8. Water withdrawal locations along portions of the MVP project (Mountain Valley 2020) that may affect listed species.

Species	Stream Name	Stream ID	County, State	Approximate	
				Latitude	Longitude
CD	Gauley River	S-J29	Nicholas, WV	38.270814	-80.682775

Typical construction procedure 7 of 8. Commissioning – verifying that equipment has been properly installed and is working, verifying that controls and communication systems are functioning, and confirming that the pipeline is ready for service. As a final step, the pipeline will be purged of air and loaded with natural gas.

Typical construction procedure 8 of 8. Cleanup and restoration – grading and restoration of all work areas to pre-construction topographic contours as closely as possible.

Specialized Construction Methods – Required when the pipeline is installed across waterbodies, wetlands, roads, railroads, foreign utilities, steep slopes, residences, agricultural lands, and other sensitive environmental resources. A brief description of the specialized construction methods is included below. Additional details describing the specialized construction methods are included in Sections 2.4.2.9 through 2.4.2.18 of the FEIS (FERC 2017a).

1. Waterbody crossings (dry open-cut crossings) –
   - Flume construction method – diversion of streamflow through flume pipes and placement of dam structures to exclude water flow from trench area.
   - Dam-and-pump construction method – diversion of stream flow using pumps and hoses and placement of dam structures to exclude water flow from trench area.
   - Cofferdam method – installation of a temporary diversion structure from 1 bank of the waterbody to the approximate midpoint of the waterbody crossing to isolate that section of the stream from the remainder of the waterbody, creating discrete dry sections around which water flows unimpeded.

Stream Crossing Methods – The MVP project crosses 637 waterbodies and 330 wetlands in WV and VA (Mountain Valley 2022). The number of waterbody and wetland crossings accounts for resources that will experience temporary or permanent discharge of fill material (i.e., open-cut crossings, timber mat crossings, culverts, ARs, and ATWS) and crossings of waters of the U.S. (both open-cut and trenchless), though trenchless crossings are not reasonably anticipated to cause temporary or permanent discharge of fill material to the waterbodies and wetlands being crossed. The open-cut, dry-ditch crossing method was originally the proposed method for crossing streams containing federally listed species (Mountain Valley 2020). Updates and changes to the proposed crossing methods are as follows (Table 9):

- The Gauley River crossing (MP 118.9, S-J29) changed from an open-cut dry crossing to a trenchless crossing method (Mountain Valley 2020).
- The North Fork Roanoke River ROW crossing (MP 227.2, S-G36) was installed in 2018 using an open-cut, dry-ditch method as planned (M. Neylon, Mountain Valley, letter to J. Martin, FERC, November 27, 2019).
- In 2019, the Pigg River ROW crossing (MP 289.2, S-E11) was installed using a horizontal directional drill (HDD) method, rather than the originally planned open-cut crossing method (M. Neylon, Mountain Valley, letter to J. Martin, FERC, November 27,

2019). The Pigg River crossing is the only long-HDD crossing (M. Eggerding, Mountain Valley, letter to J. Martin, FERC, May 27, 2020).

- Bradshaw Creek AR (MP 231.6, MN-0276) is no longer proposed for use as an AR (P. Moore, Beveridge & Diamond PC, email to C. Schulz, Service, November 9, 2022). This AR has been removed from Table 9.
- On February 19, 2021, Mountain Valley filed an application for a certificate amendment to FERC requesting to change the crossing method for 183 waterbodies and wetlands to a trenchless crossing method. On April 8, 2022, FERC granted the certificate amendment subject to Mountain Valley receiving all necessary permits and authorizations. As a result, the proposed crossing method changed for some streams previously analyzed for effects to federally listed aquatic species (Mountain Valley 2022).

Table 9. Stream crossing locations and methods related to federally listed aquatic species (M. Neylon, Mountain Valley, letter to J. Martin, FERC, November 27, 2019; J. Martin, FERC, letter to M. Eggerding, Mountain Valley, May 27, 2020; M. Neylon, Mountain Valley, email to J. Stanhope, Service, August 6, 2020; Mountain Valley 2022).

Species	Stream Name	Stream ID	MP	County, State	Project Feature	Change in Crossing Location (ft)	TOYR Start/End	2017 BA Crossing Method	Current Crossing Method / Completion Status
RLP	North Fork Roanoke River	S-G36	227.2	Montgomery, VA	AR1	0	1-Oct / 30-Jun	fill/culvert	temporary, single-span bridge / installed
RLP	North Fork Roanoke River1	S-G36	227.2	Montgomery, VA	Pipeline Centerline	0	1-Oct / 30-Jun	open-cut, dry-ditch	open-cut, dry-ditch crossing / completed in 2018
RLP	Bradshaw Creek1	S-C21	230.9	Montgomery, VA	Pipeline Centerline	0	1-Oct / 30-Jun	open-cut, dry-ditch	conventional bore / pending
RLP	Roanoke River	S-NN16	235.6	Roanoke, VA	Pipeline Centerline	0	15-Mar / 30-Jun	open-cut, dry-ditch	microtunnel / delayed
RLP	Pigg River	S-E11	289.2	Pittsylvania, VA	Pipeline Centerline	16	15-Mar / 30-Jun	open-cut, dry-ditch	HDD / completed in 2019
RLP	Harpen Creek1	S-C3	290	Pittsylvania, VA	Pipeline Centerline	9.8	15-Mar / 30-Jun	open-cut, dry-ditch	conventional bore / pending
RLP	North Fork Roanoke River	S-GH16	231.7	Montgomery, VA	AR2	0	1-Oct / 30-Jun	temporary fill	single-span bridge / existing structure
CD	Gauley River	S-J29	118.9	Nicholas, WV	Pipeline Centerline	0	1-Jul / 31-Mar	open-cut, dry-ditch	microtunnel / pending
CD	Stony Creek	S-S5	200.45	Giles, VA	Pipeline Centerline	0	15-Aug / 31-Jul	open-cut, dry-ditch	guided conventional bore / pending

Trenchless crossings minimize impacts in the riparian zones by eliminating construction activities within or directly adjacent to the crossed stream (M. Eggerding, Mountain Valley, letter to J. Martin, FERC, May 13, 2020). Because no open-cut trenching is performed for these streams, the stream channel itself is not impacted, reducing impacts to existing riparian vegetation near the stream banks during construction. Within WV, horizontal boring will be performed starting near the elevation of the ordinary highwater mark (OHWM) on both banks of the bored stream (M. Eggerding, Mountain Valley, letter to J. Martin, FERC, May 13, 2020). The OHWM is the boundary of aquatic features, so limited impacts within the riparian zone are expected. Approved permitted E&S control and restoration best management practices (BMPs) will be followed throughout construction to limit the potential release of sediment from the ROW to the riparian zone and/or stream channel (M. Eggerding, Mountain Valley, letter to J. Martin, FERC, May 13, 2020).

The following is an explanation of conventional boring provided by Mountain Valley (M. Neylon, Mountain Valley, email to S. Hoskin, Service, May 18, 2020). Conventional boring is a collection of techniques that allows for trenchless construction across an area. To complete a conventional bore, two pits will be excavated, one on each side of the feature to be bored. The pits will be sloped or shored in line with all local, state, and federal safety regulations. The bottom of the excavations will be levelled and gravel placed to allow the track for a conventional auger bore machine to be placed in the entry pit. These pits are typically closer to the feature being crossed due to design length constraints for a conventional bore. The conventional bore pits on both sides of the crossing will be reinforced using sheet piling or trench boxes, which provide structural support, and help control groundwater. A boring machine will be lowered into one pit, and a horizontal hole (or series of holes with increasing diameter) will be bored at the depth of the pipeline installation. Boring will begin and the auger will remove all spoil from the hole and the bore. Sacrificial bore pipe will be pushed into the hole during the auger advancement towards the exit pit to case the hole in lieu of the line pipe during the boring process. Once the auger and bore casing pipe have reached the exit side, line pipe will be welded to the end of the casing and pushed through the hole with the boring machine in sections. The auger and sacrificial bore pipe will be cut up and removed on the exit side in manageable length sections until only the line pipe remains in the crossing. In some instances, the casing pipe may be left in place and the line pipe inserted through the casing. At this point, fittings and tie-ins may be made to complete construction in the area, appropriate backfilling of the excavations will be performed, and the site will be returned to natural grade. For stream crossings, the conventional bore technique avoids all instream construction activities and all direct impacts associated with such activities. Drilling fluids are not used for conventional bores, so there is no risk of inadvertent return (IR) of these fluids within the stream.

The following explanation was provided by Mountain Valley (M. Eggerding, Mountain Valley, letter to K. Bose, FERC, May 20, 2020). Microtunneling and "Direct Pipe" are sometimes used interchangeably to describe the same crossing technique because they are very similar. Both use the same microtunneling boring machine (MTBM), the same cutting head, the same fluids, the same spoil handling strategy, and share similar capability and limitations to completing a trenchless crossing. Both directly install pipe immediately following the boring machine, resulting in a single pass installation. Microtunneling is an enhanced drilling technique that allows for trenchless construction below features. Unlike a conventional auger bore, which typically uses a non-steerable auger to establish the bore hole, microtunneling utilizes a MTBM, which uses remote operated hydraulic cylinders to steer the machine along the proposed bore path. The primary advantage of microtunneling over conventional auger boring is that the steerability of the MTBM enables drilling over longer distances and mitigates the risk of the bore deviating from the planned profile. The MTBM is typically the full diameter of the finished bore hole, and the product pipe is inserted behind the MTBM as it completes the bore and thereby significantly reduces the risk of collapse during boring and protects the rock integrity of the borehole. In comparison to HDD, microtunneling only requires one drilling pass compared to multiple drilling passes with a product pipe pullback on an HDD. The MTBM drilling head uses a drilling mud slurry for lubrication and conveyance of cuttings. While employing this method, the annular pressure is drastically reduced in comparison to the HDD method. This is because the MTBM uses fluid only at the cutting head and the annular space outside the product pipe, while cuttings are conveyed through an isolated slurry pipe that is fully contained within the product pipe. Therefore, the annular pressure in a microtunneling operation consists of only the hydrostatic pressure of drilling fluids. HDD fills the entire bore hole with drilling fluid and circulates a much larger volume of drilling fluid at higher pressure to both lubricate the hole and remove cuttings. Microtunneling's use of a much smaller volume of drilling fluid at a drastically reduced pressure greatly minimizes the risk of an IR. An HDD, in comparison, may have downhole pressures up to 10 times the downhole pressure in a microtunnel bore. By controlling the thrusting force, rate-of-penetration, and tunneling pressures, the risk for IR is drastically reduced in a microtunneling operation compared to the traditional HDD methodology. Restrictions of microtunneling include that it is limited in crossing length compared to an HDD, but that restriction does not affect this project because the bore lengths are well within the envelope of the technology. Also, the bore pit logistics only enable one project pipe joint to be inserted at a time, which results in a slower drilling rate as drilling must stop to weld, test, and coat each joint.

Mountain Valley has successfully completed trenchless crossings of a number of streams without environmental issues or instances of IR (M. Eggerding, Mountain Valley, letter to J. Martin, FERC, May 13, 2020). Table 10 describes the potential mechanism for an inadvertent release for the 5 remaining trenchless crossings (probability of a release, amount of release material, composition and nature of release material (M. Eggerding, Mountain Valley, letter to J. Martin, FERC, May 13, 2020).

Table 10. Potential mechanism for an IR (M. Eggerding, Mountain Valley, letter to J. Martin, FERC, May 13, 2020; P. Moore, Beveridge & Diamond PC, email to C. Schulz, Service, November 17, 2022).

Species	Stream Name	Stream ID	MP	County, State	Proposed Trenchless Crossing Method	Potential for IR; Amount of Return Material in the Event of IR; Composition and Nature of Return Material
CD	Gauley River	S-J29	118.9	Nicholas, WV	Microtunnel	Potential: Very low. Microtunnel has much lower fluid volumes and downhole pressures as compared to HDD, which reduces risk of IR. Groundwater pressure

Species	Stream Name	Stream ID	MP	County, State	Proposed Trenchless Crossing Method	Potential for IR; Amount of Return Material in the Event of IR; Composition and Nature of Return Material
						counterbalances the fluid pressure, which reduces the risk for IR. Downhole pressure monitoring and remote-controlled valving further reduce the risk of IR and minimize any potential fluid loss. Amount: Less than 50 gallons. Composition: Water, small amount of bentonite and soda ash, cuttings/debris from borehole.
CD	Stony Creek	S-S5	200.45	Giles, VA	Guided conventional bore	Potential: Very low. Any risk of IR is only during the pilot hole phase when fluids are used. During that phase, groundwater pressure counterbalances the fluid pressure, which reduces the risk for IR. Downhole pressure monitoring, remote-controlled valving, and/or surface monitoring further reduce the risk of IR and minimize any potential fluid loss. No fluids are used during the conventional bore phase. Amount: Less than 50 gallons. Composition: Water, negligible amounts of biodegradable vegetable oil, cuttings/debris from borehole.
RLP	Roanoke River	S-NN16	235.6	Roanoke, VA	Microtunnel	Potential: Very low. Microtunnel has much lower fluid volumes and downhole pressures as compared to HDD, which reduces risk of IR. Groundwater pressure counterbalances the fluid pressure, which reduces the risk for IR. Downhole pressure monitoring and remote-controlled valving further reduce the risk of IR and minimize any potential fluid loss. Amount: Less than 50 gallons. Composition: Water, small amount of bentonite with additional additive, cuttings/debris from borehole.
RLP	Bradshaw Creek	S-C21	230.9	Montgomery, VA	Conventional Bore	Potential: Very low to zero. Because a conventional bore does not convey cuttings using a high-pressure drilling fluid slurry, this method avoids the potential for an IR during the crossing. However, in some situations, particularly in longer bores or in bores through mixed ground or clay, small quantities of water, bentonite, or polymer-based lubricant may be applied to the cutting head and exterior of the casing to reduce friction and increase the likelihood of success of the crossing. No fluids are used during the conventional bore phase. Composition: Any lubricants used will be non-petrochemical based, non-hazardous, and NSF-60-compliant.
RLP	Harpen Creek	S-C3	290	Pittsylvania, VA	Conventional Bore	Potential: Very low to zero. Because a conventional bore does not convey cuttings using a high-pressure drilling fluid slurry, this method avoids the potential for an IR during the crossing. However, in some situations, particularly in longer bores or in bores through mixed ground or clay, small quantities of water, bentonite, or polymer-based lubricant may be applied to the cutting head and exterior of the casing to reduce friction and increase the likelihood of success of the crossing. No fluids are used during the conventional bore phase. Composition: Any lubricants used will be non-petrochemical based, non-hazardous,

Species	Stream Name	Stream ID	MP	County, State	Proposed Trenchless Crossing Method	Potential for IR; Amount of Return Material in the Event of IR; Composition and Nature of Return Material
						and NSF-60-compliant.

<u>Open-Cut Stream Crossing Information Specific to RLP</u> – Only 1 stream supporting suitable RLP habitat has been impacted from instream open-cut construction activities: North Fork Roanoke River 1 (Mountain Valley 2022) (Table 9). That crossing (MP 227.2, S-G36) was completed in 2018 using the open-cut dry-ditch method. The single open-cut crossing resulted in the temporary disturbance of 22.9 meters (m) of stream reach within the LOD (Mountain Valley 2022). Immediately before instream construction work began, Mountain Valley's consultants conducted fish removals and relocations, but no RLP were encountered or relocated. Mountain Valley completed full restoration of the North Fork Roanoke River crossing (Mountain Valley 2022). Post-construction RLP habitat assessments completed in 2020 confirmed both the presence of suitable RLP habitat and the presence of RLP within the stream reach (EDGE 2020). No additional open-cut stream crossings within suitable RLP habitat are planned.

<u>Open-Cut Stream Crossing Information Specific to CD</u> – No open-cut stream crossings within suitable CD habitat are planned (Mountain Valley 2022) (Table 9).

2. Wetland crossings – construction ROWs through wetlands are typically 75-ft wide with ATWS located in upland areas a minimum of 50 ft from wetland edge, unless granted site-specific approval for a reduced setback. Mountain Valley has requested a ROW greater than 75 ft wide in wetlands at several specific locations as listed in Appendix G of the FEIS (FERC 2017a). Sediment barriers such as silt fence and staked straw bales will be utilized during clearing and construction. Wetlands will be crossed by wet or dry open trench lay, or open ditch push-pull methods.

3. Road and railroad crossings – railroads and paved roads will generally be crossed by boring beneath the road or railroad. Most gravel, dirt, and grass roads will be crossed by open-cut method; traffic will be maintained during construction by use of steel plates or detours.

4. Residential construction – implement measures to minimize construction-related impacts on all residences and other structures located within 50 ft of the construction ROW following site-specific *Residential Construction Plans* included in Appendix H of the FEIS (FERC 2017a).

5. Foreign utilities – buried pipelines and utilities will be identified and crossed without damage by implementing multiple measures, including using One-Call systems.

6. Agricultural areas – identify and flag existing irrigation systems and drainage tiles; any

damaged irrigation and drainage systems will be repaired or replaced. A minimum of 12 inches of topsoil will be segregated from the construction ROW in agricultural lands, in accordance with the FERC Plan (FERC 2013a).

7. Rugged topography – temporary and permanent control measures such as silt socks, reinforced "super" silt fence, slope breakers, trench breakers, trench drains, erosion control matting, and hydro-mulching will be put in place to minimize E&S. In areas where the pipeline route crosses laterally along a slope, "two-tone" construction techniques may be used. Equipment on steep slopes will be suspended from a series of winch tractors.

8. Karst terrain – crossing of karst terrain will follow the project-specific construction, restoration, and mitigation methods summarized in Section 4.1.2.5 in the FEIS (FERC 2017a) and described in the *Karst Mitigation Plan* (Draper Aden Associates 2017).

9. Winter construction – specialized construction methods or procedures will be utilized to protect resources during the winter season as described in the *Winter Construction Plan* (Mountain Valley 2016a).

<u>Monitoring and Post-Approval Variances</u> – Mountain Valley developed procedures for construction monitoring and quality control, environmental inspection, compliance monitoring, and post-approval variances. A brief description of the procedures is below. Additional details describing the procedures are included in Section 2.4.4 of the FEIS (FERC 2017a).

1. Coordination – copies of all applicable environmental permits, construction drawings, and specifications will be provided to construction contractors.

2. Environmental inspection and training – trained environmental inspectors (EIs) will be employed to ensure that construction complies with construction and mitigation plans and environmental conditions imposed by FERC and other regulatory agencies and conduct environmental training for company employees. EIs will have the authority to immediately "stop-work" for all activities and to take corrective actions to remedy instances of non-compliance.

3. FERC compliance monitoring – in addition to EIs, a third-party compliance monitoring program will be funded to provide daily environmental monitoring services during construction and daily reports to the FERC Project Manager. Other federal, state/commonwealth, and local agencies may also monitor the project to the extent determined necessary by the agency.

<u>Increased E&S Control Inspection Frequency</u> (T. Normane, Mountain Valley, letter to D. Sligh, Wild Virginia, February 25, 2020) – The Henrico County Circuit Court in VA approved a

comprehensive Consent Decree on December 11, 2019, to resolve alleged violations that occurred through September 18, 2019. Prior to entry of the Consent Decree, Mountain Valley committed to an increased E&S control inspection frequency (all controls inspected at least every 4 days) and an accelerated deadline to repair ineffective controls (within 24 hours). In addition to regular inspections by Mountain Valley, Virginia Department of Environmental Quality (VDEQ), and FERC staff, Mountain Valley entered into a Memorandum of Agreement with VDEQ to fund ($6.7 million) third-party inspectors contracted by VDEQ to provide additional daily inspections of the project. There are approximately 50 individual inspectors monitoring the VA portion of the MVP project. That number includes Mountain Valley's inspection staff, third-party Environmental Auditors, VDEQ staff inspectors, VDEQ's third-party inspection contractor, FERC inspectors, and USFS inspectors. There are approximately 60 individual inspectors monitoring the WV portion of the MVP project. That number includes Mountain Valley's inspection staff, WVDEP inspectors, and FERC inspectors. In addition to their scheduled inspections, the WVDEP also conducted inspections based on citizen information. To enhance resource protection, Mountain Valley committed to a more robust inspection frequency than what is typically required in the WVDEP General Water Pollution Control Permit by requiring inspections to be completed within 24 hours following a storm event greater than 0.25 inches per a 24-hour period and every 7 days.

As a result of the Consent Decree, Mountain Valley created a comprehensive "punchlist" system to consolidate all issues identified by VDEQ, Mountain Valley, and FERC inspectors and to verify that they are addressed within the required timeframes. Mountain Valley engaged a third-party Environmental Auditor to conduct regular inspections and assessments of the project's compliance with the Commonwealth's E&S control and stormwater management requirements. The Environmental Auditor will be providing publicly available reports on the performance of Mountain Valley's full-time inspection staff and environmental field crews. Since the date the Consent Decree was entered, the Environmental Auditor has been performing field inspections and document reviews, which are summarized in biweekly and quarterly reports available at https://www.mountainvalleypipeline.info/news-info/.

4. Post-approval variance process – variance requests for minor modifications within the previously surveyed corridor that will not impact sensitive resources, and have landowner acceptance, will be submitted to the third-party compliance monitor for review and approval. Larger or more complex variance requests will be submitted to FERC staff for review and final determination.

Variances – Variances for the MVP project have been approved by FERC since issuance of the 2017 Opinion (M. Neylon, Mountain Valley, letter to J. Martin, FERC, November 27, 2019; P. Moore, Beveridge & Diamond PC, email to C. Schulz, Service, April 10, 2020). Some of these variance requests required additional surveys for the presence of federally listed species and/or their suitable habitat and all surveys were negative (see Appendix E Table 1 for details).

After issuance of the 2020 Opinion, Mountain Valley completed additional field studies to comply with requirements of the 2020 Opinion; address issues identified by the U.S. Court of Appeals for the Fourth Circuit in its February 3, 2022, order; and support further analysis of the MVP project related to changes to the proposed action and potential effects to listed species (Mountain Valley 2022). The changes to the proposed action include, but are not limited to, installation and operation of water quality monitoring stations, changes in stream crossing methods (open-cut to trenchless), slip repairs, and removal of hazardous trees (Mountain Valley 2022). Each of these changes required FERC's approval of a variance (Appendix I in Mountain Valley 2022; P. Moore, Beveridge & Diamond PC, email to C. Schulz, Service, December 2, 2022). Several variance requests were submitted to FERC for activities proposed to occur in areas not previously evaluated for potential winter habitat for listed bat species. Portal searches were completed by qualified, permitted bat biologists in accordance with state and federal requirements (Appendix I in Mountain Valley 2022). All tree clearing conducted or pending associated with variances in bat habitat is related to slips (Appendix E Table 2) and is part of the acreage included in the 2020 Opinion (Table 5 in 2020 Opinion) as estimated tree removal to remediate future slips.

5. Post-construction monitoring – follow-up inspections and monitoring of all disturbed upland areas will be conducted for at least the first and second growing seasons to determine the success of restoration, including until revegetation thresholds are met, temporary erosion control devices are removed, and restoration is deemed complete.

6. Monitoring the ROW grant for federal lands – the USFS and U.S. Army Corps of Engineers (USACE) will monitor implementation of the MVP project mitigation measures on federal lands to assure that the terms and conditions of the ROW Grant issued by BLM are carried out (40 CFR 1505.3) and that negative impacts from construction and operation of the pipeline on federal lands are minimized to the extent possible.

O&M – the pipeline and aboveground facilities will be operated and maintained in accordance with USDOT regulations in 49 CFR 192, FERC's regulations at 18 CFR 380.15, and the maintenance provisions found in the FERC Plan (FERC 2013a) and Mountain Valley's modified FERC Procedures (FERC 2013b, 2017a). A brief description of the O&M details is included below. Additional details describing O&M are included in Section 2.6 of the FEIS (FERC 2017a) and Section 3.2 of the BA (FERC 2017b).

1. Pipeline facility O&M – an O&M plan and an emergency plan will be established that include procedures to minimize the hazards in a natural gas pipeline emergency. Vegetation removal and maintenance within the 50-ft permanent ROW will be conducted in accordance with the FERC Plan (FERC 2013a). Regular patrols, inspection, and repair of the pipeline will be conducted.
2. Aboveground facility O&M – all equipment at aboveground facilities will be routinely

inspected and maintained by Mountain Valley. Routine maintenance checks will include equipment and instrumentation calibration and safety equipment testing. The aboveground facilities will be unmanned, with start/stop capabilities controlled from corporate headquarters. When the safety system or alarms are activated, personnel are notified and dispatched.

Future Plans and Abandonment – Mountain Valley may seek to expand or modify its facilities in the future if market conditions change. Any future expansion will require filing an amendment to its application or a new application to FERC. The expected useful lifespan of the project would be about 50 years. While there is no termination date for a FERC natural gas certificate, at the end of the 50-year period, Mountain Valley may need to repair, replace, or abandon facilities. Any of those actions would require permission from FERC. Abandonment activities would require an application to FERC under Section 7(b) of the Natural Gas Act. Facilities could either be abandoned in place or by removal.

Avoidance and Minimization Measures (AMMs) – Conservation measures proposed as part of the action (measures that will avoid, minimize, or mitigate effects of the proposed action on the species and/or benefit the species as a whole) are referred to as AMMs in this Opinion. AMMs are provided in the FEIS (FERC 2017a), BA (FERC 2017b), SBA (Mountain Valley 2020), and SBA2 (Mountain Valley 2022).

Mountain Valley designed the project to avoid and minimize impacts to the natural environment by selecting a route that avoids to the extent possible critical or sensitive habitats, national wildlife refuges, sensitive soils, disruption to mineral resources, environmental hazards, and geologic/topographic hazards (Mountain Valley 2020, 2022). In addition to route selection, Mountain Valley is implementing BMPs for construction, operation, and maintenance of the project to minimize impacts to wetlands, waterbodies, and associated riparian habitats (Mountain Valley 2020, 2022). Changes to AMMs identified in the BA are described below.

E&S Control AMMs – When implemented as described below, these AMMs may avoid, minimize, or mitigate effects of the proposed action on VASP, Ibat, NLEB, RLP, CD and/or CD critical habitat and/or benefit the species or critical habitat as a whole. Mountain Valley has implemented the use of enhanced measures for E&S control throughout the MVP project in both VA and WV (M. Eggerding, Mountain Valley, letter to K. Bose, FERC, May 14, 2020). Enhanced measures implemented beyond the approved E&S control plans include the following: hydraulically applied or pelletized mulch/tackifier upgraded from a less protective stabilization measure (approximately 65 miles), waterbar end treatments upgraded from single compost filter sock (CFS) to triple stack CFS (approximately 85 miles), increased size of CFS, upgrade of standard silt fence to Priority 1 belted silt retention fence, erosion control blanket installed in flow path and at the outfall end treatments of waterbars (in areas with erosive soils), temporary slope drain pipes installed to convey waterbar discharge across fill slopes where the ROW is benched, among other enhancements. Not all enhanced BMPs are expected to perform the same and should not be considered identical in terms of their reduction in expected sediment loads. Since construction commenced in 2018, approximately 65 formal enhancements have been prepared by Mountain Valley's field engineer in response to changing site conditions.

Pesticide/Herbicide Use AMMs (Mountain Valley 2022) – When implemented as described below, these AMMs may avoid, minimize, or mitigate effects of the proposed action on VASP, Ibat, NLEB, RLP, CD and/or CD critical habitat and/or benefit the species or critical habitat as a whole. In response to localized outbreaks of fall armyworm (*Spodoptera frugiperda*) that destroyed stabilizing vegetation in portions of the MVP project ROW each fall in 2019, 2020, and 2021, Mountain Valley requested a minor amendment to its Pesticide/Herbicide Use AMM, the original version of which precluded Mountain Valley from treating the outbreaks with pesticide products absent the request of the landowner or a land-management agency. Due to the significant localized damage these outbreaks have on the integrity of affected vegetation planted to temporarily stabilize the ROW, Mountain Valley has committed to taking the following steps under the slightly revised AMM. Implementation of these Pesticide/Herbicide Use AMMs will have no effect or are not likely to adversely affect listed species or critical habitat, as provided in Appendix B Tables 1-6.

- Mountain Valley will avoid the use of herbicides and pesticides to maintain any portion of the project ROW or aboveground facilities, unless requested by a landowner or land-management agency or needed to spot treat exotic/invasive species or pest species that threaten the integrity of stabilizing revegetation when fall mowing is unsuitable to treat the pest species.
- In the event of future outbreaks that risk the integrity of stabilizing vegetation, fall mowing will be evaluated as the first treatment option along affected revegetated portions of the ROW to minimize the impact of the pest. Before using this primary treatment option in any area, the specific circumstances will be evaluated to ensure that it would be effective and does not pose a risk of exacerbating damage to the stabilizing vegetation or expanding the scope of the outbreak (e.g., in some instances armyworms or other pests will impact newly sprouted vegetation that is not suitable for mowing or mowing could decrease the pest's immediately available food source and cause the pest to move to adjacent areas).
- When mowing treatment is unsuitable to address a localized outbreak, Mountain Valley will use only an appropriate pesticide product on a limited basis, in the specific and discrete areas of outbreak occurrence, in strict compliance with the product label requirements identified by federal and state regulators and the manufacturer, and in direct response to an identified outbreak that jeopardizes the integrity of a revegetated area.
- Upon discovery of an infestation or outbreak that may require management and with direction from Mountain Valley, a Licensed Insecticide Applicator will review potential treatment options, give recommendations, and select a commercially available, EPA-

approved pesticide or other treatment product that is appropriate for the specific location and circumstances and that:
    - Has shown effectiveness in treating the pest,
    - Is approved for treating the pest in the State of work, and
    - Is approved for treating infestations occurring in turf/grasses.
- Mountain Valley will perform only spot treatments by hand or using equipment approved for precise, localized product application; aerial application will not be used.
- Mountain Valley will not use any pesticide product during or within 12 hours of measurable rainfall, and, unless a greater setback distance is identified on the product label (EPA-approved conditions), will adhere to a minimum of 150-ft horizontal buffer around the following features:
    - Pastures and other livestock grazing areas,
    - Buildings and yards,
    - Streams, wetlands, and ponds,
    - Karst features,
    - "No Spray" property lines, and
    - Drains, culverts, and storm sewer inlets.

  According to Mountain Valley, the minimum 150-ft buffer is a conservative approach to help ensure that the setback distance is at least as protective as the EPA-approved conditions for the product, and in most cases is expected to be greater than the EPA-approved distance. In addition, according to Mountain Valley, this distance is significantly more conservative than the setback that the U.S. Forest Service requires in National Forest lands.

VASP AMMs – (M. Neylon, Mountain Valley, letter to J. Martin, FERC, November 27, 2019):
- Avoiding introduction of exotic/invasive species in organic materials brought onsite during construction by thoroughly cleaning equipment prior to mobilization to Project Area.
- Establishing equipment cleaning stations to thoroughly wash all equipment before transporting it to the next construction spread.
- Implementing selective spot treatment or eradication of exotic/invasive plant species encountered during construction and operating of the Project.
- In wetlands, agricultural, and residential areas, stripping 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.
- Minimizing the amount of time bare soil is exposed during construction to reduce opportunity for exotic/invasive plants to become established.

Aquatic Species AMMs –

- Throughout the project area, Mountain Valley located the ROW and as many ATWSs as possible at least 100 ft away from the water's edge of any stream potentially supporting federally listed aquatic species.
- Mountain Valley will implement several methods to reduce potential risks during stream crossings to isolate the work area and reduce sedimentation (M. Neylon, Mountain Valley, emails to J. Stanhope, Service, May 29, 2020, and June 10, 2020; M. Hoover, Mountain Valley, email to B. Smrekar et al., Service, December 15, 2022):
    - Open-cut stream crossings were not started unless the weather forecast reflected limited or no upcoming rain events.
    - Mountain Valley will attempt to complete stream crossings during low flow.
    - Environmental monitors will be onsite during the stream crossing to evaluate any changing conditions.
    - Stream crossing crews will be required to have additional sandbags and E&S control devices, back-up pumps, and spill kits on-site prior to starting the stream crossing. Additional E&S control devices, including turbidity curtains, will be deployed downstream if necessary.
    - All fuel supplies and pumps will be required to be in secondary containment.
    - The stream crossing team will complete stream crossings as quickly as possible to eliminate the duration in the stream.
    - Any temporary impacts to the stream banks and any adjacent areas from the crossing activity will be restored directly following the stream crossing.
- Mountain Valley employed enhanced E&S control measures in many places along the project. Enhanced measures have been used at hundreds of locations across the project, with a specific focus on sensitive resources (streams and wetlands), karst areas, and steep slopes (M. Hoover, Mountain Valley, email to B. Smrekar et al., Service, December 15, 2022). If not already identified on the state-specific stormwater plans, the decision to implement enhanced measures is location-specific based on best professional judgment of Mountain Valley's environmental coordinators, environmental inspectors, independent third-party inspectors, and state agency personnel. Enhanced measures include increasing the size of sediment traps, bolstering downslope perimeter controls with additional layers (e.g., adding new silt fences or compost socks), and increasing the use of soil stabilization products on exposed soil slopes. These measures provide additional protections to aquatic species by minimizing the potential for sediment to leave the project area and impact waterways during precipitation events.
- Mountain Valley has prepared a Comprehensive Stream and Wetland Monitoring, Restoration, and Mitigation Framework ("Mitigation Framework") that further minimizes impacts at each stream and wetland crossing. The Mitigation Framework incorporates 6 interrelated elements that Mountain Valley developed in consultation with the USACE, WVDEP, and VDEQ to support attainment of its overall mitigation objective (Mountain Valley 2022).

Impacts to VASP and other aquatic resources are expected to be minimized using BMPs and avoidance of riparian corridors and wetlands (M. Neylon, Mountain Valley, letter to J. Martin, FERC, November 27, 2019). These include:

- Reducing the construction ROW width from 125 ft to 75 ft at stream and wetland crossings.
- Expediting construction within any waterbody, effectively reducing disturbance to the streambed and adjacent soils and the quantity of suspended sediments.
- Clearly marking 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.
- Avoiding removal of riparian canopy or stabilizing vegetation, if possible. Crushing or shearing streamside woody vegetation is preferable to complete removal.
- Stabilizing waterbody banks and installing 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 1 full growing season after construction).
- 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 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-ditch crossing methods by pumping or fluming water around if water is flowing at the time of construction.
- Conducting pipeline assembly in upland areas unless the wetland is dry enough to adequately support skids and pipe. Timber mats are used to cross wetlands.
- Minimizing the length of time that the trench is open, to the maximum extent practicable, especially within wetlands.
- Minimizing 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.
- Prohibiting construction equipment, vehicles, hazardous materials, chemicals, fuels, lubricating oils, and petroleum products from being parked, stored, or serviced within a 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.
- Locating as many ATWS as possible at least 50 ft away from the water’s edge. Storing trench spoil excavated from within a stream at least 10 ft from the top of the bank to minimize suspended sediment caused by erosion.

- Avoiding the use of herbicides and pesticides to maintain any portion of the Project ROW or aboveground facilities, unless requested by a land-management agency or needed to spot treat exotic/invasive species.
- Installing temporary equipment bridges within the ROW to reduce suspended sediment and sedimentation caused by construction and vehicular traffic.
- Minimizing crossing of the pipeline through forested wetlands to the maximum extent practicable.
- When forested wetlands are crossed, Mountain Valley will maintain no more than a 10-ft wide, herbaceous strip centered over the pipeline and only remove woody vegetation within a 30-ft wide strip centered over the pipeline.
- Allowing vegetation in wetlands to recover more rapidly by only removing tree stumps located directly over the trench line or where safety is a concern.
- Restoring 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.
- 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 VA for hydrostatic testing. Municipal source waters will be used instead.
- Implementing sustainable water-use practices to ensure water resources and environmentally responsible stream flows are maintained during water withdrawal activities. All water withdrawals 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, screened intakes will be used. The intake end of the pump will contain an appropriately sized screen (i.e., less than 0.1875-inch mesh size), and withdrawal rates will be reduced (i.e., screen approach velocity will be 0.5 ft/second or less).
- Discharging hydrostatic test water to the ground in an upland, well-vegetated area and not directly to surface waters.

Bat AMMs (Mountain Valley 2022) –

- Mountain Valley will implement AMMs described for bat species in the 2017 BA.
- Mountain Valley has actively avoided and minimized impacts to portal P-BTH-001 in Giles County, VA and will continue to do so (Mountain Valley 2020).
- To avoid the risk of disturbing hibernating bats when constructing trenchless crossings, Mountain Valley will avoid construction during hibernation season at the 9 trenchless crossings where there are known/assumed occupied Ibat and NLEB hibernacula within 2 miles of the workspaces that could experience noise levels above ambient levels due to construction activities at the trenchless crossings.

- If burning brush piles within 0.25 mile of known or assumed occupied hibernacula from August 15 to May 15, the brush piles will be no more than 25 ft by 25 ft, spaced at least 100 ft apart, and located at least 100 ft from known hibernacula entrances and associated sinkholes, fissures, or other karst features.
- No woody vegetation or spoil (e.g., soil, rock, etc.) disposal will occur within 100 ft of known or assumed occupied hibernacula entrances and associated sinkholes, fissures, or other karst features.
- Potential recharge areas of cave streams and other karst features that are hydrologically connected to known or assumed occupied hibernacula will be protected by employing relevant erosion control standards for stream and wetland crossings, as well as spill prevention, containment and control.
- Blasting within 0.5 mile of known or assumed occupied hibernacula will be conducted in a manner that would not compromise the structural integrity or alter the karst hydrology of the hibernacula (e.g., maximum charge of 2 inches per second ground acceleration would avoid impact to nearby structures).
- Equipment servicing and maintenance areas will be sited at least 100 ft away from streambeds, sinkholes, fissures, or other karst features.
- Whenever possible, tree removal, limb trimming, or pruning will be conducted between November 15 and March 31 to avoid disturbance to bats. An exception may be made when there is a human safety issue. Time of year restrictions for tree removal associated with future slip remediation are discussed below. In accordance with FERC's Upland Erosion Control, Revegetation, and Maintenance Plan, vegetation maintenance/removal will not be done more frequently than every 3 years (FERC 2013a).
- Utilizing "full cut-off" lighting fixtures to maximize shielding to prevent unintentional lighting of surrounding areas. While there are occasional instances when project work may need to extend beyond civil twilight, these occasions are rare (i.e., approximately 12 instances over the life of the project since construction commenced in 2018) and limited to instances when unforeseen complications arise during daytime construction hours, which are a safety issue that must be resolved and/or activity-specific (i.e., drilling for HDD or bores, work at compressor stations, hydrostatic testing, tie-ins, and extended work to comply with stream crossing time requirements and upcoming inclement weather) (M. Hoover, Mountain Valley, email to C. Schulz et al., Service, February 15, 2023). However, tree removal will be/has been completed prior to the start of these additional work activities.
- Operators, employees, and contractors working in areas of known or presumed NLEB habitat will be educated on the biology of the NLEB, activities that may affect bat behavior, and ways to avoid and minimize these effects.
- E&S control measures will be strictly implemented, any ground disturbance will be restored to pre-existing topographic contours, and restoration will use native vegetation

(where possible), as specified in the Mountain Valley's Restoration and Rehabilitation Plan, upon completion of work.

- While the locations of any future slips that may require tree clearing to remediate the slip area are unknown, Mountain Valley will implement the following protocol before cutting any trees in those areas to avoid and minimize adverse effects to bats (Mountain Valley 2022):
    - (1) Complete the tree clearing between November 15 and March 31 whenever possible throughout the life of the project.
    - (2) No tree cutting from June 1 through July 31 (to avoid pup season when pups cannot yet fly) to address future slips, barring an unforeseen emergency arising.
    - (3) Should an emergency arise, that would require tree clearing from June 1 through July 31, Mountain Valley will consult with the Service and FERC regarding the need for emergency consultation.

<u>Voluntary Mitigation</u> – The BA (FERC 2017b) stated Mountain Valley would, as a voluntary conservation measure, provide funding for RLP and bat mitigation. Mountain Valley was to place the funding in an interest-bearing escrow account and identify an appropriate third-party, non-profit conservation organization to develop a Memorandum of Understanding.

Mountain Valley would voluntarily provide funds to continue and expand restoration efforts along the North Fork Roanoke River and expand on an existing successful, landscape approach that tangibly benefits the RLP within its known occupied range (FERC 2017b). While providing funds to implement restoration will likely provide conservation benefits for the RLP, its potential beneficial impact was not considered in the analysis or conclusion below because the nature and extent of that benefit is not determinable at this time. Further, support will be provided for stream restoration activities within the range of RLP within the pipeline corridor (FERC 2017b). Proper stream restoration activities can provide a multitude of environmental and economic benefits including, but not limited to, the following: improved water quality; augmentation of habitat diversity; re-establishment of critical watershed functions; increased property and aesthetic values; and reduction of flood damages and riparian property loss. Targeted restoration activities in or near waterbodies will take place at 55 stream crossing locations along the action area. While supporting stream restoration activities will likely provide conservation benefits for the RLP, its potential beneficial impact was not considered in the analysis or conclusion below because the nature and extent of that benefit is not determinable at this time.

In collaboration with the VA and WV state environmental agencies, a mitigation model has been developed for federally listed bats. The mitigation model utilizes interior forest as the benchmark to which habitat impacts are compared. The goal of the model is to identify the quantity of acres required to fully offset forest impacts from the MVP project. In coordination with the WVDNR, Mountain Valley has agreed to place funds in an interest-bearing account for the purchase of optimal bat habitat that is essential to the recovery of the species, throughout VA and WV. In VA, Mountain Valley contributed to the Comprehensive Mitigation Agreement. This Agreement establishes commitments related to forest conservation and water quality. Funds from this Agreement have been utilized for projects with the U.S. Endowment for Forestry and Communities, the Environmental Endowment, and water quality projects with the USGS. The amount of acreage for WV will be determined in coordination with the Service and applicable state agencies and a Memorandum of Understanding with the WVDNR is being developed to establish criteria for ensuring the funds from the conservation escrow account are disbursed in accordance with the final mitigation proposal. While implementation of this mitigation will likely provide additional conservation for federally listed bats, its potential beneficial impact was not considered in the analysis or conclusion below because the nature and extent of that benefit is not determinable at this time.

ACTION AREA

The action area is defined (50 CFR 402.02) as "all areas to be affected directly or indirectly by the federal action and not merely the immediate area involved in the action." As the regulation indicates, the action area constitutes the *physical area* (land, air, or water) affected by the project as determined through deconstruction of the action into its component parts. This determination is not influenced by the presence or location of listed species or critical habitat but should be used to help generate the species list. The potential effects to listed species are not considered in this delineation of the action area and are evaluated after the physical area affected by the project has been identified.

As described in the BA (FERC 2017b) and the SBA (Mountain Valley 2020), the action area was defined by a combination of effects related to movement of dust, light levels, noise, and water quality. The extent of expected effects from the project associated with dust and light are unchanged from the BA (FERC 2017b, Mountain Valley 2022). Additional analyses, described below, indicated that the extent of noise and water quality effects from the project warranted revising the action area from the 2017 Opinion (Mountain Valley 2020). FERC reviewed the information provided below related to revising the action area and agreed with the revised action area (J. Martin, FERC, letter to C. Schulz, Service, May 7, 2020). In the SBA2 (Mountain Valley 2022), the extent of noise and water quality effects is unchanged from the SBA (Mountain Valley 2020), except for 1 new stream segment in the aquatic action area, as described below.

<u>Action Area for Dust Effects</u> – The extent of dust impacts is not expected to exceed 350 ft from the project construction ROW (Mountain Valley 2020, 2022).

<u>Action Area for Light Effects</u> – Any light emitted is not expected to travel more than 1,200 ft from the project construction ROW (Mountain Valley 2020, 2022).

<u>Action Area for Noise Effects</u> (Mountain Valley 2020, 2022) – Energy transmitted by pressure

waves through media such as air or water creates sound, and when sound becomes excessive, annoying, or otherwise unwanted it is referred to as noise (USDOT 2006). A decibel (dB) is a unit of sound pressure used to express the level of noise heard and is quantified in terms of base-ten logarithmic units of ratios of the sound pressure being measured to a reference pressure squared (termed "bel") multiplied by 10 to get "deci-bel." A-weighted sound level (dBA) is used to understand effects of noise on people and is based on the dB unit but emphasizes frequencies in the range humans hear best. Sound levels decrease with distance from a sound source at a rate of 6 dBA with every doubling of distance from a point source when unobstructed by topography or vegetation and when atmospheric conditions are not considered.

Ambient or background sound levels are those emanated from natural and artificial resources that currently exist on a given landscape and are often referred to as baseline noise levels. The magnitude and frequency of ambient noise vary over a 24-hour period and throughout the year due to weather conditions, vegetative cover, wildlife, and human activity. Noise impacts are determined by quantifying increases over ambient levels caused by a given activity. Humans cannot discern less than a 3 dBA increase, an increase of 5 dBA is considered clearly noticeable, and increases of 10 dBA are perceived as a doubling of noise or becoming twice as loud.

Existing ambient conditions were estimated using American National Standards Institute (ANSI) S12.9-2018/Part 3 (ANSI/ASA 2013 as cited in Mountain Valley 2020) and information obtained from project-specific ambient measurements. The ANSI standard provides estimated ambient equivalent (Leq) sound levels based on land-use categories. The lowest ambient sound levels are provided for areas described as "very quiet suburban and rural residential," which correspond to areas with population densities of less than 200 people per square mile. The estimated ambient sound level for this land-use category is 40 dBA during daytime hours and 34 dBA during nighttime hours.

The sound levels from the ANSI standard were compared to the ambient noise levels measured at proposed compressor stations, interconnect sites, and 1 representative stream crossing. The measured ambient noise levels vary greatly depending on location along the route and differ from day (34.7 to 57.9 dBA) and night (27.8 to 53.7 dBA). The highest and lowest measured values were not representative of the project area, and the majority of the measurements were above the ANSI standards. Therefore, the measured results support use of the ANSI standards for "very quiet suburban and rural residential" for ambient conditions along the project route even though higher ambient sound levels are anticipated in many areas. This approach was taken to identify a conservative estimate of ambient conditions. Mountain Valley (2022) confirmed that these ANSI standards continue to reflect a conservative estimate of ambient conditions.

Pipeline construction generates noise along the entire length of the project, with prevalent noise sources coming from internal combustion engines of construction equipment used during the earthmoving phase. On average, noise levels emitted from construction equipment measure approximately 85 dBA at 50 ft when operating at full capacity during daytime hours (FHWA

2006). Nighttime construction neither occurred nor is anticipated except as noted below in this section.

Blasting has occurred along approximately 127 miles from 2018 through 2021 during daytime hours. Additional blasting in other limited areas may be necessary but will not occur at night. Sound levels produced during a blasting event are instantaneous and vary based on type and amount of explosive used, below-ground depth of detonation, and any noise mitigation applied. An average conservative estimate (i.e., assuming no noise shield or barrier between noise source and receptor is used) of blasting operation noise level is approximately 94 dBA at 50 ft (FHWA 2006).

Construction of the 3 compressor stations generated noise levels comparative to general pipeline construction (i.e., 85 dBA at 50 ft) through use of bulldozers, excavators, dump trucks, front end loaders, drill rigs, and generators. Construction at the compression facilities occurred during normal daytime hours (i.e., 7:00 AM to 10:00 PM) except for 24-hour rock crushing disposal activities at the Bradshaw Compressor Station from mid-March to May 31, 2018.

Crossings of railroads and aquatic resources (i.e., streams and wetlands) have and will require the use of conventional bore, guided conventional bore, microtunneling, Direct Pipe®, and/or HDD methodologies. The highest estimated combined noise level for all equipment used at the entry and exit points during these boring events is 91 dBA at 50 ft (FHWA 2006). Boring at some aquatic resource crossings has involved or will involve 24-hour boring operations, namely the crossings of the Elk River, Greenbrier River, Gauley River, Stony Creek, Little Stony Creek, Pigg River, and Roanoke River. Conventional boring at the other aquatic resource crossings occurs during normal daytime hours but requires the use of pumps and generators overnight to ensure the bore pits remain dry. The highest noise level emitted from the pump/generator combination is estimated at 81 dBA at 50 ft (FHWA 2006).

On behalf of Mountain Valley, SLR International Corporation modeled sound attenuation for noise levels produced during project development using the ISO 9613-1 standard calculation within the Cadna/A propagation software. To evaluate the effects of varying meteorological conditions on sound propagation, the attenuation calculations were conducted not only for standard atmospheric conditions (i.e., 59 degrees Fahrenheit [ºF] and 60% relative humidity [RH]) but also for the general range of temperature and RH conditions for each season that will result in the least amount of attenuation (i.e., the highest sound levels, thus a broader action area) (Table 11). In general, attenuation decreases with increasing humidity, but the relationship is not linear and varies by octave band.

Table 11. Distances construction noise attenuates to ambient conditions. Nighttime noise ambient level is 34 dBA; loudest nighttime construction activity is 91 dBA at 50 ft. Daytime noise ambient level is 40 dBA; loudest daytime construction activity is 94 dBA at 50 ft (Mountain Valley 2020, 2022).

Season, Temperature, RH	Nighttime Noise	Daytime Noise
Winter, 26°F, 100%	10,750 ft (2.0 miles)	8,775 ft (1.7 miles)

Spring/Autumn, 63°F, 100%	9,750 ft (1.9 miles)	7,800 ft (1.5 miles)
Summer, 89°F, 100%	9,675 ft (1.8 miles)	7,475 ft (1.4 miles)
Standard, 59°F, 60%	9,600 ft (1.8 miles)	7,800 ft (1.5 miles)

The sounds produced by the noisiest construction equipment used during nighttime and daytime hours under varying seasonal and weather conditions will have attenuated to ambient level of 34 dBA at night, and 40 dBA during the day, within 9,600 to 10,750 ft (1.8 to 2.0 miles) and 7,475 to 8,775 ft (1.4 to 1.7 miles), respectively, from the source. Thus, sound from the project has a measurable impact no farther than 10,750 ft (2.0 miles) from the project construction ROW.

Action Area for Changes in Water Quality – In response to additional information received since issuance of the 2017 Opinion, Mountain Valley (2020) reevaluated the action area in aquatic systems. Specifically, Mountain Valley refined its methodology for accounting for potential increased sediment to streams and rivers attributed to the project's construction, including construction activities in upland areas.

On behalf of Mountain Valley, Geosyntec Consultants, Inc. prepared a Hydrologic Analysis of Sedimentation (Appendix B in the SBA [Mountain Valley 2020]) that was evaluated by the Service, USFS, and BLM, as well as each agency's chosen expert reviewers, and determined to provide an appropriate means of delineating the aquatic action area (J. Martin, FERC, letter to C. Schulz, Service, May 7, 2020). Based on the expert reviews of the sedimentation analysis and FERC's determination, the Service accepted that the sedimentation analysis provided an appropriate means of defining the action area, but also added the mixing zones described below. The final Hydrologic Analysis of Sedimentation report was revised to address comments provided by those agencies and associated expert reviewers. The Hydrologic Analysis of Sedimentation estimated potential delivered sediment loads to 14 streams that (1) exhibit suitable habitat for at least 1 threatened, endangered, or sensitive aquatic species and (2) include project ROW within their corresponding watersheds. The evaluation used the Revised Universal Soil Loss Equation (RUSLE) (Renard et al. 1997 as cited in Mountain Valley 2020) at a watershed scale together with RUSLE Version 2 (RUSLE2) (Renard et al. 2011 as cited in Mountain Valley 2020) at a site-specific scale. As described in detail in the Hydrologic Analysis of Sedimentation report, the RUSLE approach is an average annual model that accounts for site-specific seasonal rainfall, topography, construction sequencing, climate, soils, vegetation, and management practices. The standard E&S control BMPs approved by VDEQ and WVDEP were also incorporated into the model with clearing and grading activity schedules and subsequent proposed construction tasks. By modeling standard BMPs, the models underestimate the amount of erosive protection provided in the E&S control plans and likely overpredict the amount of sediment loss during construction and restoration.

The Hydrologic Analysis of Sedimentation yielded conservative estimates (the assumptions to ensure conservativism are detailed in Section 6.2 of the Hydrologic Analysis of Sedimentation [Mountain Valley 2020]) of delivered sediment loads to each analyzed stream (stream of interest) based on 4 scenarios: (1) Baseline (pre-existing conditions), (2) Felled (trees felled and left in place prior to clearing), (3) During Construction (from time of clearing through seeding), and (4) Restoration (one-year duration from completion of seeding) (Mountain Valley 2020). Comparing the latter 3 scenarios to Baseline conditions allowed for determination of the relative impact of the project activity scenarios on the streams of interest.

These results reflect estimated sedimentation loads from all project construction activity in the respective watersheds, in addition to baseline sediment loads from other sources in the watersheds (Mountain Valley 2020). The loads were determined using stream trace downs to account for the locations upstream and downstream of the ROW crossings that may receive sediment inputs from the project within the corresponding watersheds, as opposed to the assumption that all sediment enters a stream only at the ROW or AR road crossings.

Mountain Valley (2022) confirmed that the Hydrologic Analysis of Sedimentation and modeled expected delivered sediment loads described in Mountain Valley (2020) continue to reflect the best available science. Mountain Valley (2022) reviewed the most recent versions of publicly available datasets used to develop the input parameters for the 2020 Supplement Sedimentation Analysis and determined that the changes between the datasets were minimal, falling within expected variability from year to year and primarily being concentrated outside the project ROW.

<u>Delineation of Aquatic Action Area</u> – To identify aquatic areas that would be reasonably expected to experience measurable or detectable environmental effects from the project, Geosyntec undertook an analysis to identify the extent of the National Hydrography Dataset (NHD) surface water features (i.e., streams) that may receive and transport measurable sediment attributable to the project (Mountain Valley 2020). Sediment from the project may enter streams through 2 pathways: (1) sediment from direct impacts where the project crosses the stream; or (2) sediment from upland workspaces delivered via overland flow to streams.

For every stream segment that may receive measurable sediment attributable to the project, the start of the aquatic portion of the action area is defined as the most upstream point at which measurable sediment attributed to the project may enter a NHD stream segment via 1 of the 2 pathways described above. The farthest upstream point was identified either through the use of the Trace Downstream tool in ArcGIS (ESRI 2020 as cited in Mountain Valley 2020) using a digital elevation model of the watershed topography (Mountain Valley 2020) or by identifying the upstream end of the NHD stream segment modeled to received measurable sediment attributed to the project (Mountain Valley 2022).

The downstream extent of the aquatic portion of the action area for each stream segment that may receive measurable sediment attributable to the project is defined in 1 of 2 ways: (1) the downstream point at which the stream becomes impounded to an extent that water velocity slows and sediment settles out or (2) the downstream point at which the project's estimated maximum increase in delivered sediment concentration to the stream is attenuated to the point where an increase in measurable sediment concentration (e.g., total suspended solids or suspended sediment concentration) from the project could not be discerned from background sediment concentrations (i.e., the concentration attenuation threshold) (Mountain Valley 2020). The concentration attenuation thresholds are 4.1 mg/L and 2.7 mg/L for VA and WV, respectively, which are based on the point at which small increases in concentration caused by the project could be discerned from background concentrations. Mountain Valley (2020) provides a detailed description of the analysis and assumptions for determining these thresholds. In summary, these thresholds are based on the standard deviation associated with observed average background sediment conditions for each state because a measured increase less than the standard deviation for the background concentration would not be considered a reliable indication that any increase has occurred. This action area is inclusive of stream segments upstream and downstream of dry, open-cut crossings.

For stream segments that the project crosses but a measurable increase in sediment is not expected (e.g., streams that will be crossed using trenchless methods [i.e., conventional bore, microtunnel, or HDD] and will not experience measurable sedimentation from upland activities), the start of the aquatic portion of the action area is the point 200 m upstream of the crossing and the downstream extent is the point 800 m downstream of the crossing (Mountain Valley 2020). Although these areas are not expected to experience discernible increases in sediment concentration, including them in the aquatic portion of the action area is appropriate to account for physical effects, such as increased sunlight due to tree-clearing (Alberts et al. 2018) that may be experienced due to potential clearing and work in riparian areas at the stream crossing. These effects are not expected to be discernible beyond the width of the ROW, but the 1,000 m area is conservatively used to meet the screening function of the action area definition. The extent of aquatic action area is unchanged from the 2020 Opinion, except that Mountain Valley has corrected a typographic error in the mapping it previously provided to the Service on May 6, 2020 that inadvertently included an additional 10 stream miles of aquatic action area associated with the Gauley River watershed in WV (P. Moore, Beverage & Diamond PC, email to J. Stanhope, Service, November 29, 2022). The SBA2 (Mountain Valley 2022) correctly depicts the aquatic action area based on the FERC approved methodology of the “10-year design storm.” This accounts for the new total aquatic action area in this Opinion of approximately 1,153 miles (2020 Opinion total aquatic action area was approximately 1,163 miles).

In addition to the aquatic action area described above, the Service is including the mixing zone in a stream segment where project-related sediment from tributaries (tributaries crossed or receiving sediment from construction activities in the upland area) is delivered to streams/rivers, including the “streams of interest” where listed aquatic species and/or critical habitat are potentially present. Although the sediment increases for those tributaries are carried into and reflected in the results for the streams of interest, the analysis did not take into account the mixing zone area where the sediment is initially diluted by the receiving waters, suspended sediment concentrations will be elevated, and sediment may be deposited. The size of a mixing zone depends on a number of factors including the suspended sediment concentrations in the tributary, concentrations in the receiving water, tributary discharge volume and flow rate, receiving water flow rate and turbulence, and the geometry of the tributary and the receiving water boundaries (U.S. Environmental Protection Agency [USEPA] and USACE 1998). Due to the large number of variables, each individual mixing zone area could not be quantified. Instead, the mixing zones were qualitatively assessed and were conservatively estimated to fall within an area extending 200 m upstream and 800 m downstream of the point where the tributary enters the stream of interest. The basis for this estimate is provided below. At the Service's request, Mountain Valley further assessed and identified mixing zones in any waterbody, in addition to the streams of interest (P. Moore, Beveridge & Diamond PC, emails to J. Stanhope, Service, August 14, 2020, and August 18, 2020). The mixing zones were identified at all locations where the calculated sediment concentration in a tributary to any receiving waterbody (regardless of whether or not the receiving water is a stream of interest) was above the concentration attenuation threshold (i.e., the point of discernibility as defined in the aquatic action area methodology above) at the receiving waterbody. In other words, the mixing zone location is when the tributary concentration is greater than the concentration attenuation threshold at the point it flows into the receiving water. These mixing zones are part of the aquatic action area (Mountain Valley 2022).

Summary of Action Area – The action area is defined as the project construction ROW plus the distance or location where (Mountain Valley 2020, 2022):

- meaningful concentrations of dust are expected to travel outside the project area, estimated at 350 ft;
- emitted nighttime light is expected to travel from the project area, estimated at 1,200 ft;
- air or substrate-borne sound or vibration is expected to travel, estimated at 2.0 miles;
- the dilution evaluation within streams (performed by stream reach) yields concentrations above the concentration attenuation threshold; and 800 m downstream/200 m upstream in any stream crossed by the project where evaluation indicates that no measurable increase in project-related sediment is expected to occur but where the crossing potentially could influence stream conditions (e.g., riparian clearing); and
- the mixing zones where the tributary sediment concentration is expected to be greater than the concentration attenuation threshold at the point it flows into the receiving water.

The scope of the terrestrial impacts described above are all within the 2.0-mile area associated with the maximum distance that sound from the project will occur above ambient conditions. As a result, 2.0 miles is used for the terrestrial portion of the action area. The aquatic portion of the action area is: (1) the distance at which the concentration attenuation threshold is reached in each stream expected to experience a measurable increase in project-related sediment, or (2) 800 m downstream and 200 m upstream – the area in which riparian clearing potentially could influence stream conditions – for any stream that the project crosses that is not expected to experience a measurable increase in project-related sediment, or (3) the mixing zone in a stream segment where sediment from tributaries (crossed or receiving sediment from the project) is delivered to receiving water. As such, the action area for this project consists of all lands within 2.0 miles of the boundaries of the project area and approximately 1,153 miles of potentially impacted streams (note that the 1,153 miles does not include mixing zone distance due to qualitative assessment) (Figure 3) (P. Moore, Beveridge & Diamond PC, email to J. Stanhope, Service, November 14, 2022). Detailed maps of the action area, including the mixing zone action area locations, are in Appendix D in the SBA2 (Mountain Valley 2022).

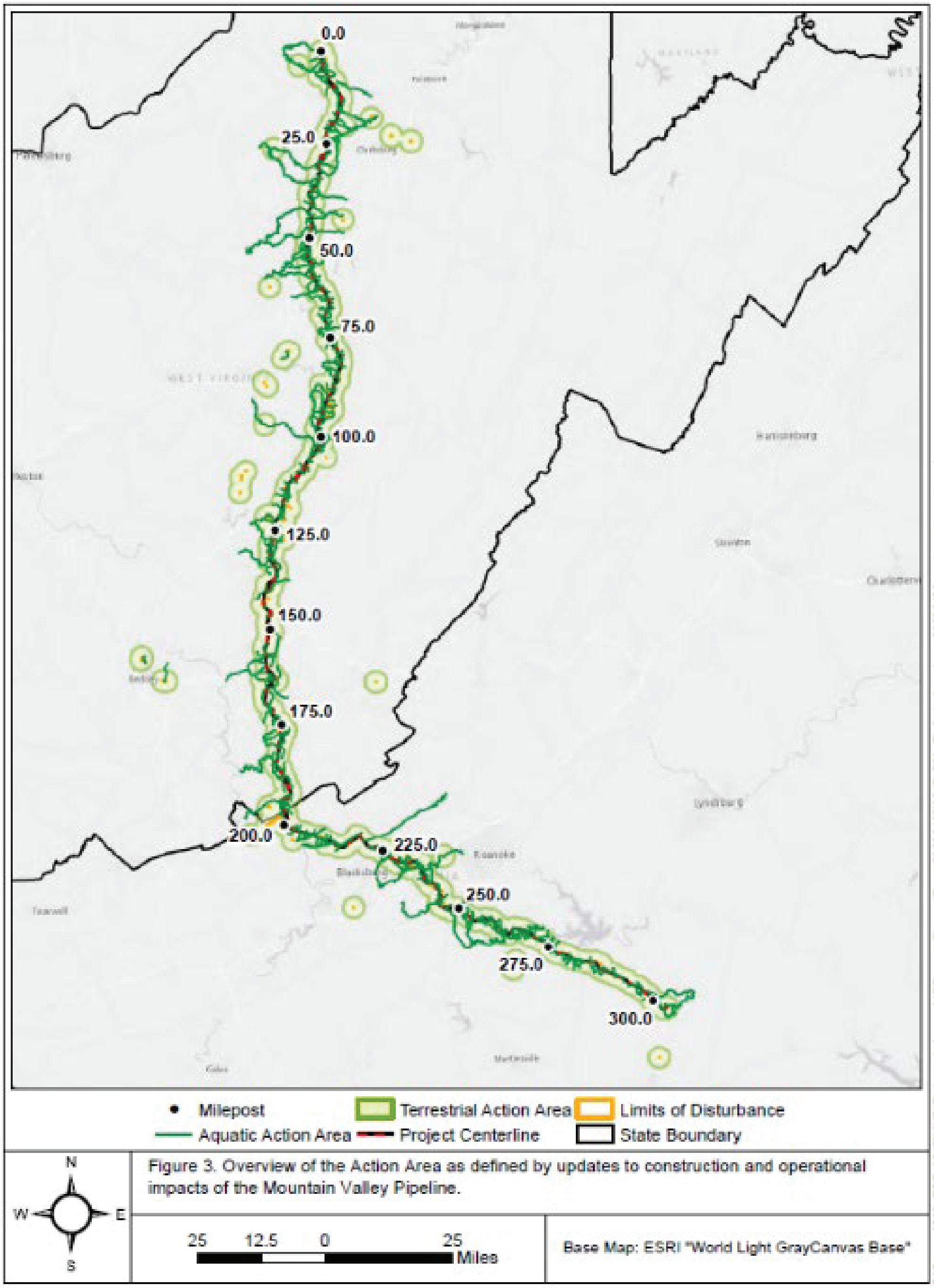

Figure 3. Overview of the Action Area as defined by updates to construction and operational impacts of the Mountain Valley Pipeline.

Base Map: ESRI "World Light GrayCanvas Base"

Figure 3. Action area overview (Mountain Valley 2022).

STATUS OF THE SPECIES

Per ESA Section 7 regulations (50 CFR 402.14(g)(2)), it is the Service's responsibility to "evaluate the current status of the listed species or critical habitat." To assess the current status of the species, it is helpful to understand the species' conservation needs. The Service frequently describes conservation needs via the conservation principles of resiliency (ability of species/populations to withstand stochastic events which is measured in metrics such as numbers, growth rates), redundancy (ability of a species to withstand catastrophic events which is measured in metrics such as number of populations and their distribution), and representation (variation/ability of a species to adapt to changing conditions which may include behavioral, morphological, genetics, or other variation) (collectively known as the 3Rs) (Wolf et al. 2015, Smith et al. 2018). The Service can then apply the appropriate regulatory framework and standards to these principals to address a variety of ESA-related decisions (e.g., listing status, recovery criteria, jeopardy and adverse modification analysis). For Section 7(a)(2) purposes, the 3Rs can be translated into the reproduction, numbers, and distribution (RND) of a species.

Climate Change

Global climate change is well-documented and generally accepted within the scientific community. Evidence of the warming of the climate system is unequivocal and long-term climate changes observed include widespread changes in precipitation, extreme temperature patterns, sea level rise, and changes in extreme weather and climate events (e.g., droughts, heavy precipitation and flooding, heat waves, hurricanes) (Intergovernmental Panel on Climate Change [IPCC] 2014, Hayhoe et al. 2018, IPCC 2021, Arias et al. 2021). Global average temperature has increased 1.7 degrees F (0.9 degrees C) between 1901 and 2016 (Hayhoe et al. 2018). The global warming trend has increased since 2012, with 2016-2020 the hottest 5-year period since 1850 (Arias et al. 2021). When comparing the period of 1850 to 1900 relative to the past decade (2011-2020), the global average temperature has increased 1.96 degrees F (1.09 degrees C). Although the IPCC conducted an updated assessment on climate change in 2021 (https://www.ipcc.ch/report/ar6/wg1/; accessed January 6, 2023), it does not include an in-depth analysis of the U.S., which the U.S. Fourth National Climate Assessment does (e.g., Wehner et al. 2017, Wuebbles et al. 2017, Hayhoe et al. 2018); therefore, we do not discuss it further. However, the 2021 IPCC generally confirms and improves analysis of trends observed and projected for climate change globally and North America (IPCC 2021, Arias et al. 2021).

Over the contiguous U.S., annual average temperature has increased 1.2 degrees F (0.7 degrees C) for the period of 1986 to 2016 relative to 1901 to 1960 (Hayhoe et al. 2018). Temperatures increased during that time at a regional scale as well, with the largest changes (average increases of more than 1.5 degrees F [0.8 degrees C]) in Alaska, the Northwest, Southwest, and Northern

Great Plains and the least change in the Southeast (increase of 0.46 degrees F [0.26 degrees C]) (Vose et al. 2017, Hayhoe et al. 2018). The Southeast region includes VA and the Northeast region includes WV. Annual average precipitation has increased by 4% since 1901 across the entire U.S. with increases over the Northeast, Midwest, and Great Plains and decreases over parts of the West, Southwest, and Southeast (Hayhoe et al. 2018). The frequency and intensity of heavy precipitation events across the U.S. have increased more than the increases in average precipitation (Hayhoe et al. 2018). Heavy precipitation events (amount of precipitation falling in the heaviest 1% of events) have increased across most of the U.S., in particular in the Northeast, Midwest, and Southeast, on average 55%, 42%, and 27% respectively, when measured from 1958 to 2016 (Hayhoe et al. 2018). Although precipitation affects extreme events, such as floods, it is more difficult to estimate and project trends related to extreme events because of other influencing factors such as local land use, landcover change, and water management. The effects of climate change on drought are complicated. In some regions of the U.S., including the Great Plains, Midwest, and West, significant droughts and associated heat waves have occurred since 2011 (Wehner et al. 2017, Hayhoe et al. 2018). However, drought frequency appears to have decreased over most of the continental U.S. from 1901 to 2014 in association with long-term increases in precipitation (McCabe et al. 2017, Wehner et al. 2017). Atlantic hurricane activity has increased since 1970, which causes heavy precipitation events, flooding, and very high, sustained winds (Hayhoe et al. 2018). Frequency of large forest fires have increased in the western U.S. and Alaska since the 1980s due to both natural and human factors, including temperature, soil moisture, relative humidity, wind speed, and vegetation (Wehner et al. 2017).

Temperatures are expected to continue rising, and heat waves and extreme precipitation events are predicted to become more frequent, last longer, and become more intense throughout most of the world over the coming century (IPCC 2014, Wuebbles et al. 2017, Hayhoe et al. 2018). Over the next few decades, annual average temperature over the contiguous U.S. is projected to increase by about 2.2 degrees F (1.2 degrees C) relative to 1985 to 2015, regardless of any currently used representative concentration pathway (RCP 2.6 to RCP 8.5) (Hayhoe et al. 2018). Larger increases are projected by late century of 2.3 to 6.7 degrees F (1.3 to 3.7 degrees C) under RCP 4.5 and 5.4 to 11.0 degrees F (3.0 to 6.1 degrees C) under RCP 8.5, relative to 1986 to 2015 (Hayhoe et al. 2018). For the period of 2070 to 2099 relative to 1986 to 2015, precipitation increases of up to 20% are projected in winter and spring for northcentral U.S., with decreases by 20% or more in the Southwest in spring (Hayhoe et al. 2018). The frequency and intensity of heavy precipitation events are expected to continue to increase across the U.S., with the largest increases in the Northeast and Midwest (Hayhoe et al. 2018). Projections show large declines in snowpack in the western U.S. and shifts of snow to rain in many parts of the central and eastern U.S. (Hayhoe et al. 2018). With temperature projected to increase, as well as evaporation rates, surface soil moisture is projected to decrease across much of the U.S (Hayhoe et al. 2018). As a result, future droughts may be more intense and possibly last longer. In areas where precipitation is projected to decrease in most seasons, such as the Southwest and Southern Great Plains, future droughts may become more frequent. With a warming climate, some studies predict an increase in the frequency of more intense hurricanes (e.g., category 4 and 5) by the end of the 21st

century, in particular in the western Atlantic Ocean north of 20ºN latitude (i.e., Cuba and north), which would likely cause periodic, extreme inland flooding and high wind events (Bender et al. 2010, Knutson et al. 2010, Hayhoe et al. 2018). Additionally, changing temperature and precipitation patterns resulting from climate change are predicted to affect streamflow in a study of the Northeast and Midwest regions of the U.S. (Demaria et al. 2016). For the period of 2028 to 2082 relative to 1951 to 2005, streams across these regions are projected to have positive trend in 3-day peak flows, decreased magnitude of 7-day low flows and mean base flows, and extended length of the low flow season by an average of 5 days. In other words, streams are projected to have higher high flows and lower low flows in the future. Forest fires are projected to increase in the western U.S. and Alaska with increased temperature, decreased surface soil moisture, and increased drought (Wehner et al. 2017).

The SBA2 (Mountain Valley 2022) provided information regarding current and anticipated future effects of climate change on each species within the action area, which is referenced in species-specific sections below in the Environmental Baseline section.

Virginia spiraea (VASP)

The Service listed VASP as threatened on July 21, 1989 (54 FR 30577). The following is a summary of VASP general life history drawn from the VASP recovery plan (Service 1992a), VASP 5-year review (Service 2021), reports, and peer-reviewed publications.

VASP is a perennial shrub that occurs in the Blue Ridge and Appalachian (including Cumberland) Plateau physiographic provinces (Ogle 1991a, 1991b; Service 1992a, 2021). The current range of VASP has not changed since the recovery plan was completed (Service 1992a); the species occurs in 7 states (Georgia [GA], Kentucky [KY], North Carolina [NC], Ohio [OH], Tennessee [TN], VA, WV) within the Ohio and Tennessee River basins. It remains extirpated from Pennsylvania (PA) and Alabama (AL) (Figure 4). The species is primarily clonal, with a root system and vegetative characteristics that allow it to thrive under disturbance regimes in streams and rivers. VASP habitat includes scoured banks of high gradient, second- and third-order streams and meander scrolls, point bars, natural levees, and braided features of lower stream reaches (i.e., often near stream mouth). The riverine sites where VASP occur are frequently characterized as having enough erosion to inhibit competition from trees and shrubs (i.e., less shading and greater sunlight), but also having depositional patterns to allow establishment of vegetative propagules (plant fragments from parent plant, which is an example of asexual reproduction). The exception to the species' riverine habitat is 3 populations in WV that are found in atypical habitat (Service 1992a; WVDNR 2012, 2013). These atypical habitats include forested or shrubby wetlands, open wetlands, and small streams.

VASP is a 1-3 m tall shrub with often profuse branching patterns and 5-22 centimeter (cm) wide corymbs (flower clusters) that are yellowish/greenish to clear, pale white in color. Its leaves are shaped ovate to lanceolate, 2-5 cm wide by 3-15 cm long, acute, entire or completely serrate, and glaucous beneath. Flowering is rare on first-year plants and occurs from late May to late July. Although flowers attract insects, the species primarily reproduces asexually by vegetative propagation (Service 1992a, 2021; Ogle 2008). Availability and viability of pollen do not appear to be barriers to sexual reproduction, but seed viability and germination are very low. Dispersal has only been observed by downstream distribution of propagules and no dispersal upstream or between drainage systems has been documented.

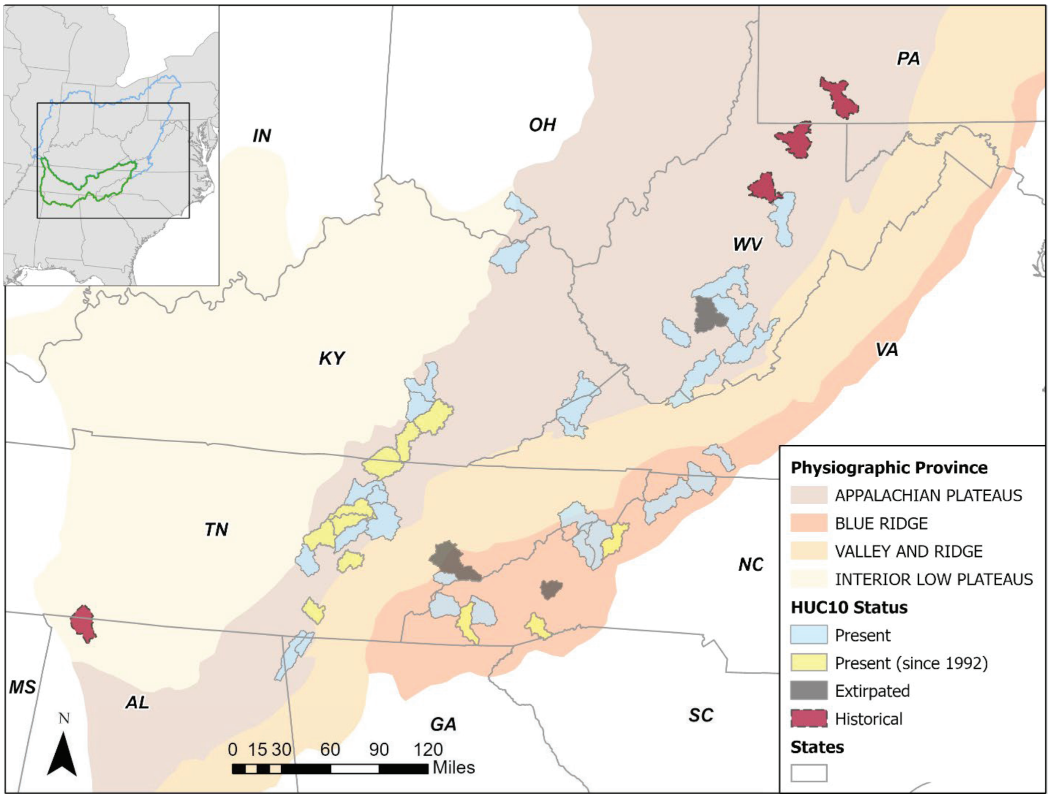

Figure 4. Historical and current range of VASP as shown by hydrologic unit code 10 (HUC10) watersheds in physiographic provinces (Service 2021). HUC10s with extant element occurrences (EOs) as of 2019 have “Present” status (i.e., discovered 1992 and earlier). HUC10s with EOs discovered since 1992 and still extant in 2019 are labeled as “Present (since 1992).” HUC10s with “Extirpated” or “Historical” status are based on the EO ranks assigned by the state natural resource agencies. Note: All EOs with F rank (“failed to find”) occurred in HUC10s that also had EOs that are present (e.g., A, B, C, D, or E ranks).

Conservation Needs

The Service finalized a recovery plan for VASP in 1992. The recovery objective for VASP is to delist the species. The Service outlined the following conditions that would result in the species no longer meeting the definition of a threatened species (Service 1992a): (1) 3 stable populations are permanently protected in each drainage where populations are currently known, (2) stable populations are established on protected sites in each drainage where documented specimens have been collected, (3) potential habitat in the states with present or past collections has been searched for additional populations, and (4) representatives of each genotype are cultivated in a permanent collection.

The primary actions to address these conditions include: (1) Protect existing populations and essential habitat. (2) Conduct rangewide searches in areas of suitable habitat for additional populations. (3) Conduct site-specific habitat manipulation to maintain existing populations. (4) Distinguish between N (the number of genetically different plants) and n (the number of genetically identifiable nodules or clones that are in reality a single plant) individuals and identify genetically different populations. (5) Maintain representative material from each known genotype in permanent cultivation. (6) Investigate the species' environmental tolerances and habitat characteristics. (7) As appropriate, reintroduce VASP in additional drainage systems within the species' historical range. (8) Develop an information packet for landowners and land managers. (9) Evaluate the effectiveness of protection and management programs and redirect efforts as necessary.

Current Condition

Now that we have described the species' basic needs, we can assess its current condition. Data gathered since the 1992 recovery plan provide additional information on the abundance and number of populations of VASP throughout its range, but it is difficult to assess population trends due to different monitoring approaches for abundance and definitions for populations over time and among the states. To attempt to compare and assess abundance/population trends, occurrence data provided by state natural resource agencies are summarized by element occurrence (EO) (Table 12), based on the agency's own EO definition (Service 2021). An EO is the spatial representation of a species or ecological community at a specific location and originated within the state Natural Heritage Programs after 1992. Current data suggest that at least 72 of the 89 historically known EOs are extant. Populations were evaluated by state natural resource agencies and were assessed as stable in GA, KY, NC, OH, TN, and VA and stable to decreasing in WV (Table 12) (Service 2021). Table 13 provides a summary of VASP current condition in terms of the 3Rs.

Table 12**.** Number of VASP EOs and sub-EOs in 2019, and number of extant EOs located in managed/protected land and their EO rank (i.e., estimated viability by state natural resource agency). Extant EOs are those with A, B, C, D, or E rank. N/A = not applicable. Table adapted from Service (2021).

State	**Number of extant EOs in 2019**	**Number of extant sub-EOs in 2019 (of total sub-EOs)**	**Total Number of EOs (all ranks)**	**Number of extant EOs located on public or permanently managed/ protected land**			**Population stability as assessed by survey respondents in 2019/2020**
				A or B rank[1]	**C rank[1]**	**Total extant (all ranks)**	
AL	0	N/A	1	N/A	N/A	N/A	N/A
GA	3	6+ (of 8+)	3	3	0	3	Stable
KY	13	15+ (of 37)	16	1	3	7	Stable
NC	14	46 (of 55)	16	2	0	3	Stable
OH	6	9 (of 9)	6	0	1	1	Stable
PA	0	N/A	1	N/A	N/A	N/A	N/A
TN	22	57 (of 67)	28	9	5	16 (3 partial)	Stable

VA	4	24 (of 25)	5	2	0	3	Stable
WV	10 [2]	126 (of 136)	13	3	0	3	Stable to Decreasing
All States	**72**	**283+ (of 337+)**	**89**	**20**	**9**	**36**	

[1] A or B rank (excellent or good viability) includes B?-ranked and BC-ranked occurrences, though there is uncertainty regarding the rank. C rank (fair viability) includes BCD-ranked and CD-ranked occurrences (D indicates poor viability). See the NatureServe Element Occurrence Data Standard (2002) for more details on ranking methodology.
[2] Includes new EO found in 2020.

Table 13**.** VASP 3Rs in VASP 5-year review (Service 2021).

3Rs	Requisites	Description	Current Condition
Resiliency (ability to withstand stochastic events)	Healthy populations and habitat.	Populations with: • High gradient streams/rivers with scoured banks, meander scrolls, point bars, natural levees, or other braided features; • Normal hydrologic flows to maintain habitat integrity and reduce competing arboreal and invasive vegetation; • Connectivity — waterways without impoundments and significant barriers to allow dispersal.	Each population or EO with excellent or good (A or B rank) current condition is thought to be healthy and have adequate habitat, thus has high or moderate resiliency, respectively. • 72 of 89 EOs (80.9%) are known to be extant. • EO status: – 32 EOs (36.0%) excellent/good condition – 23 EOs (25.8%) fair condition (C rank) – 15 EOs (16.9%) poor condition (D rank) – 2 EOs (2.2%) unknown condition (E rank) – 17 EOs (19.1%) presumed extirpated (F or X rank) or historical
Redundancy (ability to withstand catastrophic events)	Sufficient distribution of healthy populations.	Sufficient distribution of healthy populations to prevent catastrophic losses of species' adaptive capacity due to severe flood events. Multiple healthy populations and occupied HUC10s (watersheds) distributed within the species range are important for the species' redundancy.	• Healthy EOs (good to excellent condition) throughout range, but not evenly distributed in some areas: fewer healthy EOs in specific areas of middle portion of the range and northern and southern extents of range. • Loss of occupied HUC10s in the northern and southern extents of the range (historically; prior to 1992). • Increase in occupied HUC10s in the middle portion of the range due to increased searches for the species.
Redundancy (ability to withstand catastrophic events)	Sufficient number of healthy populations.	Sufficient number of healthy populations and occupied HUC10s to prevent catastrophic losses of adaptive capacity.	• 32 of 89 EOs (36.0%) are good to excellent condition across the range. – Ohio basin: 14 of 52 (26.9%) are good to excellent condition. 16 of 52 (30.8%) are fair condition. – Tennessee basin: 18 of 37 (48.6%) are good to excellent condition. 7 of 29 (24.1%) are fair condition. • 40 of 47 HUC10 watersheds (85%) currently occupied.

3Rs	Requisites	Description	Current Condition
Representation (ability to adapt)	Sufficient capacity to adapt to new, continually changing environments.	Genetic diversity within and among populations contribute to and maintain adaptive capacity. Occupied HUC10s distributed across the range, including the ecological diversity of river basins and physiographic provinces that contribute to and maintain adaptive capacity. Adequate dispersal ability for the species to migrate to suitable habitat and climate over time.	Low genetic diversity documented among populations analyzed thus far, but able to reproduce asexually. Connected, occupied HUC10s found in both river basins and physiographic provinces. **River basin:** • Ohio – 22 of 26 HUC10s (84.6%) occupied. • Tennessee – 18 of 21 HUC10s (85.7%) occupied. **Physiographic province:** • Appalachian Plateau – 28 of 32 HUC10s (87.5%) occupied. • Blue Ridge – 12 of 14 HUC10s (85.7%) occupied. • Interior Low Plateau – 0 of 1 HUC10 (0%) occupied.

Threats

The primary factors influencing the status include competition by both native and non-native invasive plant species, anthropogenic disturbances to habitat, and changes in hydrologic regime (Service 1992a, 2021). These threats remain ongoing, occur throughout the species range, and are expected to continue in the future. Invasive non-native plant species, such as Japanese knotweed (*Polygonum cuspidatum*), purple loosestrife (*Lythrum salicaria*), Japanese spiraea (*Spiraea japonica*), multiflora rose (*Rosa multiflora*), honeysuckle (*Lonicera spp*.), and bamboo are significant threats to VASP by competing with the species, in particular by shading and reducing light. Native plant species, such as poison ivy (*Toxicodendron radicans*), may also compete with VASP. Anthropogenic disturbance of land along streams and rivers, due to activities such as vegetation clearing, mowing, herbicide application, road and bridge construction/maintenance, electric/gas line placement, recreational use of rivers, and dam construction, may impact VASP by directly crushing/removing the plants, altering their riverine habitat, and creating conditions conducive to invasive plants (Ogle 2008, Service 2021). Dams, constructed for flood control and/or generating power, alter natural hydrologic regimes and limit downstream dispersal of VASP (Service 2021). Since the species is dependent on scour, regulating the flow of water below a dam has the effect of eliminating normal erosion and deposition cycles upon which the plant depends for maintenance, reduction of arboreal/invasive species competition, and any reproduction that may be associated with dispersal. However, in the Gauley River, WV, Summersville Dam may potentially reduce seasonal streamflow fluctuations and provide some stability for plants (i.e., ameliorate severe flooding events that may wash VASP from habitat). For multiple EOs throughout the range, severe and repeated flooding events were noted as a threat due to extreme scour and erosion of the habitat, washing away plants, or large debris piles accumulating on the habitat (i.e., exceeding the unknown threshold of beneficial scour that removes competing vegetation). Scour and flooding are potentially exacerbated by increased development and impervious surfaces in watersheds and global climate change, with extreme precipitation events predicted to increase, as described above in Climate Change section.

Another threat to the species is low genetic diversity. Research supports that the species is primarily clonal (Service 2021) and this trait may reduce levels of genetic variation. Low genetic diversity is well documented as a threat to a species because it decreases the ability of the species to adapt to short- and long-term changes in physical and biological environments. VASP may not be able to adapt to changes, such as those caused by climate change. The genetic analyses of VASP populations have been conducted in a subset of the populations across the range and are ongoing in additional populations.

As described above, climate change is occurring globally and is another threat to the species. Climate projections downscaled to the Ohio Valley region, which overlaps with the VASP range and are based on 11 global climate models, indicate that the following climate variables will increase during the 2011-2050 period when compared to 1981-2005: average annual temperature (median of about 1.4ºC), number of extreme hot days (median of about 12 days), percent change of annual precipitation (median of about 2.5%), and percent change of number of precipitation extremes (mean of about 10%; precipitation extreme is when "daily precipitation magnitude exceeds the climatological value of the 95th percentile of the baseline precipitation") (Ashfaq et al. 2016). With the predicted increase in the frequency of more intense hurricanes in the Atlantic Ocean, as discussed above, there will likely be periodic, extreme inland flooding events, potentially resulting in loss of VASP habitat and populations through extreme scouring events. Projected periods of more intense drought and reduced baseflow may negatively affect VASP by reducing river flow and decreasing beneficial scouring of habitat that removes competing vegetation and disperses propagules. VASP may also be stressed by drought and temperature increases, although we are unaware of information about their drought or temperature tolerances. The threat of invasive plant species may increase with global climate change due to increasing air temperature and atmospheric carbon dioxide (Liu et al. 2017), but there is large uncertainty about the scale of effects of climate change on invasive plants (https://www.fs.usda.gov/ccrc/topics/invasive-plants; accessed March 23, 2021).

Summary

There are multiple (redundancy) VASP populations in each state and these populations are spread across the geographic range of the species (GA, KY, NC, OH, TN, VA, and WV) (representation). The species remains extirpated in PA and AL. Multiple populations (36.0% of historically known EOs) are considered healthy (e.g., moderately to highly resilient) and many of these populations are located on public or permanently managed/protected lands (22.5% of historically known EOs), which generally provides protection from habitat loss due to development. Since the recovery plan was published (Service 1992a), 1 EO with historical documentation has been rediscovered (Cheoah River, NC) and 38 additional EOs (32 of them extant as of 2019) have been discovered due to searches of rivers/streams with suitable habitat in known drainages, surveys of rivers/streams with known occurrences, and incidental finds when surveying for other species. However, 11 EOs became presumed extirpated since 1992. The VASP is established in cultivation, with several extant collections in arboreta and universities. Studies of genetic diversity and structure for populations in VA, NC, WV, and KY, as recommended in the species recovery plan (Service 1992a), are in progress and will inform and guide future propagation/reintroduction efforts, if appropriate, and help determine which additional genotypes should be added to cultivation in permanent collections.

In summary, as a whole, the rangewide status of the species appears to be stable, with some populations improving and some declining and the Service recommended maintaining the current classification as a threatened species in its 5-year review (Service 2021). For additional documents related to VASP (e.g., recovery plan, Federal Register notices, biological opinions, etc.) refer to https://ecos.fws.gov/ecp/species/1728.

Indiana bat (Ibat)

The Ibat is a temperate, insectivorous, migratory bat that hibernates colonially in mines and caves in the winter and spends summers in wooded areas. The key stages in the annual Ibat life cycle are: hibernation, spring staging and migration, pregnancy, lactation, volancy/weaning, fall migration, and swarming (Figure 5). All periods outside of hibernation are considered the "active season" for the Ibat. While varying with weather and latitude, this species generally hibernates from mid-fall through mid-spring each year. In the spring, reproductive females migrate and form maternity colonies where they bear and raise their young in wooded areas throughout the summer. In the Northeast, the spring migration period is generally from mid-March or early April to mid-May, as females depart shortly after emerging from hibernation and are pregnant when they reach their summer area. Males and non-reproductive females often do not roost in colonies and may stay close to their hibernaculum; however, some migrate to summer habitat as well. Young are born between late May and early June, with nursing continuing until weaning, which is shortly after young become volant (able to fly) about a month later (mid- to late-July). Fall migration likely occurs between mid-August and mid-October (Service 2007b). The timing of these events is also influenced by weather.

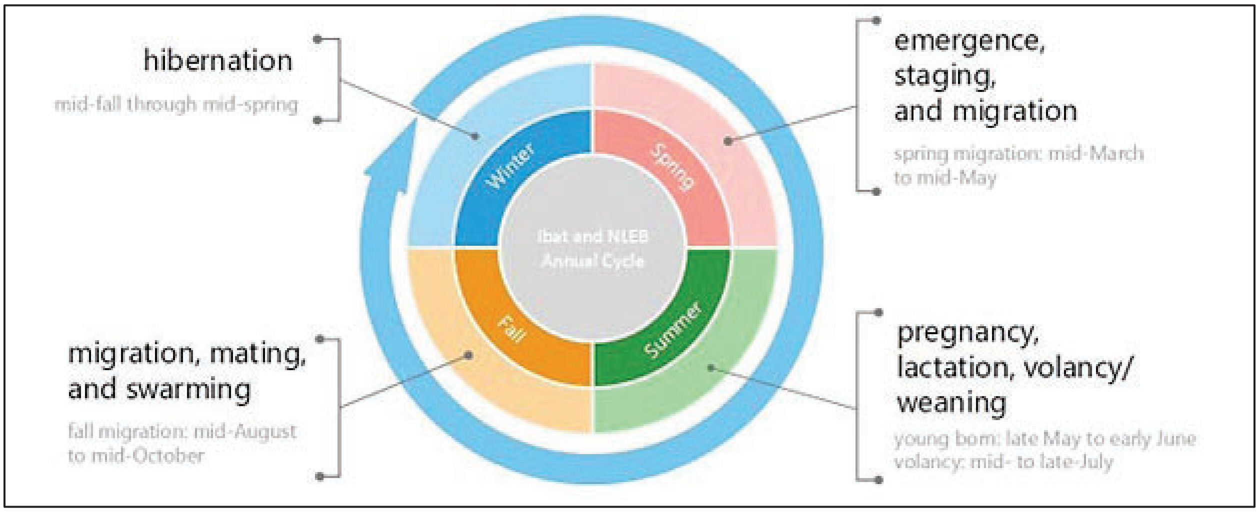

Figure 5. Illustration of the major components and timing of Ibat annual cycle. Note: graphic not necessarily representative of the length of time spent in each life stage.

The basic resource needs for the Ibat across its entire range are safe winter hibernation sites; forested spring staging/fall swarming habitat; connected forested summer habitat for roosting, foraging, and commuting; forested migratory stop-over habitat; safe migration passage; insects; and clean drinking water (e.g., streams, riparian areas, and wetlands).

Ibat Conservation Needs

The Ibat was one of 78 species first listed as being in danger of extinction under the Endangered Species Preservation Act of 1966 (32 FR 4001, March 11, 1967). The ESA extended full protection to the species. The Service prepared a recovery plan for the species in 1983 (Service 1983) and drafted a revised recovery plan that was made available for public comment in 2007 (Service 2007b). This draft was not officially adopted because white-nose syndrome (WNS) impacts were discovered during that time period and resources were shifted towards addressing this new threat; however, this draft embodies the best available scientific information and outlines recovery actions that are relevant to the majority of stressors for the species. In addition, 5-year reviews (Service 2009, 2019b) provide current summaries of the status of the species rangewide, including updates on threats, status of hibernacula counts, and recommended priority actions. Priority actions include: incorporating WNS into the recovery plan; monitoring status of hibernacula; monitoring status of maternity colonies; implementing the North American Bat Monitoring Program; providing for continual recruitment of high quality roosting habitat; securing permanent/long-term protection of Priority 1 and Priority 2 hibernacula; conducting additional research to understand the causes and potential spread of WNS; researching management actions aimed at minimizing the spread of WNS (i.e., an adaptive management approach); continuing public education/outreach efforts about WNS; and continuing to refine survey protocols.

The Ibat recovery plan (Service 2007b) delineates recovery units (RUs) based on population discreteness, differences in population trends, and broad level differences in land use and macrohabitats: Ozark-Central, Midwest, Appalachian Mountains, and Northeast (Figure 6). To help maintain adaptive capacity for the species (representation), multiple (redundant) healthy (resilient) populations should occur in all 4 RUs. The proposed action is located within the Appalachian Mountains RU (AMRU), which includes all of WV and a portion of VA.

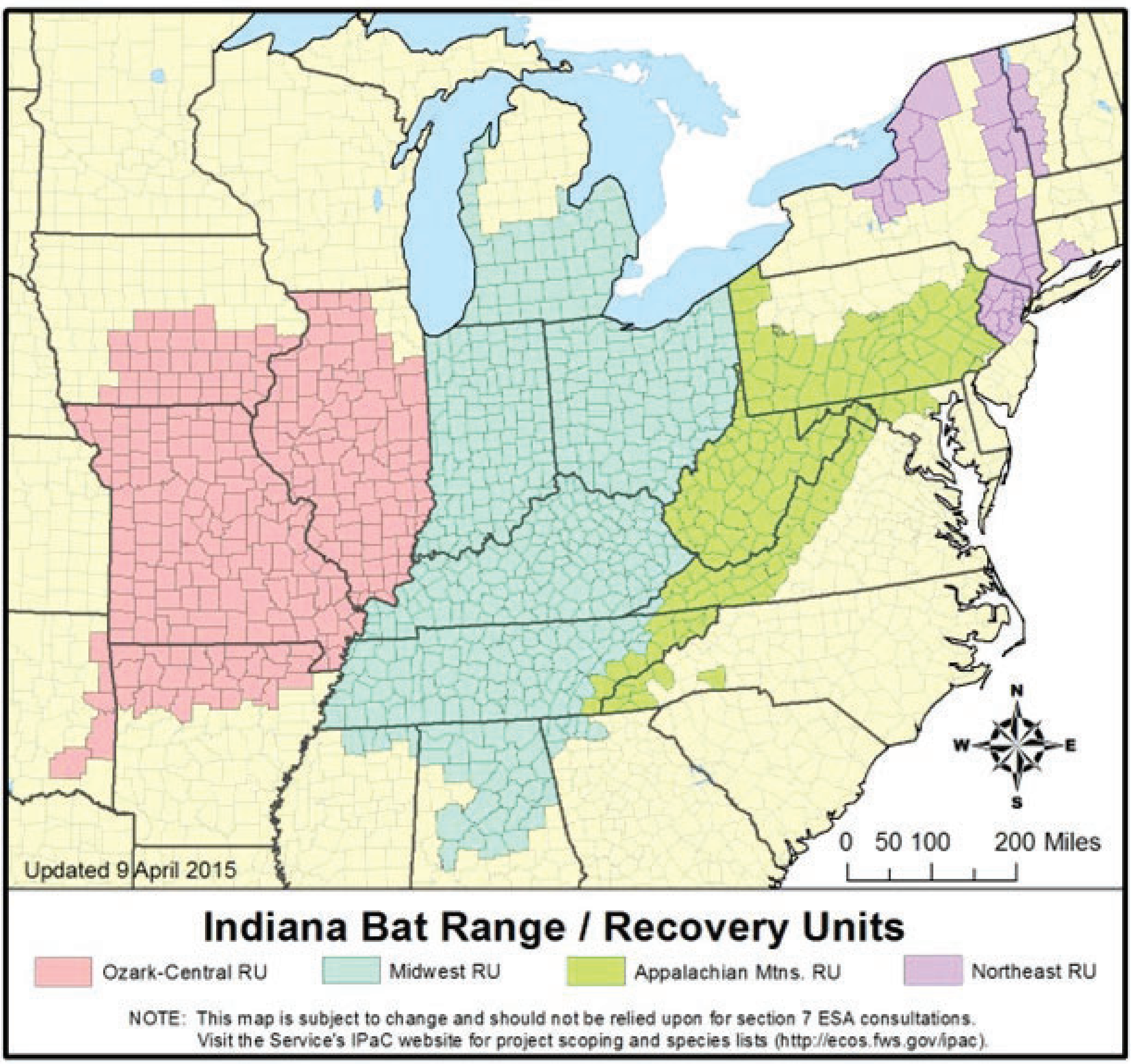

Figure 6. Ibat Recovery Units.

Conservation and recovery of the Ibat will require conserving the species' ecological, behavioral, and genetic representation and providing redundancy and resiliency at the species level by conserving healthy bat populations across the species' current range and managing threats acting upon the species. To do this, the Service's Northeast region tiered off the recovery plan to describe our current focus of addressing the following conservation needs (Service 2018c):

- Managing the effects of WNS;
- Conserving and managing winter colonies, hibernacula, and surrounding swarming habitat;
- Conserving and managing maternity colonies; and
- Conserving migrating bats.

Ibat Current Condition

Now that we have described the species basic needs, we can assess its current condition. The Service's 2019 Ibat 5-year review contains the latest information on the status of the species. Currently, the rangewide status of the species is declining (Figure 7, Service 2019a). Declines are associated with the onset of WNS (described below) which has spread from New York (NY) south and west across the range. Impacts to Ibats to date are most severe in areas with the longest exposure to WNS (e.g., 75-99% declines in NY, WV, and PA) but declines have been observed in all RUs. The AMRU declined from 32,465 Ibats in 2011 to 1,996 Ibats in 2019.

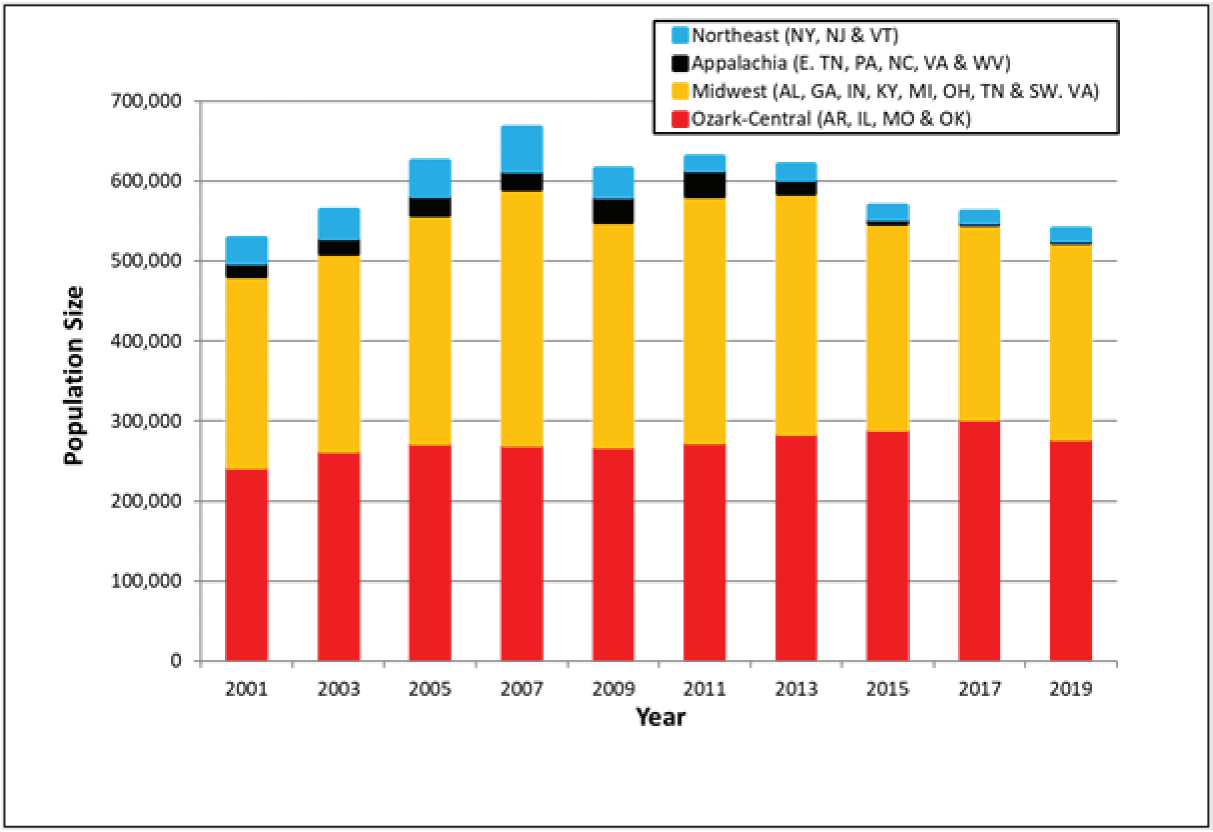

Figure 7. Ibat population estimates by Recovery Unit from 2001 to 2019 (from Service 2019a, Figure 4).

Redundancy of populations rangewide has been significantly reduced, with several hibernacula now believed to have no Ibats and the concentration of remaining Ibats into fewer sites. In an analysis completed by the Service for the most recent 5-year review (the most complete summary data available for Ibat; surveys are generally conducted every 2 years, but surveys planned for 2021 were partial [many were cancelled due to Covid-19]), as of 2019, 93% (12,570 of 13,510) of the Ibats hibernating in the Northeast RU occur at 1 location and 72% (1,435 of 1,996) of the Ibats hibernating in the AMRU occur at 3 locations (Service 2019a). These concentrations of hibernating bats after WNS puts the species at tremendous risk, should adverse impacts occur at any of these locations. Based on winter counts rangewide, the resiliency of populations varies, with some winter populations believed to be extirpated and others with virtually no decline. We do not have an understanding of the causes of this variation in mortality by site and why some sites appear to have greater survival rates. We also lack a good understanding of the changes to associated maternity colonies, but we expect the variation to be the same as that observed in winter.

Ibat Threats

Threats to the Ibat are discussed in detail in the draft recovery plan (Service 2007b), 5-year review (Service 2019b), and Northeast Region Indiana Bat Conservation Strategy (Service 2018c). Traditionally, occupied summer habitat loss/degradation during the active or inactive (winter) seasons, winter disturbance while Ibats are in hibernation, and environmental contaminants have been considered the greatest threats to Ibats. The draft recovery plan (Service 2007b) identified and expounded upon additional threats, including collisions with man-made objects (e.g., wind turbines). The 2009 5-year review (Service 2009) was the first review to include the threat of WNS, which is now considered the most significant threat to the recovery of the species. The fungus that causes the disease, *Pseudogymnoascus destructans*, invades the skin of bats and infection leads to increases in the frequency and duration of arousals during hibernation and eventual depletion of fat reserves needed to survive winter, and often results in mortality. WNS has spread across the range of the Ibat (Figure 8) with declines varying among hibernacula. Overall, the Service finds that WNS has significantly reduced the redundancy and overall resiliency of the Ibat to withstand other cumulative threats. For example, Erickson et al. (2016) modeled the interaction of WNS and wind turbine mortality and the interaction resulted in a larger population impact than when considering the effects of either stressor alone. The primary issues addressed in this Opinion are the loss of summer habitat, spring staging/fall swarming habitat, and any compounding effects from WNS.

As described in the above Climate Change section, climate change is occurring globally. As with the NLEB, climate change variables, such as changes in temperature and precipitation, may influence Ibat resource needs, such as suitable roosting habitat for all seasons, foraging habitat, and prey availability. Although there may be some benefit to Ibats from a changing climate, there are also likely to be negative impacts, especially at local levels. Currently, it remains unclear whether the potential negative effects can be balanced by positive effects of climate change, and what degree of adaptability Ibats will exhibit rangewide in the face of a changing climate (Service 2019b).

According to the Ibat 5-year review (Service 2019b), climate change "poses a serious and increasing threat" to the Ibat in the future. The species is vulnerable to disruption from extreme weather events and disease, both of which are expected to increase with a changing climate. In addition, because climate influences food availability, timing of hibernation and migration, frequency and duration of torpor, rate of energy expenditure, reproduction, and development rates of juveniles, each of these factors could be affected by climate change.

Researchers have indicated that warmer climates might benefit female Ibats by causing earlier parturition and weaning of young, allowing more time to mate and store fat reserves in preparation for hibernation, while earlier gestation and parturition may benefit juveniles by providing a longer growth period prior to the breeding season (Service 2019b). On the other hand, disruption of hibernation, extreme weather events, reduced water availability in arid environments, and the spread of disease may also cause significant mortalities (Service 2019b).

Climate change could cause suitable habitat for the Ibat to decrease within its historic range. As temperatures warm, the western part of the range (Missouri, Iowa, Illinois, Kentucky, Indiana, and Ohio)—currently considered the heart of Ibat maternity range—would become unsuitable under most future climate scenarios that researchers have modeled (Service 2019b). Specifically, if average summer (May through August) maximum temperatures reach 27.4°C (81.3°F), the climatic suitability of the area for Ibat maternity colonies would decline. If these temperatures reach 29.9°C (85.8°F), the area would be expected to become completely unsuitable (Service 2019b). It is uncertain, however, how Ibat maternity colonies will respond to such changes. Due to female fidelity to maternity roost areas, initial shifts might occur at the microhabitat scale with females selecting roosts in more shaded locations. Over the long term, larger-scale range shifts might occur if Ibats must move to more climatically suitable areas, which could result in temporary or long-term disruption of colony structure. In addition, in separate studies, several researchers' models have predicted that long-term projected temperature changes could cause the most suitable summer range of Ibats to decline and become concentrated in northeastern U.S. and Appalachian Mountains, where Ibats might benefit from increased precipitation coupled with warmer winter conditions that may allow for higher reproduction and winter survival. If this occurs, the Northeast and Appalachian RUs for Ibats might become climatic refugia for the species.

Fortunately, there is ample habitat area in those locations to accommodate displaced Ibat populations. The Northeast and Appalachian RUs represent a combined area of 70,930,868 acres (110,829 square miles) but have by far the least Ibat occupancy (approximately 2.88% of the total species population based on USFWS's latest estimates) (Service 2019b). This is especially the case in WV and VA, which together represent 24,472,952 acres (38,239 square miles) of the Appalachian RU but which currently are inhabited by only an estimated 1,149 individual Ibats (based on winter count estimates). That said, it is uncertain whether climate change will significantly impact the preferred tree species for roosting Ibats in these areas.

Rising temperatures also could affect hibernation periods for the Ibat. With sufficient warming, bats could emerge from hibernation earlier or more frequently, which likely would result in depleted energy stores (Service 2019b). This would make female bats in particular, more vulnerable to other stressors when migrating to maternity habitat and separately would pose a threat to the viability of bat pups. As a result, finding suitable maternity sites might become a function of finding new hibernacula, and summer and winter range shifts may occur concurrently (Service 2019b). But it remains uncertain how climate change might influence and interact with future WNS infection rates of Ibats.

Notwithstanding the various predictions summarized above, uncertainty remains regarding the degree to which negative effects of climate change will be offset by positive effects on other life history features, whether population losses in one part of the species' range will be offset by gains in other regions, and the degree to which bats can adapt by adjusting their behavioral, ecological, and phenological characteristics. Further monitoring and research are needed to better understand the impacts of climate change on Ibats and their habitat (Service 2019b).

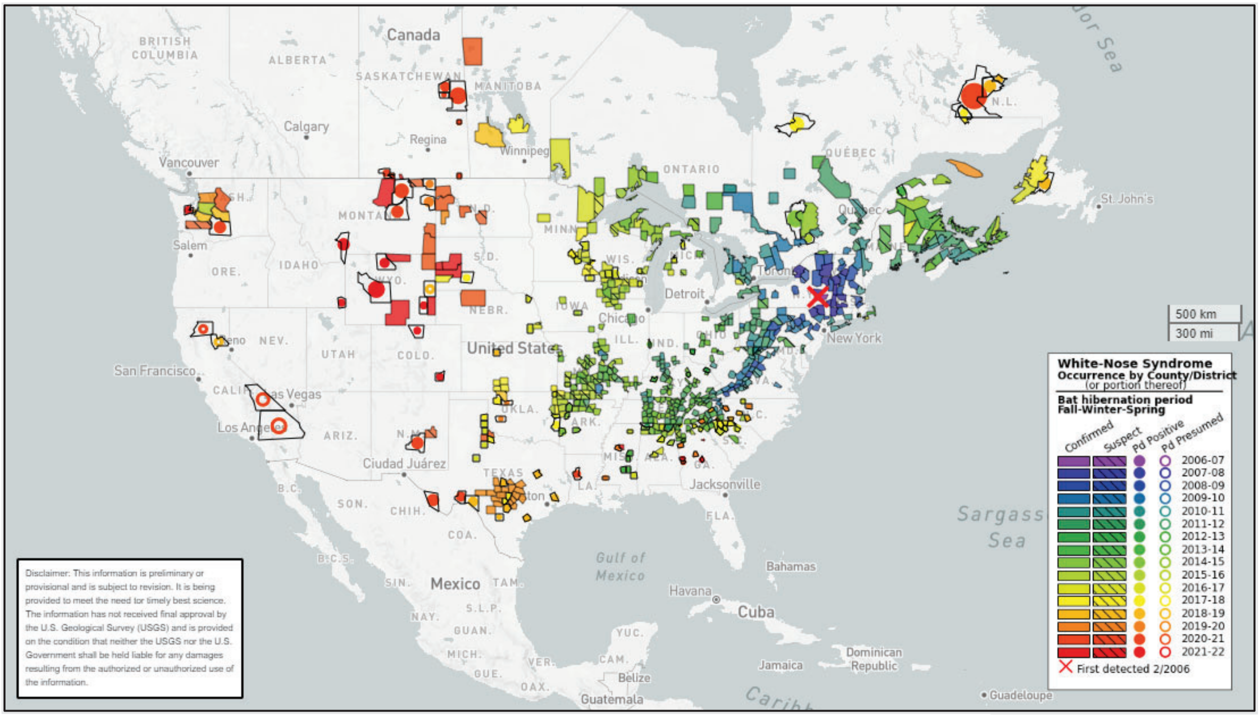

Figure 8. White-nose syndrome spread map (https://whitenosesyndrome.org accessed 10/11/2022).

In addition to extrinsic factors discussed above, there are several intrinsic biological constraints affecting Ibats. High Ibat adult female survival is required for stable or increasing growth rates (Thogmartin et al. 2013). Given the significant declines in populations across much of the range, it is essential to minimize impacts to reproductive potential for surviving Ibats. Healthy adult females have a maximum of 1 pup per year. Thus, the ability of the species to increase reproductive success is limited. Ibats also show strong philopatry to their summer maternity areas, and even interannual fidelity to specific roost trees for as long as the roost trees remain suitable and standing (Kurta 2005). Because Ibats rely on a previously established network of roosts (fidelity), roost tree loss, regardless of whether it occurs during the active or inactive (winter) seasons, may affect the fission-fusion dynamics of their maternity colonies through colony fragmentation. Maternity colony fragmentation is expected to result in reduced thermoregulatory benefits and either increased energy expenditures or increased use of torpor resulting in: (1) reduced recruitment and/or (2) reduced adult survival.

While forest habitat is not generally considered a limited resource across the range of the Ibat, the species' strong site fidelity contributes to the importance of forest where the species actually occurs. In other words, the impacts are associated with the losses of forest *within* the home range of Ibat colonies. Further, where Ibat colonies remain after WNS has been present on the landscape for over 10 years, the importance of that particular occupied habitat for the remaining survivors of WNS is magnified. Thus, the identification and protection of maternity sites is increasingly crucial for even the short-term survival and eventual recovery of the species.

Ibat Summary

At present, few healthy winter populations (and likely associated maternity colonies) of Ibats remain in the Northeast RU and AMRU. WNS impacts are expected to continue across the range for years to come as are other ongoing threats (e.g., climate change, wind turbines) to the bats and their habitats. Given the species' limited reproductive potential, populations are not likely to rebound in the near term. In short, over the past decade, WNS has increased the species' risk of extinction as the resiliency, redundancy, and representation of its remaining populations have declined. Most of the Ibats' population-based and protection-based recovery criteria have not yet been achieved, identified threats have not yet been sufficiently reduced, and stable population growth at the most important hibernacula has not been sustained. In summary, as a whole, the rangewide status of the species is declining, with some winter populations stabilized/improving and most declining. Improving sites may be a result of movement of Ibats from other winter sites along with reduced impacts of WNS. It is important to note that very few sites have had this kind of response. The Service recommended maintaining the current classification as an endangered species in its last 5-year review (Service 2019b). For more information on the Ibat (e.g., life history, population dynamics, threats, conservation needs) refer to the Service's Ibat webpage (https://www.fws.gov/species/indiana-bat-myotis-sodalis?$skip=40), the Ibat species profile on the Environmental Conservation Online System (https://ecos.fws.gov/ecp0/profile/speciesProfile?sId=5949), and the Service's 2018 Revised Programmatic Biological Opinion for Transportation Projects in the Range of the Indiana Bat and Northern Long-Eared Bat (https://www.fws.gov/media/programmatic-biological-opinion-transportation-projects-range-indiana-bat-and-northern-long).

Northern long-eared Bat (NLEB)

The Service listed the NLEB as a threatened species on April 2, 2015 (80 FR 17974). The Service issued a final 4(d) rule for the NLEB on January 14, 2016 (81 FR 1900). On March 23, 2022 (87 FR 16442), the Service proposed reclassification of the NLEB as an endangered species. On November 30, 2022, the Service published a final rule reclassifying the NLEB from threatened to endangered and removing the species-specific 4(d) rule (87 FR 73488). The decision reclassifying the NLEB as an endangered species and removing the species-specific 4(d) rule is scheduled to take effect March 31, 2023 (88 FR 4908). The following is a summary of NLEB general life history drawn from the NLEB Species Assessment Report (USFWS 2022).

Life History and Biology

The NLEB is a wide-ranging bat species, found in 37 states and 8 provinces in North America, typically overwinters in caves or mines and spends the remainder of the year in forested habitats. The species generalized annual life history is summarized for NLEB in Figure 9.

Winter Hibernation – NLEBs are thought to predominantly overwinter in hibernacula that include caves and abandoned mines. NLEBs are typically found roosting singly or in small numbers in cave or mine walls or ceilings, often in small crevices or cracks, sometimes with only the nose and ears visible and thus are easily overlooked during surveys (Griffin 1940a, Barbour and Davis 1969, Caire et al. 1979, van Zyll de Jong 1985, Caceres and Pybus 1997, Whitaker and Mumford 2009). NLEBs have also been observed overwintering in other types of habitat that have similar conditions (e.g., temperature, humidity levels, air flow) to cave or mine hibernacula. The species may use these alternate hibernacula in areas where caves or mines are not present (Griffin 1945). Further, Girder et al. (2016) found NLEB to be present and active year round on the coastal plain of North Carolina (NC), where there is no known non-cavernicolous (cave-like) hibernacula; therefore, it is possible this population was not (traditionally) hibernating.

Summer Roosting – During the summer, NLEBs typically roost singly or in maternity colonies, consisting of females and young, underneath bark or more often in cavities or crevices of both live trees and snags (Sasse and Pekins 1996, Foster and Kurta 1999, Owen et al. 2002, Carter and Feldhamer 2005, Perry and Thill 2007, Timpone et al. 2010). Adult females give birth to a single pup annually (Barbour and Davis 1969). Parturition (birth) may occur as early as late May or early June (Easterla 1968, Caire et al. 1979, Whitaker and Mumford 2009) and may occur as late as mid-July (Whitaker and Mumford 2009). Juvenile volancy (flight) often occurs by 21 days after birth (Kunz 1971, Krochmal and Sparks 2007) and has been documented as early as 18 days after birth (Krochmal and Sparks 2007). Males' and non-reproductive females' summer roost sites may also include cooler locations, including caves and mines (Barbour and Davis 1969, Amelon and Burhans 2006). NLEBs are flexible in tree species selection and while they may select for certain tree species regionally, they likely are not dependent on certain species of trees for roosts throughout their range; rather, many tree species that form suitable cavities or retain bark will be used by the bats opportunistically (Foster and Kurta 1999, Silvis et al. 2016, Hyzy et al. 2020). NLEBs are nocturnal insectivorous foragers and use hawking (catching insects in flight) and gleaning (picking insects from surfaces) behaviors in conjunction with passive acoustic cues (Nagorsen and Brigham 1993, Ratcliffe and Dawson 2003). NLEB seem to prefer intact mixed-type forests with small gaps (i.e., forest trails, small roads, or forest-covered creeks) in forest with sparse or medium vegetation for forage and travel rather than fragmented habitat or areas that have been clear cut (USFWS 2015).

Spring staging and fall swarming – Spring staging for the NLEB is the time period between winter hibernation and spring migration to summer habitat (Whitaker and Hamilton 1998). During this time, bats begin to gradually emerge from hibernation, exit the hibernacula to feed, but re-enter the same or alternative hibernacula to resume daily bouts of torpor (state of mental or physical inactivity) (Whitaker and Hamilton 1998).

The swarming season occurs between the summer and winter seasons (Lowe 2012) and the purpose of swarming behavior may include: introduction of juveniles to potential hibernacula, copulation, and stop-over sites on migratory pathways between summer and winter regions (Kurta et al. 1997, Parsons et al. 2003, Lowe 2012, Randall and Broders 2014).

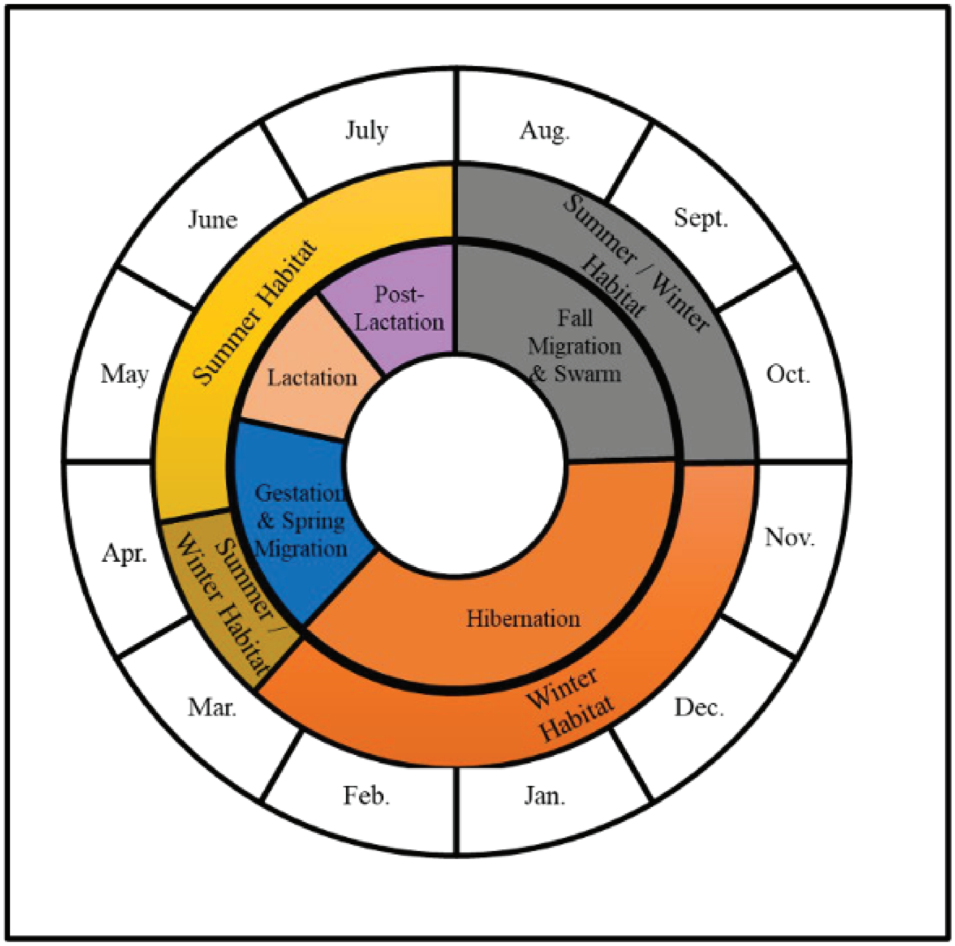

Figure 9. Generalized annual life history diagram for NLEB (adapted from Silvis et al. 2016).

Overall, for survival and reproduction at the individual level, the NLEB requires access to food and water resources when not hibernating, along with suitable habitat throughout its annual life cycle. During the spring, summer and fall seasons, NLEB requires suitable foraging, roosting, migrating (between summer and winter habitat) and swarming habitat with appropriate conditions for maternity colony members; during the winter, NLEB requires habitat with suitable conditions for prolonged bouts of torpor. For NLEB populations to be healthy, they require a population size and growth rate sufficient to withstand natural environmental fluctuations, habitat of sufficient quantity and quality to support all life stages, gene flow among populations, and a matrix of interconnected habitats that support spring migration, summer maternity colony formation, fall swarming, and winter hibernation (USFWS 2022).

Conservation Needs

The NLEB Species Status Assessment (SSA) report was exclusively referred to in determining conservation needs (USFWS 2022) as there is currently no recovery plan available for the species. The SSA serves as a synthesis of the best available information on the biological status and thus is helpful in assessing the current and future conservation needs of the species. The needs of the NLEB include having a sufficient number and distribution of healthy populations to ensure NLEB can withstand annual variation in its environment (resiliency), catastrophes (redundancy), and novel or extraordinary changes in its environment (representation). Resiliency is best measured by the number, distribution, and health of populations across the species' range. Redundancy can be measured through the duplication and distribution of resilient populations across the species' range relative to potential catastrophic events. Representation can be measured by the number and distribution of healthy populations across areas of unique adaptive diversity. For NLEB, 5 representation units (RPUs) were identified: Eastern Hardwoods, Southeast, Midwest, Subarctic, and East Coast (Figure 10). NLEB's requirements for resiliency, redundancy, and representation are summarized in Table 14.

Table 14. Species-level ecology: Requisites for long-term viability (ability to maintain self-sustaining populations over a biologically meaningful timeframe). From NLEB SSA (USFWS 2022).

3 Rs	Requisites Long-Term Viability	Description
Resiliency (populations able to withstand stochastic events)	Demographic, physically, and genetically healthy populations across a diversity of environmental conditions	Self-sustaining populations are demographically, genetically, and physiologically robust, have sufficient quantity of suitable habitat
Redundancy (number & distribution of populations to withstand catastrophic events)	Multiple and sufficient distribution of populations within areas of unique variation, i.e., Representation units	Sufficient number and distribution to guard against population losses and losses in species adaptive diversity, i.e., reduce covariance among populations; spread out geographically but also ecologically
Representation (genetic & ecological diversity to maintain adaptive potential)	Maintain adaptive diversity of the species	Populations maintained across breadth of behavioral, physiological, ecological, and environment diversity
	Maintain evolutionary processes	Maintain evolutionary drivers--gene flow, natural selection--to mimic historical patterns

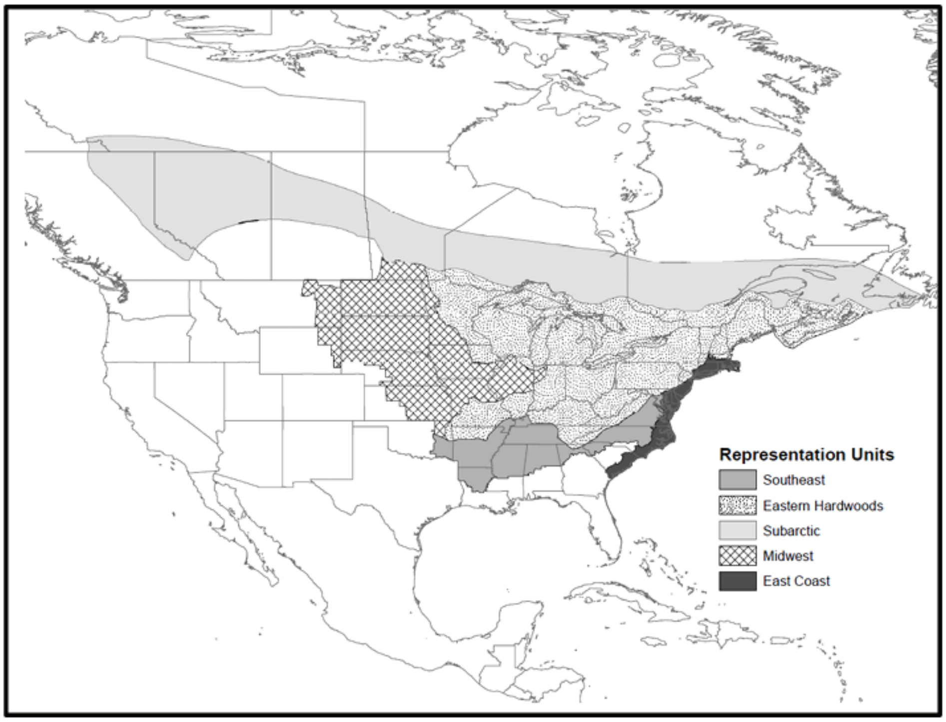

Figure 10. Range of NLEB organized into 5 Representation Units. From NLEB SSA (USFWS 2022).

Current condition

In the NLEB SSA report, the Service evaluated current condition (abundance, health, and distribution of populations in 2020) of the NLEB, using the best available data. Winter hibernacula counts provide the most consistent, long-term, reliable trend data, and provide the most direct measure of WNS impacts, even for species such as NLEB that may be undercounted (due to their proclivity to roost in crevices). Although the availability and quality of summer data vary temporally and spatially, this data offered additional support (to winter data results) in evaluating population trends. The SSA relied upon the data derived from North American Bat Monitoring Program (NABat) analyses for all available winter (NABat 2021) and summer data (NABat 2020, USFWS 2022).

Although there are many factors influencing the status of NLEB, the primary factor influencing the viability of the NLEB is WNS, a disease of bats caused by a fungal pathogen. Other primary factors that influence NLEB's viability include: wind energy mortality, effects from climate change, and habitat loss. WNS has been the foremost stressor on NLEB for more than a decade. The fungus that causes the disease, *P. destructans*, invades the skin of bats and infection leads to increases in the frequency and duration of arousals during hibernation and eventual depletion of fat reserves needed to survive winter, and often results in mortality. WNS has caused estimated NLEB population declines of 97–100% across 79% of the species' range. Wind energy-related mortality of NLEB is also proving to be a stressor at local and regional levels, especially in combination with impacts from WNS. Most bat mortality at wind energy projects is caused by direct collisions with moving turbine blades. Wind energy mortality may occur over 49% of the NLEB range.

As described in the above Climate Change section, climate change is occurring globally. Climate change variables, such as changes in temperature and precipitation, may influence NLEB resource needs, such as suitable roosting habitat for all seasons, foraging habitat, and prey availability. Although there may be some benefit to NLEB from a changing climate, overall negative impacts are anticipated, especially at local levels. Although any climate change effects to the NLEB to date are currently considered “low,” there is growing concern about impacts to bat populations in response to climate change (Service 2022).

Habitat loss may include loss of suitable roosting or foraging habitat, resulting in longer flights between suitable roosting and foraging habitats due to habitat fragmentation, fragmentation of maternity colony networks, and direct injury or mortality. Loss of or modification of winter roosts (i.e., making hibernaculum no longer suitable) can result in impacts to individuals or at the population level (USFWS 2022). Researchers have identified several climate change factors that may impact bats, including changes in hibernation; mortality from extreme drought, cold, or excessive rainfall; cyclones; loss of roosts from sea-level rise; and impacts from human responses to climate change (e.g., wind turbines). Climate change is also likely to influence disease dynamics as temperature, humidity, phenology, and other factors affect the interactions between WNS and hibernating bats (USFWS 2022). In addition, climate change could result in phenological mismatch (e.g., timing of various insect hatches not aligning with key life-history periods of spring emergence, pregnancy, lactation, or fall swarming) and cause shifts in distribution of forest communities, invasive plants, invasive forest pest species, or insect prey. Changes in temperature and precipitation likely will influence NLEB resource needs, such as suitable roosting habitat for all seasons, foraging habitat, and prey availability (USFWS 2022).

The NLEB’s risk of exposure to climate change is rangewide (USFWS 2022). However, the magnitude, direction, and seasonality of climate variable changes are not consistent rangewide. In addition, the resiliency of populations and inherent differences among populations (e.g., genetics, summer roost microclimates) may result in differing ability for the species to respond to the same types of changes across the range. While researchers have not observed these impacts in NLEB to date, based on studies of other insectivorous bat species, the Service has identified the following potential future risks: reduced reproduction due to drought conditions leading to decreased availability of drinking water and reduced adult survival during dry years; decreased insect availability and reduced echolocation ability resulting in decreased foraging success during heavy precipitation events; and reduced reproduction during cooler, wetter springs (USFWS 2022). As a result, the Service predicts “medium impact” to the NLEB from climate change in the future (USFWS 2022).

Available evidence, including both winter and summer data, indicates NLEB abundance has declined substantially from historical conditions. Winter abundance (from known hibernacula) has declined rangewide (49%) and across most RPUs (0–90%). In addition, the number of extant winter colonies declined rangewide (81%; Figure 11) and across all RPUs (40–88%). There has also been a noticeable shift towards smaller colony sizes, with a 96–100% decline in the number of large hibernacula (≥100 individuals). Declining trends in abundance and occurrence are also evident across much of the NLEB's summer range. Rangewide summer occupancy declined by 80% from 2010–2019 (Figure 12). Data collected from mobile acoustic transects found a 79% decline in rangewide relative abundance from 2009–2019 and summer mist-net captures declined by 43–77% compared to pre-WNS capture rates (USFWS 2022).

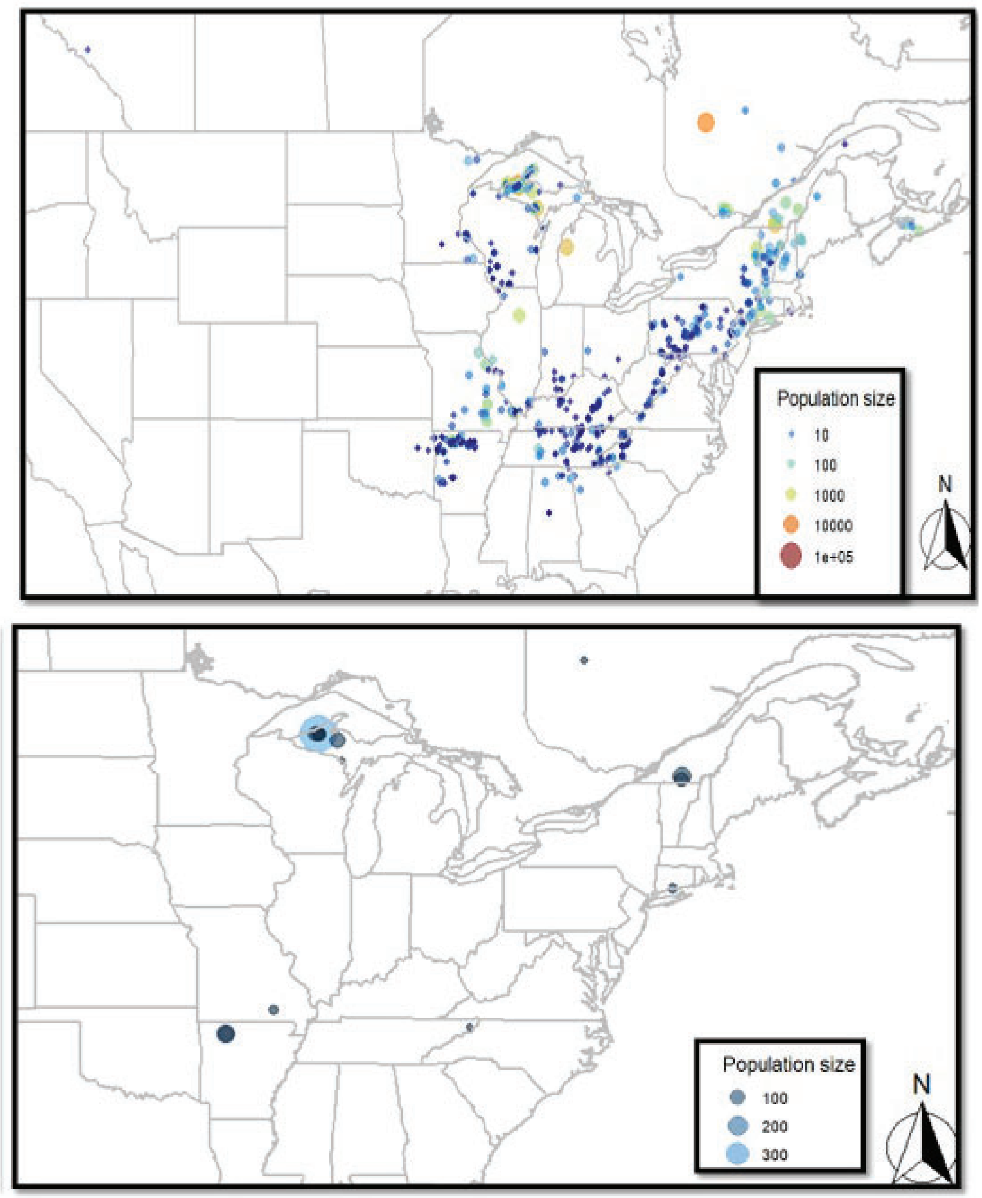

Figure 11. NLEB extant hibernacula at year 2000 (top) and projected at 2030 (bottom) given current state conditions (encompass the current abundance, growth rate, WNS occurrence, and installed wind energy capacity). Color and size reflect median hibernacula abundance (USFWS 2022).

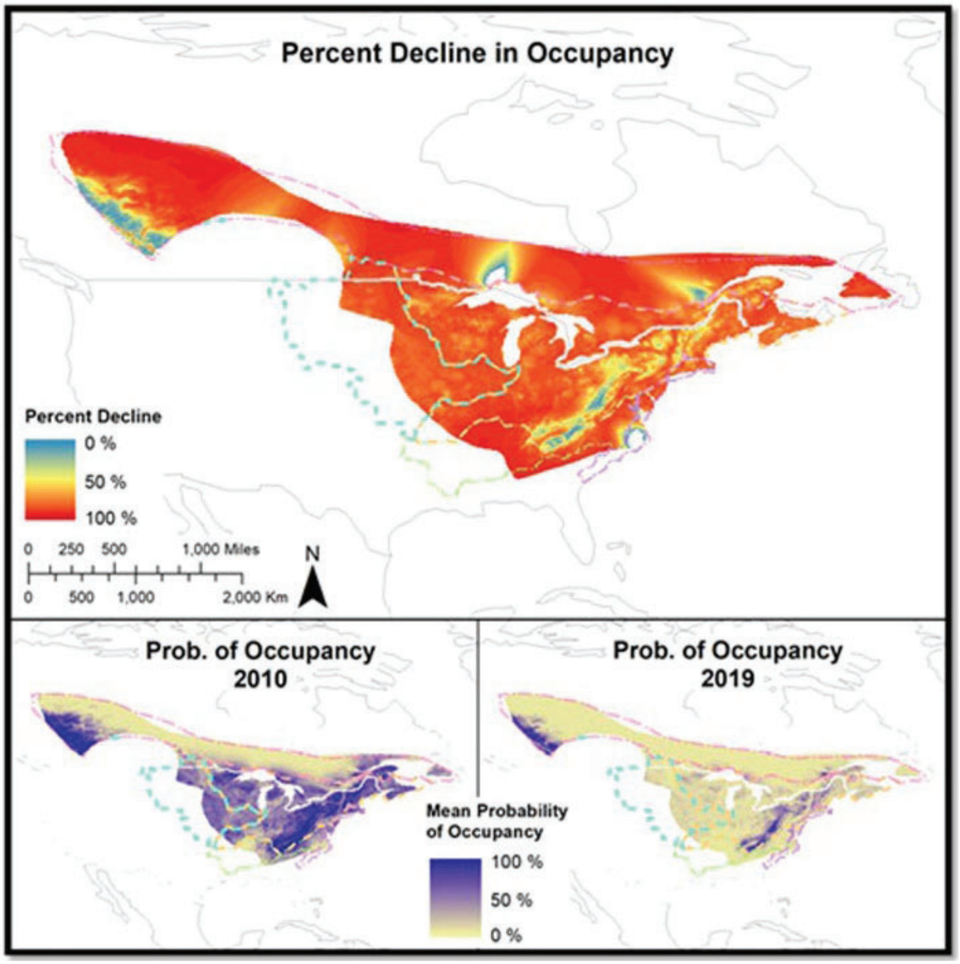

Figure 12. Predicted percent decline in probability of occupancy (top) and probability of NLEB summer occupancy in 2010 (bottom left) and 2019 (bottom right) based on data collected from stationary and mobile transect acoustic monitoring and capture records summarized at the 10 km x 10 km NABat grid cell (Stratton and Irvine 2022). Dotted boundaries correspond to RPUs. Cooler colors represent lower percent declines (top panel) or higher probability of occupancy (bottom panels; USFWS 2022).

