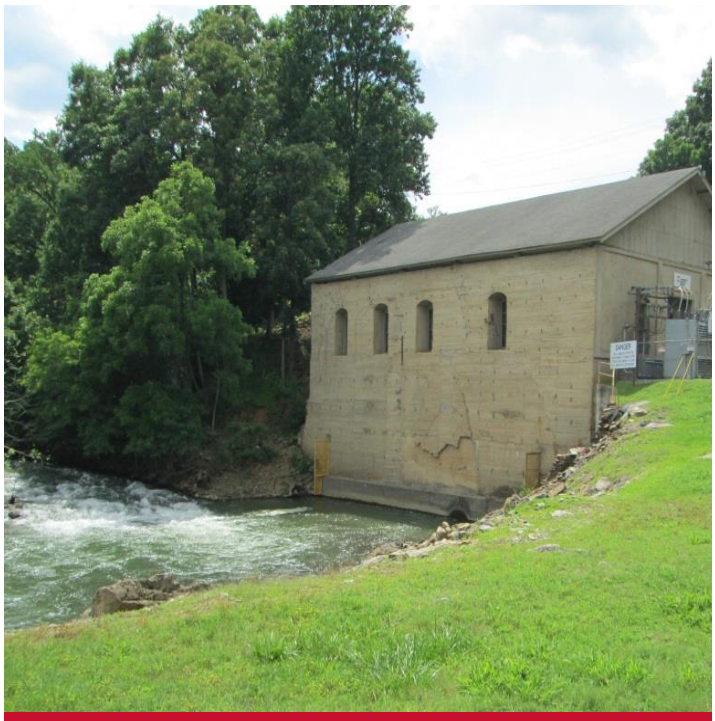

FINAL LICENSE APPLICATION

Volume I of IV

Exhibits A, E, F, G, and H

Niagara Hydroelectric Project
(FERC No. 2466)

February 28, 2022

Prepared by:

Prepared for:

APPALACHIAN POWER℠

An AEP Company

BOUNDLESS ENERGY℠

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NIAGARA HYDROELECTRIC PROJECT
FERC PROJECT NO. 2466
FINAL LICENSE APPLICATION

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Acronyms and Abbreviations

°C	degrees Celsius
°F	degrees Fahrenheit
ADA	Americans with Disabilities Act
AEP	American Electric Power
Appalachian or Licensee	Appalachian Power Company
APE	area of potential effect
CFR	Code of Federal Regulations
cfs	cubic feet per second
COC	Columbus Operations Center
CWA	Clean Water Act
CEII	Critical Energy/Electric Infrastructure Information
CUI/PRIV	Controlled Unclassified Information / Privileged
CVSZ	Central Virginia Seismic Zone
DLA	Draft License Application
DO	dissolved oxygen
DSM	demand-side management
EAP	Emergency Action Plan
EDGE	Edge Engineering and Science, LLC
EE	Energy Efficient
EL.	elevation
EIA	U.S. Energy Information Administration
EPRI	Electric Power Research Institute
ESA	Endangered Species Act
ETSZ	Eastern Tennessee Seismic Zone
FERC or Commission	Federal Energy Regulatory Commission
FLA	Final License Application
FORVA	Friends of the Rivers of Virginia
ft	feet/foot
GCSZ	Giles County Seismic Zone
GIS	Geographic Information System
HDR	HDR Engineering, Inc.
Hydrolab	Hach Hydrolab® MS5
HUC	Hydrologic Unit Code
ILP	Integrated Licensing Process
IRP	Integrated Resource Plan

ISR	Initial Study Report
KOP	key observation point
kVa	kilovolt-ampere
kW	kilowatt
m	meter
mg/l	milligrams per liter
M_w	moment magnitude scale
MW	megawatt
MWh	megawatt hour
NERC	North American Electric Reliability Corporation
NMFS	National Marine Fisheries Service
NGVD	Nation Geodetic Vertical Datum of 1929
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act of 1966
NRHP	National Register of Historic Places
NWI	National Wetlands Inventory
NOI	Notice of Intent
NPS	National Park Service
PAD	Pre-Application Document
PFM	Potential failure mode
PFMA	Potential failure mode analysis
PJM	Pennsylvania-New Jersey-Maryland Interconnection Interconnection
PM&E	protection, mitigation, and enhancement
POR	period of record
Project	Niagara Hydroelectric Project
PSP	Proposed Study Plan
RRBC	Roanoke River Blueway Commission
RCC	roller compacted concrete
RMP	Recreation Management Plan
rpm	rotations per minute
RSP	Revised Study Plan
RTE	Rare, threatened, and endangered
RVARC	Roanoke Valley-Alleghany Regional Commission
RVGC	Roanoke Valley Greenway Commission
SHPO	State Historic Preservation Officer
SD1	Scoping Document 1

SD2	Scoping Document 2
SD3	Scoping Document 3
SDR	Supporting Design Report
SPD	Study Plan Determination
STID	Supporting Technical Information Document
TBSA	Turbine Blade Strike Analysis
TMDL	total maximum daily load
TOYR	Time-of-Year-Restriction
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
USC	United States Code
USR	Updated Study Report
VAC	Virginia Administrative Code
VDCR	Virginia Department of Conservation and Recreation
VDEQ	Virginia Department of Environmental Quality
VDGIF	Virginia Department of Game and Inland Fisheries
VDWR	Virginia Department of Wildlife Resources (formerly named VDGIF)
Virginia Act	Grid Transformation and Security Act
WMP	Wildlife Management Plan (Management Plan for Riparian Forest Wildlife Habitat/Wildlife)
YES	Young Energy Services
µS/cm	microsiemens per centimeter

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FINAL LICENSE APPLICATION

NIAGARA HYDROELECTRIC PROJECT

(FERC NO. 2466)

EXECUTIVE SUMMARY

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Executive Summary

Introduction

Appalachian Power Company (Appalachian or Licensee), a unit of American Electric Power (AEP), is the Licensee, owner, and operator of the Niagara Hydroelectric Project (Project) (Federal Energy Regulatory Commission [FERC or Commission] Project No. 2466), located on the Roanoke River in Roanoke County, Virginia.

The Project is currently licensed by FERC under the authority granted to FERC by Congress through the Federal Power Act, 16 United States Code (USC) §791(a), et seq., to license and oversee the operation of non-federal hydroelectric projects on jurisdictional waters and/or federal land.

The Project underwent relicensing in the early 1990s, including conversion to run-of-river operations and incorporating additional protection, mitigation, and enhancement (PM&E) measures. The current operating license for the Project expires on February 29, 2024. Accordingly, Appalachian is pursuing a subsequent license for the Project pursuant to the Commission's Integrated Licensing Process (ILP), as described at 18 Code of Federal Regulations (CFR) Part 5. In accordance with FERC's regulations at 18 CFR §16.9(b), Appalachian must file its Final License Application (FLA) with FERC no later than February 28, 2022. Appalachian is applying for a 40-year license for the Project.

Summary of Niagara Hydroelectric Project

The Project consists of a single development located approximately six miles southeast of the City of Roanoke, on the Roanoke River. The Niagara Project is operated as a run-of-river hydroelectric facility; there is no appreciable reservoir storage available, and inflows are either used for generation or spilled. The Project is operated to maintain the reservoir at elevation (EL.) 884.4 feet (ft)[1], which is 0.6 ft below the crest of the spillway. The principal structures at the Project consist of a free-overflow, ogee-type concrete spillway; an intake structure integrated into the dam; an overflow auxiliary spillway on the left[2] side of the main spillway; sluice structure controlled with an inflatable Obermeyer gate; a non-overflow section that forms the right abutment; a penstock; and the powerhouse.

[1] All elevations are referenced to National Geodetic Vertical Datum of 1929 (NGVD).

[2] For usages of "left" and "right" throughout this document, the reference point is as viewed looking downstream.

The Project has been operated by Appalachian over the previous license term to provide up to 2.4 megawatts (MW) of renewable capacity and average annual energy generation of 8,557 megawatt hours (MWh).

Agency Consultation and Relicensing Process

Appalachian followed FERC's ILP in support of preparing this application for new license. Appalachian filed a Pre-Application Document (PAD) and associated Notice of Intent (NOI) with the Commission on January 28, 2019, to initiate the ILP. The PAD provided a description of the Project and summarized existing, relevant, and reasonably available information to assist resource agencies, federally recognized Indian tribes, non-governmental organizations (NGOs) and other interested parties (collectively, "stakeholders") in identifying issues, determining information needs, preparing study requests, and analyzing the license application.

The Commission issued Scoping Document 1 (SD1) for the Project on March 26, 2019. As provided in 18 CFR §5.8(a) and §5.18(b), the Commission issued a notice of commencement of the relicensing proceeding concomitant with SD1. On April 24 and 25, 2019, the Commission held public scoping meetings in Vinton, Virginia. During these meetings, FERC staff presented information regarding the ILP and details regarding the study scoping process and how to request a relicensing study, including the Commission's study criteria. In addition, FERC staff solicited comments regarding the scope of issues and analyses for the Environmental Assessment. Pursuant to 18 CFR §5.8(d), a public site visit of the Project was conducted on April 24, 2019. Resource agencies, Indian Tribes, NGOs, and other interested parties were afforded a 60-day period to request studies and provide comments on the PAD and SD1. The comment period was initiated with the filing of the Commission's March 26, 2019 SD1 notice and concluded on May 25, 2019. During the comment period, 12 stakeholders filed letters with the Commission providing general comments, comments regarding the PAD, comments regarding SD1, and/or study requests. Sixteen formal study requests were received from FERC, U.S. Fish and Wildlife Service (USFWS), Virginia Department of Wildlife Resources (VDWR) (formerly named the Game and Inland Fisheries [VDGIF]), and Virginia Polytechnic Institute and State University (Virginia Tech) during the comment period. Copies of the letters filed with the Commission are provided in Appendix H in Volume II of the license application.

FERC issued Scoping Document 2 (SD2) on July 9, 2019 and in accordance with 18 CFR §5.11, Appalachian developed a Proposed Study Plan (PSP) for the Project that was filed with the Commission and made available to stakeholders on July 9, 2019. The PSP described Appalachian's proposed approaches for conducting studies and addressed agency and stakeholder study requests. Pursuant to 18 CFR §5.11(e), Appalachian held a PSP Meeting on August 1, 2019, for the purpose of

clarifying the PSP, explaining any initial information gathering needs, and addressing any outstanding issues associated with the PSP. Appalachian received timely formal comments on the PSP from FERC, USFWS, VDWR, Virginia Tech, Friends of the Rivers of Virginia (FORVA), Roanoke Valley Greenway Commission (RVGC), U.S. Environmental Protection Agency (USEPA), Roanoke River Blueway Commission (RRBC), and Virginia Department of Environmental Quality (VDEQ), which are included in Appendix H (Volume II). In accordance with 18 CFR §5.11, Appalachian developed a Revised Study Plan (RSP) for the Project, which takes into account comments and study requests considered in developing the PSP, the Commission's July 9, 2019 SD2 and comments on the PSP, and it was filed with the Commission and made available to stakeholders on November 6, 2019. On December 6, 2019 FERC issued the Study Plan Determination (SPD) for the proposed eight studies to be performed in support of issuing a new license for the Project, as listed below.

(1) Flow and Bypass Reach Aquatic Habitat Study
(2) Water Quality Study
(3) Fish Community Study
(4) Benthic Aquatic Resources Study
(5) Wetlands, Riparian, and Littoral Habitat Characterization Study
(6) Shoreline Stability Assessment Study
(7) Recreation Study
(8) Cultural Resources Study

On July 27, 2020, Appalachian filed an updated ILP study schedule and a request for extension of time to file the Initial Study Report (ISR) to account for fieldwork delays resulting from the COVID-19 pandemic. The request was approved by FERC on August 10, 2020, and the filing deadline for the ISR for the Project was extended from November 17, 2020 to January 11, 2021.

On December 22, 2020, FERC issued Scoping Document 3 (SD3) for the Project, to account for updates about Commission staff's intent to conduct their National Environmental Policy Act (NEPA) review in accordance with the Council on Environmental Quality's (CEQ) updated NEPA regulations at 40 CFR Part 1500-1518.

Appalachian filed the ISR on January 11, 2021, conducted a virtual ISR Meeting on January 21, 2021, and filed the ISR Meeting summary with the Commission on February 5, 2021. The following parties provided written comments in response to Appalachian's filing of the ISR meeting summary: FERC staff, Roanoke County, USFWS, Roanoke Regional Partnership, Roanoke River Blueway Committee, Roanoke Valley Greenways, and the VDEQ. Appalachian provided response to comments on April 6, 2021. FERC provided its Determination on Requests for Study Modifications on May 10, 2021.

Throughout the study phase of the ILP (i.e., July 2020 through the USR), either by separate filing or in conjunction with the filings described above, Appalachian provided FERC and relicensing participants with quarterly ILP study progress reports describing study activities completed by Appalachian, updates to the study schedule, and variances from the schedule or methods of the RSP.

In addition to the formal consultation activities describe above and as represented in Appendix H (Volume II) of this FLA, throughout the ILP, Appalachian conducted consultation with specific stakeholders in support of the Cultural Resources Study, informal consultation with stakeholders in association with study activities, and convened and participated in additional meetings with relicensing participants throughout the pre-filing consultation period, including:

- September 25, 2019: Fish Community and Roanoke Logperch Study Plan Meeting (VDWR, USFWS, VDEQ, VA Tech)
- June 29, 2020: ILP Study Schedule Update to Agencies (VDWR, VDEQ, USFWS)
- April 20, 2021: Recreation Stakeholder Meeting (Town of Vinton, Roanoke Valley-Alleghany Regional Commission [RVARC], FORVA, Roanoke County, National Park Service (NPS), Virginia Department of Conservation and Recreation [VDCR])
- June 7, 2021: Roanoke Logperch Studies Update (USFWS, VDWR, FERC Staff)

On October 1, Appalachian filed the Draft License Application (DLA) with the Commission and distributed notice of these filings to the Project's mailing list. Comments on the DLA were filed by the following: FERC (12/29/2021), Roanoke County (12/27/2021), Roanoke Regional Partnership (21/30/2021), Roanoke River Blueway Committee (12/28/2021), Roanoke Valley Greenways (12/22/2021), USFWS (12/14/2021) and VDWR (12/30/2021).

Studies were completed in 2021 with the exception of one task for the Fish Community Study: the Roanoke Logperch Larval Drift Survey. The field effort for this study is planned for completion in the spring of 2022, and Appalachian expects to file a revised study report to include results of this survey with the Commission as supplemental information to this FLA in late 2022. The USR was filed with the FERC on December 6, 2021 and the USR meeting was held on December 14, 2021. The meeting summary was filed on December 27, 2021. The following parties provided written comments in response to Appalachian's filing of the USR meeting summary: FERC staff (1/27/2022), FORVA (1/28/2022), RRBC (1/28/2022), and RVGC (1/28/2022).

Appalachian has reviewed and considered comments received on both the DLA and USR as evidenced through further development of the Licensee's measures proposed in this FLA and summarized in Table ES-1.

Table ES-1. Resolution of Comments on Niagara Hydroelectric Project Draft License Application and Updated Study Reports

Comment Number	Agency	Comment	Resolution of Comment in Final License Application
		Comments on the DLA	
1	USFWS	This section states that the Project is operated to provide minimum flows to the bypass reach of 8 cubic feet per second (cfs) (during periods of powerhouse generation) or 50 cfs (during non-generating periods). During periods of power generation, the minimum flow is only provided through the Obermeyer gate on the north side of the dam. The Service recommends that Appalachian evaluates how the flow is distributed and at what elevation the reservoir is maintained during operations for the upcoming license. It may be beneficial to raise the elevation of the reservoir so that the minimum flow is provided over the dam crest instead of only through the Obermeyer gate. This change in flow distribution could provide water quality benefits for aquatic organisms and provide more habitat for aquatic organisms in the bypass reach. The results from the Flow and Bypass Reach Aquatic Habitat Study should be helpful for determining the method and location for flow delivery into the bypass reach to provide year-round habitat for aquatic organisms.	Water Quality PM&E measures are discussed in Section E.8.3. As described in this section, Appalachian has evaluated and rejected this recommendation due to the additional burdens it would place on Project operations (including challenges for license compliance) and the lack of water quality or aquatic habitat benefits operating in this mode would provide the bypass reach, compared to Appalachian's proposed 30 cfs continuous minimum flow release through the Obermeyer gate in the sluice structure.
2	USFWS	This section states that Appalachian plans to qualitatively evaluate the relationship between areas in the upper bypass reach where low dissolved oxygen was measured during the lowest flow period of 2021 and the occurrence of aquatic habitat. This section further states that if an adjustment to the minimum flow to the bypass reach during summer months is prudent based on the findings of the relicensing studies, Appalachian will include this proposal in the Final License Application (FLA), following additional consultation with the Virginia Department of Environmental Quality (VDEQ) and Virginia Department of Wildlife Resources (VDWR) in association with the Updated Study Report (USR). The Service supports this approach and would like to work with Appalachian to develop protection, mitigation and enhancement (PM&E) measures to ensure water quality in the bypass reach and below the Project are sufficient to support aquatic organisms, including RLP.	Comment noted by Licensee and supports the minimum flow requirement proposed by Appalachian in this FLA (30 cfs continuous minimum flow release through the Obermeyer gate in the sluice structure).
3	USFWS	This section states that the targeted RLP surveys proposed for 2021 included a spring larval drift study upstream of the dam as shown in Figure E.9-3. This section refers to the incorrect figure. It should be referencing Figure E.9-4. Because of delays in obtaining the necessary permits, the larval RLP surveys could not be completed in 2021 and are scheduled to be performed in spring 2022. This section should be updated to reflect the new schedule. These surveys will determine whether operations have the potential to impact larval RLP from drifting into less suitable habitat in the impoundment and/or from entrainment. If potential impacts are occurring, PM&E measures will need to be developed to address this impact. The results of this study will be needed to fully develop PM&E measures to protect RLP in the Roanoke River.	The correct figure has been cross-referenced and a paragraph has been added (Section E.9.2) to clarify the new Roanoke Logperch sampling schedule.
4	USFWS	This section states that based on the findings from the current relicensing study, entrainment of fish early life stages (eggs and larvae) is likely minimal given the life history characteristics of species in the vicinity of the Project. This conclusion does not consider the life history of the RLP. Larvae of almost all members of the Percina genus drift for long distances downstream from their spawning habitats (Buckwalter et al. 2019). 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. 2016). Larval RLP spawned upstream of the Project may drift into the Project intake and through the turbines. This life history characteristic of the RLP should be considered in this conclusion. The RLP larval drift study scheduled to be completed in 2022 will determine whether larval RLP could be entrained at the Project. This section states that burst swim speed data were compiled from the literature, however if data for a specific species or group was not directly available, it was calculated as two times the critical swim speed defined by Bell (1991). Bell (1991) does not define "critical" swim speed, but does define "cruising," "sustained," and "darting" swim speeds. This section should clarify how "critical" swim speed is defined.	Text was inserted (Section E.9.2.1) to acknowledge dispersal distance and that the potential for larval Roanoke Logperch spawned upstream of the Project to drift into the Project intake and through the turbines is unknown at this time. The Roanoke Logperch larval drift survey is scheduled to be completed in spring 2022 and is expected to determine whether larval Roanoke Logperch drift is occurring upstream of and near the Project intake where they could be susceptible to entrainment. Results of the larval drift study will be used to inform further evaluation of Project effects on Roanoke Logperch. Clarification was added regarding critical speed based on Bell (1991).

Comment Number	Agency	Comment	Resolution of Comment in Final License Application
5	USFWS	This section states that the Licensee does not anticipate that operation and maintenance of the Project over the new license term will have any short- or long-term, unavoidable, adverse impacts on aquatic resources. It is premature to make this statement as the RLP larval drift study and the bypass reach study are not completed and Appalachian has not yet proposed a new minimum flow in the bypass reach. If FERC determines that operation of the Project under the new license conditions may affect RLP, FERC should request consultation with the Service pursuant to the ESA.	This is the Licensee's conclusion based on existing information and additional information will be provided in the forthcoming study report on the results of the Roanoke Logperch larval drift survey (late 2022).
6	USFWS	This section states that preliminary 2021 RLP sampling results indicate that RLP are utilizing the available habitat in the Niagara bypass channel provided by the 8 cfs minimum flow requirement. Provide the flow information during the period when RLP were documented in the bypass reach to support this statement. If flows were higher than 8 cfs at the time that RLP were documented using the bypass reach, the above statement is misleading, as a determination has not yet been made regarding whether a minimum flow of 8 cfs is sufficient to support RLP use of the bypass channel.	Summary table of flows for the bypass and powerhouse channels and combined totals were provided in a table (E.9-16) and referenced in Section E.9.2.2.
7	USFWS	This section states that fish passage facilities are not available at downstream barriers and diadromous fish are not present at the Smith Mountain Lake Project (FERC Project No. 2210) located downstream of the Project; therefore, it is unlikely that diadromous fish are present downstream or upstream of the Project. The Service agrees with this conclusion. However, on dams below Smith Mountain Lake, there are ongoing efforts to pass American eels (Anguilla rostrata) and eventually pass anadromous fish (e.g., American shad [Alosa sapidissima]). In the event diadromous fish passage is provided to the Project during the upcoming licensing period, the Secretary of Interior, through the Service, will be reserving its authority under Section 18 of the FPA to prescribe fishways for upstream and downstream passage for diadromous fish species at the Project when it becomes warranted.	Comment noted by Licensee and acknowledged throughout the application as appropriate.
8	USFWS	This section states that during the new license term, activities performed under the Roanoke Logperch Plan, which Appalachian presently implements for the downstream Smith Mountain Lake Project, could potentially include enhancement projects or studies that would benefit this species at or in the vicinity of this Project. The Final Roanoke Logperch Plan developed in 2008 as part of the relicensing for the Smith Mountain Lake Project has been an important mechanism for mitigating impacts from this project. License Article 408 for this project requires the licensee to develop, fund, and complete projects annually, to facilitate the recovery of the RLP in the upper Roanoke River watershed. A similar approach could be utilized at the current Project to compensate for unavoidable impacts from Project operations. Impacts from this Project are similar to impacts from the Smith Mountain Lake Project in that this Project serves to physically and genetically isolate RLP populations in the upper Roanoke River. The Service recommends that Appalachian consider a similar approach at this Project to fund projects related to the recovery of the RLP in the upper Roanoke River watershed as a PM&E measure to compensate for unavoidable impacts.	Appalachian understands USFWS's interests and anticipates further consultation with USFWS and other stakeholders regarding appropriate PM&E measures following completion of the Roanoke Logperch larval drift surveys and study report in 2022.
8a	USFWS	This section states that Appalachian anticipates that potential modifications to the minimum flow to the bypass reach, particularly during low flow periods of the year, will be evaluated in consultation with relicensing participants through the USR process and may be proposed in the FLA and/or recommended by agencies. This section further states that Appalachian will update this section in the FLA to reflect the findings and recommendations of the ongoing Aquatic Resources studies. Section E.9.2.2.2 states that juvenile and adult RLP were found in the bypass reach during the spring 2021 snorkel surveys including 9 adult RLP and 1 juvenile RLP. Because of the presence of RLP in the bypass reach, the Service supports this evaluation to ensure aquatic habitat in the bypass is available during low flow periods for resident fish, including RLP. The Service would like to work with Appalachian to develop PM&E measures to ensure sufficient flows are provided in the bypass reach to support the full assemblage of native fish through the entire year, including the RLP.	For the reasons discussed in Sections E.8 and E.9 and based on stakeholder comments in response to the DLA and the USR, as part of its relicensing proposal, Appalachian proposes to provide a 30 cfs continuous minimum flow release to the bypass reach, to be released through the Obermeyer gate in the sluice structure.
8b	USFWS	While there are currently no diadromous fish species above the Project, resident fish will still move within the river either seasonally for spawning or during natural dispersal. Many of these resident fish species are hosts for freshwater mussels and their ability to disperse helps mussels recolonize new areas and allows better genetic exchange. No reliable safe downstream passage for fish is provided at the Project during low flow periods. The Service does not recognize passage through the turbine intakes as an acceptable downstream route for fish (Service 2019). Fish that	PM&E measures regarding fish passage, including increased minimum flow to the bypass reach, are discussed in Section E.9.3.

Comment Number	Agency	Comment	Resolution of Comment in Final License Application
		pass through the intake and turbines are subject to injury or mortality from entrainment. The only other viable downstream passage routes are through the Obermeyer gate at low flow and over the dam at high flow. Fish that pass through the Obermeyer gate are subject to injury or mortality as there is no plunge pool and fish would impact bedrock/dam face before entering the pool at the base of the dam. In addition, any fish currently surviving passage through the Obermeyer gate may be subjected to low minimum flow, high temperature and low dissolved oxygen within the bypass reach. Therefore, Appalachian should develop PM&E measures to modify Project operations or Project components to provide safer downstream passage for fish during low flow periods including safer passage through the Obermeyer gate. A PM&E measure to provide higher minimum flows in the bypass reach is also needed to ensure water quality and flow is sufficient to allow safe downstream passage through the Project	
9	USFWS	This section states that there are no plans for improvements or activities at the Project that would require the clearing of potentially suitable roosting habitat or trees that may support maternity colonies for protected bat species. This statement is confusing. This statement implies that a habitat assessment was conducted and that some clearing may occur but only in areas that are not suitable habitat. This issue should be clarified. This section states that in the event such clearing activities were proposed to be undertaken in the future in support of Project operation, modifications, or development of new recreational facilities within the Project Boundary, Appalachian would consult or coordinate with the Service in advance of the proposed activities. The section further states that similar consultation would be expected to occur if activities were proposed that could potentially affect other protected species, including bald eagles. The Service agrees with this approach. For any future construction/maintenance activities, Appalachian should use our online project review process (https://www.fws.gov/northeast/virginiafield/endangered/projectreviews.html) which includes a search using the Information for Planning and Consultation system, to identify any federally proposed or listed species and proposed or designated critical habitat that may occur in the action area. The Service recommends a specific PM&E measure be developed to require Appalachian to coordinate with the Service on any construction/maintenance activities that occur at the Project during the licensing period to ensure that impacts to federally proposed or listed species and proposed or designated critical habitat are avoided and minimized. Section 7(a)(2) of the ESA requires every Federal agency, in consultation with and with the assistance of the [Department of the Interior] Secretary, to ensure that any action it authorizes, funds, or carries out, in the United States or upon the high seas, is not likely to jeopardize the continued existence of any listed species or results in the destruction or adverse modification of critical habitat (50 CFR 402.01). If FERC determines that proposed operation of the Project, including but not limited to activities proposed to be undertaken in the future in support of Project operation, modifications, or development of new recreational facilities, may affect federally proposed or listed species and/or proposed or designated critical habitat that may occur in the action area, FERC should request consultation with the Service pursuant to the ESA and its implementing regulations.	The statement regarding potentially suitable habitat was clarified in Section E.10.3. A formal habitat assessment was not required or performed as part the approved ILP study plans. Also as described in this section, throughout the new license term, Appalachian expects to continue to consult with USFWS and VDWR in advance of activities that would disturb wildlife habitat. Appalachian proposes to develop a Terrestrial Resources Protection Plan in consultation with USFWS and VDWR, to include provisions, as suggested by USFWS, for Appalachian's coordination over the new license term with USFWS and VDWR prior to commencing Project operation, modifications, or development of new recreational facilities that may disturb wildlife habitat.
10	USFWS	This section states that the Project facilities and operations described in this Application are compatible with the comprehensive waterway plans for the Roanoke River. The Service thinks it is premature for Appalachian to make this conclusion as the effects of continued operations on RLP have not yet been fully evaluated.	This is the Licensee's conclusion based on existing information and additional information will be provided following completion of the Roanoke Logperch larval drift survey.
11	Roanoke County	As stated in Section E.6.2, Applicant's Proposal, Appalachian is not proposing any changes to its project facilities or project operation; however, it states that stakeholder consultation activities are ongoing and Appalachian is still evaluating measures that will be updated in the Final License Application (FLA). Roanoke County supports increased education and awareness efforts to better inform the public of the recreational opportunities allowed within the Niagara Project Boundary. Roanoke County requests to be included in any future stakeholder consultation activities related to outdoor recreation. In order to ensure that recreational use is monitored within the project boundary, Roanoke County requests that Appalachian consider conducting a Recreational Use Survey every six years in conjunction with its filing of the FERC Form 80 Recreation Report Survey to evaluate the adequacy of existing facilities and/or need for new or improved facilities.	As described in Section E.11.3, following issuance of the new license, Appalachian proposes to develop a Recreation Management Plan in consultation with interested Project stakeholders, to include improvements to the canoe portage take-out and trail and development and maintenance of a public website for information related to river flows downstream of the run-of-river Project and recreational facilities (Project and Non-Project) at the Niagara Project. Appalachian notes that the Form 80 report is no longer required by FERC's regulations.
12	Roanoke County	As stated in Section E.11.3, "Appalachian expects to develop a Recreation Management Plan (RMP) that will provide an inventory of the Project recreation facilities and associated general maintenance measures", as well as "detail the proposed enhancements to the existing Portage Trail". Based on the USR meeting held on December 14, 2021, it is	Given the need for further stakeholder consultation and resolution of land ownership/lease issues related to existing facilities and the resources, Appalachian has chosen to defer preparation of the Recreation Management Plan in consultation with interested stakeholders until new license issuance.

Comment Number	Agency	Comment	Resolution of Comment in Final License Application
		unclear when the RMP will be developed. Roanoke County requests that the completion of a RMP be a condition of the relicensing and that development of the RMP be coordinated with recreation stakeholders.	The Recreation Management Plan, including documentation of consultation, will be filed with FERC for approval. In the interim, Appalachian expects to continue to consult directly with recreation stakeholders for required coordination or approvals to facilitate near-term non-project facility recreation improvements being pursued by others (e.g., Greenway expansion).
13	Roanoke County	Roanoke County requests that proposed non-project recreational facilities be included in the FLA and RMP, such as the Roanoke River Greenway, Wolf Creek Greenway, Roanoke River Blueway, and Explore Park. These projects are proposed within or adjacent to the Project boundary and are publicly supported, as demonstrated in the Virginia Outdoors Plan, Roanoke County Strategic Plan, and the Explore Park Adventure Plan.	Because proposed expansion would abut or overlap in some areas the Project boundary, Appalachian has included additional information about the Roanoke River Greenway in Section E.11.1.2. Appalachian is not aware of any nexus between the other areas or facilities referenced in this comment and Project operations or features, and no additional analysis is believed to be required in this FLA to support the Commission's evaluation of Appalachian's relicensing proposal. Appalachian does not propose to include Non-Project Recreation Facilities in the Recreation Management Plan to be developed, unless there is a requirement or commitment of Appalachian related to these facilities in the new license.
14	Roanoke County	In accordance with Section E.11.3, Roanoke County acknowledges there are challenges with developing a portage on the southside of the Roanoke River near the Niagara Dam, such as private land ownership and steep topography. Roanoke County continues negotiating with the property owners of Tax Parcel ID 071.03-01-13.01-0000 located at 3124 Highland Road for the right-of-way needed to develop recreational improvements such as the Roanoke River Greenway, Roanoke River Blueway, and expansion of Explore Park. Roanoke County would appreciate that Appalachian consider this parcel, as well as adjacent VRFA-owned parcels, in the RMP as a future opportunity to provide or enhance public access to the Niagara Project Boundary, should the right-of-way be acquired.	Comment noted by Appalachian and to be taken into consideration during preparation of the Recreation Management Plan.
15	Roanoke County	During the USR virtual meeting held on December 14, 2021, there was discussion that the Recreation Survey results indicated that the public is accessing the Niagara Project boundary from the community located north of the Roanoke River and from the Blue Ridge Parkway. The Niagara Project access road on the north side of the Roanoke River is gated and doesn't allow for public access. Roanoke County requests that Appalachian evaluate public access opportunities on the north side of the Roanoke River.	Appalachian does not believe that formal access from the north side of the river is feasible due to the active CSX railroad tracks and no designated crossing in this area. Formal trails are infeasible due to safety concerns associated with the existing CSX railroad, steep topography, and land ownership issues. Additional discussion is included in a footnote in E.11.2.1.
16	Roanoke County	Roanoke County supports improvements to the existing portage around the Niagara Dam. The take-out is difficult for paddlers to use, due to the steep banks, water depths, and debris accumulation on the stairs. Roanoke County requests that Appalachian consider the installation of a floating dock or platform with a ladder that would define the take-out location, allow for fluctuation with the river levels, provide a place to moor boats, and provide stability for paddlers climbing out of the water. Roanoke County requests that Appalachian confirm the location of the portage put-in, as DLA Figure E.11-1 Recreation Facilities Within and Adjacent to the Project Boundary shows the portage put-in located within the project boundary. If the put-in location is determined to be outside of the Niagara Project Boundary, Roanoke County requests that Appalachian coordinate with the adjacent property owner (i.e., National Park Service/Blue Ridge Parkway) and the Roanoke River Blueway Committee for improvements that better define the put-in location and make it more user-friendly.	Enhancements to the proposed Canoe Portage Trail and Take-out and signage improvements will be identified in the Recreation Management Plan to be developed. Land ownership at The Canoe Portage Trail Put-In is clarified in the FLA in E.11.1, and Appalachian now classifies the put-in as a Non-Project Recreation Facility.
16a	Roanoke County	Roanoke County also requests that safety measures be considered to better educate and warn the public about the Niagara Dam Hydroelectric Project and the portage. Improvements such as relocating and updating the existing sign to direct boaters away from the dangerous spillway and replacing the faded boat barrier would be beneficial to the public.	Comment noted by Appalachian and to be taken into consideration during preparation of the Recreation Management Plan or forthcoming update to the FERC-approved Public Safety Plan.
17	Roanoke County	Roanoke County is disappointed that Appalachian is not proposing to include formal license provisions to augment recreational boating flows downstream of the Project, as this would require a departure from the normal run-of-river licensed operating mode, resulting in greater impoundment drawdown over a shorter period than would typically occur. Additionally, Appalachian states that drawing down the reservoir to its minimum required elevation would also present challenges for AEP operations to refill the reservoir to normal levels, depending on inflow conditions. Roanoke County is proposing development of a publicly supported in-river whitewater park in Explore Park, which is located downstream of the Niagara Dam near the Smith Mountain Lake Project Boundary (P-2210). The Roanoke	Appalachian does not presently propose to include formal license provisions to augment recreational boating flows downstream of the Project. Operation of the Project in this manner would require a departure from the normal run-of-river licensed operating mode and result in greater impoundment drawdown over a shorter period than would typically occur. Drawing down the reservoir to its minimum required elevation would also present challenges for AEP operations to refill the reservoir to normal levels, depending on inflow conditions. Furthermore, any augmented recreational flow release would be minimal in volume, duration, and frequency.

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		Regional Partnership commissioned a study in 2015 to investigate the feasibility of creating a whitewater park along the section of the Roanoke River that runs through Explore Park. The study found that river along Explore Park is largely composed of bedrock which, at lower levels, currently impedes the ability to easily float the river. At average peak flows, the whitewater features will be an attraction for beginner and intermediate boaters who'd like to practice surfing and basic whitewater maneuvers. At higher flows, the waves will grow in power and complexity and will become an attraction for more experienced boaters. As the FLA and RMP are developed, Roanoke County requests that the Appalachian reconsider the potential for short-term, scheduled recreational releases in support of the Roanoke River Blueway and Explore Park. Controlled releases of the Niagara Dam in late summer or early fall would allow paddlers the ability to navigate this stretch of river during lower flow months and enhance the future in-river whitewater park. Additionally, controlled releases would also support a public-private partnership in Explore Park that has been developed between Roanoke County and Blue Mountain Adventures to provide camping, mountain bike rentals, and canoe, kayak, and tubing programs along the Roanoke River.	
18	Roanoke County	As stated in the DLA and USR, current hydroelectric operations allow debris to overtop the spillway during high river flows, resulting in accumulations downstream of the Niagara Dam that negatively impact the Blue Ridge Parkway, Explore Park, and the Smith Mountain Lake hydroelectric project boundary (P-2210); however, Appalachian is not proposing to modify Project operations to collect non-organic debris that enters the Roanoke River upstream of the Niagara reservoir, as it is not practical. Roanoke County acknowledges that Appalachian did not generate this debris and that Appalachian spends a considerable amount of resources removing debris from the Niagara and Smith Mountain Lake project boundaries. Roanoke County, along with other regional stakeholders, have been organizing community volunteer work days to remove trash and debris along the Roanoke River. Roanoke County encourages Appalachian to continue evaluating trash and debris removal alternatives and support regional efforts to remove trash and debris from the Roanoke River.	Appalachian will continue to support and partner with regional organizations regarding land- or river-based debris removal efforts within the watershed, such as trash cleanups and river sweeps, which have proven effective in recent years. Additional information and requirements may be included in the Recreation Management Plan to be developed in the new license term.
19	Roanoke River Blueway Committee	The Roanoke River Blueway Committee supports improvements to the portage take-out, put-in, trail and signage. On page E-104 of the DLA, the consultants for Appalachian Power (APCO) report that the take-out is "poorly signed and difficult to use." The Committee agrees with the assessment that the take-out is difficult to use. The Roanoke River Blueway would like to work with APCO to develop take-out improvements as part of the Management Plan for this Project. Also on page E-104 the put-in is described as difficult to use. The Committee agrees with the assessment that the put-in is difficult to use. Additionally, the Updated Study Report (USR) notes that the put-in location may not be within the Project Boundary. The Roanoke River Blueway Committee sees a need for a more defined put-in location and improvements to that location. We would like to work with APCO to envision what that might look like. Should APCO determine that the ideal put-in location is outside of the Project Boundary, access through APCO's property and the Project on the part of local stakeholders and the National Park Servce would still be required to make improvements to the put-in location, and should be included as a provision of the Management Plan.	Appalachian is presently evaluating options for improvement and enhancement of the Canoe Portage Trail and will present this proposal in the Recreation Management Plan. Appalachian agrees that the put-in location is on National Park Service land and proposes in the FLA that it is a Non-Project facility, maintained by Appalachian. Appalachian has investigated moving the put-in location upstream onto their land, however the terrain is steep, and the water is fast flowing in the tailrace and does not result in a more desirable put-in location than present.
20	Roanoke River Blueway Committee	On page E-112 of the DLA APCO states: "The Recreation Management Plan will also detail the proposed enhancement to the existing Portage Trail […]." The Roanoke River Blueway Committee is concerned that no copy of the Recreation Management Plan to be submitted with the FLA has been made available for review. The Committee is not familiar with the proposals APCO plans to make in that document outside of the text included here. The Committee would prefer that APCO work directly with local stakeholders to develop this document.	Appalachian proposes to develop a Recreation Management Plan in consultation with recreation stakeholders in the new license term.
21	Roanoke River Blueway Committee	Page E-102 of the DLA should note that the current Roanoke River Greenway alignment to connect the City of Roanoke to Explore Park passes within the Project Boundary. This project is a high priority for the regional greenway network and for outdoor recreation in the region.	The FLA (Section E.11) has been updated to include discussion and a map of the proposed greenway extension alignment and the Project Boundary. Appalachian is supportive of the County's efforts to extend the Greenway as proposed and has and will cooperate, as prudent, to provide access or easement across lands owned or controlled by Appalachian, in accordance with existing License Article 202 (FERC's standard land use article). Additionally, under License Article 202, Appalachian's authorization of these development activities within the Project boundary may require prior notification to and approval by FERC for non-project use of project lands (as

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			well as other applicable federal, state, or local permits or approvals, to be pursued by the requesting party).
22	Roanoke River Blueway Committee	On page E-112 APCO states that they support “recreation stakeholders in their desired improvements to the Non-Project facilities […]." The Roanoke River Blueway Committee feels that projects past a certain planning stage can and should be included in the Recreation Management Plan. Projects such as the Roanoke River Greenway have clear, planned alignments that impact the Project Boundary.	See response to Comment 21 above.
23	Roanoke River Blueway Committee	While the Recreational Release was evaluated and the evaluation was included in the DLA, APCO has stated in this document that they do not wish to pursue this because of potential impacts to operations. However, development of an in-river kayak park is a key element of the Explore Park Master Plan. An in-river kayak park could generate as many as 15,000 trips a year according to an Economic Impact Study produced in Stoughton, Wisconsin, which would produce a significant boost to visits to the Explore Park and an accompanying boost in revenue. Development of this park may be negatively impacted by the low flow downriver of the dam. The Committee requests further clarification on the impacts of Recreational Releases on Project function, and that APCO reconsider releases for special events during low flow summer months.	See response to Comment 17 above.
24	Roanoke River Blueway Committee	During the USR meeting on December 14, 2021 the consultant presented evidence that foot access from adjoining residential properties and the Blue Ridge Parkway was occurring on river left, the powerhouse side of the river, within the Project Boundary. The Committee hopes that APCO will be amenable to further exploring this data and possible visitor use management efforts in the future.	See response to Comment 15 above.
25	Roanoke River Blueway Committee	Additionally, the Roanoke River Blueway Committee has made previous comments about the desire for collaboration with APCO in order to investigate potential trash removal programs in the future. Trash removal could have positive benefits to the Project. The Committee recognizes that APCO is not responsible for the trash in the river, but hopes that APCO will be amenable to working with the Blueway Committee and the Regional Commissions’ member governments, as well as other stakeholders, when clean-up opportunities present themselves. It would be of great help to be able to access the Project area and the road into the Project Boundary in order to safely and efficiently remove trash from the reservoir and the spillway.	See response to Comment 18 above.
26	FERC	The DLA does not contain a Supporting Design Report (SDR), as required by sections 4.61(e) and 4.41(g)(3) of the Commission’s regulations. In Exhibit F of the DLA, Appalachian states that given the project has been inspected by an independent consultant within the past five years and an updated Potential Failure Modes Analysis Review Memo was filed with the Commission on March 1, 2021, in accordance with the Commission’s Part 12 Dam Safety regulations, that further discussions regarding geological and subsurface investigations, hydrologic and hydraulic analyses, and stability analyses for all major structures will not be reiterated as part of an SDR. Although this statement is not an explicit request for a waiver of the requirement that Exhibit F contains an SDR, the statement implies that Appalachian does not intend to file an SDR with the FLA. While we understand that your project is subject to the Commission’s Part 12 requirements on an on-going basis, an SDR is a standard requirement for an FLA in accordance with sections 4.61(e) and 4.41(g)(3) of the Commission’s regulations. Therefore, the SDR should be included in your FLA in accordance with the regulations.	A Supporting Design Report (SDR) has been developed and is included in Volume III of the FLA (CEII).
27	FERC	Sections 5.17(e) and 4.38(b)(2)(vi) of the Commission’s regulations require that every application for a license for a project with a capacity of 80 megawatts or less must include in its application copies of statements of whether it is seeking benefits under section 210 of the Public Utilities Regulatory Policies Act of 1978 (PURPA). The draft license application (DLA) does not indicate whether Appalachian Power Company (Appalachian) is seeking PURPA benefits. Therefore, in the final license application (FLA), please indicate if benefits are being sought under 210 of PURPA; if so, provide the necessary documentation for doing so in accordance with section 4.38(b)(2)(vi) of the Commission’s regulations.	Appalachian will not be seeking benefits under Section 210 of the Public Utility Regulatory Policies Act (PURPA) of 1978 for qualifying hydroelectric small power production facilities in §292.203 of this chapter. This has been added to Section A.3.9.

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28	FERC	Page A-3 of Exhibit A describes the project's transmission facilities. However, Exhibit A does not provide the length of the transmission lines. Please provide this information in the FLA.	As described in the existing license, transmission facilities are limited to two 50-foot-long 2.4-kilovolt (kV) generator leads and a 3-phase, 2.4/12-kV, 2,500-kilovolt ampere (kVA) step-up transformer. The length of the generator leads has been added to sections A.2, E 5.2, and H.5. There are no primary transmission lines associated with the licensed Niagara Project.
29	FERC	Table A.2-7 of Exhibit A shows monthly and annual flows at the project. The table contains flows for minimum, 90% exceedance, average, 10% exceedance, and maximum. However, median flows are not included in Table A.2-7. In order to calculate a dependable capacity for the project, please provide the monthly median flows at the project in the FLA.	Monthly median flow column was added to Table A.2-7.
30	FERC	As previously requested in our March 5, 2021 comments on the Initial Study Report, please file with the FLA the geospatial data (e.g., exports from Global Positioning System (GPS) devices, or Geographic Information System (GIS) shapefiles), including the sampling locations, mesohabitat, substrate, and cover maps; shoreline habitat classifications; and any other GIS data layers that were created for the following studies: (1) Bypass Reach Flow and Aquatic Habitat Study; (2) Benthic Aquatic Resources Study; (3) Fish Community Study; (4) Water Quality Study; (5) Shoreline Stability Assessment Study; and (6) Wetlands, Riparian, and Littoral Habitat Characterization Study.	Requested GIS files (.shp) will be made available to the Commission electronically.
31	FERC	Page E-25 of Exhibit E states that there are several water withdrawals and discharges in the project vicinity upstream of the project impoundment. In the FLA, please provide a map showing the locations of the water withdrawals and discharges.	A new map with water withdrawals and discharges has been inserted.
32	FERC	Page E-25 of Exhibit E states that monthly average flows for the project over the term of the previous license ranged from 289 cubic feet per second (cfs) to 801 cfs. However, the monthly average flows range from 289 cfs in August to 853 cfs in February in Table E.8-1. Please clarify the discrepancy in the FLA.	Text has been updated to match table.
33	FERC	Table E.10-1 in section E.10.1.3 of Exhibit E states that 27.25 acres of wetland habitat are present within the project boundary based on data from the National Wetlands Inventory (NWI). However, results from the Wetlands, Riparian, and Littoral Habitat Study presented in the Updated Study Report (USR) identified 61.36 total acres of wetland habitat in the project boundary based on NWI data. Additionally, the USR indicated that 12.45 acres of additional wetlands were identified in the field, beyond the NWI. In the FLA, please reconcile the discrepancy between these estimates and provide updated wetland acreages and mapping to reflect any changes.	The USR and the FLA have been updated to correct these acreage values.
34	FERC	As noted in item 2 above, Exhibit A does not include sufficient information on transmission lines. In providing such information in the FLA, please also explain how the project transmission line right of way is maintained and if any such activities could affect terrestrial resources or protected species.	Note that there are no primary transmission lines associated with the Project, therefore, there are no clearing or vegetation maintenance activities that would affect terrestrial species near the Project. As described in the existing license, transmission facilities are limited to two 50-foot-long 2.4-kilovolt (kV) generator leads and a 3-phase, 2.4/12-kV, 2,500-kilovolt ampere (kVA) step-up transformer. The length of the generator leads has been added to sections A.2, E 5.2, and H.5. There are no primary transmission lines associated with the licensed Niagara Project.
35	FERC	Section E.10.1.6 of Exhibit E includes information on federally listed species from a 2017 correspondence with the U.S. Fish and Wildlife Service (FWS) but does not include a more recent review of federally listed species using FWS's Information for Planning and Consultation (IPaC) tool. Because such reviews need to be periodically updated to reflect potential listing of new threatened, endangered, or candidate species (e.g., monarch butterfly), please conduct an IPaC review for this project and include the results in the FLA.	The USR and the FLA have been updated to include new (2021) IPaC results, which include the monarch butterfly (Candidate species).
36	FERC	Section 4.61(f) of the Commission's regulations requires, in part, that an application includes an Exhibit G with a map or series of maps that complies with section 4.41(h) of the Commission's regulations. Section 4.41(h) requires project boundary data in a geo-referenced electronic format. However, no project boundary data in a geo-referenced electronic format are provided in the DLA. Therefore, please provide this information in the FLA.	Exhibit G (Project Boundary Map) is provided in Volume I of the FLA.
37	FERC	Section 4.39(a) of the Commission's regulations requires that Exhibit G maps and drawings be stamped by a registered land surveyor. The Exhibit G maps and drawings provided in the DLA lack a registered land surveyor's stamp.	Exhibit G Project Boundary Map(s) have been stamped by a registered land surveyor.

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38	Roanoke Valley Greenways	The Roanoke Valley Greenway Commission provided comments on the Scoping Document, the PAD, and the Preliminary Recreation Study Report for Niagara Hydroelectric Project, FERC No. 2466. We appreciate that some of our initial concerns were addressed in the final Recreation Study Report, but still feel that it falls short of the recreational needs of the Roanoke Valley and has too narrow a view of the project's impacts. In particular, the omission of proposed greenway projects as being outside the scope of the Recreation Study ignores that the member localities of the Greenway Commission have long been in conversation with Appalachian Power to implement the Roanoke River Greenway. Additionally, the efforts to create a Roanoke River Blueway are acknowledged in the regional overview in the summary of the study, but not how the Blueway's creation would impact the existing project recreational facility and the two non-project facilities (all included in the study area). The proposed development of a Recreational Management Plan for the project would help address these issues, but it potentially may not occur until after the licensing renewal is completed in 2024. As the purpose of a RMP for the project would be to enhance public access, we request that the development and completion of an RMP be a condition of the relicensing of the Niagara Project.	See response to Comment 12 above.
39	Roanoke Valley Greenways	The Roanoke River Greenway, a thirty-plus mile corridor is planned from Montgomery County to Franklin County at Back Creek. During the study period, The Roanoke River Greenway sections that are completed saw unprecedented numbers of users. Although these increases were initially attributed to the restrictions required to contain the spread of the Covid -19, trail use counters show that the high level of use has continued. This reflects national participation trends in trail activities. Extending the Roanoke River Greenway as far as Rutrough Point will provide greater amenities to users, and will help alleviate crowding issues closer to the City of Roanoke. The eastern section of Roanoke River Greenway in Roanoke County from the City line to Highland Road is within the Project boundary and has completed its engineer phase. The next section under the Blue Ridge Parkway has received funding for construction and the portion within Explore Park to Back Creek is being designed. This extension of Roanoke River Greenway will dramatically increase recreation use within the Project area. Roanoke County and AEP have been cooperating on coordination of Roanoke River Greenway construction. The completion of a RMP sooner rather than later will ensure that progress toward completing the Roanoke River Greenway will continue and are an acknowledgement that these facilities will enhance recreational use of the Project area.	See response to Comment 21 above.
40	Roanoke Valley Greenways	The proposed Roanoke River Blueway is an effort to improve recreational access along the Roanoke River at existing facilities, develop in-water play features and to provide consistent, welcoming wayfinding all along the corridor. More effective maps and consistent signage on the water will encourage paddlers to connect the different boat access points. In all, the goal is to encourage paddlers to explore more of the Roanoke River, while helping them to understand the value of improving the watershed. Any opportunity to lengthen the time people spend on the water is a chance to meet that goal. The Recreational Study Report demonstrates the need for the Blueway effort. Few of the paddlers who were interviewed for the study understood that there was a portage around the spillway and the author of the study notes that the signage at the portage is substandard and that the put in is not well defined. In river signage coupled with an improved, defined portage route will improve the user experience and increase the overall participation numbers.	See response to Comment 17 above regarding flow releases. Additional comment about information and signage noted by Appalachian and to be taken into consideration during preparation of the Recreation Management Plan.
41	Roanoke Valley Greenways	We also acknowledge that the debris and trash that collects on the boat boom before the spillway was not created by AEP, but because it is most visible at this point, it is seen by the general public as AEP's problem. AEP has an opportunity to facilitate a discussion with various regional stakeholders to come up with solutions for this issue. We would like to see included in the re-licensing agreement a commitment from AEP to provide access to the project site for a discussion of what can be done rather than allowing the debris to move further downstream. We are confident that the departments responsible for stormwater management at the city and county of Roanoke would be eager to engage with AEP to develop an acceptable plan to begin to address the issues.	See response to Comment 18 above.
42	Roanoke Valley Greenways	In closing, we would ask that AEP commit to the following steps as a part of the re-licensing process: a. Start the work to develop a Recreational Management Plan that will be completed prior to when the renewed license is issued.	See response to Comment 12 above.

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43	Roanoke Valley Greenways	In closing, we would ask that AEP commit to the following steps as a part of the re-licensing process: b. Provide Roanoke County with right-of-way for Roanoke River Greenway on river right on AEP land.	See response to Comment 39 above.
44	Roanoke Valley Greenways	In closing, we would ask that AEP commit to the following steps as a part of the re-licensing process: c. Work with the localities to provide debris removal at the dam and sponsor periodic clean ups of trash in the Project Area.	See response to Comment 18 above.
45	Roanoke Regional Partnership	We fully support the formal comments submitted by Roanoke County, City of Roanoke, Town of Vinton, Roanoke Valley Alleghany Regional Commission, and Roanoke Valley Greenway Commission and encourage you to adopt and implement their requests.	Comment noted by Licensee.
46	Roanoke Regional Partnership	Key requests we would like to draw your attention to include: • Request that the development of a Recreation Management Plan be a requirement, not just a recommendation, in the issuance of the new relicense.	See response to Comment 12 above.
47	Roanoke Regional Partnership	Key requests we would like to draw your attention to include: • Request Appalachian reconsider the potential for short-term, scheduled recreational water releases. Controlled releases of the Niagara Dam in late summer and early fall would allow paddlers the ability to navigate this stretch of river during lower flow months and enhance the future in-river whitewater park. Controlled releases would also support a public-private partnership in Explore Park that has been developed between Roanoke County and Blue Mountain Adventures to provide camping, mountain bike rentals, and canoe, kayak, and tubing programs along the Roanoke River.	See response to Comment 17 above.
48	Roanoke Regional Partnership	Key requests we would like to draw your attention to include: • Requested improvements to the existing portage trail around the dam, specifically the take-out and put-in. Request a portage on the north side of the river be evaluated.	Comment noted by Appalachian and to be taken into consideration during preparation of the Recreation Management Plan.
49	Roanoke Regional Partnership	Key requests we would like to draw your attention to include: • Request Appalachian implement trash and debris removal alternatives and support regional efforts. Current procedure is to push debris over the dam, so it becomes someone else's problem.	See response to Comment 18 above.
50	Roanoke Regional Partnership	Key requests we would like to draw your attention to include: •Request Appalachian continue support of the greenway (VDOT UPC No. 91191) proposed within and adjacent to the Niagara Dam Project Boundary, as FERC approval is required for non-project use of project lands and water to allow Appalachian to grant Roanoke County the right-of-way necessary to construct sections of the greenway in 2022-2023.	As described in Section E.11.3, because the schedule and feasibility of development of the Greenway extension is and will continue to be driven by Roanoke County and by factors beyond Appalachian's control, and Appalachian understands that the County desires to advance this project prior to new license issuance expected in early 2024, Appalachian does not propose to include measures related to the Greenway extension in the Recreation Management Plan. Appalachian will instead continue to cooperate with Roanoke County to provide and obtain necessary authorizations and approvals for activities on lands controlled or owned by Appalachian and for activities within the Project boundary, and in accordance with the requirements and protections of the standard land use article that will be included in the new license.
51	VDWR	We have reviewed the DLA, as well as comments submitted by the US Fish and Wildlife Service (USFWS). We concur with those comments submitted by USFWS regarding this project. We agree that certain aspects of this project are incomplete, pending the results of planned studies (e.g., Roanoke Logperch Percina rex larval sampling and full analyses of the Bypass Reach instream flow studies). As a result, we are unable to offer relevant comments regarding recommended flow regimes for the Bypass Reach or fish entrainment/impingement impacts at this time. Those comments will be forthcoming once all the studies and analyses have been completed.	Comment noted by Licensee.
52	VDWR	In general, we commend the Applicant and their Agents for conducting a very transparent and responsive process. All issues raised by stakeholders appear to have been considered and discussed. Many of the issues raised during the course of this relicensing have been satisfactorily resolved.	Comment noted by Licensee. Appalachian thanks the VDWR for their participation in this licensing process.
53	VDWR	As noted previously, we will withhold comments regarding Bypass Reach flow regimes and entrainment/impingement impacts pending the completion of additional studies and analyses. This would also apply to potential project impacts on Roanoke Logperch. However, we would agree with USFWS that some additional mitigation measures benefitting Roanoke Logperch may be appropriate as part of the Final License Application.	Comment noted by Licensee.
54	VDWR	We would disagree with the Applicant's statement that…existing Project and Non-Project recreation facilities and public access to the Project are sufficient to meet current recreational demand." It appears that recreational demand for water access to the Roanoke River in this area is generally high, as one might expect given the population density	Comment noted by Licensee and to be taken into consideration during development of the Recreation Management Plan. Appalachian believes the level of recreation enhancement proposed in this FLA to be appropriate for the scale of the Niagara Project.

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		in the area. We do agree with the Applicant that practicable recreational enhancement options in the immediate project vicinity are extremely limited. Given this, we would suggest that the Applicant may want to explore options for working with Stakeholders to enhance recreational opportunities on segments of the Roanoke River outside of the immediate project area, in order to mitigate for lost opportunities associated with project operations and development. Such options could include assisting localities and other Stakeholders with Greenway/Blueway enhancements or expansions to meet the high demand for Roanoke River access in the area.	
		Comments on the USR	
1	FERC	Continuously recorded (15-minute) water temperature and dissolved oxygen (DO) data from each monitoring location during the 2020 and 2021 water quality monitoring seasons are presented graphically in Attachment 1 of the Water Quality Study Report filed with the Updated Study Report (USR). However, it is difficult to ascertain from these graphs the number of days that DO values were inconsistent with state water quality standards in the forebay and bypassed reach in 2020 and 2021, respectively. Therefore, to assist staff's analysis of project effects on water quality, please provide the tables, or a spreadsheet file, that reports for each day, the daily minimum, maximum, and average DO values at the continuous water quality monitoring sites in the forebay (monitoring season 2020) and bypassed reach (monitoring season 2021). Please provide all water temperature data in degrees Fahrenheit and all DO data in units of milligrams per liter (mg/L).	Tables of daily water quality have been created and are appended to the Water Quality Study Report (Appendix B, Volume II).
2	FERC	Attachment 3 of the Bypassed Reach Flow and Aquatic Habitat Study Report provides habitat suitability maps for species/guilds specified in Table 3 of Attachment 2 for each modelled flow scenario (i.e., 7 cubic feet per second [cfs], 24 cfs, 33 cfs, and 91 cfs). In addition, please provide: (1) depth and velocity heat maps for each of the modelled flow scenarios; and (2) tabulations, for each modelled flow scenario the weighted usable area (WUA) for the species (all life stages of Roanoke logperch) and guilds specified in Table 3.	The requested maps and table are provided in the Bypass Reach Flow and Aquatic Habitat Study Report (Appendix A, Volume II).
3	FERC	Page 30 and Table 3 of Attachment 2 states that the modelled shallow-slow guild includes three categories: (1) fine and coarse mixed substrate sizes with no boulder/bedrock (represented by spawning redbreast sunfish), (2) all substrate sizes with aquatic vegetation (represented by young-of-year silver redhorse), and (3) coarse substrate (represented by generic shallow-slow guild). However, the aforementioned habitat suitability maps in Attachment 3 (item 2 above) did not include a map for the second category (i.e., all substrate sizes with aquatic vegetation). Please provide a habitat suitability map for this category as well as the tabulated WUA.	Shallow-Slow Guild representative Silver redhorse young-of-year only has preference for the following cover/substrate combinations: (1) no cover and silt or terrestrial vegetation, (2) overhead vegetation and terrestrial vegetation, and (3) aquatic vegetation and aquatic macrophytes. None of these three combinations were present in the Niagara bypass reach based on dominant substrate types. As such, the model results indicated no available habitat for this guild representative, therefore, no figure was generated.
4	FERC	The desktop-study results presented at the USR meeting stated that 61.4 acres of wetlands were identified from National Wetlands Inventory (NWI) data and that several somewhat severely stressed wetlands were identified using the Virginia Department of Environmental Quality Wetland Conditional Assessment Tool (WetCAT). Please clarify whether the WetCAT wetlands are included within the 61.4 acres from the NWI data or additional to that total. If the latter, please provide details on any additional acreages from the WetCAT data.	All stressed wetland acreage was within the NWI wetland data.
5	FERC	The NWI maps presented at the USR meeting and in the Wetlands, Riparian, and Littoral Characterization Study Report use different wetland terminologies (e.g., freshwater emergent, freshwater forested, freshwater pond, riverine) than what is presented in their respective text sections (e.g., palustrine forested, palustrine emergent, palustrine unconsolidated bottom, riverine). Therefore, please use consistent NWI terminologies across both text and maps in future filings.	The referenced study report (Appendix E, Volume II) has been modified to reflect both Cowardin et al. (1979) and NWI wetlands terminology to be consistent with NWI terminology in figures.
6	FERC	Potential recreation enhancements were discussed while reviewing the Recreation Study Report during the USR meeting. For any specific enhancements proposed in the final license application (FLA), please discuss any potential land-disturbing, land clearing, or land-development activities. In providing such detail, please describe the extent of such enhancements (in acres) and characterize any habitats that may be affected so that staff can analyze potential effects of construction, maintenance, and/or increased visitor activity on terrestrial resources (including any federally listed or state-protected species).	At this time, Appalachian is not proposing any changes to the Project or operations that would have any impacts on existing recreation facilities, land use, or aesthetics. In the future, if enhancements are made to Project facilities that would require land disturbance, Appalachian would coordinate with USFWS, VDEQ, VDWR, Virginia Department of Historic Resources and other applicable agencies to complete necessary permitting and other regulatory approvals, including wetland/waterbody delineation, any necessary resource surveys or identification of time of year restrictions for certain activities, and cultural resources consultation, prior to commencement of any construction in support of the recreation improvements.
7	FORVA	Along with the Roanoke River Blueway Committee, Roanoke County, and the Roanoke Regional Partnership, FORVA encourages Appalachian (APCo) to support development of a public access facility (river-right) and adjacent to the Niagara reservoir that will provide vehicular parking. A river access at this location would reduce or obviate the need for any portage on river left if boaters could use a shuttle around the dam and put in again below the dam. Roanoke County has agreed to provide land owned by the Virginia Recreational Facilities Authority and under a lease to Explore Park.	Appalachian does not propose to provide a newly constructed portage or parking area on river-right. See discussion in E.11.2.

Comment Number	Agency	Comment	Resolution of Comment in Final License Application
8	FORVA	Alternatively, a hand carry portage trail on river right should be considered that would allow boaters to access the river below the dam. While potentially expensive such a portage is possible. Currently, to start their float trips many boaters carry their kayaks upstream from an informal river trail off the Blue Ridge Parkway to just below the dam. Such a portage trail would provide better access for the section below the dam. While APCo has said a river right portage is infeasible due to length and topography, this conclusion was based on a public vehicular river access from the nearby road system and included a parking area. However, a simple river right portage trail could be built without public access or parking. This option should be studied and an estimate prepared.	Appalachian does not propose to provide a newly constructed portage trail on river-right. See discussion in E.11.2.
9	FORVA	Finally, if current status of property ownership prohibits developing a river right portage, then APCo should create a set-aside fund in anticipation of the resolution of such issues in future years. Such a mechanism has been used on other hydro projects and can be managed by the Department of Conservation and Recreation. An appropriate amount for the 30 year license should be at least $100,000, which is less than one third the annual displaced fuel cost. The response by APCo that the river right option is infeasible should be determined by an independent third party to provide credibility in the matter.	Comment noted by Appalachian and to be taken into consideration during preparation of the Recreation Management Plan.
10	RRBC	Clarification on the Posting of Signage Regarding BRP Construction On page 4 of the summary document, under Stakeholder Questions/Comments, the following is written: Amanda McGee stated that Roanoke County put up notices for recreationists and visitors to stay away from the areas around the Blue Ridge Parkway bridge construction, and that may have deterred users from trying to access these facilities over the course of this year. This statement should be corrected. Ms. McGee did not intend to imply that Roanoke County was the only locality to put up signage, which was placed in the City of Roanoke and the Town of Vinton as well. Notification was also provided on the Roanoke River Blueway Facebook page. The signage specifically warned Blueway users about passing under the Roanoke River Overlook bridge during construction. Signage was placed at the request of the Blue Ridge Parkway. Construction began in May of 2021. Ms. McGee wished to emphasize that visitor numbers may have been depressed by the postings, but Blueway users were not prohibited from traveling under the bridge only advised that there was risk.	Comment noted by Licensee. No revision to FLA or study report required.
11	RRBC	The Roanoke River Blueway Committee supports improvements to the portage take-out, put-in, trail and signage. The Updated Study Report (USR) notes that the put-in location may not be within the Project Boundary. The Roanoke River Blueway Committee reiterates a need for a more defined put-in location and improvements to that location to address this development.	Appalachian is presently evaluating options for improvement and enhancement of the Canoe Portage Trail and will present this proposal in the Recreation Management Plan. Appalachian agrees that the put-in location is on National Park Service land and proposes in the FLA that it is a Non-Project facility, maintained by Appalachian. Appalachian has investigated moving the put-in location upstream onto their land, however the terrain is steep, and the water is fast flowing in the tailrace and does not result in a more desirable put-in location than present.
12	RRBC	The Recreation Study portion of the USR meeting was supposed to be held at 10:30 am according to the schedule distributed to stakeholders by AEP. Unfortunately, the meeting concluded before this time. At least one regional stakeholder, Pete Eshelman from Roanoke Outside, was unable to attend the correct portion of the meeting because it was not at the advised time.	Comment noted; the meeting invitation stated that the agenda is intended as an approximation and more or less time may be spent on individual studies, as needed.
13	RRGC	1) We are concerned that public participation in the Study Meeting was hindered by the accelerated presentation schedule on December 14'h, which led to the presentation times differing significantly from the meeting's announced schedule. It had been communicated ahead of time that the Recreation Study would be discussed at 10:30am. In the meeting itself though, the earlier presentations were finished ahead of schedule and the decision was made to skip the morning break. This led to the Recreation Study being presented and discussed approximately 45 minutes earlier, wrapping up before 10:30. We know of at least one recognized stakeholder who attempted to join the call at the designated time, but since the meeting was on an extended lunch break at that time, they did not get to participate.	See response to Comment 12.
14	RRGC	Because of the uncertain location of the canoe/kayak put in as was discussed during the Recreation Study review, a group of stakeholders made a visit to the area of the National Park Service's overlook trail below the Roanoke River Bridge. It was clear from our visit that recreational users who are utilizing the portage are leaving the project area and accessing the river within the National Park Service boundary. It is our belief that this clearly points to the need for the put in location to be formally developed within the Appalachian Power project boundary. Offering a portage that is only established at the take out point is effectively a non-functioning portage.	See response to Comment 11.

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Summary of Proposed Action and Enhancement Measures

The Niagara Project operates in a run-of-river mode under all flow conditions, where inflow equals outflow. The Project is operated to maintain the impoundment at or near elevation 884.4 ft, which is 0.6 ft below the crest of the spillway. During extreme flow conditions, such as rapidly changing inflows, Appalachian operates the Project with a minimum impoundment elevation of 883.4 ft. Run-of-river operation may be temporarily modified by operating emergencies beyond the control of Appalachian and for short periods upon mutual agreement among Appalachian, USFWS, and the VDWR. Appalachian proposes to continue operating the Project in the existing run-of-river mode over the new license term.

Appalachian is presently required to release a minimum flow of 50 cubic ft per second (cfs) or inflow to the Project, whichever is less, downstream of the Project powerhouse when the powerhouse is not generating, and 8 cfs to the bypass reach during all other periods. Flows are measured at the U.S. Geological Survey (USGS) gage located approximately 200 ft downstream of the powerhouse (USGS 2056000 Roanoke River at Niagara, Virginia); this gage is operated by USGS in cooperation with Appalachian. Under the new license term, for the protection of water quality and aquatic resources, including the endangered Roanoke Logperch (*Percina rex*), Appalachian proposes to operate the Project with a single (i.e., continuous, year-round) minimum flow requirement of 30 cfs to the bypass reach. In support of this new requirement, Appalachian proposes to continue funding of the USGS Roanoke River at Niagara gage.

Appalachian also proposes to implement the following additional enhancement measures under the new license term:

- Develop and implement a Terrestrial Resources Protection Plan in consultation with USFWS and VDWR, to include supporting information about potentially sensitive areas, as well as the limits of the Project Boundary and lands owned by Appalachian; standard protection measures implemented by Appalachian; identification and communication of activities that may disturb wildlife or wildlife habitat; and other coordination measures, as applicable.

- Develop and implement Recreation Management Plan in consultation with Project stakeholders, to include improvements to canoe portage take-out and trail, and development and maintain a public website for information related to river flows downstream of the run-of-river Project and recreational facilities (Project and Non-Project) at the Niagara Project.

License Application Road Map

This Final License Application consists of four volumes.

Volume I of IV (Public)

- **Table of Contents**
- **Executive Summary**
- **Initial Statement and Additional Information Required by 18 CFR §4.32**
- **Exhibit A – Project Description**
- **Exhibit E – Environmental Exhibit**
- **Exhibit F – List of General Design Drawings:** Includes the list of design drawings filed as Critical Electric/Energy Infrastructure Information (CEII) in accordance with 18 CFR §388.112. The Design Drawings are included in Volume III (CEII). A Supporting Design Report has been developed and is also included in Volume III (CEII).
- **Exhibit G – Project Boundary Maps:** Includes map showing the Project Boundary for the Niagara Project (*Electronic Project Boundary files also included*)
- **Exhibit H – Ability to Operate:** Describes the commitment and responsibility of Appalachian as a Licensee to continue to operate and maintain the Project and the needs and costs for power from the Project or alternate sources.

Volume II of IV (Public)

Volume II contains two parts. It includes the Study Reports/Appendices to Exhibit E as Part I of 2 and documentation of agency consultation as Part 2 of 2. Note that the Aquatic Resources Study Report (Appendix C) will be filed as supplemental information by April 14, 2022, upon completion of the Roanoke Logperch larval drift study.

- **Exhibit E Appendices**
    - Appendix A – Bypass Reach Flow and Aquatic Habitat Study
    - Appendix B – Water Quality
    - Appendix D – Benthic Aquatic Resources Study
    - Appendix E – Wetlands, Riparian, and Littoral Habitat Study
    - Appendix F – Shoreline Stability Study
    - Appendix G – Recreation Study
    - Appendix H – Consultation

Volume III of IV (CEII)

Volume III contains CEII materials not intended for public release, and includes the following:

- **Exhibit F – General Design Drawings and Supporting Design Report**
- **Exhibit H – Single-Line Diagram of the Transmission System**

Volume IV of IV (Controlled Unclassified Information/PRIVILEGED [CUI/PRIV])

Volume IV contains CUI/PRIV materials not intended for public release and includes the following:

- **Cultural Resources Study Report**

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FINAL LICENSE APPLICATION

NIAGARA HYDROELECTRIC PROJECT

(FERC NO. 2466)

Initial Statement (18 CFR §4.61(b))

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BEFORE THE UNITED STATES OF AMERICA FEDERAL ENERGY REGULATORY COMMISSION

NIAGARA HYDROELECTRIC PROJECT
(FERC NO. 2466)

APPLICATION FOR A NEW LICENSE FOR A MAJOR WATER POWER PROJECT – 5 MEGAWATTS OR LESS

(1) Appalachian Power Company (Appalachian or Licensee or Applicant), a unit of American Electric Power (AEP) applies to the Federal Energy Regulatory Commission (FERC or Commission) for a new license for the Niagara Hydroelectric Project (Project or Niagara) (FERC Project No. 2466). The current license for the Project was issued on March 25, 1994 and expires on February 29, 2024.

(2) The location of the Project is:

State or territory:	Virginia
County:	Roanoke
Township or nearby town:	City of Roanoke
Stream or other body of water:	Roanoke River

(3) The exact name, address and telephone number of the applicant are:

Appalachian Power Company
Stephen A. Dolan
Plant Manager Hydro and Ceredo
American Electric Power Service Corporation
40 Franklin Road SW
Roanoke, Virginia 24011

(4) The exact name, address and telephone number of each person authorized to act as an agent for the applicant in this application are:

Mr. Jonathan Magalski
Environmental Supervisor, Renewables
American Electric Power Service Corporation
1 Riverside Plaza
Columbus, OH 43215
(614) 716-2240
jmmagalski@aep.com

Ms. Elizabeth B. Parcell
Process Supervisor
American Electric Power Service Corporation
40 Franklin Road SW
Roanoke, VA 24011

(540) 985-2441
ebparcell@aep.com

(5) The applicant is a domestic corporation and is not claiming preference under Section 7(a) of the Federal Power Act Section 16 U.S.C. 796.

(6) The statutory or regulatory requirements of the state in which the Project is located that affect the Project as proposed with respect to bed and banks and the appropriation, diversion, and use of water for power purposes, and with respect to the right to engage in the business of developing, transmitting, and distributing power and in any other business necessary to accomplish the purposes of the license under the Federal Power Act are: Water rights involved are merely the riparian rights appurtenant, under Virginia law, to the various lands needed for dam site, flowage and tailrace purposes.

The Project was constructed and being utilized prior to 1928, the effective date of the (Virginia) Water Power Act and thus was exempted from the requirement that a license be obtained under the Act. Under said Act (Section 3581(13) of Michie Code 1942), all persons, firms, associations, or corporations who constructed and were utilizing their water power developments prior to 1928, and their lessees, successors and assigns, have, as to such developments and any reconstructions or enlargements thereof, all of the rights and powers conferred by the Act to the same extent as if they were licensees under the Act except that they do not have the power of eminent domain thereunder. By Section 62-88 of Chapter 5 of Title 62 of the Code of Virginia, the provisions of Section 3581(13) of Michie Code 1942 were continued in effect. Appalachian is incorporated under the laws of the Commonwealth of Virginia and qualified to do business as a public utility in Virginia.

The applicant will apply for the Section 401 Water Quality Certification per 18 Code of Federal Regulations (CFR) § 5.23(b). Under Section 401 of the Clean Water Act (CWA) (33 USC § 1251 et seq.), a federal agency may not issue a license or permit to conduct any activity that may result in any discharge into waters of the United States unless the state or authorized tribe where the discharge would originate either issues a Section 401 Water Quality Certification finding compliance with existing water quality requirements or waives the certification requirement. In the Commonwealth of Virginia, under § 62.1-44.15 of the Code of Virginia, the Virginia Department of Environmental Quality (VDEQ) provides Section 401 Water Quality Certification through the Virginia Water Protection (VWP) Program, as authorized by the State Water Control Law and as described in the VWP Permit Regulation. Appalachian is preparing a joint permit application for a VWP permit and surface water withdrawal for the continued operation of the Project in parallel with the FERC licensing process and intends, to the greatest extent possible, to use licensing documents including but not limited to study reports and the license application exhibits to satisfy this parallel regulatory process. Requirements for a VWP permit are described in 9 Virginia Administrative Cody (VAC) 25-210-80 and 9VAC25-210-340.

(7) Brief Project Description: The Niagara Hydroelectric Project is located on the Roanoke River, approximately 6 miles southeast of the City of Roanoke, in Roanoke County, Virginia. The Project was constructed in 1906. As presently licensed, the Project consists of: (1) a 52-

foot-high, 462-foot-long concrete dam, inclusive of the right non-overflow abutment (70 feet) and main overflow spillway (392 feet); (2) a 62-acre impoundment with a gross storage capacity of 425 acre-feet at the normal pool elevation of 884.4 feet; (3) an 11-foot-diameter, 500-foot-long corrugated metal pipe penstock with associated entrance and discharge structures; (4) a 1,500-foot-long bypass reach; (5) a 92-foot-long, 58-foot-wide, 42-foot-high concrete powerhouse containing two generating units with a total authorized installed capacity of 2.4 MW; (6) a 103-foot-long auxiliary spillway with a crest elevation of 886 feet located downstream of the upstream intake; (7) transmission facilities consisting of 50-foot-long 2.4-kilovolt (kV) generator leads and a 3-phase, 2.4/12-kV, 2,500-kilovolt ampere (kVA) step-up transformer; and (8) appurtenant facilities. The Project operates in a run-of-river mode under all flow conditions, where inflow equals outflow.

(8) The Project Boundary encompasses 0.9 acres of lands that Appalachian understands to be owned by the National Park Service. The location of these lands is shown on Exhibit G.

(9) The Project is an existing constructed project.

Additional Information Required by 18 CFR §4.32(a)

(1) Identify every person, citizen, association of citizens, domestic corporation, municipality, or state Identify every person, citizen, association of citizens, domestic corporation, municipality, or state that has or intends to obtain and will maintain any proprietary right necessary to construct, operate, or maintain the project:

Appalachian presently holds and will continue to hold the proprietary rights necessary to operate and maintain the Project.

(2) Identify (providing names and addresses):

i. Every county in which any part of the project, and any Federal facilities that would be used by the project would be located:

Name	Address
Roanoke County, Virginia	Administrator Roanoke County P.O. Box 29800 Roanoke VA 24018

ii. The names and addresses of every city, town or similar local political subdivision in which any part of the Project, and any Federal facilities that would be used by the Project, are located or that has a population of 5,000 or more people and is located within fifteen (15) miles of the project dam are as follows:

Name	Address
City of Roanoke, Virginia	Mayor City of Roanoke 215 Church Avenue Roanoke, Virginia 24011
City of Salem, Virginia	Mayor City of Salem P.O. Box 869 Salem, Virginia 24153
Town of Vinton, Virginia	Manager Town of Vinton P.O. Box 338 Vinton, Virginia 24178
Town of Boones Mill, Virginia	Manager Town of Boones Mill P.O. Box 66 Boones Mill, Virginia 24065
Town of Troutville, Virginia	Manager Town of Troutville P.O. Box 276 Troutville, Virginia 24175
Franklin County, Virginia	Administrator Franklin County

	302 Virgil H. Goode Bldg. Rocky Mount, Virginia 24151
Botetourt County, Virginia	Administrator Botetourt County P.O. Box 279 Fincastle, Virginia 24090
Bedford County, Virginia	Administrator Bedford County P.O. Box 234 Bedford, Virginia 24523

The Project Boundary encompasses 0.9 acres of lands that Appalachian understands to be owned by the National Park Service. The location of these lands is shown on Sheet 1 of Exhibit G.

iii. Every irrigation district, drainage district, or similar special purpose political subdivision:

A. In which any part of the project, and any Federal facilities that would be used by the project, would be located, or (B) That owns, operates, maintains, or uses any project facilities or any Federal facilities that would be used by the project:

There are no irrigation or drainage districts, or similar special purpose political subdivisions associated with or in the general area of the Project. There are no federal facilities used by the Project.

iv. Every other political subdivision in the general area of the Project that there is reason to believe would likely be interested in, or affected by, the application.

There are no other political subdivisions in the general area of the Project that there is reason to believe would likely be interested in, or affected by, the application.

v. All Indian tribes that may be affected by the Project:

Tribe	**Address**
Catawba Indian Nation	Wenonah Haire Tribal Historic Preservation Officer Catawba Indian Nation 1536 Tom Steven Rd. Rock Hill, SC 29730
Delaware Nation	Erin Paden Director of Historic Preservation Delaware Nation PO Box 825 Anadarko, OK 73005
Monacan Indian Nation	Kenneth Branham Chief Monacan Indian Nation P.O. Box 960 Amherst, VA 24521

Tribe	Address
Pamunkey Indian Tribe	Terry Clouthier Cultural Resources Director Pamunkey Indian Tribe 1054 Pocahontas Trail King William, VA 23086

VERIFICATION

This application is executed in the

State of: Virginia

City of: Roanoke

Stephen A. Dolan
Plant Manager Hydro and Ceredo
American Electric Power Service Corporation
40 Franklin Road SW
Roanoke, Virginia 24011

The undersigned being duly sworn, deposes and says that the contents of this application are true to the best of his knowledge or belief. The undersigned applicant has signed this application this 23 day of February, 2022.

Stephen A. Dolan

Subscribed and sworn to before me, a Notary Public of the State of Virginia, this 23rd day of February, 2022.

Notary Public

ANNA ELISE PAINTER
NOTARY PUBLIC
REG. #7796940
MY COMMISSION EXPIRES
04/30/2022
COMMONWEALTH OF VIRGINIA

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FINAL LICENSE APPLICATION

NIAGARA HYDROELECTRIC PROJECT (FERC NO. 2466)

EXHIBIT A

PROJECT DESCRIPTION (18 CFR §4.61(c))

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Exhibit A Project Description (18 CFR §4.61(c))

A.1 Project Overview and Location

Appalachian Power Company (Appalachian or Licensee) is the Licensee, owner, and operator of the run-of-river, 2.4-megawatt (MW) Niagara Hydroelectric Project (Project) (Federal Energy Regulatory Commission [FERC or Commission] Project No. 2466), located on the Roanoke River (river mile 355) in Roanoke County, Virginia.

The Project is located approximately six miles southeast of the City of Roanoke. Figure A.1-1 provides an overview of the Project setting and the FERC Project Boundary (see Exhibit G) and Figure A.2-1 shows the location of the Project within the Roanoke River Basin. The upper portion of the Project Boundary and reservoir, including the mainstem of the Roanoke River as well as Tinker Creek immediately above its confluence with the Roanoke River, occupies a developed area within the Town of Vinton and along the outer limit of the City of Roanoke. Land use in this area and immediately upstream is predominantly low to medium-density development and forested. Development along the southern shoreline of the reservoir is generally limited by terrain, with development along the northern shoreline limited by the existing (active) CSX railroad. The total area of the watershed for the Project reservoir is approximately 511 square miles.

The Niagara Project is operated as a run-of-river hydroelectric facility on the Roanoke River; there is no appreciable reservoir storage available, and inflows are either used for generation or spilled. The Project is operated to maintain the reservoir at elevation (EL.) 884.4 feet (ft), which is 0.6 ft below the crest of the spillway. The principal structures at the Project consist of an overflow, ogee-type concrete spillway; an intake structure integrated into the dam; an overflow auxiliary spillway on the left side of the main spillway; sluice structure controlled with an inflatable Obermeyer gate; a non-overflow section that forms the right abutment; a penstock; and the powerhouse.

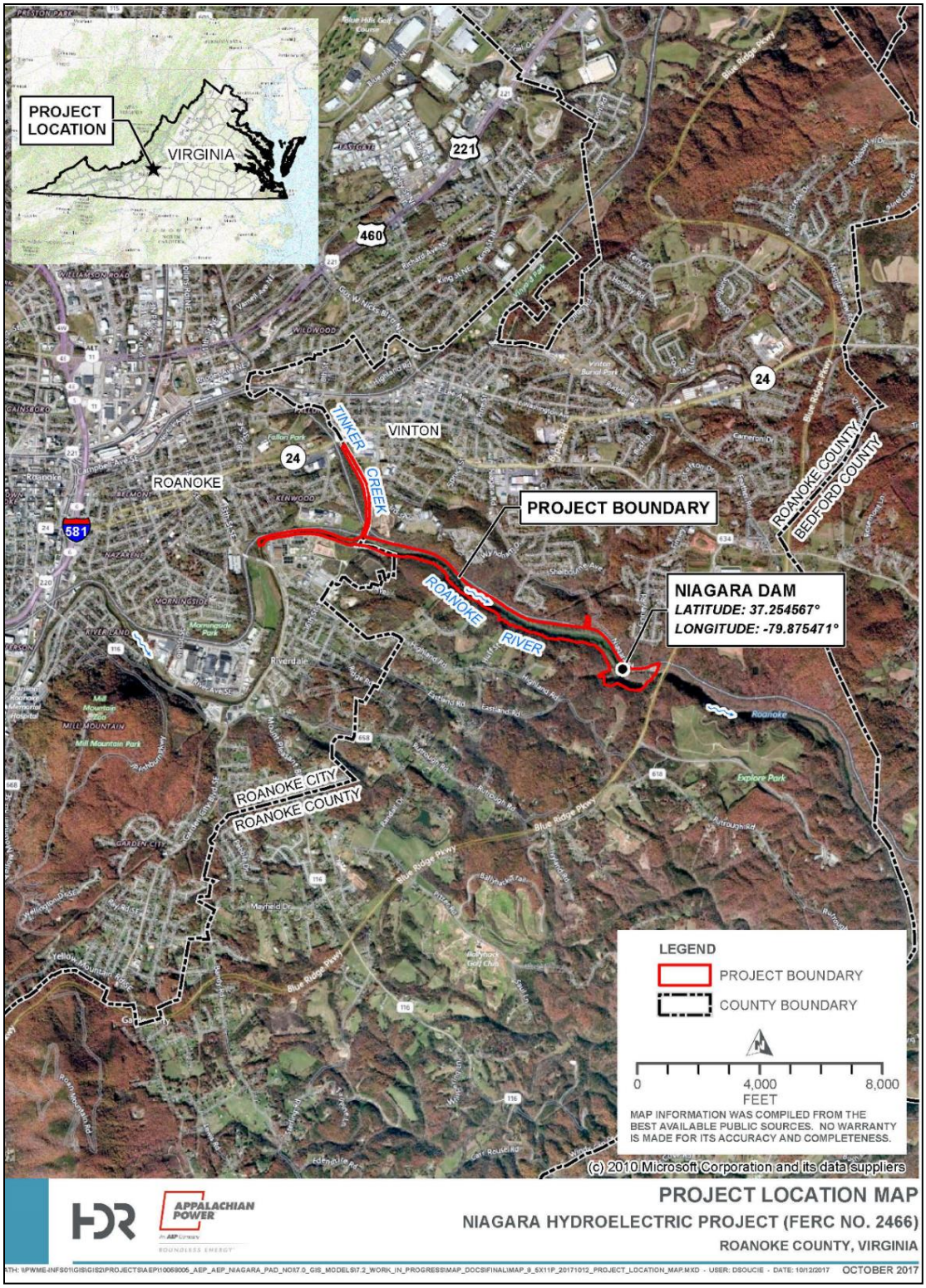

Figure A.1-1. Project Location Map

A.2 Project Description

The Project was constructed in 1906 and was operated by the Roanoke Railroad and Electric Company until Appalachian took ownership of the Project in 1924. As further described in the subsections that follow, under the term of the existing license, the Project has undergone and continues to undergo rehabilitation and modernization to ensure the continued safety and reliability of Project structures and power generation.

The licensed Project works consist of: (1) a 52-ft-high, 452-ft-long concrete dam creating a 62-acre reservoir; (2) an 11-ft-diameter, 500-ft-long, corrugated metal pipe penstock with associated entrance and discharge structures; (3) a 92-ft-long by 58-ft-wide by 42-ft-high concrete powerhouse on the north end of the dam containing two generating units with a total installed capacity of 2.4 MW; (4) transmission facilities consisting of 50-ft-long 2.4-kilovolt (kV) generator leads and a 3-phase, 2.4/12-kV, 2500-kilovolt ampere (kVA) step-up transformer; and (5) appurtenant facilities.

Brief descriptions of the major civil components are provided in Sections A.2.1.1 through A.2.1.7, and existing Project Facilities are shown on Figure A.2-1. Drawings that present the Project Boundary for the facility are presented in Exhibit G. The facilities and structures listed above are detailed below and are also depicted in the general design drawings included in Exhibit F (Volume III of this Final License Application (FLA) filed as Critical Energy/Electric Infrastructure Information (CEII).

A.2.1 Existing Project Facilities

A.2.1.1 Non-overflow Section

The right non-overflow section is approximately 85 ft long with a maximum height of 26 ft. The first 24 ft of the right non-overflow section starting from the right abutment is slush grouted riprap. The next 61 ft was constructed of steel sheet pile keyed into rock with riprap placed against its upstream and downstream sides. The riprap placed against the downstream side of the sheet pile was slush grouted. A concrete cap with a crest EL. of 898 ft covers the riprap and embeds the top 1.5 ft of the sheet pile wall. The upstream and downstream rockfill inclinations are approximately 1H to 1V. The sheet piling connects to an embedded concrete block on the right side for anchorage. A 5-ft-wide reinforced concrete wingwall with crest EL. of 897 ft provides anchorage for the left side of the sheet piling and retains the left side of the grouted rockfill.

A.2.1.2 Spillway/Dam

The main spillway is an approximately 392-ft-long gravity structure with a crest EL. of 885 ft and maximum height of 50 ft. The original spillway was a cyclopean concrete structure. The structure was

modified (in 1998) with the addition of a roller compacted concrete (RCC) section on the downstream side and a rebuilt ogee crest constructed from conventional concrete. The RCC and original sections are connected by rock bolts installed along the toe of the RCC. The RCC section incorporated a 2-ft overbuild to account for future erosion of material.

A.2.1.3 Sluice Structure

At the left (east) end of the spillway is a 6.5-ft-wide sluice structure. Water is release through this structure over an inflatable Obermeyer (pneumatically actuated) gate. The Obermeyer gate has a width of 6 ft, a minimum gate EL. of 878.40 ft, and a maximum gate EL. of 885.33 ft, and is capable of providing flow releases of approximately 7 ft per second (cfs) to 287 cfs under the licensed reservoir operating range of 883.4 ft to 884.4 ft, respectively. Required and installed equipment to operate the Obermeyer gate includes two air compressors that provide for redundant inflation of the air bladder. The Obermeyer gate can be lowered in the event of a power failure by releasing air from the bladder via a manually operated valve.

The discharge rating curve for the Obermeyer gate is provided on Figure A.5-3. As shown on Table A.2-4, the gate opening (or elevation) to provide a specific minimum flow varies with reservoir elevation.

A.2.1.4 Mud Gates

There are three mud gates (3 ft wide by 4 ft tall) below the normal pond level to the east of the sluice gate. The three mud gates openings are currently covered by steel bulkheads that were bolted to the downstream face. The bulkheads contain valves that are left open.

A.2.1.5 Intake and Forebay

The intake is a 60-ft-long cyclopean concrete structure that contains five vertical steel headgates. The deck elevation of the intake section is approximately EL. 888.5 ft. A downstream flood wall increases the water retaining height of the intake section to EL. 897 ft. Inclined steel trash racks are mounted on the upstream side of the intake. An automated trash rake system cleans the trash racks and prevents buildup of debris and sediment in front of the intake.

A log boom consisting of interconnected floating platforms is utilized to direct larger floating objects away from the intake screens. The log boom is anchored to the north bank of the river, approximately 90 ft upstream of the upper intake structure and extends for approximately 135 ft to the south side of the intake structure.

A.2.1.6 Auxiliary Spillway

The auxiliary spillway located downstream of the intake is 103.5 ft long with a crest EL. of 886 ft and a maximum height of 27 ft. The original cyclopean concrete was modified in 1998 by adding reinforced concrete to the upstream face and a 4-ft extension to the spillway crest. The concrete added to the original section was doweled into the existing concrete and anchored into the foundation with 1-3/8 inch grouted post-tensioned bar anchors.

A.2.1.7 Water Conveyance and Penstock

The water conveyances consist of a penstock entrance structure, a penstock, and a penstock discharge structure. The penstock entrance structure is a 41-ft-long reinforced concrete head wall with an ungated opening for the penstock inlet. The head wall crest is at EL. 897 ft. The structure creates a small upper forebay approximately 40 ft wide by 80 ft long. The penstock is a 11-ft-diameter, 500-ft-long corrugated metal pipe supported on timber cradles that are founded on crushed stone bedding. The penstock discharge structure is a basin for the lower forebay constructed of three reinforced concrete cantilever walls and a downstream cyclopean concrete wall. The downstream wall contains four ballasted steel gates that lead to four riveted penstocks. The steel gates are operated with a moveable hoist crane. The penstocks carry flow to the powerhouse where they merge into two larger penstocks leading to the spiral case of the turbines.

A.2.1.8 Powerhouse

The Project powerhouse is approximately 92-ft-long, 58-ft-wide, 42-ft-high with two levels. The upper level, which is of concrete construction, consists of a single room covered by fiberglass shingles on a plywood roof supported by wood decking on steel trusses. The upper level of the powerhouse houses the two generating units, as well as switching equipment, bus structure, governors, pumps, and miscellaneous accessory equipment required for Project operation.

The lower level of the powerhouse contains two turbine wheel pits which are constructed of steel cylinders set on concrete flooring. The cylinders are approximately 12 ft in diameter and 11 ft high. The lower level of the powerhouse also houses portions of the steel turbine penstocks which feed water to the turbines.

A small Generator Step-Up transformer is located adjacent to the powerhouse structure.

A.2.1.9 Reservoir

The reservoir formed by the Project is approximately 2 miles long and covers a surface area of 62 acres. The gross storage capacity is approximately 425 acre-ft (see Table A.2-1).

Table A.2-1. Reservoir Data

Description	Metric
Drainage area	511 square miles
Shoreline length	7.1 miles
Typical surface area	62 acres
Maximum Depth	10 ft (estimated)
Permanent crest of dam EL.	885 ft
Typical normal surface water EL.	884.4 ft
Operations	Run-of-river
Storage capacity	425 acre-ft

A.2.1.10 Bypass Reach

The Project includes an approximately 1,500-ft-long bypass reach (the original Roanoke River channel). Normal releases to the bypass reach are provided via the sluice structure and overflow spillway, as well as through leakage through the mud gates.

Figure A.2-1. Existing Project Facilities

A.2.2 Turbines and Generators

Contained in the upper level of the powerhouse are two generating units. The existing AC generators are identical and were manufactured by the Elliott Company. They are each rated at 1,200 kilowatts (kW) at 80 percent power factor, 3 phase, 60 cycles and 2,400 volts. Each 26 pole generator has a rotor speed of 277 rotations per minute (rpm) at 60 hertz and is direct-connected to a vertical shaft hydraulic turbine. Each generator stator has an inside diameter of 7.4 ft and contains 162 coils. Each coil slot is 11 inches high by 21/32 inches wide by 2.75 inches deep.

The lower level of the powerhouse contains two turbine wheel pits which are constructed of steel cylinders set on concrete flooring. Each of these cylinders, which are approximately 12 ft in diameter and 11 ft high, houses a vertical shaft Francis hydraulic turbine. The Unit 1 turbine, located at the south end of the powerhouse, is designated as Type F and was manufactured by James Leffel & Company. The existing Unit 1 turbine was installed in 1954 and is direct-connected to a generator located in the upper level of the powerhouse. On July 30, 1990, the Niagara Unit 2 turbine sustained irreparable damage to the runner and wicket gate components. The new Unit 2 turbine was installed within the wheel pit vacated by the damaged unit, north of the Unit 1 wheel pit, in 1991 and is direct-connected to the existing generator located in the upper level of the powerhouse. Turbine and generator data is presented in Table A.2-2.

The 500-ft-long, 11 ft inside diameter corrugated metal pipe penstock which channels flow from the upper intake to the powerhouse intake is designed to pass a steady-state flow of 600 cfs. However, near maximum plant output conditions, it is estimated that the penstock can pass up to approximately 750 cfs.

Table A.2-2. Turbine and Generator Data

Turbines	
Number of Units	2
Type	Vertical shaft Francis unit
Design Head	Unit 1: 60 ft Unit 2: 57 ft
Rated Capacity	1,200 kW (each)
Minimum Discharge	Approximately 100 cfs (per unit)
Maximum Discharge	Unit 1: 379 cfs Unit 2: 305 cfs

Turbines	
Operating Speed	Unit 1: 277 rpm Unit 2: 277 rpm
Generators	
Type	AC generators manufactured by the Elliott Company
Rated Capacity	1,500 kVA / 1,200 kW each (Power Factor = 0.8)
Phase	3-phase
Voltage	2,400 volts
Frequency	60 Hertz
Synchronous Speed	277 rpm

A list of other mechanical and electrical equipment necessary for project operation is contained in Table A.2-3.

Table A.2-3. Appurtenant Mechanical and Electrical Equipment[1]

Equipment	Manufacturer	Description
Governors	Woodward Governor Company	2-oil pressure governor type HR; 10, 500 ft pounds
Exciters	General Electric	1-Continuous current generator type CL, 360 amperes, 125 volts.
Step-up transformer	Niagara Transformer Corporation	Transformer, 2500 kva, 2.4/12 kv, 3 phase
Trash rake (upper intake)	Northfork Electric	Drag rake operated by system of motorized cable hoists that move a raking beam in a cyclical motion
Powerhouse Crane	ACECO	Manually operated; 40,000 pounds capacity

[1] Equipment listed does not include electrical equipment required for the efficient operation of the plan but located outside of the Project works (e.g., powerlines, station service transformers, etc.).

A.2.3 Project Operations

A.2.3.1 Normal Operations

The Niagara Hydroelectric Project is an unmanned, partially automated, hydroelectric generating facility. The Project operates as a run-of-river facility for the purpose of generating electric power.

Operations are performed both locally and remotely. The Project is normally attended by one plant operator on the day shift from Monday to Thursday to perform routine maintenance activities. Operations personnel for the Niagara Project split their time with Appalachian's Smith Mountain Project (FERC Project No. 2210), located 42 miles downstream. Operations are monitored remotely by the AEP's Hydro Operations Center in Columbus, Ohio, which is staffed 24-hours per day, 365 days per year.

Powerhouse operation is automated and can be controlled from the Columbus Operations Center (COC). The units can only be started or stopped manually, but the COC does have the ability to trip off the units in the event of an emergency.

The generation units are operated locally or from the COC through a programmable logic controller and float controller. The Project operates in a run-of-river mode under all flow conditions, with outflows from the Project approximating inflows to the Project. This is achieved by adjusting the water flow to the turbines to match available river flow. There is no appreciable storage available, and inflows are either used for generation or spilled. As presently licensed, the Project is operated to maintain the reservoir at or near EL. 884.4 ft, which is 0.6 ft below the crest of the spillway. During extreme flow conditions, such as rapidly changing inflows, Appalachian is authorized to operate the Project with a minimum reservoir EL. of 883.4 ft. Run-of river operation may be temporarily modified, if required, by operating emergencies beyond the control of Appalachian and for short periods upon mutual agreement among Appalachian, USFWS, and VDWR.

Under the new license, Appalachian expects the Project will be required to release minimum flows in the bypass reach. Outflows from the Project (including powerhouse and bypass reach discharge) are measured at the U.S. Geological Survey (USGS) gauge located approximately 300 ft downstream of the powerhouse (USGS 2056000 Roanoke River at Niagara, VA).

With the exception of minimum flows to the bypass, Appalachian does not propose any changes in Project operation at this time and does not expect to propose any substantive changes in Project operation in the license application that will be filed in February 2022. As noted above, releases to the bypass reach are provided via the sluice structure and overflow spillway, as well as through leakage through the mud gates.

A.2.3.2 Flood Operations

The COC continually monitors upper and lower forebay elevations. Upstream river gauges (including the USGS Roanoke River AB Walnut St. Bridge at Roanoke, VA gauge) are monitored by AEP's COC for conditions approaching flood stage (10 ft). The Project has no spillway gates, and the main spillway

is an uncontrolled overflow structure that discharges at a headwater EL. 885 ft. Water begins to spill over the auxiliary spillway when headwater reaches EL. 886 ft. The generating units are shut down when the tailwater level at the powerhouse reaches EL. 832 (river flow of 35,000 cfs). During high water events, both the upper and lower intake gates are left in the open position. If the reservoir were to reach 890 ft, operations personnel would move to high ground. At reservoir EL. 897 ft, the left abutment would begin to overtop. Actions and notifications during flood operations are guided by the Emergency Action Plan (EAP) that has been developed for the Project and is on file with FERC.