Summary

In summary, the rangewide status of the NLEB is declining. After a review of the best available scientific and commercial information, the Service found that the NLEB meets the ESA's definition of an endangered species. On November 30, 2022, the Service published a final rule reclassifying the NLEB from threatened to endangered (87 FR 73488), which will become effective on March 31, 2023 (88 FR 4908). The SSA report (USFWS 2022) provided the scientific basis that informed the uplisting for the species. Below, is a summary of the SSA report's findings.

The SSA concluded, using multiple data types and analyses, downward trends in NLEB population abundance and distribution over the last 14 years and consequently, found no evidence to suggest that this downward trend will change in the future. NLEB abundance (winter and summer), number of occupied hibernacula, spatial extent, probability of persistence, and summer habitat occupancy across the range and within all RPUs are decreasing. Since the arrival of WNS, NLEB abundance steeply declined. At these low population sizes, maternity colonies are vulnerable to extirpation from stochastic events. Furthermore, NLEB's ability to recover from these low abundances is limited given their low reproduction output (1 pup per year). Therefore, NLEB's resiliency is greatly compromised in its current condition (and is projected to decline under modeled future scenarios). Additionally, because NLEB's abundance and spatial extent are projected to decline dramatically, NLEB will also become more vulnerable to catastrophic events. NLEB's representation has also been reduced. The steep and continued declines in abundance have likely led to reductions in genetic diversity, and thereby reduced NLEB adaptive capacity. Further, the projected widespread reduction in the distribution of hibernacula will lead to losses in the diversity of environments and climatic conditions occupied, which will impede natural selection and further limit NLEB's ability to adapt. Moreover, at its current low abundance, loss of genetic diversity via genetic drift will likely accelerate. Consequently, limiting natural selection process and decreasing genetic diversity will further lessen NLEB's ability to adapt to novel changes (currently ongoing as well as future changes) and exacerbate declines due to continued exposure to WNS, mortality from wind turbines, and impacts associated with habitat loss and climate change. Thus, even without further WNS spread and additional wind energy development, NLEB's viability is likely to rapidly decline over the next 10 years (USFWS 2022).

More information on the NLEB (e.g., SSA report, previous consultations, proposed and final uplisting rule) can be found by visiting the Service's NLEB website: https://www.fws.gov/species/northern-long-eared-bat-myotis-septentrionalis

Roanoke logperch (RLP)

The Service listed the RLP as endangered on August 18, 1989 (54 FR 34468). The following is a summary of RLP general life history drawn from the RLP recovery plan (Service 1992b), the RLP 5-year review (Service 2007a, Service 2022a), RLP SSA (Service 2022b), and peer-reviewed publications.

The RLP is a small darter (fish) found in VA and NC. Genetic analysis (Roberts et al. 2013) of RLP indicated a dispersal extent of up to 80 kilometers (km); however, median lifetime dispersal distance is 6-24 km (Roberts et al. 2016a). Adult RLP occupy medium to large warmwater streams with moderate to low gradient (Jenkins and Burkhead 1994). Microhabitats with loosely embedded substrate free of silt appear to be critical to this species (Rosenberger and Angermeier 2003). However, as noted in the SSA (Service 2022b), "…quantitative relationships between sediment measures like embeddedness and biological measures like growth, survival, and reproduction are unknown for RLP." The prevailing assumptions are: (1) habitat suitability depends on the amount of embedded stream bottom and that selection preference for least embedded becomes stronger with ontogenetic shifts (changes in RLP habitat requirements as individuals develop), and (2) studies have shown negative effects of deposited fine sediment on macroinvertebrate density (Rabeni et al. 2005) and hatching success of other gravel-spawning fishes (e.g., Harvey et al. 2009), which we assume would apply to RLP.

Male RLP mature in 2 years and most females mature in 3 years (Burkhead and Jenkins 1991). Maximum age has been documented at about 6.5 years (Jenkins and Burkhead 1994). Spawning occurs in April or May. Jenkins and Burkhead (1994) observed RLP spawning behavior and reported that several males acted aggressively to each other upon locating a female. Eggs are adhesive and deposited on the stream bottom (Jenkins and Burkhead 1994) where they are subsequently fertilized. Darters, such as the RLP, that bury or attach their eggs provide no subsequent parental care (Mattingly et al. 2003).

RLP are sight feeders and flip rocks with their snout to expose invertebrates and ingest the exposed prey (Jenkins and Burkhead 1994, Rosenberger and Angermeier 2003). The species does not actively select certain taxa but consumes most food items encountered. Young feed primarily on chironomid (non-biting midge) larvae and adults primarily consume caddisfly larvae and chironomids (Burkhead 1983).

Conservation Needs

The Service finalized a recovery plan for the RLP in 1992. The recovery objectives for RLP are to downlist to threatened then, once achieved, delist the species. The Service outlined the following conditions that we believed would result in the species no longer meeting the definition of an endangered species (Service 1992b): protecting and enhancing habitat containing RLP populations and expanding populations within river corridors that either now support this species or supported it historically.

The primary actions to address these criteria include: (1) Maintain and increase the health and vigor of present populations through a watershed-level conservation approach that addresses sediment loading and preserves ecological processes that provide ephemeral, seasonal, and persistent types of habitat required over RLP ontogeny; (2) Evaluate the feasibility of propagating RLP and determine whether a controlled propagation and reintroduction/augmentation plan should be developed; (3) Increase connectivity of RLP populations by identifying major and minor artificial movement barriers and eliminating them when feasible; (4) Prevent and reduce the risk of catastrophic extirpation from toxic spills through identification, evaluation, and improvement of present and proposed road crossings, agricultural, and industrial facilities; (5) Survey streams with suitable habitat and continue to identify habitat that is potentially suitable for RLP reintroduction/augmentation; and (6) Revise the recovery plan to include measurable criteria that specifically address each of the relevant listing factors and incorporate currently available information about population abundance and distribution (Service 2007a).

Because the recovery plan (Service 1992b) is more than 30 years old, the plan criteria do not reflect adequate metrics to assess recovery (Service 2022a). For example, the reclassification and delisting criteria do not include NC because RLP was not known to occur in that State at that time. Additionally, as discussed below, identifying what constitutes a population is unclear.

Current Condition

Now that we have described the species' basic needs, we can assess its current condition. Since the time of the RLP listing (1989) the most notable update is the expansion of its known range. The RLP geographic distribution, as tracked by stream, river basin, or U.S. Geological Survey hydrologic unit code (HUC), has increased. Originally RLP was only known in VA but was first observed in NC in 2007. It had been observed in 14 streams at the time of listing (1989), then increased to 31 streams in 2019. In terms of HUCs, the number of 12-digit HUCS in which the RLP has been observed has increased from a total of 27 HUCs at the time of listing (1989) to 55 HUCs in 2019.

It is difficult to assess long-term population trends primarily due to 2 factors: (1) the expanded range resulting in part from new surveys; and (2) changing methodologies used to identify populations. The recovery plan (Service 1992b), RLP 5-year review (Service 2007a), Roberts et al. (2013), and Roberts and Strickland (2017) used different methods to identify RLP populations. The RLP 5-year review (Service 2022a) and SSA (Service 2022b) use management units (MU) to assess the current and future condition, and we incorporate those designations into our analyses below because we believe they are based upon the best and most current information available pertaining to the species' population structure. The definition of a MU is: "At the smallest spatial grain, we defined a MU as a group of individuals occupying a discrete, local geographic area in which demographic exchange is common and habitat conditions are relatively homogeneous. At a larger grain, we defined a metapopulation as a group of MUs located in an evolutionarily similar setting and in close-enough proximity that some dispersal and gene flow among MUs within that metapopulation likely has occurred in recent ecological time, at least prior to anthropogenic habitat alteration. The species as a whole was the sum of all metapopulations" (Service 2022b). Table 15 provides a summary of the current conditions of RLP MUs in terms of the 3Rs.

Table 15. Table 6 from the SSA (Service 2022b). Overall current resiliency for each occupied RLP MU and current redundancy for each metapopulation based on population, habitat, and genetic conditions. Green, yellow, and red color coding indicates higher, intermediate, or lower potential for resiliency, respectively. Overall current resiliency is calculated for each MU, whereas overall current redundancy is calculated at the scale of metapopulations.

Metapopulation	Management unit	Population density	Effective population size	Habitat quality	Stream segments	Overall current resiliency score	Overall current redundancy score
Roanoke Mountain	Upper Roanoke	40.3	4792	High	7	7	49
Roanoke Piedmont	Pigg	30.4	2404	Average	3	6	24
Roanoke Piedmont	Goose	13.4	44	Average	1	1	
Roanoke Piedmont	Otter	9.5	396	Average	2	2	
Roanoke Piedmont	Middle Roanoke	13.6	Unknown	Low	1	1	
Dan	Upper Smith	28.2	784	Average	4	6	60
Dan	Middle Smith	24.8	458	Average	2	4	
Dan	Lower Smith	21.7	651	Average	1	4	
Dan	Lower Mayo	23.6	516	Average	1	4	
Dan	Middle Dan	18.5	1168	Average	4	5	
Chowan	Nottoway	21.1	1200	Average	5	6	30

Threats

The SSA identified 6 factors that have a strong effect on the RLP: (1) fine-sediment deposition; (2) chronic chemical pollution; (3) dams and other barriers; (4) climate change; (5) existing legal and regulatory mechanisms; and (6) management/restoration activities aimed at improving habitat quality. Of those, factors 1-4 were identified as threats to the RLP. These factors align with many of the threats discussed in the 2007 5-year review (Service 2007a): large dams and reservoirs, small dams/barriers, channelization that will lead to increased sedimentation, agricultural and silvicultural activities (non-point source pollution in the form of fine sediment), and toxic spills.

Many of the specific threats to the RLP are intertwined and as stated in section 3.3 of the SSA (Service 2022b), "no previous research has directly quantified relationships between these six factors and RLP vital rates (reproduction and survival rates), so in assessing current and future condition, we based our assumptions about the nature of these relationships on a combination of ecological theory, expert judgment, and simulation models." Effects from specific threats identified in the RLP recovery plan (Service 1992b) such as fine sediment deposition, chemical pollution, dams and other barriers, and the newer threat of climate change are represented in the SSA simulation models but are not explicitly attributed to each threat. As described above in the Climate Change section, climate change is occurring globally and as noted in the SSA (Service 2022b), outputs from the Climate Voyager model (Climate Voyager, version 0.5. [2016, July], retrieved May 18, 2021, from http://climate.ncsu.edu/voyager) predicted an average of 5-8° Fahrenheit increase with approximately 1 inch increase in precipitation per year. Climate change may affect precipitation frequency and intensity, runoff patterns, and stream hydrology (Ingram et al. 2013, Burt et al. 2016), which may negatively affect the RLP's abilities to forage, shelter, and reproduce.

Improvements

Beneficial modifications to the species habitat include numerous instream and bank restoration projects that have been completed across the species' range. Multiple dams/barriers have also been removed in both VA and NC, connecting hundreds of miles of RLP habitat. Additional details are presented in the SSA (Service 2022b).

Summary

The overall resiliency index for current species condition was highest in Upper Roanoke, Pigg, Upper Smith, Middle Dan, and Nottoway MUs and was high or intermediate in all but 2 of the MUs (Table 15). Additionally, redundancy, which incorporates resiliency and connectedness of the species, was high in 7 of the 11 MUs and intermediate in the remaining 4 MUs.

As discussed in more detail below, the SSA (Service 2022b) simulated population-size changes and future conditions under 12 scenarios featuring alternative combinations of urbanization, climate change, and conservation intervention. Scenario 4 was the most dire, with no management, increased risk of watershed urbanization, decreased habitat suitability, no population augmentation, and no barrier removal. Under this scenario at least 1 MU persisted in each metapopulation. Both the Upper Roanoke MU and Pigg MU persisted in this scenario.

In summary, as a whole the rangewide status of the species is improving and the Service recommended delisting the RLP due to recovery in its 5-year review (Service 2022a). The RLP has a low risk of extinction in the near term, and that the risk is not likely to increase appreciably in the foreseeable future (Service 2022a). For additional documents related to the RLP (e.g., recovery plan, Federal Register notices, biological opinions, etc.) refer to: https://www.fws.gov/species/roanoke-logperch-percina-rex.

Candy darter (CD)

The Service listed the CD as endangered on December 21, 2018 (83 FR 58747). The following is a summary of CD general life history drawn from the CD SSA (Service 2018a), reports, and peer-reviewed publications.

The CD is a small, freshwater fish endemic to second order and larger streams and rivers within portions of the upper Kanawha River basin, which is synonymous with the Gauley and greater New River watersheds in VA and WV. The CD is a habitat specialist and is typically found in high- to moderate-gradient, cool- or cold-water stream ecosystems, although warm-water conditions may also be tolerated. The species is most often found in riffle, glide, or run habitats, and is relatively uncommon in pool habitats. CDs are generally intolerant of excessive stream sedimentation and resulting cobble embeddedness (the degree to which cobbles are covered in fine-sized substrate particles). However, YOY and juveniles may be more capable of utilizing habitats with slower-moving water containing smaller substrate and a greater proportion of fine sediments than adults. CDs are benthic invertivores (McCormick et al. 2001) and their main prey items are benthic macroinvertebrates, such as mayflies and caddisflies.

CDs were previously thought to have a relatively short life cycle, reaching sexual maturity by age 2 and often dying during their third year (Jenkins and Burkhead 1994). However, research by McBaine and Hallerman (2020) on the age structure of CD populations in VA found individuals up to age 5, with the majority of individuals in the Stony Creek, VA population in age classes 2 and 3. The findings in McBaine and Hallerman (2020) also suggest the CD reproductive lifespan may be 4 years, as opposed to the 2 years reported in Jenkins and Burkhead (1994). McBaine et al. (2022) also found evidence that females can reproduce in 4 consecutive years – with many females spawning in 2 or 3 years – which coincides with sexual maturity at age 2. Parentage assignment provided evidence that both sexes spawn with multiple partners each year. Spawning occurs from late spring to early summer, typically April 15 through June 30 in WV and VA. The CD is considered a brood-hiding, benthic spawner, with gravid females depositing eggs in pebble and gravel substrate among larger cobbles and boulders, where they are fertilized by attendant males. Although females may lay multiple clutches, they have a relatively low number of ova per clutch (Schoolcraft et al. 2002). Eggs incubate for 5 to 30 days depending on stream water temperature.

Ontogenetic shifts (changes in CD habitat requirements as individuals develop) and seasonal habitat plasticity (adaptability of CDs to differences between habitats as seasons change) may introduce complexity when identifying suitable habitat for some CD populations (Dunn and Angermeier 2016). Candy darters exhibit complex intra-system spatial distributions and ontogenetic movement patterns. During early life stages, larvae are likely to exhibit movement over greater distances and are prone to moving in a downstream direction but then tend to move upstream over the remainder of their first 2 years of life. After investigating parent-offspring genetic analyses (i.e., parentage analyses) in VA streams, McBaine et al. (2022) reported YOY were generally captured farther from parents than age 1+ offspring. Additionally, sibling CD pairs exhibited greater separation from one another in Stony Creek, by comparison to Laurel Creek (Bland County, VA), which is likely an artifact of discrepant spatial distributions available in the 2 streams. Stony Creek supports 18.8 skm of suitable habitat whereas Laurel Creek supports 4.25 skm. In Stony Creek, full sibling pairs were generally separated by more than 100 m. The average distance between full sibling pairs was 5.3 km and ranged from 0 to 10.25 km.

Conservation Needs

The Service developed a recovery outline for the CD in 2018 (Service 2018b). As described in this outline, CD conservation needs include: an absence of nonnative fish species (particularly, the closely related variegate darter [*Etheostoma variatum*]); unembedded gravel and cobble substrates with minimal sedimentation; adequate water quality (temperatures, physical and chemical parameters); an abundant, diverse benthic macroinvertebrate community; and sufficient water quantity and velocities. Absence or degradation of these features could limit populations of the CD.

The primary actions to address these needs include: maintain extant populations by conserving the genetic diversity and physical and biological features on the landscape that are essential for the species' conservation; minimize the risk of variegate darter introductions or spread in areas with little evidence of introgression; investigate factors that would minimize and control hybridization, and implement those measures in currently occupied areas that are affected by ongoing hybridization; repatriate CDs to historically occupied areas where variegate darters are not present; and investigate feasible methods to remove variegate darters and repatriate CDs.

Current Condition

The historical distribution of CD was more expansive than the current distribution (Figure 13, Jenkins and Burkhead 1994). Historically, the CD occurred in 35 populations distributed across 7 metapopulations located in the Bluestone, Lower New River, Upper Gauley, Lower Gauley, Greenbrier, Upper New, and Middle New watersheds. However, the CD has been extirpated from almost half of its historical range; 17 of 35 known populations and 2 of 7 known metapopulations have been extirpated. The species is no longer known to naturally occur in the Bluestone and Lower New River watersheds. In furtherance of reintroduction and recovery efforts, propagated CD have recently been stocked in locations that were historically occupied by CD in the Bluestone River watershed in WV, above Bluestone Dam, outside of the aquatic action area. It will take years to determine whether the reintroduction efforts result in a naturally reproducing CD population at the restoration locations or if any benefits occur to the species as a whole. Chipps and Perry (1993) reported on the status of CD on the Monongahela National Forest and found them to be well-distributed in the Cherry, Upper Greenbrier, and Upper Gauley river systems. However, they expressed concerns for populations in the Williams River, Deer Creek, and Anthony Creek and identified siltation as the major threat to these CD populations. The species has since been extirpated from Anthony Creek, largely due to hybridization with the variegate darter (Service 2018a). The most abundant remaining CD populations occur in the Upper Gauley and upper Greenbrier River watersheds, and in Stony Creek in the Middle New River watershed (Service 2018a).

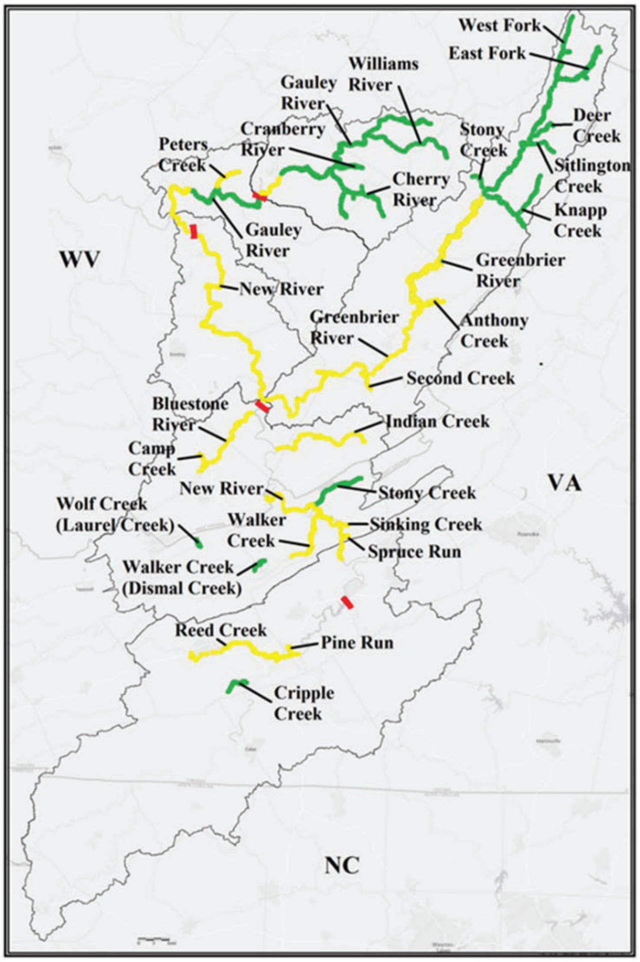

Figure 13. Current and historical distribution of the CD. Green indicates extant populations; yellow indicates historical or extirpated populations (Service 2018a). Red lines are major dams that present barriers to fish movement. Recent CD reintroductions are not reflected in the figure.

Excessive sedimentation was likely a primary cause of the historical decline of the CD (Service 2018a). The primary factor influencing the current status in WV is hybridization with the introduced but closely related variegate darter (Figure 14, Service 2018a). Other contributing threats to CD populations include increases in water temperature, excessive sedimentation, habitat fragmentation, changes in water chemistry and water flow, and competition with non-native species. As stated in the CD SSA (Service 2018a), “While water temperature, sedimentation, habitat fragmentation, water chemistry, water flow, and nonnative competition likely influenced the species’ current condition and may affect some individual populations in the future, the hybridization with variegate darters appears to be having, and will continue to have, the greatest influence on candy darter populations and its overall viability within the next 25 years.” In the early 1980s, variegate darters or putative hybrids were first collected at locations upstream of Kanawha Falls, and have since undergone range expansion. Widespread hybridization was found throughout populations of CDs, with the geographic range of hybridization expanding from 2004 to 2014. Gibson et al. (2019) concluded that introgressive hybridization threatens the genetic integrity of the CD and may lead to population extirpation or extinction. Evaluation of CD range and speciation has helped to identify streams where CD populations still occur, where variegate darter are hybridizing with CD, and where there is relative robustness of remaining intact populations of CD (Switzer et al. 2008, Gibson 2017, Service 2018a, Gibson et al. 2019). "Genetic swamping" is a process in which populations of genetically pure CD are repeatedly hybridized with introduced variegate darters over successive generations until alleles from CD are entirely replaced. In such cases, CD populations are eventually replaced entirely by a combination of variegate darters and CD/variegate darter hybrids, with no pure CD remaining. While genetic swamping by variegate darters is underway in the lower Gauley River, the upper Gauley River still retains relatively pure CD populations (Gibson et al. 2019).

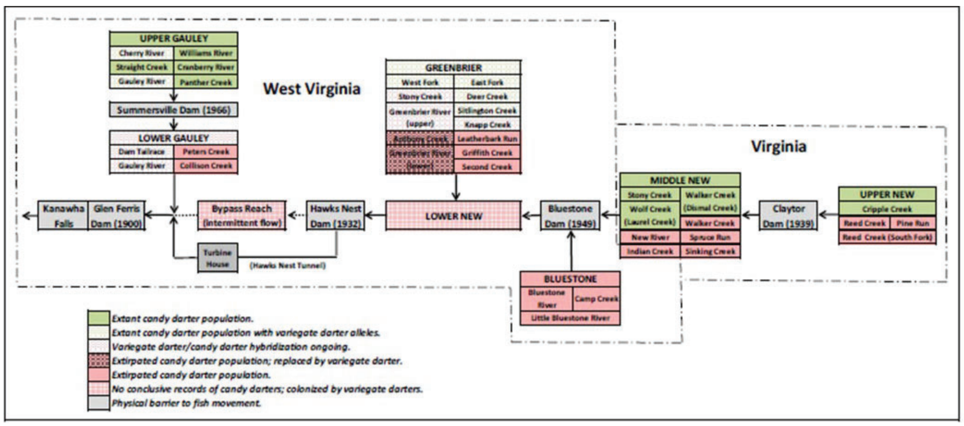

Figure 14. Conceptual model of CD distribution, connectivity, and hybridization status (as of April 2017). Arrows indicate direction of water flow (Service 2018a).

Sedimentation remains a problem in many streams within the range of the CD. In the Ridge and Valley physiographic province of WV, which includes the Greenbrier River watershed, an estimated 21.5% of the total stream miles were rated as "poor" with respect to sedimentation, 43.2% were rated "fair," and 35.3% were rated as "good." In the Appalachian Plateaus province, which includes the Gauley and Lower New River watersheds, 41.5% of the stream miles were rated as "poor," 36.3% as "fair," and 22.2% as "good" (WVDEP 2012). A similar regional breakdown of stream sedimentation is not available for VA, but statewide estimates indicate that 40.0% of the stream miles were "suboptimal" with respect to sedimentation, 17.4% were "fair," and 42.6% were "optimal" (VDEQ 2018).

As described in the above Climate Change section, climate change is occurring globally. Climate change may affect precipitation frequency and intensity, runoff patterns, and stream hydrology (Ingram et al. 2013, Burt et al. 2016), which may negatively affect the CD's abilities to forage, shelter, and reproduce. To date, the CD and its habitat are not known to have experienced effects attributable to climate change (P. Angermeier, USGS, email to J. Spaeth, EDGE, June 15, 2022).

As stated in the CD SSA, "Empirical data on the effects of warm water temperatures on candy darter physiology or reproductive success are lacking, therefore we are uncertain about the significance of increased water temperatures on the species' viability." Consideration of the effects of climate change on the CD over the next 25 years suggested that in the higher elevation, CD populations (i.e., upper Gauley and upper Greenbrier) in more forested areas may be at low risk of the effects of climate change, while the populations in less forested areas in the middle and upper New River watersheds may be increasingly stressed as warming trends continue (Service 2018a).

Summary

Of the 18 extant CD populations, 5 currently have high or moderate to high resiliency. These populations are located in the Upper Gauley, Greenbrier, and Middle New River metapopulations. The remaining 2 extant metapopulations (Lower Gauley and Upper New River) maintain populations with moderate and low resiliency. Therefore, the CD currently maintains moderate resiliency (Service 2018a). The loss of CD populations and the areas they represented within the species' historical range, as well as the fragmentation of extant populations, has compromised the species' ability to repatriate those areas or avoid species level effects from a catastrophic event. Therefore, the CD's current redundancy is moderate to low (Service 2018a).

The best available data for the CD indicate that there is a high level of genetic differentiation between the Greenbrier River and Upper and Lower Gauley River metapopulations. These metapopulations currently have moderate resiliency, however the loss of either would represent a substantial reduction in the species' genetic representation. Although the CD retains representation in both the Appalachian Plateaus and Valley and Ridge physiographic provinces, the species has a different distribution than it had historically, and likely a different ability to respond to stochastic and catastrophic events, thereby putting the species at increased risk of extinction from any such events. Therefore, we conclude that the species' representation is currently moderate to low (Service 2018a).

Within these 2 physiographic provinces, the CD has been extirpated from almost half of its historical range; 17 (49%) of 35 known populations (and 2 [29%] of 7 known metapopulations), with the extirpations representing a complete loss of resiliency in those populations. Combining physical habitat metrics, non-native competition metrics, and CD demographic metrics, we have concluded that of the 18 extant populations, 5 (28%) have high or moderate to high resiliency, 9 (50%) have moderate resiliency, and 4 (22%) have low or moderate to low resiliency. The 5 populations with higher resiliency occur in 3 metapopulations (Upper Gauley, Greenbrier, and Middle New River); the remaining 2 extant metapopulations (Lower Gauley and Upper New River) maintain populations with moderate and low resiliency. Therefore, we conclude the CD currently maintains moderate resiliency (Service 2018a).

In summary, as a whole, the rangewide status of the species is declining. The ongoing threats of introgressive hybridization and stream degradation make the recovery potential low for CD in the near term. For additional documents related to the CD (e.g., recovery plan, Federal Register notices, biological opinions, etc.) refer to: https://ecos.fws.gov/ecp/species/1396

STATUS OF CRITICAL HABITAT

No critical habitat has been designated for: VASP, RLP, or NLEB. Critical habitat for Ibat has been designated in 13 winter hibernacula (11 caves and 2 mines) in 6 states (including Hellhole Cave in Pendleton County, WV) (41 FR 41914); however, this action does not affect any of those areas and none of them occur in or near the action area.

Candy darter (CD) critical habitat

The Service designated critical habitat for the CD on May 7, 2021 (86 FR 17956). A total of 368 stream miles in 5 critical habitat units were designated for the CD in WV and VA: (1) Greenbrier River, (2) Middle New River, (3) Lower Gauley River, (4) Upper New River, and (5) Upper Gauley River (Figure 15).

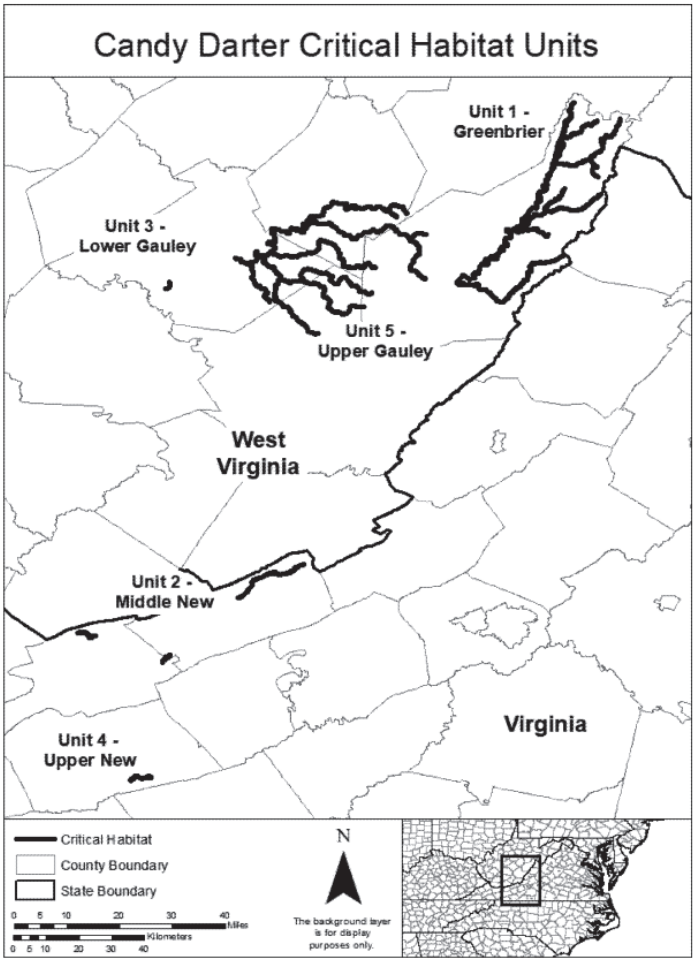

Figure 15. CD critical habitat units.

The critical habitat final rule (86 FR 17956) provided the overall habitat characteristics that are important for the CD. These include “sufficiently stabilized forest streambanks throughout the watersheds such that water quality allows for normal feeding, breeding, and sheltering in an area with sufficiently low numbers of nonnative species (Service 2018a). The features essential to the conservation of the candy darter may require special management considerations or protections to reduce the following threats: (1) Hybridization with the nonnative variegate darter; (2) general increase in water temperature, primarily attributed to land use changes; (3) changes in water chemistry, including, but not limited to, changes in pH levels or concentrations of certain contaminants (such as, but not limited to, coliform bacteria); (4) habitat fragmentation primarily due to construction of barriers and impoundments; (5) excessive sedimentation and stream bottom embeddedness (the degree to which gravel, cobble, rocks, and boulders are surrounded by, or covered with, fine sediment particles); and (6) competition for habitat and other instream resources and predation from nonnative fishes.”

The designated critical habitat is characterized by having the following physical or biological features (PBFs) that are essential for the conservation needs of the CD: (1) Ratios or densities of nonnative species that allow for maintaining populations of CDs; (2) cobble that allows for normal breeding, feeding, and sheltering behavior; (3) Adequate water quality characterized by seasonally moderated temperatures and physical and chemical parameters (e.g., pH, dissolved oxygen levels, turbidity, etc.) that support normal behavior, growth, and viability of all life stages of the CD; (4) An abundant, diverse benthic macroinvertebrate community (e.g., mayfly nymphs, midge larvae, caddisfly larvae) that allows for normal feeding behavior; and (5) Sufficient water quantity and velocities that support normal behavior, growth, and viability of all life stages of the CD.

As noted in the CD final rule (86 FR 17956), the 5 designated critical habitat units are currently (i.e., at the time of listing) occupied by the CD. These units are considered occupied year-round for the purposes of consultation based on current survey data. The 5 critical habitat units contain one or more of the PBFs to support life-history processes essential to the conservation of the CD. Some units contain all of the identified PBFs and support multiple life-history processes. Some units contain only some of the PBFs necessary to support the CD's particular use of that habitat. In these areas, any actions that may affect the species or its habitat would also affect designated critical habitat, and it is unlikely that any additional conservation efforts would be recommended to address the adverse modification standard over and above those recommended as necessary to avoid jeopardizing the continued existence of the CD.

Of the 5 units, 4 are marginally secure, and the Upper New unit is generally insecure (Service 2018a). The Upper Gauley unit is the most secure, based on a high percentage of forest cover (an indicator of low levels of siltation and embeddedness of stream substrate), absence of variegate darters, and a high degree of connectivity among populations. The Upper Gauley unit has cold waters, with some degree of water quality impairment by aluminum, iron, or high water acidity. The Greenbrier Unit generally has better water quality than the Upper Gauley unit, but the CD has a high degree of hybridization with the variegate darter in this watershed (Service 2018a).

Variegate/CD darter hybridization is known to occur in the Greenbrier and Lower Gauley units, while variegate alleles in CD are present in portions of the Upper Gauley unit at very low prevalence. There are no variegate darter hybridization or alleles in CD in the Middle New or Upper New units. Non-native trout species, which are CD predators, are known to occur in all units. The Upper Gauley and Middle New units are partially within the action area. The other units are not within the action area.

The final critical habitat designation does not include all streams known to have been historically occupied by the species; instead, it focuses on occupied streams within the historical range that retain the necessary PBFs that allow for the maintenance and expansion of existing populations (83 FR 59232). In summary, as a whole, the status of critical habitat is stable to declining for most designated critical habitat units. The ongoing threats of introgressive hybridization and stream degradation make the recovery potential low for CD in the near term. For more information about CD designated critical habitat, refer to: https://ecos.fws.gov/ecp/species/1396.

ENVIRONMENTAL BASELINE

In accordance with 50 CFR 402.02, the environmental baseline refers to the condition of the listed species or its designated critical habitat in the action area, without the consequences to the listed species or designated critical habitat caused by the proposed action. The environmental baseline includes the past and present impacts of all Federal, State, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early Section 7 consultation, and the impact of State or private actions which are contemporaneous with the consultation in process. The consequences to listed species or designated critical habitat from ongoing agency activities or existing agency facilities that are not within the agency's discretion to modify are part of the environmental baseline.[10]

In response to direction from the U.S. Court of Appeals for the Fourth Circuit, the SBA2 (Mountain Valley 2022) includes a comprehensive review of the MVP project's terrestrial and aquatic action area to identify and characterize the activities and stressors that contributed to the environmental baseline condition for each of the affected species. The assessment was guided by the long-standing definition of environmental baseline at 50 C.F.R. § 402.02 and includes the past and present impacts of all federal, state, or private actions and other human activities, as well as natural factors, leading to the condition of each species, its local ecosystem, and its habitat. The SBA2 identifies all known stressors to each species and its environment as well as the past and present activities and natural factors that can cause or contribute to those stressors and therefore influence the condition of each species and its habitat in the action area.

The baseline assessment in the SBA2 also determined the baseline conditions in each stream potentially containing listed aquatic species using field evaluations of all publicly accessible areas in the streams of interest, supported by drone surveys and aerial imagery review of any areas not publicly accessible. These tools were used to aid overall understanding of external, existing, contributing natural and third-party stressors and operations adjacent to the aquatic action area, including but not limited to mining, agriculture, timber management, urbanization, and commercial facilities. Supplemental information related to anthropogenic influences and water quality issues or impairments were also compiled to provide a baseline stream characterization of each waterbody. The aquatic action area in streams of interest was assessed

[10] Note that in addition to typical analyses of each species' status in the action area, some project-specific information related to effects is discussed in order to provide relevant background that is helpful for comprehension of the environmental baseline analysis. To be clear, the Service is not analyzing the project as part of the environmental baseline. Moreover, beyond the contextual purposes this information serves here, it also provides the foundation for the effects analyses that follow later in this Opinion.

using a combination of geographic information system (GIS) desktop analyses and imagery data capture for ground-truthing purposes. In addition to desktop analyses, georeferenced photographs and high-resolution aerial imagery using drones were used to qualitatively evaluate the riparian zones, instream habitats, anthropogenic influences, substrate compositions, and bank stability and erosion. The complete results of this work are presented in Appendix J in the SBA2 (Mountain Valley 2022).

The SBA2 baseline assessment also includes use of a novel aerial imagery survey platform to identify land cover classes across the project's entire action area and surrounding locations to help establish environmental baseline conditions potentially affecting listed species within the action area. The program, developed by Mountain Valley's consultants, achieved results that were more representative of current baseline conditions than USGS National Land Cover Database (NLCD) values, with a spatial resolution 9 times finer than NLCD, and was able to identify bare soil land cover at higher resolution. The program was used to identify land cover classifications for each USGS HUC-12 watershed containing aquatic or terrestrial action area for each project construction spread. This approach enabled the aerial imagery analysis to account for land classifications both within and in relevant proximity to the action area that could give rise to aquatic species stressors within the action area. It also enabled overlay of each species' habitat areas and occurrences within the terrestrial action area to evaluate the various stressor types affecting each species, allowing for a highly specialized and granular characterization of the environmental baseline for each species. This program enabled an assessment of environmental baseline conditions far more advanced than any other available method. The complete results of this work are presented in Appendix H in the SBA2 (Mountain Valley 2022).

The Service has independently reviewed the data collection methods used in the comprehensive baseline assessment provided in the SBA2 (Mountain Valley 2022) and concludes that the resulting information represents the best available information regarding the physical conditions, activities, and stressors in the action area that may influence the baseline condition of each affected species and its habitat. As a result, we have incorporated the results of Mountain Valley's assessment into our analysis of the environmental baseline for each species.

Greene Interconnect – Greene Interconnect is a metering and regulating station located adjacent to the MVP project, near MP 180.5 in Monroe County, WV. The project is designed to deliver approximately 1 billion cubic feet per day of natural gas from the MVP project to Columbia Gas Transmission, LLC's KA transmission system. Greene Interconnect is a distinct project that had not been proposed at the time the 2017 Opinion was finalized. On June 4, 2019, Mountain Valley filed with FERC in Docket No. CP19-477 to request authorization to construct the interconnect. In August 2019, the Service's WVFO completed Section 7 consultation on the Greene Interconnect project. The Service concluded that the project was not likely to adversely affect any listed species or designated critical habitat and any take of NLEB was exempted under the 4(d) rule (D. Bremer, Service, letter to D. Swearingen, FERC, August 1, 2019). The Greene Interconnect is within the MVP project action area. Construction work on the Greene

Interconnect is mechanically complete, and the facility is ready for commissioning.

MVP Southgate – MVP Southgate is a natural gas pipeline system that will run approximately 75 miles from the terminus of the MVP project at the Lambert Compressor Plant in southern VA into central NC. MVP Southgate is a distinct project that was not proposed at the time the 2017 Opinion was issued; the project proponent submitted its application to FERC requesting authorization to construct the pipeline on November 6, 2018. In March 2020, the Service's Raleigh, NC Field Office completed Section 7 consultation on the MVP Southgate project. The Service concluded that MVP Southgate is not likely to adversely affect any listed species or designated critical habitat (P. Benjamin, Service, letter to K. Bose, FERC, March 19, 2020). A small section of MVP Southgate overlaps with the MVP project action area.

Because the Service concluded that MVP Southgate and the Greene Interconnect are not likely to adversely affect listed species or designated critical habitat, the projects do not materially alter the environmental baseline for the MVP project described below.[11]

Status of the Species within the Action Area

Virginia spiraea (VASP)

The proposed action crosses portions of the Gauley, Greenbrier, and Meadow Rivers, in Nicholas and Summers Counties, WV, which provide habitat for VASP (https://ecos.fws.gov/ecp/species/1728). VASP surveys were completed near these rivers across a 300 ft wide environmental study corridor (a total of 3.64 acres along 0.14 mile) (ESI 2015a) in 2015 and no VASP was found (ESI 2016a). Route realignments and variance requests have occurred since the issuance of the Service's 2017 Opinion; however they did not necessitate additional surveys because they did not impact any additional potential habitat for this species.

Due to restricted access, 2.3 acres (parcel WV-SU-046) within the construction ROW, ARs, and ATWS in close proximity to the Greenbrier River in Summers County was not surveyed prior to the issuance of the Service's 2017 Opinion. A survey for VASP was conducted within the parcel on December 20, 2017. However, the survey was conducted during a time of year (i.e., December) when surveys for VASP cannot confirm presence or absence of the species (Service 2021), and the photos/summary of the habitat included in the reports for the December 2017 survey (ESI 2018a, ESI 2018b) did not otherwise confirm that VASP habitat is not present. A VASP survey was conducted in July 2022 on parcel WV-SU-046 during the appropriate survey window and the survey determined that no VASP were present and that the site did not contain suitable habitat for the species, based on the typical habitat described for VASP (ESI 2022). However, because WV has known occurrences of VASP in atypical habitats such as forested or shrubby wetlands, open wetlands, and small streams (Service 1992a; WVDNR 2012, 2013), the

[11] For the same reason, if MVP Southgate and the Greene Interconnect are considered consequences of the MVP project, the projects would not materially change our analysis of the effects of the action detailed below.

parcel contains a wetland and small stream, and tree-clearing and timber mat placement occurred on the site, including in the wetland, in September 2018 (as discussed below), the Service cannot confirm that VASP was absent and that no suitable habitat was present before work was initiated on the parcel. Therefore, the Service is not able to confirm that the 2.3-acre parcel does not contain suitable occupied VASP habitat.

Potentially suitable habitat for VASP has been identified in the 2.3-acre area based on the VASP habitat model (WVDNR 2017). Because VASP occurs along rivers, streams, and wetlands, we used National Wetlands Inventory maps to confirm that the 2.3 acres contain suitable habitat. Thus, for the purposes of this Opinion, presence of VASP suitable habitat is assumed within the 2.3 acres.

To estimate the extent of VASP within the 2.3 acres, we used 1996-2010 VASP occurrence data from the Greenbrier River (Table 16). This data was collected from 3 VASP occurrences (WVDNR 2011), which together are considered 1 population (the Greenbrier River population). More recent data is available for these occurrences. The more recent data was collected using the stem count method, instead of the extent of VASP coverage method used in previous years. The stem count method focuses on the number of individual stems present rather than the amount of area occupied. Therefore, because of the difficulty in using this new data to determine extent of coverage, we are utilizing the 1996-2010 data. However, the more recent stem count surveys indicate the occurrences appear to be healthy and comparable in size to previous years (WVDNR 2019).

Based on the survey data collected from the Greenbrier River population, the extent of VASP coverage averaged 221.33 m^2 (0.05 acre) for each occurrence (Table 16). It is unlikely that there would be more than 1 VASP occurrence within the 2.3-acres because of the limited amount of suitable habitat present within the parcel. Therefore, we are assuming the extent of VASP coverage within the 2.3 acres is 0.05 acre, and that the VASP on this 0.05 acre is 1 occurrence, which is also part of the Greenbrier River population.

Table 16. Estimated coverage of VASP at a WVDNR monitoring site on the Greenbrier River (WVDNR 2011).

Year	**Extent of Coverage (m^2)**
1996	205.31
1997	183.00
2001	226.37
2003	226.37
2005	233.07
2007	237.61
2010	237.61
Average	221.33

Since VASP is a species that occurs along rivers, streams, and wetlands, we are assuming that within the 2.3 acres the 0.05 acre of VASP is either along a 406.45 linear ft reach of an unnamed tributary of the Greenbrier River (S-EF53) or within a 1.21-acre wetland (W-MM20-PFO), between MP 171.2-171.4, that overlaps with the construction ROW, ARs, and ATWS (Figure

16). Tributary S-CV 17 (Figure 16) was not considered potential VASP habitat because it is not a direct tributary of the Greenbrier River, which is where VASP is known to occur; therefore it is unlikely that the Greenbrier River population would be able to establish an occurrence in Tributary S-CV 17.

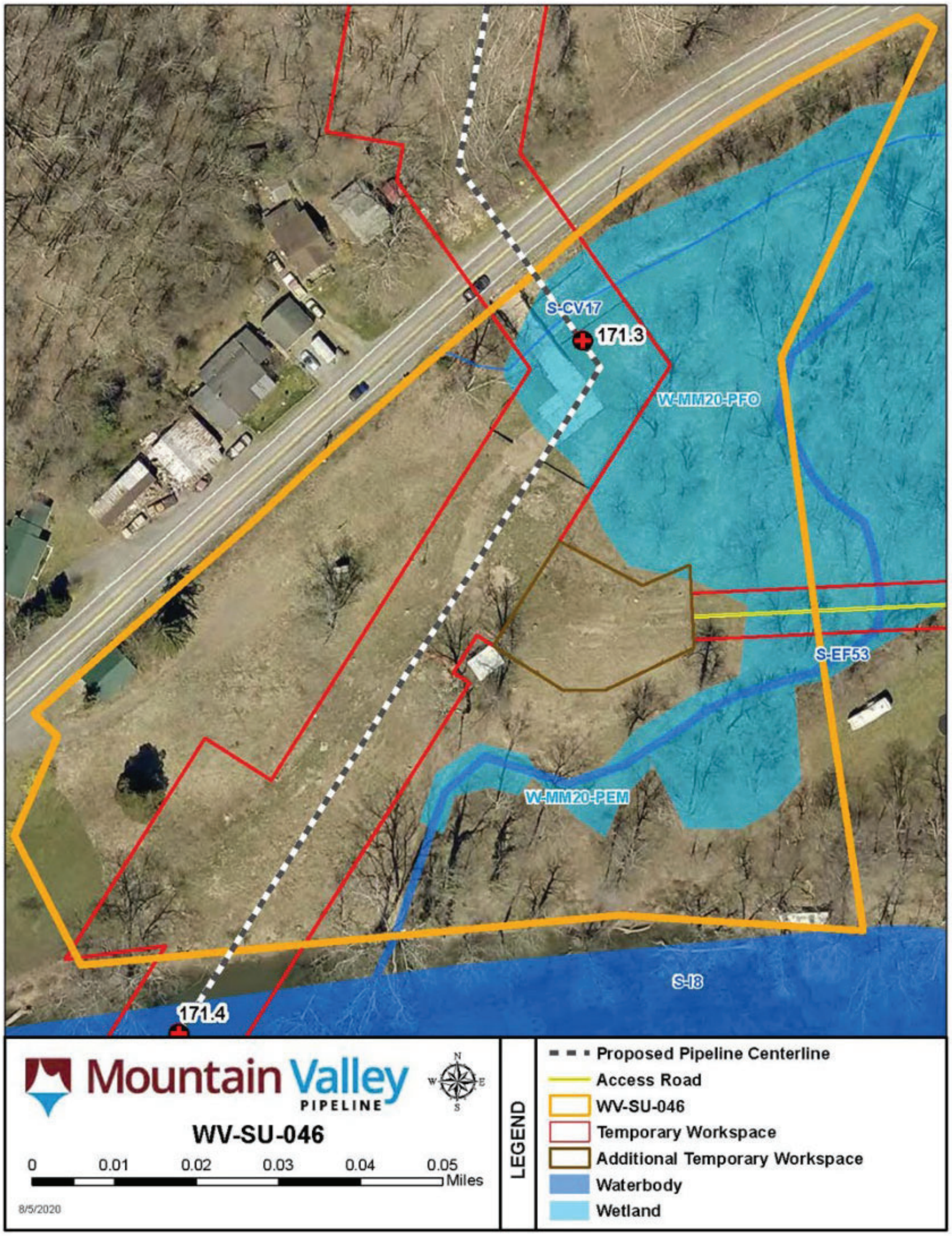

Figure 16. 2.3-acre parcel and the construction ROW, ARs, and ATWS.

On parcel WV-SU-046, tree felling (1.31 acre) and placement of timbermats across the wetland (0.05 acre) occurred in September 2018; pipe installation and final restoration need to be completed (P. Moore, Beveridge & Diamond PC, email to J. Martin, FERC, August 12, 2020; P. Moore, Beveridge & Diamond PC, email to C. Schulz, Service, November 28, 2022). Approximately 0.24 acres of wetland would be temporarily impacted on parcel WV-SU-046 with the installation of the AR and pipeline (P. Moore, Beveridge & Diamond PC, email to J. Martin, FERC, August 12, 2020). A travel lane will be reinstalled within the previously approved LOD for construction to access stream crossings (M. Neylon, Mountain Valley, letter to J. Martin, FERC, November 27, 2019).

The baseline assessment in the SBA2 (Mountain Valley 2022) did not find specific activities within the action area adversely affecting VASP. Therefore, Mountain Valley conducted an analysis of land cover classes in the action area where VASP potentially occurs, which found some land cover types that are potential stressors to VASP (e.g., dirt roads, impervious, railroads, rooftops); however, the dominant land cover is forest (70%) and pasture/hay (12%). Aside from the construction activities noted above, we are not aware of specific activities that have occurred or will occur in the action area adversely affecting VASP. Potential general threats to the species' habitat within the action area include: invasive species, such as Japanese knotweed and purple loosestrife that compete with VASP; changes in water flow regimes from weather related factors; recreational access and use along streams and rivers (e.g., fishing, rafting, ATV use, hiking); and land disturbance and construction activities along streams and rivers (e.g., clearing, mowing, dock building) (Ogle 2008, Service 2021, Mountain Valley 2022). All of these threats may directly kill or crush plants or affect the amount of habitat available for the species along the streambanks in the action area.

The role of the action area with regards to conservation/recovery of the species is that the project area provided habitat for 1 assumed VASP occurrence on the Greenbrier River (Figure 16). The action area also contains VASP potential habitat; these areas were previously surveyed and VASP was not documented. There is also suitable, unsurveyed, VASP habitat located upstream and downstream of the 1 assumed occurrence within the action area but outside of the project area. This suitable, unsurveyed habitat will not be disturbed by construction or post-construction activities in a manner that could adversely affect VASP (if present) or that could make the habitat unsuitable for the species.

<u>Indiana bat (Ibat)</u>

The terrestrial action area (1,002,627.7 acres) is located within the Ibat AMRU, which is a total of 51,400,965.4 acres in WV, VA, and TN (Service 2007b). The Ibat AMRU includes 8,788,657.5 acres in VA and 15,506,118.3 acres in WV, with the remaining acreage in TN. Approximately 166,696.78 acres of the action area in VA are outside of the AMRU and Ibats are unlikely to occur in this area. Thus, the action area comprises approximately 1.626% of the AMRU [(1,002,627.7-166,696.78)/51,400,965.4*100]. The action area is approximately 1.86%

of the AMRU in VA [(330,875.7-166,696.78)/8,788,657.5*100] and 4.33% in WV (671,752/15,506,118.3*100). The Ibat range in VA and WV includes approximately 18,889,053 acres of potential habitat (6,369,616.47 in VA and 12,519,436.45 in WV), based on NLCD 2016 land cover data. The total amount of suitable Ibat habitat that will be removed by the MVP project within the AMRU is 4,694.73 acres (includes 3,212.15 acres of known and unknown use Ibat habitat, 247.68 acres of expected future slips, and 1,234.91 acres suitable, unoccupied habitat) or 0.025% of the total amount of suitable Ibat habitat in VA and WV. Based on existing data and surveys conducted by ESI, we define 6 categories of Ibat habitat within the action area:

- Known occupied hibernacula in VA and WV;
- Assumed occupied hibernacula in VA and WV;
- Known use spring staging/fall swarming habitat in VA and WV;
- Unknown use spring staging/fall swarming habitat in VA and WV;
- Known use summer habitat in WV; and
- Unknown use summer habitat in VA and WV.

The best available science indicates that disease and parasites, habitat destruction, human disturbance, wind energy and turbines, nonnative and invasive species, light pollution, development, predation, and competition have occurred and continue to occur in areas across the Ibat's range. In the largely rural and forested action area in WV and VA, wind energy and turbines, light pollution, and development are not common on the landscape. Nevertheless, for purposes of analyzing the environmental baseline for Ibat, all of the stressors are expected to be present to some degree in the action area. Furthermore, we expect that the status of Ibat within the action area reflects the current status of the AMRU (declining), as described in the Service's 2019 Ibat 5-year review (Service 2019b). The number of Ibats in the AMRU declined from 32,465 Ibats in 2011 to 1,996 Ibats in 2019. Impacts to Ibats have been most severe in areas with the longest exposure to WNS, which includes WV within the AMRU.

The SBA2 (Mountain Valley 2022) provided information on stressors affecting the Ibat's baseline condition in VA and WV, which form a relatively smaller portion of the AMRU (53% of the AMRU is in TN, while 47% is in VA and WV collectively), to provide more accurate information on the baseline condition of Ibat within the action area. While VA's small Ibat population has only had a minor decline, WV has seen steep declines in Ibat populations since 2007. The population of Ibats hibernating in WV has declined by 96% since 2007 (Service 2019b), with the most significant decline in hibernating Ibats occurring at Hellhole Cave in Pendleton County, WV.

Specific information was not available regarding activities or land uses that may have resulted in these stressors occurring within the counties the project crosses or within the action area. As a result, using the novel platform described above and aerial imagery for the years 2020 through 2022, the SBA2 (Mountain Valley 2022) identified land cover classifications at a finer spatial resolution and more recent conditions than publicly available data. This review identified land uses, specific activities, and related stressors that could reasonably have affected the baseline condition for Ibats in the action area. Based on this data, while most of the area within the Ibat action area is forested, other activities with significant potential to affect the baseline condition include agricultural use (crops and pasture/hay) and development (roads, impervious surfaces, and rooftops). Agricultural use and development can affect Ibats through conversion of forest and loss of forested habitat, felling of occupied roost trees, increased forest fragmentation, changes to forest composition from invasive species, wind energy related mortality, and disturbance from noise and light. Development may also affect Ibats by destroying and degrading winter hibernacula, such as caves and mines, and increasing vulnerability of these sites to exploration, commercialization, vandalism, flooding, modification of entrances, microclimate changes, and incompatible surrounding land use.

Hibernacula and Associated Spring Staging/Fall Swarming Habitat – Known hibernacula are defined as caves/mine portals which are currently occupied, or were historically occupied, by hibernating Ibats. Assumed occupied hibernacula are defined by the Service as suitable caves and their associated sinkholes, fissures, and other karst features, as well as anthropogenic features such as mines and tunnels, which are reasonably certain to be occupied by hibernating Ibats. It is appropriate to conservatively assume presence of hibernating bats for features that occur within the range of the species, are determined to be suitable in accordance with the Service's Rangewide Indiana Bat Survey Guidelines, and for which occupancy surveys are not completed to determine presence/probable absence.

Potential hibernacula surveys for Ibats were conducted within the original 0.6-mile action area (i.e., "all lands within 0.6 miles of the boundaries of the Project Area..." FERC 2017a) in VA and WV between November 2014 and September 2017 (FERC 2017b; M. Neylon, Mountain Valley, email to T. Lennon, Service, June 10, 2020). Initially, potential hibernacula surveys yielded a total of 134 suitable caves/mine portals within 5 miles of the 0.6-mile action area from the 2017 Opinion. Of these, 85 potential hibernacula were determined to be suitable based on field survey results or information provided by a team of karst specialists with demonstrated experience in karst and karst hydrogeology in southern WV and southwestern VA (M. Neylon, Mountain Valley, email to T. Lennon, Service, June 12, 2020). Of those hibernacula that were deemed suitable, 16 were within the 0.6-mile action area (M. Stahl, EQT, email to T. Lennon, Service, November 9, 2017).

Since the issuance of the 2017 Opinion, 3 additional portals have been discovered, 1 of which Mountain Valley determined to be potentially suitable for hibernating bats (portal P-BTH-0001 near MP 207.5 in Giles County, VA). This portal was further reviewed by the Service, WVDNR, and Virginia Department of Wildlife Resources (VDWR), and given the internal dimensions and relatively small entrance size and steep downward angle, a determination was made that this portal was unsuitable and therefore not reasonably likely to support federally listed bats (A. Silvis, WVDNR, email to T. Lennon, Service, June 23, 2020; R. Reynolds, VDWR, email to S. Hoskin, Service, July 1, 2020). However, in response to a later request by the Virginia

Department of Conservations and Recreation (VDCR) Natural Heritage Program, the float rock covering the portal was removed by Mountain Valley so that VDCR biologists could view the portal. After inspection, VDCR advised Mountain Valley to install a safety cover over the entrance in place of the original float rock to allow VDCR to have temporary continued access to the portal (Mountain Valley 2022b). However, the replacement of the float rock at the entrance to P-BTH-0001 with a safety cover was/is not expected to alter the physical or environmental conditions of the portal; as such it remains unsuitable to support hibernating federally listed bat species (S. Simon and S. Hoskin, Service, pers. comm. to Mountain Valley, May 17, 2022). Despite this expectation, Mountain Valley voluntarily decided to conduct harp trapping at P-BTH-0001, due to the continued interest in the feature by VDCR karst specialists (Mountain Valley 2022b). Fall emergence harp trapping was conducted from September 21, 2022 to October 26, 2022, and this trapping effort exceeded the survey effort required to comply with the Service's Range-wide Indiana Bat and Northern Long-eared Bat Survey Guidelines (Service 2022). No bats were detected during the trapping efforts, indicating probable absence of bats within portal P-BTH-0001 and further supporting the assertion that portal P-BTH-0001 is not considered suitable habitat for hibernating bats. Because surveys documented probable absence of bats within the portal, Ibats are not anticipated to be present in or affected by any project activities impacting portal P-BTH-0001.

The expansion of the terrestrial action area from 0.6 to 2.0 miles from the project ROW, as a result of sound attenuation associated with construction noise (discussed in Action Area section), resulted in additional suitability analyses for 47 portals. Based on field investigation, sampling (harp trap) results, desktop analyses, and coordination with karst specialists, the updated total portal and cave features evaluated for potential use by Ibats within the 2.0-mile action area is as follows:

- 2 known occupied hibernacula;
- 62 suitable features; and
- 124 unsuitable features.

The 2.0-mile action area is within 5 miles of 2 known Ibat hibernacula, 1 in VA and 1 in WV, and the most recent Ibat population estimates for each are summarized in Table 17. Based on the protections included in the Karst Mitigation Plan provided in the FEIS (FERC 2017a), the hydrologic and geologic analysis (FERC 2017b) that was completed for Tawney's Cave in VA, the information provided in the November 9, 2017, Potentially Suitable Hibernacula within the Action Area table (M. Stahl, EQT, email to T. Lennon, J. Stanhope, and S. Hoskin, Service, November 9, 2017), the AMMs and analyses included in the SBA (Mountain Valley 2020) and SBA2 (Mountain Valley 2022b) and Mountain Valley's supplemental comment response documents (e.g., all blasting activities within close proximity to known and assumed occupied hibernacula will occur outside of the bat hibernating season, and site-specific blasting plans will be developed for all blasting activities proposed within 0.5 mile of any known or assumed occupied hibernacula to avoid adverse overpressure or vibration impacts to any bats occupying the features and to ensure the structural integrity of both the aboveground and subsurface features of a cave or portal during blasting events), we do not expect hibernating Ibats in any known or assumed occupied hibernacula to be exposed to the stressors associated with the MVP project construction (e.g., noise, vibration, feature collapse/modification, etc.). We also expect no impacts to the hibernacula themselves that would render them unsuitable for future use by Ibats.

On October 27 and November 5, 2020, and between April 1 and May 26, 2021, 18 blasting shots were performed within 0.5 mile of known or assumed occupied Ibat hibernacula. Site-specific blasting plans for all shots were completed in accordance with Mountain Valley procedures; however, due to an administrative error in Mountain Valley's communications procedures, Mountain Valley failed to submit the prepared blasting plans to USFWS or FERC for approval prior to the blasts, as required in the 2020 Opinion. However, all blasting was performed outside of bat hibernation season and therefore, is not likely to have had direct impacts on hibernating Ibats. Moreover, Mountain Valley ensured that the blasts' vibration levels were regulated, such that the structural integrity of the hibernacula was not impacted. Mountain Valley is committed to taking remedial actions to resolve the process issue and prevent the potential for this error to reoccur (M. Hoover, Mountain Valley, emails to C. Schulz, Service, January 18 and January 19, 2023).

Known use spring staging/fall swarming habitat is defined as roosting and foraging habitat within a 5-mile radius of a known Priority 3 and 4 hibernacula or a 10-mile radius of a known Priority 1 and 2 hibernacula[12]. There are 2 known Ibat (Priority 3 and 4) hibernacula within 5 miles of the action area[13] (Table 17 and Figure 17). Approximately 17.5 miles of construction ROW and 7.5 miles of ARs, a total of 308.48 acres (131.72 acres in VA and 176.76 acres in WV), occurs within known use spring staging/fall swarming habitat, all of which has already been cleared (Table 18). Approximately 391,792.8 acres of forested habitat occur within 5 miles of the 64 features (88 openings) considered to be known or assumed occupied Ibat hibernacula within action area (Mountain Valley 2022).

Table 17. Known Ibat hibernacula within 5 miles of the action area (Powers et al. 2015; Service 2007b; A. Silvis, WVDNR, email to B. Douglas, Service, May 29, 2020; Mountain Valley 2022b).

County, State	Hibernaculum Name	Approximate Distance (miles) to Project	Hibernaculum Priority Number[1]	WNS Status (date)	Ibat Population Estimate (date)
Monroe, WV	Greenville Saltpeter Cave	2 (AR)	3	Confirmed[2] (2012)	3 (2012) 16 (2014) 4 (2016) 2 (2018) 7 (2020)
Giles, VA	Tawney's Cave	0.04 (ROW)	4	Confirmed[3] (2009)	14 (2007) 0 (2013) 0 (2019)

[12] There are no known Priority 1 or 2 hibernacula in the action area.
[13] The 2017 Opinion noted that Patton Cave was within 5 miles of the action area. However, upon further review and coordination with the WVDNR it was confirmed that this hibernaculum is not within 5 miles of the action area.

[1]Priority 1 is highest priority, and most essential to recovery of the species. Priority 4 is least important to recovery (Service 2007b).
[2]A. Silvis, WVDNR, email to T. Lennon, Service, June 30, 2020.
[3]https://microbiology.usgs.gov/documents/Swezey_Garrity_2011.pdf.

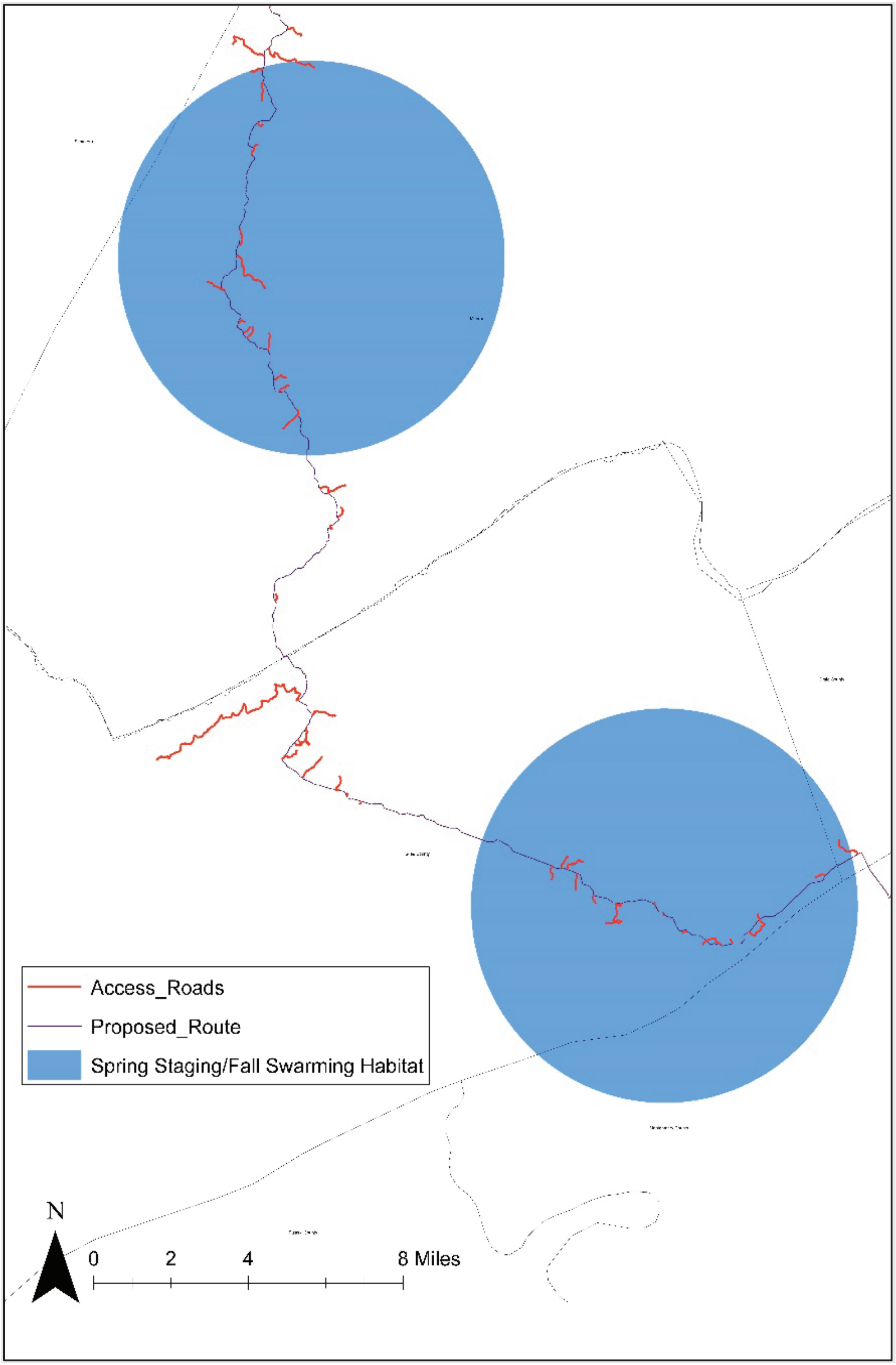

Figure 17. Ibat known use spring staging/fall swarming habitat.

Unknown use spring staging/fall swarming habitat is defined as roosting and foraging habitat within a 5-mile radius of a potentially suitable hibernaculum that has not been surveyed for Ibat presence during fall and spring. There are 69 caves/mine portals within 5 miles of the MVP project that were not individually surveyed; Mountain Valley is assuming these portals are occupied hibernacula, based on the assumption that they are suitable for hibernation (M. Neylon, Mountain Valley, email to T. Lennon, Service, June 12, 2020). Sixty-two of the portals are located within the 2-mile action area, as discussed above. However, it is not reasonable to assume that all 69 suitable features would be occupied post-WNS. Therefore, the Service used known cave occupancy data from VA and WV to estimate how many of the suitable features within the action area are reasonably certain to be occupied by Ibats. To estimate this, the Service first determined the proportion of caves reasonably likely to be occupied by Ibats by dividing the total number of suitable caves within WV and VA known to contain Ibats (59) by the total number of caves surveyed to date (395) in WV and VA. The total number of initially assumed occupied features (69) was then multiplied by the proportion of caves with known Ibat occurrences (0.15) to estimate the number of assumed occupied Ibat caves within the action area (10.35 caves was rounded down to the nearest whole cave = 10 caves). The Service cannot know which 10 caves are occupied, only that it is a reasonable assumption that 10 additional caves are occupied by hibernating Ibats within the action area, post-WNS.

Approximately 42.3 miles of construction ROW and 32.2 miles of ARs, a total of 828.63 acres[14] (524.69 acres in VA and 303.94 acres in WV), occur within unknown use spring staging/fall swarming habitat, 828.47 acres of which has already been cleared (Table 18). As most of the acreage has already been cleared, it is not possible to verify what percentage, if any, was in fact utilized by Ibats for spring staging/fall swarming prior to clearing. Thus, a total of 1,137.11 acres of known and unknown use fall and spring habitat has been removed (1136.95) or will be removed for a known variance (0.16 acres); 391.21 acres will be permanent, and 745.88 acres will be allowed to regenerate (Mountain Valley 2022).

[14] Because the majority of the potentially suitable features (69) within 5 miles of the project overlap, the Service applied the estimated acreages provided within the SBA2 (Mountain Valley 2022) for all of these features to the 10 assumed occupied hibernacula.

Table 18. Ibat forested spring staging/fall swarming habitat removal in VA and WV (P. Moore, Beveridge & Diamond PC, email to C. Schulz, Service, November 30, 2022, and December 9, 2022). Numbers in rows and columns may not sum to exact totals due to rounding.

Habitat Category[a]	Acres of Tree Removal								
	Felled Before 2020 Opinion		Downed Trees Due to Slips Before 2020 Opinion	Removed Since 2020 Opinion		Total Cleared and Slips to Date	Total Not Yet Cleared (Project Locations and Variances/Known Slips		Total[b]
	WV	VA		WV	VA		WV	VA	
Known use spring staging/fall swarming habitat	176.76	131.43	0	0	0.29	308.48	0	0	308.48
Unknown use spring staging/fall swarming habitat	303.67	521.51	0	0.24	3.05	828.47	0.03	0.13	828.63

[a] Habitat categories are based on the 2.0-mile terrestrial action area.
[b] These totals differ from 2020 Opinion values because the 2020 Opinion included future slip acreage estimates in each habitat category. For this reinitiation, a total of 247.68 acres is estimated for future slips (includes downed trees and trees cleared during slip remediation) across the action area. Mountain Valley states that the exact locations and acreages associated with future slips is unknown and unpredictable. Therefore, in the Effects of the Action section, we use the "worst-case scenario" for potential effects to the Ibat for each habitat category. The "worst-case scenario" for each habitat category would occur when all 247.68 acres of future slips occur only in that particular habitat category; thus, the analysis in the Effects of the Action section below is based on this scenario for each of the 4 affected habitat categories. However, we acknowledge that it is unlikely that all acreage related to future slips would occur in a single habitat category.

Determining the Number of Ibats Hibernating within the Action Area – WNS was first detected in VA and WV during the 2008/2009 winter hibernacula surveys (Stihler 2012, Powers et al. 2015). VA and WV hibernacula surveys indicate Ibat populations have decreased at least 95% since the discovery of WNS (https://www.fws.gov/midwest/endangered/mammals/inba/pdf/2019_IBat_Pop_Estimate_6_27_2019a.pdf). Acoustic monitoring data were collected by Mountain Valley at the 2 known Ibat hibernacula affected by the project from 2018 to 2022, in accordance with the monitoring and reporting requirements of the 2020 Opinion (Service 2020). While bat activity (not species-specific) had been more consistent from monitoring years 2019-2021, it appears to have dropped significantly during the 2021-2022 monitoring period (Mountain Valley 2019; 2020; 2021; 2022c). However, the factors that may have contributed to this apparent decline are unknown. Further monitoring will continue at these caves until 2 hibernating seasons post-construction, which should reveal if bat activity at these caves continues to decline.

To inform the current status of the species within the action area, the Service used the best scientific data available to estimate the number of hibernating Ibats that may be present within all assumed occupied hibernacula[15] (10) and known hibernacula (2) (Table 19). The Service used 2017-2020[16] winter cave count data and harp-trap survey data to determine the median number of hibernating bats per hibernacula within the states. The median number of hibernating bats per hibernacula (8) was then multiplied by the number of assumed occupied Ibat caves (10) and known occupied hibernacula (2) to estimate the total number of hibernating Ibats within the action area (96). The median number of hibernating bats (8) is also similar to the number of documented Ibats in Greenville Saltpeter Cave (7).

Based on the information discussed above, it is reasonably likely that 10 of the assumed occupied Ibat hibernacula occurring within the action area can be considered occupied for purposes of this analysis, in addition to the 2 known Ibat hibernacula. Given this information and previous survey information from Greenville Saltpeter Cave, it is also reasonable to conclude that each of those 10 hibernacula and the 2 known hibernacula support approximately 8 Ibats. Therefore, an estimated 96 individual Ibats (associated with 10 assumed occupied hibernacula and 2 known hibernacula) may be present within the action area during the winter and spring staging/fall swarming period.

Table 19. Summary of Ibat hibernacula data and estimates.

Total number of suitable hibernacula features within 5 miles of the MVP project	69
Median number of hibernating Ibats per known P3 and P4 Ibat hibernacula in WV and VA	8
Total number of caves with Ibats in WV and VA	59
Total number of caves surveyed for bats in WV and VA	395
Proportion of caves occupied by Ibats	0.15
Number of assumed occupied Ibat caves within the action area	10
Number of known occupied Ibat caves within the action area	2
Total number of estimated hibernating Ibats within the action area	96

Summer Habitat – Both known use and unknown use Ibat summer habitat are present within the project area.

Known Use Summer Habitat – Known use summer habitat is defined as areas within a 5-mile radius (home range) of a pregnant female or juvenile Ibat capture or within 2.5 miles of a known Ibat roost tree. There is no documented known use summer habitat in the VA portion of the action area; however, a pregnant female was captured during a 2010 survey approximately 1.7 miles from the project ROW in Wetzel County, WV. Approximately 10.3 miles of construction ROW and 10.3 miles of ARs, a total of 238.53 acres, occurs within the potential Ibat home range defined above (Figure 18), 238.47 acres of which has already been removed as a result of slips (Table 20). Habitat assessment surveys were conducted in 2015 in the project area located within

[15] The Service assumes that all hibernating bats will utilize the habitat surrounding the 10 assumed occupied hibernacula during the spring staging/fall swarming periods. This habitat is considered to be unknown use spring staging/fall swarming habitat.
[16] The Service only included the most recent post-WNS data and excluded winter count data for P1 and P2 hibernacula. Based on the effects of WNS, and because no additional P1/P2 hibernacula have been identified since the 1970s as a result of cave surveys conducted within the AMRU, it is unreasonable to assume that any of these suitable features (69) would support as many hibernating bats as a P1/P2 hibernaculum.

the known use summer habitat and suitable roosting and foraging habitat was documented throughout the LOD (e.g., 413 potential roost trees were documented within a 236.43-acre area, with 74 potential primary trees and 339 potential secondary trees; M. Stahl, EQT, email to T. Lennon, Service, November 8, 2017).

All planned project clearing in known summer use habitat has occurred outside of the active bat season. However, in March 2019, FERC initiated emergency Section 7 consultation with the Service as a result of slips that occurred within and adjacent to the MVP project's LOD within the area described above. The 2020 consultation addressed the removal of additional suitable habitat (2.47 acres total) within the Ibat known use summer habitat. Approximately 1.92 acres and 0.55 acres was cleared during the bat active season in April and August 2019, respectively. The removal of this habitat during the active season was not evaluated in the 2017 Opinion; however, it was included in the 2020 Opinion as an after-the-fact consultation pursuant to 50 CFR 402.05. Accordingly, it is addressed below in this Opinion in Effects of the Action section.

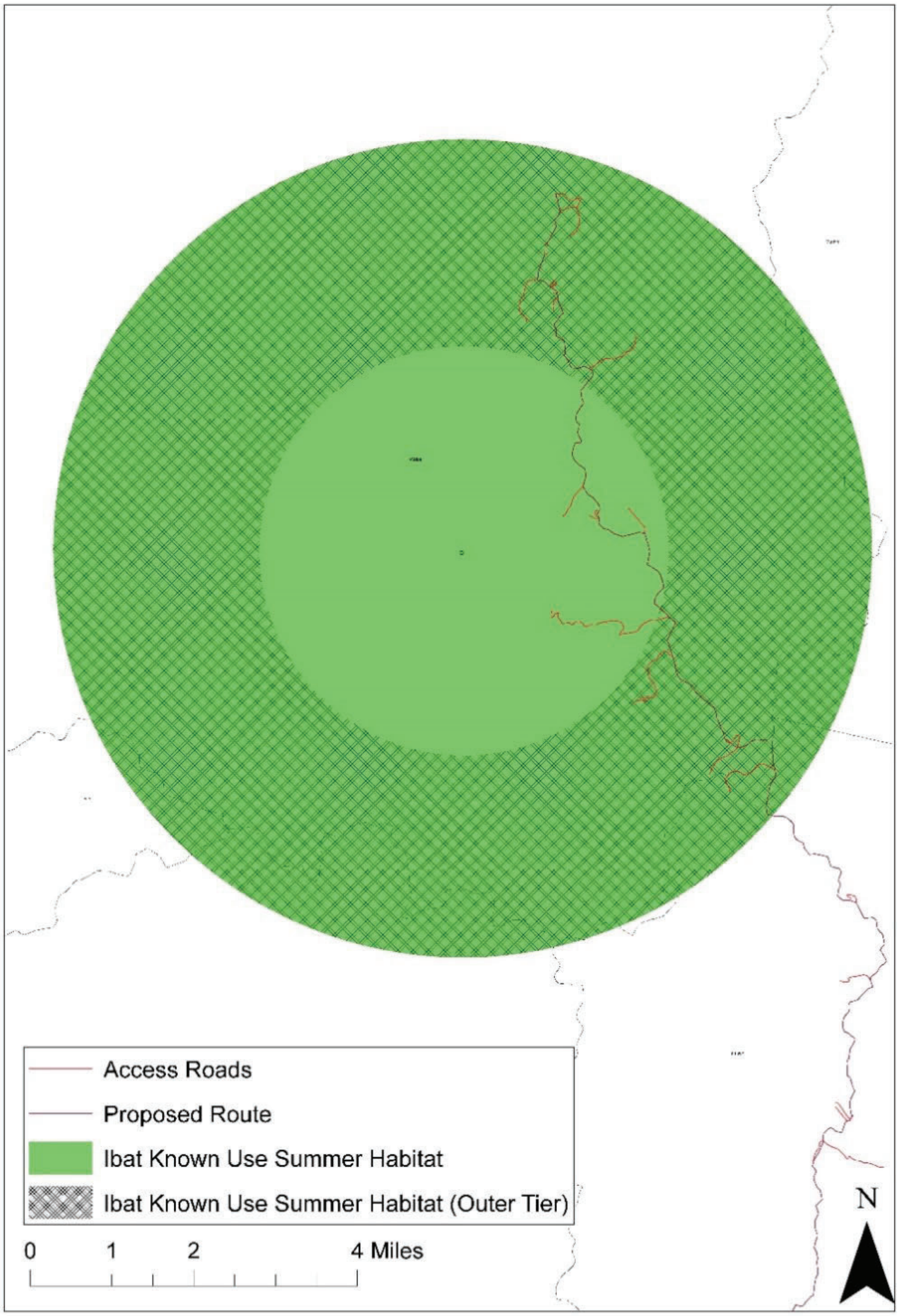

Figure 18. Ibat known use summer habitat in Wetzel County, WV.

Survey Efforts – As stated on page 1 of the Range-wide Indiana Bat and Northern Long-Eared Bat Summer Survey Guidance, "The following guidance is designed to determine whether IBAT and/or NLEB are present[17] or absent (P/A)[18] at a given site during the summer (May 15 to August 15)…" These guidelines have been in use for many years and have been periodically updated based on new scientific information and public feedback[19]. While they are not the same as regulations, the Service accepts the results of surveys if they were conducted in accordance with the guidelines. The exception to this is when there is new information or a better understanding of other existing site-specific information.

Since 2018, the Service has accepted negative surveys rangewide for a *minimum* of 5 years, unless new information (e.g., other nearby surveys) suggest otherwise (Service 2018d); prior to 2018, survey results were accepted for a *minimum* of 2 years. There is no automatic expiration of survey results after that time, as these are minimums. Through discussions with the local Service field office, applicants and action agencies may consider conducting additional surveys or continue to use prior survey results, particularly where (as in this case) there is no new information to suggest the results are no longer valid. This approach been applied across the range of the species and is consistent with the use of these guidelines. Coordination consistent with this approach occurred between Mountain Valley and the Service and resulted in the Service's determination that no new bat surveys were needed for this reinitiation, as discussed further below.

To determine the presence or probable absence of potential Ibat maternity colonies, summer mist-net surveys were conducted in 2015 and 2016. Surveys followed the Range-wide Indiana Bat Summer Survey Guidance current at that time (Service 2015, 2016). Mist-net surveys were not conducted along approximately 128.9 miles (42.4%) of the construction ROW and 102.3 miles (50%) of ARs in WV and VA (ESI 2015c, 2015d, 2016b). In these areas, Mountain Valley chose to assume presence for Ibats.

The Service accepted the results of the 2015 and 2016 bat mist net surveys as valid for the 2020 Opinion, as surveys had been completed within a minimum of 5 years and there was no new information to suggest that the survey results were no longer valid. The Service recommended that no additional bat surveys be completed for the current reinitiation, because the previously surveyed areas have been cleared of trees and they are no longer considered to be suitable roosting habitat for the species (Mountain Valley 2022b). Thus, the best available data on the presence or probable absence of Ibats within the surveyed sections of the action area continues to be the results of the 2015-2016 survey efforts, described below.

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[17] The guidance is not intended to be rigorous enough to provide sufficient data to fully determine population size or structure.
[18] Recognizing protocols are not 100% likely to detect Ibat and NLEB when present and identification errors may occur.
[19] https://www.fws.gov/library/collections/range-wide-indiana-bat-and-northern-long-eared-bat-survey-guidelines

Mist-net surveys in suitable summer habitat were conducted between May 15 and August 15, 2015, and May 15 and May 26, 2016 (FERC 2017b) along approximately 140.9 miles (64.6 miles in WV and 76.3 miles in VA) of the construction ROW and 79.7 miles (43.0 miles in WV and 36.7 miles in VA) of ARs (ESI 2015c, 2015d; M. Neylon, Mountain Valley, email to T. Lennon, Service, June 12, 2020). These surveys covered a total of 1,234.85 acres of the project area (P. Moore, Beveridge & Diamond PC, email to C. Schulz, Service, December 9, 2022). A total of 1,398 bats of 9 species were captured at the 441 mist-net sites (M. Neylon, Mountain Valley, email to T. Lennon, Service, June 12, 2020). No Ibats were captured, suggesting probable absence during the summer months on these portions of the project. Based on the negative survey results, no Ibats are expected to be present or exposed to stressors in these surveyed areas; thus, the Service does not anticipate any adverse effects in individuals of the species in those areas from the proposed action. The surveys described above were completed in accordance with the survey guidelines. After trees were cleared from the project area, it is no longer considered suitable roosting habitat for the species. No additional bat surveys have been completed since tree felling occurred and the Service does not recommend surveys in habitat that is unsuitable for a species. Therefore, the best available data indicates that Ibats were not using the surveyed areas at the time tree clearing occurred and are not currently using those areas for roosting. Further, because Ibats exhibit summer site fidelity (see Status of the Species section for more information) and based on continuing declines in winter hibernacula counts in the AMRU due to WNS, there is no reasonable basis for concluding that Ibats moved into the previously surveyed areas since the surveys were conducted or are likely to move into the previously surveyed areas in the foreseeable future.

Unknown Use Summer Habitat – In addition to the areas that were surveyed as described above, there are portions of the MVP project that are unsurveyed, but where Ibats are reasonably likely to occur, based on location (i.e., within the range of the species) and presence of suitable habitat. These areas are defined as unknown use summer habitat and FERC has elected to assume Ibat presence in this habitat. Mist-net surveys were not conducted along approximately 128.9 miles (42.4%) of the construction ROW and 102.3 miles (50%) of ARs in WV and VA (ESI 2015c, 2015d).

There are approximately 97.5 miles of the construction ROW (4.9 miles in VA and 92.6 miles WV) and 56.4 miles of ARs (1.1 miles in VA and 55.3 miles in WV), totaling 1,836.51 acres (74.78 acres in VA and 1,1761.73 acres in WV) within unknown use summer habitat for the Ibat, 1,833.33 acres of which has already been cleared or removed as a result of slips (Table 20). Habitat assessment surveys were conducted in 2015 on the portions of the project area where presence of Ibats is assumed and suitable roosting and foraging habitat was documented throughout the area (e.g., 2,552 potential roost trees were documented within an 1,828.58-acre area, with 470 potential primary trees and 2,082 potential secondary trees; M. Stahl, EQT, email to T. Lennon, Service, November 8, 2017). No additional habitat assessments, including potential roost tree surveys, have been conducted within these areas since the issuance of the

2017 Opinion, as the vast majority of the habitat in the LOD has since been cleared of trees.

Table 20. Acres of Ibat forested summer habitat removal in VA and WV (P. Moore, Beveridge & Diamond PC, email to C. Schulz, Service, November 30, 2022). Numbers in rows and columns may not sum to exact totals due to rounding.

Habitat Category[a]	Tree Removal Before 2020 Opinion[b]		Trees Downed Due to Slips[c] Before 2020 Opinion (all WV)	Tree Removal Since 2020 Opinion		Total Tree Removal to Date	Total Not Yet Removed for Variances and Remediation of Known Slips[d] (all WV)	Total[e]
	WV	VA		WV	VA			
Known use summer habitat	226.29	0	10.14	2.04	0	238.47	0.06	238.53
Unknown use summer habitat	1,748.98	74.78	4.82	4.75	0	1,833.33	3.18	1,836.51

[a] Habitat categories are based on the 2.0-mile terrestrial action area.
[b] This total includes acres of planned project tree removal and also acres of tree clearing to remediate known slips.
[c] This total does not include additional acres of tree removal to remediate slips.
[d] No planned project location tree removal remains in Ibat summer habitat.
[e] These totals differ from 2020 Opinion values because the 2020 Opinion included future slip acreage estimates in each habitat category. For this reinitiation, a total of 247.68 acres is estimated for tree removal associated with future slips across the action area. Mountain Valley states that the exact locations and acreages associated with future slips is unknown and unpredictable. Therefore, in the Effects of the Action section, we use the "worst-case scenario" for potential effects to the Ibat for each habitat category. The "worst-case scenario" for each habitat category would occur when all 247.68 acres of future slips occurs only in that particular habitat category. We analyze this scenario for each of the 4 affected habitat categories.

There is the potential that certain areas of spring staging/fall swarming habitat (known and unknown use) may also contain summer maternity habitat. However, determining where this overlap may occur, and the quantity of the overlap is impracticable based on the information available. Thus, for the purposes of this Opinion, Ibat habitat removed will be classified as either summer habitat or spring staging/fall swarming habitat (Tables 18 and 20).

Future Slips-Unknown Ibat Habitat Category – Mountain Valley estimates a total of 247.68 acres of tree removal associated with future slips in suitable known and unknown use summer and known and unknown use spring staging/fall swarming Ibat habitat across the action area will occur. Mountain Valley is unable to estimate the amount of acreage per slip or location (i.e., bat habitat category) of future slips. Therefore, in this Opinion we analyze the worst-case scenario for effects to Ibats for each of the 4 affected habitat categories in the Effects of the Action section. We have determined that the worst-case scenario occurs when all of the estimated acreage for future slips occurs in 1 habitat category type. All tree removal associated with slip remediation is expected to occur prior to final ROW restoration.

Determining the Number of Ibat Maternity Colonies within the Action Area – As discussed above, there is 1 known (previously documented) Ibat maternity colony within the action area and additional acreage of summer habitat that has not been surveyed for the presence of Ibats, but for which it is reasonable to expect that Ibats are or were present within all or a portion of that habitat. Here we calculate the number of Ibat maternity colonies that it is reasonable to expect to be present within the unsurveyed summer habitat (i.e., unknown summer use habitat category), which we add to the 1 known colony to determine the total number of maternity colonies likely to be affected within the action area. Most of the unknown use summer habitat has already been cleared or removed as a result of slips (1,833.33 acres of 1,836.51 acres). For this calculation, we will also assume 247.68 acres associated with future slips occurs in unknown summer use habitat. Adding the total tree removal in unknown use summer habitat (1,836.51 acres) to the estimated tree removal associated with future slips (247.68 acres), the total tree removal in unknown use summer habitat (unsurveyed) is 2,084.19 acres. To inform the status of the species within the action area, the Service used the best scientific data available to estimate the number of additional Ibat maternity colonies that may have been or may be present within these unsurveyed areas. The Service used 2009-2018[20] capture data collected from projects in forested areas located within WV counties intersected by the MVP project (hereafter referred to as the counties of interest[21]) to develop a ratio of Ibats captured per survey and then derive an estimate of the number of maternity colonies within the action area.

Because bat survey results available to the Service for this calculation are tracked on a per survey basis rather than a per project basis, it was not possible to directly estimate the number of Ibats captured by project acreage. Therefore, to estimate the number of Ibats within unsurveyed areas, the Service used Ibat capture rate per survey and the number of surveys that the MVP project would represent. Ibat capture rate per survey (0.299) was calculated by dividing the total number of Ibat captures (47) by the number of surveys conducted within the counties of interest (157). The number of surveys that the MVP project would have represented (123.11) was calculated by dividing tree removal from the MVP project (2,084.19 acres) by the average tree removal in projects tracked by the Service (16.93[22]), thereby putting capture rate on equivalent habitat scales. By multiplying the capture ratio (0.299) by the number of surveys the MVP project would represent on a habitat basis (123.11), the Service determined the estimated number of Ibats expected to be captured within the action area (36.81, rounded to 37 Ibats). The Service determined the proportion of captures representing a colony by dividing the number of adult Ibat females/juveniles[23] captured in the 4 counties of interest by the total number of Ibats captured in the previous surveys (47), which produced a ratio of 0.09. This ratio, indicating the proportion of

[20] The Service only included post-WNS capture data and excluded survey results for bat box monitoring and cave surveys, because this data is associated with long-term monitoring efforts at documented Ibat locations. These excluded results (if included) would bias our estimates, as the number of Ibats has greatly declined since the onset of WNS and it is not reasonable to expect similar numbers of Ibats to be present on the landscape post-WNS as were present pre-WNS. Additionally, using results from cave surveys and bat box monitoring would artificially inflate the capture ratio that we developed for bat captures on a forested landscape, as caves and bat boxes target known Ibat locations, with repeated surveys on a regular basis over a long time period. The survey methodology is very different when performing cave and bat box counts, and in many cases, there is near 100% capture rate of individuals targeted in the survey. Thus, these capture/count rates from cave and bat boxes would be a skewed estimate of the actual frequency of Ibats encountered at a landscape scale.

[21] The following WV counties are referred to as the counties of interest: Braxton, Doddridge, Fayette, Greenbrier, Harrison, Lewis, Monroe, Nicholas, Summers, Upshur, Webster, and Wetzel.

[22] This value was calculated based on the average amount of forest loss per project for 1,177 projects in WV from 2016-2018.

[23] The Service is assuming that only adult female and juvenile captures represent maternity colonies.

captures representing a colony (0.09) was then multiplied by the number of Ibats expected to be captured within the project area (37) to determine the number of colonies affected by the MVP project (3.33 colonies, rounded to the nearest whole colony = 3 colonies[24]) (Table 21).

Capture data and information regarding average amount of forest loss per project was not available for Giles, Montgomery, Craig, and Roanoke counties, VA. However, because the average percent forest cover in VA is similar to the average percent forest cover in WV (65.12% in VA and 80.21% in WV[25]), the approach to estimating the number of colonies over the unknown use summer habitat in the action area across both states described above was reasonable.

Given the previous survey results in Wetzel County, WV, and the capture data discussed above, it is likely that 3 Ibat maternity colonies occur within the action area in addition to the 1 known Ibat maternity colony.

We have no detailed information about the current status of the 1 known maternity colony within the action area because Ibats have not been captured and tracked and no emergence surveys have been conducted, and such information cannot be readily obtained during consultation. This is because Ibats comprising a summer colony are spread out across multiple roost trees and switch trees every couple of days. Attempting to conduct an accurate population count of the colony would entail month-long radio tracking studies of a large percentage of individual adults associated with the colony. To conduct radio tracking, researchers would first need to capture individual bats. Extensive mist-netting would be required to capture even a few individuals and the likelihood of capturing multiple adult females from the same colony is quite low. After bats are captured, transmitters are attached and bats would be tracked daily until the transmitters fall off (which can be after just a few days) or until the battery fails. Additional bats would need to be captured throughout the summer to find more roosts. At night, multiple people would need to conduct emergence surveys at every tree identified as a roost (adding new trees daily) and count all bats that exit. Not every bat exits on a given night. Once the baseline number of adult females is established, monitoring would need to continue throughout the next month to attempt to estimate the number of newly produced volant young. After multiple years of monitoring a colony of Ibats, we may still not have an actual estimate of the number of Ibats in that colony.

As discussed above, we have estimated 3 additional unknown maternity colonies within the action area. These colonies could be located anywhere throughout the action area. Therefore, to determine baseline numbers, many years of surveys would need to be conducted throughout the entire action area where suitable habitat occurs and no presence/probable absence surveys have been previously conducted. However, as discussed above, we expect that the status of the known

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[24] Conventional rounding to the nearest whole number is appropriate and consistent with the best available information because a colony is either present in an area or it is not; there are no "partial colonies" of Ibats.

[25] Average percent forest cover was only calculated for the VA and WV counties intersected by the MVP project. Percent forest cover per county data can be found here: https://www.fws.gov/media/157366

and unknown colonies within the action area is the same as the current rangewide and AMRU status of the species (declining). Prior to impacts from WNS, estimated maternity colony sizes averaged from 80-100 adult female bats (Harvey 2002, Whitaker and Brack 2002).

Given the on-going observed winter count decline[26] of Ibats in the AMRU by 95%, we expect that associated maternity colonies will be substantially less than 80-100 adult female bats in size. It is likely that some maternity colonies have been extirpated, while other colonies may have fragmented resulting in reduced colony size (although we expect that they will continue to occupy their prior home ranges because of their high site fidelity). Since we have limited information about maternity colony sizes in WV or VA post-WNS and the information is not readily obtainable, we will conduct our analyses based on a reasonable range of 20-40 adult female bats per colony and 1 pup per female. This range is reasonable and conservative given that the pre-WNS average was 80-100 adult females per colony, and that winter Ibat counts in the AMRU have declined significantly since the onset of WNS. This range is also consistent with post-WNS emergence count studies conducted at a nearby long-term Ibat monitoring site in Kanawha and Fayette County, WV (Apogee 2018).

Therefore, an estimated 160-320 adult females and pups (associated with 4 maternity colonies) may be present within the action area during the summer maternity season. Adult males are not included in this estimate because they typically stay close to hibernacula and do not coalesce with adult females and pups during the summer months.

Table 21. Summary of Ibat maternity colony estimates.

Ibats per project (capture ratio)	0.299
Total forest loss within the MVP project area (unknown suitable summer habitat only)	2,084.19 acres
Average project forest loss	16.93 acres
Number of average surveys the MVP project represents	123.11
Number of Ibats expected to be captured within the project area	37
Proportion of captures representing a colony	0.09
Estimated number of Ibat maternity colonies in the MVP project area	4[a]
Estimated number of adult females in each colony	20-40
Estimated number of pups in each colony	20-40
Total number of Ibat present. This range includes adult females and pups	160-320

[a] Includes the one known maternity colony in Wetzel County, WV.

The role of the action area with regards to conservation and recovery of the species is that it provides habitat for feeding, breeding, and sheltering of 4 maternity colonies, 2 known occupied hibernacula, and 10 assumed occupied hibernacula. Since the species has been heavily impacted by WNS (discussed in detail above), remaining populations are vulnerable to other stressors, especially during sensitive life stages (e.g., hibernation, breeding and pup seasons), including tree clearing. To support all life stages, Ibat populations require a matrix of interconnected

[26] It is possible to count live Ibats in the winter when they are readily observable because they are in torpor and on the side of cave/mine walls in large clusters.

habitats that support spring migration, summer maternity colony formation and foraging, fall swarming, and winter hibernation. When active (outside of hibernation), Ibat populations are known (from summer surveys; 1 known maternity colonies within the action area) to use forested habitat within the project area for foraging, commuting, and breeding. The action area also includes 12 known or assumed occupied suitable hibernacula which provide habitat with suitable conditions for prolonged bouts of winter torpor and shortened periods of arousal. Although the suitable habitat provided within the action area is a minimal portion of suitable habitat within the species' entire range, known summer and known or assumed winter habitat within the action area contributes to the conservation and recovery of the species at the population level.

Northern long-eared bat (NLEB)

As described above, the Service listed the NLEB as a threatened species on April 2, 2015 (80 FR 17974). The Service issued a final 4(d) rule for the NLEB on January 14, 2016 (81 FR 1900). On November 30, 2022, the Service published a final rule reclassifying the NLEB from threatened to endangered (87 FR 73488). The final reclassification rule will become effective on March 31, 2023 (88 FR 4908).

Because 4(d) rules are only available for threatened species, the 4(d) rule for NLEB will be removed upon the effective date of the reclassification rule. However, the 4(d) rule was in effect during the previous consultations on this project and during project activities completed to date. Section 4(d) of the ESA directs the Service to issue regulations deemed "necessary and advisable to provide for the conservation of threatened species." 16 U.S.C. 1533(d). It allows the Service to promulgate special rules for species listed as threatened that provide flexibility in implementing the ESA. The Service uses 4(d) rules to target the take prohibitions to those that provide conservation benefits for the species. This targeted approach can reduce ESA conflicts by allowing some activities that do not harm the species to continue, while focusing our efforts on the threats that make a difference to the species' recovery.

In the 4(d) rule for the NLEB, the Service determined that WNS is such an overwhelming threat to the NLEB that regulating most other sources of harm or mortality will not help conserve the species at this time. The 4(d) rule focused prohibitions on protecting bats in areas affected by WNS and when and where bats are most vulnerable: maternity roost trees during June and July pup-rearing and at hibernation sites.

Under the 4(d) rule, for areas of the country impacted by WNS (which includes the project action area in VA and WV) incidental take of NLEBs was considered prohibited only under the following circumstances:

1) If it occurs within a hibernaculum;
2) If it results from tree removal activities and the activity occurs within 0.25 mile (0.4 km) of a known hibernaculum; or

3) The activity cuts or destroys a known, occupied maternity roost tree or other trees within a 150 ft radius from the maternity roost tree during the pup season from June 1 through July 31.

The Service completed Section 7 consultation and issued a non-jeopardy programmatic Biological Opinion for the finalization and implementation of the 4(d) rule. (https://www.fws.gov/midwest/endangered/mammals/nleb/pdf/BOnlebFinal4d.pdf). That 2016 Opinion for the NLEB 4(d) rule accounts for the effects of incidental take that is not prohibited under the rule. For federal activities that result in non-prohibited incidental take, federal agencies were able to rely upon the Service's non-jeopardy finding to fulfill their project-specific Section 7 responsibilities (see 81 FR 1900, 1903; January 14, 2016).

The Service provided a Northern Long-Eared Bat 4(d) Streamlined Consultation Form for use with the optional streamlined consultation framework for NLEB under the 4(d) rule. This framework allowed federal agencies to rely upon the 2016 Opinion for the NLEB 4(d) rule for section 7 compliance by: (1) notifying the Service that an action agency will use the streamlined framework; (2) describing the project with sufficient detail to support the required determination; and (3) enabling the Service to track effects and determine if reinitiation of consultation is required per 50 CFR 402.16. FERC submitted the Streamlined Consultation Form for the MVP project to the Service in November 2017 and determined that the project may affect the NLEB, but any resulting incidental take of the NLEB was not prohibited by the 4(d) rule. The Form, which required estimated total acres for forest conversion or timber harvest for a proposed project, estimated 4,453[27] acres of forest conversion accounted for under the 2016 Opinion for the NLEB 4(d) rule. As stated in the Form, since the Service did not respond within 30 days of submittal of the Form, FERC was entitled to presume that its determination was informed by the best available information and that its project responsibilities under Section 7(a)(2) with respect to NLEB were fulfilled through the 2016 Opinion for the NLEB 4(d) rule

Accordingly, while the majority of activities associated with this project that could affect NLEBs have been completed and those effects were fully accounted for by the 2016 Opinion for 4(d) rule on NLEB, assessment of any remaining activities that could affect the species and its habitat subsequent to the effective date of the uplisting are discussed below. As discussed below and in Effects of the Action, subactivities that involve tree clearing are the only project activities likely to affect NLEB. The Effects of the Action section includes a summary of impacts that have already occurred and were accounted for under the 4(d) rule 2016 Opinion, discussion of impacts that have already occurred as authorized by the 2020 Opinion and ITS, and analysis of future effects. The ITS includes take associated with these future tree clearing activities, as well as take associated with tree removal activities within 0.25 mile of a known hibernaculum that was previously included in the 2020 Opinion. Furthermore, given the imminent reclassification to

[27] The Form referenced additional project effects to NLEB, including clearing within 0.25 miles of hibernacula and potential noise impacts to hibernating bats, that would be separately addressed in formal consultation with the Service.

endangered status, the effect of all tree clearing in suitable NLEB habitat over the life of the project is considered for purposes of the jeopardy analysis.

Although the Service is currently developing guidance in light of the reclassification for all projects within the range of NLEB that have previously undergone consultation but are not yet complete, that guidance is not yet available. Therefore, the Service has taken a conservative approach for purposes of this Opinion by considering all acres of project-related tree removal in NLEB habitat, including effects associated with activities that did not constitute prohibited take under the 4(d) rule at the time that they occurred. This approach is consistent with the Service's responsibilities under the ESA and is expected to be consistent with, or more conservative than, the forthcoming guidance.

Upon the effective date of NLEB endangered status, the 4(d) rule will no longer apply and all future take of NLEB will be prohibited under the ESA without an ITS. However, tree removal activities that occur outside of suitable habitat or within suitable unoccupied habitat are unlikely to result in take. 87 FR at 73502. Accordingly, this Opinion focuses on future tree clearing in the action area that will occur in suitable habitat, i.e., areas within 3 miles of a NLEB capture or 1.5 miles of a known roost tree (known use summer habitat) and areas within 5 miles of a known or potential hibernaculum (spring staging/fall swarming habitat).[28]

The total amount of suitable NLEB habitat that will or has been removed by the MVP project is 4,694.73 acres. A total of 3,824.90 acres have been cleared pursuant to the streamlined consultation under the 2016 Opinion for the 4(d) rule. The amount of acres within 5 miles of known hibernacula that has been cleared is 615.27 acres from a total of 28,200,537.53 acres (0.002%) of forested habitat in VA and WV. No future tree clearing is planned within known use and unknown use spring staging/fall swarming habitat (although as discussed below, up to 247.68 acres of clearing associated with unknown slips and variances may occur in this habitat category).

As was discussed for Ibat above, based on existing data and surveys conducted by ESI, we define 6 categories of NLEB habitat within the action area:

- Known occupied hibernacula in VA and WV;
- Assumed occupied hibernacula in VA and WV;
- Known use spring staging/fall swarming habitat in VA and WV;
- Unknown use spring staging/fall swarming habitat in VA and WV;
- Known use summer habitat in WV; and
- Unknown use summer habitat in VA and WV.

As discussed above in the NLEB Status of the Species section, the primary factor influencing the status of NLEB is WNS. The best available science indicates that, while the primary stressor

[28] No unknown use summer habitat in VA or WV has been or is expected to be cleared for the project.

continues to be WNS, other threats, such as wind energy development, habitat loss, human disturbance, along with synergistic effects of those stressors acting together also have occurred and continue to occur in areas across the NLEB's range. Impacts associated with climate change are expected to occur across NLEB range in the future. For purposes of analyzing the environmental baseline for NLEB, all of these stressors are therefore expected to be present in the action area.

The SBA2 (Mountain Valley 2022) provided information on stressors affecting the NLEB's baseline condition in VA and WV, which is a small portion of the Eastern Hardwoods representation unit (Figure 10; USFWS 2022), to provide more accurate information on the baseline condition of NLEB within the action area. Specific information was not available regarding activities or land uses that may have resulted in these stressors occurring within the counties the project crosses or within the action area. As a result, using the novel platform described above and aerial imagery for the years 2020 through 2022, the SBA2 (Mountain Valley 2022) identified land cover classifications at a finer spatial resolution and more recent conditions than publicly available data. This review identified land uses, specific activities, and related stressors that could reasonably have affected the baseline condition for NLEB in the action area. Based on this data, while most of the area within the NLEB action area is forested, other activities with significant potential to affect the baseline condition include agricultural use (crops and pasture/hay) and development (roads, impervious surfaces, and rooftops). Agricultural use and development can affect NLEB through conversion of forest and loss of forested habitat, felling of occupied roost trees, increased forest fragmentation, changes to forest composition from invasive species, wind energy related mortality, and disturbance from noise and light. Development may also affect NLEB by destroying and degrading winter hibernacula, such as caves and mines, and increasing vulnerability of these sites to exploration, commercialization, vandalism, flooding, modification of entrances, microclimate changes, and incompatible surrounding land use.

Hibernacula and Associated Spring Staging and Fall Swarming Habitat – Known hibernacula are defined as caves or mines that are currently occupied, or were historically occupied, by hibernating NLEBs. Assumed occupied hibernacula are defined by the Service as suitable caves and their associated sinkholes, fissures, and other karst features, as well as anthropogenic features such as mines and tunnels, which are reasonably certain to be occupied by hibernating NLEBs. It is appropriate to conservatively assume presence of hibernating bats for features that occur within the range of the species, are determined to be suitable in accordance with the Service's Rangewide Indiana Bat/Northern long-eared bat Survey Guidelines, and for which occupancy surveys are not completed to determine presence/probable absence. The 2017 Opinion discussed 3 known NLEB hibernacula in the action area: Canoe and Tawney's Caves, Giles County, VA, and PS-WV3-Y-P1 mine portal, Braxton County, WV. Defining these as known hibernacula are based on previous hibernacula surveys or harp trapping.

Hibernacula surveys in Canoe Cave documented 1 NLEB in 1982 and 0 NLEB in 2015.

Hibernacula surveys in Tawney’s Cave documented 1 NLEB in Tawney’s Cave in 2011, 2009, 1990, and 1986 (R. Reynolds, VDGIF, email to S. Hoskin, Service, October 30, 2017) and 0 NLEB in 2013 and 2020 (Mountain Valley 2020). Given the difficulty in finding NLEB in the winter, these sites are still considered occupied known hibernacula.

Additionally, harp trap surveys in October 2015 captured 1 NLEB at PS-WV3-Y-P1 (FERC 2017b). While harp trap surveys cannot confirm a feature in fact is used for hibernation, they indicate presence are a good indication of hibernation use. Since January 2018, Mountain Valley has conducted internal and external acoustic monitoring at PS-WV3-Y-P1. The highest reported activity of bat calls occurs during summer and fall swarming. Mountain Valley concludes that it is unlikely that PS-WV3-Y-P1 is a NLEB hibernaculum; however, Mountain Valley and the FERC are considering PS-WV3-Y-P1 as assumed to be occupied by NLEB for this project. Further, the WVDNR and Service consider this an occupied hibernaculum (T. Lennon, Service, email to P. Friedman, FERC, and M. Stahl, EQT, January 16, 2018) and given the high amount of summer activity, it appears there is periodic use in the summer as well.

In addition to the 3 sites discussed previously, there is a fourth NLEB hibernaculum within the action area, the Greenville Saltpeter Cave in Monroe County, WV. NLEB have been documented at this site in 2006, 2012, 2016, and 2018 (A. Silvis, WVDNR, email to B. Douglas, Service, May 29, 2020). This site had a total of 1,134 observed hibernating bats and 0 NLEB observed during surveys in February 2020 (A. Silvis, WVDNR, email to B. Douglas, Service, May 29, 2020). However, no project activities previously occurred within 0.25 miles of this hibernaculum, previous activities outside 0.25 mile were accounted for under the 2016 Opinion for the 4(d) rule. Although no future tree removal activities are planned within the 5 mile buffer of the hibernaculum, it is possible that a portion of the 247.68 acres associated with expected future slips (discussed above in Description of Proposed Action) may occur within the 5 mile buffer of Greenville Saltpeter Cave or the other known occupied hibernacula.

Since the issuance of the 2017 Opinion, 3 additional portals have been discovered, 1 of which Mountain Valley determined to be potentially suitable for hibernating bats (portal P-BTH-0001 near MP 207.5 in Giles County, VA). This portal was further reviewed by the Service, WVDNR, and VDWR, and given the internal dimensions and relatively small entrance size and steep downward angle, a determination was made that this portal was unsuitable and therefore not reasonably likely to support federally listed bats (A. Silvis, WVDNR, email to T. Lennon, Service, June 23, 2020; R. Reynolds, VDWR, email to S. Hoskin, Service, July 1, 2020). As discussed above with respect to Ibat, portal P-BTH-0001 is not considered suitable habitat for hibernating bats and, because recent surveys documented probable absence of bats within the portal, NLEBs are not anticipated to be affected by any project activities impacting the portal.

The expansion of the terrestrial action area from 0.6 to 2.0 miles from the project ROW, as a result of sound attenuation associated with construction noise (discussed in Action Area section), resulted in additional suitability analyses.

As explained above, for all future activities, impacts within a 5-mile buffer of all known occupied hibernacula within 5 miles of the action area are considered. This adds 2 known occupied hibernacula; Clover Hollow and Laurel Creek Cave (Figure 19). These hibernacula were not discussed in the 2017 or 2020 Opinions as only activities that occurred within 0.25 miles of known hibernacula were considered (no tree clearing was planned within 0.25 miles of these 2 hibernacula) and previous activities outside 0.25 mile were accounted for under the 2016 Opinion for the 4(d) rule. Nevertheless, effects from previous tree removal activities within 5 miles of these hibernacula are considered below for purposes of the jeopardy analysis.

Based on field investigation, sampling (harp trap) results, desktop analyses, and coordination with karst specialists, the updated total portal and cave features evaluated for potential use by NLEB within the 2.0-mile action area and expanded 5-mile buffer around known hibernacula for future impacts are as follows:

- 6 known occupied hibernacula (Figure 19); and
- 60 suitable features.

The Service received a site-specific plan dated March 14, 2018, for construction activities within 0.5 mile of portal PS-WV3-Y-P1 (M. Stahl, EQT, email to T. Lennon, Service, March 14, 2018). The plan ensured that no alteration occurred, physical or otherwise, to the portal's entrance or environment that would have adversely affected its use by federally listed bats, including those hibernating within the portal (Mountain Valley 2020).

Mountain Valley conducted a hydrologic and geologic analysis of the risk of the pipeline to Canoe and Tawney’s Caves (Mountain Valley 2020). In summary, they determined that the catchment area for Canoe Cave is topographically higher than and upgradient of the pipeline and the pipeline is approximately 900 ft from the nearest entrance and 800 ft from the nearest mapped passage. Similarly, the pipeline will be on an opposite ridge west of Tawney’s Cave, topographically higher, and below the known cave passages (FERC 2017b).

Based on the protections included in the Karst Mitigation Plan provided in the FEIS (FERC 2017a); the information provided in the November 9, 2017, Potentially Suitable Hibernacula within the Action Area table (M. Stahl, EQT, email to T. Lennon, J. Stanhope, and S. Hoskin, Service, November 9, 2017); the AMMs included in the SBA (Mountain Valley 2020); and Mountain Valley’s supplemental comment response documents (e.g., all blasting activities within close proximity to known and assumed occupied hibernacula will occur outside of the bat hibernating season, and site-specific blasting plans will be developed for all blasting activities proposed within 0.5 mile of any known or assumed occupied hibernacula to avoid adverse overpressure or vibration impacts to any bats occupying the features and to ensure the structural integrity of both the aboveground and subsurface features of a cave or portal during blasting events), we do not expect hibernating NLEBs in any known or assumed occupied hibernacula to be exposed to the stressors associated with MVP project construction (e.g., noise, vibration, feature collapse/modification, etc.). We also expect no impacts to the hibernacula themselves that would render them unsuitable for future use by NLEBs.

Unknown use spring staging/fall swarming habitat is defined as roosting and foraging habitat within a 5-mile radius of potentially suitable hibernaculum that have not been surveyed for NLEB. There are 60 presumed occupied (in addition to 6 known occupied) that FERC is assuming are occupied hibernacula within the project's 2-mile action area and 65 presumed occupied within 5 miles of the action area (M. Neylon, Mountain Valley, email to T. Lennon, Service, June 12, 2020). However, it is not reasonable to assume that all 65 suitable features would be occupied post-WNS. Therefore, the Service used the same analysis used for Ibat, using known cave occupancy data from VA and WV to estimate how many of the suitable features within the action area are reasonably certain to be occupied by NLEBs. To estimate this, the Service first determined the proportion of caves reasonably likely to be occupied by NLEBs by dividing the total number of suitable caves within WV and VA known to contain NLEBs (178) by the total number of caves surveyed to date (658) in WV and VA. The total number of initially assumed occupied features within 5 miles of the action area (65) was then multiplied by the proportion of caves with known NLEB occurrences (0.27) to estimate the number of assumed occupied NLEB hibernacula within the action area (17.58 caves was rounded up to the nearest whole cave = 18 hibernacula).

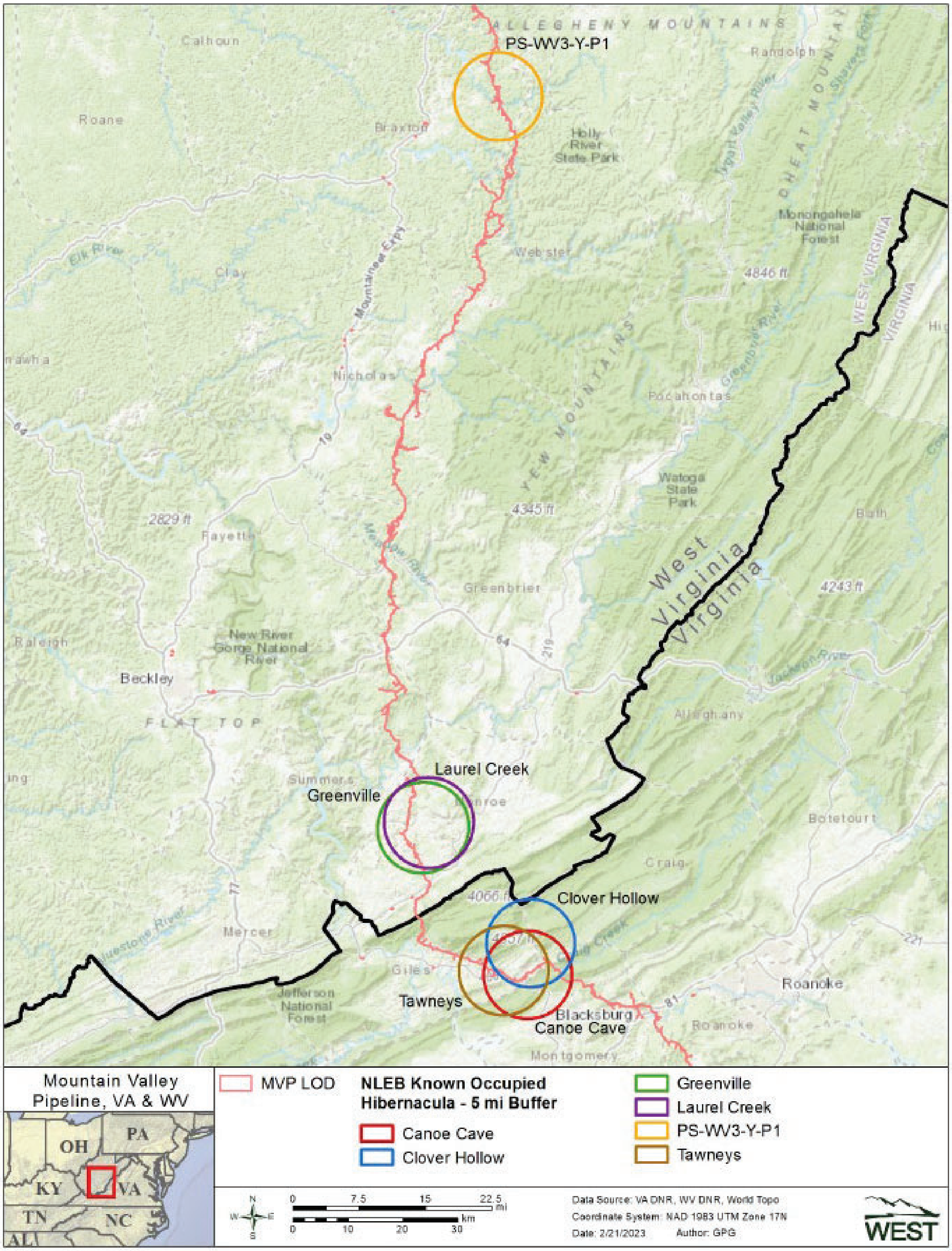

Figure 19. Known occupied hibernacula within 5-mile buffers that overlap the action area.

Estimating the number of NLEB at hibernacula and within spring staging/fall swarming habitat – Although hibernacula surveys offer the best available trend data for the NLEB, they do not relay accurate total number of NLEBs hibernating because NLEB are found in small crevices or cracks in the walls or ceiling, often only their noses and ears are visible, and they are easily overlooked (78 FR 61046-61080). While we acknowledge hibernacula surveys likely underestimate winter abundance, we do not have an estimate of how the counts might correlate to the number of bats hibernating in that particular hibernaculum. Therefore, we cannot precisely estimate the number of hibernating NLEB within the action area and such information cannot be readily obtained during consultation. WNS was first detected in VA and WV during the 2008/2009 winter hibernacula surveys (Stihler 2012, Powers et al. 2015). Since that time, WNS has been confirmed in all areas of VA and WV where NLEB hibernacula are known to occur (Stihler 2012, Powers et al. 2015). Given the continued declines associated with WNS, there may be no NLEB in these features or there could be several NLEB hibernating in each feature. For example, for the only available record of exit counts for NLEB in VA and WV, 17 NLEBs were captured exiting Cudjo's Cave in VA, but no NLEBs have ever been observed during winter counts at that hibernacula (R. Reynolds, VDGIF, email to S. Hoskin, Service, October 30, 2017). Based on the limited available data, for the purposes of our analyses we assume up to 17 NLEB are hibernating in each of these 6 hibernacula and 18 assumed occupied (see calculation above).

Summer Habitat

Survey effort – As stated above in the Ibat Environmental Baseline section, Range-wide Indiana Bat Summer Survey Guidance is designed to determine whether Ibat and/or NLEB are present or absent (P/A) at a given site during the summer (Service 2017a). These guidelines have been in use for many years and have been periodically updated based on new scientific information and public feedback. While the guidelines are considered voluntary, the Service accepts the results of surveys. The exception to this is when there is new information or a better understanding of other existing site-specific information.

As explained above, the Service recommended that no additional bat surveys be completed for the current reinitiation, because the previously surveyed areas have been cleared of trees and they are no longer considered to be suitable habitat for the species (Mountain Valley 2022). Thus, the best available data on the presence or probable absence of NLEB within the surveyed sections of the action area continues to be the results of the 2015-2016 survey efforts, described below.

Mist-net surveys were conducted between May 15 and August 15, 2015, and May 15 and May 26, 2016 (FERC 2017b) along approximately 140.8 miles (64.6 miles in WV and 76.3 miles in VA) of the construction ROW and 79.6 miles (43.0 miles in WV and 36.7 miles in VA) of ARs (ESI 2015c, 2015d; M. Neylon, Mountain Valley, email to T. Lennon, Service, June 12, 2020). A total of 1,398 bats of 9 species were captured at the 441 mist-net sites (M. Neylon, Mountain

Valley, email to T. Lennon, Service, June 12, 2020). Seventy-four NLEBs were captured during these surveys (FERC 2017b). One was captured in Montgomery County, VA, and the rest in WV. Radio transmitters were placed on 56 NLEB and 43 were successfully tracked to roost trees. Two known, occupied NLEB maternity roosts occurred within the project's construction workspace. One of the occupied maternity roosts (Roost 499-1) occurred on private land and has since been removed due to logging events by the landowner. Mountain Valley agreed to avoid the remaining occupied maternity roost (Roost 423-1) by shifting an AR and fencing off the tree to avoid any direct impacts (Mountain Valley 2020). Therefore, this one occupied maternity roost within the action area was previously considered the only known maternity colony in the action area. Mountain Valley also implemented conservation measures outlined in the 4(d) rule, avoiding the removal of documented roosts and trees within 150 ft around roosts during the pup season, June 1 through July 31.

Determining the Number of NLEB Maternity Colonies within the Action Area – Based on a broader analysis area for this Opinion, ten NLEB roosts are known (or have been known) within the action area (A. Silvis, WVDNR, pers. Comm., December 9, 2022); 2 of these were within the project's LOD (limits of disturbance) and were identified in the Service's 2017 and 2020 Opinions. The additional 8 maternity NLEB colonies were not mentioned in previous Opinions as they fell outside the area previously analyzed for impacts to the NLEB. As described above, one known roost occurred on private land and has been removed; therefore, future affects from tree clearing to 9 colonies were assessed. Because no tree removal associated with the project has occurred or will occur in unknown use summer habitat, no additional maternity colonies will be affected in the action area.

NLEB maternity colonies range widely in size, although 30-60 adult females may have been most common pre-WNS (Service 2014). However, as discussed above, we expect that the status of the known colony within the action area is the same as the current status of the species rangewide and in VA and WV (declining). It is likely that some maternity colonies have been extirpated, while other colonies may have fragmented resulting in reduced colony size (although we expect that they will continue to occupy their prior home ranges because of their high site fidelity). Since we have limited information about maternity colony sizes in WV or VA post-WNS and the information is not readily obtainable, we will conduct our analyses based on a reasonable range of 5-40 adult female bats per colony and 1 pup per female per year. This range is reasonable given that the pre-WNS average was 30-60 adult females per colony and winter counts have declined significantly (49% rangewide, with declines of 97-100% for portions of the range) since the onset of WNS. This range is also consistent with post-WNS studies conducted at WV artificial roosts containing 3-38 individuals (average of 12.24 adult females per capture event) (T. Lennon, Service, email to R. Niver, Service, July 22, 2020). As described above, 1 pup per year is the reproductive rate for female NLEB. Adult males are not included in this estimate because they typically stay closer to hibernacula and do not coalesce with adult females and pups during the summer months. Therefore, an estimated 5-40 adult females and 5-40 pups (associated with 1 maternity colony) were estimated to be present within the action area during the summer maternity season for previous tree clearing and 45-360 adult females and 45-360 pups are estimated to be present (associated with 9 maternity colonies) for future tree clearing.

The role of the action area with regards to conservation and recovery of the species is that the project area provides habitat for feeding, breeding, and sheltering of 9 maternity colonies, 6 known occupied hibernacula, and 18 assumed occupied hibernacula. Since the species has been heavily impacted by WNS (discussed in detail above), remaining populations are vulnerable to other stressors, especially during sensitive life stages (e.g., hibernation, breeding and pup seasons), including tree clearing. To support all life stages, NLEB populations require a matrix of interconnected habitats that support spring migration, summer maternity colony formation and foraging, fall swarming, and winter hibernation. When active (outside of hibernation), NLEB populations are known (from summer surveys; 9 known maternity colonies within 5 miles of action area) to use forested habitat within the project area for foraging, commuting, and breeding. The project area also includes 24 known or assumed occupied suitable hibernacula which provide habitat with suitable conditions for prolonged bouts of winter torpor and shortened periods of arousal. Although the suitable habitat provided within the project area is a minimal portion of suitable habitat within the species' entire range, known summer and known or assumed winter habitat within the project area contributes to the conservation and recovery of the species at the population level.

Roanoke logperch (RLP)

As discussed, the environmental baseline refers to the condition of the listed species or its designated critical habitat in the action area. Because critical habitat has not been designated for the RLP, we must assess the condition of the RLP in the portion of the aquatic action area that is likely occupied (or presumed occupied) by the species. RLP presence in the action area is assumed where suitable habitat was identified in drainages known to support RLP.

To provide the necessary information for our baseline analysis for aquatic species, Mountain Valley completed comprehensive stream assessments covering 417 km, including 174 km in WV and 243 km in VA (Mountain Valley 2022). These assessments including field evaluations of all publicly accessible areas in the streams of interest, supported by drone surveys and aerial imagery review of any areas not publicly accessible. Supplemental information related to anthropogenic influences and water quality issues or impairments were also compiled to provide a baseline stream characterization of each waterbody.

Mountain Valley 2022, including appendices H and J, contains detailed baseline stream characterizations and threat assessments for the portion of the aquatic action area potentially supporting the RLP. This includes the North Fork Roanoke River, Bradshaw Creek, South Fork Roanoke River, Roanoke River, Pigg River, and Harpen Creek. As stated above, we have reviewed Mountain Valley's data collection methods and conclude that the resulting information is comprehensive and represents the best available information regarding the physical conditions, activities, and stressors in the RLP action area that may influence the condition of RLP and its habitat. We therefore adopt those stream characterizations and threat assessments and summarize them below.

North Fork Roanoke River – The North Fork Roanoke River is a small to medium-sized, moderate-gradient, perennial stream that flows through the Valley and Ridge physiographic province, merges with the South Fork Roanoke River, and forms the Roanoke River at their confluence. Substrates are generally coarse, dominated by gravel and cobble. In the upper portion, the river passes through a valley pervaded with agricultural practices and dominated by hayfields and pasturelands. In many sections, cattle have direct access to the stream, whereas other farms have installed cattle-exclusion fencing within proximity to the riparian shore. To facilitate access to pastures, hayfields, residences, and forested hillsides, numerous low-water ford crossings are present, many of which are culverts and serve as an impediment to fish passage. Due to the local land-use practices, a significantly large portion of the upper North Fork Roanoke River experiences elevated solar exposure from denuded streambanks and frequent power line crossings. Large woody debris is present instream, however, and the remnant forested riparian zones, although periodic and limited, provide current and expected future sources of large woody debris.

In the lower portions of the North Fork Roanoke River, substrates include episodic bedrock exposures and boulder fields. Two low-head dams occur in the lower section of the river in proximity to Interstate 81 (near the I-81 Rest Area) and within 0.8 km of its confluence with the South Fork Roanoke River. Additional instream features observed along the length of North Fork Roanoke River include a private gravel mining operation, evidence of recent stream restoration efforts (i.e., cross-vane structures apparent), and numerous National Pollutant Discharge Elimination System (NPDES) permit locations. The river also passes through the Blacksburg Country Club, a private 175-acre golf course. According to VDEQ (2020), the North Fork Roanoke River is impaired for recreational use due to E. coli.

Bradshaw Creek – Bradshaw Creek is a small, perennial, low-gradient, warmwater stream that empties into the North Fork Roanoke River in Montgomery County, VA. Substrates are dominated by heterogeneous and coarse particle-size composition including cobble and gravel with large expanses of uplifted (exposed) or underlying bedrock. Large woody debris is present instream and presence of remnant forested riparian zone areas provide current and future sources of large woody debris. Bradshaw Creek passes through a narrow valley that is home to residential properties, natural forest cover, pasturelands, and agriculture uses (livestock, hayfields, etc.). Near the extreme headwaters, cattle have direct access to the stream in several locations. Land along this section of Bradshaw Creek is privately owned, and forestry practices are common on the forested mountain slopes. The narrow valley also has a roadway (Bradshaw Road) that parallels the stream along most of its length. Access from the roadway to agricultural and residential properties on the opposing side of the stream facilitates an abundance of private bridges that contribute to an increase in solar exposure. On the opposing (eastern) side of the stream, an active railroad carves into the hillslope in proximity to the stream for the entire stream reach. The railroad leads to the headwaters of Bradshaw Creek and originates at a large, active mining facility. The proximity of these transportation infrastructures includes numerous culverts that empty or plunge into the stream and the streambanks. According to VDEQ (2020), Bradshaw Creek is impaired for recreational use due to E. coli and for non-support of the aquatic life use due to pH. The initial 303(d) listing occurred in 2010.

Roanoke River – The Roanoke River is a small to medium-sized, moderate-gradient, warmwater river that originates at the confluence of the North Fork Roanoke and South Fork Roanoke rivers near the town of Lafayette in Montgomery County, VA. Substrates are generally coarse, dominated by cobble and gravel, with episodic bedrock exposures and boulder fields. In the upper portion, the river passes through a forested valley partially saturated with agricultural practices dominated by hayfields, pasturelands, and cultivated crops. In the lower sections of the aquatic action area, the river passes through an urban environment where the predominant local land use is residential and commercial properties. Interstate-81 bisects the Roanoke River and partially traverses the river valley. A railroad parallels the entire aquatic action area and includes several bridge crossings. Similarly, roadways crisscross the river valley and include an abundance of bridge crossings. Additionally, numerous power line corridors bisect the river and receive regular vegetation maintenance. The abundance of existing river crossing infrastructure reduces forested riparian zones and canopy cover, thereby increases the amount of solar exposure received by the river. However, large woody debris is present instream, and the presence of remnant forested riparian zones, although periodic and limited, provide current and expected future sources of large woody debris.

As previously mentioned, the river passes through an urban environment; thus, public access points are prevalent along the river to facilitate recreational activities in or on the water, including fishing. VDWR stocks a portion of the river with rainbow trout and brown trout. Commercial facilities are frequent along or near the river, with a commensurate occurrence of NPDES permitted discharges, including wet-weather discharges composed of point source and combination of stormwater, sanitary sewer overflows, or combined sewer overflows. According to VDEQ (2020), Roanoke River is impaired for recreational use due to E. coli, for non-support of the aquatic life-use due to water temperature and benthic macroinvertebrate bioassessments, and for fish consumption due to mercury in fish tissue. The initial 303(d) listing occurred in 2010.

In 2005, the Service issued an Opinion for the Roanoke River Flood Reduction Project (RRFRP), which involved earth-moving and instream activities during channel modification within and along a 10-mi section of the Roanoke River that were anticipated to adversely affect RLP and its habitat through increased sedimentation/suspended sediment and deposition and loss of riparian habitat (Service 2005). It was recognized that the RRFRP could generate large amounts of silt, and that impacts on RLP could include both losses of carrying capacity (i.e., reduction in un-silted habitat) and reductions in vital rates (i.e., reduced feeding efficiency and reproductive success). Other perceived threats from construction included permanent loss of habitat in highly modified areas (e.g., within the footprints of man-made structures) and direct mortality from heavy equipment crossing the riverbed. Allowable take of the relevant RLP population was set at 75% over one year or 25% averaged over 3 years. Such reductions, though seemingly dramatic, were deemed necessary to distinguish RRFRP-induced declines from natural variability. Due to potential long-term effects, the Opinion required monitoring before construction, every year during construction, and 1, 2, 3, 4, 5, 7, 10, 15, and 20 years following completion of construction. Construction began in 2006 and ended in 2011. Post-construction monitoring occurred for 4 years from 2012-2015 and funding for monitoring was discontinued after year 4 because of limited evidence of project impacts. Roberts et al. 2016c found that, "[b]ased on best-supported BACI [Before-After-Control-Impact] models, all hypotheses involving RRFRP impacts demonstrated non-significant or no effects, with other factors explaining a greater proportion of the spatiotemporal variation in adult P. rex [RLP] density observed." (Roberts 2016c). River discharge had a significant negative effect in all models tested. Furthermore, USGS conducted a concurrent study on river habitat and found no significant differences in river-channel geomorphology, bed-sediment composition, and suspended sediments between project phases (Jastram et al. 2015).

South Fork Roanoke River – The South Fork Roanoke River a small to medium-sized, moderate-gradient, perennial stream that originates at the confluence of Bottom Creek and Goose Creek near Piedmont, VA. Substrates are generally coarse, dominated by gravel and cobble substrates. The river passes through a valley that is home to pasturelands and agriculture uses (livestock, hayfields, etc.) with cattle having direct access to the river in numerous locations. Land along this section of the South Fork Roanoke River is privately owned, and forestry practices are common on the forested mountain slopes. The narrow valley also has a roadway (Alleghany Springs Road) that parallels the stream along most of its length and, in concert with hayfields within the floodplain, causes limitations in the width of forested riparian zones. Additionally, access from the roadway to agricultural and residential properties on the opposing side of the stream facilitates an abundance of private bridges and low-water ford crossings. Due to the local land-use practices, a significantly large portion of the South Fork Roanoke River experiences elevated solar exposure from the denuded streambanks and lack of forested riparian areas. More than half of the stream reach within the upper portions of South Fork Roanoke River exhibit limited canopy cover because a forested riparian buffer is less than 10 m wide. However, large woody debris is present in stream, and the presence of remnant forested riparian zone areas, although periodic and limited, provide current and future sources of large woody debris.

In the lower sections of South Fork Roanoke River, the stream flows through an urban setting, which includes increased frequencies of bridge crossings (railway and roadway), utility line crossings, commercial properties, and NPDES discharges. The South Fork Roanoke River is designated as a warmwater stream, although it supports a trout fishery composed of rainbow trout and brown trout. According to VDEQ (2020), South Fork Roanoke River is impaired for recreational use due to E. coli and for non-support of the aquatic life use due to water temperature.

Pigg River – The Pigg River is a medium-sized, low-gradient, warmwater river that flows through the Piedmont physiographic provinces and empties into Leesville Lake in VA. Substrates are generally dominated by sand and episodic bedrock exposures. Land along this section of the Pigg River is privately owned, and forestry and agricultural practices are common in the river's valley. Due to these land uses near the river and within the watershed and the presence of irregular riparian buffers, the river receives elevated levels of sedimentation; thus, available coarse substrates exhibit relatively high embeddedness. These practices also increase the river's solar exposure. Riffles are present and are less frequent than those in the Upper Roanoke (e.g., North Fork Roanoke River, South Fork Roanoke River) and the dominant substrates therein are composed of gravel and bedrock. Pools are most common in this river section, and the relatively low water velocities facilitate deposition of non-coarse substrates. Additionally, large woody debris is abundant; particularly along the stream margins. According to VDEQ (2020), the Pigg River is impaired for recreational use due to E. coli. The initial 303(d) listing occurred in 2012.

Harpen Creek – Harpen Creek is a small, perennial, low-gradient, warmwater stream in the headwaters of the Pigg River watershed in Pittsylvania County, VA that flows through the Piedmont physiographic province. Substrates are generally dominated by a heterogeneous mixture of non-coarse particle sizes dominated by silt, sand, and gravel. A private reservoir was constructed by installing a dam on Harpen Creek in 2014. The reservoir has an earthen dam and serves as a barrier to fish passage. Harpen Creek is in a rural watershed, and the predominant land use is composed of agricultural and logging practices. In many sections, cattle have direct access to the stream, and, in other sections, pasturelands flank a narrow riparian buffer. Logging is regularly performed in forested tracts of adjacent land. The mixture of land-use practices (e.g., cattle, agriculture, timber) that border the stream (as well as the watershed) serve as a significant existing sedimentation source. However, the newly constructed reservoir serves as a sediment trap that prevents transport of downstream sediments. Within the free-flowing stream sections (downstream of reservoir), streambank erosion and siltation are high, and substrates are highly embedded. The denuded riparian zones, as well as the newly constructed reservoir, afford little to no canopy cover; therefore, the stream experiences vast stretches of elevated solar exposure. However, large woody debris is abundant in portions of the stream, and the presence of forested riparian zone areas, although periodic and limited, provide current and expected future sources of large woody debris. According to VDEQ (2020), Harpen Creek is impaired for recreational use due to E. coli.