Table A.2-4. Obermeyer Gate Discharge (in cfs) Rating Table

Gate Elev. (ft)	C	Upstream Water Elevation (ft)														
		885.83	885.34	884.84	884.35	883.85	883.36	882.86	882.37	881.87	881.37	880.88	880.38	879.89	879.39	878.90
878.40	3.30	401	362	324	287	252	218	187	156	128	102	77	55	36	20	7
878.90	3.32	364	326	289	254	220	188	157	129	102	78	56	36	20	7	0
879.39	3.34	328	291	255	221	189	158	130	103	78	56	36	20	7	0	0
879.89	3.36	293	257	223	190	159	131	104	79	56	37	20	7	0	0	0
880.38	3.39	259	224	192	161	131	104	79	57	37	20	7	0	0	0	0
880.88	3.41	226	193	162	132	105	80	57	37	20	7	0	0	0	0	0
881.37	3.43	194	163	133	106	80	58	37	20	7	0	0	0	0	0	0
881.87	3.45	164	134	106	81	58	38	21	7	0	0	0	0	0	0	0
882.36	3.47	135	107	81	58	38	21	7	0	0	0	0	0	0	0	0
882.86	3.49	108	82	59	38	21	7	0	0	0	0	0	0	0	0	0
883.35	3.51	83	59	38	21	7	0	0	0	0	0	0	0	0	0	0
883.85	3.54	60	39	21	8	0	0	0	0	0	0	0	0	0	0	0
884.34	3.56	39	21	8	0	0	0	0	0	0	0	0	0	0	0	0
884.84	3.58	21	8	0	0	0	0	0	0	0	0	0	0	0	0	0
885.33	3.60	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Note: See Figure A.5-3 for Obermeyer gate rating curves

A.2.4 Generation and Outflow

The Project operates in a run-of-river mode, and inflows to the Project are dependent on upstream flows. Table A.2-5 provides a summary of monthly and annual Project generation in gross MWh for the most recent period of record (POR) (i.e., 2018 to 2021), which is representative of existing operating conditions, as the plant was offline and undergoing a variety of refurbishment activities from 2015-2017. Average annual generation at the Project for this period is approximately 8,557 MWh.

Table A.2-6 provides a summary of monthly and annual average flows through the Project in cfs for the past 5 years. For the purposes of this document, flows at the Project were estimated from USGS gauge 02056000, which is immediately downstream of the Project.

Figure A.5-4 and Figure A.5-5 show Project discharge vs. generator output for each unit.

Table A.2-5. Monthly and Annual Generation (MWh) (2018-2021)

Period	2018	2019	2020	2021	Average
January	0.00	1,375.85	969.77	1,059.63	851
February	0.00	1,366.43	1,137.93	1,182.55	922
March	382.00	1,605.02	1,238.71	1,533.76	1,190
April	1,050.58	1,373.07	867.24	1,151.77	1,111
May	1,110.08	1,116.74	335.13	967.87	882
June	981.42	59.29	965.32	849.37	714
July	648.85	771.42	867.41	601.43	722
August	635.31	490.30	951.50	495.50	643
September	629.47	261.86	217.08	N/A	369
October	675.95	446.85	0.00	N/A	374
November	738.40	589.54	0.00	N/A	443
December	1,006.16	1,038.39	482.90	N/A	842
Total	7,858.21	10,494.76	8,032.99	7,841.87	8,556.96

Note: 2021 data only goes through August. Periods of 0 generation represent complete powerhouse outage.

Table A.2-6. Monthly and Annual Average Project Outflows (cfs) (2016-2020)

Period	2016	2017	2018	2019	2020	Average
January	714	1,061	207	1,052	621	731
February	1,978	380	792	1,981	1,445	1,315
March	840	340	590	1,053	741	713
April	430	1,301	1,117	1,139	1,533	1,104
May	666	1,485	1,366	464	3,247	1,446
June	433	579	454	855	1,895	843
July	361	234	319	402	416	346
August	491	161	314	248	555	354
September	465	180	1,380	177	431	526
October	853	284	1,336	286	613	674
November	227	198	982	340	1,551	660
December	378	163	1,683	569	1,140	787
Average	**653**	**530**	**878**	**714**	**1,182**	**792**

A.2.5 Estimated Average Head

The average gross head on the Project is based on the forebay elevation and the tailwater elevation associated with the mean annual flow through the Project and is approximately 61 ft. As previously noted, the design heads for the turbine-generator units are 60 ft (Unit 1) and 57 ft (Unit 2).

A plant tailwater rating curve and an extended tailwater rating curve for the Project are shown in Figure A.5-6 and Figure A.5-7, respectively.

A.2.5.1 Head vs. Capability

Minimum plant power output occurs when one unit operates at minimum discharge and maximum operating head conditions. Maximum plant power output occurs when both units are operating near full power output at approximately normal operating head conditions. A plot of operating head versus power plant capability is shown in Figure A.5-8.

A.2.6 Reservoir

The reservoir formed by the Project is approximately two miles long and covers a surface area of 62 acres. The gross storage capacity is approximately 425 acre-ft. Since the Project operates in a run-of-river mode, net storage capacity is not applicable. A storage-volume (storage capacity) curve for the Project, based on mapping and surveys performed in 1989, is shown on Figure A.5-9.

A.2.7 Hydraulic Capacity and Streamflow

The estimated hydraulic capacity of the Niagara plant is approximately 684 cfs.

The drainage area for the Niagara Hydroelectric Project is 511 square miles. The average flow through the Project is estimated at 573 cfs based on flow data recorded at the USGS 02056000 gaging station, which approximately 300 ft downstream of the Niagara powerhouse. Flow data from 1994 through 2020 were utilized to develop monthly average, minimum, and maximum flow data as well as flood frequency data (Table A.2-7). Annual and monthly flow duration curves along with a bar chart of monthly mean flows were generated from this data and are shown on Figure A.5-11 through Figure A.5-24.

When Project inflows exceed the plant's hydraulic capacity, the excess water will flow into the bypass reach via the main spillway, Obermeyer sluice gate, and/or auxiliary spillway. Table A.2-8 shows the number of days per month that the Niagara plant hydraulic capacity was exceeded for the period 2016-2020 and is indicative of the number of days that excess flow would have passed into the bypass reach.

Table A.2-7. Niagara Flow Data (1994-2020)

Period	Minimum (cfs)	90% Exceedance (cfs)	Average (cfs)	Median (cfs)	10% Exceedance (cfs)	Maximum (cfs)
January	100	172	646	416	1,140	14,200
February	115	195	853	496	1,796	12,400
March	110	231	801	594	1,482	12,600
April	190	258	794	538	1,311	10,400
May	161	231	738	429	1,350	23,100
June	109	159	580	324	1,040	13,500
July	91	151	376	246	562	18,800
August	80	126	289	212	482	4,580
September	81	129	407	190	610	16,800
October	87	126	353	207	585	10,400
November	99	138	443	218	792	16,100
December	102	147	593	333	1,204	7,770
Annual	**110**	**172**	**573**	**321**	**1,029**	**13,388**

Source: USGS 02056000 Roanoke River at Niagara, VA
https://waterdata.usgs.gov/va/nwis/uv/?site_no=02056000&PARAmeter_cd=00065,00060,62620,62614

Table A.2-8. Number of Days Exceeding Hydraulic Capacity (2016-2020)

Year	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
2016	11	25	15	0	12	2	0	5	3	7	0	2	82
2017	8	0	0	12	23	6	0	0	0	2	0	0	51
2018	0	8	12	11	15	3	0	0	15	10	15	18	107
2019	23	17	18	15	0	6	1	0	0	1	2	6	89
2020	7	14	7	22	21	21	0	5	4	4	12	26	143
Total	**49**	**64**	**52**	**60**	**71**	**38**	**1**	**10**	**22**	**24**	**29**	**52**	

A.2.8 Proposed Mode of Operation

During the term of a new FERC license, Appalachian proposes to continue operating the Project in the existing run-of-river mode as described in the sections above.

Appalachian is presently required to release a minimum flow of 50 cfs or inflow to the Project, whichever is less, downstream of the Project powerhouse when the powerhouse is not generating, and 8 cfs to the bypass reach during all other periods. Flows are measured at USGS 2056000; this gage is operated by USGS in cooperation with Appalachian. Under the new license term, for the protection of water quality and aquatic resources, including the endangered Roanoke Logperch (*Percina rex*), Appalachian proposes to operate the Project with a single (i.e., continuous, year-round) minimum flow requirement of 30 cfs to the bypass reach.

A.3 Project Costs, Value, and Purpose

A.3.1 Estimated Cost of the Project

Since this license application for the Project does not contain any plans for new hydropower development by Appalachian, estimates of costs associated with new development are not applicable.

A.3.2 Estimated Operations and Maintenance Costs Associated with Proposed Environmental Measures

Table A.3-1 presented the estimated capital costs and the estimated operations and maintenance (O&M) expenses of each proposed environmental measure.

Table A.3-1. Costs of Proposed Environmental Measures

Item	Capital Cost (2022 Dollars)	Incremental Operations & Maintenance or Annual Cost (2022 Dollars)
Release of 30 cfs continuous minimum flow to the bypass reach	$5,000	$27,500[1]
Continue funding of the USGS Roanoke River at Niagara gage	-	$16,200
Prepare Terrestrial Resources Protection Plan in consultation with VDWR and U.S. Fish and Wildlife Service	$15,000	$5,000
Develop and implement Recreation Management Plan in consultation with Project stakeholders, to include improvements to canoe portage take-out and trail and development and maintenance of a public website for information related to river flows downstream of the run-of-river Project and recreational facilities (Project and Non-Project) at the Niagara Project	$75,000	$5,000
Total	**$95,000**	**$53,700**

[1] Approximately calculated as modeled lost generation (MWh) multiplied by average 2021 power revenue ($/MWh)

A.3.3 Purpose of the Project

The electrical energy generated at this station is transformed to the proper voltage and distributed into Appalachian's electrical grid. Currently, Appalachian serves over 1 million customers, including both retail and wholesale customers, located in the states of Virginia, West Virginia, and Tennessee. Appalachian meets its customers' future capacity and energy requirements through operation of its fleet of generation resources and portfolio of power purchase agreements.

A.3.4 Cost to Develop the License Application

The estimated costs to develop the license application for the Project, including studies (completed and planned for completion), consultants, and internal management and administrative costs is approximately $1,750,000.

A.3.5 Value of Project Power

Appalachian sells all of the electricity generated at the Project into PJM Interconnection[3] (PJM). Based on average 2021 revenue for the Project of $34.45/MWh and generation in 2021 of 8,946 MWh, in 2021 the value of Project power was $308,171.

A.3.5.1 On-Peak and Off-Peak Value

The Project operates in a run-of-river mode. Therefore, this section is not applicable.

A.3.6 Changes in Project Generation or Operation

As described above, Appalachian proposes to modify the minimum flow release to the bypass reach from 8 cfs to 30 cfs. Based on an operations model developed for the Project for Appalachian, this increase in spill at the dam is estimated to result in a reduction in average annual generation of 797 MWh.

Appalachian will continually evaluate the potential for Project improvements over the term of the new license and pursue amendments of the license if substantive modifications are proposed.

A.3.7 Net Investment of the Project

The total lifetime investment in the Project through December 31, 2021 was $9,105,148. The net investment in the Project (investment minus lifetime depreciation expense) through December 31, 2021 was approximately $2,046,384. This value should not be interpreted as the fair market value of the Project.

A.3.8 Annual Operation and Maintenance Costs

O&M procedures for the Project are appropriately developed. Unit operations are carried out in compliance with FERC license requirements for power generation and flow regulation. Routine maintenance actions are conducted at regular intervals and as needs are identified during regular inspections. Larger maintenance projects are being appropriately planned and staffed by AEP and contractor resources to maintain the Project in good condition and provide life extension of water

[3] The PJM Interconnection is a regional transmission organization that coordinates the movement of electricity in all or parts of 13 Mid-Atlantic and Midwestern states plus the District of Columbia.

retaining structures. In 2021, the annual costs of Project O&M including annualized capital and general costs were $$275,928.

A.3.9 PURPA Benefits

Appalachian is not seeking benefits under Section 210 of the Public Utility Regulatory Policies Act (PURPA) of 1978 for qualifying hydroelectric small power production facilities in §292.203 of this chapter.

A.4 Singe Line Diagram

A detailed single-line electrical diagram for the Niagara Project is included in Volume III, as it is being filed as CEII.

A.5 Measures to Ensure Safe Management of the Project

The Niagara Project, including the spillway, dams, powerhouse, and appurtenant structures, are being well maintained and inspected; the water-retaining structures are observed to be in generally good condition. Several important projects have been completed over recent years to reduce risks associated with aging components of the Project works and address other issues observed during routine inspections. There are no ongoing issues that need to be addressed for continued safe operation of the Project. Maintenance needs related to the spillway as well as all other structures will continue to be evaluated as they age.

The Licensee has safely operated, maintained, and managed the Project since its acquisition. These same practices will be continued under the new license, subject to any new terms and conditions contained therein.

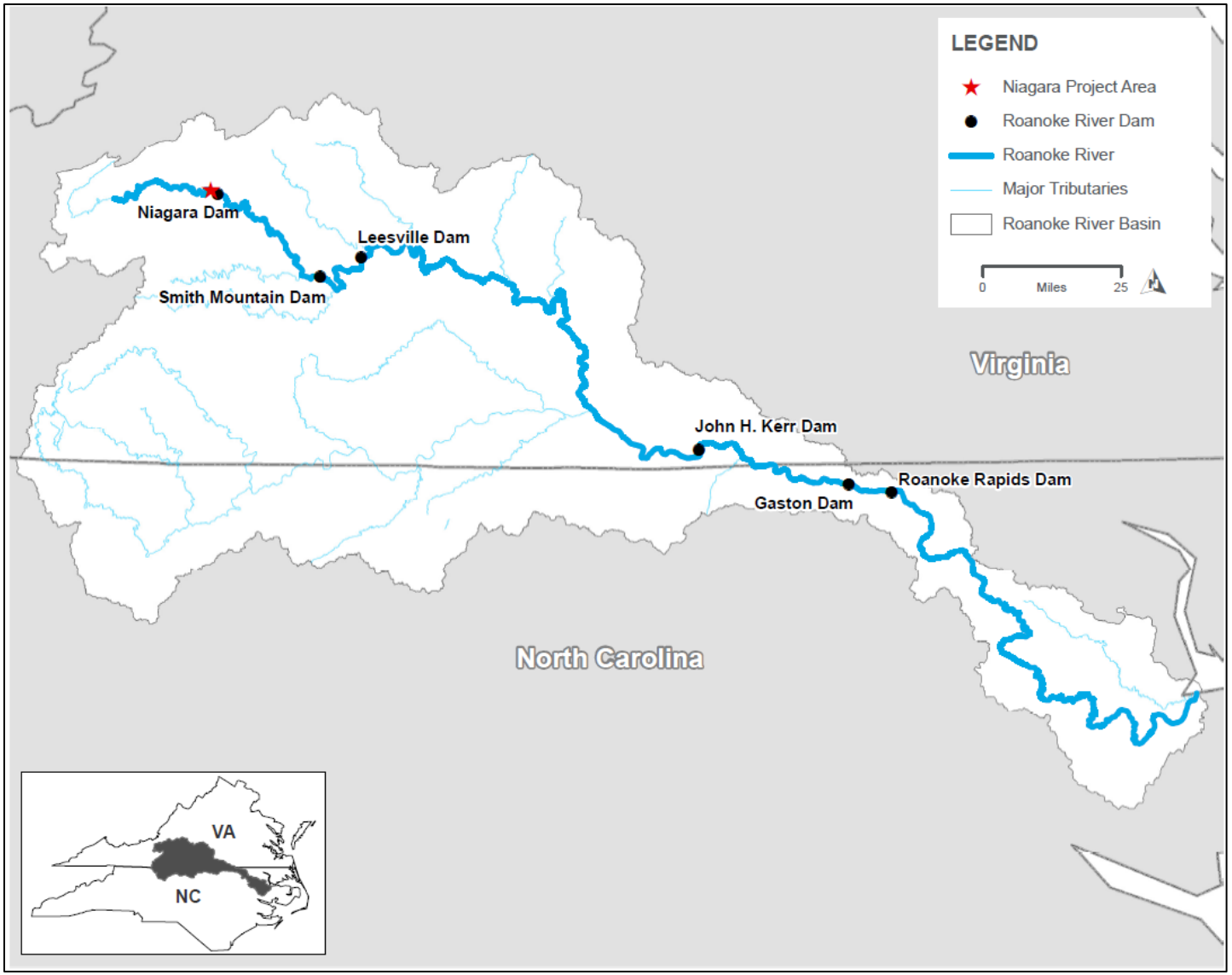

Figure A.5-1. Roanoke River Basin Map with Existing Roanoke River Hydroelectric Projects

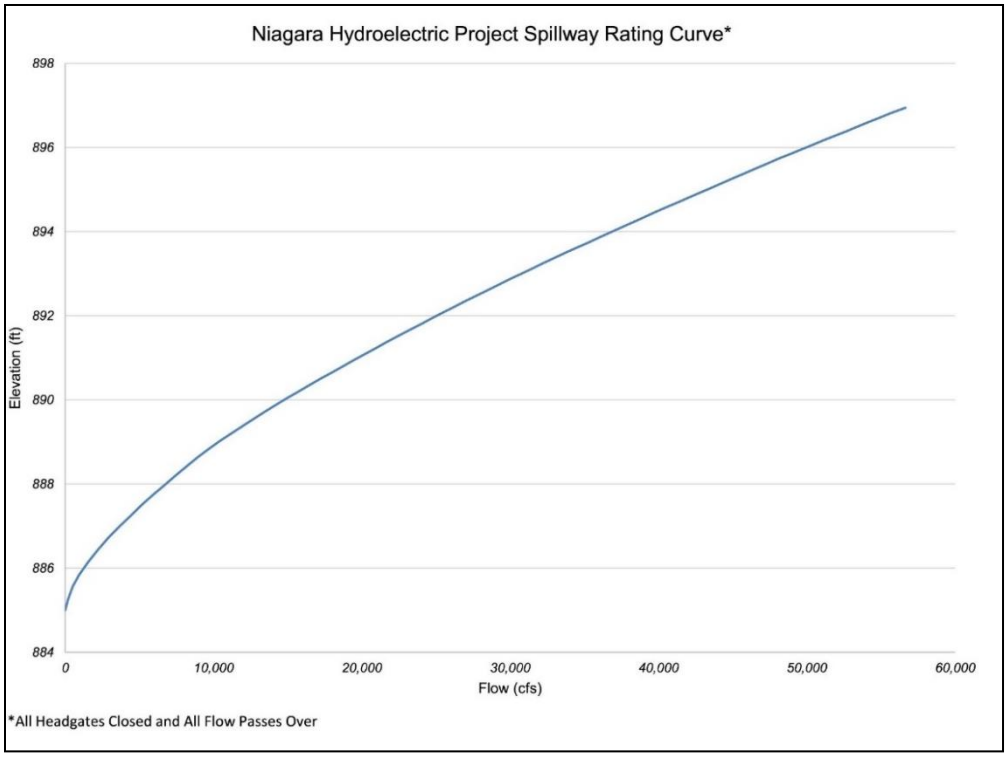

Figure A.5-2. Niagara Hydroelectric Project Spillway Rating Curve

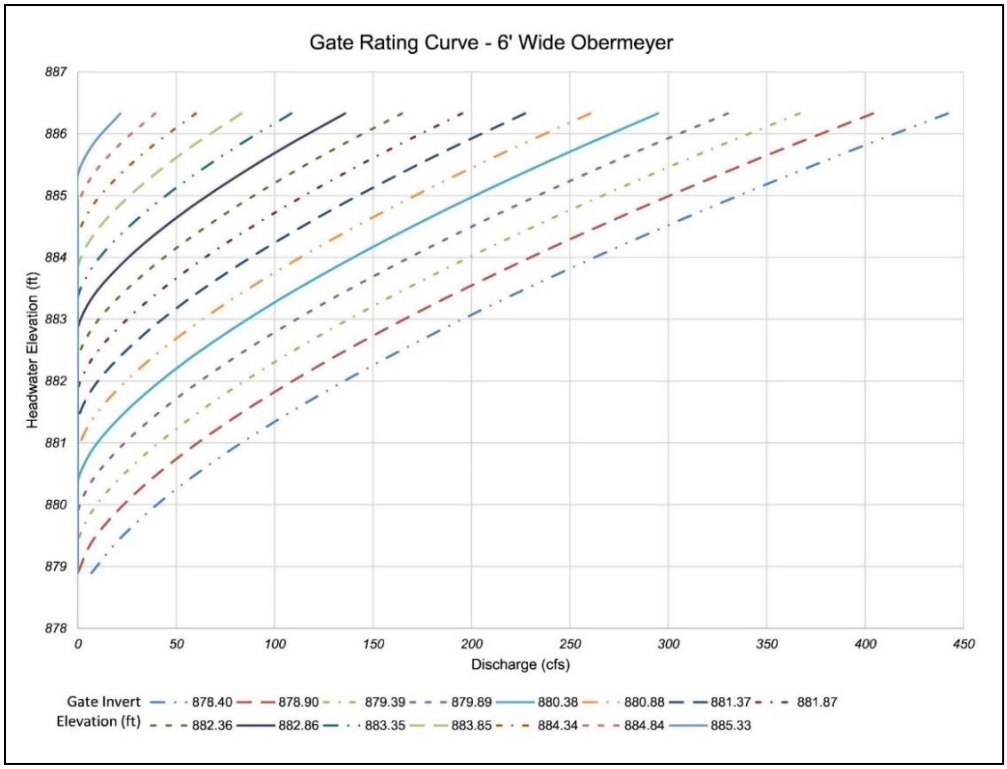

Figure A.5-3. Niagara Hydroelectric Project Gate Rating Curve for Recently Installed Obermeyer Gate

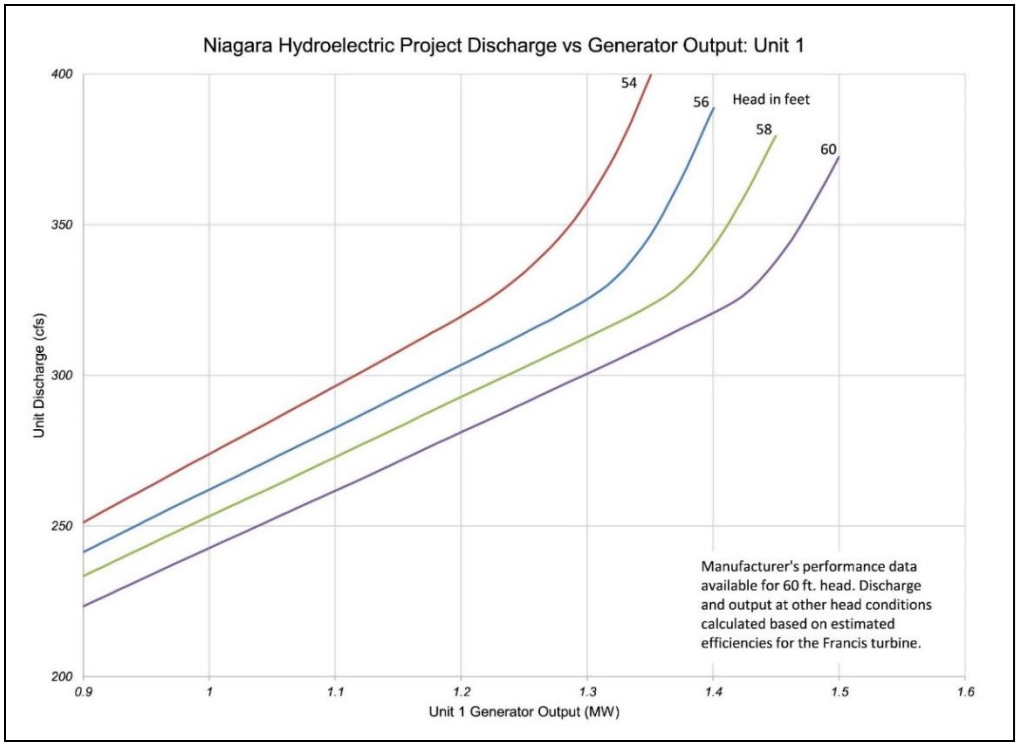

Figure A.5-4. Niagara Hydroelectric Project Discharge vs. Generator Output (Unit 1)

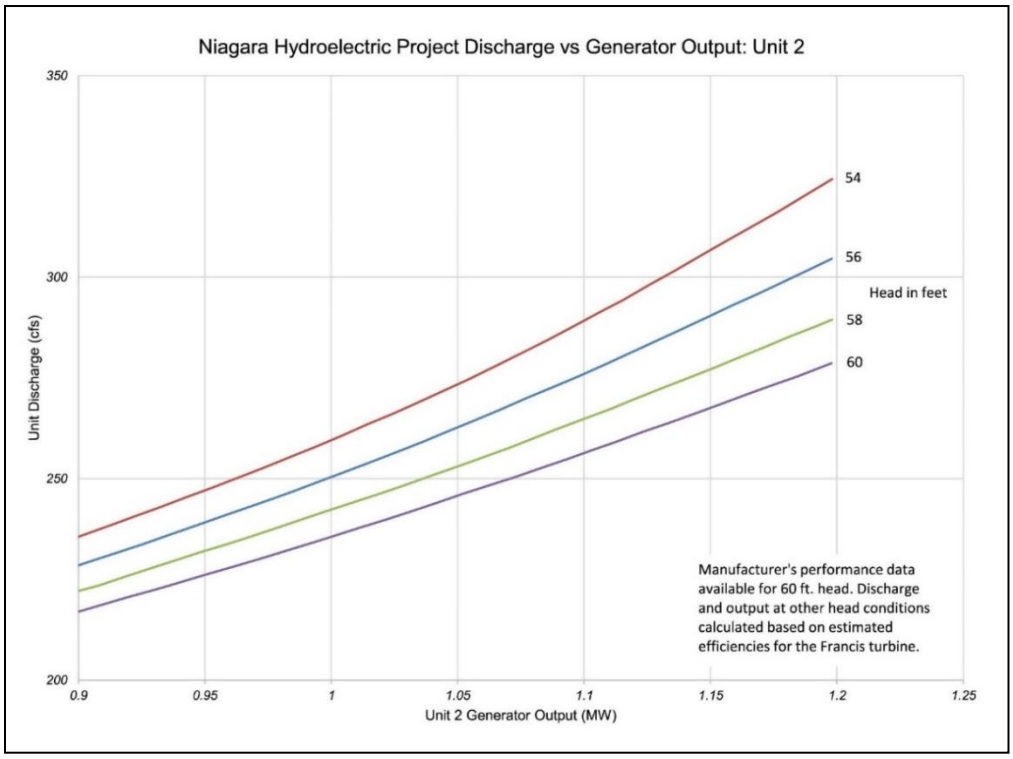

Figure A.5-5. Niagara Hydroelectric Project Discharge vs. Generator Output (Unit 2)

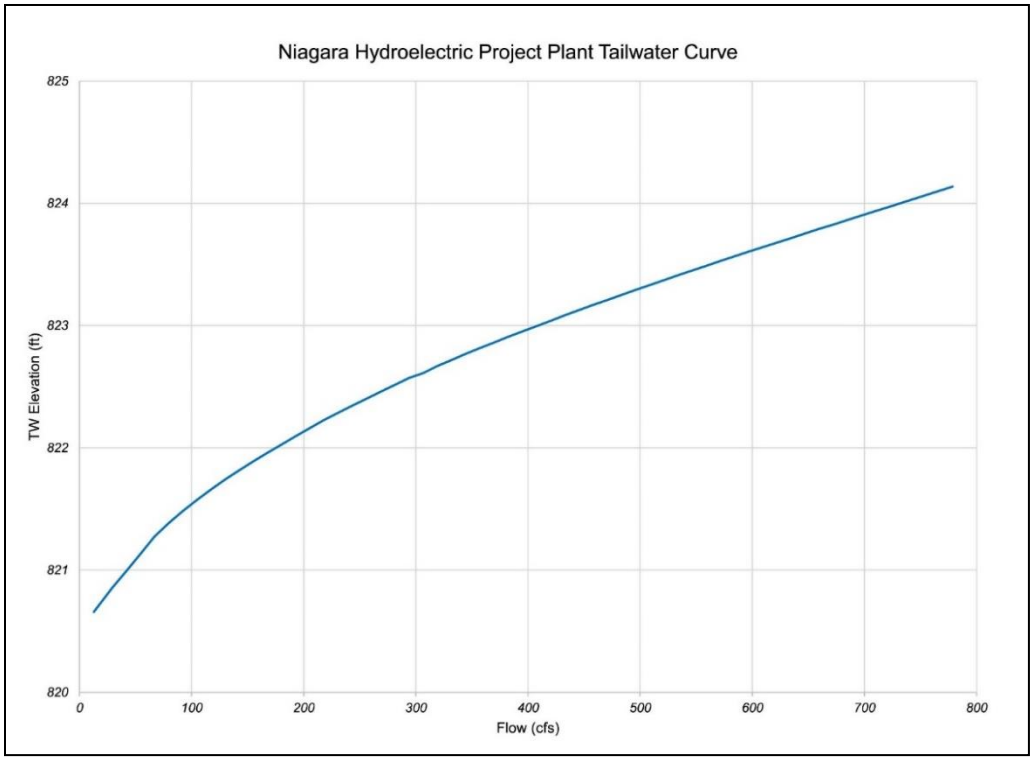

Figure A.5-6. Niagara Hydroelectric Project Tailwater Curve

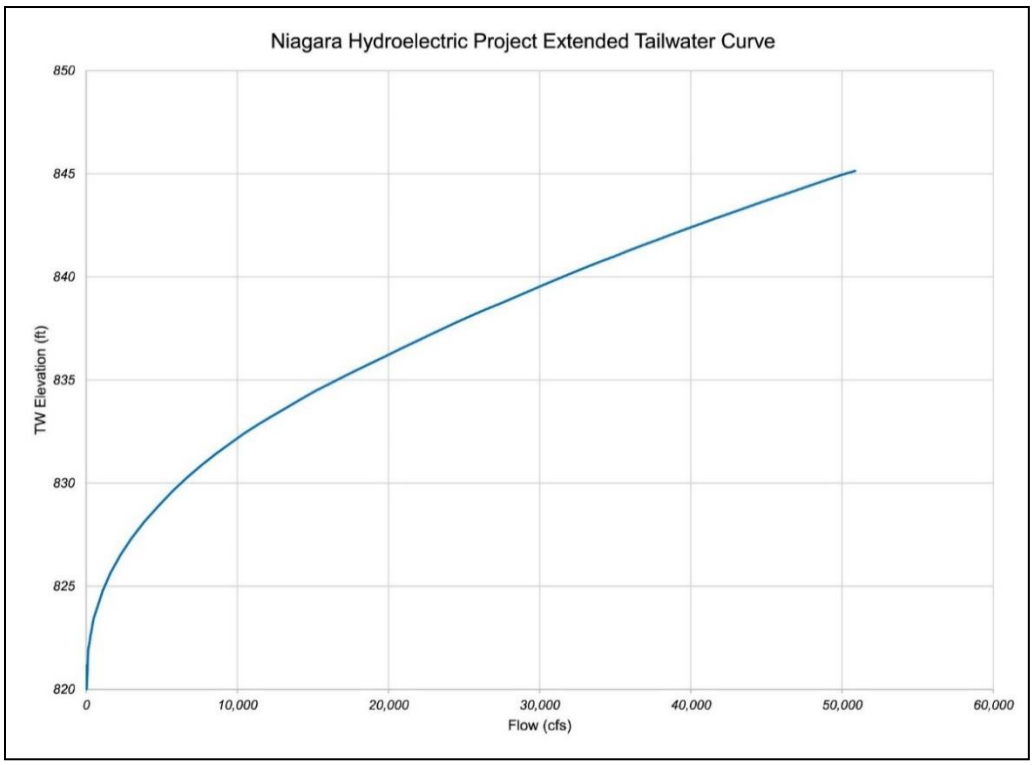

Figure A.5-7. Niagara Hydroelectric Project Extended Tailwater Curve

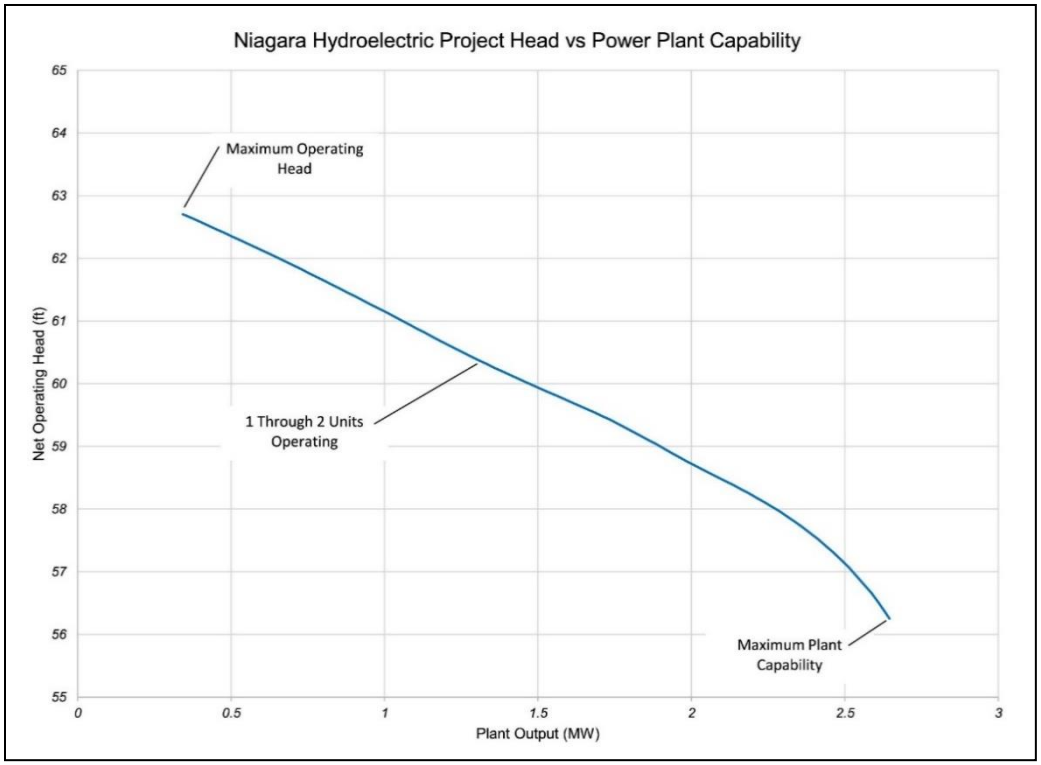

Figure A.5-8. Niagara Hydroelectric Project Head vs. Power Plant Capability

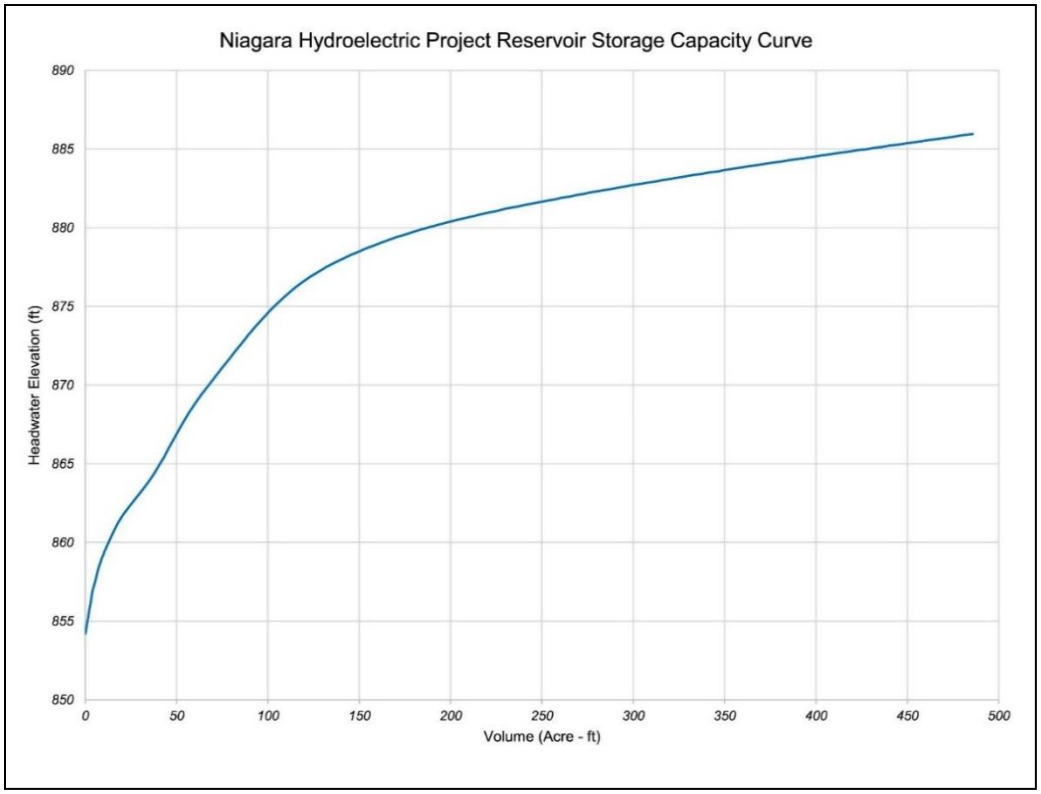

Figure A.5-9. Niagara Hydroelectric Project Reservoir Storage Capacity Curve

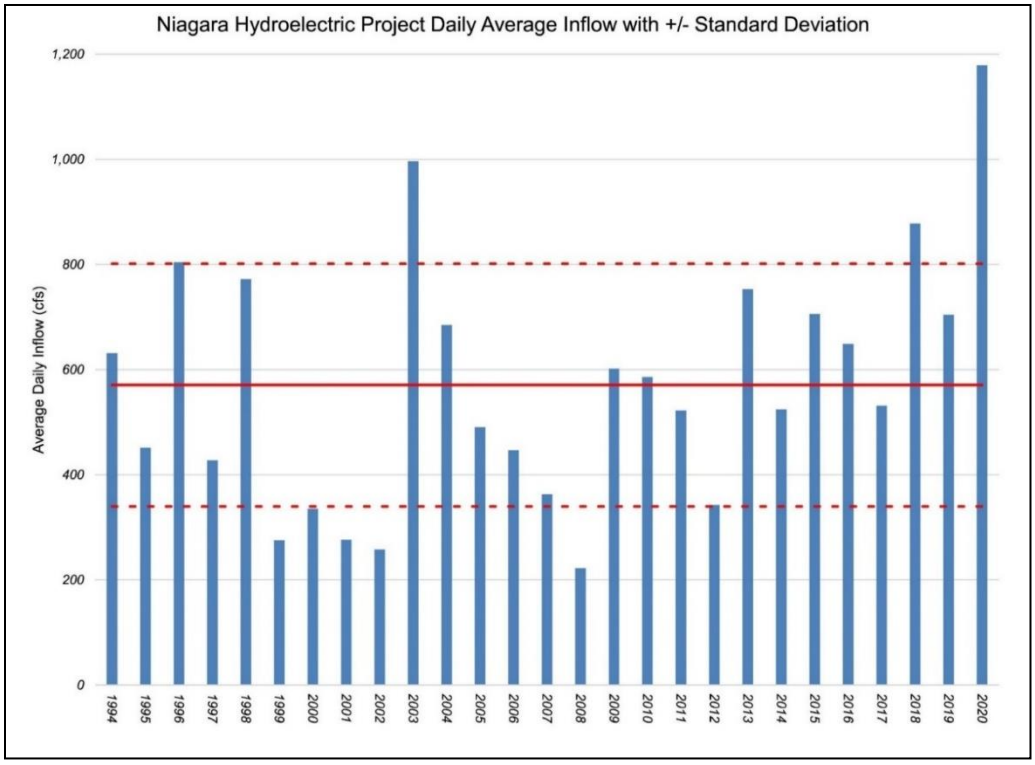

Figure A.5-10. Niagara Hydroelectric Project Average Daily Flow (1994-2020)

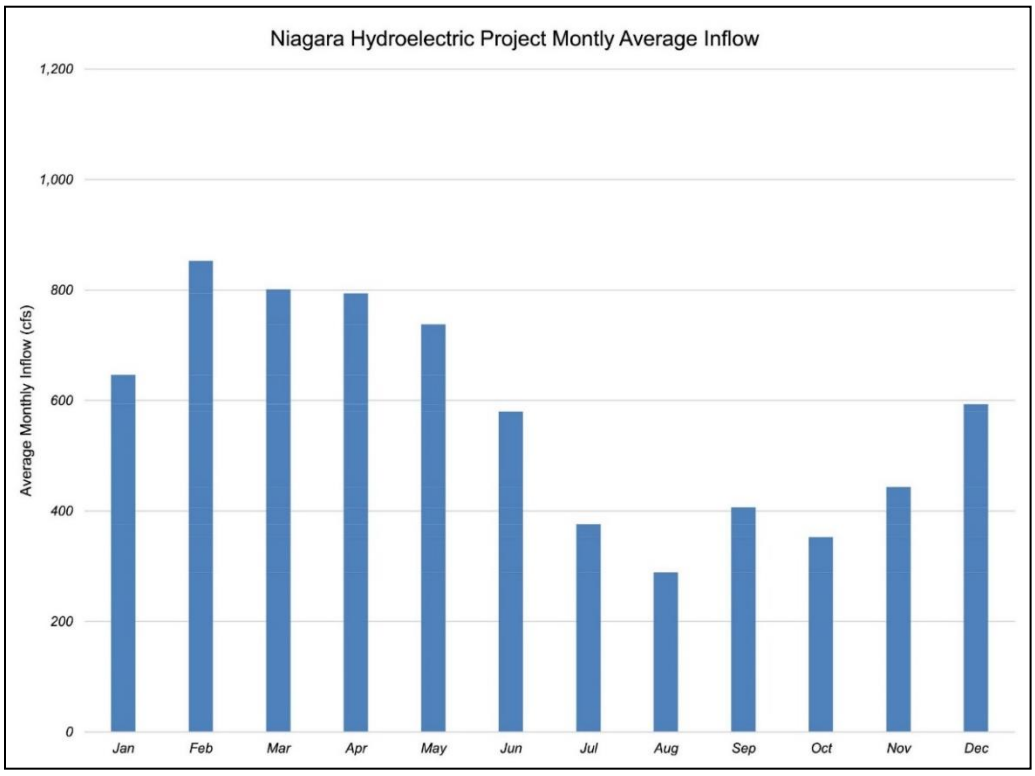

Figure A.5-11. Niagara Hydroelectric Project Average Monthly Flow (1994-2020)

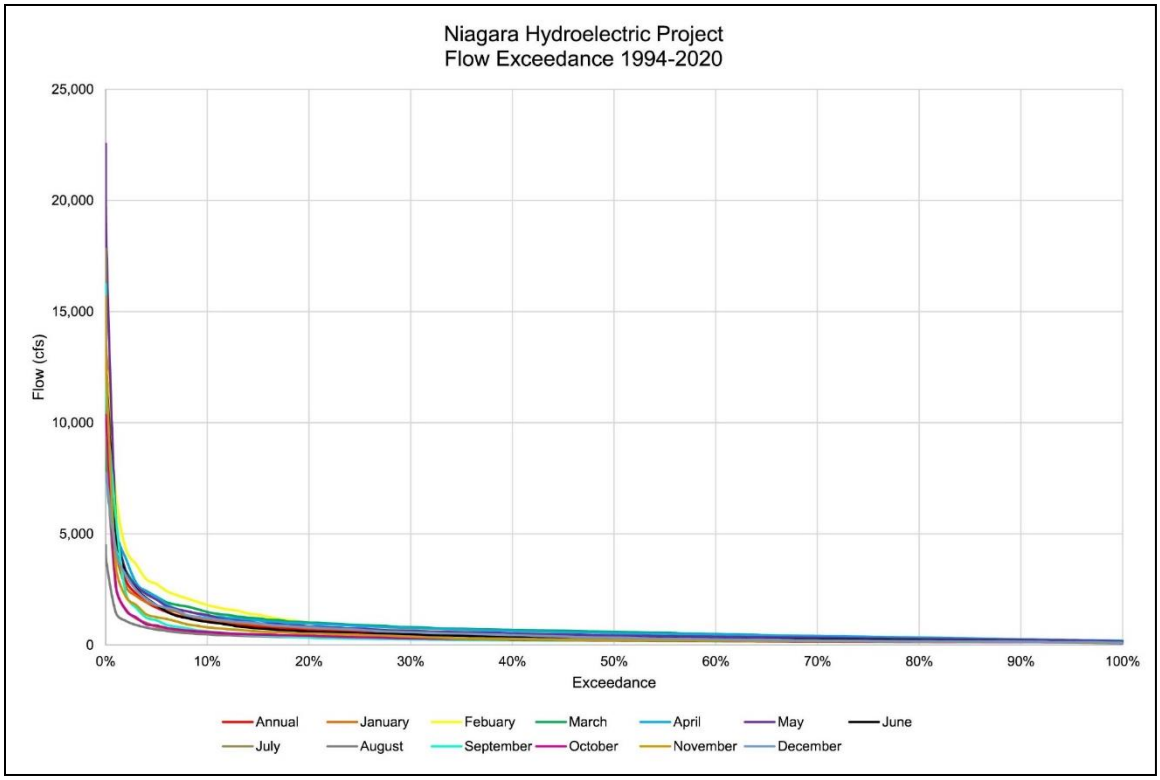

Figure A.5-12. Niagara Hydroelectric Project Annual Flow Duration (1994-2020)

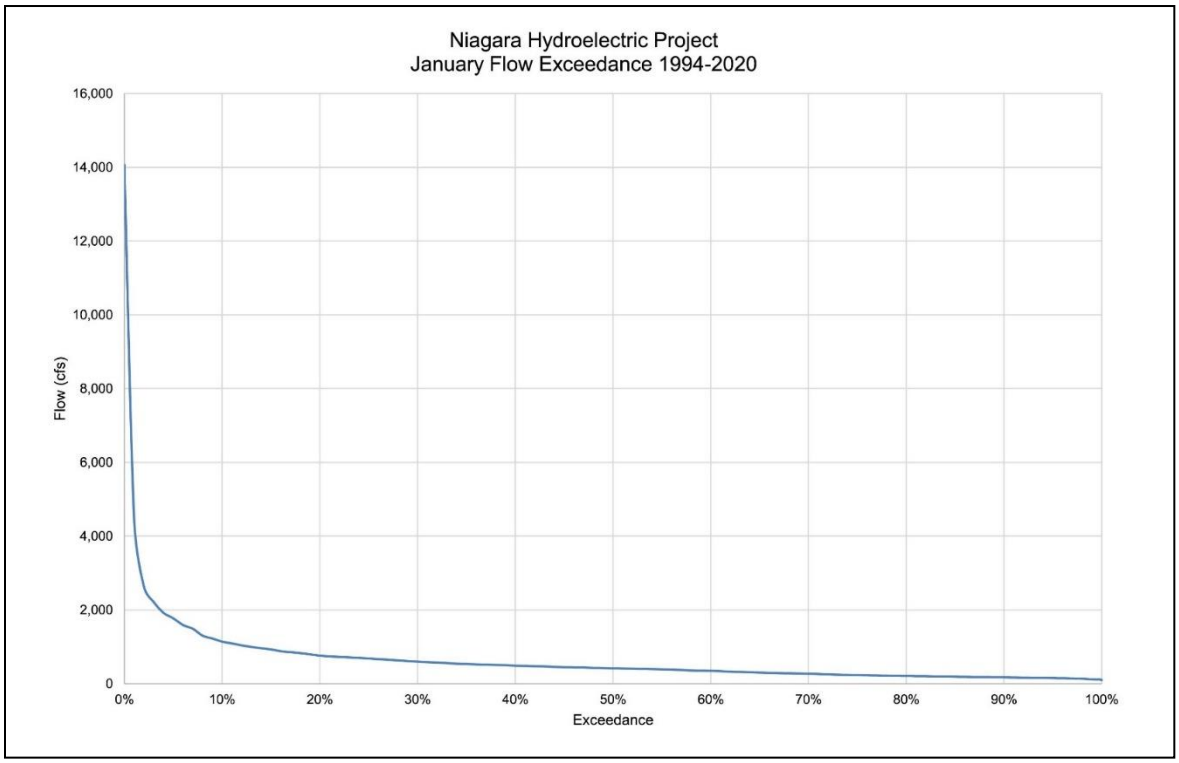

Figure A.5-13. Niagara Hydroelectric Project Annual Flow Duration for January

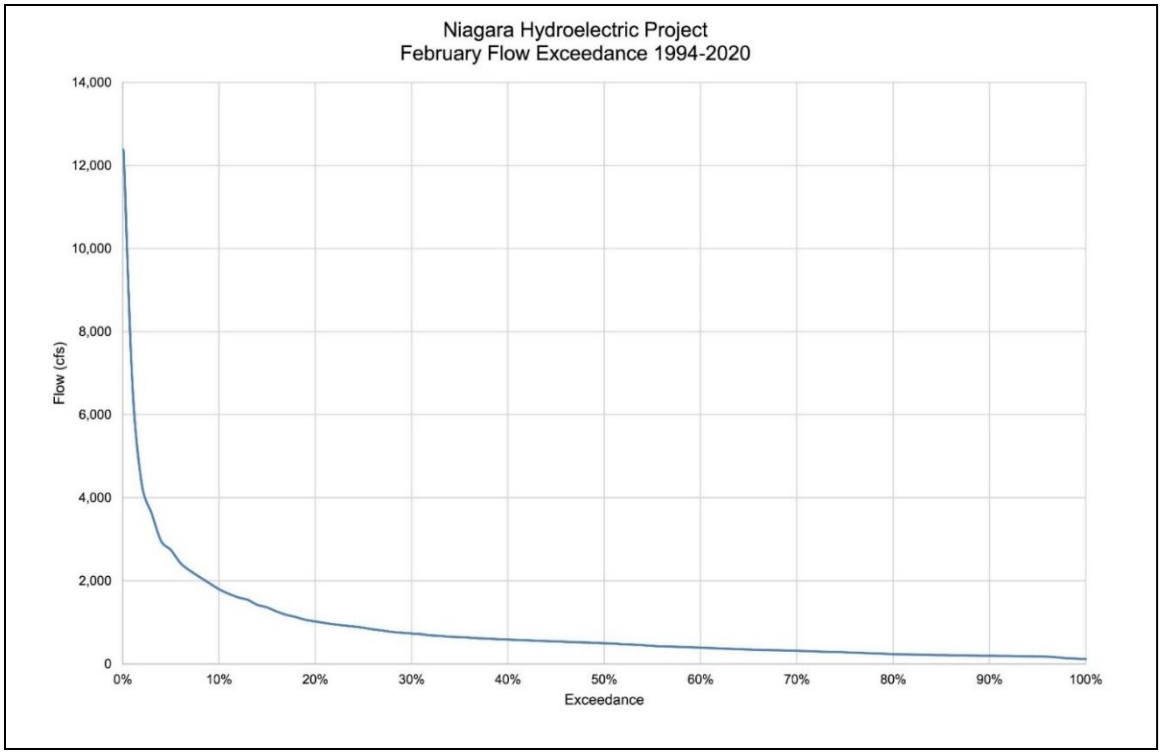

Figure A.5-14. Niagara Hydroelectric Project Annual Flow Duration for February

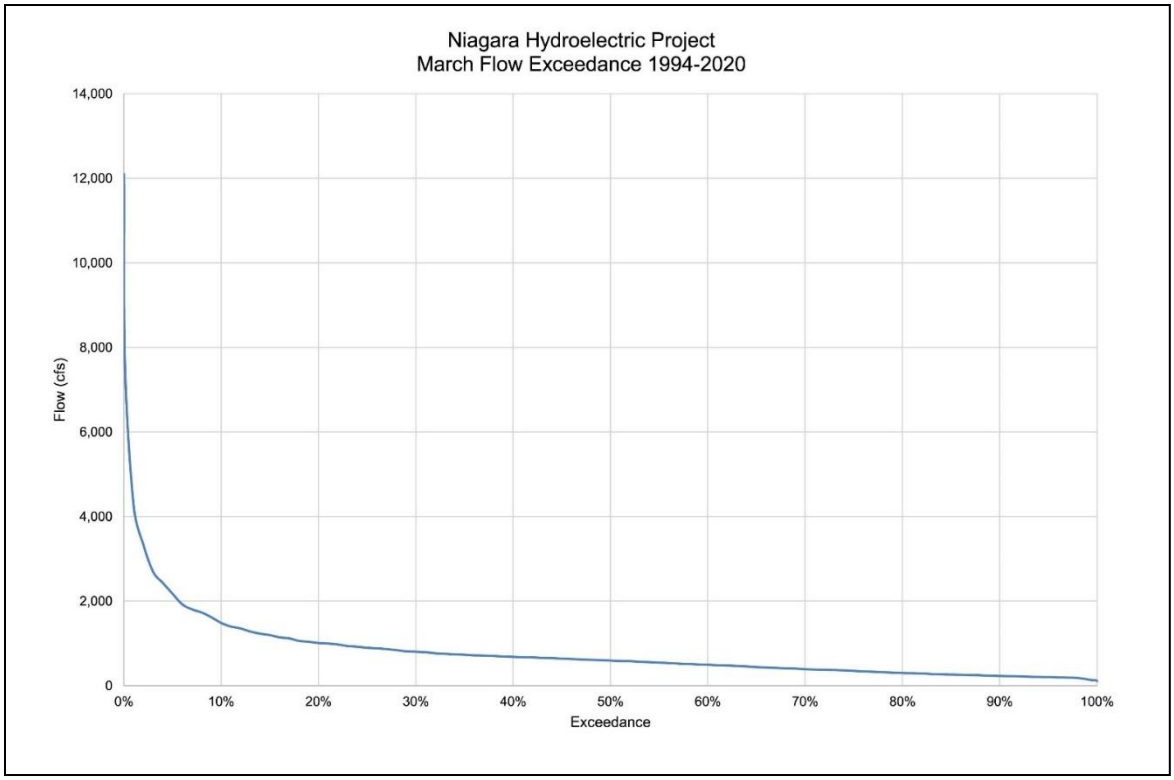

Figure A.5-15. Niagara Hydroelectric Project Annual Flow Duration for March

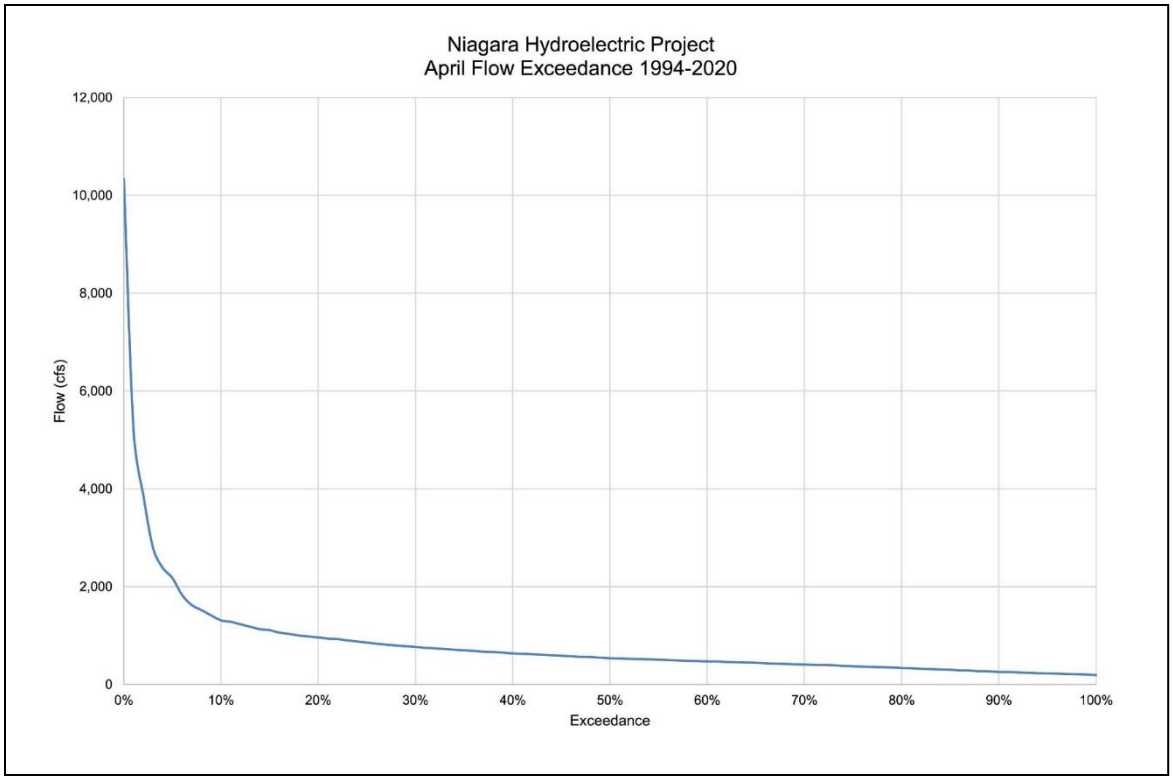

Figure A.5-16. Niagara Hydroelectric Project Annual Flow Duration for April

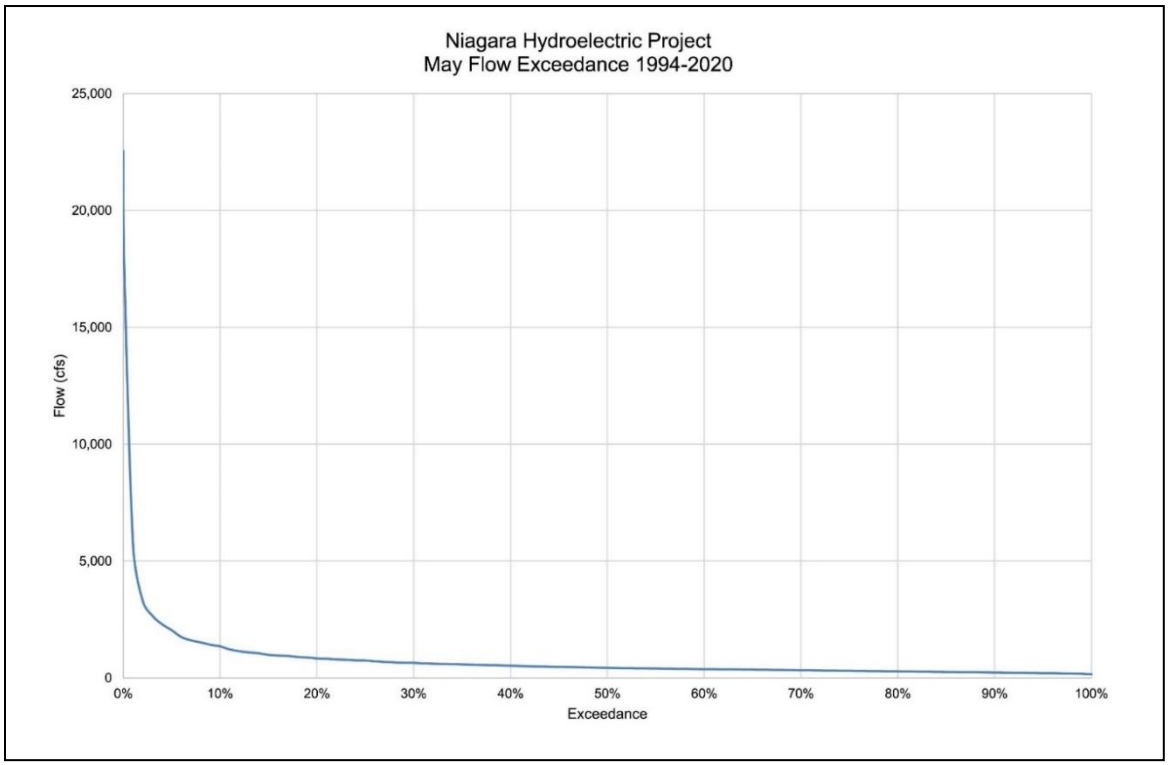

Figure A.5-17. Niagara Hydroelectric Project Annual Flow Duration for May

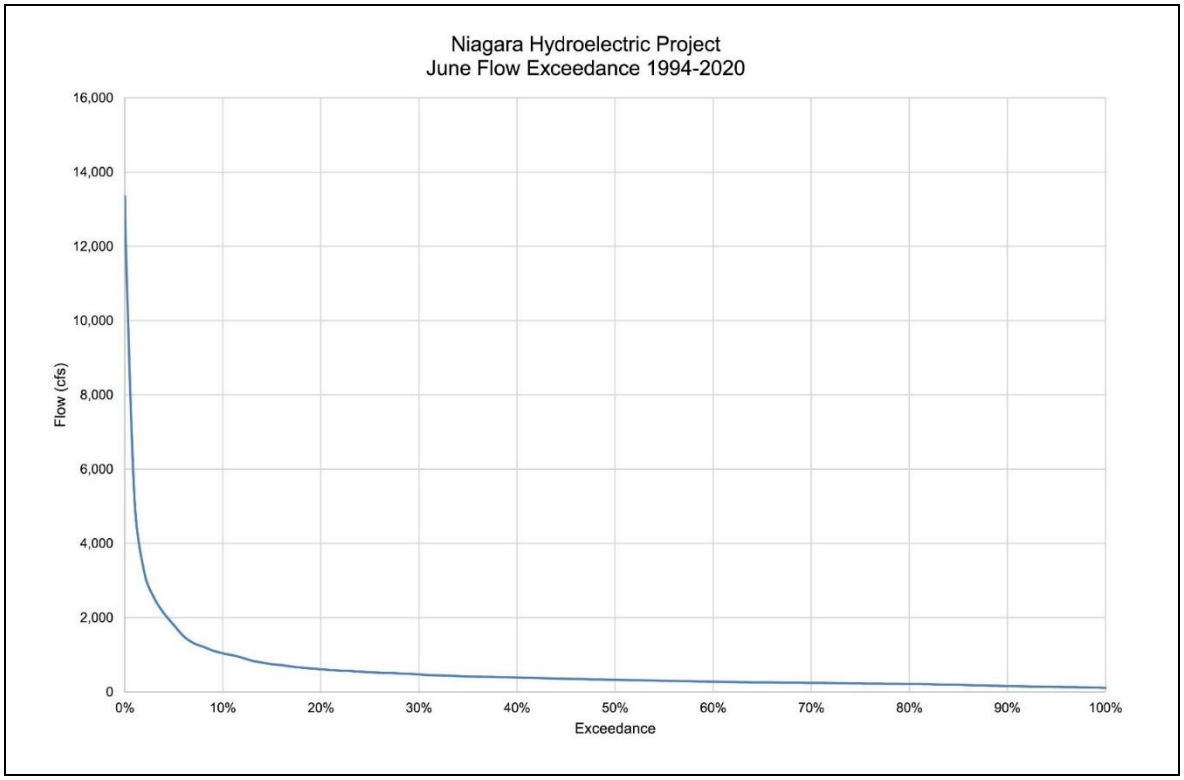

Figure A.5-18. Niagara Hydroelectric Project Annual Flow Duration for June

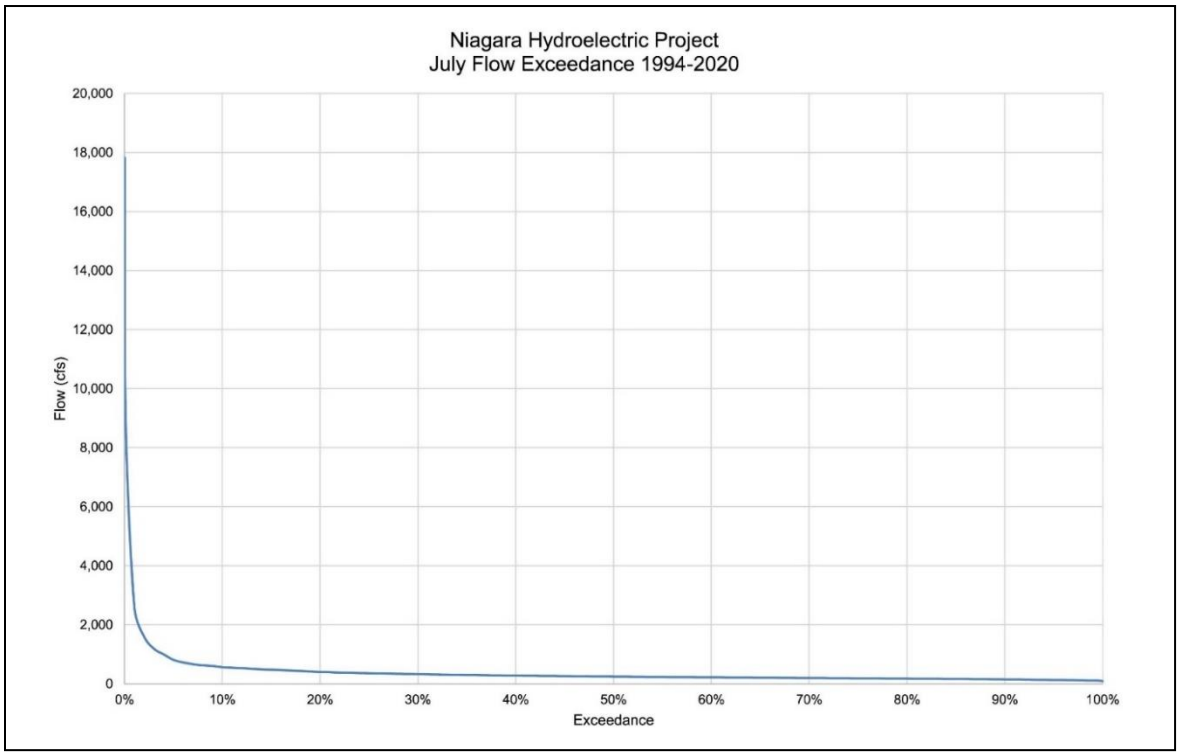

Figure A.5-19. Niagara Hydroelectric Project Annual Flow Duration for July

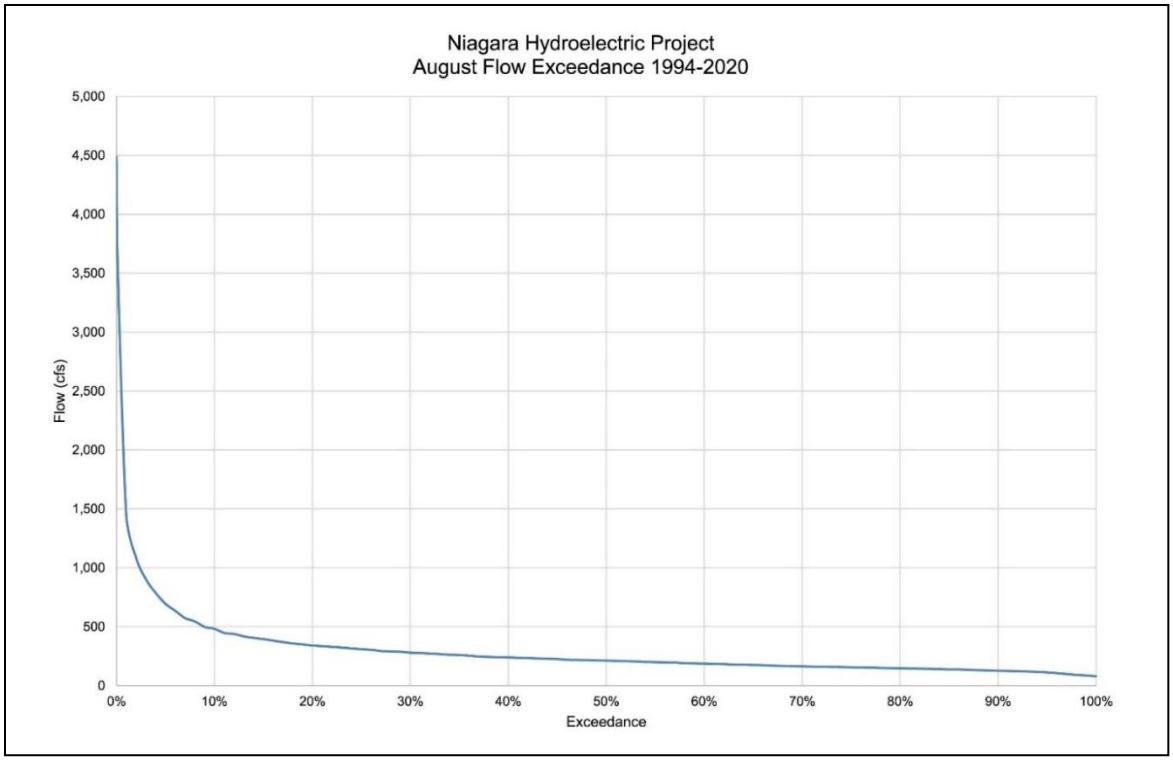

Figure A.5-20. Niagara Hydroelectric Project Annual Flow Duration for August

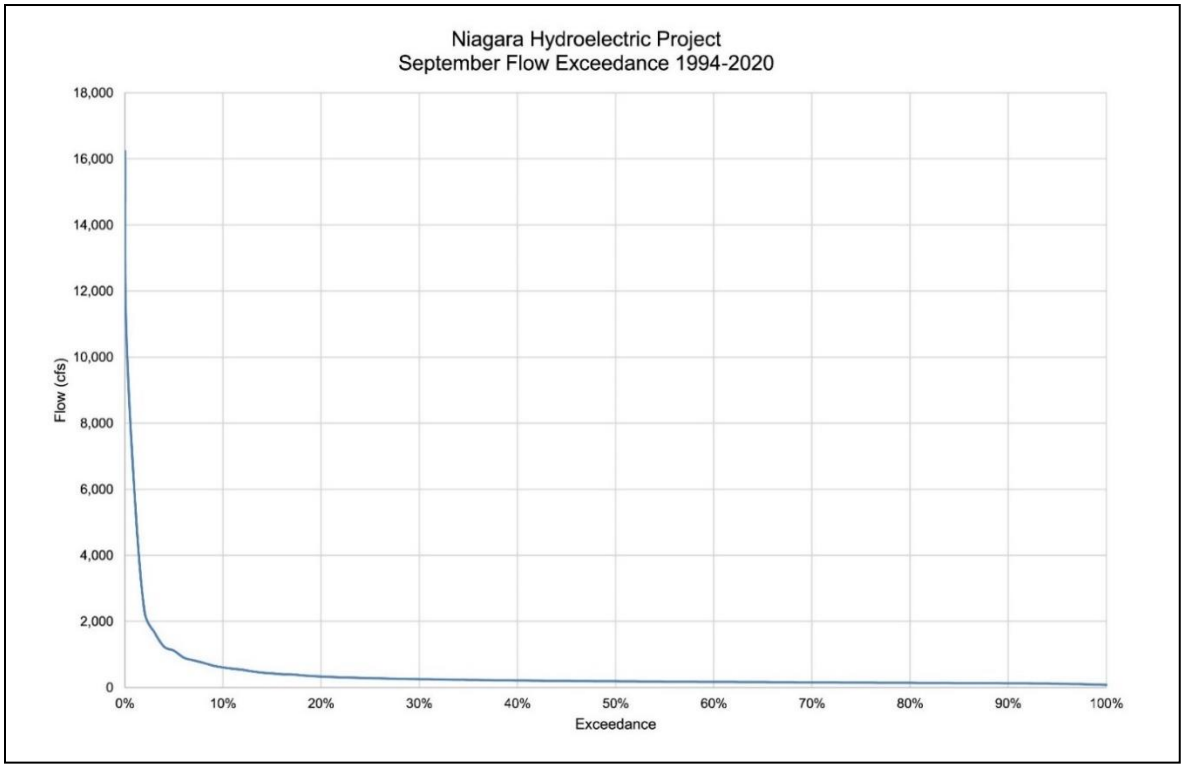

Figure A.5-21. Niagara Hydroelectric Project Annual Flow Duration for September

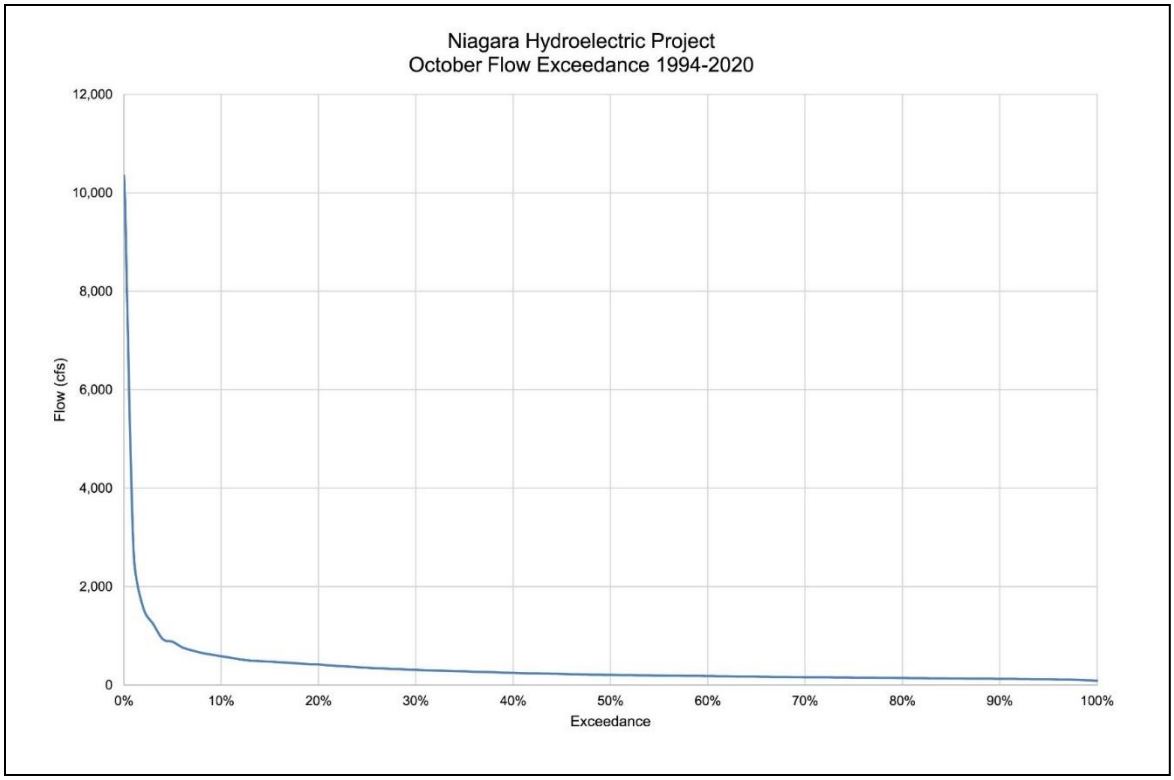

Figure A.5-22. Niagara Hydroelectric Project Annual Flow Duration for October

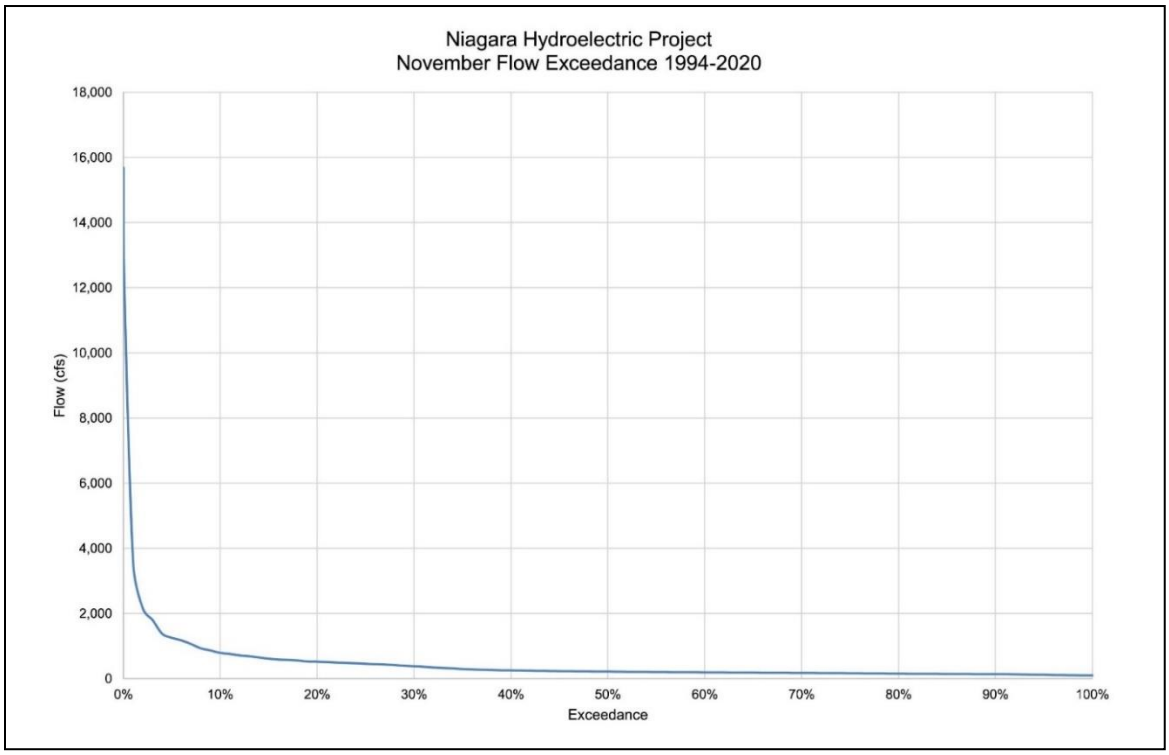

Figure A.5-23. Niagara Hydroelectric Project Annual Flow Duration for November

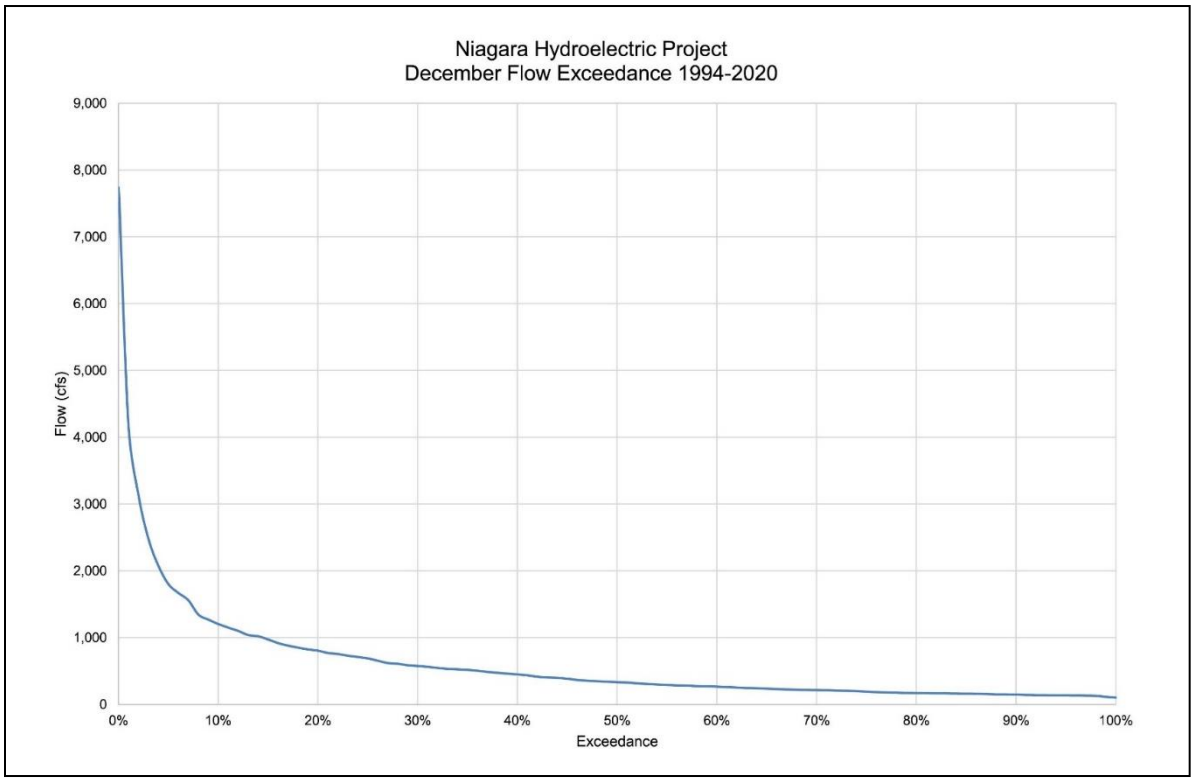

Figure A.5-24. Niagara Hydroelectric Project Annual Flow Duration for December

FINAL LICENSE APPLICATION

NIAGARA HYDROELECTRIC PROJECT (FERC NO. 2466)

EXHIBIT E

Environmental Report (18 CFR §4.61(d)(2))

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Exhibit E Environmental Report (18 CFR §5.18(b))

E.1 Introduction

The Appalachian-owned and operated Niagara Project is located at Roanoke River mile 355 in Roanoke County, Virginia. The Project is located approximately 6 miles southeast of the City of Roanoke and the total area of the watershed is approximately 511 square miles. Figure E.1-1 provides the location of the Project setting and the FERC Project Boundary. The upper portion of the Project Boundary and reservoir, including the mainstem of the Roanoke River as well as Tinker Creek immediately above its confluence with the Roanoke River, occupies a developed area within the Town of Vinton and along the outer limit of the City of Roanoke. Land use in this area and immediately upstream is predominantly low to medium-density development and forested. Development along the southern shoreline of the reservoir is generally limited by steep terrain and along the northern shoreline by the existing (active) CSX railroad.

The Project is operated as a run-of-river hydroelectric facility on the Roanoke River and inflows are either used for generation or spilled. The Project is operated to maintain the reservoir at EL. 884.4 ft, which is 0.6 ft below the crest of the spillway and provide minimum flows to the bypass reach of 8 cfs (during periods of powerhouse generation) or 50 cfs (non-generating periods). The Project facilities include the right non-overflow section, the main spillway, the sluice structure, the intake, the auxiliary spillway, water conveyances, and the powerhouse.

The Project is currently licensed by the FERC under the authority granted to FERC by Congress through the Federal Power Act, 16 United States Code (USC) §791(a), et seq., to license and oversee the operation of non-federal hydroelectric projects on jurisdictional waters and/or federal land. The Project underwent relicensing in the early 1990s, and the current operating license for the Project expires on February 29, 2024. Accordingly, Appalachian is pursuing a new license for the Project pursuant to the Commission's Integrated Licensing Process (ILP), as described at 18 Code of Federal Regulations (CFR) Part 5. In accordance with FERC's regulations at 18 CFR §16.9(b), the Licensee must file its final application for a new license with FERC no later than February 28, 2022.

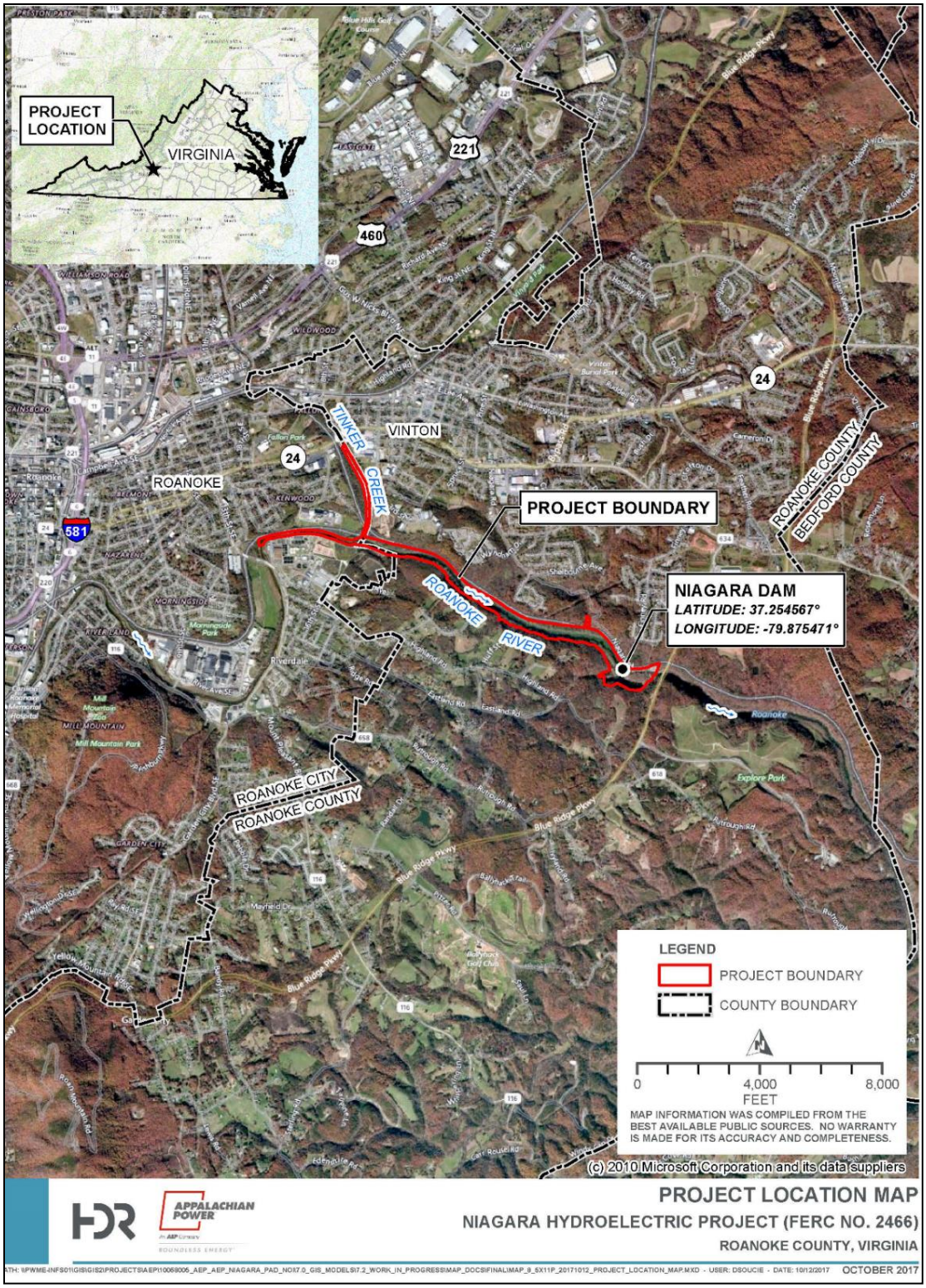


Figure E.1-1. Project Location Map and Project Boundary

E.1.1 Pre-Filing Consultation

Appalachian followed FERC's ILP in support of preparing this application for new license. Appalachian filed a Pre-Application Document (PAD) and associated Notice of Intent (NOI) with the Commission on January 28, 2019, to initiate the ILP. The PAD provided a description of the Project and summarized existing, relevant, and reasonably available information to assist resource agencies, federally recognized Indian tribes, non-governmental organizations (NGOs) and other interested parties (collectively, "stakeholders") in identifying issues, determining information needs, preparing study requests, and analyzing the license application.

The Commission issued Scoping Document 1 (SD1) for the Project on March 26, 2019. As provided in 18 CFR §5.8(a) and §5.18(b), the Commission issued a notice of commencement of the relicensing proceeding concomitant with SD1. On April 24 and 25, 2019, the Commission held public scoping meetings in Vinton, Virginia. During these meetings, FERC staff presented information regarding the ILP and details regarding the study scoping process and how to request a relicensing study, including the Commission's study criteria. In addition, FERC staff solicited comments regarding the scope of issues and analyses for the Environmental Assessment. Pursuant to 18 CFR §5.8(d), a public site visit of the Project was conducted on April 24, 2019. Resource agencies, Indian Tribes, NGOs, and other interested parties were afforded a 60-day period to request studies and provide comments on the PAD and SD1. The comment period was initiated with the filing of the Commission's March 26, 2019 SD1 notice and concluded on May 25, 2019. During the comment period, 12 stakeholders filed letters with the Commission providing general comments, comments regarding the PAD, comments regarding SD1, and/or study requests. Sixteen formal study requests were received from FERC, USFWS, VDWR, and Virginia Polytechnic Institute and State University (Virginia Tech) during the comment period. Copies of the letters filed with the Commission are provided in Appendix H in Volume II of the license application.

FERC issued Scoping Document 2 (SD2) on July 9, 2019 and in accordance with 18 CFR §5.11, Appalachian developed a Proposed Study Plan (PSP) for the Project that was filed with the Commission and made available to stakeholders on July 9, 2019. The PSP described Appalachian's proposed approaches for conducting studies and addressed agency and stakeholder study requests. Pursuant to 18 CFR §5.11(e), Appalachian held a PSP Meeting on August 1, 2019, for the purpose of clarifying the PSP, explaining any initial information gathering needs, and addressing any outstanding issues associated with the PSP.

Appalachian received timely formal comments on the PSP from FERC, USFWS, VDWR, Virginia Tech, Friends of the Rivers of Virginia (FORVA), Roanoke Valley Greenway Commission (RVGC), U.S.

Environmental Protection Agency (USEPA), Roanoke River Blueway Commission (RRBC), and Virginia Department of Environmental Quality (VDEQ), which are included in Appendix H (Volume II). In accordance with 18 CFR §5.11, Appalachian developed a Revised Study Plan (RSP) for the Project, which takes into account comments and study requests considered in developing the PSP, the Commission's July 9, 2019 SD2 and comments on the PSP, and it was filed with the Commission and made available to stakeholders on November 6, 2019. On December 6, 2019 FERC issued the Study Plan Determination (SPD) for the proposed eight studies to be performed in support of issuing a new license for the Project, as listed below.

(1) Flow and Bypass Reach Aquatic Habitat Study
(2) Water Quality Study
(3) Fish Community Study
(4) Benthic Aquatic Resources Study
(5) Wetlands, Riparian, and Littoral Habitat Characterization Study
(6) Shoreline Stability Assessment Study
(7) Recreation Study
(8) Cultural Resources Study

On July 27, 2020, Appalachian filed an updated ILP study schedule and a request for extension of time to file the Initial Study Report (ISR) to account for fieldwork delays resulting from the COVID-19 pandemic. The request was approved by FERC on August 10, 2020, and the filing deadline for the ISR for the Project was extended from November 17, 2020 to January 11, 2021.

On December 22, 2020, FERC issued Scoping Document 3 (SD3) for the Project, to account for updates about Commission staff's intent to conduct their National Environmental Policy Act (NEPA) review in accordance with the Council on Environmental Quality's (CEQ) updated NEPA regulations at 40 CFR Part 1500-1518.

Appalachian filed the ISR on January 11, 2021, conducted a virtual ISR Meeting on January 21, 2021, and filed the ISR Meeting summary with the Commission on February 5, 2021. The following parties provided written comments in response to Appalachian's filing of the ISR meeting summary: FERC staff, Roanoke County, USFWS, Roanoke Regional Partnership, Roanoke River Blueway Committee, Roanoke Valley Greenways, and the VDEQ. Appalachian provided response to comments on April 6, 2021. FERC provided its Determination on Requests for Study Modifications on May 10, 2021.

Throughout the study phase of the ILP (i.e., July 2020 through the USR), either by separate filing or in conjunction with the filings described above, Appalachian provided FERC and relicensing participants with quarterly ILP study progress reports describing study activities completed by Appalachian, updates to the study schedule, and variances from the schedule or methods of the RSP.

In addition to the formal consultation activities describe above and as represented in Appendix H (Volume II) of this FLA, Appalachian conducted consultation with specific stakeholders in support of the Cultural Resources Study, informal consultation with stakeholders in association with study activities, and convened and participated in additional meetings with relicensing participants throughout the pre-filing consultation period, including:

- September 25, 2019: Fish Community and Roanoke Logperch Study Plan Meeting (VDWR, USFWS, VDEQ, VA Tech)
- June 29, 2020: ILP Study Schedule Update to Agencies (VDWR, VDEQ, USFWS)
- April 20, 2021: Recreation Stakeholder Meeting (Town of Vinton, Roanoke Valley-Alleghany Regional Commission [RVARC], FORVA, Roanoke County, National Park Service (NPS), Virginia Department of Conservation and Recreation [VDCR])
- June 7, 2021: Roanoke Logperch Studies Update (USFWS, VDWR, FERC Staff)

On October 1, Appalachian filed the Draft License Application (DLA) with the Commission and distributed notice of these filings to the Project's mailing list. Comments on the DLA were filed by the following: FERC (December 29, 2021), Roanoke County (12/27/2021), Roanoke Regional Partnership (12/30/2021), Roanoke River Blueway Committee (12/28/2021), Roanoke Valley Greenways (12/22/2021), USFWS (12/14/2021) and VDWR (12/30/2021).

Studies were completed in 2021 with the exception of one task for the Fish Community Study: the Roanoke Logperch Larval Drift Survey. The field effort for this study is planned for completion in the spring of 2022, and Appalachian expects to file a revised study report to include results of this survey with the Commission as supplemental information to this FLA, in late 2022. The USR was filed with the FERC on December 6, 2021 and the USR meeting was held on December 14, 2021. The meeting summary was filed on December 27, 2021. The following parties provided written comments in response to Appalachian's filing of the USR meeting summary: FERC staff (1/27/2022), FORVA (1/28/2022), RRBC (1/28/2022), and RVGC (1/28/2022).

Appalachian has reviewed and considered all comments received; comments are summarized in Table ES-1 of the Executive Summary.

E.1.2 Resource Areas and Environmental Analysis Addressed in this Exhibit

As required by FERC's ILP regulations at 18 CFR § 5.18(b), Exhibit E presents effects of the Project on environmental resources using the information filed in the Licensee's PAD, information developed through the Licensee's FERC-approved study plan, and other information developed or obtained by the Licensee. As a significant amount of information exists or has been developed for many resource areas, Appalachian has included the most important and relevant information, and by reference this Exhibit accounts for and reflects the relicensing filings, in particular the study reports.

This environmental report contains information about the affected environment; analysis of anticipated continuing or new environmental impacts due to Project operation or proposed changes thereto, based on existing information and the results of relicensing studies; proposed environmental measures and measures recommended by relicensing participants; and unavoidable adverse impacts that may occur despite recommended or proposed environmental measures.

Consistent with the PAD and Scoping Documents 1,2, and 3 issued by FERC, the following resources are addressed in this exhibit:

- Geology, geomorphology, and soils
- Water use and quality
- Fish and aquatic resources (including protected and sensitive species)
- Botanical, wetland, and terrestrial resources (including protected and sensitive species)
- Recreational resources (including aesthetics)
- Historic and archaeological resources

E.2 General Description of the River Basin (18 CFR §5.18(b)(1))

E.2.1 Roanoke River Watershed

The Roanoke River is 410 miles long from its origins on the eastern slope of the Appalachian Mountains to its mouth at the Atlantic Ocean at Albemarle Sound. The headwaters begin in the mountainous terrain of eastern Montgomery County, Virginia, where the North Fork and South Fork of the river merge at an approximate EL. of 1,195 ft (Figure E.2-1). It then flows southeasterly to the Virginia/North Carolina state line. The Roanoke River basin is approximately 220 miles long, from 10 to 100 miles wide, and covers a total drainage area of approximately 9,580 square miles. The Roanoke River watershed lies within four physiographic provinces: the Valley and Ridge province, the Blue Ridge province, the Piedmont Plateau, and the Atlantic Coastal Plain. The basin is bound by the James

River basin on the north, to the east by the Chowan River basin, and to the west by the New River basin.

The Roanoke River is divided into seven USGS hydrologic units represented by hydrologic unit codes (HUC). The Project is located in HUC 03010101 – Upper Roanoke. The drainage area for the Project is 511 square miles, which represents approximately 5 percent of the total drainage basin for the Roanoke River. The upper portions of the Project drainage basin consist of mountainous terrain, narrow valleys, and fast-running streams typical of the Valley and Ridge and Blue Ridge provinces. The area surrounding Project are not as rugged and steep as in upper portions of the drainage basin and land is more developed.

E.2.2 Geography, Topography, and Climate

The topography of the Roanoke River basin ranges from steep slopes and valleys in the Valley and Ridge Province to gently sloping terrain east of the mountains in the Piedmont Province (VDEQ 2015). Roanoke County includes two distinct physiographic provinces including the Valley and Ridge province to the west and the Blue Ridge on the east (Woodward 1932). The Valley and Ridge province is northwest of the Blue Ridge and its foothills. It has developed on parallel beds of weak limestone and shale alternating with beds of resistant sandstone. The eastern portion of this province is a lowland, which is widely known as the Great Valley and is known locally as the Valley of Virginia. The western part of the Valley and Ridge province consists primarily of prominent, narrow, linear mountains and elongate, narrow intermontane valleys (Woodward 1932).

The Blue Ridge is a narrow, mountainous belt of resistant, complex rocks (Woodward 1932). The drainage is dendritic, except in some of the narrow valleys between the main ridge and the foothills. The topography is coarse with broad interstream areas. The Blue Ridge has been eroded primarily by streams, which have developed the relief mainly by lowering the beds of weaker rocks. The Roanoke River is the only stream in Roanoke County that crosses the Blue Ridge, which divides it into two parts, including: (1) a northern narrow ridge section underlain mainly by crystalline rocks, and (2) a broad southern plateau and foothill section containing crystalline rocks in the main part and sandstones in two belts of the western foothills (Woodward 1932).

On average, the areas surrounding Roanoke receive 42 inches of rain and 15 inches of snow per year. Summer high temperatures in the hottest month (July) are around 87 degrees Fahrenheit (ºF) on average and winter low temperatures in the coldest month (January) are around 26 ºF.

E.2.3 Dams and Diversions in the Watershed

The Project is the farthest project upstream on the mainstem Roanoke River. Downstream from the Project, there are five reservoirs along the mainstem of the river, impounding about 140 of the approximately 300 miles of river channel between the Project and the tidewater of Albemarle Sound. The largest of these, the multipurpose U.S. Army Corps of Engineers (USACE) John H. Kerr reservoir, which was constructed in the early 1950s for flood control and hydroelectric generation, has a useable storage of 2,808,000 acre-ft. The other four mainstem Roanoke River projects, all of which are projects under FERC jurisdiction, are as follows, from upstream to downstream: Smith Mountain (182,000 acre-ft usable storage) (FERC Project No. 2210), Leesville (110,000 acre-ft usable storage) (FERC Project No. 2210), Gaston Dam (435,000 acre-ft usable storage) (FERC Project No. 2009), and Roanoke Rapids (77,500 acre-ft usable storage) (FERC Project No. 2009). The Smith Mountain and Leesville Projects are also owned and operated by Appalachian. The Roanoke River Basin and the five mainstem power facilities are shown on Figure E.2-1.

E.2.4 Tributary Rivers and Streams

Major tributaries in the northern section of the Roanoke basin are the Little Otter, Big Otter, Blackwater, and Pigg rivers. Major tributaries in the southern portion include the Dan River, Smith River, and Banister River (VDEQ 2015). The lower portion of Tinker Creek, a smaller stream tributary to the Roanoke River, and the mouth of Wolf Creek are included in the Project Boundary. No other tributaries were identified within the Project Boundary.

E.2.5 General Land and Water Use

In the vicinity of the Project, in addition to hydroelectric power, the Roanoke River is used for municipal and industrial water supply, wastewater disposal, and recreation. Within the general Project area, land cover and land use along the river is primarily deciduous forest, with low-intensity development along the left descending bank. Land in the western portion of the Project Boundary is primarily low- and medium-intensity development. Areas of hay and pastureland are located in the general area but are typically outside of the Project Boundary with the exception of areas along Tinker Creek. Lands adjacent to and downstream of the Project are owned by the NPS in association with the Blue Ridge Parkway. The Project Boundary includes 0.9 acres of land owned by NPS.

Table E.2-1 lists the estimated land use acreage within the Project Boundary and land use types are also shown on Figure E.2-2.