We next determine how baseline habitat conditions in the above-described RLP action area have affected, and are affecting, the condition of the relevant RLP populations. We rely on the assessments in the RLP SSA (Service 2022b) for each of the relevant RLP MUs: the Upper Roanoke MU and the Pigg River MU. Although we recognize that RLP action areas fall within, but are not entirely coextensive, with the two MUs, reliance on the recent MU assessments is appropriate for several reasons. First, as the SSA explains, an MU is defined "as a group of individuals occupying a discrete, local geographic area in which demographic exchange is common and habitat conditions are relatively homogeneous." Although the authors recognized that each MU may exhibit some heterogenous habitat and demographic conditions that could reduce the precision of their projections for the MU as a whole, they concluded that the values selected for fish density, vital rates, habitat quality, and catastrophic risk for each MU adequately represent the average conditions throughout the MU, and that any lack of precision did not create significant bias. Moreover, the baseline stream assessments summarized above did not identify any unique or unusual conditions or stressors that cast doubt on the applicability of the SSA MU assessments to the action area portion of each MU. For example, the SSA assessments are designed to address and account for fine sediment deposition and pollution resulting from urbanization, agricultural activities, and silvicultural activities. Most of the ongoing activities within the action area component of the MUs fall within those categories. The SSA was also prepared by species experts and subjected to peer and partner review, and there is no superior data or methodology that could be used to assess how past and ongoing stressors are affecting the current condition of RLP in the action area portions of the MUs, or in the MUs as a whole. As the authors explained, "there have been no empirical studies of relationships between individual fitness measures or population vital rates" and the key factors affecting the species, including fine sediment, pollution events, and dams. "For example, we do not know how much a given percentage increase in watershed urbanization will increase the percentage embeddedness of riffle gravel, or how much this increase in embeddedness will decrease individual growth or population recruitment." Given the absence of better data or a superior methodology, the MU assessments represent the best available information regarding the current condition of the species in the action area, which reflects the impacts of all past and ongoing activities.

The North Fork Roanoke River, South Fork Roanoke River, and Roanoke River are listed as part of the Upper Roanoke MU (linear range extent 354 km, Service 2022b). Bradshaw Creek (a tributary to the North Fork Roanoke River, length 6 km) has suitable RLP habitat (FERC 2017b) and is within the geographical bounds of the Upper Roanoke MU. The Upper Roanoke MU is known to support RLP and sections are VDWR designated threatened and endangered species waters. The assumption of RLP presence at the North Fork River crossing location discussed below has been confirmed by project related observations. In addition to the 2 RLP observed at the North Fork Roanoke River crossing, a RLP was observed on November, 2017 (Mountain Valley 2020) and RLP were observed during mussel salvage efforts; 10 adult RLP in July 2018 (J Spaeth, ESI, email to collection permits, VDGIF, July 2, 2018) and 7 RLP (6 adults and 1 juvenile) in October 2021 (J Spaeth, Edge, email to A. Martin, VDWR, October 21, 2021), no other observations have been reported in the Roanoke River.

Portions of the Roanoke River are identified as impaired segments for aquatic life use based on impaired benthic macroinvertebrate communities and are on the Virginia 303(d) list of Impaired Waters. The benthic macroinvertebrate standard is a metric that corresponds to sediment load in the waterbody and is discussed in more detail below. Numerous instream and bank restoration projects have been completed and impediment removal projects have reconnected 185 miles in the Roanoke River. Additionally, the National Response Center database was searched for the prior 10 years and there were no records of any spills in the RLP mixing zones or crossing locations in the Upper Roanoke MU.

The SSA estimates current population size for each MU by taking the arithmetic mean of two different estimators. The first estimator was elicited from species experts during structured decision-making (SDM) team meetings. These values represent expert judgment based on knowledge of relative variation in habitat quantity and quality among MUs. The second was based on the approach described by Roberts (2012a) and Roberts (2018), which involved using previously-collected empirical habitat and fish data to: (1) estimate the linear extent of each MU, as the stream distance between the downstream-most and all upstream-most collection locations in each MU, (2) estimate the mean distance between suitable habitat patches (i.e., riffle-run channel-units) in that MU, (3) estimate the mean number of adult RLP per habitat patch, and (4) by combining these quantities, estimate the total population size of the MU.

The authors of the SSA also focused on population density rather than total abundance as a demographic indicator of current condition. The overall estimate of current population size for each MU was divided by the linear extent of the MU to obtain an estimate of current population density (adult fish km^{-1}) for each MU. To estimate a “minimum viable population density” for RLP, the authors used a simulation model to forecast extinction probability 50 years in the future. Extinction risk was nearly 100% when density was less than 10 fish km^{-1}, decreased rapidly as density increased to 20 fish km^{-1}, and was close to zero at larger population densities. MUs with a density $\geq$ 20 fish km^{-1} are therefore considered to have the highest resiliency. Resiliency reflects the ability of a species and its constituent populations to withstand the range of favorable and unfavorable conditions all natural populations face, including demographic and environmental stochasticity. At the population level, resiliency to such factors might be measured using demographic indicators like population size or the vital rates (survival, recruitment, immigration) that sustain it. Resiliency also requires that a population resist the negative effects of inbreeding depression and maintain the potential to adapt to novel selection pressures

Current RLP population size in the Upper Roanoke MU is estimated at 12,000 individuals based on expert opinion and 16,557 individuals based on field-based empirical estimates of fish catch, habitat spacing, and range extent. Population density in the SSA (Service 2022b) is estimated at 40.3 RLP/km (more than twice the “high resiliency” threshold), calculated as mean population size (14,279 individuals) divided by the estimated linear range extent (km) of the MU (354.0 km, Service 2022b). Population density of the Upper Roanoke MU, including Bradshaw Creek is estimated at 39.7 RLP/km, calculated as mean population size (14,279 individuals) divided by the estimated linear range of the MU plus Bradshaw Creek (354 km + 6 km = 360 km). This number is appropriate to use with the addition of Bradshaw Creek because RLP have not been documented in Bradshaw Creek.

Considering the biology of the species and key factors influencing condition, the SSA assessed current resiliency of occupied RLP MUs based on indices of genetically effective population size, habitat quality, and geographic range complexity in addition to population density. The Upper Roanoke MU exhibits high potential for resiliency in each of the relevant categories and has the highest overall resiliency score (7) of currently occupied MUs. A MU with an overall score ≥ 5 exhibited at least 3 "high" indices and is considered to have highest resiliency.

Based on the SSA, the RLP 5-year review (Service 2022a), the other information summarized above, and the restoration projects in the North Fork Roanoke River, which help ameliorate the threats associated with fine sediment and issues associated with connectivity, we conclude the RLP in the action area portion of the Upper Roanoke MU and in the MU as a whole are stable or improving.

The Pigg River is listed as part of the Pigg MU (linear range extent 233.2 km, Service 2022b). Harpen Creek (at the headwaters of the Pigg River) is 3.2 km from the mouth of the Pigg River upstream to the impoundment, has suitable RLP habitat (FERC 2017b), and is within the geographical bounds of the Pigg MU, but as explained below, is not included in the impact area. The Pigg MU is known to support RLP and sections are VDWR designated threatened and endangered species waters. RLP presence is assumed in the impact area described below.

Numerous instream and bank restoration projects have been completed in the action area and impediment removal projects have reconnected a total of 97 miles of aquatic habitat in the Pigg MU. Additionally, the National Response Center database was searched for the prior 10 years and there were no records of any spills in the RLP mixing zones or crossing locations in the Pigg River.

Current RLP population size of the Pigg MU is estimated at 9,000 individuals based on expert opinion and 5,160 individuals based on field-based empirical estimates of fish catch, habitat spacing, and range extent. Population density in the SSA (Service 2022b) is estimated at 30.4 RLP/km, calculated as mean population size (7,080 individuals) divided by the estimated linear range extent (km) of the MU (233.2 km, Service 2022b). Population density of the Pigg MU, including the suitable RLP habitat section of Harpen Creek is estimated at 29.9 RLP/km, calculated as mean population size (7,080 individuals) divided by the estimated linear range of the MU plus the suitable RLP habitat Harpen Creek (233.2 km + 3.2 km = 236.4 km). This number is appropriate to use with the addition of suitable RLP habitat in Harpen Creek because RLP have not been documented in Harpen Creek.

The Pigg MU exhibits high potential for resiliency in the categories of population size and density and genetic conditions and is rated average for habitat quality. The MU exhibited the second-highest overall current resiliency score (6) of the 7 currently occupied MUs.

Based on the SSA, the RLP 5-year review (Service 2022a), the other information summarized above, and the restoration projects in the Pigg River, which help ameliorate the threats associated with fine sediment and issues associated with connectivity, we conclude the RLP in the action area portion of the Pigg MU and in the MU as a whole are stable or improving.

In summary, the Upper Roanoke and Pigg MUs provide feeding, breeding, and sheltering for the RLP. The Pigg MU in particular provides an unobstructed dispersal corridor, which allows for unrestricted gene flow. Because these MUs cover a large geographic extent, contain an estimated large population, and run a lower risk of being susceptible to extirpation (Roberts et al. 2016b) we expect they underpin the recovery of the species.

We now address the MVP project waterbody crossings in waters categorized as potential RLP habitat and explain why most of the crossings do not require further analysis. The following MVP project waterbody crossings were categorized as RLP suitable habitat identified by desk-top analysis or in-situ assessment: Bradshaw Creek 1 (MP 230.9), Bradshaw Creek AR (MP 231.6), North Fork Blackwater River (MP 249.8), Teels Creek 4 (MP 262.4), Little Creek 1.5 (MP 262.7), Little Creek 2 (MP 263.4), Maggodee Creek 1 (MP 269.4), Blackwater River 3 (MP 269.8), and Harpen Creek 1 (MP 290). The following MVP project waterbody crossings were categorized as known to support RLP: North Fork Roanoke River AR1 (MP 227.2), North Fork Roanoke River AR2 (MP 231.7), North Fork Roanoke River (MP 227.2), Roanoke River (MP 235.6), and Pigg River (MP 289.2).

Bradshaw Creek 1 crossing (MP 230.9, Stream ID S-C21), Montgomery County, VA, is 2.5 km above the confluence of Bradshaw Creek with the Roanoke River. As mentioned above, Bradshaw Creek (a tributary to the North Fork Roanoke River) has suitable RLP habitat (FERC 2017b) and is within the geographical bounds of the Upper Roanoke MU. RLP presence is assumed by FERC although RLP have never been documented in Bradshaw Creek. The crossing method has changed from open-cut dry ditch to conventional bore (Table 9). As stated in the Description of Proposed Action, conventional bore techniques avoid all instream construction activities and all direct impacts and there is no risk of IR because drilling fluids are not used (Table 10). Because no open-cut trenching will be performed, the stream channel itself will not be impacted, allowing existing riparian vegetation near the stream banks to remain in place. Therefore, we expect no instream construction impacts to RLP at this crossing and this crossing will not be discussed further in this Opinion.

Bradshaw Creek AR crossing (MP 231.6), Montgomery County, VA, is no longer proposed for use as an AR (P. Moore, Beveridge & Diamond PC, email to C. Schulz, Service, November 9, 2022). Therefore, this crossing will not be discussed further in this Opinion.

Based on discussions with species experts and lack of evidence via traditional survey methods or eDNA sampling that RLP occupy the Blackwater River drainage (Mountain Valley 2022), the Blackwater River drainage was removed from the Predicted Suitable Habitat layer for RLP

(Virginia Natural Heritage Program 2019) in 2019 (D. Bucklin, VDCR-DNH, email to S. Hoskin, Service, May 20, 2021). Therefore, the North Fork Blackwater River, Teels Creek 4, Little Creek 1.5, Little Creek 2, Maggodee Creek 1, and Blackwater River 3 crossings are not considered occupied by the RLP and will not be discussed further in this Opinion.

Harpen Creek 1 crossing (MP 290, Stream ID S-C3), Pittsylvania County, VA, is 2.3 km above the confluence with the Pigg River. Harpen Creek contains limited suitable RLP habitat based on an in-situ assessment (ESI 2015b), is within the geographical bounds of the Pigg MU, and RLP presence is assumed although RLP have never been documented in Harpen Creek. The crossing method has changed from open-cut dry ditch to conventional bore (Table 9). As stated in the Description of Proposed Action, conventional bore techniques avoid all instream construction activities and all direct impacts and there is no risk of IR because drilling fluids are not used (Table 10). Because no open-cut trenching will be performed, the stream channel itself will not be impacted, allowing any existing riparian vegetation near the stream banks to remain in place. Therefore, we expect no instream construction impacts or impacts to RLP at this crossing and this crossing will not be discussed further in this Opinion.

The North Fork Roanoke River AR1 crossing (MP 227.2, Stream ID S-G36), Montgomery County, VA, is known to support RLP. The crossing method is a temporary single span bridge (Table 9) and no temporary fill placement will occur at the temporary ARs (M. Stahl, EQT, email to S. Hoskin, Service, November 9, 2017). Therefore, no instream construction impacts or impacts to RLP are anticipated at this crossing and this crossing will not be discussed further in this Opinion.

The North Fork Roanoke River AR2 crossing (MP 231.7, Stream ID S-GH16), Montgomery County, VA, is known to support RLP. Reese Mountain Road, an existing road that includes a paved bridge across the river, will be used as the AR to reach the construction site; therefore, no instream construction impacts or impacts to RLP are anticipated at this crossing and this crossing will not be discussed further in this Opinion.

Roanoke River crossing (MP 235.6, Stream ID NN16), Roanoke County, VA, is known to support RLP. The proposed crossing method is microtunnel (M. Neylon, Mountain Valley, email to J. Stanhope, Service, August 6, 2020) (Tables 9 and 10). This trenchless crossing method minimizes impacts in the riparian zones by eliminating construction activities within or directly adjacent to the crossed stream (M. Eggerding, Mountain Valley, letter to J. Martin, FERC, May 13, 2020). It also minimizes the risk of IR (Table 10). Because no open-cut trenching is performed, the stream channel itself would not be impacted, allowing any existing riparian vegetation near the stream banks to remain in place. Therefore, no instream construction impacts or impacts to RLP are anticipated at this crossing and this crossing will not be discussed further in this Opinion.

Pigg River crossing (MP 289.2, Stream ID S-E11), Pittsylvania County, VA, is known to support RLP. The crossing method was HDD, which was completed in 2019 (Table 9). This trenchless crossing method minimized impacts in the riparian zones by eliminating construction activities within or directly adjacent to the crossed stream (M. Eggerding, Mountain Valley, letter to J. Martin, FERC, May 13, 2020). Because no open-cut trenching was performed, the stream channel itself was not impacted, allowing any existing riparian vegetation near the stream banks to remain in place. Therefore, no instream construction impacts or impacts to RLP are anticipated at this crossing and this crossing will not be discussed further in this Opinion.

The North Fork Roanoke River 1 crossing (MP 227.2, Stream ID S-G36), Montgomery County, VA, is 34 km above the confluence of the North Fork Roanoke River with the Roanoke River. As discussed, the North Fork Roanoke River is known to support RLP and is part of the Upper Roanoke MU. The North Fork Roanoke River is a VDWR designated threatened and endangered species waters, which "identifies streams and rivers that contain documented occurrences of federal/state- or state-listed threatened or endangered species and their associated habitat." The North Fork Roanoke River 1 crossing is the only crossing where adverse impacts to RLP are expected. The Predicted Suitable Habitat layer for RLP (Virginia Natural Heritage Program 2019) identifies the crossing as potential RLP habitat and RLP presence is assumed at this location. The construction ROW is 22.86 m wide at this crossing. The crossing was completed in July 2018 via open-cut dry ditch (Table 9). No RLP were observed during the fish removals associated with 2 dewatering events (July 17-18, 2018 and August 15-17, 2018) at this crossing (Mountain Valley 2020). The streambed was re-contoured to reflect pre-construction streambed contours and restoration was finalized August 2018. Post-construction monitoring of RLP habitat was completed October 16-19, 2020. This crossing was completed prior to the 2020 Opinion, which required Mountain Valley to assess RLP habitat 6 months after the construction activities related to the crossings were completed and to monitor water quality in RLP streams. The habitat assessment for this crossing site has been completed.

The habitat assessment noted that, unrelated to the project, cattle have access to the river from approximately 400 – 800 m downstream of the crossing; habitat in this area appeared degraded. However, degraded habitat was not observed "adjacent to the Project crossings nor were anecdotal differences in substrate quality or silt coverage between upstream and downstream areas of the Project crossings." (Edge 2020). During the habitat assessment, 2 RLP were observed near microhabitat classified as high quality (Edge 2020). The habitat assessments "documented the continued presence of suitable Roanoke logperch habitats (and individuals) in the river." (Mountain Valley 2022).

As part of the monitoring and reporting requirements from the 2020 Opinion, Mountain Valley installed monitoring stations as detailed in Appendix F; 2 mixing zones are no longer considered part of the impact area (Appendix D, Table 1). Stations were fully commissioned and subject to the Monitoring Plan (Appendix F) reporting requirements once construction had resumed in the watershed. The monitoring stations were installed and became operational prior to Mountain Valley resuming construction in each watershed and provides an indication of potential upland sediment contribution from the MVP project to the streams of interest (Appendix L in Mountain Valley 2022).

The role of the action area with regards to conservation/recovery of the species is that it provides feeding, breeding, and sheltering for the RLP in 2 MUs. As mentioned above, both the Upper Roanoke and the Pigg MUs provide feeding, breeding, and sheltering for RLP. The Pigg MU in particular provides an unobstructed dispersal corridor, which allows for unrestricted gene flow. Because these MUs, which include the portions of the aquatic action area that fall within them, cover a large geographic extent, contain an estimated large population, and run a lower risk of being susceptible to extirpation (Roberts et al. 2016b) we expect they underpin the recovery of the species.

Candy darter (CD)

The aquatic action area includes portions of the Gauley River in Nicholas County, WV, and Stony Creek in Giles County, VA. Although presence/absence surveys for CD were not conducted for the proposed action, CD presence is assumed based on recent surveys and research by WVDNR, VDWR, and researchers from West Virginia University and Virginia Tech. These surveys have repeatedly documented CD presence in Stony Creek, VA, and the Gauley River, WV. Data available during the CD SSA indicated recent (2016) survey detections in the lower Stony Creek, VA watershed and multiple locations throughout the Gauley River with CD detections in 2016. During the listing process for the species, the Service determined that, although all sections of Stony Creek and the Gauley River have not been surveyed for CDs, the lower 21.2 miles of Stony Creek and 64.5 miles of the Upper Gauley River contain habitat that is suitable for the species; thus, CD presence is assumed throughout Stony Creek and the Gauley River within the action area. The action area also overlaps stream reaches where CD extirpation occurred historically, including Indian Creek (Monroe County, WV) and Greenbrier River (Summers County, WV). The MVP project proposed Greenbrier River crossing is downstream of the extant Greenbrier River CD populations (USFWS 2018a). These streams are not discussed further in this Opinion.

The Gauley River is a 5th order, moderate-to-high gradient stream that drains approximately 9,526 square miles in southeastern WV. The mainstem Gauley River is formed at the confluence of the North, Middle, and South Forks of the Gauley River in Pocahontas County, WV. The 268.7-km long Gauley River terminates at its confluence with the New River in Fayette County, WV. The Gauley River has a deep gorge with whitewater rapids and exhibits riffles, runs, and pools. The river exhibits swift flows and a moderate gradient of less than 6.5 m/km. Substrates are generally dominated by a large heterogeneous mixture of boulder, cobble, and gravel with extensive areas of bedrock exposures. Massive boulders are present instream and capable of withstanding swift flows, particularly during elevated water levels. The Gauley River is generally characterized as a high-quality stream supporting numerous designated uses (i.e., recreation, public water supply, aquatic life). However, the watershed historically experienced significant water quality impairments from resource extraction (e.g., logging, coal mining) that persist into the present day. Approximately 30% of the Gauley River mainstem was listed as partially impaired or impaired due to pH excursions or elevated levels of metals and siltation (West Virginia Bureau for Public Health 2002). The elevated metal levels and pH excursions within the system are presumably the result of input from abandoned surface and deep mining and other industrial activities. Sources of anthropogenic influences include NPDES outfalls, runoff from reclaimed mining operations, roadway runoff, stocking of fish predators, utility crossings, islands/braided channeling, and trash.

The USACE constructed the Summersville Lake Dam in 1966 and created a 2,700-acre reservoir in Nicholas County that separates the upper and lower Gauley River. Within the aquatic action area, the CD occurs in the Gauley River upstream of Summersville Lake and thus is considered part of the upper Gauley River watershed.

The portion of the Gauley River within the action area falls within subunit 5b of the species' designated critical habitat (86 FR 17956). Although the baseline conditions of the affected critical habitat are discussed in the next section of this Opinion, they are also discussed here because they relate to the condition of the species in the action area. Subunit 5b consists of approximately 43.8 skm (27.2 smi) of the Gauley River from the confluence of the Gauley and Williams Rivers at Donaldson, WV, downstream to a point approximately 1.6 skm (1.0 smi) upstream of the Big Beaver Creek confluence. The adjacent land is mostly forested; however, aerial imagery shows forest clearings with varying degrees of regrowth, indicating ongoing timber harvests in some areas. Other human development consists primarily of low density residential areas and small communities with some commercial facilities. Small agricultural fields are associated with some of the scattered residences. Approximately 14.6 skm (9.2 smi) of subunit 5b is within the Monongahela National Forest and/or adjacent to land owned by the USACE. The streams in the remainder of the subunit are adjacent to almost entirely private land, except for a small amount that is publicly owned in the form of bridge crossings, road easements, and the like. Surveys of subunit 5b captured CDs at several locations. The subunit (including those portions within the action area) provides connectivity between other CD streams in the Upper Gauley watershed and contributes to the redundancy of the Upper Gauley CD metapopulation.

The aquatic action area in the Gauley River includes the project ROW crossing of the Gauley River and 2 mixing zones that collectively amount to approximately 2.95 skm because the project ROW crossing and 1 of the mixing zones overlap (there is 1.0 km upstream in the Gauley River plus an overlapping zone of 1.95 km just above Summersville Lake). Each of the 2 mixing zones exists at the confluence with a stream and extends approximately 200 m upstream and 800 m downstream of the input stream's mouth. The mixing zones are disjunctive segments and separated by approximately 23 skm. The mixing zones are located at the termini of Coon Creek (Mixing Zone 19) and Little Laurel Creek (Mixing Zone 20). Mixing Zone 20 overlaps with the buffers applied to the MVP project ROW crossing of the Gauley River.

As stated in the SBA2 (Mountain Valley 2022) "land use immediately adjacent to the Action Area in the Gauley River is predominantly natural forest and reclaimed mining areas with limited residential properties and agricultural land uses. The Gauley River exhibits a broad river channel with full solar exposure. Large woody debris exists throughout the Action Area in the river, and the existing forests within the riparian corridor will continue to provide inputs of large woody debris. Logging and historical mining operations are pervasive along the hill sides adjacent to the Gauley River, and timber stands are observable in various stages of growth or harvest." The photos and assessments of the action area in the Gauley River contained in Appendix J in the SBA2 provide additional information on existing conditions, including physical characteristics and both natural and anthropogenic impacts.

As discussed above in the Climate Change section and CD Status of the Species section, there is little empirical evidence related to the potential effects of climate change on CD. However, in the Upper Gauley River portion of the action area, the high elevation and high percentage of forest cover may offer buffers to the effects of climate change that make CD at low risk to the negative impacts (Service 2018a).

Stony Creek is a 3rd order, moderate gradient stream that flows directly into the New River in Giles County, VA. Substrates are dominated by a heterogeneous mixture including boulder, cobble, and gravel with large expanses of uplifted (exposed) bedrock. Stony Creek's headwaters drain from Jefferson National Forest mountain slopes and the creek supports a year-round trout fishery. Native trout populations are present in the headwaters where the stream is designated as a cold water fishery. In the middle and lower portions, VDWR supports a trout stocking program and the lower-most portions of the stream support a warm water fishery. The effects of introduced trout on the population viability of the CD are difficult to discern from the available information. The CD SSA found that despite continued rainbow trout stocking and the presence of a reproducing brown trout population in Stony Creek, CD remain abundant there (Service 2018a). Stony Creek is listed by the VDWR as a 303(d) impaired water under the fish consumption criteria due to polychlorinated biphenyls (PCB) contamination from unknown sources although it is listed as fully supporting aquatic life use criteria (VDEQ 2020). The initial 303(d) listing occurred in 2020.

The portion of Stony Creek within the action area falls within subunit 2b of the species' designated critical habitat (86 FR 17956). Subunit 2b consists of approximately 31.1 skm (19.3 smi) of Stony Creek from the confluence with White Rock Branch, downstream to the confluence with the New River. The land adjacent to this subunit is largely forested, with some scattered residences and a large underground lime mine, a processing plant, and a railroad spur line along the downstream portion, adjacent to the action area. Approximately 16.1 skm (10.0 smi) of subunit 2b is within the George Washington and Jefferson National Forest, with the remainder adjacent to almost entirely private land, except for a small amount that is publicly owned in the form of bridge crossings, road easements, and the like. Surveys documented CDs at multiple locations within this subunit. Subunit 2b contains the most robust CD population in VA and contributes to the representation and redundancy of the species.

The portion of Stony Creek within the aquatic action area is approximately 2 km in length in the lower-most portion and is composed of 2, 1-km disjunctive segments separated by approximately 140 stream meters. These 2 segments include the Stony Creek pipeline crossing area and a separate mixing zone upstream of the crossing at the confluence with Kimballton Branch. The Stony Creek pipeline crossing (Stream ID S-S5) (Table 9) area is known to support CD. The proposed crossing method is conventional bore. This trenchless crossing method minimizes impacts in the riparian zones by eliminating construction activities within or directly adjacent to the crossed stream (M. Eggerding, Mountain Valley, letter to J. Martin, FERC, May 13, 2020). Mountain Valley (2022) reports that the Stony Creek crossing area lacks any appreciable riparian vegetation due to historic third-party activity. Regardless, because no open-cut trenching is performed, the stream channel itself would not be impacted, allowing existing riparian vegetation near the stream banks to remain in place. Therefore, no instream construction impacts or impacts to CD are anticipated at this crossing. Although no impacts are anticipated, the aquatic action area includes the segment of Stony Creek from 200 m upstream to 800 m downstream of the ROW crossing to account for physical effects, such as increased sunlight due to tree-clearing (Alberts et al. 2018) that may be experienced due to potential clearing and work in riparian areas at the stream crossing, as described in the Action Area section. These effects are not expected to be discernible beyond the width of the ROW, but the 1,000 m area is conservatively used to meet the screening function of the action area definition.

The Kimballton Branch AR crossing site is not known to support CD. The proposed crossing method is an existing private drive from Rogers Road (Route 683). Mountain Valley is utilizing both the existing drive with culverts previously placed in the stream by others and the existing Rogers Road to access the project (M. Neylon, Mountain Valley, email to J. Richard, Service, June 16, 2020). Because an existing road and culverts will be used, the stream channel itself and stream banks would not be impacted and this crossing Therefore, no instream construction impacts or impacts to CD are anticipated at this crossing and this crossing will not be discussed further in this Opinion.

The Kimballton Branch pipeline crossing location also is not known to support CD. The crossing is located approximately 900 m upstream from the confluence of Kimballton Branch and Stony Creek and, as noted, CDs are present in Stony Creek. The proposed crossing method is open-cut dry crossing using the dam and pump method (M. Neylon, Mountain Valley, emails to J. Richard, Service, June 16, 2020 and July 13, 2020). Due to the distance from the confluence with Stony Creek, impacts to CD from this crossing are not anticipated. The action area also includes 200 m upstream and 800 m downstream of Kimballton Branch's confluence with Stony Creek (Mixing Zone 21), because the tributary sediment concentration is expected to be greater than the concentration attenuation threshold at the point it flows into the receiving water, as described in the Action Area section, which was based on sediment load modeling in the Hydrologic Analysis of Sedimentation report that accounts for potential sediment losses from upland construction that may enter Kimballton Branch and be transported into Stony Creek (Mountain Valley 2020).

The action area segments of Stony Creek pass through a narrow valley that is home to residential properties, natural forest, and mining operations. The narrow valley has a roadway (Big Stony Creek Road, Norcross Road) that parallels the stream along most of its length, thus limiting a forested riparian zone and increasing solar exposure. Multiple road crossings, residential lawns, and commercial properties have eliminated the contiguous forested riparian cover, thereby increasing the solar exposure. Sources of anthropogenic influences within the aquatic action area include bridges, riprap, water intake, public access, trash, stocking of fish predators, utility crossings, adjacent roads, commercial development, agriculture, and islands/braided channeling. The photos and assessments of the action area in Stony Creek contained in Appendix J in the SBA2 (Mountain Valley 2022) provide additional information on existing conditions, including physical characteristics and both natural and anthropogenic impacts.

As noted, the lower 5.3 skm (3.3 smi) of Stony Creek, which includes the action area in the Stony Creek watershed, is adjacent to a large underground limestone mine, an associated lime plant, a railroad spur line, and a paved road, which could increase the risk of unpermitted spills or releases of chemicals, petroleum, or other substances toxic to aquatic organisms (Service 2018). The potential effect of any spill or release to the CD population in Stony Creek would be dependent on the nature of the release (i.e., aquatic toxicity, quantity, etc.) and possibly other factors such as weather conditions or time of year. No data is available that would allow us to quantify this risk. The lowest 1.5 km of Stony Creek prior to its confluence with the New River, which is beyond the downstream extent of the action area, has intermittent seasonal flow as a result of past underground mining activities, and these areas may serve as either a nursery habitat for YOY CD or a population sink (McBaine et al. 2022). Currently, water from upstream portions of Stony Creek is entering a mine through karst channels and flooding lower portions of the underground mine. Sump pumps are being used to continually pump settled water back to Stony Creek via a permitted discharge outfall. The mine has been inactive since January 2021, and all current activities are part of an ongoing effort to remove potential contaminants from the upper, unflooded levels of the mine. Once the upper levels are cleared, the mine will be allowed to slowly flood entirely, at which point water from upper Stony Creek will no longer be lost to the mine (B. Leatherland, Hurt & Proffitt, email to J. Richard, Service, March 15, 2022). These ongoing efforts will also reduce the risk of spills or releases of potentially toxic materials from the dormant mine site. At present, however, surface flow in the lower 1.5 km of Stony Creek is intermittent, which may act as a seasonal barrier to fish movement (McBaine et al. 2022).

The CD SSA suggested that the isolated CD populations in the less forested areas of the Middle and Upper New River may be increasingly stressed from climate change as warming trends continue (Service 2018a). However, the Stony Creek watershed, including the portion within the action area, exhibits relatively higher quality habitat and population demographics, which may make the CD population less vulnerable to climate change than in the other more degraded portions of the Middle and Upper New River populations.

A survey of Stony Creek found CD in 74% of habitat units sampled (n = 942) throughout the 13.8-skm (8.6-smi) survey length (Leftwich et al. 1996). CD were observed in all stream habitat types (82% of riffles, 90% of runs, 79% of glides, and 41% of pools) with densities ranging 0-30 CD per 100 m^2. The highest densities were found in riffles, with an average of 10 CD/100 m^2 (Leftwich et al. 1996). Similar surveys have not been conducted for the Gauley River.

Recent work by McBaine and Hallerman (2020) addressed demographics and population genetics of CD populations in VA. These studies found that CD relative density measured by catch-per-unit-effort (CPUE) within Stony Creek was highest in the midpoint of the watershed, with lower abundances closer to the confluence with the New River, where the action area is located. However, CD were also captured consistently at the lower, center, and upper sites, and CD presence remained constant at sites within the species' known distributions in Stony Creek. This indicates that the entire area, including in the action area in the lower reaches above the intermittent flow area, continues to function as CD habitat, notwithstanding the documented stressors and anthropogenic activities within the action area. Comparisons of CPUE data between Dunn (2013) and McBaine and Hallerman (2020) found the studied populations, including the Stony Creek population, to be relatively stable between the 2 time points. Though there was a 13% decrease in CPUE for the middle Stony Creek site from 2013 to 2018, McBaine and Hallerman (2020) indicated that these figures should be interpreted with caution and should not be interpreted as signs of a declining population size. CD age structure analysis found individuals from ages 0 to 5 in Stony Creek, with the greatest proportions comprised of age-2 and age-3 individuals (McBaine and Hallerman 2020). Observed movement patterns within Stony Creek found that movements were generally upstream and short-distance (average 53 m), though 1 individual moved 4.2 km upstream. Because short-distance movements are detected more frequently than long-distance movements (Albanese et al. 2003), it is possible that longer movements by CD may occur more regularly than observed. No comparable data is available for the Upper Gauley population or action area.

Although CD population estimates for Stony Creek and the Gauley River are unavailable, both populations have been found to contain very few variegate darter alleles, and are considered to be among the most genetically pure populations (Gibson et al. 2019). For the Upper Gauley River population, including the portion within the action area, Summersville Dam serves as a barrier to the potential upstream movement of variegate darters known to inhabit the lower Gauley River (Mountain Valley 2020). Bluestone Dam may also hinder variegate darter intrusion into the New River watershed above the dam, which includes the Stony Creek population and action area (Service 2018a, McBaine and Hallerman 2020). It is notable here that, while barriers that fragment habitat are generally considered detriments to species viability, the Summersville and Bluestone Dams are likely limiting the upstream expansion of variegate darters into the Upper Gauley and Stony Creek CD populations, including into the action area, thereby helping to maintain their viability. This gives added importance to these particular populations for the future conservation and recovery of the species.

Based on a review of physical habitat metrics, non-native competition metrics, and population demographic metrics, CD populations in Stony Creek and the Gauley River were determined to be "generally secure" or "marginally secure" in the SSA (Service 2018a), and are considered so in the action area for the purposes of this Opinion. With regards to applying population-level models from the SSA to specific CD populations within the action area, it is critical to note that fluvial ecosystems are the sum of their collective watersheds. When considering habitat quality metrics such as temperature, sedimentation, erosion, and water quality parameters, it is necessary to evaluate more than the immediate surrounding area. Thus, our application of population-level characteristics to describe conditions of CD within the action area is a necessary and appropriate methodology.

The Gauley River action area is occupied by the population identified in the SSA as the Gauley River (upper) CD population. The SSA defines the population to include the Gauley River from its confluence with the Williams River downstream to the Summersville Reservoir (Appendix A in Service 2018a). Overall, the SSA rated the CD population as "moderate" (marginally secure). Total percent forest cover was used to infer instream habitat conditions (sedimentation, stream bottom embeddedness, and water temperature), which are associated with the distribution and abundance of the candy darter. For the Gauley River (upper) population, the watershed landcover is 90 percent forested, resulting in a "moderate" forest cover rating, and water quality is rated as "high," indicating that the river segment is a cool/cold water stream that meets all designated use standards (Appendix B Tables 1-2 in Service 2018a). In the SSA modeling, forest cover >90% received a rating of "high" while 75-90% forest cover received a rating of "moderate". It is noteworthy that the Upper Gauley River watershed was evaluated as 90% forested. Thus, it was assigned a "moderate" score based on the ranking system, despite being on the cusp of the highest quality habitat rating. The population was given a "low" rating for competition by non-native trout (indicating that a reproducing brown trout population is present). However, as noted above, despite continued rainbow trout stocking and the presence of a reproducing brown trout population in Stony Creek, CD remain abundant there. The population rated "moderate" for risk of variegate darter hybridization, meaning that variegate darters – or their genetic markers – have been present in the population for 5 years or less. In the Upper Gauley River CD population, this metric was based on the presence of low concentrations of variegate darter alleles. All variegate darter alleles observed by Gibson et al. (2019) in the Gauley River watershed above Summersville Dam were at very low concentrations. The individuals in which they were observed were all classified as advanced-generation hybrids (i.e., generation F2+, and/or backcrosses with either CD or variegate darters), which indicates that a large-scale hybridization event has yet to be observed in the Upper Gauley drainage and active hybridization zones above Summersville Dam have yet to be detected (Gibson et al. 2019). Finally, the population was rated "high" in all population demographic metrics, including space (greater than 10 stream miles of occupied habitat), abundance, and connectivity.

The Upper Gauley River population received a composite score of 38 in the SSA modeling, thus classifying it as a "moderate" (marginally secure) population. The scoring system assigned "low" scores to populations scoring <0, "moderate" scores to populations scoring 0-40, and "high" scores to populations scoring >40. At the population level, CD in the Upper Gauley River are in moderate – bordering on high – condition. We conclude that the SSA's overall "moderate" rating for the Gauley River (upper) CD population applies equally to the portion of the population occurring within the action area. More importantly for purposes of the jeopardy analysis, we conclude that the recent observations and data summarized above regarding baseline habitat conditions in the action area do not cast doubt on the continued validity of the SSA's "moderate" rating for the population as a whole. These conclusions are based on the following considerations. First, the observed conditions in the action area are not expected to increase the risk of competition with nonnative species or, more importantly, variegate darter hybridization, which is the greatest threat to the species. The presence of variegate darter alleles at low levels in the population indicates that previous introductions of variegate darters have occurred in the Upper Gauley watershed, but have been backcrossed repeatedly with pure CD to the point that they are nearly undetectable. Within the action area, this resilience against hybridization is the same as the larger watershed, as Summersville Dam and reservoir provide a barrier to the upstream movement of a large variegate darter swarm that potentially be more successful in genetically swamping CD populations. Second, despite ongoing anthropogenic activities and stressors in the adjacent watersheds, the observed stream conditions in the action area – as detailed in Appendix J in the SBA 2 (Mountain Valley 2022) – include moderate to high streambank stability, moderate erosion, and low instream embeddedness and siltation, all of which are consistent with the SSA's moderate rating for the population.

The Stony Creek action area is occupied by the Stony Creek population (Middle New River watershed) evaluated in the SSA. The population was given an overall rating of "high" (generally secure). The population was also rated "high" for watershed landcover (97 percent forested), water quality, hybridization (meaning that variegate darters are not known in the population), and all population demographic metrics except for connectivity, which was given a "low" rating (indicating that the population is isolated from others within the metapopulation and movement of individuals between populations is highly unlikely).

We conclude that the SSA's "generally secure" rating for the Stony Creek population applies equally to the portion of the population occurring within the action area, even though habitat conditions in and adjacent to the aquatic action area might be more accurately characterized as moderate or marginally secure. More importantly for purposes of the jeopardy analysis, the available information regarding baseline conditions in the action area do not cast doubt on the SSA's "generally secure" rating for the population as a whole. These conclusions are based on the following considerations. First despite the ongoing activities and stressors observed in and adjacent to the action area segments, recent studies have consistently documented CD in (or in close proximity to) the action area portion of Stony Creek (McBaine and Hellerman 2020; McBaine et al. 2022), indicating that the action area segments remain functional CD habitat.

Second, the observed stream conditions in the action area include high streambank stability, moderate erosion, low instream embeddedness, and low siltation, all of which are associated with good quality CD habitat. Third, the observed conditions are not expected to increase the risk of competition with nonnative species or variegate darter hybridization. Finally, although the lower 1.5 km of Stony Creek adjacent to the lower portion of the aquatic action area may experience intermittent flows, that is a longstanding issue and the population remains robust (Service 2018a). As noted above, the limestone mine, lime plant, railroad spur line, and paved road adjacent to the action area could increase the risk of spills or releases of chemicals, petroleum, or other toxic substances. But the extent of that risk is difficult to assess, and steps are being to both reduce that risk and address the intermittent seasonal flows in the lower portion of the Stony Creek (B. Leatherland, Hurt & Proffitt, email to J. Richard, Service, March 15, 2022). Currently, all discharges from the mine are permitted and regularly monitored as NPDES discharges to detect any potential violations that might affect CD. Given that the mine is inactive and has been designated for closure, any ongoing risks and impacts associated with it are expected to decrease in the future as a result of completing the mine closure activities. The current risk of dewatering due to mine seepage through karst features is mediated by the return of water to the stream via pumps. Upon final closure of the mine, flooding will proceed at a controlled rate (again, mitigated by return pumps) to ensure that a catastrophic dewatering of Stony Creek does not threaten CD. Once the mine is fully flooded, we expect the risk of water loss to cease. Because the remaining specific stressors in action area described above are all long standing factors that were known and incorporated in evaluation of the population condition and future scenarios by the SSA, it is appropriate to apply the SSA's evaluation of their effects to the population to the localized population within the action area. The current conditions in the action area thus do not undermine the conclusion in the SSA and the critical habitat designation that the Stony Creek CD population remains generally secure and robust.

The role of the action area with regards to conservation/recovery of the species is that the project area provides habitat for feeding, breeding, and sheltering of CD in 2 metapopulations. The Gauley River above Summersville Lake provides feeding, breeding, and sheltering habitat for CDs as well as important connectivity between the other populations in the Upper Gauley metapopulation, including Panther Creek, Williams River, Cranberry River, and Cherry River. These areas within the Upper Gauley metapopulation represent the majority of extant CD populations with a "good" population condition score. Thus, their continued existence and connectivity within the watershed is critical to the recovery of the species. Within the Middle New and Upper New CD metapopulations, Stony Creek is the only CD population with a "good" population condition score (Service 2018a). The Upper Gauley and Middle New metapopulations are relatively free from hybridization, making them essential to the recovery of the species.

<u>Status of Critical Habitat within the Action Area</u>

<u>Candy darter (CD) critical habitat</u>

Much of the above discussion of the baseline condition of CD in the action area applies equally to the portions of CD critical habitat in the action area. As discussed, the aquatic action area for CD overlaps with portions of two CD critical habitat units, the Upper Gauley River unit (unit 5) and Middle New River unit (unit 2). The Upper Gauley unit contains 182 smi, or almost half, of the total stream miles of critical habitat. The action area in the Upper Gauley River system (2.95 km = 1.83 mi), assumed to support CD, represents approximately 6.74% of the CD occupied habitat within the Upper Gauley population (i.e., the 43.8 km in critical habitat subunit 5b) and 1.01% of potential habitat within the Upper Gauley River system metapopulation. There are a total of 6 critical habitat subunits within the Upper Gauley unit. Subunits 5c, 5d, 5e, and 5f are not part of the action area. The Gauley River is designated as critical habitat subunits 5a and 5b. Subunit 5a is not part of the action area. The Upper Gauley River, Nicholas and Webster Counties, WV, is designated as subunit 5b and is within the action area and will be affected by the proposed action.

The Middle New unit contains 25.1 smi, 6.79% of the total stream miles designated as critical habitat. There are a total of 3 critical habitat subunits within the Middle New unit. Subunits 2a and 2c are not part of the action area. Stony Creek, Giles County, VA, is designated as critical habitat subunit 2b and is within the action area and will be affected by the proposed action. The action area in the Middle New River unit (2 km), assumed to support CD, represents approximately 6.4% of the CD occupied habitat within the Stony Creek population (31.1 km in critical habitat subunit 2b) and 4.9% of potential habitat within the Middle New River metapopulation.

As discussed above, Subunit 5b is comprised of the Gauley River from the confluence of the Gauley and Williams Rivers at Donaldson, WV, downstream to a point approximately 1.6 skm (1.0 smi) upstream of the Big Beaver Creek confluence. Subunit 5b of the Gauley River comprises 27.2 smi, or approximately 15.0% of the total stream miles of critical habitat in unit 5 and 7.4% of the total stream miles of critical habitat. The Upper Gauley River serves as critical habitat for the CD in all stages of its life cycle, and is occupied year-round by the species. The Upper Gauley River subunit is noted as being important to the redundancy of the Upper Gauley CD metapopulation, and may serve as a connection among the 6 CD-occupied streams in the Upper Gauley watershed (Service 2018b).

The habitat conditions in the action area component of subunit 5b in the Gauley River are discussed above in the Environmental Baseline section for the CD. Generally, the Upper Gauley subunit is in good condition. The CD metapopulation containing this subunit has the highest overall condition score of the species' 5 extant metapopulations and has 6 populations of CDs. Throughout the watershed, the habitat condition is considered to be moderately conducive to the species; there is generally high forest cover (over 90%), which is an indicator of higher quality habitat conditions specific to the CD (lower water temperature, and lower instream sedimentation and substrate embeddedness). There is a high percentage of public land ownership for some of the subpopulations, but a mix of private and public landownership in other parts of the watershed. The water conditions throughout the Upper Gauley watershed are cold waters, with some degree of water quality impairment. Most of the streams within the watershed have some degree of impairment by aluminum, iron, or high water acidity. The Upper Gauley watershed has some stocking of brown and rainbow trout, which are known predators of darters; trout are reproducing in some of the rivers. However, the Upper Gauley CD metapopulation is the only one that is currently secure from hybridization with the variegate darter. As this is considered the greatest threat to the species' continued existence, the importance of the pure CD genetics in the Upper Gauley watershed is likely to increase in time, with the expected increase in hybridization in other watersheds. Finally, the Upper Gauley watershed exhibits good connectivity among populations and subpopulations, such that darters can migrate between different populations. Good connectivity is especially important in watersheds with limited habitat availability, such as with the Upper Gauley River unit, where 4 of the 11 occupied streams and rivers have 10 or more miles of habitat (Service 2018a).

The baseline habitat conditions in the action area component of subunit 2b in Stony Creek are discussed above in the Environmental Baseline section for the CD. Generally, the Middle New watershed is in moderate to poor condition, however, the Stony Creek subunit is in considerably better condition than any other CD streams in VA (which includes both the Middle New and Upper New units). The Stony Creek watershed has habitat conducive to the species, with a high percentage of forest cover (97%) and a high percentage of public land ownership. Stony Creek is listed as "fully supporting" aquatic life use criteria in the 2018 integrated report from VDEQ (2018); however, it is listed as impaired under the fish consumption criteria due to PCB contamination from unknown sources. The water conditions throughout Stony Creek are reflective of the forested landscape, with generally cold, fast-flowing waters, high water quality, and low substrate embeddedness. As discussed above, the portion of the action area where critical habitat will be affected is comprised of 2 tributaries within the Stony Creek watershed and a 1 km area within Stony Creek where the pipeline crossing will occur (200 m upstream through 800 m downstream of the crossing).

The scope of potential effects to CD critical habitat is limited to approximately the lowest 4.15 smi of Stony Creek, from the confluence of Stony Creek with the New River up to the confluence of the unnamed tributary to Stony Creek at smi 4.15. All project activities potentially affecting the Stony Creek subunit will be limited to this lower 4.15 smi. Within the Stony Creek watershed, sediment from project activities west of Stony Creek will primarily enter the watershed via the unnamed tributary at Stony Creek smi 4.15 and Kimballton Branch. However, sediment entering via the unnamed tributary at smi 4.15 is expected to be at levels that have insignificant and/or discountable effects on CD, and will not be addressed further in this Opinion. Sediment from activities east of Stony Creek will enter directly to Stony Creek. As discussed above, upland sediment from east of Stony Creek will enter the watershed within the 1 km area surrounding the crossing and is accounted for based on elevated sediment calculations for the area within 800 m downstream of the crossing. This sediment from east of Stony Creek will not be carried via tributary streams. As stated above, the area below the end of the 800 m zone downstream of the crossing and outside of the action area occurs in an area that is regularly dry during low summer flows; therefore, sediment is not anticipated to be carried beyond this zone. The remainder of effects discussed in Stony Creek are within the mixing zone 200 m upstream and 800 m downstream of the confluence with Kimballton Branch.

The role of critical habitat in the action area with regards to conservation/recovery of the species is that the project area provides habitat for feeding, breeding, and sheltering of CD in 2 metapopulations. The Gauley River above Summersville Lake provides feeding, breeding, and sheltering habitat for CDs as well as important connectivity between the other populations in the Upper Gauley metapopulation, including Panther Creek, Williams River, Cranberry River, and Cherry River. These areas within the Upper Gauley metapopulation represent the majority of extant CD populations with a “good” population condition score. Thus, their continued existence and connectivity within the watershed is critical to the recovery of the species. Within the Middle New and Upper New CD metapopulations, Stony Creek is the only CD population with a “good” population condition score (Service 2018a). The Upper Gauley and Middle New metapopulations are relatively free from hybridization, making them essential to the recovery of the species.

EFFECTS OF THE ACTION

In accordance with 50 CFR 402.02, effects of the action are all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action. A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action (see § 402.17).

Prior to analyzing the effects of the action on listed species, we must determine whether there are activities that are not part of the proposed action itself, but are nevertheless consequences of the proposed action (i.e., activities that would not occur but for the proposed action and are reasonably certain to occur) (50 CFR 402.02, 402.17).

<u>Non-jurisdictional facilities (NJFs)</u>

FERC, under Section 7 of the Natural Gas Act, is required to consider, as part of its decision to authorize interstate gas facilities, all factors bearing on the public convenience and necessity. This includes any NJFs that do not come under the jurisdiction of FERC but may be integral to the project objective. These NJFs and their effects may be considered effects of the proposed action because these facilities likely would not exist but for the proposed action and are reasonably certain to occur.

The NJFs are not part of the proposed MVP project but will occur as a result of the project. These NJFs are short utility lines developed by third parties (M. Hoover, Mountain Valley, email to C. Schulz, Service, January 17, 2023). All NJFs are within the action area.

For each of these NJFs, Mountain Valley has requested or will request service from a local utility company, and that company plans, designs, and constructs the facility without Mountain Valley's involvement. Mountain Valley does not have precise engineering specifications or information about any AMMs the utility providers will implement. Mountain Valley is also unable to determine whether any of these NJFs will have a federal nexus and whether Section 7 consultation will be required because these activities are controlled by third parties and are separate from the MVP project. For example, the utility companies will decide on the final pole location in relation to waters of the U.S. The utility companies will likely strive to avoid pole placement in waters of the U.S. and will reduce tree felling and land clearing to the maximum extent practicable. These utilities average less than 700 ft in length and will often be collocated by the third parties with existing linear features, such as roads or the project ROW.

The location of each NJF, estimated length and width, estimated tree-felling acreage, Information for Planning and Consultation (IPaC) tool results, bat habitat category (if applicable), potential for listed plant habitat, distance to nearest known or presumed occupied portal, and whether tree felling activities may be required are provided in Appendix G. The Service has reviewed this information and concludes that no impacts to listed aquatic species are anticipated due to the minimal surface disturbance associated with these facilities and utility providers' standard practice of spanning aquatic resources. Impacts to listed plant species are not anticipated. Based on previous field surveys and a desktop survey/aerial review of existing conditions, listed plants are unlikely to be present except in 2 locations: MLV28 and RGC Lafayette. Potential habitat for the smooth coneflower (*Echinacea laevigata*) may be present at both locations. However, if potential habitat is present, it is likely that the responsible utility can span the area and thus avoid the potential habitat. No critical habitat was identified in any of the IPaC results.

Table 22 summarizes tree clearing for NJFs that may occur in Ibat and NLEB habitat categories (M. Hoover, Mountain Valley, email to C. Schulz, Service, January 17, 2023).

Table 22. Tree clearing (acres) for NJFs that has or will occur in Ibat and NLEB habitat categories.

Habitat Type	**Ibat**	**NLEB**
Known Use Summer	0.00	3.26
Unknown Use Summer	1.33	0.00
Unknown Use Spring Staging/Fall Swarming	2.54	0.81
Known Use Spring Staging/Fall Swarming	0.31	0.31

Potential impacts to Ibats and NLEBs from tree clearing for these NJFs are analyzed below and further considered in the Jeopardy Analysis section.

To standardize the effects analysis, the proposed action was divided into discrete actions described as subactivities. Defining subactivities allows for easier interpretation and consideration of complex activities. The project subactivities are defined in the species and critical habitat effects tables (Appendix B Tables 1-6).

Virginia spiraea (VASP)

The potential effects of the proposed action on VASP are described in Appendix B Table 1. Subactivities that are no effect (NE) or may affect, not likely to adversely affect (NLAA) VASP are described in Appendix B Table 1 and will not be further discussed in this Opinion. Subactivities that may affect and are likely to adversely affect (LAA) VASP that are assumed to occur on 0.05 acres within parcel WV-SU-046 (Figure 16) are listed in Appendix B Table 1 and include:

- Vehicle operation and foot traffic
- Clearing – herbaceous vegetation and ground cover
- Clearing – trees and shrubs
- ARs – upgrading existing roads, new roads temporary and permanent – grading and graveling
- Stream equipment crossing structures
- Crossings, wetlands and other water bodies (non-riparian) – clearing

For some components of the proposed action that may affect VASP, AMMs have been incorporated to ameliorate those effects and those are also noted below. These subactivities are LAA VASP by physically impacting individual plants and/or altering or degrading its habitat.

Subactivities in the 0.05-acre area related to vehicle operation, clearing, and grading and graveling will kill VASP stems, bury seeds, and alter/degrade VASP habitat. Vehicle operation, foot traffic and herbaceous vegetation and shrub/tree clearing will cause individual VASP to experience decreased fitness (e.g., from competition with introduced invasive species), decreased reproductive success (e.g., from physical damage, competition with introduced invasive species, habitat disturbance), and crushing or death (e.g., from cutting, digging up, burying, soil compaction). Clearing for stream and wetland crossings and stream equipment crossing structures will cause soil compaction and sedimentation and hydrological changes that will degrade and alter habitat. As a result, plants and seeds will be buried and reestablishment of VASP in the construction ROW, ARs, or ATWS post-construction is not expected. Grading and graveling for ARs will cause habitat loss in all permanently maintained areas, preventing reestablishment of VASP post-construction. The combined effects from these subactivities will result in the permanent removal of all VASP plants, seeds, and habitat in the 0.05 acre.

AMMs have been included in the proposed action that will minimize the extent and significance of adverse effects on VASP. These AMMs include: implementing sediment and erosion control measures during and after construction; ensuring restoration of pre-existing topographic contours after any ground disturbance; restoring native vegetation (where possible); developing plans and procedures for invasive species management; expediting construction within any waterbody, effectively reducing disturbance to the streambed and adjacent soils and the quantity of suspended sediments; prohibiting construction equipment, vehicles, hazardous materials, chemicals, fuels, lubricating oils, and petroleum products from being parked, stored, or serviced within a 100 ft radius of any wetland or waterbody; and avoiding the use of herbicides and pesticides to maintain any portion of the construction ROW. While these AMMs may initially minimize the extent and significance of adverse effects on VASP, effects from the subactivities described above will result in the permanent removal of all plants and habitat in the 0.05 acre.

In summary, on parcel WV-SU-046, tree felling and placement of timbermats across the wetland has occurred; pipe installation and final restoration need to be completed (P. Moore, Beveridge & Diamond PC, email to J. Martin, FERC, August 12, 2020; P. Moore, Beveridge & Diamond PC, email to C. Schulz, Service, November 28, 2022). All proposed AMMs are being implemented (Mountain Valley 2020). The combined effects from the subactivities listed above will result in the permanent removal of all assumed VASP plants, seeds, and habitat, which are assumed to occur on 0.05 acres, in the 2.3-acre portion of the action area and reestablishment of VASP in that area is not expected.

<u>Indiana bat (Ibat)</u>

The potential effects of the proposed action on Ibat are described in Appendix B Table 2. We did not reach a NE determination for Ibat for any of the subactivities. Subactivities that are NLAA Ibat are listed in Appendix B Table 2 and will not be further discussed in this Opinion beyond the paragraphs below.

Several subactivities had the potential to result in impacts to bats or alter their habitat through changes to baseline noise, lighting, air quality, and water quality conditions or alteration of hibernacula. As discussed in the Environmental Baseline section, for those subactivities, we anticipate no impacts to hibernating bats or hibernacula given the description of the proposed action and conservation measures. In addition, we have determined that impacts from project components that are completed after tree removal are unlikely to result in any discernible impacts to the Ibat (i.e., are not likely to adversely affect the Ibat). This is because the tree removal in areas of known or assumed use is already anticipated to result in changes in individual Ibat foraging, roosting, and travel behavior. Due to this displacement, bats are not likely to be exposed to consequences as a result of increased noise, lighting or dust within the areas of habitat removal. Additionally, AMMs will further avoid and minimize potential impacts from noise, lighting, and dust. For example, during the active season, the project's construction hours generally do not overlap with the periods of highest bat activity. While there are occasional instances when project work may need to extend beyond civil twilight, these occasions are rare (i.e., approximately 12 instances over the life of the project since construction commenced in 2018) and limited to instances when unforeseen complications arise during daytime construction hours, which are a safety issue that must be resolved and/or activity-specific (i.e., drilling for HDD or bores, work at compressor stations, hydrostatic testing, tie-ins, and extended work to comply with stream crossing time requirements and upcoming inclement weather). However, tree removal will be/has been completed prior to the start of the additional work activities listed, and as discussed above, Ibats are not anticipated to be in the area.

Mountain Valley has committed to bat, E&S control, and pesticide/herbicide use AMMs that are listed in the Description of the Proposed Action section. No significant changes in water quality or invertebrate prey that would adversely affect Ibats are anticipated from earth work or wetland/stream crossings because erosion control measures will be applied throughout the project area to protect water quality and reduce sedimentation associated with wetland/stream crossings. Despite the E&S control measures, as detailed in the discussion of the Effects of the Action section on aquatic species, there have been and will be erosion and increased sedimentation from wetland/stream crossings and from upland sedimentation that have caused or will cause increased embeddedness as well as short-term declines in water quality and in aquatic insect populations in adjacent wetlands, ponds, and other waterbodies. However, since potential impacts from suspended sediment associated with sedimentation are expected to be localized, foraging bats are expected to have alternative adequate drinking water and foraging locations. Likewise, no significant changes in water quality or invertebrate prey are expected to occur as a result of pesticide application within the ROW. Fall mowing will be the first option pursued by Mountain Valley, should an outbreak occur, which would greatly reduce potentially adverse effects to Ibats from pest control. If necessary, limited pesticide application will occur. However, it will occur on a limited basis and target specific pest outbreaks in areas where revegetation of the ROW is being negatively impacted. As needed, pesticide application will be applied by hand in spot treatments, and no pesticides will be used within a minimum 150-ft buffer around aquatic resources. Given the limited application of pesticides in the ROW, in strict compliance with product label instructions, as well as adherence to a protective buffer, and the proposed hand application method, potential effects to foraging bats as a result of degradation of aquatic resources related to pesticide application in the ROW are anticipated to be insignificant. Furthermore, the surrounding landscape will continue to provide an abundant prey base for both terrestrial and aquatic insects during project construction, operation, and maintenance. Therefore, any potential effects to Ibats from a reduction in water quality are anticipated to be insignificant.

Additionally, Mountain Valley (Appendix G in Mountain Valley 2020) assessed the effects of noise and vibration impacts on known and assumed occupied Ibat hibernacula and concluded that adverse effects are not likely to occur, as described above in the Environmental Baseline section. The Service has reviewed the information included in the SBA related to noise and vibration impacts and we concur with Mountain Valley's determination.

Subactivities that are LAA Ibats are listed in Appendix B Table 2 and include:[29]

- Clearing – trees and shrubs
- ARs – upgrading existing roads, new roads temporary and permanent – tree trimming and tree removal
- Crossings, wetlands, and other water bodies (non-riparian) – clearing
- Vegetation management – chainsaw, tree clearing, and tree side trimming

For some components of the proposed action that are likely to affect Ibats, AMMs have been incorporated to reduce those effects to some degree and those are also noted below. The above subactivities, all of which involve tree removal, will temporarily or permanently remove a total of 3,212.15 acres of suitable known or unknown use habitat within the 4 habitat categories listed in Table 23. Additionally, 247.68 acres of tree removal for future slips (slip remediation and downed trees due to slips) is anticipated to temporarily remove suitable known and unknown use Ibat habitat within these same 4 habitat categories. While they have estimated a total amount of acreage that is anticipated to be associated with future slips in the action area, Mountain Valley is unable to reliably predict the exact location, acreage, and timing of individual future slips. Therefore, in this Opinion, the Service will assess the potential effects to the Ibat from a "worst case scenario" in each habitat category. We assume that the "worst-case scenario" for each habitat category would occur when all 247.68 acres of future slips occurs only in that particular habitat category. While we analyze such a scenario for each of the 4 affected habitat categories below, we also acknowledge that it is unlikely that all predicted slips would occur in a single habitat category and tree removal associated with these future slips is more likely to be spread across all habitat categories.

Mountain Valley has implemented bat TOYRs (Table 23) for the vast majority of tree clearing across the action area. Furthermore, they have committed to adhering to the TOYR for any remaining tree removal activities associated with future slip repair work, whenever possible. If tree removal must occur outside of the TOYRs below (i.e., June 1 – July 31), Mountain Valley will confer with the Service about the potential need for emergency consultation. We expect these TOYRs to limit the amount of lethal impacts to individual Ibats from these subactivities; however, they will not eliminate the effects of habitat loss.

[29] "General appurtenance and cathodic protection construction – off ROW clearing" was previously included in the list of activities that are LAA Ibat and NLEB in the 2020 Opinion, which was in error. Project activities related to general appurtenance and cathodic protection construction – including off ROW clearing, trenching, anode, bell hole – were also included in error in the 2020 Opinion (Appendix B) as NLAA RLP, CD, and CD proposed critical habitat and NE to VASP. Any activities associated with general appurtenance and cathodic protection construction that have occurred or will occur off ROW are subject to additional landowner approval and the FERC variance process. FERC is required to reinitiate consultation with the Service for any variance that may affect listed species or critical habitat.

Table 23. Tree clearing by Ibat habitat category.

Habitat Category	TOYRs	Season/Months when Tree Clearing Occurred or Could Occur[b]
Known use summer	Trees will be removed between November 15 and March 31, when Ibats will not be present, and potentially in April, August, and September	winter, April, August, September
Unknown use summer	Trees will not be removed between June 1 and July 31, when young cannot fly	winter, April, May[a], August, September
Unknown use spring staging/fall swarming	Trees will be removed between November 15 and March 31, and potentially in April, May, August, and September	winter, April, May, August, September
Known use spring staging/fall swarming	Trees will be removed between November 15 and March 31, when Ibats will not be present	winter
Future slips in unknown habitat category [b]	Trees will be removed when Ibats will not be present, between November 15 and March 31, whenever possible. Trees could potentially be removed in April, May, and from August to November 15. Trees will not be removed June 1 to July 31, when young cannot fly[c].	winter, April, May, August, September, October, and November until the 15th

[a] Approximately 0.31 acres of tree removal occurred in June 2018; no future tree removal is proposed during this time period.
[b] Up to 247.68 acres of future slips are estimated; the vast majority of all other tree removal has occurred, with 3.4 acres total of tree removal remaining that is associated with planned project locations and existing slips and variances.
[c] If tree removal associated with slip repair must occur during Ibat pup season, Mountain Valley will confer with the Service regarding the possibility of emergency consultation.

Known and unknown use summer habitat – We expect effects to Ibats from tree clearing in known and unknown use summer habitat within the action area in WV and VA. Approximately 238.53 acres of known use summer habitat in WV has been or will be cleared. An additional 247.68 acres of tree removal associated with future slips may also occur in known use summer habitat; therefore, under a worst-case scenario, a total of 486.21 acres of Ibat known summer use habitat removal will occur in WV. There is no known use summer habitat within the project action area in VA. Approximately 1,836.51 acres of unknown use summer habitat in VA and WV has been or will be cleared; for our worst-case scenario, we also will consider that the future slip acreage of 247.68 acres may occur in unknown use summer habitat, for a total of up to 2,084.19 acres of Ibat unknown use summer habitat removal. We anticipate tree clearing will impact individuals associated with 1 known and 3 unknown Ibat maternity colony home ranges in summer use habitat. However, not all unknown use summer habitat is expected to be occupied because, as discussed in the Environmental Baseline section, Ibat populations are greatly reduced in WV and VA, post-WNS. Thus, with fewer Ibats on the landscape, we estimate a maximum of 3 additional colonies are anticipated to occur within the unknown use summer habitat in the action area. It would not be reasonable to assume that these 3 colonies occupy all unknown use summer habitat, which is present along 153.9 miles of construction ROW and ARs throughout the action area, because areas used by maternity colonies are non-linear in highly forested landscapes (such as in the action area of WV and VA). Thus, Ibats are likely to only occupy a portion of the "unknown use habitat" within the action area. In addition, Ibat home ranges are not linear, so it is likely that clearing of the 125-ft wide construction ROW may only displace Ibats from a portion of their home range, not their entire home range, though FWS also recognizes that slip areas, while typically small, will not necessarily be linear.

Tree removal in known use summer habitat (during the active season) – Effects from the loss of up to 250.21 acres of known use summer habitat within the 5-mile buffer of a documented maternity colony in Wetzel County, WV (Figure 18) during the active Ibat season are anticipated. Previous tree removal in known use summer habitat during the active season has consisted of 2.47 acres that was covered under an emergency Section 7 consultation in the previous Opinion. The 2020 Opinion incorrectly included 10.14 acres of existing slips and 9.55 acres to remediate existing slips in active season clearing in this habitat category; these acres of tree removal associated with known slips occurred during the inactive season in this habitat category and will be discussed under the next heading (Tree removal in known use summer habitat (during the inactive season). Therefore, we consider effects from up to 250.21 acres of suitable habitat in the known maternity colony within the action area that may be removed during the active bat season for our worst-case scenario. This acreage includes 2.47 acres from the previous emergency consultation, as well as slips (0.06 acres for an existing slip and 247.68 acres of future slips). Mountain Valley has committed to avoid conducting any remaining tree removal activities associated with future tree removal to remediate existing slips (0.06 acres) and anticipated tree removal due to future slips (247.68 acres) in this known use summer habitat from November 15 to March 31, whenever possible. Tree removal will not be conducted during the period of time when Ibat pups are anticipated to be nonvolant (June 1 – July 31) without emergency consultation. Therefore, the majority of future tree removal activities within this known use area are expected to be conducted during the winter months while bats are in hibernation, which further reduces the likelihood of lethal impacts to bats.

Maternity colonies use a minimum of 10 to 20 trees per season, but only 1 to 3 of these are primary roosts used by the majority of bats for some or all of the summer (Callahan et al. 1997, Miller et al. 2002). Ibats have primary and secondary roosts and will shift between roosts every few days throughout the season (Humphrey et al. 1977, Gardner et al. 1991, Callahan 1993, Kurta et al. 1993, Romme et al. 1995). The MVP project will not result in the removal of any known, documented maternity roosts, as none have been located within the action area. However, based on previous mist-net survey results (capture of a pregnant female in 2010) and potential roost tree surveys within these areas (ESI 2018c, ESI 2018d), and the high maternity site fidelity that Ibats exhibit, we anticipate that there are undocumented roosting and foraging areas present within this known maternity colony. If an occupied roost tree is cut down, bats are known to either stay in the tree and be injured or killed (adults or non-volant pups) upon felling or fly out (adults or volant pups) during felling (e.g., Belwood 2002). Daytime flights may make bats more susceptible to predation (e.g., by raptors). The risk of injury or death is greater for adults during cooler weather when bats periodically enter torpor and will be unable to arouse quickly enough to respond if the tree they are roosting in is felled. The likelihood of potential roost trees containing large number of tree roosting bats is greatest during pregnancy and lactation (April-July) (Barclay and Kurta 2007).

Home ranges include roosting and foraging habitat, as well as travel areas between these habitats. Observed home ranges for individual Ibats associated with maternity colonies vary widely (205.1 to 827.8 acres) (Menzel et al. 2005, Sparks et al. 2005, Watrous et al. 2006, Jachowski et al. 2014, Kniowski and Gehrt 2014). Colonies have larger home ranges than individual bats with areas of overlapping core roosting/foraging areas and areas that do not overlap. A long-term study at the Indianapolis Airport estimated much larger home ranges (over 2,000 acres) for individual Ibats, with the overall home range (roosting and foraging) of the entire maternity colony being over 9,900 acres (Divoll and O'Keefe 2018). The colony in the Airport study occurs in a heavily fragmented landscape dominated by agriculture and development, unlike the action area in WV and VA, which is heavily forested.

While home ranges may be thousands of acres in size, core roosting areas are smaller than foraging areas, with roosts often clustered in space. Size of both foraging and core roosting areas likely varies depending on habitat quality. At a site in Michigan with a superabundance of suitable roosts, Kurta and Murray (2002) observed bats moving an average of 74 m between roosts. At a site with less abundant potential roosts, Kurta et al. (1996) observed bats moving an average of 686 m between roosts, ranging from 4 m to 5.8 km. On Fort Drum Military Installation, most roosts are found within approximately 2,200 acres (U.S. Army 2011). Two KY colonies with long-term tracking have roosting areas of approximately 2,400 to 3,200 acres (M. Armstrong, Service, email to R. Niver, Service, April 4, 2019). In most cases, the Service does not have sufficient information to map core roosting and foraging areas or documented travel areas for known maternity colonies. Therefore, the Service developed standard protocols[30] for mapping potential home ranges based on varying levels of existing data. The larger the individual project or the higher the frequency of smaller projects in a given area, the greater the likelihood of projects intersecting with home range components (e.g., roosting, foraging, or travel habitat), resulting in exposure of individual or multiple bats to stressors associated with the project.

The assumed home range for the known colony in Wetzel County, WV, consists of 50,248 acres, over 80% of which is currently forested. We lack information about where roosts or foraging areas are located for this colony. However, given that only 4 small areas were previously cleared (ranging in size from 0.04-1.40 acres) during the active season and the lack of potential primary roost trees within these areas (ESI 2018c, ESI 2018d), it is unreasonable to assume that the previous clearing of 2.47 acres associated with the emergency Section 7 consultation resulted in the loss of an undocumented maternity roost. However, the prior clearing in April and August, and all future tree removal conducted in the active bat season (April, May, and August to November 14) associated with slip repair in our worst-case scenario analysis, is expected to have resulted, or will result, in death of individuals and temporary reduced reproductive success for

[30] https://www.fws.gov/sites/default/files/documents/inbaS7and10WindGuidanceFinal26Oct2011.pdf

some females.

As discussed above, to date only 2.47 acres of tree clearing has occurred during the active bat season in known use summer habitat; however, up to an additional 247.74 acres of suitable habitat in the known maternity colony within the action area may be removed during the active bat season for our worst-case scenario. This acreage is associated with slips (0.06 acres of existing and 247.68 acres of future) and includes downed trees due to the slip itself, as well as acres of tree clearing needed to repair the slip. Tree removal and construction activities associated with the MVP project within known use summer habitat in WV during the active season may result in removal of portions of roosting and foraging areas. Clearing of the ROW results in new forest openings of 125-ft in width. Ibats can easily and routinely cross this size opening and continue to forage and roost in alternative suitable locations if they occur within their home ranges. However, future tree clearing may result in actual removal of preferred roosts. In certain circumstances, pregnant females displaced from portions of preferred roosting/foraging areas may have to expend additional energy to search for alternative habitat, which would likely result in reduced reproductive success (failure to carry to full term or failure to raise pup to volancy) for some females. Females that do give birth may have pups with lower birth weights and given the already increased energy demands associated with longer flights, some of these pups are likely to experience delayed development. These longer flights would also be experienced by pups once they become volant, which will likely affect the survival of some of these pups as they enter hibernation with potentially reduced fat reserves. Therefore, regardless of the timing of tree removal, impacts may occur to returning Ibats the following active season from the loss of preferred roosts and foraging areas. However, these kinds of effects on Ibat maternity colonies are primarily anticipated to occur in areas that are already fragmented or with limited suitable forest available. Given that the potential home range associated with this colony will remain more than 80% forested after tree clearing associated with this project has been completed, we anticipate that Ibats will locate new roosting/foraging areas with no effects or minimal effects to individuals.

In areas with WNS, there are additional energetic demands for Ibats. For example, WNS-affected bats have less fat reserves than non-WNS-affected bats when they emerge from hibernation (Reeder et al. 2012, Warnecke et al. 2012) and have wing damage (Meteyer et al. 2009, Reichard and Kunz 2009) that makes migration and foraging more challenging. Females that survive the migration to their summer habitat must partition energy resources between foraging, keeping warm, successful pregnancy and pup-rearing, and healing. The potential effects described above will be greatest to WNS-affected bats returning to maternity areas while tree removal is occurring.

The effects of future slips on Ibats can vary, depending on the timing and size of the slip and slip repair. While the timing and locations of future slips along the action area are unpredictable, in general, more slips are expected during the wetter months of the year (typically November through April) with fewer slips occurring during the dry summer months. However, should a period of intense rain (e.g., rain associated with a tropical storm remnant) occur during the summer, slips can result. For example, approximately 3.31 acres of slips have occurred in other habitat categories during the active season. Thus, it remains possible that slips could occur during the active Ibat season. Additionally, while slip remediation will occur during the winter whenever possible, there may be instances when slip repair during the active bat season (excluding the Ibat pup season) is necessary to prevent further slip expansion. These slips and slip repairs could result in the downing of potential occupied roost trees.

The size of future slips is also unpredictable, but past known slips along the MVP project ROW and ARs have been small (average slip size through 2018 is 0.40 acres, and after tree removal for slip repair, the average slip was approximately 1 acre) (M. Hoover, Mountain Valley, email to B. Smrekar, Service, January 25, 2023). However, slips can sometimes continue to expand if not remediated in a timely manner. Thus, significantly larger slips can occur, although rarely. While most of the known slips on the MVP project have been below 1 acre in size, there have been 3 larger slips; 2 under 2 acres, and one was 4.58 acres in size. Thus, while larger slips remain possible, we anticipate that most of these areas of downed trees to be small in size, based on the size of the average slip repair. Furthermore, the likelihood of slips occurring during the period of time when young bats are nonvolant (June-July) is also reduced, given that slips are expected to occur more often in wetter winter and spring months than in the typically drier summer. Mountain Valley has also committed to do future tree clearing associated with remediation of future slips during the winter, whenever possible. When work must occur during the active bat season, Mountain Valley has further committed to avoid conducting any remaining tree removal activities associated with slip repair work in this known use summer habitat (0.06 acres for existing slip repair and up to 247.68 acres for future slips) during the June 1 – July 31 period. This significantly reduces the likelihood of lethal impacts to bats by avoiding the period when young bats cannot fly. Future slips would be expected to occur in areas that are adjacent to previously disturbed areas (i.e., the ROW and ARs). Because these slips would be expected to occur adjacent to areas that have already been disturbed and cleared of trees, Ibats are expected to have relocated to nearby areas. While the habitat immediately adjacent to the ROW and ARs could be occupied, it is more likely that many of the displaced Ibats will have relocated to areas further from the previous and on-going construction disturbance, given that there is abundant intact forested habitat in the surrounding areas. Thus, the likelihood of lethal impacts to Ibats from future slips and slip repairs is reduced. Finally, although some slip repair may occur during a portion of the active bat season (April and August through November 14), this work will occur only for slips that are unstable and may continue to expand without intervention. In that case, the repairs will prevent the further loss of forested habitat if the slip were to continue to expand. While some Ibats could be present in the area, there would be no non-volant pups and most Ibats would be expected to move away from the slip and slip remediation area.

In summary, we lack information about where roosts or foraging areas are located for the known maternity colony within the action area. However, given the assumption that there are undocumented roosting and foraging areas present within this known maternity colony, it is possible that individual Ibats will be injured or killed from active season tree removal of 250.21 acres associated with existing slip repair and future slips and slip repair during the active season in this known maternity colony. We have no precise way to estimate how many individuals will be injured or killed. If no Ibats are using the roosts at the time they are felled, then none will be injured or killed. If some Ibats are using the roosts at the time they are felled, then a portion of those bats may be injured or killed. The Service compiled a summary of accounts documenting the removal of occupied maternity roosts and used any relevant information to roughly estimate the number of individuals that may be injured or killed from the removal of undocumented occupied roost trees within this habitat category. Each event had slightly different long-term impacts on the affected bats, but all resulted in mortality of some adults and juveniles due to trauma from the fallen tree.

The first account led to the discovery of the first Ibat maternity colony in Indiana in 1971 when a dead elm (*Ulmus* sp.) tree containing a maternity colony was bulldozed on August 3 during a hedgerow clearing (Cope et al. 1973). Approximately 50 Ibats flew from the tree; 8 (16%) of these were either killed or injured allowing them to be captured (J. Whitaker, Indiana State University, pers. comm., 2005 from Service 2007b). The 8 individuals were comprised of 2 adult females and 6 immature individuals (2 males, 4 females). Subsequent surveys in the vicinity of the lost roost indicated that the reproductive females were still foraging in the area, but a roost tree could not be located.

The second account occurred around September 8, 1984, in Knox County, IN (J. Whitaker, pers. comm., 2005). Eleven dead adult female Ibats were retrieved by a landowner when their roost, a shagbark hickory (*Carya ovata*), was felled in a pastured woodlot containing multiple dead trees. The 11 individuals were submitted for rabies testing to the state health department and subsequently sent to Indiana State University for positive identification by J. Whitaker. This event occurred outside the time when we anticipate colonies will be largest and overlaps with migration periods. In addition, there is no information available to assess the overall colony size and what proportion of the colony may have been impacted. Therefore, this study is not relevant to this project and was not considered further.

The third account occurred in OH. The first maternity colony of Ibats in OH was accidentally discovered on July 8, 1996, when a tree was felled to keep it from falling on a residence in a subdivision (Belwood 2002). Homeowners retrieved 34 individuals, 1 dead adult female, 3 dead non-volant juveniles, and 30 live non-volant juveniles. J. Belwood assisted the homeowners and placed live juveniles on the downed tree and in a nearby bat house. Overnight, adults retrieved the live juveniles; 2 additional non-volant juveniles died overnight. One adult female died out of a presumed 33 adult females based on 33 non-volant pups and 5 of the 33 observed non-volant pups died (total of 18% of Ibats were killed). A portion of the maternity colony (approximately 15 individuals) used a nearby tree later that same maternity season. However, the colony abandoned their maternity area for 3 years following the loss of their roost tree. Surveys during the fourth year after loss of the roost documented a low number of females (i.e., 2) present in the neighborhood.

Based on the accounts summarized above, an estimate of 7 to 15 individuals[31] (i.e., 16 to 18%[32]), depending on the size of the known maternity colony present during the active season (as noted above, we assume 20-40 adult females per colony and 1 pup per female), may be injured or killed from the felling of undocumented occupied roost trees. However, as discussed above, there may be no bats roosting in the trees that are removed.

For the purposes of this analysis, we will utilize the average of all of the values discussed above[33] and assume that 1 adult female and 9 pups (for a total of 10 individuals) may be injured or killed from the felling of undocumented occupied roost trees during the active season in the known use summer habitat in the action area (Table 24). This assumption represents an appropriate synthesis of the best available data and allows for an adequate assessment of the effects of the project for purposes of the jeopardy analysis.

Tree removal in known use summer habitat (outside of the active season) – Effects to Ibats from the loss of up to 483.68 acres of suitable summer use habitat could occur during the inactive season under a worst-case scenario across 10.3 miles of pipeline, ARs and ATWS. This acreage includes 225.86 acres of project tree clearing (including 9.55 acres for known slip remediation) and 10.14 acres of trees that fell as a result of slips during the non-active season for Ibats. Effects to Ibats are also expected as a result of tree removal on up to an additional 247.68 acres associated with future slips, Acreage associated with slip repairs is likely to be removed outside of the active season based on Mountain Valley's commitment to do so whenever possible. However, the potential injury or death of Ibats associated with future slips is discussed in the preceding section (*Tree removal in known use summer habitat - during the active season*), as it could happen during the active season (excluding June-July). Tree removal in known use summer habitat during the winter is likely to alter roosting, foraging, and travel habitat. This will result in displaced Ibats expending additional energy seeking alternate roosts, foraging areas, and travel areas when they return the following season. The MVP project will not result in the removal of any known documented maternity roosts. However, based on previous mist-net

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[31] Including all adult females and juveniles.
[32] This range is based on the numbers of total Ibats killed during occupied roost tree felling referenced in the accounts above for IN (16%) and OH (18%).
[33] As explained in the Environmental Baseline section, because we have limited information about maternity colony sizes in WV or VA post-WNS and the information is not readily obtainable, we will conduct our analyses based on a reasonable range of 20-40 adult female bats per colony and 1 pup per female. For purposes of this analysis, we are utilizing the average (i.e., 30 adults + 30 pups = 60 total bats per colony). We then used the average (i.e., 17%) of the number of total Ibats killed during occupied roost tree felling referenced in the accounts for IN (16%) and OH (18%). 60 total bats x 17% = 10.2 total bats. Rounded to the nearest whole individual = 10 total bats. In the summary of accounts documenting the removal of occupied maternity roosts, at least 1 adult female bat was killed or injured in each instance. Therefore, we are assuming the total of 10 bats is comprised of 1 adult female and 9 pups.

survey results (capture of a pregnant female in 2010), we anticipate that there are undocumented roost trees within this known use area. In the previously disturbed areas within this habitat category, 413 potential roost trees were located, of which 74 were potential primary trees and 339 were potential secondary trees.

As discussed, one area of known use summer habitat in WV will be crossed by the MVP project. Therefore, primary roosts or multiple alternate roosts have been or may be removed. Ibats have primary and secondary roosts and will shift between sites during a season (Humphrey et al. 1977, Gardner et al. 1991, Callahan 1993, Kurta et al. 1993, Romme et al. 1995). Roost trees, although ephemeral in nature, are known to be occupied by a colony for a number of years until the roost trees are no longer available (i.e., the roost has naturally fallen to the ground) or suitable (i.e., the bark has completely fallen off of a snag). Although loss of a roost (e.g., blowdown, bark loss) is a natural phenomenon that Ibats have adapted to, the loss of multiple roosts may stress individual bats, affect reproductive success, or impact the social structure of a colony (Service 2007b). Removal of an Ibat primary roost tree (that is still suitable for roosting) in winter can result in disruption of maternity colony cohesion and temporary or permanent colony fragmentation. Smaller colonies may be expected to provide less thermoregulatory benefits for adults and non-volant pups in cool spring and early summer temperatures. Also, removal of a primary roost may result in increased energy expenditures for affected bats. Female bats have tight energy budgets, and in the spring need to have sufficient energy to keep warm, forage, and sustain pregnancies. Increased flight distances or smaller colonies may result in a portion of bats present within the colony having reduced breeding success. Removal of multiple alternate roost trees in winter may also result in similar effects.

For the MVP project, there is no way to verify whether any of the previously documented potential roost trees in the cleared areas were used by Ibats prior to clearing. However, even if some of those potential roost trees were used by Ibats, because there is substantial roosting habitat remaining in the action area, we expect the majority of Ibats that previously used the roost trees will relocate roosting areas with no effects or minimal effects to individuals.

In addition to impacts to roosting habitat, we anticipate some areas in this habitat category cleared during the winter are currently used as travel areas (i.e., areas used by Ibats as they travel between roosts and foraging areas), and/or foraging areas and that effects will be greatest to pregnant females that expend additional energy to seek alternate travel or foraging areas as a result of tree clearing. However, as discussed above, this kind of effect is anticipated primarily in areas that are already fragmented or with limited suitable forest available. Given that the potential home range associated with this colony will remain more than 80% forested after tree clearing associated with this project has been completed, we anticipate that Ibats will locate new travel and foraging areas with no effects or minimal effects to individuals. We expect the extent of effects from the removal of travel and foraging areas may range from no effect to temporary reduced reproductive fitness.

In summary, it is likely that individual Ibats have been or will be harmed from inactive season slips and clearing of roosting habitat in this known colony. We anticipate that effects of tree removal in known use summer habitat (outside of the active season) will vary with some individuals experiencing no effects to others experiencing temporary reduced breeding success. We have no precise way to estimate how many individuals have been or will be harmed. Above, we discussed that lethal effects from tree-clearing during the active season are anticipated to up to 1 adult female and 9 pups. Comparatively, the effects from the removal of trees while bats are hibernating is lower in magnitude (nonlethal) than those experienced by bats present during the active season, and these effects will only be experienced by adult females, as they return to their maternity colony during the season following the winter clearing and adjust to changes in their summer use habitat. Above we describe that we expect 1 adult female to be killed or harmed by the felling of an occupied roost tree during the active season, which is based on known occurrences of occupied roost tree felling (see footnote 33). Because we expect the impacts of winter tree removal to be less than those expected from tree removal in the active season, we assume that no more than 1 adult female will be harmed as a result of clearing in the known use maternity buffer outside of the active season (Table 24). Since Ibat pups are able to fly and are on their own by the time they enter hibernation in the fall, that life stage will not be affected. Adverse effects that occur to this individual are anticipated to extend through the duration of construction, with the greatest effects expected the first season after tree removal has occurred, until the individual acclimates to the altered landscape and establishes new foraging and roosting areas.

Tree removal in unknown use summer habitat (during the active season) – Tree removal in unknown use summer habitat during the active season is expected to affect Ibats using undocumented occupied roosts and Ibat foraging areas within 3 unknown maternity colony home ranges. Up to 1,813.32 acres of suitable unknown use summer habitat may be removed under a worst-case scenario; this includes 1,562.46 acres previously removed (including 3.31 acres that were downed in slips during April and May) and 3.18 acres associated with existing slips that have yet to be repaired, as well as 247.68 acres for future slips. We expect the same types and extent of effects will occur from tree removal during the active season in unknown use summer habitat as those described above for known use summer habitat. Of the 1,562.46 acres where prior tree removal occurred during the active season in this habitat category, no trees were removed between June 1 and July 31, when young cannot fly.

Mountain Valley has committed to avoid all future tree removal associated with slip repairs in unknown use summer habitat (3.18 acres for existing and pending slips and variances and up to 247.68 acres for future slips) during the time when bat colonies are most concentrated (largest colony counts in fewer trees) and young bats cannot fly (June – July). This TOYR is expected to minimize effects from loss of undocumented occupied roosts when pups are non-volant. If adherence to this TOYR is not possible, Mountain Valley will consult with the Service regarding the need for emergency consultation. Mountain Valley will also avoid tree removal associated with remediation of future slips during the active Ibat season (April 1 through November 14), whenever possible. Thus, we anticipate that much of the future tree removal will occur during the inactive bat season, which further reduces the likelihood of lethal take. As discussed for known use summer habitat, slips may occur in the active season (although typically they occur in the wetter winter and spring timeframe), and slip remediation may be necessary in the active season to prevent slip expansion. However, given the typical small average size of known slips, the time of year when slips are more likely to occur (which coinicides with the inactive bat season in large part), and the location of slips, which are expected adjacent to and along already cleared and disturbed areas (ROWs and ARs), while Ibats could be present in slip areas, the likelihood of lethal take is reduced, given that most Ibats are likely to have already relocated to areas further from the ROW and ARs.

In summary, as discussed above, an estimate of 17% of individuals of the known maternity colony present during the active season (we assume 30 adult females per colony and 1 pup per female), have been or will be injured or killed from the felling of undocumented occupied roost trees during the active season. However, as discussed above, there may be no bats roosting in the trees that are removed. For the purposes of this analysis, and consistent with our analysis of active tree clearing in known summer use habitat, we utilize the average of all of the values discussed above (see footnote 33) and assume that 1 adult female and 9 pups (for a total of 10 individuals per colony) have been or will be injured or killed from the felling of undocumented occupied roost trees during the active season (Table 24).

Non-jurisdictional facilities (NJFs) – An additional 1.33 acres of unknown use summer habitat will be removed for NJFs. These acres represent 6 facilities in WV and range from 0.06 - 0.58 acres removed per facility (Appendix G). A reasonable worst-case scenario is the trees will be removed during the active season. The additional 1.33 acres added to the total acreage to be cleared in unknown use summer habitat for the MVP project (2,084.19 acres, including future slips) results in a total of 2,085.52 acres cleared in this habitat category. The estimated number of Ibats to be affected does not change when the additional acreage is incorporated into the calculations, as detailed below. Therefore, the estimated number of maternity colonies (3) to be affected does not change. We do not anticipate any additional adverse effects other than those described above for known use summer habitat.

The calculations are as follows:

- Acres removed for MVP project (2084.19)/average tree removal per projects tracked by the Service (16.93) = number of surveys the MVP project would have represented (123.11)
- Capture ratio (0.299) x number of surveys the MVP project would have represented (123.11) = estimated number of Ibats expected to be captured in MVP project area (36.81, rounded to 37 bats)
- Colony ratio (0.09) x estimated number of Ibats (37) = number of colonies affected (3.33, rounded to 3 colonies)
- Calculation with NJFs acreage added: 2,085.52/16.93 = 123.18

- With NJFs acreage added: 0.299 x 123.18 = 36.83, rounded to 37 Ibats

Tree removal in unknown use summer habitat (outside of the active season) – Up to 518.55 acres of unknown use summer habitat have been or will be removed during the winter, including 270.87 acres previously removed and up to an additional 247.68 acres or tree removal for future slips. We expect the same types and extent of effects will occur from tree removal outside the active season in unknown use summer habitat as those described above for non-active season clearing in known use summer habitat. We assume 20-40 adult females make up each of the unknown maternity colonies. Above, we discussed that lethal effects are anticipated to up to 1 adult female and 9 pups. Comparatively, the effects from the removal of trees while bats are hibernating is lower in magnitude (nonlethal) than those experienced by bats present during the active season, and these effects will only be experienced by adult females. Because we expect the impacts to be less than those expected from tree removal in the active season, we conclude that no more than 1 adult female[34] per colony (as discussed above, see footnote 33), and thus 3 total, may be harmed as a result of tree removal in these areas (Table 24). The adverse effects to individuals are anticipated to extend through the duration of construction, with the greatest effects expected the first season after tree removal has occurred, until Ibats acclimate to the altered landscape and establish new foraging and roosting areas.

Known and unknown use spring staging/fall swarming habitat – We expect effects to Ibats from tree clearing in Ibat known and unknown use spring staging/fall swarming habitat in VA and WV. Approximately 1,137.11 acres (59.8 miles of construction ROW and 39.7 miles of ARs) of known use (308.48 acres) and unknown use (828.63 acres) of spring staging/fall swarming Ibat habitat have been or will be cleared. An additional 247.68 acres of tree removal associated with future slips may also occur in spring staging/fall swarming habitat. Therefore, under a worst-case scenario, a total of 1,384.79 acres of Ibat spring staging/fall swarming will be removed through tree clearing and tree loss associated with future slips and slip remediation. As discussed previously, because the locations and acreages of individual slips cannot be reliably predicted, our analysis below is conducted using these worst-case scenarios. We anticipate tree clearing will impact individuals associated with 2 known and 10 assumed occupied Ibat hibernacula; however, not all 1,384.79 acres are likely to be occupied because this acreage is based on 69 potential hibernacula, and we only estimate 10 of these are actually occupied (in addition to the 2 known hibernacula). In addition, Ibat foraging areas are not linear, so it is likely that the 125-ft wide construction ROW will only displace Ibats from a small portion of their spring staging/fall swarming habitat.

Tree removal in known use spring staging/fall swarming habitat (active season) – Effects to Ibats from the loss of up to 247.68 acres of suitable spring staging/fall swarming habitat around Greenville Saltpeter Cave and Tawney's Cave are anticipated to occur during the active bat season in a worst-case scenario. All tree removal activities within this habitat category to date

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[34] No pups are present during this time of year.

have been completed during the winter months (when bats were not present), and Mountain Valley has committed to clearing trees for all future slips (247.68 acres) during the winter, whenever possible. Therefore, while we expect the majority of tree removal activities within this habitat category to occur during the winter (November 15 to March 31) when bats are not present on the landscape, as discussed previously, it remains possible for future slips to occur during the active season, as well as the subsequent remediation of these slips if they are unstable and will continue to expand without repair.

Bats use the area around hibernacula to forage in order to build fat reserves prior to hibernation, as well as to socialize and mate in the fall. In the spring, individual Ibats may spend a few hours to a few days around hibernacula, or they may migrate immediately to summer habitat. Tree removal from up to 247.68 acres associated with future slips and slip remediation activities within the known use spring staging and fall swarming habitat around Tawney's Cave (VA) and Greenville Saltpeter Cave (WV) during the active season may result in the loss of an undocumented occupied roost tree and the disruption of bats engaging in fall swarming and spring staging behavior. The effects of tree loss from future slips will vary, depending on the size of the slip and the location of the slip. It is assumed that exposure or risk of bats being harmed from loss of this habitat type is greater the closer the tree removal is to a hibernaculum, but this has not been well established. Given that most known slips are approximately 1 acre in size, and more likely to occur during the wetter season (outside of summer), the likelihood that an occupied roost tree is downed (and the likelihood of lethal take) is reduced. However, it is possible that more sizeable slips could occur. Mountain Valley has committed to do future tree clearing associated with remediation of future slips during the winter, whenever possible, which should further reduce the lethal effects to Ibats present during spring staging and fall swarming, when higher numbers of bats are present around hibernacula. While not all slips will be linear, they are typically small in size and are expected to occur in areas adjacent to the previously cleared and disturbed ROW and ARs. Thus, we also expect that the likelihood of lethal take to Ibats will be reduced, as we expect that fewer Ibats will be present in areas where slips are most likely to occur.

Clearing trees around hibernacula may decrease foraging and roosting habitat. Depending on the amount and location of removal, this may require bats to spend more time searching for food, which could result in bats entering hibernation with less fat reserves and the potential for individuals to have decreased overwinter survival or poorer spring body condition. Interruption of fall-swarming behavior (i.e., a reduction in time spent on social interactions) may lead to reduced breeding success if the interruption is significant enough to impede mating activity. Bats could be killed, injured, or forced to flee if an occupied roost tree is cut. There is an increased risk to Ibats during cooler late fall and early spring temperatures, as Ibats periodically enter torpor during periods of low temperatures and are less able to arouse quickly enough to respond, should an occupied tree fall. It is expected that this risk would be greatest to bats toward the end of the fall swarming season and to individuals emerging in the spring. The spring emergence period (April through May) is also a sensitive time period for bats in general, but increasingly so for WNS-affected bats that are likely to be weakened by the effects of the disease. WNS-affected bats may have reduced fat reserves and damage to wing membranes, making it more difficult to fly. These individuals may be less likely to survive long-distance migrations to summer areas as well. They may also emerge from hibernation sites earlier and may be more likely to stay closer to the hibernation site for a longer period of time following spring emergence, increasing the risk of individuals being killed or harmed if an occupied tree is downed during the active season. However, during spring staging/fall swarming, bats often roost individually rather than in groups, typically have numerous suitable day-roosts available, and frequently roost-switch. Therefore, there is less potential to affect a tree being used by multiple bats or a large bat colony, and effects are likely restricted to smaller groups of bats or individual bats.

In summary, it is possible that individual Ibats will be harmed or killed from active season slips and tree clearing associated with slip remediation on 247.68 acres of known use spring staging/fall swarming habitat around 2 hibernacula within the action area. The effects of active season tree removal in known use spring staging/fall swarming habitat will vary. As discussed previously, past slips have been small in size and are more likely to occur during the wetter seasons (late winter and early spring), which reduces the likelihood that Ibats will have emerged from hibernation and be exposed to slips that may occur along the ROW and ARs within the action area. Furthermore, Mountain Valley will conduct tree clearing for slip remediation during the inactive bat season (November 15 to March 31), when possible, which further reduces the likelihood that Ibats will be exposed to active season tree removal in their spring and fall habitat. Exceptions may be when a slip is very unstable and expected to continue to expand without immediate repair. We have no precise way to estimate how many of these individuals will be injured, killed, or experience reduced breeding success. If no Ibats are using the roosts at the time they are cleared or fall as a result of a slip, then none will be affected. If some Ibats are using the roosts at the time they are cleared or fall, then a portion of those bats may be injured, killed, or experience a reduction in breeding success. As discussed in the Environmental Baseline section, we assume that 16 total Ibats are hibernating in the 2 known hibernacula within the action area. Therefore, for the purposes of this Opinion, we estimate that 8 individual Ibats could be present and affected by tree removal occurring during the active season in the spring staging and fall swarming habitat surrounding each known hibernaculum, Greenville Saltpeter Cave and Tawney's Cave (see footnote 12). Because we have no information on Ibats that have been present in roost trees felled in spring staging and fall swarming habitat, we will apply the best available information from known occupied maternity colony roost tree losses (see footnote 33). As discussed above, 1 adult bat present in felled roosts was injured or killed in maternity colonies. Pups are not present in roosts during spring staging/fall swarming. Therefore, for the purposes of our analyses, we will assume that no more than 1 adult bat will be injured, killed, or experience reduced breeding success per hibernacula (Table 24).

Tree removal in known use spring staging/fall swarming habitat (outside of the active season) – A total of 308.48 acres of known use spring staging and fall swarming habitat has been removed from around 2 known hibernacula in the action area; approximately 176.76 acres was cleared from around Greenville Saltpeter Cave in WV and approximately 131.72 acres has been removed from around Tawney's Cave in VA. For our worst-case scenario analysis, we assume half of the total acreage anticipated for future slips (247.68 acres) will occur around each hibernaculum. Therefore, a total of 300.60 acres and a total of 255.56 acres of suitable habitat has been or will be removed around Greenville Saltpeter Cave and Tawney's Cave, respectively. The maximum amount of habitat available within 5 miles of any given hibernacula is 50,265.60 acres. Approximately 38,653.79 acres surrounding Greenville Saltpeter Cave and 36,512.5 acres surrounding Tawney's Cave are considered suitable spring staging/fall swarming habitat. These habitat impacts represent 0.78% and 0.70% of available spring staging/fall swarming habitat for Greenville Saltpeter Cave and Tawney's Cave, respectively, for our worst-case scenario analysis. Tree removal in known use spring staging/fall swarming habitat during the winter will remove foraging and roosting areas for a concentrated number of Ibats during spring emergence or fall swarming. As described above, bats use the area around hibernacula to forage, socialize, and mate in the fall. In the spring, bats spend a few hours to a few days around hibernacula or they may migrate immediately to summer habitat.

As discussed previously, the spring emergence period (April through May) is also a sensitive time period for bats in general, but increasingly so for WNS-affected bats that survive hibernation but are in a weakened condition. They may also emerge from hibernation sites earlier and may be more likely to stay closer to the hibernation site for a longer time period following spring emergence. Therefore, we anticipate that any effects incurred will be greatest to WNS-affected bats emerging in the spring the first season after tree removal has occurred.

All tree removal activities within this habitat category to date have been completed during the winter months (when bats were not present), and no impacts to Ibat hibernacula or hibernating bats were documented or are anticipated to have occurred for the reasons stated in the Environmental Baseline section. However, tree clearing within these areas has resulted in and will result in temporary and permanent habitat loss. As stated above, depending on the amount and location of removal, bats may need to spend more time searching for food, which could result in bats entering hibernation with less fat reserves resulting in decreased overwinter survival or poorer spring body condition or result in less time on social interactions, and result in decreased breeding success. In this case, however, the tree removal completed for the project ROW is linear in nature with a maximum width of 125-ft of clearing and represents 0.70% to 0.78% of available spring staging/fall swarming habitat around the known hibernacula. The closest clearing is approximately 0.04 miles from the entrance of Tawney's Cave in VA. Therefore, we do not expect reduced overwinter survival from tree removal that occurs in spring staging and fall swarming habitat during the inactive bat season. As discussed above, WNS-affected Ibats will be more affected by roost tree and foraging habitat loss around these 2 hibernacula than non-affected Ibats. However, given that the majority of the spring staging and fall swarming habitat will remain intact and available, even under a worst-case scenario, we only anticipate temporary, sublethal effects to WNS-affected bats emerging in the spring to tree removal in spring staging habitat. We expect fall-swarming Ibats and healthy Ibats emerging in spring to adapt to the presence of a 125-ft cleared ROW and any associated ARs, as they can and do fly across narrow forest openings. We also expect that healthy Ibats will respond to future slips and slip remediation occurring during the inactive season in a similar manner, given the typically small size, even if slips and slip remediations are not linear.

In summary, it is likely that individual Ibats have been or will be harmed from inactive season clearing in the 2 known use spring staging/fall swarming areas in the action area. We anticipate that effects of tree removal in known use spring staging/fall swarming habitat (outside of the active season) will vary with some individuals experiencing no effects to others experiencing temporary reduced breeding success. We anticipate that any effects incurred will be greatest to WNS-affected bats emerging in the spring the first season after tree removal has occurred. We have no precise way to estimate how many individuals have been or will be harmed. However, using the information discussed above in the Environmental Baseline section, we estimate that up to 8 adults associated with each known hibernacula may be harmed as a result of tree removal in these areas. If we assume a 50:50 sex ratio, then there are up to 4 adult females within each hibernaculum. If all 4 adult females are reproductively active, they will disperse to their associated maternity colonies and experience temporary sublethal impacts (i.e., temporary reduced breeding success) (Table 24). We do not anticipate impacts to males hibernating in these sites because males have less energetic demands than females. Males do not generally migrate to maternity colonies and do not have the energetic demands associated with pregnancy and lactation.

Non-jurisdictional facilities (NJFs) – An additional 0.31 acre of known use spring staging/fall swarming habitat will be removed for NJFs. These acres represent 1 NJF in Giles County, VA (Appendix G). Again, we assess the worst-case scenario in which all future tree loss associated with future slips occurs in spring staging and fall swarming habitat. The additional 0.31 acres added to the total acreage cleared and anticipated to be lost due to future slips around Tawney's Cave in VA. Thus, the total acres affected around Tawney's Cave increases from 255.56 to 255.87; however, these total habitat impacts still represent 0.70% of available spring staging/fall swarming habitat for Tawney's Cave, which is the same percentage described above, without the NJFs. We do not anticipate additional adverse effects from tree clearing for NJFs other than those described above for known use spring staging/fall swarming habitat.

Tree removal in unknown use spring staging/fall swarming habitat (during the active season) – A total of 577.12 acres of suitable unknown use spring staging and fall swarming habitat has been cleared during the active Ibat season; 0.03 acre in this habitat category associated with a known slip has yet to be cleared. Because the timing and location of future slips is unpredictable and slips requiring immediate repair could occur during any time of year, in our worst-case scenario analysis we anticipate that an additional 247.68 acres of habitat loss associated with future slips will occur in this habitat type during the active season. Therefore, the total unknown use spring and fall habitat removed by this project during the active season under a worst-case scenario is 824.80 acres. Tree removal in unknown use spring staging/fall swarming habitat during the active season (April, May, and from August until November 15) will disrupt bats engaging in fall swarming, spring staging, and roosting behavior. Bats could be killed, injured, or forced to flee if an occupied roost tree is cut. During spring staging/fall swarming, bats often roost individually rather than in groups, typically have numerous suitable day-roosts available, and frequently roost-switch. Therefore, there is less potential to affect a tree being used by multiple bats or a large bat colony, and effects are likely restricted to smaller groups of bats or individual bats. We expect the same types and extent of effects will occur from tree removal during the active season in unknown use spring staging/fall swarming habitat as those described for active season tree removal in known use spring and fall habitat above. Approximately 0.31 acres was removed in June 2018 (emergence surveys were performed on all suitable roosts within this area prior to removal and no bats were documented). The emergence surveys are expected to have minimized effects from loss of undocumented occupied roosts.

Up to 824.80 acres of unknown use spring staging and fall swarming habitat has been and may be removed during the active season. However, Mountain Valley has committed to clearing trees associated with the 247.68 acres of future slip tree loss and remediation during the inactive bat season (November 15 to March 31), whenever possible. As discussed above, we anticipate tree clearing will impact individuals associated with 10 assumed occupied Ibat hibernacula; however, not all 824.80 acres are likely to be occupied because this acreage is based on 69 potential hibernacula, and we only estimate 10 of these are actually occupied. We estimate up to 8 individual Ibats are using each of the 10 assumed occupied hibernacula and the surrounding spring staging/fall swarming habitat. Furthermore, the likelihood of lethal impacts to individual Ibats from trees lost in slips is reduced, as most slips are small and tend to occur in the wetter months more typical of the inactive bat season. However, it is possible that individual Ibats have been or will be injured or killed from active season clearing in unknown use spring and fall habitat. We have no precise way to estimate how many individuals have been or will be injured or killed. If no Ibats are using the roosts at the time they are felled, then none will be injured or killed. If some Ibats are using the roosts at the time they are felled, then a portion of those bats may be injured or killed. Because we have no information on Ibats that have been present in roost trees felled in spring staging and fall swarming habitat, we will apply the best available information from occupied known maternity colony roost tree losses (see footnote 33). Thus, we are assuming that 1 adult female bat present in roosts that are felled has been or will be killed. For the purposes of our analyses, we will assume that 1 individual will be injured or killed per hibernacula (Table 24).

Non-jurisdictional facilities (NJFs) – An additional 2.54 acres of unknown use spring staging/fall swarming habitat will be removed for NJFs. These acres represent 6 facilities in 4 counties in WV and VA and range from 0.01 - 1.30 acres removed per NJF (Appendix G). Again, we assess the worst-case scenario in which all future tree loss associated with future slips occurs in spring staging and fall swarming habitat during the active bat season. The additional 2.54 acres added to the total acreage cleared and anticipated to be lost during active Ibat season due to future slips in unknown spring staging/fall swarming habitat (824.80 acres) results in a total of 827.34 acres. The amount of tree clearing for this habitat category from NJFs is a 0.30% increase; therefore, we maintain our assumptions stated above and do not anticipate any additional adverse effects other than those described above.

Tree removal in unknown use spring staging/fall swarming habitat (outside of the active season) – Approximately 251.51 acres of unknown use spring staging/fall swarming habitat was removed during the winter; we also anticipate that up to an additional 247.68 acres of tree removal associated with future slips could occur in this habitat category during the inactive season. We expect the same types and extent of effects will occur from tree removal outside the active season in unknown use spring staging/fall swarming habitat as those described above for inactive season tree removal in known use spring staging/fall swarming habitat. We have no precise way to estimate how many individuals were harmed as a result of this tree clearing. However, using the information discussed above in the Environmental Baseline section, we estimate that up to 8 adults associated with each assumed occupied hibernacula may be harmed as a result of tree removal in these areas. If we assume a 50:50 sex ratio, then there are up to 4 adult females within each hibernaculum. If all 4 adult females are reproductively active, they will disperse to their associated maternity colonies and experience sublethal impacts (i.e., reduced breeding success) (Table 24). We do not anticipate impacts to males hibernating in these sites because males have less energetic demands than females. Males do not generally migrate to maternity colonies and do not have the energetic demands associated with pregnancy and lactation.

Table 24 identifies the acreage of each habitat type that will be cleared and the corresponding number of individual Ibats that have been or will be affected by the project.

Table 24. Acreage of each Ibat habitat type that has been or will be cleared for the MVP project and NJFs and the corresponding number of individual bats that have been or will be affected. Totals may not sum due to rounding.

Habitat Type	Acreage Cleared for MVP	Acreage Cleared NJFs	Associated Colonies or Hibernacula	Number of Adult Female Ibats Affected	Number of Ibat Pups Affected	Types of Effects Anticipated
Known use summer (active season)	247.74[a]	0	1 known maternity colony	1	9	Injury or death
Known use summer (inactive season)	236.0	0	(Same colony as above)	1	N/A	Reduced breeding success
Known use summer (total)	486.27[b]	0	1 known maternity colony	2	9	See above
Unknown use summer (active season)	1813.32[c]	1.33	3 unknown maternity colonies	3 (1 per colony)	27 (9 per colony)	Injury or death
Unknown use summer (inactive season)	270.87	0	(Same 3 colonies as above)	3 (1 per colony)	N/A	Reduced breeding success
Unknown use summer (total)	2,084.19	1.33	3 unknown maternity colonies	6	27	See above

Habitat Type	Acreage Cleared for MVP	Acreage Cleared NJFs	Associated Colonies or Hibernacula	Number of Adult Female Ibats Affected	Number of Ibat Pups Affected	Types of Effects Anticipated
Known use spring staging/fall swarming (active season)	247.68[d]	0.31	2 known hibernacula	2 (1 per hibernacula)	N/A	Injury or death
Known use spring staging/fall swarming (inactive season)	308.48	0	(Same 2 hibernacula as above)	8 (4 per hibernacula)	N/A	Reduced breeding success
Known use spring staging/fall swarming (total)	556.16	0.31	2 known hibernacula	10	N/A	See above
Unknown use spring staging/fall swarming (active)	824.80[e]	2.54	10 assumed occupied hibernacula	10 (1 per hibernacula	N/A	Injury or death
Unknown use spring staging/fall swarming (inactive)	251.52	0	(Same 10 hibernacula as above)	40 (4 per hibernacula)	N/A	Reduced breeding success
Unknown use spring staging/fall swarming (total)	1,076.32	2.54	10 assumed occupied hibernacula	50	N/A	See above

[a] Future slip acreage (247.68 acres) is added to the 0.06 acres of active season clearing for worst-case scenario in the known use summer habitat category.
[b] Includes 2.47 acres associated with emergency consultation. Although the previous removal of 2.47 acres during the active season had discountable effects on Ibats, the 2.47 acres is included in the overall effects of the total habitat loss (regardless of clearing season) in this habitat category.
[c] Future slip acreage (247.68 acres) is added to the active season clearing for worst-case scenario in unknown use summer habitat.
[d] Future slip acreage (247.68 acres) is added to the active season clearing for worst-case scenario in known use spring staging/fall swarming habitat.
[e] Future slip acreage (247.68 acres) is added to the active season clearing for worst-case scenario in unknown use spring staging/fall swarming habitat.

The majority of tree removal activities associated with the MVP project, as well as the effects associated with those activities, have been completed and/or already occurred. However, tree removal anticipated for future slips (downed trees and slip repairs), existing slip remediation, and variance requests remains (Table 25). This tree removal is incorporated in the effects discussion and analyses above and is included in the acreage figures in Table 24.

Table 25. Ibat forested habitat categories with remaining tree removal (M. Hoover, Mountain Valley, email to C. Schulz, Service, December 14, 2022).

Habitat Category	Project Locations, Slips and Variance Requests*	Future Slips
Known use summer	0.06	TBD
Unknown use summer	3.18	TBD
Known use spring staging/fall swarming	0	TBD
Unknown use spring staging/fall swarming	0.16	TBD
Unknown habitat category	N/A	247.68

*These acreages are accounted for in the totals in Tables 21 and 23.

Voluntary Conservation Action – To voluntarily provide a conservation benefit to Ibats within unknown use spring staging/fall swarming habitat, a 121-acre property was acquired by Mountain Valley in Braxton County, WV. The parcel contains mature, upland deciduous forest dominated by mostly oak (*Quercus* spp.), hickory (*Carya* spp.), and red maple (*Acer rubrum*). There are numerous travel/foraging areas and snags for bats throughout the property. Approximately 860 ft of the construction ROW crosses the eastern portion of the property. After project completion, approximately 106 acres will remain as interior forest and will be maintained as such in perpetuity. Protection of this property may provide habitat, immediately adjacent to the project area, for bats displaced during construction activities. Due to the property's proximity to the construction ROW, displaced bats will only need to travel a short distance to locate alternative spring staging/fall swarming habitat. It is anticipated that the availability and protection of this property may reduce adverse effects on returning bats; however, bats have not been detected on this property as of the date of this Opinion. While implementation of this mitigation will likely provide additional conservation for Ibat, its potential beneficial impact was not considered in the analysis or conclusion below because the nature and extent of that benefit is not determinable at this time.

Northern long-eared bat (NLEB)

The potential effects of the proposed action are described in Appendix B Table 3. In the 2020 Opinion, the only effects analyzed were: (1) those that have the potential to result in the incidental take of NLEBs in hibernacula; (2) those that have the potential to result in the incidental take of NLEBs by altering a known hibernaculum's entrance or interior environment if the alteration impairs an essential behavioral pattern, including sheltering NLEBs; or (3) tree-removal activities that have the potential to result in the incidental take of NLEBs when the activity either occurs within 0.25 mile (0.4 km) of a known hibernaculum, or cuts or destroys known, occupied maternity roost trees or any other trees within a 150-ft (45-m) radius from the maternity roost tree during the pup season (June 1 through July 31). As explained above, effects outside those analyzed in the 2020 Opinion were previously analyzed under the 2016 Opinion for the 4(d) rule. Accordingly, while the majority of activities associated with this project that could affect NLEBs have been completed and those effects were accounted for by the 2016 Opinion, assessment of any remaining activities that could affect the species and its habitat subsequent to the effective date of the uplisting are discussed below. Furthermore, given the immiment reclassification to endangered status, this section includes discussion of impacts that already occurred under the 2016 Opinion, discussion of impacts that have already occurred as authorized by the 2020 Opinion and ITS, and analysis of future effects. The effects of all tree clearing in suitable NLEB habitat over the life of the project are considered in the jeopardy analysis. We did not reach a NE determination for NLEB for any of the subactivities. The subactivities that we determined are NLAA NLEB are described in Appendix B Table 3 and will not be further discussed in this Opinion beyond the paragraphs set forth below.

Several subactivities had the potential to result in impacts to bats or alter their habitat through changes to baseline noise, lighting, air quality, and water quality conditions or alteration of hibernacula. As discussed in the Environmental Baseline section, for those subactivities we anticipate no impacts to hibernating bats or hibernacula given the description of the proposed action and AMMs. In addition, we have determined that impacts from project components that are completed after tree removal are unlikely to result in any discernible impacts to the NLEB (i.e., are NLAA the NLEB). This is because the tree removal in areas of known use is already anticipated to result in changes in individual NLEB foraging, roosting, and travel behavior. Due to this displacement, bats are not likely to be exposed to consequences as a result of increased noise, lighting, or dust within the areas of habitat removal. In addition, AMMs will further avoid and minimize potential impacts from noise, lighting, and dust. For example, during the active season, the project's construction hours generally do not overlap with the periods of highest bat activity. While there are occasional instances when project work may need to extend beyond civil twilight, these occasions are rare (i.e., approximately 12 instances over the life of the project since construction commenced in 2018) and limited to instances when unforeseen complications arise during daytime construction hours, which are a safety issue that must be resolved and/or activity-specific (i.e., drilling for HDD or bores, work at compressor stations, hydrostatic testing, tie-ins, and extended work to comply with stream crossing time requirements and upcoming inclement weather). However, tree removal will be/has been completed prior to the start of the additional work activities listed, and as discussed above, NLEBs are not anticipated to be in the area. Mountain Valley has committed to bat, E&S control, and pesticide/herbicide use AMMs that are listed in the Description of the Proposed Action section.

No significant changes in water quality or invertebrate prey that would adversely affect NLEB are anticipated from earth work or wetland/stream crossings because E&S control measures will be applied throughout the project area to protect water quality and reduce sedimentation associated with wetland/stream crossings. Despite the E&S control measures, and as detailed in the discussion of the effects of the action on aquatic species, there have been and will be erosion and sedimentation from stream crossing and from upland sedimentation that have caused or will cause increased embeddedness as well as short-term declines in water quality and in aquatic insect populations in adjacent wetlands, ponds, and other water bodies. However, since potential impacts from suspended sediment associated with sedimentation are expected to be localized, foraging bats are expected to have alternative adequate drinking water and foraging locations. The surrounding landscape will continue to provide an abundant prey base for both terrestrial and aquatic insects during project construction, operation, and maintenance. Therefore, any potential effects to NLEB from a reduction in water quality are anticipated to be insignificant. Likewise, no significant changes in water quality or invertebrate prey are expected to occur as a result of pesticide application within the ROW. Fall mowing will be the first option pursued by Mountain Valley, should an outbreak occur, which would greatly reduce potentially adverse effects to NLEBs from pest control. If necessary, limited pesticide application will occur. However, it will occur on a limited basis and target specific pest outbreaks in areas where revegetation of the ROW is being negatively impacted. As needed, pesticide application will be applied by hand in spot treatments, and no pesticides will be used within a minimum 150-ft buffer around aquatic and other resources. Given the limited application of pesticides in the ROW in strict compliance with product label instructions, as well as adherence to a protective buffer, and the proposed hand application method, potential effects to foraging bats as a result of degradation of aquatic resources related to pesticide application in the ROW are anticipated to be insignificant. Furthermore, the surrounding landscape will continue to provide an abundant prey base for both terrestrial and aquatic insects during project construction, operation, and maintenance. Therefore, any potential effects to NLEBs from a reduction in water quality are anticipated to be insignificant.

Additionally, Mountain Valley assessed the effects of noise and vibration impacts on Ibats hibernacula, which would also be applicable to NLEB and came to the conclusion that adverse effects are not likely (Appendix G in Mountain Valley 2020 SBA). The Service has independently reviewed the information included in the SBA related to noise and vibration impacts and we concur with Mountain Valley's determination.

There are other subactivities of the project that are LAA NLEB, all of which involve tree removal. For some components of the proposed action that are likely to affect NLEB, AMMs have been incorporated to reduce those effects and those are also noted below. These LAA subactivities are listed in Appendix B Table 3 and include:[35]

- Clearing – trees and shrubs
- ARs – upgrading existing roads, new roads temporary and permanent – tree trimming and tree removal
- Crossings, wetlands and other water bodies (non-riparian) – clearing
- Vegetation management – chainsaw, tree clearing, and tree side trimming

Past effects – Past effects from these subactivities include tree clearing within 0.25 mile of hibernacula: Canoe Cave, Tawney's Cave, and PS-WV3-Y-P1. A total of 15.64 acres of tree removal associated with these subactivities within 0.25 mile of a hibernacula was analyzed in the 2020 Opinion and included in the ITS. That tree removal was completed in accordance with the 2020 ITS and is reflected in the ITS for this Opinion. A total of 3,824.90 acres of tree removal associated with the project in NLEB suitable occupied habitat, but outside the 0.25 mile radius of a hibernaculum, has already occurred. When these subactivities were completed, the associated take was not prohibited per the 4(d) rule. Accordingly, this take is not included in the ITS.

[35] "General appurtenance and cathodic protection construction – off ROW clearing" was previously included in the list of activities that are LAA Ibat and NLEB in the 2020 Opinion, which was in error. Project activities related to general appurtenance and cathodic protection construction – including off ROW clearing, trenching, anode, bell hole – were also included in error in the 2020 Opinion (Appendix B) as NLAA RLP, CD, and CD proposed critical habitat and NE to VASP. Any activities associated with general appurtenance and cathodic protection construction that have occurred or will occur off ROW are subject to additional landowner approval and the FERC variance process. FERC is required to reinitiate consultation with the Service for any variance that may affect listed species or critical habitat.

However, in order to avoid immediate reinitation of consultation due to imminent reclassification of NLEB to endangered, the tree clearing in this acreage is discussed in this effects analysis and considered for purposes of the jeopardy analysis.

Future effects – Future tree clearing in NLEB habitat includes 3.45 acres (including 0.05 acre within suitable unoccupied habitat; therefore, only 3.40 acres are considered within effects analysis and ITS below) associated with known variances and slips and 4.38 acres of clearing associated with NJFs These impacts are analyzed by the 3 affected habitat categories below.

Additionally, 247.68 acres of tree removal associated with future slips is anticipated to temporarily remove suitable known and unknown use NLEB habitat within these 3 habitat categories (Table 26). Mountain Valley is unable to reliably predict the exact timing, location and acreage associated with each future slip that may occur. Therefore, in this Opinion, the Service will assess the potential effects to the NLEB for a "worst case scenario" in each habitat category. The "worst-case scenario" for each habitat category would occur when all 247.68 acres of future slips occurs only in that particular habitat category during the active season. We analyze this scenario for each of the 3 affected habitat categories below. However, as we discuss further below, it remains unlikely that all future predicted slips would occur in 1 habitat category or during the active season.

We expect the TOYRs (Table 26) to limit the amount of lethal impacts to NLEB from these subactivities, but will not eliminate the effects of habitat loss.

Table 26. Tree clearing by NLEB habitat category.

Habitat Category	**TOYRs**	**Season/Months when Tree Clearing Occurred or Could Occur**[b]
Known use summer	Trees will be removed between November 15 and March 31, when NLEBs will not be present, and potentially in April, August, and September	winter, April, August, September
Unknown use spring staging/fall swarming	Trees will be removed between November 15 and March 31, and potentially in April, May, August, and September	winter, April, May, August, September
Known use spring staging/fall swarming	Trees will be removed between November 15 and March 31, when NLEB will not be present	winter
Future Slips in Unknown Habitat Category [a]	Trees will be removed between November 15 and March 31, when NLEBs will not be present, whenever possible. Trees could potentially be removed in April, May, and from August to November 15. Trees will not be removed June 1 to July 31, when young cannot fly	winter, April, May, August, September, October, and November until the 15th

[a] Up to 247.68 acres of future slips are estimated. Future slip acreage includes acres of tree removal associated with the slip. Mountain Valley has agreed to avoid all future tree removal from June 1- July 31 at minimum and to complete clearing between November 15 and March 31 whenever possible. Mountain Valley will confer with the agencies on emergency consultation if clearing must occur June 1-July 31.

[b] The vast majority of all other tree removal has occurred, with 3.4 acres total of planned tree removal remaining in suitable known or unknown use habitat.

Known and unknown use summer habitat – It is anticipated that 3.40 acres of future clearing associated with known variances and slips and 247.68 acres (Table 29) for future slips may occur in known use summer habitat. No unknown use summer habitat in VA or WV has been or is expected to be cleared. For purposes of the jeopardy analysis, we consider effects to NLEBs from tree clearing on a total of 2,892.74 acres in known use summer habitat in WV (2,646.14 acres) and VA (246.60 acres). An additional 247.68 acres (at most) of future tree clearing for predicted slips may also occur in known use summer habitat (discussed further below). Therefore, under a “worst-case scenario,” a total of 3,140.42 acres of known summer use habitat has been or will be cleared in WV during the inactive season. We anticipate tree clearing will impact individuals associated with 9 known current NLEB maternity colony home range. NLEB home ranges are not linear, so it is likely that the 125-ft wide construction ROW may only displace NLEB from a portion of their home range, not their entire home range. While slip areas and work areas will not necessarily be linear, they are generally isolated and confined.

Tree removal in known use summer habitat (during active season) – Tree removal in known use summer habitat during the active season is expected to affect NLEB using occupied roosts and NLEBs foraging within 9 known maternity colonies. Approximately 3.40 acres of tree removal as a result of future known slips or variances is expected. Mountain Valley plans to conduct future tree removal (including future slip-related removal totaling as much as 247.68 acres) in this known use summer habitat during the winter whenever possible. At minimum, Mountain Valley has committed to avoid conducting future tree removal in this known use summer habitat, during the period of time when NLEB colonies are most concentrated and any pups are anticipated to be nonvolant (June 1 – July 31) and to confer with the agencies on emergency Section 7 consultation when not possible. Future tree removal in this habitat category may be as much as 247.68 acres due to slips. If all unknown slips and associated remediation occurs in this habitat category, a total of 251.08 acres (247.68 acres + 3.40 acres) of tree clearing would occur during the active season within summer habitat. Future slip acreage includes all tree removal associated with the slip. Slips could occur during any time of year, although they are more likely to occur in the spring and less likely to occur in summer. Mountain Valley has committed to complete future tree clearing associated with remediation of future slips during the inactive season, whenever possible. However, although unlikely, slips could occur during the active NLEB season and remediation may be necessary during the active season to address safety concerns or prevent further damage from spreading of the slip. Again, the majority of future tree removal activities within this known use area is expected to be conducted during the winter months while bats are in hibernation, which reduces the likelihood of lethal impacts to bats.

Individual NLEBs associated with 9 maternity colonies may be injured or killed from active season tree removal of 251.08 acres associated with existing slip repair, future slips, and slip repair during the active season. We have no precise way to estimate how many individuals will be injured or killed. If no NLEBs are using the roosts at the time they are felled, then no individuals will be injured or killed. If some NLEBs are using the roosts at the time they are felled, then a portion of those bats may be injured or killed. The Service compiled a summary of accounts documenting the removal of occupied maternity roosts for Ibats (see Ibat Tree removal in known use summer habitat (during the active season) section of the Effects of the Action section) and used any relevant information to roughly estimate the number of individuals that may be injured or killed from the removal of occupied roost trees within this habitat category for NLEB as we do not have accounts for NLEB and expect similar impacts to NLEB as Ibat from these types of events because NLEBs have similar life history strategies as Ibats. Each event had slightly different long-term impacts on the affected bats, but all resulted in mortality of some adults and juveniles due to trauma from the fallen tree.

Based on these accounts summarized in the Ibat Tree removal in known use summer habitat (during the active season) section of the Effects of the Action section, an estimate of 2 to 15 individuals[31] (i.e., 16 to 18%[32]), depending on the size of the known maternity colony present during the active season (as noted above, we assume 5-40 adult NLEB females per colony and 1 pup per female), may be injured or killed from the felling of undocumented occupied roost trees. However, as discussed above, there may be no bats roosting in the trees that are removed. For purposes of this analysis, we are utilizing the average or mean colony size for NLEBs (i.e., 22.5 adults + 22.5 pups = 45 total bats per colony). We then used the average (i.e., 17%) of the number of total Ibats killed during occupied roost tree felling referenced in the accounts for IN (16%) and OH (18%). The calculation is 45 total bats x 17% = 7.65 total bats, rounded to the nearest whole individual (8 total bats). In the summary of accounts documenting the removal of occupied maternity roosts, at least 1 adult female bat was killed or injured in each instance. Therefore, we are assuming the total of 8 bats is comprised of 1 adult female and 7 pups.

For the purposes of this analysis, we will utilize the average of all of the values discussed above and assume at most that 9 adult females and 63 pups (for a total of 72 individuals) associated with 9 maternity colonies may be injured or killed from the felling of occupied roost trees during the active season in the known use summer habitat in the action area (Table 28). This assumption represents an appropriate synthesis of the best available data and allows for an adequate assessment of the effects of the project for purposes of the jeopardy analysis.

Non-jurisdictional facilities (NJFs) – An additional 3.26 acres of known use summer habitat will be removed by third parties for NJFs. These acres represent 10 facilities in WV and 2 in VA, and range from 0.01 – 0.88 acres removed per facility (Appendix G). A reasonable worst case scenario is the trees will be removed during the active season.

The additional 3.26 acres to be removed from NJFs in this habitat category added to the total "worst case scenario" acreage to be cleared for the MVP project (251.08 acres of tree removal associated with potential future slips and planned slip remediation) results in a total of 254.34 acres cleared in this habitat category.

Tree removal in known use summer habitat (during inactive season) – Effects from tree removal in 2,889.34 acres of known use summer habitathave already occurred and were previously assessed in the 2016 Opinion for the NLEB 4(d) rule. When these activities were completed, the associated take was not prohibited per the 4(d) rule. Accordingly, this take is not included in the ITS. Nevertheless, as mentioned above, effects from tree clearing in this acreage are considered for purposes of the jeopardy analysis.

Loss of 12.43 acres summer known suitable maternity colony habitat associated with past clearing of summer habitat within 0.25 miles of PS-WV3-Y-P1 is also discussed below and was included in the 2020 Opinion and ITS. This 12.43 acres overlaps with known use spring staging/fall swarming habitat and was analyzed as part of the 15.64 acres of clearing in that habitat type authorized in the 2020 ITS. Accordingly, the 2020 Opinion considered effects from loss of these 12.43 acres of known use summer habitat in this overlap area, and those effects are discussed below. The 2020 Opinion noted that maternity colony presence was likely only around PS-WV3-Y-P1, as a juvenile male (Bat 791) was captured near the hibernaculum in 2015. The future tree removal activities for the project within this known use area are expected to be conducted during the winter months while bats are in hibernation, which further reduces the likelihood of lethal impacts to bats.

Future clearing in known use summer habitat includes future felling for known variances and slips in addition to potential slips and tree clearing associated with these potential slips. Up to 247.68 acres of known use summer habitat may be removed during the winter for future slips and associated remediation. The future tree removal activities for the project within this known use area are expected to be conducted during the winter months while bats are in hibernation, which further reduces the likelihood of lethal impacts to bats.

Tree removal in known use summer habitat during the winter may alter roosting, foraging, and commuting habitat. The MVP project will not result in the removal of any known documented maternity roosts or foraging areas. However, we anticipate that there are undocumented roost trees or foraging habitat within this known use area. NLEBs will avoid the permanently cleared areas and start exploring undisturbed areas for future roost sites. Any direct effects to NLEBs from tree removal were avoided because of winter tree removal. However, similar to Ibats, effects to NLEBs may occur even if maternity roost trees are cleared during the hibernation period. Johnson et al. (2012) found that NLEBs form social groups among networks of roost trees that are often centered around a central-node roost. Central-node roost trees may be similar to Ibat primary roost trees (locations for information exchange, thermal buffering) but they were identified by the degree of connectivity with other roost trees rather than by the number of individuals using the tree (Johnson et al. 2012). NLEBs form smaller social groups within a maternity colony and exhibit nonrandom roosting behaviors, with some female NLEBs roosting more frequently together than with others (Garroway and Broders 2007, Patriquin et al. 2010, Johnson et al. 2012).

Similar to Ibats, NLEBs exhibit fidelity to the general summer maternity area (Foster and Kurta 1999, Jackson 2004, Johnson et al. 2009, Patriquin et al. 2010, Perry 2011, Broders et al. 2013). Roost trees, although ephemeral in nature, may be used by a colony for a number of years until they are no longer available (i.e., the roost has naturally fallen to the ground) or suitable (i.e., the bark has completely fallen off of a snag). Some trees have shorter life expectancy as a roost than others (e.g., living shagbark hickories can provide suitable roosts for similar species, such as Ibat, for decades while elm snags may lose their bark within a few years). Although loss of a roost (e.g., blow down, bark loss) is a natural phenomenon that NLEBs must deal with regularly, the loss of multiple roosts, which could comprise most or all of a home range, likely stresses individual bats, affects reproductive success, and impacts the social structure of a colony.

NLEBs are flexible in their tree species roost selection and roost trees are an ephemeral resource; therefore, the species would be expected to tolerate some loss of roosts provided suitable alternative roosts are available. Silvis et al. (2014) modeled the effects of roost-loss on NLEBs and then Silvis et al. (2015) removed known NLEB roosts during the winter to investigate the effects. Once removals exceeded 20–30% of documented roosts (ample similar roosts remained), a single maternity colony network started showing patterns of break-up. Sociality is believed to increase reproductive success (Silvis et al. 2014) and smaller colonies would be expected to have reduced reproductive success. Similar to the Ibat discussion, smaller colonies would be expected to provide less thermoregulatory benefits for adults in cool spring temperatures and for non-volant pups. Female bats have tight energy budgets, and in the spring need to have sufficient energy to keep warm, forage, and sustain pregnancies. Increased flight distances or smaller colonies are expected to result in a portion of bats present within the colony having reduced breeding success. In this case, removal of multiple alternate roost trees in winter could result in similar effects. However, 89% of the forested acres within 0.25 miles of PS-WV3-Y-P1 remains after tree-clearing. Because there is substantial roosting habitat remaining in the area, and we expect the majority of NLEBs will relocate roosting areas with no to minimal effects to individuals.

In addition to potential disruption of colony networks (Silvis et al. 2015), removal of roosting and/or foraging habitat can result in longer flights for NLEBs to find alternative suitable habitat. NLEBs emerge from hibernation with their lowest fat reserves and return to their summer home ranges where they are familiar with roosting and foraging areas. Since NLEBs have summer home range fidelity (Foster and Kurta 1999, Patriquin et al. 2010, Broders et al. 2013), loss or alteration of forest habitat, depending upon the extent and proximity to roosting trees, can put additional stress on females when returning to summer roost or foraging areas after hibernation if females were forced to find new roosting or foraging areas (expend additional energy). Hibernation and reproduction are the most energy-demanding periods for temperate-zone bats like the NLEB (Broders et al. 2013). Further, flight is an energy-demanding mode of transportation (particularly for pregnant females). Bats may reduce costs of searching for food by concentrating their foraging in areas of known high profitability, a benefit that could result from local knowledge and site fidelity (Broders et al. 2013). Cool spring temperatures provide an additional energetic demand as bats need to stay sufficiently warm or enter torpor. Entering torpor comes at a cost with delayed parturition; bats born earlier have a greater chance of surviving their first winter and breeding their first year (Frick et al. 2009). Delayed parturition may be costly because young of the year and adult females would have less time to prepare for hibernation (Broders et al. 2013). NLEB females roost colonially with their largest counts in spring (Foster and Kurta 1999), presumably this is one way to reduce thermal costs for individual bats (Foster and Kurta 1999). In summary, NLEBs have multiple energetic demands (particularly in spring) and must have sufficient suitable roosting and foraging habitat available in close enough proximity to allow for successful reproduction. In this case, there will be sufficient habitat remaining in close proximity (directly adjacent) to the cleared areas that should lessen the additional stress on females when returning to summer roost or foraging areas after hibernation if females were forced to find new roosting or foraging areas (expend additional energy).

In areas with WNS, there are additional energy demands for NLEBs. For example, WNS-affected bats have less fat reserves than non-WNS-affected bats when they emerge from hibernation (Reeder et al. 2012, Warnecke et al. 2012) and have wing damage (Reichard and Kunz 2009, Meteyer et al. 2009) that makes migration and foraging more challenging. Females that survive the migration to their summer habitat must partition energy resources between foraging, keeping warm, successful pregnancy and pup-rearing, and healing.

Mean NLEB home range sizes for individual females have been minimally estimated at 60.2-72.3 hectares (148.8-173.7 acres) (Owen et al. 2003, Lacki et al. 2009). Carter and Feldhamer (2005) estimated roosting area size for NLEB at 186.3 hectares (460.4 acres). The home range for colonies are likely much larger with some overlapping home ranges of individuals. This project removed 12.43 acres of suitable habitat within 0.25 miles of a hibernaculum that is also summer maternity habitat. This represents up to 8% of the home range of an individual NLEB associated with the colony. Given the highly forested nature of this area, we anticipate that NLEBs will locate new travel corridors/foraging areas with no effects or minimal effects to individuals.

In summary, it is likely that individual NLEBs have been or will be harmed from inactive season clearing of roosting or foraging habitat in 9 known colonies. We anticipate that effects of tree removal will vary with some individuals experiencing no effects to others experiencing temporary reduced pregnancy success. As discussed in the Environmental Baseline section, NLEB maternity colonies are anticipated to range in size from 5-40 adult females and 5-40 juveniles. We have no precise way to estimate how many individuals have been or will be harmed. Above, we discussed that lethal effects from tree clearing during the active season are anticipated to up to 1 adult female and 7 pups. Comparatively, the effects from the removal of trees while bats are hibernating is lower in magnitude (nonlethal; see discussion above) than those experienced by bats present during the active season, and these effects will only be experienced by adult females, as they return to their maternity colony during the season following the winter clearing and adjust to changes in their summer use habitat. Above we describe that we expect 1 adult female to be killed or harmed by the felling of an occupied roost tree during the active season, which is based on known occurrences of occupied roost tree felling. Because we expect the impacts of winter tree removal to be less than those expected from tree removal in the active season, we assume that no more than 9 adult females (1 per known maternity colony) will be harmed as a result of clearing in the known use maternity buffer outside of the active season. Since NLEB pups (or juveniles) are able to fly and are independent by the time they enter hibernation in the fall, that life stage will not be affected. Adverse effects that occur to this individual are anticipated to extend through the duration of construction, with the greatest effects expected the first season after tree removal has occurred, until the individual acclimates to the altered landscape and establishes new foraging and roosting areas. The total acreage potentially impacted is 260.11 acres (12.43 acres from past clearing, 247.68 from future unknown slips).

Tree removal in known use spring staging/fall swarming habitat (outside of the active season) – Based on 2016 NLCD, within 0.25 miles of Canoe Cave, Tawney's Cave, and portal PS-WV3-Y-P1, there are approximately 91.1, 80.6, and 104.5 acres of forest, respectively. The project has resulted in the removal of 0.51, 2.70, and 12.43 acres (a total of 15.64 acres[36]) or forest within 0.25 miles of Canoe Cave, Tawney's Cave, and PS-WV3-Y-P1, or 0.56%, 3.3%, and 11.9% of available forest within this buffer, respectively (Table 27). Although this tree-clearing has occurred outside of the active spring staging season (April 1-May 31) as well as the broader bat active season, tree removal in known use spring staging/fall swarming habitat during the winter removes foraging and roosting areas for a concentrated number of NLEBs during spring emergence or fall swarming. Bats use the area around hibernacula to build fat reserves prior to hibernation and to socialize and mate in the fall. In the spring, bats spend a few hours or days around hibernacula or migrate immediately to summer habitat. Clearing trees around hibernacula may decrease foraging and roosting habitat. The spring emergence period (April 1 through May 31) is also a sensitive time period for bats in general, but increasingly so for WNS-affected bats that do not die during hibernation and may be weakened by the effects of the disease and may have reduced fat reserves and damage to wing membranes. WNS-affected bats may have difficulty flying and may be less likely to survive long-distance migrations to summer areas. They may also emerge from hibernation sites earlier and may be more likely to stay closer to the hibernation site for a longer time period following spring emergence.

Tree clearing within these areas results in temporary and permanent habitat loss. In certain circumstances, depending on the amount and location of removal, bats may need to spend more time searching for food, which could result in bats entering hibernation with less fat reserves resulting in decreased overwinter survival or poorer spring body condition or result in less time on social interactions, which could result in decreased breeding success. In this case, tree removal represents 0.5-11.9% of the 0.25-mile buffer habitat around each of the 3 hibernacula. However, although we focused our previous analysis on a small area directly located around the hibernacula pursuant to the 4(d) rule, in reality, NLEB are anticipated to be using a much larger area as part of their spring staging and fall swarming habitat (up to 5 miles around the hibernaculum). This is why a 5-mile buffer is used in considering effects to NLEB from future tree clearing (USFWS 2014) outside of the 4(d) rule (as explained above and in the

[36] 12.43 acres of this total also serves as known use summer habitat.

environmental baseline). For example, there are approximately 36,593.88 acres of forest within 5 miles of Tawney's Cave and the removal of 2.70 acres represents 0.007% loss of available spring staging/fall swarming habitat. In addition, the planned project tree removal is typically linear in nature with a maximum width of 125-ft of clearing or isolated and confined (in the case of slips and work areas). Therefore, we do not expect reduced overwinter survival and only anticipate temporary, sublethal effects to WNS-affected bats emerging in the spring.