Table E.2-1. Estimated Land Use Acreage within the Project Boundary

Land Use	Estimated Acres
Deciduous Forest	23
High-Intensity Development	0.22
Low-Intensity Development	24
Medium-Intensity Development	5.4
Developed Open Space	12
Evergreen Forest	0.5
Hay/Pasture	3
Mixed Forest	7.5
Open Water	51

Data Source: National Land Cover Database 2011

E.2.6 Downstream Reach Gradients

The topography of the Roanoke River basin ranges from steep slopes and valleys to gently sloping terrain. Below the Niagara Dam, the bypass reach extends approximately 1,500 ft to the powerhouse, with the riverbed sloping at an average rate of approximately 78 ft per mile[4]. For the reach one mile below the powerhouse, the riverbed slopes at an average rate of approximately 15 ft per mile.

[4] This results in a 22-ft elevation difference between the powerhouse and the dam.

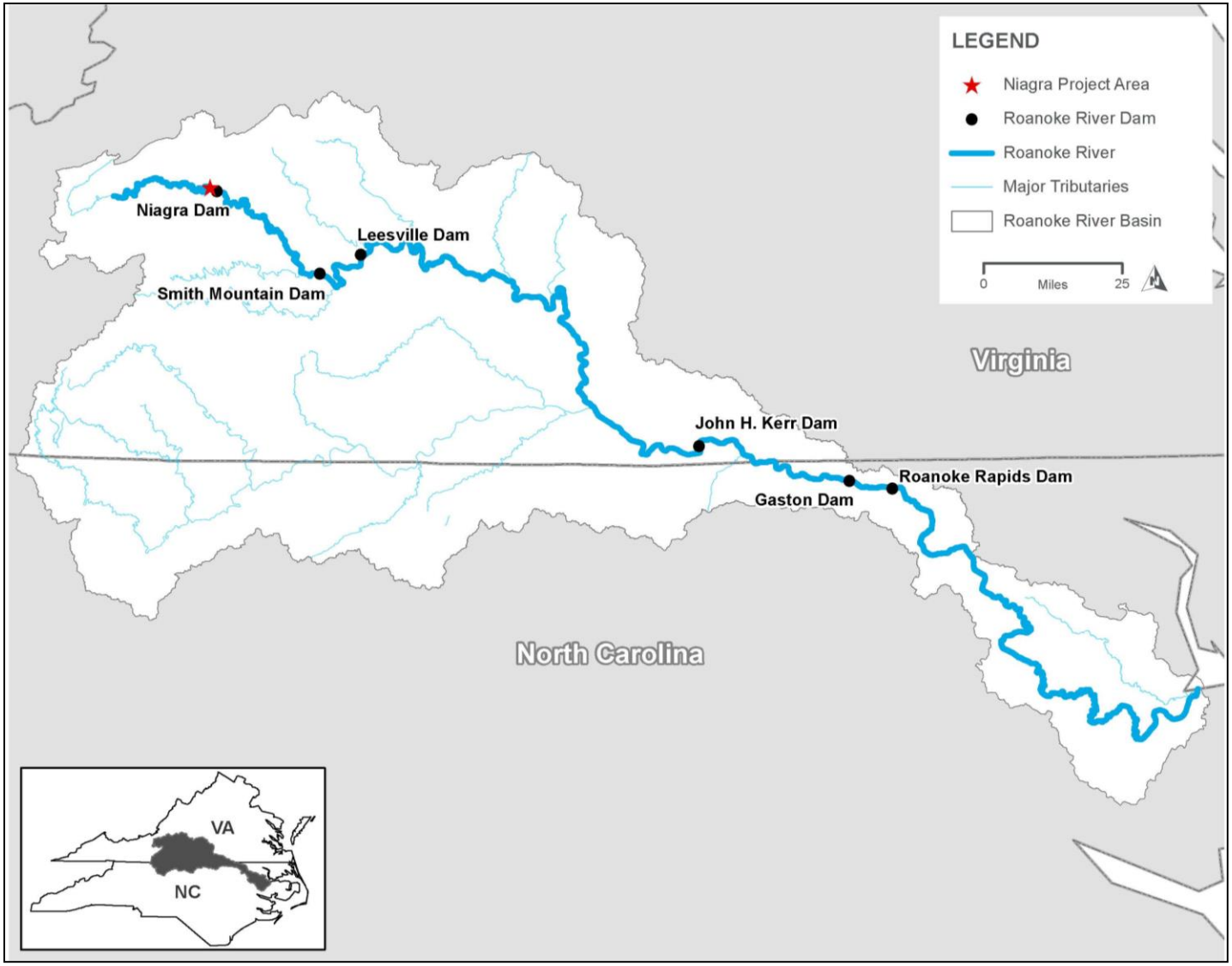


Figure E.2-1. Roanoke River Basin and Location of Project

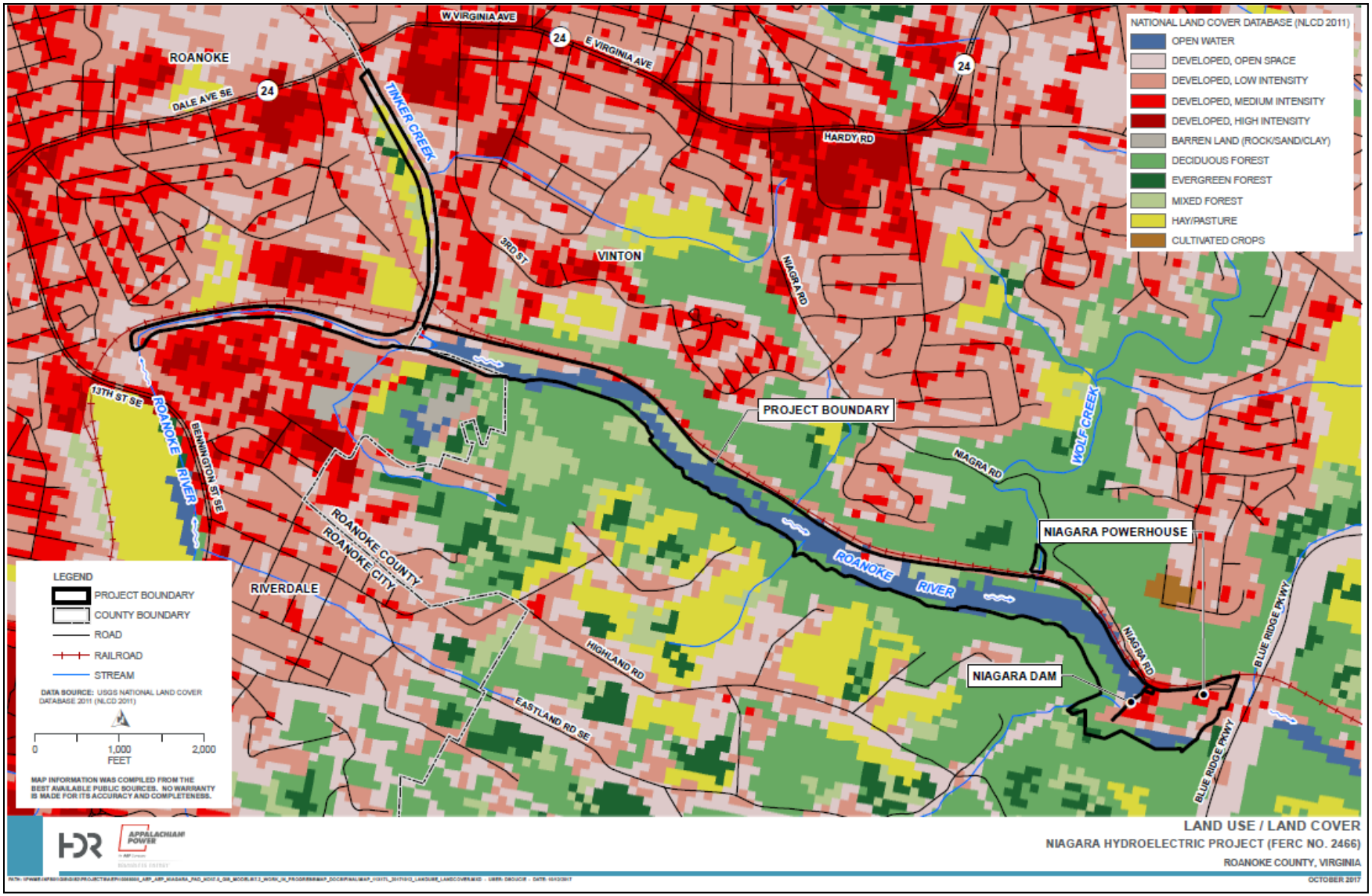


Figure E.2-2. Land Use and Land Cover

E.3 Cumulative Effects (18 CFR §5.18(b)(2))

According to the CEQ regulations for implementing NEPA (40 CFR § 1508.7), a cumulative effect was historically defined as the effect on the environment that results from the incremental effect of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative effects can result from individually minor but collectively significant actions taking place over a period of time, including hydropower and other land and water development activities.

However, in a final rule issued on July 15, 2020, CEQ revised its regulations under 40 CFR Parts 1500-1518 that federal agencies use to implement NEPA. The revised regulations repealed the definition of cumulative effects and provided a new definition for effects to be considered in the environmental analysis as follows; FERC's NEPA document will be consistent with this definition:

> *Effects or impacts means changes to the human environment from the proposed action or alternatives that are reasonably foreseeable and have a reasonably close causal relationship to the proposed action or alternatives, including those effects that occur at the same time and place as the proposed action or alternatives and may include effects that are later in time or farther removed in distance from the proposed action or alternatives.*
>
> *(1) Effects include ecological (such as the effects on natural resources and on the components, structures, and functioning of affected ecosystems), aesthetic, historic, cultural, economic (such as the effects on employment), social, or health effects. Effects may also include those resulting from actions that may have both beneficial and detrimental effects, even if on balance the agency believes that the effect will be beneficial.*
>
> *(2) A "but for" causal relationship is insufficient to make an agency responsible for a particular effect under NEPA. Effects should generally not be considered if they are remote in time, geographically remote, or the product of a lengthy causal chain. Effects do not include those effects that the agency has no ability to prevent due to its limited statutory authority or would occur regardless of the proposed action.*

On the basis of this regulatory change, and because FERC removed discussion of cumulative effects on water quality (i.e., dissolved oxygen [DO] and water temperature), aquatic habitat, and fisheries resources (i.e., diadromous fishes and Roanoke Logperch) in SD3, Appalachian is not separately addressing cumulative effects in this FLA.

E.4 Compliance With Applicable Laws (18 CFR §5.18(b)(3))

E.4.1 Section 401 of the Clean Water Act

Under Section 401 of the Clean Water Act (CWA) (33 USC § 1251 et seq.), a federal agency may not issue a license or permit to conduct any activity that may result in any discharge into waters of the United States unless the state or authorized Tribe where the discharge would originate either issues a Section 401 Water Quality Certification finding compliance with existing water quality requirements or waives the certification requirement. In the Commonwealth of Virginia, under § 62.1-44.15 of the Code of Virginia, the Virginia Department of Environmental Quality (VDEQ) provides Section 401 Water Quality Certification through the Virginia Water Protection (VWP) Program, as authorized by the State Water Control Law and as described in the VWP Permit Regulation.

Appalachian is preparing a joint permit application for a VWP permit and surface water withdrawal for the continued operation of the Project in parallel with the FERC licensing process and intends, to the greatest extent possible, to use licensing documents including but not limited to study reports and the license application exhibits to satisfy this parallel regulatory process. Requirements for a VWP permit are described in 9 Virginia Administrative Cody (VAC) 25-210-80 and 9VAC25-210-340. Pursuant to 18 CFR § 5.23(b), Appalachian will file an application for water quality certification with VDEQ no later than 60 days of the Commission's Notice of Acceptance and Ready for Environmental Analysis. The VDEQ must act on the request for WQC within the one-year timeframe allowed under the CWA.

E.4.2 Endangered Species Act

Section 7 of the Endangered Species Act (ESA) (19 USC §1536(c)), as amended, requires federal agencies to ensure that their actions are not likely to jeopardize the continued existence of endangered or threatened species or result in the destruction or adverse modification of the critical habitat of such species. Under the ESA, the USFWS is responsible for freshwater and terrestrial species, and the National Marine Fisheries Service (NMFS) (National Oceanic and Atmospheric Administration [NOAA] Fisheries) is responsible for marine and anadromous species (not applicable to the Niagara Project). In the notice of the Licensee's intent to file a FLA, filing of the PAD, commencement of pre-filing process, and scoping issued on March 26, 2019, the Commission designated Appalachian as the Commission's non-federal representative for carrying out informal consultation pursuant to Section 7 of the ESA. Information from the USFWS and the VDWR and collected during execution of the relicensing studies has been used by the Licensee to identify endangered or threatened species in the

Project area. A discussion of the rare, threatened, and endangered (RTE) species relevant to the Project is contained in Sections E.9.1.5 and E.10.1.6.

E.4.3 Magnuson-Stevens Fishery Conservation and Management Act

The 1996 amendments to the Magnuson-Stevens Act authorized the NMFS, in accordance with regional fisheries management councils, to delineate essential fish habitat for the protection of habitat of marine, estuarine, and anadromous finfish, mollusks, and crustaceans. Essential Fish Habitat includes "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." The Project area is not located within designated Essential Fish Habitat for any species.

E.4.4 Coastal Zone Management Act

Section 307(c)(3) of the Coastal Zone Management Act requires that activities conducted or supported by a federal agency that affect the coastal zone be consistent with the enforceable policies of the federally-approved state coastal management plan to the maximum extent practicable. Policies associated with the Coastal Zone Management Act are not applicable to the Project, which is not located within Virginia's designated Coastal Zone.

E.4.5 National Historic Preservation Act

Section 106 of the National Historic Preservation Act (NHPA) (54 USC §300101 et seq.) requires federal agencies to take into account the effects of their undertakings on historic properties and to afford the Advisory Council on Historic Preservation a reasonable opportunity to comment on such actions. Historic properties include significant sites, buildings, structures, districts, and individual objects listed in or eligible for inclusion in the National Register of Historic Places (NRHP). If a property has not yet been nominated to the NRHP for determined eligible for inclusion, it is the responsibility of FERC to ascertain its eligibility.

The Commission's issuance of a new license for the continued operation of the Project is considered an undertaking subject to the requirements of Section 106 and its implementing regulations. FERC initiated consultation under Section 106 with federally recognized Indian tribes by letter dated September 10, 2018. By notice dated March 26, 2019, FERC designated Appalachian as its non-federal representative for purposes of conducting informal consultation pursuant to Section 106. A discussion of this consultation process and studies conducted in support of these requirements is contained in Section E.12.

E.4.6 Wild and Scenic Rivers and Wilderness Act

The reach of the Roanoke River in the vicinity of the Project is not located within or adjacent to any presently designated National Wild and Scenic River systems or state protected river segments. The Project does not occur in or occupy lands designated as wilderness area under the Wilderness Act.

E.5 Project Facilities and Operations (18 CFR §5.18(b)(4))

E.5.1 Maps of Project Facilities Within Project Boundary

The following figures in this FLA depict the Project facilities within the Project Boundary:

- Figure A.2-1. Existing Project Facilities
- Figure A.1-1 Project Location Map and Project Boundary
- Exhibit G (Sheets 1 and 2). Project Boundary Map

E.5.2 Project Facilities

The licensed Project works consist of: (1) a 52-ft-high, 452-ft-long concrete dam creating a 62-acre reservoir; (2) an 11-ft-diameter, 500-ft-long, corrugated metal pipe penstock with associated entrance and discharge structures; (3) a 92-ft-long by 58-ft-wide by 42-ft-high concrete powerhouse on the north end of the dam containing two generating units with a total installed capacity of 2.4 MW; (4) transmission facilities consisting of 50-ft-long 2.4-kilovolt (kV) generator leads and a 3-phase, 2.4/12-kV, 2500-kilovolt ampere (kVA) step-up transformer; and (5) appurtenant facilities.

E.5.3 Project Waters

The reservoir formed by the Niagara Dam, including the mainstem of the Roanoke River as well as Tinker Creek immediately above its confluence with the Roanoke River, is approximately 2 miles long and covers a surface area of 62 acres. The Project also includes an approximately 1,500-ft-long bypass reach (the original Roanoke River channel). Outflows from the Project (including powerhouse and bypass reach discharge) are measured at the U.S. Geological Survey (USGS) gauge located approximately 300 ft downstream of the powerhouse (USGS 2056000 Roanoke River at Niagara, VA).

E.5.4 Turbine and Generator Specifications

Turbine and generator specifications for both existing units are provided in Table A.2-2 and provided below for reference in this exhibit.

Table E.5-1. Turbine and Generator Data

Turbines	
Number of Units	2
Type	Vertical shaft Francis unit
Design Head	Unit 1: 60 ft Unit 2: 57 ft
Rated Capacity	1,200 kW (each)
Minimum Discharge	Approximately 100 cfs (per unit)
Maximum Discharge	Unit 1: 379 cfs Unit 2: 305 cfs
Operating Speed	Unit 1: 277 rpm Unit 2: 277 rpm
Generators	
Type	AC generators manufactured by the Elliott Company
Rated Capacity	1,500 kVA / 1,200 kW each (Power Factor = 0.8)
Phase	3-phase
Voltage	2,400 volts
Frequency	60 Hertz
Synchronous Speed	277 rpm

E.5.5 Project Operations

The Niagara Project is operated as a run-of-river hydroelectric facility on the Roanoke River; there is no appreciable reservoir storage available. The Project is operated to maintain the reservoir at EL. 884.4 ft[5], which is 0.6 ft below the crest of the spillway. Project inflows are either used for generation or spilled. The estimated hydraulic capacity of the Niagara powerhouse (two turbine-generator units and associated water conveyance facilities) is approximately 684 cfs.

[5] All elevations are referenced to National Geodetic Vertical Datum of 1929 (NGVD).

Normal releases to the bypass reach are provided via the sluice structure and overflow spillway, as well as through leakage through the mud gates. License Article 403 established an 8-cfs minimum flow requirement for the bypass reach, but flows can be higher depending on Project inflows and/or spillway sluice gate operations. Under normal operating conditions, the Project uses available flows for powerhouse generation, maintaining the elevation of the Niagara reservoir between elevations of 884.4 and 883.4 ft. Under Article 403 of the current license, Appalachian is also required to maintain 50 cfs minimum flow release or inflow, whichever is less, downstream of the Project powerhouse. Because there is no existing means of providing discharge to the powerhouse tailrace other than through the turbines, this minimum flow is spilled at the dam. When inflow to the Project exceeds the powerhouse discharge capacity (684 cfs), the excess flows are passed over and through the spillway.

E.6 Proposed Action and Alternatives (18 CFR §5.18(b)(5))

E.6.1 No-Action Alternative

Under the no-action alternative, the Niagara Project would continue to operate as required by the current Project license (i.e., there would be no change to the existing environment). No new environmental protection, mitigation, or enhancement measures would be implemented. This alternative establishes baseline environmental conditions for comparison with other alternatives.

The following resource protection measures are required by the existing license and implemented by Appalachian:

- Geological and Soil Resources
    - There are no specific license article requirements related to geology and soils for the Niagara Project; however, operation of the Project in a run-of-river mode with maintenance of the reservoir at EL. 884.4 ft provides relatively stable water levels in the reservoir that serve to reduce the potential for shoreline erosion as a result of Project operations.

- Aquatic Resources
    - Operate the project in a run-of-river mode, maintaining the elevation of the impoundment at or near 884.4 ft (Article 401).
    - Provide a minimum flow of 50 cfs, or inflow to the project, whichever is less, to the Roanoke River downstream of the powerhouse (Article 402).
    - Provide a minimum flow of 8 cfs to the project's bypass reach (Article 403).

- Terrestrial Resources
    - Follow the Commission-approved Wildlife Management Plan that includes monitoring habitat over the term of the existing license (Article 407).

- Threatened and Endangered Species

  - There are no existing license article requirements related to threatened and endangered species for the Niagara Project.

- Recreation and Land Use and Aesthetic Resources
  - Provide recreation access via a Canoe Portage Trail (Article 411).

- Cultural Resources
  - The Licensee is required to consult with the State Historic Preservation Office (SHPO) and prepare a plan if archaeological sites are found during Project operation (Article 409).

E.6.2 Applicant's Proposal

The proposed action is to continue the existing operation and maintenance of the Project, with updated or additional protection, mitigation, and enhancement (PM&E) measures as follows:

- Operate to the Project in a run-of-river mode under all flow conditions, where inflow equals outflow. The Project is operated to maintain the impoundment at or near elevation 884.4 ft, which is 0.6 ft below the crest of the spillway. During extreme flow conditions, such as rapidly changing inflows, Appalachian operates the project with a minimum impoundment elevation of 883.4 ft. Run-of-river operation may be temporarily modified by operating emergencies beyond the control of Appalachian and for short periods upon mutual agreement among Appalachian, USFWS, and the VDWR.

- Operate the Project with a single (i.e., continuous, year-round) minimum flow requirement of 30 cfs to the bypass reach. In support of this new requirement, Appalachian proposes to continue funding of the USGS Roanoke River at Niagara gage.

- Develop and implement a Terrestrial Resources Protection Plan in consultation with USFWS and VDWR to include supporting information about potentially sensitive areas, as well as the limits of the Project Boundary and lands owned by Appalachian; standard protection measures implemented by Appalachian; identification and communication of activities that may disturb wildlife or wildlife habitat; and other coordination measures.

- Develop and implement Recreation Management Plan in consultation with Project stakeholders, to include improvements to canoe portage take-out and trail, and development and maintain a public website for information related to river flows downstream of the run-of-river Project and recreational facilities (Project and Non-Project) at the Niagara Project.

E.6.3 Alternatives

For the reasons described in FERC's SD3, Federal Government Takeover, issuance of a non-power license, and Project decommissioning are not considered to be reasonable alternatives based on the relicensing proceeding to date and are not expected to be analyzed in FERC's NEPA document.

E.7 Geology, Geomorphology, and Soils

E.7.1 Affected Environment

E.7.1.1 Geology

Bedrock Geology

The central and northwestern parts of Roanoke County consist primarily of sandstone, limestone, and shale of Paleozoic age, whereas the southeastern part consists of crystalline rocks of pre-Cambrian age. Along the western edge of the Blue Ridge province, the resistant pre-Cambrian rocks have been over thrust from the south and east with less resistant Paleozoic rocks (Woodward 1932).

Surficial Geology

Alluvial deposits of the Roanoke River are indicated on either side of the dam. The local alluvial deposits are underlain by mylonite gneiss, which is typically described as a dark-greenish-gray, well foliated, coarse-grained mylonite (augen) gneiss containing feldspar porphyroblasts. This mylonite was derived locally from the porphyroblastic granulite gneisses during Paleozoic deformation. Closely associated with the mylonite gneiss and mapped near the southwest dam abutment is a porphyroblastic granulite gneiss. This gneiss is commonly described as dark-grayish-green to dark-green, coarse-grained quartzo-feldspathic gneiss. Common characteristics of this gneiss are pegmatic greenish-white feldspar and garnet porphyroblasts. The texture is dominantly xenomorphic granular with poorly developed segregation layering (DTA 2005).

Mineral Resources

Many of the rocks in Roanoke County contain minerals that are of economic value. Materials that have been harvested include clay, stone for building, and crushed rock, limestone, nelsonite, and slight amounts of iron. Coal, iron, manganese, glass sand, barite, and cement can also be found in this area. No oil, gas, or mineral resources were identified within the Project Boundary (Woodward 1932).

E.7.1.2 Soils and Sediment

Soil types in the vicinity of the Project are variable and reflect the diversity of parent materials, the local topography, and the physiographic position of landforms (Woodward 1932). Mapped soils in the Project vicinity are shown on Figure E.7-1. The soils in the Project Boundary downstream from the confluence of Tinker Creek, along the shoreline of the Roanoke River, are generally very stony Hayesville channery fine sandy loam with 25 to 50 percent slopes. The Hayesville series consists of very deep, well-drained soils on gently sloping to very steep ridges and side slopes of the Southern Appalachian Mountains. They most commonly form in residuum weathered from igneous and high-grade metamorphic rocks such as granite, granodiorite, mica gneiss, and schist, but in some places formed from thickly-bedded metagraywacke and metasandstone (USDA 2017).

The soils within the Project Boundary upstream from Tinker Creek vary and primarily include occasionally flooded Speedwell-Urban land complex with 0 to 2 percent slopes, Chiswell-Litz complex with 25 to 50 percent slopes, urban land, and Udorthents-Urban land complex. The Speedwell series consists of very deep, well-drained, moderately permeable soils on floodplains. They formed in medium-textured alluvium. The Chiswell series consists of shallow, well-drained, moderately permeable soils on uplands. They formed in materials weathered from shale, siltstone, and fine-grained sandstone. The Litz series consists of moderately deep, well-drained soils formed in residuum from leached calcareous shale and with widely spaced thin layers of limestone (USDA 2017).

E.7.1.3 Shorelines and Streambanks

The topography bordering the reservoir is relatively steep in areas, especially along the southern bank. The steeper slopes flatten out close to the shoreline resulting in an undulating topography. Canopy vegetation is present in the reservoir area, as well as groundcover layers of vegetation (shrubs, small trees, perennials) that thrive under tree canopies. Grasses and perennial species grow along the shoreline in various areas, and the vegetation located along the shoreline of the reservoir prevents shoreline erosion.

The shoreline downstream of the Project's dam and powerhouse is generally steep and graded in areas (especially near the powerhouse). The downstream shoreline typically consists of relatively steep slopes with forest canopy vegetation and underlain in areas by established shrub and herbaceous layers. Large boulders and exposed bedrock are the prevalent substrates along the downstream shoreline.

Appalachian conducted a Shoreline Stability Assessment for the Project in the summer of 2021 as one of the eight studies for the relicensing effort. Details are provided in Section E.7.2.1.

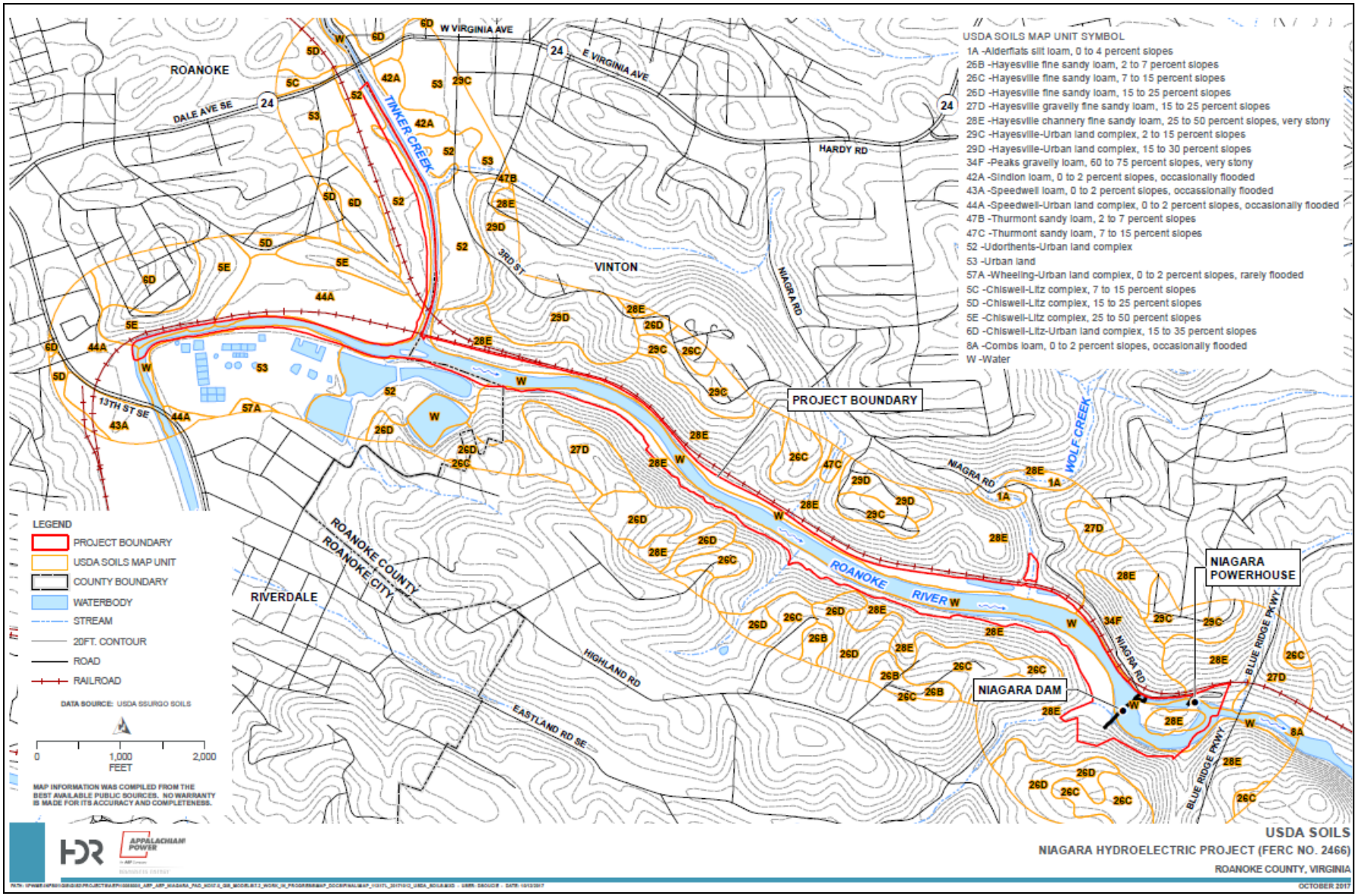


Figure E.7-1. Mapped Soils in the Vicinity of the Project

E.7.1.4 Seismicity

Local Seismicity

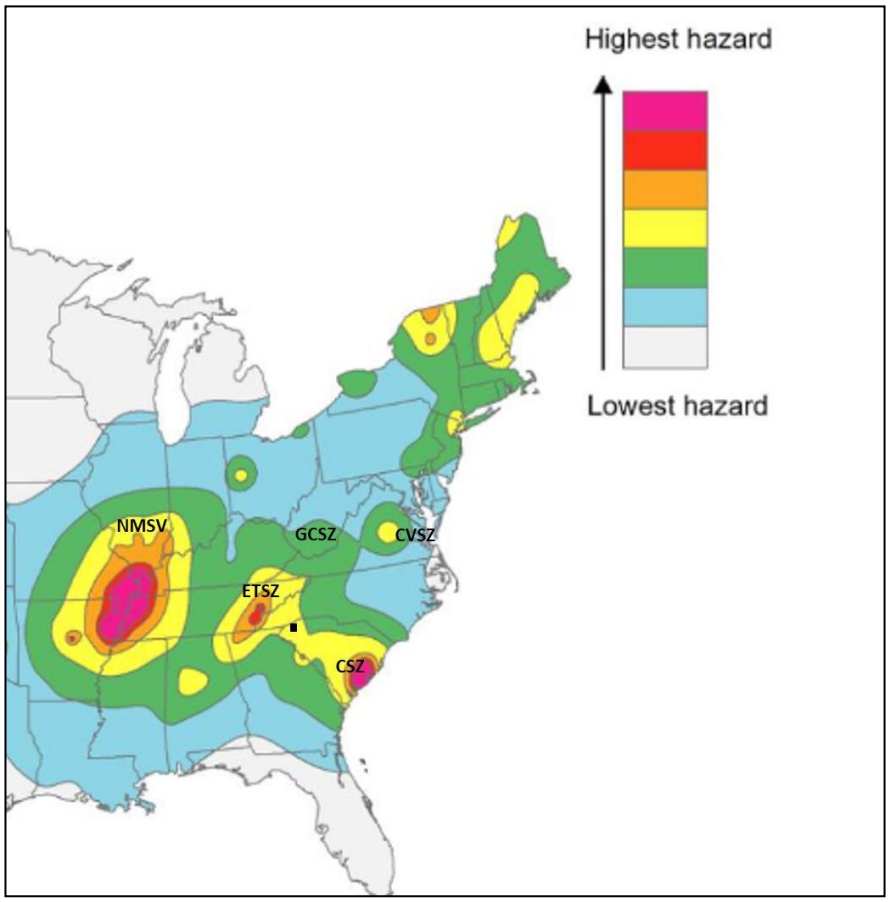
The geologic map of Virginia indicates that faulting is present within approximately 300 ft southeast of the Project dam. Two rock types come together along a shallow dipping fault known as the Rockfish Valley Fault, which crosses the Roanoke River Valley nearly perpendicular to river flow at a point about halfway between the dam and the powerhouse. This faulting defines a zone of ductile deformation, which formed in Middle Paleozoic time. Relatively lower metamorphic-grade granulite gneisses of the Lovingston massif were thrust upward over somewhat higher grade granulite gneiss of the Pedlar massif. This fault system separates the Lovingston and Pedlar massifs. In addition to the Rockfish Valley Fault, the Blue Ridge Fault passes approximately two miles northwest of the Project. The faults near the Project are not known to be seismically active.

Regional Seismicity

Most faults and fault sequences in the state of Virginia are considered inactive. Earthquakes that have occurred in the region are associated with three major seismic zones including the Central Virginia Seismic Zone (CVSZ), the Giles County Seismic Zone (GCSZ), and the Eastern Tennessee Seismic Zone (ETSZ). The Project is located to the east of the GCSZ and southwest of the CVSZ. The Central Virginia Earthquake of August 23, 2011 (moment magnitude scale [M_w] 5.7 - 5.8) was the largest earthquake in the central and eastern United States since the 1886 Charleston, South Carolina earthquake (M_w 6.8 - 7.0). The earthquake occurred on a north or northeast-striking plane with reverse faulting within the CVSZ. The CVSZ is located in the Appalachian Piedmont Province between Richmond and Charlottesville, Virginia (see Figure E.7-2). The depth of the earthquakes ranged from near surface to 12 kilometers, placing them above the Appalachian detachment (Chapman 2015) in contrast to the Eastern Tennessee Seismic Zone, where earthquakes occur below the detachment. The CVSZ has produced small and moderate earthquakes since at least the 18th century. The previous largest historical shock from the CVSZ occurred in 1875. Additionally, a magnitude VIII event (Modified Mercalli Intensity Scale) occurred in Giles County, Virginia in May of 1897. It was felt in the Project area with chimneys shaken down in Roanoke, VA (DTA 2005).

More recently, a 5.1-M_w earthquake occurred on August 9, 2020 with an epicenter near Sparta, approximately 85 miles southeast of the Project and just south of the Virginia-North Carolina border (Figure E.7-2). The earthquake caused damage to over 500 buildings and other infrastructure (Hill 2020). It has not been determined whether the isolated event is associated with the GCSZ or the CVSZ (or neither).

Regional seismic activity in the area is considered low, with low to moderate peak ground acceleration values as determined by the USGS (USGS 2018).



Note: GCSZ = Giles County Seismic Zone; ETSZ = East Tennessee Seismic Zone; CVSZ = Central Virginia Seismic Zone; CSZ = Charleston Seismic Zone; NMSZ = New Madrid Seismic Zone. Project location indicated by black square (source: USGS)

Figure E.7-2. Relative Seismic Hazard in the Southeastern U. S. with Identified Seismic Zones (modified from USGS 2018)

E.7.2 Environmental Analysis

E.7.2.1 Studies in Support of the Current Relicensing

Appalachian conducted a Shoreline Stability Assessment for the Project in the summer of 2021 as one of the eight studies for the relicensing effort. The study area for the Shoreline Stability Assessment Study includes the reservoir shoreline, bypass reach, and tailrace area downstream of the Niagara powerhouse.

The goals and objectives of the Shoreline Stability Assessment were to:

- Survey the Project's reservoir, bypass reach, and tailrace area to characterize the shoreline, with the focus on erosion or shoreline instability using the Bank Erosion Hazard Index method (BEHI) (Rosgen 2001;WVDEP 2015);
- Inventory, map, and document any areas of erosion or shoreline instability; and
- Prioritize any areas where remedial action or further assessment may be needed.

The majority of the Project reservoir consists of undeveloped riverbanks with steep slopes and tree cover. There is limited upland area within the study area and there are no private docks in the Project reservoir. The topography bordering the reservoir is relatively steep in areas, especially along the southern bank. The steeper slopes transition to lower gradients near the shoreline. Existing relevant and reasonably available information regarding geology and soils in the Project vicinity was presented in Section 5.2 of the PAD (Appalachian 2019) and main soil types of the Project vicinity are described in Section E.7.1.2. Over 62 percent of the Roanoke River basin is forested, about 25 percent is cropland and pasture, and 10 percent is urban (Appalachian 2019). Within the general Project vicinity, land cover along the river is primarily deciduous forest, with low-intensity development along the left descending bank due to the presence of the CSX railroad track. Land use in the western portion of the Project Boundary is primarily low- and medium-intensity development. Areas of hay and pastureland exist along areas along Tinker Creek. The upstream portion of the study area (Tinker Creek and the upper reach of the Roanoke River) is located in an urban area associated with the towns of Roanoke and Vinton. These urban areas have a high concentration of impervious surface; therefore, the upper Roanoke River and Tinker Creek in this portion of the study area experience flashy stormwater flows during rainfall events. In general, high flow events increase the probability of stream bank erosion in any watershed, but bank erosion can be accelerated in urban areas. Riparian buffers are limited in the upstream portions of the study area and become wider downstream of the confluence of the Roanoke River and Tinker Creek.

Shoreline Stability Assessment Methodology

The Shoreline Stability Assessment was performed as a desktop analysis followed by field confirmation of shoreline areas within the study area, including the reservoir, bypass reach, and the riverine section of the Roanoke River and its tributary streams identified in the desktop analysis as requiring confirmation or additional investigation.

Geographic Information System (GIS) layers including ESRI and Virginia Geographic Information Network aerial photos, U.S. Geological Survey topographic maps, and Natural Resources Conservation Service soil surveys were reviewed to assess bank composition and erosion potential in the study area. The shoreline was assessed in the field for susceptibility to erosion, and for need and potential for remediation. The field surveys for the Shoreline Stability Assessment Study were conducted on June 22nd and June 23rd, 2021. Streambanks were assessed based on visual observations by two, two-person field crews either by canoe or walking along the bank. Best professional judgement was used to estimate root depths and density since bank materials were not disturbed or removed during the study. Bank stability and erosion potential for this study effort was analyzed using the Rosgen (2001) BEHI method and the West Virginia Department of Environmental Protection (WVDEP) complete BEHI procedure (WVDEP 2015). The BEHI method assesses physical

and geomorphic properties of the streambank to validate the probable sources of bank instability using streambank variables. The metrics used to estimate BEHI include ratio of bank height to bankfull height, ratio of root depth to bank height, root density percentage, surface protection percentage, and bank angle in degrees (WVDEP 2015). These metrics are associated with scores and are totaled to categorize the overall condition of the stream reach assessed. Refer to Appendix F for more details on the BEHI classification system.

Shoreline Stability Assessment Results

Of the approximate seven miles of shoreline assessed, results of the field investigation indicated that approximately 90 percent of the shoreline within the study area exhibited no signs of erosion. The areas identified as having some degree of shoreline erosion had average BEHI scores ranging from 13.75 (low) to 33.85 (high) (see Table 3 in Appendix F). There were no areas categorized as having extreme or very high erosion potential. Where erosion was noted, coordinates were recorded on the upstream and downstream side of the erosion area, and in between, if necessary. Individual points within each area of erosion scored into the same total category (i.e., high, moderate, low). The average scores for each area of erosion are provided in Table 3 of Appendix F. Figure E.7-3 shows the locations of the erosion areas assessed within the study area.

The majority of the banks with some level of visible erosion had moderate to high root depth, moderate to high surface protection, and moderate to high bank angle. Generally, banks that were steep exhibiting moderate to high channel incision (BH Ratio >1.5) were least stable. High erosion potential was observed in localized areas along both banks of Tinker Creek and immediately downstream of the confluence of Tinker Creek and the Roanoke River. Streambanks in the upstream portion of the Roanoke River exhibited generally moderate erosion potential. Erosion areas were mainly concentrated in areas in the upstream reaches that experienced higher and/or more flashy flows. No active erosional areas were observed further downstream on the Roanoke River (below the confluence of Tinker Creek) or below Niagara Dam and bypass reach.

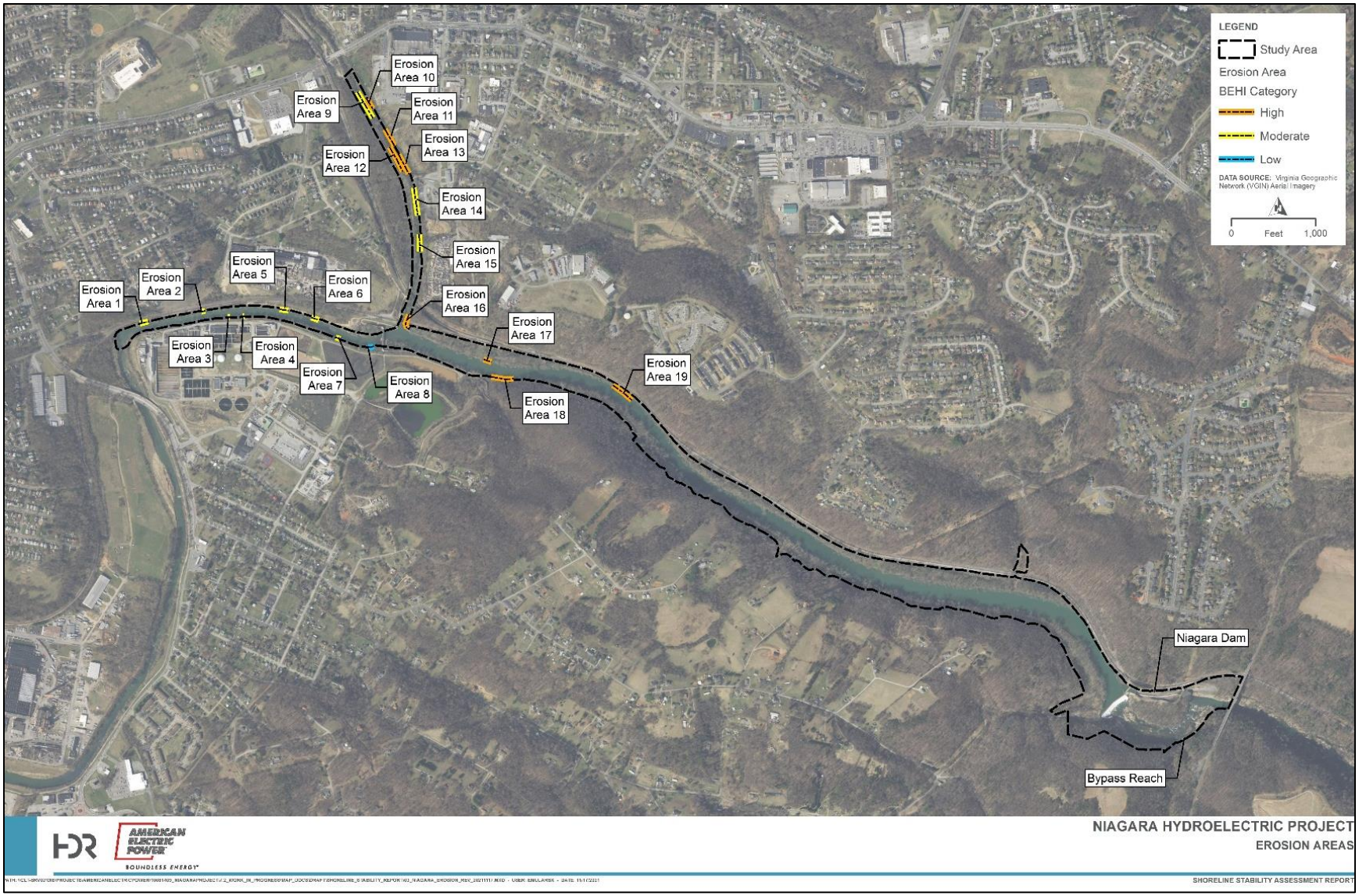


Figure E.7-3. Erosion Areas in the Study Area Categorized by BEHI

E.7.2.2 Project Impacts on Geology, Geomorphology, and Soils

In SD3, FERC identified a single environmental issue related to geologic and soils resources to be addressed in its NEPA document:

- Effects of continued project operation and maintenance on shoreline stability of the impoundment.

Results of the Shoreline Stability assessment (Appendix F) indicated that that the existing run-of-river mode—including stable reservoir surface elevation—at the Project, in combination with the vegetated and undeveloped nature of the shorelines in the Project Boundary, provide protection against bank erosion. The Shoreline Stability assessment included an evaluation of the relative stability of approximately seven miles on Project shoreline based on the observed bank conditions. Study results indicated that approximately 90 percent of the shoreline within the study area exhibited no signs of erosion, with remaining areas ranging from "low" to "high" BEHI scores based on Rosgen's (2001) methods under present conditions. Erosion areas that received a "high" bank erosion score (i.e., Erosion Areas 10-13 in the upstream reach of Tinker Creek and Erosion Areas 16-19 downstream of the confluence of Tinker Creek and the Roanoke River) are the most susceptible to high flows during storm events and subsequent potential accelerated erosion rates. The remaining erosional areas were categorized as "moderate" or "low".

Overall, visual inspection of the majority of the Project shoreline during this study indicated stable banks, no noticeable aggradation/degradation, and only localized streambank erosion. The most significant signs of erosion observed during the study occurred in the upper Roanoke River reach and Tinker Creek reach, which are located in urban areas. Accelerated shoreline erosion due to anthropogenic impacts is a well-documented phenomenon and is not driven by operations at the Project. Appalachian does not propose remediation of any shoreline areas in the Project Boundary or study area at this time.

Sediment runoff from sources such as urban stormwater runoff, streambank erosion, and sediment loss from habitat degradation associated with urbanization has previously been identified as a stressor impacting benthic macroinvertebrates in the upper Roanoke River (The Louis Berger Group, Inc. 2006). Future actions such as construction and land development within the watershed could potentially increase sediment runoff and loading to the river upstream of the Project. Historically, sediment accumulation behind the Niagara Dam has not affected operation of the Project; the reservoir is not drawn down for maintenance purposes, and sediment is not mechanically removed from the reservoir. Coordination of any necessary future dredging in areas around Project facilities would be done by Appalachian in consultation with USACE and VDEQ pursuant to standard License Article 12 and additional permits and approvals issued by these agencies.

The Licensee does not anticipate that operation and maintenance of the Project over the new license term will have any short- or long-term, unavoidable, adverse impacts on geology, geomorphology, and soils.

E.7.3 Protection, Mitigation, and Enhancement Measures Proposed by the Applicant, Resource Agencies, and/or Other Consulting Parties

The Shoreline Stability Assessment is complete and the results indicate that banks potentially affected by Project operations are stable and do not show signs of mass wasting or slumping; therefore, no PM&E measures beyond the continued requirement of run-of-river operation and standard license articles are proposed for the protection of geology, geomorphology, and soils.

E.8 Water Use and Quality

The subsections below describe water resources in the vicinity of the Project, consider the effects of continued operation of the Project as proposed by the Licensee on water quantity and quality using available data presented in the Licensee's PAD, and the results of the Water Quality Study, which was initially presented in the Licensee's ISR and USR and is filed as final in this Volume of the FLA.

E.8.1 Affected Environment

E.8.1.1 Drainage Area

The Roanoke River basin covers a total drainage area of approximately 9,580 square miles. The drainage area upstream of the Project is approximately 511 square miles, which represents approximately five percent of the total drainage basin for the Roanoke River.

E.8.1.2 River Flows

Roanoke River streamflow characteristics are typical of the southeastern U.S.; river flows are typically higher in the winter and spring and lower in the summer and fall. Flows at the Project were estimated from USGS gauge 02056000, which is located immediately downstream of the Project. The estimated monthly flows (Table E.8-1) are considered to be representative of discharge from run-of-river operation of the Project. Flow Duration Curves for the period of record 1994-2020 are provided in Exhibit A.

Monthly average flows for the Project over the term of the previous license ranged from 289 cfs to 853 cfs (Table E.8-1). Significant historic floods for which streamflow data is available occurred in November 1985 (52,300 cfs) and April 1978 (29,300 cfs).

Table E.8-1. Monthly Average Flow Data (1994-2020)

Period	Minimum (cfs)	90% Exceedance (cfs)	Average (cfs)	10% Exceedance (cfs)	Maximum (cfs)
January	100	172	646	1,140	14,200
February	115	195	853	1,796	12,400
March	110	231	801	1,482	12,600
April	190	258	794	1,311	10,400
May	161	231	738	1,350	23,100
June	109	159	580	1,040	13,500
July	91	151	376	562	18,800
August	80	126	289	482	4,580
September	81	129	407	610	16,800
October	87	126	353	585	10,400
November	99	138	443	792	16,100
December	102	147	593	1,204	7,770
Annual	110	172	573	1,029	13,388

Source: USGS 02056000Roanoke River at Niagara, VA
https://waterdata.usgs.gov/va/nwis/uv/?site_no=02056000&PARAmeter_cd=00065,00060,62620,62614

E.8.1.3 Water Uses

Existing uses of Project waters include municipal and industrial water supply, wastewater disposal, recreation, and hydroelectric generation. The City of Roanoke, VA and several industries draw water from the river upstream of the Niagara reservoir, and the regional wastewater treatment plant discharges to the river 2.5 miles above the dam (FERC 1994). These locations are shown on Figure E.8-1.

The VDEQ issues Virginia Pollutant Discharge Elimination System permits for all point source discharges to surface waters, to dischargers of stormwater from Municipal Separate Storm Sewer Systems, and to dischargers of stormwater from industrial activities.

Existing instream flow uses of waters of the Roanoke River within the Project Boundary include various recreational activities (e.g. fishing and boating) and hydroelectric generation.

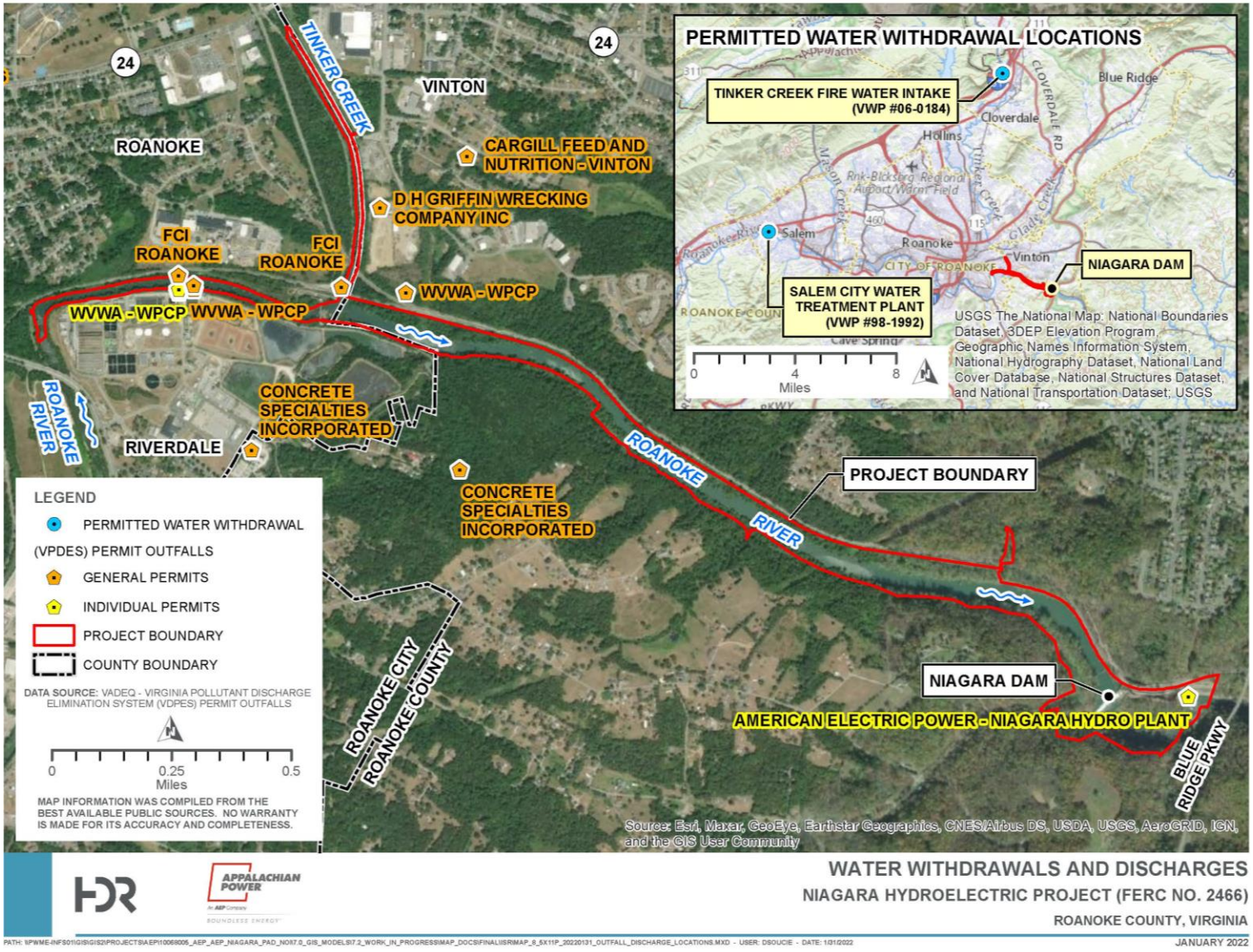


Figure E.8-1. Water Withdrawals and Discharges in the Project Vicinity

E.8.1.4 Water Quality

Approved Water Quality Standards

The VDEQ is responsible for carrying out the mandates of the State Water Control Law as well as meeting federal obligations under the CWA (VDEQ 2017a). All state waters are designated for recreational uses; the propagation and growth of a balanced, indigenous population of aquatic life, including game fish, which might reasonably be expected to inhabit them; wildlife; and the production of edible and marketable natural resources (9VAC25-260-10). All state waters shall be free from substances attributable to sewage, industrial waste, or other waste in concentrations, amounts, or combinations which contravene established standards or interfere directly or indirectly with designate uses of such water or which are inimical or harmful to human, animal, plant, or aquatic life.

Waters in the Roanoke River Basin are classified in 9VAC25-260-450. The Roanoke River is designated as Class IV (Mountainous Zone) waters. Tinker Creek is designated as Class VII (Swamp Waters). Numerical criteria for DO, pH, and water temperature for Class IV and VII waters are identified in 9VAC25-260-50 and are summarized in Table E.8-2.

Table E.8-2. Numeric Water Quality Criteria for Class IV and VII Waters

Parameter	Class IV Standard (Roanoke River)	Class VII Standard (Tinker Creek)
Minimum Instantaneous DO***	4.0 milligram per liter (mg/l)	*
Daily Average DO	5.0 mg/l	*
pH	6.0 – 9.0	3.7-8.0*
Maximum water temperature	31 degrees Celsius (ºC)	**

*This classification recognizes that the natural quality of these waters may fluctuate outside of the values for DO and pH set forth above as water quality criteria in Class I through VI waters. The natural quality of these waters is the water quality found or expected in the absence of human-induced pollution. Water quality standards will not be considered violated when conditions are determined by the VDEQ to be natural and not due to human-induced sources. The State Water Control Board may develop site specific criteria for Class VII waters that reflect the natural quality of the waterbody when the evidence is sufficient to demonstrate that the site-specific criteria rather than narrative criterion will fully protect aquatic life uses. Virginia Pollutant Discharge Elimination System limitations in Class VII waters shall not cause significant changes to the naturally occurring DO and pH fluctuations in these waters.

** Maximum temperature will be the same as that for Classes I through VI waters as appropriate.

***The water quality criteria in this section do not apply below the lowest flow averaged (arithmetic mean) over a period of seven consecutive days that can be statistically expected to occur once every 10 climatic years (a climatic year begins April 1 and ends March 31). Site-specific adjustments to these criteria are defined by 9VAC25-260-310 and 9VAC25-260-380 through 9VAC25-260-540.

Impaired Waters

The VDEQ develops and maintains the Section 303(d) list of all impaired waters in the state that details the pollutant causing each impairment and the potential sources of each pollutant per requirements of the CWA and the Virginia Water Quality Monitoring, Information, and Restoration Act. Additionally, the VDEQ is required to develop and implement a TMDL for waters listed on the Section 303(d) list.

A TMDL is used to determine the total amount of a pollutant that a waterbody can handle without resulting in the impaired status of that waterbody (VDEQ 2017b).

Due to a range of factors not related to Project operations, multiple reaches within the Project Boundary were listed as impaired in the 2016 303(d) Water Quality Assessment Integrated Report include (VDEQ 2017c):

- Assessment Unit ID: VAW-L05R_TKR01A00 – a 5.4 mile reach of the mainstem of Tinker Creek from its confluence with the Roanoke River upstream to the mouth of Carvin Creek.
- Assessment Unit ID: VAW-L04R_ROA06A00 – a 4.3 mile reach of the mainstem of the Roanoke River from the Murray Run mouth downstream to the Western Virginia Water Authority Roanoke Regional Water Control Plant.
- Assessment Unit ID: VAW-L04R_ROA05A00 – a 0.4-mile reach on the mainstem of the Roanoke River from the Western Virginia Water Authority Roanoke Regional Water Control Plant downstream to the Tinker Creek confluence.
- Assessment Unit ID: VAW-L04R_ROA04A00 – a 0.2-mile reach of the Roanoke River from near the backwaters of the Niagara Impoundment to the Tinker Creek confluence.
- Assessment Unit I: VAW-L04R_ROA03A00 – a 0.9-mile reach of the Roanoke River mainstem from near the backwaters of the Niagara Impoundment upstream to the end of the WQS designated public water supply.
- Assessment Unit ID: VAW-L04R_ROA02A00 – a 0.8-mile reach of the Roanoke River impounded by the Niagara Dam.

The 3.2-mile reach of the Roanoke River from Niagara Dam downstream to the mouth of Back Creek is also listed as impaired (Assessment Unit ID: VAW-L04R_ROA01A00). Table E.8-3 provides additional information on the designated use assessments and cause of impairments for these reaches. Potential sources impairing water quality included discharges from municipal separate storm sewer systems, industrial point source discharges, landfills, municipal areas, on-site treatment systems, sanitary sewer outflows, and wildlife (VDEQ 2017d), all of which are notably not attributed to Project operations.

TMDLs for aquatic life (benthic) use, polychlorinated biphenyls (PCB), and bacteria have been developed for the Roanoke River (The Louis Berger Group, Inc. 2006; Tetra Tech, Inc. 2009; George Mason University and The Louis Berger Group, Inc. 2006). According to the benthic TMDL prepared for the upper Roanoke River (The Louis Berger Group, Inc. 2006), sediment has been identified as the most probable stressor impacting benthic macroinvertebrates in the biologically impaired segments of the Roanoke River. Excessive sediment loading can negatively impact benthic macroinvertebrates by silting over invertebrate habitat, choking invertebrates with suspended sediment particles, and bringing invertebrates into contact with other pollutants that enter surface

water via adhesion to sediment particles. Potential sources of sediment loading in the watershed include urban stormwater runoff, streambank erosion, and sediment loss from habitat degradation associated with urbanization. Additionally, there is an existing fish consumption advisory for portions of the Roanoke River, including Project waters (Table E.8-4).

Approximately 165 gallons of Termix 5301, a type of surfactant that is added to herbicide and pesticide products before application, was spilled into Tinker Creek in late July 2017 (VDEQ 2017e). The spill occurred in Cloverdale, Virginia, and resulted in a fish kill that was estimated to kill tens of thousands of fish in Tinker Creek. The fish kill occurred outside of the Project Boundary, and no effects have been identified in the mainstem of the Roanoke River.

Table E.8-3. Designated Use Assessment and Causes of Impairment for Stream Reaches within the Project Boundary

Reach ID	Miles Impaired	Designated Use Assessment[2]					Cause of Impairment[2]					
		Aquatic Life	Fish Consumption	PWS	Recreation	Wildlife	Benthic-macroinvertebrate bioassessment	*E. coli*	Water Temperature	Mercury in Fish Tissue	PCB in Fish Tissue	PCB in Water Column
VAW-L05R_TKR01A00	5.4	NS	NS	NA	NS	II	5A	4A	5C	-	4A	
VAW-L04R_ROA06A00	4.3	NS	NS	NA	NS	NS	4A	4A	-	5A	4A	4A
VAW-L04R_ROA05A00	0.4	NS	NS	NA	NS	NS	4A	4A	-	5A	4A	4A
VAW-L04R_ROA04A00	0.2	NS	NS	NA	NS	NS	4A	4A	-	-	4A	4A
VAW-L04R_ROA03A00	0.9	NS	NS	NS	NS	NS	4A	4A	-	-	4A	4A
VAW-L04R_ROA02A00	0.8	II	NS	NS	NS	NS	-	4A	-	-	4A	4A
VAW-L04R_ROA01A00	3.2	NS	NS	NS	NS	NS	5A	4A	-	-	4A	4A

[1]Designated Use Assessment: NS - not supporting, NA - not applicable, FS - fully supporting, II - insufficient information.

[2] Category 4A = water is impaired or threatened for one or more designated uses but does not require a TMDL (an EPA approved TMDL already exists or the waterbody has been nested within an approved TMDL). In the case of a nested water, a new TMDL is not necessary to address the newly impaired water if the nesting procedure is followed (see Part VII, Rule 3).

Category 5A - a Water Quality Standard is not attained. The water is impaired or threatened for one or more designated uses by a pollutant(s) and requires a TMDL (303d list).

Category 5C - the Water Quality Standard is not attained due to “suspected” natural conditions. The water is impaired for one or more designated uses by a pollutant(s) and may require a TMDL (303d list). WQ Standards for these waters may be re-evaluated due to the presence of natural conditions.

Source: VDEQ 2021a

Table E.8-4. Fish Consumption Advisory for Project Waters

Common Name	Scientific Name	Upper section of the Roanoke River to Niagara Dam	Roanoke River below the Niagara Dam to Smith Mountain Dam
Bluehead chub	*Nocomis leptocephalus*	X	-
Common carp	*Cyprinus carpio*	-	X
Channel catfish	*Ictalurus punctatus*	X	X
Flathead catfish (<32 inches)	*Pylodictis olivaris*	-	X
Flathead catfish (≥32 inches)	*Pylodictis olivaris*	-	X*
Gizzard shad	*Dorosoma cepedianum*	-	X
Largemouth bass	*Micropterus salmoides*	X	X
Redbreast sunfish	*Lepomis auritus*	X	-
Redhorse species	*Moxostoma spp.*	X	X
Rock bass	*Ambloplites rupestris*	X	-
Smallmouth bass	*Micropterus dolomieu*	X	-
Striped bass	*Morone saxatilis*	-	X

X indicates advisory is not to consume more than two meals/month.
X* indicates advisory is not to consume any fish.
"-" indicates no advisory for fish species.
Source: Virginia Department of Health (VDH) 2021

Historical Water Quality Data from the Project Study Area

Water quality data has been collected in close proximity to the Project by the USGS and the VDEQ. Daily mean water temperature and specific conductance data is available from 2007 to 2009 just downstream of the Project powerhouse at USGS gauge 02056000. Daily mean water temperatures ranged from 1.9°C to 26.9°C and were below the maximum water temperature criterion. Daily mean specific conductance ranged from 183 micro-Siemens per centimeter (µS/cm) to 697 µS/cm. The annual mean flows for these three years (447 cfs in 2007; 228 cfs in 2008; 381 cfs in 2009) are all below the 90-year mean annual flow, 522 cfs, at this gauge. The annual mean flow for only one year, 2007, is in the middle quartile while the other two years, 2008 and 2009, are in the lower quartile for the 90-year period of record.

The VDEQ collects water quality data along the mainstem of the Roanoke River. Water temperature, DO concentration, pH, and specific conductance data were collected (2005-2015) at two sites in close proximity to the Project: Site 4AROA199.20 and Site 4AROA202.20. Data were collected from both sites at a depth of approximately 0.3 meters (m). Water temperatures ranged from 5.4°C to 27.0°C and were below the maximum water temperature criterion. DO concentrations ranged from 7.6 milligrams per liter (mg/l) to 14.4 mg/l and were well above the state criterion of 4.0 mg/l. All measured pH values were within the acceptable range and specific conductance ranged from 210 µS/cm to 516 µS/cm. Based on review of data from USGS gauge 02056000 approximately 300 ft downstream of the

powerhouse, compared to the 90-year period of record for this gauge, this period (2005 through 2015) included two wet years, 2010 and 2013, which are in the upper quartile for the 90-year period of record, as well as six drier years, for which the mean annual flows are in the lower quartile for the period of record, including one year (2008) for which the mean annual flow was the third lowest in the 90-year period of record.

Site 4AROA202.20 was located approximately 2.6 miles upstream of the Project's dam. Data collected from 1976 to 2015 were compiled. Water temperatures ranged up to 28.7°C and were below the maximum water temperature criterion. DO concentration typically ranged from 5.4 mg/l to 15.6 mg/l and were well above the state criterion of 4.0 mg/l. Typically pH values were within the acceptable range and specific conductance ranged from 70 µS/cm to 514 µS/cm.

The historical data summarized above suggest that inflows to and outflows from the Project meet numeric water quality standards.

Due to non-Project factors, the reservoir has collected a substantial amount of sediment since its formation in 1906. The original storage volume of the Project at spillway crest EL. 885 ft (estimated as 1,425 acre-ft), was reduced to 442 acre-ft by 1972 according to a study by the State of Virginia Water Control Board (Appalachian 1991). According to Appalachian (1991), this referenced study concluded that accumulated sediments should remain in the reservoir and that additional accumulation of sediments would be minor since the resulting decrease in storage volume subsequently decreased the available retention time. As concluded in the 1972 study, the Niagara reservoir could be expected to be less than 1.5 percent efficient in removing sediments that enter the reservoir. Appalachian (1991) further noted that this conclusion was substantiated by a field survey of the Project reservoir in 1990 that indicated the remaining storage volume had decreased to 425 acre-ft, or less than 4 percent over the 18-year period since the 1972 study. Rates of sediment accumulation over the existing license term can be expected to have proceeded at a further reduced rate.

E.8.2 Environmental Analysis

E.8.2.1 Studies in Support of the Current Relicensing

In support of the current relicensing, Appalachian conducted a Water Quality Study in 2020 and 2021. The specific objectives and a summary of the methods and results of the Water Quality Study are included below.

- Gather baseline water quality data sufficient to determine consistency of existing Project operations with applicable Virginia state water quality standards and designated uses (VAC Chapter 260).

- Provide data (temperature and DO concentration) to determine the presence and extent, if any, of temperature or DO stratification in the Niagara impoundment.
- Provide data to support a Virginia Water Protection Permit application (CWA Section 401 Certification).
- Provide information to support evaluation of whether additional or modified PM&E measures may be appropriate for the protection of water quality at the Project.

Methods

Continuous temperature and DO monitoring and discrete multiparameter water quality sampling was carried out at eight locations within the study area. Vertical profile data was also collected at the reservoir and forebay monitoring locations. The Water Quality study area and monitoring locations are shown on Figure E.8-2.

During 2020, water quality monitoring was conducted at eight locations for approximately three months (late-July through early-November):

- One location in the free-flowing section of river upstream of the reservoir and confluence with Tinker Creek;
- One location in Tinker Creek;
- One location in the reservoir downstream of the confluence with Tinker Creek;
- Two locations in the forebay area (one near surface and the other near bottom);
- One location in the tailrace below the powerhouse; and
- Two locations in the bypass reach (upstream location and downstream location).

During the 2020 water quality monitoring period, flows in the bypass reach were higher than normal due to higher than normal Project inflows, damage to the sluice gate hoist operating system, and a powerhouse outage which began on September 8, 2020 and lasted through the end of the study period. While water quality data collected in the bypass reach met Virginia Class IV standards during the 2020 study period, it was recommended that two continuous temperature and DO sondes be re-installed in the bypass reach during the warmest portion of the year in 2021 (i.e., July through October) to record daily fluctuations in temperature and DO under a more typical bypass flow regime. In addition, water quality data (temperature, DO, pH, and specific conductivity) recorded at both the Thirteenth Street Bridge U.S. Geological Survey (USGS) gage (USGS 02055080) and USGS gage at Tinker Creek above Glade Creek (USGS 0205551614) are included in the 2021 water quality monitoring reporting. As a result, during 2021, water quality monitoring was conducted at four monitoring locations and also reported from the two USGS gages mentioned previously from July through October 2021:

- One location on the Roanoke River at the Thirteenth Street Bridge (USGS 02055080; continuous monitoring) (data collection by others);
- One location at Tinker Creek above Glade Creek (USGS 0205551614; continuous monitoring) (data collection by others);
- One location in the forebay area (i.e., discrete vertical profile data);
- One location in the tailrace below the powerhouse (continuous monitoring); and
- Two locations in the bypass reach: upstream location and downstream location (continuous monitoring).

During the initial deployment and subsequent download events, discrete multi-parameter water quality measurements (i.e. spot measurements) of temperature, DO concentration, pH, and specific conductivity were collected at each monitoring location using a Hach Hydrolab® MS5 (Hydrolab). For riverine monitoring locations, Hydrolab water quality data was collected at one location within the water column at a depth similar to the sondes. Profile measurements were collected at 1.0-foot (ft) vertical intervals using the Hydrolab for the two reservoir monitoring locations to record temperature and DO values throughout the water column at the time of the data sonde downloads.

Calibrated Onset® HOBO U26 DO/Temperature Loggers (i.e. sondes) were deployed for continuous in situ measurements and were set to record water temperature and DO at 15-minute intervals. During the 2020 study period, continuous data was collected from July 29 through November 10 and the data sondes were downloaded five times (August 12 and 26, September 22-23, October 21, and November 9-10, 2020). At each of the eight continuous monitoring locations, two data sondes were deployed to provide redundancy. In the forebay, one sonde was deployed near the water surface and a second was deployed near the reservoir bottom to capture temperature and DO stratification. The download schedule was accelerated from monthly to bi-weekly when possible to reduce effects associated with biofouling, which was greater than anticipated at the time of the RSP development. During the 2021 study period, continuous data was collected from June 29 through October 27. At each of the three continuous monitoring locations installed by Appalachian (i.e., bypass reach upstream, bypass reach downstream, and tailrace), two data sondes were deployed to provide redundancy. The download schedule was roughly every two to three weeks, and the data sondes were downloaded seven times over the monitoring period.

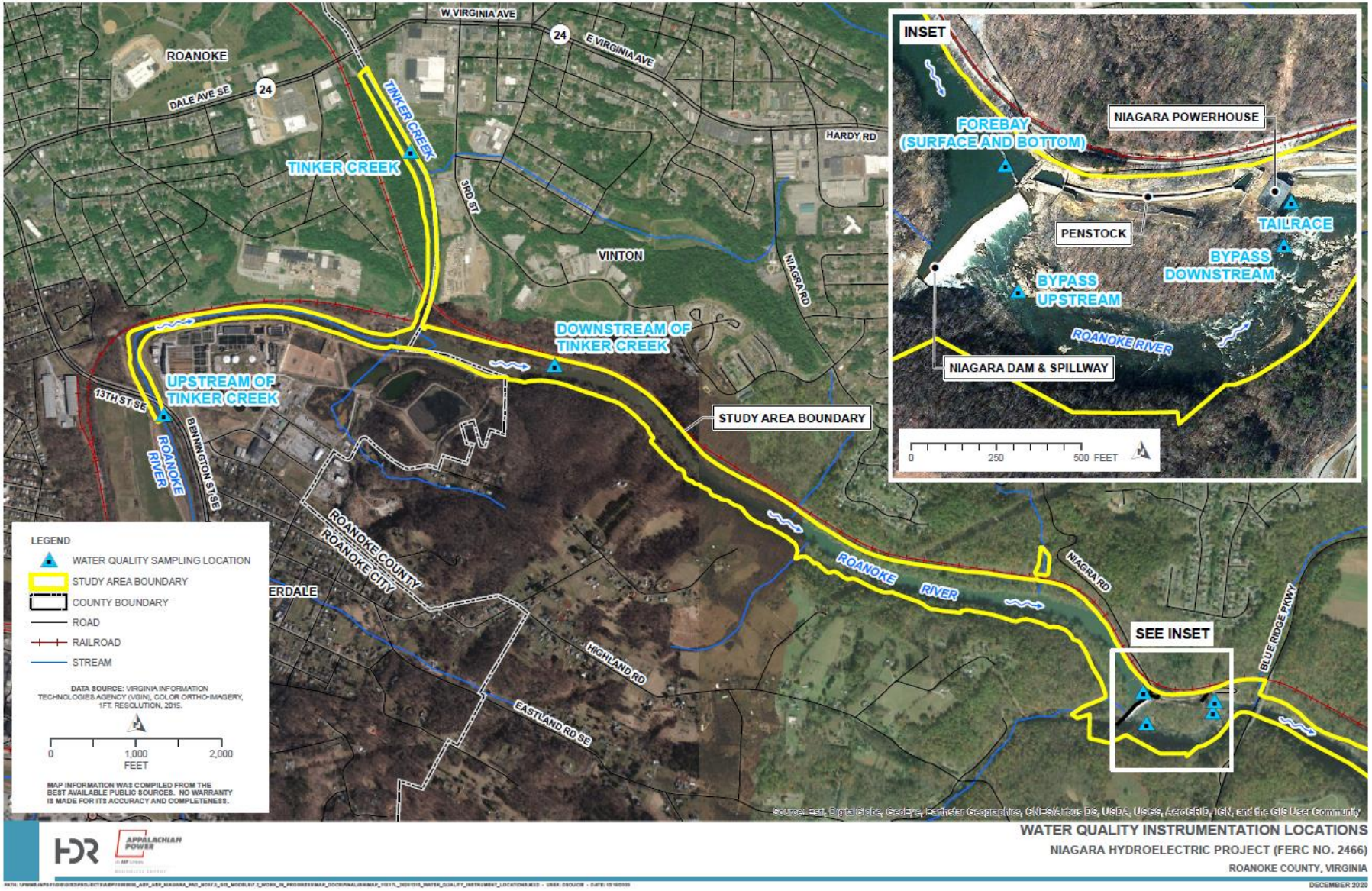


Figure E.8-2. Water Quality Study Monitoring Locations

Results

Water Temperature

Water temperatures varied seasonally at continuous and discrete water temperature data collection locations. Figure E.8-3 and Figure E.8-4 provide continuous and discrete water temperature data at all water quality locations for 2020 and 2021, respectively. Water temperatures generally decreased during the 2020 study period and dropped to approximately 10ºC by early November 2020. Tinker Creek water temperatures were several degrees cooler and exhibited larger daily fluctuations compared to the Roanoke River monitoring locations. The Tinker Creek monitoring location is heavily canopied which may contribute to the cooler temperatures, and the drainage area is developed and relatively small[6] which may contribute to the larger daily fluctuations.

Water temperature measurements during July and August 2021 were slightly higher than during 2020 at all monitoring locations with daily peaks in the 22 – 30ºC range. The diurnal variation in temperature fluctuation at the two bypass reach monitoring locations in 2021 was also greater than 2020. The higher water temperatures and greater diurnal variation in water temperatures were likely the result of lower Project inflows during 2021, particularly in the bypass reach. While 2021 water temperatures were generally higher than in 2020, water temperatures for both years were less than the state maximum water temperature limit of 31ºC. All discrete temperature data for 2020 and 2021 are included in Attachment 2 of the Water Quality Study Report (Appendix B) and all daily water temperature data (maximum, mean, and minimum) are provided in Attachment 5 of Appendix B.

Vertical profile temperature data plots are included in Attachment 3 of Appendix B. Forebay vertical profile temperature data are shown on Figure E.8-5 and Figure E.8-6. While water temperature varied seasonally, there was no thermal stratification at the reservoir monitoring location during 2020 and no to very weak (i.e., <1.0ºC) thermal stratification at the forebay monitoring location for most of 2020 and 2021. The two exceptions were during the August 12, 2021 and September 15, 2021 download events where the difference between forebay surface and bottom temperatures was approximately 2.7ºC and 3.1ºC, respectively. The stratification observed during the August 12, 2021 download event was mostly in the upper 1 ft of the water column indicating a very warm summer day with solar heating at the water's surface. The September 15, 2021 download event occurred during a powerhouse outage when flows in the forebay area were reduced, thus allowing the water column to thermally stratify.

[6] The drainage area at the Tinker Creek monitoring location is approximately 78 square miles; 66 of which are classified as urban land use, as compared to the Roanoke River drainage area at the Thirteenth Street Bridge monitoring location which is approximately 390 square miles.

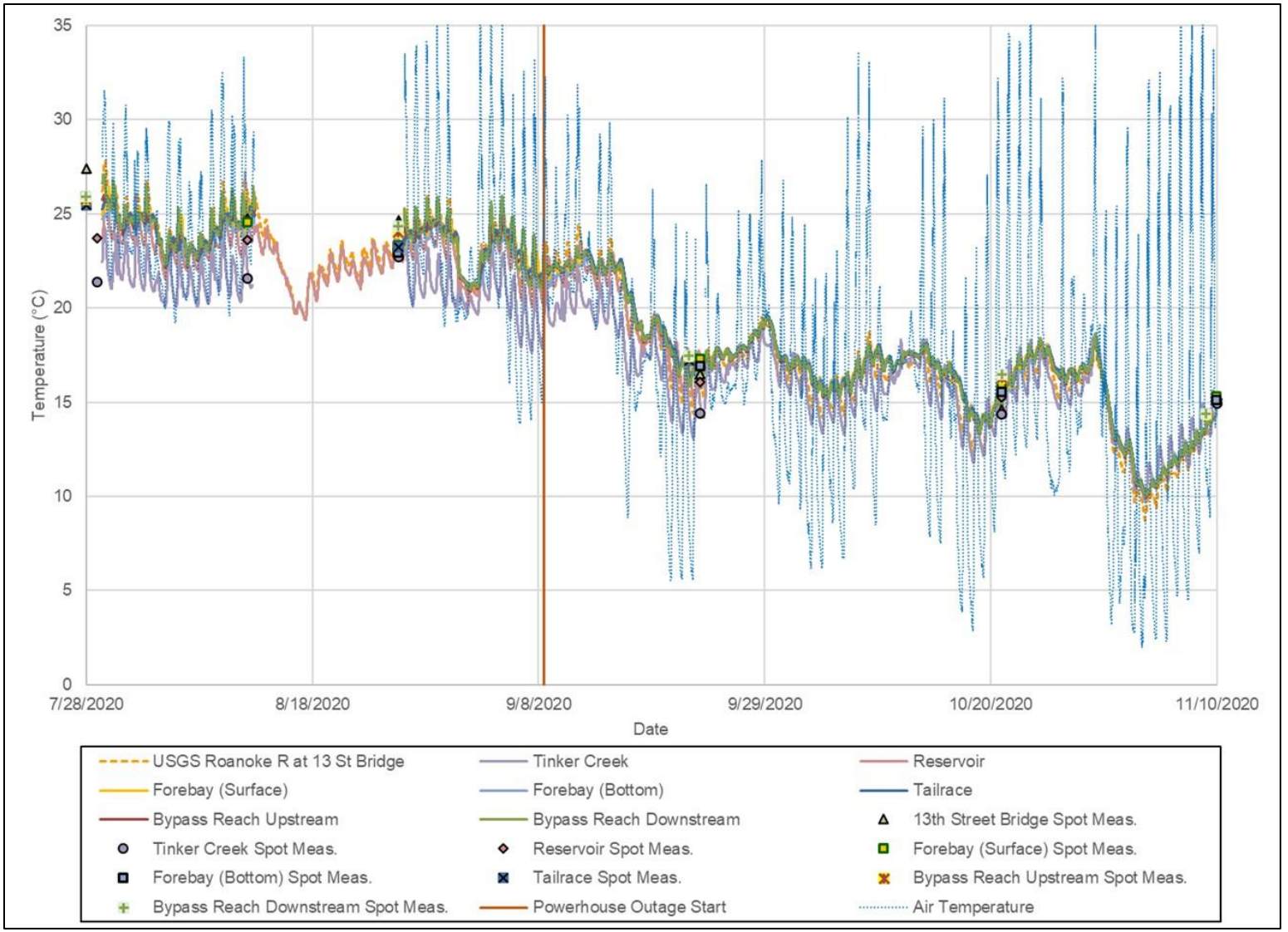


Figure E.8-3. Continuous and Discrete Temperature Measurements at All Water Quality Monitoring Locations (2020)

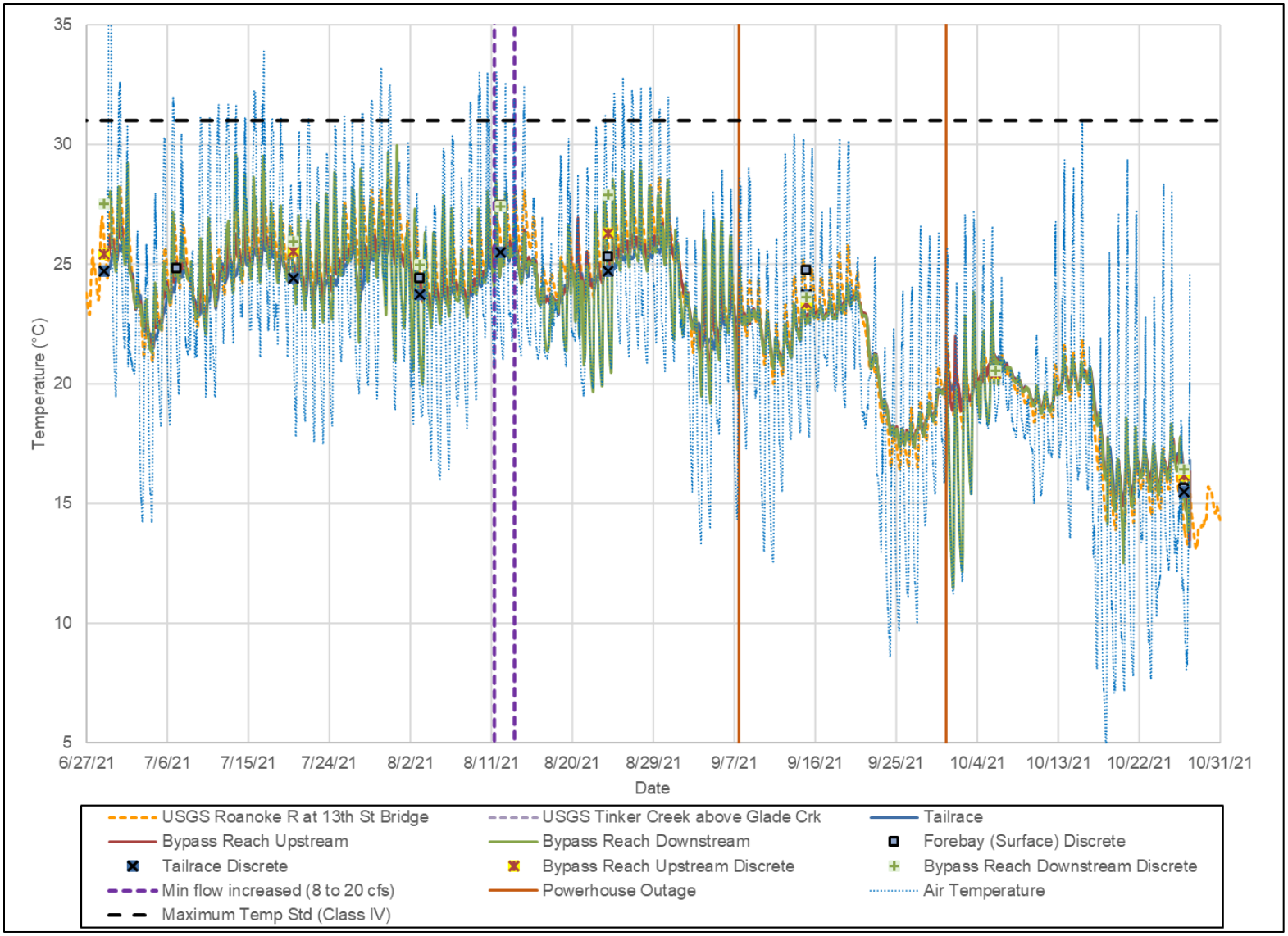


Figure E.8-4. Continuous and Discrete Temperature Measurements at All Water Quality Monitoring Locations (2021)

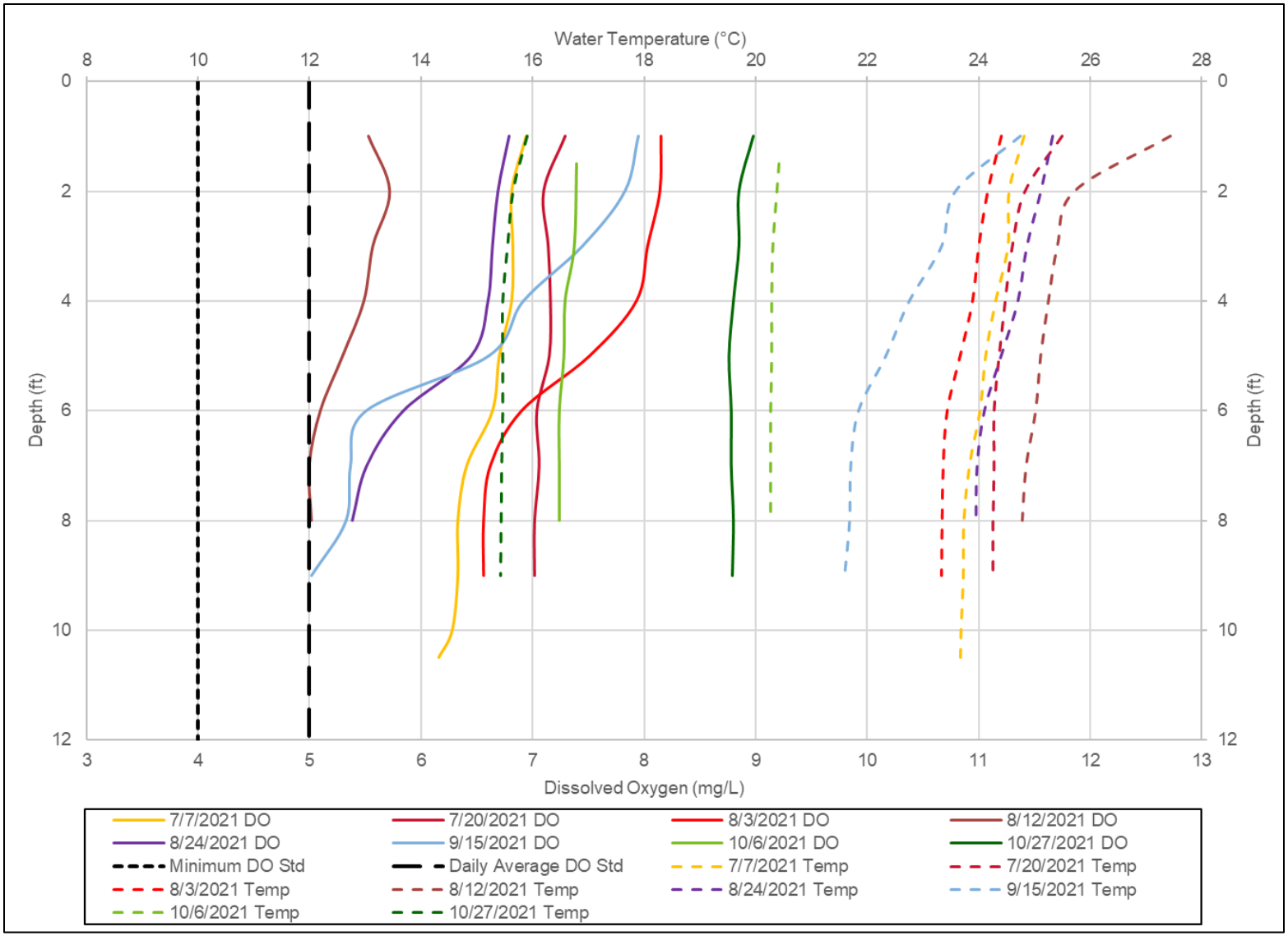


Figure E.8-5. Forebay Vertical Profile—Temperature and Dissolved Oxygen Concentration (2020)

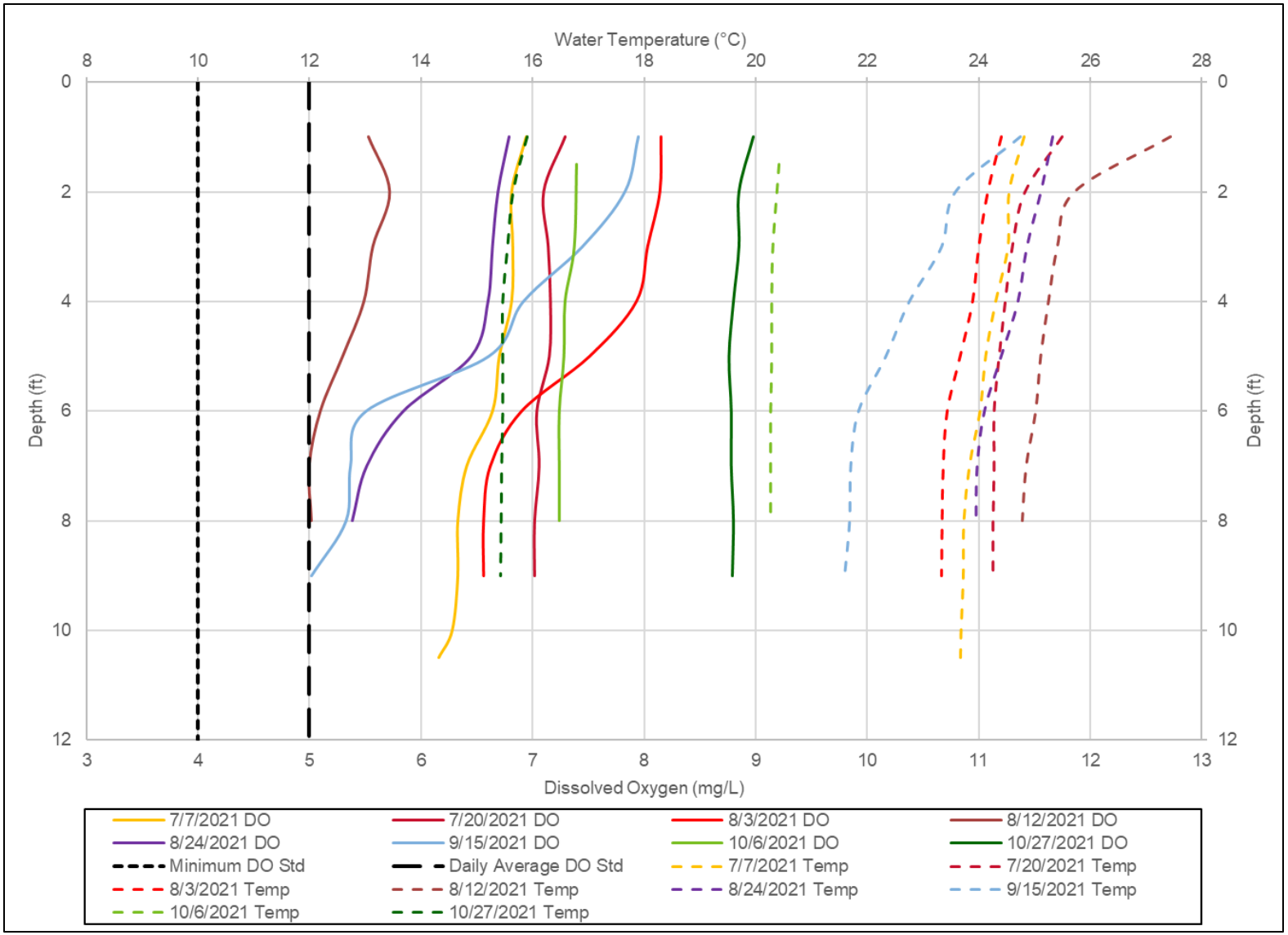


Figure E.8-6. Forebay Vertical Profile—Temperature and Dissolved Oxygen Concentration (2021)

Dissolved Oxygen

All discrete DO data for 2020 and 2021 are included in Attachment 2 of Appendix B and daily minimum, mean, and maximum DO data (in mg/l) are included in Attachment 5 of Appendix B. Throughout the study, all upstream measurements were greater than the 5.0 mg/l daily average DO state standards with typical daily fluctuations in the 2 – 5 mg/l range at both locations. The sharp decline in Tinker Creek DO concentrations the first week of September 2020 was likely the result of a 3-inch rainfall runoff event that occurred at the beginning of that week. Figures 1-3 and 1-4 in Appendix B provide continuous and discrete DO concentration data at the upstream water quality monitoring locations (Thirteenth Street Bridge and Tinker Creek) during 2020 and 2021, respectively.

Figure 1-5 of Attachment 1 in the Water Quality Study report provides continuous and discrete DO concentration data at the Project's forebay and tailrace monitoring locations in 2020. DO values exceeded the 4.0 mg/l instantaneous and 5.0 mg/l daily average standard (9 VAC 25-260-50) except in the Project's forebay on September 8 and 11, 2020. Instantaneous DO concentrations on these dates (recorded at the sonde near the reservoir bottom) were 3.3 mg/l and 3.4 mg/l, respectively. Each occurrence of instantaneous DO concentrations below 4.0 mg/l lasted less than 1.5 hours in duration. Also, both dates coincided with the start of a planned outage at the Niagara plant, which began on September 8, 2020 and continued throughout the end of the monitoring period. Because there was no flow through the powerhouse, instantaneous DO concentrations fluctuated (albeit very short-lived) between the forebay surface and bottom elevations. During these two events, DO concentrations near the surface remained above 5.0 mg/l and as a result, overall DO concentrations in the forebay met the state's DO criteria.[7] Daily fluctuations in DO concentrations were typically in the 1.0 – 2.0 mg/l range at the forebay and tailrace monitoring locations; slightly less than the daily fluctuations at the two upstream monitoring locations. Similar to water temperature profile trends, there was little (i.e., < 0.5 mg/l) difference in DO concentrations between the forebay surface and bottom sonde locations (with the exception of the two events noted above); indicating little to no stratification of DO concentrations throughout the forebay water column. DO concentrations in the tailrace were generally higher (by less than 0.5 mg/l) compared to the surface forebay monitoring location during both periods of generation and non-generation (see data pre- and post- powerhouse outage on September 8, 2020). DO concentrations exceeded the 4.0 mg/l instantaneous and 5.0 mg/l daily average standards throughout the 2021 monitoring period at these two monitoring locations.

[7] For a thermally stratified man-made lake or reservoir in Class III, IV, V or VI waters that are listed in 9VAC25-260-187, these dissolved oxygen and pH criteria apply only to the epilimnion of the waterbody. When these waters are not stratified, the dissolved oxygen and pH criteria apply throughout the water column.

The bypass reach was monitored during the 2020 and 20201 study periods. Do concentration data for 2020 in the bypass reach is shown on Figure E.8-7 and Figure E.8-8 for 2021. In 2020, the overall magnitude and trends in DO concentrations were very similar between the forebay, tailrace and bypass reach monitoring locations. All measurements were greater than the 5.0 mg/l daily average DO standard with daily fluctuations typically in the 1.5 – 2.5 mg/l range prior to the powerhouse outage that occurred on September 8, 2020; after which, daily fluctuations were less than 1.0 mg/l due to the large flow throughput in the bypass reach when generation flows ceased. During 2021, continuous and discrete DO concentration data indicated that all values exceeded the 4.0 mg/l instantaneous and 5.0 mg/l daily average standard with the exception of the upper bypass reach monitoring location during the hottest portion of the summer (July/August) when bypass flows were at the 8.0 cfs minimum required release. The upper bypass reach data sonde is located in a slow moving/stagnant pool which at times exhibited DO concentrations less than 4.0 mg/l during nighttime hours on several days in July and August. Hot, relatively dry weather conditions conducive to supersaturation due to photosynthesis during daylight hours and a DO sag during nighttime hours is assumed to be the principal cause; significant biofouling that occurred in these instruments under the lowest monitored flow likely contributed to low DO values. From August 11 – 13, 2021, the bypass flow was increased from 8.0 cfs to approximately 20 cfs due to an operational adjustment associated with the Obermeyer trash sluice gate. During this 2-day period, DO concentrations at the upstream bypass reach monitoring location remained above the 4.0 mg/l instantaneous and 5.0 mg/l daily average standard and did not experience a nighttime DO sag. After August 13, 2021, the Obermeyer gate returned to its normal operating mode and DO concentrations in the bypass reach remained above the Virginia standard during the remainder of the 2021 monitoring period. A planned powerhouse maintenance outage occurred from September 7 – 30, 2021, during which time all Project inflow was routed through the bypass reach. This resulted in DO concentrations greater than 8.0 mg/l during the outage. As water temperatures continued to cool during October 2021, DO concentrations in the bypass reach remained high (i.e., > 8.0 mg/l).

DO vertical profile data for the forebay monitoring location are presented Attachment 2 of the Water Quality Study report and are depicted on Figure E.8-5 and Figure E.8-6. Similar to the water temperature profile data, during 2020 there was no stratification of DO concentrations at the reservoir monitoring location and no to very weak stratification at the forebay monitoring location. During 2021, vertical DO profile measurements during several download events in August and September indicated some degree of DO stratification at the forebay monitoring location; the strongest of which was measured on September 15, 2021 during the powerhouse outage. During this download event, DO concentrations ranged from 8.0 mg/l at the surface to 5.0 mg/l near the bottom of the forebay.

All DO concentrations measured at the forebay monitoring location in 2021 were greater than 5.0 mg/l at all depths.

pH

Vertical profiled pH data for the forebay and reservoir locations in 2020 and 2021 are provided in the Water Quality Study report and indicate only minor variations (between 7.5 and 8.0) during each discrete sampling event; there was little to no stratification between the reservoir surface and bottom measurements at both monitoring locations. All discrete pH data for 2020 and 2021 are included in Attachment 2 of the Water Quality Study report. Continuous pH measurements are also provided for the upstream USGS water quality monitoring locations for 2021; the pH at both locations ranged from 7.5 – 8.5, which was slightly higher than the discrete pH measurements at the forebay, tailrace, and bypass reach monitoring locations in 2021, but was within the Virginia standard for pH values.

Specific Conductivity

While Virginia does not have a state standard for specific conductivity, concentrations between 150-500 microsiemens per centimeter (µS/cm) are generally considered suitable for most fish species (USEPA 2012). Data tables and figures for specific conductivity are provided in the Water Quality Study report. For the 2020 sampling period, conductivity at the forebay monitoring location varied with each sampling event, but concentrations were typically the same from reservoir surface to bottom and ranged from 369 – 435 µS/cm over four sampling events during the study period. Specific conductivity at the reservoir monitoring location also varied with each sampling event and concentrations were typically the same from reservoir surface to bottom, but with a slightly higher (and narrower) range between 411 – 436 µS/cm) over the four sampling events. For 2021, specific conductivity at the forebay monitoring location was slightly higher than in 2020 ranging from 369 – 501 µS/cm over eight sampling events.

Discrete measurements of specific conductivity at the Tinker Creek monitoring location (2020 only) ranged from 461 – 497 µS/cm which is slightly higher than at the Thirteenth Street Bridge monitoring location, which ranged from 319 – 396 µS/cm. Similar to the discrete monitoring results, specific conductivity in Tinker Creek is generally higher than at the Thirteenth Street Bridge monitoring location by approximately 110 µS/cm on average. Sharp declines in specific conductivity at both upstream locations correspond to higher flows during rainfall runoff events.