No future tree clearing is planned by Mountain Valley within 5-miles of known NLEB hibernacula, except for potential slip acreage of up to 247.68 (see explanation above).

In summary, therefore, it is possible that individual NLEBs have been harmed from inactive season clearing in these known use spring staging/fall swarming areas. This is most likely around PS-WV3-Y-P1, with the greatest amount of tree clearing, but it also could occur due to future clearing around any of the other 5 known hibernacula as well. We anticipate that effects of tree removal in known use spring staging/fall swarming habitat (outside of the active season) will vary with some individuals experiencing no effects to others experiencing temporary reduced breeding success. We anticipate that any effects incurred were greatest to WNS-affected bats emerging in the spring the first season after tree removal has occurred. We have no precise way to estimate how many individuals have been harmed. For past clearing, the total amount of clearing within 0.25 miles of these hibernacula is 15.64 acres. Future clearing of up to 247.68 acres may occur in the inactive season known use spring staging/fall swarming areas due to unknown slip and associated remediation acreage. The amount of acreage that may occur within 5 miles of the 6 known NLEB hibernacula is unknown. The total acreage that may be cleared in this habitat category is 263.32 acres. As discussed in the Environmental Baseline section, up to 17 NLEB may be overwintering in each hibernacula. Given the likely small quantity of tree removal around each hibernacula, we expect that for individuals that are affected, the likely effects will be temporary and sublethal. If we assume a 50:50 sex ratio of hibernating NLEB (Whitaker and Rissler 1992), then there are up to 9 adult females within each hibernacula. If all 9 adult females are reproductively active, they will disperse to their associated maternity colonies and experience sublethal impacts (i.e., temporary reduced pregnancy success). We do not anticipate impacts to males hibernating in these sites because males have less energetic demands than females. Males do not generally migrate to maternity colonies and do not have the energetic demands associated with pregnancy and lactation. We expect a total of 54 (9 per hibernacula) adult females could be impacted at most (Table 28).

Tree removal in known use spring staging/fall swarming habitat (active season) – No future tree clearing is planned by Mountain Valley within 5-miles of known NLEB hibernacula during the active season, except for potential slip acreage of up to 247.68 (see related discussion above). As stated earlier, NLEBs have similar life history strategies as Ibats and similar colony sizes. See Ibat *Tree removal in known use spring staging/fall swarming habitat (active season)* in Effects of the Action section for explanation on how tree removal in this habitat category may impact NLEB.

In summary, it is possible that individual NLEBs will be harmed or killed from active season slips and tree clearing associated with slip remediation on 247.68 acres of known use spring staging/fall swarming habitat around 6 hibernacula within the action area. The effects of active season tree removal in known use spring staging/fall swarming habitat will vary. As discussed previously, past slips have been small in size and are more likely to occur during the wetter seasons (late winter and early spring), which reduces the likelihood that NLEBs will have emerged from hibernation and be exposed to slips that may occur along the ROW and ARs within the action area. Furthermore, Mountain Valley will conduct tree clearing for slip remediation during the inactive bat season (November 15 to March 31), when possible, which further reduces the likelihood that NLEBs will be exposed to active season tree removal in their spring and fall habitat. Exceptions may be when a slip is very unstable and expected to continue to expand without immediate repair. We have no precise way to estimate how many of these individuals will be injured, killed, or experience reduced breeding success. If no NLEBs are using the roosts at the time they are cleared or fall as a result of a slip, then none will be affected. If some NLEBs are using the roosts at the time they are cleared or fall, then a portion of those bats may be injured, killed, or experience a reduction in breeding success. As discussed in the Environmental Baseline section, we assume that NLEBs are hibernating in the 6 known hibernacula within the action area. Therefore, for the purposes of this Opinion, we estimate that 9 individual NLEBs could be present and affected by tree removal occurring during the active season in the spring staging and fall swarming habitat surrounding each known hibernaculum.

Because we have no information on NLEBs that have been present in roost trees felled in spring staging and fall swarming habitat, we will apply the best available information from known occupied maternity colony roost tree losses (see footnote 33). As discussed above, 1 adult bat present in felled roosts was injured or killed in maternity colonies. Pups are not present in roosts during spring staging/fall swarming. Therefore, for the purposes of our analyses, we will assume that no more than 1 adult bat will be injured, killed, or experience reduced breeding success per hibernacula (total of 6 adult NLEBs; Table 28).

Non-jurisdictional facilities (NJFs) – An additional 0.31 acre of known use spring staging/fall swarming habitat will be removed by third parties for NJFs. These acres represent 1 NJF in Giles County, VA (Appendix G). Because tree removal will occur around a documented hibernaculum (Tawney's Cave) and the Service typically recommends a TOYR in these buffers, it is likely the trees will be removed during the inactive season. However, this clearing may also occur during the active season. The additional 0.31 acres to be removed from NJFs in this habitat category added to the total "worst case scenario" acreage to be cleared for the MVP project (263.32 acres of tree removal associated with past clearing and potential future slips) results in a total of 263.63 acres cleared in this habitat category.

Tree removal in unknown use spring staging/fall swarming habitat (during the active season) – No future tree clearing is planned by Mountain Valley within 5-miles of unknown

NLEB hibernacula during the active season, except for potential slip acreage of up to 247.68 (see further discussion above). Because the timing and location of future slips is unpredictable and slips requiring immediate repair could occur during any time of year, in our worst-case scenario analysis we anticipate that an additional 247.68 acres of habitat loss associated with future slips will occur in this habitat type during the active season. Therefore, the total unknown use spring and fall habitat removed by this project during the active season under a worst-case scenario is 247.68 acres. We expect the same types and extent of effects will occur from tree removal in active season in unknown use spring staging/fall swarming habitat as those described above for active season tree removal in known use spring staging/fall swarming habitat. We have no precise way to estimate how many individuals were harmed as a result of this tree clearing. Thus, we are assuming that 1 adult female bat present in roosts that are felled has been or will be killed. For the purposes of our analyses, we will assume that 1 individual will be injured or killed per hibernacula (Table 28).

Non-jurisdictional facilities (NJFs) – An additional 0.81 acres of unknown use spring staging/fall swarming habitat will be removed for NJFs. These acres represent 3 facilities in VA and range from 0.01 - 0.79 acres removed per NJF (Appendix G). Because tree removal will occur around unknown hibernacula, a reasonable worst case scenario is the trees will be removed during the active season. This additional 0.81 acres is the total acreage to be cleared for the MVP project in this habitat category. The additional 0.81 acres to be removed from NJFs in this habitat category added to the total "worst case scenario" acreage to be cleared for the MVP project (263.32 acres of tree removal associated with past clearing and potential future slips) results in a total of 264.13 acres cleared in this habitat category.

Tree removal in unknown use spring staging/fall swarming habitat (during the inactive season) – No future tree clearing is planned by Mountain Valley within 5-miles of unknown NLEB hibernacula during the inactive season, except for potential slip acreage of up to 247.68 (see further discussion above). We expect the same types and extent of effects will occur from tree removal outside the active season in unknown use spring staging/fall swarming habitat as those described above for inactive season tree removal in known use spring staging/fall swarming habitat. We have no precise way to estimate how many individuals were harmed as a result of this tree clearing. However, using the information discussed above in the Environmental Baseline section, we estimate that up to 17 adults associated with each assumed occupied hibernacula may be harmed as a result of tree removal in these areas. If we assume a 50:50 sex ratio, then there are up to 9 adult females within each hibernaculum. If all 9 adult females are reproductively active, they will disperse to their associated maternity colonies and experience sublethal impacts (i.e., reduced breeding success) (Table 28). We do not anticipate impacts to males hibernating in these sites because males have less energetic demands than females. Males do not generally migrate to maternity colonies and do not have the energetic demands associated with pregnancy and lactation.

Table 27. Tree removal within 5 miles of NLEB hibernacula[a]. All clearing has already occurred and was considered in the 2020 Opinion and the 2016 NLEB 4(d) Opinion.

Feature	Acres of Tree Removal	
	Within 5 miles [b]	Within 0.25 miles [c]
Canoe Cave Only	23.47	0.51
Tawney's Cave Only	38.68	2.70
Greenville Saltpeter Only	1.13	0.00
PS-WV3-Y-P1 Only	236.15	12.43
Laurel Creek Only	6.72	0.00
Clover Hollow Only	0.00	0.00
Overlap:Tawney's and Canoe Caves	26.09	0.00
Overlap: Canoe and Clover Hollow Caves	39.92	0.00
Overlap: Clover Hollow and Tawney's Caves	0.00	0.00
Overlap: Greenville and Laurel Creek Caves	166.17	0.00
Overlap: Canoe, Clover Hollow, and Tawney's Caves	66.93	0.00
Total	615.25	15.64

[a] M. Stahl, EQT, email to S. Hoskin, Service, October 30, 2017; P. Moore, Beveridge & Diamond PC, email to C. Schulz, Service, August 17, 2020.
[b] M. Hoover, Mountain Valley, email to C. Schulz, January 11, 2023. Updated Table 23, Known northern long-eared bat hibernacula within the Action Area.
[c] The total acreage in this column is 0.01 acre larger than the sum of the individual acreages due to rounding.

Table 28. Acreage of each NLEB habitat type that has been or will be cleared for the MVP project (including NJFs) and the corresponding number of individual bats that have been or will be affected.[4]

Habitat Type	Acreage Cleared MVP[1]	Acreage to be cleared NJFs	Acreage planned for clearing MVP[2]	Associated Colonies or Hibernacula	Number of Adult Female NLEB Affected	Number of NLEB Pups Affected	Types of Effects Anticipated
Known use summer (active season)	0	3.26	251.08	9 known colonies	9	63	Injury or death
Known use summer (inactive season)	12.43	0	247.68	1 known maternity colony	1	N/A	Reduced breeding success
Known use spring staging/fall swarming (active season)	0	0.31	247.68	6 known hibernacula	6 (1 per hibernacula)	N/A	Injury or death
Known use spring staging/fall swarming (inactive season)	15.64	0	247.68	6 known hibernacula[3]	54 (9 per hibernacula)	N/A	Reduced breeding success
Unknown use spring staging/fall swarming	0	0.81	247.68	18 assumed occupied hibernacula	18 (1 per hibernacula)	N/A	Injury or death

Habitat Type	Acreage Cleared MVP[1]	Acreage to be cleared NJFs	Acreage planned for clearing MVP[2]	Associated Colonies or Hibernacula	Number of Adult Female NLEB Affected	Number of NLEB Pups Affected	Types of Effects Anticipated
(active season)[3]							
Unknown use spring staging/fall swarming (inactive season)[3]	0	0	247.68	18 assumed occupied hibernacula	162 (9 per hibernacula)	N/A	Reduced breeding success

[1]These losses already occurred when the 4(d) rule was in effect.
[2] Future slip acreage (247.68 acres) is added to all (active season) habitat NLEB categories for "worst-case scenario."
[3] Similar analysis used as for Ibat (Table 24) in determining number of female individual NLEBs that will be affected by activity.
[4] This table does not include acres previously cleared and accounted for in the 2016 Opinion for 4(d) rule on NLEB (discussed above), but those acreages are accounted for in the jeopardy analysis below.

Table 29. NLEB forested habitat categories with remaining tree removal (M. Hoover, Mountain Valley, email to C. Schulz, Service, January 11, 2023).

Habitat Category	Acres of Tree Removal
	Known variances and slips
Known use summer	3.40
Unknown use summer	0
Known use spring staging/fall swarming	0
Unknown use spring staging/fall swarming	0
Unknown habitat category	247.68

Voluntary Conservation Action – To voluntarily provide a conservation benefit to NLEB within known use spring staging/fall swarming habitat, Mountain Valley acquired a 121-acre property in Braxton County, WV. Five NLEBs were captured 4 miles north of the property and 1 NLEB was captured about 3 miles south of the property. The parcel contains mature, upland deciduous forest dominated by mostly oak, hickory, and red maple. There are numerous travel/foraging corridors and snags for bats throughout the property. Approximately 860 ft of the construction ROW crosses the eastern portion of the property. After project completion, approximately 106 acres will remain as interior forest and will be maintained as such in perpetuity. Protection of this property provides habitat, immediately adjacent to the project area, for bats that may be displaced during construction activities. Due to the property's proximity to the construction ROW, displaced bats will only need to travel a short distance to locate alternative spring staging/fall swarming habitat. It is anticipated that the availability and protection of this property may reduce adverse effects on returning bats; however, bats have not been detected on this property as of the date of this Opinion. While implementation of this mitigation will likely provide additional conservation for NLEB, its potential beneficial impact was not considered in the analysis or conclusion below because the nature and extent of that benefit is not determinable at this time.

Roanoke logperch (RLP)

The potential effects of the proposed action on RLP are described in Appendix B Table 4. Subactivities that are NE or NLAA RLP are described in Appendix B Table 4 and will not be further discussed in this Opinion. Subactivities that are LAA RLP are listed in Appendix B Table 4 and include[37]:

- Clearing – herbaceous vegetation and ground cover
- Clearing – trees and shrubs
- Grading, erosion control devices
- Trenching (digging, blasting, dewatering, open trench, sedimentation)
- Regrading and Stabilization – restoration of corridor
- ARs – upgrading existing roads, new roads temporary and permanent – grading, graveling
- ARs – upgrading existing roads, new roads temporary and permanent – tree trimming and tree removal
- Stream Crossing, dam and pump

For some components of the proposed action that are anticipated to affect RLP, AMMs have been incorporated to ameliorate those effects and those are also noted below. These subactivities are anticipated to result in a loss of prey items and/or an ability to see the prey, temporarily remove habitat, or result in habitat degradation and loss due to vegetation removal, pump around, placement of temporary dam structures, and/or altering water quality.

Subactivities related to clearing, ARs, and the North Fork Roanoke River 1 crossing (MP 227.2, Stream ID S-G36) will harm or kill RLP and alter/degrade RLP habitat. The following stressors will, or are expected to, occur from one or more of the subactivities listed above: increased sedimentation, increased embeddedness, increased water temperature, decreased dissolved oxygen, and impoundments.

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[37] The 2020 Opinion also listed the following post-construction operation and maintenance (O&M) activities as LAA RLP, CD, and CD critical habitat: (1) ROW repair, regrading, revegetation (upland) – hand, mechanical; (2) AR maintenance – grading, graveling; and (for RLP only) (3) ROW repair, regrading, revegetation – instream stabilization and/or fill (which pertains only to the North Fork Roanoke River crossing 1). However, the extent to which these activities will actually occur in a RLP or CD watershed, and whether they will be implemented in a manner that is LAA RLP, CD, or CD critical habitat, cannot be determined at this point. Therefore, before beginning any future activity falling within categories (1)-(3) in any RLP or CD watershed, Mountain Valley has committed to submitting a pre-work plan to the Service for review and approval. The work plan will detail the specific location of the work, timing (e.g., season)/expected duration, scope of the work (e.g., amount of ground disturbance), any other ground-disturbing O&M subactivities that have occurred or are scheduled to occur in that watershed, and any specific AMMs/BMPs that will be implemented. This commitment applies only to O&M activities in the species watersheds that will not already require independent Section 7 consultation (e.g., O&M activities requiring Clean Water Act authorization would be subject to Section 7 consultation requirements and obviate the need to submit a pre-work plan). If we determine that the activity described in the work plan is LAA RLP, CD, or CD critical habitat, reinitiation of Section 7 consultation will be required.

Increased sedimentation/suspended sediment[38] – Increased sedimentation/suspended sediment is anticipated from all the subactivities listed above, although the magnitude and duration will vary depending on the specific subactivity. Measurable increases in sedimentation/suspended sediment from the project are expected to be episodic and temporary, resulting from waterbody crossings and storm events that deliver sediment from upland construction to waterbodies. We do not anticipate long-term sediment loss from upland areas or stream crossings after revegetation and restoration is completed. As described in the Description of the Proposed Action section, Mountain Valley adopted FERC's general construction, restoration, and operational mitigation measures as outlined in FERC's Upland Erosion Control Revegetation and Maintenance Plan (FERC 2013a). Within 20 days of backfilling the trench (10 days in residential areas), all work areas will be graded and restored, which includes permanent seeding and mulching (FERC 2017a). The goals of permanent seeding are to establish a dense, self-propagating, low-maintenance ground cover to minimize erosion and sedimentation while providing wildlife habitat benefits (Appendix B in Mountain Valley 2022). Mountain Valley anticipates that one full growing season is needed after restoration planting is complete to achieve revegetation. In addition, Mountain Valley is implementing post-construction monitoring, in which follow-up inspections and monitoring of all disturbed upland areas will be conducted for at least the first and second growing seasons to determine the success of restoration, including until revegetation thresholds are met, temporary erosion control devices are removed, and restoration is deemed complete. These measures are designed to ensure that erosion control measures and restoration efforts are successful and that long-term sediment loss is avoided.

Excessive sedimentation and suspended sediment in aquatic systems can cause multiple adverse effects on all life stages of benthic fish, including loss of stream habitat essential for sheltering, foraging, and spawning; increased mortality of eggs, YOY, juveniles, and adults; increased predation on eggs by sediment-dwelling invertebrates; avoidance of previously occupied habitat; increased vulnerability of adults to predation; reduced reproductive success; increased physiological stress; reduced feeding and subsequent weight loss; reduced prey availability; increased parasitism; reduced disease resistance; and clogging, abrasion, and necrosis of gills (Kundell and Rasmussen 1995, Newcombe and Jensen 1996).

Excessive sedimentation/suspended sediment increases sublethal impacts such as growth rate and gill health. Studies have found signs of physiological stress, such as increased oxygen consumption and loss of equilibrium, in remaining fish downstream of disturbed areas, as well as decreased abundance of fish downstream of instream work sites (Reid and Anderson 1999,

[38] Measurement of sediment suspended in water can be described in several ways such as suspended sediment, turbidity, total suspended solids (TSS), or suspended sediment concentration (SSC). For purposes of this Opinion, references to suspended sediment, turbidity, TSS, and SSC each refer to sediment that is suspended and has not settled out of water column. Furthermore, turbidity, SSC, and TSS are different methods for measuring suspended sediment. Turbidity is the "measure of relative clarity of a liquid. It is an optical characteristic of water and is a measurement of the amount of light that is scattered by material in the water when a light is shined through the water sample." (https://www.usgs.gov/special-topics/water-science-school/science/turbidity-and-water; accessed February 16, 2023; Rasmussen et al. 2009). TSS and SSC are defined below in this sub-section.

Levesque and Dube 2007). Sutherland and Meyer (2007) found growth rate of YOY spotfin chub (*Erimonax monachus*, federally listed threatened) was significantly and inversely related to increasing suspended sediment concentrations. They hypothesized that stress inhibited normal feeding behavior. Gill damage in spotfin chubs was noted with increased suspended sediment concentrations. There is no similar study for RLP, but we expect similar impacts would occur to YOY RLP when sediment enters small tributaries where individuals occur. Although this study focused on YOY we expect similar increased sedimentation would also impact the gills of adult RLP and stress might inhibit their normal feeding behavior.

Studies have shown negative effects of increases in sedimentation/suspended sediment on prey consumption and foraging behavior of darters (Swanbrow Becker et al. 2016, Kellogg and Leipzig-Scott 2017). RLP are sight feeders and flip rocks to expose invertebrates (Rosenberger and Angermeier 2002). Sediment deposited on the waterbody bottom will interfere with the ability of RLP to feed (Robertson et al. 2006). Increased sedimentation is anticipated to result in a loss of prey items and/or an ability to see the prey. Various studies have documented adverse effects to the benthic community from increased sedimentation (e.g., reduction in abundance and species diversity) and these effects can persist after construction has been completed, between 6 months and 4 years post-construction (Reid and Anderson 1999, Reid et al. 2008, Levesque and Dube 2007). Two studies (cited in Reid et al. 2008) documented no effect to benthic community and downstream habitats during and after construction. Seven studies (cited in Reid and Anderson 1999 and Reid et al. 2008) indicated recovery of the benthic invertebrate communities occurred within 6 months to 1 year after pipeline construction, with suspended sediment concentrations from 44 mg/L for a 12.4-hour duration up to 6,247 mg/L for 20 hours, which may have also led to sediment deposition. Increased rates of benthic invertebrate drift were also observed during construction for very short time periods (i.e., hours) due to high suspended sediment concentrations, ranging from 997 mg/L to 1,679 mg/L for a 7-hour duration (Reid et al. 2008). Armitage and Gunn (1996; cited in Levesque and Dube 2007) indicated that adverse effects from suspended sediment continued for 4 years after pipeline construction until a high, scouring flow event changed the stream bed; however, this study did not provide details on suspended sediment concentrations. The response and recovery time of sites to disturbances are expected to be variable and are generally related to the hydraulic and substrate characteristics of the stream bed and flushing events due to increased streamflow from rain events. As discussed below, we are conservatively assuming effects to benthic invertebrates in aquatic areas that receive significant increased sedimentation as a result of the MVP project will persist for up to 4 years. This assumption is particularly conservative because most of the available studies indicate post-construction recovery of benthic invertebrate communities within 0.5 to 1 year of pipeline construction activities (Reid and Anderson 1999, Reid et al. 2008, Mountain Valley 2022). Moreover, our conservative assumption does not mean that the affected aquatic areas will be devoid of benthic invertebrates for up to 4 years; rather, we would expect that increased sedimentation would reduce invertebrate populations in the affected areas and that those populations would gradually increase to pre-construction baseline levels over the course of no more than 4 years, as had been documented in studies cited in Reid et al. (2008) (e.g., Tsui and McCart 1981, Reid et al. 2002a). RLP would be expected to return to the impact areas after initial sediment plumes dissipate and to continue to use the areas as habitat as benthic invertebrate populations gradually return to baseline levels.

Fish species that require clean cobble and gravel for spawning had decreased abundance in sediment-impaired streams (Sutherland et al. 2002) and typical riffle-dwelling fish species declined with increased siltation (Berkman and Rabeni 1987), indicating that RLP numbers may be reduced by increased suspended sediment concentrations in areas heavily affected by sediment. Increased sediment deposition and substrate compaction from instream construction can degrade fish spawning habitat, resulting in the production of fewer and smaller fish eggs, impaired egg and larvae development, and limited food availability for YOY (Reid and Anderson 1999, Levesque and Dube 2007). Burkhead and Jelks (2001) reported a decrease in spawning of the tricolored shiner (*Cyprinella trichroistia*) as suspended sediment concentration increased (0 [control], 100, 300, and 600 mg/L) for 6 days. When fish spawned, fewer eggs were laid as sediment concentrations increased, and spawning activity was delayed at higher levels of suspended sediment. Egg and larval mortality was negligible. Increased sedimentation is anticipated to result in similar effects to RLP if sediment entering a waterbody prior to the start of the TOYR is resuspended during the TOYR and reaches levels that could temporarily degrade ambient spawning conditions in swift waters and potential nursery habitats (i.e., lentic habitats).

The duration and severity of the effects of increased suspended sediment on individuals and populations depends on factors such as the duration of disturbance, the amount of sediment loading, the length of stream segment directly affected by construction, and whether there were repeated disturbances (Newcombe and Jensen 1996, Yount and Niemi 1990, Vondracek et al. 2003). Most studies documented recovery of the affected stream reach within 1 to 3 years after construction (Reid and Anderson 1999, Yount and Niemi 1990).

The effects to RLP will depend, in part, on the type, amount, and extent of sediments released into the water column, the magnitude and duration of discharge, and background suspended sediment concentrations in the waterbody. For the North Fork Roanoke River 1 crossing (MP 227.2, Stream ID S-G36), at the crossing location, temporary dam structure placement/removal and effluent pumped from within the temporary dam structures and through filter bags likely generated a temporary sediment plume.

The 2017 Opinion analyzed and expected that the clearing of herbaceous vegetation and trees and shrubs in the riparian corridor and uplands, AR grading, and the trenching would have minimal impacts to RLP based on implementation of E&S control measures. However, numerous alleged E&S control violations were documented, in part due to 2018 being the wettest year recorded in VA (https://www.ncei.noaa.gov/news/national-climate-201812 accessed 8/12/2020), and failure and/or improper installation and maintenance of E&S control measures. The petitioners in the Fourth Circuit litigation and others have submitted letters to the Service asserting other violations and sediment control failures along the project ROW (e.g., E. Benson, Sierra Club, letter to K. Hastie, S. Marino, and C. Schulz, Service, August 13, 2022). This letter states that the Service cannot ignore “the actual sedimentation and erosion impacts of the

Pipeline" or "real-world information in the form of MVP's long history of water quality related violations and other erosion and sedimentation problems." The letter also notes that the Fourth Circuit court remanded the environmental impact statement prepared by the USFS and BLM to those agencies and directed them to consider "relevant information indicating that the modeling used in the EIS may not be consistent with data about the actual impact of the Pipeline and its construction." The USFS and BLM's administrative process in response to the court's order is ongoing and will not be completed until after this Opinion is issued. Mountain Valley disputes the assertions in this letter and in similar assertions others submitted to the Service (e.g., T. Normane, Mountain Valley, letter to D. Olsen, USDA Forest Service, October 19, 2022, and M. Hoover, Mountain Valley, letter to Cindy Schulz, Service, December 16, 2022), and, as noted above, Mountain Valley has committed to increased E&S control inspection frequency and an accelerated deadline to repair ineffective controls. Mountain Valley has also noted that none of the alleged E&S violations that were documented alleged that project-related sediment loss significantly degraded aquatic habitat for listed species in the project action area or alleged violations under Virginia's Endangered Species Act.

For purposes of our analysis, to the extent any past violations or sediment control failures resulted in observable degradation of aquatic habitat for listed species in the project action area, those impacts likely would be reflected in the comprehensive baseline stream assessments conducted in 2022, which represent the best and most current information regarding stream conditions in the action area. As discussed, we are appropriately relying on those assessments to provide the required snapshot of current streambank and instream conditions in the aquatic action area. Our analysis of the effects of the action on RLP (and CD) described herein is also designed to capture the likely effects of the entire action, including portions of the project that have already been completed. We are aware of no alternative accurate and scientifically reliable methodology that would allow us to determine, at this point, the extent to which past violations, sediment control failures, or completed work may have impacted listed species or habitat conditions in the aquatic action area. Nor has the Service uncritically accepted the results of Mountain Valley's sediment modeling in defining the aquatic action area or impact areas, as suggested in the August 2022 letter referenced above. Mountain Valley's Hydrologic Analysis of Sedimentaion was peer reviewed by experts at multiple federal agencies, who concluded that it was a proper method for defining the aquatic action area. As noted elsewhere in this Opinion, the Service also conservatively added areas around stream crossings and mixing zones to the aquatic action area and the impact area initially defined using Mountain Valley's modeling. In addition, to avoid unanticipated impacts on listed species (whether from potential future failure of E&S control measures or other project-related factors), to ensure compliance with the ITS in the 2020 Opinion and in this Opinion, and to ensure that the aquatic impact areas are accurately delineated, the 2020 Opinion and this Opinion included an Aquatic Species Monitoring Plan (Appendix F). As outlined in the Monitoring Plan, a Rapid Response Protocol (RRP) is implemented when the predetermined take risk concentration is measured by a monitoring station for a particular impact area. The Monitoring Plan was reviewed by a USGS water quality expert, who concluded that the Plan (as revised in response to his review) would meet the objective of detecting project-related increases in suspended sediment in streams occupied by

RLP and CD. The monitoring and reporting requirements thus serve as a check on the sufficiency of Mountain Valley's E&S control measures, the results of Mountain Valley's modeling, and our delineation of the aquatic impact area, and will help ensure that impacts on RLP (and CD) from project-related sediment loss are no greater than anticipated. Finally, to the extent the USFS and BLM's ongoing administrative process ultimately identifies any deficiencies in Mountain Valley's modeling that indicate that the project's impacts on listed species or critical habitat may be greater than anticipated in this Opinion, reinitiation of formal consultation would be required 50 CFR 402.16(a)(2).

To date, the RRP was initiated 4 times, none of the events occurred in areas or catchments where active MVP project construction was occurring, follow-up inspections did not identify any damage to or failure of the E&S controls, nor was any project-related sediment loss observed. The RRP was triggered either from equipment requiring recalibration, a disconnected cable, or a non-MVP project related source (Appendix L in Mountain Valley 2022).

The benthic macroinvertebrate standard is a metric that corresponds to sediment load in the waterbody. The 2016 Roanoke River Bacteria and Sediment Total Maximum Daily Load (TMDL) Implementation Plan Part 1 (2016 VDEQ) states "During development of the benthic TMDL, a stressor analysis identified sedimentation as the most probable cause of the benthic macroinvertebrate community impairment. Using a reference watershed approach, the numeric TMDL endpoint for the impaired watershed was established based on the sediment loading rate in a similar, but non-impaired reference watershed." It identified portions of the Roanoke River (14 km) that exceed sediment standards for a healthy benthic community and calculated the need for a 75% reduction in sediment loading from all land use sources and instream erosion to meet the TMDL standard. However, the portion of the Roanoke River that is listed as impaired for benthic macroinvertebrates is 33.28 km downstream of the MVP project ROW and beyond the limits of the action area. The upper, headwater sections of the Pigg River (7.2 km) are on the list for benthic macroinvertebrate and are approximately 100 km upstream of the ROW, also beyond the limits of the action area. Based on the distances from the project ROW to the location of the benthic macroinvertebrate TMDL sections in the Roanoke and Pigg Rivers, we do not expect that the previous MVP project ground-disturbing activities or instream construction activities contributed additional sediment to those TMDL areas and would not further impact the benthic macroinvertebrate community in those areas.

Based on past events, sediment modeling conducted by Mountain Valley (2020), and conservative estimates of sediment concentration in waterways (M. Neylon, Mountain Valley, email to J. Stanhope, Service, June 10, 2020; M. Neylon, Mountain Valley, email to S. Hoskin, Service, June 17, 2020), we anticipate that clearing of herbaceous vegetation and trees and shrubs in the riparian corridor and uplands and the other ground-disturbing activities listed above will cause increases in sedimentation that will impact RLP and have incorporated portions of RLP habitat into our impact area, see additional discussion below.

Depending on the size and duration of a sediment plume that may occur, RLP may alter feeding behaviors, and move to clearer water, resume normal activities, and use the area once again when suspended sediment concentrations return to background levels. Roberts et al. (2016a) indicated that RLP are very mobile and determined that median lifetime dispersal distance is 3.7 to 15 miles. Therefore, we expect that most adult RLP will have the ability to avoid areas of heavy sediment deposition and move to other areas of suitable habitat within the system as sediment above background levels moves within the channel. Younger life stages may not be able to move out of the area and, depending on the amount of sediment, will experience loss of habitat for feeding and sheltering. Changing foraging areas will cause decreased fitness to the majority of RLP that move from the North Fork Roanoke River 1 crossing (MP 227.2, Stream ID S-G36) area or any areas experiencing sedimentation from upland activities. If the RLP move into an already occupied area there is the potential for a decrease in fitness to some of the resident RLP because there will be increased competition for food if trophic resources are limited at the site. However, relocating is not unusual for RLP; Roberts et al. (2008) reported RLP frequently moved between marking and recapture site (15-75 m away) or to another site (2.5-3.2 km away). Therefore, shifting foraging areas or having additional RLP shift into a foraging area is a behavior to which the RLP is accustomed, and we expect it would take a large influx of RLP to decrease the fitness of the resident RLP. After the waterbody has returned to background suspended sediment concentrations, we anticipate that RLP will resume use of the waterbody. Therefore, we do not expect that project-related sedimentation will render any currently suitable RLP habitat permanently unsuitable.

As mentioned above and in the SBA2 (Mountain Valley 2022), there are no studies on specific suspended sediment concentrations (e.g., thresholds) and their effects on RLP and CD, and the data needed to develop species-specific thresholds is not available or readily obtainable. Obtaining such data would involve conducting novel laboratory research to quantify the effects of increased sedimentation levels on RLP and CD biology and physiology at multiple temporal scales (e.g., immediate short-term effects to physiology as well as longer-term effects to reproductive cycles and population dynamics). Such research would also necessitate sacrifice of numerous RLP and CD as experimental subjects. As such, this data is not readily obtainable for the purposes of this Opinion. To assess the suspended sediment concentrations at which adverse effects to both RLP and CD will occur and to determine the downstream extent to which these effects may extend as a result of the proposed project (impact area), we adapted the analytical framework in the Biological Effects of Sediment on Bull Trout and Their Habitat – Guidance for Evaluating Effects (Muck 2010) (framework; Appendix C). This framework was developed by the Service's Washington Fish and Wildlife Office (WAFWO) to assist in determining effects for Section 7 consultation for bull trout (*Salvelinus confluentus*). Newcombe and Jensen (1996) provided the basis for analyzing sediment effects to bull trout in Muck (2010) and is being applied in this Opinion as the basis for analyzing sediment effects to RLP and CD and their habitat.

Newcombe and Jensen (1996) conducted a literature review of pertinent documents on sediment effects to salmonids and nonsalmonids (none of the documents had specific data on bull trout or RLP or CD). The authors assessed 264 suspended-sediment dose-responses of fish based on a literature review of 80 studies. They developed multiple models that calculated the "severity-of-effect" (SEV) to salmonids and nonsalmonids based on the suspended sediment dose (exposure duration) and concentration. In particular, they developed an adult freshwater nonsalmonids model (model 6), which might appear to be more appropriate; however, there are drawbacks to this model such as a small sample size (n=22), no juvenile data, and no values for sub-lethal effects. Due to these drawbacks, the Service does not believe it is reasonable to apply model 6 for nonsalmonids in Newcombe and Jensen (1996) to the RLP and CD. The most data rich model is the salmonid SEV model for adults and juveniles (model 1 in Newcombe and Jensen [1996] and Figure 1 in Muck [2010]); it provides sub-lethal levels and is based on a large sample size (n=171) that includes data for both adult and juvenile salmonids in multiple states and Canada in multiple eco-regions. The Service has determined that this salmonid SEV model for adults and juveniles is the most appropriate available model to use for establishing effects thresholds for RLP and CD, based on the above stated reasons and that RLP and CD share physical habitat requirements similar to salmonids, which is habitat that is relatively free of fine sediment for their breeding and feeding. In addition, suspended sediments affect behavior and physiology of both salmonids and nonsalmonids, including reducing their visibility. Darters, including RLP and CD rely strongly on vision for reproductive activities, including mate selection, recognizing conspecifics, and initiating spawning activities, and therefore might be as vulnerable to increased suspended sediment as salmonids (J. Roberts, Georgia Southern University, letter to S. Hoskin, Service, May 6, 2020). In addition, although RLP and CD are benthic feeders while salmonids are drift-feeders, RLP and CD are sight feeders (see Rosenberger and Angermeier 2002, Schoolcraft et al. 2007) and depth perception for RLP, CD, and salmonids is necessary for foraging in a three-dimensional benthic environment. Suspended sediment generally occurs throughout the water column, including the bottom layer, and therefore will likely affect RLP and CD. Sediment deposited on the waterbody bottom due to suspended sediment will interfere with the ability of RLP and CD to feed (see Robertson et al. 2006). Due to qualitative information on the sensitivity of RLP and CD to suspended sediments, studies on effects of suspended sediment concentrations on other nonsalmonid and darter species (Burkhead and Jelks 2001, Sutherland and Meyer 2007, Swanbrow Becker et al. 2016, Kellogg and Leipzig-Scott 2017), and no studies to indicate darters are more or less sensitive to suspended sediment than salmonids, including the bull trout (J. Roberts, Georgia Southern University, letter to S. Hoskin, Service, May 6, 2020), application of model 1 in Newcombe and Jensen (1996) is the most appropriate available model to use for establishing effects thresholds for RLP and CD.

The framework for evaluating effects to RLP and CD is based on suspended sediment concentration (SSC), duration, and exposure. Factors influencing SSC, exposure, and duration include waterbody size, volume of flow, the nature of the construction activity, construction methods, erosion controls, and substrate and sediment particle size. Factors influencing the SEV include duration and frequency of exposure, concentration, and life stage. Availability and access to refugia are other important considerations.

The framework requires an estimate of SSC (mg/L) and exposure duration. We expect that any measurable increases in suspended sediment will be short-term and episodic from waterway crossings and from storm events that deliver sediment from construction activities in upland areas into waterways. Using this approach (an adaptation of Figure 1 in Muck [2010]) and an SEV of 5 to include sublethal effects to juveniles, we expect that adverse effects to adult, subadult, and juvenile RLP and CD are likely to occur under any of the following thresholds:

a. Any time sediment concentrations exceed 148 mg/L over background.
b. When sediment concentrations exceed 99 mg/L over background for more than 1 hour continuously.
c. When sediment concentrations exceed 40 mg/L over background for more than 3 hours continuously.
d. When sediment concentrations exceeded 20 mg/L over background for over 7 hours continuously.

The sediment concentration to be measured is SSC, and not total suspended sediment or solids (TSS), which are 2 different constituents and are not interchangeable (D. Chambers, USGS, email to J. Stanhope, Service, August 12, 2020). As described in Gray et al. (2000), "the method for determining SSC produces relatively reliable results for samples of natural water, regardless of the amount or percentage of sand-size material in the samples" and the method for determining TSS tends to have a bias towards lower concentration values than SSC when sediment dry weight samples have greater than 25% sand-size material. SSC is the method widely used by USGS. In addition, Newcombe and Jensen (1996), the basis for the framework in Muck (2010), uses the terminology of "suspended sediment concentration." Therefore, application of the SSC method is a conservative method to measure sediment concentration.

As noted in our 2020 Opinion, Muck (2010) used the term "cumulatively" instead of "continuously" for thresholds c and d, but used the term "continuously" for threshold b. "Cumulative" is defined as "summing or integrating overall data or values of a random variable less than or equal to a specified value" or "increasing by successive additions"; "continuous" is defined as "marked by uninterrupted extension in space, time, or sequence" (https://www.merriam-webster.com/dictionary/; accessed 8/31/2020). Newcombe and Jensen (1996), the basis for the framework in Muck (2010), used the term "exposure duration" in hours for their analysis and "duration" is defined as "continuance in time" (https://www.merriam-webster.com/dictionary/; accessed 8/31/2020). To be consistent with the basis for the determination of adverse effects, it is more appropriate to use "continuously." In its decision the Fourth Circuit Court encouraged the Service "to expound upon the reasons for its departure from the bull-trout framework on remand," so we do so here.

The use of "continuous" exposure duration for all 3 thresholds is consistent with Newcombe and Jensen (1996), which identified concentration thresholds using exposure duration without any reference to intermittent or cumulative exposures. Some of the 80 studies that the authors used to develop their thresholds may have considered intermittent or cumulative exposures. But had Newcombe and Jensen (1996) intended to incorporate intermittent or cumulative exposures into their SEV thresholds, they would have so stated and they would have provided the requisite time period over which those cumulative exposures should be tallied. If cumulative exposures were part of the threshold, a set time period for measuring any cumulative exposures would be a critical component because, for example, sediment concentrations exceeding 40 mg/L over background for more than 3 hours in a 12-hour period would represent very different conditions than sediment concentrations exceeding 40 mg/L over background for more than 3 hours in a 1-month period. Thus, the only logical reading of Newcombe and Jensen (1996) is that the thresholds established therein are meant to reflect continuous exposure at or above the specified exposure concentration threshold. As stated in Levesque and Dube (2007), the dose-response models for fish developed by Newcombe and Jensen (1996) allow for quantification of effect significance through severity of-ill-effects values "based on the duration and concentration of sediment exposure *for a given sediment release event*" (italics added), not based on the aggregated total duration of intermittent release events over an unspecified period of time.

The sediment concentrations in Figure 1 of Newcombe and Jensen (1996) also do not represent average concentrations. Again, some of the controlled studies that the authors reviewed may have measured average concentrations over a fixed period. But Newcome and Jensen (1996) defines a sediment "dose" as a single "concentration of suspended sediment (SS) times duration of exposure," not as the average sediment concentration over the specified duration. Figure 1 also presents the "*Average empirical severity-of-ill-effect scores* … in the matrix of suspended sediment (SS) concentration and duration of exposure." "*Severity-of-ill-effect values* for each of the six data groups are presented *as rounded averages* in the cells of dose matrixes whose axes are concentration of suspended sediment and duration of exposure." If the sediment concentrations in the dose matrixes were also averages the authors would have noted that. The Muck (2010) analytical framework based on Newcombe and Jensen (1996) also does not call for measuring average concentrations, and we are not aware of any other state or federal regulatory entity applying the Figure 1 values in Newcombe and Jensen (1996) in that manner. Moreover, while measuring average concentrations may be useful in a controlled study, it is not feasible to develop take thresholds for use in the field based on average sediment concentrations because the average will depend entirely on when measurements begin and end.

Muck (2010) does not explain its departure from Newcombe and Jensen (1996) in adopting a cumulative exposure approach for the 40 mg/L and 20 mg/L concentration thresholds rather than the continuous exposure approach that Newcombe and Jensen (1996) developed and that Muck (2010) itself used for the 99 mg/L concentration threshold. Muck (2010) also does not identify any specific time period for measuring cumulative exposures for the 40 mg/L and 20 mg/L concentration thresholds, which as stated is required to determine when each threshold has been exceeded.

As Mountain Valley (2022) correctly notes, the Service's West Coast field offices that have looked to the Bull Trout Guidance during Section 7 consultations involving potential effects to the bull trout have also taken different approaches to this issue. One Opinion identified a 10-hour workday to track cumulative exceedances and reset the count each day (Service 2010). Another Opinion used a 10-hour workday in several sections of the document and a 12-hour workday in another section, resetting after each day (Service 2017d). The different approaches appear to have been tied to the duration of the daily instream work for each project, which was identified as the predominant cause of increased sedimentation. For the MVP project, a predominant cause of increased sedimentation will be stormwater runoff from upland areas, regardless of whether Mountain Valley is engaged in upland construction work when a storm occurs, and (unlike instream work) storms may occur at any time of day rather than within the confines of a 10- or 12-hour workday. In addition, there were different approaches for frequency of measurements. One Opinion relied on monitoring at 30-minute intervals from the start of sediment generating activities, and if 3 consecutive 30-minute measurements did not exceed a specific threshold, then monitoring would occur once every 3 hours for the remainder of workday (Service 2010). Another Opinion also relied on monitoring at 30-minute intervals but indicated monitoring would occur once every 6 hours for the remainder of the workday if 3 consecutive 30-minute measurements did not exceed a specific threshold (Service 2017d). For the MVP project, monitoring is occurring at 15-minute intervals continuously 24 hours a day and every day. Thus, we believe that measuring continuous exposure duration for thresholds b, c, and d is both consistent with Newcombe and Jensen (1996) and appropriate for this specific project.

Finally, although Levesque and Dube (2007) discussed the potential for cumulative impacts from multiple pipeline crossings of streams within a watershed, the authors stated that the potential effects are not well understood and that future studies were needed to investigate the issue. To our knowledge, no such studies have been conducted. This project also does not involve multiple open-cut crossings of RLP- or CD-Occupied streams involving instream construction, the crossing technique of primary concern in Levesque and Dube (2007). Depending on the manner in which open-cut crossing are implemented, they may result not only in increased sedimentation, but also in the direct alteration of stream channels, beds, and banks resulting in changes in cover, channel morphology, and sediment transport dynamics, increased water velocities, stream degradation, and migrations in stream channel. Those impacts to the physical characteristics of RLP- and CD-occupied streams are not expected to result from upland construction activities, which are the primary concern for this project for RLP and CD. There is also no indication that such impacts resulted from the ROW crossing of the North Fork Roanoke River 1 open-cut crossing (MP 227.2, Stream ID S-G36), the one open-cut crossing of a RLP-occupied stream that was completed in 2018 (Mountain Valley 2022). If the open-cut crossing of a tributary to a RLP- or CD-occupied stream resulted in changes to the physical characteristics of the tributary at the crossing location, which appears unlikely based on the results of the North Fork Roanoke River 1 open-cut crossing (MP 227.2, Stream ID S-G36), it is difficult to predict the extent to which such changes could influence conditions in the occupied stream itself. Although the crossing of the tributary (or upland construction activities adjacent to the tributary) may contribute sediment to the occupied stream at levels that may harm RLP or CD, the impact areas in RLP- and CD-occupied streams defined below are designed to account for that potential harm where such potential exists. We are also unaware of any studies indicating that repeated exposures, over a particular time period, to sediment doses (whether from tributary crossing or from upland construction) that are below the above thresholds derived from Newcombe and Jensen (1996) would be reasonably certain to harm RLP or CD. Therefore, and for the additional reasons stated above, we believe that the model 1 thresholds in Newcombe and Jensen (1996) that form the basis for our analysis provide the best available methodology for determining when any project-related sedimentation release event would reasonably be expected to adversely affect RLP or CD.

Because sediment sampling for concentration is labor intensive, the framework in Muck (2010) is based on using turbidity as a surrogate for SSC. To do this, the sediment concentration above background at which adverse effects to the species and/or habitat occurs expressed as mg/L will be converted to nephelometric turbidity units (NTU), based on existing regression relationships, as described in Hyer et al. (2015) or based on guidelines developed by USGS (Rasmussen et al. 2009).

To assess the potential extent of these effects due to the North Fork Roanoke River 1 open-cut crossing (MP 227.2, Stream ID S-G36), we relied on published literature. Reid et al. (2008) reviewed 27 past monitoring studies of open-cut pipeline crossings (both wet and dry crossing techniques) throughout Canada and the U.S. and found that sediment released from the construction sites was generally limited to a short distance downstream. This review found that biological effects to fish and benthic invertebrates were limited to several hundred meters downstream of the crossings and were temporary (<1 year). Some of the studies reviewed by Reid et al. (2008) found no effects on warmwater fish abundance (including darter species) downstream of pipeline crossings, however fish abundance does not account for sublethal impacts. Roberts et al. (2016c) observed that RLP densities routinely fluctuated by more than 25% per year, and occasionally by as much as 75% per year. This variability suggests difficulty in statistically detecting changes in darter species abundance if there is a 75% or less reduction in abundance. Reid et al. (2008) also reviewed pipeline crossing TSS monitoring data for different crossing methods and found that for dry, open-cut crossings using the dam and pump method, the mean TSS concentration was 22.7 mg/L (standard error [SE]=5.0 mg/L) above background levels, with mean peak TSS concentration of 334.0 mg/L (SE=23.0 mg/L) occurring a mean distance of 52.5 m (SE=6.3 m) downstream of the crossing. Reid et al. (2002a) studied the effects of a pipeline water crossing, using both wet and dry crossing techniques, on fish and benthic invertebrate communities. They reported habitat conditions >500 m downstream of the crossing were unaffected. Specifically, TSS concentrations decreased 500 m downstream of the crossing to 89-96% lower than the levels measured 50 m downstream of the crossing. Additional studies found that downstream impacts due to increases in TSS concentrations and sediment deposition occurred within 500 m of pipeline crossings and TSS concentrations in most of these studies were less than 1,500 mg/L (Reid and Anderson 1999; Reid et al. 2002b, 2004). To be protective of the RLP, we have determined that RLP will be impacted in the stream 200 m above and 800 m below the open-cut crossing plus the construction ROW width (23 m [75 ft]).

For RLP, the impact area (stream length) due to the open-cut crossing is 1,023 m in the North Fork Roanoke River (Table 30). Mountain Valley completed this open-cut crossing in 2018, subsequently completed the required restoration activities, and concluded the required post-restoration habitat assessment. During that habitat assessment, fish biologists confirmed suitable RLP habitat and observed RLP occupying the restored habitat.

Table 30. Open-cut crossing impacting RLP.

County in VA	River Basin	RLP Stream Impacted	Stream ID	Stream Crossing MP	Total Length (m) of RLP Stream Impacts
Montgomery	Roanoke	North Fork Roanoke River	S-G36	227.2	1,023

In general, the effects of removal of streambank vegetation on sedimentation rates could be expected to continue for 3-5 years as streamside vegetation develops to provide streambank stabilization (FERC 2017b). However, as discussed above, Mountain Valley's post-construction monitoring and habitat assessments at the North Fork Roanoke River 1 open-cut crossing (MP 227.2, Stream ID S-G36) crossing site documented the continued presence of suitable RLP habitat and individuals, suggesting that RLP habitat has been restored (Mountain Valley 2022). The habitat assessment was conducted approximately 2 years post construction and demonstrated impacts were less than the 3-5 years that were originally estimated. Additional effects of clearing of streambank vegetation likely would be limited to minor temperature increases during the summer season, which would not be expected to harm RLP given that large segments of known occupied streams, including the North Fork Roanoke River and the stream section in the vicinity of the crossing site in particular, have at most limited forested riparian zones and RLP continue to occupy those areas (Mountain Valley 2022).

For the mixing zone areas, where sediment in tributaries discharges to occupied streams during storm events (i.e., sediment from construction in upland areas) and contributes increased suspended sediments, the areal extent of impact will vary depending on numerous factors including rainfall duration and the suspended sediment concentrations in the tributary, tributary discharge volume and flow rate, receiving water flow rate and turbulence, and the geometry of the tributary and the receiving water boundaries (USEPA and USACE 1998).

The Service reviewed estimated sediment concentrations (mg/L) modeled in the streams GIS shapefile that Mountain Valley provided, which is based on the screening-level methodology used to define the aquatic action area (M. Neylon, Mountain Valley, email to J. Stanhope, Service, June 10, 2020; M. Neylon, Mountain Valley, email to S. Hoskin, Service, June 17, 2020). As described in the Action Area section and based on expert review, it was determined that utilizing Mountain Valley's sedimentation analysis to develop the aquatic action area was a reasonable and conservative approach (J. Martin, FERC, letter to C. Schulz, Service, May 7, 2020). Mountain Valley indicated that their approach is conservative and overestimates the expected increased sediment concentrations from the project because it assumes all sediment loads from construction activities, in response to a 24-hour design storm, will arrive simultaneously to the stream segments within the watershed. The assumptions designed to ensure conservativism are detailed in Section 6.2 of the Hydrologic Analysis of Sedimentation report attached as Appendix B in the SBA2 (Mountain Valley 2022). In addition, following issuance of the 2020 Opinion, Mountain Valley completed installation of the monitoring stations in each monitoring watershed before resuming construction (Mountain Valley 2022). Those monitoring stations were brought online upon installation, with commission dates starting from July 2021 through September 2021, and have been collecting data since that time. Mountain Valley reports that the monitoring data collected at the aquatic species impact areas for the RLP confirms that the sedimentation modeling is conservative and significantly overstates potential sediment loss from the project (Mountain Valley 2022 and Appendix L in Mountain Valley 2022). As noted by FERC, it is difficult to extrapolate conditions following the commissioning of the monitoring stations to the conditions that existed in 2018 and 2019, when most of the project construction occurred (J. Martin, FERC, letter to C. Schulz, Service, January 11, 2023). However, the monitoring "has confirmed that runoff from the Project right-of-way during some large rain events over the monitoring period did not cause an exceedance of the TRC [Take Risk Concentration] for the Streams of Interest." For the timeframe when the monitoring stations were commissioned, as stated by Mountain Valley, "The Project, at most, contributes negligible amounts of sediment to species streams that are well below the concentrations at which USFWS concluded the RLP and CD would be impacted. In fact, the commissioned station tributary data, which are the most direct measure of potential Project sediment, show that, even during tropical and other flood-inducing severe storm events, sediment losses attributable to the Project do not appreciably contribute to suspended sediment levels in species streams." (Mountain Valley 2022 and Appendix L in Mountain Valley 2022).

The highest sediment concentration predicted for the MVP project in a tributary to a RLP stream was 702 mg/L (Mountain Valley 2020), which is in the same range of TSS concentrations from pipeline crossing studies that found downstream impacts due to increases in TSS concentrations and sediment deposition that occurred within 500 m of pipeline crossings (Reid and Anderson 1999; Reid et al. 2002b, 2004). Because the predicted sediment concentrations provided in the GIS shapefile from Mountain Valley are based on calculations and not actual laboratory methods, the Service thinks they are indicative of SSC values and do not have a bias towards lower values. As stated above, the method for determining TSS tends to have a bias towards lower concentration values and the SSC method is a conservative method to measure sediment concentration. As discussed above, some of the downstream impacts included short-term changes in abundance and community structure of benthic invertebrates and changes in fish abundance. To be protective of the RLP, the Service anticipates the areas in which the species will be impacted will be similar to the open-cut crossing and will also occur within 200 m above and 800 m below the point where the tributary enters the RLP-occupied stream (1,000 m total within the RLP-occupied stream). The 200 m area in the RLP-occupied stream upstream of the confluence with the tributary is included to address uncertainty of the mixing zone plume extent (i.e., due to the factors described above).

Based on the GIS shapefile, the Service identified:

- the tributaries with $\geq$20 mg/L sediment concentrations above background that discharged to assumed or known RLP-occupied streams and determined these to be mixing zone areas; and
- stream segments with assumed or known RLP-occupied streams that are predicted to have elevated sediment concentrations $\geq$20 mg/L above background beyond the mixing zone.

The mixing zone areas, applying the 200 m above and 800 m below distance to these inputs from tributaries, and the stream segments with elevated sediment concentrations beyond the mixing zone increases the total length of the impact area as follows (including the open-cut crossing) (Appendix D Table 1 and Figures 1 and 2): a total of 17.1 km, 11.3 km in the Upper Roanoke MU (7.0 km in the North Fork Roanoke River; 1 km in the South Fork Roanoke; and 3.3 km in the Roanoke River) plus 5.8 km in Bradshaw Creek (11.3 + 5.8 = 17.1 km); and a total of 4.7 km in the Pigg MU.

The potential habitat within the Upper Roanoke MU (range extent 354 km) plus the potential habitat in Bradshaw Creek (6 km) equal 360 km. The impact area consisting of portions of the Upper Roanoke MU plus Bradshaw Creek equals 17.1 km and represents approximately 4.8% (17.1 km/360 km = 0.048) of the RLP potential habitat within the Upper Roanoke MU plus Bradshaw Creek. As stated in the Environmental Baseline section, the mean current population size for the Upper Roanoke MU is 14,279 RLP and the mean current population density of the Upper Roanoke MU, including Bradshaw Creek is 39.7 RLP/km. We used this information to estimate the total number of RLP that would be likely present within the impact area. Assuming RLP are evenly distributed, approximately 679 RLP are present within the impact area (39.7 RLP/km x 17.1 km = 679 RLP), representing 4.8% of the total estimated number of RLP in the Upper Roanoke MU (679/14,279 = 0.048).

When estimating population size, the SSA (Service 2022b) focused on RLP 1 year of age or older because younger RLP are difficult to reliably capture (Rosenberger and Angermeier 2003). The SSA (Service 2022b) does not estimate the total population of YOY or juvenile RLP within the known range extent of the MUs, and no data is available or readily obtainable that would allow us to develop such an estimate with any degree of confidence. Attempting to develop such an estimate would require information such as: egg fecundity, hatching success, and natural mortality (FERC 2017b), which is unknown for RLP, and it would take extensive studies over numerous years to collect the information. While YOY estimates have been calculated using RLP population growth rates from information compiled from the literature, it is potentially biased (FERC 2017b). Attempting to develop a numeric estimate of juveniles present thus would require us to make multiple assumptions and would inadvertently suggest a level of confidence not justified by the available information. Therefore, although we cannot estimate the number of YOY or juveniles that may be present in the impact area, it is reasonable to assume that the proportion of YOY or juveniles present corresponds to the proportion of adults present (i.e., 4.8% of the total number of YOY or juvenile RLP in the Upper Roanoke MU are likely present in the impact area).

The potential habitat within the Pigg MU (range extent 233.2 km) plus the suitable RLP habitat section of Harpen Creek (3.2 km) equal 236.4 km. The impact area consists of portions of the Pigg MU (4.7 km) and represents approximately 2% (4.7 km/236.4 km = 0.019) of the RLP potential habitat within the Pigg MU plus the suitable habitat section of Harpen Creek. Harpen Creek is not in an impact area but as stated in the Environmental Baseline section, a portion is considered suitable habitat. As such, the mean current population size for the Pigg MU is 7,080 RLP and the mean current population density of the Pigg MU, including the suitable portions of Harpen Creek is 29.9 RLP/km. We used this information to estimate the total number of RLP that would be likely present within the impact area. Assuming RLP are evenly distributed, approximately 141 RLP are present within the impact area (29.9 RLP/km x 4.7 km = 140.5 = 141 RLP), representing approximately 2% of the total estimated Pigg River population (141/7,080 = 0.02). Although the number of YOY and juveniles present in the impact area cannot practicably be estimated for the reasons stated above, assuming the proportion of YOY and juveniles present corresponds to the proportion of adults present, roughly 2% of YOY and juveniles in the Pigg MU would be present in the impact area.

The total impact area for the project is 21.8 km and a total of 820 adult RLP would be present in the impact area (679 RLP + 141 RLP). We expect this overestimates the number of adult RLP in the impact area because, as noted above, Roberts et al. (2016a) indicates that RLP are very mobile, and so we expect that most adult RLP will have the ability to avoid the impact areas and move to other areas of suitable habitat as sediment moves within the channel.

Increased embeddedness – Increased embeddedness is correlated with excessive sedimentation and is anticipated from all of the subactivities listed above although the magnitude and duration will vary depending on the specific subactivity. A commonly documented effect of instream work includes silt deposition that fills interstitial spaces in gravel and cobble substrates and reduces water flow through the substrate in the area where the instream work in occurring, as well as in areas downstream of the disturbance; the resulting increase in substrate embeddedness is expected to temporarily reduce habitat heterogeneity and primary productivity; increases fish egg and larval mortality; alters, degrades, and entombs microbenthic communities that RLP depend on as a food source (Burkhead and Jenkins 1991). These effects would be expected to persist until the deposited sediment is flushed downstream, which generally would be expected to occur within 1 year after construction (Reid and Anderson 1999), although, as noted above, we are conservatively assuming that the effects may persist for up to 4 years. Sutherland (2001) reported marginally significant negative relationship difference between both embeddedness and foraging time and feeding strikes of the gilt darter (*Percina evides*), where mean substrate embeddedness ranged from 40-70%. Sutherland (2001) also observed increased resting time with increased percent embeddedness although this relationship was not as strong. Overall, the study found embeddedness and foraging behavior was correlated, but the author did not determine if it was a function of increased turbidity, increased physiological stress, or possibly decreased prey abundance.

Rosenberger and Angermeier (2002) compared the habitat of RLP in the Roanoke, Pigg, and Nottoway Rivers. The following is a summary of their findings pertaining to embeddedness: RLP were observed using less embedded substrate in the winter than in the summer; they were consistently observed over loosely embedded substrate with little to no silt cover; RLP in the Roanoke River inhabit areas that are more embedded than those in the Pigg or Nottoway rivers; and RLP subadults were not observed selecting for embeddedness or silt in the Roanoke River although none of the age classes were observed in severely embedded or heavily silted substrate.

Because embeddedness is correlated with increased sedimentation we anticipate effects to RLP from embeddedness will be similar to those discussed in the increased sedimentation/suspended sediment section above. Moreover, the reaches likely impacted by sediment deposition and increased embeddedness would also be those that will exhibit the highest levels of project-related suspended sediment (Mountain Valley 2020, Mountain Valley 2022). Because 20 mg/L is a relatively low sediment concentration (Mountain Valley 2020), the conservatively-defined mixing zones associated with tributaries with $\geq$20 mg/L sediment concentration above background, and the stream segments with assumed or known RLP-occupied streams that are predicted to have elevated sediment concentrations of $\geq$20 mg/L above background beyond the mixing zone, encompass the areas in which project-related increases in embeddedness are reasonably likely to harm RLP. For the mixing zones, this conclusion is supported by the studies of pipeline crossings referenced above, which found that downstream impacts due to increases in TSS concentrations and sediment deposition occurred within 500 m of the crossings (Reid and Anderson 1999; Reid et al. 2002b, 2004). As previously noted, the highest sediment concentration predicted for the MVP project in a tributary to a RLP stream was 702 mg/L (Mountain Valley 2020), which is in the same range of TSS concentrations from the pipeline crossings analyzed in those studies.

Mountain Valley previously used a different methodology to identify deposition/embeddedness zones (Mountain Valley 2020), a portion of which fall outside the impact area derived under our methodology. Because we are not relying on Mountain Valley's methodology for the reasons discussed above and in the incidental take statement for RLP section, it would be inappropriate to use that methodology to identify areas where deposition is likely to harm RLP. Furthermore, under our approach, deposition posing a risk to the species will occur across 21.8 km of suitable RLP habitat where suspended sediment is expected to be elevated, whereas Mountain Valley's approach predicts that increased embeddedness will only occur over 10.5 km, regardless of any project-related increase in suspended sediment concentrations. Our approach is therefore more conservative and better accounts for the relationship between increases in suspended sediment concentrations and deposition. Mountain Valley now adopts the Service's more conservative approach (Mountain Valley 2022). In short, the impact area defined above encompasses the stream reaches in which harm to RLP from increased sedimentation/suspended sediment and from increased embeddedness is reasonably certain to occur.

Project-related sediment embedded in the impact areas may become resuspended during storm events and flushed downstream. In addition, studies show that sediment can remain in the river-floodplain system for an extended period of time (e.g., decades to centuries) before it is entirely flushed out of the system (Hamilton 2012). The sediment is stored in multiple areas throughout the river-floodplain system and not just the river channel, including fringing bars, islands, behind impoundments, and floodplain areas. This raises the possibility that resuspended sediment from the project could create new downstream impact areas. This risk would depend on numerous variables including flow rates associated with the storm events, stream channel geometry, the extent of sediment embedded in the impact areas at the time of a storm, the characteristics (e.g., particle size, weight) of embedded sediment, the rates at which embedded sediment may be resuspended and transported downstream, and the distance any resuspended sediment may travel before resettling on the stream floor. To our knowledge there is no reliable and accurate methodology for determining the likelihood that resuspended sediments from the project may create new downstream impact areas, where such areas might be located or the potential size of such areas.

For two reasons we believe the risk is low that localized resuspension of project-related sediment will lead to new downstream impact areas. First, any embedded project-related sediment is expected to be transported downstream over time and during multiple storm events rather than all at once; that in part is the basis for our assumption that the effects of embedded sediment on benthic invertebrate populations in the impact areas could persist for up to 4 years. We do not expect the resuspended sediment will all be deposited in the same area. The resuspension of embedded sediment over time and during multiple storm events would be expected to settle gradually as the sediment travels downstream and over large distances depending on flow conditions, sediment particle size, and stream channel geometry, which reduces the likelihood that large quantities of project-related sediment will be deposited in significant quantities in the same area. Resuspended sediment may also be deposited in areas outside the river channel during storm events. Second, as discussed above, our impact areas are already conservatively defined (large) and thus may encompass any areas where significant resuspension and redeposition may occur before project-related sediment has been flushed downstream. For these reasons, we do not expect resuspended project-related sediments are likely to create new downstream impact areas in RLP-occupied habitat.

Impoundments – Impoundments resulted from the use of temporary dam structures as part of the dam and pump method associated with the North Fork Roanoke River 1 open-cut crossing (MP 227.2, Stream ID S-G36). As discussed above, the construction ROW is 22.86 m wide at this crossing. The crossing was completed in July 2018 via open-cut dry ditch (Table 9). No RLP were observed during the fish removals associated with 2 dewatering events (July 17-18, 2018, and August 15-17, 2018) at this crossing (Mountain Valley 2020). The streambed was re-contoured to reflect pre-construction streambed contours and restoration was finalized August 2018. Post-construction monitoring of RLP habitat was completed October 16-19, 2020. This crossing was completed prior to the 2020 Opinion, which required Mountain Valley to assess RLP habitat 6 months after the construction activities related to the crossings were completed and to monitor water quality in RLP streams. The habitat assessment for this crossing site has been completed.

The habitat assessment noted that cattle have access to the river from approximately 400 – 800 m downstream of the crossing; habitat in this area appeared degraded. However, degraded habitat was not observed "adjacent to the Project crossings nor were anecdotal differences in substrate quality or silt coverage between upstream and downstream areas of the Project crossings." (Edge 2020). During the habitat assessment, 2 RLP were observed near microhabitat classified as high quality (Edge 2020).

Relocating RLP likely minimized effects from instream work (e.g., stream diversion, temporary dam structure placement). The fish removal/relocation portion of the action was conducted by individuals with state (VDWR) permits that are issued as part of the Cooperative Agreement for Management of Endangered Species between the Service and VDGIF (now called VDWR), thus no additional effects analysis is required for that portion of the action (Mountain Valley 2022). If RLP remained in the crossing area after removal/relocation efforts, we anticipate they would have become entrained. Instream structure placement also would have resulted in temporary impoundments which might have decreased feeding activity if RLP were in the impounded area and are no longer able to see their prey if water conditions are turbid. Because we anticipate that the majority of RLP would have been removed from the area, we expect at most there was the potential for 1 individual to remain in the impounded area. This individual either may have experienced a reduction in fitness due to a decrease in feeding or became entrained.

Summary – In summary, the duration of all project-related effects on RLP depend on the AMMs (e.g., trenchless crossing, TOYRs, fish removal and relocation, FERC Plan [FERC 2013a], and Restoration and Rehabilitation Plan [Mountain Valley 2017]), which are anticipated to protect RLP when they are spawning, and reduce surface water runoff and sedimentation, but not to insignificant levels (Mountain Valley 2020). The Restoration and Rehabilitation Plan states that herbaceous and woody seed mixes native to the area will be applied to the temporary construction ROW. Herbaceous seeds are assumed to take approximately 4 weeks to establish, 6 months to develop, and 1 year to become a maturing crop. A minimum of 6 tree species (bare-root saplings) and 4 shrub species will be planted at each stream crossing. We expect the effects from sedimentation and suspended sediment on food sources (benthic invertebrate community) within the impact areas will last up to 4 years (Reid and Anderson 1999, Reid et al. 2008, Levesque and Dube 2007) as reduced benthic invertebrate populations gradually return to baseline levels. However, we do not expect that project-related sedimentation will render any currently suitable RLP habitat permanently unsuitable. The effects of removal of streambank vegetation at the North Fork Roanoke River 1 open-cut crossing (MP 227.2, Stream ID S-G36) on sedimentation rates are expected to continue for 3-5 years as streamside vegetation develops to provide streambank stabilization (FERC 2017b). While implementation of AMMs is expected to significantly reduce the likelihood of injury or mortality and reduce adverse effects from habitat alteration, all impacts to RLP will not be avoided or minimized.

Candy darter (CD)

The potential effects of the proposed action on CD are described in Appendix B Table 5. Subactivities that are NE or NLAA CD are described in Appendix B Table 5. Subactivities that are LAA CD are listed in Appendix B Table 5 and include[39]:

- Clearing – herbaceous vegetation and ground cover
- Clearing – trees and shrubs
- Grading, erosion control devices
- Trenching (digging, blasting, dewatering, open trench, sedimentation)
- Regrading and Stabilization – restoration of corridor
- ARs – upgrading existing roads, new roads temporary and permanent – grading, graveling
- ARs – upgrading existing roads, new roads temp and permanent – tree trimming and tree removal

The Gauley River pipeline crossing (Stream ID S-J29) (Table 9) is known to support CD. The proposed crossing method is microtunnel. This trenchless crossing method minimizes impacts in the riparian zones by eliminating construction activities within or directly adjacent to the crossed stream (M. Eggerding, Mountain Valley, letter to J. Martin, FERC, May 13, 2020). Because no open-cut trenching is performed, the stream channel itself would not be impacted, allowing existing riparian vegetation near the stream banks to remain in place. Therefore, no instream construction impacts or impacts to CD are anticipated at this crossing and this crossing will not be discussed further in this Opinion. However, as discussed above in the Environmental Baseline section for the CD, the ROW crossing area is included in the aquatic action area and addressed below because it overlaps with Mixing Zone 20.

The Gauley River, Nicholas County, WV, (Stream Project ID S-J29) water withdrawal location (Table 8) is known to support CD. Water withdrawals are conducted in compliance with conditions in the WVDEP Division of Water and Waste Management's Water Withdrawal Guidance Tool to avoid and minimize adverse impacts to aquatic organisms and ensure maintenance of existing instream physical, chemical, and biological characteristics. Mountain Valley will refrain from withdrawing water during low flows and drought conditions by adhering to the restrictions identified in the West Virginia Water Withdrawal Guidance Tool (M. Eggerding, Mountain Valley, letter to J. Martin, FERC, May 27, 2020). Mountain Valley anticipates installing holding tanks near the withdrawal points to pull water over a longer period, instead of a more acute withdrawal (M. Eggerding, Mountain Valley, letter to J. Martin, FERC, May 13, 2020). Mountain Valley commits to placing temporary water intakes within pools rather than riffles in the Gauley River (M. Eggerding, Mountain Valley, letter to J. Martin, FERC, May 27, 2020). Mountain Valley is committed to limiting surface water withdrawals to 10% of a stream's instantaneous flow, installing temporary water intakes situated above the instream substrates with screened openings not to exceed 3/16-inch mesh, and ensuring through-screen approach velocities less than 0.5 ft per second (Mountain Valley 2020). Therefore, no impacts to CD are anticipated from water withdrawals at this location and this water withdrawal will not be discussed further in this Opinion.

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[39] See footnote 37 regarding post-construction O&M activities.

At MP 118.8 in Nicholas County, WV, near the Gauley River ROW crossing, the project crosses through a former deep-mining disposal area that was active 60 years ago (Mountain Valley 2022). The mine extracted in-place coal reserves from the Sewell coal seam and utilized a portion of the current project area to dispose of coal refuse waste materials that were generated during the extraction and processing operations; those materials are still present today. Mountain Valley's contactor performed a subsurface geotechnical survey of the buried refuse materials within and immediately adjacent to the MVP project ROW. Upon completion of the investigation, the WVDEP Division of Mining and Reclamation was consulted for disposal and handling options. Information collected during this geotechnical exploration indicates that several stratified areas within the mine refuse area exhibit temperatures above subsurface background conditions. The location of the mine spoils exhibiting temperatures above background is approximately 300 ft north of the Gauley River, outside of the OHWM, and outside of the location of the planned bore pits for the project's Gauley River crossing. The work at the Nicholas County Refuse Site requires no new tree cutting and will occur entirely within the project's existing LOD. Material that will be excavated and removed to create a buffer between the pipeline and the remaining coal refuse will be treated as necessary at a zero-discharge treatment location within the existing LOD to reduce elevated temperatures and then taken to an existing offsite refuse disposal facility. The excavated trench will then be backfilled with clean soils prior to pipeline insulation. As a result, project-related work at this site is not likely to cause any new impacts to CD or its habitat and will not be discussed further in this Opinion.

For some components of the proposed action that are anticipated to affect CD, AMMs have been incorporated to ameliorate those effects and those are also noted below. Subactivities related to clearing, grading, trenching, and ARs will harm or kill CD and alter/degrade CD habitat. The following stressors will, or are expected to, occur from one or more of the subactivities listed above: increased sedimentation/suspended sediment and increased embeddedness.

Increased sedimentation/suspended sediment – Increased sedimentation/suspended sediment is anticipated from all of the subactivities listed above, although the magnitude and duration will vary depending on the specific subactivity. Measurable increases in sedimentation/suspended sediment from the project are expected to be episodic and temporary, resulting from waterbody crossings and storm events that deliver sediment from upland construction to waterbodies. Excessive sedimentation and suspended sediments in aquatic systems can cause multiple adverse effects on all life stages of benthic fish, including loss of stream habitat essential for sheltering, foraging, and spawning; increased mortality of eggs, YOY, juveniles, and adults; increased predation on eggs by sediment-dwelling invertebrates; avoidance of previously occupied habitat; increased vulnerability of adults to predation; reduced reproductive success; creased physiological stress; reduced feeding and subsequent weight loss; reduced prey availability; increased parasitism; reduced disease resistance; and clogging, abrasion, and necrosis of gills (Kundell and Rasmussen 1995, Newcombe and Jensen 1996).

Excessive sedimentation/suspended sediment increases sublethal impacts such as growth rate and gill health. Studies have found signs of physiological stress, such as increased oxygen consumption and loss of equilibrium, in remaining fish downstream of disturbed areas, as well as decreased abundance of fish downstream of instream work sites (Reid and Anderson 1999, Levesque and Dube 2007). Sutherland and Meyer (2007) found growth rate of YOY spotfin chub was significantly and inversely related to increasing suspended sediment concentrations. They hypothesized that stress inhibited normal feeding behavior. Gill damage in spotfin chubs was noted with increased suspended sediment concentrations. We expect similar impacts would occur to YOY CD if sediment were to enter small tributaries or stream margins and settle. Although this study focused on YOY we expect similar increased sedimentation would also impact the gills of adult CDs and stress might inhibit their normal feeding behavior.

Studies have shown negative effects of increases in sedimentation/suspended sediment on prey consumption and foraging behavior of darters (Swanbrow Becker et al. 2016, Kellogg and Leipzig-Scott 2017). CD are opportunistic invertivores, feeding almost exclusively on benthic macroinvertebrates (in particular, mayflies and caddisflies) (Schoolcraft et al. 2007). Sediment deposited on the waterbody bottom will interfere with the ability of CD to feed (Robertson et al. 2006). Increased sedimentation is anticipated to result in a loss of prey items and/or an ability to see the prey. Various studies have documented adverse effects to the benthic community from increased sedimentation (e.g., reduction in abundance and species diversity) and these effects can persist after construction has been completed, between 6 months and 4 years post-construction (Reid and Anderson 1999, Reid et al. 2008, Levesque and Dube 2007). Two studies (cited in Reid et al. 2008) documented no effect to benthic community and downstream habitats during and after construction. Seven studies (cited in Reid and Anderson 1999 and Reid et al. 2008) indicated recovery of the benthic invertebrate communities occurred within 6 months to 1 year after pipeline construction, with suspended sediment concentrations from 44 mg/L for a 12.4-hour duration up to 6,247 mg/L for 20 hours, which may have also led to sediment deposition. Increased rates of benthic invertebrate drift were also observed during construction for very short time periods (i.e., hours) due to high suspended sediment concentrations, ranging from 997 mg/L to 1,679 mg/L for a 7-hour duration (Reid et al. 2008). Armitage and Gunn (1996; cited in Levesque and Dube 2007) indicated that adverse effects from suspended sediment continued for 4 years after pipeline construction until a high, scouring flow event changed the stream bed; however, this study did not provide details on suspended sediment concentrations. The response and recovery time of sites to disturbances are expected to be variable and are generally related to the hydraulic and substrate characteristics of the stream bed and flushing events due to increased streamflow from rain events. As discussed below, we are conservatively assuming effects to benthic invertebrates in aquatic areas that receive significant increased sedimentation as a result of the MVP project will persist for up to 4 years. This assumption is conservative because most of the available studies indicate post-construction recovery of benthic invertebrate communities within 0.5 to 1 year of pipeline construction activities (Reid and Anderson 1999, Reid et al. 2008, Mountain Valley 2022). Moreover, our conservative assumption does not mean that the affected aquatic areas will be devoid of benthic invertebrates for up to 4 years; rather, we would expect that increased sedimentation would reduce invertebrate populations in the affected areas and that those populations would gradually increase to pre-construction baseline levels over the course of no more than four years, as had been documented in studies cited in Reid et al. (2008)

(e.g., Tsui and McCart 1981, Reid et al. 2002a). CD would be expected to return to the impact areas after initial sediment plumes dissipate and to continue to use the areas as habitat as benthic invertebrate populations gradually return to baseline levels.

Fish species that require clean cobble and gravel for spawning had decreased abundance in sediment-impaired streams (Sutherland et al. 2002) and typical riffle-dwelling fish species declined with increased siltation (Berkman and Rabeni 1987), indicating that CD numbers may be reduced by increased suspended sediment concentrations in areas heavily affected by sediment. Increased sediment deposition and substrate compaction from instream construction can degrade spawning habitat, resulting in the production of fewer and smaller fish eggs, impaired egg and larvae development, and limited food availability for YOY (Reid and Anderson 1999, Levesque and Dube 2007). As brood-hiding, benthic spawners that deposit eggs between unembedded pebble and gravel substrates within larger cobbles and boulders, CD are particularly sensitive to changes resulting from increased sedimentation. Burkhead and Jelks (2001) reported a decrease in spawning of the tricolored shiner as suspended sediment concentration increased (0 [control], 100, 300, and 600 mg/L) for 6 days. When fish spawned, fewer eggs were laid as sediment concentrations increased, and spawning activity was delayed at higher levels of suspended sediment. Egg and larval mortality was negligible. Increased sedimentation is anticipated to potentially result in similar effects to CD if the sediment entering a waterbody via tributaries rises to similar levels.

The duration and severity of the effects of increased sedimentation on individuals and populations depends on factors such as the duration of disturbance, the amount of sediment loading, the length of stream segment directly affected by construction, and whether there were repeated disturbances (Newcombe and Jensen 1996, Yount and Niemi 1990, Vondracek et al. 2003); however most studies documented recovery of the affected stream reach within 1 to 3 years after construction (Reid and Anderson 1999, Yount and Niemi 1990).

The effects to CD will depend, in part, on the type, amount, and extent of sediments released into the water column, the magnitude and duration of discharge, and background suspended sediment concentrations. The clearing of herbaceous vegetation and trees and shrubs in the riparian corridor and uplands, AR grading, and the trenching is expected to cause increases in sedimentation that will have impacts to CD. Based on past events, sediment modeling conducted by Mountain Valley (2020), which were confirmed to represent the best available information for the purposes of this reinitiated consultation, and conservative estimates of sediment concentration in waterways (M. Neylon, Mountain Valley, email to J. Stanhope, Service, June 10, 2020; M. Neylon, Mountain Valley, email to S. Hoskin, Service, June 17, 2020), we anticipate these activities will impact CD and have incorporated portions of CD habitat into our impact area, see additional discussion below.

Depending on the size and duration of a sediment plume that occurs, CD may alter normal feeding behaviors until sediment levels return to background levels. McBaine and Hallerman (2020) indicates that CD are mobile (i.e., capable of movements >4 km), but are generally expected to move only within adjacent riffle complexes. Therefore, we expect that most adult CD will likely not avoid areas of heavy sediment deposition by moving to other areas of suitable habitat within the system as the sediment moves within the channel. However, if CDs were to undertake such movements to avoid areas of increased sedimentation, the physiological toll from such efforts may have negative consequences to individuals. Further, we expect a significant increase in the risk of predation if CDs were to move upstream across run/pool habitats, as they are primarily a benthic species that shelters within interstitial spaces in shallow riffles. Younger life stages may not be capable of moving out of an area and will experience loss of habitat for feeding and sheltering. However, recent work by McBaine et al. (2022) has challenged this assumption by finding that movement capacity of younger CD life stages is greater than previously believed.

As mentioned above and in the SBA2 (Mountain Valley 2022), there are no studies on specific suspended sediment concentrations (e.g., thresholds) and their effects on RLP and CD, and the data needed to develop such thresholds is not available or readily obtainable. Obtaining such data would involve conducting novel laboratory research to quantify the effects of increased sedimentation levels on RLP and CD biology and physiology at multiple temporal scales (e.g., immediate short-term effects to physiology as well as longer-term effects to reproductive cycles and population dynamics). Such research would also necessitate sacrifice of numerous RLP and CDs as experimental subjects. As such, this data is not readily obtainable for the purposes of this Opinion. As discussed above in the Effects of the Action section for the RLP, to assess the suspended sediment concentrations at which adverse effects to both RLP and CD will occur and to determine the downstream extent to which these effects may extend as a result of the proposed project, we adapted the analytical framework in Biological Effects of Sediment on Bull Trout and Their Habitat – Guidance for Evaluating Effects (Muck 2010) (framework; Appendix C), using as the basis for our analysis the model 1 thresholds in Newcombe and Jensen (1996).

Using this approach (an adaptation of Figure 1 in Muck [2010]) and an SEV of 5 to include sublethal effects to juveniles, we expect that adverse effects to adult, subadult, and juvenile RLP and CD are likely to occur under any of the following thresholds:

a. Any time sediment concentrations exceed 148 mg/L over background.
b. When sediment concentrations exceed 99 mg/L over background for more than 1 hour continuously.
c. When sediment concentrations exceed 40 mg/L over background for more than 3 hours continuously.
d. When sediment concentrations exceeded 20 mg/L over background for over 7 hours continuously.

As discussed in the Effects of the Action section for RLP, the sediment concentration to be measured is SSC, and not TSS. Because sediment sampling for concentration is labor intensive, the framework in Muck (2010) is based on using turbidity as a surrogate for SSC. To do this, the sediment concentration above background at which adverse effects to the species and/or habitat occurs expressed as mg/L will be converted to NTUs, based on existing regression relationships, as described in Hyer et al. (2015) or based on guidelines developed by USGS (Rasmussen et al. 2009).

For the mixing zone areas, where sediment in tributaries discharges to occupied streams during storm events (i.e., sediment from construction in upland areas) and contributes increased suspended sediments, the areal extent of impact will vary depending on numerous factors including rainfall duration and the suspended sediment concentrations in the tributary, tributary discharge volume and flow rate, receiving water flow rate and turbulence, and the geometry of the tributary and the receiving water boundaries (USEPA and USACE 1998).

The Service reviewed estimated sediment concentrations (mg/L) modeled in the streams GIS shapefile that Mountain Valley provided, which is based on the screening-level methodology used to define the aquatic action area (M. Neylon, Mountain Valley, email to J. Stanhope, Service, June 10, 2020; M. Neylon, Mountain Valley, email to S. Hoskin, Service, June 17, 2020). As described in the Action Area section and based on expert review, it was determined that utilizing Mountain Valley's sedimentation analysis to develop the aquatic action area was a reasonable and conservative approach (J. Martin, FERC, letter to C. Schulz, Service, May 7, 2020). Mountain Valley indicated that their approach is conservative and overestimates the expected increased sediment concentrations from the project because it assumes all sediment loads from construction activities, in response to a 24-hour design storm, will arrive simultaneously to the stream segments within the watershed. The assumptions designed to ensure conservativism are detailed in Section 6.2 of the Hydrologic Analysis of Sedimentation report attached as Appendix B in the SBA2 (Mountain Valley 2022). In addition, following issuance of the 2020 Opinion, Mountain Valley completed installation of the monitoring stations in each monitoring watershed before resuming construction (Mountain Valley 2022). Although project construction activities had not resumed in the CD watersheds, monitoring stations were brought online upon installation (date not provided) and have been collecting data since that time. Mountain Valley reports that the monitoring data collected at the aquatic species impact areas for the RLP confirms that the sedimentation modeling is conservative and significantly overstates potential sediment loss from the project (Mountain Valley 2022 and Appendix L in Mountain Valley 2022). As noted by FERC, it is difficult to extrapolate conditions following the commissioning of the monitoring stations to the conditions that existed in 2018 and 2019, when most of the project construction occurred (J. Martin, FERC, letter to C. Schulz, Service, January 11, 2023). However, the monitoring "has confirmed that runoff from the Project right-of-way during some large rain events over the monitoring period did not cause an exceedance of the TRC [Take Risk Concentration] for the Streams of Interest." For the timeframe when the monitoring stations were commissioned, as stated by Mountain Valley, "The Project, at most, contributes negligible amounts of sediment to species streams that are well below the concentrations at which USFWS concluded the RLP and CD would be impacted. In fact, the commissioned station tributary data, which are the most direct measure of potential Project sediment, show that, even during tropical and other flood-inducing severe storm events, sediment losses attributable to the Project do not appreciably contribute to suspended sediment levels in species streams." (Mountain Valley 2022 and Appendix L in Mountain Valley 2022).

The highest sediment concentration predicted for the MVP project in a tributary to a CD stream was 159 mg/L (Mountain Valley 2020), which is in the same range of TSS concentrations from pipeline crossing studies that found downstream impacts due to increases in TSS concentrations and sediment deposition that occurred within 500 m of pipeline crossings (Reid and Anderson 1999; Reid et al. 2002b, 2004). Because the predicted sediment concentrations provided in the GIS shapefile from Mountain Valley are based on calculations and not actual laboratory methods, the Service believes they are indicative of SSC values and do not have a bias towards lower values. As discussed above, some of the downstream impacts included short-term changes in abundance and community structure of benthic invertebrates and changes in fish abundance. To be protective of the CD, the Service anticipates the areas in which the species will be impacted will be similar to open-cut crossings and also occur within 200 m above and 800 m below the point where the tributary enters the CD-occupied stream (1,000 m total within CD-occupied stream). The 200 m area in the CD-occupied stream upstream of the confluence with the tributary is included to address uncertainty of the mixing zone plume extent (i.e., due to the factors described above).

Based on the GIS shapefile, the Service identified the tributaries with $\geq$20 mg/L sediment concentrations above background that discharged to assumed or known CD-occupied streams and determined these to be mixing zone areas. The GIS shapefile did not indicate any stream segments within assumed or known CD-occupied streams that are predicted to have elevated sediment concentrations $\geq$20 mg/L above background beyond the mixing zone.

The mixing zone areas, applying the 200 m above and 800 m below distance to these inputs from tributaries, results in the total impact lengths of (Appendix D Table 2 and Figures 3 and 4): 2,000 m in the Gauley River system (1,000 m of the Gauley River from each of Coon Creek and Little Laurel Creek); and 1,000 m in the Stony Creek system (1,000 m in Stony Creek from Kimballton Branch). As discussed above, the Stony Creek action area also includes a 1,000 m area around the Stony Creek ROW crossing (which is not expected to impact CD) to account for physical effects, such as increased sunlight due to tree-clearing (Alberts et al. 2018) that may be experienced due to potential clearing and work in riparian areas at the stream crossing. Mountain Valley (2022) reports that the Stony Creek crossing area lacks any appreciable riparian vegetation; therefore, changes in sunlight are anticipated to be insignificant. Furthermore, because the potential sediment loss is not expected to cause increases of >20 mg/L sediment concentrations above background in Stony Creek based on sediment load modeling in the Hydrologic Analysis of Sedimentation report (Mountain Valley 2020, 2022), this portion of the Stony Creek action area is not included in the Stony Creek CD impact area discussed below.

The Upper Gauley River metapopulation contains 6 populations within close proximity to each other (182 smi total) (Service 2018a), of which the Upper Gauley River population (within critical habitat unit 5b) constitutes 27.2 smi. The impact area in the Upper Gauley River system (2 km = 1.24 mi), assumed to support CD, represents approximately 4.56% of the CD occupied habitat within the Upper Gauley population and 0.68% of potential habitat within the Upper

Gauley River system metapopulation. CD abundance was considered "good" in the Upper Gauley River during the SSA (Service 2018a), but no specific population estimates are available to estimate the number of CD in the impact area.

All sections of Stony Creek have not been surveyed for CDs, but the lower 19.3 smi of Stony Creek contain habitat that is suitable for the species and CD presence is assumed. The impact area in Stony Creek (1 km = 0.62 mi), assumed to support CD, represents approximately 3.21% of potential habitat within Stony Creek. CD CPUE is highest in the midpoint of the watershed in Stony Creek, with lower abundances within the impact area, closer to the confluence with the New River (McBaine and Hallerman 2020). No recent population density estimates are available to estimate the number of CD in the impact area.

Increased embeddedness – Increased embeddedness is correlated with excessive sedimentation and is anticipated from all of the subactivities listed above, although the magnitude and duration will vary depending on the specific subactivity. A commonly documented effect of upland deforestation/clearing includes silt deposition that fills interstitial spaces in gravel and cobble substrates and reduces water flow through the substrate in the areas downstream of the disturbance. The resulting increase in substrate embeddedness is expected to temporarily reduce habitat heterogeneity and primary productivity, increase egg and larval mortality, and alter, degrade, and entomb benthic macroinvertebrate communities that CD depend on as a food source (Burkhead and Jenkins 1991). These effects would be expected to persist until the deposited sediment is flushed downstream, which generally would be expected to occur within one year after construction (Reid and Anderson 1999), although, as noted above, we are conservatively assuming that the effects may persist for up to four years. Sutherland (2001) reported a marginally significant negative relationship difference between both embeddedness and foraging time and feeding strikes of the gilt darter, mean substrate embeddedness ranged from 40-70%. Sutherland (2001) also observed increased resting time with increased percent embeddedness although this relationship was not as strong. Overall, the study found embeddedness and foraging behavior was correlated, but the author did not determine if it was a function of increased turbidity, increased physiological stress, or possibly decreased prey abundance.

Because embeddedness is correlated with increased sedimentation we anticipate effects to CD from embeddedness will be similar to those discussed in the increased sedimentation/suspended sediment section above. Moreover, as discussed in the Effects of the Action section for RLP, the reaches likely impacted by sediment deposition and increased embeddedness would also be those that will exhibit the highest levels of project-related suspended sediment (Mountain Valley 2020). Because 20 mg/L is a relatively low sediment concentration (Mountain Valley 2020), the conservatively defined mixing zones associated with tributaries with ≥20 mg/L sediment concentrations above background encompass the areas in which project-related increases in embeddedness are reasonably likely to harm CD. This conclusion is supported by the studies of pipeline crossings referenced above, which found that downstream impacts due to increases in TSS concentrations and sediment deposition occurred within 500 m of the crossings (Reid and Anderson 1999; Reid et al. 2002b, 2004). As previously noted, the highest sediment concentration predicted for the MVP project in a tributary to a CD stream was 159 mg/L (Mountain Valley 2020; Mountain Valley 2022), which is in the same range of TSS concentrations from the pipeline crossings analyzed in those studies. In short, the impact area defined above encompasses the stream reaches in which harm to CD from increased sedimentation/suspended sediment and from increased embeddedness is reasonably certain to occur.

Project-related sediment embedded in the impact areas may become resuspended during storm events and flushed downstream. In addition, studies show that sediment can remain in the river-floodplain system for an extended period of time (e.g., decades to centuries) before it is entirely flushed out of the system (Hamilton 2012). The sediment is stored in multiple areas throughout the river-floodplain system and not just the river channel, including fringing bars, islands, behind impoundments, and floodplain areas. This raises the possibility that resuspended sediment from the project could create new downstream impact areas. This risk would depend on numerous variables including flow rates associated with the storm events, stream channel geometry, the extent of sediment embedded in the impact areas at the time of a storm, the characteristics (e.g., particle size, weight) of embedded sediment, the rates at which embedded sediment may be resuspended and transported downstream, and the distance any resuspended sediment may travel before resettling on the stream floor. To our knowledge there is no reliable and accurate methodology for determining the likelihood that resuspended sediments from the project may create new downstream impact areas, where such areas might be located or the potential size of such areas.

For three reasons we believe the risk is low that localized resuspension of project-related sediment will lead to new downstream impact areas in CD occupied habitat. First, any embedded project-related sediment is expected to be transported downstream over time and during multiple storm events rather than all at once; that in part is the basis for our assumption that the effects of embedded sediment on benthic invertebrate populations in the impact areas could persist for up to 4 years. We do not expect the resuspended sediment will all be deposited in the same area. The resuspension of embedded sediment over time and during multiple storm events would be expected to settle gradually as the sediment travels downstream and over large distances depending on flow conditions, sediment particle size, and stream channel geometry, which reduces the likelihood that large quantities of project-related sediment will be deposited in significant quantities in the same area. Resuspended sediment may also be deposited in areas outside the river channel during storm events. Second, as discussed above, our impact areas are already conservatively defined (large) and thus may encompass any areas where significant resuspension and redeposition may occur before project-related sediment has been flushed downstream. Third, as summarized in the 2020 SBA and the 2022 SBA2, sediment deposition modeling performed for the project indicated that no Sediment Deposition Impact Area will form in any candy darter streams. Although we did not rely on Mountain Valley's sediment deposition modeling to define the CD impact areas, the modeling results further support our assessment that the risk of significant resuspension and downstream redeposition or project-related sediment is low. For these reasons, we do not expect resuspended project-related sediments are likely to create new downstream impact areas in CD-occupied habitat.

Summary – The duration of all project-related effects on CD depends on the AMMs (e.g., FERC Plan [FERC 2013a], and Restoration and Rehabilitation Plan [Mountain Valley 2017]), which are anticipated to reduce surface water runoff and sedimentation, but not to insignificant levels (Mountain Valley 2020). The Restoration and Rehabilitation Plan states that herbaceous and woody seed mixes native to the area will be applied to the temporary construction ROW. Herbaceous seeds are assumed to take approximately 4 weeks to establish, 6 months to develop, and 1 year to become a maturing crop. A minimum of 6 tree species (bare-root saplings) and 4 shrub species will be planted at each stream crossing. We expect the effects from sedimentation and turbidity on food sources (benthic invertebrate community) will last up to 4 years (Reid and Anderson 1999, Reid et al. 2008, Levesque and Dube 2007) as reduced benthic invertebrate populations gradually return to baseline levels. However, we do not expect that project-related sedimentation will render any currently suitable CD habitat permanently unsuitable. Direct instream impacts at stream crossings known to support CD will be avoided using guided conventional bore or microtunneling methods. While implementation of AMMs is expected to significantly reduce the likelihood of injury or mortality and reduce adverse effects from habitat alteration, all impacts to CD will not be avoided or minimized.

Candy darter (CD) critical habitat

The potential effects of the proposed action on CD critical habitat are described in Appendix B Table 6. Subactivities that are NE or NLAA CD critical habitat are described in Appendix B Table 6 and will not be further discussed in this Opinion. Subactivities that are LAA CD critical habitat are listed in Appendix B Table 6 and include[40]:

- Clearing – herbaceous vegetation and ground cover
- Clearing – trees and shrubs
- Grading, erosion control devices
- Trenching (digging, blasting, dewatering, open trench, sedimentation)
- Regrading and Stabilization – restoration of corridor
- ARs – upgrading existing roads, new roads temporary and permanent – grading, graveling
- ARs – upgrading existing roads, new roads temporary and permanent – tree trimming and tree removal

Subactivities related to clearing, grading, trenching, and ARs will affect PBFs of both critical habitat subunit 2b (Stony Creek) and 5b (Upper Gauley River). The effects to PBFs described below will be limited to the impact areas within those subunits (see Appendix D Table 2 and Figures 3 and 4 for impact areas). The following stressors will, or are expected to, occur from one or more of the subactivities listed above: increased sedimentation/suspended sediment and

[40] See footnote 37 regarding post-construction O&M activities.

increased embeddedness.

Increased sedimentation/suspended sediment – Increased sedimentation/suspended sediment is anticipated from all of the subactivities listed above although the magnitude and duration will vary depending on the specific subactivity. The effects to the PBFs will depend, in part, on the type, amount, and extent of sediments released into the water column, the magnitude and duration of discharge, and background suspended sediment concentrations.

Increased sedimentation will affect PBF 2 (a blend of unembedded gravel and cobble that allows for normal breeding, feeding, and sheltering behavior) by introducing increased silt and fine particles to the unembedded gravel and cobble substrate characteristic of CD streams. This PBF will still function as required by the species, but at a reduced level. The reduced function of this PBF within the impact areas is expected to occur during construction and restoration activities and remain until after restoration is completed and fine sediments have been flushed through the watershed by storm events that do not carry additional sediment from project activities. Following restoration, this PBF is expected to return to background levels.

Increased sedimentation/suspended sediment will affect PBF 3 (adequate water quality characterized by seasonally moderated temperatures and physical and chemical parameters [e.g., pH, dissolved oxygen levels, turbidity] that support normal behavior, growth, and viability of all life stages of the CD) by altering water quality parameters via reduced light levels and visibility, decreased DO levels, and altered pH. This PBF will still function as required by the species within the impact areas, but at a reduced level. These changes are expected to be limited in duration to the length of time that construction and restoration activities are actively contributing excess sediment to the watershed. Following restoration, this PBF is expected to return to background levels.

Increased suspended and deposited sediment is anticipated to affect PBF 4 (an abundant, diverse benthic macroinvertebrate community [e.g., mayfly nymphs, midge larvae, caddisfly larvae] that allows for normal feeding behavior) through loss of prey items. This PBF will still function as required by the species, but at a reduced level. The reduced function of this PBF within the impact areas is expected to occur during construction and restoration activities and will remain until after restoration is completed. Once fine sediments have been flushed through the watershed by storm events that do not carry additional sediment from project activities and macroinvertebrate populations have recovered via recolonization and new reproductive cycles, this PBF is expected to return to background levels. These effects on the benthic invertebrate community can persist after construction has been completed. Various studies have documented adverse effects to the benthic community from increased sedimentation (e.g., reduction in abundance and species diversity) and these effects can persist after construction has been completed, between 6 months and 4 years post-construction (Reid and Anderson 1999, Reid et al. 2008, Levesque and Dube 2007). Two studies (cited in Reid et al. 2008) documented no effect to benthic community and downstream habitats during and after construction. Seven studies (cited in Reid and Anderson 1999 and Reid et al. 2008) indicated recovery of the benthic invertebrate communities occurred within 6 months to 1 year after pipeline construction, with suspended sediment concentrations from 44 mg/L for 12.4-hour duration up to 6,247 mg/L for 20 hours, which may have also led to sediment deposition. Increased rates of benthic invertebrate drift were also observed during construction for very short-term time period (i.e., hours) due to high suspended sediment concentrations, ranging from 997 mg/L to 1,679 mg/L for a 7-hour duration (Reid et al. 2008). Armitage and Gunn (1996; cited in Levesque and Dube 2007) indicated that adverse effects from suspended sediment continued for 4 years after pipeline construction until a high, scouring flow event changed the stream bed; however, this study did not provide details on suspended sediment concentrations. The response and recovery time of sites to disturbances are expected to be variable and are generally related to the hydraulic and substrate characteristics of the stream bed and flushing events due to increased streamflow from rain events. As discussed above for CD, we are conservatively assuming effects to benthic invertebrates in aquatic areas that receive significant increased sedimentation as a result of the MVP project will persist for up to a maximum of 4 years, as reduced benthic invertebrate populations gradually return to baseline levels.

Increased embeddedness – Increased embeddedness is correlated with excessive sedimentation and is anticipated from all of the subactivities listed above, although the magnitude and duration will vary depending on the specific subactivity. Increased embeddedness is anticipated to reduce the quality of PBF 2 within the impact areas. A commonly documented effect of instream work and upland deforestation/clearing includes silt deposition that fills interstitial spaces in gravel and cobble substrates and reduces water flow through the substrate in the area where instream work is occurring, as well as in areas downstream of the disturbance. This PBF will still function as required by the species, but at a reduced level. These changes are expected to occur during construction and restoration activities and will remain until after restoration is completed and fine sediments have been flushed through the watershed by storm events that do not carry additional sediment from project activities. Following restoration, this PBF is expected to return to background levels.

The resulting increase in substrate embeddedness is expected to reduce habitat heterogeneity and primary productivity, and alter, degrade, and entomb benthic macroinvertebrate communities that CD depend on as a food source, per PBF 4 (Burkhead and Jenkins 1991). In the short-term, PBF 4 will experience increased sediment deposition and filling of interstitial spaces. This PBF will still function as required by the species within the impact areas, but at a reduced level. These changes are expected to occur during construction and restoration activities and will remain until after restoration is completed. Once fine sediments have been flushed through the watershed by storm events that do not carry additional sediment from project activities and macroinvertebrate populations have recovered via recolonization and new reproductive cycles, this PBF is expected to return to background levels.

In summary, in the short-term, the quality of PBFs 2, 3, and 4 are anticipated to continue to function for CD within the impact areas but will be temporarily reduced in quality. In the long-term, these PBFs are expected to return to their previous quality as stream conditions return to previous baseline levels following restoration of the action area. Project subactivities in critical habitat subunit 2b and 5b are not anticipated to affect PBF 1 or PBF 5 as no part of the proposed action is predicted to introduce nonnative species or meaningfully alter water quantity or velocity.

CUMULATIVE EFFECTS

Cumulative effects are those "effects of future State or private activities, not involving federal activities, that are reasonably certain to occur within the action area" considered in this Opinion (50 CFR 402.02). While there are numerous state and private activities currently occurring within the action area (i.e., were ongoing as of commencement of MVP project construction as discussed below), these activities are ongoing, and the effects created by those activities are considered in the Status of the Species and Status of Critical Habitat and Environmental Baseline sections of this Opinion.

Although portions of the MVP project have been completed, this Opinion analyzes the effects of the entire project since it began. Thus, the cumulative effects analysis includes the effects of non-federal activities that were reasonably certain to occur or have effects within the action area on or after January 1, 2018.

To identify non-federal activities with potential effects in the action area, Mountain Valley (2022) compiled information from all activities proposed (2018 to current) anywhere within the boundary of each 12-digit HUC (HUC-12) watershed in which any portion of the action area occurs. The HUC-12 boundaries encompass an area beyond the footprint of the action area, making certain that all reasonably certain effects that could occur within the action area are included. Mountain Valley (2022) requested this information from numerous local and state agencies including the WVDEP; WV Division of Forestry; WVDEP Division of Mining and Reclamation; WV Department of Transportation, Division of Highways; WV Division of Natural Resources – Office of Land and Streams; VDEQ; Virginia Department of Transportation; VA Department of Forestry; VA Department of Energy; regional planning departments; county planning departments; and county floodplain coordinators. Mountain Valley submitted Freedom of Information Act requests and/or directly contacted county and regional planning agencies located in each WV and VA county crossed by the MVP project. Mountain Valley also contacted the City of Salem, VA, and the City of Roanoke, VA, regarding comprehensive plans and future development, as well as public service districts located within each WV and VA county crossed by the MVP project. The Service concludes that the efforts undertaken by Mountain Valley to identify activities in the action area that may give rise to cumulative effects were comprehensive. The Service accordingly relies on the results of Mountain Valley's investigation for its cumulative effects analysis.

The Service reviewed the list of non-federal activities compiled by Mountain Valley (Appendix K in Mountain Valley 2022; M. Hoover, Mountain Valley, email to C. Schulz, Service, December 28, 2022; L. Henley, VA Department of Transportation, email to C. Schulz, Service, January 5, 2023; M. Hoover, Mountain Valley, email to C. Schulz, Service, January 16, 2023) and determined that some activities have a federal nexus, as listed below. Those activities with a federal nexus have undergone or will undergo separate Section 7 consultation and are therefore not cumulative effects.

- All NPDES permits are regulated by U.S. EPA (February 22, 2001, Memorandum of Agreement Between the EPA, FWS and NMFS Regarding Enhanced Coordination Under the CWA and ESA (66 FR 11202- 11217). U.S. EPA's NPDES program (https://www.epa.gov/npdes/npdes-state-program-authority).
- The Surface Mining Control and Reclamation Act of 1977 (SMCRA) establishes a program of cooperative federalism that allows a State or Indian Tribe to assume primary jurisdiction (primacy) over the regulation of surface coal mining and reclamation operations within its borders once its regulatory program has been approved by the DOI Secretary. The WVDEP Division of Mining and Reclamation and Virginia Energy have assumed primacy. On October 16, 2020, USFWS issued the Endangered Species Act Section 7 Consultation Final Programmatic Biological Opinion and Conference Opinion on the United States Department of the Interior Office of Surface Mining Reclamation and Enforcement's Surface Mining Control and Reclamation Act Title V Regulatory Program. This programmatic opinion fulfills ESA requirements related to surface coal mining for Virginia Energy and WVDEP Division of Mining and Reclamation.
- The U.S. Department of Housing and Urban Development administers the Community Development Block Grant (CDBG) Program (authorized under Title 1 of the Housing and Community Development Act of 1974, Public Law 93-383, as amended 42 U.S.C. 5301 et seq.).
- The Federal Emergency Management Agency (FEMA) leverages capacity to coordinate within the federal government to make sure America is equipped to prepare for and respond to disasters.
- Some VA Department of Transportation (VDOT) activities are funded in whole or in part with federal funds through Federal Highway Administration (FHWA) funding. Of the 98 VDOT activities, 40 are not federally funded.

Further, certain non-federal activities (both those with a federal nexus noted above and those remaining) identified by Mountain Valley may have temporary or permanent impacts to waters of the U.S., requiring a permit from the USACE, which is also a federal nexus.

Additionally, WVDEP Oil and Gas Development Permits Projects (Appendix K in Mountain Valley 2022) that are permit type "plugging" indicated no disturbance acreage will occur and are assumed to be plugging an existing oil/gas development and therefore are not a future State or private activity with effects in the action area.

The remaining projects (Appendix K in Mountain Valley 2022; M. Hoover, Mountain Valley, email to C. Schulz, Service, December 28, 2022) were assumed to be non-federal activities with effects reasonably certain to occur within the action area. However, because there was not a way to easily definitively identify and eliminate all of the activities with a federal nexus and/or the WVDEP permit type "plugging" activities from consideration, these activities are included in the analysis below.

The activities below could result in impacts to listed species and their designated critical habitat from tree cutting and removal; agricultural activities; industrial, commercial, and residential development; construction and operation of transportation infrastructure; and traditional and renewable energy development and operation.

Virginia spiraea (VASP) – Because VASP occurs in a variety of riverine and wetland habitat types (see Status of the Species section for details), the Service included both the aquatic and terrestrial action areas in the VASP cumulative effects analysis to ensure that all potential effects to VASP were evaluated. Four HUC-12 watersheds contain a portion of the aquatic and terrestrial action area occupied or assumed to be occupied by VASP: Hungard Creek–Greenbrier River, Otter Creek–Meadow River, Meadow Creek–Meadow River, and Boulder Run–Greenbrier River. The available information (Mountain Valley 2022) indicated there are:

- 31 activities in the Hungard Creek–Greenbrier River HUC-12 watershed, with 2,364 acres of associated disturbance, or approximately 10.73% of this HUC-12 watershed.
- 37 activities in the Otter Creek–Meadow River HUC-12 watershed, with 1,142 acres of associated disturbance, or approximately 3.20% of this HUC-12 watershed.
- 50 activities in the Meadow Creek–Meadow River HUC-12 watershed, with 1,709 acres of associated disturbance, or approximately 5.25% of this HUC-12 watershed.
- 1 activity (a car wash) in the Boulder Run–Greenbrier River HUC-12 watershed, with unknown acres of associated disturbance, but likely less than 1 acre, or approximately 0.005% of this HUC-12 watershed.

The primary factors influencing the VASP status include competition by both native and non-native invasive plant species, anthropogenic disturbances to habitat, and changes in hydrologic regime (Service 1992a, 2021). Anthropogenic disturbance of land along streams and rivers, due to activities such as vegetation clearing, mowing, herbicide application, road and bridge construction/maintenance, electric/gas line placement, recreational use of rivers, and dam construction, may impact VASP by directly crushing/removing the plants, altering their riverine habitat, and creating conditions conducive to invasive plants (Ogle 2008, Service 2021). For multiple EOs throughout the range, severe and repeated flooding events were noted as a threat due to extreme scour and erosion of the habitat, washing away plants, or large debris piles accumulating on the habitat (i.e., exceeding the unknown threshold of beneficial scour that removes competing vegetation). Scour and flooding are potentially exacerbated by increased development and impervious surfaces in watersheds and global climate change, with extreme precipitation events predicted to increase.

None of the proposed activities overlap with the aquatic action area or VASP known or assumed occurrences in the aquatic action area. The activities in the 4 HUC-12 watersheds that overlap the VASP's known or assumed occurrences within the terrestrial action area may: cause increased sedimentation from upland activities that alters VASP habitat; cause increased flooding that could wash away VASP and degrade its habitat; and create conditions for invasive plants that outcompete VASP.

The extent and intensity of these activities and the associated disturbances are uncertain. The extent of impact of the activities in each of the 4 HUC-12 watersheds, which range from 0.005% to 10.73% of the watershed, is a conservative estimate given that not all these activities are within the terrestrial action area and/or will affect the terrestrial action area and as a result affect VASP. In the Hungard Creek–Greenbrier River HUC-12 watershed, the activities that occur in the terrestrial action area that could affect the assumed VASP occurrence are NPDES. As explained above NPDES activities have a federal nexus and will have undergone or will undergo separate Section 7 consultation, removing them from consideration as cumulative effects. In the Otter Creek–Meadow River HUC-12 watershed, 17 of the 37 activities occur in the terrestrial action area with 978 acres of disturbance, or approximately 2.74% of this HUC-12 watershed, none of which overlap with VASP known or assumed occurrences. In the Meadow Creek–Meadow River HUC-12 watershed, 17 of the 50 activities occur in the terrestrial action area with 510 acres of disturbance, or approximately 1.57% of this HUC-12 watershed, none of which overlap with VASP known or assumed occurrences. In the Boulder Run–Greenbrier River HUC-12 watershed, 1 activity occurs in the terrestrial action area with unknown acres of associated disturbance, but likely less than 1 acre, or approximately 0.005% of this HUC-12 watershed, which does not overlap with VASP known or assumed occurrences.

In summary, none of the non-federal activities overlap with the aquatic action area or VASP known or assumed occurrences in the aquatic action area. Cumulative effects within the relevant HUC-12 watersheds in the terrestrial action area could result in a total of 1,489 acres of disturbance, ranging from 0.005% to 2.74% of each watershed, none of which overlap with VASP known or assumed occurrences. We conclude that cumulative effects reasonably certain to occur in the action area from all future non-federal activities do not pose a significant risk to VASP populations and are unlikely to alter the baseline condition of those populations.

Indiana bat (Ibat) – Effects from approximately 772 activities are reasonably expected to occur within the terrestrial action area. Based on available information, which did not always include anticipated disturbance acreage, approximately 47,712.26 acres of disturbance would occur as a result of these activities (Mountain Valley 2022). The terrestrial action area (1,002,627.7 acres) is located within the Ibat AMRU, which is a total of 51,400,965.4 acres in WV, VA, and TN (Service 2007b). The Ibat AMRU includes 8,788,657.5 acres in VA and 15,506,118.3 acres in WV, with the remaining acreage in TN. Approximately 166,696.78 acres of the action area in VA are outside of the AMRU and Ibats are unlikely to occur in this area. Thus, the action area comprises approximately 1.626% of the AMRU [(1,002,627.7-166,696.78)/51,400,965.4*100]. The action area is approximately 1.86% of the AMRU in VA [(330,875.7-166,696.78)/8,788,657.5*100] and 4.33% in WV (671,752/15,506,118.3*100). The Ibat range in VA and WV includes approximately 18,889,053 acres of potential habitat (6,369,616.47 in VA and 12,519,436.45 in WV), based on NLCD 2016 land cover data.

Assuming these acres are all forest, loss of suitable forested habitat from these activities represents approximately 4.76% of the terrestrial action area [(47,712.26/1,002,627.7)*100] and

0.09% of the Ibat AMRU [(47,712.26/51,400,965.4)*100]. This is a conservative estimate given the assumption that all of these acres are forested, the extent and intensity of these activities and the associated disturbances are uncertain, and, as indicated above, some of these activities have a federal nexus and will have undergone or will undergo separate Section 7 consultation. While forest habitat is not generally considered a limited resource across the range of the Ibat or within the action area, the species' strong site fidelity contributes to the importance of forest where the species actually occurs. Where Ibat colonies remain after WNS has been present on the landscape for over 10 years, the importance of that particular occupied habitat for the remaining survivors of WNS is magnified.

Tree removal associated with these 772 activities is expected to alter roosting, foraging, and travel habitat and affect roosting and foraging Ibats within the action area. The disturbance acreage (47,712.26 acres) from these activities is 0.25% of the suitable habitat present within the AMRU in VA and WV (18,889,053 acres) and 4.76% of the 1,002,627.7 acres within the terrestrial action area, making it likely that adequate habitat will remain to maintain Ibat numbers, reproduction, and viability in the action area.

In addition, while activities that increase noise levels above the baseline environment in the action area might affect the Ibat, the species is exposed to this stressor from a variety of sources, and it not possible to differentiate between additional inputs attributed to existing sources, federal actions, and non-federal activities based on the available information.

In summary, cumulative effects could result in loss of up to 47,712.26 acres of forested habitat within the terrestrial action area, which is 4.76% of the terrestrial action area and 0.09% of the Ibat AMRU. The Ibat range in VA and WV includes approximately 18,889,053 acres of potential habitat, so tree removal associated with activities identified as cumulative effects is 0.25% of the suitable habitat within the AMRU in VA and WV. We conclude that cumulative effects reasonably certain to occur in the action area from all future non-federal activities do not pose a significant risk to the affected Ibat populations and are unlikely to significantly alter the baseline condition of those populations.

Northern long-eared bat (NLEB) – Although the NLEB does not currently have a recovery plan to assess the impact within a recovery unit as has been done above for Ibat, the general analysis provided above for Ibat also applies to NLEB. WNS has caused estimated NLEB population declines of 97–100% across 79% of the species' range. Although WNS is the predominant threat influencing the status of NLEB, another factor that influences NLEB's viability is habitat loss. WNS has caused estimated NLEB population declines of 97–100% across 79% of the species' range. Wind energy-related mortality of NLEB is also proving to be a stressor at local and regional levels, especially in combination with impacts from WNS. Habitat loss may include loss of suitable roosting or foraging habitat, resulting in longer flights between suitable roosting and foraging habitats due to habitat fragmentation, fragmentation of maternity colony networks, and direct injury or mortality. Loss of or modification of winter roosts (i.e., making hibernaculum no longer suitable) can result in impacts to individuals or at the population level (USFWS 2022a).

Habitat loss in the form of tree removal from the 772 activities is expected to alter roosting, foraging, and travel habitat and affect roosting and foraging NLEBs.

The total amount of NLEB suitable habitat in VA and WV is 28,200,537.53 acres. The disturbance acreage (47,712.26 acres) from the 772 activities (described above for Ibat) is 0.17% of the suitable habitat present within VA and WV, making it likely that adequate habitat will remain to maintain NLEB numbers, reproduction, and viability in the action area.

The amount of acreage to be disturbed is a conservative estimate given the assumption that all of these acres are forested, the extent and intensity of these activities and the associated disturbances are uncertain, and, as indicated above, some of these activities have a federal nexus and will have undergone or will undergo separate Section 7 consultation.

In addition, while activities that increase noise levels above the baseline environment in the action area might affect the NLEB, the species is exposed to this stressor from a variety of sources, and it not possible to differentiate between additional inputs attributed to existing sources, federal actions, and non-federal activities based on the available information.

In summary, cumulative effects could result in loss of up to 47,712.26 acres of forested habitat within the terrestrial action area, which is 4.76% of the terrestrial action area. The NLEB range in VA and WV includes 18,889,053 acres of suitable habitat, so tree removal associated with activities identified as cumulative effects is 0.25% of the suitable habitat within VA and WV. We conclude that cumulative effects reasonably certain to occur in the action area from all future non-federal activities do not pose a significant risk to the affected NLEB populations and are unlikely to significantly alter the baseline condition of those populations.

Roanoke logperch (RLP) – Eight HUC-12 watersheds contain a portion of the aquatic action area occupied by RLP: Purgatory Creek–South Fork Roanoke River, Brake Branch–South Fork Roanoke River, Bradshaw Creek–North Fork Roanoke River, Dry Run–North Fork Roanoke River, Wilson Creek–North Fork Roanoke River, Sawmill Hollow–Roanoke River, Owens Creek–Pigg River, and Tomahawk Creek–Pigg River. Each HUC-12 watershed, and the activities that may result in cumulative effects on RLP, is briefly discussed below. More detailed information is contained in Appendix K in Mountain Valley (2022).

Dry Run–North Fork Roanoke River – The total area of the Dry Run-North Fork Roanoke River HUC-12 watershed is 32,811 acres. Total distance of the aquatic action area within this HUC-12 watershed is approximately 19.033 smi. Eight activities were identified with 63 acres of associated disturbance, which represents approximately 0.19% of this HUC-12 watershed. Five different activity types are represented: utility line, residential, commercial/industrial, transportation, and forestry. Although these activities do not occur within the aquatic action area, they could cause indirect effects within the action area in light of their occurrence within the same watershed.

Bradshaw Creek–North Fork Roanoke River – The total area of the Bradshaw Creek-North Fork Roanoke River HUC-12 watershed is 15,320 acres. Total distance of the aquatic action area within this HUC-12 watershed is approximately 13.043 smi. Four activities were identified with 31 acres of associated disturbance, which represents approximately 0.20% of this HUC-12 watershed. Three different activity types are represented: utility line, transportation, and other NPDES/VPDES. Although most of the activities do not occur within the aquatic action area, they could cause indirect effects within the action area in light of their occurrence within the same watershed. One transportation activity (a rail spur conversion) overlaps with the aquatic action area and is reasonably certain to cause effects within the action area.

Wilson Creek–North Fork Roanoke River – The total area of the Wilson Creek-North Fork Roanoke River HUC-12 watershed is 25,895 acres. Total distance of the aquatic action area within this HUC-12 watershed is approximately 13.44 smi. Thirty-three activities were identified with 411 acres of associated disturbance, which represents approximately 1.59% of this HUC-12 watershed. Seven different activity types are represented: utility line, commercial/industrial, residential development, transportation, forestry, mining, and other NPDES/VPDES. Most of the acreage of disturbance is associated with 3 forestry activities (representing 99 acres of proposed forestry-activity-related disturbance in upland areas), 1 mining activity (191.6 acres), commercial/industrial activities (92.19 acres), and residential development activities (21.55 acres). Only 1 of the 3 forestry activities occurs within the terrestrial action area (representing 16 acres of disturbance). The mining activity and the 2 remaining forestry activities are located several miles from the terrestrial action area. The commercial/industrial and residential development activities are also located outside of and several miles from the terrestrial action area. See Figure 66 in Appendix K in Mountain Valley (2022). One transportation activity (the Route 122 bridge replacement over the Blackwater River) occurs within the aquatic action area and is reasonably certain to affect the aquatic action area, although as noted in the RLP Environmental Baseline section, the Blackwater River is not considered occupied by the RLP and is not included in the Predicted Suitable Habitat layer for RLP (Virginia Natural Heritage Program 2019). Although the remaining activities do not occur within the aquatic action area, they could cause indirect effects within the action area in light of their occurrence within the same watershed.

Sawmill Hollow–Roanoke River – The total area of the Sawmill Hollow-Roanoke River HUC-12 watershed is 40,523 acres. Total distance of the aquatic action area within this HUC-12 watershed is approximately 24.698 smi. Fifty activities were identified with 355 acres of associated disturbance, which represents approximately 0.88% of this HUC-12 watershed. Seven different activity types are represented: utility line, commercial/industrial, residential, transportation, forestry, oil and gas, and other NPDES/VPDES. Although these activities do not occur within the aquatic action area, they could cause indirect effects within that the action area in light of their occurrence within the same watershed.

Brake Branch–South Fork Roanoke River – The total area of the Brake Branch-South Fork Roanoke River HUC-12 watershed is 21,870 acres. Total distance of the aquatic action area within this HUC-12 watershed is approximately 4.985 smi. Sixteen activities were identified with 21 acres of associated disturbance, which represents approximately 0.10% of this HUC-12 watershed. Five different activity types are represented: commercial/industrial, 1 residential/recreational, other NPDES/VPDES, transportation, forestry, and mining. Although these activities do not occur within the aquatic action area, they could cause indirect effects within the action area in light of their occurrence within the same watershed.

Purgatory Creek-South Fork Roanoke River – The total area of the Purgatory Creek-South Fork Roanoke River HUC-12 watershed is 10,897 acres. Total distance of the aquatic action area within this HUC-12 watershed is approximately 0.022 smi. Three activities were identified with 70 acres of disturbance, representing approximately 0.64% of this HUC-12 watershed. These include 1 transportation (road reconstruction) activity and 2 forestry activities. Although these activities do not occur within the aquatic action area, they could cause indirect effects within the action area in light of their occurrence within the same watershed.

Owens Creek–Pigg River – The total area of the Owens Creek-Pigg River HUC-12 watershed is 23,204 acres. Total distance of the aquatic action area within this HUC-12 watershed is approximately 16.721 smi. Twenty-nine activities were identified with 1,791 acres of associated disturbance, which represents approximately 7.72% of this HUC-12 watershed. Four different activity types are represented: commercial/industrial, forestry, mining, and other NPDES/VPDES. Most of the disturbance acreage (1,653.30 acres) is associated with 26 forestry activities, including 12 forestry activities (representing 541.6 acres of upland disturbance) within the terrestrial action area and 14 forestry activities (representing 1,111.7 acres) within the HUC-12 watershed, but outside of the terrestrial action area. See Figure 78 in Appendix K in Mountain Valley (2022). Although these activities do not occur within the aquatic action area, they could cause indirect effects within the action area in light of their occurrence within the same watershed.

Tomahawk Creek–Pigg River – The total area of the Tomahawk Creek-Pigg River HUC-12 watershed is 26,599 acres. Total distance of the aquatic action area within this HUC-12 watershed is approximately 12.898 smi. Twenty-eight activities were identified with 778 acres of associated disturbance, which represents approximately 2.92% of this HUC-12 watershed. All of the activities are forestry. Although these activities do not occur within the aquatic action area, they could cause indirect effects within the action area in light of their occurrence within the same watershed.

All of the activities identified above except 2 are outside of aquatic action area, and many are also outside of the terrestrial action area. See Figures 64-68, 70, 78-79 in Appendix K in Mountain Valley (2022). For 5 of the 8 HUC-12 watersheds, the disturbance acreages associated with the activities amount to less than 1% of the total acreage within the HUC-12 watershed, although disturbance acreages were not available for all of the identified activities.

We next assess how the activities identified above are likely to affect baseline conditions in the action area using the best available data. As discussed above the RLP SSA (Service 2022b) identified 6 factors that have a strong effect on the RLP: (1) fine-sediment deposition emanating from urbanization, agriculture, and other sources that smothers eggs and reduces feeding efficiency, potentially resulting in reduced growth, survival, and recruitment; (2) chronic chemical pollution that reduces habitat suitability for RLP and acute pollution events that reduce survival and population size; (3) dams and other barriers that inhibit fish movement, fragmenting populations into smaller areas and reducing demographic rescue and gene flow among populations; (4) climate change that may alter hydrology and sediment delivery by increasing flood magnitudes and flow variability general, reducing flow predictability, decreasing summer/fall base flows, and increasing erosion and runoff of sediment, potentially reducing habitat suitability for RLP and increasing direct mortality of vulnerable juveniles during spring floods; (5) existing legal and regulatory mechanisms that likely benefit the species; and (6) management/restoration activities aimed at improving habitat quality. Of those, factors 1-4 were identified as threats to the RLP. These factors align with many of the threats discussed in the 2007 5-year review (Service 2007): large dams and reservoirs, small dams/barriers, channelization that will lead to increased sedimentation, agricultural and silvicultural activities (non-point source pollution in the form of fine sediment), and toxic spills. There is no evidence to suggest that other natural or manmade factors are a significant threat to this species in the action area (Service 2022a).

The activities identified above in the 8 HUC-12 watersheds fall within threat categories (1) and (2) discussed in the RLP SSA because those activities have the potential to increase sediment concentrations and (to a lesser extent) pollution in RLP streams. As a result, those activities may cause the following effects in the action area: reductions in RLP foraging as a result of sediment deposited on the waterbody bottom (Robertson et al. 2006); sediment plumes and increased suspended sediment causing RLP to alter feeding behavior, move to clearer water, resume normal activities, and use the area once again when sediment levels return to background levels; RLP expending more energy to seek out different foraging areas; and/or removal of riparian vegetation that will decrease fitness of individual RLP. In some cases, the combined effects of increased sedimentation, decreased dissolved oxygen, and increased temperature could result in the death of a small portion of the RLP present in the impact areas.

The extent and intensity of these activities and the associated disturbances are uncertain. The extent of impact of the activities in each of the 8 HUC-12 watersheds, which range from 0.10 to 7.72% of the watershed, is a conservative estimate given that not all of these activities are within the action area and/or will affect the action area and as a result cumulatively affect the RLP. In addition, as indicated above, some of these activities have a federal nexus and will have undergone or will undergo separate Section 7 consultation, and thus do not fall within the regulatory definition of cumulative effects.

As discussed in the Environmental Baseline section, portions of the aquatic action area fall within the RLP Upper Roanoke MU and Pigg MU (Service 2022b). We use the future simulations for each MU discussed in the RLP SSA to assess whether the cumulative effects of the activities identified above, in conjunction with the potential effects of climate change and dams/barriers, are likely to significantly affect baseline conditions of the RLP in the action area. We also consider the risk projections for the relevant RLP populations discussed in Roberts et al. (2016b). The RLP SSA assesses future resiliency of RLP MUs over a 50-year period (through 2070) using a population viability analysis (PVA) simulation tool that modeled future population size under 3 categories of future scenarios. A 50-year timeframe was used because information was available to reasonably assess urbanization and climate change and risks over that timeframe. The SSA focused on 4 factors when assessing how future conditions might influence RLP, including watershed urbanization, climate change, population restoration, and connectivity restoration via barrier removal.

Watershed urbanization alters hydrology, increases the delivery of fine sediment, and increases the frequency and severity of chemical pollution events and fish kills. Climate change potentially alters rainfall, temperature, evapotranspiration, and storm patterns, which could affect runoff, stream flows, fine-sediment delivery, and vital rates for RLP, particularly during early life history. The nature, speed, and magnitude of future climate changes are subject to much uncertainty, based partly on uncertainty about future policy decisions that will affect anthropogenic greenhouse gas emissions. The SSA projections used 2 potential climate-change scenarios that bracket a plausible range of futures: a scenario that assumes a leveling-off of greenhouse gas emissions by mid-century, and a scenario that assumes increasing emissions through 2100. Further details on the data inputs used to account for differing climate change scenarios are provided in the SSA (Service 2022b).

In developing future scenarios, the RLP SSA considered climate change and urbanization to each have 1 type of effect (decreased habitat quality and increased catastrophe risk, respectively), when in fact both climate change and urbanization are likely to have both chronic and acute effects on RLP vital rates. In future-condition modeling, the authors nominally attributed declines in habitat quality and annual vital rates to climate change. Increasing urbanization would also reduce habitat quality and vital rates, particularly through increased sedimentation, but disentangling the effects of climate change and urbanization is nearly impossible, as these factors interact and will co-occur. This uncertainty in attribution does not negate the SSA's findings about how declining habitat quality might affect RLP persistence. It simply decreases the ability to pinpoint the ultimate cause of those habitat declines (climate change, urbanization, or a combination of the two). As the authors explained, scenarios involving a decline of habitat quality "can be viewed as a means of assessing how declining habitat conditions might affect future RLP condition *regardless the cause* of that habitat decline." (Service 2022b). And the parameters used in the simulations "attempted to bracket a plausible range of uncertainty in the (a) expected magnitude of possible changes to habitat conditions, and (b) expected magnitude of possible biological responses to these habitat changes." (Service 2022b).

The RLP SSA (Service 2022b) simulations thus would be expected to account for the potential effects of activities like the sediment- and pollution-producing activities discussed above that are reasonably certain to occur in the 8 HUC-12 watersheds. None of those projects is unusual or represents a significant departure from past human activities in RLP habitat. Although some of the activities are agricultural or otherwise do not qualify as "urbanization," they would be expected to affect RLP in the same manner: by causing a decline in habitat quality. Moreover, no data suggests that the range of scenarios evaluated in the SSA is insufficient to capture the potential effects of habitat declines caused by the activities like those identified above. For these reasons, and in the absence of any superior data or methodology, it is appropriate to rely on the SSA simulations in assessing whether activities like those identified above are likely to significantly degrade the baseline condition of the RLP and its habitat in the action area.

The 3 categories of future scenarios evaluated in the SSA assumed either (1) no management intervention, (2) implementation of population restoration through propagation, augmentation, reintroduction, translocation, and introduction of fish (i.e., PARTI), or (3) implementation of both PARTI and targeted dam removals to increase connectivity. Within each category, the SSA contrasted scenarios involving (a) no change to current environmental conditions, (b) greater climate change resulting in worsening rangewide habitat suitability, (c) increasing urbanization resulting in increased risk of catastrophic pollution events, and (d) the combination of worsening habitat suitability and increased pollution risk. Each of these 12 scenarios were simulated 100 replicate times for 50 years into the future, and the authors estimated future resiliency based on how often each MU remained extant at the end of the simulation. The authors considered MUs with a greater than 95% chance of persistence to be highly resilient, whereas MUs below that threshold were not considered resilient.

The Upper Roanoke MU and the Pigg MU both exhibited a 100% chance of persisting under each of 12 alternative scenarios of future urbanization, climate change, and conservation management. Importantly, regardless of increases in urbanization or climate change, and even in the absence of barrier removal or other conservation-related actions, both MUs had high persistence probabilities and therefore relatively high resilience. Even under the "worst-case" scenario of worsening habitat quality, increased risk, and no management, both MUs still remained highly resilient by year 50.

The results of the SSA simulations for the relevant RLP populations are consistent with the risk projections in Roberts et al. (2016b). Roberts et al. (2016b) conducted a RLP population viability analysis for the Roanoke River and Pigg River RLP populations affected by the MVP project. Roberts et al. (2016b) conducted a RLP population viability analysis that included these watersheds. They defined a "minimum viable population" as the minimum number of individuals sufficient to sustain 99% probability of population persistence in 100 years. The study determined that the Roanoke River population and the Pigg River population were well above the "minimum viable population" threshold. Roberts et al. (2016b) also projected 100-year extinction risks for each population using certain variables, including "catastrophe" regimes. The study characterized catastrophes as anthropogenic disturbances that cause fish kills that could "acutely and dramatically reduce the size of populations..." Environmental events such as floods and droughts were not included because they occur frequently and did not seem to dramatically affect RLP population size. Three catastrophe scenarios were developed (1) no catastrophes, (2) a less severe catastrophe, and (3) a more severe catastrophe. The severity of the catastrophe was the relationship of the total fish kill to the extent of the river. Under the "severe catastrophe" scenario, a severe fish kill (e.g., a kill that eliminates a significant percentage of the entire population) was predicted to occur, on average, once every 5 years. They calculated all populations had a greater than 95% probability of persisting for the next 100 years under a less severe catastrophe scenario. Under the severe catastrophe scenario, the Roanoke and Pigg Rivers populations would still be considered viable. The calculated extinction risk for the largest population, Roanoke River, was always near 0.

Given the probability of RLP population persistence and the relatively small extent of the impact in the action area from the activities in each of the 8 HUC-12 watersheds, we conclude that cumulative effects reasonably certain to occur in the action area from all the future non-federal activities identified above do not pose a significant risk to the baseline condition of RLP populations in the action area. This conclusion is further supported by the following considerations:

- For 6 of the HUC-12 watersheds, the acreages of disturbance associated with the future projects that are reasonably certain to occur comprise less than 1% of the total acreage within each watershed, although we recognize that disturbance acreage was not available for every activity. For the remaining 2 HUC-12 watersheds, activities accounting for a significant percentage of the acreages of disturbances were located well outside of both the aquatic and terrestrial action areas, which may reduce the risk that those activities will significantly increase sedimentation in RLP streams in those watersheds.
- The future activities do not appear to differ significantly from the types of activities that have occurred in the past in the relevant watersheds, and the best available data shows that RLP in the Upper Roanoke MU and Pigg MU are currently stable and highly resilient (Service 2022b).
- In the SSA simulations, the Upper Roanoke MU and Pigg MU both exhibited a 100% chance of persisting, and were predicted to remain highly resilient, after year 50 even under the "worst-case" scenario of worsening habitat quality, increased risk, and no conservation management. Similarly, under the "severe catastrophe" scenario evaluated in Roberts et al. (2016b), which involved a severe fish kill occurring on average once every 5 years, the Roanoke and Pigg River populations would still be viable after 100 years. The potential indirect effects of the activities identified above would be unlikely to result in a single significant fish kill that could acutely and dramatically reduce the size of populations.

The potential cumulative effects of the activities thus are not expected to significantly alter baseline conditions of the RLP in the action area.

<u>Candy darter (CD) and CD critical habitat</u> – Three HUC-12 watersheds contain a portion of the aquatic action area occupied by CD or its critical habitat: Panther Creek–Gauley River, Big Laurel Creek–Gauley River, and Stony Creek. The available information (Mountain Valley 2022) indicated there are:

- 39 activities in the Panther Creek–Gauley River HUC-12 watershed, with approximately 1,380 acres of disturbance, which represents approximately 4.5% of this HUC-12 watershed.
- 31 activities in the Big Laurel Creek–Gauley River HUC-12 watershed, with 980 acres of associated disturbance, which represents approximately 2.70% of this HUC-12 watershed.
- 3 activities in the Stony Creek HUC-12 watershed, with 218 acres of associated disturbance, which represents approximately 0.70% of this HUC-12 watershed.

The primary factor influencing the CD current status in WV is hybridization with the introduced but closely related variegate darter (Service 2018a). Other contributing threats to CD populations include increases in water temperature, excessive sedimentation, habitat fragmentation, changes in water chemistry and water flow, and competition with non-native species. Actions impacting critical habitat are those that would significantly increase water temperature or sedimentation and stream bottom embeddedness. Such activities could include, but are not limited to, land use changes that result in an increase in sedimentation, erosion, and bankside destruction or the loss of the protection of riparian corridors and leaving insufficient canopy cover along banks.

The activities in the 3 HUC-12 watersheds may cause: temporary reductions in CD foraging as a result of increased sedimentation; CD to move to new habitat to avoid sedimentation, resulting in increased energy expenditures and stress, as well as increased risk of predation; and reduced spawning efficiency. The critical habitat PBFs in the action area may be impacted from the activities in the 3 HUC-12 watersheds by: temporary reductions in water quality and habitat quality as a result of increased sedimentation reducing visibility, decreasing available prey, increasing embeddedness, and filling interstitial spaces with fine sediment; increased sedimentation from upland land-disturbing activities and due to suspension and re-deposition of substrate sediments disturbed during storm events.

The extent and intensity of these activities and the associated disturbances and effects in the action area are uncertain. The extent of impact of the activities in each of the 3 HUC-12 watersheds, which range from 0.70 to 4.5% of the watershed, is a conservative estimate given that not all these activities are within the action area and/or will affect the action area and as a result cumulatively affect the CD or its critical habitat. In addition, as indicated above, some of these activities have a federal nexus and will have undergone or will undergo separate Section 7 consultation.

In the Panther Creek–Gauley River HUC-12 watershed, there are 4 types of activities with potential effects in the action area: utility line, forestry, mining, and NPDES. As explained above mining and NPDES activities have a federal nexus and will have undergone or will undergo separate Section 7 consultation, removing them from consideration as cumulative effects. None of the activities overlap with the aquatic action area, but they could have effects in the aquatic action area due to their occurrence within the HUC-12 watershed. One proposed water line extension (no acreage amount available) was identified within the watershed, outside of the terrestrial action area, that could affect the terrestrial and aquatic action areas, depending on how the activity is implemented. Thirty forestry activities (total of 1,351 acres) were identified within the watershed; 14 activities are within the terrestrial action area, representing 682 acres of new upland disturbance, and 16 activities are outside the terrestrial action area, representing 669 acres of new upland disturbance. These activities could affect the terrestrial and aquatic action areas, depending on how those activities are implemented. The total area of the Panther Creek-Gauley River HUC-12 watershed is 30,377 acres and the terrestrial action area is 14,635 acres within this HUC-12 watershed. The 30 forestry activities could result in the loss of 4.45% (1,351 acres/30,377 acres) forest cover in the Panther Creek-Gauley River HUC-12; 2.25% (682 acres/30,377 acres) of that forest cover is within the terrestrial action area and 2.20% (669 acres/30,377 acres) is outside the terrestrial action area.

In the Big Laurel Creek–Gauley River HUC-12 watershed, there are 4 types of activities with potential effects in the action area: commercial/industrial, forestry, mining, and NPDES/VPDES. As explained above mining and NPDES activities have a federal nexus and will have undergone or will undergo separate Section 7 consultation, removing them from consideration as cumulative effects. None of the activities overlap with the aquatic action area, but they could have effects in the aquatic action area due to their occurrence within the HUC-12 watershed. Four commercial/industrial activities (total of 11 acres) were identified within the watershed, all within the terrestrial action area. Nineteen forestry activities (total of 969 acres) were identified within the watershed; 12 activities are within the terrestrial action area, representing 685 acres of new upland disturbance, and 7 activities are outside the terrestrial action area, representing 284 acres of new upland disturbance. These activities could affect the terrestrial and aquatic action areas, depending on how those activities are implemented. The total area of the Big Laurel Creek-Gauley River HUC-12 watershed is 36,238 acres and the terrestrial action area is 18,644 acres within this HUC-12 watershed. The 23 (4 commercial/industrial + 19 forestry) activities could result in the loss of 2.70% (11 + 969 acres/36,238 acres) forest cover in the Big Laurel Creek–Gauley River HUC-12; 1.92% (11 + 685 acres/36,238 acres) of that forest cover is within the terrestrial action area and 0.78% (0 + 284 acres/36,238 acres) is outside the terrestrial action area.