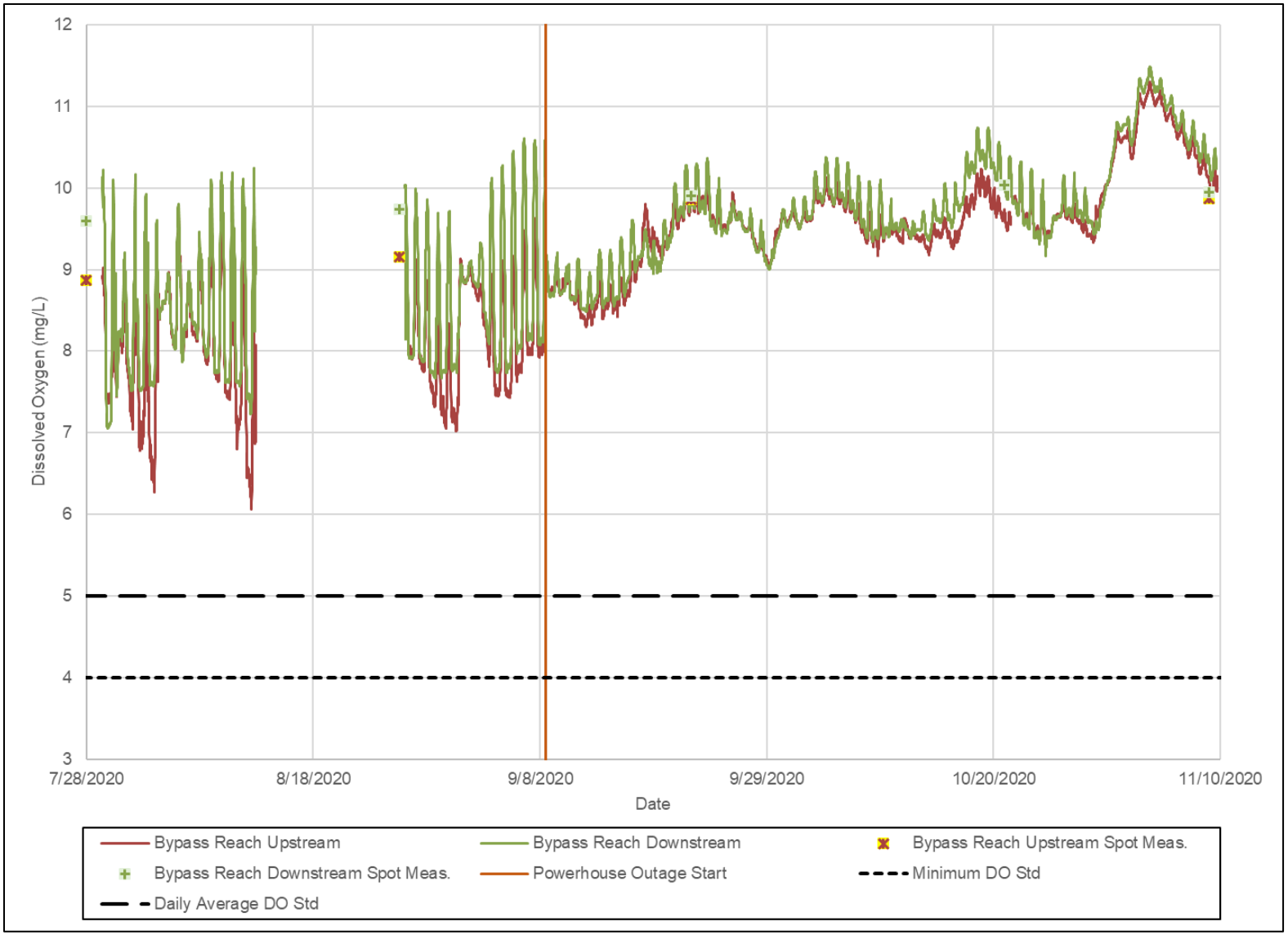


Figure E.8-7. Continuous and Discrete Dissolved Oxygen Concentrations at the Bypass Reach Water Quality Monitoring Locations (2020)

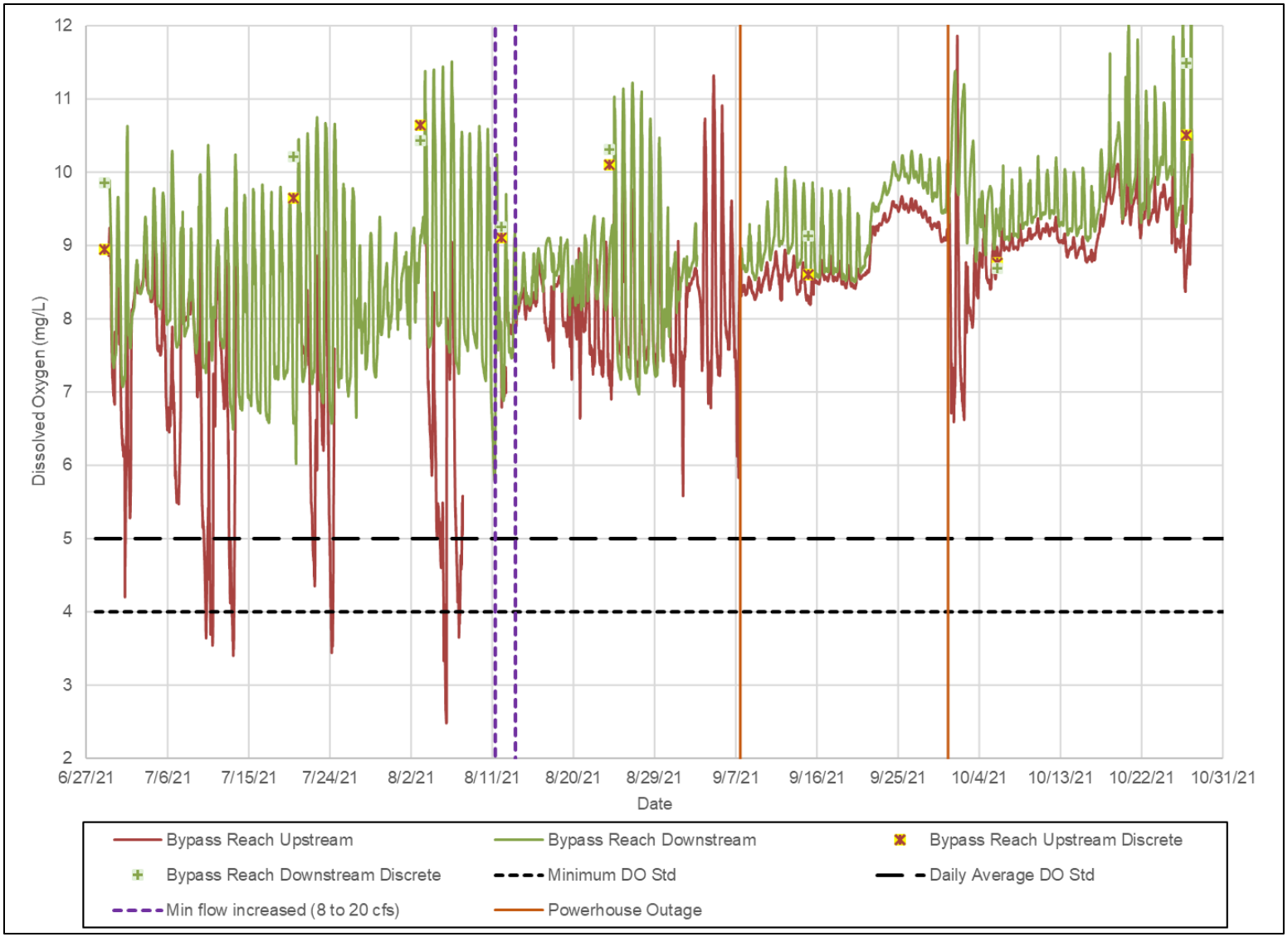


Figure E.8-8. Continuous and Discrete Dissolved Oxygen Concentrations at the Bypass Reach Water Quality Monitoring Locations (2021)

Continuous and discrete water quality data collected during the 2020 study period met Virginia Class IV (Roanoke River) and Class VII (Tinker Creek) water quality standards for temperature (<31 ºC), DO (>4.0 mg/l instantaneous minimum; >5.0 mg/l daily average), and pH (range 6.0 – 9.0 for Class IV and 3.7 – 8 for Class VII) at all monitoring locations during the study period. The continuous monitoring data captured two events when forebay bottom DO concentrations dropped to, or slightly below 4 mg/l for a short period (typically less than 1.5 hours in duration for each event), which was likely the result of a powerhouse outage. Even with these short-lived events, the Project met state water quality criteria throughout the 2020 study period.

Continuous and discrete water quality data collected during the 2021 study period also met Virginia Class IV (Roanoke River) water quality standards with the exception of the DO instantaneous standard (4.0 mg/l) at the upstream bypass reach monitoring location during the hottest portion of the summer (July/August) when bypass flows were at the 8.0 cfs minimum required release. Increasing the bypass reach flow to approximately 20 cfs for a 2-day period in mid-August 2021 reduced nighttime DO sags and resulted in DO concentrations above the Virginia standard. After the 2-day period, the Obermeyer trash sluice gate returned to normal operations and DO concentrations at the upstream monitoring location remained above the Virginia standard for the remainder of the 2021 study period.

Continuous and discrete water quality data collected during the 2020 study period indicated little to no thermal or DO stratification at the reservoir and forebay monitoring locations. Water temperatures typically varied less than 1.0ºC from reservoir surface to bottom, and DO concentrations typically varied less than 1.0 mg/l from reservoir surface to bottom. Continuous and discrete water quality data collected during the 2021 study period indicated little to no thermal or DO stratification (forebay location) with the exception of periods of relatively low Project inflow and/or powerhouse outages when thermal and DO stratification in the forebay area was present.

E.8.2.2 Project Impacts on Water Resources

In SD3, FERC identified a single environmental issue related to water resources to be addressed in its NEPA document:

- Effects of continued project operation and maintenance on water quality, DO and water temperature, upstream and downstream of the impoundment, including the bypass reach.

Existing uses of Project waters include municipal and industrial water supply, wastewater disposal, recreation, and hydroelectric generation. The City of Roanoke and several industries draw water from the river upstream of the Project impoundment (see Figure E.8-1), and the regional wastewater treatment plant discharges to the river 2.5 miles above the dam. There are multiple sections of Project

waters listed as impaired in the 2016 §303(d) Water Quality Assessment Integrated Report. Water quality impacts were attributed to benthic macroinvertebrate bioassessments, *Escherichia coli*, water temperature, mercury, and PCBs in fish tissue, as well as PCBs in the water column. Potential sources impairing water quality included discharges from municipal separate storm sewer systems, industrial point source discharge, landfills, municipal areas, on-site treatment systems, sanitary sewer outflows, and wildlife (VDEQ 2017d), none of which are attributed to Project operations.

Water quality in the streams flowing into the Niagara reservoir, the reservoir itself (including the Project's forebay area), tailrace, and bypass reach meets or exceeds applicable Virginia state water quality standards for temperature, DO, and pH for Class IV (Roanoke River) and Class VII (Tinker Creek) surface waters. While there is no state standard for specific conductivity, concentrations were above 150 µS/cm and less than 500 µS/cm, which is generally considered to be suitable for most fish (USEPA 2012).

Due to the existing and proposed run-of-river operations, and the short retention time of the reservoir, the Project has little to no effect on water quality in the upper Roanoke River. Project operation has the potential to locally alter water quality in the bypass reach during periods of minimum flow and high ambient air temperatures.

E.8.3 Protection, Mitigation, and Enhancement Measures Proposed by the Applicant, Resource Agencies, and/or Other Consulting Parties

During the new license term, Appalachian proposes to continue to operate the Project in the existing run-of-river mode. Based on the results of the Water Quality Study, Appalachian recognizes the potential for Project operations to impact localized water quality in the bypass reach, particularly during high air temperature, low-flow periods. For the protection of water quality and aquatic resources and habitat, Appalachian is proposing to increase the required year-round minimum flow to the bypass reach from 8 cfs to 30 cfs over the new license term.

Because (1) Project operations have not shown in the relicensing studies or historical data to be impacting water quality in the Roanoke River downstream of the Project, (2) water quality in the Roanoke River upstream and downstream is periodically monitored by public agencies, and (3) out of recognition of the intensive effort, cost, and equipment challenges associated with collection of this data for the relicensing, Appalachian does not propose and does not believe it is necessary to conduct long-term or periodic water quality monitoring over the term of the new license.

In their comments submitted to the FERC on December 14, 2021, the USFWS recommended that Appalachian conduct an evaluation to determine how flow is distributed through the Obermeyer gate and at what elevation the reservoir is maintained during operations for the upcoming license as there may be some benefit to raising the elevation of the reservoir so that the minimum flow is provided over the dam crest instead of only through the Obermeyer gate. The USFWS added that this change in flow distribution could provide water quality benefits for aquatic organisms and provide more habitat for aquatic organisms in the bypass reach.

Appalachian has evaluated this recommendation and based on this evaluation is not proposing to operate in this manner in the new license term. The 30-cfs continuous minimum flow release to the bypass reach through the gated sluice structure proposed by Appalachian will provide a stable flow compatible with existing run-of-river operation, reservoir operations, and Project instrumentation and controls. The recommendation to operate the reservoir at or above the spillway crest (approximately 1 inch of spill would be required to provide the same 30 cfs minimum flow) is rejected by Appalachian based on the following factors:

- Operations and license compliance: Wave runup will periodically cause more water to spill over the spillway than required. Slight elevation differences along the long spillway crest will cause a large (in proportion to elevation differences) change in spilled water. This would likely create changing conditions that will be difficult to operationally manage. For example, release of flow over the spillway 10 percent above the requirement could quickly change to 10 percent below the requirement based on wind or reduction of inflows. Appalachian would be forced to intentionally spill significantly more than the required minimum flow simply to maintain minimum flow compliance, with resultant reduction in generation and negligible incremental benefits to bypass reach resources.

- No significant benefits to flows in the bypass reach: The 400-ft-wide plunge pool at the base of the spillway necks down to an approximately 50-ft wide channel 80 ft downstream of the spillway. This channel constriction is the hydraulic control for the bypass reach; therefore, flow regimes in the bypass reach below the control will be the same regardless of whether flow is released from the Obermeyer gate in the sluice structure or over the main spillway.

- No expected benefits to water quality in the bypass reach: Sheet flow over the spillway will be warmer entering the bypass reach compared to concentrated flow from the gate as it is heated by the large surface area of the spillway. Concentrated flow releases from the Obermeyer gate will be deeper and have higher velocity. This will increase turbulence while traveling down the spillway chute aerating the flow and will result in a plunging flow regime as it enters the pool.

Plunging flow carries water to depth where oxygen has a higher likelihood of dissolving. Conversely sheet flow is generally laminar and is unlikely to produce significant additional DO.

E.9 Fish and Aquatic Resources

E.9.1 Affected Environment

E.9.1.1 Aquatic Habitat

Impoundment

A desktop analysis of the Niagara reservoir was conducted during the previous relicensing in 1990 to evaluate the percentage of estimated fish spawning habitat that may become exposed during reservoir fluctuations related to the previous mode of Project operations (Appalachian 1991). This analysis indicated that up to 17 percent of available habitat is potentially exposed under natural riverine conditions, lower than the 9 to 57 percent potentially exposed by Project-related fluctuations that occurred prior to the implementation of the current narrow reservoir fluctuation limits imposed by the existing license. The analysis also indicated that the highest percentage of spawning habitat exposed was for the cyprinid/sunfish group due to their preference for littoral zone spawning sites. Aquatic vegetation in the reservoir has historically been limited to a few algal and vascular plant species (Appalachian 1991).

Bypass Reach

The 1,500-ft-long Niagara bypass reach consists primarily of exposed bedrock and rock outcroppings. For a description of bypass reach aquatic habitat, see Section E.9.2.1. Availability of aquatic habitat in the bypass reach under varying flows was evaluated by Appalachian for the Bypass Reach Flow and Aquatic Habitat Study, see Section E.9.2.1 for additional details.

Tailrace

The short, approximately 65-ft-wide tailrace channel extends from the downstream wall of the powerhouse approximately 54 ft to rejoin the main river channel, at the confluence with the bypass reach. The descending-left bank (looking downstream) is very steep and lined with riprap, and the right bank is natural hillside.

During the previous relicensing, potential effects of Project operations on tailrace habitat were evaluated with respect to sediment erosion and deposition, spring spawning habitat, and low-flow summer habitat during the previous relicensing in 1990. Erosion and deposition impacts were considered negligible due to the steep, rocky, and relatively straight river channel.

The study indicated that fish seeking habitat to spawn in the tailrace would likely do so in the spring when water levels are elevated. Because the channels are steep-sided, little spawning surface is exposed and therefore impacts to spring spawning habitat are minimal. Based on field observations during various flows, a flow of 28 cfs was determined to be adequate for fish habitat (Appalachian 1991).

E.9.1.2 Essential Fish Habitat

Based on a review of the NMFS online database, no essential fish habitat under the Magnuson-Stevens Fishery Conservation and Management Act or established by the NMFS has been identified in the vicinity of the Project.

E.9.1.3 Resident Fish Community

General Fish Community

The Roanoke River within the Project area supports a variety of warmwater game and forage species, with relatively similar fish community composition above and below the dam. In 1990, fisheries surveys were conducted in the Project area as part of the previous relicensing of the Project (Appalachian 1991). Adult and juvenile fish were sampled in the upper, middle, and lower sections of the Niagara reservoir by electrofishing, hoop netting, and gillnetting techniques. In addition, riffle/run habitats were sampled upstream and downstream of the Project by electrofishing. Each station was sampled six times: twice in June and September, and once in July and October (Appalachian 1991).

A total of 1,936 fish representing 36 species were collected during the prior relicensing study (Appalachian 1991). Redbreast Sunfish (*Lepomis auritus*) and Silver Redhorse (*Moxostoma anisurum*) dominated samples, but Common Carp (*Cyprinus carpio*), White Sucker (*Catostomus commersonii*), Spotttail Shiner (*Notropis hudsonius*), and Golden Redhorse (*Moxostoma erythrurum*) were also abundant. Common Carp and Silver Redhorse (*Moxostoma anisurum*) contributed the most sample biomass, followed by White Sucker, Golden Redhorse, Redbreast Sunfish, and Channel Catfish (*Ictalurus punctatus*). Three specimens of the state and federally endangered Roanoke Logperch (*Percina rex*) were collected during the fall 1990 sampling efforts at the most upstream riffle/run electrofishing site located above the confluence of the Roanoke River and Tinker Creek (Appalachian 1990).

Additionally, sampling was performed by Appalachian and VDGIF in September 1991 to determine if Roanoke Logperch were using areas further downstream below Niagara dam (Appalachian 1991). Three Roanoke Logperch, each approximately 110 millimeters in length, were collected from a 0.25-mile reach of riffle/run habitat located 0.5 miles downstream of the Project.

Refer to Section E.9.2.1 for a characterization of the current fish community based on the results of the 2020 Fish Community Study conducted for the current relicensing effort.

To the best of Appalachian's knowledge, there are presently no stocking programs or locations in the Project area, but stocking programs do occur in Smith Mountain Lake, the nearest known fish stocking location. In 2014, approximately 300,000, 1.25-inch-long, Roanoke strain Striped Bass were stocked in Smith Mountain Lake (VDWR 2017). Historically, Walleye (*Sander vitreus*), Muskellunge *(Esox masquinongy*), and Tiger Musky (*Esox masquinongy* x *Esox lucius*) have been stocked in Smith Mountain Lake (Appalachian 2004). No data were found regarding these stocking efforts. However, 2014 stocking records indicated that, aside from Striped Bass, no other fish were stocked in Smith Mountain Lake or the Project area in 2014 (VDWR 2017).

No specific information was available on diadromous fish in the study area. Fish passage facilities are not available at downstream facilities and diadromous fish are not present at the Smith Mountain Project (Appalachian 2008). It is, therefore, unlikely diadromous fish are present at the Project, and none were collected during the fish community survey performed for this relicensing. The striped bass are a landlocked population and are maintained through stocking. The Roanoke River Diadromous Fish Restoration Plan outlines the mechanisms for restoring historic fish migration reaches on the Roanoke River (Appalachian 2008). The plan indicates that the greatest gains in mainstem river habitat would be obtained by passing fish above the John H. Kerr Dam, which is the next hydropower project downstream of the Smith Mountain Project (Appalachian 2008).

Historical Impingement and Entrainment Assessment

A desktop assessment of entrainment potential was conducted for the Project during the previous relicensing (Appalachian 1991) based on data from the Electric Power Research Institute (EPRI), project characteristics, and behavioral and life history characteristics of the resident fish community. The study determined that there is a low likelihood of substantial numbers of fish occurring in the Project forebay. Egg entrainment is expected to be low for most species that occur in the Project area because they broadcast adhesive, demersal eggs or deposit eggs into nests or other vegetated habitats not found in the forebay. Similarly, larval entrainment is expected to be low for most species as the larvae would remain on the nest or in sheltered slackwater areas until they become free swimming. However, Gizzard Shad and cyprinid larvae may experience increased susceptibility at the intake structure due to their tendency to broadcast spawn large numbers of buoyant eggs into the current where they can be carried toward the intake structure. Similarly, adult entrainment susceptibility was considered low for Flathead Catfish, suckers, and centrarchids based on their preference of shallow, shoreline habitats away from the velocities at the intake structure; Gizzard

Shad, Common Carp, White and Channel catfish, bullheads, Black Crappie, and shiners would have slightly higher susceptibility based on their increased mobility and preference of deep, open-water habitats (Appalachian 1991).

The calculated intake velocities at upper and lower normal Project forebay operating elevations ranged from 0.9 to 1.2 ft/second and are similar to the current velocity of the free-flowing portion of the Roanoke River. Therefore, the intake velocities were determined to likely be navigable by most fish (Appalachian 1991).

In the event a fish enters the turbine, turbine passage effects were considered to be primarily restricted to contact with runner blades. The probability of contact with runner blades was estimated to be less than 10 percent for young (i.e., smaller) fish (which are more likely to be entrained due to size). Pressure change, cavitation, turbulence, and shear stress were determined not to be a likely cause of substantial harm to fish at the Project. Due to low head and slow runner speed, blade contact was estimated to be minimal and would not exceed 10 percent. The study concluded impacts from turbine entrainment on fish populations in the vicinity of the Niagara Project were negligible (Appalachian 1991).

E.9.1.4 Benthic Aquatic Community

The Roanoke River supports a diverse community of aquatic biota, however historical macroinvertebrate data in the vicinity of the Project is limited to sampling conducted by the VDEQ along the mainstem Roanoke River downstream of the Project (see Section 5.4.6 of the PAD). Similarly, limited information exists regarding the freshwater mussel community near the Project. Available data characterizing the macroinvertebrate and mussel communities of the Roanoke River near the Project are summarized below. Refer to Section E.9.2.1 for a description of the results of surveys conducted for this relicensing.

Benthic Macroinvertebrate Community

Macroinvertebrate sampling has been conducted by the VDEQ along the mainstem of the Roanoke River downstream of the Project. As indicated in Section E.8.1.4, the benthic community is impaired along a 3.2-mile reach of the Roanoke River from Niagara Dam downstream to the mouth of Back Creek (Assessment Unit ID: VAW-L04R_ROA01A00). The community was dominated by net-spinning caddisfly larvae and midges. There was low taxa richness and diversity as well as a low number of pollution-sensitive taxa (i.e., mayflies and stoneflies). Although instream habitat, riparian zone vegetation, and bank stability were considered optimal and provide conditions favorable for a healthy benthic community, filamentous algae and periphyton growth was thick on the surface of stream

substrates indicating that nutrients may be excessive in this reach of the river (VDEQ 2017a). No additional macroinvertebrate community data were available prior to the surveys conducted for this relicensing.

Freshwater Mussel Community

Based on a geographic search on the VDWR's Fish and Wildlife Information Service, seven mussel species have been historically known to occur within a 3-mile radius of the Project (VDGIF 2017) (Table E.9-1). No additional mussel data was available for the Project area prior to the surveys conducted for this relicensing.

Table E.9-1. Mussel Species Previously Known to Occur within Three Miles of the Project

Common Name	Scientific Name
Atlantic pigtoe[1]	*Fusconaia masoni*
Carolina slabshell	*Elliptio congaraea*
Creeper	*Strophitus undulatus*
Eastern elliptio	*Elliptio complanata*
Notched rainbow	*Villosa constricta*
Triangle floater	*Alasmidonta undulata*
Yellow lance[2]	*Elliptio lanceolata*

[1]State threatened.

[2]Federal threatened.

In comments filed on the PAD and SD1, USFWS stated that additional state and federally listed mussel species have the potential to occur in the study area, including (in addition to the Atlantic pigtoe and yellow lance [*Elliptio lanceolata*]), green floater (*Lasmigona subviridis*, state threatened) and James spinymussel (*Pleurobema collina*, federally and state endangered).

Invasive Benthic Aquatic Species

Invasive aquatic species known to occur in the Roanoke River include the Asiatic clam (*Corbicula fluminea*). The Asiatic clam is a small bivalve, which can be found at the sediment surface or slightly buried. It is a filter feeder and removes particles from the water column. It reproduces rapidly and is intolerant to cold temperatures, which can produce fluctuations in annual population sizes. The invasive clam substantially alters benthic substrate and competes with native species for limited

resources and has been associated with biofouling on power plant and industrial water systems (USGS 2017).

E.9.1.5 Threatened or Endangered Aquatic Species and Aquatic Species of Special Concern

Federally Listed Threatened, Endangered, or Candidate Species
Roanoke Logperch

By letter dated August 14, 2017, the USFWS indicated that the federally endangered Roanoke Logperch may occur within the vicinity of the Project.

The Roanoke Logperch is endemic to the Roanoke River basin within North Carolina and Virginia and the Chowan River basin in Virginia. The distribution in the upper Roanoke system extends roughly 1.8 miles downstream of the Niagara Dam upstream into the North Fork Roanoke River and to the South Fork Roanoke River (USFWS 1992). The species predominantly occurs in those portions of the drainage within the Piedmont and Ridge and Valley physiographic provinces. Populations are vulnerable due to limited range and low densities. The Roanoke Logperch is not typically found in reservoirs or other lentic environments, although two specimens were collected in a cove of Leesville Reservoir in 1989. These specimens were believed to have been swept into the reservoir from the Pigg River during high flow conditions.

The Roanoke Logperch is a large darter, which reaches lengths of about 6 inches. According to USFWS (1992), during the different phases of its life history and seasons, most of the riverine habitat types are used. During the reproductive period, males are primarily associated with shallow riffles, while spawning females are common in deep runs over gravel and small cobble. Young and juveniles usually occur in slow runs and pools with clean bottoms. Winter habitat of all phases is believed to be under boulders in deep pools (USFWS 1992). Roanoke Logperch in the Roanoke River have been found primarily in runs, select deep, fast habitats with exposed, silt-free gravel substrate, occasionally in riffles, and rarely in pools. Roanoke Logperch have been found at a variety of depths and velocities, but quite consistently in silt-free, loosely embedded substrate (Rosenberger 2002). Young-of-year congregate in mixed-species schools in shallow habitat underlain by sand and gravel along stream margins (USFWS 2020a). The Roanoke Logperch does not migrate and does not have significant temporal distribution.

Roanoke Logperch actively feeds during the warmer months by flipping over stones with their snout and feeding on the exposed bottom-dwelling organisms. Spawning occurs in April or May in deep runs over gravel and small cobble substrate. They typically bury their eggs and do not provide parental care

(USFWS 2017). Larval drift may be an important dispersal and recolonization mechanism (USFWS 2020a).

Four Roanoke Logperch (*Percina rex*) were collected upstream of the Project in riffle/run habitat during a fish survey conducted for relicensing of the Project in 1990; and in 1991, another three Roanoke Logperch were collected in riffle/run habitat 0.5 miles downstream of the Project (Appalachian 1991). Roanoke Logperch have also been found in select tributaries downstream from the Project. In the Upper Roanoke River, Roanoke Logperch were found primarily in deep, high-velocity runs with exposed, silt-free gravel, and occasionally in riffles, and rarely in pools (DTA 2007). Additional Roanoke Logperch samplings w performed during the spring (10 specimens collected) and late summer of 2021; final results from these efforts will be provided in the USR and the FLA.

No biological opinions were identified for the Roanoke Logperch, however, the general status of this species, the associated listing, fact sheets, range maps, and other important information are available on the USFWS website. A draft recovery plan was issued for the Roanoke Logperch in 1992 (USFWS 1992), which cited turbidity and siltation, chemical spills and organic pollution, channelization, reservoirs, and cold-water releases as the biggest threats to the known Roanoke Logperch populations. In the Upper Roanoke River, home to the largest population of the species, human stress, non-point source pollution, spills, and siltation have been accredited for possible population decline. In 2007, the Roanoke Logperch Recovery Plan was updated to include more recent information available on this species and provide monitoring recommendations.

Appalachian presently implements a Roanoke Logperch Plan for the downstream Smith Mountain Project (FERC Project No. 2210). The plan outlines how Appalachian will cooperate in the enhancement of Roanoke Logperch habitat that may have been lost or affected by the construction of the Smith Mountain Project. (For that relicensing, USFWS found that the Smith Mountain Project was not currently adversely affecting this species or modifying any critical habitat and that formal Section 7 consultation was not required; USFWS did, however, state that construction of the project had contributed to the species' historical degradation.) Under the Smith Mountain Project plan, Appalachian partners with USFWS and VDWR in the development, funding, and completion of projects (including habitat restoration and reintroduction of the species) related to the recovery of the Roanoke Logperch in the upper Roanoke River watershed. Also, under this plan, Appalachian provides matching funds each year to be used for stream restoration and stocking projects that would benefit Roanoke Logperch in the upper Roanoke River watershed. The approximate cost of implementing this plan for the 636-MW Smith Mountain Project is $50,000 annually. A report detailing recovery efforts implemented under this plan is filed with FERC every five years; the most recent 5-year report was filed with FERC by Appalachian on July 13, 2021.

Yellow Lance

The yellow lance received federal protection, where it is found, as a threatened species on April 3, 2018 (USFWS 2018). On February 6, 2020 (USFWS 2020b), critical habitat was designated for the species in the Patuxent, Potomac, York, Rappahannock, James, Chowan, Tar, and Neuse River Basins on April 8, 2021 (USFWS 2021).

The yellow lance is an elongate mussel with a shell that is twice as long as it is tall, growing up to 84 mm in length. The shell is bright yellow and its periostracum typically has a waxy appearance with growth rests appearing brown, the shell is not typically rayed (Alderman 2003). The posterior ridge of the shell is rounded and curves dorsally toward the posterior end; with one long lateral tooth in the right valve and two in the left valve. Each valve has two psuedocardinal teeth, a posterior one on the left value and a vestigial one on the right valve (Lea 1828).

The yellow lance is a short-term brooder that spawns from late April to early May by releasing stringy clumps of mucous covered, hookless glochidia (USFWS 2021). The reproductive strategy of this species is unconfirmed but assumed to involve the clumps of glochidia floating in the middle water column where they can be consumed by sight-feeding minnows, when after consumption, the glochidia will attach themselves to the gills of the host. Based on recent lab studies that evaluated 26 potential host fish species, White Shiner (*Luxilus albeolus*) was the most efficient host species of those known to occur in the Project area (Eads and Levine 2009).

The yellow lance is typically found in sandy habitats, where they bury deep in clean, coarse to medium sand and have been documented migrating with shifting sands (NatureServe 2021. The species requires clean, unpolluted, moderately flowing water with high DO concentration in large creeks and rivers and are often found in sand at the downstream end of stable sandy gravel bars (Alderman 2003, USFWS 2021).

Yellow lance is not historically known from within the Project Boundary or the Roanoke River; and no yellow lance specimens were collected during the 2020 Benthic Aquatic Resources Survey (EDGE 2020). Potentially suitable substrates are located within the Project Boundary; however, the presence of point sources of pollution immediately upstream of the Project would be expected to prevent establishment or survival of yellow lance in the reach of the Roanoke River downstream from the point source, including within the Project Boundary.

State-listed Threatened, Endangered, and Candidate Species

By letter dated September 20, 2017, the VDCR identified three species of concern within the Project vicinity: the Orangefin Madtom (*Noturus gilberti*), Roanoke Logperch, and spatulate snowfly (*Allocapnia simmonsi*). The VDCR also specified that the Roanoke River, Glade Creek, and Tinker Creek have been designated by the VDWR as "Threatened and Endangered Species Waters." The designation for the Roanoke River is due to the presence of Orangefin Madtom and the Roanoke Logperch within two miles of the Project. The designation for Glad Creek and Tinker Creek is due to the presence of the Roanoke Logperch within two miles of the Project.

The Orangefin Madtom is listed as a species of concern by the USFWS and as threatened by the VDWR. The Orangefin Madtom is native to the Roanoke River system, where it inhabits moderate to strong riffles and runs having little or no silt in moderate gradient, intermontane and upper Piedmont streams. It is an intersticine dweller and is found in or near cavities formed by rubble and boulders. No Orangefin Madtom were collected during fish surveys performed in the Project vicinity in 2020 or those completed to-date in 2021.

Spatulate snowfly is a stonefly recorded in only two locations in Virginia. Stoneflies are insects that are found under stones in streams and are very sensitive to water quality or habitat degradation. The reservoir does not likely have suitable habitat for this species and, due to the multiple existing water quality impairments for the Roanoke River, it is unlikely this species is located within the vicinity of the Project.

A summary of additional state-protected rare species with known occurrences near the Project is provided in Table E.9-2.

Table E.9-2. State-protected Rare Aquatic Species with Recent or Historical Occurrences within the Project Vicinity

Common Name	Scientific Name	Status*	Tier**
Fish			
Alewife	*Alosa pseudoharengus*		IVa
American Eel	*Anguilla rostrate*		IIIa
American Shad	*Alosa sapidissima*		IVa
Appalachia Darter	*Percina gymnocephala*		IVc
Ashy Darter	*Etheostoma cinereum*		Ib
Bigeye Jumprock	*Moxostoma ariommum*		IIIc

Common Name	Scientific Name	Status*	Tier**
Black Sculpin	*Cottus baileyi*		IVc
Blotchside Logperch	*Percina burtoni*		IIa
Blueback Herring	*Alosa aestivalis*		IVa
Bridle Shiner	*Notropis bifrenatus*		Ia
Brook Trout	*Salvelinus fontinalis*		IVa
Highfin Shiner	*Notropis altipinnis*		IVc
Longear Sunfish	*Lepomis megalotis*		IVb
Notchlip Redhorse	*Moxostoma collapsum*		IVc
Orangefin Madtom	*Noturus gilberti*	ST	IIb
Roanoke Bass	*Ambloplites cavifrons*		Ia
Roanoke Hogsucker	*Hypentelium roanokense*		IVc
Roanoke Logperch	*Percina rex*	FESE	IIa
Rustyside Sucker	*Thoburnia hamiltoni*		IIIc
Silver Redhorse	*Moxostoma anisurum*		IIIc
Mussels			
Atlantic Pigtoe	*Fusconaia masoni*	ST	Ia
Carolina Slabshell	*Elliptio congaraea*		IVa
Creeper	*Strophitus undulates*		IVa
Notched Rainbow	*Villosa constricta*		IIIa
Triangle Floater	*Alasmidonta undulata*		IVa
Yellow Lance	*Elliptio lanceolate*	FT	IIa

*****FE=Federal Endangered; SE=State Endangered; ST=State Threatened

******I=VA Wildlife Action Plan - Tier I – Critical Conservation Need; II=VA Wildlife Action Plan – Tier II – Very High Conservation Need; III=VA Wildlife Action Plan – Tier III – High Conservation Need; IV=VA Wildlife Action Plan – Tier IV – Moderate Conservation Need.

Virginia Wildlife Action Plan Conservation Opportunity Ranking:

a – On-the-ground management strategies/actions exist and can be feasibly implemented.

b – On-the-ground actions or research needs have been identified but cannot feasibly be implemented at this time.

c – No-on-the ground actions or research needs have been identified or all identified conservation opportunities have been exhausted.

E.9.2 Environmental Analysis

E.9.2.1 Studies in Support of the Current Relicensing

Several studies related to aquatic resources were carried out in support of the current relicensing, including the (1) Bypass Reach Flow and Aquatic Habitat Study, the (2) Fish Community Study and Fish Impingement and Entrainment Study, and the (3) Benthic Aquatic Resources Study. Preliminary results of these individual studies are summarized in the sub-sections that follow and will be reported detailed in the USR and associated appendices.

Bypass Reach Flow and Aquatic Habitat Study

Appalachian conducted a Bypass Reach Flow and Aquatic Habitat Study, in the study boundary illustrated in Figure E.9-1, with the following objectives:

- To delineate and quantify aquatic habitats and substrate types within the bypass reach.
- To identify and characterize locations of habitat management interest located within the bypass reach.
- To develop an understanding of surface water travel times and water surface elevation responses for varying Obermeyer gate openings (i.e., varying flow scenarios) in the bypass reach study area to:
    - Demonstrate the efficacy of the existing bypass reach minimum flow requirement (i.e., 8 cfs) on maintaining suitable habitat for aquatic species.
    - Evaluate potential seasonal minimum flow releases in the bypass reach.

Figure E.9-1. Bypass Reach Flow and Aquatic Habitat Study Area

As a result of the delay to the start of the 2020 field season, higher than normal seasonal flow conditions in the Roanoke River, inoperability of the sluice gate hoist operating system, construction activities associated with installation of the new Obermeyer gate, and temporarily reduced unit generation capability at the Niagara powerhouse, the study fieldwork was postponed to 2021. Desktop habitat mapping of the bypass reach was completed in 2020 and subsequently field-verified in 2021; these results are presented below. Hydrological field data collected in support for the hydraulic model was also performed in 2021, and the results of that effort and initial model scenarios are presented in the USR and summarized in the below.

Desktop Habitat Delineation and Verification

High-resolution aerial imagery was used for desktop habitat mapping of the bypass reach according to substrate size (e.g., sand, gravel, cobble, etc.), cover (e.g., no cover, overhead vegetation, etc.), and mesohabitat types. Cover and substrate classifications are provided in Table E.9-3. If multiple types of cover were present, the most immediate cover type was selected assuming it would have greater influence over aquatic organism behavior (e.g., if instream cover and overhead vegetation both exist, instream cover was selected). While substrate could be composed of several types/sizes, the dominate size class was selected. Mesohabitats were delineated based on typical stream and river morphological, longitudinal sequences (i.e., riffle, run, pool, glide) (Wildland Hydrology 1996) and aerial signatures denoting flow and turbulence at leakage, low-flow, or moderate-flow conditions. Desktop mesohabitat delineation codes used in the aquatic habitat study are included in Table E.9-4 and the delineated bypass reach is depicted on Figure E.9-2.

Table E.9-3. Cover-Substrate Classifications Used for the Hydraulic Model in the Niagara Flow and Aquatic Habitat Study

Cover-Substrate Classifications		
Code	**Cover**	**Substrate**
01	No Cover	and silt or terrestrial vegetation
02	No Cover	and sand
03	No Cover	and gravel
04	No Cover	and cobble
05	No Cover	and small boulder
06	No Cover	and boulder, angled bedrock, or woody debris
07	No Cover	and mud or flat bedrock[1] (unsuitable as cover)
08	Overhead vegetation	and terrestrial vegetation
09	Overhead vegetation	and gravel
10	Overhead vegetation	and cobble

Cover-Substrate Classifications		
Code	**Cover**	**Substrate**
11	Overhead vegetation	and small boulder, angled bedrock[3], or woody debris
12	Instream cover	and cobble
13	Instream cover	and small boulder, angled bedrock[3], or woody debris
14	Proximal[2]	and cobble
15	Proximal[2]	and small boulder, angled bedrock[3], or woody debris
16	Instream or proximal[2]	and gravel
17	Overhead, instream, or proximal[2]	and silt or sand
18	Aquatic vegetation	and aquatic macrophytes

[1] Flat bedrock consists of bedrock that is smooth, with or without crater-like divots, or otherwise unsuitable as instream cover.
[2] "Proximal" is defined as within 4 ft of suitable cover.
[3] Angled bedrock is angular, jutting or semi-vertical, slab-like bedrock. Angled bedrock was categorized as instream cover, regardless of presence of overhead vegetation.

Table E.9-4. Mesohabitat Classifications Used for Descriptive Purposes in the Niagara Flow and Aquatic Habitat Study

Mesohabitat Type	Description
Upland	Areas typically not inundated and possibly exhibiting upland vegetation growth
Riffle	Streambed feature with steep and swift flow with approximately parallel surface water-to-thalweg gradients
Run	Streambed feature upstream of pool features with swift flow and gradually diverging surface water-to-thalweg gradients
Pool	Streambed feature with slow-moving or standing flow with approximately parallel water surface-to-thalweg gradients
Glide	Streambed feature downstream of pool features with swift and gradually converging surface water-to-thalweg gradients
Shoal	Bedrock areas with sheet flow
High Flow	Areas experiencing inundation during high flow events and/or on a seasonal basis

The total area evaluated for the Niagara bypass reach was 6.87 acres, with an additional 1.01 acres for the tailrace from the powerhouse discharge to the Blue Ridge Parkway bridge (Figure E.9-2). Approximately half of the bypass reach contained instream cover (60.6 percent), followed by overhead cover (27.3 percent) (Table E.9-5). The majority of substrate in the bypass consisted of boulder, bedrock, or woody debris (63.2 percent), followed by cobble at 25.9 percent. Much of the bypass was categorized as shoal habitat (32.1 percent), however pools and riffles were also prevalent (24.1 and 15.8 percent, respectively). Approximately 11.3 percent of the bypass was characterized as "upland", which includes areas that are exposed during the 8 cfs minimum bypass

flow requirement, but may be inundated at higher flows (i.e., during rainfall runoff events that result in flow over the Project's main and auxiliary spillways).

The relatively short tailrace reach was categorized as run mesohabitat type, composed mainly of boulder and bedrock (85.5 percent) with no cover (99.8 percent).

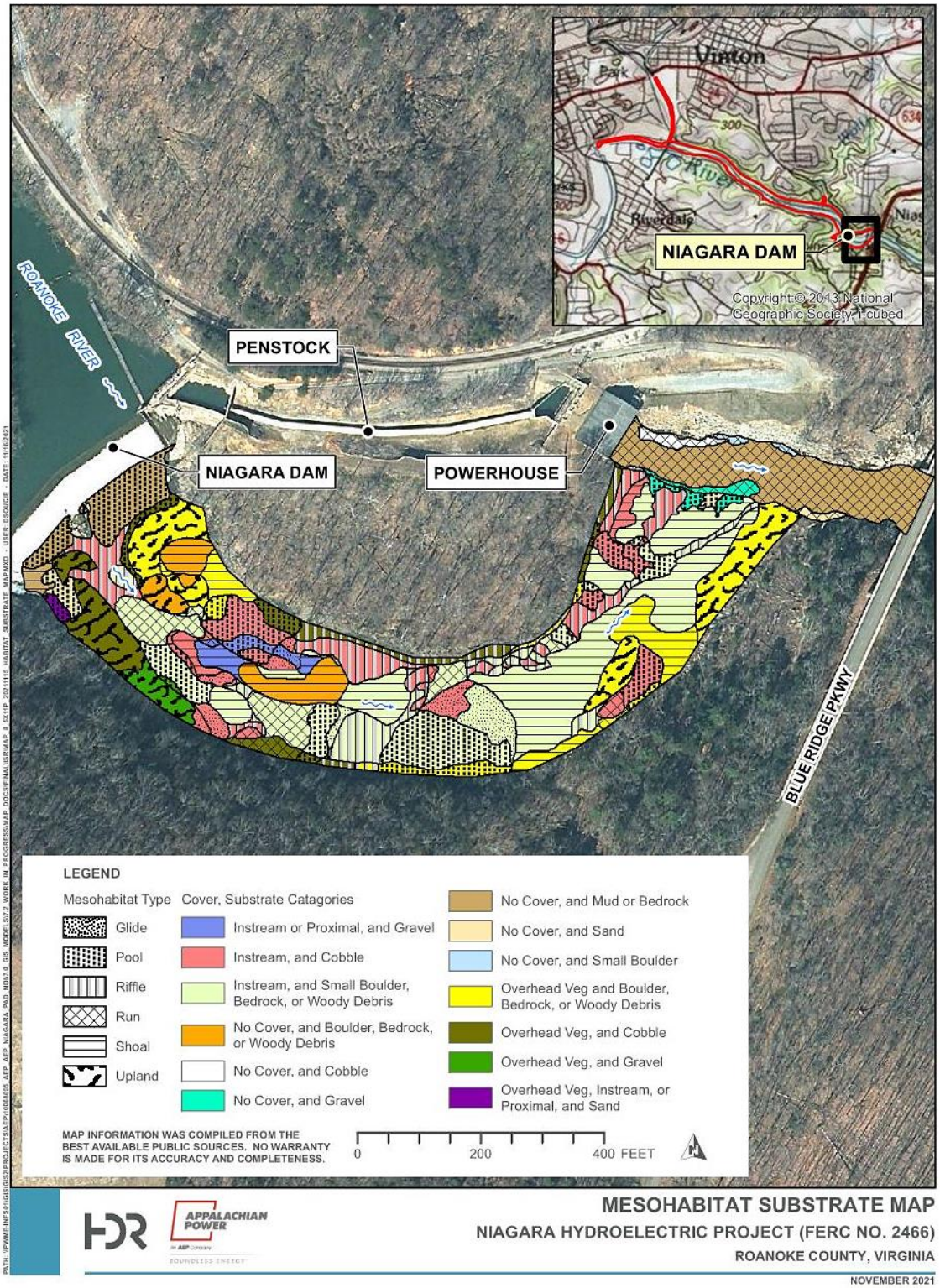


Figure E.9-2. Bypass Reach Flow and Aquatic Habitat Study Area

Table E.9-5. Summary of Aquatic Habitat Characteristics

Habitat Characteristics	Bypass		Tailrace	
	Area (ac.)	Percent	Area (ac.)	Percent
Cover				
Instream Cover	4.16	60.6	--	--
Overhead Vegetation	1.88	27.3	<0.01	0.2
No Cover	0.83	12.1	1.01	99.8
Total	6.87	100.0	1.01	100.0
Substrate				
Boulder, Bedrock, or Woody Debris	4.34	63.2	0.86	85.5
Cobble	1.78	25.9	0.06	5.5
Mud or Flat Bedrock	0.35	5.2	0.05	4.9
Gravel	0.31	4.5	0.02	2.1
Sand	0.09	1.3	0.02	2.1
Total	6.87	100.0	1.01	100.0
Mesohabitat				
Shoal	2.20	32.1	--	--
Pool	1.65	24.1	--	--
Riffle	1.08	15.8	--	--
Upland	1.08	15.8	--	--
Run	0.49	7.2	1.01	100.0
Glide	0.35	5.1	--	--
Total	6.87	100.0	1.01	100.0

Hydraulic Model

Appalachian reviewed the hydrologic record for the Project study reach, sluice gate operating procedures and design capacity, existing topographic and geologic maps, and available recent and historical aerial imagery. Light detection and ranging data (LiDAR) were collected to support development of comprehensive three-dimensional elevation and visual surface layers of the bypass reach. The topographic information was then incorporated as a GIS base layer for field data collection and hydraulic modeling efforts.

In 2021, field data was collected to support the development of a two-dimensional (2-D) hydraulic model (Innovyze Infoworks Integrated Catchment Model [ICM] software v. 7.0) of the Project's tailrace and bypass reach. The model is capable of simulating depth and velocities in a 2-D triangular mesh over a wide range of flow conditions. For details on the model and model development, refer to the ICM Development Report included in Appendix A, Volume II of the license application.

Aquatic Habitats and Substrate Types

A wide variety of habitats are available in the Niagara bypass reach shoals, shallow and deep pools, riffles, and runs. Substrate is dominated by larger particle sizes ranging from cobbles and boulders to irregular bedrock. Smaller substrate sizes (sands and gravels) are also present, but at lower percentages compared to the larger substrate sizes. Instream cover and overhead cover is also prevalent in the bypass reach.

Model Calibration Flow Releases

Field data were collected in the bypass reach during two site visits between June 29 – July 8, 2021 at four model calibration flow releases (Table E.9-6). Each model calibration flow was designed to capture a controlled, steady flow in the bypass reach delivered via the Obermeyer trash sluice gate[8]. For each calibration flow release, depths and velocities were recorded along a fixed transect to determine the total bypass reach flow. In addition, depths, water surface elevations, and point velocity data were also collected to aid in model calibration. During the bypass reach controlled flow releases, powerhouse flows were also calculated by subtracting the measured bypass reach flows from flows recorded at the Niagara USGS flow gaging station (USGS 02056000 Roanoke River at Niagara, VA) immediately downstream from the confluence of the tailrace and bypass reach (Table E.9-6).

[8] In addition to flows released via the Obermeyer trash sluice gate, a small amount of flow from leakage through the mud gates (estimated at approximately 1.0 cfs) was also included.

Table E.9-6. Model Calibration Flows

Calibration Flow	Bypass Reach Flow (cfs)	Powerhouse Flow (cfs)
Day 1 (Minimum Flow)	7	225
Day 2 (Low Flow)	24	185
Day 3 (Mid Flow)	33	175
Day 4 (High Flow)	91	218

Surface Water Travel Times and Water Surface Elevation Responses

Level logger data collected during the model calibration flow fieldwork (i.e., June 29 – July 8, 2021) were used to determine surface water travel times in the Niagara bypass reach for each flow release. A summary of key findings is provided below:

- The main flow path through the bypass reach shifts from river right (looking downstream) near the spillway to river left at approximately the mid-point of the reach.
- Along this main flow path, depths increased approximately 0.32 ft between the minimum flow and low flow, 0.14 ft between the low and mid flows, and 0.46 ft between the mid and high flows. Overall depth increase from the minimum flow to high flow was approximately 0.92 ft.
- Compared to river left, changes in depth along the right descending bank (outside the main flow path) were less noticeable as the channel bed elevation is slightly higher along the right bank (which forces flow to the lower left side of the bypass reach channel).
- Flow travel times through the approximately 1,500-ft-long bypass reach were approximately 35 minutes for the low and mid calibration flows and 16 minutes for the high calibration flow.