In the Stony Creek HUC-12 watershed, there is 1 activity type with potential effects in the action area: commercial/industrial. None of the activities overlap with the aquatic action area, but they could have effects in the aquatic action area due to their occurrence within the HUC-12 watershed. Three activities (total of 218.22 acres) were identified within the watershed and are all within the terrestrial action area, representing new upland disturbance that could affect the terrestrial and aquatic action areas, depending on how those activities are implemented. The total area of the Stony Creek HUC-12 watershed is 31,289 acres and the terrestrial action area is 7,300.30 acres within this HUC-12 watershed. The 3 activities could result in 0.70% (218.22 acres/31,289 acres) upland disturbance in the Stony Creek HUC-12; all of which is within the terrestrial action area.

The CD SSA (Service 2018a) modeled effects of 5 future scenarios on CD population persistence based on combinations of changes in habitat quality and variegate darter range expansion. For at least 2 reasons, it is appropriate to use the modeled scenarios in the SSA to assess how the activities in the 3 HUC-12 watersheds are likely to influence the baseline condition of the relevant CD populations. First, as discussed below, the likely effects of the activities fall within the range of potential future impacts analyzed in the SSA. Second, subject to a caveat discussed below relating to the SSA's predictions of potential variegate darter introgression and expansion, there is no superior available data or methodology for predicting the likely effects of the activities.

Scenario 2 (negative habitat change) assumed 10% loss of forest cover would result in watersheds where land ownership is either mostly private or a mix of private and public. Effects to CD as a result of the assumed scenario included degradation of stream habitat quality (specifically, increases in sedimentation and water temperature) resulting in decreased CD abundance and connectivity. Under the assumptions of Scenario 2, the Upper Gauley River population (which includes the entire portion of the Gauley River in the Panther Creek-Gauley River HUC-12 and the Big Laurel Creek-Gauley River HUC 12) is expected to remain in moderate condition, representing no change from the current condition, while the Stony Creek population is expected to remain in high condition, representing no change from the current condition. While Scenario 2 indicated a reduction in population condition from moderate to low in the Panther Creek population under the negative habitat scenario, this was specific to the CD population within Panther Creek, which is not within the aquatic action area. Scenarios 3-5 modeled expansion of variegate darters into new watersheds, under neutral habitat conditions (Scenario 3), positive habitat changes (Scenario 4), and negative habitat changes (Scenario 5, assuming the same habitat degradation as Scenario 2). Changes in the population condition predicted by Scenarios 3-5 all indicated a reduction in population condition (extirpation for the Upper Gauley population, and a decrease from high to moderate condition for the Stony Creek population). However, the model indicated that there was no difference in outcome for the Upper Gauley River or Stony Creek populations regardless of the habitat conditions (Service 2018a, Table 5).

It is important to note that while the CD SSA identified the expansion of variegate darter range and hybridization in Scenario 3 as the most likely future scenario, this does not mean that full expansion of the hybridization zone throughout the Greenbrier River and Gauley River populations is a foregone conclusion. The modeled scenarios represent best guesses at future outcomes to the species as a whole, given various sets of potential circumstances. Regarding Scenario 3, the SSA states "The data suggest variegate darters have been introduced into the Upper Gauley watershed and that additional bait bucket transfers will result in the pattern of candy darter hybridization and loss previously observed in the Lower Gauley and Greenbrier to be repeated." The 5-year increments modeled for Scenario 3 indicated that at the +5 year mark, the Upper Gauley CD populations would be significantly degraded, with almost half of those extirpated entirely by the +10 year mark. Given that the SSA was published in March 2018, we have now reached the +5 year point of the initial model. The best available evidence does not indicate that the predicted aggressive expansion of variegate darters in the upper Gauley River watershed has proceeded as estimated by Scenario 3. To date, all known genetic assays of CD in the Upper Gauley have yielded only faint traces of variegate darter alleles. We attribute this discrepancy to several factors: (1) The SSA modeled the predicted rates “Based on the observed range expansion of the variegate darter in the Lower New, Lower Gauley, and Greenbrier River watersheds and the subsequent decline or loss of candy darters where the two species are in contact.” Given that these rates are based exclusively on watersheds where variegate darters have unimpeded access to CD, the barriers to movement at Summersville Dam and Bluestone Dam are likely providing substantial protection from variegate darter incursions. (2) The SSA states “While we have data with which to estimate the expansion of variegate darters within a candy darter metapopulation, we cannot predict with accuracy if or when a bait bucket transfer (or other anthropogenic mechanism) would result in the establishment of the species in other candy darter Watersheds." Thus, the assumption that variegate darters would overrun the Upper Gauley metapopulation is explicitly acknowledged to be highly unpredictable. (3) The conditions modeled in the SSA are based upon the conditions observed at the time – when the species was not protected under the ESA – and do not evaluate what changes would occur if the species were listed. We reiterate these points to emphasize that the risk of extirpation of the Upper Gauley CD metapopulation is a *risk*, but is not a foregone conclusion or inevitable outcome. The presence of advanced generation hybrid CD/variegate darters that have backcrossed to the point of near-purity of CD alleles indicates that previous small-scale introductions of variegate darters above Summersville Dam failed to cause genetic swamping of the population.

The modeled 10% loss in forest cover evaluated in scenarios 2 and 5 is an extreme scenario based upon a 100x increase in the rate of change in forest cover observed from the 10-year period of 2001-2011 (NLCD, see Homer et al. 2015). For the 3 HUC-12 watersheds that contain a portion of the aquatic action area occupied by CD or its critical habitat, the non-federal activities identified above will remove no more than 4.45%, 2.70%, 0.70%, respectively, which are all below the modeled 10% change in forest cover predicted to result in no change from the current condition to the affected CD populations. None of the activities overlap with the aquatic action area, but their occurrence within the HUC-12 watershed could cumulatively affect the CD within the aquatic action area. Of the 56 non-federal activities that could occur in the 3 watersheds, 33 are in the terrestrial action area and 23 are located outside the terrestrial action area.

Given the probability of CD population persistence and the relatively small extent of the impact of the activities in each of the 3 HUC-12 watersheds, we conclude that cumulative effects reasonably certain to occur in the action area from all future non-federal activities do not pose a significant risk to the affected CD populations and are unlikely to significantly alter the baseline condition of those populations. For the same reasons, the activities in each of the 3 HUC-12 watersheds are unlikely to significantly alter the PBFs of critical habitat or reduce the conservation role of individual critical habitat subunits.

JEOPARDY AND ADVERSE MODIFICATION ANALYSIS

Section 7(a)(2) of the ESA requires that federal agencies ensure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of designated critical habitat.

Jeopardy Analysis Framework

"Jeopardize the continued existence of" means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species (50 CFR 402.02). In accordance with policy and regulation, the jeopardy analysis in this Opinion relies on 4 components: (1) Status of the Species, which evaluates the species rangewide condition, the factors responsible for that condition, and its survival and recovery needs; (2) Environmental Baseline, which evaluates the status of the species in the action area, the factors responsible for that condition, and the relationship of the action area to the survival and recovery of the species, (3) Effects of the Action, which determines impacts of the proposed action, and (4) Cumulative Effects, which evaluates the effects of future, non-federal activities in the action area on the species. The jeopardy analysis in this Opinion emphasizes the rangewide survival and recovery needs of the listed species and the role of the action area in providing for those needs. It is within this context that we evaluate the significance of the proposed federal action, taken together with cumulative effects, for purposes of making the jeopardy determination (see 50 CFR 402.14(g)).

In this section, we add the effects of the action and the cumulative effects to the status of the species and critical habitat and to the environmental baseline to formulate our Opinion as to whether the proposed action is likely to appreciably: (1) reduce the likelihood of both the survival and recovery of a listed species in the wild by reducing the RND of that species; or (2) appreciably diminish the value of critical habitat for both the survival and recovery of a listed species.

Per the Service's consultation handbook (Service and National Marine Fisheries Service 1998), survival is defined as "the species' persistence as listed or as a recovery unit, beyond the conditions leading to its endangerment, with sufficient resilience to allow for the potential recovery from endangerment. Said another way, survival is the condition in which a species continues to exist into the future while retaining the potential for recovery. This condition is characterized by a species with a sufficient population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring, which exists in an environment providing all requirements for completion of the species' entire life cycle, including reproduction, sustenance, and shelter."

Per the Service's consultation handbook (Service and National Marine Fisheries Service 1998), recovery is defined as "improvement in the status of listed species to the point at which listing is no longer appropriate under the criteria set out in Section 4(a)(1) of the ESA." The "criteria set out in Section 4(a)(1)" means determining when a species no longer meets the definition of an "endangered species" or a "threatened species" because of any of the following factors:

(A) present or threatened destruction, modification, or curtailment of habitat or range;
(B) overutilization for commercial, recreational, scientific, or educational purposes;
(C) disease or predation;
(D) inadequate existing regulatory mechanisms; and
(E) other natural or manmade factors affecting the species continued existence.

An endangered species is "in danger of extinction throughout all or a significant portion of its range" (see ESA Section 3(6)). A threatened species is "likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range" (see ESA Section 3(20)).

To conduct this analysis, we begin by assessing whether there are effects to any individuals of the species of interest (as discussed in the effects analysis section above). If all effects are insignificant, discountable, or wholly beneficial, no further consultation is required. In other words, if we conclude that individuals are *not* likely to experience reductions in reproductive success or survival likelihood, fitness consequences for the species rangewide would not be expected as well. In this case, the agency has ensured that their action is not likely to jeopardize the continued existence of the species and our analysis is completed. Conversely, if we are unable to show that individuals are unlikely to experience reductions in their reproductive success or survival likelihood, we are required to assess how those effects are or are not anticipated to result in an appreciable reduction in the likelihood of both the survival and recovery <u>of the species</u>. We do not assess appreciable reduction of reproduction, numbers or distribution at an individual level because we do not assess appreciable reduction of <u>survival and recovery</u> at an individual level.

Because many species are composed of multiple populations and there may be meaningful differences in those populations (e.g., genetics, morphology, size) to the overall species survival and recovery, it is a logical intermediate step to evaluate the effects of impacts to individuals on the population(s) they are associated with. If our analyses indicate that reductions in the fitness of the population(s) are not likely to occur then there can be no appreciable reductions in reproduction, numbers, or distribution at a species level and we conclude that the agency has ensured that their action is not likely to jeopardize the continued existence of the species. If there are reductions in the fitness of the population(s) impacted, we then assess whether those changes affect the overall species survival and recovery rangewide based on the importance of the population(s) for species level representation, resiliency and redundancy, the level of impact, and the status of the species.

Analysis for Jeopardy

Virginia spiraea (VASP)

Impacts to Individuals – In this step we determine whether any individuals of the species will be exposed to stressors from the various activities that are part of the proposed action. If exposure is likely, the next step is to determine the fitness consequences of individuals exposed to those stressors. The fitness of an individual can be measured by its reproductive success (which is determined by vital rates such as fertility rates, age at first reproduction, and reproductive intervals) and its survival likelihood. To assess whether fitness consequences may occur, we determine whether and how individuals are likely to respond[41] upon exposure to the stressors and beneficial actions associated with the proposed action. As the response of individuals upon exposure depends upon their condition (i.e., their health and resiliency), we must first establish the baseline conditions for those individuals. If the baseline condition of the individuals is unknown, generally we can use information about the status of the population or of the species as a whole (depending on the information available) to infer the degree of resiliency possessed by the individuals.

The proposed action includes vehicle operation and foot traffic, herbaceous vegetation and shrub/tree clearing, AR grading and graveling, stream equipment crossing structures, and stream and wetland crossings subactivities. As discussed in the Effects of the Action, effects of the action include effects to VASP assumed to be present within parcel WV-SU-046 year-round. Effects generally include decreased fitness, decreased reproductive success, or death of individual VASP due to physical damage, competition with introduced invasive species, habitat disturbance, crushing, cutting, digging up, burying, or soil compaction. Additionally, these activities are expected to permanently alter and degrade habitat such that conditions are no longer favorable for VASP re-establishment post-construction. The AMMs will initially minimize some of these adverse effects, but we expect that all assumed VASP individuals in the 0.05 acre will be killed. On parcel WV-SU-046, tree felling and placement of timbermats across the wetland has occurred; pipe installation and final restoration need to be completed (P. Moore, Beveridge & Diamond PC, email to J. Martin, FERC, August 12, 2020; P. Moore, Beveridge & Diamond PC, email to C. Schulz, Service, November 28, 2022). This will result in the permanent removal of all assumed VASP plants, seeds, and habitat, which are assumed to occur on 0.05 acre, in the 2.3-acre parcel and reestablishment of VASP in that area is not expected.

In summary, we anticipate impacts to individual VASP in either their survival or reproductive rates.

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[41] There are many possible biological responses (such as startle, alarm, flee, avoid, abandon/displace, reduced feeding success, reduced growth, reduced reproductive success, reproductive failure, and increased mortality) and many of these represent a form of take and thus must be expressed and evaluated in our Opinions. For our jeopardy analyses, however, reproductive success and survival are two metrics that may lead to population level consequences and are thus most relevant.

Impacts to Populations – As we have concluded that individual VASP are likely to experience reductions in their annual survival or reproductive rates, in this section, we evaluate the aggregated consequences of the reductions in the fitness of individuals on the population(s) to which those individuals belong. Specifically, we are analyzing how the reductions in individual fitness affect the population's abundance, reproduction, or growth rates to make inferences about the population's future reproductive success and its viability. Whether a population can withstand the consequences of aggregated fitness reductions in individuals depends upon its baseline status (i.e., its resiliency). Thus, our analysis entails defining the population(s) the individuals comprise and determining the current and future baseline condition of that population.

We expect that the population level impacts from decreased fitness, decreased reproductive success, death of individual VASP, and habitat degradation and loss will be relatively minor because the proposed action only affects 1 assumed occurrence of VASP. This assumed occurrence represents a new occurrence of the Greenbrier River population, which to date has been comprised of 3 known occurrences of VASP. These 3 known occurrences in the population will not be affected by the proposed action, and based on 2019 survey information (WVDNR 2019), these 3 known occurrences appear healthy. As discussed above, none of the non-federal activities identified in watersheds containing a portion of the action area occupied by VASP overlap with the aquatic action area or VASP known or assumed occurrences. Any impacts to the terrestrial action area within these watersheds from cumulative effects are expected to be relatively insignificant.

Therefore, the loss of this 1 new assumed occurrence will not affect the stability and recovery of the Greenbrier River population as a whole.

Impacts to Species – The final step in our analysis is to ascertain whether the anticipated impacts on the population(s) or recovery unit are likely to reduce the likelihood of both survival and recovery of the species by impacting its RND. Our analysis evaluates how the population-level effects determined above influence the likelihood of progressing towards or maintaining the conservation needs of the species rangewide. To complete this analysis we need to first determine the rangewide status of the species and then compare (1) what the species needs, (2) what it has, and (3) what the future expected status is. Here we connect the relative importance of the impacted population(s) to the rangewide status of the species to the impacts (positive and negative) from the proposed action.

If our analyses indicate that appreciable reductions in numbers, reproduction, and distribution are likely to occur, we conclude that the action is likely to jeopardize the continued existence of the species. Appreciable reduction means that it impacts the species in a meaningful and consequentially negative way that is more than "background" noise of the species' population dynamics. If the population-level reductions do not appreciably (i.e., meaningfully) reduce the likelihood of progressing towards or maintaining one or more of the species' conservation needs, then the action is not likely to appreciably reduce the likelihood of both survival and recovery of the species, and our analysis is complete, and a non-jeopardy determination is required.

As we have concluded that the Greenbrier River population of VASP is unlikely to experience any meaningful reductions in fitness, there will be no reduction in RND on the species as a whole and therefore, the continued existence of VASP will not be jeopardized.

Impacts to Recovery of the Species – As stated in the Status of the Species section, the Service prepared a recovery plan for the species in 1992. Primary actions to address recovery include: (1) Protect existing populations and essential habitat. (2) Conduct rangewide searches in areas of suitable habitat for additional populations. (3) Conduct site-specific habitat manipulation to maintain existing populations. (4) Distinguish between N (the number of genetically different plants) and n (the number of genetically identifiable nodules or clones that are in reality a single plant) individuals and identify genetically different populations. (5) Maintain representative material from each known genotype in permanent cultivation. (6) Investigate the species' environmental tolerances and habitat characteristics. (7) As appropriate, reintroduce VASP in additional drainage systems within the species' historical range. (8) Develop an information packet for landowners and land managers. (9) Evaluate the effectiveness of protection and management programs and redirect efforts as necessary. The Service outlined the following conditions that would result in the species no longer meeting the definition of a threatened species (Service 1992a): (1) 3 stable populations are permanently protected in each drainage where populations are currently known, (2) stable populations are established on protected sites in each drainage where documented specimens have been collected, (3) potential habitat in the states with present or past collections has been searched for additional populations, and (4) representatives of each genotype are cultivated in a permanent collection.

As discussed in the Status of the Species section, there are multiple (redundancy) populations in each state and these populations are spread across the geographic range of the species in multiple states (GA, KY, NC, OH, TN, VA, and WV) (representation). Multiple populations (36.0% of historically known EOs) are considered healthy (i.e., moderately to highly resilient) and many of these populations are located on public or permanently managed/protected lands (22.5% of historically known EOs), which generally provides protection from habitat loss due to development. The status of the species rangewide appears to be stable, with some populations improving and some declining (Ogle 2008, Service 2021).

This project is anticipated to result in impacts to VASP assumed to be present within parcel WV-SU-046 year-round. These impacts are expected to permanently alter and degrade the VASP habitat such that conditions are no longer favorable for VASP re-establishment post-construction. We expect that all assumed VASP individuals in the 0.05 acre will be killed.

This assumed occurrence is 1 of 4 that comprise the Greenbrier River population. The other 3 known occurrences will not be affected by the proposed action, and based on 2019 survey information (WVNDR 2019), these 3 known occurrences appear healthy. The loss of this 1 new assumed occurrence will not affect the recovery of the Greenbrier River population as a whole.

Therefore, the loss of 1 assumed VASP occurrence within the Greenbrier River population is not likely to appreciably reduce the species' ability to attain any of the 4 recovery criteria outlined in the recovery plan. The overall status of the species appears to be stable and the effects from this specific project are not anticipated to reduce appreciably the suitable habitat available for recovery or the recovery potential for the species.

Indiana bat (Ibat)

Impacts to Individuals – In this step we determine whether any individuals of the species will be exposed to stressors from the various activities that are part of the proposed action. If exposure is likely, the next step is to determine the fitness consequences of individuals exposed to those stressors. The fitness of an individual can be measured by its reproductive success (which is determined by vital rates such as fertility rates, age at first reproduction, and reproductive intervals) and its survival likelihood. To assess whether fitness consequences may occur, we determine whether and how individuals are likely to respond[42] upon exposure to the stressors and beneficial actions associated with the proposed action. As the response of individuals upon exposure depends upon their condition (i.e., their health and resiliency), we must first establish the baseline conditions for those individuals. If the baseline condition of the individuals is unknown, generally we can use information about the status of the population or of the species as a whole (depending on the information available) to infer the degree of resiliency possessed by the individuals.

The proposed action includes removal of a total of 3,212.15 acres of known or unknown use Ibat habitat (Tables 18 and 20). An additional 247.68 acres of habitat loss associated with future slips is anticipated as well, bringing the total Ibat habitat loss to 3,459.83 acres (Table 2a). As discussed in the Effects of the Action (Table 24), effects of the MVP project (3,459.83 acres) and the NJFs (4.18 acres) include effects to Ibats present within the action area year-round.

Tree removal in known use and unknown use summer habitat during winter will alter roosting, foraging, and travel habitat. Displaced Ibats will expend additional energy seeking out alternate roosts and travel corridors when they return the following season. Tree removal during winter in known use and unknown use summer habitat will result in temporary reduced pregnancy success for 1 adult female per colony (1 known maternity colony and 3 unknown maternity colonies). These effects will be greatest the first season after tree removal has occurred.

Tree removal in the active Ibat season in known and unknown use summer habitat is expected to affect Ibats using undocumented occupied roosts and foraging areas. A total of 238.53 acres has

[42] There are many possible biological responses (such as startle, alarm, flee, avoid, abandon/displace, reduced feeding success, reduced growth, reduced reproductive success, reproductive failure, and increased mortality) and many of these represent a form of take and thus must be expressed and evaluated in our Opinions. For our jeopardy analyses, however, reproductive success and survival are two metrics that may lead to population level consequences and are thus most relevant.

been removed in the known maternity colony assumed home range during the winter. While tree removal has been extremely limited during active season clearing in the known maternity colony buffer to date, up to 247.74 additional acres associated with 1 existing slip (0.06 acres) and future slips (247.68 acres) may also be removed from known use summer habitat during the active season under a worst-case scenario. Approximately 1,565.61 acres of tree removal in unknown use summer habitat has occurred during the active bat season. No trees were removed between June 1 and July 31 when young cannot fly. Mountain Valley has also committed to avoid conducting any future tree removal activities associated with slip repair in known and unknown use summer habitat (up to 247.74 acres) during the inactive bat season (November 15 through March 31), whenever possible. They have further committed to avoiding future tree removal during the period of time when pups are non-volant (June 1 – July 31), unless presence/probable absence surveys (in accordance with the Service's current Ibat Range-wide Survey Guidelines) indicate the probable absence of Ibat. Should an emergency arise, that would require tree clearing from June 1 to July 31, Mountain Valley will consult with the Service and FERC regarding the need for emergency consultation. While the timing and location of slips that are anticipated to occur in known and unknown use summer habitat are unpredictable under a worst-case scenario, they are more likely to occur during the wetter early spring and winter months, when Ibats are not active on the landscape. Additionally, existing slips have been small in acreage in the past, averaging 1.0 acre in size (including trees downed in the slip and removed during slip remediation). Furthermore, by nature, slips will occur along the ROW and ARs, areas that have been previously disturbed and will have on-going disturbance until the project construction period ends. Fewer Ibats are anticipated to be found immediately adjacent to these areas while construction is ongoing. Therefore, for the reasons described above, the potential for lethal effects from future tree removal during the active Ibat season due to slips and slip remediation is reduced.

As discussed in the Effects of the Action section, we anticipate 1 adult female and 9 pups present within each of the known and unknown maternity colony home ranges will be injured or killed from the felling of undocumented occupied roost trees. We expect that some individuals have or will experience reduced pregnancy success associated with increased energy expenditure from the loss of roosting/foraging habitat. Furthermore, bats impacted by WNS have additional energetic demands and reduction in flight ability. This compounds the stress of having to find new roosting and/or foraging habitat. Some individuals may have also expended additional energy finding prey, experienced higher predation risk, and/or experienced complications with pregnancy and rearing young, resulting in reduced reproductive potential. However, the AMMs (including TOYRs) will minimize reductions in the number of individuals and the reproductive rates in affected maternity colonies.

Tree removal in known use and unknown use spring staging/fall swarming habitat during the active bat season habitat is expected to affect Ibats using undocumented occupied roosts and foraging areas and disrupt bats engaging in fall swarming, spring staging, and roosting behavior. To date, active season clearing has occurred on 577.12 acres in unknown use spring and fall habitat; no tree removal has occurred during the active season in the habitat buffers around the 2 known hibernacula (Greenville Saltpeter Cave and Tawney's Cave) when Ibats would be expected to be present. However, up to an additional 247.68 acres could be removed during the active bat season for future slips under our worst-case scenario analysis in spring and fall Ibat habitat. Bats could be killed, injured, or forced to flee if an occupied roost tree is cut, or experience reduced breeding success. As discussed in the Effects of the Action, we anticipate that 8 Ibats are hibernating in each of the known hibernacula and that 1 adult bat per known hibernacula (total of 2) could be killed or injured if an occupied roost tree is felled as a result of a slip during the active bat season in known use spring and fall Ibat habitat around Tawney's Cave and Greenville Saltpeter Cave. We also anticipate 1 adult Ibat per hibernacula (10 assumed occupied hibernacula) will be injured or killed from the felling of undocumented occupied roost trees within unknown use spring staging/fall swarming habitat. We also expect that some individuals will experience temporary reduced mating success or reduced pregnancy success with increased energy expenditure from the loss of roosting/foraging habitat. Some individuals may also temporarily expend additional energy finding prey, experienced higher predation risk, and/or experience complications with pregnancy and rearing young, resulting in temporary reduced reproductive potential. To minimize impacts to individual Ibats, MVP has committed to avoid conducting any future tree removal activities associated with slip repair in known and unknown use spring and fall habitat during the active period (April 1 to November 14), whenever possible. .

Tree removal in known and unknown use spring staging/fall swarming habitat during the winter will remove foraging and roosting areas for a concentrated number of Ibats during spring emergence or fall swarming. The majority of tree removal activities within known use spring staging/fall swarming habitat (308.48 acres) and 251.51 acres within unknown use spring staging/fall swarming habitat was completed during the winter months (when bats were not present) and no direct impacts to Ibat hibernacula or hibernating bats were documented or are expected to have occurred for the reasons stated in the Environmental Baseline section. However, tree clearing within these areas resulted in temporary and permanent habitat loss, which we expect to cause decreased breeding success. We anticipate 4 adult females per hibernacula (2 known hibernacula and 10 assumed occupied hibernacula) were harmed from the loss of suitable spring staging/fall swarming habitat during the winter months.

In summary, we anticipate impacts to individual Ibats in either their survival or reproductive rates. As explained in the Effects of the Action section, these impacts are not expected to increase due to the additional NJF acres.

Impacts to Populations – As we have concluded that individual Ibats are likely to experience some reductions in their annual survival or reproductive rates, in this section, we evaluate the aggregated consequences of the reductions in the fitness of individuals on the population(s) to which those individuals belong. Specifically, we are analyzing how the reductions in individual fitness affect the population's abundance, reproduction, or growth rates to make inferences about the population's future reproductive success and its viability. Whether a population can withstand the consequences of aggregated fitness reductions in individuals depends upon its baseline status (i.e., its resiliency). Thus, our analysis entails defining the population(s) the individuals comprise and determining the current and future baseline condition of that population.

The affected Ibats fall within the AMRU. As noted in the Environmental Baseline section, at present, few healthy winter populations (and likely associated maternity colonies) remain in the AMRU, primarily as a result of WNS. The AMRU population has declined from 32,465 Ibats in 2011 to 1,996 Ibats in 2019, and WNS impacts are expected to continue across the range for years to come as are other ongoing threats (e.g., climate change, wind turbines) to the bats and their habitats. The Service (2019a) estimates the 2019 hibernating Ibat population is 648 in VA and 620 in WV; these numbers indicate a 30.9% increase in VA and a 42.4% decline in WV since the 2017 census. Overall, however, the status of the Ibat populations in VA and WV remain reduced. Taking into account the declining status of the species in the action area, we must assess whether the proposed action will appreciably reduce the likelihood of the continued survival of those populations, and ultimately, of the species as a whole.

As noted in the Status of the Species section, high Ibat adult female survival is required for stable or increasing growth rates and given the significant declines in populations across much of the range, it is essential to minimize impacts to reproductive potential for surviving Ibats. Individuals associated with 1 known and 3 unknown maternity colonies, including adult females, will be or have been affected by the MVP project in the form of injury, temporary reduced reproductive success, or, potentially, lethal harm in some cases. These effects are not expected to measurably decrease the fitness of these colonies overall, however, for several reasons. The majority of tree removal activities within known use summer habitat were, or likely will be, completed in the winter when bats are not present (November 15 - March 31), which is expected to significantly reduce the potential for death of Ibats in this known maternity colony during tree felling. Additionally, the removal of potential roost trees for all future slips and within unknown use summer habitat during the period of time when lactating females and non-volant pups are present (June – July) was and will continue to be avoided, which is expected to significantly avoid reductions in population numbers and reproductive rates in affected maternity colonies overall, because it reduces the likelihood of lethal impacts to bats. Further, not every bat from the 4 colonies is expected to have been exposed to stressors associated with the proposed action as they occur within a small portion of each colony's potential home range.

All impacts associated with the loss of any roosting or foraging habitat are anticipated to be short-term in nature, lasting up to two seasons post-construction. We do not anticipate a long-term reduction in any maternity colony fitness in this situation, because the Ibats are expected to acclimate to changes in the landscape given the amount of suitable habitat remaining within their anticipated home ranges. In addition, given the linear nature of the MVP project, we do not anticipate that significant areas of habitat (roosting, foraging, and travel) associated with these maternity colonies has been/will be affected by the MVP project. We expect that there will be suitable habitat adjacent to the LOD available to Ibats after future hibernation events.

Therefore, despite the declining status of the species in the action area, we conclude that adequate habitat will remain to maintain numbers, reproduction, and viability for any given maternity colony in the action area.

There are 2 known hibernacula and we have estimated that 10 additional hibernacula occur within the action area, all of which have associated spring staging/fall swarming habitat. No impacts to hibernating bats are expected; however, we anticipate impacts to individual Ibats present within known and unknown use spring staging/fall swarming habitat from tree clearing activities. There has been no active season tree clearing or tree loss associated with slips in known spring and fall habitat thus far; however, during our worst-case scenario analysis, 247.68 acres of future tree loss related to future slips is anticipated. However, Mountain Valley has committed to clearing trees to remediate future slips during the winter, as much as possible. Additionally, a review of past slips shows that they are typically small in size. Slips are also expected to occur adjacent to areas that have had previous tree removal (i.e., the ROW and ARs). Therefore, we anticipate that effects of tree clearing and slips on Ibats during the active season will be reduced, as we expect few Ibats to have relocated to areas immediately adjacent to the on-going disturbance. As a result of TOYRs, most past tree removal activities occurred when Ibats were not present. Most effects occurred during the first fall swarm after tree clearing. Ibats are expected to have acclimated to this change and shifted to alternative habitat within the known and unknown use spring staging/fall swarming areas. We do not expect a long-term reduction in any hibernating populations because a significant portion of the known and unknown use spring staging/fall swarming habitat will remain. Additionally, winter hibernacula counts were conducted in 2019 (post-tree removal activities) and Ibat numbers within Greenville Saltpeter Cave in WV were reported to have increased by 71.4% since 2018. The Ibat counts in Tawney's Cave in VA remain the same (0); however, the overall winter population estimates for the entire state of VA increased by 30.9%, indicating that known hibernating bat populations within the action area are stable and/or increasing. Therefore, we do not anticipate a long-term reduction in fitness because Ibats are expected to have acclimated to changes in the landscape given the amount of suitable habitat present within the AMRU in VA and WV (18,889,053 acres). Given the linear nature of the MVP project, we do not anticipate significant areas of habitat (roosting, foraging, and travel) associated with these spring staging/fall swarming areas has been/will be affected. We expect that there will be suitable habitat adjacent to the LOD available to Ibats after future hibernation events. Therefore, notwithstanding the declining baseline conditions in the action area, we conclude that the overall long-term health and viability of spring staging/fall swarming populations will not be negatively impacted.

As discussed above, tree removal associated with activities identified as cumulative effects is approximately 0.025% of the suitable habitat within the AMRU in VA and WV. Given the amount of suitable habitat present within the AMRU in VA and WV relative to the extent of the impact of these activities, the cumulative effects of future non-federal activities reasonably certain to occur within the action area do not pose a significant risk to Ibat populations in the action area in conjunction with project impacts. Furthermore, as discussed above, it remains unclear whether potential negative effects of climate change on Ibats will be balanced by positive effects of climate change and to what degree Ibats may adapt rangewide to a changing climate.

Accordingly, we conclude that the effects from the proposed action, when considered in light of the baseline conditions in the action area and in conjunction with potential cumulative effects and effects of climate change, do not pose a significant risk to Ibat populations in the action area and will not result in permanent population declines.

Impacts to Species – The final step in our analysis is to ascertain whether the anticipated impacts on the population(s) or recovery unit are likely to reduce the likelihood of both survival and recovery of the species by impacting its RND. Our analysis evaluates how the population-level effects determined above influence the likelihood of progressing towards or maintaining the conservation needs of the species rangewide, and therefore this analysis addresses species recovery in addition to species survival. To complete this analysis, we need to first determine the rangewide status of the species and then compare (1) what the species needs, (2) what it has, and (3) what the future expected status is. Here we connect the relative importance of the impacted population(s) to the rangewide status of the species to the impacts (positive and negative) from the proposed action.

If our analyses indicate that appreciable reductions in numbers, reproduction, and distribution are likely to occur, we conclude that the action is likely to jeopardize the continued existence of the species. Appreciable reduction means that it impacts the species in a biologically meaningful and consequentially negative way. If the population-level reductions do not appreciably (i.e., meaningfully) reduce the likelihood of maintaining or progressing towards one or more of the species' conservation needs, then the action is not likely to appreciably reduce the likelihood of both survival and recovery of the species, and our analysis is completed and a non-jeopardy determination is required.

As discussed above, currently, the rangewide status of the species is declining (Figure 8, Service 2019a). Declines are associated with the onset of WNS which has spread from NY south and west across the range. Impacts to Ibats to date are most severe in areas with the longest exposure to WNS (e.g., 75-99% declines in NY, WV, and PA) but declines have been observed in all RUs. Although we acknowledge those range-wide declines, the effects of the proposed action itself are limited to largely non-lethal and short-term impacts to 4 Ibat maternity populations and 12 hibernating Ibat populations. As we have concluded that the affected maternity and hibernating populations are unlikely to experience long-term reductions in fitness due to the limited magnitude, duration, and nature of the impacts of the action, there will be no appreciable reduction in RND on the species as a whole.

Impacts to Recovery of the Species – As stated in the Status of the Species section, the Service prepared a recovery plan for the species in 1983 (Service 1983) and drafted a revised recovery plan that was made available for public comment in 2007 (Service 2007b). In addition, 5-year reviews (Service 2009; 2019b) provide current summaries of the status of the species rangewide. Priority actions include: incorporating WNS into the recovery plan; monitoring status of hibernacula; monitoring status of maternity colonies; implementing the North American Bat Monitoring Program; providing for continual recruitment of high quality roosting habitat; securing permanent/long-term protection of Priority 1 and Priority 2 hibernacula; conducting additional research to understand the causes and potential spread of WNS; researching management actions aimed at minimizing the spread of WNS (i.e., an adaptive management approach); continuing public education/outreach efforts about WNS; and continuing to refine survey protocols.

Criteria for reclassification and delisting from the 2007 draft Recovery Plan are as follows:

Reclassification:

1. Permanent protection of a minimum of 80% of Priority 1 hibernacula in each RU, 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.
3. Documentation that shows important hibernacula within each RU have a positive annual population growth rate over the next 10-year period (i.e., 5 survey periods).

Delisting:

1. Permanent protection of a minimum of 50% of Priority 2 hibernacula in each RU.
2. A minimum overall population estimate equal to the 2005 population estimate of 457,000.
3. Documentation that shows a positive population growth rate within each RU over an additional 5 sequential survey periods (i.e., 10 years).

As discussed in the Status of the Species section, the Ibat draft recovery plan (Service 2007b) delineates RUs based on population discreteness, differences in population trends, and broad level differences in land use and macrohabitats. To help maintain adaptive capacity for the species (representation), multiple (redundant) healthy (resilient) populations should occur in all 4 RUs. As previously stated, the baseline status of the species within the AMRU is considered declining.

This project is anticipated to result in impacts (primarily nonlethal) to individual bats associated with 1 known and 3 unknown maternity colonies, 2 known (one Priority 3 and one Priority 4), and 10 unknown hibernacula. There are no known Priority 1 or 2 hibernacula within the action area. The persistence of the affected Ibat populations is not anticipated to be changed by this project. Therefore, those populations will retain the ability to contribute to the recovery of the species as a whole if they are not lost from WNS, to the same degree as would be expected without the project. While we anticipate that some adult females will be injured or killed or experience decreased reproductive success, these impacts will be to few individuals within a given colony, and the nonlethal impacts will be temporary. Additionally, we anticipate the number of females that will be killed is a subset of those few individuals that are injured, which further reduces the effects on recovery. Therefore, they will not have a significant effect on recovery potential of the affected colonies as a whole. In addition, we considered the potential impacts to recovery from the overall project including the loss of suitable surveyed habitat where no Ibats were captured. The entire Ibat range includes approximately 157,702,200 acres of potential habitat based on 2016 NLCD data. Because NLCD cover classes are coarse categories, it is difficult to assess how much of this potential habitat is truly suitable without additional field work. However, assuming all potential habitat is suitable allows for a conservative analysis. If all of this habitat was cleared, there is no likelihood of recovery of Ibats. If all documented currently occupied habitat was cleared, which is a subset of the larger potential habitat category, the likelihood of recovery would be significantly reduced given the high site fidelity of the species. If all unoccupied habitat (areas where presence/probable absence surveys were conducted and results were negative) was cleared, an argument could be made that the likelihood of recovery would be decreased; however, this may or may not be the case depending on numerous factors. There may still be sufficient habitat for a long-term increase in Ibat population size if maternity colony sizes rebound and expand in size in existing colony locations (known and unknown). Regardless, for purposes of this recovery analysis, we are only analyzing the potential impacts from clearing 1,234.91 acres of suitable unoccupied habitat, which are expected to be insignificant to recovery for the reasons below. Clearing associated with this project is 4,694.73 acres overall; 547.01 acres of occupied, 2,665.14 acres of unknown, 1,234.91 acres of unoccupied habitat; and 247.68 acres for future slips that are not assigned to a habitat category.

The AMRU is highly forested. For example, the Ibat range in VA and WV includes approximately 18,889,053 acres of potential habitat, based on NLCD 2016 land cover data. This project removes 4,694.73 acres in WV and VA within the AMRU and is linear in nature. Therefore, the habitat impacts associated with the MVP project, even including suitable unoccupied habitat for the purpose of analyzing recovery, represent less than 0.03% of available Ibat habitat within the AMRU.

As discussed in the Environmental Baseline section, we do not anticipate the status of Ibat populations to rapidly improve and fill in previously unoccupied suitable habitat. The closest summer location is approximately 9 miles from unoccupied previously surveyed habitat. While the overall status of the species is declining, the effects from this specific project are not anticipated to reduce appreciably the suitable habitat available for recovery or the recovery potential for the species.

<u>Northern long-eared bat (NLEB)</u>

Impacts to Individuals – In this step we determine whether any individuals of the species will be exposed to stressors from the various activities that are part of the proposed action. If exposure is likely, the next step is to determine the fitness consequences of individuals exposed to those stressors. The fitness of an individual can be measured by its reproductive success (which is determined by vital rates such as fertility rates, age at first reproduction, and reproductive intervals) and its survival likelihood. To assess whether fitness consequences may occur, we determine whether and how individuals are likely to respond[43] upon exposure to the stressors and beneficial actions associated with the proposed action. As the response of individuals upon exposure depends upon their condition (i.e., their health and resiliency), we must first establish the baseline conditions for those individuals. If the baseline condition of the individuals is unknown, generally we can use information about the status of the population or of the species as a whole (depending on the information available) to infer the degree of resiliency possessed by the individuals.

The majority of impacts to NLEBs were previously addressed in the 2016 Opinion for 4(d) rule on NLEB, which concluded that those effects were not likely to jeopardize the continued existence of the species. Pursuant to the streamlined consultation framework under the 4(d) rule, any resulting incidental take, which has already occurred, from the 3,824.90 acres of tree removal included in that consultation was accounted for under the 2016 NLEB 4(d) Opinion, which is less than the estimated total acres for forest conversion estimated by FERC during the streamlined consultation process under the 4(d) rule (4,453.10 acres). Nevertheless, due to the imminent reclassification of NLEB to endangered, effects of the total acreage of tree removal associated with the project are considered below. Some effects to NLEBs associated with impacts to habitat surrounding Canoe Cave, Tawney's Cave, and PS-WV3-Y-P1 were not covered by the 2016 Opinion. The action includes the permanent removal of 15.64 acres within 0.25 miles around these hibernacula, all of which has already been cleared. This area is likely to be used as roosting/foraging habitat in the fall or spring and the 12.43 acres around PS-WV3-Y-P1 is also likely to be used by 1 maternity colony in summer.

As a result of past clearing, individual NLEBs may have been temporarily affected by loss of fall swarming, spring staging, and summer habitat resulting in reduced reproductive success. Displaced NLEBs will expend additional energy seeking out alternate roosts and foraging habitat when they return the following season. These temporary effects will be greatest the first season after tree removal has occurred.

Tree removal in known use spring staging/fall swarming habitat during the inactive season will remove foraging and roosting areas for a concentrated number of NLEBs during spring emergence or fall swarming. All tree removal activities within known use spring staging/fall swarming habitat were completed during the winter months (when bats were not present) and no impacts to NLEB hibernacula or hibernating bats were expected or were documented to have occurred. However, tree clearing within these areas may have resulted in temporary and minimal permanent habitat loss, which we expect caused temporary decreased breeding success.

Future clearing includes tree clearing due to unknown slips, known slips and variances, and NJFs

[43] There are many possible biological responses (such as startle, alarm, flee, avoid, abandon/displace, reduced feeding success, reduced growth, reduced reproductive success, reproductive failure, and increased mortality) and many of these represent a form of take and thus must be expressed and evaluated in our Opinions. For our jeopardy analyses, however, reproductive success and survival are two metrics that may lead to population level consequences and are thus most relevant.

(a total of 255.46 acres). Unknown future slips may include up to 247.68 acres in any habitat category. Since the habitat category is unknown, we assumed the "worst case scenario," which included evaluating the affect to maternity colonies and assigning the highest level of take values (number of individual females and pups) for the activity. We anticipate up to up to 9 adult females per hibernacula (6 known hibernacula) may be injured or killed from future potential loss of suitable spring staging/fall swarming habitat during the active season. Also, we anticipate potential harm, injury, or death of up to one female and 7 pups per colony from loss of 9 maternity colonies in known use summer habitat. Other planned slip remediation and variances (all within known use summer habitat) contributed minimally and did not change the number of maternity colonies or hibernacula affected in this habitat category. NJFs will result in minimal clearing (generally less than 1 acre in patch size), but some patches may be permanent in nature.

In summary, we anticipate past clearing activity to have had temporary impacts to individual NLEBs in their reproductive rates. We also anticipate future impacts to individuals. As explained in the Effects of the Action section, these impacts are not expected to increase due to the additional NJF acres.

Impacts to Populations – As we have concluded it is likely that individual NLEBs have experienced and will experience temporary reductions in annual reproductive rates, in this section, we evaluate the aggregated consequences of the reductions in the fitness of individuals on the population(s) to which those individuals belong. Specifically, we are analyzing how the reductions in individual fitness affect the population's abundance, reproduction, or growth rates to make inferences about the population's future reproductive success and its viability. Whether a population can withstand the consequences of aggregated fitness reductions in individuals depends upon its baseline status (i.e., its resiliency). Thus, our analysis entails defining the population(s) the individuals comprise and determining the current and future baseline condition of that population.

As noted in the Environmental Baseline section, the status of the NLEB populations in VA and WV is declining from impacts due to WNS. Taking into account the declining status of the species in the action area, we must assess whether the proposed action will appreciably reduce the likelihood of the continued survival of those populations, and ultimately, of the species as a whole.

Individuals associated with 9 known maternity colonies have been or are anticipated to be affected by the MVP project. These effects are not expected to measurably decrease the fitness of this colony, however, for several reasons. The tree removal activities within known use summer habitat were completed in the winter when bats were not present (November 15 - March 31), which is expected to avoid the potential for direct injury or mortality of NLEBs in these known maternity colonies. Further, not every bat from these colonies is expected to have been exposed to stressors associated with the proposed action as they occur within a small portion of the colonies' potential home ranges. Future clearing includes tree clearing due to unknown slips, known slips and variances, and NJFs (a total of 255.46 acres). Again, we anticipate population-level affects to up to 9 maternity colonies from these activities. Individuals within populations may be injured or killed from future potential loss of suitable spring staging/fall swarming habitat during the active season whereas clearing during the inactive season may result in temporary impact to colonies from reduced breeding success associated with loss of roosting, travel, and foraging habitat. Mountain Valley has committed to complete other future slip-related clearing described above outside of the active season when bats are not present when possible, and pursuant to Mountain Valley's commitment described above, Mountain Valley will avoid the non-volant pup season absent negative surveys or conferring first with USFWS on emergency consultation. Therefore, we do not expect a decrease in fitness of bats occupying the affected maternity colonies.

All impacts associated with the loss of any roosting or foraging habitat are anticipated to be short-term in nature, lasting up to two seasons post-construction. We do not anticipate a long-term reduction in maternity colony fitness because in this situation, the NLEBs are expected to acclimate to changes in the landscape given the amount of suitable habitat remaining within their anticipated home ranges. In addition, given the primarily linear nature of the MVP project, we do not anticipate that significant areas of habitat (roosting, foraging, and travel) associated with this maternity colony have been/will be affected by the MVP project. We expect that there will be suitable habitat adjacent to the LOD available to NLEBs after future hibernation events.

Therefore, despite the declining status of the species in the action area, we conclude that adequate habitat will remain to maintain numbers, reproduction, and viability for any known maternity colony in the action area.

There are 6 known hibernacula within the action area, all of which have associated spring staging/fall swarming habitat. No impacts to hibernating bats were documented or are anticipated to have occurred; however, we anticipate impacts to individual NLEBs present within spring staging/fall swarming habitat from tree clearing activities. Again, future clearing includes tree clearing due to unknown slips, known slips and variances, and NJFs (a total of 255.46 acres), which may occur when bats are present and active. As a result of TOYRs, most tree removal activities occurred or will occur when NLEBs were or are not present. Although there is risk to reduced survivorship or direct mortality of individuals (adults) associated with occupied roost tree removal during the active season, impacts are expected to be low (no more than 1 bat per hibernacula) and most effects occurred or are anticipated to occur during the first fall swarm after tree clearing. NLEBs are expected to have acclimated to this change and shifted to alternative habitat within the spring staging/fall swarming areas. We do not expect a long-term reduction in any hibernating populations because a significant portion of the spring staging/fall swarming habitat will remain in the action area. Given the primarily linear nature of the MVP project, we do not anticipate significant areas of habitat (roosting, foraging, and travel) associated with these spring staging/fall swarming areas have been/will be affected. We expect that there will be suitable habitat adjacent to the LOD available to NLEBs after future hibernation events.

Therefore, notwithstanding the declining baseline conditions in the action area, we conclude that the overall long-term health and viability of known spring staging/fall swarming populations will not be negatively impacted.

The total amount of known or unknown suitable NLEB habitat that will or has been removed by the MVP project is 4,091.62 acres, including 3,840.54 acres previous cleared that was authorized pursuant to the 2016 Opinion for the 4(d) rule or the 2020 Opinion when it occurred and 251.08 acres of future clearing. The total amount of suitable occupied or unknown habitat removed as a result of the project (4,091.62) is 0.015% of the total amount of suitable NLEB habitat (forested acres) in VA and WV (28,200,537.53 acres based on NLCD 2019 land cover data acres).

As discussed above, disturbance associated with activities identified as cumulative effects is 47,712.26 acres of spring staging/fall swarming habitat. Given the amount of suitable habitat present for NLEB in VA and WV relative to the extent of the impact of these activities, the cumulative effects of future non-federal activities reasonably certain to occur within the action area do not pose a significant risk to NLEB populations in the action area in conjunction with project impacts. Furthermore, although NLEB are expected to be impacted by climate change in the future, impacts are currently considered to be low. Therefore, the risk is low that significant aggregate effects will occur over the period during which effects of the action are expected to persist.

Accordingly, we conclude that the effects from the proposed action, when considered in light of the baseline conditions in the action area and in conjunction with potential cumulative effects and effects of climate change, do not pose a significant risk to NLEB populations in the action area and will not result in permanent population declines.

Impacts to Species – The final step in our analysis is to ascertain whether the anticipated impacts on the population(s) or recovery unit are likely to reduce the likelihood of both survival and recovery of the species by impacting its RND. Our analysis evaluates how the population-level effects determined above influence the likelihood of progressing towards or maintaining the conservation needs of the species rangewide, and therefore this analysis addresses species recovery in addition to species survival. To complete this analysis we need to first determine the rangewide status of the species and then compare (1) what the species needs, (2) what it has, and (3) what the future expected status is. Here we connect the relative importance of the impacted population(s) to the rangewide status of the species to the impacts (positive and negative) from the proposed action.

If our analyses indicate that appreciable reductions in numbers, reproduction, and distribution are likely to occur, we conclude that the action is likely to jeopardize the continued existence of the species. Appreciable reduction means that it impacts the species in a meaningful and consequentially negative way that is more than "background" noise of the species' population dynamics. If the population-level reductions do not appreciably (i.e., meaningfully) reduce the likelihood of progressing towards or maintaining one or more of the species' conservation needs, then the action is not likely to appreciably reduce the likelihood of both survival and recovery of the species, and our analysis is completed and a non-jeopardy determination is required.

As discussed above, currently, the rangewide status of the species is declining. Declines are associated with the onset of WNS which has spread from NY south and west across the range. Although we acknowledge those rangewide declines, the effects of the proposed action itself are limited to individuals within 9 NLEB maternity colonies and 24 hibernating (known and from assumed occupied hibernacula) NLEB populations. As we have concluded that the affected maternity and hibernating populations are unlikely to experience long-term reductions in fitness, there will be no appreciable reduction in RND on the species as a whole.

Impacts to Recovery of the Species – As stated in the Status of the Species section, there is no recovery plan for the NLEB. However, our current focus addresses the following conservation needs similar to the Ibat:

- Managing the effects of WNS;
- Conserving and managing winter colonies, hibernacula, and surrounding swarming habitat;
- Conserving and managing maternity colonies; and
- Conserving migrating bats.

This project is anticipated to result in impacts to individual bats associated with 6 known hibernacula. Given that the persistence of affected populations is not likely to be affected by this project, they will retain the ability to contribute to the recovery of the species as a whole to the same degree as would be expected without the project. While we anticipate decreased reproductive success of some adult females, these impacts will be to few individuals within a given colony and will be temporary. Therefore, they will not have a significant effect on recovery potential.

In addition, we considered the potential impacts to recovery from the overall project including the loss of suitable surveyed habitat where no NLEB were captured. For purposes of this recovery analysis, we analyze the potential impacts from clearing 603.11 acres of suitable unoccupied habitat, which are expected to be insignificant to recovery for the reasons below. Clearing associated with this project is 4,694.73 acres overall; 3,508.01 acres of suitable occupied, 335.93 acres of suitable unknown, 603.11 acres of suitable unoccupied habitat; and 247.68 acres for future slips that are not assigned to a habitat category.

Virginia and WV are highly forested, with 28,200,537.53 acres of suitable (occupied or unknown) NLEB habitat. This project removes 4,091.62 of suitable (occupied or unknown) acres in VA and WV and is primarily linear in nature. Therefore, the habitat impacts represent 0.015 % of available NLEB habitat in VA and WV. This project removes a total of 4,694.73 acres of forested habitat overall in WV and VA and is linear in nature. Therefore, the habitat impacts associated with the MVP project, even including suitable unoccupied habitat for the purpose of analyzing recovery, represent less than 0.017% of available NLEB habitat in VA and WV. Because the availability of suitable habitat is not currently a limiting factor and most of the available suitable habitat (both in the vicinity of the 6 known hibernacula and elsewhere in the species' range) will remain after project completion, the project will not appreciably reduce the quantity of suitable habitat available for species recovery.

While the overall status of the species is declining, the effects from this specific project are not anticipated to reduce appreciably the suitable habitat available for recovery or the recovery potential for the species.

Roanoke logperch (RLP)

Impacts to Individuals – In this step we determine whether any individuals of the species will be exposed to stressors from the various activities that are part of the proposed action. If exposure is likely, the next step is to determine the fitness consequences of individuals exposed to those stressors. The fitness of an individual can be measured by its reproductive success (which is determined by vital rates such as fertility rates, age at first reproduction, and reproductive intervals) and its survival likelihood. To assess whether fitness consequences may occur, we determine whether and how individuals are likely to respond[44] upon exposure to the stressors and beneficial actions associated with the proposed action. As the response of individuals upon exposure depends upon their condition (i.e., their health and resiliency), we must first establish the baseline conditions for those individuals. If the baseline condition of the individuals is unknown, generally we can use information about the status of the population or of the species as a whole (depending on the information available) to infer the degree of resiliency possessed by the individuals.

The proposed action includes clearing – trees and shrubs and herbaceous vegetation and ground cover; grading, erosion control devices; trenching (digging, blasting, dewatering, open trench, sedimentation); regrading and stabilization – restoration of corridor; ARs – upgrading existing roads, new roads temporary and permanent – grading, graveling, tree trimming and tree removal; and stream crossing – dam and pump. As discussed in the Effects of the Action, effects of the action include effects to RLP present within the impact area year-round. For the North Fork Roanoke River 1 open-cut crossing (MP 227.2, Stream ID S-G36), temporary reductions in RLP foraging were expected as a result of temporary dams preventing access to foraging areas and individuals moving to new habitat to avoid sedimentation. As previously mentioned, sediment deposited on the waterbody bottom from upland sedimentation will interfere with the ability of RLP to feed (Robertson et al. 2006). In response to sediment plumes and increased suspended sediment, most RLP are anticipated to alter feeding behavior, move to clearer water, resume

[44] There are many possible biological responses (such as startle, alarm, flee, avoid, abandon/displace, reduced feeding success, reduced growth, reduced reproductive success, reproductive failure, and increased mortality) and many of these represent a form of take and thus must be expressed and evaluated in our Opinions. For our jeopardy analyses, however, reproductive success and survival are two metrics that may lead to population level consequences and are thus most relevant.

normal activity, and use the area again once until sediment levels return to background levels. Individuals will expend more energy to seek out different foraging areas. A TOYR (March 15 - June 30) to protect RLP during their spawning season will be implemented, which will minimize the potential for effects from sedimentation to spawning adults and larvae.

In summary, we anticipate impacts to individual RLP in either their survival or reproductive rates.

Impacts to Populations – As we have concluded it is likely that individual RLP have experienced and will experience temporary reductions in annual reproductive rates, in this section, we evaluate the aggregated consequences of the reductions in the fitness of individuals on the population(s) to which those individuals belong. Specifically, we are analyzing how the reductions in individual fitness affect the population's abundance, reproduction, or growth rates to make inferences about the population's future reproductive success and its viability. Whether a population can withstand the consequences of aggregated fitness reductions in individuals depends upon its baseline status (i.e., its resiliency). Thus, our analysis entails defining the population(s) the individuals comprise and determining the current and future baseline condition of that population.

We expect that the population level impacts from habitat alteration, foraging disruption, injury, and death, to the RLP will be relatively small in light of the baseline conditions of the relevant populations, and because the proposed action affects a small number of individuals relative to the overall population numbers and most of the effects of sedimentation on individual RLPs are expected to be sublethal. As discussed in the Environmental Baseline section, despite degraded habitat conditions in portions of the action area, the relevant RLP populations are currently stable and well above minimum viability thresholds (Service 2022b; Roberts et al. 2016b). As stated above, approximately 679 adult RLP (4.8% of the total estimated adult population), and approximately 4.8% of the total YOY and juvenile population would be present within the Upper Roanoke MU impact area, which represents 4.8% of the RLP potential habitat within the Upper Roanoke MU (with the addition of Bradshaw Creek). Approximately 141 adult RLP (2% of the total estimated adult population), and approximately 2% of the total YOY and juvenile population, would be present within the Pigg MU impact area, which represent 2% of the RLP potential habitat within the Pigg MU (with the addition of Harpen Creek). None of the affected habitat in the Upper Roanoke or Pigg MUs will be rendered permanently unsuitable as a result of the project. The Upper Roanoke and Pigg MUs represent 2 of the 3 largest mean current RLP population sizes (Service 2022b). For several reasons we do not anticipate a long-term reduction in fitness in these populations: (1) sufficient numbers of adult, YOY, and juvenile RLP are likely to be present in suitable habitat outside of the impact area such that individuals are available to repopulate the impact area as project effects dissipate; (2) following completion of each subactivity that results in adverse effects to RLP, we expect that the RLP population, given no other new major stressors above baseline conditions, will recover to baseline levels within 3-5 years; (3) the amount of habitat to be temporarily impacted is minor (0.6%) compared to the total range extent of all the MUs (3,514 km); and the amount of habitat impacted in each MU is also relatively minor (4.8% of in the Upper Roanoke MU plus Bradshaw Creek, and 2% in the Pigg MU plus Harpen Creek); (4) the effects of the proposed action are expected to be primarily temporary; (5) in general, RLP habitat will recover to a suitable condition following temporary impacts; (6) RLP are expected to continue to occupy waterways within the impact areas during and after the project, as most of the project-related effects are expect to be sublethal; and (7) RLP are highly mobile and are capable of avoiding impact areas by moving to additional areas of suitable habitat and then back to impact areas once temporary impacts lessen or abate. As mentioned earlier, the SSA (Service 2022b) simulated population-size changes and future conditions under 12 scenarios featuring alternative combinations of urbanization, climate change, and conservation intervention. Scenario 4 was the most dire, with no management, increased risk of watershed urbanization, decreased habitat suitability, no population augmentation, and no barrier removal. Under this scenario at least 1 MU persisted in each metapopulation. Both the Upper Roanoke MU and Pigg MU persisted in this scenario. We do not expect that the MVP project will cause significant reductions in short-term fitness or any reduction in long-term fitness of these RLP MUs, let alone rise to the level that is simulated in scenario 4.

In addition, the project's effects on RLP are expected to last up to four years, as benthic invertebrate communities affected by sedimentation gradually return to baseline levels; most of the sedimentation-related effects would be expected to last no more than 1-2 years. For two reasons, we do not expect that the effects of the action would aggregate with cumulative effects, the effects of climate change, and the effects of dams and other barriers during this period in a manner that would pose significant risks to the relevant RLP populations. First, as discussed above, cumulative effects are unlikely to significantly degrade baseline conditions in the action area. Second, the adverse effects of climate change and declines in habitat quality over a far longer 50-year period are unlikely to significantly affect the resiliency of the relevant populations, even under a worst-case scenario (Service 2022b). Therefore, the risk is low that significant aggregate effects will occur over the four-year period during which the effects of the action are expected to persist. For these reasons, we conclude that the effects from the proposed action, when considered in light of the baseline conditions in the action area and in conjunction with potential cumulative effects, the effects of climate change, and the effects of dams and other barriers, do not pose a significant risk to the RLP Upper Roanoke or Pigg MUs and will not result in permanent population declines.

Impacts to Species – The final step in our analysis is to ascertain whether the anticipated impacts on the population(s) or recovery unit are likely to reduce the likelihood of both survival and recovery of the species by impacting its RND. Our analysis evaluates how the population-level effects determined above influence the likelihood of progressing towards or maintaining the conservation needs of the species rangewide. To complete this analysis we need to first determine the rangewide status of the species and then compare (1) what the species needs, (2) what it has, and (3) what the future expected status is. Here we connect the relative importance of the impacted population(s) to the rangewide status of the species to the impacts (positive and negative) from the proposed action.

If our analyses indicate that appreciable reductions in numbers, reproduction, and distribution are likely to occur, we conclude that the action is likely to jeopardize the continued existence of the species. Appreciable reduction means that it impacts the species in a meaningful and consequentially negative way that is more than "background" noise of the species' population dynamics. If the population-level reductions do not appreciably (i.e., meaningfully) reduce the likelihood of progressing towards or maintaining one or more of the species' conservation needs, then the action is not likely to appreciably reduce the likelihood of both survival and recovery of the species, and our analysis is complete, and a non-jeopardy determination is required.

As we have concluded that the Upper Roanoke and Pigg MUs of RLP are unlikely to experience meaningful reductions in in fitness, there will be no reduction in RND on the species as a whole.

Impacts to Recovery of the Species – As stated in the Status of the Species section, the Service prepared a recovery plan for the species in 1992 (Service 1992b). The 5-year review (Service 2022a) recommends delisting the species due to recovery. Based on the species' current representation, resiliency, and redundancy and an analysis of threats that may influence its future condition, the 5-year review concluded that the RLP has a very low risk of extinction in the near term and that this risk is not likely to increase appreciably in the foreseeable future.

As discussed in the Status of the Species section, there are multiple (i.e., 11) (redundancy) MUs spread across the geographic range of the species (representation); however, the health (resiliency) of those populations varies across the range but is high in the Upper Roanoke and Pigg MUs. The RLP has a very low risk of extinction in the near term and that risk is not likely to increase appreciably in the foreseeable future (Service 2022a). As a whole, the rangewide status of the species is improving.

As discussed above, this project is anticipated to affect a small number of individuals in the Upper Roanoke and Pigg MUs relative to the overall population numbers and most of the effects are expected to be sublethal. None of the affected habitat in the Upper Roanoke or Pigg MUs will be rendered permanently unsuitable as a result of the project.

The amount of habitat to be impacted is minor (0.6%) compared to the total range extent of all the MUs (3,514 km); and the amount of habitat impacted in each MU is also relatively minor (4.8% of in the Upper Roanoke MU plus Bradshaw Creek, and 2% in the Pigg MU plus Harpen Creek); the effects of the proposed action are expected to be primarily temporary; in general, RLP habitat will recover to a suitable condition following temporary impacts; and RLP are expected to continue to occupy waterways within the impact area during and after the project. Although the MVP project will temporarily increase sedimentation and embeddedness in portions of the action area that fall within the RLP Upper Roanoke and Pigg MUs as detailed above, the project will not increase other threats listed in the RLP recovery plan (Service 1992b) such as building dams or other impediments to movement; increase channelization; remove woody debris; or create a long-term water withdrawal project. The overall status of the species is improving and the effects from this specific project are not anticipated to reduce appreciably the suitable habitat available for recovery or the recovery potential for the species.

Candy darter (CD)

Impacts to Individuals – In this step we determine whether any individuals of the species will be exposed to stressors from the various activities that are part of the proposed action. If exposure is likely, the next step is to determine the fitness consequences of individuals exposed to those stressors. The fitness of an individual can be measured by its reproductive success (which is determined by vital rates such as fertility rates, age at first reproduction, and reproductive intervals) and its survival likelihood. To assess whether fitness consequences may occur, we determine whether and how individuals are likely to respond[45] upon exposure to the stressors and beneficial actions associated with the proposed action. As the response of individuals upon exposure depends upon their condition (i.e., their health and resiliency), we must first establish the baseline conditions for those individuals. If the baseline condition of the individuals is unknown, generally we can use information about the status of the population or of the species as a whole (depending on the information available) to infer the degree of resiliency possessed by the individuals.

The proposed action includes clearing – trees and shrubs and herbaceous vegetation and ground cover; grading, erosion control devices; trenching (digging, blasting, dewatering, open trench, sedimentation); regrading and stabilization – restoration of corridor; ARs – upgrading existing roads, new roads temp and permanent – grading, graveling; and ARs – upgrading existing roads, new roads temporary and permanent – tree trimming and tree removal. As discussed in the Effects of the Action, effects of the action include effects to CD present within the impact area year-round. Temporary reductions in CD foraging are expected as a result of increased sedimentation/suspended sediment reducing visibility, decreasing available prey, and preventing access to foraging areas (interstitial spaces) filled in by sediment. CD may move to new habitat to avoid sedimentation, resulting in increased energy expenditures and stress, as well as increased risk of predation while moving to new area. In response to sediment plumes, most CD are anticipated to temporarily alter feeding behavior and/or move to clearer water until sediment levels return to background levels. In the event of prolonged exposure to elevated sediment plumes, individuals may resume attempts to feed in the same areas, but at reduced efficiency (requiring increased effort) due to the combination of reduced visibility and reduced prey availability. Individuals will expend more energy to seek out different foraging areas. Decreased visibility is expected to reduce spawning efficiency via increased effort to find suitable spawning partners. Increased sediment deposition is expected to reduce spawning efficiency by reducing the availability of suitable substrates for egg-laying.

[45] There are many possible biological responses (such as startle, alarm, flee, avoid, abandon/displace, reduced feeding success, reduced growth, reduced reproductive success, reproductive failure, and increased mortality) and many of these represent a form of take and thus must be expressed and evaluated in our Opinions. For our jeopardy analyses, however, reproductive success and survival are two metrics that may lead to population level consequences and are thus most relevant.

In summary, we anticipate impacts to individual CD in either their survival or reproductive rates.

Impacts to Populations – As we have concluded it is likely that individual CDs have experienced and will experience temporary reductions in annual reproductive rates, in this section, we evaluate the aggregated consequences of the reductions in the fitness of individuals on the population(s) to which those individuals belong. Specifically, we are analyzing how the reductions in individual fitness affect the population's abundance, reproduction, or growth rates to make inferences about the population's future reproductive success and its viability. Whether a population can withstand the consequences of aggregated fitness reductions in individuals depends upon its baseline status (i.e., its resiliency). Thus, our analysis entails defining the population(s) the individuals comprise and determining the current and future baseline condition of that population.

As discussed above, the project will affect the Gauley River (upper) and Stony Creek CD populations. The SSA rated the overall condition of the Gauley River (upper) population "moderate" (marginally secure). The overall condition of the Stony Creek population was rated "high" (generally secure) (Service 2018a). The SSA contains the best available information on the condition of the relevant CD populations, and the more recent baseline stream assessments do not cast doubt on the continued validity of the SSA's population assessments. Also as discussed, the cumulative effects of the activities identified in the 3 HUC-12 watersheds adjacent stream segments occupied by these populations are unlikely to significantly change the baseline condition of each population or the habitat occupied by that population.

The SSA modeling suggests that the baseline condition of each population is likely to be degraded by hybridization with the variegate darter, an independent factor that represents the single greatest threat to the species. The SSA identified Scenario 3, involving variegate darter expansion, as the most likely future scenario. Scenario 3 modeled the effects of variegate darter expansion in isolation (i.e., no concurrent changes to the habitat metrics). In scenario 3a (5-year variegate darter expansion), the condition of the Gauley River (upper) population changed from moderate to low (population generally insecure). In scenario 3b (10-year variegate darter expansion), the Gauley River (upper) population is extirpated. In scenarios 3d and 3e (20- and 25-year variegate darter expansion), the condition of the Stony Creek population changes from high to moderate (population is marginally secure) (Service 2018a, Table 6).

However, as discussed above, it is important to note that while the CD SSA identified the expansion of variegate darter range and hybridization in Scenario 3 as the most likely future scenario, this does not mean that full expansion of the hybridization zone throughout the Greenbrier River and Gauley River populations is a foregone conclusion. The modeled scenarios represent best guesses at future outcomes to the species as a whole, given various sets of potential circumstances. Regarding Scenario 3, the SSA states "The data suggest variegate darters have been introduced into the Upper Gauley watershed and that additional bait bucket transfers will result in the pattern of candy darter hybridization and loss previously observed in the Lower Gauley and Greenbrier to be repeated." The 5-year increments modeled for Scenario 3 indicated that at the +5 year mark, the Upper Gauley CD populations would be significantly degraded, with almost half of those extirpated entirely by the +10 year mark. Given that the SSA was published in March 2018, we have now reached the +5 year point of the initial model. The best available evidence does not indicate that the predicted aggressive expansion of variegate darters in the upper Gauley River watershed has proceeded as estimated by Scenario 3. To date, all known genetic assays of CD in the Upper Gauley have yielded only faint traces of variegate darter alleles. We attribute this discrepancy to several factors: (1) The SSA modeled the predicted rates "Based on the observed range expansion of the variegate darter in the Lower New, Lower Gauley, and Greenbrier River watersheds and the subsequent decline or loss of candy darters where the two species are in contact." Given that these rates are based exclusively on watersheds where variegate darters have unimpeded access to CD, the barriers to movement at Summersville Dam and Bluestone Dam are likely providing substantial protection from variegate darter incursions. (2) The SSA states "While we have data with which to estimate the expansion of variegate darters within a candy darter metapopulation, we cannot predict with accuracy if or when a bait bucket transfer (or other anthropogenic mechanism) would result in the establishment of the species in other candy darter Watersheds." Thus, the assumption that variegate darters would overrun the Upper Gauley CD metapopulation is explicitly acknowledged to be highly unpredictable. (3) The conditions modeled in the SSA are based upon the conditions observed at the time – when the species was not protected under the ESA – and do not evaluate what changes would occur if the species were listed. We reiterate these points to emphasize that the risk of extirpation of the Upper Gauley CD metapopulation is a risk, but is not a foregone conclusion or inevitable outcome. The presence of advanced generation hybrid CD/variegate darters that have backcrossed to the point of near-purity of CD alleles indicates that previous small-scale introductions of variegate darters above Summersville Dam failed to cause genetic swamping of the population. Therefore, the risk of significant variegate darter expansion or genetic swamping in the Upper Gauley population may not be as severe or as imminent as suggested in the SSA's risk projections.

However, even accepting the SSA's risk projections under Scenario 3, our jeopardy analysis would remain unchanged. Scenario 3 suggests that regardless of whether the project proceeds, hybridization may significantly degrade the Stony Creek population and potentially extirpate the Upper Gauley population. That possibility, however, does not automatically require a jeopardy determination for this project or alter our inquiry at this step of the analysis. Even when a species faces significant threats unrelated to the proposed action, the jeopardy analysis focuses on the effects of the action and asks whether that action will reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild (50 CFR 402.02). As noted, an "appreciable reduction" means a reduction that impacts the species as a whole in a biologically meaningful and consequentially negative way.

Therefore, notwithstanding the severe threats that hybridization poses, we must evaluate whether the project's likely effects on individual CD within each affected population (considered in conjunction with potential cumulative effects and the effects of climate change) are likely to negatively impact that population's abundance, reproduction, or growth rates in a manner that reduces its future reproductive success and viability or its prospects for recovery. With respect to the hybridization threat, we consider whether the proposed action is likely to exacerbate that threat or preclude population recovery if ongoing hybridization is arrested. In other words, will the proposed action alter the condition of each population in a way that exacerbates or accelerates the threat of hybridization? Consistent with Section 7 of the ESA, these inquiries are generally answered with respect to the species as a whole, rather than at the population level. But for purposes of this particular consultation, we first ask those questions with respect to each affected population before determining the answers with respect to the species as a whole, which is the ultimate focus of the jeopardy inquiry.

Relevant to this issue, several courts have stated that "where baseline conditions already jeopardize a species, an agency may not take action that deepens the jeopardy by causing additional harm." National Wildlife Federation v. National Marine Fisheries Service, 524 F.3d 930 (Ninth Circuit 2008). That statement cannot be interpreted to mean that when baseline conditions for a listed species are degraded, any proposed action that will harm individual members of the species automatically requires a jeopardy determination: the ESA authorizes the Service to permit take of individual members of an endangered species, which by definition is currently in danger of extinction throughout all or a significant portion of its range, 16 USC 1532(6), provided that the take does not jeopardize the continued existence of the species as a whole, 16 USC 1536(b)(4)(B). Part of the confusion resulting from the Ninth Circuit court's statement is that the ESA does not use the term "jeopardy" to describe baseline conditions; the statute instead uses the phrase, "to jeopardize the continued existence of," 16 USC 1536(a)(2), which means "to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild," 50 CFR 402.02. So at all times, the proposed action, not baseline conditions, is the subject of the jeopardy determination. As a general matter, the more degraded the baseline conditions for the species at issue, the less harm that a proposed action may cause to individual members of that species before triggering a jeopardy determination. But in all cases, the proposed action cannot result in jeopardy unless that action will reduce appreciably the likelihood of both the survival and recovery of the species as whole, taking into account the environmental baseline in the action area, cumulative effects, and environmental conditions such as climate change.

For both the Gauley River (upper) and Stony Creek populations, we expect that the population level impacts from habitat alteration, foraging disruption, injury, and death to the CD will be relatively minor, including when the project's effects are aggregated with potential effects from other activities, because most of the effects of sedimentation on individual CDs are expected to be sublethal and because the impact areas in which CD will be affected comprise a relatively small portion of the species' range within these populations. Further, although the extent to which the other activities in the relevant watersheds discussed above could affect conditions in CD-occupied streams is uncertain and would depend upon how those activities are implemented, our best judgment is that the cumulative effects in the action area are unlikely to significantly degrade baseline conditions in the aquatic action area and are not expected to aggregate with the project's effects to create significant new impact areas given the relatively limited nature and extent of the activities that may cause cumulative effects, the distance of many of the activities from aquatic action area, and the increased implementation of forestry and construction best management practices designed to reduce erosion and sedimentation (Service 2018a).

Robust population estimates are not available for CD populations in the Gauley River and Stony Creek. The Upper Gauley River metapopulation contains 6 populations within close proximity to each other (182 smi total) (Service 2018a), of which the Upper Gauley River population constitutes 27.2 smi. The impact area includes approximately 1.24 smi of the Upper Gauley River known to support CD, which represents approximately 4.56% of the CD occupied habitat within the Upper Gauley River and 0.68% of the occupied habitat within the Upper Gauley River metapopulation. CD abundance was considered “good” in the Upper Gauley River during the SSA (Service 2018a), but no specific population estimates are available or can be readily obtained. The Middle New River metapopulation (25.1 smi) contains 3 disjunct populations, of which the Stony Creek population constitutes 19.3 smi. The impact area includes approximately 0.62 mi of Stony Creek known to support CD, which represents approximately 3.21% of the CD occupied habitat within Stony Creek and 2.47% of the occupied habitat within the Middle New River metapopulation.

For several reasons we do not anticipate that the project’s effects on individual CD are likely to result in a long-term reduction in fitness in these populations, including when the project’s effects are aggregated with potential effects from other activities: (1) CD are likely to be present in suitable habitat outside of the impact area such that individuals are available to repopulate the impact area as project effects dissipate; (2) habitat quality within the Gauley River and Stony Creek is rated as “moderate” and “good” respectively, and is not expected to be permanently altered; (3) effects are expected to occur for a short duration and are expected to be primarily temporary; (4) following completion of each action that results in adverse effects to CD, we expect that the CD population, given no other major stressors, will recover to baseline levels within 3-5 years; (5) the amount of habitat to be temporarily impacted is minor (0.51%) compared to the overall amount of CD habitat available rangewide (368 smi total); (6) in general, CD habitat will recover to a suitable condition following temporary impacts; (7) CD are expected to continue to occupy waterways within the impact area during and after the project; (8) the project’s effects are unlikely to increase the risk hybridization with the variegate darter; and (9) the best available science now shows that CD are more mobile and have a longer lifespan than previously believed.

Consideration of potential cumulative effects within the action area does not alter our conclusion. As discussed above, even under the extreme negative habitat scenario modeled in the SSA, which involved a 10% loss of forest cover in areas where land ownership is either mostly private or a mix of private and public, the overall condition of the Upper Gauley River and Stony Creek CD populations did not change. Combined, the project and the other identified activities in the 3 relevant HUC-12 watersheds would not result in the clearing 10% of forest cover in any watershed. Nor are the project and other identified activities combined likely to cause impacts to CD habitat that would be comparable to the impacts resulting from clearing 10% of the forest cover in any watershed. The combined effects of the project and the other activities identified in the 3 HUC-12 watersheds also are not expected to increase the risk of hybridization with the variegate darter. Although the SSA notes the possibility that negative habitat changes could selectively benefit variegate darters and increase the rate at which pure CD are extirpated, it also notes that this hypothesis is unconfirmed (Service 2018a). There is also no data suggesting that habitat changes in the form of increased sedimentation—the primary effect of the project and the other identified activities in the 3 HUC-12 watersheds that could give rise to cumulative effects—would selectively benefit variegate darter. Furthermore, this risk would be most acute where hybridization is already occurring. The Upper Gauley population is thought to be relatively pure, with low-frequency occurrence of variegate darter alleles (Gibson et al. 2019), and the Stony Creek population is thought to be isolated from West Virginia populations and hybridization events by Bluestone Dam and Reservoir (McBaine and Hallerman 2020; Service 2018a).

Although the potential effects of climate change on the Upper Gauley River and Stony Creek are highly uncertain, climate change effects are also unlikely to aggregate with cumulative effects and the effects of the action to cause significant population-level harm. As discussed, the period during which such aggregation could occur would be limited to no more than 4 years after construction, when any remaining effects of the project are expected to dissipate. Although there is little empirical evidence related to the potential effects of climate change on the CD, we conclude that the potential effects are unlikely to be significant during that relatively limited period.

Climate change could impact CD primarily through changes in water flow, which could adversely affect the physical characteristics of CD-occupied streams, and through changes in water temperature. NOAA State Climate Summaries for 2022 provides current information on precipitation trends in VA and WV (https://statesummaries.ncics.org/#about). Both states are expected to experience increased precipitation and storm events as a result of climate change, which could adversely affect CD habitat thorough scouring, increased sedimentation, channelization, and reduced streambank stability.

Statewide, total annual precipitation in VA shows a small upward trend, with multiyear values mostly above average since 1995. The driest multiyear periods were in the early 1930s and late 1960s, and the wettest were in the late 1970s and late 2010s. The driest consecutive 5-year interval was 1963–1967, and the wettest was 2016–2020. The wettest year on record was 2018 (statewide total of 63.5 inches), and 2020 was the third wettest (61.4 inches), while 1930 was the driest (24.7 inches). Total summer precipitation is highly variable and was above average during the 2015–2020 period. Since 1990, the number of 2-inch extreme precipitation events has been trending upward, with the 2015–2020 period surpassing the previous high of the late 1990s. Annual precipitation is projected to increase in VA. The state is part of a large area across the northern and central United States that shows projected increases in precipitation by midcentury. The number and intensity of extreme precipitation events are also projected to increase, continuing recent trends. Periodic droughts, a natural part of VA's climate, are projected to be more intense. Even if overall precipitation increases, higher temperatures will increase the rate of soil moisture loss during dry spells. However, there is substantial regional variation in climate due to the state's diverse geographic elements, which include the Appalachian and Blue Ridge Mountains in the west and the Atlantic coastal region in the east. Temperature and precipitation patterns are highly influenced by these geographic features, and the west and north tend to be cooler and drier than the eastern coastal region. Rainfall amounts generally decrease toward the west. For example, annual average (1991–2020 normals) precipitation is less than 40 inches in parts of the central mountain region of the state, compared to around 50 inches along the tidewater coastal region.

In WV, due to the state's rugged topography, climate conditions vary considerably. The central portion of WV receives 50 or more inches of precipitation per year, while the west, along the Ohio River, receives around 40 inches. A rain shadow (an area of reduced rainfall due to sheltering hills) exists to the west of the state's Eastern Panhandle, where annual average precipitation drops to about 35 inches. Statewide, total annual precipitation in WV has been variable, with a slight increase over the 126-year period of record. Precipitation has generally been near to above average since the early 1990s, with the last 6-year period (2015–2020) being the wettest. The driest consecutive 5-year interval was 1962–1966, averaging 39.6 inches per year, and the wettest was 2016–2020, averaging 51.9 inches. The number of 2-inch extreme precipitation events was above average during the 1995–2004 interval but has been near average since then. Annual precipitation is projected to increase for WV over this century, with the largest increases occurring during winter and spring. The number and intensity of extreme precipitation events are also projected to increase. These events will likely lead to greater flood risk. Drought is a periodically occurring natural phenomenon in the state. Higher temperatures are projected to increase the rate of soil moisture loss during dry spells, resulting in more intense naturally occurring droughts in the future.

For both VA and WV, the NOAA Climate Summaries project a 5-10% increase in total annual precipitation (%) for the middle of the 21st century compared to the late 20th century under a higher emissions pathway.

A 2017 technical report prepared by the USACE and the Ohio River Basin Alliance projected a 15-25% increase in precipitation by 2040 in the Kanawha watershed, which encompasses CD habitat in the project action area (USACE 2017). The Kanawha watershed was included in the subset of watersheds in the Ohio River Basin that likely are at greatest risk to experience some level of sensitive fish and mussel human impacts form projected climatic changes. The report's forecasts also indicated, however, that significant changes in river flow discharges and mean annual air temperatures will not be occurring before 2040. "Generally, with a few minor exceptions for precipitation increases in some watersheds during [2011-2040], the climate will not vary substantially from what has been experienced between 1952 and 2001. After 2040, precipitation may increase or decrease substantially across the basin depending on one's location."

The available information thus does not indicate that climate change is reasonably likely to cause significant near-term flow increases in the Upper Gauley River or Stony Creek that could degrade baseline conditions in the action area or exacerbate the project's effects on CD or CD habitat. Although minor flow increases and more frequent storm events are possible, floods and droughts are not new phenomenon, and studies indicate that CD may be tolerant of variability in streamflow (McBaine and Hallerman 2020, Service 2018a), provided that streams maintain at least moderately flowing water and otherwise suitable habitat conditions (Service 2018a).

Climate change may also cause temperature increases in the project action area. The USACE technical report, for example, projected a slight increase (0.5 degrees Fahrenheit) in the annual monthly mean temperature per decade through 2040 in the Ohio River Basin. Although such increases could increase water temperatures in the Upper Gauley River and Stony Creek, some data suggests that the CD is tolerant of warm water conditions, and in the Upper Gauley River portion of the action area, the high elevation and high percentage of forest cover may offer buffers to the effects of climate change that put CD at low risk of negative impacts over the next 25 years (Service 2018a). The Stony Creek watershed, including the portion within the action area, also exhibits relatively higher quality habitat and population demographics, which may make the CD population less vulnerable to climate change impacts (Service 2018a).

In summary, over the short-term, when considering the effects of the MVP project alone as well as when aggregated with the effects from other activities and stressors, the CD populations within the action area will likely persist, but with temporarily decreased survival and reproductive rates due to increased physiological stress, decreased foraging efficiency, and decreased spawning success. In the long-term, again in response to the MVP project alone and in response to the project and other activities and stressors, these CD populations are expected to recover to previous abundances within 3-5 years as stream conditions return to previous baseline levels following restoration of the action area. The project and cumulative effects also are not expected to increase the risk or rate of variegate darter hybridization in either population or meaningfully reduce the populations' recovery potential. Therefore, we conclude that the effects from the proposed action, both alone and in combination with the effects from other activities and the potential effects of climate change, do not pose a significant risk to the CD Gauley River or Stony Creek populations and will not result in long-term population declines.

Impacts to Species – The final step in our analysis is to ascertain whether the anticipated impacts on the population(s) or recovery unit are likely to reduce the likelihood of both survival and recovery of the species by impacting its RND. Our analysis evaluates how the population-level effects determined above influence the likelihood of progressing towards or maintaining the conservation needs of the species rangewide. To complete this analysis we need to first determine the rangewide status of the species and then compare (1) what the species needs, (2) what it has, and (3) what the future expected status is. Here we connect the relative importance of the impacted population(s) to the rangewide status of the species to the impacts (positive and negative) from the proposed action.

If our analyses indicate that appreciable reductions in numbers, reproduction, and distribution are likely to occur, we conclude that the action is likely to jeopardize the continued existence of the species. Appreciable reduction means that it impacts the species in a meaningful and consequentially negative way that is more than "background" noise of the species' population dynamics. If the population-level reductions do not appreciably (i.e., meaningfully) reduce the likelihood of progressing towards or maintaining one or more of the species' conservation needs, then the action is not likely to appreciably reduce the likelihood of both survival and recovery of the species, and our analysis is complete and a non-jeopardy determination is required.

As we have concluded that the Stony Creek and Gauley River populations of CD are unlikely to experience meaningful reductions in fitness, there will be no reduction in RND on the species as a whole.

Impacts to Recovery of the Species – As stated in the Status of the Species section, the Service developed a recovery outline for the species in 2018 (Service 2018b). The primary actions to address CD conservation needs include: maintain extant populations by conserving the genetic diversity and PBFs on the landscape that are essential for the species' conservation; minimize the risk of variegate darter introductions or spread in areas with little evidence of introgression; investigate factors that would minimize and control hybridization, and implement those measures in currently occupied areas that are affected by ongoing hybridization; repatriate CDs to historically occupied areas where variegate darters are not present; and investigate feasible methods to remove variegate darters and repatriate CDs.

As described in the recovery outline (Service 2018b), CD conservation needs include: an absence of nonnative fish species (particularly, the variegate darter); unembedded gravel and cobble substrates with minimal sedimentation; adequate water quality; an abundant, diverse benthic macroinvertebrate community; and sufficient water quantity and velocities. Absence or degradation of these features could limit populations of the CD. The ongoing threats of introgressive hybridization and stream degradation make the recovery potential low for CD in the near term.

As discussed in the Status of the Species section, of the 18 extant populations, 5 currently have high or moderate to high resiliency. These populations are located in the Upper Gauley, Greenbrier, and Middle New metapopulations. The remaining 2 extant metapopulations (Lower Gauley and the Upper New River) maintain populations with moderate and low resiliency. Therefore, the CD currently maintains moderate resiliency (Service 2018a). The loss of CD populations and the areas they represented within the species' historical range, as well as the fragmentation of extant populations, has compromised the species' ability to repatriate those areas or avoid species level effects from a catastrophic event. Therefore, the CD's current redundancy is moderate to low (Service 2018a), though the Service actively is collaborating with its state partners to captively propagate and reintroduce CD to the goal of helping to improve this. In 2022, USFWS completed CD reintroductions in West Virginia streams outside of the project action area. Though it is too soon to confirm that these reintroductions will be successful in the long-term, the Service is monitoring the status of these reintroduced populations. The best available data for the CD indicate that there is a high level of genetic differentiation between the Greenbrier River and Upper and Lower Gauley River metapopulations. These metapopulations currently have moderate resiliency, however the loss of either would represent a substantial reduction in the species' genetic representation. Although the CD retains representation in both of the Appalachian Plateaus and Valley and Ridge physiographic provinces, the species has a different distribution than it had historically, and likely a different ability to respond to stochastic and catastrophic events, thereby putting the species at increased risk of extinction from any such events. Therefore, we conclude that the species' representation is currently moderate to low (Service 2018a). As previously stated, the baseline rangewide status of the species is declining.

As discussed above, the project impacts are anticipated to be relatively small because most of the effects of sedimentation are expected to be sublethal and occur within a relatively small portion of the species range within each affected population. The Upper Gauley River metapopulation contains 6 populations (182 smi total) (Service 2018a), of which the Upper Gauley River population constitutes 27.2 smi. The impact area includes approximately 1.24 smi of the Upper Gauley River known to support CD, which represents approximately 4.56% of the CD occupied habitat within the Upper Gauley River and 0.68% of the occupied habitat within the Upper Gauley River metapopulation. The Middle New River metapopulation (25.1 smi) contains 3 disjunct populations, of which the Stony Creek population constitutes 19.3 smi. The impact area includes approximately 0.62 mi of Stony Creek known to support CD, which represents approximately 3.21% of the CD occupied habitat within Stony Creek and 2.47% of the occupied habitat within the Middle New River metapopulation.

The amount of habitat to be temporarily impacted is minor (0.51%) compared to the overall amount of CD habitat available rangewide (368 smi total); in general, CD habitat will recover to a suitable condition following temporary impacts; and CD are expected to continue to occupy waterways within the impact area during and after the project, and cumulative effects reasonably certain to occur in the action area from all future non-federal activities do not pose a significant risk to the affected CD populations and are unlikely to significantly alter the baseline condition of those populations. The CD SSA (Service 2018a) predicted future condition scenarios based on negative impacts to habitat, increased hybridization with variegate darters, and a combination of both. In the predicted future scenarios resulting from negative impacts to CD habitats, the Gauley River population condition changed from "high" to "moderate" while the Stony Creek population remained "high" even under degraded habitat conditions.

Consistent with the conservation needs in the recovery outline, the affected populations will be maintained; the PBFs of the affected area that are essential for species conservation will only be temporarily affected in the impact areas; there will be no increase in the risk of variegate darter introductions or spread; and the ability to repatriate CDs to historically occupied areas will not be diminished. Although the overall status of the species is declining, the effects from this specific project are not anticipated to reduce appreciably the suitable habitat available for recovery or the recovery potential for the species.

Adverse Modification Analysis Framework

In accordance with 50 CFR 402.02, "destruction or adverse modification" means a direct or indirect alteration that appreciably diminishes the value of critical habitat as a whole for the conservation of a listed species.

The following analysis relies on 4 components: (1) Status of Critical Habitat, (2) Environmental Baseline, (3) Effects of the Action, and (4) Cumulative Effects. For purposes of making the destruction or adverse modification determination, the effects of the proposed federal action, together with any cumulative effects, are evaluated to determine if the critical habitat rangewide would remain functional (or retain the current ability for the PBFs to be functionally re-established in areas of currently unsuitable but capable habitat) to serve its intended conservation/recovery role for the species.

The key factor related to the adverse modification determination is whether, with implementation of the proposed federal action, the affected critical habitat would continue to serve its intended conservation role for the species. Activities that may destroy or adversely modify critical habitat are those that result in a direct or indirect alteration that appreciably diminishes the value of critical habitat for the conservation of the species. Such alterations may include, but are not limited to, those that alter the PBFs essential to the conservation of these species or that preclude or significantly delay development of such features. The role of critical habitat is to support PBFs essential to the conservation of a listed species and provide for the conservation of the species.

Analysis for Adverse Modification

<u>Candy darter (CD) critical habitat</u>

The final critical habitat rule for the CD (86 FR 17956)) includes a brief evaluation and description of activities involving a Federal action that may destroy or adversely modify the proposed critical habitat. The list of activities includes the following: "Actions that would significantly increase water temperature or sedimentation and stream bottom embeddedness. Such activities could include, but are not limited to, land use changes that result in an increase in sedimentation, erosion, and bankside destruction or the loss of the protection of riparian corridors and leaving insufficient canopy cover along banks." The impact area includes approximately 1.86 smi of CD critical habitat, 0.51% of the total critical habitat area for the species (368 smi total). Within the Gauley River, the 1.24 smi impact area represents approximately 4.56% of critical habitat within the 27.2 smi of unit 5b (Upper Gauley River, Nicholas and Webster Counties, WV) and 0.68% of unit 5 (Upper Gauley) as a whole (182 smi total). Within Stony Creek, the 0.62 smi impact area represents approximately 3.21% of critical habitat within the 19.3 smi of unit 2b (Stony Creek, Giles County, VA) and 2.47% of unit 2 (Middle New) as a whole (25.1 smi total).

The proposed action includes clearing – trees and shrubs and herbaceous vegetation and ground cover; grading, erosion control devices; trenching (digging, blasting, dewatering, open trench, sedimentation); regrading and stabilization – restoration of corridor; ARs – upgrading existing roads, new roads temp and permanent – grading, graveling; and ARs – upgrading existing roads, new roads temp and permanent – tree trimming and tree removal. As discussed in the Effects of the Action, effects of the action include effects to PBFs of both critical habitat subunit 2b (Stony Creek) and 5b (Upper Gauley River) within the impact areas. Temporary reductions in water quality and habitat quality are expected as a result of increased sedimentation reducing visibility, decreasing available prey, increasing embeddedness, and filling interstitial spaces with fine sediment. These effects are expected to be limited in relative severity and duration, including when the project's effects are aggregated with potential effects from the other activities discussed in the cumulative effects analysis above. Some short-term and immediate changes in the conditions of PBFs 2, 3, and 4 in the impact areas in both critical habitat subunits 2b and 5b are anticipated due to increased sedimentation from upland project activities and due to suspension and re-deposition of substrate sediments disturbed during storm events. However, these impacts are expected to be relatively minor and occur within a small portion of subunits 2b and 5b, and no new impact areas are expected to occur from the aggregation of project effects with effects in the action area from other activities. Within Stony Creek (subunit 2b), the impact area occurs in the lower reaches of the stream before its confluence with the New River; therefore, anticipated impacts will leave the PBFs in the upper 96.79% of critical habitat within Stony Creek unaffected. In the Gauley River (subunit 5b), the amount of critical habitat within the impact area is also small (4.56%), and as a result a large proportion of the PBFs in the subunit will be unaffected and available for the CD. None of the affected habitat in the Gauley River or Stony Creek systems will be rendered permanently unsuitable as a result of the project.

As we have concluded that the PBFs are unlikely to experience significant alterations, there will be no reduction in the conservation role of individual critical habitat subunits or the conservation role of critical habitat as a whole.

CONCLUSION

Virginia spiraea (VASP)

We considered the current overall stable rangewide status of VASP and the stable condition of the species within the action area (environmental baseline). We then assessed the effects of the proposed action and the potential for cumulative effects in the action area on individuals, populations, and the species as a whole. As stated in the Jeopardy Analysis, we do not anticipate any reductions in the overall RND of the VASP. It is the Service's opinion that authorization to construct and operate the pipeline, as proposed, including the activities that have already been completed, is not likely to jeopardize the continued existence of the VASP.

Indiana bat (Ibat)

We considered the current overall declining rangewide status of Ibat and the declining condition of the species within the action area (environmental baseline). We then assessed the effects of the proposed action and the potential for cumulative effects in the action area on individuals, populations, and the species as a whole. As stated in the Jeopardy Analysis, we do not anticipate any reductions in the overall RND of the Ibat. It is the Service's opinion that authorization to construct and operate the pipeline, as proposed, including the activities that have already been completed, is not likely to jeopardize the continued existence of the Ibat.

Northern long-eared bat (NLEB)

We considered the current overall declining rangewide status of NLEB and the declining condition of the species within the action area (environmental baseline). We then assessed the effects of the proposed action and the potential for cumulative effects in the action area on individuals, populations, and the species as a whole. As stated in the Jeopardy Analysis, we do not anticipate any reductions in the overall RND of the NLEB. It is the Service's opinion that authorization to construct and operate the pipeline, as proposed, including the activities that have already been completed, is not likely to jeopardize the continued existence of the NLEB.

Roanoke logperch (RLP)

We considered the current overall improving rangewide status of RLP and the improving condition of the species within the action area (environmental baseline). We then assessed the effects of the proposed action and the potential for cumulative effects in the action area on individuals, populations, and the species as a whole. As stated in the Jeopardy Analysis, we do not anticipate any reductions in the overall RND of the RLP. It is the Service's opinion that authorization to construct and operate the pipeline, as proposed, including the activities that have already been completed, is not likely to jeopardize the continued existence of the RLP.

Candy darter (CD)

We considered the current overall declining rangewide status of CD and the stable condition of the species within the action area (environmental baseline). We then assessed the effects of the proposed action and the potential for cumulative effects in the action area on individuals, populations, and the species as a whole. As stated in the Jeopardy Analysis, we do not anticipate any reductions in the overall RND of the CD. It is the Service's opinion that authorization to construct and operate the pipeline, as proposed, including the activities that have already been completed, is not likely to jeopardize the continued existence of the CD and is not likely to destroy or adversely modify designated critical habitat.

INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and federal regulation pursuant to Section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without a special exemption. Take is defined in Section 3 of the ESA as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns including breeding, feeding, or sheltering (50 CFR § 17.3). Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of Section 7(b)(4) and Section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the ESA provided that such taking is in compliance with the terms and conditions of this incidental take statement (ITS).

The measures described below are nondiscretionary and must be undertaken by FERC so that they become binding conditions of any grant or permit issued to Mountain Valley, as appropriate, for the exemption in Section 7(o)(2) to apply. FERC has a continuing duty to regulate the activity covered by this ITS. If FERC: (1) fails to assume and implement the terms and conditions or (2) fails to require Mountain Valley to adhere to the terms and conditions of the ITS through enforceable terms that are added to the permit or grant document, the protective coverage of Section 7(o)(2) may lapse. To monitor the impact of incidental take, FERC or Mountain Valley must report the progress of the action and its impact on the species to the Service as specified in the ITS [50 CFR 402.14(i)(3)].

The NJFs described and analyzed above in the Effects of the Action and Jeopardy Analysis sections likely would not exist but for the proposed action and are reasonably certain to occur. However, these NJFs are not under the jurisdiction of FERC. Additionally, these NJFs are not part of Mountain Valley's proposed project. For each of these NJFs, Mountain Valley has requested or will request service from a local utility company, and that company plans, designs, and constructs the facility without Mountain Valley's involvement. Because FERC and Mountain Valley do not have discretion or control over these NJFs, any incidental take resulting from these NJFs is not included in the ITS below. The project proponent for each NJF will need to obtain incidental take coverage by coordinating with the Service (and any associated federal agency) to receive a separate ITS or ESA Section 10 incidental take permit.

Sections 7(b)(4) and 7(o)(2) of the ESA generally do not apply to listed plants species. However, limited protection of listed plants from take is provided to the extent that the ESA prohibits the removal and reduction to possession of federally listed endangered plants or the malicious damage of such plants on areas under federal jurisdiction, or the destruction of endangered plants on non-federal areas in violation of State law or regulation or in the course of any violation of a State criminal trespass law.

AMOUNT OR EXTENT OF TAKE ANTICIPATED

The Service analyzed the effects to the species above.

<u>Indiana bat (Ibat)</u>

Numeric Estimate of Anticipated Incidental Take/Use of Surrogate for Monitoring Take

The Service has used available data to quantify and numerically express anticipated incidental take of Ibat. This numerical estimate provides a clear limit on the incidental take anticipated and authorized in this Opinion. However, based on the difficulties associated with monitoring take in terms of affected individuals, the Service also uses surrogates to provide an additional, alternative means of monitoring take of Ibat. Under this approach, reinitiation of consultation will be triggered if the incidental take from the project exceeds either the number of Ibat specified below or exceeds, in any amount or manner, the surrogates specified below.

50 CFR 402.14(i)(1)(i) states that surrogates may be used to express the amount or extent of anticipated take provided the Opinion or ITS: (1) describes the causal link between the surrogate and take of the listed species; (2) describes why it is not practical to express the amount of anticipated take *or* to monitor take-related impacts in terms of individuals of the listed species; and (3) sets a clear standard for determining when the amount or extent of the taking has been exceeded.

In situations where some data exist that may be used to calculate a numerical estimate of take for a species but there are challenges associated with measuring take in terms of individuals, the Service has used surrogates as an additional means of monitoring take. In those instances, project effects outside of a specifically defined amount of affected surrogate serves as a trigger indicating that the numerical take estimate may have been exceeded and reinitiation is required.

Numeric Estimate of Anticipated Incidental Take

To conduct our jeopardy analysis, we estimated the number of Ibats harmed or killed by tree-clearing in the affected habitat categories using the best available data (see Effects of the Action section). Based on our analysis of the environmental baseline and effects of the proposed action, individuals from 4 Ibat maternity colonies and spring staging/fall swarming habitat associated with 12 Ibat hibernacula, will be impacted as a result of the MVP project. The incidental take is expected to be in the form of harm or death. The anticipated take is described in Table 33. In the preceding Opinion, we determined that the anticipated level of take is not likely to jeopardize the continued existence of the Ibat.

Surrogate for Monitoring Take

It is not practical to monitor take-related impacts in terms of individual Ibats for the following reasons: (1) the Ibat has a small body size, is drab in color, which makes encountering dead or injured individuals unlikely; (2) any dead or injured Ibats may be eaten or scavenged; (3) Ibats occupy summer habitats (heavily forested) where they are difficult to locate (multiple roosts located within and outside of the action area); (4) Ibats spend a substantial portion of their lifespan hibernating underground; (5) take may occur offsite (e.g., the bat dies outside of the action area); (6) starvation or failure to reproduce cannot be detected; (7) losses may be masked by fluctuations in numbers associated with WNS; and (8) the majority of tree removal has already occurred. Moreover, for several habitat categories in which tree-clearing occurs during the inactive season, take would occur only when the bats return to the area in the active season and, as a result, it is impossible to track, or monitor take in real time. Furthermore, as discussed in the Environmental Baseline section, there are challenges with being able to locate and monitor individuals. Therefore, even when tree clearing occurs in the active season, available survey techniques are effective only for determining bat presence/probable absence in a particular area; they cannot be used to track in real time the number of bats that may experience lethal or sublethal take from ongoing activities. For all of these reasons, it is not practicable to monitor take-related impacts in terms of individuals of the species, requiring the use of a surrogate.

Because tree-clearing is the cause of all forms of take that are reasonably certain to result from the project, there is a clear causal link between the acres of habitat impacted and take of the Ibats. In addition, because the location, timing, and acreage of habitat impacts can be readily identified, measured, and monitored, this surrogate is the most reasonable means for monitoring the anticipated take, and for detecting when the anticipated level of take may be exceeded, thereby providing a clear trigger for reinitiating consultation. The Service therefore will use the acreage of affected habitat as a surrogate for monitoring the amount and extent of anticipate take.

The anticipated take is described in Table 31 below.

Table 31. Ibat amount and type of anticipated incidental take.

Habitat Type	Acreage Cleared[a]	Associated Colonies or Hibernacula	Life Stage when Take is Anticipated	Type of Take	Number of Adult Females Affected	Number of Pups Affected	Types of Effects Anticipated
Known use summer (active season)	250.21[b]	1 known maternity colony	Adults/pups	Harm or Kill	1	9	Reduced survivorship or direct mortality of individuals (adults and pups) associated with occupied roost tree removal.
Known use summer (inactive season) [c]	483.68[d]	(Same colony as above)	Adults	Harm	1	N/A	Temporary reduced breeding success of individuals associated with loss of (and relocating) roosting, travel, and foraging habitat.

Habitat Type	Acreage Cleared[a]	Associated Colonies or Hibernacula	Life Stage when Take is Anticipated	Type of Take	Number of Adult Females Affected	Number of Pups Affected	Types of Effects Anticipated
Unknown use summer (active season)	1813.32[e]	3 unknown maternity colonies	Adults/pups	Harm or Kill	3 (1 per colony)	27 (9 per colony)	Reduced survivorship or direct mortality of individuals (adults and pups) associated with occupied roost tree removal.
Unknown use summer (inactive season)[c]	518.55[f]	(Same 3 colonies as above)	Adults	Harm	3 (1 per colony)	N/A	Temporary reduced breeding success of individuals associated with loss of (and relocating) roosting, travel, and foraging habitat.
Known use spring staging/fall swarming (active season) [c]	247.68[g]	2 known hibernacula	Adults	Harm or Kill	2 (1 per colony)	N/A	Reduced survivorship or direct mortality of individuals (adults) associated with occupied roost tree removal and decreased breeding success (adults).
Known use spring staging/fall swarming (inactive season) [c]	556.15	2 known hibernacula	Adults	Harm	8 (4 per hibernacula)	N/A	Temporary or permanent habitat loss will cause decreased breeding success (adults).
Unknown use spring staging/fall swarming (active season) [c]	824.80	10 assumed occupied hibernacula	Adults	Harm or Kill	10 (1 per hibernacula)	N/A	Reduced survivorship or direct mortality of individuals (adults) associated with occupied roost tree removal.
Unknown use spring staging/fall swarming (inactive season)[c]	499.19	(Same 10 hibernacula as above)	Adults	Harm	40 (4 per hibernacula)	N/A	Temporary or permanent habitat loss will cause decreased breeding success (adults).

[a] Unknown location future slip acreage (247.68 acres) was evaluated as a "worst-case scenario" in all categories and is included in the totals in the Acreage Cleared column. Therefore, it is important to note that the totals in the Acreage Cleared column do not sum to the total acres of tree removal associated with the project (4,694.73). The maximum amount of tree removal anticipated due to future slips is 247.68. If total tree removal associated with future slips, in any combination of habitat categories, exceeds 247.68 acres, reinitiation of consultation is required.

[b] This total includes 2.47 acres that were covered under the 2020 Opinion as an emergency Section 7 consultation.

[c] Pups are not present during these timeframes.

[d] This total includes the 10.14 acres of downed trees associated with reported slips.

[e] This total includes the 3.31 acres of downed trees associated with reported slips.

[f] This total includes the 1.51 acres of downed trees associated with reported slips.

[g] No active season tree removal has occurred to date in Ibat known use spring staging/fall swarming habitat. However, under our worst-case scenario analysis, effects of future slips in this habitat category (up to 247.68 acres) are discussed in the Ibat Effects of the Action section.

Northern long-eared bat (NLEB)

The majority of impacts to NLEBs associated with this project have already occurred and were fully accounted for in the 2016 Opinion for 4(d) rule on NLEB, which concluded that those impacts were not likely to jeopardize the continued existence of the species. A total of 15.64 acres of tree removal within 0.25 mile of a hibernacula were analyzed in the 2020 Opinion and ITS. That tree removal was completed in accordance with the 2020 ITS and is reflected in this ITS, along with take associated with future tree removal activities in NLEB habitat pursuant to the reclassification rule that will become effective on March 31, 2023.

Numeric Estimate of Anticipated Incidental Take/Use of Surrogate for Monitoring Take

The Service has used available data to quantify and numerically express anticipated incidental take of NLEB. This numerical estimate provides a clear limit on the incidental take anticipated and authorized in this Opinion. However, based on the difficulties associated with monitoring take in terms of affected individuals, the Service also uses surrogates to provide an additional, alternative means of monitoring take of NLEB. Under this approach, reinitiation of consultation will be triggered if the incidental take from the project exceeds either the number of NLEB specified below or exceeds, in any amount or manner, the surrogates specified below.

50 CFR 402.14(i)(1)(i) states that surrogates may be used to express the amount or extent of anticipated take provided the Opinion or ITS: (1) describes the causal link between the surrogate and take of the listed species; (2) describes why it is not practical to express the amount of anticipated take or to monitor take-related impacts in terms of individuals of the listed species; and (3) sets a clear standard for determining when the amount or extent of the taking has been exceeded.

In situations where some data exist that may be used to calculate a numerical estimate of take for a species but there are challenges associated with measuring take in terms of individuals, the Service has used surrogates as an additional means of monitoring take. In those instances, project effects outside of a specifically defined amount of affected surrogate serves as a trigger indicating that the numerical take estimate may have been exceeded and reinitiation is required.

Numeric Estimate of Anticipated Incidental Take

To conduct our jeopardy analysis, we estimated the number of NLEB harmed by tree-clearing (see Effects of the Action section). The anticipated take previously assessed under the 2016 Opinion for 4(d) rule on NLEB in the 2020 Opinion and ITS for tree clearing within 0.25 mile of the 3 known (at the time of the 2020 Opinion) hibernacula and an overlapping maternity colony is included in Table 32 below. The incidental take is expected to be in the form of harm or kill. In this Opinion and the preceding Opinions, we determined that the anticipated level of take is not likely to jeopardize the continued existence of the NLEB.

Surrogate for Monitoring Take

It is not practical to monitor take-related impacts in terms of individual NLEB for the following reasons: (1) the NLEB has a small body size, is drab in color, which makes encountering dead or injured individuals unlikely; (2) any dead or injured NLEB may be eaten or scavenged; (3) NLEB occupy summer habitats (heavily forested) where they are difficult to locate (multiple roosts located within and outside of the action area); (4) NLEB spend a substantial portion of their lifespan hibernating underground; (5) take may occur offsite (e.g., the bat dies outside of the action area); (6) starvation or failure to reproduce cannot be detected; (7) losses may be masked by fluctuations in numbers associated with WNS; and (8) the majority of tree removal has already occurred. Moreover, take would occur only when the bats return to the area in the active season and, as a result, it is impossible to track or monitor take in real time. Furthermore, available survey techniques are effective only for determining bat presence/probable absence in a particular area; they cannot be used to track in real time the number of bats that may experience lethal or sublethal take from ongoing activities. For all of these reasons, it is not practicable to monitor take-related impacts in terms of individuals of the species, requiring the use of a surrogate.

Because tree-clearing is the cause of all forms of take that are reasonably certain to result from the project, there is a clear causal link between the acres of habitat impacted and take of the NLEB. In addition, because the location, timing, and acreage of habitat impacts can be readily identified, measured, and monitored, this surrogate is the most reasonable means for monitoring the anticipated take and for detecting when the anticipated level of take may be exceeded, thereby providing a clear trigger for reinitiating consultation. The Service therefore will use the acreage of affected habitat as a surrogate for monitoring the amount and extent of anticipated take.

The prior take that occurred within 0.25 mile of the 3 known (at the time of take) hibernacula and an overlapping maternity colony in addition to all future anticipated takeis described in Table 32 below.

Table 32. NLEB amount and type of anticipated incidental take. Acreage of each NLEB habitat type that has been or will be cleared for the MVP project and the corresponding number of individual bats that have been or will be affected.[a]

Habitat Type	Acreage Cleared MVP[c]	Acreage planned for clearing MVP[b]	Type of take	Associated Colonies or Hibernacula	Number of Adult Female NLEB Affected	Number of NLEB Pups Affected	Types of Effects Anticipated
Known use summer (active season)	0	251.08	Harm or kill	9 known maternity colonies (same colonies as below)	9	63	Reduced survivorship or direct mortality of individuals (adults) associated with occupied roost tree removal and decreased breeding success (adults).

Habitat Type	Acreage Cleared MVP[c]	Acreage planned for clearing MVP[b]	Type of take	Associated Colonies or Hibernacula	Number of Adult Female NLEB Affected	Number of NLEB Pups Affected	Types of Effects Anticipated
Known use summer (inactive season)	12.43	247.68	Harm	9 known maternity colony	9	N/A	Temporary or permanent habitat loss will cause decreased breeding success (adults).
Known use spring staging/fall swarming (active season)	0.00	247.68	Harm or kill	6 known hibernacula	6 (1 per hibernaculum)	N/A	Reduced survivorship or direct mortality of individuals (adults) associated with occupied roost tree removal and decreased breeding success (adults).
Known use spring staging/fall swarming (inactive season)	15.64	247.68	Harm	6 known hibernacula	54 (9 per hibernacula)	N/A	Reduced breeding success
Unknown use spring staging/fall swarming (active season)	0	247.68	Harm or kill	18 assumed occupied hibernacula	18 (1 per hibernaculum)	N/A	Reduced survivorship or direct mortality of individuals (adults) associated with occupied roost tree removal and decreased breeding success (adults).
Unknown use spring staging/fall swarming (inactive season)	0	247.68	Harm	18 assumed occupied hibernacula	162 (9 per hibernaculum)	N/A	Temporary reduced breeding success of individuals associated with loss of (and relocating) roosting, travel, and foraging habitat.

[a] This table does not include acres previously cleared and accounted for in the 2016 Opinion for 4(d) rule on NLEB (discussed above), but those acreages are accounted for in the jeopardy analysis.
[b] Unknown location future slip acreage (247.68 acres) was evaluated as a "worst-case scenario" in all categories and is included in the totals in the Acreage Cleared column. Therefore, it is important to note that the totals in the Acreage Cleared column do not sum to the total acres of tree removal associated with the project (4,694.73). The maximum amount of tree removal anticipated due to future slips is 247.68. If total tree removal associated with future slips, in any combination of habitat categories, exceeds 247.68 acres, reinitiation of consultation is required.
[c] These losses occurred when the 4(d) rule was in effect.

Roanoke logperch (RLP)

Numeric Estimate of Anticipated Incidental Take/Use of Surrogate for Monitoring Take

The Service has used available data to quantify and numerically express anticipated incidental take of adult RLP. This numerical estimate provides a clear limit on the incidental take of adult RLP anticipated and authorized in this Opinion. However, because the anticipated incidental take of YOY and juvenile RLP cannot practicably be expressed in terms of a specific number of individuals for the reasons stated in the Effects of the Action section and based on the difficulties associated with monitoring take in terms of affected individuals, the Service also uses surrogates to provide an additional, alternative means of monitoring take of RLP. Under this approach, reinitiation of consultation will be triggered if the incidental take from the project exceeds either the number of adult RLP specified below or exceeds, in any amount or manner, the surrogates specified below.

50 CFR 402.14(i)(1)(i) states that surrogates may be used to express the amount or extent of anticipated take provided the Opinion or ITS: (1) describes the causal link between the surrogate and take of the listed species; (2) describes why it is not practical to express the amount of anticipated take *or* to monitor take-related impacts in terms of individuals of the listed species; and (3) sets a clear standard for determining when the amount or extent of the taking has been exceeded.

In situations where some data exist that may be used to calculate a numerical estimate of take for a species but there are challenges associated with measuring take in terms of individuals, the Service has used surrogates as an additional means of monitoring take. In those instances, project effects outside of a specifically defined amount of affected surrogate serves as a trigger indicating that the numerical take estimate may have been exceeded and reinitiation is required.

Numeric Estimate of Anticipated Incidental Take

The numerical estimate of incidental take of adult RLP was calculated based on an estimate of 820 RLP within the impact areas outside of the impoundment area created for the North Fork Roanoke River 1 open-cut crossing (MP 227.2, Stream ID S-G36) crossing (see calculations in Effects of the Action section). In the Effects of the Action section, we explained why the number of YOY and juvenile RLP within the impact area cannot practicably be estimated, and that discussion is incorporated here by reference. All 820 adult RLP within the impact areas and any YOY or juveniles within the impact areas (estimated to be 4.8% of the YOY and juveniles present in the Upper Roanoke MU and 2% of the YOY and juveniles present in the Pigg MU), are expected to be affected by the proposed action and at most, 1 RLP is expected to be entrained in impoundments associated with the North Fork Roanoke River crossing. As stated earlier, the North Fork Roanoke River crossing was completed in July 2018 via open-cut dry ditch (Table 9). No RLP were observed during the fish removals associated with 2 dewatering events (July 17-18, 2018, and August 15-17, 2018) at this crossing (Mountain Valley 2020). The streambed was re-contoured to reflect pre-construction streambed contours and restoration was finalized August 2018. Within the Upper Roanoke and Pigg MUs 21.8 km are expected to be impacted through water quality and habitat degradation. Incidental take of adult RLP accounts for the take for any subsequent egg production. The incidental take is expected to be in the form of harm, including lethal harm in some instances. The anticipated take is described in Table 33. In the preceding Opinion, we determined that the anticipated level of take is not likely to jeopardize the continued existence of the RLP.

Surrogate for Monitoring Take

It is not practical to monitor take-related impacts in terms of individual RLP for the following reasons: the RLP has a small body size making it difficult to locate, which makes encountering dead or injured individuals unlikely; scavengers may consume the carcass or the carcass may be swept downstream; losses may be masked by annual fluctuations in numbers; take may occur offsite (e.g., a RLP may die outside of the impact area) and would not be detected; and most of the anticipated take including non-lethal injury of individual RLP is not directly observable.

We expect incidental take of RLP in the form of harm or kill resulting from entrainment due to dewatering and stream diversion for the open-cut crossing of North Fork Roanoke River. River bottom disturbance is being used as a surrogate to monitor the extent of authorized take related to installing and removing temporary dam structures because it is not practical to monitor take-related impacts in terms of individuals. We calculated the area impacted (i.e., wetted width of the waterbody by the construction ROW width) for temporary dam structure placement and removal: North Fork Roanoke River 1 (22 m x 22.86 m) = 502.92 m^2. The 503 m^2 of river bottom disturbance sets a clear, enforceable standard, and river bottom disturbance related to installing and removing temporary dam structures outside of that specific area exceeds take. The surrogate for monitoring anticipated take is described in Table 33.

We expect incidental take of RLP in the form of harm (including lethal harm in some instances) resulting from exposure to degraded surface water quality and elevated suspended sediment and sedimentation during construction. The impact areas in which project-related SSC/turbidity levels are expected to exceed one or more of the take thresholds described below are being used as a surrogate to express and monitor the extent of authorized take for the RLP related to clearing trees, shrubs, and herbaceous vegetation, grading, trenching, regrading, graveling, installing and removing temporary dam structures, crossing a RLP waterbody, and constructing or upgrading because it is not practical to express the number of affected YOY and juveniles numerically or to monitor take-related impacts in terms of individuals. These impact areas are described in the Effects of the Action section and depicted in Appendix D Figures 1 and 2. The level of anticipated, authorized take of RLP expressed using this surrogate will be exceeded if implementation of the procedures set forth in the monitoring plan (Appendix F) indicates that project-related SSC/turbidity levels cause an exceedance of any of the following thresholds adapted from Figure 1 of Muck (2010) at the downstream limit of any of the impact areas depicted in Appendix D Figures 1 and 2:

- 148 mg/L sediment concentration above background at any time; or
- 99 mg/L sediment concentration above background for more than 1 hour, continuously; or
- 40 mg/L sediment concentration above background for more than 3 hours, continuously; or
- 20 mg/L sediment concentration above background for more than 7 hours, continuously

Because the SSC/turbidity levels measure the conditions that result in take, a clear causal link exists between the surrogate and take of the listed species.

SSC and embeddedness are different parameters to assess the habitat quality for fish although both impact fish health in slightly different ways. However, measuring SSC due to sedimentation can be measured in real-time, while embeddedness is more of a delayed response. Moreover, measuring SSC is a standard monitoring approach, and can be correlated to impacts to fish. Furthermore, as discussed in the Effects of the Action section above, the impact area defined based on open-cut crossing or using the sediment concentration threshold of ≥20 mg/L above background (e.g., mixing zone and additional stream segments downstream of mixing zones) encompasses the stream reaches in which harm to RLP from project-related increases in embeddedness is reasonably certain to occur.

Furthermore, although several studies have measured embeddedness, a standard technique to measure embeddedness does not yet exist, see Sylte and Fischenich (2002) for a summary of different methods. That study also listed additional limitations to using embeddedness as a comparison measure such as:

- "Cobble embeddedness exhibits high spatial and temporal variability in both natural and disturbed streams. Sampling must be intensive within streams or stream reaches to detect changes (Potyondy 1988 [*in* Sylte and Fischenich 2002]);
- Repeat monitoring must be conducted at the same site because of high instream variability (Munther and Frank 1986, Potyondy 1988 [*in* Sylte and Fischenich 2002]); and
- Application of the method in streams <6.1 m (20 ft) wide may destroy sites for future monitoring (Potyondy 1988 [*in* Sylte and Fischenich 2002])."

Kramer (1989 *in* Sylte and Fischenich 2002) identified limitations to the embeddedness measuring methods developed by Burns (1984 *in* Sylte and Fischenich 2002) and Skille and King (1989 *in* Sylte and Fischenich 2002) and pointed out that after a certain point embeddedness does not accurately reflect stream bottom conditions. Kramer (1989 *in* Sylte and Fischenich 2002) found that the percent embeddedness decreased with increasing fines when rocks became 100% embedded because they were then excluded from being measured. Similar to this concept is that the rate of substrate embeddedness will depend not only on new inputs, but also on the amount of existing fine sediment in the interstitial spaces, thus an already embedded habitat has less capacity to accept new sediment deposits, which complicates estimation of project impacts (J. Roberts, Georgia Southern University, letter to S. Hoskin, Service, May 6, 2020). Another confounding issue is unlike suspended sediments, which is generally homogenous throughout the water column, embeddedness may be unpredictably heterogeneous due to depth and variation in velocity. This unpredictably may make establishing a pre-project baseline condition difficult to establish and statistical changes difficult to detect (J. Roberts, Georgia Southern University, letter to S. Hoskin, Service, May 6, 2020). Similar to the limitations Potyondy (1988 *in* Sylte and Fischenich 2002) identified regarding sampling intensity, surveying small areas for a dam operation change did not seem sufficient to adequately reflect the overall conditions of the stream (P. Shute, retired Service employee, email to C. Schulz, Service, May 11, 2020). Due to these limitations, USFS does not routinely use embeddedness to monitor streambed conditions (Potyondy and Sylte 2008, Sylte and Fischenich 2002). While Rosenberger and Angermeier (2003) reported microhabitat data, including embeddedness, in RLP habitat in the Roanoke and Nottoway rivers, we cannot correlate it to impact thresholds. Absent standard methodologies to measure increases in embeddedness in real time and the ability to correlate those measures to impacts to darters, measuring SSC/turbidity is the most feasible approach to monitor take.

The anticipated take is described in Table 33 below.

Table 33. RLP amount and type of anticipated incidental take.

Species	Amount of Take Anticipated (Surrogate)	Amount of Take Anticipated (Individuals)	Life Stage when Take is Anticipated	Type of Take	Take is Anticipated as a Result of
RLP	503 m^2 of river bottom disturbance	1	All	Harm or kill	Entrainment due to temporary dam structures or stream diversion
RLP	The impact areas in which project-related SSC/turbidity is expected to exceed one of the thresholds described above. See Appendix D Figures 1 and 2.	820 adult RLP and 4.8% of YOY/juvenile RLP present in the Upper Roanoke MU and 2% of YOY/ juvenile RLP present in the Pigg MU.	All	Harm	Habitat alteration from instream structure placement and removal, streambank vegetation clearing/trimming, and upland vegetation clearing, trenching, and grading during construction. Exposure to degraded surface water quality and elevated suspended sediment and sedimentation from construction activities.

Candy darter (CD)

The Service has reviewed available data and is unable to quantify and numerically express anticipated incidental take of CD. For Stony Creek, Leftwich et al. (1996) calculated densities ranging 0-30 CD per 100 m^2 with the highest densities found in riffles, with an average of 10 CD/100 m^2. With a lack of data on specific habitat types throughout Stony Creek, the density estimates are not suitable for generating reliable estimates of absolute abundance. Further, data from Leftwich et al. (1996) is based on collections from 1995, which is not recent enough to reliably use for an assessment of current condition. More recently, McBaine and Hallerman

(2020) attempted to calculate CD population abundances in Stony Creek using mark recapture data, but found that low recapture rates for CD resulted in low precision for abundance and survival estimates. The estimates for abundance within the survey reach at the Lower Stony Creek site by McBaine and Hallerman (2020) are based on Cormack Jolly-Seber mark-recapture models and indicate abundance estimates with 95% confidence intervals (CI) (the 95% CI defines a range of values with a 95% probability of containing the true population mean). The Lower Stony Creek population estimate was approximately 800 individuals (95% CI = 0 – 1,850 individuals) for summer 2016, 800 individuals (95% CI = 0 – 1,850 individuals) for spring 2017, and <20 individuals (no CI provided) for summer 2017. The wide variability in these successive population estimates, taken together with the caveats from the authors about low precision resulting from low recapture rates, indicate that this data should not be used to estimate population abundances for CD in Stony Creek for this Opinion. While recent CPUE-based measures are available for CD populations in Stony Creek from both McBaine and Hallerman (2020) and Dunn (2013), these are measures of relative abundance and are not suitable for generating reliable estimates of absolute abundance. Similar surveys have not been conducted for the Gauley River. Therefore, there is no data available for generating reliable abundance estimates for CDs within the Gauley River, and such data cannot be readily obtained. Because impacts to the CD from project activities are expected to occur via water quality degradation (e.g., sedimentation, suspended sediment, and impacts to prey), they are expected to affect all CDs present within the impact area. Thus, quantifying the specific number of individuals affected is not practicable. Therefore, the Service uses a surrogate to provide an alternative means of expressing and monitoring take of CD. Reinitiation of consultation will be triggered if the incidental take from the project exceeds the surrogates specified below.

The Service has conducted 1 formal consultation for the CD and also did not calculate number of individuals for incidental take from “habitat degradation stemming from the effects of sedimentation during in-water project repairs in the Williams River and from in-stream rock placement in the Williams River and sandbag placement during channel diversions” (D. Carlson Bremer, Service, letter to K. Rose, Federal Highway Administration, August 9, 2019). In these cases, a surrogate for take, in terms of amount of habitat affected, was used.

50 CFR 402.14(i)(1)(i) states that surrogates may be used to express the amount or extent of anticipated take provided the Opinion or ITS: (1) describes the causal link between the surrogate and take of the listed species; (2) describes why it is not practical to express the amount of anticipated take *or* to monitor take-related impacts in terms of individuals of the listed species; and (3) sets a clear standard for determining when the amount or extent of the taking has been exceeded.

In situations where some data exist that may be used to calculate a numerical estimate of take for a species but there are challenges associated with measuring take in terms of individuals, the Service has used surrogates as an additional means of monitoring take. In those instances, project effects outside of a specifically defined amount of affected surrogate serves as a trigger indicating that the numerical take estimate may have been exceeded and reinitiation is required.

Numeric Estimate of Anticipated Incidental Take

As discussed above, a numerical estimate of incidental take of CD was not calculated because data is either unavailable (Gauley River) or lacks the precision needed to generate meaningful take estimates (Stony Creek), and such data cannot be readily obtained. The wide range of population estimate CIs (0 – 1,850 individuals as described above) found by McBaine and Hallerman (2020) in lower Stony Creek indicates that even with targeted efforts to estimate population size within a given reach, sufficient precision cannot be achieved. Further, considerable harm could come to CD populations if an extensive set of repeated surveys were conducted in all CD stream reaches downstream of affected areas in order to generate precise population estimates. Such methods would include repeated depletion sampling with electrofishing in all affected project reaches. The tradeoff of less numerical precision in favor of avoiding the harm of such repeated electrofishing efforts in multiple locations of the Gauley River and Stony Creek populations is in the best interest of the species. All CD within the impact areas are expected to be affected by the proposed action. Within the Stony Creek and Gauley River systems 3.0 km are expected to be impacted through temporary water quality and habitat degradation.

Surrogate for Estimating and Monitoring Anticipated Incidental Take

Use of a habitat surrogate is also appropriate for a second, independent reason: it is not practical to monitor take-related impacts in terms of individual CD for the following reasons: available data for generating quantitative estimates and incidental take limits are either unavailable or vary by orders of magnitude (making the estimates unusable), the CD has a small body size making it difficult to locate, which makes encountering dead or injured individuals unlikely; scavengers may consume the carcass or the carcass may be swept downstream; losses may be masked by annual fluctuations in numbers; take may occur offsite (e.g., a CD may die outside of the impact area) and would not be detected; and most of the anticipated take including non-lethal injury of individual CD is not directly observable.

We expect incidental take of CD in the form of harm (including lethal harm in some instances) resulting from exposure to degraded surface water quality and elevated suspended sediment and sedimentation during construction. The impact areas in which project-related SSC/turbidity levels are expected to exceed one or more of the take thresholds described below are being used as a surrogate to express and monitor the extent of authorized take for the CD related to clearing trees, shrubs, and herbaceous vegetation, trenching, and constructing or upgrading ARs because it is not practical to monitor take-related impacts in terms of individuals. These impact areas are described in the Effects of the Action section and depicted in Appendix D Figures 3 and 4. The level of anticipated, authorized take of CD expressed using this surrogate will be exceeded if implementation of the procedures set forth in the monitoring plan (Appendix F) indicates that project-related SSC/turbidity levels cause an exceedance of any of the following thresholds adapted from Figure 1 of Muck (2010) at the downstream limit of any of the impact areas depicted in Appendix D Figures 3 and 4:

- 148 mg/L sediment concentration above background at any time; or
- 99 mg/L sediment concentration above background for more than 1 hour, continuously; or
- 40 mg/L sediment concentration above background for more than 3 hours, continuously; or
- 20 mg/L sediment concentration above background for more than 7 hours, continuously

Because the SSC/turbidity levels measure the conditions that result in take, a clear causal link exists between the surrogate and take of the listed species.

SSC and embeddedness are different parameters to assess the habitat quality for fish. While both impact fish health in slightly different ways. However, measuring SSC due to sedimentation can be measured in real-time, while embeddedness is more of a delayed response. Moreover, measuring SSC is a standard monitoring approach, and can be correlated to impacts to fish. Furthermore, as discussed in the Effects of the Action section above, the impact area defined using the sediment concentration threshold of ≥20 mg/L above background (e.g., mixing zone and additional stream segments downstream of mixing zones) encompasses the stream reaches in which harm to CD from project-related increases in embeddedness is reasonably certain to occur.

Furthermore, although several studies have measured embeddedness, a standard technique to measure embeddedness does not yet exist, see Sylte and Fischenich (2002) for a summary of different methods. That study also listed additional limitations to using embeddedness as a comparison measure such as:

- "Cobble embeddedness exhibits high spatial and temporal variability in both natural and disturbed streams. Sampling must be intensive within streams or stream reaches to detect changes (Potyondy 1988 [*in* Sylte and Fischenich 2002]);
- Repeat monitoring must be conducted at the same site because of high instream variability (Munther and Frank 1986, Potyondy 1988 [*in* Sylte and Fischenich 2002]); and
- Application of the method in streams <6.1 m (20 ft) wide may destroy sites for future monitoring (Potyondy 1988 [*in* Sylte and Fischenich 2002])."

Kramer (1989 *in* Sylte and Fischenich 2002) identified limitations to the embeddedness measuring methods developed by Burns (1984 *in* Sylte and Fischenich 2002) and Skille and King (1989 *in* Sylte and Fischenich 2002) and pointed out that after a certain point embeddedness does not accurately reflect stream bottom conditions. Kramer (1989 *in* Sylte and Fischenich 2002) found that the percent embeddedness decreased with increasing fines when rocks became 100% embedded because they were then excluded from being measured. Similar to this concept is that the rate of substrate embeddedness will depend not only on new inputs, but also on the amount of existing fine sediment in the interstitial spaces, thus an already embedded habitat has less capacity to accept new sediment deposits, which complicates estimation of project impacts (J. Roberts, Georgia Southern University, letter to S. Hoskin, Service, May 6, 2020). Another confounding issue is unlike suspended sediments, which is generally homogenous throughout the water column, embeddedness may be unpredictably heterogeneous due to depth and variation in velocity. This unpredictably may make establishing a pre-project baseline condition difficult to establish and statistical changes difficult to detect (J. Roberts, Georgia Southern University, letter to S. Hoskin, Service, May 6, 2020). Similar to the limitations Potyondy (1988 *in* Sylte and Fischenich 2002) identified regarding sampling intensity, surveying small areas for a dam operation change did not seem sufficient to adequately reflect the overall conditions of the stream (P. Shute, retired Service employee, email to C. Schulz, Service, May 11, 2020). Due to these limitations, USFS does not routinely use embeddedness to monitor streambed conditions (Potyondy and Sylte 2008, Sylte and Fischenich 2002). Absent standard methodologies to measure increases in embeddedness in real time and the ability to correlate those measures to impacts to darters, measuring SSC/turbidity is the most feasible approach to assess and monitor take.

The anticipated take is described in Table 34 below.

Table 34. CD amount and type of anticipated incidental take.

Species	Amount of Take Anticipated (Surrogate)	Life Stage when Take is Anticipated	Type of Take	Take is Anticipated as a Result of
CD	The impact areas in which project-related SSC/turbidity is expected to exceed one of the thresholds described above. See Appendix D Figures 3 and 4.	All	Harm	Habitat alteration from upland vegetation clearing, trenching, and grading during construction. Exposure to degraded surface water quality and elevated suspended sediment and sedimentation from construction activities.

REASONABLE AND PRUDENT MEASURES

The Service believes the following reasonable and prudent measures are necessary and appropriate to minimize take.

Indiana bat (Ibat)

- Provide information to individuals involved in project construction on how to avoid and minimize potential effects to the Ibat.
- Submit site-specific plans for all blasting activities proposed within 0.5 mile of any known or assumed occupied hibernacula.
- Conduct future tree removal activities outside of critical spring staging/fall swarming periods in unknown use spring staging/fall swarming habitat.

Northern long-eared bat (NLEB)

- Provide information to individuals involved in project construction on how to avoid and minimize potential effects to the NLEB.

- Submit site-specific plans for all blasting activities proposed within 0.5 mile of any known or assumed occupied hibernacula.
- Conduct future tree removal activities outside of critical spring staging/fall swarming periods in unknown use spring staging/fall swarming habitat.

Roanoke logperch (RLP)

- Provide information to individuals involved in project construction on how to avoid and minimize potential effects to the RLP.
- Conduct construction in a manner that minimizes disturbance to RLP.
- Minimize and monitor incidental take caused by elevated SSC/turbidity and sedimentation due to construction activities.

Candy darter (CD)

- Provide information to individuals involved in project construction on how to avoid and minimize potential effects to the CD.
- Conduct construction in a manner that minimizes impacts to CD.
- Minimize and monitor incidental take caused by elevated SSC/turbidity and sedimentation due to construction activities.

TERMS AND CONDITIONS

In order to be exempt from the prohibitions of Section 9 of the ESA, FERC must comply with the following terms and conditions, which implement the reasonable and prudent measures described above and outline required reporting/monitoring requirements. These terms and conditions are nondiscretionary.

Indiana bat (Ibat)

1. Prior to initiation of on-site work, notify all prospective employees, operators, and contractors about the presence and biology of the Ibat, special provisions necessary to protect the Ibat, activities that may affect the Ibat, and ways to avoid and minimize these effects. This information can be obtained by reading Ibat-related information in this Opinion or a fact sheet containing this information can be created and provided by FERC or the applicant.
2. A mechanism for preservation of the Braxton County conservation property must be in place prior to completion of project construction or on a date mutually agreed upon with the Service. Contact the WVFO (FW5_WVFO@fws.gov) regarding Service approval.
3. Finalize the Memorandum of Understanding regarding federally listed bat mitigation prior to the completion of project construction. Contact the WVFO (FW5_WVFO@fws.gov) and VAFO (sumalee_hoskin@fws.gov) regarding Service review and approval.

4. Prior to initiation of any blasting activities within 0.5 mile of any known or assumed occupied hibernacula, Mountain Valley will provide site-specific blasting plans to the Service and FERC for review and approval.
5. Avoid conducting future tree removal activities within unknown use spring staging/fall swarming habitat during April and October, whenever possible.
6. Adhere to the monitoring and reporting requirements for the Ibat detailed below.

<u>Northern long-eared bat (NLEB)</u>

1. Prior to initiation of on-site work, notify all prospective employees, operators, and contractors about the presence and biology of the NLEB, special provisions necessary to protect the NLEB, activities that may affect the NLEB, and ways to avoid and minimize these effects. This information can be obtained by reading NLEB-related information in this Opinion or a fact sheet containing this information can be created and provided by FERC or the applicant.
2. A mechanism for preservation of the Braxton County conservation property must be in place prior to completion of project construction or on a date mutually agreed upon with the Service. Contact the WVFO (FW5_WVFO@fws.gov) regarding Service review and approval.
3. Finalize the Memorandum of Understanding regarding federally listed bat mitigation prior to the completion of project construction. Contact the WVFO (FW5_WVFO@fws.gov) and VAFO (sumalee_hoskin@fws.gov) regarding Service review and approval.
4. Prior to initiation of any blasting activities within 0.5 mile of any known or assumed occupied hibernacula, Mountain Valley will provide site-specific blasting plans to the Service and FERC for review and approval.
5. Avoid conducting future tree removal activities within unknown use spring staging/fall swarming habitat during April and October, whenever possible.
6. Adhere to the monitoring and reporting requirements for the NLEB detailed below.

<u>Roanoke logperch (RLP)</u>

1. Prior to initiation of on-site work, notify all prospective employees, operators, and contractors about the presence and biology of the RLP, special provisions necessary to protect the RLP, activities that may affect the RLP, and ways to avoid and minimize these effects. This information can be obtained by reading RLP-related information in this Opinion or a fact sheet containing this information can be created and provided by FERC or the applicant.
2. Use the most non-lethal technique first when removing fish from the instream workspaces.
3. Construct temporary dam structures (North Fork Roanoke River 1 (MP 227.2, Stream ID S-G36)) using non-erodible materials. Remove temporary dam structures in their entirety upon project completion. This requirement has been fulfilled.

4. Fill any sandbags used in temporary dam structures with clean sand and no other materials. All sandbags must be new with no prior use and must be removed at the time of temporary dam structure removal. This requirement has been fulfilled.
5. Build temporary dam structures to a height, strength, and configuration to resist no less than normal peak daily flows. All construction within suitable habitat for the species must take place outside of the RLP TOYR.
6. Minimize instream foot traffic in RLP watersheds during construction.
7. Vehicles or construction equipment may not enter waterbodies with suitable RLP habitat, except within temporary dam structures.
8. Inspect all vehicles for leaks immediately prior to instream or temporary dam structure work (North Fork Roanoke River 1 (MP 227.2, Stream ID S-G36). This requirement has been fulfilled.
9. Prior to work in RLP watersheds, repair any leaks and clean construction vehicles thoroughly to remove any residual dirt, mud, debris, grease, motor oil, hydraulic fluid, coolant, or other hazardous substances from construction vehicles. Inspections, repairs, cleaning, and/or servicing will be conducted either before the vehicle, equipment, or machinery is transported into the field or at the work site within the staging area. All wash-water runoff and/or harmful materials will be appropriately controlled to prevent entry into the waterbody, including the riparian zone.
10. Adhere to the monitoring and reporting requirements for the RLP detailed below.

Candy darter (CD)

1. Prior to initiation of on-site work, notify all prospective employees, operators, and contractors about the presence and biology of the CD, special provisions necessary to protect the CD, activities that may affect the CD, and ways to avoid and minimize these effects. This information can be obtained by reading CD-related information in this Opinion or a fact sheet containing this information can be created and provided by FERC or the applicant.
2. Construct temporary dam structures in CD watersheds (Stony Creek and Gauley River) using non-erodible materials. Remove temporary dam structures in their entirety upon project completion.
3. Fill any sandbags used in temporary dam structures with clean sand and no other materials. All sandbags must be new with no prior use and must be removed at the time of temporary dam structure removal.
4. Build temporary dam structures to a height, strength, and configuration to resist no less than normal peak daily flows.
5. Minimize instream foot traffic in CD watersheds during construction.
6. Inspect all vehicles for leaks immediately prior to instream or cofferdam work in CD watersheds (Stony Creek and Gauley River). Repair any leaks and clean construction vehicles thoroughly to remove any residual dirt, mud, debris, grease, motor oil, hydraulic fluid, coolant, or other hazardous substances from construction vehicles. Inspections,

repairs, cleaning, and/or servicing will be conducted either before the vehicle, equipment, or machinery is transported into the field or at the work site within the staging area. All wash-water runoff and/or harmful materials will be appropriately controlled to prevent entry into the waterbody, including the riparian zone.

7. Adhere to the monitoring and reporting requirements for the CD detailed below.

MONITORING AND REPORTING REQUIREMENTS

Care must be taken in handling any dead specimens of proposed or listed species to preserve biological material in the best possible state. In conjunction with the preservation of any dead specimens, the finder has the responsibility to ensure that evidence intrinsic to determining the cause of death of the specimen is not unnecessarily disturbed. The finding of dead specimens does not imply enforcement proceedings pursuant to the ESA. The reporting of dead specimens is required to enable the Service to determine if take is reached or exceeded and to ensure that the terms and conditions are appropriate and effective. Upon locating a dead specimen, notify the Service's VA Law Enforcement Office at 804-771-2883 and VAFO at the phone number provided below or at 804-693-6694.

Indiana bat (Ibat)

1. FERC or the applicant shall notify the Service regarding the projected and actual re-start dates, progress, and completion of the project and verify that the acres of clearing identified in Table 31 was not exceeded and all conservation measures were followed. Provide a report containing this information by December 31 of each year until construction is complete to the WVFO (FW5_WVFO@fws.gov) and VAFO (sumalee_hoskin@fws.gov).
2. Monitor Ibat activity around Greenville Saltpeter Cave and Tawney's Cave to assess status of Ibats in the fall swarming/spring staging areas. Two weeks prior to the start of tree clearing place acoustic monitors outside the entrance of each cave (i.e., Greenville Saltpeter Cave, Tawney's Cave). Monitors will remain in place until completion of 2 hibernating seasons post-construction. The raw acoustic monitoring data will be evaluated to identify bats to species using Service approved (https://www.fws.gov/media/automated-acoustic-bat-id-software-programs) acoustical detection software. All potential *Myotis* species detections shall be manually vetted by a qualified expert. A report of this analyzed acoustic data shall be provided to the Service that identifies bat calls to species at each hibernaculum, includes an analysis of trends in activity by all species (not only Ibat and NLEB) at the known hibernacula, and provides a discussion on the potential changes in bat activity trends and any potential causes. Provide a report, every year on March 30 to the WVFO (FW5_WVFO@fws.gov) and VAFO (sumalee_hoskin@fws.gov). In the event additional time is necessary to complete manual vetting, inform the Service prior to the end of the reporting period how much additional time is needed to provide the report. Raw acoustic data shall be retained by Mountain Valley for 7 years post-construction and made available to the Service upon

request.

3. Raw acoustic monitoring data collected to date around Greenville Saltpeter Cave and Tawney's Cave in the fall swarming/spring staging areas shall be evaluated to identify bats to species using Service approved (https://www.fws.gov/media/automated-acoustic-bat-id-software-programs) acoustical detection software and all potential *Myotis* species calls/detections shall be manually vetted by a qualified expert. A report of this analyzed acoustic data shall be provided to the Service that identifies bat calls to species at each hibernaculum, includes an analysis of trends in bat activity by all species (not only Ibat and NLEB) at the known hibernacula, and provides a discussion on the potential changes in bat activity trends and any potential causes. The report shall be provided by March 30, 2024, to the WVFO (FW5_WVFO@fws.gov) and VAFO (sumalee_hoskin@fws.gov).

Northern long-eared bat (NLEB)

1. FERC or the applicant shall notify the Service regarding the projected and actual re-start dates, progress, and completion of the project and verify that the acres of clearing in Table 32 was not exceeded and all conservation measures were followed. Provide a report containing this information by December 31 of each year until construction is complete to the WVFO (FW5_WVFO@fws.gov) and VAFO (sumalee_hoskin@fws.gov).
2. Monitor NLEB activity around Greenville Saltpeter Cave, Canoe Cave, Tawney's Cave, PS-WV3-Y-P1, Laurel Creek Cave, and Clover Hollow Cave to assess status of NLEBs in the fall swarming/spring staging areas. Two weeks prior to the start of tree clearing place acoustic monitors outside the entrance of each cave (i.e., Greenville Saltpeter Cave, Canoe Cave, Tawney's Cave, PS-WV3-Y-P1, Laurel Creek Cave, and Clover Hollow Cave). Monitors will remain in place until completion of 2 hibernating seasons post-construction. The raw acoustic monitoring data will be evaluated to identify bats to species using Service approved (https://www.fws.gov/media/automated-acoustic-bat-id-software-programs) acoustical detection software. All potential *Myotis* species detections shall be manually vetted by a qualified expert. A report of this analyzed acoustic data shall be provided to the Service that identifies bat calls to species at each hibernaculum, includes an analysis of trends in activity by all species (not only Ibat and NLEB) at the known hibernacula, and provides a discussion on the potential changes in bat activity trends and any potential causes. Provide a report, every year on March 30 to the WVFO (FW5_WVFO@fws.gov) and VAFO (sumalee_hoskin@fws.gov). In the event additional time is necessary to complete manual vetting, inform the Service prior to the end of the reporting period how much additional time is needed to provide the report. Raw acoustic data shall be retained by Mountain Valley for 7 years post-construction and made available to the Service upon request.
3. Raw acoustic monitoring data collected to date around Greenville Saltpeter Cave, Canoe Cave, Tawney's Cave, and PS-WV3-Y-P1, Laurel Creek Cave, and Clover Hollow Cave in the fall swarming/spring staging areas shall be evaluated to identify bats to species using Service approved (https://www.fws.gov/media/automated-acoustic-bat-id-software-

programs) acoustical detection software and all potential *Myotis* species calls/detections shall be manually vetted by a qualified expert. A report of this analyzed acoustic data shall be provided to the Service that identifies bat calls to species at each hibernaculum, includes an analysis of trends in bat activity by all species (not only Ibat and NLEB) at the known hibernacula, and provides a discussion on the potential changes in bat activity trends and any potential causes. The report shall be provided by March 30, 2024, to the WVFO (FW5_WVFO@fws.gov) and VAFO (sumalee_hoskin@fws.gov).

Roanoke logperch (RLP)

1. Any high water event that disturbs the construction site that introduces sediment or other materials, including failure or overtopping of temporary dam structures or disturbance of a bridge over RLP occupied streams, must be reported to the Service (804) 824-2426 or within 24 hours.
2. Any spills of motor oil, hydraulic fluid, coolant, or similar fluids, not contained before entry into the action area, must be reported to the Service at the contact number/email provided below and National Response Center (800-424-8802) immediately.
3. Conduct a RLP habitat assessment at North Fork Roanoke River crossings 6 months after construction activities related to the crossing are completed to assess the status of the RLP habitat. If the habitat assessment indicates RLP habitat has not been restored, conduct an additional habitat assessment in 6 months. Habitat assessments will be conducted within the ROW and 200 m upstream and 800 m downstream of the crossing site by a qualified surveyor(s). Provide a report containing raw data and summarized information from the habitat assessments at each site to the VAFO (sumalee_hoskin@fws.gov) within 30 days of completion of each habitat assessment. This requirement has been fulfilled.
4. Implement and adhere to the provisions of the monitoring plan detailed in Appendix F.
5. FERC or the applicant shall notify the Service regarding the projected and actual start dates, progress, and completion of instream construction and verify that 503 m^2 of river bottom disturbance was not exceeded and all conservation measures were followed. Provide a report containing this information by December 31 of each year until construction is complete to the VAFO at sumalee_hoskin@fws.gov.
6. After review and approval by FERC and the Service, Mountain Valley may discontinue monitoring, detailed in Appendix F, when sufficient vegetation has been re-established along the ROW within RLP watersheds to prevent any likelihood of adverse effects on RLP from suspended sediment/sedimentation (e.g., during the first growing season in the next calendar year after re-establishment of vegetation).
7. In addition to complying with the notification requirements detailed in the monitoring plan (Appendix F), FERC or the applicant shall submit a monthly report to the VAFO at sumalee_hoskin@fws.gov, on or before the 15th of each month until the month after monitoring has been terminated, summarizing the prior month's activities under the

monitoring plan and providing any monitoring data that has not previously been provided. The report shall document any refinements to the NTU conversions that will initially be based on Hyer et al. (2015), and shall identify the site-specific SSC data that form the basis for those refinements.

8. Within 6 months of the termination of monitoring (Appendix F), Mountain Valley shall submit a draft report to FERC and the Service summarizing the monitoring data, with statistical analysis of the monitoring data. FERC, Mountain Valley, and the Service will agree to the contents of this report prior to submission of the draft report. A final report will be submitted within 3 months following receipt of comments on the draft report.

Candy darter (CD)

1. Any high water event that disturbs the construction site that introduces sediment or other materials, including failure or overtopping of cofferdams, within the CD watershed must be reported to the Service at (804) 824-2426 or cindy_schulz@fws.gov within 24 hours.
2. Any spills of motor oil, hydraulic fluid, coolant, or similar fluids, not contained before entry into the action area, must be reported to the Service at the contact number/email provided below and National Response Center (800-424-8802) immediately.
3. Implement and adhere to the provisions of the monitoring plan detailed in Appendix F.
4. FERC or the applicant shall notify the Service regarding the projected and actual start dates, progress, and completion of instream construction and all conservation measures were followed. Provide a report containing this information by December 31 of each year until construction is complete to the VAFO at jordan_richard@fws.gov.
5. After review and approval by FERC and the Service, Mountain Valley may discontinue monitoring, detailed in Appendix F, when sufficient vegetation has been re-established along the ROW within CD watersheds to prevent any likelihood of adverse effects on CD from suspended sediment/sedimentation (e.g., during the first growing season in the next calendar year after re-establishment of vegetation).
6. In addition to complying with the notification requirements detailed in the monitoring plan (Appendix F), FERC or the applicant shall submit a monthly report to the VAFO at jordan_richard@fws.gov, on or before the 15th of each month until the month after monitoring has been terminated, summarizing the prior month's activities under the monitoring plan and providing any monitoring data that has not previously been provided. The report shall document any refinements to the NTU conversions that will initially be based on Hyer et al. (2015), and shall identify the site-specific SSC data that form the basis for those refinements.
7. Within 6 months of the termination of monitoring (Appendix F), Mountain Valley shall submit a draft report to FERC and the Service summarizing the monitoring data, with statistical analysis of the monitoring data. FERC, Mountain Valley, and the Service will agree to the contents of this report prior to submission of the draft report. A final report will be submitted within 3 months following receipt of comments on the draft report.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information.

Virginia spiraea (VASP)

- Permanently protect habitat for the Greenbrier River VASP population.
- Assist with breeding ecology (seed viability/pollinators/compatibility) and genetic diversity research efforts.

Indiana bat (Ibat)

- Fund research on understanding/controlling and mitigating the effects of WNS.
- Fund research to improve knowledge of Ibat use of suitable habitat in VA and WV.
- Plant native trees with exfoliating bark in the temporary construction ROW to replace those that were cleared. Contact the VAFO (sumalee_hoskin@fws.gov) and WVFO (FW5_WVFO@fws.gov) for area-specific recommendations.
- Conduct mist-net surveys and telemetry studies within 5 miles of the location of the pregnant female Ibat captured in Wetzel County, WV to identify occupied roost trees.
- Conduct surveys and telemetry studies within the action area to determine if unknown maternity colonies are present.
- Coordinate with the WVDNR to purchase and protect critical entrances of Greenville Saltpeter Cave.
- Implement habitat enhancement measures (e.g., erect artificial roost structures, create vernal pools, girdle trees, etc.) on the Braxton County conservation property. Develop a site-specific plan for the conservation property that includes: a description of the quality of the habitat; extent and location of on-site enhancements; and a long-term management plan. Conduct bat monitoring on the property to document use by bats. Contact the WVFO (FW5_WVFO@fws.gov) for specific recommendations.

Northern long-eared bat (NLEB)

- Fund research on understanding/controlling and mitigating the effects of WNS.
- Permanently protect parcels with documented roosts or hibernacula.
- Fund research to improve knowledge of NLEB use of suitable habitat in VA and WV.
- Conduct mist-net and acoustic surveys and telemetry studies within the action area to determine if unknown maternity colonies are present.
- Coordinate with the WVDNR to purchase and protect critical entrances of Greenville Saltpeter Cave.

- Implement habitat enhancement measures (e.g., erect artificial roost structures, create vernal pools, girdle trees, etc.) on the Braxton County conservation property. Develop a site-specific plan for the conservation property that includes: a description of the quality of the habitat; extent and location of on-site enhancements; and a long-term management plan. Conduct bat monitoring on the property to document use by bats. Contact the WVFO (FW5_WVFO@fws.gov) for specific recommendations.

Roanoke logperch (RLP)

- Fund or conduct projects to identify and remove manmade barriers to fish passage that will benefit RLP.
- Continue to work with the VAFO (sumalee_hoskin@fws.gov) to identify appropriate restoration efforts.
- Contribute funding to a RLP population recovery program for captive propagation, restoration, and reintroductions.
- Contribute funding to help develop a standard survey protocol for use in the post-delisting monitoring plan.
- Contribute funding to help develop a post delisting monitoring plan.

Candy darter (CD)

- Conduct activities to reduce sedimentation:
    - Utilizing enhanced BMPs designed to reduce sedimentation, erosion, and bankside destruction when implementing construction and forestry projects.
    - Avoiding or reducing other watershed activities that release sediments, pollutants, or nutrients into the water or that result in instream disturbances.
- Conduct activities to reduce potential spills and discharges including:
    - Rerouting roads away from riparian corridors.
    - Constructing or reconstructing guard rails in areas adjacent to streams.
    - Modifying drainage systems at stream crossings or impervious cover so that discharges or spills are directed away from streams.
    - Locating or relocating facilities that could result in spills away from CD streams.
    - Developing spill prevention and response plans.
- Additional landscape level conservation planning will help refine and effectively implement the overall recovery strategy. Activities include:
    - Encouraging voluntary stewardship such as through watershed group, stream monitoring, etc.
    - Working with project proponents through ESA Section 7 consultations, to avoid, minimize, and mitigate for potential adverse effects to CD and its habitat.
- Contribute funding to a CD population recovery program for captive propagation, restoration, and reintroductions.

For the Service to be kept informed of actions minimizing or avoiding adverse effects or benefitting listed species or their habitats, the Service requests notification of the implementation of any conservation recommendations.

REINITIATION NOTICE

This concludes formal consultation on the actions outlined in the reinitiation request. As provided in 50 CFR 402.16, reinitiation of consultation is required where discretionary federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of taking specified in the incidental take statement is exceeded; (2) new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not considered in this Opinion; (3) the action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this Opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In light of the conservative approach to analysis of project impacts on NLEB in this Opinion, including accounting for all potential effects within the action area over the life of the project in the jeopardy analysis and analyzing potential future effects under an endangered species framework, reinitiation is not required as a result of the final rule reclassifying NLEB as endangered, which goes into effect on March 31, 2023.

Recent submissions by the Fourth Circuit petitioners

Our regulations establish deadlines for completing the Section 7 consultation process and for issuing our biological opinion. These deadlines may be extended only with the agreement of the action agency (here FERC) and any applicant (here Mountain Valley). See 50 CFR 402.14(e), (g)(5). For this consultation, the consulting parties initially agreed to a 60-day extension until February 10, 2023, and subsequently agreed to an additional extension until February 28, 2023. Those extensions were intended to cover not only the completion of formal consultation, but also the post-consultation period during which we are required to draft and finalize our biological opinion using the information gathered and discussed during consultation. 50 CFR 402.14(e). Both components of the Section 7 process are generally included in the shorthand reference to "Section 7 consultation."

Our letter to FERC memorializing the most recent extension reflects the agencies' and Mountain Valley's understanding that there would be no further extensions and that we would issue our Opinion by February 28, 2023. FERC and Mountain Valley indicated that this deadline is important because other federal agencies that are considering project-related approvals, including the USFS, BLM, and USACE, will use our Opinion to meet their own ESA Section 7 responsibilities. Those agencies thus cannot complete their ongoing administrative proceedings until the Opinion is issued, and the Service cannot defer this Opinion until after those agencies have made their final decisions.

Our letter to FERC memorializing the extension of the Section 7 process until February 28, 2023 was posted on FERC's docket, as was our December 12, 2022 letter memorializing the initial 60-

day extension until February 10, 2023. As a result, both letters were available to the public.

Shortly before the February 28, 2023 deadline for this Opinion, as we were finalizing the Opinion, the petitioners in the prior Fourth Circuit litigation submitted voluminous materials to the Service. These materials included a February 21, 2023 letter from an attorney for the Sierra Club accompanied by hundreds of pages of attachments; a separate 172-page letter (dated February 21, 2023) from attorneys for the petitioners and other environmental organizations that was submitted to the Service on February 22, 2023; approximately 478 pages of additional materials submitted by one of the petitioners on February 10, 2023, and February 21, 2023; and a separate 128-page letter (dated February 25, 2023) from attorneys for the petitioners that was provided to the Service on February 27, 2023.

Although some of the attachments to these letters had already been submitted to the Service or were otherwise considered during consultation, petitioners' last-minute submissions also included new materials that had not previously been submitted and were not available earlier in the Section 7 process. These new materials include extensive comments on the USFS's draft supplemental environmental impact statement in support of its proposed project approvals, which BLM will also use to support its related approvals, and on the USACE's proposed project approvals. Among other things, the comments raise numerous issues relating to Mountain Valley's Hydrologic Analysis of Sedimentation and its assessment of the project's potential impact on the aquatic environment. The USFS, BLM, and USACE have not yet had an opportunity to address those comments as part of their ongoing administrative processes.

Unlike the administrative process under other statutes, the ESA Section 7 consultation process does not involve public participation. Section 7 establishes a closed process between the action agency, the Service, and (in this case) the applicant. Section 7 thus does not provide for a public comment period or require the Service to respond to unsolicited comments. Nevertheless, the Service has consistently considered information provided by the public during consultation on this project, so long as the information was provided in a timely manner so that it could be meaningfully discussed and evaluated by the Service, FERC, and Mountain Valley during formal consultation and addressed in our Opinion, as appropriate.

In this instance, the Service recommenced informal consultation with FERC and Mountain Valley in March 2022, shortly after the Fourth Circuit issued its decision identifying defects in the 2020 Opinion. In October 2022, in response to petitioners' concerns about the process, the Service encouraged petitioners to submit any information they had relating to the project's potential effects on listed species as soon as possible so that the information could be timely evaluated during formal consultation and incorporated into this Opinion, as appropriate. Petitioners did not timely provide any relevant information in response to our invitation. And petitioners' recent submissions—several of which were provided a few days before the February 28, 2023 deadline for this Opinion (and one of which was provided the day before)—came far too late in the Section 7 process to be practicably and meaningfully addressed in this Opinion.

The ESA provides two mechanisms for ensuring that any significant new information contained in petitioners' last-minute submissions is addressed. First, the action agencies must evaluate, as part of their ongoing administrative processes, whether the late submissions contain any new information that prevents them from relying on this Opinion to meet their ESA Section 7 obligations. See City of Tacoma v. FERC, 460 F.3d 53, 76 (D.C. Cir. 2006); Pyramid Lake Paiute Tribe of Indians v. U.S. Dept of the Navy, 898 F.2d 1410, 1415 (9th Cir.1990). Second, the Service must also consider whether the submissions contain any new information that requires reinitiation of consultation under 50 CFR 402.16. To that end, we will request by separate correspondence FERC's initial assessment of whether any information in petitioners' submissions affects any of the methodologies employed or findings made in the SBA2. After we have received FERC's response, we will independently assess whether reinitiation of consultation is required. If the USFS, BLM, and USACE have completed their administrative processes at that time, we will take their conclusions and their analyses of petitioners' submssions into account in making our determination.

If you have any questions regarding this Opinion or our shared responsibilities under the ESA, please contact me at (804) 824-2426 or cindy_schulz@fws.gov.

Sincerely,

Cindy Schulz
Field Supervisor
Virginia Ecological Services

Enclosures

cc: BLM, Falls Church, VA (Attn: Sally Spencer)
USACE, Huntington WV (Attn: Mike Hatten)
USACE, Norfolk, VA (Attn: William Walker)
USACE, Pittsburgh, PA (Attn: Scott Hanns)
USFS, Atlanta, GA (Attn: Dan Olsen)
VDACS, Richmond, VA (Attn: Keith Tignor)
VDCR-DNH, Richmond, VA (Attn: Jason Bulluck)
VDWR, Richmond, VA (Attn: Becky Gwynn)
WVDNR, Elkins, WV (Attn: Jocelyn Phares)
Beveridge and Diamond, Washington, DC (Attn: Parker Moore)
Mountain Valley, Canonsburg, PA (Attn: Matt Hoover, Megan Neylon)

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NLEB
N/A

RLP
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Adverse Modification Analysis Framework
N/A

CD Critical Habitat
N/A

Amount or Extent of Take Anticipated

Ibat
N/A

NLEB
N/A

RLP
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Ibat

N/A

NLEB

N/A

RLP

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CD

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Appendix A. Consultation History

10-13-14	Mountain Valley sent the Service an introductory letter regarding the MVP project.
04-03-15	VAFO sent a letter to ESI providing comments on the MVP project VA segments.
04-17-15	FERC issued a Notice of Intent to prepare an EIS for the planned the MVP project.
10-23-15	FERC provided notification that Mountain Valley filed its certificate application and attached an EIS schedule.
11-13-15	Mountain Valley sent a letter to the Service submitting notification of intent to initiate formal consultation.
02-01-16	Mountain Valley submitted the draft BA to the Service.
03-08-16	VAFO sent a letter to ESI providing recommendations for the MVP project and surveys in VA.
04-07-16	The Service met with Mountain Valley and ESI to discuss the draft BA.
04-20-16	ESI sent a letter to VAFO responding to the Service's March 8, 2016, letter.
06-24-16	Mountain Valley submitted the updated BA to the Service.
06-28-16	FERC issued a Notice of Schedule for Environmental Review of the MVP project.
09-27-16	FERC published a Notice of Availability of the Draft EIS for the proposed the MVP project.
09-28-16	FERC issued the Draft EIS for the projects proposed by Mountain Valley and Equitrans LP.
10-25-16	Mountain Valley submitted the updated BA to the Service.
03-31-17	FERC issued a Notice of Revised Schedule for Environmental Review of the MVP project.
05-18-17	Mountain Valley filed responses to data requests and comments on the draft BA.
06-23-17	FERC issued a Notice of Availability of the FEIS for the MVP project.

07-10-17	FERC sent a letter to the Service requesting initiation of formal consultation and submitting the BA.
07-27-17	Mountain Valley sent a letter to FERC filing Supplemental Information to the BA.
08-04-17	The Service sent a letter to FERC initiating formal consultation.
09-01-17	Mountain Valley provided their Upland Forest Impact Assessment and Voluntary Mitigation Plan.
09-08-17	The Service sent a letter to FERC regarding Mountain Valley's final Migratory Bird Conservation Plan.
11-08-17	Mountain Valley sent a letter to the Service providing avoidance and minimization measures for SWP and VASP.
11-21-17	The Service issued a non-jeopardy Opinion to FERC for the MVP project.
05-21-18	Southern Environmental Law Center sent a letter to FERC stating that FERC must enforce the terms of its order and prohibit pipeline construction until the Service approves of the pipeline route by completing Section 7 consultation and issuing a statement concerning incidental take.
05-22-18	Sierra Club sent a letter to FERC requesting reinitiation of formal consultation on the MVP project.
06-06-18	The Service sent a letter to FERC regarding Mountain Valley's May 30, 2018, requested approval to clear trees in 2 areas of the Jefferson National Forest between June 1 and July 31, 2018.
03-29-19	Mountain Valley sent a letter to FERC providing information about landslide conditions along the MVP project corridor so that FERC may consider initiating emergency consultation with the Service under Section 7 of the ESA.
03-29-19	FERC sent a letter to the Service requesting expedited consultation under the ESA using the emergency consultation procedures specified at 50 CFR §402.05.
04-03-19	FERC posted correspondence to the FERC docket regarding the MVP project and emergency Section 7 consultation.
04-12-19	The Service sent a letter to FERC providing a list of questions and information/data needs to assist FERC and the Service in determining how best to proceed under the ESA regarding certain activities related to the MVP project.

05-01-19	Sierra Club sent a letter to the Service stating that "the Service must reinitiate consultation; update its analysis to account for new information regarding the manner and extent of impacts on imperiled species; and remedy its defective ITS."
05-22-19	The Service sent a letter to Sierra Club indicating that the Service is currently engaging with FERC to determine whether reinitiation of our consultation under the ESA may be appropriate and that we do not believe yellow lance are present in the area affected by the MVP project such that consultation is required.
07-02-19	Mountain Valley emailed the Service providing a response to the Service's April 12, 2019, data request.
08-12-19	Sierra Club sent a letter to the Service requesting the Service stay its November 21, 2017, Opinion and ITS for the MVP project.
08-13-19	Wild Virginia et al. petitioned the U.S. Court of Appeals for the 4th Circuit for review of the Service's November 21, 2017, Opinion and ITS to FERC for the MVP project.
08-15-19	Mountain Valley sent FERC and the Service a letter indicating voluntary suspension of certain activities for the MVP project.
08-15-19	The Service sent Sierra Club a letter indicating that an administrative stay of the 2017 Opinion and ITS is not necessary at this time to avoid adverse effects to listed species.
08-21-19	Sierra Club filed a motion for stay of the Service's 2017 Opinion and ITS in the U.S. Court of Appeals for the 4th Circuit.
08-28-19	FERC sent a letter to the Service requesting to reinitiate consultation.
09-11-19	The Service sent FERC a letter accepting FERC's August 28, 2019, letter requesting reinitiation of Section 7 consultation, pursuant to the ESA on the MVP project.
10-01-19	Sierra Club sent a letter to FERC requesting that FERC enforce Environmental Conditions 9 and 28 by issuing a stop work order halting all construction activities, and by suspending all notices to proceed for the MVP project.
10-15-19	FERC issued a letter to Mountain Valley notifying them that that construction activity along all portions of the MVP project and in all work areas must cease

immediately, with the exception of restoration and stabilization of the ROW and work areas.

10-16-19 The Service sent FERC a letter requesting additional data/information.

11-19-19 The Service, FERC, USGS, and Mountain Valley met to discuss technical issues.

11-27-19 Mountain Valley sent a letter to FERC responding to the Service's October 16, 2019, request for information.

12-10-19 The Service sent a letter to FERC documenting the agreement between the Service and FERC to extend the consultation period by 60 days to February 10, 2020.

12-18-19 Mountain Valley sent a letter to FERC and the Service responding to Southern Environmental Law Center's October 18, 2019, letter regarding the Atlantic Coast Pipeline project and assertions about the MVP project.

12-31-19 Mountain Valley sent a letter to FERC submitting a supplemental answer to the Motion for Revised Peak Stormwater Discharge Analysis filed on September 4, 2019.

02-07-20 The Service sent a letter to FERC documenting the agreement between the Service and FERC, with the consent of the project applicant, to extend the consultation period by an additional 45 days until March 26, 2020.

03-25-20 The Service sent a letter to FERC documenting the agreement between the Service and FERC, with the consent of the project applicant, to extend the consultation period by an additional 32 days until April 27, 2020.

04-03-20 FERC sent a letter to the Service providing an updated effects determination for SWP.

04-27-20 The Service sent a letter to FERC documenting the agreement between the Service and FERC, with the consent of the project applicant, to extend the consultation period by an additional 30 days until May 27, 2020.

04-27-20 Mountain Valley submitted a SBA to the Service.

05-04-20 Mountain Valley submitted a revised SBA to the Service.

05-07-20 FERC sent a letter to the Service confirming FERC's agreement with the action area in the SBA.

05-11-20	The Service sent a letter to Mountain Valley and FERC providing comments on SBA.
05-28-20	Mountain Valley submitted a second revised SBA to the Service.
07-08-20	FERC sent a letter to the Service providing updated Section 7 determinations.
07-09-20	The Service sent a letter to FERC concurring with FERC's Section 7 determinations.
07-22-20	The Service sent a letter to FERC transmitting the Service's preliminary draft non-jeopardy/adverse modification Opinion.
08-27-20	The Service sent a letter to FERC transmitting the Service's revised draft non-jeopardy/adverse modification Opinion.
09-04-20	The Service issued a non-jeopardy Opinion to FERC for the MVP project.
05-05-21	FERC sent a letter to the Service requesting that the Service confirm the September 4, 2020, conference opinion as the biological opinion for candy darter designated critical habitat.
05-14-21	The Service sent a letter to FERC confirming the September 4, 2020, conference opinion as the biological opinion for candy darter critical habitat.
06-04-21	FERC sent a letter to the Service requesting concurrence with Section 7 determinations for changes in crossing methods for 136 streams and 48 wetlands, and 2 alignment shifts to avoid 1 wetland and 1 waterbody.
07-29-21	The Service sent a letter to FERC requesting additional information in response to FERC's June 4, 2021, letter.
10-06-21	FERC sent a letter to the Service providing the information requested in the Service's July 29, 2021, letter.
01-18-22	The Service sent a letter to FERC responding to FERC's June 4, 2021, letter requesting Section 7 concurrence.
02-03-22	The U.S. Court of Appeals for the 4th Circuit vacated and remanded the September 4, 2020, Opinion and ITS.
06-24-22	FERC sent a letter to the Service regarding reinitiation of Section 7 consultation on the MVP project.

07-29-22 The Service received Mountain Valley's SBA2 dated July 2022.

09-28-22 The Service sent a letter to FERC responding to FERC's June 24, 2022, letter regarding reinitiation of Section 7 consultation on the MVP project.

10-04-22 The Service sent a letter to FERC requesting clarification and/or additional information regarding the SBA2.

10-07-22 The Sierra Club sent a letter to FERC and the Service regarding reinitiation of consultation on the MVP project and the SBA2.

10-19-22 FERC sent a letter to Mountain Valley providing comments from FERC and the Service on the SBA2.

10-27-22 The Service sent a letter to Sierra Club responding to Sierra Club's October 7, 2022, letter.

11-18-22 FERC sent a letter to Mountain Valley providing comments from FERC and the Service on Appendix L of the SBA2.

12-12-22 The Service sent a letter to FERC extending Section 7 consultation on the MVP project.

01-11-23 FERC sent a letter to the Service providing an analysis of Appendix L of the SBA2.

02-10-23 The Service sent a letter to FERC extending Section 7 consultation on the MVP project.

Appendix B. Species-Specific and Critical Habitat Effects Tables.

Tables 1-6 are color coded:

- NE rows are green
- NLAA rows are yellow
- LAA rows are blue

Table 1. Analysis of effects on Virginia spiraea.

Pipeline Activity	Subactivity	Environmental Impact or Threat	Stressor	Stressor Pathway (optional)	Exposure (Resource Affected)	Range of Response	Conservation Need Affected	Demographic Consequences	NE, NLAA, or LAA	Comments
New Disturbance - Construction	Vehicle operation and foot traffic	physical impacts to individuals, habitat alteration and/or degradation	crushing, soil compaction	vehicles	habitat, population, individuals	injury, death	reproduction, nutrition, habitat	numbers, reproduction	LAA	See Effects of the Action section.
New Disturbance - Construction	Clearing - herbaceous vegetation and ground cover	physical impacts to individuals, habitat alteration and/or degradation	burying, soil compaction, introduction of invasive species, cutting, digging up, and crushing	NA	habitat, population, individuals	injury, death	reproduction, nutrition, habitat	numbers, reproduction	LAA	See Effects of the Action section.
New Disturbance - Construction	Clearing - trees and shrubs	physical impacts to individuals, habitat alteration and/or degradation	crushing, burying, digging up, cutting	NA	habitat, population, individuals	injury, death	reproduction, nutrition, habitat	numbers, reproduction	LAA	See Effects of the Action section.
New Disturbance - Construction	Vegetation Disposal (upland) - dragging, chipping, hauling, piling, stacking	neutral	none	NA	NA	NA	NA	NA	NE	VASP is a riparian/wetland species and is not found in upland areas. No impacts to riparian/wetland habitats are anticipated from this subactivity.
New Disturbance - Construction	Vegetation Disposal (upland) - brush pile burning	neutral	none	NA	NA	NA	NA	NA	NE	VASP is a riparian/wetland species and is not found in upland areas. No impacts to riparian/wetland habitats are anticipated from this subactivity.
New Disturbance - Construction	Vegetation Clearing - tree side trimming by bucket truck or helicopter	habitat alteration and/or degradation	altered sunlight	NA	NA	discountable - beneficial	NA	NA	NLAA	This subactivity will occur in the construction ROW and ATWS. Methods described in the Exotic and Invasive Species Control Plan (Mountain Valley 2016) will minimize impacts due to invasive species. VASP is not a shade tolerant species; overtopping from arboreal species will eventually eliminate VASP. Effects from side trimming along the ROW will range from discountable to beneficial over an extended period of time.
New Disturbance - Construction	Grading, erosion control devices	physical impacts to individuals, habitat alteration and/or degradation, temporary loss of habitat	crushing, burying, cutting roots	NA	NA	NA	NA	NA	NLAA	This subactivity will occur in the construction ROW and ATWS. Soil compaction and ground disturbance will increase surface water flow and erosion rates and alter surface and subsurface hydrology in the watershed, further degrading VASP habitat. AMMs (e.g., Upland Erosion Control, Revegetation, and Maintenance Plan [FERC 2013a], Restoration and Rehabilitation Plan [Mountain Valley 2017]) are anticipated to reduce surface water runoff and sedimentation; therefore, all effects are anticipated to be insignificant.
New Disturbance - Construction	Trenching (digging, blasting, dewatering, open trench, sedimentation)	physical impacts to individuals, habitat alteration and/or degradation, temporary loss of habitat	crushing, burying, cutting roots	NA	NA	NA	NA	NA	NLAA	This subactivity will occur in the construction ROW. Digging, blasting, dewatering, open trench, and sedimentation will increase surface water flow and erosion rates and alter surface and subsurface hydrology in the watershed, further degrading VASP habitat. AMMs (e.g., Upland Erosion Control, Revegetation, and Maintenance Plan [FERC 2013a], Restoration and Rehabilitation Plan [Mountain Valley 2017]) are anticipated to reduce surface water runoff and sedimentation; therefore, all effects are anticipated to be insignificant.
New Disturbance - Construction	Pipe Stringing - bending, welding, coating, padding and backfilling	neutral	none	NA	NA	NA	NA	NA	NE	This subactivity will occur in the construction ROW, which has already been disturbed by previous activities and no longer provides suitable habitat for VASP.
New Disturbance - Construction	Hydrostatic Testing (water withdrawal and discharge)	neutral	none	NA	NA	NA	NA	NA	NE	The water used during hydrostatic testing will be stored, if necessary, at the discharge location. The discharge location is on the other side of the river, in an upland area not suitable for VASP.
New Disturbance - Construction	Regrading and Stabilization - restoration of corridor	neutral	none	NA	NA	NA	NA	NA	NE	This subactivity will occur in the construction ROW, which has already been disturbed by previous activities and no longer provides suitable habitat for VASP.
New Disturbance - Construction	Facilities - noise, lights	neutral	none	NA	NA	NA	NA	NA	NE	Subactivity not proposed within VASP habitat.
New Disturbance - Construction	Access Roads - upgrading existing roads, new roads temporary and permanent - grading, graveling	physical impacts to individuals, habitat alteration and/or degradation, temporary or permanent loss of habitat	crushing, changes in hydrology, contaminants, burying, digging up	NA	habitat, population, individuals	injury, death	reproduction, nutrition, habitat	numbers, reproduction	LAA	See Effects of the Action section.
New Disturbance - Construction	Access Roads - upgrading existing roads, new roads temporary and permanent - culvert installation	neutral	none	NA	NA	NA	NA	NA	NE	Subactivity not proposed within VASP habitat.

Pipeline Activity	Subactivity	Environmental Impact or Threat	Stressor	Stressor Pathway (optional)	Exposure (Resource Affected)	Range of Response	Conservation Need Affected	Demographic Consequences	NE, NLAA, or LAA	Comments
New Disturbance - Construction	Access Roads - upgrading existing roads, new roads temporary and permanent- tree trimming and tree removal	habitat alteration and/or degradation	altered sunlight	NA	NA	discountable - beneficial	NA	NA	NLAA	This subactivity will occur along ARs. VASP is not a shade tolerant species; overtopping from arboreal species will eventually eliminate VASP. Effects from side trimming along ARs will range from discountable to beneficial over an extended period of time.
New Disturbance - Construction	Stream Crossings, flume	neutral	none	NA	NA	NA	NA	NA	NE	Subactivity not proposed within VASP habitat.
New Disturbance - Construction	Stream Crossings, dam & pump	neutral	none	NA	NA	NA	NA	NA	NE	Subactivity not proposed within VASP habitat.
New Disturbance - Construction	Stream Crossings, cofferdam	neutral	none	NA	NA	NA	NA	NA	NE	Subactivity not proposed within VASP habitat.
New Disturbance - Construction	Stream Equipment Crossing Structures	habitat alteration and/or degradation	sedimentation, soil compaction	NA	limited to some habitat, population, few to some individuals	injury, death	reproduction, nutrition, habitat	numbers, reproduction	LAA	See Effects of the Action section.
New Disturbance - Construction	Stream Crossing - Horizontal Directional Drill (HDD)	neutral	none	NA	NA	NA	NA	NA	NE	Subactivity not proposed within VASP habitat.
New Disturbance - Construction	Stream Crossing - Conventional Bore/microtunnel	neutral	none	NA	NA	NA	NA	NA	NE	Subactivity not proposed within VASP habitat.
New Disturbance - Construction	Crossings, wetlands and other water bodies (non-riparian) - clearing	physical impacts to individuals, habitat alteration and/or degradation	burying, soil compaction, introduction of invasive species, cutting and crushing	NA	habitat, population, individuals	injury, death	reproduction, nutrition, habitat	numbers, reproduction	LAA	See Effects of the Action section.
New Disturbance - Construction	Crossings, wetlands and other water bodies (non-riparian) - tree side trimming	habitat alteration and/or degradation	none	NA	NA	NA	NA	NA	NE	This subactivity will occur in the construction ROW, access road footprint, and ATWS, which have already been disturbed by previous activities and no longer provide suitable habitat for VASP.
New Disturbance - Construction	Crossings, wetlands and other water bodies (non-riparian) - grading, trenching, regrading	physical impacts to individuals, habitat alteration and/or degradation	none	NA	NA	NA	NA	NA	NE	This subactivity will occur in the construction ROW, access road footprint, and ATWS, which have already been disturbed by previous activities and no longer provide suitable habitat for VASP.
New Disturbance - Construction	Crossings, wetlands and other water bodies (non-riparian) - pipe stringing	neutral	none	NA	NA	NA	NA	NA	NE	This subactivity will occur in the construction ROW, which has already been disturbed by previous activities and no longer provides suitable habitat for VASP.
Operation & Maintenance	Facilities - vehicles, foot traffic, noise	neutral	none	NA	NA	NA	NA	NA	NE	Subactivity not proposed within VASP habitat.
Operation & Maintenance	Vegetation Management - mowing	physical impact to individuals	none	NA	NA	NA	NA	NA	NE	This subactivity will occur in the permanent ROW, which has already been disturbed by previous activities and no longer provides suitable habitat for VASP. We do not anticipate VASP re-establishing and growing in the permanent ROW post-construction due to removal of plants, seed, and alteration/removal of habitat.
Operation & Maintenance	Vegetation Management - chainsaw, tree clearing, tree side trimming	neutral	none	NA	NA	NA	NA	NA	NE	Subactivity not proposed within VASP habitat.
Operation & Maintenance	Vegetation Management - pesticide/herbicide - by hand or using equipment approved for precise, localized product application	neutral	none	NA	NA	NA	NA	NA	NE	Subactivity not proposed within VASP habitat.
Operation & Maintenance	Vegetation Disposal (upland) - dragging, chipping, hauling, piling, stacking	neutral	none	NA	NA	NA	NA	NA	NE	VASP is a riparian/wetland species and is not found in upland areas. No impacts to riparian/wetland habitats are anticipated from this subactivity.
Operation & Maintenance	Vegetation Disposal (upland) - brush pile burning	neutral	none	NA	NA	NA	NA	NA	NE	VASP is a riparian/wetland species and is not found in upland areas. No impacts to riparian/wetland habitats are anticipated from this subactivity.
Operation & Maintenance	ROW repair, regrading, revegetation (upland) - hand, mechanical	physical impacts to individuals, habitat alteration and/or degradation	none	NA	NA	NA	NA	NA	NE	VASP is a riparian/wetland species and is not found in upland areas. No impacts to riparian/wetland habitats are anticipated from this subactivity.

Pipeline Activity	Subactivity	Environmental Impact or Threat	Stressor	Stressor Pathway (optional)	Exposure (Resource Affected)	Range of Response	Conservation Need Affected	Demographic Consequences	NE, NLAA, or LAA	Comments
Operation & Maintenance	ROW repair, regrading, revegetation (wetland) - hand, mechanical	physical impacts to individuals, habitat alteration and/or degradation, temporary or permanent loss of habitat	none	NA	NA	NA	NA	NA	NE	This subactivity will occur in the permanent ROW, which has already been disturbed by previous activities and no longer provides suitable habitat for VASP. We do not anticipate VASP re-establishing and growing in the permanent ROW post-construction due to removal of plants, seed, and alteration/removal of habitat.
Operation & Maintenance	ROW repair, regrading, revegetation - instream stabilization and/or fill	physical impacts to individuals, habitat alteration and/or degradation, temporary or permanent loss of habitat	none	NA	NA	NA	NA	NA	NE	This subactivity will occur in the permanent ROW, which has already been disturbed by previous activities and no longer provides suitable habitat for VASP. We do not anticipate VASP re-establishing and growing in the permanent ROW post-construction due to removal of plants, seed, and alteration/removal of habitat.
Operation & Maintenance	Access Road Maintenance - grading, graveling	neutral	none	NA	NA	NA	NA	NA	NE	This subactivity will occur along access roads, which have already been disturbed by previous activities and no longer provides suitable habitat for VASP.
Operation & Maintenance	Access Road Maintenance - culvert replacement	neutral	none	NA	NA	NA	NA	NA	NE	This subactivity will occur along access roads, which have already been disturbed by previous activities and no longer provides suitable habitat for VASP.
Operation & Maintenance	Inspection Activities - ground and aerial	neutral	none	NA	NA	NA	NA	NA	NE	Subactivity not proposed within VASP habitat.

Table 2. Analysis of effects on Indiana bat.

Pipeline Activity	Subactivity	Environmental Impact or Threat	Stressor	Stressor Pathway (optional)	Exposure (Resource Affected)	Range of Response	Conservation Need Affected	Demographic Consequences	NE, NLAA, or LAA	Comments
New Disturbance - Construction	Vehicle Operation and Foot Traffic	Human activity and disturbance	daytime arousal	human presence & noise	all life stages, spring-fall	NA	NA	NA	NLAA	See relevant sections of Opinion.
New Disturbance - Construction	Clearing - herbaceous vegetation and ground cover	Vegetation removal, human activity and disturbance	alteration of summer roosting/foraging habitat & staging/swarming habitat, daytime arousal	Vegetation removal, human presence & noise	all life stages, spring-fall	NA	NA	NA	NLAA	See relevant sections of Opinion.
New Disturbance - Construction	Clearing - trees and shrubs - this is associated with multiple other subactivities and all tree removal for new construction is addressed here unless otherwise specifically called out in its own subactivity below	Tree removal, loss or alteration of forested habitat, human disturbance	alteration of summer roosting/foraging/travel habitat & staging/swarming habitat, daytime arousal	Vegetation removal, human presence & noise	all life stages, spring-fall	kill, harm	feeding, breeding, sheltering	numbers, reproduction	LAA	See Effects of the Action section.
New Disturbance - Construction	Vegetation Disposal (upland) - dragging, chipping, hauling, piling, stacking	Human activity and disturbance, obstructed hibernacula entrances or vents	alteration of hibernacula conditions, hibernacula no longer suitable, daytime arousal	alteration of water or air flow in/out of hibernacula, human presence & noise	all life stages, all seasons	NA	NA	NA	NLAA	See relevant sections of Opinion.
New Disturbance - Construction	Vegetation Disposal (upland) - brush pile burning	Human activity and disturbance, smoke	alteration of hibernacula conditions, daytime arousal, inhalation of smoke	smoke, human presence & noise	all life stages, all seasons	NA	NA	NA	NLAA	See relevant sections of Opinion.
New Disturbance - Construction	Vegetation Clearing - tree side trimming by bucket truck or helicopter	Alteration of forested habitat, human disturbance	daytime arousal, tree damage	human presence & noise	all life stages, spring-fall	NA	NA	NA	NLAA	See relevant sections of Opinion.
New Disturbance - Construction	Grading, erosion control devices	Alteration of water flow, vegetation removal, human activity	alteration of hibernacula conditions	alteration of water or air flow in/out of hibernacula	all life stages, all seasons	NA	NA	NA	NLAA	See relevant sections of Opinion.
New Disturbance - Construction	Trenching (digging, blasting, dewatering, open trench, sedimentation)	Human activity, ground disturbance, instream and riparian disturbance, temporary dewatering	alteration of hibernacula conditions, decreased aquatic invertebrates, daytime arousal	loss or alteration of hibernacula, alteration of water or air flow in/out of hibernacula, instream sedimentation & water flow disruption, human presence & noise	all life stages, all seasons	NA	NA	NA	NLAA	See relevant sections of Opinion.
New Disturbance - Construction	Pipe Stringing - bending, welding, coating, padding and backfilling	Human activity and disturbance	daytime arousal	human presence & noise	all life stages, spring-fall	NA	NA	NA	NLAA	See relevant sections of Opinion.
New Disturbance - Construction	Hydrostatic Testing (water withdrawal and discharge)	Withdrawal/discharge of water into aquatic habitats, human activity	decreased aquatic invertebrates, daytime arousal, alteration of hibernacula conditions	water alterations, human presence & noise, alteration of water or air flow in/out of hibernacula	all life stages, all seasons	NA	NA	NA	NLAA	See relevant sections of Opinion.
New Disturbance - Construction	Regrading and Stabilization - restoration of corridor	Human activity and disturbance	daytime arousal	human presence & noise	all life stages, spring-fall	NA	NA	NA	NLAA	See relevant sections of Opinion.
New Disturbance - Construction	Facilities - noise, lights	Human activity and disturbance	daytime arousal, altered foraging behavior	human presence and noise, lighting	all life stages, spring-fall	NA	NA	NA	NLAA	See relevant sections of Opinion.
New Disturbance - Construction	Access Roads - upgrading existing roads, new roads temp and permanent - grading, graveling	Alteration of surface water flow, vegetation removal, human activity	alteration of hibernacula conditions, alteration of foraging habitat, daytime arousal	removal of vegetation, alteration of surface water flow into hibernacula, human presence & noise	all life stages, all seasons	NA	NA	NA	NLAA	See relevant sections of Opinion.
New Disturbance - Construction	Access Roads - upgrading existing roads, new roads temp and permanent - culvert installation	Human activity and disturbance, instream and riparian disturbance, temporary dewatering	alteration of hibernacula conditions, decreased aquatic invertebrates, daytime arousal	instream sedimentation & water flow disruption, human presence & noise, alteration of water flow & humidity in hibernacula	all life stages, all seasons	NA	NA	NA	NLAA	See relevant sections of Opinion.

Pipeline Activity	Subactivity	Environmental Impact or Threat	Stressor	Stressor Pathway (optional)	Exposure (Resource Affected)	Range of Response	Conservation Need Affected	Demographic Consequences	NE, NLAA, or LAA	Comments
New Disturbance - Construction	Access Roads - upgrading existing roads, new roads temp and permanent- tree trimming and tree removal	Tree removal, loss or alteration of forested habitat, human disturbance	alteration of summer roosting/foraging/travel habitat & staging/swarming habitat, daytime arousal	Vegetation removal, human presence & noise	all life stages, spring-fall	kill, harm	feeding, breeding, sheltering	numbers, reproduction	LAA	See Effects of the Action section.
New Disturbance - Construction	Stream Crossings, flume	human activity and disturbance, instream and riparian disturbance, temporary dewatering	alteration of foraging habitat and drinking sources, daytime arousal, decreased aquatic invertebrates, alteration of hibernacula conditions	vegetation removal, instream sedimentation & water flow disruption, human presence & noise, alteration of water flow & humidity in hibernacula	all life stages, all seasons	NA	NA	NA	NLAA	See relevant sections of Opinion.
New Disturbance - Construction	Stream Crossings, dam & pump	human activity disturbance, instream and riparian disturbance, temporary dewatering	alteration of foraging habitat and drinking sources, daytime arousal, decreased aquatic invertebrates, alteration of hibernacula conditions	vegetation removal, instream sedimentation & water flow disruption, human presence & noise, alteration of water flow & humidity in hibernacula	all life stages, all seasons	NA	NA	NA	NLAA	See relevant sections of Opinion.
New Disturbance - Construction	Stream Crossings, cofferdam	human activity disturbance, instream and riparian disturbance, temporary dewatering	alteration of foraging habitat and drinking sources, daytime arousal, decreased aquatic invertebrates, alteration of hibernacula conditions	vegetation removal, instream sedimentation & water flow disruption, human presence & noise, alteration of water flow & humidity in hibernacula	all life stages, all seasons	NA	NA	NA	NLAA	See relevant sections of Opinion.
New Disturbance - Construction	Stream Equipment Crossing Structures	human activity disturbance, instream and riparian disturbance, temporary dewatering	alteration of foraging habitat and drinking sources, daytime arousal, decreased aquatic invertebrates, alteration of hibernacula conditions	vegetation removal, instream sedimentation & water flow disruption, human presence & noise, alteration of water flow & humidity in hibernacula	all life stages, all seasons	NA	NA	NA	NLAA	See relevant sections of Opinion.
New Disturbance - Construction	Stream Crossing - Horizontal Directional Drill (HDD)	Vegetation removal, human activity and disturbance, riparian disturbance	Alteration of foraging habitat, and increased daytime arousal	Vegetation removal; contamination of drinking water; human presence & noise	all life stages, all seasons	NA	NA	NA	NLAA	See relevant sections of Opinion.
New Disturbance - Construction	Stream Crossing - Conventional Bore/microtunnel	Vegetation removal, human activity and disturbance, riparian disturbance	Alteration of foraging habitat, and increased daytime arousal	Vegetation removal, human presence & noise	all life stages, all seasons	NA	NA	NA	NLAA	See relevant sections of Opinion.
New Disturbance - Construction	Crossings, wetlands and other water bodies (non-riparian) - clearing	Tree removal, loss or alteration of forested habitat, human activity and disturbance	alteration of summer roosting/foraging/travel habitat & staging/swarming habitat, daytime arousal	vegetation removal, human presence & noise	all life stages, spring-fall	kill, harm	feeding, breeding, sheltering	numbers, reproduction	LAA	See Effects of the Action section.
New Disturbance - Construction	Crossings, wetlands and other water bodies (non-riparian) - tree side trimming	Alteration of forested habitat, human activity and disturbance	daytime arousal, tree damage	vegetation removal, human presence & noise	all life stages, spring-fall	NA	NA	NA	NLAA	See relevant sections of Opinion.
New Disturbance - Construction	Crossings, wetlands and other water bodies (non-riparian) - grading, trenching, regrading	Alteration of surface water flow, vegetation removal, human activity and disturbance, wetland disturbance	alteration of hibernacula conditions, decreased aquatic invertebrates, alteration of foraging habitat, daytime arousal	removal of wetland vegetation, water disruption, human presence & noise, alteration of water flow & humidity in hibernacula	all life stages, all seasons	NA	NA	NA	NLAA	See relevant sections of Opinion.
New Disturbance - Construction	Crossings, wetlands and other water bodies (non-riparian) - pipe stringing	Human activity and disturbance	daytime arousal	human presence & noise	all life stages, spring-fall	NA	NA	NA	NLAA	See relevant sections of Opinion.
Operation & Maintenance	Facilities - vehicles, foot traffic, noise	Human activity and disturbance	daytime arousal	human presence & noise	all life stages, spring - fall	NA	NA	NA	NLAA	See relevant sections of Opinion.
Operation & Maintenance	Vegetation Management - mowing	Vegetation removal, human activity and disturbance	daytime arousal	human presence & noise	all life stages, spring-fall	NA	NA	NA	NLAA	See relevant sections of Opinion.
Operation & Maintenance	Vegetation Management - chainsaw, tree clearing, and tree side trimming	Tree removal, loss or alteration of forested habitat, human activity disturbance	alteration of summer roosting/foraging/travel habitat & staging/swarming habitat, daytime arousal	vegetation removal, human presence & noise	all life stages, spring-fall	kill, harm	feeding, breeding, sheltering	numbers, reproduction	LAA	See Effects of the Action section.

Pipeline Activity	Subactivity	Environmental Impact or Threat	Stressor	Stressor Pathway (optional)	Exposure (Resource Affected)	Range of Response	Conservation Need Affected	Demographic Consequences	NE, NLAA, or LAA	Comments
Operation & Maintenance	Vegetation Management - pesticide/herbicide - by hand or using equipment approved for precise, localized product application	Chemical contamination, vegetation loss	lethal or sublethal exposure to toxins	contamination of water & vegetation, loss of herbaceous vegetation	all life stages, all seasons	NA	NA	NA	NLAA	See relevant sections of Opinion.
Operation & Maintenance	Vegetation Disposal (upland) - dragging, chipping, hauling, piling, stacking	Human activity and disturbance, obstructed hibernacula entrances or vents	alteration of hibernacula conditions, hibernacula no longer suitable, daytime arousal	alteration of water or air flow in/out of hibernacula, human presence & noise	all life stages, all seasons	NA	NA	NA	NLAA	See relevant sections of Opinion.
Operation & Maintenance	Vegetation Disposal (upland) - brush pile burning	Human activity and disturbance, smoke	alteration of hibernacula conditions, daytime arousal, inhalation of smoke	smoke, human presence & noise	all life stages, all seasons	NA	NA	NA	NLAA	See relevant sections of Opinion.
Operation & Maintenance	ROW repair, regrading, revegetation (upland) - hand, mechanical	human activity and disturbance	daytime arousal	human presence & noise	all life stages, spring-fall	NA	NA	NA	NLAA	See relevant sections of Opinion.
Operation & Maintenance	ROW repair, regrading, revegetation (wetland) - hand, mechanical	human activity and disturbance	daytime arousal	human presence & noise	all life stages, spring-fall	NA	NA	NA	NLAA	See relevant sections of Opinion.
Operation & Maintenance	ROW repair, regrading, revegetation - instream stabilization and/or fill	human activity and disturbance, instream and riparian disturbance	daytime arousal, decreased aquatic invertebrates	human presence & noise, instream sedimentation	all life stages, spring-fall	NA	NA	NA	NLAA	See relevant sections of Opinion.
Operation & Maintenance	Access Road Maintenance - grading, graveling	human activity and disturbance	daytime arousal	human presence & noise	all life stages, spring-fall	NA	NA	NA	NLAA	See relevant sections of Opinion.
Operation & Maintenance	Access Road Maintenance - culvert replacement	human activity and disturbance, instream and riparian disturbance, temporary dewatering	decreased aquatic invertebrates, daytime arousal	instream sedimentation & water flow disruption, human presence & noise	all life stages, spring-fall	NA	NA	NA	NLAA	See relevant sections of Opinion.
Operation & Maintenance	Inspection Activities - ground and aerial	Human activity and disturbance	daytime arousal	human presence & noise	all life stages, spring-fall	NA	NA	NA	NLAA	See relevant sections of Opinion.

Table 3. Analysis of effects on Northern long-eared bat.

Pipeline Activity	Subactivity	Environmental Impact or Threat	Stressor	Stressor Pathway (optional)	Exposure (Resource Affected)	Range of Response	Conservation Need Affected	Demographic Consequences	NE, NLAA, or LAA	Comments
New Disturbance - Construction	Vehicle Operation and Foot Traffic	Human activity and disturbance	daytime arousal	human presence & noise	all life stages, spring-fall	NA	NA	NA	NLAA	See relevant sections of Opinion.
New Disturbance - Construction	Clearing - herbaceous vegetation and ground cover	Vegetation removal, human activity and disturbance	alteration of summer roosting/foraging habitat & staging/swarming habitat, daytime arousal	Vegetation removal, human presence & noise	all life stages, spring-fall	NA	NA	NA	NLAA	See relevant sections of Opinion.
New Disturbance - Construction	Clearing - trees and shrubs - this is associated with multiple other subactivities and all tree removal for new construction is addressed here unless otherwise specifically called out in its own subactivity below	Tree removal, loss or alteration of forested habitat, human disturbance	alteration of summer roosting/foraging/travel habitat & staging/swarming habitat, daytime arousal	Vegetation removal, human presence & noise	all life stages, spring-fall	kill, harm	feeding, breeding, sheltering	numbers, reproduction	LAA	See Effects of the Action section
New Disturbance - Construction	Vegetation Disposal (upland) - dragging, chipping, hauling, piling, stacking	Human activity and disturbance, obstructed hibernacula entrances or vents	alteration of hibernacula conditions, hibernacula no longer suitable, daytime arousal	alteration of water or air flow in/out of hibernacula, human presence & noise	all life stages, all seasons	NA	NA	NA	NLAA	See relevant sections of Opinion.
New Disturbance - Construction	Vegetation Disposal (upland) - brush pile burning	Human activity and disturbance, smoke	alteration of hibernacula conditions, daytime arousal, inhalation of smoke	smoke, human presence & noise	all life stages, all seasons	NA	NA	NA	NLAA	See relevant sections of Opinion.
New Disturbance - Construction	Vegetation Clearing - tree side trimming by bucket truck or helicopter	Alteration of forested habitat, human disturbance	daytime arousal, tree damage	human presence & noise	all life stages, spring-fall	NA	NA	NA	NLAA	See relevant sections of Opinion.
New Disturbance - Construction	Grading, erosion control devices	Alteration of water flow, vegetation removal, human activity	alteration of hibernacula conditions	alteration of water or air flow in/out of hibernacula	all life stages, all seasons	NA	NA	NA	NLAA	See relevant sections of Opinion.
New Disturbance - Construction	Trenching (digging, blasting, dewatering, open trench, sedimentation)	Human activity, ground disturbance, instream and riparian disturbance, temporary dewatering	alteration of hibernacula conditions, decreased aquatic invertebrates, daytime arousal	loss or alteration of hibernacula, alteration of water or air flow in/out of hibernacula, instream sedimentation & water flow disruption, human presence & noise	all life stages, all seasons	NA	NA	NA	NLAA	See relevant sections of Opinion.
New Disturbance - Construction	Pipe Stringing - bending, welding, coating, padding and backfilling	Human activity and disturbance	daytime arousal	human presence & noise	all life stages, spring-fall	NA	NA	NA	NLAA	See relevant sections of Opinion.
New Disturbance - Construction	Hydrostatic Testing (water withdrawal and discharge)	Withdrawal/discharge of water into aquatic habitats, human activity	decreased aquatic invertebrates, daytime arousal, alteration of hibernacula conditions	water alterations, human presence & noise, alteration of water or air flow in/out of hibernacula	all life stages, all seasons	NA	NA	NA	NLAA	See relevant sections of Opinion.
New Disturbance - Construction	Regrading and Stabilization - restoration of corridor	Human activity and disturbance	daytime arousal	human presence & noise	all life stages, spring-fall	NA	NA	NA	NLAA	See relevant sections of Opinion.
New Disturbance - Construction	Facilities - noise, lights	Human activity and disturbance	daytime arousal, altered foraging behavior	human presence and noise, lighting	all life stages, spring-fall	NA	NA	NA	NLAA	See relevant sections of Opinion.
New Disturbance - Construction	Access Roads - upgrading existing roads, new roads temp and permanent - grading, graveling	Alteration of surface water flow, vegetation removal, human activity	alteration of hibernacula conditions, alteration of foraging habitat, daytime arousal	removal of vegetation, alteration of surface water flow into hibernacula, human presence & noise	all life stages, all seasons	NA	NA	NA	NLAA	See relevant sections of Opinion.
New Disturbance - Construction	Access Roads - upgrading existing roads, new roads temp and permanent - culvert installation	Human activity and disturbance, instream and riparian disturbance, temporary dewatering	alteration of hibernacula conditions, decreased aquatic invertebrates, daytime arousal	instream sedimentation & water flow disruption, human presence & noise, alteration of water flow & humidity in hibernacula	all life stages, all seasons	NA	NA	NA	NLAA	See relevant sections of Opinion.

Pipeline Activity	Subactivity	Environmental Impact or Threat	Stressor	Stressor Pathway (optional)	Exposure (Resource Affected)	Range of Response	Conservation Need Affected	Demographic Consequences	NE, NLAA, or LAA	Comments
New Disturbance - Construction	Access Roads - upgrading existing roads, new roads temp and permanent- tree trimming and tree removal	Tree removal, loss or alteration of forested habitat, human disturbance	alteration of summer roosting/foraging/travel habitat & staging/swarming habitat, daytime arousal	Vegetation removal, human presence & noise	all life stages, spring-fall	kill, harm	feeding, breeding, sheltering	numbers, reproduction	LAA	See Effects of the Action section
New Disturbance - Construction	Stream Crossings, flume	human activity and disturbance, instream and riparian disturbance, temporary dewatering	alteration of foraging habitat and drinking sources, daytime arousal, decreased aquatic invertebrates, alteration of hibernacula conditions	vegetation removal, instream sedimentation & water flow disruption, human presence & noise, alteration of water flow & humidity in hibernacula	all life stages, all seasons	NA	NA	NA	NLAA	See relevant sections of Opinion.
New Disturbance - Construction	Stream Crossings, dam & pump	human activity disturbance, instream and riparian disturbance, temporary dewatering	alteration of foraging habitat and drinking sources, daytime arousal, decreased aquatic invertebrates, alteration of hibernacula conditions	vegetation removal, instream sedimentation & water flow disruption, human presence & noise, alteration of water flow & humidity in hibernacula	all life stages, all seasons	NA	NA	NA	NLAA	See relevant sections of Opinion.
New Disturbance - Construction	Stream Crossings, cofferdam	human activity disturbance, instream and riparian disturbance, temporary dewatering	alteration of foraging habitat and drinking sources, daytime arousal, decreased aquatic invertebrates, alteration of hibernacula conditions	vegetation removal, instream sedimentation & water flow disruption, human presence & noise, alteration of water flow & humidity in hibernacula	all life stages, all seasons	NA	NA	NA	NLAA	See relevant sections of Opinion.
New Disturbance - Construction	Stream Equipment Crossing Structures	human activity disturbance, instream and riparian disturbance, temporary dewatering	alteration of foraging habitat and drinking sources, daytime arousal, decreased aquatic invertebrates, alteration of hibernacula conditions	vegetation removal, instream sedimentation & water flow disruption, human presence & noise, alteration of water flow & humidity in hibernacula	all life stages, all seasons	NA	NA	NA	NLAA	See relevant sections of Opinion.
New Disturbance - Construction	Stream Crossing - Horizontal Directional Drill (HDD)	Vegetation removal, human activity and disturbance, riparian disturbance	Alteration of foraging habitat, and increased daytime arousal	Vegetation removal; contamination of drinking water; human presence & noise	all life stages, all seasons	NA	NA	NA	NLAA	See relevant sections of Opinion.
New Disturbance - Construction	Stream Crossing - Conventional Bore/microtunnel	Vegetation removal, human activity and disturbance, riparian disturbance	Alteration of foraging habitat, and increased daytime arousal	Vegetation removal, human presence & noise	all life stages, all seasons	NA	NA	NA	NLAA	See relevant sections of Opinion.
New Disturbance - Construction	Crossings, wetlands and other water bodies (non-riparian) - clearing	Tree removal, loss or alteration of forested habitat, human activity and disturbance	alteration of summer roosting/foraging/travel habitat & staging/swarming habitat, daytime arousal	vegetation removal, human presence & noise	all life stages, spring-fall	kill, harm	feeding, breeding, sheltering	numbers, reproduction	LAA	See Effects of the Action section.
New Disturbance - Construction	Crossings, wetlands and other water bodies (non-riparian) - tree side trimming	Alteration of forested habitat, human activity and disturbance	daytime arousal, tree damage	vegetation removal, human presence & noise	all life stages, spring-fall	NA	NA	NA	NLAA	See relevant sections of Opinion.
New Disturbance - Construction	Crossings, wetlands and other water bodies (non-riparian) - grading, trenching, regrading	Alteration of surface water flow, vegetation removal, human activity and disturbance, wetland disturbance	alteration of hibernacula conditions, decreased aquatic invertebrates, alteration of foraging habitat, daytime arousal	removal of wetland vegetation, water disruption, human presence & noise, alteration of water flow & humidity in hibernacula	all life stages, all seasons	NA	NA	NA	NLAA	See relevant sections of Opinion.
New Disturbance - Construction	Crossings, wetlands and other water bodies (non-riparian) - pipe stringing	Human activity and disturbance	daytime arousal	human presence & noise	all life stages, spring-fall	NA	NA	NA	NLAA	See relevant sections of Opinion.
Operation & Maintenance	Facilities - vehicles, foot traffic, noise	Human activity and disturbance	daytime arousal	human presence & noise	all life stages, spring - fall	NA	NA	NA	NLAA	See relevant sections of Opinion.
Operation & Maintenance	Vegetation Management - mowing	Vegetation removal, human activity and disturbance	daytime arousal	human presence & noise	all life stages, spring-fall	NA	NA	NA	NLAA	See relevant sections of Opinion.
Operation & Maintenance	Vegetation Management - chainsaw, tree clearing, and tree side trimming	Tree removal, loss or alteration of forested habitat, human activity disturbance	alteration of summer roosting/foraging/travel habitat & staging/swarming habitat, daytime arousal	vegetation removal, human presence & noise	all life stages, spring-fall	kill, harm	feeding, breeding, sheltering	numbers, reproduction	LAA	See Effects of the Action section.

Pipeline Activity	Subactivity	Environmental Impact or Threat	Stressor	Stressor Pathway (optional)	Exposure (Resource Affected)	Range of Response	Conservation Need Affected	Demographic Consequences	NE, NLAA, or LAA	Comments
Operation & Maintenance	Vegetation Management - pesticide/herbicide - by hand or using equipment approved for precise, localized product application	Chemical contamination, vegetation loss	lethal or sublethal exposure to toxins	contamination of water & vegetation, loss of herbaceous vegetation	all life stages, all seasons	NA	NA	NA	NLAA	See relevant sections of Opinion.
Operation & Maintenance	Vegetation Disposal (upland) - dragging, chipping, hauling, piling, stacking	Human activity and disturbance, obstructed hibernacula entrances or vents	alteration of hibernacula conditions, hibernacula no longer suitable, daytime arousal	alteration of water or air flow in/out of hibernacula, human presence & noise	all life stages, all seasons	NA	NA	NA	NLAA	See relevant sections of Opinion.
Operation & Maintenance	Vegetation Disposal (upland) - brush pile burning	Human activity and disturbance, smoke	alteration of hibernacula conditions, daytime arousal, inhalation of smoke	smoke, human presence & noise	all life stages, all seasons	NA	NA	NA	NLAA	See relevant sections of Opinion.
Operation & Maintenance	ROW repair, regrading, revegetation (upland) - hand, mechanical	human activity and disturbance	daytime arousal	human presence & noise	all life stages, spring-fall	NA	NA	NA	NLAA	See relevant sections of Opinion.
Operation & Maintenance	ROW repair, regrading, revegetation (wetland) - hand, mechanical	human activity and disturbance	daytime arousal	human presence & noise	all life stages, spring-fall	NA	NA	NA	NLAA	See relevant sections of Opinion.
Operation & Maintenance	ROW repair, regrading, revegetation - instream stabilization and/or fill	human activity and disturbance, instream and riparian disturbance	daytime arousal, decreased aquatic invertebrates	human presence & noise, instream sedimentation	all life stages, spring-fall	NA	NA	NA	NLAA	See relevant sections of Opinion.
Operation & Maintenance	Access Road Maintenance - grading, graveling	human activity and disturbance	daytime arousal	human presence & noise	all life stages, spring-fall	NA	NA	NA	NLAA	See relevant sections of Opinion.
Operation & Maintenance	Access Road Maintenance - culvert replacement	human activity and disturbance, instream and riparian disturbance, temporary dewatering	decreased aquatic invertebrates, daytime arousal	instream sedimentation & water flow disruption, human presence & noise	all life stages, spring-fall	NA	NA	NA	NLAA	See relevant sections of Opinion.
Operation & Maintenance	Inspection Activities - ground and aerial	Human activity and disturbance	daytime arousal	human presence & noise	all life stages, spring-fall	NA	NA	NA	NLAA	See relevant sections of Opinion.

Table 4. Analysis of effects on Roanoke logperch.

Pipeline Activity	Subactivity	Environmental Impact or Threat	Stressor	Stressor Pathway (optional)	Exposure (Resource Affected)	Range of Response	Conservation Need Affected	Demographic Consequences	NE, NLAA, or LAA	Comments
New Disturbance - Construction	Vehicle Operation and Foot Traffic	Neutral	None	NA	NA	NA	NA	NA	NE	No impacts to stream habitats are anticipated from this action. Will not introduce sediment or contaminants into the streams or rivers.
New Disturbance - Construction	Clearing - herbaceous vegetation and ground cover	Habitat degradation and water quality degradation, stress on individuals, reduction in prey population	Sedimentation	Denuding bank and upland areas, grubbing with heavy equipment, disturbing soil	Habitat, Population, Individuals	Harm, Kill	Breeding, Feeding, Sheltering	Numbers, reproduction, distribution	LAA	See Effects of the Action section.
New Disturbance - Construction	Clearing - trees and shrubs	Habitat degradation and water quality degradation, stress on individuals, reduction in prey population	Sedimentation	Denuding bank and upland areas, grubbing with heavy equipment, disturbing soil	Habitat, Population, Individuals	Harm, Kill	Breeding, Feeding, Sheltering	Numbers, reproduction, distribution	LAA	See Effects of the Action section.
New Disturbance - Construction	Vegetation Disposal (upland) - dragging, chipping, hauling, piling, stacking	Neutral	None	NA	NA	NA	NA	NA	NE	No impacts to stream habitats are anticipated from this action. Will not introduce sediment or contaminants into the streams or rivers.
New Disturbance - Construction	Vegetation Disposal (upland) - brush pile burning	Neutral	None	NA	NA	NA	NA	NA	NE	No impacts to stream habitats are anticipated from this action. Will not introduce sediment or contaminants into the streams or rivers.
New Disturbance - Construction	Vegetation Clearing - tree side trimming by bucket truck or helicopter	Habitat degradation and water quality degradation, Stress on eggs	Increase in water temperatures, decrease of dissolved oxygen	Habitat and water quality degradation since vegetation no longer provides shade to stream	NA	NA	NA	NA	NLAA	Instream and bankwork (vegetation removal) will occur at one location and will be slight. The construction ROW at waterbody crossings is narrowed to 75 ft to minimize clearing of trees and riparian vegetation. Post construction, a 10 ft wide ROW will be maintained, which will further lessen impacts from vegetation removal. Therefore, effects from this habitat change are expected to be insignificant.
New Disturbance - Construction	Grading, erosion control devices	Temporary loss of habitat, habitat degradation, physical impacts to individuals, reduction of prey population	Sedimentation	Stormwater erosion	Habitat, Population, Individuals	Harm, Kill	Breeding, Feeding, Sheltering	Numbers, reproduction, distribution	LAA	See Effects of the Action section.
New Disturbance - Construction	Trenching (digging, blasting, dewatering, open trench, sedimentation)	Temporary loss of habitat, Water quality degradation, Physical impacts, Reduction of prey population	Sedimentation, Short-term altered flow, Contaminants	Near, in-stream, upland, and tributary earth disturbance may result in increased sedimentation, altered flow result in increased sedimentation and short-term impoundment, contaminant spills from equipment located in- stream and tributary, noise from in water work	Habitat, Population, Individuals	Harm, Kill	Breeding, Feeding, Sheltering	Numbers, reproduction, distribution	LAA	See Effects of the Action section.
New Disturbance - Construction	Pipe Stringing - bending, welding, coating, padding and backfilling	Temporary loss of habitat, Water quality degradation, Physical impacts, Reduction of prey population	Sedimentation, Short-term altered flow, Contaminants	Near, in-stream, and tributary earth disturbance may result in increased sedimentation, altered flow result in increased sedimentation and short-term impoundment, contaminant spills from equipment located in- stream and tributary, noise from in water work	NA	NA	NA	NA	NLAA	This subactivity occurs after the stream crossing has been isolated behind cofferdams and impacts to RLP from the placement and removal of cofferdams are discussed below. Effects from any sediment that may leak through the cofferdam or noise generated from behind the cofferdam are expected to be insignificant. These activities may take place along some RLP habitat, while E&S control measures will be in place to minimize impacts. Instream structure placement and removal will result in temporary change in water flow. Based on one steam crossing that was completed in the North Fork Roanoke River we expect flow will be altered for 5 days (M. Neylon, EQT, email to S. Hoskin, Service June 10, 2020). Altered flow may increase the stream velocity at a particular location thereby making the area too swift for some YOY RLP to navigate; however, the crossing sites are in typical adult habitat. Adult and juvenile RLP are found in swift moving water so we anticipate altered flow would have minimal affects. The spill prevention and response plan takes all reasonable precautions to prevent a spill. Additionally, there will be no permanent structures such as parking lots that would be a source point for introduction of contaminants. Because of the spill plan and lack of permanent parking lots we expect impacts from contaminants would be unlikely. For this subactivity in the upland areas, Mountain Valley will implement AMMs to minimize sedimentation (e.g., Upland Erosion Control, Revegetation, and Maintenance Plan [FERC 2013a] and Restoration and Rehabilitation Plan [Mountain Valley 2017]), therefore we expect sediment generated from this subactivity to be insignificant.

Pipeline Activity	Subactivity	Environmental Impact or Threat	Stressor	Stressor Pathway (optional)	Exposure (Resource Affected)	Range of Response	Conservation Need Affected	Demographic Consequences	NE, NLAA, or LAA	Comments
New Disturbance - Construction	Hydrostatic Testing (water withdrawal and discharge)	Temporary loss of habitat, Habitat degradation	Minor sedimentation, Altered flow	Withdrawal and discharge of water	NA	NA	NA	NA	NLAA	Municipal water sources will be used for this subactivity. Discharge water will be discharged through sediment filters in vegetated uplands away from waterbodies and wetlands. Therefore, we expect any effects to be discountable.
New Disturbance - Construction	Regrading and Stabilization - restoration of corridor	Permanent or temporary loss of habitat, Habitat degradation, Water quality degradation, Physical impacts to individuals, Reduction of prey	Minor sedimentation, Loss of prey, Contaminants	Tributary and/or near stream earth disturbance can cause minor increase in sedimentation, stormwater runoff. Fertilizers used in revegetation can cause algae blooms which will lower dissolved oxygen.	Habitat, Population, Individuals	Harm, Kill	Breeding, Feeding, Sheltering	Numbers, reproduction, distribution	LAA	See Effects of the Action section.
New Disturbance - Construction	Facilities - noise, lights	Neutral	None	NA	NA	NA	NA	NA	NE	No impacts to stream habitats are anticipated from this action. Will not introduce sediment or contaminants into the streams or rivers.
New Disturbance - Construction	Access Roads - upgrading existing roads, new roads temp and permanent - grading, graveling	Temporary loss of habitat, Water quality degradation, Physical impacts, Reduction of prey population	Sedimentation, Short-term altered flow, Contaminants, Loss of prey, Disruption of spawning, Crushing or removal of eggs	Near, in-stream, and tributary earth disturbance may result in increased sedimentation, altered flow result in increased sedimentation and short-term impoundment, contaminant spills from equipment located in- stream and tributary, noise from in-water work	Habitat, Population, Individuals	Harm, Kill	Breeding, Feeding, Sheltering	Numbers, reproduction, distribution	LAA	See Effects of the Action section.
New Disturbance - Construction	Access Roads - upgrading existing roads, new roads temp and permanent - culvert installation	Permanent or temporary loss of habitat, Habitat degradation, Physical impacts to individuals, Reduction of prey population	Sedimentation, Contaminants, Altered flow,	Tributary and instream earth disturbance can cause increase in sedimentation and turbidity. Equipment located in stream or tributary can increase chance of spills, altered flow velocities and temporary impoundment from in-water work, minor noise from construction activities in	NA	NA	NA	NA	NE	This subactivity is not proposed in RLP occupied habitat.
New Disturbance - Construction	Access Roads - upgrading existing roads, new roads temp and permanent - tree trimming and tree removal	Habitat degradation and water quality degradation, Stress on individuals, Reduction in prey population	Sedimentation	Denuding bank, grubbing with heavy equipment, disturbing soil	Habitat, Population, Individuals	Harm, Kill	Breeding, Feeding, Sheltering	Numbers, reproduction, distribution	LAA	See Effects of the Action section.
New Disturbance - Construction	Stream Crossings, flume	Permanent or temporary loss of habitat, Habitat degradation, Physical impacts to individuals, Reduction of prey population	Sedimentation, Contaminants, Altered flow	Tributary and instream earth disturbance can cause increase in sedimentation and turbidity. Equipment located in stream or tributary can increase chance of spills, altered flow velocities and temporary impoundment from in-water work, minor noise from construction activities in	NA	NA	NA	NA	NE	This subactivity is not proposed in RLP occupied habitat. Mountain Valley is using the dam and pump approach for its open cut crossings of the streams of interest (M. Neylon, EQT, email to S. Hoskin, Service June 10, 2020)
New Disturbance - Construction	Stream Crossings, dam & pump	Temporary loss of occupied habitat, Physical impacts to individuals, Habitat degradation and water quality degradation, reduction of prey population	Sedimentation, Altered flow, Contaminants, Impoundment	Tributary and near stream earth disturbance may result in increased sedimentation altered flow may result in increased sedimentation, contaminant spills from equipment located in tributary stream, dam could restrict up/down stream movement of species, noise from in-water work	Habitat, Population, Individuals	Harm, Kill	Breeding, Feeding, Sheltering	Numbers, reproduction, distribution	LAA	See Effects of the Action section.

Pipeline Activity	Subactivity	Environmental Impact or Threat	Stressor	Stressor Pathway (optional)	Exposure (Resource Affected)	Range of Response	Conservation Need Affected	Demographic Consequences	NE, NLAA, or LAA	Comments
New Disturbance - Construction	Stream Crossings, cofferdam	Temporary loss of occupied habitat, Physical impacts to individuals, Habitat degradation and water quality degradation, Reduction of prey population	Sedimentation, altered flow, contaminants, impoundment, noise	Tributary and near stream earth disturbance may result in increased sedimentation altered flow may result in increased sedimentation, contaminant spills from equipment located in tributary stream, dam could restrict up/down stream movement of species, noise from in-water work	NA	NA	NA	NA	NE	Per the description in the 2017 FEIS, the dam and pump method includes "Temporary dams installed across the waterbody and the downstream side of the construction right-of-way, usually using sandbags or plastic sheeting." Therefore the impacts from damming the waterbody are included in the dam and pump subactivity. Per the decription in the 2017 FEIS, "Cofferdams are typically used for waterbody crossings with larger high flow volumes that may be unsuitable for flume or dam-and-pump methods." This subactivity is not proposed in RLP occupied habitat.
New Disturbance - Construction	Stream Equipment Crossing Structures	Permanent or temporary loss of habitat, Habitat degradation, Physical impacts to individuals, Reduction of prey population	Sedimentation, Contaminants, Altered flow, Noise	Tributary and in stream earth disturbance can cause increase in sedimentation and turbidity. Equipment located in stream or tributary can increase chance of spills, altered flow velocities and temporary impoundment from in-water work, minor noise from construction activities in	NA	NA	NA	NA	NE	This subactivity is not proposed in RLP occupied habitat.
New Disturbance - Construction	Stream Crossing - Horizontal Directional Drill (HDD)	Vegetation removal; human activity; riparian disturbance	Sedimentation, Contaminants, Noise	Vegetation removal; instream drilling fluids; noise, human presence	NA	NA	NA	NA	NLAA	This trenchless crossing method minimized impacts in the riparian zones by eliminating construction activities within or directly adjacent to the crossed stream (M. Eggerding, Mountain Valley Pipeline LLC, letter to J. Martin, FERC, May 13, 2020). Because no open-cut trenching was performed, the stream channel itself was not be impacted, allowing existing riparian vegetation near the stream banks to remain in place. The Pigg River crossing (MP 289.2) was completed in 2019 via HDD. No inadvertent returns occurred and riparian zone impacts were minimized. Therefore, we expect any effects to be insignficant.
New Disturbance - Construction	Stream Crossing - Conventional Bore/microtunnel	Vegetation removal; human activity; riparian disturbance	Sedimentation; Noi se	Vegetation removal; instream drilling fluids; noise, human presence	NA	NA	NA	NA	NLAA	The trenchless crossings would minimize impacts in the riparian zones by eliminating construction activities within or directly adjacent to the crossed stream (M. Eggerding, Mountain Valley Pipeline LLC, letter to J. Martin, FERC, May 13, 2020). Because no open-cut trenching would be performed for these streams, the stream channel itself would not be impacted, allowing existing riparian vegetation near the stream banks to remain in place. For stream crossings, the conventional bore technique avoids all instream construction activities and all direct impacts associated with such activities. Drilling fluids are not used for conventional bores, so there is no risk of inadvertent return of these fluids within the stream. Microtunnel has much lower fluid volumes and downhole pressures as compared to HDD, which reduces risk of IR. Groundwater pressure counterbalances the fluid pressure, which reduces the risk for IR. Downhole pressure monitoring and remote-controlled valving further reduce the risk of IR and minimize any potential fluid loss. Therefore, we expect any effects to be
New Disturbance - Construction	Crossings, wetlands and other water bodies (non-riparian) - clearing	Neutral	None	NA	NA	NA	NA	NA	NE	Subactivity is not located in streams or rivers. In addition, if non-riparian then activity will not be adjacent to occupied habitat.
New Disturbance - Construction	Crossings, wetlands and other water bodies (non-riparian) - tree side trimming	Neutral	None	NA	NA	NA	NA	NA	NE	Subactivity is not located in streams or rivers. In addition, if non-riparian then activity will not be adjacent to occupied habitat.
New Disturbance - Construction	Crossings, wetlands and other water bodies (non-riparian) - grading, trenching, regrading	Neutral	None	NA	NA	NA	NA	NA	NE	Subactivity is not located in streams or rivers. In addition, if non-riparian then activity will not be adjacent to occupied habitat.
New Disturbance - Construction	Crossings, wetlands and other water bodies (non-riparian) - pipe stringing	Neutral	None	NA	NA	NA	NA	NA	NE	Subactivity is not located in streams or rivers. In addition, if non-riparian then activity will not be adjacent to occupied habitat.
Operation & Maintenance	Facilities - vehicles, foot traffic, noise	Neutral	None	NA	NA	NA	NA	NA	NE	Subactivity is not located in streams or rivers.
Operation & Maintenance	Vegetation Management - mowing	Neutral	None	NA	NA	NA	NA	NA	NE	No impacts to stream habitats are anticipated from this action. Will not introduce sediment or contaminants into the streams or rivers.

Pipeline Activity	Subactivity	Environmental Impact or Threat	Stressor	Stressor Pathway (optional)	Exposure (Resource Affected)	Range of Response	Conservation Need Affected	Demographic Consequences	NE, NLAA, or LAA	Comments
Operation & Maintenance	Vegetation Management - chainsaw, tree clearing, tree side trimming	Habitat degradation and water quality degradation, Stress on individuals, Reduction in prey population	Sedimentation, Increase in Water Temperatures, Decrease of dissolved oxygen	Denuding bank, grubbing with heavy equipment, disturbing soil, water quality degradation since vegetation no longer provides shade to stream	NA	NA	NA	NA	NLAA	Instream and bank work (vegetation removal) will only occur at one location. Post-construction, a 10 ft wide ROW will be maintained, which will further lessen impacts from vegetation removal. Effects from this habitat change are expected to be insignificant.
Operation & Maintenance	Vegetation Management - pesticide/herbicide - by hand or using equipment approved for precise, localized product application	Habitat degradation and water quality degradation, Stress on individuals, Reduction in prey population	Chemical Contaminants	Direct exposure to chemicals from spills and stormwater runoff	NA	NA	NA	NA	NLAA	Pesticide/herbicides use will be on a local scale following the AMMs listed in the Opinion. Effects from this subactivity are expected to be insignificant.
Operation & Maintenance	Vegetation Disposal (upland) - dragging, chipping, hauling, piling, stacking	Neutral	None	NA	NA	NA	NA	NA	NE	No impacts to stream habitats are anticipated from this action.
Operation & Maintenance	Vegetation Disposal (upland) - brush pile burning	Neutral	None	NA	NA	NA	NA	NA	NE	No impacts to stream habitats are anticipated from this action.
Operation & Maintenance	ROW repair, regrading, revegetation (upland) - hand, mechanical	Habitat degradation, Water quality degradation	Minor sedimentation, Lowered dissolved oxygen, Contaminants	Tributary and/or near stream earth disturbance can cause minor increase in sedimentation, stormwater runoff. Fertilizers used in revegetation can cause algae blooms which will lower dissolved oxygen	NA	NA	NA	NA	NLAA	If earth disturbance is necessary Mountain Valley will submit a pre-work plan for the Service to review and approve prior to beginning work in any RLP or CD watershed. The pre-work plan will detail the specific location (e.g., where in the species watershed) of the work, timing (e.g., season)/expected duration of the work, scope of the work (e.g., amount of ground disturbance), any other ground-disturbing O&M subactivities that have occurred or are scheduled to occur in that watershed, and any specific AMMs/BMPs that will be implemented. If FWS determines that the pre-work plan will not ensure NLAA, then Mountain Valley agrees consultation would need to be reinitiated. This commitment applies only to O&M activities in the species watersheds that will not require independent Section 7 consultation (e.g., O&M activities requiring Clean Water Act authorization for work in a WOTUS already would be subject to Section 7 consultation requirements and obviate the need to submit a pre-work plan). Mountain Valley will continue to use enhanced E&S control measures that are also listed in 2020 BiOp (pg31) throughout the MVP project in both VA and WV. These measures may include one or more of the following: hydraulically applied or pelletized mulch/tackifier; upgraded waterbar end treatments (minimum of triple stack compost filter sock); Priority 1 silt fence; erosion control blanket installed in flow paths and at the outfall end treatments of waterbars (in areas with erosive soils); and temporary slope drain pipes to convey waterbar discharge across fill slopes where the ROW is has been benched. The size and scale of the E&S controls will be dependent on the activity, but any earth disturbance will incorporate one or more of the items listed above. Site inspections will continue as required by West Virginia or Virginia, depending on the location of the O&M activity. If there is any work within streams or wetlands, Mountain Valley will coordinate with the USACE and receive the appropriate permits. (M. Hoover, Mountain Valley Pipeline LLC, email to C. Schulz, Service, February 15, 2023).
Operation & Maintenance	ROW repair, regrading, revegetation (wetland) - hand, mechanical	Permanent or temporary loss of habitat, Habitat degradation, Water quality degradation, Physical impacts to individuals, Reduction of prey	Minor sedimentation, Lowered dissolved oxygen, Contaminants	Tributary and/or near stream earth disturbance can cause minor increase in sedimentation, stormwater runoff. Fertilizers used in revegetation can cause algae blooms which will lower dissolved oxygen. Equipment located in connected wetland can increase chance of spills.	NA	NA	NA	NA	NLAA	AMMs will minimize contaminant spill (e.g., Spill Prevention, Control, and Countermeasure Plan) and sedimentation (e.g., Upland Erosion Control, Revegetation, and Maintenance Plan [FERC 2013a] and Restoration and Rehabilitation Plan [Mountain Valley 2017] outline the use of E&S control measures and restoration of graded areas) impacts, we do not anticipate this subactivity will generate a large amount of sediment. Effects from this subactivity are expected to be insignificant.

Pipeline Activity	Subactivity	Environmental Impact or Threat	Stressor	Stressor Pathway (optional)	Exposure (Resource Affected)	Range of Response	Conservation Need Affected	Demographic Consequences	NE, NLAA, or LAA	Comments
Operation & Maintenance	ROW repair, regrading, revegetation - instream stabilization and/or fill	Permanent or temporary loss of habitat, Habitat degradation, Water quality degradation, Physical impacts to individuals, Reduction of prey	Sedimentation, Contaminants	Tributary and in stream earth disturbance can cause increase in sedimentation and turbidity. Equipment located in stream or tributary can increase chance of spills, altered flow velocities and temporary impoundment from in-water work	NA	NA	NA	NA	NLAA	If earth disturbance is necessary Mountain Valley will submit a pre-work plan for the Service to review and approve prior to beginning work in any RLP or CD watershed. The pre-work plan will detail the specific location (e.g., where in the species watershed) of the work, timing (e.g., season)/expected duration of the work, scope of the work (e.g., amount of ground disturbance), any other ground-disturbing O&M subactivities that have occurred or are scheduled to occur in that watershed, and any specific AMMs/BMPs that will be implemented. If FWS determines that the pre-work plan will not ensure NLAA, then Mountain Valley agrees consultation would need to be reinitiated. This commitment applies only to O&M activities in the species watersheds that will not require independent Section 7 consultation (e.g., O&M activities requiring Clean Water Act authorization for work in a WOTUS already would be subject to Section 7 consultation requirements and obviate the need to submit a pre-work plan). Mountain Valley will continue to use enhanced E&S control measures that are also listed in 2020 BiOp (pg31) throughout the MVP project in both VA and WV. These measures may include one or more of the following: hydraulically applied or pelletized mulch/tackifier; upgraded waterbar end treatments (minimum of triple stack compost filter sock); Priority 1 silt fence; erosion control blanket installed in flow paths and at the outfall end treatments of waterbars (in areas with erosive soils); and temporary slope drain pipes to convey waterbar discharge across fill slopes where the ROW is has been benched. The size and scale of the E&S controls will be dependent on the activity, but any earth disturbance will incorporate one or more of the items listed above. Site inspections will continue as required by West Virginia or Virginia, depending on the location of the O&M activity. If there is any work within streams or wetlands, Mountain Valley will coordinate with the USACE and receive the appropriate permits. (M. Hoover, Mountain Valley Pipeline LLC, email to C. Schulz, Service, February 15, 2023).
Operation & Maintenance	Access Road Maintenance - grading, graveling	Temporary loss of habitat, Habitat degradation, Physical impacts to individuals, Reduction of prey population	Sedimentation	Tributary and in stream earth disturbance can cause increase in sedimentation	NA	NA	NA	NA	NLAA	If earth disturbance is necessary Mountain Valley will submit a pre-work plan for the Service to review and approve prior to beginning work in any RLP or CD watershed. The pre-work plan will detail the specific location (e.g., where in the species watershed) of the work, timing (e.g., season)/expected duration of the work, scope of the work (e.g., amount of ground disturbance), any other ground-disturbing O&M subactivities that have occurred or are scheduled to occur in that watershed, and any specific AMMs/BMPs that will be implemented. If FWS determines that the pre-work plan will not ensure NLAA, then Mountain Valley agrees consultation would need to be reinitiated. This commitment applies only to O&M activities in the species watersheds that will not require independent Section 7 consultation (e.g., O&M activities requiring Clean Water Act authorization for work in a WOTUS already would be subject to Section 7 consultation requirements and obviate the need to submit a pre-work plan). Mountain Valley will continue to use enhanced E&S control measures that are also listed in 2020 BiOp (pg31) throughout the MVP project in both VA and WV. These measures may include one or more of the following: hydraulically applied or pelletized mulch/tackifier; upgraded waterbar end treatments (minimum of triple stack compost filter sock); Priority 1 silt fence; erosion control blanket installed in flow paths and at the outfall end treatments of waterbars (in areas with erosive soils); and temporary slope drain pipes to convey waterbar discharge across fill slopes where the ROW is has been benched. The size and scale of the E&S controls will be dependent on the activity, but any earth disturbance will incorporate one or more of the items listed above. Site inspections will continue as required by West Virginia or Virginia, depending on the location of the O&M activity. If there is any work within streams or wetlands, Mountain Valley will coordinate with the USACE and receive the appropriate permits. (M. Hoover, Mountain Valley Pipeline LLC, email to C. Schulz, Service, February 15, 2023).

Pipeline Activity	Subactivity	Environmental Impact or Threat	Stressor	Stressor Pathway (optional)	Exposure (Resource Affected)	Range of Response	Conservation Need Affected	Demographic Consequences	NE, NLAA, or LAA	Comments
Operation & Maintenance	Access Road Maintenance - culvert replacement	Permanent or temporary loss of habitat, Habitat degradation, Physical impacts to individuals, Reduction of prey population	Sedimentation, Contaminants, Altered flow	Tributary and in stream earth disturbance can cause increase in sedimentation and turbidity. Equipment located in stream or tributary can increase chance of spills, altered flow velocities and temporary impoundment from in- water work, minor noise from construction activities in	NA	NA	NA	NA	NE	This subactivity is not proposed in RLP occupied habitat.
Operation & Maintenance	Inspection Activities - ground and aerial	Neutral	None	NA	NA	NA	NA	NA	NE	No impacts to stream habitats are anticipated from this action. Will not introduce sediment or contaminants into the streams or rivers.

Table 5. Analysis of effects on candy darter.

Pipeline Activity	Subactivity	Environmental Impact or Threat	Stressor	Stressor Pathway (optional)	Exposure (Resource Affected)	Range of Response	Conservation Need Affected	Demographic Consequences	NE, NLAA, or LAA	Comments
New Disturbance - Construction	Vehicle Operation and Foot Traffic	Neutral	None	NA	NA	NA	NA	NA	NE	No impacts to stream habitats are anticipated from this action. Will not introduce sediment or contaminants into the streams or rivers.
New Disturbance - Construction	Clearing - herbaceous vegetation and ground cover	Habitat degradation and water quality degradation, Stress on individuals, Reduction in prey population	Sedimentation	Denuding bank and upland areas, grubbing with heavy equipment, disturbing soil, water quality degradation since vegetation no longer provides stormwater filter	Habitat, Population, Individuals	Harm, Kill	Breeding, Feeding, Sheltering	Numbers, reproduction, distribution	LAA	See Effects of the Action section.
New Disturbance - Construction	Clearing - trees and shrubs	Habitat degradation and water quality degradation, Stress on individuals, Reduction in prey population	Sedimentation	Denuding bank and upland areas, grubbing with heavy equipment, disturbing soil, water quality degradation	Habitat, Population, Individuals	Harm, Kill	Breeding, Feeding, Sheltering	Numbers, reproduction, distribution	LAA	See Effects of the Action section.
New Disturbance - Construction	Vegetation Disposal (upland) - dragging, chipping, hauling, piling, stacking	Neutral	None	NA	NA	NA	NA	NA	NE	No impacts to stream habitats are anticipated from this action. Will not introduce sediment or contaminants into the streams or rivers.
New Disturbance - Construction	Vegetation Disposal (upland) - brush pile burning	Neutral	None	NA	NA	NA	NA	NA	NE	No impacts to stream habitats are anticipated from this action. Will not introduce sediment or contaminants into the streams or rivers.
New Disturbance - Construction	Vegetation Clearing - tree side trimming by bucket truck or helicopter	Habitat degradation and water quality degradation, Stress on eggs	Increase in Water Temperatures, Decrease of dissolved oxygen	Habitat and water quality degradation since vegetation no longer provides shade to stream	NA	NA	NA	NA	NLAA	No instream and bank work will occur at crossings of CD occupied streams, but are occurring at tributaries. Due to the distance of the crossings in the tributaries from the confluence with CD occupied streams (>800 m), we expect impacts would be insignificant and discountable.
New Disturbance - Construction	Grading, erosion control devices	Habitat degradation and water quality degradation, Stress on individuals, Reduction in prey population	Sedimentation	Upland earth disturbance can cause increase in sedimentation	Habitat, Population, Individuals	Harm, Kill	Breeding, Feeding, Sheltering	Numbers, reproduction, distribution	LAA	See Effects of the Action section.
New Disturbance - Construction	Trenching (digging, blasting, dewatering, open trench, sedimentation)	Habitat degradation and water quality degradation, Stress on individuals, Reduction in prey population	Sedimentation, Contaminants	Upland earth disturbance can cause increase in sedimentation	Habitat, Population, Individuals	Harm, Kill	Breeding, Feeding, Sheltering	Numbers, reproduction, distribution	LAA	See Effects of the Action section.
New Disturbance - Construction	Pipe Stringing - bending, welding, coating, padding and backfilling	Temporary loss of habitat, Water quality degradation, Reduction of prey population	Sedimentation, Short-term altered flow, Contaminants	Near, in-stream, tributary, and upland earth disturbance may result in increased sedimentation, altered flow result in increased sedimentation and short-term impoundment, contaminant spills from equipment located in-stream and tributary, noise from in-water work	NA	NA	NA	NA	NLAA	No instream work will occur at crossings of CD occupied streams, but are occurring at tributaries. Due to the distance of the crossings in the tributaries from the confluence with CD occupied streams (>800 m), we expect impacts from contaminants and sediment would be insignificant and discountable. For this subactivity in the upland areas, Mountain Valley will implement AMMs to minimize sedimentation (e.g. Upland Erosion Control, Revegetation, and Maintenance Plan [FERC 2013a] and Restoration and Rehabilitation Plan [Mountain Valley 2017]), therefore we expect sediment generated from this subactivity to be insignificant.
New Disturbance - Construction	Hydrostatic Testing (water withdrawal and discharge)	Temporary loss of habitat, Habitat degradation	Minor sedimentation, Altered flow	Withdrawal and discharge of water	NA	NA	NA	NA	NLAA	Water withdrawals are conducted in compliance with conditions in the WVDEP Division of Water and Waste Management's Water Withdrawal Guidance Tool to avoid and minimize adverse impacts to aquatic organisms and ensure maintenance of existing instream physical, chemical, and biological characteristics. Mountain Valley will refrain from withdrawing water during low flows and drought conditions by adhering to the restrictions identified in the West Virginia Water Withdrawal Guidance Tool (M. Eggerding, Mountain Valley Pipeline LLC, letter to J. Martin, FERC, May 27, 2020). Mountain Valley anticipates installing holding tanks near the withdrawal points to pull water over a longer period, instead of a more acute withdrawal (M. Eggerding, Mountain Valley Pipeline LLC, letter to J. Martin, FERC, May 13, 2020). Mountain Valley commits to placing temporary water intakes within pools rather than riffles in the Gauley River (M. Eggerding, Mountain Valley Pipeline LLC, letter to J. Martin, FERC, May 27, 2020). Mountain Valley is committed to limiting surface water withdrawals to 10% of a stream's instantaneous flow, installing temporary water intakes situated above the instream substrates with screened openings not to exceed 3/16-inch mesh, and ensuring through-screen approach velocities less than 0.5 ft per second (Mountain Valley 2020). Therefore, no impacts to CD are

Pipeline Activity	Subactivity	Environmental Impact or Threat	Stressor	Stressor Pathway (optional)	Exposure (Resource Affected)	Range of Response	Conservation Need Affected	Demographic Consequences	NE, NLAA, or LAA	Comments
New Disturbance - Construction	Regrading and Stabilization - restoration of corridor	Habitat degradation and water quality degradation, Stress on individuals, Reduction in prey population	Sedimentation	Upland earth disturbance can cause increase in sedimentation	Habitat, Population, Individuals	Harm, Kill	Breeding, Feeding, Sheltering	Numbers, reproduction, distribution	LAA	See Effects of the Action section.
New Disturbance - Construction	Facilities - noise, lights	Neutral	None	NA	NA	NA	NA	NA	NE	No impacts to stream habitats are anticipated from this action. Will not introduce sediment or contaminants into the streams or rivers.
New Disturbance - Construction	Access Roads - upgrading existing roads, new roads temp and permanent - grading, graveling	Habitat degradation and water quality degradation, Stress on individuals, Reduction in prey population	Sedimentation	Upland earth disturbance may result in increased sedimentation	Habitat, Population, Individuals	Harm, Kill	Breeding, Feeding, Sheltering	Numbers, reproduction, distribution	LAA	See Effects of the Action section.
New Disturbance - Construction	Access Roads - upgrading existing roads, new roads temp and permanent - culvert installation	Permanent or temporary loss of habitat, Habitat degradation, Physical impacts to individuals, Reduction of prey population	Sedimentation, Contaminants, Altered flow	Tributary and instream earth disturbance can cause increase in sedimentation and turbidity. Equipment located in stream or tributary can increase chance of spills, altered flow velocities and temporary impoundment from in-water work, minor noise from construction activities in water.	NA	NA	NA	NA	NE	This is not proposed at CD crossings.
New Disturbance - Construction	Access Roads - upgrading existing roads, new roads temp and permanent - tree trimming and tree removal	Habitat degradation and water quality degradation, Stress on individuals, Reduction in prey population	Sedimentation	Grubbing with heavy equipment, disturbing soil	Habitat, Population, Individuals	Harm, Kill	Breeding, Feeding, Sheltering	Numbers, reproduction, distribution	LAA	See Effects of the Action section.
New Disturbance - Construction	Stream Crossings, flume	Permanent or temporary loss of habitat, Habitat degradation, Physical impacts to individuals, Reduction of prey population	Sedimentation, Contaminants, Altered flow	Tributary and instream earth disturbance can cause increase in sedimentation and turbidity. Equipment located in stream or tributary can increase chance of spills, altered flow velocities and temporary impoundment from in-water work, minor noise from construction activities in	NA	NA	NA	NA	NE	This is not proposed at CD crossings. MVP is using the dam and pump approach for its open cut crossings of the streams of interest (M. Neylon, EQT, email to J. Richard, Service June 16, 2020)
New Disturbance - Construction	Stream Crossings, dam & pump	Temporary loss of occupied habitat, Physical impacts to individuals, Habitat degradation and water quality degradation, reduction of prey population	Sedimentation, Altered flow, Contaminants, Impoundment	Tributary and near stream earth disturbance may result in increased sedimentation altered flow may result in increased sedimentation, contaminant spills from equipment located in tributary stream, dam could restrict up/down stream movement of species, noise from in-water work.	NA	NA	NA	NA	NLAA	No instream work will occur at crossings of CD occupied streams, but are occurring at tributaries. Due to the distance of the crossings in the tributaries from the confluence with CD occupied streams (>800 m), we expect impacts from contaminants and sediment would be insignificant and discountable.
New Disturbance - Construction	Stream Crossings, cofferdam	Temporary loss of occupied habitat, Physical impacts to individuals, Habitat degradation and water quality degradation, Reduction of prey population	Sedimentation, altered flow, contaminants, impoundment, noise	Tributary and near stream earth disturbance may result in increased sedimentation altered flow may result in increased sedimentation, contaminant spills from equipment located in tributary stream, dam could restrict up/down stream movement of species, noise from in-water work.	NA	NA	NA	NA	NE	Per the description in the 2017 FEIS, the dam and pump method includes "Temporary dams installed across the waterbody and the downstream side of the construction right-of-way, usually using sandbags or plastic sheeting." Therefore the impacts from damming the waterbody are included in the dam and pump subactivity. Per the decription in the 2017 FEIS, "Cofferdams are typically used for waterbody crossings with larger high flow volumes that may be unsuitable for flume or dam-and-pump methods." This subactivity is not proposed in CD occupied habitat.

Pipeline Activity	Subactivity	Environmental Impact or Threat	Stressor	Stressor Pathway (optional)	Exposure (Resource Affected)	Range of Response	Conservation Need Affected	Demographic Consequences	NE, NLAA, or LAA	Comments
New Disturbance - Construction	Stream Equipment Crossing Structures	Permanent or temporary loss of habitat, Habitat degradation, Physical impacts to individuals, Reduction of prey population	Sedimentation, Contaminants, Altered flow, Noise	Tributary and in stream earth disturbance can cause increase in sedimentation and turbidity. Equipment located in stream or tributary can increase chance of spills, altered flow velocities and temporary impoundment from in-water work, minor noise from construction activities in	NA	NA	NA	NA	NE	This is not proposed at CD crossings.
New Disturbance - Construction	Stream Crossing - Horizontal Directional Drill (HDD)	Vegetation removal; human activity; riparian disturbance	Sedimentation, Contaminants, Noise	Vegetation removal; instream drilling fluids; noise, human presence	NA	NA	NA	NA	NE	This is not proposed at CD crossings.
New Disturbance - Construction	Stream Crossing - Conventional Bore/microtunnel	Vegetation removal; human activity; riparian disturbance	Sedimentation; Noise	Vegetation removal; instream drilling fluids; noise, human presence	NA	NA	NA	NA	NLAA	The trenchless crossings would minimize impacts in the riparian zones by eliminating construction activities within or directly adjacent to the crossed stream (M. Eggerding, Mountain Valley Pipeline LLC, letter to J. Martin, FERC, May 13, 2020). Because no open-cut trenching would be performed for these streams, the stream channel itself would not be impacted, allowing existing riparian vegetation near the stream banks to remain in place. For stream crossings, the conventional bore technique avoids all instream construction activities and all direct impacts associated with such activities. Drilling fluids are not used for conventional bores, so there is no risk of inadvertent return of these fluids within the stream. Microtunnel has much lower fluid volumes and downhole pressures as compared to HDD, which reduces risk of IR. Groundwater pressure counterbalances the fluid pressure, which reduces the risk for IR. Downhole pressure monitoring and remote-controlled valving further reduce the risk of IR and minimize any potential fluid loss.
New Disturbance - Construction	Crossings, wetlands and other water bodies (non-riparian) - clearing	Neutral	None	NA	NA	NA	NA	NA	NE	Subactivity is not located in streams or rivers. In addition, if non-riparian then activity will not be adjacent to occupied habitat.
New Disturbance - Construction	Crossings, wetlands and other water bodies (non-riparian) - tree side trimming	Neutral	None	NA	NA	NA	NA	NA	NE	Subactivity is not located in streams or rivers. In addition, if non-riparian then activity will not be adjacent to occupied habitat.
New Disturbance - Construction	Crossings, wetlands and other water bodies (non-riparian) - grading, trenching, regrading	Neutral	None	NA	NA	NA	NA	NA	NE	Subactivity is not located in streams or rivers. In addition, if non-riparian then activity will not be adjacent to occupied habitat.
New Disturbance - Construction	Crossings, wetlands and other water bodies (non-riparian) - pipe stringing	Neutral	None	NA	NA	NA	NA	NA	NE	Subactivity is not located in streams or rivers. In addition, if non-riparian then activity will not be adjacent to occupied habitat.
Operation & Maintenance	Facilities - vehicles, foot traffic, noise	Habitat degradation, Water quality degradation	Sedimentation, Contaminants	Stormwater runoff from pollution generating pavement, stormwater erosion	NA	NA	NA	NA	NE	Subactivity is not located in streams or rivers.
Operation & Maintenance	Vegetation Management - mowing	Neutral	None	NA	NA	NA	NA	NA	NE	No impacts to stream habitats are anticipated from this action. Will not introduce sediment or contaminants into the streams or rivers.
Operation & Maintenance	Vegetation Management - chainsaw, tree clearing, tree side trimming	Habitat degradation and water quality degradation, Stress on individuals, Reduction in prey population	Sedimentation, Increase in Water Temperatures, Decrease of dissolved oxygen	Denuding bank, grubbing with heavy equipment, disturbing soil, water quality degradation since vegetation no longer provides shade to stream	NA	NA	NA	NA	NLAA	No instream and bank work will occur at crossings of CD occupied streams, but are occurring at tributaries. Due to the distance of the crossings in the tributaries from the confluence with CD occupied streams (>800 m), we expect impacts would be insignificant and discountable.
Operation & Maintenance	Vegetation Management - pesticide/herbicide - by hand or using equipment approved for precise, localized product application	Habitat degradation and water quality degradation, Stress on individuals, Reduction in prey population	Chemical Contaminants	Direct exposure to chemicals from spills and stormwater runoff	NA	NA	NA	NA	NLAA	Pesticide/herbicides use will be on a local scale following the AMMs listed in the Opinion. Effects from this subactivity are expected to be insignificant.

Pipeline Activity	Subactivity	Environmental Impact or Threat	Stressor	Stressor Pathway (optional)	Exposure (Resource Affected)	Range of Response	Conservation Need Affected	Demographic Consequences	NE, NLAA, or LAA	Comments
Operation & Maintenance	Vegetation Disposal (upland) - dragging, chipping, hauling, piling, stacking	Neutral	None	NA	NA	NA	NA	NA	NE	No impacts to stream habitats are anticipated from this action.
Operation & Maintenance	Vegetation Disposal (upland) - brush pile burning	Neutral	None	NA	NA	NA	NA	NA	NE	No impacts to stream habitats are anticipated from this action.
Operation & Maintenance	ROW repair, regrading, revegetation (upland) - hand, mechanical	Habitat degradation and water quality degradation, Stress on individuals, Reduction in prey population	Sedimentation	Upland earth disturbance can cause increase in sedimentation	Habitat, Population, Individuals	Harm, Kill	Breeding, Feeding, Sheltering	Numbers, reproduction, distribution	NLAA	If earth disturbance is necessary Mountain Valley will submit a pre-work plan for the Service to review and approve prior to beginning work in any RLP or CD watershed. The pre-work plan will detail the specific location (e.g., where in the species watershed) of the work, timing (e.g., season)/expected duration of the work, scope of the work (e.g., amount of ground disturbance), any other ground-disturbing O&M subactivities that have occurred or are scheduled to occur in that watershed, and any specific AMMs/BMPs that will be implemented. If FWS determines that the pre-work plan will not ensure NLAA, then Mountain Valley agrees consultation would need to be reinitiated. This commitment applies only to O&M activities in the species watersheds that will not require independent Section 7 consultation (e.g., O&M activities requiring Clean Water Act authorization for work in a WOTUS already would be subject to Section 7 consultation requirements and obviate the need to submit a pre-work plan). Mountain Valley will continue to use enhanced E&S control measures that are also listed in 2020 BiOp (pg31) throughout the MVP project in both VA and WV. These measures may include one or more of the following: hydraulically applied or pelletized mulch/tackifier; upgraded waterbar end treatments (minimum of triple stack compost filter sock); Priority 1 silt fence; erosion control blanket installed in flow paths and at the outfall end treatments of waterbars (in areas with erosive soils); and temporary slope drain pipes to convey waterbar discharge across fill slopes where the ROW is has been benched. The size and scale of the E&S controls will be dependent on the activity, but any earth disturbance will incorporate one or more of the items listed above. Site inspections will continue as required by West Virginia or Virginia, depending on the location of the O&M activity. If there is any work within streams or wetlands, Mountain Valley will coordinate with the USACE and receive the appropriate permits. (M. Hoover, Mountain Valley Pipeline LLC, email to C. Schulz, Service, February 15, 2023).
Operation & Maintenance	ROW repair, regrading, revegetation (wetland) - hand, mechanical	Permanent or temporary loss of habitat, Habitat degradation, Water quality degradation, Physical impacts to individuals, Reduction of prey	Minor sedimentation, Lowered dissolved oxygen, Contaminants	Tributary and/or near stream earth disturbance can cause minor increase in sedimentation, stormwater runoff. Fertilizers used in revegetation can cause algae blooms which will lower dissolved oxygen. Equipment located in connected wetland can increase chance of spills.	NA	NA	NA	NA	NLAA	AMMs will minimize contaminant spill (e.g., Spill Prevention, Control, and Countermeasure Plan) and sedimentation (e.g., Upland Erosion Control, Revegetation, and Maintenance Plan [FERC 2013a] and Restoration and Rehabilitation Plan [Mountain Valley 2017] outline the use of E&S control measures and restoration of graded areas) impacts, we do not anticipate this subactivity will generate a large amount of sediment. We do not anticipate this activity occurring in wetland areas adjacent to CD-occupied streams, therefore, effects from this habitat change are expected to be insignificant.
Operation & Maintenance	ROW repair, regrading, revegetation - instream stabilization and/or fill	Habitat degradation and water quality degradation, Stress on individuals, Reduction in prey population	Sedimentation, Contaminants	Tributary and in stream earth disturbance can cause increase in sedimentation and turbidity. Equipment located in stream or tributary can increase chance of spills, altered flow velocities and temporary impoundment from in-water	NA	NA	NA	NA	NLAA	No instream work will occur at crossings of CD occupied streams, but are occurring at tributaries. Due to the distance of the crossings in the tributaries from the confluence with CD occupied streams (>800 m), we expect impacts from contaminants and sediment would be insignificant and discountable.

Pipeline Activity	Subactivity	Environmental Impact or Threat	Stressor	Stressor Pathway (optional)	Exposure (Resource Affected)	Range of Response	Conservation Need Affected	Demographic Consequences	NE, NLAA, or LAA	Comments
Operation & Maintenance	Access Road Maintenance - grading, graveling	Habitat degradation and water quality degradation, Stress on individuals, Reduction in prey population	Sedimentation	Upland earth disturbance can cause increase in sedimentation	Habitat, Population, Individuals	Harm, Kill	Breeding, Feeding, Sheltering	Numbers, reproduction, distribution	NLAA	If earth disturbance is necessary Mountain Valley will submit a pre-work plan for the Service to review and approve prior to beginning work in any RLP or CD watershed. The pre-work plan will detail the specific location (e.g., where in the species watershed) of the work, timing (e.g., season)/expected duration of the work, scope of the work (e.g., amount of ground disturbance), any other ground-disturbing O&M subactivities that have occurred or are scheduled to occur in that watershed, and any specific AMMs/BMPs that will be implemented. If FWS determines that the pre-work plan will not ensure NLAA, then Mountain Valley agrees consultation would need to be reinitiated. This commitment applies only to O&M activities in the species watersheds that will not require independent Section 7 consultation (e.g., O&M activities requiring Clean Water Act authorization for work in a WOTUS already would be subject to Section 7 consultation requirements and obviate the need to submit a pre-work plan). Mountain Valley will continue to use enhanced E&S control measures that are also listed in 2020 BiOp (pg31) throughout the MVP project in both VA and WV. These measures may include one or more of the following: hydraulically applied or pelletized mulch/tackifier; upgraded waterbar end treatments (minimum of triple stack compost filter sock); Priority 1 silt fence; erosion control blanket installed in flow paths and at the outfall end treatments of waterbars (in areas with erosive soils); and temporary slope drain pipes to convey waterbar discharge across fill slopes where the ROW is has been benched. The size and scale of the E&S controls will be dependent on the activity, but any earth disturbance will incorporate one or more of the items listed above. Site inspections will continue as required by West Virginia or Virginia, depending on the location of the O&M activity. If there is any work within streams or wetlands, Mountain Valley will coordinate with the USACE and receive the appropriate permits. (M. Hoover, Mountain Valley Pipeline LLC, email to C. Schulz, Service, February 15, 2023).
Operation & Maintenance	Access Road Maintenance - culvert replacement	Permanent or temporary loss of habitat, Habitat degradation, Physical impacts to individuals, Reduction of prey population	Sedimentation, Contaminants, Altered flow	Tributary and in stream earth disturbance can cause increase in sedimentation and turbidity. Equipment located in stream or tributary can increase chance of spills, altered flow velocities and temporary impoundment from in-water work, minor noise from construction activities in	NA	NA	NA	NA	NE	Culvert placement will not occur at CD crossings.
Operation & Maintenance	Inspection Activities - ground and aerial	Neutral	None	NA	NA	NA	NA	NA	NE	No impacts to stream habitats are anticipated from this action. Will not introduce sediment or contaminants into the streams or rivers.

Table 6. Analysis of effects on candy darter critical habitat.

Pipeline Activity	Subactivity	Environmental Impact or Threat	Stressor	Stressor Pathway (optional)	Physical and Biological Feature Affected	Conservation Need Affected	Demographic Consequences	NE, NLAA, or LAA	Comments
New Disturbance - Construction	Vehicle Operation and Foot Traffic	Neutral	None	NA	NA	NA	NA	NE	No impacts to CD critical habitat are anticipated from this action. Will not introduce sediment or contaminants into the streams or rivers.
New Disturbance - Construction	Clearing - herbaceous vegetation and ground cover	Habitat degradation and water quality degradation, Stress on individuals, Reduction in prey population	Sedimentation	Denuding bank and upland areas, grubbing with heavy equipment, disturbing soil, water quality degradation since vegetation no longer provides stormwater filter	PBF 2, PBF 3, PBF 4	Breeding, Feeding, Sheltering	Numbers, reproduction, distribution	LAA	See Effects of the Action section
New Disturbance - Construction	Clearing - trees and shrubs	Habitat degradation and water quality degradation, Stress on individuals, Reduction in prey population	Sedimentation	Denuding bank and upland areas, grubbing with heavy equipment, disturbing soil, water quality degradation	PBF 2, PBF 3, PBF 4	Breeding, Feeding, Sheltering	Numbers, reproduction, distribution	LAA	See Effects of the Action section
New Disturbance - Construction	Vegetation Disposal (upland) - dragging, chipping, hauling, piling, stacking	Neutral	None	NA	NA	NA	NA	NE	No impacts to CD critical habitat are anticipated from this action. Will not introduce sediment or contaminants into the streams or rivers.
New Disturbance - Construction	Vegetation Disposal (upland) - brush pile burning	Neutral	None	NA	NA	NA	NA	NE	No impacts to CD critical habitat are anticipated from this action. Will not introduce sediment or contaminants into the streams or rivers.
New Disturbance - Construction	Vegetation Clearing - tree side trimming by bucket truck or helicopter	Habitat degradation and water quality degradation, Stress on eggs	Increase in Water Temperatures, Decrease of dissolved oxygen	Habitat and water quality degradation since vegetation no longer provides shade to stream	NA	NA	NA	NLAA	Temperature increases from vegetation removal will be slight and occur at tributaries to CD critical habitat. The construction ROW at waterbody crossings is narrowed to 75 ft to minimize clearing of trees and riparian vegetation. Post-construction, a 10 ft wide ROW will be maintained, which will further lessen impacts from vegetation removal. Therefore, effects from this habitat change are expected to be insignificant to CD critical habitat.
New Disturbance - Construction	Grading, erosion control devices	Habitat degradation and water quality degradation, Stress on individuals, Reduction in prey population	Sedimentation	Upland earth disturbance can cause increase in sedimentation	PBF 2, PBF 3, PBF 4	Breeding, Feeding, Sheltering	Numbers, reproduction, distribution	LAA	See Effects of the Action section
New Disturbance - Construction	Trenching (digging, blasting, dewatering, open trench, sedimentation)	Habitat degradation and water quality degradation, Stress on individuals, Reduction in prey population	Sedimentation, Contaminants	Upland earth disturbance can cause increase in sedimentation	PBF 2, PBF 3, PBF 4	Breeding, Feeding, Sheltering	Numbers, reproduction, distribution	LAA	See Effects of the Action section
New Disturbance - Construction	Pipe Stringing - bending, welding, coating, padding and backfilling	Temporary loss of habitat, Water quality degradation, Reduction of prey population	Sedimentation, Short-term altered flow, Contaminants	Near, instream, tributary, and upland earth disturbance may result in increased sedimentation, altered flow result in increased sedimentation and short-term impoundment, contaminant spills from equipment located instream and tributary, noise from in-water work	NA	NA	NA	NLAA	No instream work will occur in CD critical habitat. Due to the distance of the crossings in the tributaries to CD critical habitat (>800 m), we expect impacts from contaminants and sediment would be insignificant and discountable. For this subactivity in the upland areas, Mountain Valley will implement AMMs to minimize sedimentation (e.g. Upland Erosion Control, Revegetation, and Maintenance Plan [FERC 2013a] and Restoration and Rehabilitation Plan [Mountain Valley 2017]), therefore we expect sediment generated from this subactivity to be insignificant.

Pipeline Activity	Subactivity	Environmental Impact or Threat	Stressor	Stressor Pathway (optional)	Physical and Biological Feature Affected	Conservation Need Affected	Demographic Consequences	NE, NLAA, or LAA	Comments
New Disturbance - Construction	Hydrostatic Testing (water withdrawal and discharge)	Temporary loss of habitat, Habitat degradation	Minor sedimentation, Altered flow	Withdrawal and discharge of water	NA	NA	NA	NLAA	Water withdrawals are conducted in compliance with conditions in the WVDEP Division of Water and Waste Management's Water Withdrawal Guidance Tool to avoid and minimize adverse impacts to aquatic organisms and ensure maintenance of existing instream physical, chemical, and biological characteristics. Mountain Valley will refrain from withdrawing water during low flows and drought conditions by adhering to the restrictions identified in the West Virginia Water Withdrawal Guidance Tool (M. Eggerding, Mountain Valley Pipeline LLC, letter to J. Martin, FERC, May 27, 2020). Mountain Valley anticipates installing holding tanks near the withdrawal points to pull water over a longer period, instead of a more acute withdrawal (M. Eggerding, Mountain Valley Pipeline LLC, letter to J. Martin, FERC, May 13, 2020). Mountain Valley commits to placing temporary water intakes within pools rather than riffles in the Gauley River (M. Eggerding, Mountain Valley Pipeline LLC, letter to J. Martin, FERC, May 27, 2020). Mountain Valley is committed to limiting surface water withdrawals to 10% of a stream's instantaneous flow, installing temporary water intakes situated above the instream substrates with screened openings not to exceed 3/16-inch mesh, and ensuring through-screen approach velocities less than 0.5 ft per second (Mountain Valley 2020). Therefore, no impacts to CD critical habitat are anticipated from water withdrawals.
New Disturbance - Construction	Regrading and Stabilization - restoration of corridor	Habitat degradation and water quality degradation, Stress on individuals, Reduction in prey population	Sedimentation	Upland earth disturbance can cause increase in sedimentation	PBF 2, PBF 3, PBF 4	Breeding, Feeding, Sheltering	Numbers, reproduction, distribution	LAA	See Effects of the Action section
New Disturbance - Construction	Facilities - noise, lights	Neutral	None	NA	NA	NA	NA	NE	No impacts to CD critical habitat are anticipated from this action. Will not introduce sediment or contaminants into the streams or rivers.
New Disturbance - Construction	Access Roads - upgrading existing roads, new roads temp and permanent - grading, graveling	Habitat degradation and water quality degradation, Stress on individuals, Reduction in prey population	Sedimentation	Upland earth disturbance may result in increased sedimentation	PBF 2, PBF 3, PBF 4	Breeding, Feeding, Sheltering	Numbers, reproduction, distribution	LAA	See Effects of the Action section
New Disturbance - Construction	Access Roads - upgrading existing roads, new roads temp and permanent - culvert installation	Permanent or temporary loss of habitat, Habitat degradation, Physical impacts to individuals, Reduction of prey population	Sedimentation, Contaminants, Altered flow	Tributary and instream earth disturbance can cause increase in sedimentation and turbidity. Equipment located in stream or tributary can increase chance of spills, altered flow velocities and temporary impoundment from in-water work, minor noise from construction activities in water.	NA	NA	NA	NE	This is not proposed in CD critical habitat.
New Disturbance - Construction	Access Roads - upgrading existing roads, new roads temp and permanent - tree trimming and tree removal	Habitat degradation and water quality degradation, Stress on individuals, Reduction in prey population	Sedimentation	Grubbing with heavy equipment, disturbing soil	PBF 2, PBF 3, PBF 4	Breeding, Feeding, Sheltering	Numbers, reproduction, distribution	LAA	See Effects of the Action section
New Disturbance - Construction	Stream Crossings, flume	Permanent or temporary loss of habitat, Habitat degradation, Physical impacts to individuals, Reduction of prey population	Sedimentation, Contaminants, Altered flow	Tributary and instream earth disturbance can cause increase in sedimentation and turbidity. Equipment located in stream or tributary can increase chance of spills, altered flow velocities and temporary impoundment from in-water work, minor noise from construction activities in	NA	NA	NA	NE	This is not proposed at CD critical habitat.

Pipeline Activity	Subactivity	Environmental Impact or Threat	Stressor	Stressor Pathway (optional)	Physical and Biological Feature Affected	Conservation Need Affected	Demographic Consequences	NE, NLAA, or LAA	Comments
New Disturbance - Construction	Stream Crossings, dam & pump	Temporary loss of occupied habitat, Physical impacts to individuals, Habitat degradation and water quality degradation, reduction of prey population	Sedimentation, Altered flow, Contaminants, Impoundment	Tributary and near stream earth disturbance may result in increased sedimentation altered flow may result in increased sedimentation, contaminant spills from equipment located in tributary stream, dam could restrict up/down stream movement of species, noise from in-water work	NA	NA	NA	NLAA	No instream work will occur in CD critical habitat. Due to the distance of the crossings from critical habitat (>800 m), we expect impacts from contaminants and sediment would be insignificant and discountable.
New Disturbance - Construction	Stream Crossings, cofferdam	Temporary loss of occupied habitat, Physical impacts to individuals, Habitat degradation and water quality degradation, Reduction of prey population	Sedimentation, altered flow, contaminants, impoundment, noise	Tributary and near stream earth disturbance may result in increased sedimentation altered flow may result in increased sedimentation, contaminant spills from equipment located in tributary stream, dam could restrict up/down stream movement of species, noise from in-water work	NA	NA	NA	NE	Per the description in the 2017 FEIS, the dam and pump method includes "Temporary dams installed across the waterbody and the downstream side of the construction right-of-way, usually using sandbags or plastic sheeting." Therefore the impacts from damming the waterbody are included in the dam and pump subactivity. Per the decription in the 2017 FEIS, "Cofferdams are typically used for waterbody crossings with larger high flow volumes that may be unsuitable for flume or dam-and-pump methods." This subactivity is not proposed in CD occupied habitat or designated critical habitat.
New Disturbance - Construction	Stream Equipment Crossing Structures	Permanent or temporary loss of habitat, Habitat degradation, Physical impacts to individuals, Reduction of prey population	Sedimentation, Contaminants, Altered flow, Noise	Tributary and in stream earth disturbance can cause increase in sedimentation and turbidity. Equipment located in stream or tributary can increase chance of spills, altered flow velocities and temporary impoundment from in-water work, minor noise from construction activities in	NA	NA	NA	NE	This is not proposed at CD critical habitat.
New Disturbance - Construction	Stream Crossing - Horizontal Directional Drill (HDD)	Vegetation removal; human activity; riparian disturbance	Sedimentation, Contaminants, Noise	Vegetation removal; instream drilling fluids; noise, and human presence	NA	NA	NA	NE	This is not proposed in CD critical habitat.
New Disturbance - Construction	Stream Crossing - Conventional Bore/microtunnel	Vegetation removal; human activity; riparian disturbance	Sedimentation; Noise	Vegetation removal; instream drilling fluids; noise, human presence	NA	NA	NA	NLAA	The trenchless crossings would minimize impacts in the riparian zones by eliminating construction activities within or directly adjacent to the crossed stream (M. Eggerding, Mountain Valley Pipeline LLC, letter to J. Martin, FERC, May 13, 2020). Because no open-cut trenching would be performed for these streams, the stream channel itself would not be impacted, allowing existing riparian vegetation near the stream banks to remain in place. For stream crossings, the conventional bore technique avoids all instream construction activities and all direct impacts associated with such activities. Drilling fluids are not used for conventional bores, so there is no risk of inadvertent return of these fluids within the stream. Microtunnel has much lower fluid volumes and downhole pressures as compared to HDD, which reduces risk of IR. Groundwater pressure counterbalances the fluid pressure, which reduces the risk for IR. Downhole pressure monitoring and remote-controlled valving further reduce the risk of IR and minimize any potential fluid loss.
New Disturbance - Construction	Crossings, wetlands and other water bodies (non-riparian) - clearing	Neutral	None	NA	NA	NA	NA	NE	Subactivity is not located in streams or rivers. In addition, if non-riparian then activity will not be adjacent to critical habitat.
New Disturbance - Construction	Crossings, wetlands and other water bodies (non-riparian) - tree side trimming	Neutral	None	NA	NA	NA	NA	NE	Subactivity is not located in streams or rivers. In addition, if non-riparian then activity will not be adjacent to critical habitat.
New Disturbance - Construction	Crossings, wetlands and other water bodies (non-riparian) - grading, trenching, regrading	Neutral	None	NA	NA	NA	NA	NE	Subactivity is not located in streams or rivers. In addition, if non-riparian then activity will not be adjacent to critical habitat.

Pipeline Activity	Subactivity	Environmental Impact or Threat	Stressor	Stressor Pathway (optional)	Physical and Biological Feature Affected	Conservation Need Affected	Demographic Consequences	NE, NLAA, or LAA	Comments
New Disturbance - Construction	Crossings, wetlands and other water bodies (non-riparian) - pipe stringing	Neutral	None	NA	NA	NA	NA	NE	Subactivity is not located in streams or rivers. In addition, if non-riparian then activity will not be adjacent to occupied habitat.
Operation & Maintenance	Facilities - vehicles, foot traffic, noise	Habitat degradation, Water quality degradation	Sedimentation, Contaminants	Stormwater runoff from pollution generating pavement, stormwater erosion	NA	NA	NA	NE	Subactivity is not located in streams or rivers.
Operation & Maintenance	Vegetation Management - mowing	Neutral	None	NA	NA	NA	NA	NE	No impacts to CD critical habitat are anticipated from this action. Will not introduce sediment or contaminants into the streams or rivers.
Operation & Maintenance	Vegetation Management - chainsaw, tree clearing, tree side trimming	Habitat degradation and water quality degradation, Stress on individuals, Reduction in prey population	Sedimentation, Increase in Water Temperatures, Decrease of dissolved oxygen	Denuding bank, grubbing with heavy equipment, disturbing soil, water quality degradation since vegetation no longer provides shade to stream	NA	NA	NA	NLAA	Post-construction, a 10 ft wide ROW will be maintained, which will further lessen impacts from vegetation removal. Effects from this habitat change are expected to be insignificant.
Operation & Maintenance	Vegetation Management - pesticide/herbicide - by hand or using equipment approved for precise, localized product application	Habitat degradation and water quality degradation, Stress on individuals, Reduction in prey population	Chemical Contaminants	Direct exposure to chemicals from spills and stormwater runoff	NA	NA	NA	NLAA	Pesticide/herbicides use will be on a local scale following the AMMs listed in the Opinion. Effects from this subactivity are expected to be insignificant.
Operation & Maintenance	Vegetation Disposal (upland) - dragging, chipping, hauling, piling, stacking	Neutral	None	NA	NA	NA	NA	NE	No impacts to stream habitats are anticipated from this action.
Operation & Maintenance	Vegetation Disposal (upland) - brush pile burning	Neutral	None	NA	NA	NA	NA	NE	No impacts to stream habitats are anticipated from this action.
Operation & Maintenance	ROW repair, regrading, revegetation (upland) - hand, mechanical	Habitat degradation and water quality degradation, Stress on individuals, Reduction in prey population	Sedimentation	Upland earth disturbance can cause increase in sedimentation	PBF 2, PBF 3, PBF 4	Breeding, Feeding, Sheltering	Numbers, reproduction, distribution	NLAA	If earth disturbance is necessary Mountain Valley will submit a pre-work plan for the Service to review and approve prior to beginning work in any RLP or CD watershed. The pre-work plan will detail the specific location (e.g., where in the species watershed) of the work, timing (e.g., season)/expected duration of the work, scope of the work (e.g., amount of ground disturbance), any other ground-disturbing O&M subactivities that have occurred or are scheduled to occur in that watershed, and any specific AMMs/BMPs that will be implemented. If FWS determines that the pre-work plan will not ensure NLAA, then Mountain Valley agrees consultation would need to be reinitiated. This commitment applies only to O&M activities in the species watersheds that will not require independent Section 7 consultation (e.g., O&M activities requiring Clean Water Act authorization for work in a WOTUS already would be subject to Section 7 consultation requirements and obviate the need to submit a pre-work plan). Mountain Valley will continue to use enhanced E&S control measures that are also listed in 2020 BiOp (pg31) throughout the MVP project in both VA and WV. These measures may include one or more of the following: hydraulically applied or pelletized mulch/tackifier; upgraded waterbar end treatments (minimum of triple stack compost filter sock); Priority 1 silt fence; erosion control blanket installed in flow paths and at the outfall end treatments of waterbars (in areas with erosive soils); and temporary slope drain pipes to convey waterbar discharge across fill slopes where the ROW is has been benched. The size and scale of the E&S controls will be dependent on the activity, but any earth disturbance will incorporate one or more of the items listed above. Site inspections will continue as required by West Virginia or Virginia, depending on the location of the O&M activity. If there is any work within streams or wetlands, Mountain Valley will coordinate with the USACE and receive the appropriate permits. (M. Hoover, Mountain Valley Pipeline LLC, email to C. Schulz, Service, February 15, 2023).

Pipeline Activity	Subactivity	Environmental Impact or Threat	Stressor	Stressor Pathway (optional)	Physical and Biological Feature Affected	Conservation Need Affected	Demographic Consequences	NE, NLAA, or LAA	Comments
Operation & Maintenance	ROW repair, regrading, revegetation (wetland) - hand, mechanical	Permanent or temporary loss of habitat, Habitat degradation, Water quality degradation, Physical impacts to individuals, Reduction of prey	Minor sedimentation, Lowered dissolved oxygen, Contaminants	Tributary and/or near stream earth disturbance can cause minor increase in sedimentation, stormwater runoff. Fertilizers used in revegetation can cause algae blooms which will lower dissolved oxygen. Equipment located in connected wetland can	NA	NA	NA	NLAA	AMMs will minimize contaminant spill (e.g., Spill Prevention, Control, and Countermeasure Plan) and sedimentation (e.g., Upland Erosion Control, Revegetation, and Maintenance Plan [FERC 2013a] and Restoration and Rehabilitation Plan [Mountain Valley 2017] outline the use of E&S control measures and restoration of graded areas) impacts, we do not anticipate this subactivity will generate a large amount of sediment. We do not anticipate this activity occurring in wetland areas adjacent to CD critical habitat, therefore, effects from this habitat change are expected to be insignificant.
Operation & Maintenance	ROW repair, regrading, revegetation - instream stabilization and/or fill	Habitat degradation and water quality degradation, Stress on individuals, Reduction in prey population	Sedimentation, Contaminants	Tributary and in-stream earth disturbance can cause increase in sedimentation and turbidity. Equipment located in stream or tributary can increase chance of spills, altered flow velocities and temporary impoundment from in-water	NA	NA	NA	NLAA	No instream work will occur at CD critical habitat. Due to the distance of the crossings in the tributaries to CD critical habitat (>800 m), we expect impacts from contaminants and sediment would be insignificant and discountable.
Operation & Maintenance	Access Road Maintenance - grading, graveling	Habitat degradation and water quality degradation, Stress on individuals, Reduction in prey population	Sedimentation	Upland earth disturbance can cause increase in sedimentation	PBF 2, PBF 3, PBF 4	Breeding, Feeding, Sheltering	Numbers, reproduction, distribution	NLAA	If earth disturbance is necessary Mountain Valley will submit a pre-work plan for the Service to review and approve prior to beginning work in any RLP or CD watershed. The pre-work plan will detail the specific location (e.g., where in the species watershed) of the work, timing (e.g., season)/expected duration of the work, scope of the work (e.g., amount of ground disturbance), any other ground-disturbing O&M subactivities that have occurred or are scheduled to occur in that watershed, and any specific AMMs/BMPs that will be implemented. If FWS determines that the pre-work plan will not ensure NLAA, then Mountain Valley agrees consultation would need to be reinitiated. This commitment applies only to O&M activities in the species watersheds that will not require independent Section 7 consultation (e.g., O&M activities requiring Clean Water Act authorization for work in a WOTUS already would be subject to Section 7 consultation requirements and obviate the need to submit a pre-work plan). Mountain Valley will continue to use enhanced E&S control measures that are also listed in 2020 BiOp (pg31) throughout the MVP project in both VA and WV. These measures may include one or more of the following: hydraulically applied or pelletized mulch/tackifier; upgraded waterbar end treatments (minimum of triple stack compost filter sock); Priority 1 silt fence; erosion control blanket installed in flow paths and at the outfall end treatments of waterbars (in areas with erosive soils); and temporary slope drain pipes to convey waterbar discharge across fill slopes where the ROW is has been benched. The size and scale of the E&S controls will be dependent on the activity, but any earth disturbance will incorporate one or more of the items listed above. Site inspections will continue as required by West Virginia or Virginia, depending on the location of the O&M activity. If there is any work within streams or wetlands, Mountain Valley will coordinate with the USACE and receive the appropriate permits. (M. Hoover, Mountain Valley Pipeline LLC, email to C. Schulz, Service, February 15, 2023).
Operation & Maintenance	Access Road Maintenance - culvert replacement	Permanent or temporary loss of habitat, Habitat degradation, Physical impacts to individuals, Reduction of prey population	Sedimentation, Contaminants, Altered flow	Tributary and in stream earth disturbance can cause increase in sedimentation and turbidity. Equipment located in stream or tributary can increase chance of spills, altered flow velocities and temporary impoundment from in-water work, minor noise from construction activities in	NA	NA	NA	NE	Culvert placement will not occur at CD critical habitat.
Operation & Maintenance	Inspection Activities - ground and aerial	Neutral	None	NA	NA	NA	NA	NE	No impacts to stream habitats are anticipated from this action. Will not introduce sediment or contaminants into the streams or rivers.

Appendix C. Biological Effects of Sediment on Bull Trout and Their Habitat – Guidance for Evaluating Effects (Muck 2010).

BIOLOGICAL EFFECTS OF SEDIMENT ON BULL TROUT AND THEIR HABITAT –

GUIDANCE FOR EVALUATING EFFECTS

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July 13, 2010

BIOLOGICAL EFFECTS OF SEDIMENT ON BULL TROUT AND THEIR HABITAT

Anthropogenic sediment input into water bodies can have a variety of impacts to fish species from behavioral effects such as avoidance or abandonment of cover to lethal effects. The Washington Fish and Wildlife Office reviews numerous projects where sediment is generated during construction. A scientific approach was needed to determine the concentration and duration of sediment input where adverse effects of project-related sediment would occur.

The following document addresses the biological effects of sediment on bull trout and their habitat. The document is divided into two sections:

1. A literature review on the biological effect of sediment on fish (Page 3).
2. Effects analysis for project related sediment input (Page 23).

The literature review addresses the different types of sediment and the biological effects on bull trout. Direct effects include gill trauma and impacts to spawning, redds, eggs, and alevins. Indirect effects include impacts to macroinvertebrates, feeding efficiency, habitat, physiological stress, and behavioral changes.

The effects analysis section provides a step-by-step process to determine the concentration and duration of sediment input to a stream where adverse affects occur. Newcombe and Jensen (1996) and Anderson et al (1996) provide the basis for the analyzing sediment effects to bull trout and their habitat.

Introduction

As a stream or river flows downslope, it transports sediment and dissolved matter (Skinner and Porter 2000, p. 252). A stream has a natural amount of sediment that is transported through the system that varies throughout the year in response to natural hydrological changes (Galbraith et al. 2006, p. 2488). The amount of sediment that a stream can transport annually is based on numerous factors: precipitation, surface water transport, erosion, topography, geology, streamflow, riparian vegetation, stream geomorphologic characteristic, human disturbance, atmospheric deposition, etc. (Bash et al. 2001o, p. 7;Berry et al. 2003, p. 7). Therefore, different watersheds will have different levels or concentrations of turbidity and suspended sediment. A glaciated stream will have higher sediment levels than a spring fed stream (Uehlinger et al. 2002, p. 1;Ahearn 2002, p. 2).

Many watersheds are subject to anthropogenic disturbances that can produce substantial inputs of sediments into streams (Barrett et al. 1992, p. 437). Turbidity, suspended solids, sediment, and siltation have been consistently listed as impairments in the U.S. Environmental Protection Agency's (EPA) 305(b) water quality reports in rivers and streams, lakes, reservoirs, ponds, wetlands, and oceans shoreline waters (Berry, Rubinstein, Melzian, and Hill 2003, p. 4). The EPA's 305(b) list provides the U.S. Congress and the public a means of determining or assessing the current condition of water quality within each individual state. Excessive sedimentation, natural and anthropogenic, has been estimated to occur in 46 percent of all streams and rivers in the U.S. and is considered the most important factor limiting fish habitat and causing water quality impairment (Judy et al. 1984 as cited in Henley et al. 2000, p. 126;Berry, Rubinstein, Melzian, and Hill 2003, pp. 4, 7). One of the most pervasive influences of land-use activities on stream ecosystems is an increase in sediment yield resulting from point source discharges associated with in-stream activities (Suren and Jowett 2001, p. 725).

Aquatic organisms have adapted to the natural variation in sediment load that occurs seasonally within the stream (ACMRR/IABO Working Party on Ecological Indices of Stress to Fishery Resources 1976, pp. 13, 15;Birtwell 1999, p. 7). Field experiments have found a thirty-fold increase in salmonids' (coho salmon) tolerance to suspended solids between August and November when naturally occurring concentrations are expected to be high (Cederholm and Reid 1987, p. 388).

The introduction of sediment in excess of natural amounts can have multiple adverse effects on bull trout and their habitat (Rhodes et al. 1994, pp. 16-21;Berry, Rubinstein, Melzian, and Hill 2003, p. 7). The effect of sediment beyond natural background conditions can be fatal at high levels. Embryo survival and subsequent fry emergence success have been highly correlated to percentage of fine material within the streambed (Shepard et al. 1984, pp. 146, 152). Low levels of sediment may result in sublethal and behavioral effects such as increased activity, stress, and emigration rates; loss or reduction of foraging capability; reduced growth and resistance to disease; physical abrasion; clogging of gills; and interference with orientation in homing and migration (McLeay et al. 1987a, p. 671;Newcombe and MacDonald 1991, pp. 72, 76, 77;Barrett, Grossman, and Rosenfeld 1992, p. 437;Lake and Hinch 1999, p. 865;Bash et al. 2001n, p. 9;Watts et al. 2003, p. 551;Vondracek et al. 2003, p. 1005;Berry, Rubinstein, Melzian, and Hill

2003, p. 33). The effects of increased suspended sediments can cause changes in the abundance and/or type of food organisms, alterations in fish habitat, and long-term impacts to fish populations (Anderson et al. 1996, pp. 1, 9, 12, 14, 15;Reid and Anderson 1999, pp. 1, 7-15). No threshold has been determined in which fine-sediment addition to a stream is harmless (Suttle et al. 2004, p. 973). Even at low concentrations, fine-sediment deposition can decrease growth and survival of juvenile salmonids.

Aquatic systems are complex interactive systems, and isolating the effects of sediment to fish is difficult (Castro and Reckendorf 1995d, pp. 2-3). The effects of sediment on receiving water ecosystems are complex and multi-dimensional, and further compounded by the fact that sediment flux is a natural and vital process for aquatic systems (Berry, Rubinstein, Melzian, and Hill 2003, p. 4). Environmental factors that affect the magnitude of sediment impacts on salmonids include duration of exposure, frequency of exposure, toxicity, temperature, life stage of fish, angularity and size of particle, severity/magnitude of pulse, time of occurrence, general condition of biota, and availability of and access to refugia (Bash et al. 2001m, p. 11). Potential impacts caused by excessive suspended sediments are varied and complex and are often masked by other concurrent activities (Newcombe 2003, p. 530). The difficulty in determining which environmental variables act as limiting factors has made it difficult to establish the specific effects of sediment impacts on fish (Chapman 1988, p. 2). For example, excess fines in spawning gravels may not lead to smaller populations of adults if the amount of juvenile winter habitat limits the number of juveniles that reach adulthood. Often there are multiple independent variables with complex inter-relationships that can influence population size.

The ecological dominance of a given species is often determined by environmental variables. A chronic input of sediment could tip the ecological balance in favor of one species in mixed salmonid populations or in species communities composed of salmonids and nonsalmonids (Everest et al. 1987, p. 120). Bull trout have more spatially restrictive biological requirements at the individual and population levels than other salmonids (USFWS (U.S. Fish and Wildlife Service) 1998, p. 5). Therefore, they are especially vulnerable to environmental changes such as sediment deposition.

Bull trout are apex predators that prey on a variety of species including terrestrial and aquatic insects and fish (Rieman and McIntyre 1993, p. 3). Fish are common in the diet of individual bull trout that are over 110 millimeters or longer. Large bull trout may feed almost exclusively on fish. Therefore, when analyzing impacts of sediment on bull trout, it is very important to consider other fish species that are part of their prey base. While sediment may not directly impact bull trout, the increased sediment input may affect the spawning and population levels of Chinook and coho salmon, cutthroat trout, and steelhead, or other species that are potential prey for bull trout. The following effects of sediment are not specific to bull trout alone. All salmonids can be affected similarly.

This document identifies the biological effects of sediment on fish and their habitat including the different life stage(s) affected by sediment input. It also provides an analysis to determine the level of sediment concentrations and duration that results in adverse effects to bull trout (and all salmonids) and their habitat.

Sediment Classifications and Definitions

Sediment within a stream can be classified into a variety of categories: turbidity, suspended sediment, bedload, deposited sediment, and wash load (Waters 1995, pp. 13-14;Bash et al. 2001l, pp. 3-4). Sediment category definitions include:

- Turbidity - Optical property of water which results from the suspended and dissolved materials in the water. This causes light to be scattered rather than transmitted in straight lines. Turbidity is measured in nephelometric turbidity units (NTUs). Measurements of turbidity can quickly estimate the amount of sediment within a sample of water.
- Suspended sediment - Represents the actual measure of mineral and organic particles transported in the water column. Suspended sediment is measured in mg/L and is an important measure of erosion, and is linked to the transport of nutrients, metals, and industrial and agricultural chemicals through the river system.
- Bedload - Consists of larger particles on the stream bottom that move by sliding, rolling, or saltating along the substrate surface. Bedload is measured in tons/day, or tons/year.
- Deposited sediment - The intermediate sized sediment particles that settle out of the water column in slack or slower moving water. Based on water velocity and turbulence, these intermediate size particles may be suspended sediment or bedload.
- Wash load - Finest particles in the suspended load that are continuously maintained in suspension by the flow turbulence. Therefore significant quantities are not deposited in the bed.

Suspended sediment, turbidity, and deposited sediment are not associated with specific particle sizes, as there will be considerable overlap depending on velocity, turbulence, and gradient (MacDonald et al. 1991, p. 98;Waters 1995, p. 14). Turbidity cannot always be correlated with suspended solid concentrations due to the effects of size, shape and refractive index of particles (Bash et al. 2001k, p. 5). Turbidity and suspended sediment affect the light available for photosynthesis, visual capability of aquatic animals, gill abrasion, and physiology of fish. Suspended and deposited sediment affect the habitat available for macroinvertebrates, the quality of gravel for fish spawning, and the amount of habitat for fish rearing (Waters 1995, p. 14).

The size of particles within the stream is also important. The quantity of "fines" within a stream ecosystem is usually associated with the degree of fish population declines (Castro and Reckendorf 1995c, p. 2). Particle diameters less than 6.4 mm are generally defined as "fines" (Bjornn et al. 1977c, p. 1;Shepard, Leathe, Waver, and Enk 1984, p. 148;Hillman et al. 1987, p. 185;Chapman 1988, p. 14;Bjornn and Reiser 1991, p. 103;Rieman and McIntyre 1993, p. 6;Castro and Reckendorf 1995b, p. 2;MBTSG (The Montana Bull Trout Scientific Group) 1998a, p. 8).

Biological Effects of Sediment on Bull Trout

Classification of Sediment Effects

In the absence of detailed local information on population dynamics and habitat use, any increase in the proportion of fines in substrates should be considered a risk to the productivity of an environment and to the persistence of associated bull trout populations (Rieman and McIntyre 1993, p. 6). Specific effects of sediment on fish and their habitat can be put into three classes that include (Newcombe and MacDonald 1991, pp. 72-73;Waters 1995, pp. 81-82;Bash et al. 2001j, p. 10):

Lethal: Direct mortality to any life stage, reduction in egg-to-fry survival, and loss of spawning or rearing habitat. These effects damage the capacity of the bull trout to produce fish and sustain populations.

Sublethal: Reduction in feeding and growth rates, decrease in habitat quality, reduced tolerance to disease and toxicants, respiratory impairment, and physiological stress. While not leading to immediate death, may produce mortalities and population decline over time.

Behavioral: Avoidance and distribution, homing and migration, and foraging and predation. Behavioral effects change the activity patterns or alter the kinds of activity usually associated with an unperturbed environment. Behavior effects may lead to immediate death or population decline or mortality over time.

<u>Direct Effects</u>

Gill trauma

High levels of suspended sediment and turbidity can result in direct mortality of fish by damaging and clogging gills (Curry and MacNeill 2004, p. 140). Fish gills are delicate and easily damaged by abrasive silt particles (Bash et al. 2001i, p. 15). As sediment begins to accumulate in the gill filaments, fish excessively open and close their gills to expunge the silt. If irritation continues, mucus is produced to protect the gill surface, which may impede the circulation of water over the gills and interfere with fish respiration (Bash et al. 2001h, p. 15). Gill flaring or coughing abruptly changes buccal cavity pressure and is a means of clearing the buccal cavity of sediment. Gill sediment accumulation may result when fish become too fatigued to continue clearing particles via the cough reflex (Servizi and Martens 1991a, p. 495).

Fish are more susceptible to increased suspended sediment concentrations at different times of the year or in watersheds with naturally high sediment such as glaciated streams. Fish secrete protective mucous to clean the gills (Erman and Ligon 1985, p. 18). In glaciated systems or during winter and spring high flow conditions when sediment concentrations are naturally high, the secretion of mucous can keep gills clean of sediment. Protective mucous secretions are inadequate during the summer months, when natural sediment levels are low in a stream system. Consequently, sediment introduction at this time may increase the vulnerability of fish to stress and disease (Bash et al. 2001g, p. 12).

Spawning, redds, eggs, and alevins

The effects of suspended sediment, deposited in a redd and potentially reducing water flow and smothering eggs or alevins or impeding fry emergence, are related to sediment particle sizes of the spawning habitat (Bjornn and Reiser 1991, p. 98). Sediment particle size determines the pore openings in the redd gravel. With small pore openings, more suspended sediments are deposited and water flow is reduced compared to large pore openings.

Survival of eggs is dependent on a continuous supply of well oxygenated water through the streambed gravels (Cederholm and Reid 1987, p. 384;Anderson, Taylor, and Balch 1996, p. 13). Eggs and alevins are generally more susceptible to stress by suspended solids than are adults. Accelerated sedimentation can reduce the flow of water and, therefore, oxygen to eggs and alevins. This can decrease egg survival, decrease fry emergence rates (Cederholm and Reid 1987, p. 384;Chapman 1988, pp. 12-16;Bash et al. 2001f, pp. 17-18), delay development of alevins (Everest, Beschta, Scrivener, Koski, Sedell, and Cederholm 1987, p. 113), reduce growth and cause premature hatching and emergence (Birtwell 1999, p. 19). Fry delayed in their emergence are also less able to compete for environmental resources than fish that have undergone normal development and emergence (intra- or interspecific competition) (Everest, Beschta, Scrivener, Koski, Sedell, and Cederholm 1987, p. 113). Sedimentation fills the interstitial spaces and can prevent alevins from emerging from the gravel (Anderson, Taylor, and Balch 1996, p. 13;Suttle, Power, Levine, and McNeely 2004, pp. 971-972).

Several studies have documented that fine sediment can reduce the reproductive success of salmonids. Natural egg-to-fry survival of coho salmon, sockeye and kokanee has been measured at 23 percent, 23 percent and 12 percent, respectively (Slaney et al. 1977, p. 33). Substrates containing 20 percent fines can reduce emergence success by 30-40 percent (MacDonald, Smart, and Wissmar 1991, p. 99). A decreases of 30 percent in mean egg-to-fry survival can be expected to reduce salmonid fry production to extremely low levels (Slaney, Halsey, and Tautz 1977, p. 33).

Indirect Effects

Macroinvertebrates

Sedimentation can have an effect on bull trout and fish populations through impacts or alterations to the macroinvertebrate communities or populations (Anderson, Taylor, and Balch 1996, pp. 14-15). Increased turbidity and suspended sediment can reduce primary productivity by decreasing light intensity and periphytic (attached) algal and other plant communities (Anderson, Taylor, and Balch 1996, p. 14;Henley, Patterson, Neves, and Lemly 2000, p. 129;Suren and Jowett 2001, p. 726). This results in decreased macroinvertebrates that graze on the periphyton.

Sedimentation also alters the habitat for macroinvertebrates, changing the species density, diversity and structure of the area (Waters 1995, pp. 61-78;Anderson, Taylor, and Balch 1996, pp. 14-15;Reid and Anderson 1999, pp. 10-12;Shaw and Richardson 2001, p. 2220). Certain groups of macroinvertebrates are favored by salmonids as food items. These include mayflies, caddisflies, and stoneflies. These species prefer large substrate particles in riffles and are negatively affected by fine sediment (Everest, Beschta, Scrivener, Koski, Sedell, and Cederholm

1987, p. 115;Waters 1995, p. 63). Increased sediment can affect macroinvertebrate habitat by filling of interstitial space and rendering attachment sites unsuitable. This may cause invertebrates to seek more favorable habitat (Rosenberg and Snow 1975, p. 70). With increasing fine sediment, invertebrate composition and density changes from available, preferred species (i.e., mayflies, caddisflies, and stoneflies) to non-preferred, more unavailable species (i.e., aquatic worms and other burrowing species) (Reid and Anderson 1999, p. 10;Henley, Patterson, Neves, and Lemly 2000, pp. 126, 130;Shaw and Richardson 2001, p. 2219;Suren and Jowett 2001, p. 726;Suttle, Power, Levine, and McNeely 2004, p. 971). The degree to which substrate particles are surrounded by fine material was found to have a strong correlation with macroinvertebrate abundance and composition (Birtwell 1999, p. 23). At an embeddedness of one-third, insect abundance can decline by about 50 percent, especially for riffle-inhabiting taxa (Waters 1995, p. 66).

Increased turbidity and suspended solids can affect macroinvertebrates in multiple ways through increased invertebrate drift, feeding impacts, and respiratory problems (Cederholm and Reid 1987, p. 384;Shaw and Richardson 2001, p. 2218;Berry, Rubinstein, Melzian, and Hill 2003, pp. 8, 11). The effect of turbidity on light transmission has been well documented and results in increased invertebrate drift (Waters 1995, p. 58;Birtwell 1999, pp. 21, 22). This may be a behavioral response associated with the night-active diel drift patterns of macroinvertebrates. While increased turbidity results in increased macroinvertebrate drift, it is thought that the overall invertebrate populations would not fall below the point of severe depletion (Waters 1995, p. 59). Invertebrate drift is also an important mechanism in the repopulation, recolonization, or recovery of a macroinvertebrate community after a localized disturbance (Anderson, Taylor, and Balch 1996, p. 15;Reid and Anderson 1999, pp. 11-12).

Increased suspended sediment can affect macroinvertebrates by abrasion of respiratory surface and interference with food uptake for filter-feeders (Anderson, Taylor, and Balch 1996, p. 14;Birtwell 1999, p. 21;Shaw and Richardson 2001, p. 2213;Suren and Jowett 2001, pp. 725-726;Berry, Rubinstein, Melzian, and Hill 2003, p. 11). Increased suspended sediment levels tend to clog feeding structures and reduce feeding efficiencies, which results in reduced growth rates, increased stress, or death of the invertebrates (Newcombe and MacDonald 1991, p. 73). Invertebrates living in the substrate are also subject to scouring or abrasion which can damage respiratory organs (Bash et al. 2001e, p. 25).

Feeding Efficiency

Increased turbidity and suspended sediment can affect a number of factors related to feeding for salmonids, including feeding rates, reaction distance, prey selection, and prey abundance (Barrett, Grossman, and Rosenfeld 1992, pp. 437, 440;Henley, Patterson, Neves, and Lemly 2000, p. 133;Bash et al. 2001d, p. 21). Changes in feeding behavior are primarily related to the reduction in visibility that occurs in turbid water. Effects on feeding ability are important as salmonids must meet energy demands to compete with other fishes for resources and to avoid predators. Reduced feeding efficiency would result in lower growth and fitness of bull trout and other salmonids (Barrett, Grossman, and Rosenfeld 1992, p. 442;Sweka and Hartman 2001, p. 138).

Distance of prey capture and prey capture success both were found to decrease significantly when turbidity was increased (Berg and Northcote 1985, pp. 1414-1415;Sweka and Hartman 2001, p. 141;Zamor and Grossman 2007, pp. 168, 170, 174). Waters (1995, p. 83) states that loss of visual capability, leading to reduced feeding, is one of the major sublethal effects of high suspended sediment. Increases in turbidity were reported to decrease reactive distance and the percentage of prey captured (Sweka and Hartman 2001, p. 141;Bash et al. 2001c, pp. 21-23;Klein 2003, pp. 1, 21). At 0 NTUs, 100 percent of the prey items were consumed; at 10 NTUs, fish frequently were unable to capture prey species; at 60 NTUs, only 35 percent of the prey items were captured. At 20 to 60 NTUs, significant delay in the response of fish to prey was observed (Bash et al. 2001b, p. 22). Loss of visual capability and capture of prey leads to depressed growth and reproductive capability.

To compensate for reduced encounter rates with prey under turbid conditions, prey density must increase substantially or salmonids must increase their active searches for prey (Sweka and Hartman 2001, p. 144). Such an increase in activity and feeding rates under turbid conditions reduces net energy gain from each prey item consumed (Sweka and Hartman 2001, p. 144).

Sigler et al. (1984, p. 150) found that a reduction in growth occurred in steelhead and coho salmon when turbidity was as little as 25 NTUs. The slower growth was presumed to be from a reduced ability to feed; however, more complex mechanisms such as the quality of light may also affect feeding success rates. Redding et al. (1987, p. 742) found that suspended sediment may inhibit normal feeding activity, as a result of a loss of visual ability or as an indirect consequence of increased stress.

Habitat Effects

Compared to other salmonids, bull trout have more specific habitat requirements that appear to influence their distribution and abundance (Rieman and McIntyre 1993, p. 7). All life history stages are associated with complex forms of cover including large woody debris, undercut banks, boulders, and pools. Other habitat characteristic important to bull trout include channel and hydrologic stability, substrate composition, temperature, and the presence of migration corridors (Rieman and McIntyre 1993, p. 5).

Increases in sediment can alter fish habitat or the utilization of habitats by fish (Anderson, Taylor, and Balch 1996, p. 12). The physical implications of sediment in streams include changes in water quality, degradation of spawning and rearing habitat, simplification and damage to habitat structure and complexity, loss of habitat, and decreased connectivity between habitat (Anderson, Taylor, and Balch 1996, pp. 11-15;Bash et al. 2001a, pp. 1, 12, 18, 30). Biological implications of this habitat damage include underutilization of stream habitat, abandonment of traditional spawning habitat, displacement of fish from their preferred habitat, and avoidance of habitat (Newcombe and Jensen 1996, p. 695).

As sediment enters a stream it is transported downstream under normal fluvial processes and deposited in areas of low shear stress (MacDonald and Ritland 1989, p. 21). These areas are usually behind obstructions, near banks (shallow water) or within interstitial spaces. This episodic filling of successive storage compartments continues in a cascading fashion downstream until the flow drops below the threshold required for movement or all pools have reached their storage capacities (MacDonald and Ritland 1989, p. 21). As sediment load increases, the stream compensates by geomorphologic changes in increased slope, increased channel width, decreased depths, and decreased flows (Castro and Reckendorf 1995a, p. 21). These processes contribute to increased erosion and sediment deposition that further degrade salmonid habitat.

Loss of acceptable habitat and refugia, as well as decreased connectivity between habitats, reduces the carrying capacity of streams for salmonids (Bash et al. 2001p, p. 30). This loss of habitat or exclusion of fish from their habitat, if timed inappropriately, could impact a fish population if the habitat within the affected stream reach is critical to the population during the period of the sediment release (Anderson, Taylor, and Balch 1996, p. 12;Reid and Anderson 1999, p. 13). For example, if summer pool habitat used by adults as holding habitat prior to spawning is a limiting factor within a stream, increased sediment and reduced pool habitat during the summer can decrease the carrying capacity of the stream reach and decrease the fish population. In systems lacking adequate connectivity of habitats, fish may travel longer distances or use less desirable habitats, increasing biological demands and reducing their fitness.

The addition of fine sediment (less than 6.4 mm) to natural streams during summer decreased abundance of juvenile Chinook salmon in almost direct proportion to the amount of pool volume lost to fine sediment (Bjornn et al. 1977b, p. 31). Similarly, the inverse relationship between fine sediment and densities of rearing Chinook salmon indicates the importance of winter habitat and high sediment loads (Bjornn et al. 1977a, pp. 26, 38, 40). As fine sediments fill the interstitial spaces between the cobble substrate, juvenile Chinook salmon were forced to leave preferred habitat and to utilize cover that may be more susceptible to ice scouring, predation, and decreased food availability (Hillman, Griffith, and Platts 1987, p. 194). Deposition of sediment on substrate may lower winter carrying capacity for bull trout (Shepard, Leathe, Waver, and Enk 1984, p. 153). Food production in the form of aquatic invertebrates may also be reduced.

Juvenile bull trout densities are highly influenced by substrate composition (Shepard, Leathe, Waver, and Enk 1984, p. 153;Rieman and McIntyre 1993, p. 6;MBTSG (The Montana Bull Trout Scientific Group) 1998b, p. 9). During the summer, juvenile bull trout hold positions close to the stream bottom and often seek cover within the substrate itself. When streambed substrate contains more than 30 percent fine materials, juvenile bull trout densities drop off sharply (Shepard, Leathe, Waver, and Enk 1984, p. 152). Any loss of interstitial space or streambed complexity through the deposition of sediment would result in a loss of summer and winter habitats (MBTSG (The Montana Bull Trout Scientific Group) 1998c, p. 9). The reduction of rearing habitat will ultimately reduce the potential number of recruited juveniles and therefore reducing population numbers (Shepard, Leathe, Waver, and Enk 1984, pp. 153-154). In fact, Johnston et al. (2007, p. 125) found that density-dependent survival during the earliest of the juvenile stages (between egg and age-1) regulated recruitment of adult bull trout in the population.

Although an avoidance response by fish to increased sediment may be an initial adaptive survival strategy, displacement from cover could be detrimental. It is possible that the consequences of fish moving from preferred habitat, to avoid increasing levels of suspended sediment, may not be beneficial if displacement is to sub-optimal habitat, because they may be stressed and more vulnerable to predation (Birtwell 1999, p. 12).

In addition to altering stream bed composition, anthropogenic input of sediment into a stream can change channel hydrology and geometry (Owens et al. 2005, pp. 694-695). Sediment release can reduce the depth of pools and riffle areas (Anderson, Taylor, and Balch 1996, p. 12). This can reduce available fish habitat, decrease fish holding capacity, and decrease fish populations (Anderson, Taylor, and Balch 1996, pp. 12, 14).

Physiological Effects

Sublethal levels of suspended sediment may cause undue physiological stress on fish, which may reduce the ability of the fish to perform vital functions (Cederholm and Reid 1987, p. 388, 390). Stress is defined as a condition perceived by an organism which threatens a biological function of the organism, and a set of physiological and behavioral responses is mounted to counteract the condition (Overli 2001, p. 7). A stressor is any anthropogenic or natural environmental change severe enough to require a physiological response on the part of a fish, population, or ecosystem (Anderson, Taylor, and Balch 1996, pp. 5-6;EPA (U.S. Environmental Protection Agency) 2001a, pp. 1-2;Jacobson et al. 2003, p. 2). At the individual level, stress may affect physiological systems, reduce growth, increase disease, and reduce the individual's ability to tolerate additional stress (Anderson, Taylor, and Balch 1996, p. 7;Bash et al. 2001q, p. 17). At the population level, the effects of stress may include reduced spawning success, increased larval mortality, reduced recruitment to succeeding life stages and, therefore, overall population declines (Bash et al. 2001r, p. 17).

Upon encountering a stressor, the fish responds through a series of chemical releases in its body. These primary chemical and hormonal releases include catecholamine (e.g. epinephrine, norepinehprine) in the circulatory system, corticosteroids (e.g. cortisol) from the interregnal tissue, and hypothalamic activation of the pituitary gland (Gregory and Wood 1999, p. 286;Schreck et al. 2001, p. 5;Barton 2002, p. 517;Davis 2006, p. 116). Primary chemical releases result in secondary releases or changes in plasma, glucose, tissue ion, metabolite levels, and hematological features. These secondary responses relate to physiological adjustments in metabolism, respiration, immune and cellular function (Mazeaud et al. 1977, p. 201;Barton 2002, p. 517;Haukenes and Buck 2006, p. 385). After secondary responses, continued stress results in tertiary stress responses which affect whole-animal performance such as changes in growth, condition, resistance to disease, metabolic scope for activity, behavior, and ultimately survival (Pickering et al. 1982, p. 229;Barton 2002, p. 517;Portz et al. 2006, pp. 126-127).

Stress in a fish occurs when the homeostatic or stabilizing process in the organism exceed the capability of the organism to compensate for the biotic or abiotic challenge (Anderson, Taylor, and Balch 1996, p. 5). The response to a stressor is an adaptive mechanism that allows the fish to cope with the real or perceived stressor in order to maintain its normal or homeostatic state (Barton 2002, p. 517). Acclimation to a stressor can occur if compensatory physiological responses by the fish are able to re-establish a satisfactory relationship between the changed environment and the organism (Anderson, Taylor, and Balch 1996, p. 5). The ability of an individual fish to acclimate or tolerate the stress will depend on the severity of the stress and the physiological limits of the organism (Anderson, Taylor, and Balch 1996, p. 5). In a natural system, fish are exposed to multiple chemical and physical stressors which can combine to cause adverse effects (Berry, Rubinstein, Melzian, and Hill 2003, p. 4). The chemical releases from each stressor results in a cumulative or additive response (Barton et al. 1986, pp. 245, 247;EPA (U.S. Environmental Protection Agency) 2001b, pp. 3, 25;Cobleigh 2003, pp. 16, 39, 55;Milston et al. 2006, p. 1172).

Stress in fish results in extra cost and energy demands. Elevated oxygen consumption and increased metabolic rate result from the reallocation of energy to cope with the stress (Barton and Schreck 1987, pp. 259-260;Contreras-Sanchez et al. 1998, pp. 439, 444;McCormick et al. 1998, pp. 222, 231). An approximate 25 percent increase in metabolic cost, over standard metabolism requirements, is needed to compensate for a perceived stress (Barton and Schreck 1987, p. 260;Davis 2006, p. 116). Stressed fish would thus have less energy available for other life functions such as seawater adaptation, disease resistance, reproduction, or swimming stamina (Barton and Schreck 1987, p. 261;Contreras-Sanchez, Schreck, Fitzpatrick, and Pereira 1998, p. 444).

Tolerance to suspended sediment may be the net result of a combination of physical and physiological factors related to oxygen availability and uptake by fish (Servizi and Martens 1991b, p. 497). The energy needed to perform repeated coughing (see Gill trauma section) increases metabolic oxygen demand. Metabolic oxygen demand is related to water temperature. As temperatures increase, so does metabolic oxygen demand, but concentrations of oxygen available in the water decreases. Therefore, a fish's tolerance to suspended sediment may be primarily related to the capacity of the fish to perform work associated with the cough reflex. However, as sediment increases, fish have less capability to do work, and therefore less tolerance for suspended sediment (Servizi and Martens 1991c, p. 497).

Once exposed to a stressor, the primary chemical releases can take one-half to twenty-four hours to peak (Schreck 1981, p. 298;Barton 2002, p. 520;Quigley and Hinch 2006, p. 437). Recovery or return of the primary chemical release to normal or resting levels can take two hours to two weeks (Mazeaud, Mazeaud, and Donaldson 1977, pp. 205-206;Schreck 1981, p. 313). In a study of handling stress, chemical release of cortisol peaked at two hours and returned to normal in four hours. However, complete recovery took 2 weeks (Pickering, Pottinger, and Christie 1982, pp. 236, 241). Fish exposed to two or more stresses require longer recovery times than fish exposed only to one stressor indicating the cumulative effects of stress (Sigismondi and Weber 1988, pp. 198-199).

Redding el al.(1987, pp. 740-741) observed higher mortality in young steelhead trout exposed to a combination of suspended sediment (2500 mg/L) and a bacteria pathogen, than when exposed to the bacteria alone. Physiological stress in fishes may decrease immunological competence, growth, and reproductive success (Bash et al. 2001s, p. 16).

Behavioral effects

Increased turbidity and suspended sediment may result in behavior changes in salmonids. These changes are the first effects evoked from increased levels of turbidity and suspended sediment

(Anderson, Taylor, and Balch 1996, p. 6). These behavioral changes include avoidance of habitat, reduction in feeding, increased activity, redistribution and migration to other habitats and locations, disruption of territoriality, and altered homing (Anderson, Taylor, and Balch 1996, p. 6;Bash et al. 2001t, pp. 19-25;Suttle, Power, Levine, and McNeely 2004, p. 971). Many behavioral effects result from changes in stream habitat (see Habitat effects section). As suspended sediment concentration increases, habitat may be lost which results in abandonment and avoidance of preferred habitat. Stream reach emigration is a bioenergetic demand that may affect the growth or reproductive success of the individual fish (Bash et al. 2001u, p. 12). Pulses of sediment result in downstream migration of fish, which disrupts social structures, causes downstream displacement of other fish and increases intraspecific aggression (McLeay et al. 1987b, pp. 670-671;Bash et al. 2001v, pp. 12, 20;Suttle, Power, Levine, and McNeely 2004, p. 971). Loss of territoriality and the breakdown of social structure can lead to secondary effects of decreased growth and feeding rates, which may lead to mortality (Berg and Northcote 1985, p. 1416;Bash et al. 2001w, p. 20).

Downstream migration by bull trout provides access to more prey, better protection from avian and terrestrial predators, and alleviates potential intraspecific competition or cannibalism in rearing areas (MBTSG (The Montana Bull Trout Scientific Group) 1998d, p. 13). Benefits of migration from tributary rearing areas to larger rivers or estuaries may be increased growth potential. Increased sedimentation may result in premature or early migration of both juveniles and adults or avoidance of habitat and migration of nonmigratory resident bull trout.

High turbidity may delay migration back to spawning sites, although turbidity alone does not seem to affect homing. Delays in spawning migration and associated energy expenditure may reduce spawning success and therefore population size (Bash et al. 2001x, p. 29).

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DETERMINING EFFECTS FOR SECTION 7 CONSULTATIONS

There are numerous factors that can influence project-specific sediment effects on bull trout and other salmonids. These factors include the concentration and duration of sediment input, existing sediment conditions, stream conditions (velocity, depth, etc.) during construction, weather or climate conditions (precipitation, wind, etc.), fish presence or absence (bull trout plus prey species), and best management practice effectiveness. Many of these factors are unknown.

Newcombe and Jensen (1996) and Anderson et al. (1996) provide the basis for analyzing sediment effects to bull trout and other salmonids and their habitat. Newcombe and Jensen (1996) conducted a literature review of pertinent documents on sediment effects to salmonids and nonsalmonids. They developed a model that calculated the severity of ill effect (SEV) to fish based on the suspended sediment dose (exposure) and concentration. No data on bull trout were used in this analysis. Anderson et al. (1996), using the methods used by Newcombe and Jensen (1996), developed a model to estimate sediment impacts to salmonid habitat.

A 15-point scale was developed by Newcombe and Jensen (1996, p. 694) to qualitatively rank the effects of sediment on fish (Table 1). Using a similar 15-point scale, Anderson et al. (1996)

Table 1 – Scale of the severity (SEV) of ill effects associated with excess suspended sediment on salmonids.

SEV	Description of Effect
	Nil effect
0	No behavioral effects
	Behavioral effects
1	Alarm reaction
2	Abandonment of cover
3	Avoidance response
	Sublethal effects
4	Short-term reduction in feeding rates; short-term reduction in feeding success
5	Minor physiological stress; increase in rate of coughing; increased respiration rate
6	Moderate physiological stress
7	Moderate habitat degradation; impaired homing
8	Indications of major physiological stress; long-term reduction in feeding rate; long-term reduction in feeding success; poor condition
	Lethal and paralethal effects
9	Reduced growth rate; delayed hatching; reduced fish density
10	0-20% mortality; increased predation; moderate to severe habitat degradation
11	> 20 – 40% mortality
12	> 40 – 60% mortality
13	> 60 – 80% mortality
14	> 80 – 100% mortality

ranked the effects of sediment on fish habitat (Table 2).

We analyzed the effects on different bull trout life history stages to determine when adverse effects of project-related sediment would occur. Table 3 shows the different ESA effect calls for bull trout based on severity of ill effect.

The effect determination for a proposed action should consider all SEV values resulting from the action because sediment affects individual fish differently depending on life history stage and site-specific factors. For juvenile bull trout, an SEV of 5 is likely to warrant a "likely to adversely affect" (LAA) determination. However, abandonment of cover (SEV 2), or an avoidance response (SEV 3), may result in increased predation risk and mortality if habitat features are limiting in the project's stream reach. Therefore, a LAA determination may be warranted at an SEV 2 or 3 level in certain situations. For subadult and adult bull trout, however, abandonment of cover and avoidance may not be as important. A higher SEV score is more appropriate for adverse effects to subadult and adult bull trout. In all situations, we assume that SEV scores associated with adverse effects are also sufficient to represent a likelihood of harm or harass[1].

Table 2 – Scale of the severity (SEV) of ill effects associated with excess suspended sediment on salmonid habitat.

SEV	Description of Effect
3	Measured change in habitat preference
7	Moderate habitat degradation – measured by a change in invertebrate community
10	Moderately severe habitat degradation – defined by measurable reduction in the productivity of habitat for extended period (months) or over a large area (square kilometers).
12	Severe habitat degradation – measured by long-term (years) alterations in the ability of existing habitats to support fish or invertebrates.
14	Catastrophic or total destruction of habitat in the receiving environment.

When evaluating impacts to habitat as a surrogate for species effects, adverse effects may be anticipated when there is a notable reduction in abundance of aquatic invertebrates, and an alteration in their community structure. These effects represent a reduction in food for bull trout and other salmonids, and correspond to an SEV of 7 – moderate habitat degradation.

Newcombe and Jensen (1996) used six data groups to conduct their analysis. These groups were 1) juvenile and adult salmonids (Figure 1), 2) adult salmonids (Figure 2), 3) juvenile salmonids (Figure 3), 4) eggs and larvae of salmonids and non-salmonids (Figure 4), 5) adult estuarine nonsalmonids (no figure provided), and 6) adult freshwater nonsalmonids (no figure provided). No explanation was provided for why juvenile and adult salmonids were combined

[1] Harm and harass in this context refers to the FWS's regulatory definition at 50 CFR 17.3. E.g., Harm means "an act which actually kills or injures wildlife. Such an act may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavior patterns, including breeding, feeding, or sheltering."

for group 1. As juveniles are more adapted to turbid water (Newcombe 1994, p. 5), their SEV levels are generally lower than for adult salmonids given the same concentration and duration of sediment (Figures 1-3).

Table 3 – ESA Effect calls for different bull trout life stages in relation to the duration of effect and severity of ill effect. Effect calls for habitat, specifically, are provided to assist with analysis of effects to individual bull trout.

	SEV	ESA Effect Call
Egg/alevin	1 to 4	Not applicable - alevins are still in gravel and are not feeding.
	5 to 14	LAA - any stress to egg/alevin reduces survival
Juvenile	1 to 4	NLAA
	5 to 14	LAA
Subadult and Adult	1 to 5	NLAA
	6 to 14	LAA
Habitat	1 to 6	NLAA
	7 to 14	LAA due to indirect effects to bull trout

The figures of Newcombe and Jensen (1996) have been modified in this document. In each figure, values (in mg/L) are provided for each duration to determine when adverse effects would occur. Specific values are also given for when harm would be likely to occur. For example:

> Figure 1 – This figure is for both juveniles and adults. From Table 2, bull trout are "likely to be adversely affected" given an SEV of 5. On Figure 1, a sediment concentration of 99 mg/L for one hour is anticipated to be the maximum concentration for an SEV of 4. At 100 mg/L, an SEV of 5 occurs. In addition, one hour of exposure to 5,760 mg/L is the maximum for an SEV of 7. Exposure to 5,761 mg/L for one hour would warrant an SEV of 8. This would be the threshold between harassment and harm. An SEV of 7 would be harassment, and an SEV of 8 would be considered harm.

The following provides some guidance on use of the figures.

Definitions from Newcombe and Jensen (1996, p. 696). These definitions are provided for consultations that may have impacts to bull trout prey such as Chinook and coho salmon.

> Eggs and larvae – eggs, and recently hatched fish, including yolk-sac fry, that have not passed through final metamorphosis.

> Juveniles – fry, parr, and smolts that have passed through larval metamorphosis but are sexually immature.

Adults – mature fish.

Bull trout use:

Newcombe and Jensen (1996) conducted their analysis for freshwater, therefore the use of the figures within this document in marine waters should be used with caution.

Figure 1 – Juvenile and Adult Salmonids. This figure should be used in foraging, migration and overwintering (FMO) areas. In FMO areas, downstream of local populations, both subadult and adult bull trout may be found.

Figure 2 – Adult Salmonids. This figure will not be used very often for bull trout. There may be circumstances, downstream of local population spawning areas that may have just adults, but usually this would not be the case. Justification for use of this figure should be stated in your consultation.

Figure 3 – Juvenile Salmonids. This figure should be used in local population spawning and rearing areas outside of the spawning period. During this time, only juveniles and sub-adults should be found in the area. Adults would migrate to larger stream systems or to marine water. If the construction of the project would occur during spawning, then Figure 1 should be used.

Figure 4 – Eggs and Alevins. This figure should be used if eggs or alevins are expected to be in the project area during construction.

Figure 5 – Habitat. This figure should be used for all projects to determine whether alterations to the habitat may occur from the project.

Background and Environmental Baseline

In determining the overall impact of a project on bull trout, and to specifically understand whether increased sediment may adversely affect bull trout, a thorough review of the environmental baseline and limiting factors in the stream and watershed is needed. The following websites and documents will help provide this information.

1. Washington State Conservation Commission's Limiting Factors Analysis. A limiting factors analysis has been conducted on watersheds within the State of Washington. Limiting factors are defined as "conditions that limit the ability of habitat to fully sustain populations of salmon, including all species of the family Salmonidae." These documents will provide information on the current condition of the individual watersheds within the State of Washington. The limiting factors website is http://salmon.scc.wa.gov. Copies of the limiting factors analysis can be found at the Western Washington Fish and Wildlife Library.

2. Washington Department of Fish and Wildlife's (1998) Salmonid Stock Inventory (SaSI). The Washington Department of Fish and Wildlife (WDFW) inventoried bull

trout and Dolly Varden (*S. malma*) stock status throughout the State. The intent of the inventory is to help identify available information and to guide future restoration planning and implementation. SaSI defines the stock within the watershed, life history forms, status and factors affecting production. Spawning distribution and timing for different life stages are provided (migration, spawning, etc.), if known. SaSi documents can be found at http://wdfw.wa.gov/fish/sasi/index.htm.

3. U.S. Fish and Wildlife Service's (USFWS 1998a) Matrix of Diagnostics/Pathways and Indicators (MPI). The MPI was designed to facilitate and standardize determination of project effects on bull trout. The MPI provides a consistent, logical line of reasoning to aid in determining when and where adverse affects occur and why they occur. The MPI provides levels or values for different habitat indicators to assist the biologist in determining the level of effects or impacts to bull trout from a project and how these impacts may cumulatively change habitat within the watershed.

4. Individual Watershed Resources. Other resources may be available within a watershed that will provide information on habitat, fish species, and recovery and restoration activities being conducted. The action agency may cite a publication or identify a local watershed group within the Biological Assessment or Biological Evaluation. These local groups provide valuable information specific to the watershed.

5. Washington State Department of Ecology (WDOE) - The WDOE has long- and short-term water quality data for different streams within the State. Data can be found at http://www.ecy.wa.gov/programs/eap/fw_riv/rv_main.html. Clicking on a stream or entering a stream name will provide information on current and past water quality data (when you get to this website, scroll down to the Washington map). This information will be useful for determining the specific turbidity/suspended sediment relationship for that stream (more information below).

6. Washington State Department of Ecology (WDOE) - The WDOE has also been collecting benthic macroinvertebrates and physical habitat data to describe conditions under natural and anthropogenic disturbed areas. Data can be found at http://www.ecy.wa.gov/programs/eap/fw_benth/index.htm. You can access monitoring sites at the bottom of the website.

7. U.S. Forest Service, Watershed Analysis Documents - The U.S. Forest Service (USFS) is required by the Record of Decision for Amendments to the USFS and Bureau of Land Management Planning Documents within the Range of the Northern Spotted Owl to conduct a watershed analysis for watersheds located on FS lands. The watershed analysis determines the existing condition of the watershed and makes recommendations for future projects that move the landscape towards desired conditions. Watershed analysis documents are available from individual National Forests or from the Forest Plan Division.

8. U.S. Fish and Wildlife Service - Bull Trout Recovery Plans and Critical Habitat Designations. The draft Bull Trout Recovery Plan for the Columbia River Distinct

Population Segment (DPS) (also the Jarbidge River and the St. Mary-Belly River DPS) and the proposed and final critical habitat designations provide current species status, habitat requirements, and limiting factors for bull trout within specific individual recovery units. These documents are available from the Endangered Species Division as well as the Service's web page (www.fws.gov).

These documents and websites provide baseline and background information on stream and watershed conditions. This information is critical to determining project-specific sediment impacts to the aquatic system. The baseline or background levels need to be analyzed with respect to the limiting factors within the watershed.

Consultation Sediment Analysis

The analysis in this section only applies to construction-related physiological and behavioral impacts, and the direct effects of fine sediment on current habitat conditions. Longer-term effects to habitat from project-induced channel adjustments, post-construction inputs of coarse sediment, and secondary fine sediment effects due to re-mobilization of sediment during the following runoff season, are not included in the quantitative part of this effects determination. Those aspects are only considered qualitatively.

The background or baseline sediment conditions within the project area or watershed will help to determine whether the project will have an adverse effect on bull trout. The following method should be followed to assist in reviewing effects determinations and quantifying take in biological opinions.

1) Determine what life stage(s) of bull trout will be affected by sedimentation from the project. Life history stages include eggs and alevins, juveniles, and sub-adults and adults. If projects adhere to approved work timing windows, very few should be constructed during periods when eggs and alevins are in the gravels. However, streambed or bank adjustments may occur later in time and result in increased sedimentation during the time of the year when eggs and alevins may be in the gravels and thus affected by the project.

2) Table 4 (Page 45) provides concentrations, durations, and SEV levels for different projects. This table will help in analyzing similar projects and to determine sediment level impacts associated with that type of project. Based on what life history stage is in the project area and what SEV levels may result from the project, a determination may be made on effects to bull trout.

3) Once a "likely to adversely affect" determination has been made for a project, the figures in Newcombe and Jensen (1996) or Anderson et al. (1996) are used to determine the concentration (mg/L) at which adverse effects[2] and "take" will occur (see Figures 1-5). For example, if a project is located in FMO habitat, Figure 1 would be used to determine the concentrations at which adverse effects will occur. Since Figure 1 is used for both adults and juveniles, an SEV of 5 (for juveniles) is used (see Table 2). For (a.) the level

[2] For the remainder of the document, references to "adverse effects" also refer to harm and harass under 50 CFR 17.3.

when instantaneous adverse effects occur, find the SEV level of 5 in the one hour column. The corresponding concentration is the instantaneous value where adverse affects occur. In this example, it is 148 mg/L. For (b), (c), and (d), adverse effects will occur when sediment concentrations exceed SEV 4 levels. The exact concentrations for this have been provided. For each category, find the SEV 4 levels and the corresponding concentration levels are the values used.

For impacts to individual bull trout, adverse effects would be anticipated in the following situations:

a. Any time sediment concentrations exceed 148 mg/L over background.
b. When sediment concentrations exceed 99 mg/L over background for more than one hour continuously.
c. When sediment concentrations exceed 40 mg/L over background for more than three hours cumulatively.
d. When sediment concentrations exceeded 20 mg/L over background for over seven hours cumulatively.

For habitat effects, use Figure 5 and the same procedure as above for individual bull trout. For example, adverse effects would be expected to occur in the following situations:

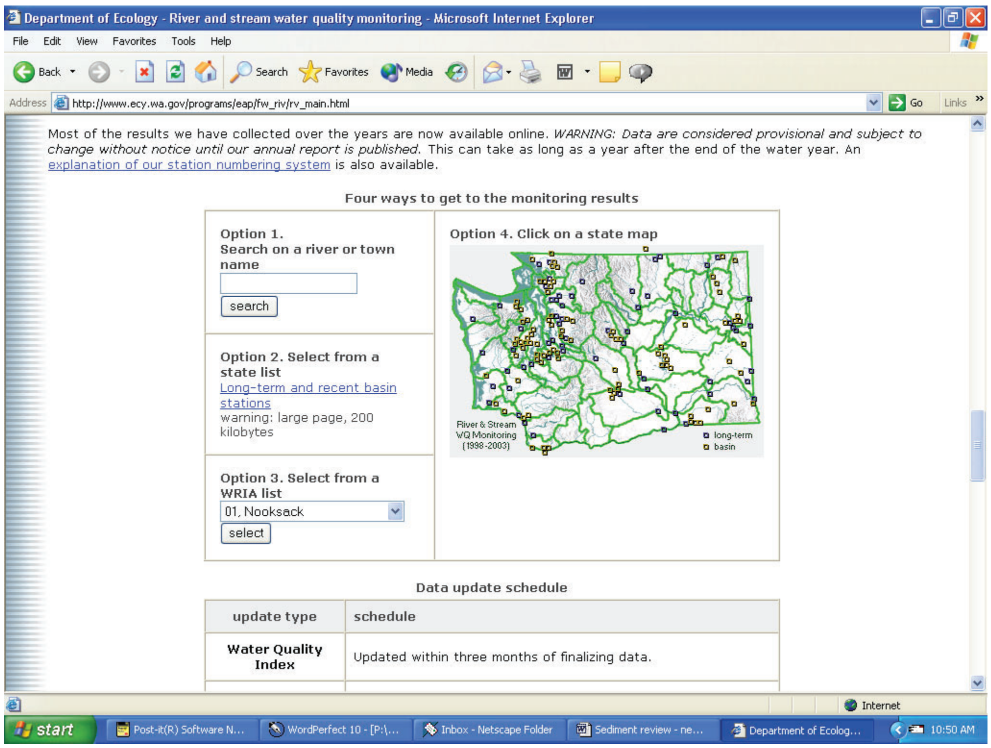
a. Any time sediment concentrations exceed 1,097 mg/L over background.
b. When sediment concentrations exceed 885 mg/L over background for more than one hour continuously.
c. When sediment concentrations exceed 345 mg/L over background for more than three hours cumulatively.
d. When sediment concentrations exceeded 167 mg/L over background for over seven hours cumulatively.

4) Because sediment sampling for concentration (mg/L) is labor intensive, many applicants prefer to monitor turbidity as a surrogate. To do this, the sediment concentration at which adverse effects to the species and/or habitat occurs is converted to NTUs. Two methods, regression analysis and turbidity to suspended solid ratio, are available for this conversion. The regression analysis method should be used first. If not enough data are available then the turbidity to suspended solid ratio method should be used.

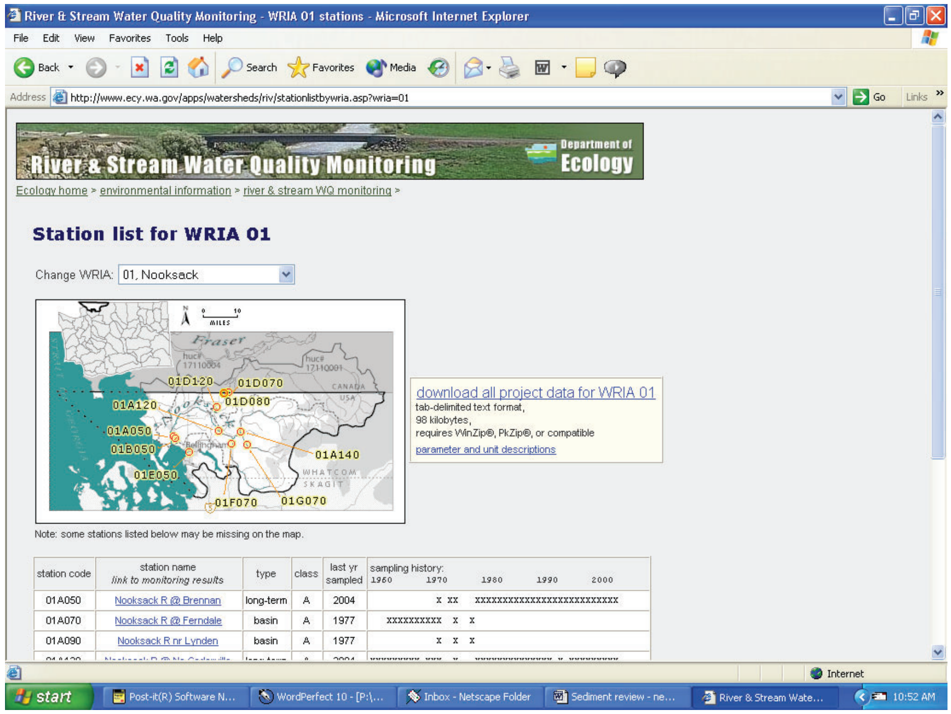
   a. Data – as described above in Background and Environmental Baseline, an attempt should be made to find turbidity and suspended solid information from the project area, action area, or the stream in which the project is being constructed. This information may be available from the Tribes, watershed monitoring groups, etc. Try to obtain information for the months in-water construction will occur, which is usually during the fish timing window (in most cases, July through September). If you are unable to find any data for the action area, use the WDOE water quality monitoring data. The following are the steps you need to go through to locate the information on the web and how to download the data:

i. Go to the WDOE webpage (http://www.ecy.wa.gov/programs/eap/fw_riv/rv_main.html).

ii. When you get to the website, the page will state "River and Stream Water Quality Monitoring." If you scroll down the page, you will see the following text and map.



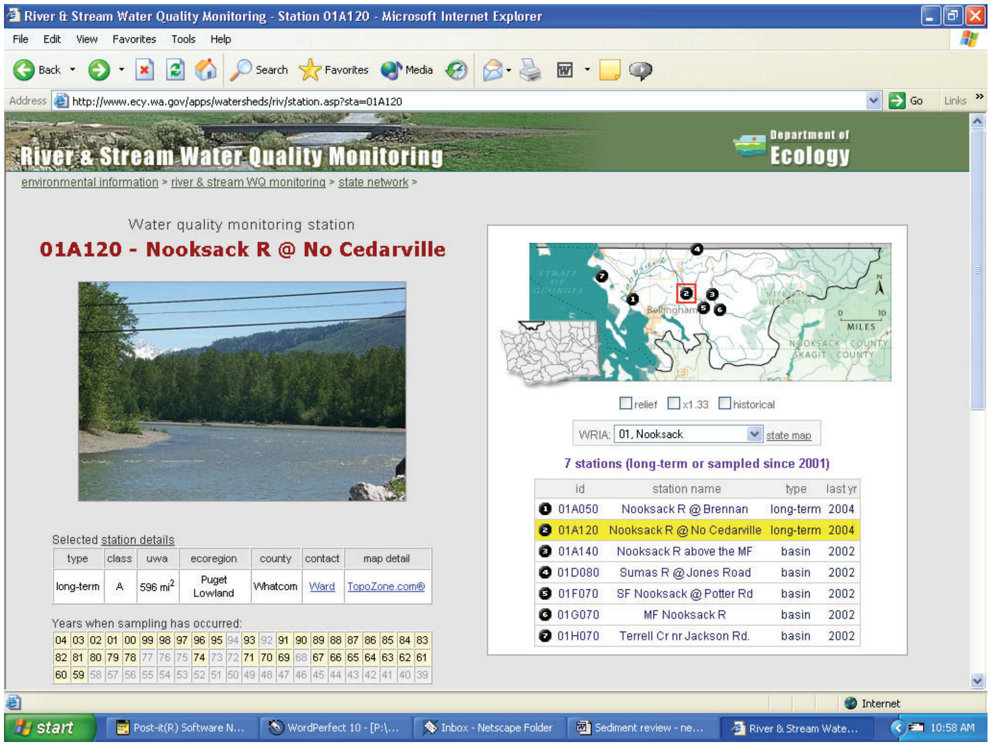
iii. The map shows all the water quality monitoring stations in Washington. You can click on a watershed, or go to Option 3, click on the down arrow and find your watershed. You will then get the following webpage. This is an example for the Nooksack River.



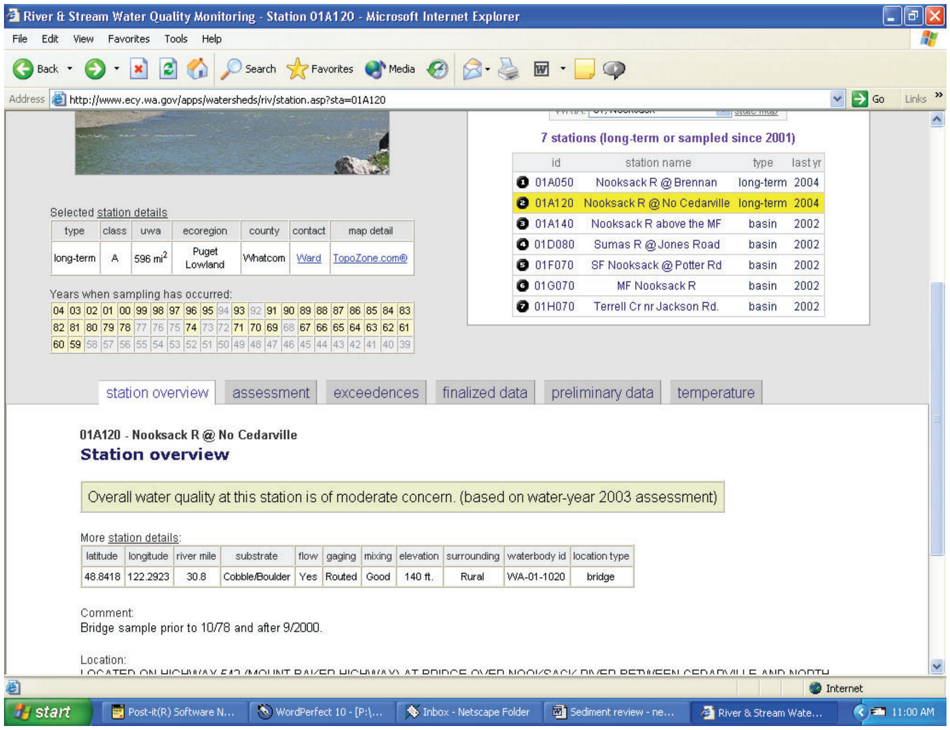
iv. This webpage shows you all the monitoring stations in this watershed. Scrolling down a little on the webpage, you get a list of the monitoring stations and the years that data were collected. The more years in which data were collected the better; however, you want to pick the monitoring station closest to the project site. If a project is located on a tributary, do not use data from the main river in the watershed. Find a monitoring station on a tributary and use that data. **Justification for the use of the data needs to be made in the BO.** The following language was used in the Anthracite Creek Bridge Scour BO. Changes to this paragraph to represent regression analysis are not italicized.

"*The guidance of Newcombe and Jensen (1996) requires a measurement of the existing suspended sediment concentration levels (mg/L) and duration of time that sediment impacts would occur. The Service used data available on the Washington Department of Ecology (WDOE) website to determine a ratio of turbidity (NTU) to suspended solids (mg/L)*(website to find the correlation between turbidity and suspended solids) *in Anthracite Creek. No water quality data was available for Anthracite Creek, so the Service used water quality monitoring data from a different tributary within the Snohomish River watershed. Patterson Creek, which is a tributary to the Snoqualmie River, was used to determine the ratio of turbidity to suspended solids* (correlation between turbidity and suspended solids). *The Service believes that Patterson Creek would have very comparable water quality data as Anthracite Creek. The turbidity to suspended solid ratio for Patterson Creek is 1:2.4 during the proposed months of construction (July through September).*" Delete the last sentence for regression analysis or put in the equation used for analysis and the R^2.

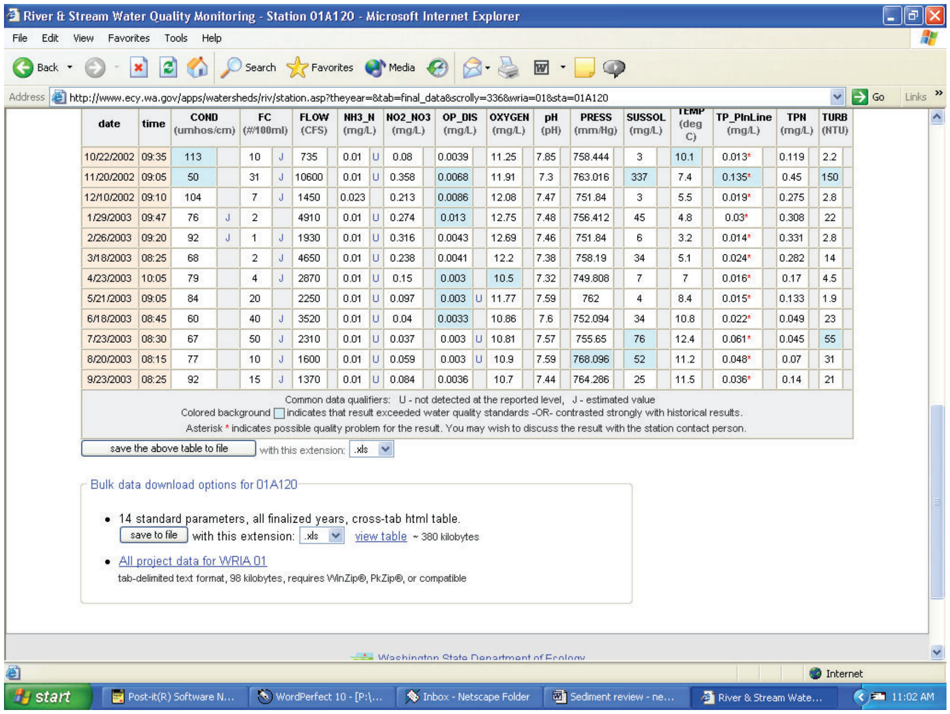
v. When you select the monitoring station, the following webpage appears. This monitoring station is on the Nooksack River at North Cedarville.



vi. Moving down the webpage, you find the following. The page shows the years data were collected and 4 to 6 tabs that provide different information. Click on the finalized data tab.



vii. Selecting the finalized data, a new page comes up; scrolling down that page you see the following. The top part of the page shows the finalized data for the most recent year data were collected. Below the data is a box that says "Bulk data download options..." Click on the "save to file" button for the 14 standardized data parameters. Follow the instructions to save this file. This saves all the data from that monitoring station so the regression analysis can be conducted.



River & Stream Water Quality Monitoring - Station 01A120 - Microsoft Internet Explorer

http://www.ecy.wa.gov/apps/watersheds/riv/station.asp?theyear=&tab=final_data&scrolly=336&wria=01&sta=01A120

date	time	COND (umhos/cm)	FC (#/100ml)	FLOW (CFS)	NH3_N (mg/L)	NO2_NO3 (mg/L)	OP_DIS (mg/L)	OXYGEN (mg/L)	pH (pH)	PRESS (mm/Hg)	SUSSOL (mg/L)	TEMP (deg C)	TP_PlnLine (mg/L)	TPN (mg/L)	TURB (NTU)
10/22/2002	09:35	113	10 J	735	0.01 U	0.08	0.0039	11.25	7.85	758.444	3	10.1	0.013*	0.119	2.2
11/20/2002	09:05	50	31 J	10600	0.01 U	0.358	0.0068	11.91	7.3	763.016	337	7.4	0.135*	0.45	150
12/10/2002	09:10	104	7 J	1450	0.023	0.213	0.0086	12.08	7.47	751.84	3	5.5	0.019*	0.275	2.8
1/29/2003	09:47	76 J	2	4910	0.01 U	0.274	0.013	12.75	7.48	756.412	45	4.8	0.03*	0.308	22
2/26/2003	09:20	92 J	1 J	1930	0.01 U	0.316	0.0043	12.69	7.46	751.84	6	3.2	0.014*	0.331	2.8
3/18/2003	08:25	68	2 J	4650	0.01 U	0.238	0.0041	12.2	7.38	758.19	34	5.1	0.024*	0.282	14
4/23/2003	10:05	79	4 J	2870	0.01 U	0.15	0.003	10.5	7.32	749.808	7	7	0.016*	0.17	4.5
5/21/2003	09:05	84	20	2250	0.01 U	0.097	0.003 U	11.77	7.59	762	4	8.4	0.015*	0.133	1.9
6/18/2003	08:45	60	40 J	3520	0.01 U	0.04	0.0033	10.86	7.6	752.094	34	10.8	0.022*	0.049	23
7/23/2003	08:30	67	50 J	2310	0.01 U	0.037	0.003 U	10.81	7.57	755.65	76	12.4	0.061*	0.045	55
8/20/2003	08:15	77	10 J	1600	0.01 U	0.059	0.003 U	10.9	7.59	768.096	52	11.2	0.048*	0.07	31
9/23/2003	08:25	92	15 J	1370	0.01 U	0.084	0.0036	10.7	7.44	764.286	25	11.5	0.036*	0.14	21

Common data qualifiers: U - not detected at the reported level, J - estimated value
Colored background indicates that result exceeded water quality standards -OR- contrasted strongly with historical results.
Asterisk * indicates possible quality problem for the result. You may wish to discuss the result with the station contact person.

save the above table to file with this extension: .xls

Bulk data download options for 01A120

- 14 standard parameters, all finalized years, cross-tab html table. save to file with this extension: .xls view table ~ 380 kilobytes
- All project data for WRIA 01
  tab-delimited text format, 98 kilobytes, requires WinZip®, PkZip®, or compatible

viii. Open Excel and open the file that was just downloaded. Verify that all data appear to be available. After you have worked with these files, you will get an idea if something appears wrong. If the data looks like something is wrong, verify it by comparing the data to the finalized data on the webpage (look at each year's finalized data). After the file is open, delete all columns except the date, sussol (mg/L) and turb (NTU).

ix. Next delete the rows that do not need to be included. Only save the months in which the project will be constructed. For example, if work will be conducted during the work timing window of July 15 through August 31, delete all rows except those that contain data for July and August. The data consist of one data collection point each month. In addition, delete any values that have a "U" or "J" in the column to the right of the NTU value. This data may not be accurate; data may not be detectable at reported level or is an estimated value. The blue cells indicate the value exceeds water quality standards or contrasted strongly with historical results.

x. After deleting the unnecessary columns and rows, your data should contain 5 columns. You can now delete the columns to the right of the values. This will give you 3 columns. The first being the date, the second column contains the suspended solid data (mg/L) and the third column the turbidity (NTU) data.

b. Regression analysis. Once you have the data reduced to the months construction will occur, you can determine the relationship between turbidity and suspended solids using regression. The following steps will provide the regression equation using the data obtained above. These steps are for Excel 2007.

i. With your mouse, highlight both columns of data (suspended solid and turbidity), but do not include the heading information.

ii. Then click on "Insert", "Scatter" and then the graph that does not have any lines on it (should be the upper left graph).

iii. The graph is placed on your Excel sheet, so move it over so you can see all the data and the graph.

iv. Now add the trendline to the graph. This is done by clicking (left button) once on any of the points on the graph. Then right click. A window pops open and click on "Add Trendline." A "Format Trendline" window appears. Make sure Linear is checked, and down on the bottom, check Display Equation on chart and Display R-squared value on chart. Click on close.

    1. The X and Y data are opposite of what you want so you need to swap the values. This is done by left clicking once anywhere on the graph and then right click and click on "select data." A window pops open and you want to click on Edit. An Edit Series window appears and you want to click on the little red arrow next to Series X values. This allows you to select the data in the table. Upon clicking the red arrow, you will see the column under sussol (mg/L) being selected by a moving line around the cells. Select the data under Turb (NTU) by left clicking and holding the button down and drag all the way down to the last cell in that column. The whole column should have the moving line around all the cells. Click on the little red arrow in the Edit Series window. That will expand out the window and you will do the same for the Series Y values. Click on the red arrow next to that, then left click and hold and select all the cells in the column under Sussol (mg/L), and then click on the red arrow again. When the Edit Series window expands, click on OK, and then click on OK.

v. The equation that you want to use for your conversion from NTUs to suspended solids is now on the graph. Hopefully, your R-squared value is also high. This gives you an indication of how well your data fits the line. A one (1) is perfect. If this number is low (and a ballpark figure is less than 0.60) then you may want to consider using the ratio method to determine your conversion from NTUs to suspended solids.

    1. Outliers – sometimes there will be data that will be far outside the norm. These values can be deleted and that will help increase your R-squared value. If you are good at statistics there are ways of

determining outliers. If not, you will probably just use the data as is, unless you think something is really not right, then you may want to delete those data points.

vi. Using the equation for the regression analysis, convert the sediment concentrations found for when adverse affects occur to bull trout and their habitat (number 3 above) to NTUs. For our example, let's say our NTU to suspended solid equation is: $y = 1.6632x - 0.5789$. Adverse effects would then occur at (solve for x):

For impacts to the species adverse effect would occur in the following situations:

a. Any time sediment concentrations exceed 89 NTU over background.
b. When sediment concentrations exceed 60 NTU over background for more than one hour continuously.
c. When sediment concentrations exceed 24 NTU over background for more than three hours cumulatively.
d. When sediment concentrations exceeded 12 NTU over background for over seven hours cumulatively.

For impacts to habitat

a. Any time sediment concentrations exceed 660 NTU over background.
b. When sediment concentrations exceed 532 NTU over background for more than one hour continuously.
c. When sediment concentrations exceed 208 NTU over background for more than three hours cumulatively.
d. When sediment concentrations exceeded 101 NTU over background for over seven hours cumulatively.

c. Turbidity:suspended solid ratio: To calculate the turbidity to suspended solid ratio you need to download the same data off the Ecology website as described above. Sometimes the monitoring stations have limited amount of data and by running the regression analysis it is possible to get a negative slope (an increase in turbidity results in a decrease in suspended solids). This is very unlikely to occur in a stream. Other times you have so few data points that the R^2 value shows that the correlation between suspended solid and turbidity is not very good. When R^2 values are below 0.60, determine the turbidity to suspended solid ratio. The following are the steps needed to calculate the turbidity to suspended solid ratio.

i. After you deleted all the columns and rows of data you do not need, you should have 3 columns of data. The first being the date, the second column contains the suspended solid data (mg/L) and the third column the turbidity (NTU) data.

ii. Calculate the average turbidity and suspended solid value for all data. Average the turbidity column and average the suspended solid column.

iii. Calculate the turbidity to suspended solid value for the average turbidity and average suspended solid value obtained in ii. Divide the average suspended solid value by the average turbidity value.

iv. If any outliers are identified, they should be deleted. Recalculate the turbidity:suspended solid ratio if outliers have been removed (should automatically be done when values are deleted).

vii. Using the turbidity to suspended solid ratio, convert the sediment concentrations found for when adverse effects occur to bull trout and their habitat (number 3 above) to NTUs. For our example, let's say our NTU to suspended solid ratio is 2.1. Adverse effects to the species would then occur in the following situations:

a. Any time sediment concentrations exceed 70 NTU over background.
b. When sediment concentrations exceed 47 NTU over background for more than one hour continuously.
c. When sediment concentrations exceed 19 NTU over background for more than three hours cumulatively.
d. When sediment concentrations exceeded 10 NTU over background for over seven hours cumulatively.

Adverse effects to the species through habitat impacts would occur in the following situations:
a. Any time sediment concentrations exceed 522 NTU over background.
b. When sediment concentrations exceed 421 NTU over background for more than one hour continuously.
c. When sediment concentrations exceed 164 NTU over background for more than three hours cumulatively.
a. When sediment concentrations exceeded 80 NTU over background for over seven hours cumulatively.

5) Determine how far downstream adverse effects and take will occur. There is no easy answer for determining this. Table 4 provides some sediment monitoring data for a variety of projects. These data can be used to determine the downstream extent of sediment impacts for a project. Note that in Table 4 there is not a single downstream point that can always be used because sediment conveyance and mixing characteristics are different for each stream. **An explanation of how the distance downstream was determined needs to be included in each BO.**

Figure 1 – Severity of ill effect scores for juvenile and adult salmonids. The individual boxes provide the maximum concentration for that SEV. The concentration between 4 and 5 represents the threshold for harassment, and the concentration between 7 and 8 represents the threshold for harm.

Juvenile and Adult Salmonids
Average severity of ill effect scores

Concentration (mg/L)	Hours			Days			Weeks		Months		
	1	3	7	1	2	6	2	7	4	11	30
162755	10	11	11	12	12	13	14	14	-	-	-
59874	9	10	10	11	12	12	13	13	14	-	-
22026	8	9	10	10	11	11	12	13	13	14	-
8103	8	8	9	10	10	11	11	12	13	13	14
2981	$\boxed{5760}$ 7	8	8	9	9	10	11	11	12	12	13
1097	6	$\boxed{2335}$ 7	$\boxed{1164}$ 7	8	9	9	10	10	11	12	12
403	5	6	7	$\boxed{491}$ 7	8	9	9	10	10	11	12
148	5	5	6	7	$\boxed{214}$ 7	8	8	9	10	10	11
55	$\boxed{99}$ 4	5	5	6	6	$\boxed{95}$ 7	8	8	9	9	10
20	3	$\boxed{40}$ 4	$\boxed{20}$ 4	5	6	6	$\boxed{42}$ 7	8	8	9	9
7	3	3	4	$\boxed{8}$ 4	5	6	6	$\boxed{18}$ 7	$\boxed{8}$ 7	8	9
3	2	2	3	4	$\boxed{4}$ 4	5	5	6	7	$\boxed{4}$ 7	8
1	1	2	2	3	3	$\boxed{2}$ 4	5	5	6	7	$\boxed{2}$ 7

Figure 2 - Severity of ill effect scores for adult salmonids. The individual boxes provide the maximum concentration for that SEV. The concentration between 5 and 6 represents the threshold for harassment, and the concentration between 7 and 8 represents the threshold for harm.

Adult Salmonids
Average severity of ill effect scores

Concentration (mg/L)	1	3	7	1	2	6	2	7	4	11	30
162755	11	11	12	12	13	13	14	14	-	-	-
59874	10	10	11	11	12	12	13	13	14	14	-
22026	9	10	10	11	11	12	12	13	13	14	14
8103	8	9	9	10	10	11	11	12	12	13	13
2981	8	8	9	9	10	10	11	11	12	12	13
	$\boxed{2190}$										
1097	7	8	8	8	9	9	10	10	11	11	12
		$\boxed{1095}$	$\boxed{642}$								
403	6	7	7	8	8	9	9	10	10	11	11
	$\boxed{156}$			$\boxed{331}$	$\boxed{175}$						
148	5	6	6	7	7	8	8	9	9	10	10
		$\boxed{78}$				$\boxed{94}$					
55	5	5	6	6	7	7	8	8	9	9	9
			$\boxed{46}$	$\boxed{24}$			$\boxed{50}$	$\boxed{27}$			
20	4	4	5	5	6	6	7	7	8	8	9
					$\boxed{12}$				$\boxed{14}$	$\boxed{8}$	
7	3	4	4	5	5	6	6	7	7	7	8
						$\boxed{7}$	$\boxed{4}$				$\boxed{4}$
3	2	3	3	4	4	5	5	6	6	7	7
								$\boxed{2}$	$\boxed{1}$		
1	2	2	3	3	4	4	5	5	5	6	6
	Hours			Days			Weeks		Months		

Figure 3 - Severity of ill effect scores for juvenile salmonids. The individual boxes provide the maximum concentration for that SEV. The concentration between 4 and 5 represents the threshold for harassment, and the concentration between 7 and 8 represents the threshold for harm.

Juvenile Salmonids
Average severity of ill effect scores

Concentration (mg/L)	1	3	7	1	2	6	2	7	4	11	30
	Hours			Days			Weeks		Months		
162755	9	10	11	11	12	13	14	14	-	-	-
59874	9	9	10	11	11	12	13	14	14	-	-
22026	8	9	9	10	11	11	12	13	13	14	-
8103	$\boxed{13119}$ 7	8	9	9	10	11	11	12	13	13	14
2981	6	$\boxed{4448}$ 7	8	9	9	10	11	11	12	13	13
1097	6	6	$\boxed{1931}$ 7	8	9	9	10	11	11	12	13
403	5	6	6	$\boxed{687}$ 7	8	9	9	10	11	11	12
148	$\boxed{197}$ 4	5	6	6	$\boxed{254}$ 7	8	9	9	10	11	11
55	4	$\boxed{67}$ 4	5	6	6	$\boxed{96}$ 7	8	8	9	10	11
20	3	4	$\boxed{29}$ 4	5	6	6	$\boxed{36}$ 7	8	8	9	10
7	2	3	4	$\boxed{10}$ 4	5	6	6	$\boxed{13}$ 7	8	8	9
3	1	2	3	4	$\boxed{4}$ 4	5	6	6	$\boxed{5}$ 7	8	8
1	1	1	2	3	4	$\boxed{1}$ 4	5	6	6	8	8

Figure 4 - Severity of ill effect scores for eggs and alevins of salmonids. The individual boxes provide the maximum concentration for that SEV. The concentration between 4 and 5 represents the threshold for both harassment and harm to eggs and alevins.

Eggs and Alevins of Salmonids
Average severity of ill effect scores

Concentration (mg/L)	Hours			Days			Weeks		Months		
	1	3	7	1	2	6	2	7	4	11	30
162755	7	9	10	11	12	13	14	-	-	-	-
59874	7	8	9	10	12	13	14	-	-	-	-
22026	7	8	9	10	11	12	13	-	-	-	-
8103	7	8	9	10	11	12	13	14	-	-	-
2981	6	7	8	10	11	12	13	14	-	-	-
1097	6	7	8	9	10	11	12	14	-	-	-
403	6	7	8	9	10	11	12	13	14	-	-
148	5	6	7	9	10	11	12	13	14	-	-
55	5	6	7	8	9	10	12	13	14	-	-
20	5	6	7	8	9	10	11	12	13	-	-
7	4	5	7	8	9	10	11	12	13	14	-
3	4	5	6	7	8	10	11	12	13	14	-
1	4	5	6	7	8	9	10	11	13	14	-

11

Figure 5 - Severity of ill effect scores for salmonid habitat. The individual boxes provide the maximum concentration for that SEV. The concentration between 6 and 7 represents the threshold for anticipating adverse effects to bull trout through habitat modifications.

Salmonid Habitat
Average severity of ill effect scores

Concentration (mg/L)	Hours			Days			Weeks		Months		
	1	3	7	1	2	6	2	7	4	11	30
162755	11	12	12	13	14	-	-	-	-	-	-
59874	10	11	12	12	13	14	-	-	-	-	-
22026	9	10	11	11	12	13	14	14	-	-	-
8103	8	9	10	11	11	12	13	14	14	-	-
2981	8	8	9	10	11	11	12	13	13	14	-
1097	7	7	8	9	10	10	11	12	13	13	14
	885										
403	6	7	7	8	9	10	10	11	12	12	13
		345	167								
148	5	6	6	7	8	9	9	10	11	12	12
				68							
55	4	5	6	6	7	8	9	9	10	11	11
					29						
20	3	4	5	5	6	7	8	8	9	10	11
						12					
7	2	3	4	5	5	6	7	7	8	9	10
							5				
3	2	2	3	4	5	5	6	7	8	8	9
								2			
1	1	1	2	3	4	4	5	6	7	7	8

Reference List

1. Anderson, P. G., B. R. Taylor, and G. C. Balch. 1996. Quantifying the effects of sediment release on fish and their habitats.Canadian Manuscript Report of Fisheries and Aquatic Sciences 2346.

2. Newcombe, C. P. and J. O. T. Jensen. 1996. Channel suspended sediment and fisheries: synthesis for quantitative assessment of risk and impact. North American Journal of Fisheries Management 16(4): 693-727.

3. Newcombe, C. P. 1994. Suspended sediment in aquatic ecosystems: ill effects as a function of concentration and duration of exposure.Victoria, British Columbia.

ESA Consultations:

While reviewing a project for sediment related impacts, there are a couple things to think about.

1. Time frame – how does sediment affect feeding, breeding, and sheltering. This is important when thinking about the likelihood of harm (significant impairment of essential behavior…) and/or harassment (significantly disrupt normal behavior…). During ESA consultations this must always be in the back of your mind.

2. Individual fish – Throughout this document, the term bull trout and their habitat are used. Please remember to think about risks to individual bull trout. The ESA is designed to protect individuals as well as populations, but effect determination and analysis or take are both about effects to individuals. For example, on page 4 of the Sediment Template (literature review), under Biological Effects of Sediment on bull trout, the last sentence in the first paragraph states "Specific effects of sediment on fish and their habitat can be put into three classes that include:" The document then defines lethal, sublethal, and behavioral effects. These effects can be to an individual or to multiple individuals within a reach.

3. Habitat – similarly, sediment input into a stream can alter habitat, and this can impact an individual bull trout as well as multiple bull trout within a reach. The preceding discussion addresses fish habitat in general and not necessarily critical habitat or PCE's. An attempt was made to clarify this in the document. It was not possible to relate sediment input to the critical habitat PCE's. The information needed to address sediment input and impacts to the PCEs can be found within the Sediment Template document.

Table 4 - Water quality monitoring data received by the Washington Fish and Wildlife Office. Calculated Values are exact SEV values for juvenile and adult salmonids (Figure 1) based on Newcombe and Jensen (1996), and for habitat (Figure 5) by Anderson et al. (1996).

Project and Watershed	Stream Characteristics at Project Location	Monitoring Locations	Original Sediment Data – how sediment data was provided in monitoring report.	Concentration (mg/L) used for determining SEV level. From original sediment data, concentration was either directly used, or was calculated using ratio or regression as stated in comments column.	Duration of elevated sediment concentration levels during project construction.	SEV (Juvenile and Adult Salmonids) Calculated SEV value for impacts to salmonids based on Newcombe and Jensen (1996)	SEV Habitat Calculated SEV value for habitat based on Anderson et al. (1996)	Comments
Culvert Removal or Removal and Replacement								
Siegel Creek Culvert Removal, Siegel Creek – Clark Fork River Watershed (Montana) Culvert removal Channel stabilization Bank reshaping	Lolo National Forest Bankfull width: 12 ft Average discharge: 2.8 CFS Slope: 6.7% Drainage area: 9,245 acres	Grab samples No distance Provided. Assume 150 ft. Automatic sampling - 150 ft downstream	Sediment load Ave: 0.07 tons/day Peak: 0.4 tons/day Sediment load Ave: 0.04 tons/day Peak: 0.3 tons/day	9.4 (average)* 53.7 (peak)* 5.4 (average)* 40.3 (peak)*	24 hrs* > 3 to 7 hrs* 24 hrs* > 3 to 7 hrs*	5 5 at 3 hrs 5 at 7 hrs 4 4 at 3 hrs 5 at 7 hrs	5 5 at 3 hrs 6 at 7 hrs 4 5 at 3 hrs 5 at 7 hrs	Creek dewatered during work. All sediment sampling was in mg/L. Concentration reached baseline at 1.5 miles downstream. Most of sediment appeared to settle within several hundred feet.
Sheep Creek Culvert Replacement Sheep Creek – Selway River Watershed (Idaho) Culvert replacement	Bitterroot National Forest Discharge: 1.5-2.0 CFS baseflow Channel width: 5 feet Slope: 8.9% Rosgen B4 channel	Approximately 100 ft. Distance not given, stated right below work area where water was put back in stream.	Baseline 1.69 mg/L 4.5 mg/L – 25 min 7.5 mg/L – 2 min 7.5 mg/L – 30 min 34.37 mg/L – 30 min 164.19 mg/L – 11 min 15,588.6 mg/L – 30 min 677 mg/L – 30 min 105.31 mg/L – 30 min 29.17 mg/L – 30 min 17.6 mg/L – 30 min 19.74 mg/L – 30 min 15,588.6 mg/L – 30 min	11..8 162.5 2,737.9 (average) 15,586.9 (peak)	1.5 hrs (building diversion dam and diverting stream) 15 min (diversion failure) 6.5 hrs (diversion removed and stream stabilizing, exact duration unknown, stopped monitoring before sediment conc. returned to background. 30 min (peak during diversion removal)	3 4 8 8	3 4 9 8	Creek dewatered during work. All sediment sampling in mg/L.

Project and Watershed	Stream Characteristics at Project Location	Monitoring Locations	Original Sediment Data	Concentration (mg/L) used for determining SEV level.	Duration of elevated sediment concentration.	SEV (Juvenile and Adult Salmonids)	SEV Habitat	Comments
Culvert Removal or Removal and Replacement, continued								
Graves Creek Road Repair Graves Creek – Quinault River Watershed (Washington) Road widening Culvert installation	Olympic National Park Project located 1.5 and 1.7 miles upstream of Upper Quinault Bridge Discharge: 3,200 – 3,700 cfs Slope: 0.4%	Distance from project site on tributary to the confluence with the Quinault was not provided. Road runs along Quinault River, so assume distance was less then 50 feet. Monitoring data is at confluence.	Baseline: 1.5 NTUs Confluence: 39 NTUs Below new culvert: 5.5 NTUs	52.5	2 hrs Monitoring report stated that construction was limited to less than two hours.	4	5	No diversion Culvert was installed on small trib. to Quinault River. Data indicates concentration and duration of sediment at trib. confluence with Quinault. Data analysis: Used Quinault River data downstream of Quinault Lake. No data available upstream. One year of data available – used July through October (4 months) NTU:SS ratio = 1:1.4 Regression: Negative slope Used ratio in analysis
Sulpher Creek State Route 241 Yakima County Culvert replacement	Project located approximately 1.5 miles of I-82 on SR141, near airport. Slope 3.5%	100 and 200 ft	Data provided in NTUs	100 ft 137.1 36.8 77.6 436.3 94.6 118.7 200 ft 33.8 50.0 55.5 213.0 147.2 141.0	 6 hr# 1 hr# 1 hr# 6 hr# 1 hr# 1 hr# 1 hr# 1 hr# 1 hr# 6 hr# 1 hr# 1 hr#	 6 4 4 7 4 5 4 4 4 6 5 5	 6 4 4 7 5 5 4 4 4 7 5 5	Dewatered stream Data analysis: Sulpher Creek has 2 monitoring stations, each a half mile apart. Both stations only have one year of data. Using individually, there would only be 2 points. Combined data for regression analysis. Used regression Regression: SS = 2.6561*NTU + 14.362 Ratios: Lower site ratio of 1:3.7 upper site has 1:3.3. Combined data 1:3.4.
Everett Vicinity Bridge 2/5N Seismic Retrofit Snohomish River and unnamed side channel Removal of 2 culverts of an existing temporary access road	Culverts removed in side channel Project located at Highway 2 over Snohomish River. Slope: In tidally influenced section of Snohomish River Construction occurred during low tide and channel had very little water running.	Work conducted in side channel of Snohomish River, sample taken 10 ft below confluence with river	Reading of 825 NTUs found, no background on that day, background next day was 15.6 NTUs.	713.4	2.5 hrs	6	7	Side channel not dewatered. Data analysis: Used Snohomish River data at Snohomish. 27 years of data on the lower Shohomish River. Used regression NTU:SS ratio = 1:2.1 Regression: SS = 0.878*NTU + 2.7839

Project and Watershed	Stream Characteristics at Project Location	Monitoring Locations	Original Sediment Data	Concentration (mg/L) used for determining SEV level.	Duration of elevated sediment concentration.	SEV (Juvenile and Adult Salmonids)	SEV Habitat	Comments
Culvert Removal or Removal and Replacement, continued								
Judd Creek Vashon Island Culvert replacement stream dewatered during construction. Water quality monitoring data for other Judd Creek project said "another stream simulation culvert replacement"	Judd Creek enters in NW corner of Quartermaster Harbor of Vashon Island. Monitoring report did not state where project was located. Drainage area: 3,292 acres. Discharge: 2.2 cfs Slope: 1.5% - used lower reach	100, 500, 1800 ft.	Data provided in graph format (NTUs). All values were estimated from graph	100 20 379.1 172 18.5 500 11.3 41.4 72.7 16.3 1800 19 41.4 9.2	 6 hrs 7 hrs 5 hrs 13 hrs 6 hrs 7 hrs 6 hrs 14 hrs 4 hrs 7 hrs 12 hrs	 4 7 6 5 4 5 5 5 4 5 4	 5 7 6 5 4 5 6 5 4 5 4	Stream was dewatered. Ecology does not monitor water quality in streams on Vashon Island. No stream water quality monitoring data available. Used 1:2 as an estimated average ratio.
Judd Creek Vashon Island Culvert Replacement stream dewatered during construction.	Judd Creek enters in NW corner of Quartermaster Harbor of Vashon Island. Drainage area: 3,292 acres. Discharge: 2.2 cfs Slope: 2.0%	100, 500, 1600 ft.	Data provided in graph format (NTUs). All values were estimated from graph	100 ft 9.6 49.7 20.6 500 ft 12 20.9 22.2 1,600 ft 10 22.5 11	 3 hrs 4 hrs 5.5 hrs 1.5 hrs 6 hrs 3.5 hrs 1 hr 2.5 hrs 2	 3 5 4 3 4 4 3 4 3	 3 5 5 3 5 4 3 4 3	Stream was dewatered. Ecology does not monitor water quality in streams on Vashon Island. No stream water quality monitoring data available. Used 1:2 as an estimated average ratio.
Harris Creek Snoqualmie River Culvert Replacement	Harris Cr. located approx. 2 miles north of Carnation, WA. Project in upper reaches of creek. Drainage area: 8,626 acres. Slope: 3.9% Discharge: 1.3 cfs (King County data)	Not provided	Document stated all water quality criteria were met except for one exceedance, 24 NTUs above background.	48	1 hr#	4	4	Stream was dewatered. Ecology does not monitor water quality in Harris Creek. No stream water quality monitoring data available. Used 1:2 as an estimated average ratio.

Project and Watershed	Stream Characteristics at Project Location	Monitoring Locations	Original Sediment Data	Concentration (mg/L) used for determining SEV level.	Duration of elevated sediment concentration.	SEV (Juvenile and Adult Salmonids)	SEV Habitat	Comments
Bank Stabilization								
Swede Heaven Bank Stabilization N.F. Stillaguamish River Project: 300 feet long, placing rock groins, LWD, and plantings	Project located approx. 5.5 miles west of Darrington, WA. Drainage area: 685 sq. miles. Discharge: 1,892 cfs Slope: 0.3% Bankfull width: 210 ft.	300, 600, and 1,200 ft downstream	Data provided in NTUs.	300 ft. 56.7 103.8 191.5 28.4 27.5 16.1 22.8 35.7 42.4 20.0 600 ft. 33.6 38.5 31.6 17.7 24.5 20.4 1,200 ft 47.6	1 hrs** 3 hrs** 3 hrs** 30 min. 1.5 hrs 30 min 30 min 1.5 hrs 30 min 1 hrs# 2 hrs** 2 hrs** 3 hrs** 1 hrs# 30 min 30 min 1 hrs**	4 5 6 3 4 3 3 4 3 3 4 4 4 3 3 3 4	4 5 6 3 4 3 3 4 3 3 4 4 4 3 3 3 4	Construction area was diverted. Streambank was isolated. Data analysis 9 years of data available for the N.F. Stillaguamish River at Darrington, used July and August months when construction occurred. NTU:SS ratio = 1:3.5 Regression: Negative slope Used ratio in analysis
MP 9.2 Oil City Road Hoh River Riprap (170 ft) and LWD placement	No project location given, Oil City Road runs along the north bank of the lower Hoh River. Discharge: 2,541 cfs Drainage area: 253 sq. miles Slope: 0.3%	300 and 600 ft downstream	Monitoring data was only for LWD placement and not riprap installation Data provided in NTUs.	300 ft. 8.4 7.7 9.4 600 ft 7.5	10 min 10 min 10 min 20 min	2 1 2 2	1 1 1 2	No information on how project constructed, dewatered. Project became influenced by WSDOT diversion dam release 5-6 miles upstream. 13 Years of data available for the Hoh River at the DNR Campground near the Hwy 101 Bridge. NTU:SS ratio = 1:1.2 Regression SS = 0.3874*NTU + 5.5385 Used regression analysis
SR 20 – debris jam Skagit River tributary	Project located at milepost 90 on SR20. No exact location, so used tributary just east of Concrete WA. Slope: 8.1%	Data stated sampling points located upstream and downstream of project area on the Skagit River. Two additional points located on two Skagit tributaries that are culverted under SR20.	Turbidity readings taken once a week in absence of any major rainfall and more frequently during a runoff producing rain event.	Met water quality standards.	Met water quality standards.			High turbidity was sampled, but this was due to runoff from rain events and not project. Channel was dewatered during construction.
Emergency Bank Protection Hoh River Rock placed in stream	No information on location of project. Work conducted in December.	Samples drawn 150 - 200 ft downstream of project.	Turbidity readings taken usually after large deposit of rock was placed in the river.	Met water quality standards. NTUs were provided for project, but levels were same as background.				NTU's read between 10.7 and 17.2. For emergency work, this seems very clear water.

Project and Watershed	Stream Characteristics at Project Location	Monitoring Locations	Original Sediment Data	Concentration (mg/L) used for determining SEV level.	Duration of elevated sediment concentration.	SEV (Juvenile and Adult Salmonids)	SEV Habitat	Comments
Bank Stabilization, continued								
Rivershore Lane Emergency Watershed Project South Fork Stilliguamish River Reconstructed 1,000 ft of riverbank and stabilized the bank with rock vanes, logs, and rootwad structures.	Project located 0.5 miles SE of Robe WA. Discharge: 461 cfs Slope: 0.4%	300, 600 ft, and 3.3 miles		600 ft 130.3 14.2 20.9 12.5 98.1 120.7 3.3 miles 50.1 32.8	 6 hrs 2.5 hrs 2 hrs 1 hr 1 hr 10.5 hrs 4 hrs 4.5 hrs**	 6 4 4 3 4 6 5 5	 6 4 4 3 5 7 5 5	Work area was dewatered by construction of a bypass channel. 9 years of data available for the N.F. Stillaguamish River at Darrington, used July and August months when construction occurred. NTU:SS ratio = 1:3.5 Regression had negative slope, used ratio. No 300 ft readings were taken, data logger not operating correctly.
Boulder Creek Bank Stabilization Montana	No project location was given. Unable to determine any stream characteristics information.	350 and 4,300 ft	Data estimated off of graph of monitoring data – in mg/L	350 ft 77.4 334.5 4,300 ft 13.25 155.6	 3.5 hrs 12.5 hrs 3.5 hrs 12.25 hrs	 5 7 4 6	 5 8 4 7	Project area was dewatered by constructing diversion channel.
Saxon Bank Stabilization Project South Fork Nooksack River Construct tree revetment and 3 rock vanes. Protecting 1,400 ft. of bank.	Project located at town of Saxon, WA. Slope: 0.7% Drainage area: 129 sq. miles Discharge: 748 cfs	300 ft	Summary of data provided in email which gave NTU levels when monitoring was above 5 NTU's, WA water quality standard.	43.0	4 hrs#	5	5	Had constructed an in-channel deflector to move the bulk of the river flow away from construction site. Data analysis. Two years of data for the S.F. Nooksack River at Potter Road. Used July through September data. NTU:SS ratio = 1:1.9 Regression: SS = 1.7249*NTU + 0.5206 Used regression
Lower Hutchinson Creek Project South Fork Nooksack River Installation of ELJs and levee setback	Project located at confluence of Hutchinson Creek and S.F. Nooksack River near Acme, WA. LEJs installed on S.F. Nooksack and Hutchinson Creek. S.F. Nooksack Slope: 0.7% Drainage area: 129 sq. miles Discharge: 748 cfs Hutchinson Creek Slope: 1.1%	300, 1200, 3000 ft.	Daily monitoring was provided in NTU's. Most work occurred either in dewatered section of Hutchinson Creek or outside wetted channel.	300 ft. 14 12	 1 hr 0.5 hr	 3 2	 3 2	Hutchinson Creek was diverted. Unable to tell from data where samples were taken, used estimated average ratio of 1:2.0 from S.F. Nooksack River (see previous entry for Saxon Bank project) NTU:SS ratio = 1:2.0 Project had low turbidity, no monitoring was done at 1200 and 3000 ft.

Project and Watershed	Stream Characteristics at Project Location	Monitoring Locations	Original Sediment Data	Concentration (mg/L) used for determining SEV level.	Duration of elevated sediment concentration.	SEV (Juvenile and Adult Salmonids)	SEV Habitat	Comments
Bank Stabilization, continued								
Green River Fish Restoration Project Green River Installation of in-stream gravel nourishment and construction of 2 ELJs	Project located at RM 60 on the Green River. 2 miles east of Palmer WA. Drainage area: 231 sq. miles Discharge 958 cfs Slope: 0.8%	300, 600, 1200, 2500 ft	Data provided in NTUS. No background values provided, so used first couple readings of the day as background.	300				Data analysis; 29 years of data for the Green River at Kanaskat. Data collected at Cumberland-Palmer Road bridge. Used July and August data. Ratio: 1:1.7 Regression: S = 0.0983*NTU + 1.9326 Used ratio, regression data not correlated.
				19.0	3.25	4	4	
				20.5	11.75#	5	5	
				39.9	9.5**	5	5	
				45.5	5.25	5	5	
				16.6	5.0	4	4	
				63.5	11.25**	6	6	
				74.6	10.5#	6	6	
				112.3	2.75**	5	5	
				27.0	7.75**	5	5	
				9.0	9.5**	4	4	
				87.1	11**	6	6	
				118.4	8.5#	6	6	
				600				
				11.1	3.25	4	4	
				121.9	0.75	4	5	
				28.8	11.75#	5	5	
				31.3	9.5**	5	5	
				35.7	9.0#	5	5	
				9.9	5.0	4	4	
				58.6	11.25**	6	6	
				67.3	10.5#	6	6	
				10.7	2.75**	3	3	
				23.5	7.75**	5	5	
				9.9	9.5**	4	4	
				121.8	11**	6	7	
				100.6	8.5#	6	6	
				1200				
				22.4	4.75	4	4	
				36.7	11.75#	5	6	
				20.6	9**	5	5	
				23.5	11.5#	5	5	
				20.2	2.25**	4	4	
				48.3	11.25**	5	6	
				130.3	6.75#	6	6	
				19.7	7.75**	5	5	
				18.8	11.75#	5	5	
				143.1	11**	6	7	
				75.6	9.0#	6	6	
				2500				
				11.4	4.75	4	4	
				19.1	3.0	4	4	
				13.4	10.0**	4	5	
				26.9	9.5	5	5	
				12.5	2.25**	3	3	
				33.4	11.25**	5	5	
				67.7	2.25#	5	5	
				48.8	4.5	5	5	
				20.9	7.75**	5	5	
				12.7	9.5**	4	4	
				104.1	11**	6	6	
				63.4	10.0#	6	6	

Project and Watershed	Stream Characteristics at Project Location	Monitoring Locations	Original Sediment Data	Concentration (mg/L) used for determining SEV level.	Duration of elevated sediment concentration.	SEV (Juvenile and Adult Salmonids)	SEV Habitat	Comments
Bank Stabilization, continued								
Maple Creek Channel Reconstruction Thornton Creek 2 culvert removals, 2 bridge installations, channel reconstruction with habitat enhancement, boulder clusters, porous weirs, logjams, etc.	Project located on the S.F. Thornton Creek, just upstream of Hale School, above 30th St. NE bridge. S.F. Thornton Creek Drainage area: 12.1 sq. miles Discharge: 8 cfs Slope: 0.3% Bankful: 8 ft	200, 600, and 1660 ft downstream	Data provided in NTUs in graph. Estimated values from graph. Project site was dewatered, data collected during rewatering site.	200 ft 131.8 600 ft 48.1 1660 ft 40.5	 1.75 hrs 3 hrs 1.5 hrs	 5 5 4	 5 5 4	Site was dewatered and had excessive flows that overtopped diversion dams and flushed system prior to monitoring. Data analysis King County water quality data was used. 30 years of data for Thornton Creek collected at mouth. Used July and August data. Ratio: 1:2.5 Regression: SS = 3.2973*NTU - 3.6295 Used regression.
Bridge Construction and/or Repair								
SR 90 – Wilson Creek Bridge Widening Project Wilson Creek tributary to Yakima River	Project located on Wilson Creek at I-90 Bridge at Ellensburg WA. Slope: 0.6% Drainage area: 13 sq, miles	100 and 200 ft downstream		100 ft. 55.2 21.4 20.6 200 ft. 202.3 28.2 22.5	 1 hr# 6 hrs 1 hr 2 hrs 4.5 hrs 1 hr	 4 4 3 5 4 3	 4 5 3 6 5 3	Data analysis 3 years of data for Wilson Creek at Highway 821. Used July through September data. NTU:SS ratio = 1:3.2 Regression SS = 2.4425NTU + 6.2212 Used regression
SR – 12 Black River Bridge Scour Protection Black River – Tributary to Chehalis River. Placement of riprap to protect bridge column, placement of filter blanket and streambed gravel, installation of temporary work platform.	Project located on Black River, approximately 2 miles SE of Oakville, WA Slope: 0.2% Drainage area: 144 sq. miles Discharge: 162 cfs	300, 500 and 600 ft	Data provided in NTUs.	300 ft 10.6 8.8 9.6 18.8 500 ft 12.0 8.1 19.1 600 ft 12.5 6.4 12.8	 0.5 hr 5 hr 5 hr 1 hr# 4.5 hr 4.5 hr 1 hr# 2.5 hr 4.5 hr 1 hr#	 2 4 4 3 4 4 3 3 3 3	 2 4 4 3 4 4 3 3 3 3	Inwater silt curtain used. Data analysis: Ecology monitoring site at project location did not have turbidity and SS data. Used the data from the Black River at Moon Road Bridge monitoring station approximately 2 miles upstream. Six years of data available, July through September. NTU:SS ratio = 1:1.5 Regression had negative slope. Used ratio.

Project and Watershed	Stream Characteristics at Project Location	Monitoring Locations	Original Sediment Data	Concentration (mg/L) used for determining SEV level.	Duration of elevated sediment concentration.	SEV (Juvenile and Adult Salmonids)	SEV Habitat	Comments
Bridge Construction and/or Repair, continued								
Monroe Trestle Bridge Skykomish River Removal of railroad trestle	Project location is unknown. Project near City of Monroe WA. Discharge: 3,946 cfs Drainage area: 842 sq. miles Slope: 0.2%	300 ft (three locations across stream)	Turbidity was only high on one side of stream, that data is analyzed.	Site 1 6.9	32 hrs	5	5	Used sediment curtain around project. Data analysis 26 years of data for Skykomish River at Monroe. Used July through September data. NTU:SS ratio = 1:1.9 Regression: SS = 0.8453*NTU + 1.9163 Used regression
Humptulips River Bridge Scour Repair Humptulips River Project involved repair and augment riprap and placement of LWD	Project located on Humptulips River at US 101 Bridge. Slope 0.4% Drainage area: 276 sq. miles, 132 Sq. miles at project location Discharge: 1,340 cfs Bankfull at project location: 80-220 ft.	300 ft.	Measurements were recorded throughout the day, 5 to 7 times. Data provided in NTUs. Because time between monitoring sampling was anywhere from one to two hours during sediment generating activities, the peak turbidity values may not have been captured.	7.6 11.0	6.5 hrs** 7 hrs#	4 4	4 4	No stream dewatering occurred. Data analysis. 25 years of data for the Humptulips near Humptulips at the Highway 101 Bridge. Used July through September data. NTU:SS ratio = 1:1.6 SS = 0.6514*NTU + 1.1202 Used regression
Humptulips River Bridge Scour Repair Humptulips River Project involved installation of rock barbs and LWD in stream.	Project located on Humptulips River at US 101 Bridge. Slope 0.4% Drainage area: 276 sq. miles, 132 Sq. miles at project location Discharge: 1,340 cfs Bankfull at project location: 80-220 ft.	300 ft.	Met water quality standards.					

Project and Watershed	Stream Charact. at Project Location	Monitoring Locations	Original Sediment Data	Concentration (mg/L) used for determining SEV level.	Duration of elevated sediment concent.	SEV (Juvenile and Adult Salmonids)	SEV Habitat	Comments
Open Trench or Dredging of Stream								
Williams Pipeline, Mt. Vernon Loop North Fork Stillaguamish River Project involved installing a pipeline under the NF. Stillaguamish River	Project located on the NF Stillaguamish approximately 1 mile north of Arlington WA. Drainage area: 262 sq miles Discharge: 1,896 cfs Slope: 0.3%	100, 600, 2000 ft and 1 mile	Monitoring conducted throughout project. Project also took samples for analysis in lab. Regression equation determined from lab analysis: SS = 2.3237*NTU + 3.6702 Equation provides higher total suspended solids then Ecology data.	100 ft				Stream is diverted and dewatered during trenching. Open trench is exposed to river when one side of river is trenched and dredging occurred on opposite side. Data analysis. Used regression from project monitoring determined in lab for both SS and NTUs. Regression SS = 2.3237*NTU + 3.6702
				185.7	1 hr	5	5	
				220.2	1 hr	5	5	
				83.4	4 hr	5	5	
				113.8	9 hrs	6	6	
				95.5	1 hr	4	5	
				312.5	20 hrs	7	8	
				338.9	20 hrs	7	8	
				76.2	4 hrs	5	5	
				145.3	12 hrs	6	7	
				1070.5	29 hrs	8	9	
				676.6	6 hrs	7	8	
				132.0	9.5 hrs	6	7	
				93.5	5 hrs	5	6	
				600 ft				
				25.9	1 hr	3	3	
				16.7	0.5 hr	3	3	
				25.4	8.5 hrs	5	5	
				13.0	3 hrs	4	4	
				37.4	8.5 hrs	5	5	
				73.0	21 hrs	6	7	
				19.8	0.5 hr	3	3	
				135.3	20.5 hrs	7	7	
				23.7	0.5 hr	3	3	
				59.8	1.5 hr	4	4	
				50.7	9.5 hrs	5	6	
				293.1	31.5 hrs	7	8	
				41.7	5.5 hrs	5	5	
				122.4	10 hrs	6	6	
				12.7	9.5 hrs	4	4	
				12.7	9 hrs	4	4	
				2000 ft				
				12.6	3 hrs	4	4	
				25.9	1.5 hrs	4	4	
				14.1	4 hrs	4	4	
				34.7	9 hrs	5	5	
				45.3	2 hrs	4	4	
				212.8	18 hrs	7	7	
				25.3	5 hrs	4	5	
				30.4	10.5 hrs	5	5	
				18.2	4 hrs	4	4	
				185.7	14.5 hrs	7	7	
				22.8	7.5	5	5	
				75.7	5.5 hrs	5	6	
				75.4	9.5 hrs	6	6	
				32.0	1.5 hrs	4	4	
				22.9	1 hrs	3	3	
				1 mile				
				20.5	1.5 hrs	4	4	
				16.5	1.5 hrs	3	3	
				45.5	2.5 hrs	4	5	
				23.1	3.5 hrs	4	4	
				394.6	0.5 hr	5	5	
				232.4	17 hrs	7	7	
				22.3	4.5 hrs	4	4	
				46.6	5.5 hrs	5	5	
				25.3	3.5 hrs	4	4	
				123.2	9.5 hrs	6	6	
				30.5	6.5 hrs	5	5	
				22.9	3.5 hrs	4	4	
				45.4	9 hrs	5	6	

Project and Watershed	Stream Characteristics at Project Location	Monitoring Locations	Original Sediment Data	Concentration (mg/L) used for determining SEV level.	Duration of elevated sediment concentration.	SEV (Juvenile and Adult Salmonids)	SEV Habitat	Comments
Open Trench or Dredging of Stream, continued								
Williams Pipeline, Mt. Vernon Loop. Pilchuck River Project involved installing a pipeline under the Pilchuck River. Used open trench method.	Exact project location unknown, used location where pipeline crosses the Pilchuck on topo map. Located SW of Machias, WA. Slope: 0.4% Drainage area: 127 sq. miles Discharge: 744 cfs	100, 400, and 1000 ft	Measurements taken every hour throughout construction.	100 ft. 54.9 400 ft. 38.5 1000 ft. 34.8	62 hrs 57 hrs 51 hrs	7 6 6	7 7 7	River was not dewatered or diverted. Open water trenching. Data analysis. 14 years of data for the Pilchuck River at Snohomish at the Highway 2 Bridge. Used July through September data. NTU:SS ratio = 1:2.3 Regression SS = 1.4319*NTU + 2.5223 Used regression
Williams Pipeline – Sumas Loop		Construction method:						
Smith Creek	Trib to mainstem Nooksack River by Lawrence WA Slope: 0.8%	Dam and pump	Met water quality standards.					
Saar Creek (two locations where crossed creeks)	Trib to Frasier River, creek enters Canada, located near Sumas, WA Slope: 0.6%	#1: Open cut #2: Dam and pump	Met water quality standards. Met water quality standards.					
Kenny Creek	Unable to locate creek	Open cut	Met water quality standards.					
Unnamed trib to Sumas River	Located 2 miles SE of Nooksack, WA. Slope: 2.3%	Dam and pump	Met water quality standards.					
Breakenridge Cr.	Trib to Sumas River, located 2 miles east of Nooksack, WA Slope: 1.9%	Dam and pump	Met water quality standards.					
Williams Pipeline – Mt. Vernon Loop		Construction method:						
Armstrong Creek	Trib to mainstem Stillaguamish at Arlington, WA Slope: 0.5%	Dam and pump	Met water quality standards.					
Trib to SF Stillaguamish River	Unable to locate creek	Dam and pump	Met water quality standards.					

Project and Watershed	Stream Characteristics at Project Location	Monitoring Locations	Original Sediment Data	Concentration (mg/L) used for determining SEV level.	Duration of elevated sediment concentration.	SEV (Juvenile and Adult Salmonids)	SEV Habitat	Comments
Open Trench or Dredging of Stream, continued								
Williams Pipeline – Snohomish Loop		Construction method:						
Sternoff Crossing	Unable to locate creek	Flume	Met water quality standards.					
Seidel Creek – had Siedel Creek on monitoring form	Trib to Bear Creek, 1.4 miles NE of Avondale, WA, which enters Sammamish River. Slope: 1.0%	Dam and pump	Met water quality standards.					
Struve Creek	Trib to Bear Creek, 1.1 miles SE of Cottage Lake, WA, which enters Sammamish River. Slope: 3.0%	Dam and pump	Met water quality standards.					
Williams Pipeline – Ft. Lewis Loop		Construction method:						
Muck Creek	Trib to the Nisqually River. Site located on Ft. Lewis, 2.7 miles W of Rocky Ridge.	Open cut	Met water quality standards.					
South Fork Creek	Trib to the Nisqually River. Site located on Ft. Lewis, 2.7 miles W of Rocky Ridge. Just South of Muck Creek crossing.	Open cut	Met water quality standards.					
Williams Pipeline Ft. Lewis Loop Nisqually River Project involved installing a pipeline under the Nisqually River Used open trench method.	Project located 0.8 miles SW if McKenna, WA Drainage area: 517 sq. miles Discharge: 1,500 cfs Slope: 0.1%	600, 1250, 2500, 5200 ft, 2 miles, and 4 miles	Samples taken approximately every hour. Samples at 2 miles was only taken once, two samples were taken at 4 miles (4.5 hours apart). These samples were used to determine downstream extent of plume. Data provided in NTUs.	600 ft. 35.1 1,250 ft. 24.4 2500 ft. 16.2 5200 ft. 12.8 2 miles 15.5 4 miles 9.5	22 hrs 22 hrs 22 hrs 22 hrs 4.5** Used 4 miles time 4.5**	6 5 5 5 4 4	6 6 5 5 4 4	Open cut, no diversion or dewatering occurred. Data analysis. 3 years of data for the Nisqually River at McKenna. Used July through September data. NTU:SS ratio = 1:0.8 Regression SS = 0.7159*NTU + 0.5214 Used regression

Project and Watershed	Stream Characteristics at Project Location	Monitoring Locations	Original Sediment Data	Concentration (mg/L) used for determining SEV level.	Duration of elevated sediment concentration.	SEV (Juvenile and Adult Salmonids)	SEV Habitat	Comments
Open Trench or Dredging of Stream, continued								
Maintenance Dredging and Disposal, Lower Snohomish River Snohomish River Clamshell and hydraulic dredging were used on the Upper and Lower Sediment Basins and the Navigational Channel. Disposal location was at Elliott Bay for clamshell dredging and Port of Everett's Riverside Business Park Disposal Site for the hydraulic dredging.	Downstream settling basin is located immediately west of the Everett Marina. Upstream settling basin is located southeast of the I-5 Bridge.	Background monitoring occurred 300 feet upstream of dredging. Clamshell dredging: samples taken at 600 ft. Three samples taken, surface (2 foot depth), mid, and bottom (2 feet above bottom). Hydraulic dredging: 300 ft for dredging activities – surface, mid and bottom readings, 600 ft for disposal activities. Samples taken twice daily, once during slack tide, once during strong ebb or flood tide. --------- Ebb tide sampling at 300, 600, 1500, 2250, and 2480 ft.		Clamshell dredging Mid and bottom reading: 58.3 Additional samples taken during ebb tide, which exceeded background levels. Not enough information provided to determine concentration and duration. Hydraulic dredging All within water quality standards.	1 hr	4	4	High turbidity readings were in mid to lower samples which may have been in higher salinity waters, not freshwater from river. Sediment analysis: Project location is in tidally influenced area. No sediment monitoring at this time location. Used lowest Snohomish River data, near City of Snohomish. 25 years of data, December through February. NTU:SS ratio = 1:1.9. Regression SS = 1.2748*NTU + 4.8946 Used regression -------- Dredging stopped during strong ebb tides to reduce sediment impacts.
Grays Harbor Dredging.	Exact location with Grays Harbor was not provided. Project was in tidal area	Samples taken at 300 and 600 feet from dredging operation. Samples taken at surface, midwater, and bottom.	Data provided in NTUs	Met water quality standards. Midwater and bottom samples highly variable. When samples were above water quality, resampling both background and at monitoring location, showed in compliance.				
Miscellaneous Activities								
Mount Vernon Wastewater Treatment Plant Outfall Project Skagit River Project involved extending the outfall from the river bank out into the thalwag of the river.	Project located in City of Mount Vernon. Drainage area: 3,093 sq. miles Discharege: 14,000 cfs Slope: 0.1%	Monitoring occurred 100 feet upstream of project and 300 feet downstream	Data provided in NTUs	Met water quality standards for sheet pile driving (cofferdam) and dewatering, no information provided on putting water back into site and removing sheet piles.				

Project and Watershed	Stream Characteristics at Project Location	Monitoring Locations	Original Sediment Data	Concentration (mg/L) used for determining SEV level.	Duration of elevated sediment concentration.	SEV (Juvenile and Adult Salmonids)	SEV Habitat	Comments
Miscellaneous Activities, continued								
Silver Creek Dam Removal Tributary to the White River. Project involved removal of 10-year-old log stringer dam about 5 ft high.	Project located approximately 1120 ft upstream of the confluence with the White River, near Silver Springs Campground. Approximately 3.3 miles SE of Snoquera, WA on Highway 410. Drainage area: 8.0 sq. miles Slope: 8.4% Discharege: 8.3 cfs	159, 559, and 1118 ft downstream	Data provided in NTUs in graph. Estimated values from graph. Project site was not dewatered, logs pulled out of stream and sediment released.	159 ft 114.5 559 ft 157.0 1118 ft. 55.2	1 hr 0.75 0.75	5 5 4	5 5 4	No BMPs or conservation measures used to minimize sedimentation. Sediment analysis. No gage located on creek. Paul Bakke monitored project and determined NTU to suspended sediment ratio of 1:1.9789 Used ratio: 1:2

* Values calculated from monitoring report. Concentration calculated using equation tons/day = 0.0027* cfs* mg/L (USACE (U.S. Army Corps of Engineers) 1995). Background concentration 1.5 mg/L (average). Stream velocity 2.76 cfs. Duration: monitoring report stated sediment concentration levels decreased to near pre-removal levels in about 24 hours (used for average values), peak values based on 8 to 10 hour work day.

** Exact duration is unknown as monitoring stopped when work day was over. Unable to determine when concentrations returned to baseline.

Exact duration is unknown as monitoring did not provide start or stop times to be able to make accurate determination.

Appendix D. Table 1 and 2 and Maps. RLP and CD Mixing Zone Impact.

Appendix D

Table 1. Mixing zone areas, applying the 200 m above and 800 m below distance to these inputs from tributaries, and the stream segments with elevated TSS concentrations beyond the mixing zone impacting Roanoke logperch. Rows in orange, which were included in the Service's 2020 Opinion, are no longer considered mixing zones impacting Roanoke logperch and the reason for removal is provided in last column.

Impact Area Number	County in VA	River Basin	Stream Impacted	Location of Tributary Entering Impacted Stream (latitude, longitude)	Tributary NHD Reach Code	Tributary Name	Tributary Type	Total Impact Length (m)	Reason why Length Different than 1,000 m
1	Montgomery	Roanoke	North Fork Roanoke River (NFRR)	Approximately 0.7 km upstream of MP 227.4 crossing of NFRR(37.272224, -80.3086258)	03010101000799	Dry Run	perennial	700	Mixing zone overlaps with impact length (200 m) upstream of MP 227.4 open-cut crossing (500 m downstream + 200 m upstream = 700 m)
2	Montgomery	Roanoke	NFRR	Approximately 3.5 km downstream of MP 227.4 crossing of NFRR (37.2605419, -80.3406138)	03010101000892	Mill Creek	perennial	1,810	Includes stream segment predicted to have elevated TSS concentrations $\geq$20 mg/L beyond the mixing zone; a total of 1.61 km in NFRR, downstream of tributary (1,610 m downstream + 200 m upstream = 1,810 m) (ends at 37.2499406, -80.3511050)
3	Montgomery	Roanoke	NFRR	Approximately 3 km downstream of MP 229.7 crossing of Flatwoods Branch tributary (37.2368939, -80.2677797)	03010101000783	Flatwoods Branch	perennial	1,000	

Impact Area Number	County in VA	River Basin	Stream Impacted	Location of Tributary Entering Impacted Stream (latitude, longitude)	Tributary NHD Reach Code	Tributary Name	Tributary Type	Total Impact Length (m)	Reason why Length Different than 1,000 m
4	Montgomery	Roanoke	Bradshaw Creek	Above MP 230.9 crossing of Bradshaw Creek; two tributaries entering Bradshaw Creek (37.2696555, -80.2524871; 37.2535861, -80.2597108)	03010101002185, 03010101002195	no name, Womack Branch	both intermittent	5,830	Includes stream segment predicted to have elevated TSS concentrations $\geq$20 mg/L beyond the mixing zone; a total of 5.63 km in Bradshaw Creek, downstream of first tributary to confluence with NFRR.(5,630 m downstream + 200 m upstream = 5,830 m)
5	Montgomery	Roanoke	NFRR	Approximately 2.5 km downstream of MP 230.9 crossing of Bradshaw Creek (37.2328306, -80.2536921)	03010101000317	Bradshaw Creek	perennial	1,000	
6	Montgomery	Roanoke	NFRR	Approximately 4.5 km upstream of MP 235.6 crossing of Roanoke River (RR) (37.2355679, -80.2407927)	03010101002184	no name	intermittent	1,000	
7	Montgomery	Roanoke	South Fork Roanoke River	Approximately 1.5 km upstream of confluence with the RR(37.2258249, -80.2083847)	03010101008530	Indian Run	intermittent	1,000	

Impact Area Number	County in VA	River Basin	Stream Impacted	Location of Tributary Entering Impacted Stream (latitude, longitude)	Tributary NHD Reach Code	Tributary Name	Tributary Type	Total Impact Length (m)	Reason why Length Different than 1,000 m
8	Montgomery	Roanoke	NFRR & RR	Approximately 2 km upstream of MP 235.6 crossing of RR (37.2397213, -80.2141063)	030101010 02183	no name	intermittent	925 (465 in NFRR; 460 in RR)	Mixing zone overlaps with downstream tributary mixing zone. One tributary enters NFRR approximately 265 m above confluence with RR. The next tributary enters RR approximately 460 m downstream of where NFRR and RR join. The tributaries are approximately 725 m apart (NFRR: 265 m downstream + 200 m upstream = 465 m; RR: 460 m downstream)
9	Montgomery	Roanoke	RR	Approximately 1 km upstream of MP 235.6 crossing of RR(37.2371433, -80.2087417)	030101010 02182	no name	intermittent	800	Mixing zone overlaps with upstream tributary mixing zone; tributaries enter NFRR and RR and are approximately 725 m apart, as noted in row above (800 m downstream only)

Impact Area Number	County in VA	River Basin	Stream Impacted	Location of Tributary Entering Impacted Stream (latitude, longitude)	Tributary NHD Reach Code	Tributary Name	Tributary Type	Total Impact Length (m)	Reason why Length Different than 1,000 m
10 (not impact area, see comment)	Montgomery/ Roanoke	Roanoke	RR	Approximately 0.3 km downstream of MP 235.6 crossing of RR (37.2343550, -80.1946638)	030101010 02181	no name	intermittent		This mixing zone was removed as an impact area because the Service and FERC received new information about 2 impoundments on the tributary and supplemental analysis about the upstream impoundments and potential delivery of project-related sediment to the Site No. 10 mixing zone action area. The new information indicated that the tributary will likely not discharge project-related TSS concentrations $\geq$ 20 mg/L above background to the mixing zone action area.[1]
11	Roanoke	Roanoke	RR	Approximately 0.8 km downstream of MP 235.6 crossing of RR (37.2334111, -80.1897257)	030101010 02349	no name	perennial	1,000	

[1] P. Moore, Beveridge & Diamond PC, email to C. Schulz, Service, October 12, 2020; P. Moore, Beveridge & Diamond PC, email to T. Andersen, Service, October 30, 2020; P. Moore, Beveridge & Diamond PC, email to J. Martin, FERC, and C. Schulz, Service, November 13, 2020; J. Martin, FERC, email to C. Schulz, Service, November 24, 2020; C. Schulz, Service, email to P. Moore, Beveridge & Diamond PC, and J. Martin, FERC, November 30, 2020.

Impact Area Number	County in VA	River Basin	Stream Impacted	Location of Tributary Entering Impacted Stream (latitude, longitude)	Tributary NHD Reach Code	Tributary Name	Tributary Type	Total Impact Length (m)	Reason why Length Different than 1,000 m
12	Roanoke	Roanoke	RR	Approximately 5.5 km downstream of MP 235.6 crossing of RR (37.2468410, -80.1655845)	030101010 02351	no name	perennial	1,000	
13	Franklin	Pigg	Pigg River	Approximately 2 km downstream of MP 280.0 crossing of Little Jacks Creek (36.9676436, -79.6979944)	030101010 01376	Jacks Creek	perennial	1,000	
14	Franklin	Pigg	Pigg River	Approximately 3 km downstream of MP 280.7 crossing of Turkey Creek (36.9563534, -79.6906697)	030101010 01373	Turkey Creek	perennial	1,000	

Impact Area Number	County in VA	River Basin	Stream Impacted	Location of Tributary Entering Impacted Stream (latitude, longitude)	Tributary NHD Reach Code	Tributary Name	Tributary Type	Total Impact Length (m)	Reason why Length Different than 1,000 m
15 (not impact area, see comment)	Franklin	Pigg	Pigg River	Approximately 3 km downstream MP 283.0 crossing of Parrot Branch (36.9481901, -79.6443586)	03010101001359	Parrot Branch	perennial		This mixing zone was removed as an impact area because the Service and FERC received new information about a lake impoundment on the tributary. Additional information about its characteristics indicated that the impoundment is more than just a conduit to downstream flow and provides enough capacity to retain storm sediment that may be generated by the project. Therefore, the tributary will likely not discharge project-related TSS concentrations ≥ 20 mg/L above background to the mixing zone action area[2]
16	Pittsylvania	Pigg	Pigg River	Approximately 2 km downstream of MP 287.2 crossing of unnamed tributary (36.9311212, -79.5753806)	03010101001349	Rocky Creek	perennial	900	Mixing zone overlaps with downstream tributary mixing zone; tributaries enter Pigg River approximately 700 m apart

[2] P. Moore, Beveridge & Diamond PC, emails to J. Martin, FERC, and C. Schulz, Service, December 16 and 18, 2020; J. Martin, FERC, email to P. Moore, Beveridge & Diamond PC, J. Fink, FERC, and A. Mardiney, FERC, December 21, 2020; T. Andersen, Service, to J. Martin, FERC, P. Moore, Beveridge & Diamond PC, C. Schulz, Service, J. Fink, FERC, and A. Mardiney, FERC, December 22, 2020.

Impact Area Number	County in VA	River Basin	Stream Impacted	Location of Tributary Entering Impacted Stream (latitude, longitude)	Tributary NHD Reach Code	Tributary Name	Tributary Type	Total Impact Length (m)	Reason why Length Different than 1,000 m
17	Pittsylvania	Pigg	Pigg River	Approximately 0.7 km downstream of confluence of Rocky Creek and Pigg River (36.9277414, -79.5691633)	03010101001348	no name	intermittent	800	Mixing zone overlaps with upstream tributary mixing zone; tributaries enter Pigg River approximately 700 m apart
18	Pittsylvania	Pigg	Pigg River	Approximately 0.6 km downstream of MP 289.2 crossing of Pigg River (36.9380142, -79.5405795)	03010101001347	no name	perennial	1000	

Table 2. Mixing zone areas, applying the 200 m above and 800 m below distance to these inputs from tributaries, impacting candy darter.

Impact Area Number	County, State	River Basin	Stream Impacted	Location of Tributary Entering Impacted Stream (latitude, longitude)	Tributary NHD Reach Code	Tributary Name	Tributary Type	Total Impact Length (m)
19	Webster, WV	Gauley	Gauley River	Approximately 1.8 km upstream of Strouds Creek confluence with Gauley River (38.3649504, -80.5979769)	05050005000952	Coon Creek	Perennial	1,000
20	Nicholas, WV	Gauley	Gauley River	Approximately 0.9 km upstream of MP 118.9 crossing of Gauley River (38.2710519, -80.6830283)	05050005000554	Little Laurel Creek	Perennial	1,000
21	Giles, VA	New River	Stony Creek	Approximately 1.1 km upstream from MP 200.3 (37.3678735, -80.6757298)	05050002000869	Kimballton Branch	Perennial	1,000

Figure 1. Map of Roanoke logperch impact areas (mixing zones highlighted by yellow or white stars and purple stream segments; instream, open-cut crossings highlighted by green stream segments) in the Roanoke River system. Blue stars are mixing zones with predicted TSS concentrations in the tributaries below the threshold TSS/SSC concentrations.

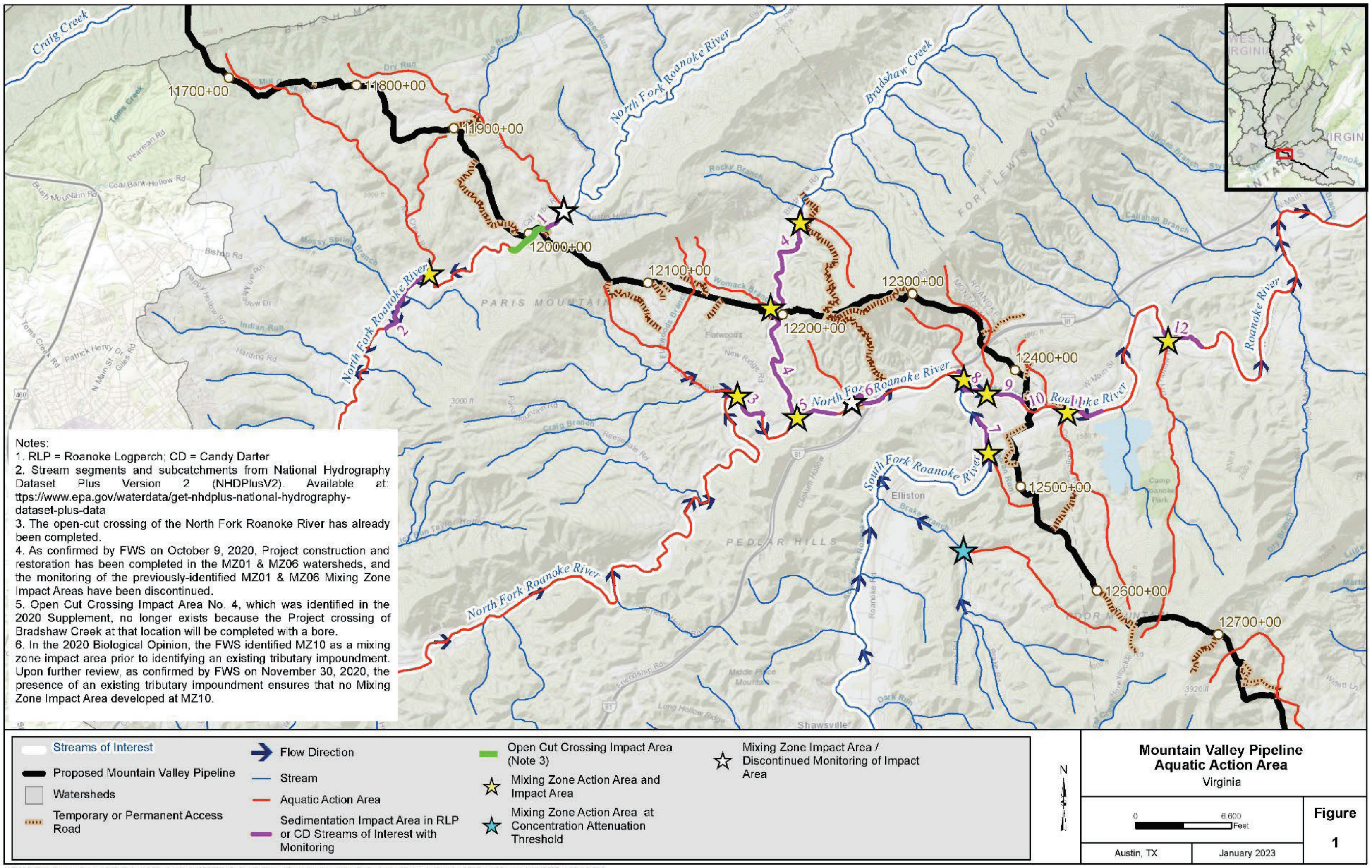


Figure 2. Map of Roanoke logperch impact areas (mixing zones highlighted by yellow or white stars and purple stream segments; instream, open-cut crossings highlighted by green stream segments) in the Pigg River system. Blue stars are mixing zones with predicted TSS concentrations in the tributaries below the threshold TSS/SSC concentrations.

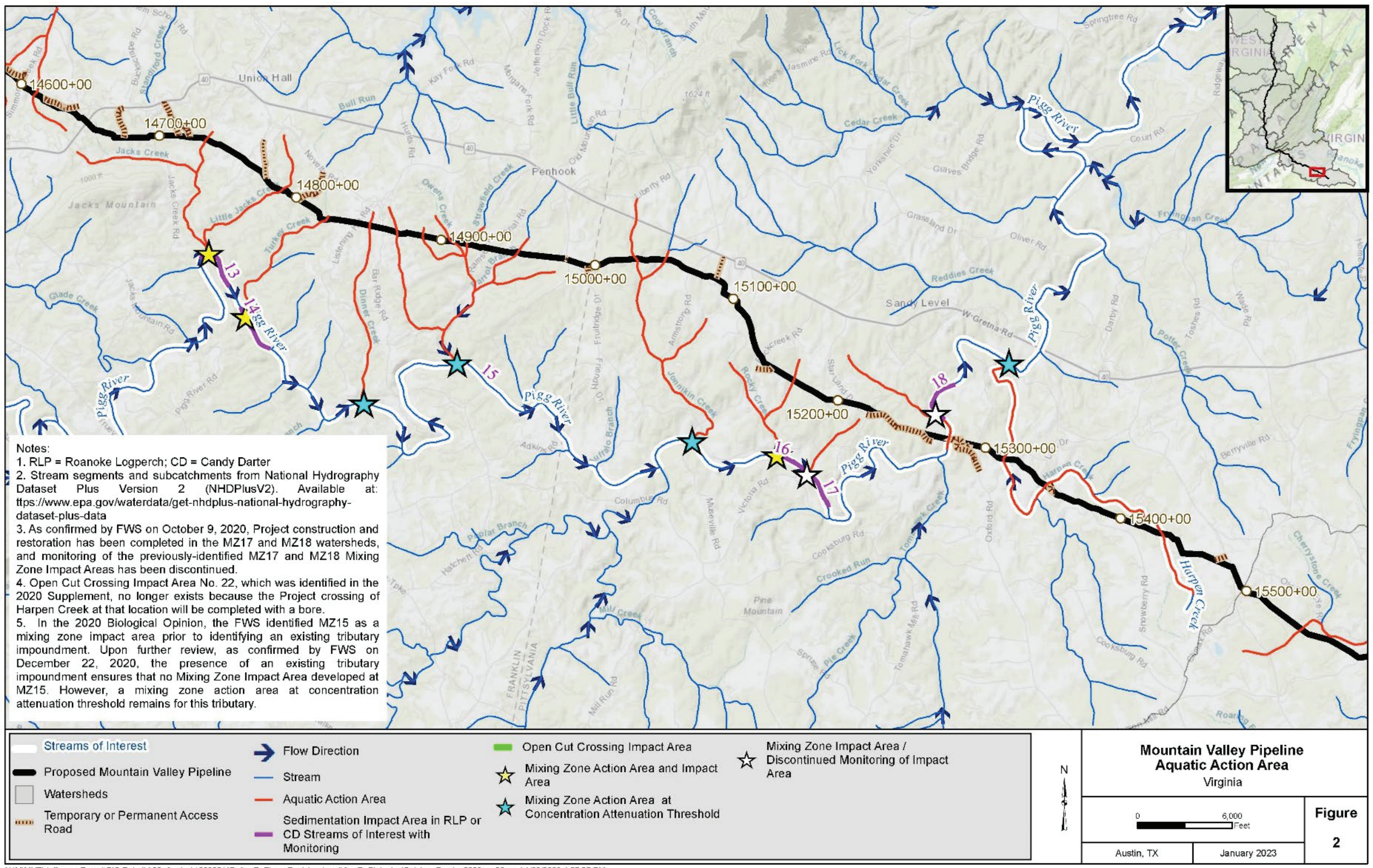


Figure 3. Map of candy darter impact areas (mixing zones highlighted by yellow or white stars and purple stream segments) in the Gauley River system. Blue stars are mixing zones with predicted TSS concentrations in the tributaries below the threshold TSS/SSC concentrations.

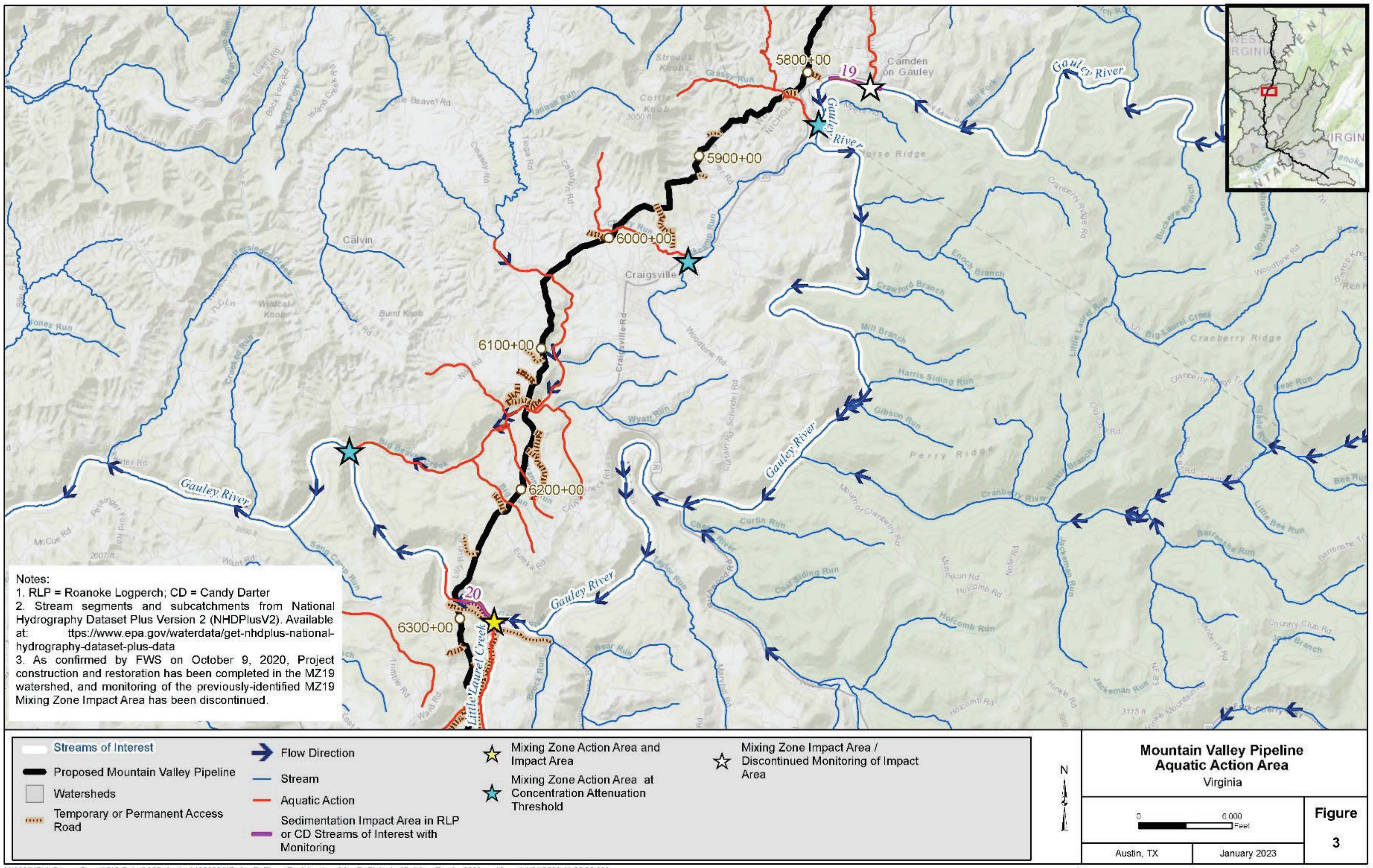
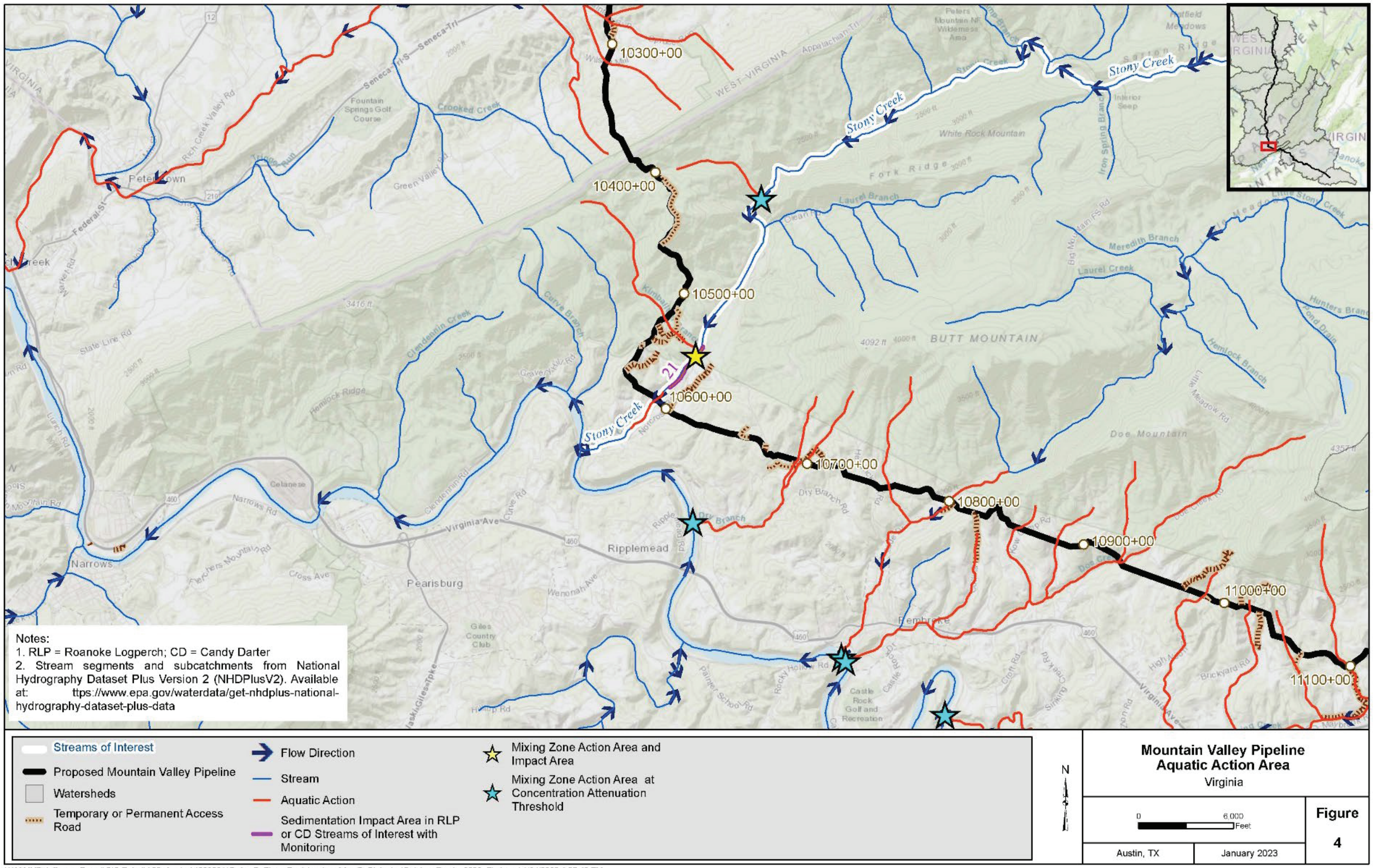


Figure 4. Map of candy darter impact areas (mixing zones highlighted by yellow stars and purple stream segments) in the Stony Creek system. Blue stars are mixing zones with predicted TSS concentrations in the tributaries below the threshold TSS/SSC concentrations.



Appendix E. Table 1 and 2. MVP project FERC-approved variances.

Table 1. MVP project FERC-approved variances since 2017 Opinion (M. Neylon, Mountain Valley Pipeline LLC, letter to J. Martin, FERC, November 27, 2019; P. Moore, Beveridge & Diamond, email to C. Schulz, Service, April 10, 2020).

MVP Variance ID	Acreage	Milepost	County	State	Species of Concern	Survey Date(s)	Survey Results	Variance Filing Date	Variance Approval Date
A-3	18.38	22.7	Harrison	WV	Bats-Portals	01/31/2018	No portals documented	4/13/2018	4/17/2018
A-5	1.58	28.97	Harrison	WV	Bats-Portals	11/13/2015 09/15/2015 08/15/2017 12/19/2017	No portals documented	5/18/2018	5/24/2018
A-6	27.75	24.1	Harrison	WV	Bats-Portals	01/31/2018	No portals documented	5/8/2018	5/10/2018
A-9	10.05	7.6	Harrison	WV	Bats-Portals	01/18/2018	No portals documented	7/23/2018	8/23/2018
A-12	2.17	6.80	Wetzel	WV	Bats-Portals	02/12/2015 11/19/2015 08/15/2016 05/03/2018	No portals documented	8/16/2018	8/23/2018
A-13	1.59	22.20	Harrison	WV	Bats-Portals	11/17/2015 06/12/2018	No portals documented	8/17/2018	8/23/2018
A-15	0.19	12	Harrison	WV	Bats-Portals	6/12/2018	No portals documented	8/28/2018	8/30/2018
A-21	5.37	5.7	Wetzel	WV	Bats-Portals	02/12/2015 08/15/2016 02/14/2019 03/13/2019	No portals documented	4/4/2019	4/5/2019
A-22	0.52	0.6	Wetzel	WV	Bats-Portals	08/23/2018	No portals documented	10/15/2018	10/18/2018
A-23	0.87	0.1	Wetzel	WV	Bats-Portals	02/16/2015 10/25/2015	No portals documented	10/18/2018	10/19/2018
A-26	15.14	3.8 - 4.2	Wetzel	WV	Bats-Portals	08/24/2018 10/06/2018 02/14/2019	No portals documented	11/7/2018	2/27/2019
A-27	0.16	3.4	Wetzel	WV	Bats-Portals	02/12/2015 10/05/2018	No portals documented	10/23/2018	10/26/2018
A-29	0.62	0.9	Wetzel	WV	Bats-Portals	02/12/2015 09/25/2018	No portals documented	3/25/2019	3/25/2019
A-30	1.65	3.9	Wetzel	WV	Bats-Portals	10/6/2018	No portals documented	11/7/2018	12/4/2018
A-32	6.24	3.55 - 3.75	Wetzel	WV	Bats-Portals	07/07/2018 09/29/2018	No portals documented	3/28/2019	3/29/2019
A-36	0.22	8.6	Wetzel	WV	Bats-Portals	02/10/2015 10/28/2015	No portals documented	3/12/2019	3/18/2019
A-38	1.4	15.52	Harrison	WV	Bats-Portals	01/19/2015 10/17/2018	No portals documented	5/9/2019	5/13/2019

MVP Variance ID	Acreage	Milepost	County	State	Species of Concern	Survey Date(s)	Survey Results	Variance Filing Date	Variance Approval Date
A-39	0.67	32.4	Doddridge	WV	Bats-Portals	11/15/2015	No portals documented	3/25/2019	3/25/2019
A-40	0.36	32.5	Doddridge	WV	Bats-Portals	04/07/2016 08/24/2016	No portals documented	4/24/2019	4/26/2019
A-41	0.93	1.2	Wetzel	WV	Bats-Portals	02/12/2015 10/12/2018	No portals documented	3/11/2019	3/15/2019
A-42	0.68	3.16	Wetzel	WV	Bats-Portals	02/12/2015	No portals documented	3/20/2019	3/21/2019
A-43	0.13	20.2	Wetzel	WV	Bats-Portals	02/14/2019	No portals documented	6/11/2019	6/14/2019
A-44	0.47	6.62	Wetzel	WV	Bats-Portals	05/03/2018 01/16/2019	No portals documented	3/26/2019	3/28/2019
A-45	0.17	9.1	Wetzel	WV	Bats-Portals	02/10/2015	No portals documented	3/28/2019	3/29/2019
A-46	0.34	2.65	Wetzel	WV	Bats-Portals	02/12/2015 08/24/2018	No portals documented	3/28/2019	3/29/2019
A-47	0.04	5.52	Wetzel	WV	Bats-Portals	02/12/2015 10/27/2015 08/15/2016	No portals documented	4/4/2019	4/5/2019
A-48	0.41	5.05	Wetzel	WV	Bats-Portals	02/12/2015	No portals documented	3/28/2019	3/29/2019
A-49	3.46	4.2	Wetzel	WV	Bats-Portals	02/14/2015 03/12/2019	No portals documented	3/28/2019	3/29/2019
A-50	7.64	3.8 - 4.2	Wetzel	WV	Bats-Portals	02/12/2015 08/24/2018 10/06/2018 02/14/2019 03/12/2019	No portals documented	3/28/2019	3/29/2019
A-51	1.2	2.1	Wetzel	WV	Bats-Portals	10/06/2018 03/12/2019	No portals documented	3/26/2019	3/28/2019
A-52	1.41	20.9	Harrison	WV	Bats-Portals	11/17/2015 01/15/2019	No portals documented	5/22/2019	5/23/2019
A-53	1.86	24.08	Harrison	WV	Bats-Portals	12/12/2014 11/10/2015 01/15/2019 02/15/2019	No portals documented	5/13/2019	5/15/2019
A-54	0.22	6.5	Wetzel	WV	Bats-Portals	02/12/2015 03/13/2019	No portals documented	3/27/2019	3/28/2019
A-55	0.93	1.2	Wetzel	WV	Bats-Portals	02/12/2015 03/27/2019	No portals documented	4/4/2019	4/5/2019
A-56	0.08	6.61	Wetzel	WV	Bats-Portals	06/15/2016	No portals documented	3/29/2019	3/29/2019
A-60	0.03	1.4	Wetzel	WV	Bats-Portals	08/15/2016	No portals documented	7/18/2019	7/23/2019

MVP Variance ID	Acreage	Milepost	County	State	Species of Concern	Survey Date(s)	Survey Results	Variance Filing Date	Variance Approval Date
A-61	0.59	13.5	Harrison	WV	Bats-Portals	01/21/2015 11/12/2015 04/30/2019	No portals documented	5/30/2019	5/30/2019
A-69	0.07	32.55	Doddridge	WV	Bats-Portals	10/16/2014 10/23/2015	No portals documented	5/7/2019	5/9/2019
A-70	0.71	20.3	Harrison	WV	Bats-Portals	11/14/2015 11/16/2015 05/26/2019	No portals documented	5/30/2019	5/31/2019
A-77	1.01	34.3	Doddridge	WV	Bats-Portals	01/19/2015 11/16/2015	No portals documented	9/17/2019	9/18/2019
A-78	0.99	1.51	Wetzel	WV	Bats-Portals	02/16/2015 10/24/2015	No portals documented	7/29/2019	8/13/2019
A-84	0.16	4.2	Wetzel	WV	Bats-Portals	03/12/2019 09/24/2019	No portals documented	10/2/2019	Pending
B-2	1.45	42.7	Lewis	WV	Bats-Portals	08/05/2016 07/29/2017	No portals documented	5/25/2018	5/29/2018
B-3	0.07	60.32	Lewis	WV	Bats-Portals	12/12/2017	No portals documented	5/29/2018	5/31/2018
B-4	9.12	45.5	Lewis	WV	Bats-Portals	09/01/2016	No portals documented	6/12/2018	6/14/2018
B-5	1.72	45.9	Lewis	WV	Bats-Portals	10/12/2015	No portals documented	7/23/2018	8/23/2018
B-6	0.39	38.1	Harrison	WV	Bats-Portals	01/18/2015 01/21/2015 10/23/2015	No portals documented	9/18/2018	9/20/2018
B-7	1.51	60.07	Lewis	WV	Bats-Portals	01/28/2015 12/12/2017 05/23/2018 06/12/2018	No portals documented	8/17/2018	8/23/2018
B-11	0.6	52.6	Lewis	WV	Bats-Portals	01/25/2015 10/12/2018	No portals documented	11/20/2018	11/29/2018
B-13	0.62	50.3	Lewis	WV	Bats-Portals	11/16/2015 09/24/2018	No portals documented	11/20/2018	11/29/2018
B-15	0.02	45.9	Lewis	WV	Bats-Portals	10/12/2015	No portals documented	7/18/2019	7/31/2019
B-16	0.52	47.13	Lewis	WV	Bats-Portals	01/20/2015 11/04/2015	No portals documented	3/15/2019	3/19/2019
B-17	1.16	57.99	Lewis	WV	Bats-Portals	10/12/2015 11/17/2015 10/17/2018	No portals documented	5/13/2019	5/15/2019
B-18	0.4	50.3	Lewis	WV	Bats-Portals	09/24/2018 03/13/2019	No portals documented	5/16/2019	5/17/2019
B-19	0.19	62.4	Lewis	WV	Bats-Portals	10/26/2015	No portals documented	5/2/2019	5/6/2019
B-20	1.62	53.5	Lewis	WV	Bats-Portals	2/28/2019	No portals documented	5/16/2019	5/17/2019
B-21	0.55	51.22	Lewis	WV	Bats-Portals	2/28/2019	No portals documented	5/17/2019	5/21/2019

MVP Variance ID	Acreage	Milepost	County	State	Species of Concern	Survey Date(s)	Survey Results	Variance Filing Date	Variance Approval Date
B-22	1.42	46.84	Lewis	WV	Bats-Portals	2/15/2019	No portals documented	4/18/2019	4/23/2019
B-24	0.2	46.89	Lewis	WV	Bats-Portals	01/20/2015 10/14/2015	No portals documented	5/9/2019	5/15/2019
B-27	0.07	46.55	Lewis	WV	Bats-Portals	01/20/2015 01/21/2015 10/14/2015	No portals documented	5/21/2019	5/23/2019
B-29	0.26	44.6	Lewis	WV	Bats-Portals	10/12/2015 04/30/2019	No portals documented	10/7/2019	Pending
B-34	0.11	46.81	Lewis	WV	Bats-Portals	02/15/2019	No portals documented	6/7/2019	6/11/2019
B-35	0.26	52.8	Lewis	WV	Bats-Portals	01/25/2015 11/03/2015	No portals documented	5/30/2019	6/3/2019
B-38	0	52.3	Lewis	WV	Bats-Portals	01/25/2015 08/01/2019	No portals documented	9/4/2019	9/9/2019
Harris-2	1.54	77.3	Braxton	WV	Bats-Portals	11/12/2017	No portals documented	4/5/2018	4/6/2018
C-3	4.78	n/a	Braxton	WV	Bats-Portals	03/04/2018	No portals documented	6/7/2018	6/8/2018
C-4	2.89	90	Braxton	WV	Bats-Portals	05/01/2018	No portals documented	6/12/2018	6/14/2018
C-5	2.45	69.9	Braxton	WV	Bats-Portals	08/18/2016 05/31/2018	No portals documented	9/7/2018	9/17/2018
C-8	0.02	81.72	Webster	WV	Bats-Portals	06/11/2018	No portals documented	9/5/2018	9/10/2018
C-10	2.88	68.4	Braxton	WV	Bats-Portals	07/10/2018	No portals documented	9/24/2018	9/28/2018
C-12	1.45	84.3 - 84.7	Webster	WV	Bats-Portals	01/20/2015 01/21/2015 10/14/2015 10/15/2015	No portals documented	10/23/2018	10/26/2018
C-13	1.6	68.9	Braxton	WV	Bats-Portals	11/15/2015	No portals documented	4/11/2019	4/15/2019
C-14; C-32	0.7	84.4	Webster	WV	Running Buffalo Clover	07/28/2018	Suitable Habitat; No individuals present	11/15/2018; 8/26/2019	11/27/2018; 9/4/2019
					Bats-Portals	10/16/2015 07/26/2018	No portals documented		
C-15	0.99	70.6	Braxton	WV	Bats-Portals	11/22/2015 12/04/2018	No portals documented	5/2/2019	5/6/2019
C-18	2.88	86.65	Webster	WV	Bats-Portals	01/03/2015 11/21/2015 04/22/2019	No portals documented	5/30/2019	5/30/2019
C-19	1.16	82.8	Webster	WV	Bats-Portals	11/19/2015 04/23/2019	No portals documented	5/30/2019	5/31/2019

MVP Variance ID	Acreage	Milepost	County	State	Species of Concern	Survey Date(s)	Survey Results	Variance Filing Date	Variance Approval Date
C-22	0.71	87.5	Webster	WV	Bats-Portals	01/14/2015 11/20/2015 05/08/2019	No portals documented	5/30/2019	5/31/2019
					Running Buffalo Clover	05/08/2019	No Suitable Habitat present		
C-23	2.36	94.26	Webster	WV	Running Buffalo Clover	05/08/2019	No Suitable Habitat present	5/30/2019	5/31/2019
					Bats-Portals	11/20/2014 02/15/2019	No portals documented		
C-25	0.22	81.62	Webster	WV	Bats-Portals	11/16/2015 11/17/2015	No portals documented	10/2/2019	Pending
C-26	1.26	92.62	Webster	WV	Bats-Portals	02/15/2015 05/08/2019	No portals documented	6/25/2019	6/26/2019
					Running Buffalo Clover	05/08/2019	No Suitable Habitat present		
C-29	8.56	96.5	Webster	WV	Running Buffalo Clover	05/05/2019	No Suitable Habitat found	6/21/2019	6/26/2019
					Bats-Portals	12/05/2018 05/08/2019	No portals documented		
A-20	0.71	87.5	Webster	WV	Running Buffalo Clover	05/08/2019	No Suitable Habitat present	12/3/2018	12/7/2018
					Bats-Portals	01/14/2015 11/20/2015 05/08/2019	No portals documented		
D-1	15.47	113	Nicholas	WV	Bats-Portals	12/07/2017	No portals documented	5/4/2018, 5/8/2018	5/9/2018
D-2	0.98	111.786	Nicholas	WV	Bats-Portals	8/30/2016 12/13/2017	No portals documented	5/15/2018	5/16/2018
D-6	2.13	115.74	Nicholas	WV	Bats-Portals	03/15/2018	No portals documented	5/29/2018	5/30/2018
D-7	4.78	119	Nicholas	WV	Bats-Portals	11/11/2015 09/15/2017 12/13/2017	No portals documented	5/30/2018	5/31/2018
D-8	0.34	112.67	Nicholas	WV	Bats-Portals	08/30/2016	No portals documented	6/13/2018	6/15/2018
D-9	9.89	n/a	Nicholas	WV	Bats-Portals	05/1/2018	No portals documented	7/16/2018	7/18/2018
D-10	0.95	119.8	Nicholas	WV	Bats-Portals	05/10/2018	No portals documented	7/16/2018	7/18/2018
D-11	8.28	120.35	Nicholas	WV	Bats-Portals	09/11/2017	No portals documented	9/20/2018	9/26/2018
D-14	0.08	111.32	Nicholas	WV	Bats-Portals	11/20/2014	No portals documented	9/19/2018	9/24/2018

MVP Variance ID	Acreage	Milepost	County	State	Species of Concern	Survey Date(s)	Survey Results	Variance Filing Date	Variance Approval Date
D-15	3.14	127.16	Nicholas	WV	Bats-Portals	05/12/2018	No portals documented	9/27/2018	9/28/2018
D-17	6.48	108.17	Webster	WV	Bats-Portals	05/30/2018	No portals documented	9/26/2018	9/28/2018
D-18	0.69	102.26	Webster	WV	Bats-Portals	09/16/2016	No portals documented	10/24/2018	10/26/2018
					Running Buffalo Clover	09/16/2016	No Suitable Habitat present		
D-19	2.83	114.75	Nicholas	WV	Bats-Portals	11/13/2015 09/29/2018	No portals documented	2/7/2019	2/8/2019
D-20	3.28	n/a	Nicholas	WV	Bats-Portals	05/01/2018 09/18/2018	No portals documented	11/20/2018	11/29/2018
D-29	0.56	112.3	Nicholas	WV	Bats-Portals	12/07/2017	No portals documented	7/12/2019	7/15/2019
D-31	0.2	122.4	Nicholas	WV	Bats-Portals	11/06/2015	No portals documented	7/12/2019	7/17/2019
D-33	0.84	114	Nicholas	WV	Bats-Portals	10/05/2018	No portals documented	10/7/2019	Pending
E-1	4.36	142	Greenbrier	WV	Bats-Portals	10/27/2017	No portals documented	4/17/2018	4/19/2018
E-2	11.11	165	Raleigh	WV	Bats-Portals	03/21/2018	No portals documented	5/18/2018	5/24/2018
E-3	15.94	n/a	Raleigh	WV	Bats-Portals	04/27/2018	No portals documented	5/23/2018	5/25/2018
E-4	7.41	165	Raleigh	WV	Bats-Portals	03/21/2018	No portals documented	5/30/2018	5/31/2018
E-5	2.1	133.5	Nicholas	WV	Bats-Portals	11/18/2014	No portals documented	5/24/2018	5/25/2018
E-12	0.08	138.4	Greenbrier	WV	Small Whorled Pogonia	08/27/2016 – 08/30/2016	Suitable Habitat; No individuals present	5/15/2019	5/15/2019
					Bats-Portals	10/24/2014 12/09/2014 11/13/2015	No portals documented		
E-13	0.25	150.6	Greenbrier	WV	Bats-Portals	10/23/2015	No portals documented	7/12/2019	7/17/2019
					Running Buffalo Clover	8/18/2015	Suitable Habitat; No individuals present		
F-1	22.71	165	Raleigh	WV	Bats-Portals	05/08/2018	No portals documented	3/27/18, 3/29/18	4/3/2018
F-6	1.41	166.07	Summers	WV	Bats-Portals	12/13/2017	No portals documented	5/29/2018	5/31/2018
F-9	22.71	165	Raleigh	WV	Bats-Portals	05/08/2018	No portals documented	9/20/2018	9/26/2018
F-10	1.63	171.33	Summers	WV	Virginia spiraea	07/29/2017	No suitable habitat present	9/5/2018	9/10/2018
					Bats-Portals	07/29/2017	No portals documented		
F-14	9.22	194.2	Monroe	WV	Bats-Portals	12/18/2017	No portals documented	10/1/2019	10/4/2019
F-15	0.03	188.4	Monroe	WV	Bats-Portals	07/19/2017	No portals documented	10/2/2019	10/4/2019
F-19	1.06	163.5	Summers	WV	Bats-Portals	02/06/2015 11/18/2015	No portals documented	8/8/2019	Pending
G-1	22.66	195.3	Monroe	WV	Bats-Portals	9/11/2017 12/06/2018	No portals documented	3/21/2018, 3/23/18	3/26/2018
G-2	14.84	202.94	Giles	VA	Bats-Portals	12/20/2017	No portals documented	3/27/2018	4/4/2018

MVP Variance ID	Acreage	Milepost	County	State	Species of Concern	Survey Date(s)	Survey Results	Variance Filing Date	Variance Approval Date
G-3	8.22	221.14 - 224.3	Montgomery	VA	Bats-Portals	01/29/2018	No portals documented	5/29/2018	5/31/2018
G-5	5.52	200.6	Giles	VA	Bats-Portals	03/30/2016 01/25/2017	No portals documented	6/12/2018	6/14/2018
G-7	0.07	200.62	Giles	VA	Bats-Portals	11/15/2015 03/08/2016 03/30/2016	No portals documented	11/7/2018	12/4/2018
G-10	3.84	n/a	Montgomery	VA	Bats-Portals	01/28/2015 11/10/2015 11/13/2015 07/10/2018 07/20/2018	No portals documented	6/18/2019	6/19/2019
H-2	15.44	240.8 - 241.53	Roanoke	VA	Bats-Portals	04/29/2016 01/25/2017	No portals documented	5/22/2018	5/25/2018
H-3	11.37	234.85 - 235.46	Roanoke / Montgomery	VA	Bats-Portals	09/14/2016 09/28/2016	No portals documented	5/18/2018	5/24/2018
H-4	20.43	235.6	Roanoke	VA	Smooth Coneflower	12/21/2017	No Suitable Habitat present	6/20/2018	6/25/2018
					Bats-Portals	12/21/2017	No portals documented		
H-5	1.92	257.9 - 258.22	Franklin	VA	Bats-Portals	04/05/2016 12/20/2017	No portals documented	5/25/2018	5/29/2018
H-6	20.69	235.58 - 236.26	Montgomery	VA	Bats-Portals	04/28/2016 12/21/2017 12/20/2017	No portals documented	5/29/2018	5/30/2018
H-9	1.47	237.5 - 238.0	Montgomery	VA	Bats-Portals	04/28/2016 06/18/2018	No portals documented	9/21/2018	9/25/2018
H-15	0.28	239.1	Roanoke	VA	Bats-Portals	04/02/2019	No portals documented	8/7/2019	Pending
H-17	0.0	246.7	Franklin	VA	Bats-Portals	10/13/2015 11/06/2015	No portals documented	7/18/2019	7/18/2019
I-1	4.98	267	Franklin	VA	Bats-Portals	12/14/2017	No portals documented	4/20/2018	4/23/2018
I-2	0.36	265.72 - 265.80	Franklin	VA	Bats-Portals	08/30/2016 01/28/2017 01/15/2018	No portals documented	5/22/2018	5/25/2018
I-4	1.36	300.73 - 300.8	Pittsylvania	VA	Bats-Portals	08/20/2015 08/15/2016	No portals documented	5/22/2018	5/25/2018
I-8	0.7	286.16	Pittsylvania	VA	Bats-Portals	04/06/2016	No portals documented	7/11/2018	7/17/2018

MVP Variance ID	Acreage	Milepost	County	State	Species of Concern	Survey Date(s)	Survey Results	Variance Filing Date	Variance Approval Date
I-10	0.07	266.3	Franklin	VA	Bats-Portals	09/01/2016 09/13/2016	No portals documented	9/5/2018	9/10/2018
I-11	0.45	289.55	Pittsylvania	VA	Bats-Portals	02/26/2015 04/06/2016 07/26/2018	No portals documented	8/16/2018	8/23/2018
I-12	0.26	286.2	Pittsylvania	VA	Bats-Portals	06/14/2018	No portals documented	9/5/2018	9/10/2018
I-13	0.43	271.1	Franklin	VA	Bats-Portals	02/28/2016 04/05/2016	No portals documented	9/27/2019	9/30/2019
I-14	0.05	272.4	Franklin	VA	Bats-Portals	02/24/2015 04/06/2016	No portals documented	7/15/2019	7/15/2019
I-15	0.3	264 - 264.1	Franklin	VA	Bats-Portals	05/04/2016 09/26/2018	No portals documented	10/1/2019	10/4/2019
Transco-1	0.11	Transco-1	Pittsylvania	VA	Bats-Portals	04/07/2016 08/24/2016	No portals documented	1/16/2019	1/24/2019

MVP Variance ID	Acreage	Milepost	County	State	Species of Concern	Survey Date(s)	Survey Results	Variance Filing Date	Variance Approval Date
A-10	0.43	5.9	Wetzel	WV	No species surveys required – existing graveled parking lot; no earth disturbance required	n/a	n/a	6/15/2018	7/16/2018
A-24	8.82	2.65	Wetzel	WV	Bats – portals	2/12/2015, 8/24/2018	No portals documented	10/18/2018	10/19/2018
A-25	1.2	2.1	Wetzel	WV	Bats – portals	2/12/2015 10/6/2018	No portals documented	10/18/2018	10/19/2018
D-5	1.74	n/a	Nicholas	WV	No species surveys required – existing laydown yard	4/10/2018	n/a	6/7/2018	6/8/2018
F-2	9.22	194.2	Monroe	WV	No species surveys required – agricultural fields	12/18/2017	n/a	5/11/2018	5/15/2018
F-3	1.75	159.27 - 159.45	Summers	WV	Bats – portals	12/20/2017	No portals documented	5/22/2018	5/25/2018
I-7	5.78	303	Pittsylvania	VA	No species surveys required – pre-existing developed area; no habitat available	n/a	n/a	6/12/2018	6/14/2018
Bradshaw-3	1.4	n/a	Wetzel	WV	Bats – detailed habitat assessment	5/11/2018	5 potential roost trees documented	3/29/2018	3/30/2018

Table 2. MVP project FERC-approved variances since 2020 Opinion that required additional field investigation (Mountain Valley 2022; M. Hoover, Mountain Valley, email to C. Schulz, Service, February 24, 2023).

Variance Type	Variance ID	MP	Variance Description	Species Survey	Tree Clearing Acreage	Bat Habitat Category	Date of Tree Clearing
Water Quality Monitoring Stations (WQMS)	MVP-026	N/A	Installation of WQMSs in 18 locations in VA as a condition of the 2020 Opinion. WQMS 03D, 03T, 03U, 04D, 04U, 07D, 09D, 09T, 11D, 11T, 11U, 12D, 12T Alt, 14U, 16D, and 21D	03D, 03T, 03U, 04D, 04U: Winter Bat Habitat/Portal Surveys; Smooth Coneflower and Pinate-Lobed Coneflower Surveys 07D, 14U, 16D: Winter Bat Habitat/Portal 09D: Winter Bat Habitat/Portal Surveys; Loggerhead Shrike Surveys; Smooth Coneflower and Pinate- Lobed Coneflower Surveys 09T, 11D, 11T, 12D, 12T, 21D: Winter Bat Habitat/Portal Surveys; Smooth Coneflower and Pinate-Lobed Coneflower Surveys 11U: Winter Bat Habitat/Portal Surveys; Loggerhead Shrike Surveys	N/A	N/A	N/A
WQMSs	MVP-027	N/A	Installation of WQMSs in 12 locations in VA as a condtion of the 2020 Opinion. WQMS 07T, 07U, 08D, 08M, 08T Alt, 13D, 13T1, 13T2 Alt, 13U, 14D Alt, 16T Alt, and 16U Alt	07T, 08D, 13D, 13T1, 13T2, 13U, 14D, 16T: Winter Bat Habitat/Portal Surveys 07U, 08M, 08T: Winter Bat Habitat/Portal Surveys; Loggerhead Shrike Surveys; Smooth Coneflower and Pinate-Lobed Coneflower 16U: Winter Bat Habitat/Portal Surveys; Smooth Coneflower and Pinate-Lobed Coneflower	N/A	N/A	N/A
WQMSs	MVP-032	N/A	Installation of WQMSs in 4 locations in VA as a condtion of the 2020 Opinion.	05D, 05U, 08U: Winter Bat Habitat/Portal Surveys; Loggerhead Shrike Surveys; Smooth Coneflower and Pinate-Lobed Coneflower 07T North, 11T2: Winter Bat Habitat/Portal Surveys; Loggerhead Shrike Surveys			
WQMSs	MVP-036	235.00 280.30	Installation of WQMSs in 3 locations in VA as a condtion of the 2020 Opinion. (21U, 12U Alt, 14T)	12U Alt, 21U: Winter Bat Habitat/Portal Surveys; Smooth Coneflower and Pinate-Lobed Coneflower Surveys 14T: Winter Bat Habitat/Portal Surveys	N/A	N/A	N/A
Slip[1]	A-91 (MVP-029)	1.10	Added acreage for slip repair	Winter Bat Habitat/Portal Surveys	0.200	Known Use Summer Habitat	March, 2021
Slip[2]	A-89 (MVP-035)	1.40	Added acreage for slip repair	Winter Bat Habitat/Portal Surveys	0.000	Known Use Summer Habitat	N/A
Slip[1]	A-93 (MVP-029)	2.05	Added acreage for slip repair	Winter Bat Habitat/Portal Surveys	0.270	Known Use Summer Habitat	March, 2021
Slip[1]	A-31 (MVP-029)	2.20	Added acreage for slip repair	Winter Bat Habitat/Portal Surveys	0.143	Known Use Summer Habitat	March, 2021
Slip[2]	A-106 (MVP-029)	3.90	Added acreage for slip repair	Winter Bat Habitat/Portal Surveys	0.010	Known Use Summer Habitat	March, 2022
Slip[1]	A-84 (MVP-035)	4.20	Added acreage for slip repair	Winter Bat Habitat/Portal Surveys	0.000	Known Use Summer Habitat	N/A
Timbermats off LOD	A-110	4.90	Added ARs MVP-WE-013 R1 and R2 due to MVP and landowner bridge	Winter Bat Habitat/Portal Surveys	N/A	N/A	N/A
Slip[1]	A-83 (MVP-029)	5.25	Added acreage for slip repair	Winter Bat Habitat/Portal Surveys	0.230	Known Use Summer Habitat	March, 2021
Slip[1]	A-63 (MVP-029)	5.26	Added acreage for slip repair	Winter Bat Habitat/Portal Surveys	0.530	Known Use Summer Habitat	March, 2021
Slip[1]	A-64 (MVP-029)	5.39	Added acreage for slip repair	Winter Bat Habitat/Portal Surveys	0.120	Known Use Summer Habitat	March, 2021
Slip[1]	A-65 (MVP-029)	5.45	Added acreage for slip repair	Winter Bat Habitat/Portal Surveys	0.268	Known Use Summer Habitat	March, 2021

Slip[2]	A-107 (MVP-029)	5.50	Added acreage for slip repair	Winter Bat Habitat/Portal Surveys	0.000	Known Use Summer Habitat	N/A
Slip[1]	A-57 (MVP-029)	6.00	Added acreage for slip repair	Winter Bat Habitat/Portal Surveys	0.040	Known Use Summer Habitat	March, 2021
Slip[2]	A-111 (MVP-035)	7.80	Added acreage for slip repair	Winter Bat Habitat/Portal Surveys	0.064	Known Use Summer Habitat	Pending
Slip[1]	A-96 (MVP-029)	8.80	Added acreage for slip repair	Winter Bat Habitat/Portal Surveys	0.130	Known Use Summer Habitat	March, 2021
Slip[1]	A-62 (MVP-028)	8.83	Added acreage for slip repair	Winter Bat Habitat/Portal Surveys	0.100	Known Use Summer Habitat	March, 2021
Slip[1]	A-82 (MVP-030)	15.89	Added acreage for slip repair	Winter Bat Habitat/Portal Surveys	0.160	Unknown Use Summer Habitat	April, 2021
Slip[1]	A-72 (MVP-030)	22.20	Added acreage for slip repair	Winter Bat Habitat/Portal Surveys	0.480	Unknown Use Summer Habitat	April, 2021
Slip[1]	A-73 (MVP-031)	22.25	Added acreage for slip repair	Winter Bat Habitat/Portal Surveys	0.150	Unknown Use Summer Habitat	August, 2021
Slip[1]	A-71 (MVP-030)	28.10	Added acreage for slip repair	Winter Bat Habitat/Portal Surveys	0.120	Unknown Use Summer Habitat	April, 2021
Slip[2]	A-74 (MVP-029)	29.10	Added acreage for slip repair	Winter Bat Habitat/Portal Surveys	0.310	N/A[3]	March, 2021
Slip[2]	A-105 (MVP-028)	32.47	Added acreage for slip repair	Winter Bat Habitat/Portal Surveys	0.090	Unknown Use Summer Habitat	March, 2021
Slip[2]	A-108 (MVP-031)	32.47-32.54	Added acreage for slip repair	Winter Bat Habitat/Portal Surveys	0.120	Unknown Use Summer Habitat	August, 2021
Slip[2]	A-109 (MVP-031)	33.90	Added acreage for slip repair	Winter Bat Habitat/Portal Surveys	0.130	N/A[3]	August, 2021
Slip[2]	A-88	34.25	Added acreage for slip repair	Winter Bat Habitat/Portal Surveys	0.005	Unknown Use Summer Habitat	March, 2021
Slip[1]	B-60 (MVP-035)	36.03	Added acreage for slip repair	Winter Bat Habitat/Portal Surveys	0.000	Unknown Use Summer Habitat	N/A
Slip[1]	B-23 (MVP-030)	39.83	Added acreage for slip repair	Winter Bat Habitat/Portal Surveys	0.080	Unknown Use Summer Habitat	April, 2021
Slip[1]			Added acreage for slip repair	Winter Bat Habitat/Portal Surveys			
Slip[1]			Added acreage for slip repair	Winter Bat Habitat/Portal Surveys			
Slip[1]	B-36 (MVP-030)	44.65	Added acreage for slip repair	Winter Bat Habitat/Portal Surveys	0.000	Unknown Use Summer Habitat	N/A
Slip[1]	B-49	46.50	Added acreage for slip repair	Winter Bat Habitat/Portal Surveys	0.077	Unknown Use Summer Habitat	April, 2021
Slip[2]	B-61 (MVP-030)	46.60	Added acreage for slip repair	Winter Bat Habitat/Portal Surveys	0.001	Unknown Use Summer Habitat	April, 2021
Slip[2]	B-67 (MVP-035)	46.85	Added acreage for slip repair	Winter Bat Habitat/Portal Surveys	0.320	Unknown Use Summer Habitat	April, 2021
Slip[1]	B-37 (MVP-		Added acreage for slip repair	Winter Bat Habitat/Portal Surveys		Unknown	

Slip[1]	B-57 (MVP-028)	52.34	Added acreage for slip repair	Winter Bat Habitat/Portal Surveys	0.100	Use Summer Habitat	March, 2021
Slip[1]			Added acreage for slip repair	Winter Bat Habitat/Portal Surveys			
Slip[2]	L1 B-185	52.50	Removal of Danger Trees hanging over the ROW.	--	0.005	Unknown Use Summer Habitat	October, 2021
Slip[1]	B-25 (MVP-030)	54.98	Added acreage for slip repair	Winter Bat Habitat/Portal Surveys	0.050	Unknown Use Summer Habitat	April, 2021
Slip[1]	B-47 (MVP-028)	57.10	Added MVP-ATWS-SM-110, MVP-ATWS- SM-065(EXT1), -065(EXT2), & -065(EXT3) for slip repair.	Winter Bat Habitat/Portal Surveys	0.268	Unknown Use Summer Habitat	March, 2021
Slip[1]		57.41	Added MVP-ATWS-SM-042(EXT), -042(EXT2), -042(EXT3) for slip repair and added MVP-ATWS-1668, -1669, &-1670 for installation of drains for slip remediation	Winter Bat Habitat/Portal Surveys			
Slip[2]	B-59	57.35	Added acreage for slip repair	Winter Bat Habitat/Portal Surveys	0.000	Unknown Use Summer Habitat	N/A
Slip[1]	B-26 (MVP-030)	58.60	Added acreage for slip repair	Winter Bat Habitat/Portal Surveys	0.060	Unknown Use Summer Habitat	April, 2021
Slip[1]	B-44 (MVP-030)	60.40	Added acreage for slip repair	Winter Bat Habitat/Portal Surveys	0.060	Unknown Use Summer Habitat	April, 2021
Slip[1]	B-41 (MVP-030)	61.02	Added acreage for slip repair	Winter Bat Habitat/Portal Surveys	0.010	N/A[3]	March, 2021
Slip[2]	B-62 (MVP-028)	61.08	Added acreage for slip repair	Winter Bat Habitat/Portal Surveys	0.001	N/A[3]	March, 2021
Slip[1]	B-56	61.70	Added acreage for slip repair	Winter Bat Habitat/Portal Surveys	0.000	Unknown Use Summer Habitat	N/A
Slip[2]	B-64 (MVP-028)	61.70	Added acreage for slip repair	Winter Bat Habitat/Portal Surveys	0.410	Unknown Use Summer Habitat	March, 2021
Slip[1]	B-39 (MVP-030)	62.10	Added acreage for slip repair	Winter Bat Habitat/Portal Surveys	0.039	Unknown Use Summer Habitat	April, 2021
Slip[2]	B-66 (MVP-035)	62.30	Added acreage for slip repair	Winter Bat Habitat/Portal Surveys	0.133	Unknown Use Summer Habitat	Felling Avoided
Slip[2]	B-65 (MVP-035)	64.60	Added acreage for slip repair	Winter Bat Habitat/Portal Surveys	0.050	N/A[3]	October, 2021
Slip[1]	B-40 (MVP-031)	65.30	Added acreage for slip repair	Winter Bat Habitat/Portal Surveys	0.130	Unknown Use Summer Habitat	August, 2021
Slip[2]	B-68 (MVP-035)	65.50	Added acreage for slip repair	Winter Bat Habitat/Portal Surveys	0.060	Unknown Use Summer Habitat	Felling Avoided
Slip[2]	C-37 (MVP-031)	86.75	Added acreage for slip repair	Winter Bat Habitat/Portal Surveys	0.600	Unknown Use Summer Habitat	September, 2022
Slip[2]	C-38 (MVP-035)	92.30	Added acreage for slip repair	Winter Bat Habitat/Portal Surveys; Running Buffalo Clover Surveys	0.000	Unknown Use Summer Habitat	N/A
Slip[1]	C-33 (MVP-030)	92.37	Added acreage for slip repair	Winter Bat Habitat/Portal Surveys; Running Buffalo Clover Surveys	0.190	Unknown Use Summer Habitat	April, 2022
WQMSs	D-39	118.90	Installation of water quality monitoring stations in 3 locations near the Gauley River as a condtion of the BO.	20U: Winter Bat Habitat/Portal Surveys	N/A	N/A	N/A
				20T: Winter Bat Habitat/Portal Surveys			
				20D: Winter Bat Habitat/Portal Surveys			

Slip[1]	D-26 (MVP-029)	119.75	Added acreage for slip repair	Winter Bat Habitat/Portal Surveys	0.030	Unknown Use Spring Staging / Fall	Pending
AR and ATWS	F-26	155.00	Added temporary access road MVP-GB- 192.02, and additional temporary workspaces MVP-ATWS-1656A, MVP- ATWS-1656B, and MVP-ATWS-1657 to facilitate upland work while avoiding impacts to wetland W-K7. The ATWS will be used for staging equipment and pipe while completing the upland work within the ROW while avoidi	Winter Bat Habitat/Portal Surveys; Running Buffalo Clover, Shale Barren Rock Cress, and Small Whorled Begonia Surveys; Meadow River Mudbug Surveys	N/A	N/A	N/A
ATWS	G-13	222.70	Added additional temporary workspaces MVP-ATWS-1606 and MVP-ATWS-1606A to facilitate delivery and installation of MVP-MLV-	Winter Bat Habitat/Portal Surveys; Smooth Coneflower	N/A	N/A	N/A

1 - Acreage included in 2020 BiOp (Table 5) as Estimated Tree Removal to Remediate Existing Slips

2 - Acreage included in 2020 BiOp (Table 5) as Estimated Tree Removal to Remediate Future Slips

3 - In unoccupied habitat (which has been determined unoccupied by standardized surveys) bats are not expected to be present in the habitat.

No Positive detections of species occurred during the surveys

Appendix F. Monitoring Plan.

The Service adopted the "Proposed Aquatic Species Monitoring Plan" provided by Mountain Valley on 9/1/2020 (T. Sibley, Hunton Andrews Kurth LLP, email to C. Schulz, Service September 1, 2020), developed in coordination with the Service and reviewed by USGS. The Monitoring Plan was updated on January 27, 2023.

Updated Aquatic Species Monitoring Plan (January 27, 2023)

The 2020 Biological Opinion[1] (BO) for the Mountain Valley Pipeline Project (the "Project") relies, in relevant part, on total suspended sediment (TSS) concentration, herein referred to as suspended sediment concentration (SSC), thresholds to determine take of Roanoke logperch (RLP) and candy darters (CD) from Project-related sediment. To ensure compliance with the amount or extent of sediment-related take identified by the U.S. Fish and Wildlife Service (USFWS) for those species, the Incidental Take Statement (ITS) requires Mountain Valley to monitor areas of RLP and CD streams to ensure that Project-related sediment concentrations do not cause more take of RLP or CD than USFWS anticipates. Specifically, the BO identifies stream areas where, under conditions modeled to delineate the aquatic portion of the Project's action area, the Project is expected to cause an increase of $\geq$20 mg/L SSC within the RLP and CD streams ("Streams of Interest") or an increase of $\geq$20 mg/L in a tributary that feeds into a Stream of Interest and could create a mixing zone at the tributary's confluence with the Stream of Interest. Tables 1 and 2 of Appendix D to the BO identify these areas as determined by USFWS.

On August 4, 2020, Mountain Valley submitted a proposed framework for monitoring sediment contributions from the Project to Streams of Interest impact areas and their tributaries.[2] Because there are numerous point sources (e.g., third party construction), nonpoint sources (e.g., disturbed land associated with forestry operations, agriculture, mining, and residential and commercial development), and natural sources (e.g., upland stormwater runoff, streambank erosion), which are unrelated to the Project but actively contribute sediment to the Streams of Interest impact areas and their tributaries, that framework describes an approach for monitoring Project-related sediment more accurately while significantly reducing the risk of measuring sediment from non-Project sources, which would skew the monitoring results.[3] As a result, monitoring in the tributary to the mixing zone, together with monitoring upstream and downstream of the mixing zone impact areas directly in the Stream of Interest, will provide a robust and more precise monitoring system for assessing any potential sediment contributions, and therefore species impacts, attributed to the Project.

To implement this monitoring approach, Mountain Valley has developed proposed "Sediment Concentration Action Thresholds" for each tributary and for the Streams of Interest using the modeling analysis and impact assessment methodology that USFWS

[1] United States Fish and Wildlife Service. 2020. Biological Opinion - Docket Number CP16-10-000. Finalized September 4, 2020. The 2020 BO, into which USFWS incorporated the Monitoring Plan as Appendix F, represents the most recent finalized BO for the Project. Mountain Valley proposes this Updated Monitoring Plan, which mirrors the version adopted by USFWS in the 2020 BO with the exception of minor updates to Project status, for USFWS's consideration for the anticipated 2023 BO.

[2] "MVP Summary of Alternative Monitoring Approach for Aquatic Species," dated August 4, 2020.

[3] In addition to reducing the likelihood of capturing contributions from non-Project sources, measuring within tributaries is expected to enable Mountain Valley to more accurately discern greater-than-anticipated SSC concentrations. Monitoring exclusively within Streams of Interest for sediment from the Project's upland construction activities would require discerning very small increases in SSC concentrations, at least some of which are likely within the error range for SSC measurement under the elevated background SSC conditions experienced in those streams during heavy rain events. By contrast, Project-related SSC concentrations from tributaries necessary to cause a $\geq$20 mg/L increase within a Stream of Interest will be much higher relative to background levels and thus much easier to discern accurately.

relied on to identify the ≥20 mg/L impact areas and the mixing zone impact areas in the Streams of Interest (see Table 2 for tributaries and below for Streams of Interest). Mountain Valley first will calculate the concentration of Project-related sediment that must occur in the tributary corresponding to those impact areas in order for the amount or extent of RLP or CD take to potentially be exceeded (the "Take Risk Concentration")—i.e., if the elevated sediment concentration from the Project expanded the downstream limit of the impact area in the Stream of Interest. The Sediment Concentration Action Threshold for each tributary will be set at 75% of the Take Risk Concentration, and Mountain Valley will monitor the tributary and complete the steps described under the Early Action Protocol below any time the concentration of Project-related sediment in the tributary exceeds the Sediment Concentration Action Threshold.[4]

Mountain Valley will set the Sediment Concentration Action Thresholds for the Streams of Interest at 75% of the durations or concentration that USFWS identifies in the BO as affecting RLP and CD. At the same time it is monitoring the tributaries, Mountain Valley also will monitor each Stream of Interest 200 meters upstream of the tributary confluence and 800 meters downstream of the tributary confluence and complete the steps described under the Early Action Protocol below any time a Project-related concentration measured at the downstream monitoring station exceeds one of the Stream of Interest Sediment Concentration Action Thresholds. Specifically, if the increase in Project-related sediment concentration in the Stream of Interest meets or exceeds 20 mg/L for more than 315 minutes continuously, 40 mg/L for more than 135 minutes continuously, 99 mg/L for more than 45 minutes continuously, or 111 mg/L for any duration, Mountain Valley will initiate the Early Action Protocol.

This paper provides the methodology for determining and implementing the Take Risk Concentration and the Sediment Concentration Action Threshold for each tributary and the protocols for implementing the above-described Sediment Concentration Action Thresholds and the USFWS-defined Take Risk Concentrations for the Streams of Interest, describes the proposed monitoring that Mountain Valley will perform to measure Project-related sediment in the tributaries and the Streams of Interest, and describes the steps that Mountain Valley will take to ensure that Project-related sediment does not increase above the Take Risk Concentration in the Streams of Interest.

This monitoring plan is designed to be consistent with USFWS's impacts analysis in the BO for the listed aquatic species. USFWS based that impacts analysis in relevant part on the modeling approach used to delineate the aquatic portion of the action area, which is described in full in the Supplement to the Biological Assessment[5] (SBA). That approach models incremental increases in delivered sediment concentration to a stream segment for a "during construction" scenario compared to a "baseline" scenario, under conditions associated with a 10-year design storm. The specific methodology was based on the

[4] The tributary's Sediment Concentration Action Threshold accounts only for the concentration of sediment in the tributary. It does not account for the duration that the elevated concentration occurs. This creates additional conservativism in Mountain Valley's protocol because USFWS's take assessment recognizes that the elevated concentrations must persist continuously to result in take of RLP and CD. Furthermore, the tributary's Sediment Concentration Action Threshold is based solely on the lowest Take Risk Concentration of 20 mg/L.

[5] Mountain Valley. 2020. Supplement to the Biological Assessment.

Hydrologic Analysis of Sedimentation, which was subjected to extensive peer review from multiple federal agencies, including USFWS, U.S. Geological Survey (USGS), and U.S. Forest Service.

The BO identifies (a) portions of Streams of Interest where the aquatic action area analysis shows the Project causing an increase of $\geq$20 mg/L, and (b) “mixing zones” where the analysis predicts that a tributary would carry 20 mg/L or more of Project-related sediment at the point of confluence with a Stream of Interest.[6] The purpose of the monitoring framework is to identify when the Project’s sediment contribution would cause an increase in sediment concentration within the Stream of Interest beyond the identified impact zones that would exceed the magnitudes and durations identified in the BO.

In its August 4, 2020 framework for monitoring sediment contributions, Mountain Valley explained the importance of monitoring within the tributaries to the Streams of Interest to more accurately isolate and measure sediment originating from the Project. As a result of subsequent conversations with USFWS and USGS, Mountain Valley not only will conduct sediment monitoring within the tributaries, but also upstream and downstream of the tributary’s confluence with the Stream of Interest. Mountain Valley will identify proposed monitoring locations for each tributary and Stream of Interest and submit the proposals to USFWS and FERC for review and approval. Each tributary monitoring location will be selected based on several tributary-specific factors, such as prevalence and scope of non-Project-related sources of sediment, topography, and availability of landowner access, but will not be installed farther upstream than the most downstream point of anticipated Project-related sediment-generating activity within the tributary catchment. Stream of Interest monitoring locations will typically focus on the limits of the mixing zone impact areas, 200 meters upstream and 800 meters downstream of the confluence with the monitored tributary. In instances where mixing zones overlap and/or the estimated sediment concentration in the Stream of Interest was calculated as >20 mg/L, the monitoring stations in the Stream of Interest may be spaced farther than 1,000 meters apart.

The results of the modeling analysis used to identify the aquatic action area provide a straightforward approach for identifying the Project-related sediment concentration within each tributary at the proposed monitoring location that would be necessary for that tributary to subsequently cause a concentration increase within the Stream of Interest of any specified magnitude. For the purpose of identifying the Sediment Concentration Action Threshold in the tributary at which Mountain Valley would need to take steps in the field to minimize, assess, or prevent the Project from contributing sediment at levels that could surpass the Take Risk Concentration, Mountain Valley calculated the amount of Project-related sediment required to cause a $\geq$20 mg/L increase at the downstream boundary of the impact area within the Stream of Interest. The methods used to calculate

[6] This analysis showed that the flow in the aquatic species stream would dilute the sediment concentration delivered by the tributary to a level below 20 mg/L and, in most cases, below a level that could be practically discerned.

the Take Risk Concentration and Sediment Concentration Action Threshold for each tributary are described below:

1. Estimate the "during construction" sediment concentration[7] in the Stream of Interest segment upstream of the tributary (C_u) for the 10-year, 24-hour duration design storm using the established aquatic action area methodology presented in the SBA. This concentration includes any Project-related sediment from upstream sources.

2. Estimate the 10-year, 24-hour duration design storm runoff volumes for the tributary watershed (V_t) and the Stream of Interest watershed upstream of the tributary (V_u) using the Curve Number method as described in the aquatic action area methodology presented in the Supplement to the Biological Assessment.

3. Calculate the maximum Stream of Interest sediment concentration downstream of the tributary such that the concentration does not reach or exceed 20 mg/L over background. The maximum downstream sediment concentration (C_d) is calculated using Equation (1).

$$C_{\mathrm{d}} = C_{\mathrm{u}} + (20 - C_{\mathrm{inc}}) \tag{1}$$

Where:

C_d = modeled sediment concentration corresponding to 20 mg/L over background in the Stream of Interest segment downstream of the tributary (mg/L),

C_u = modeled background sediment concentration in the Stream of Interest segment upstream of the tributary (mg/L), and

C_{inc} = modeled incremental increase in Project-related sediment concentration in the Stream of Interest segment upstream of the tributary (mg/L).

With respect to C_{inc}, in zones where areas disturbed by the Project do not drain into the Stream of Interest upstream of the zone, C_{inc} = 0 mg/L and the maximum downstream concentration is 20 mg/L above the upstream concentration. In zones where the Project has contributed sediment to the Stream of Interest upstream, C_{inc} > 0 mg/L and the maximum downstream concentration is <20 mg/L above the upstream concentration to account for the Project-related sediment already within the Stream of Interest.

[7] Rather than analyzing the difference (i.e., incremental increase) in delivered sediment between baseline and during construction scenarios, only the delivered sediment load for the during construction scenario is used to estimate the during construction sediment concentration. This ensures that the maximum sediment concentration established in the tributary accounts for the existing Project-related sediment contribution in the Stream of Interest.

4. Using Equation (2) from established mass balance principles, calculate the tributary sediment concentration (C_t) that will result in the maximum downstream Stream of Interest sediment concentration from Equation (1) above.

$$C_t = \frac{[C_u + (20\frac{\text{mg}}{\text{L}} - C_{inc})] \text{ x } [V_d] - C_u \text{ x } V_u}{V_t} \quad (2)$$

Where:

C_t = sediment concentration in the tributary (mg/L) necessary to produce an increase of 20 mg/L or greater in a Stream of Interest under modeled conditions,

C_u = modeled background sediment concentration in the Stream of Interest segment upstream of the tributary (mg/L),

V_t = 10-year, 24-hour design storm runoff volume in the tributary (L),

V_u = 10-year, 24-hour design storm runoff volume in the Stream of Interest segment upstream of the tributary (L), and

V_d = 10-year, 24-hour design storm runoff volume in the Stream of Interest segment downstream of the tributary (L); assuming $V_d = V_u + V_t$.

The Project-related impacts in the Stream of Interest upstream of the tributary's confluence are accounted for by including the anticipated incremental increase in during construction sediment concentration in the Stream of Interest segment upstream of the tributary (i.e., C_{inc}).

The calculated sediment concentration in the tributary (C_t) reflects the concentration from the tributary from all sources—i.e., from the Project and other sources—necessary to cause C_d to equal or exceed 20 mg/L above background. Therefore, an exceedance of C_t in samples taken from a given tributary may not indicate that the Project alone would have caused the increase. But, as described below, in most locations, a measured reading approaching C_t would indicate a need to evaluate the Project's erosion control devices, as well as potential contributions from other sources. Mountain Valley proposes to set this Sediment Concentration Action Threshold at 75% of C_t, measured through turbidity as described below.

Sediment concentrations at these locations will be measured using traditional methods for measuring SSC. In addition, to allow for more rapid feedback, turbidity also will be measured at these locations, and turbidity measurements in nephelometric turbidity units (NTUs) will be converted to sediment concentrations based on guidelines developed by Hyer et al. (2015).[8] Due to the conservative nature of this approach, it is anticipated that use of these conversions initially could result in measurements that trigger Mountain

[8] Hyer, et al. (2015). Evaluation and Application of Regional Turbidity-Sediment Regression Models in Virginia.

Valley's obligation to implement the Early Action Protocol, but that the SSC samples collected at the same time could show that Project-related sediment did not actually reach the Sediment Concentration Action Threshold. While that will provide important conservatism initially, as monitoring continues and additional site-specific SCC sampling data are collected, Mountain Valley will fine-tune the conversions as appropriate to make them even more precise and reduce the risk of false positives.

Using guidelines from Hyer, et al. (2015), the Sediment Concentration Action Threshold based on turbidity can be calculated using the relationship described in Equation (3).

$$\ln(0.75 \text{ x } C_{\mathrm{t}}) = 0.5204 + 0.9592 \text{ x } \ln(turbidity) \quad (3)$$

Solving for the monitoring turbidity threshold as described in Equation (4).

$$Turbidity\ threshold = \ e^{[\ln(0.75*\mathrm{Ct})\text{-}0.5204]\div\text{-}0.9592} \quad (4)$$

Where:

ln(turbidity) = natural logarithm transformation of turbidity (in units of NTU), and

$\ln(0.75 \times C_t)$ = natural logarithm transformation of Sediment Concentration Action Threshold (in units of mg/L).

This approach may be modified to account for characteristics specific to each impact area. In some areas, for example, the size of the Project's expected contribution relative to the expected concentrations from other sources would make it impracticable to sample within the tributary feeding a mixing zone. In other areas, landowners may preclude access to areas within the tributary where sampling would be effective.

The use of this methodology to identify Sediment Concentration Action Thresholds for tributaries would not preclude the use of other sampling locations relevant to the Project's contribution to a specific impact zone. For example, Mountain Valley may elect to sample at additional points within the tributary or within the Stream of Interest to develop data that would allow the Project's contribution to be more precisely defined.

The tributary concentrations and Sediment Concentration Action Thresholds for turbidity are summarized in Table 2.

Overview of Monitoring Protocols

Instream monitoring of sediment concentrations will incorporate in-situ (i.e., continuously logging sensors) and traditional laboratory analysis. Data collected will include turbidity, water level (i.e., stage), rainfall, and SSC. The parameter collection frequency and units are presented in Table 1.

Table 1 – Monitoring Parameters

Parameter	Sample Type	Frequency[9]	Units
Turbidity	In-Situ	15 minutes	NTU
Stage	In-Situ	15 minutes	feet
Rainfall	In-Situ	15 minutes	inches
Suspended Sediment Concentration	Automated Grab	15 minutes[10]	milligram per liter

In-situ monitoring equipment will include a turbidity sensor, a water-level sensor, a rain gauge, and a security camera. All in-situ data will be collected at a minimum of 15-minute intervals for the duration of the deployment. Site-specific conditions in the tributaries (e.g., tributaries with short-duration flow events) may require more frequent monitoring intervals (i.e., 5-minute). Turbidity sensors will be Formazin Nephelometric Unit (FNU) instruments, which use near infrared (780-900 nm) light source with a 90-degree detection angle and one detector. The sensor will be capable of measuring the range of anticipated turbidity levels, and data will be reported in NTU. Water-level sensors will be used to measure stage at each monitoring location. Stage data will be converted to flow using Manning's equation,[11] until sufficient discharge measurements are taken to develop site-specific correlations of stage and flow. Initially, surveyed channel geometry and water level will be used for area estimates; surveyed channel slope and Manning's roughness[12] will be used to derive estimated flow velocities. A tipping bucket rain gauge will record rainfall at each monitoring location.

Traditional laboratory analysis will consist of SSC analysis of water samples collected by an automatic sampler deployed at the monitoring location. The automatic sampler will have the ability to collect 24 individual samples. Samples will be time-paced at site-specific (e.g., 15-minutes) intervals following the threshold trigger from the turbidity sensor. Following the trigger of sampling, the sample bottles will be collected and sent to the laboratory for SSC analysis. To capture the hydrograph, sampling will continue until turbidity has returned to levels below the Sediment Concentration Action Threshold. The sampler will be programmed to rinse and purge between each sample interval.

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[9] Initial monitoring frequency will be conducted at 15-minute increments; site-specific conditions (e.g., tributaries with short-duration flow events) may require more frequent monitoring intervals. The 15-minute frequency is expected to be sufficient for the Streams of Interest.

[10] SSC will be triggered by a change in stage during Phase 1 sampling activities (as described below) or once the turbidity level exceeds 65% of the Take Risk Concentration during both Phase 1 and Phase 2 sampling activities.

[11] Chow, T.V. 1959. Open-Channel Hydraulics.

[12] Arcement, George J., Guide for Selecting Manning's roughness coefficients for natural channels and flood plains.

Monitoring stations will be established following guidance in USGS's *Guidelines and standard procedures for continuous water-quality monitors—Station operation, record computation, and data reporting*.[13] Stations will consist of the previously mentioned sensors and automated sampler connected to data logger; additional details are listed in the following section. Stations will be maintained according to manufacturer recommendations, guidance in *Guidelines and standard procedures for continuous water-quality monitors—Station operation, record computation, and data reporting* and Project-specific protocols. Routine maintenance is vital to maintaining data quality. Monitoring stations will incorporate a telemetry system to allow real-time access to data and provide a means for transmittal of notifications (e.g., thresholds, malfunction) to the Project team. Further details related to routine monitoring and maintenance are provided in Monitoring and Maintenance Protocols – Phase 1 and Monitoring and Maintenance Protocols – Phase 2 sections below.

Monitoring and Maintenance Protocols – Phase 1

Phase 1 of monitoring will commence within one week of commissioning of a monitoring station. During Phase 1, accelerated data collection activities will include routine weekly discrete sampling for turbidity, SSC, stage, and flow. Turbidity data collection will include equal width cross-sectional measurements at the monitoring location(s) to compare to fixed turbidity sensor measurements. An equal width interval sample will be collected across the cross-section for SSC analysis; this provides comparison to the automated sampling location and data for refining site-specific relationships. A flow measurement will be collected at the monitoring location during weekly site visits for establishing stage-flow relationships to improve confidence in the estimated flow velocities described above.

During Phase 1, to generate additional information with which to fine-tune the conversions, storm events will be targeted (beyond that described above) for collection of storm event data. Storm event protocols will be consistent with routine weekly sampling protocols. Storm event automated sampling will be triggered by change in stage. For tributaries, sampling will be triggered by a four-inch increase in stage. Automated sampling at Streams of Interest will be triggered by a six-inch rise in stage. Stage triggers may be adjusted to accommodate site-specific conditions at each of the monitoring locations.

[13] Wagner, R.J., Boulger, R.W., Jr., Oblinger, C.J., and Smith, B.A., 2006, Guidelines and standard procedures for continuous water-quality monitors—Station operation, record computation, and data reporting: U.S. Geological Survey Techniques and Methods 1–D3, 51 p. + 8 attachments; accessed April 10, 2006, at http://pubs.water.usgs.gov/tm1d3

The routine weekly and storm event sampling will continue until sufficient samples have been collected to allow for any appropriate fine-tuning of the NTU-SSC conversions, at which point Mountain Valley will transition to the Phase 2 monitoring approach described below following written notification to and approval of FERC and USFWS.

In addition, weekly site visits will include maintenance of the deployed equipment. Maintenance activities will follow guidance in *Guidelines and standard procedures for continuous water-quality monitors—Station operation, record computation, and data reporting* and Project-specific protocols.

Once commissioned, the monitoring station will initiate “take risk sampling” protocols consisting of measuring the turbidity of the water in the stream. When turbidity reaches the pre-established “notification threshold” (i.e., 65% of the Take Risk Concentration), the datalogger will confirm that the water-level sensor has an upward trend. If these conditions are met, the data logger will trigger the automatic sampler to begin its sampling routine. Simultaneously, a notification will be sent to the Project team alerting them sampling has commenced. If turbidity levels reach the Sediment Concentration Action Threshold (i.e., 75% of the Take Risk Concentration), the datalogger will transmit a notification to the Project team alerting them of the condition. The automatic sampler will continue to collect samples until the turbidity drops below the “notification threshold” or all the bottles have been filled. A notification will also be sent to the Project team when eight (8) of the 24 bottles remain to be filled (e.g., two hours at 15-minute intervals) to allow the Project team to mobilize to the sampling location with additional bottles. When the sampler has stopped sampling, a message will be transmitted to the Project team so samples can be collected.

Monitoring and Maintenance Protocols – Phase 2

Following the initial accelerated data collection period, routine sampling and maintenance will be conducted on a monthly basis. Phase 2 routine discrete sampling and maintenance will follow the same protocols as those in Phase 1 except with a reduced frequency.

For Phase 2, the monitoring station will continue only the "take risk sampling" protocols consisting of measuring the turbidity of the water in the stream. When turbidity reaches the pre-established "notification threshold" (i.e., 65% of the Take Risk Concentration in a tributary or Stream of Interest), the datalogger will confirm that the water-level sensor has an upward trend. If these conditions are met, the data logger will trigger the automatic sampler to begin its sampling routine. Simultaneously, a notification will be sent to the Project team alerting them sampling has commenced. If turbidity levels reach the Sediment Concentration Action Threshold (i.e., 75% of the Take Risk Concentration), the datalogger will transmit a notification to the Project team alerting them of the condition. The automatic sampler will continue to collect samples until the turbidity drops below the "notification threshold" or all the bottles have been filled. A notification will also be sent to the Project team when eight (8) of the 24 bottles remain to be filled (e.g., two hours at 15-minute intervals) to allow the Project team to mobilize to the sampling location with additional bottles. When the sampler has stopped sampling, a message will be transmitted to the Project team so samples can be collected.

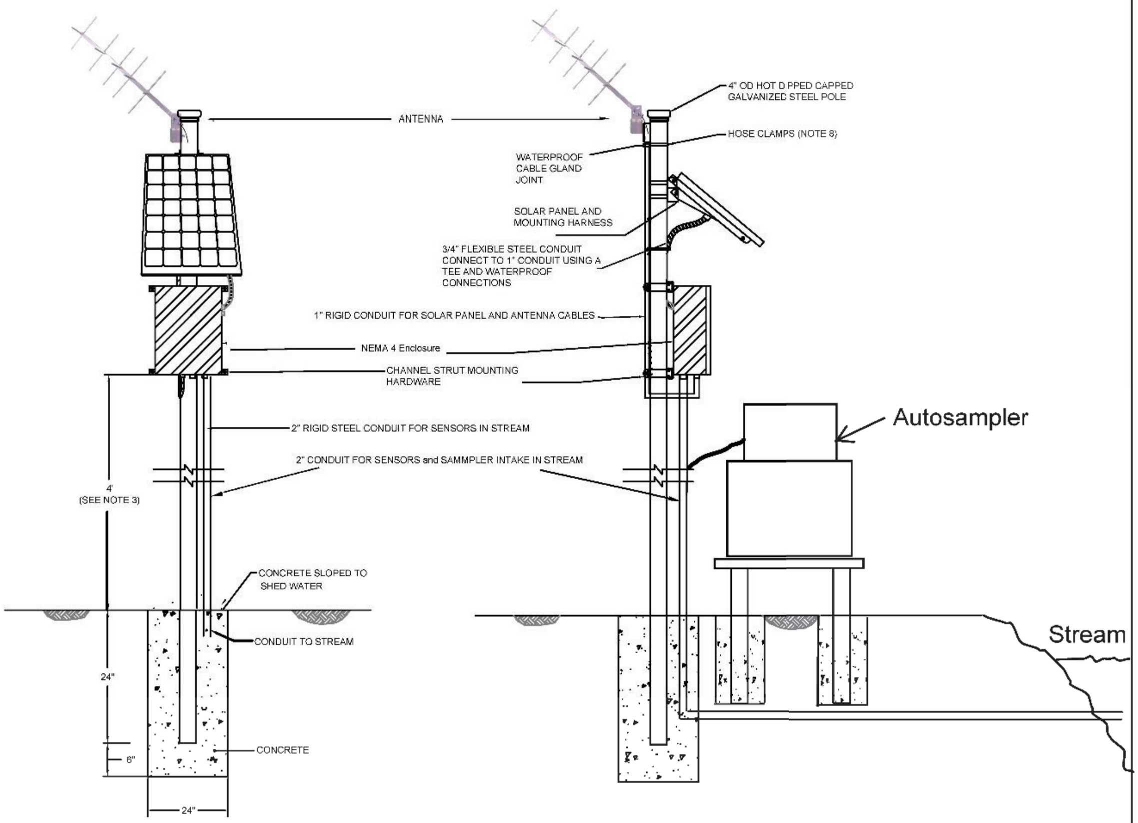
Overview of Monitoring Station Arrays

Monitoring stations will generally consist of the following major components:[14]

1) Datalogger appropriate for receiving, storing, and transmitting monitoring station data. In addition, the datalogger will be programmable in order to transmit threshold notifications and control the collection of water samples.
2) Turbidity sensor capable of measuring to the anticipated maximum turbidity levels and following the International Organization for Standardization (ISO) method 7027.
3) Automatic sampler with multi-bottle configuration (i.e., 24 bottles).
4) Water-level sensor (i.e., stage), such as a pressure transducer or bubbler, for flow estimation.
5) Tipping bucket rain gauge.
6) Camera for visual monitoring of stream conditions
7) Cellular modem or other site-appropriate telemetry.
8) Power source appropriately sized stand-alone 12-volt power source with solar charger.
9) All-weather enclosures.

[14] Monitoring station components may require minor adjustments to address site-specific conditions. Adjustments will improve, not diminish, the functionality of the station.

The following images and illustrations are included to provide a conceptual view of the monitoring station described above.



NOTES:

1. BOLT ENCLOSURE TO SUPPORT POLE USING CHANNEL STRUT AND STAINLESS STEEL MOUNTING HARNESS PROVIDED BY OPTIRTC.
2. ALL CONDUIT PENETRATIONS INTO ENCLOSURE OR TERMINATIONS ARE TO BE IP68 RATED.
3. CONTROL PANEL SHOULD BE MOUNTED AS HIGH AS POSSIBLE, HIGHER THAN THE EXPECTED HIGH WATER LEVEL IS MINIMUM RECOMMENDATION.
4. SOLAR PANEL AND MOUNTING HARNESS (EXAMPLE: AMERESCO SOLAR PART VLS-20W)
5. LEAVE MINIMUM OF 1 FOOT SPARE CABLING NEATLY COILED IN JUNCTION BOXES FOR FUTURE MAINTENANCE OR SYSTEM MODIFICATIONS.
6. MOUNT TIPPING BUCKET RAIN GAGE PER MANUFACTURERS INSTRUCTIONS. TIPPING BUCKET CAN BE MOUNTED WITH WORM-DRIVE HOSE CLAMPS TO FIT ANY SIZE POLE. ALTERNATIVELY, CHANNEL STRUT OR 90 DEGREE METAL BRACKET CAN SUPPORT THE BUCKET FROM UNDERNEATH. THE BUCKET MUST BE MOUNTED LEVEL.
7. ANTENNA SHOULD BE SITED SUCH THAT SURROUNDING OBJECTS ARE NO CLOSER THAN TWO TIMES THEIR HEIGHT ABOVE THE GAGE.
8. USE ALL STAINLESS STEEL HOSE CLAMPS OR EQUIVALENT FOR SECURING CONDUIT TO POLE.

Response to Detection of Sediment Concentration Action Threshold

In the event a monitoring station detects a concentration of Project-related sediment in a tributary above the Sediment Concentration Action Threshold (i.e., 75% of the Take Risk Concentration) or an increase within the Stream of Interest above the concentrations/durations described above, Mountain Valley will initiate the Early Action Protocol described below. Establishing the Sediment Concentration Action Threshold at 75% of the corresponding Take Risk Concentration for each site provides a minimum[15] 25% protective buffer against sediment from the Project increasing the concentration within a Stream of Interest sufficiently to expand the limits of the impact area and risk exceeding the amount or extent of RLP and CD take anticipated in the ITS. The Early Action Protocol therefore requires Mountain Valley to respond to elevated, but non-impactful, concentrations to ensure that sediment from the Project will not exceed the Take Risk Concentration.

Early Action Protocol: Mountain Valley will take the following steps if, at any time during the monitoring period, a designated Project monitoring station measures a turbidity level greater than or equal to the Sediment Concentration Action Threshold identified in Table 2 for that station and less than the corresponding Take Risk Concentration, or if an increase measured at the downstream monitoring station for an impact area in the Stream of Interest exceeds the thresholds and corresponding durations identified above.

1) Unless a different deadline is specifically identified below, complete each of the following steps within 48 hours or as soon as conditions safely allow:

   a. Inspect the monitoring equipment that measured the Sediment Concentration Action Threshold for fouling, malfunction, or failure to determine the possibility of a false reading and document the results of that inspection. If a problem with the equipment is identified, return the station to correct working order within 72 hours following inspection or as soon as conditions safely allow. If the station cannot be returned to service within that time, contact FERC and USFWS to identify an alternative monitoring approach to implement until the monitoring station can be brought back online.

   b. Comprehensively inspect all Project erosion and sediment (E&S) controls within the catchment area(s) draining to the monitoring station to identify any damage to or failures of existing controls.

[15] As explained above, the Take Risk Concentration accounts for all sediment within a tributary, including sediment contributed by non-Project sources. As shown in Table 2, the Project's contribution is a small fraction of the total expected under modeled conditions.

i. Any evidence of such damage or failure will be documented and photographed, and the control will be repaired or replaced (if warranted).

ii. The inspector will prepare a written determination stating whether the damaged or failed control(s) contributed to the elevated concentration measured at the monitoring station and explain the basis for that determination.

iii. If a damaged or failed E&S control resulted in Project-related sediment leaving the limits of disturbance but not entering the monitored stream, the inspector will document that and determine in writing whether an enhancement to the E&S control is needed to prevent recurrence and recommend any enhancement deemed needed. Within 72 hours of receiving a recommendation or as soon as conditions safely allow, Mountain Valley will implement the enhancement(s) to the E&S control. All such enhancements will be photographed upon completion of installation.

iv. If a damaged or failed E&S control resulted in Project-related sediment entering the monitored stream, the inspector will document that and identify one or more enhancements to the E&S control to prevent recurrence. Within 72 hours of receiving notification from the inspector or as soon as conditions safely allow, Mountain Valley will implement the enhancement(s) to the E&S control. All such enhancements will be photographed upon completion of installation.

v. Within 72 hours of completing installation of an enhancement under the above requirements or as soon as conditions safely allow, identify other locations within the catchment area where similar Project E&S controls did not experience damage or failure but that would benefit from installation of enhanced control to minimize the risk of future damage or failure. Mountain Valley will implement the enhanced control in all identified areas.

c. Within 72 hours or as soon as conditions safely allow, inspect accessible areas of the monitored stream and the catchment to identify any non-Project sources of sediment that the inspector believes could have appreciably contributed to the elevated concentration measured by the monitoring station. The inspector will record the location of and photograph the source and prepare a written description of the source, the inspector’s opinion of the significance of its sediment contribution, and the basis for that opinion.

2) After completing the above-described inspections, documentation, and response actions, Mountain Valley will notify FERC and USFWS of its activities under the Early Action Protocol and provide any additional information that FERC or USFWS may request.

Response to Detection of Take Risk Concentration

In the event a monitoring station detects a concentration of Project-related sediment above the Take Risk Concentration for a tributary or an increase within a Stream of Interest that meets or exceeds the thresholds as presented in the BO, Mountain Valley will initiate the Rapid Response Protocol described below. Specifically, if the increase in sediment concentration measured at the downstream monitoring station for an impact area in the Stream of Interest meets or exceeds 20 mg/L for more than 7 hours continuously, 40 mg/L for more than 3 hours continuously, 99 mg/L for more than 1 hour continuously, or 148 mg/L for any duration, the Rapid Response Protocol will be initiated. The Rapid Response Protocol contemplates that sediment from the Project *might* cause an increase in the concentration within a Stream of Interest sufficiently to expand the limits of the impact area and risk exceeding the amount or extent of RLP and CD take anticipated in the ITS. The Rapid Response Protocol therefore requires Mountain Valley to respond to potentially impactful concentrations of sediment from the Project by providing immediate notice, identifying the Project- and non-Project cause(s) of the elevated concentration, quickly implementing any measures to reduce Project-related contributions, analyzing all available information to make a preliminary determination of whether Project-related sediment in fact caused a Take Risk Concentration exceedance.

<u>Rapid Response Protocol</u>: Mountain Valley will take the following steps if, at any time during the monitoring period, a designated Project monitoring station measures a turbidity level greater than Take Risk Concentration identified in Table 2 for that station or if the downstream monitoring station for an impact area in a Stream of Interest exceeds the thresholds and corresponding durations identified above:

1) Notify FERC and USFWS in writing (e.g., email) within 24 hours, identify the location, concentration measured, provide any additional information of relevance (e.g., rainfall amount/duration) if known, and confirm that Mountain Valley is initiating the Rapid Response Protocol.

2) Unless a different deadline is specifically identified below, complete each of the following Rapid Response Protocol steps within 48 hours or as soon as conditions safely allow:

    a. Inspect the monitoring equipment that measured the Take Risk Concentration for fouling, malfunction, or failure to determine the possibility of a false reading and document the results of that inspection. If a problem with the equipment is identified, return the station to correct working order within 72 hours or as soon as conditions safely allow. If the station cannot be returned to service within that time, contact FERC and USFWS to identify an alternative monitoring approach to implement until the monitoring station can be brought back online.

b. Comprehensively inspect all Project E&S controls within the catchment area(s) draining to the monitoring station to identify any damage to or failures of existing controls.

    i. The inspector will document and photograph any evidence of such damage or failure and will repair or replace (if warranted) the control.

    ii. The inspector will prepare a written determination stating whether the damaged or failed control(s) contributed to the elevated concentration measured at the monitoring station and explain the basis for that determination.

    iii. If the inspector determines that the damage to or failure of the E&S control resulted from a design deficiency or that the damage or failure resulted in Project sediment leaving the limits of disturbance, regardless of whether it entered the monitored stream, the inspector will document that and identify one or more enhancements to the E&S control to further reduce sediment loss from the Project area and prevent recurrence. Mountain Valley will implement the enhancement(s) to the E&S control within 72 hours of receiving the inspector's notice or as soon as conditions safely allow. All such enhancements will be photographed upon completion of installation.

    iv. Within 72 hours of completing installation of an enhancement under the above requirements or as soon as conditions safely allow, Mountain Valley will identify other locations within the catchment area where similar Project E&S controls did not experience damage or failure but that would benefit from installation of enhanced control to minimize the risk of future damage or failure. Mountain Valley will implement the enhanced control in all identified areas. All such enhancements will be photographed upon completion of installation.

    v. If the inspector determined that the problem resulted from a design deficiency, within 72 hours of that determination or as soon as conditions safely allow, Mountain Valley will identify all similar Project E&S controls installed within each RLP and CD watershed that remains under construction and implement similar enhancements in those locations. All such enhancements will be photographed upon completion of installation.

c. Within 72 hours or as soon as conditions safely allow, inspect accessible areas of the monitored stream and the catchment to identify any non-Project sources of sediment that the inspector believes could have appreciably contributed to the elevated concentration measured by the monitoring station. The inspector will record the location of and photograph the source and prepare a written description of the source, the inspector's opinion of the significance of its sediment contribution, and the basis for that opinion.

3) After completing the above-described inspections, documentation, and response actions, within five days, Mountain Valley will submit a report to FERC and USFWS detailing each action taken, summarizing its analysis of the issue, and providing any additional information that FERC or USFWS may request.

Table 2. Summary of Action and Take Risk Concentration Thresholds for Monitoring Impact Areas Identified in 2020 BO (updated January 27, 2023)

ID	County	River Basin	Stream of Interest	Location of Tributary Entering Stream of Interest	Tributary NHD Reach Code	Tributary Name	Tributary Type	Total Impact Length (m) in Stream of Interest	Percent Contribution of Project-related Sediment in Tributary Under Modeled Conditions (%)	Tributary Take Risk Concentration Resulting in 20 mg/L increase in Stream of Interest (mg/L)	Tributary Sediment Concentration Action Threshold for Turbidity (NTU)
1[1]	Montgomery	Roanoke	North Fork Roanoke River	Approximately 0.7 km upstream of MP 227.4 crossing of North Fork Roanoke	03010101000799	Dry Run	perennial	700	5.3	669	380
2	Montgomery	Roanoke	North Fork Roanoke River	Approximately 3.5 km downstream of MP 227.4 crossing of North Fork Roanoke	03010101000892	Mill Creek	perennial	1,810	7.8	927	534
3	Montgomery	Roanoke	North Fork Roanoke River	Approximately 3 km downstream of MP 229.7 crossing of Flatwoods Branch tributary	03010101000783	Flatwoods Branch	perennial	1,000	5.7	721	411
4	Montgomery	Roanoke	Bradshaw Creek	Above MP 230.9 crossing of Bradshaw; two tributaries entering Bradshaw Creek	03010101002185, 03010101002195	no name, Womack Branch	both intermittent	5,830	[Note 2]	[Note 2]	[Note 2]
5	Montgomery	Roanoke	North Fork Roanoke River	Approximately 2.5 km downstream of MP 230.9 crossing of Bradshaw Creek	03010101000317	Bradshaw Creek	perennial	1,000	3.8	622	352
6[1]	Montgomery	Roanoke	North Fork Roanoke River	Approximately 4.5 km upstream of MP 235.6 crossing of Roanoke River	03010101002184	no name	intermittent	1,000	28.5	2,074	1,236
7	Montgomery	Roanoke	South Fork Roanoke River	Approximately 1.5 km upstream of confluence with the Roanoke River	03010101008530	Indian Run	intermittent	1,000	47.6	5,212	3,230
8	Montgomery	Roanoke	North Fork Roanoke River & Roanoke River	Approximately 2 km upstream of MP 235.6 crossing of Roanoke River	03010101002183	no name	intermittent	925 (465 in North Fork Roanoke River; 460 in Roanoke River)	62.4	3,019	1,828
9	Montgomery	Roanoke	Roanoke River	Approximately 1 km upstream of MP 235.6 crossing of Roanoke River	03010101002183	no name	intermittent	800	26.0	2,995	1,813
10	Montgomery/ Roanoke	Roanoke	Roanoke River	Approximately 0.3 km downstream of MP 235.6 crossing of Roanoke River	03010101002181	no name	intermittent	670	12.7	[Note 3]	[Note 3]
11	Roanoke	Roanoke	Roanoke River	Approximately 0.8 km downstream of MP 235.6 crossing of Roanoke River	03010101002349	no name	perennial	800	14.8	1,843	1,093
12	Roanoke	Roanoke	Roanoke River	Approximately 5.5 km downstream of MP 235.6 crossing of Roanoke River	03010101002351	no name	perennial	1,000	6.1	1,326	775
13	Franklin	Pigg	Pigg River	Approximately 2 km downstream of MP 280.0 crossing of Little Jacks Creek	03010101001376	Jacks Creek	perennial	1,000	3.5	1,174	683

ID	County	River Basin	Stream of Interest	Location of Tributary Entering Stream of Interest	Tributary NHD Reach Code	Tributary Name	Tributary Type	Total Impact Length (m) in Stream of Interest	Percent Contribution of Project-related Sediment in Tributary Under Modeled Conditions (%)	Tributary Take Risk Concentration Resulting in 20 mg/L increase in Stream of Interest (mg/L)	Tributary Sediment Concentration Action Threshold for Turbidity (NTU)
14	Franklin	Pigg	Pigg River	Approximately 3 km downstream of MP 280.7 crossing of Turkey Creek	03010101001373	Turkey Creek	perennial	1,000	2.8	3,092	1,874
15	Franklin	Pigg	Pigg River	Approximately 3 km downstream MP 283.0 crossing of Parrot Branch	03010101001359	Parrot Branch	perennial	1,000	3.4	[Note 4]	[Note 4]
16	Pittsylvania	Pigg	Pigg River	Approximately 2 km downstream of MP 287.2 crossing of unnamed tributary	03010101001349	Rocky Creek	perennial	900	4.0	3,365	2,047
17[1]	Pittsylvania	Pigg	Pigg River	Approximately 0.7 km downstream of confluence of Rocky Creek and Pigg River	03010101001348	no name	intermittent	800	1.4	13,757	8,886
18[1]	Pittsylvania	Pigg	Pigg River	Approximately 0.6 km downstream of MP 289.2 crossing of Pigg River	03010101001347	no name	perennial	1000	1.1	6,966	4,371
19[1]	Webster	Gauley	Gauley River	Approximately 1.8 km upstream of Strouds Creek confluence with Gauley River	05050005000952	Coon Creek	Perennial	1,000	12.0	2,803	1,692
20	Nicholas	Gauley	Gauley River	Approximately 0.9 km upstream of MP 118.9 crossing of Gauley River	05050005000554	Little Laurel Creek	Perennial	1,000	6.7	2,415	1,449
21	Giles	New River	Stony Creek	Approximately 1.1 km upstream from MP 200.3	05050002000869	Kimballton Branch	Perennial	1,000	25.1	886	509

Note 1: As confirmed by USFWS on October 9, 2020, the monitoring requirement in MZs 1, 6, 17, 18, and 19 was discontinued due to completion of Project construction and restoration in those watersheds.

Note 2: Tributary concentrations for Bradshaw Creek are not listed because the action area methodology indicates that the Project will cause an increase >20 mg/L in the entire impact area within Bradshaw Creek. Bradshaw Creek would be monitored as a tributary of North Fork Roanoke River.

Note 3: In the 2020 Biological Opinion, MZ10 was identified as a mixing zone impact area prior to identifying an existing tributary impoundment. Upon further review, as confirmed by USFWS on November 30, 2020, the presence of an existing tributary impoundment ensures that no Mixing Zone Impact Area developed at MZ10.

Note 4: In the 2020 Biological Opinion, MZ15 was identified as a mixing zone impact area prior to identifying an existing tributary impoundment. Upon further review, as confirmed by USFWS on December 22, 2020, the presence of an existing tributary impoundment ensures that no Mixing Zone Impact Area developed at MZ15.

Appendix G. Non-jurisdictional Facilities.

Summary of Non-jurisdictional Facilities for the MVP Project

Site Name	State	County	Milepost	Latitude	Longitude	Estimated Tree- Felling Acreage	Length of Project (feet)	Estimated Width (feet)	Updated IPaC Results (After December 14, 2022)[1]	Indiana Bat Habitat Type	Northern Long-Eared Bat Habitat Type	Instream work anticipated	Potential Plant Habitat (2022 Update)	UPDATED 2022 Nearest Known or Presumed Occupied Portal (miles)	Potential Tree Felling Required for Non- JD Facility
Bleier IC	VA	Montgomery	236.8	37.2180	-80.1950	0.88	2961.24	20.00	Indiana bat (*Myotis sodalis*) Northern long-eared bat (*Myotis septentrionalis*) Smooth coneflower (*Echinacea laevigata*) Candidate monarch butterfly (*Danaus plexippus*) No critical habitat identified	Unknown use spring staging/fall swarming	Known use summer habitat	No	Not likely suitable habitat for smooth coneflower. The area consists of forest, forest edge, and scrub-shrub where competition levels are high and limited preferred habitat.	1.86	Yes
Bradshaw Compressor Station	WV	Wetzel	2.7	39.533082	-80.532927	0.00	182.40	20.00	Indiana bat (*Myotis sodalis*) Northern long-eared bat (*Myotis septentrionalis*) Tricolored bat (*Perimyotis subflavus*) Clubshell (*Pleurobema clava*) Candidate monarch butterfly (*Danaus plexippus*) No critical habitat identified	Non-Jurisdictional facility to be sited in a location without tree cover.	Non-Jurisdictional facility to be sited in a location without tree cover.	No	N/A	19.77	N/A
CPGB-01A	WV	Wetzel	2.3	39.533939	-80.541225	0.00	23.43	20	Indiana bat (*Myotis sodalis*) Northern long-eared bat (*Myotis septentrionalis*) Tricolored bat (*Perimyotis subflavus*) Clubshell (*Pleurobema clava*) Candidate monarch butterfly (*Danaus plexippus*) No critical habitat identified	Non-Jurisdictional facility to be sited in a location without tree cover.	Non-Jurisdictional facility to be sited in a location without tree cover.	No	N/A	19.77	N/A
CPGB-01B	WV	Wetzel	6.5	39.490037	-80.521823	0.03	413.00	20	Indiana bat (*Myotis sodalis*) Northern long-eared bat (*Myotis septentrionalis*) Tricolored bat (*Perimyotis subflavus*) Clubshell (*Pleurobema clava*) Candidate monarch butterfly (*Danaus plexippus*) No critical habitat identified	N/A[2]	Known use summer habitat	No	N/A	17.49	Yes
CPGB-02	WV	Harrison	15.4	39.398873	-80.478224	0.00	431.31	20	Indiana bat (*Myotis sodalis*) Northern long-eared bat (*Myotis septentrionalis*) Tricolored bat (*Perimyotis subflavus*) Clubshell (*Pleurobema clava*) Candidate monarch butterfly (*Danaus plexippus*) No critical habitat identified	Non-Jurisdictional facility to be sited in a location without tree cover.	Non-Jurisdictional facility to be sited in a location without tree cover.	No	N/A	14.22	N/A
CPGB-03	WV	Harrison	23	39.316743	-80.524681	0.05	174.54	20	Indiana bat (*Myotis sodalis*) Northern long-eared bat (*Myotis septentrionalis*) Tricolored bat (*Perimyotis subflavus*) Clubshell (*Pleurobema clava*) Candidate monarch butterfly (*Danaus plexippus*) No critical habitat identified	Unknown use summer habitat	Known use summer habitat	No	N/A	9.20	Yes
CPGB-04	WV	Doddridge	34.8	39.201012	-80.552144	0.00	230.23	20	Indiana bat (*Myotis sodalis*) Northern long-eared bat (*Myotis septentrionalis*) Tricolored bat (*Perimyotis subflavus*) Clubshell (*Pleurobema clava*) Snuffbox mussel (*Epioblasma triquetra*) Candidate monarch butterfly (*Danaus plexippus*) No critical habitat identified	Non-Jurisdictional facility to be sited in a location without tree cover.	Non-Jurisdictional facility to be sited in a location without tree cover.	No	N/A	8.57	N/A
CPGB-05	WV	Lewis	45.8	39.07996	-80.582709	0.00	108.77	20	Indiana bat (*Myotis sodalis*) Northern long-eared bat (*Myotis septentrionalis*) Tricolored bat (*Perimyotis subflavus*) Clubshell (*Pleurobema clava*) Candidate monarch butterfly (*Danaus plexippus*) No critical habitat identified	Non-Jurisdictional facility to be sited in a location without tree cover.	Non-Jurisdictional facility to be sited in a location without tree cover.	No	N/A	13.95	N/A
CPGB-06	WV	Lewis	55.1	38.970309	-80.592533	0.00	204.71	20	Indiana bat (*Myotis sodalis*) Northern long-eared bat (*Myotis septentrionalis*) Tricolored bat (*Perimyotis subflavus*) Clubshell (*Pleurobema clava*) Candidate monarch butterfly (*Danaus plexippus*) No critical habitat identified	Non-Jurisdictional facility to be sited in a location without tree cover.	Non-Jurisdictional facility to be sited in a location without tree cover.	No	N/A	15.60	N/A
CPGB-07	WV	Lewis	62.2	38.892263	-80.556864	0.04	126.40	20	Indiana bat (*Myotis sodalis*) Northern long-eared bat (*Myotis septentrionalis*) Tricolored bat (*Perimyotis subflavus*) Clubshell (*Pleurobema clava*) Candidate monarch butterfly (*Danaus plexippus*) No critical habitat identified	Unknown use summer habitat	Known use summer habitat	No	N/A	9.90	Yes
CPGB-08	WV	Braxton	73.7	38.763489	-80.518536	0.00	132.75	20	Indiana bat (*Myotis sodalis*) Northern long-eared bat (*Myotis septentrionalis*) Tricolored bat (*Perimyotis subflavus*) Clubshell (*Pleurobema clava*) Candidate monarch butterfly (*Danaus plexippus*) No critical habitat identified	Non-Jurisdictional facility to be sited in a location without tree cover.	Non-Jurisdictional facility to be sited in a location without tree cover.	No	N/A	0.77	N/A
CPGB-09	WV	Webster	84	38.647722	-80.489266	0.00	52.31	20	Indiana bat (*Myotis sodalis*) Northern long-eared bat (*Myotis septentrionalis*) Tricolored bat (*Perimyotis subflavus*) Candidate monarch butterfly (*Danaus plexippus*) No critical habitat identified	Non-Jurisdictional facility to be sited in a location without tree cover.	Non-Jurisdictional facility to be sited in a location without tree cover.	No	N/A	3.59	N/A
CPGB-10	WV	Webster	93.1	38.548409	-80.54014	0.00	47.76	20	Indiana bat (*Myotis sodalis*) Northern long-eared bat (*Myotis septentrionalis*) Tricolored bat (*Perimyotis subflavus*) Diamond darter (*Crystallaria cincotta*) Northern riffleshell (*Epioblasma torulosa rangiana*) Pink mucket (*Lampsilis abrupta*) Candidate monarch butterfly (*Danaus plexippus*) No critical habitat identified	Non-Jurisdictional facility to be sited in a location without tree cover.	Non-Jurisdictional facility to be sited in a location without tree cover.	All work for the Non-jurisdictional facility will occur entirely within the project's ROW	N/A	3.93	N/A
CPGB-11	WV	Webster	98.6	38.483085	-80.554984	0.00	24.75	20	Indiana bat (*Myotis sodalis*) Northern long-eared bat (*Myotis septentrionalis*) Tricolored bat (*Perimyotis subflavus*) Diamond darter (*Crystallaria cincotta*) Northern riffleshell (*Epioblasma torulosa rangiana*) Pink mucket (*Lampsilis abrupta*) Candidate monarch butterfly (*Danaus plexippus*) No critical habitat identified	Non-Jurisdictional facility to be sited in a location without tree cover.	Non-Jurisdictional facility to be sited in a location without tree cover.	All work for the Non-jurisdictional facility will occur entirely within the project's ROW	N/A	8.50	N/A
CPGB-12	WV	Webster	111.3	38.400719	-80.5977	0.00	41.00	20	Indiana bat (*Myotis sodalis*) Northern long-eared bat (*Myotis septentrionalis*) Tricolored bat (*Perimyotis subflavus*) Candy darter (*Etheostoma osburni*) Virginia spiraea (*Spiraea virginiana*) Candidate monarch butterfly (*Danaus plexippus*) No critical habitat identified	Non-Jurisdictional facility to be sited in a location without tree cover.	Non-Jurisdictional facility to be sited in a location without tree cover.	All work for the Non-jurisdictional facility will occur entirely within the project's ROW	No potential habitat. Virginia spiraea is only found at stream crossings. Location is entirely in MVP limits of disturbance.	6.41	N/A

Summary of Nonjurisdictional Facilities for the Mountain Valley Pipeline Project

Site Name	State	County	Milepost	Latitude	Longitude	Estimated Tree- Felling Acreage	Length of Project (feet)	Estimated Width (feet)	Updated IPaC Results (After December 14, 2022)*	Indiana Bat Habitat Type	Northern Long-Eared Bat Habitat Type	Instream work anticipated	Potential Plant Habitat (2022 Update)	UPDATED 2022 Nearest Known or Presumed Occupied Portal (miles)	Potential Tree Felling Required for Non- JD Facility
CPGB-13	WV	Nicholas	122.4	38.232396	-80.709359	0.00	21.84	20	Indiana bat (*Myotis sodalis*) Northern long-eared bat (*Myotis septentrionalis*) Tricolored bat (*Perimyotis subflavus*) Candy darter (*Etheostoma osburni*) Virginia spiraea (*Spiraea virginiana*) Candidate monarch butterfly (*Danaus plexippus*) No critical habitat identified	Non-Jurisdictional facility to be sited in a location without tree cover.	Non-Jurisdictional facility to be sited in a location without tree cover.	No stream nearby	No potential habitat. Virginia spiraea is only found at stream crossings.	3.02	N/A
CPGB-14	WV	Nicholas	128.2	38.163726	-80.733441	0.00	170.99	20	Indiana bat (*Myotis sodalis*) Northern long-eared bat (*Myotis septentrionalis*) Tricolored bat (*Perimyotis subflavus*) Candy darter (*Etheostoma osburni*) Virginia spiraea (*Spiraea virginiana*) Candidate monarch butterfly (*Danaus plexippus*) No critical habitat identified	Non-Jurisdictional facility to be sited in a location without tree cover.	Non-Jurisdictional facility to be sited in a location without tree cover.	No stream nearby	No potential habitat. Virginia spiraea is only found at stream crossings.	7.90	N/A
CPGB-15	WV	Greenbrier	138.3	38.051236	-80.740693	0.00	2053.91	20	Indiana bat (*Myotis sodalis*) Northern long-eared bat (*Myotis septentrionalis*) Tricolored bat (*Perimyotis subflavus*) Small whorled pogonia (*Isotria medeoloides*) Virginia spiraea (*Spiraea virginiana*) Candidate monarch butterfly (*Danaus plexippus*) No critical habitat identified	Non-Jurisdictional facility to be sited in a location without tree cover.	Non-Jurisdictional facility to be sited in a location without tree cover.	No	No potential habitat exists for small whorled pogonia and Virginia spiraea based on results of 2015 field survey. Active ROW disturbance limits presence. Virginia spiraea is only found at stream crossings.	15.50	N/A
CPGB-16	WV	Greenbrier	149.5	37.924026	-80.739282	0.00	128.42	20	Indiana bat (*Myotis sodalis*) Northern long-eared bat (*Myotis septentrionalis*) Tricolored bat (*Perimyotis subflavus*) Small whorled pogonia (*Isotria medeoloides*) Virginia spiraea (*Spiraea virginiana*) Candidate monarch butterfly (*Danaus plexippus*) No critical habitat identified	Non-Jurisdictional facility to be sited in a location without tree cover.	Non-Jurisdictional facility to be sited in a location without tree cover.	No	No potential habitat exists for small whorled pogonia and Virginia spiraea based on results of 2015 field survey. Active ROW disturbance limits presence. Virginia spiraea is only found at stream crossings.	21.17	N/A
CPGB-17	WV	Summers	157	37.80586	-80.745764	0.21	527.95	20	Gray bat (*Myotis grisescens*) Indiana bat (*Myotis sodalis*) Northern long-eared bat (*Myotis septentrionalis*) Tricolored bat (*Perimyotis subflavus*) Small whorled pogonia (*Isotria medeoloides*) Virginia spiraea (*Spiraea virginiana*) Candidate monarch butterfly (*Danaus plexippus*) No critical habitat identified	N/A[2]	Known use summer habitat	No	No potential habitat exists for small whorled pogonia and Virginia spiraea based on results of 2015 field survey. Active ROW disturbance limits presence. Virginia spiraea is only found at stream crossings.	15.95	Yes
CPGB-18	WV	Summers	171.9	37.674621	-80.730922	0.00	33.36	20	Gray bat (*Myotis grisescens*) Indiana bat (*Myotis sodalis*) Northern long-eared bat (*Myotis septentrionalis*) Tricolored bat (*Perimyotis subflavus*) Virginia spiraea (*Spiraea virginiana*) Candidate monarch butterfly (*Danaus plexippus*) No critical habitat identified	Non-Jurisdictional facility to be sited in a location without tree cover.	Non-Jurisdictional facility to be sited in a location without tree cover.	No	No potential habitat. Virginia spiraea is only found at stream crossings.	5.80	N/A
CPGB-19	WV	Monroe	182.3	37.560588	-80.710384	0.00	155.01	20	Gray bat (*Myotis grisescens*) Indiana bat (*Myotis sodalis*) Northern long-eared bat (*Myotis septentrionalis*) Tricolored bat (*Perimyotis subflavus*) Candidate monarch butterfly (*Danaus plexippus*) No critical habitat identified	Non-Jurisdictional facility to be sited in a location without tree cover.	Non-Jurisdictional facility to be sited in a location without tree cover.	No	N/A	1.47	N/A
CPGB-20	WV	Monroe	192	37.451081	-80.667397	0.00	103.92	20	Gray bat (*Myotis grisescens*) Indiana bat (*Myotis sodalis*) Northern long-eared bat (*Myotis septentrionalis*) Tri-colored (*Perimyotis subflavus*) Candidate monarch butterfly (*Danaus plexippus*) No critical habitat identified	Non-Jurisdictional facility to be sited in a location without tree cover.	Non-Jurisdictional facility to be sited in a location without tree cover.	No	N/A	5.06	N/A
CPGB-21	VA	Giles	200.6	37.358634	-80.681933	0.01	111.57	20	Indiana bat (*Myotis sodalis*) Northern long-eared bat (*Myotis septentrionalis*) Candidate monarch butterfly (*Danaus plexippus*) No critical habitat identified	Unknown use spring staging/fall swarming	Unknown use spring staging/fall swarming	No	N/A	0.38	Yes
CPGB-22	VA	Giles	211.2	37.311547	-80.515259	0.00	152.20	20	Indiana bat (*Myotis sodalis*) Northern long-eared bat (*Myotis septentrionalis*) Candidate monarch butterfly (*Danaus plexippus*) No critical habitat identified	Non-Jurisdictional facility to be sited in a location without tree cover.	Non-Jurisdictional facility to be sited in a location without tree cover.	No	N/A	0.08	N/A
CPGB-23	VA	Montgomery	227.2	37.268971	-80.313626	0.00	939.95	20	Indiana bat (*Myotis sodalis*) Northern long-eared bat (*Myotis septentrionalis*) Roanoke logperch (*Percina rex*) Candidate monarch butterfly (*Danaus plexippus*) No critical habitat identified	Non-Jurisdictional facility to be sited in a location without tree cover.	Non-Jurisdictional facility to be sited in a location without tree cover.	No	N/A	0.28	N/A
CPGB-24	VA	Montgomery	235.5	37.233355	-80.199093	0.00	409.02	20	Indiana bat (*Myotis sodalis*) Northern long-eared bat (*Myotis septentrionalis*) Roanoke logperch (*Percina rex*) Candidate monarch butterfly (*Danaus plexippus*) No critical habitat identified	Non-Jurisdictional facility to be sited in a location without tree cover.	Non-Jurisdictional facility to be sited in a location without tree cover.	No	N/A	1.79	N/A
CPGB-25	VA	Roanoke	245.9	37.128955	-80.129824	0.00	181.62	20	Indiana bat (*Myotis sodalis*) Northern long-eared bat (*Myotis septentrionalis*) Candidate monarch butterfly (*Danaus plexippus*) No critical habitat identified	Non-Jurisdictional facility to be sited in a location without tree cover.	Non-Jurisdictional facility to be sited in a location without tree cover.	No	N/A	6.87	N/A
CPGB-26	VA	Franklin	255.5	37.088401	-80.003658	0.00	42.52	20	Northern long-eared bat (*Myotis septentrionalis*) Candidate monarch butterfly (*Danaus plexippus*) No critical habitat identified	Non-Jurisdictional facility to be sited in a location without tree cover.	Non-Jurisdictional facility to be sited in a location without tree cover.	No	N/A	12.88	N/A
CPGB-27	VA	Franklin	264.2	37.047279	-79.894335	0.00	249.87	20	Northern long-eared bat (*Myotis septentrionalis*) Candidate monarch butterfly (*Danaus plexippus*) No critical habitat identified	Non-Jurisdictional facility to be sited in a location without tree cover.	Non-Jurisdictional facility to be sited in a location without tree cover.	No	N/A	19.19	N/A
CPGB-28	VA	Franklin	274.9	37.0105	-79.755393	0.00	83.83	20	Northern long-eared bat (*Myotis septentrionalis*) Candidate monarch butterfly (*Danaus plexippus*) No critical habitat identified	Non-Jurisdictional facility to be sited in a location without tree cover.	Non-Jurisdictional facility to be sited in a location without tree cover.	No	N/A	26.89	N/A
CPGB-29	VA	Pittsylvania	286.1	36.954857	-79.582809	0.00	50.84	20	Northern long-eared bat (*Myotis septentrionalis*) Candidate monarch butterfly (*Danaus plexippus*) No critical habitat identified	Non-Jurisdictional facility to be sited in a location without tree cover.	Non-Jurisdictional facility to be sited in a location without tree cover.	No	N/A	37.04	N/A
CPGB-30	VA	Pittsylvania	296.2	36.888418	-79.432585	0.00	18.57	20	Northern long-eared bat (*Myotis septentrionalis*) Candidate monarch butterfly (*Danaus plexippus*) No critical habitat identified	Non-Jurisdictional facility to be sited in a location without tree cover.	Non-Jurisdictional facility to be sited in a location without tree cover.	No	N/A	46.54	N/A

Summary of Nonjurisdictional Facilities for the Mountain Valley Pipeline Project

Site Name	State	County	Milepost	Latitude	Longitude	Estimated Tree- Felling Acreage	Length of Project (feet)	Estimated Width (feet)	Updated IPaC Results (After December 14, 2022)*	Indiana Bat Habitat Type	Northern Long-Eared Bat Habitat Type	Instream work anticipated	Potential Plant Habitat (2022 Update)	UPDATED 2022 Nearest Known or Presumed Occupied Portal (miles)	Potential Tree Felling Required for Non- JD Facility
Dominion Hope Tap	WV	Nicholas	113.8	38.336858	-80.662917	0.68	131.93	20.00	Indiana bat (*Myotis sodalis*) Northern long-eared bat (*Myotis septentrionalis*) Tricolored bat (*Perimyotis subflavus*) Candy darter (*Etheostoma osburni*) Fanshell (*Cyprogenia stegaria*) Northern riffleshell (*Epioblasma torulosa rangiana*) Pink mucket (*Lampsilis abrupta*) Tubercled blossom (*Epioblasma torulosa*) Virginia spiraea (*Spiraea virginiana*) Candidate monarch butterfly (*Danaus plexippus*) No critical habitat identified	Unknown use spring staging/fall swarming	Known use summer habitat	No stream nearby	No potential habitat. Virginia spiraea is only found at stream crossings.	4.57	Yes
Harris Compressor Station	WV	Braxton	77.3	38.722444	-80.502616	0.00	439.87	20.00	Indiana bat (*Myotis sodali* s) Northern long-eared bat (*Myotis septentrionalis*) Tricolored bat (*Perimyotis subflavus*) Clubshell (*Pleurobema clava*) Candidate monarch butterfly (*Danaus plexippus*) No critical habitat identified	Non-Jurisdictional facility to be sited in a location without tree cover.	Non-Jurisdictional facility to be sited in a location without tree cover.	No	N/A	2.11	N/A
MLV10	WV	Webster	93.1	38.548186	-80.540223	0.01	282.94	20.00	Indiana bat (*Myotis sodalis*) Northern long-eared bat (*Myotis septentrionalis*) Tricolored bat (*Perimyotis subflavus*) Diamond darter (*Crystallaria cincotta*) Northern riffleshell (*Epioblasma torulosa rangiana*) Pink mucket (*Lampsilis abrupta*) Candidate monarch butterfly (*Danaus plexippus*) No critical habitat identified	N/A[2]	Known use summer habitat	All work for the Non-jurisdictional facility will occur entirely within the project's ROW	N/A	3.91	Yes
MLV11	WV	Webster	98.6	38.48244	-80.555732	0.00	54.66	20.00	Indiana bat (*Myotis sodalis*) Northern long-eared bat (*Myotis septentrionalis*) Tricolored bat (*Perimyotis subflavus*) Diamond darter (*Crystallaria cincotta*) Northern riffleshell (*Epioblasma torulosa rangiana*) Pink mucket (*Lampsilis abrupta*) Candidate monarch butterfly (*Danaus plexippus*) No critical habitat identified	Non-Jurisdictional facility to be sited in a location without tree cover.	Non-Jurisdictional facility to be sited in a location without tree cover.	All work for the Non-jurisdictional facility will occur entirely within the project's ROW	N/A	8.55	N/A
MLV12	WV	Webster	102.3	38.4439	-80.551487	0.00	1267.47	20.00	Indiana bat (*Myotis sodalis*) Northern long-eared bat (*Myotis septentrionalis*) Tricolored bat (*Perimyotis subflavus*) Diamond darter (*Crystallaria cincotta*) Northern riffleshell (*Epioblasma torulosa rangiana*) Pink mucket (*Lampsilis abrupta*) Candidate monarch butterfly (*Danaus plexippus*) No critical habitat identified	Non-Jurisdictional facility to be sited in a location without tree cover.	Non-Jurisdictional facility to be sited in a location without tree cover.	All work for the Non-jurisdictional facility will occur entirely within the project's ROW	N/A	11.14	N/A
MLV13	WV	Webster	111.1	38.357176	-80.631407	0.00	865.61	20.00	Indiana bat (*Myotis sodalis*) Northern long-eared bat (*Myotis septentrionalis*) Tricolored bat (*Perimyotis subflavus*) Candy darter (*Etheostoma osburni*) Virginia spiraea (*Spiraea virginiana*) Candidate monarch butterfly (*Danaus plexippus*) No critical habitat identified	Non-Jurisdictional facility to be sited in a location without tree cover.	Non-Jurisdictional facility to be sited in a location without tree cover.	No	No potential habitat. Virginia spiraea is only found at stream crossings. Location is entirely in MVP limits of disturbance.	6.41	N/A
MLV14	WV	Nicholas	121.85	38.237938	-80.703238	0.00	2745.17	20.00	Indiana bat (*Myotis sodalis*) Northern long-eared bat (*Myotis septentrionalis*) Tricolored bat (*Perimyotis subflavus*) Candy darter (*Etheostoma osburni*) Fanshell (*Cyprogenia stegaria*) Northern riffleshell (*Epioblasma torulosa rangiana*) Pink mucket (*Lampsilis abrupta*) Tubercled blossom (*Epioblasma torulosa torulosa*) Virginia spiraea (*Spiraea virginiana*) Candidate monarch butterfly (*Danaus plexippus*) No critical habitat identified	Non-Jurisdictional facility to be sited in a location without tree cover.	Non-Jurisdictional facility to be sited in a location without tree cover.	No stream nearby	No potential habitat. Virginia spiraea is only found at stream crossings. Location is entirely in MVP limits of disturbance.	2.53	N/A
MLV15	WV	Greenbrier	138.7	38.04592	-80.739917	0.58	5524.47	20.00	Indiana bat (*Myotis sodalis*) Northern long-eared bat (*Myotis septentrionalis*) Tricolored bat (*Perimyotis subflavus*) Small whorled pogonia (*Isotria medeoloides*) Virginia spiraea (*Spiraea virginiana*) Candidate monarch butterfly (*Danaus plexippus*) No critical habitat identified	Unknown use summer habitat	Known use summer habitat	No	No potential habitat for small whorled pogonia or Virginia spiraea. Small whorled pogonia is found in forest interiors; this line runs alongside the roadway. Virginia spiraea is only found at stream crossings.	15.60	Yes
MLV16	WV	Greenbrier	140.9	38.02064	-80.752505	0.20	704.07	20.00	Indiana bat (*Myotis sodalis*) Northern long-eared bat (*Myotis septentrionalis*) Tricolored bat (*Perimyotis subflavus*) Small whorled pogonia (*Isotria medeoloides*) Virginia spiraea (*Spiraea virginiana*) Candidate monarch butterfly (*Danaus plexippus*) No critical habitat identified	Unknown use summer habitat	Known use summer habitat	No	No potential habitat for small whorled pogonia. Active ROW disturbance limits presence. No potential habitat for Virginia spiraea. Virginia spiraea is only found at stream crossings.	17.70	Yes
MLV17	WV	Greenbrier	143.9	37.983657	-80.75626	0.02	201.19	20.00	Indiana bat (*Myotis sodalis*) Northern long-eared bat (*Myotis septentrionalis*) Tricolored bat (*Perimyotis subflavus*) Small whorled pogonia (*Isotria medeoloides*) Virginia spiraea (*Spiraea virginiana*) Candidate monarch butterfly (*Danaus plexippus*) No critical habitat identified	Unknown use summer habitat	Known use summer habitat	No	No potential habitat exists for small whorled pogonia or Virginia spiraea based on 2015 field survey results. Active ROW disturbance limits presence. Virginia spiraea is only found at stream crossings.	20.21	Yes
MLV18	WV	Greenbrier	144.2	37.980868	-80.75478	0.00	85.21	20.00	Northern long-eared bat (*Myotis septentrionalis*) Indiana bat (*Myotis sodalis*) Tricolored bat (*Perimyotis subflavus*) Small whorled pogonia (*Isotria medeoloides*) Virginia spiraea (*Spiraea virginiana*) Candidate monarch butterfly (*Danaus plexippus*) No critical habitat identified	This area is currently a gravel parking lot.	This area is currently a gravel parking lot.	No	No potential habitat exists for small whorled pogonia or Virginia spiraea. Area is graveled parking/pulloff. Virginia spiraea is only found at stream crossings.	20.41	N/A
MLV20	WV	Summers	170	37.693067	-80.733134	0.00	193.61	20.00	Northern long-eared bat (*Myotis septrentionalis*) Indiana bat (*Myotis sodalis*) Gray bat (*Myotis grisescens*) Tricolored bat (*Perimyotis subflavus*) Virginia spiraea (*Spiraea virginiana*) Candidate monarch butterfly (*Danaus plexippus*) No critical habitat identified	Non-Jurisdictional facility to be sited in a location without tree cover.	Non-Jurisdictional facility to be sited in a location without tree cover.	No	No potential habitat. Virginia spiraea is only found at stream crossings.	6.74	N/A
MLV21	WV	Summers	171.9	37.674585	-80.731009	0.00	68.69	20.00	Northern long-eared bat (*Myotis septrentionalis*) Indiana bat (*Myotis sodalis*) Gray bat (*Myotis grisescens*) Tricolored bat (*Perimyotis subflavus*) Virginia spiraea (*Spiraea virginiana*) Candidate monarch butterfly (*Danaus plexippus*) No critical habitat identified	Non-Jurisdictional facility to be sited in a location without tree cover.	Non-Jurisdictional facility to be sited in a location without tree cover.	No	No potential habitat. Virginia spiraea is only found at stream crossings.	5.78	N/A

Summary of Nonjurisdictional Facilities for the Mountain Valley Pipeline Project

Site Name	State	County	Milepost	Latitude	Longitude	Estimated Tree- Felling Acreage	Length of Project (feet)	Estimated Width (feet)	Updated IPaC Results (After December 14, 2022)*	Indiana Bat Habitat Type	Northern Long-Eared Bat Habitat Type	Instream work anticipated	Potential Plant Habitat (2022 Update)	UPDATED 2022 Nearest Known or Presumed Occupied Portal (miles)	Potential Tree Felling Required for Non- JD Facility
MLV22	WV	Summers	186.1	37.516786	-80.701991	0.00	128.64	20.00	Northern long-eared bat (*Myotis septrentionalis*) Indiana bat (*Myotis sodalis*) Gray bat (*Myotis grisescens*) Tricolored bat (*Perimyotis subflavus*) Candidate monarch butterfly (*Danaus plexippus*) No critical habitat identified	Non-Jurisdictional facility to be sited in a location without tree cover.	Non-Jurisdictional facility to be sited in a location without tree cover.	No	N/A	2.22	N/A
MLV23	VA	Giles	199.5	37.3696	-80.687277	0.01	138.76	20.00	Northern long-eared bat (*Myotis septentrionalis*) Indiana bat (*Myotis sodalis*) Candy darter (*Etheostoma osburni*) No critical habitat identified	Unknown use spring staging/fall swarming	Unknown use spring staging/fall swarming	No stream nearby	N/A	0.72	Yes
MLV24	VA	Giles	201.6	37.353566	-80.664144	0.00	257.23	20.00	Northern long-eared bat (*Myotis septentrionalis*) Indiana bat (*Myotis sodalis*) Candy darter (*Etheostoma osburni*) Candidate monarch butterfly (*Danaus plexippus*) No critical habitat identified	Non-Jurisdictional facility to be sited in a location without tree cover.	Non-Jurisdictional facility to be sited in a location without tree cover.	No stream nearby	N/A	0.79	N/A
MLV25	VA	Giles	209.3	37.316149	-80.545026	0.31	1695.09	20.00	Indiana bat (*Myotis sodalis*) Northern long-eared bat (*Myotis septentrionalis*) Candidate monarch butterfly (*Danaus plexippus*) No critical habitat identified	Known use spring staging/fall swarming	Known use spring staging/fall swarming	No	N/A	0.37	Yes
MLV26	VA	Montgomery	222.7	37.2961	-80.367812	0.00	1636.77	20.00	Indiana bat (*Myotis sodalis*) Northern long-eared bat (*Myotis septentrionalis*) Smooth coneflower (*Echinacea laevigata*) Candidate monarch butterfly (*Danaus plexippus*) No critical habitat identified	Non-Jurisdictional facility to be sited in a location without tree cover.	Non-Jurisdictional facility to be sited in a location without tree cover.	No	No potential habitat. Active ROW disturbance limits presence.	0.32	N/A
MLV27	VA	Montgomery	234.8	37.239799	-80.199178	0.00	793.06	20.00	Indiana bat (*Myotis sodalis*) Northern long-eared bat (*Myotis septentrionalis*) Smooth coneflower (*Echinacea laevigata*) Candidate monarch butterfly (*Danaus plexippus*) No critical habitat identified	Non-Jurisdictional facility to be sited in a location without tree cover.	Non-Jurisdictional facility to be sited in a location without tree cover.	No	No potential habitat. Active ROW disturbance limits presence.	1.40	N/A
MLV28	VA	Montgomery	236.2	37.223793	-80.202141	0.79	2338.65	20.00	Indiana bat (*Myotis sodalis*) Northern long-eared bat (*Myotis septentrionalis*) Roanoke log perch (*Percina rex*) Smooth coneflower (*Echinacea laevigata*) Candidate monarch butterfly (*Danaus plexippus*) No critical habitat identified	Unknown use spring staging/fall swarming	Unknown use spring staging/fall swarming	Stream likely will be spanned by the facility.	Potential habitat exists. Smooth coneflower is found along roadsides and edges and has the potential to exist along a two-track crossed by the utility line. The utility provider will likely be able to span this potential habitat.	2.21	Yes
MLV29	VA	Franklin	252.1	37.106272	-80.050846	0.05	1047.64	20.00	Northern long-eared bat (*Myotis septentrionalis*) Candidate monarch butterfly (*Danaus plexippus*) No critical habitat identified	Unknown use summer habitat	N/A[2]	No	N/A	10.27	Yes
MLV3	WV	Harrison	15.3	39.398799	-80.476495	0.00	92.43	20.00	Indiana bat (*Myotis sodali* s) Northern long-eared bat (*Myotis septentrionalis*) Tricolored bat (*Perimyotis subflavus*) Clubshell (*Pleurobema clava*) Candidate monarch butterfly (*Danaus plexippus*) No critical habitat identified	Non-Jurisdictional facility to be sited in a location without tree cover.	Non-Jurisdictional facility to be sited in a location without tree cover.	No	N/A	14.29	N/A
MLV30	VA	Franklin	258.2	37.089129	-79.961117	0.00	830.15	20.00	Northern long-eared bat (*Myotis septentrionalis*) Candidate monarch butterfly (*Danaus plexippus*) No critical habitat identified	Non-Jurisdictional facility to be sited in a location without tree cover.	Non-Jurisdictional facility to be sited in a location without tree cover.	No	N/A	14.40	N/A
MLV31	VA	Franklin	265.4	37.057683	-79.880452	0.00	121.77	20.00	Northern long-eared bat (*Myotis septentrionalis*) Candidate monarch butterfly (*Danaus plexippus*) No critical habitat identified	Non-Jurisdictional facility to be sited in a location without tree cover.	Non-Jurisdictional facility to be sited in a location without tree cover.	No	N/A	19.39	N/A
MLV32	VA	Franklin	269.4	37.055145	-79.829261	0.00	358.65	20.00	Northern long-eared bat (*Myotis septentrionalis*) Candidate monarch butterfly (*Danaus plexippus*) No critical habitat identified	Non-Jurisdictional facility to be sited in a location without tree cover.	Non-Jurisdictional facility to be sited in a location without tree cover.	No	N/A	21.76	N/A
MLV33	VA	Franklin	283.5	36.965835	-79.620858	0.00	180.25	20.00	Northern long-eared bat (*Myotis septentrionalis*) Candidate monarch butterfly (*Danaus plexippus*) No critical habitat identified	Non-Jurisdictional facility to be sited in a location without tree cover.	Non-Jurisdictional facility to be sited in a location without tree cover.	No	N/A	34.85	N/A
MLV34	VA	Pittsylvania	296.2	36.888355	-79.43275	0.00	835.38	20.00	Northern long-eared bat (*Myotis septentrionalis*) Candidate monarch butterfly (*Danaus plexippus*) No critical habitat identified	Non-Jurisdictional facility to be sited in a location without tree cover.	Non-Jurisdictional facility to be sited in a location without tree cover.	No	N/A	46.54	N/A
MLV35	VA	Pittsylvania	299.5	36.856323	-79.392372	0.06	741.24	20.00	Northern long-eared bat (*Myotis septentrionalis*) Candidate monarch butterfly (*Danaus plexippus*) No critical habitat identified	N/A[2]	N/A[2]	No	N/A	49.59	Yes
MLV4	WV	Harrison	15.4	39.39793	-80.477629	0.00	802.78	20.00	Indiana bat (*Myotis sodali* s) Northern long-eared bat (*Myotis septentrionalis*) Tricolored bat (*Perimyotis subflavus*) Clubshell (*Pleurobema clava*) Candidate monarch butterfly (*Danaus plexippus*) No critical habitat identified	Non-Jurisdictional facility to be sited in a location without tree cover.	Non-Jurisdictional facility to be sited in a location without tree cover.	No	N/A	14.22	N/A
MLV5	WV	Doddridge	34.3	39.208633	-80.55198	0.00	86.41	20.00	Indiana bat (*Myotis sodalis*) Northern long-eared bat (*Myotis septentrionalis*) Tricolored bat (*Perimyotis subflavus*) Clubshell (*Pleurobema clava*) Snuffbox mussel (*Epioblasma triquetra*) Candidate monarch butterfly (*Danaus plexippus*) No critical habitat identified	Non-Jurisdictional facility to be sited in a location without tree cover.	Non-Jurisdictional facility to be sited in a location without tree cover.	No	N/A	8.33	N/A
MLV6	WV	Lewis	52.9	38.995521	-80.591854	0.00	959.78	20.00	Indiana bat (*Myotis sodali* s) Northern long-eared bat (*Myotis septentrionalis*) Tricolored bat (*Perimyotis subflavus*) Clubshell (*Pleurobema clava*) Candidate monarch butterfly (*Danaus plexippus*) No critical habitat identified	Non-Jurisdictional facility to be sited in a location without tree cover.	Non-Jurisdictional facility to be sited in a location without tree cover.	No	N/A	17.13	N/A
MLV7	WV	Lewis	64.6	38.872441	-80.531408	0.00	1905.76	20.00	Indiana bat (*Myotis sodali* s) Northern long-eared bat (*Myotis septentrionalis*) Tricolored bat (*Perimyotis subflavus*) Clubshell (*Pleurobema clava*) Candidate monarch butterfly (*Danaus plexippus*) No critical habitat identified	Non-Jurisdictional facility to be sited in a location without tree cover.	Non-Jurisdictional facility to be sited in a location without tree cover.	No	N/A	8.33	N/A
MLV8	WV	Lewis	65.4	38.863141	-80.525503	0.00	85.88	20.00	Indiana bat (*Myotis sodali* s) Northern long-eared bat (*Myotis septentrionalis*) Tricolored bat (*Perimyotis subflavus*) Clubshell (*Pleurobema clava*) Candidate monarch butterfly (*Danaus plexippus*) No critical habitat identified	Non-Jurisdictional facility to be sited in a location without tree cover.	Non-Jurisdictional facility to be sited in a location without tree cover.	No	N/A	7.63	N/A
Mobley Interconnect	WV	Wetzel	0	39.56253	-80.542329	0.00	104.35	20.00	Indiana bat (*Myotis sodali* s) Northern long-eared bat (*Myotis septentrionalis*) Tricolored bat (*Perimyotis subflavus*) Clubshell (*Pleurobema clava*) Candidate monarch butterfly (*Danaus plexippus*) No critical habitat identified	Non-Jurisdictional facility to be sited in a location without tree cover.	Non-Jurisdictional facility to be sited in a location without tree cover.	No	N/A	21.56	N/A
RGC Franklin	VA	Franklin	261.4	37.069308	-79.924792	0.17	75.01	20.00	Northern long-eared bat (*Myotis septentrionalis*) Candidate monarch butterfly (*Danaus plexippus*) No critical habitat identified	Unknown use spring staging/fall swarming	Known use summer habitat	No	N/A	1.42	Yes

Summary of Nonjurisdictional Facilities for the Mountain Valley Pipeline Project

Site Name	State	County	Milepost	Latitude	Longitude	Estimated Tree- Felling Acreage	Length of Project (feet)	Estimated Width (feet)	Updated IPaC Results (After December 14, 2022)*	Indiana Bat Habitat Type	Northern Long-Eared Bat Habitat Type	Instream work anticipated	Potential Plant Habitat (2022 Update)	UPDATED 2022 Nearest Known or Presumed Occupied Portal (miles)	Potential Tree Felling Required for Non- JD Facility
RGC Lafayette	VA	Montgomery	234.8	37.232885	-80.198502	0.00	564.05	20.00	Indiana bat (*Myotis sodalis*) Northern long-eared bat (*Myotis septentrionalis*) Smooth coneflower (*Echinacea laevigata*) Candidate monarch butterfly (*Danaus plexippus*) No critical habitat identified	N/A[2]	N/A[2]	No	Potentially suitable habitat available for smooth coneflower along the perimeter of laydown yard and /or ROW, especially during naturalization process. The utility provider will likely be able to span this potential habitat.	16.93	N/A
Sherwood Interconnect	WV	Harrison	23.6	39.314	-80.535	0.39	1178.16	20.00	Indiana bat (*Myotis sodali* s) Northern long-eared bat (*Myotis septentrionalis*) Tricolored bat (*Perimyotis subflavus*) Clubshell (*Pleurobema clava*) Candidate monarch butterfly (*Danaus plexippus*) No critical habitat identified	Unknown use summer habitat	Known use summer habitat	No	N/A	8.45	Yes
Stallworth Compressor Station	WV	Fayette	154.5	37.867732	-80.757415	0.00	2746.11	20.00	Gray bat (*Myotis grisescens*) Indiana bat (*Myotis sodalis*) Northern long-eared bat (*Myotis septentrionalis*) Tricolored bat (*Perimyotis subflavus*) Virginia spiraea (*Spiraea virginiana*) Candidate monarch butterfly (*Danaus plexippus*) No critical habitat identified	Non-Jurisdictional facility to be sited in a location without tree cover.	Non-Jurisdictional facility to be sited in a location without tree cover.	No	No potential habitat exists for Virginia spiraea based on the results of a 2016 field survey. Virginia spiraea is only found at stream crossings.	17.99	N/A
Transco Interconnect	VA	Pittsylvania	303.4	36.832102	-79.342853	0.00	962.85	20.00	Northern long-eared bat (*Myotis septentrionalis*) Candidate monarch butterfly (*Danaus plexippus*) No critical habitat identified	Non-Jurisdictional facility to be sited in a location without tree cover.	Non-Jurisdictional facility to be sited in a location without tree cover.	No	N/A	52.71	N/A
Transco North Tap	VA	Pittsylvania	303.87	36.833637	-79.337088	0.00	78.12	20.00	Northern long-eared bat (*Myotis septentrionalis*) Candidate monarch butterfly (*Danaus plexippus*) No critical habitat identified	Non-Jurisdictional facility to be sited in a location without tree cover.	Non-Jurisdictional facility to be sited in a location without tree cover.	No	N/A	53.00	N/A
Transco South Tap	VA	Pittsylvania	On H-602	36.830736	-79.34408	1.08	1176.66	40.00	Northern long-eared bat (*Myotis septentrionalis*) Candidate monarch butterfly (*Danaus plexippus*) No critical habitat identified	N/A[2]	N/A[2]	No	N/A	52.92	Yes
WB Interconnect	WV	Braxton	77.3	38.724428	-80.500881	0.00	1587.31	20.00	Indiana bat (*Myotis sodali* s) Northern long-eared bat (*Myotis septentrionalis*) Tricolored bat (*Perimyotis subflavus*) Clubshell (*Pleurobema clava*) Candidate monarch butterfly (*Danaus plexippus*) No critical habitat identified	Non-Jurisdictional facility to be sited in a location without tree cover.	Non-Jurisdictional facility to be sited in a location without tree cover.	No	N/A	2.01	N/A
Webster Tap	WV	Wetzel	0.8	39.552143	-80.545608	0.00	88.89	20.00	Indiana bat (*Myotis sodalis*) Northern long-eared bat (*Myotis septentrionalis*) Tricolored bat (*Perimyotis subflavus*) Clubshell (*Pleurobema clava*) Candidate monarch butterfly (*Danaus plexippus*) No critical habitat identified	Non-Jurisdictional facility to be sited in a location without tree cover.	Non-Jurisdictional facility to be sited in a location without tree cover.	No	N/A	20.85	N/A

[1] IPaC is a screening-level tool that identifies listed species with ranges that overlap a general area (e.g., county, HUC watershed, etc.). Because IPaC lacks sufficient resolution to identify potential species occurrence in a particular area, Mountain Valley's consultants have evaluated the IPaC results using the best available science to assess potential occurrence of each species. Based on this review, the best available science confirms that diamond darter, pink mucket, northern riffleshell, fanshell, and tubercled blossom do not occur anywhere in the vicinity of the non-jurisdictional facilities or the Mountain Valley Pipeline project. In addition, the best available science confirms that candy darter, Roanoke logperch, snuffbox, and clubshell do not occur anywhere in the vicinity of the non-jurisdictional facilities or the Mountain Valley Pipeline project, except as discussed in the Updated Supplement to the BA. Round Hickorynut (*Obovaria subrotunda*) and Longsolid (*Fusconaia subrotunda*) are currently proposed for federal listing and were not identified by the IPaC review process. The identified non-jurisdictional facilities herein are upland facilities and any potential effects to any listed aquatic species from instream activities would be expected to trigger separate Section 7 consultation.

[2] In unoccupied habitat (which has been determined unoccupied by standardized surveys) bats are not expected to be present in the habitat.

Appendix H. Acronyms used in Opinion.

Appendix H. Acronyms used in Opinion.

Acronym	Description
AL	Alabama
AMM	avoidance and minimization measure
AMRU	Appalachian Mountain Recovery Unit
ANSI	American National Standards Institute
AR	access road
ATWS	additional temporary workspace
BA	biological assessment
BLM	Bureau of Land Management
BMPs	best management practices
CD	candy darter
CDBG	Community Development Block Grant
CFR	Code of Federal Regulations
CFS	compost filter sock
CI	Confidence interval
CPUE	catch-per-unit-effort
CWA	Clean Water Act
dB	Decibel
dBA	A-weighted decibel
DC	District of Columbia
DNA	deoxyribonucleic acid
DOI	Department of the Interior
DO	dissolved oxygen
E&S	erosion and sediment
eDNA	environmental DNA
EI	environmental inspector
EO	element occurrence
EPA	U.S. Environmental Protection Agency
EQT	Equitrans Midstream Corporation
ERDC	Engineer Research and Development Center
ESA	Endangered Species Act
ESI	Environmental Solutions & Innovations, Inc.
ESRI	Environmental Systems Research Institute, Inc.
FEIS	Final Environmental Impact Statement
FERC	Federal Energy Regulatory Commission
FHWA	Federal Highway Administration
FR	Federal Register
Ft	foot or feet

FTA	Federal Transit Administration
GA	Georgia
GIS	geographic information system
HDD	horizontal directional drill
HUC	hydrologic unit code
Ibat	Indiana bat
IN	Indiana
IPaC	Information for Planning and Consultation tool
IPCC	Intergovernmental Panel on Climate Change
IR	inadvertent return
ISO	International Organization for Standardization
ITS	incidental take statement
Km	Kilometer
KY	Kentucky
LAA	likely to adversely affect
Leq	ambient equivalent sound level
LOD	limits-of-disturbance
M	meter
MA	Massachusetts
MD	Maryland
M&R	meter and regulation
mg/L	milligrams/liter
MLV	mainline valve
MN	Minnesota
MP	milepost
MTBM	microtunneling boring machine
MU	management unit
MVP	Mountain Valley Pipeline
NC	North Carolina
NE	no effect
NHD	National Hydrography Dataset
NJF	Non-jurisdictional facilities
NLAA	not likely to adversely affect
NLCD	National Land Cover Database
NLEB	northern long-eared bat
NPDES	National Pollutant Discharge Elimination System
NTU	nephelometric turbidity unit
NV	Nevada
NY	New York
O&M	operation and maintenance

OHWM	ordinary highwater mark
OH	Ohio
Opinion	biological opinion
PA	Pennsylvania
PBF	physical or biological features
PCB	polychlorinated biphenyl
Psi	pounds per-square-inch
RCP	representative concentration pathway
RH	relative humidity
RLP	Roanoke logperch
RND	reproduction, numbers, and distribution
ROW	right-of-way
RU	recovery unit
RUSLE	Revised Universal Soil Loss Equation
RUSLE2	Revised Universal Soil Loss Equation, Version 2
SBA	Supplement to the Biological Assessment
SE	standard error
Service	U.S. Fish and Wildlife Service
SEV	severity-of-effect
skm	stream kilometers
SMCRA	Surface Mining Control and Reclamation Act of 1977
smi	stream miles
SSA	species status assessment
SSC	suspended sediment concentration
SWP	small whorled pogonia
TMDL	total maximum daily load
TOYR	time-of-year restriction
TN	Tennessee
TSS	total suspended sediments
UNT	unnamed tributary
USACE	U.S. Army Corps of Engineers
USDOT	U.S. Department of Transportation
USEPA	U.S. Environmental Protection Agency
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VA	Virginia
VAFO	Virginia Field Office
VASP	Virginia spiraea
VDACS	Virginia Department of Agricultural and Consumer Services

VDCR-DNH	Virginia Department of Conservation and Recreation - Division of Natural Heritage
VDEQ	Virginia Department of Environmental Quality
VDGIF	Virginia Department of Game and Inland Fisheries, now called VDWR
VDOT	Virginia Department of Transportation
VDWR	Virginia Department of Wildlife Resources
VPDES	Virginia Pollutant Discharge Elimination System
WA	Washington
WAFWO	Washington Fish and Wildlife Office
WNS	white-nose syndrome
WV	West Virginia
WVDEP	West Virginia Department of Environmental Protection
WVDNR	West Virginia Division of Natural Resources
WVFO	West Virginia Field Office
WVU	West Virginia University
YOY	young-of-the-year