Aquatic Habitat Model Results

Habitat model results for the Niagara bypass reach indicate suitable habitat for the four guilds (i.e., Deep-Fast, Deep-Slow, Shallow-Fast, and Shallow-Slow) and the Roanoke Logperch standalone target species under all four modeled flow scenarios. The bypass reach contains shoals, shallow and deep pools, riffles, and runs which offer a variety of habitat types. Model results for species and life stages that prefer larger substrate types (e.g., cobble, boulder, bedrock) with cover (e.g., instream, overhead) generally had larger amounts of potential available habitat. The amount of potential

available habitat generally increases as bypass flows increase with most of the incremental gain between the lowest modeled flow (i.e., 7 cfs) and the two middle flows (i.e., 24 – 33 cfs).

Habitat modeling results for the Roanoke Logperch indicate preferred habitat is primarily along the main flow path in the bypass reach, which is in agreement with the observation data presented in the 2021 Roanoke Logperch Survey performed by EDGE Engineering, Inc. (An updated Aquatic Resources Study Report will be submitted as supplemental information to this FLA in late 2022, following completion of the Roanoke Logperch larval drift survey). The modeling results for the adult and subadult life stages may be under-represented for the bypass reach due to the relatively low suitability values assigned to the larger substrate categories (i.e., boulder/bedrock). Most of the field observations for Roanoke Logperch in the bypass reach listed boulder/bedrock as the prevalent substrate type. Increasing the habitat suitability for the boulder/bedrock substrate category would likely increase the amount of modeled habitat for these two life stages.

A more comprehensive discussion of aquatic habitat results under the four modeled flow scenarios provided in Table E.9-6 is provided in the Bypass Reach and Aquatic Habitat Study report (Appendix A, Volume II of this FLA).

Efficacy of Existing Bypass Reach Minimum Flow Requirement

The minimum calibration flow field measurement was used to set the low end of the 2-D hydraulic model flow range. Habitat model results from this flow scenario were used to evaluate the efficacy of the existing 8 cfs minimum bypass flow requirement. Suitable habitat is available in the bypass reach at the minimum flow requirement. However, for most of the guilds and the standalone Roanoke Logperch target species, modeled habitat generally increases as bypass flows increase with a significant incremental gain at approximately 30 cfs. At bypass reach flows higher than 30 cfs, available habitat continues to increase for all modeled species and life stages, but generally at a lower rate compared to the incremental habitat gains up to 30 cfs. Between 8 cfs and 30 cfs, water depths increase by approximately 0.2 ft, velocities increase by approximately 0.3 ft/second and the total wetted area increases by approximately 27 percent.

Evaluation of Seasonal Minimum Flows

The primary purpose of providing seasonal minimum flow releases to the bypass reach would be to increase spawning habitat for species or guilds using this area, however general habitat availability could also be considered in this context. As described above, a bypass reach flow of approximately 30 cfs would provide a significant incremental increase in overall habitat compared to the existing 8 cfs minimum flow requirement. With respect to the spawning life stage, habitat for Redbreast Sunfish spawning (representing the Shallow-Slow Guild) also exhibits a sharp incremental increase between

8 cfs and 30 cfs, with additional habitat gains tapering off at bypass reach flows higher than 30 cfs (likely due to increased velocities).

HSC information for the Roanoke Logperch spawning life stage was not available for habitat modeling purposes. However, the potential effect of increasing flows in the Niagara bypass reach from 8 cfs to 30 cfs indicates an approximate doubling of potential available habitat for the Roanoke Logperch adult and subadult life stages.

Fish Community Study

In support of this relicensing, Appalachian conducted a Fish Community Study with the following objectives:

1. Collect a comprehensive baseline of the existing fish community in the Project vicinity.
2. Compare current fish community data to historical data to determine any significant changes to species composition, abundance, or distribution.
3. Collect information regarding the current status (abundance and distribution) of the federally endangered Roanoke Logperch (including larval, young-of-year, and adults) in the vicinity of the Project for the purpose of establishing a baseline and to potentially support the Commission's cumulative effects analyses.
4. Calculate flow velocities at the intake structure to facilitate a desktop assessment of entrainment and impingement potential at Niagara.
5. Perform a desktop assessment of entrainment and impingement potential at the Niagara intake structure, including an assessment of turbine mortality and survival of fish passage through the turbines or other routes using the USFWS Turbine Blade Strike Analysis Model (USFWS 2020c).

Each of the objectives have been completed except for Objective 3. Delays due to the COVID-19 Pandemic and timing of receipt of the required Section 10(a)(1)(A) permit from the USFWS regional office (received July 2021) resulted in the Roanoke Logperch Larval Drift Study (as described in the RSP) being rescheduled for Spring 2022. Assuming this study is completed as presently scoped and scheduled, Appalachian expects to file the results of the study with the Commission as additional information in late 2022, after the filing of the FLA.

General Fish Community Survey

General fish community surveys were conducted between September 15-16 and October 20-21, 2020 during relatively low flow and low-turbidity stream conditions. Sampling was performed by state-permitted fish biologists under Virginia Scientific Collecting Permit Nos. 068630 and 068631. Specific sampling dates were based on factors including (but not limited to) weather conditions, water

temperatures, river flows and reservoir elevations, and safety of field staff and the public. Sampling methods were derived from National Rivers and Streams Assessment Field Operations Manual (USEPA 2019), which guides standardized electrofishing methods in lotic waterbodies of variable sizes. Backpack electrofishing was used to target riffle/run (i.e., wadeable) habitats, two sites located upstream and five locations downstream of Niagara Dam. Boat electrofishing targeted eight (i.e., non-wadeable) pool habitats within Niagara impoundment (Figure E.9-3).

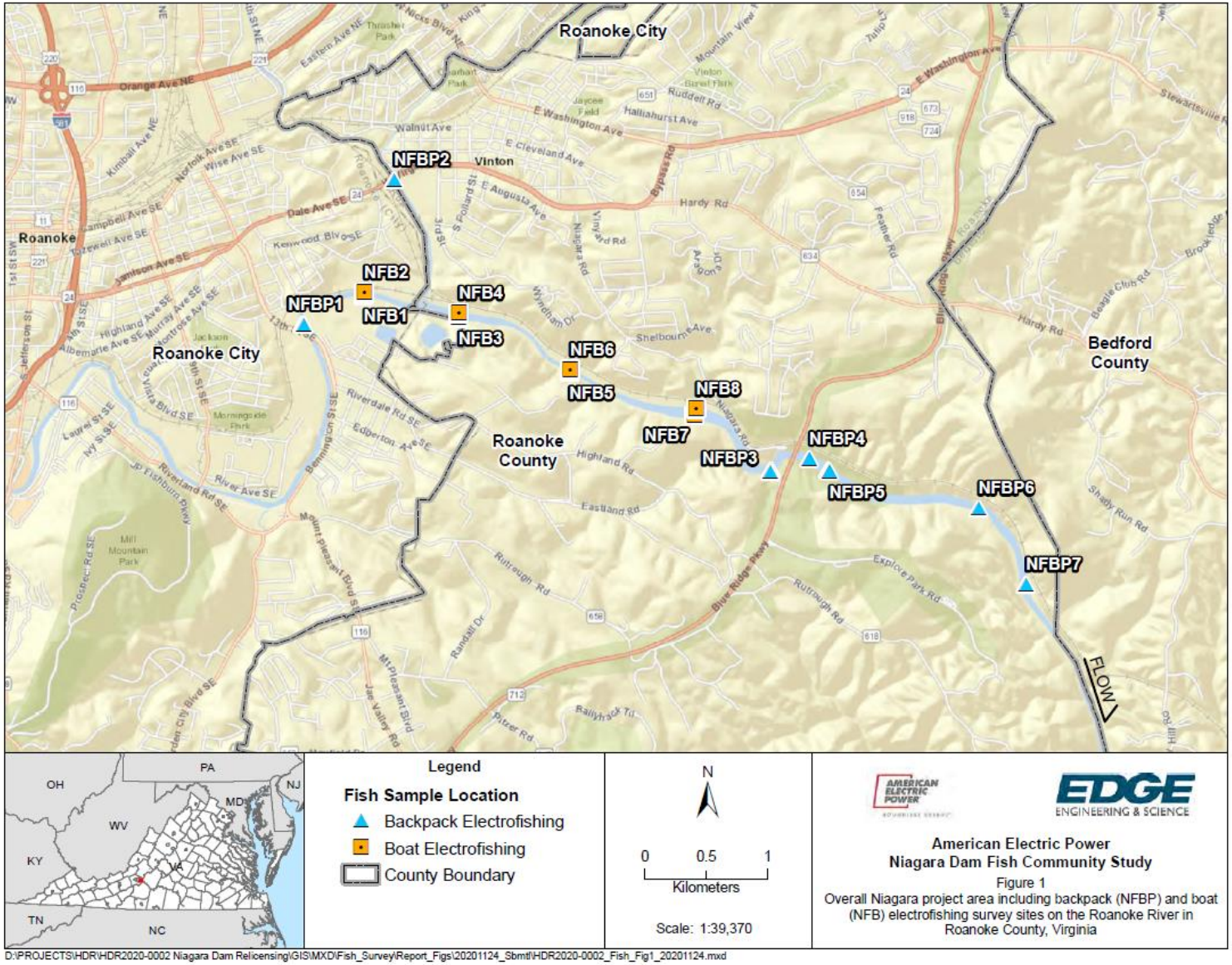


Figure E.9-3. Fish Community Survey Locations

A total of 590 fish representing 29 species were collected during the study, the majority (89 percent) of which were taken by backpack electrofishing (Table E.9-7). Twenty-six (24) species were collected upstream of Niagara Dam while 21 species were collected downstream of the dam. Central Stoneroller (*Campostoma anomalum*), Rosefin Shiner (*Lythrurus ardens*), and Riverweed Darter (*Etheostoma podostemone*) were the most abundant species at riffle/run sites (sampled via backpack electrofishing). Redbreast Sunfish (*Lepomis auratus*), Golden Redhorse (*Moxostoma erythrurum*), and Bluegill (*Lepomis macrochirus*) were the most abundant species at pool sites (sampled via boat electrofishing). Central Stoneroller, White Sucker (*Catostomus commersonii*), and Rock Bass (*Ambloplites rupestris*) were the most dominant by weight at riffle/run sites and Golden Redhorse, Redbreast Sunfish, and V-lip Redhorse (*Moxostoma pappillosum*) were the most dominant by weight at pool sites. A single Roanoke Logperch was collected at the upstream-most survey site, above the confluence of Tinker Creek and the Roanoke River.

Table E.9-7. Summary of General Fish Community Sampling Data

Common Name	Species Name	Electrofishing Method		Grand Total	Relative Abundance
		Backpack	Boat		
Blacknose Dace	*Rhinichthys atratulus*	2	--	2	0.3%
Blacktip Jumprock	*Moxostoma cervinum*	29	--	29	4.9%
Bluegill	*Lepomis macrochirus*	4	11	15	2.5%
Bluntnose Minnow	*Pimephales notatus*	1	3	4	0.7%
Bull Chub	*Nocomis raneyi*	4	--	4	0.7%
Central Stoneroller	*Campostoma anomalum*	144	--	144	24.4%
Chainback Darter	*Percina nevisense*	2	--	2	0.3%
Chub	*Nocomis* sp.	6	--	6	1.0%
Cutlip Minnow	*Exoglossum maxillingua*	11	--	11	1.9%
Fantail Darter	*Etheostoma flabellare*	26	--	26	4.4%
Golden Redhorse	*Moxostoma erythrurum*	--	12	12	2.0%
Green Sunfish	*Lepomis cyanellus*	2	--	2	0.3%
Johnny Darter	*Etheostoma nigrum*	4	--	4	0.7%
Largemouth Bass	*Micropterus salmoides*	--	6	6	1.0%
Margined Madtom	*Noturus insignis*	32	--	32	5.4%
Mimic Shiner	*Notropis volucellus*	7	--	7	1.2%
Northern Hog Sucker	*Hypentelium nigricans*	6	--	6	1.0%
Redbreast Sunfish	*Lepomis auritus*	6	26	32	5.4%

Common Name	Species Name	Electrofishing Method		Grand Total	Relative Abundance
		Backpack	Boat		
Redear Sunfish	*Lepomis microlophus*	--	1	1	0.2%
Riverweed Darter	*Etheostoma podostemone*	43	--	43	7.3%
Roanoke Darter	*Percina roanoka*	22	--	22	3.7%
Roanoke Logperch	*Percina rex*	1	--	1	0.2%
Rock Bass	*Ambloplites rupestris*	6	--	6	1.0%
Rosefin Shiner	*Lythrurus ardens*	134	--	134	22.7%
Satinfin Shiner	*Cyprinella analostana*	7	--	7	1.2%
Smallmouth Bass	*Micropterus dolomieu*	4	1	5	0.8%
Spotfin Shiner	*Cyprinella spiloptera*	2	--	2	0.3%
Spottail Shiner	*Notropis hudsonius*	11	--	11	1.9%
Sunfish	*Lepomis* sp.	5	3	8	1.4%
Swallowtail Shiner	*Notropis procne*	1	--	1	0.2%
V-lip Redhorse	*Moxostoma pappillosum*	--	1	1	0.2%
White Sucker	*Catostomus commersonii*	3	1	4	0.7%
Total		**525**	**65**	**590**	**100.0%**
Relative Abundance		**89.0%**	**11.0%**	**100.0%**	

The average catch per unit effort (CPUE; individuals per minute) was 6.55 at riffle/run sites with average diversity (H'; Shannon index) of 1.83, and CPUE was 1.44 at pool sites with average diversity of 1.10.

Roanoke Logperch Survey

Targeted Roanoke Logperch surveys were proposed for the 2020 field season in the RSP at the sampling sites identified on Figure E.9-3, and included:

- Spring Larval Drift Study upstream of Niagara Dam;
- Spring survey of the Niagara bypass reach targeting adult and juvenile Roanoke Logperch which was contingent upon receipt of a waiver of Virginia Time-of-Year-Restrictions (TOYR); and a
- Summer survey of the Roanoke River within the Project Boundary targeting juvenile and adult life stages.

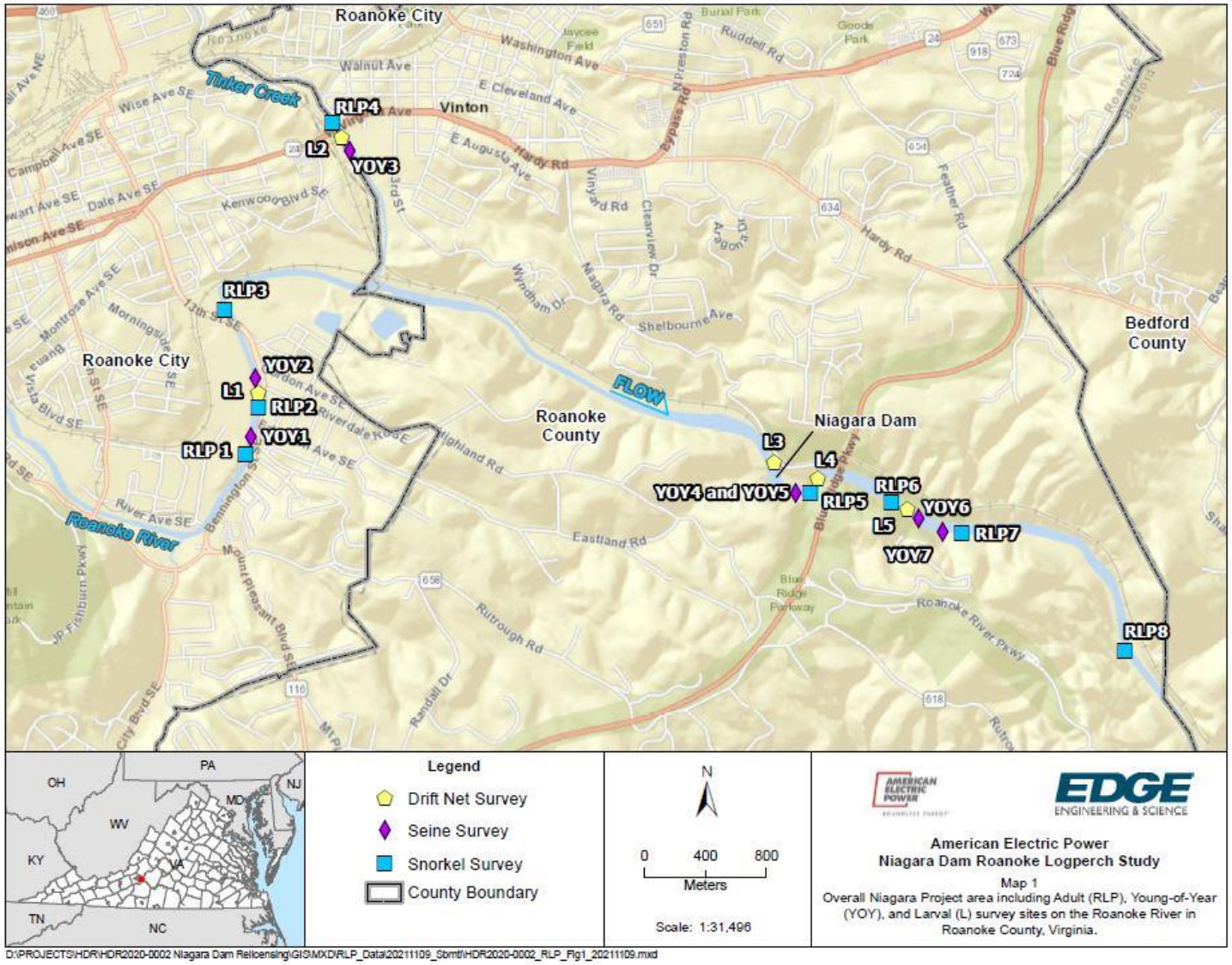


Figure E.9-4. Sampling Locations for Larval, Young-of-Year, and Adult Roanoke Logperch at the Project

As a result of the delay to the start of the 2020 field season, higher than normal seasonal flow conditions in the Roanoke River, inoperability of the sluice gate hoist operating system, construction activities associated with installation of the new Obermeyer sluice gate, and temporarily reduced unit generation capability at the Niagara powerhouse, the study fieldwork was postponed to 2021.

Consultation with the USFWS and VDWR was initiated in early 2021 to request a waiver of time-of-year (TOYR) restrictions to perform the spring 2021 backpack electrofishing survey for Roanoke Logperch in the Niagara bypass reach (this survey was requested by the USFWS and VDWR during Project scoping). Fish sampling and other in-water activities in Roanoke Logperch streams are prohibited from March 1 to June 30 each year by the VDWR TOYR (VDWR 2021). Based on input from the agencies, the TOYR waiver was approved with an agreement to change the sampling methodology for the bypass channel from backpack electrofishing to snorkel methods to minimize disturbance to Roanoke Logperch.

Adult/Juvenile Roanoke Logperch

A quantitative assessment of Roanoke Logperch habitat suitability was performed following widely used and refined procedures (e.g., Ensign et al. [2000], Anderson and Angermeier [2015], and Anderson [2016]). Four variables (depth, velocity, silt coverage, and substrate) were used to evaluate the suitability of habitat at each Roanoke Logperch snorkeling site based on the Habitat Suitability Index (HSI) developed by Ensign and Angermeier (1994) and Ensign et al. (1998). Depth, water velocity (measured at 0.6 times depth), qualitative estimations of silt coverage (i.e., 100%, 75-99%, 25-74%, 1-24%, and 0%), and five substrate measurements (on a modified Wentworth scale) were recorded at each point while using a submeter GPS unit for accuracy. An HSI score was calculated for each sample point then assigned into 1 of 5 suitability categories (i.e., HSI score of 0 is ‘Unsuitable’, >0-25 is ‘Poor’, >25-50 is ‘Fair’, >50-75 is ‘Good’, and >75 is ‘Excellent’).

Snorkel surveys for adult and juvenile Roanoke Logperch occurred at eight riffle/run sites and included four to nine transects between 30 and 235 meters in length, based on the amount and distribution of available habitat at each site. A minimum visibility requirement for the completion of surveys was set at one meter in cooperation with species experts and was assessed in the field using a Secchi disc. Transect spacing was at least 1.5 times the maximum visibility distance so that proper coverage of the area could be achieved while reducing overlap. Site photos were taken in four directions (upstream, downstream, left-descending bank, and right-descending bank; all 90 degrees to one another), and field conditions were recorded (e.g., time, date, temperature, precipitation, cloudy/overcast, etc.). Sampling effort (i.e., time snorkeling and transect length) and water quality parameters (e.g., pH, water temperature, dissolved oxygen [DO], and conductivity) were measured and recorded for each site.

Following Ensign et al. (1995), transect lines (i.e., tape or rope) were physically stretched and followed as accurately as feasible by field teams during the snorkel surveys, while minimizing in-water disturbance to the extent practicable. A two-person crew was used to collect data along each transect. The snorkeler began at the downstream end of the reach and was immediately followed by a spotter who marked the exact centerline of the snorkeler using a sub-meter GPS unit. The snorkeler continued slowly upstream, parallel to stream flow, performing visual searches by looking for Roanoke Logperch directly in front and from side to side. The distance between the snorkeler's centerline and the point where the specimen was initially observed was measured upon observation. The spotter then recorded a sub-meter GPS point in that exact location. Depth, velocity, silt cover, five substrate measurements (on a modified Wentworth scale), a habitat photo, and Roanoke Logperch age class (juvenile, adult, or male adult) were all recorded and associated with that GPS point. The snorkeler then continued upstream, skipping areas along each transect deemed unsuitable for snorkeling methodology (e.g., too shallow, or too deep). One pass was completed per transect, with the number of transects run at each site dependent upon the width of the stream at that location. Roanoke Logperch were the only target species for this survey effort, but other species observed and identified with certainty were noted as present. Additionally, the average daily stream flow in the bypass reach, tailrace of the powerhouse, and combined average daily flows downstream of the confluence of the bypass and tailwaters was calculated for each date of snorkel survey effort, as summarized in Table E.9-8.

Table E.9-8. Stream flows (cfs) in the bypass channel, powerhouse tailrace, and in the Roanoke River downstream of their confluence on dates that Roanoke Logperch were documented within the Project Boundary

Date	Stream Flows (cfs)		
	Bypass Channel	Powerhouse Tailrace	Downstream of Bypass and Tailrace Channels
Jun-30-21	24.0	--	--
Aug-10-21	27.1	162.2	189.3
Aug-11-21	42.1	230.6	272.6
Oct-19-21	135.7	91.8	227.5
Oct-20-21	5.8	190.3	196.0
Oct-21-21	15.4	174.4	189.8
Oct-22-21	24.6	180.8	205.4

(--) No survey effort completed in the designated reach of the Roanoke River

The spring 2021 snorkel survey for adult and juvenile Roanoke Logperch in the bypass channel was completed on June 30, 2021, with 9 adults and 1 juvenile documented in the bypass reach, under typical operating conditions (24 cfs in the bypass channel). The summer-fall adult and juvenile

Roanoke Logperch snorkel survey of the bypass reach was completed on August 10, 2021 under normal operating conditions (27.1 cfs in the bypass channel), and documented 13 adults and 3 juveniles.

A total of 5,460 meters of transects were surveyed and covered 21,688 square meters of Excellent (0.1%), Good (55.2%), Fair (33.3%), and Poor (11.4%) habitat categories. A total of 61 Roanoke Logperch were observed (7 juveniles and 54 adults) in Project area habitats classified as Excellent (9), Good (28), Fair (22), and Poor (2). The mean density for the entire Project area was 32 Roanoke Logperch per hectare (19.8 standard deviation). The mean density for sites within the Roanoke River above the dam and below the dam were similar at 23 and 24 Roanoke Logperch per hectare, respectively. This indicates that upstream and downstream of the Niagara dam exhibits similar Roanoke Logperch densities with upstream sites composed of habitats with Good (53%), Fair (44%), and Poor (3%) suitability scores and downstream sites composed of Good (65%), Fair (31%), and Poor (4%) suitability habitats. Mean density of Roanoke Logperch in Tinker Creek was slightly higher with 32 fish per hectare and the average density between the two sample periods (spring and summer) in the bypass reach was the greatest density (58 Roanoke Logperch per hectare) documented within the Project area. There were no signs of external parasites, disease, or physical abnormalities.

Roanoke Logperch density in the bypass reach was the greatest of any adult snorkeling site in the study area (during both sample periods), despite having the least suitable Roanoke Logperch habitat overall. The upstream terminus of this stream segment (i.e., bypass reach) provides an abundance of suitable but fair/poor habitat. Although this is arguably the most altered portion of the study area (aside from the pool habitat created by the Project impoundment), the bypass reach appears to provide suitable habitat for a relatively high density of Roanoke Logperch.

Young-of-Year Roanoke Logperch

One young-of-year sampling event was completed at each site between late summer and fall 2021. Sampling methods were derived from those described in (Argentina and Roberts 2014; Roberts et al. 2016), which are specific to Roanoke Logperch. Seining techniques were employed to most-effectively target specific sites based on the habitat types present in the Project area and were used upstream of Niagara dam at two sites in the Roanoke River and one site in Tinker Creek and at four sites located downstream of the Niagara Dam, two in the bypass reach and two in the Roanoke River downstream of the Niagara tailrace.

Seine surveys for YOY occurred at seven riffle-adjacent, low-velocity shoreline sites and included at least 20 seine hauls in target habitat. Upon arrival at seine sites, a 150- to 300-meter reach of shoreline

habitat was identified. Site photos were taken in four directions (upstream, downstream, LDB, and RDB; all 90 degrees to one another), and field conditions were recorded (e.g., time, date, temperature, precipitation, cloudy/overcast, etc.). If the necessary amount of target habitat was not present along one shoreline, both the right- and left-descending banks were sampled. At each sample site, water quality parameters (e.g., pH, water temperature, DO, and conductivity) were measured and recorded, along with total sampling effort (i.e., number of seine hauls). Each site was sampled with similar effort targeting habitat patches favorable for YOY, including (but not limited to) sandy, backwater, shallow patches of emergent vegetation (e.g., water willow; Justicia americana), and in slow-velocity patches with gravel and cobble substrates. These habitat patches typically occurred along river margins. Seining methods were supplemented with visual surveys performed along the shoreline adjacent to low-velocity habitats to augment detectability and minimize false-negative survey efforts, as described in Roberts et al. (2016). Two crew members slowly walked upstream while scanning shallow areas for YOY Roanoke Logperch. Surveyors wore polarized sunglasses while performing evaluations to minimize glare.

Despite extensive sampling effort, Roanoke Logperch YOY were not collected in any of the 140 seine hauls and were not observed in supplemental visual surveys.

Larval Drift

Larval Drift sampling will take place in April – June of 2022. The final report will be submitted to FERC at the end of 2022 as additional information to support the FLA. The Roanoke Logperch larval drift survey originally proposed for spring 2020 was rescheduled for the spring of 2021 in response to delays related to the onset of the COVID-19 pandemic. Based on discussions with VDWR and USFWS, Appalachian was notified that a federal recovery permit authorizing the incidental take of Roanoke Logperch would be required prior to performing the larval drift survey. As such, the study was subsequently rescheduled for spring of 2022 to allow time for EDGE, on behalf of Appalachian, to apply and receive a federal recovery permit authorizing the incidental take of the federally endangered Roanoke Logperch during the larval drift study.

Preliminary Conclusions

Adult Roanoke Logperch density is quite variable over space and time (Roberts et al. 2016). Results of the 2021 sampling efforts within the Project area may fall anywhere between the upper and lower range of density for this reach of the Roanoke River. The mean density for three sites above Niagara Dam and three sites below Niagara Dam (within the mainstem Roanoke River) were comparable. Additionally, upstream sites exhibited marginally lower habitat suitability and adult Roanoke Logperch

density estimates overall – indicating locally negligible differences in Roanoke Logperch status within the Project area.

Roanoke Logperch density in the bypass reach was the greatest of any adult snorkeling site in the Project area (during both sample periods), despite having the least suitable Roanoke Logperch habitat. The upstream terminus of this stream segment (i.e., bypass reach) provides an abundance of suitable but Fair/Poor habitat. Although this is arguably the most altered portion of the Project area (aside from the pool habitat created by the Project impoundment), the bypass reach appears to provide suitable habitat for a relatively high density of Roanoke Logperch.

Juvenile density is even more variable than adult density over space and time and densities in the summer tend to be lower than adult densities at the same sites (Roberts 2016). With so few juveniles observed during this study, statistical conclusions cannot be drawn. Three juveniles were observed above Niagara Dam at the upstream-most site, while the only juveniles observed below Niagara Dam were in the bypass reach (four individuals). One juvenile was observed in June and three were observed in August. Although the sample size is small, this may be a result of young Roanoke Logperch moving into swifter, deeper habitat as the summer progressed where they were observed more often during snorkel surveys.

It is also understood that dams impede small substrates from moving downstream. Young-of-year Roanoke Logperch generally rely on habitat with smaller substrates, which are not abundantly available downstream of Niagara Dam; however, this is somewhat characteristic for a reach of stream with a relatively high gradient and lack of floodplain like the reach between Niagara and Smith Mountain Lake. The lack of YOY captured during seine surveys may also be a result of their progression away from YOY habitat later in the year. Argentina and Roberts (2014) collected very few YOY overall using these methods and especially during the late summer 2021 surveys. Project logistics limited the survey window in 2021, thus, the low density of YOY Roanoke Logperch should not be mistaken for a complete lack of YOY within the Project area. Visual surveys also resulted in zero YOY Roanoke Logperch, which likely indicates YOY had moved to different habitat by the time surveys took place.

Rosenberger and Angermeier (2002) found the mean density of adult Roanoke Logperch in the Roanoke River to be approximately 84 individuals per hectare (site estimates ranging from 19.8 to 337.7 individuals per hectare) and Roberts et al. (2016) estimated adult Roanoke Logperch densities as high as 260 individuals per hectare but generally lower than 100 individuals per hectare in summer. Overall, mean density for the entire Project area in 2021 was 32 Roanoke Logperch per hectare (site

estimates ranging from 4.6 to 72.4 Roanoke Logperch per hectare).

Appalachian and AEP (1992) observed 10 total Roanoke Logperch using snorkeling and electrofishing methods downstream of Niagara Dam. They did not estimate density but stated Roanoke Logperch were not expected to populate the portion of stream outside of the reach they sampled (0.5 to 1.0 mile downstream of the dam). During 2021 sampling efforts, Roanoke Logperch were observed at each of the sample locations throughout the Project area, including the sites where they were observed in 1992. These data indicate that Roanoke Logperch are more widely distributed within the Project Boundary than previously thought and were documented utilizing a variable type and quality of habitats.

Fish Impingement and Entrainment Study

As part of the Fish Community Study for the current relicensing effort, a desktop entrainment study was performed to reexamine and update (as applicable) the historic entrainment study carried out for the previous relicensing (Appalachian 1991). In accordance with Appalachian's November 6, 2019 RSP and the Commission's December 6, 2019 SPD for the Project, the goal of this study is to verify or update certain aspects pertaining to the Niagara dam and examine entrainment potential at the Project. The study objectives are to:

- Confirm flow velocities at and near the Niagara dam intake/outlet structure located within the Roanoke River to facilitate a desktop assessment of entrainment and impingement potential at the Project.
- Perform an updated desktop review of entrainment potential at the Project during hydropower generation.
- Perform a blade strike evaluation using the U.S. Fish and Wildlife Service (USFWS) Turbine Blade Strike Analysis Model (USFWS 2020c). This model is a probabilistic Excel-based Visual Basic for Applications implementation of the methods outlined by Franke et al. (1997) for evaluating fish mortalities due to turbine entrainment.

Information on the physical and operational characteristics the Project, including trash rack bar spacing, intake velocities and flows, and intake proximity to feeding and rearing habitats was used to make general assessments of impingement and entrainment potential at the Project using a desktop study approach. A species list was developed based on data from recent (Appalachian 2020) and historical (Appalachian 1991) fish community studies (i.e., composition, abundance, listed or protected status, recreational significance) as described above, as well as known occurrence records from the VDWR for the Roanoke River at the time of the historical fish community study. The study area for the fish impingement and entrainment study is shown on Figure E.9-5.

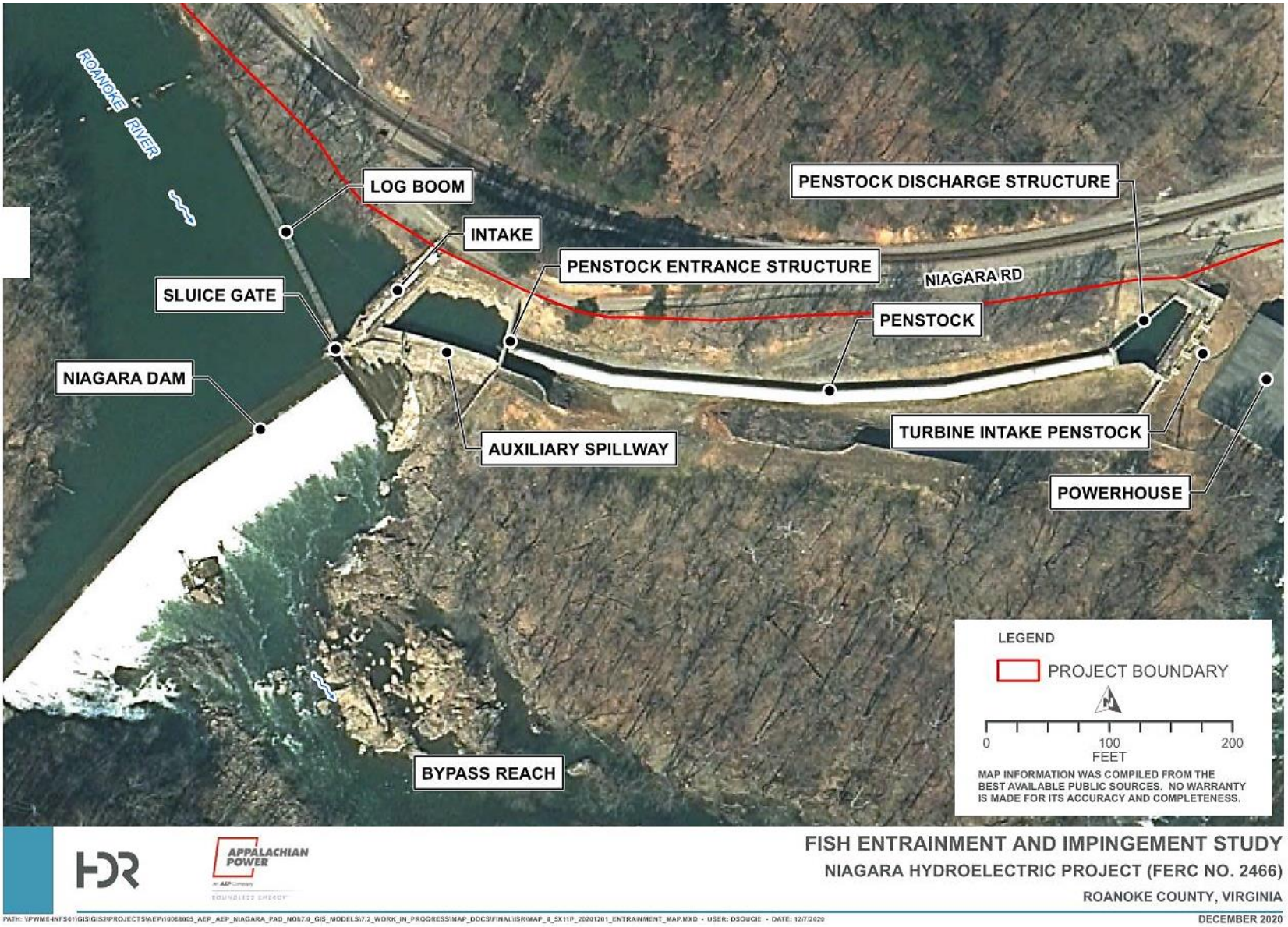


Figure E.9-5. Fish Impingement and Entrainment Evaluation Study Area

A comprehensive desktop review was carried out and a target species list was developed (Table E.9-9). Targeted species were evaluated for potential of entrainment and impingement based on swim speed, behavior, habitat preferences, life stages, and other life history characteristics. Risk assessment of impingement and entrainment potential also considered seasonal or temperature-dependent behavioral changes in fish species.

Table E.9-9. Target Fish Species and Species Groups Included in the Impingement and Entrainment Study for Niagara Hydroelectric Project

Common Name[1]	Scientific Name	Surrogate Representation
Largemouth Bass	*Micropterus salmoides*	Largemouth Bass
Smallmouth Bass/Spotted Bass	*Micropterus dolomieu/M. punctulatus*	Smallmouth Bass, Spotted Bass
Black Crappie	*Pomoxis nigromaculatus*	Black Crappie, White Crappie
Rock Bass	*Ambloplites rupestris*	Rock Bass, Roanoke Bass
Lepomis Sunfishes	*Lepomis* spp.	Bluegill, Redear Sunfish, Redbreast Sunfish, Green Sunfish, Pumpkinseed, and Warmouth
Shiners, Chubs, and Minnows	Leuciscinae	Blacknose Dace, Bluntnose Minnow, Bull Chub, Central Stoneroller, Common Carp, Creek Chub, Cutlip Minnow, Mimic Shiner, Rosefin Shiner, Satinfin Shiner, Spotfin Shiner, Spottail Shiner, and Whitetail Shiner
Bullheads and Madtoms	*Ameiurus* spp. and *Noturus* spp.	Black Bullhead, Brown Bullhead, Flat Bullhead, Yellow Bullhead, Margined Madtom, and Orangefin Madtom
Catfishes	*Ictalurus* spp.	Channel Catfish, White Catfish, and Flathead Catfish
Suckers and Redhorse	Catostomidae and *Moxostoma* spp.	Blacktip Jumprock, Golden Redhorse, Silver Redhorse, White Sucker, and Northern Hogsucker
Darters	*Etheostoma* spp.	Fantail Darter, Johnny Darter, and Riverweed Darter
Logperch	*Percina* spp.	Chainback Darter, Roanoke Darter, and Roanoke Logperch

[1]Target species/groups were based on species collected in recent (2020) or historical fish studies (Appalachian 1990) in the Roanoke River or that are known to occur in Roanoke River in or near the Project area.

Intake avoidance at the Project was determined through a comparison of available target fish swim speeds to calculated intake velocities. Burst swim speeds for target species were compared to the estimated intake velocity to evaluate whether fish may be susceptible to intake flows at the Project. Burst swim speed is the swim speed used to escape predation, maneuver through high flows, or in this case, escape intake velocities and avoid entrainment. Burst swim speed data were compiled from the literature, however if data for a specific species or group was not directly available, it was calculated as two times the critical or sustained swim speed based on Bell (1991). The desktop evaluation using

fish morphometrics and flow data from the nearest upstream gauge (USGS 02055000 Roanoke River at Roanoke, Virginia) suggests that the velocity of the river in the vicinity of the Project is comparable to that estimated in front of the intake, therefore it is likely that fish in this area can navigate intake flows similar to normal river conditions.

Impingement risk was determined by estimating minimum fish lengths for the target fish species that would be excluded or impinged by the 3.625-inch clear spacing of the trash rack. A scaling factor relating fish length to body width was used for the entrainment assessment to determine minimum sizes of the target fish species that would be physically excluded by the trash racks (Smith 1985).

According to the EPRI (1997) database selections used for this study, fish measuring less than six inches in length were the majority (88 percent) of entrained fish (Table E.9-6), and fish less than eight inches exhibit the highest entrainment rates throughout the year (Table E.9-10 and Table E.9-11). Of the fish less than eight inches in length, entrainment rates in summer and fall were greatest, suggesting these are the species likely spawned the prior spring and recently recruited to sizes large enough to be captured in the sampling nets.

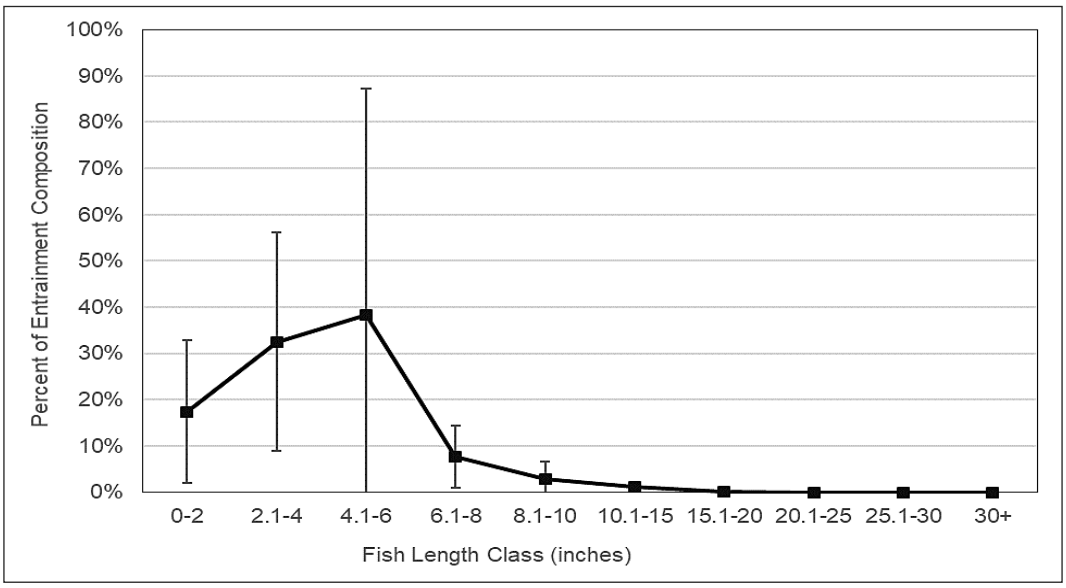


Figure E.9-6. Mean Percent (standard deviation) of Entrainment Composition by Fish Size Class According to Target Species from 33 Hydroelectric Developments (EPRI 1997)

According to FERC (1995) and Winchell et al. (2000), most fish size classes entrained at hydroelectric projects are much smaller than the minimum length of fish physically excluded by a certain clear spacing, and length frequencies of entrained fish are similar among sites with differing trash rack spacing. Thus, the low rate of large fish entrainment is likely related to their increased swimming performance and ability to avoid intake approach velocities.

Table E.9-10. Annual and Seasonal Entrainment Rates of Target Species and Species Groups by Fish Size Class

Fish Size (total length)	Average Monthly Entrainment Rate by Season (fish/hr)				
	Winter	Spring	Summer	Fall	Annual
Entrainment Rate (fish/hr) at Maximum Turbine Discharge (684 cfs)					
<4 inch	0.04	0.11	0.12	0.07	**0.34**
4-8 inch	0.04	0.04	0.06	0.17	**0.31**
8-15 inch	0.01	0.01	0.01	0.01	**0.03**
>15 inch	0.00	0.00	0.00	0.00	**0.00**
Total	**0.09**	**0.16**	**0.19**	**0.25**	**0.68**
Entrainment Rate (fish/hr) at Optimal Turbine Discharge (606 cfs)					
<4 inch	0.03	0.12	0.10	0.05	**0.30**
4-8 inch	0.03	0.04	0.09	0.12	**0.27**
8-15 inch	0.01	0.01	0.00	0.01	**0.03**
>15 inch	0.00	0.00	0.00	0.00	**0.00**
Total	**0.06**	**0.17**	**0.20**	**0.18**	**0.60**

Note: Values represent average fish/hr entrainment from 33 sites selected from the EPRI database and adjusted for maximum and optimal turbine discharge (cfs) at the Project.

Seasonal entrainment rates for target species (for all size classes) were estimated for the Project using data from the EPRI (1997) database under two turbine discharge scenarios: maximum turbine discharge of 684 cfs (Table E.9-11) and optimal turbine discharge of 606 cfs (Table E.9-12).

Table E.9-11. Seasonal and Annual Entrainment Rates for Target Species and Species Groups at Maximum Turbine Discharge (684 cfs)

Target Species/Species Group	Average Monthly Entrainment Rate (fish/hr) by Season				
	Winter	Spring	Summer	Fall	Annual
Catfishes	0.07	1.18	1.89	0.12	0.82
Rock Bass	0.55	0.71	0.52	1.48	0.82
Suckers and Redhorse	0.46	0.24	0.29	1.02	0.50
Lepomis Sunfishes	0.05	0.49	0.45	0.88	0.47
Black Crappie	0.12	0.12	0.78	0.51	0.38
Darters	0.02	0.64	0.07	0.03	0.19
Logperch	0.06	0.38	0.17	0.03	0.16
Shiners, Chubs, and Minnows	0.13	0.13	0.18	0.20	0.16

Target Species/Species Group	Average Monthly Entrainment Rate (fish/hr) by Season				
	Winter	Spring	Summer	Fall	Annual
Largemouth Bass	0.03	0.03	0.42	0.16	0.16
Bullheads and Madtoms	0.02	0.12	0.23	0.05	0.11
Smallmouth Bass	0.01	0.02	0.17	0.13	0.08
Total	**1.51**	**4.07**	**5.19**	**4.61**	3.85

Table E.9-12. Seasonal and Annual Entrainment Rates for Target Species and Species Groups at Optimal Turbine Discharge (606 cfs)

Target Species/Species Group	Average Monthly Entrainment Rate (fish/hr) by Season				
	Winter	Spring	Summer	Fall	Annual
Catfishes	0.06	1.04	1.68	0.11	0.72
Rock Bass	0.48	0.63	0.46	1.31	0.72
Suckers and Redhorse	0.41	0.21	0.26	0.91	0.45
Lepomis Sunfishes	0.04	0.44	0.40	0.78	0.42
Black Crappie	0.11	0.11	0.69	0.45	0.34
Darters	0.02	0.57	0.06	0.02	0.17
Logperch	0.05	0.34	0.15	0.03	0.14
Shiners, Chubs, and Minnows	0.11	0.12	0.16	0.18	0.14
Largemouth Bass	0.03	0.03	0.37	0.14	0.14
Bullheads and Madtoms	0.02	0.10	0.20	0.05	0.09
Smallmouth Bass	0.01	0.02	0.15	0.12	0.08
Total	**1.34**	**3.61**	**4.60**	**4.09**	3.41

Black Crappie, Rock Bass, Catfishes, suckers and redhorses, and sunfishes (*Lepomis* spp.) exhibited the highest estimated entrainment rates of the target species. Smallmouth Bass and Largemouth Bass, species often sought by anglers, have some of the lowest entrainment rates of the target species and groups, which is likely influenced by spawning habitat requirements and nest building and guarding behavior.

Entrainment rates were highest from April to October, with peaks in April, July, and October (Figure E.9-7). The peak period of entrainment was variable between the target species and species groups and likely driven by individual species life history traits and the timing of spawning movements (April), recruitment to catchable size (July or October), or large storm/flow events.

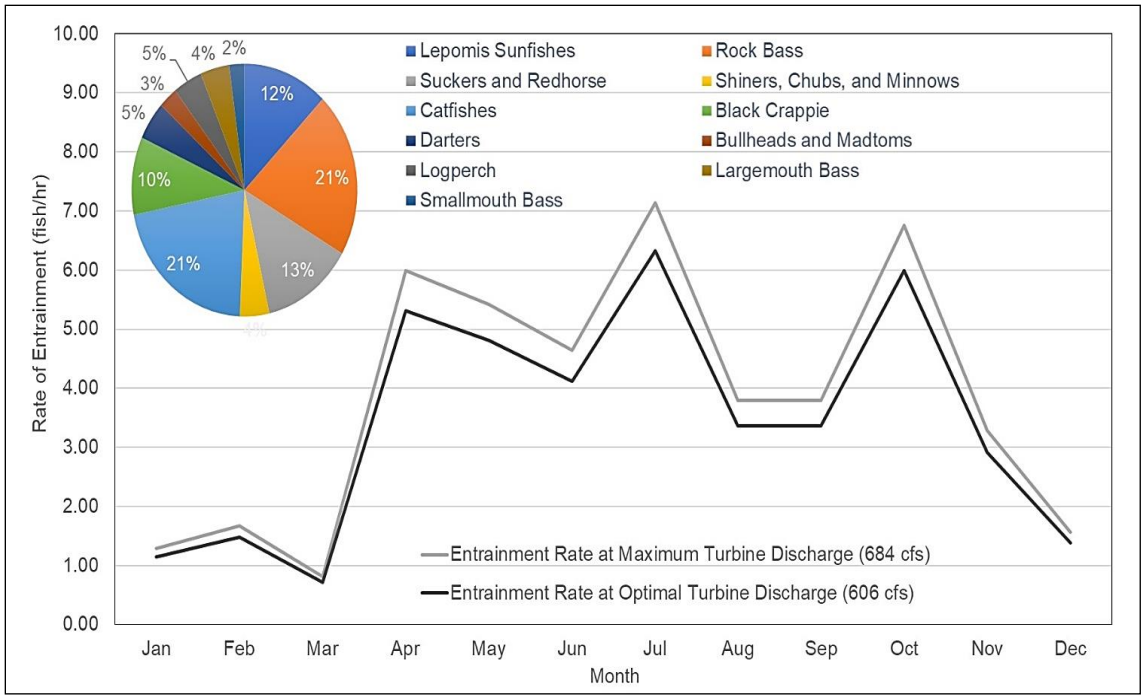


Figure E.9-7. Average Monthly Entrainment Rate and Species Composition based on EPRI (1997) Entrainment Database Selections for the Niagara Hydroelectric Project

Some species have higher entrainment rates in the spring period, which may reflect increased activity associated with spawning (e.g., dispersal for nest site selection, increased feeding); none of the species evaluated for this study exhibit fall spawning behavior. Although spring spawning is common for many species, some species migrate upstream and away from the intake (e.g., suckers and redhorse), create nests in protected areas (e.g., central stoneroller, crevice-spawning shiners), and/or require habitat not found in the vicinity of the intake; therefore, most species were given a low (L) ranking unless elevated entrainment rates were noted (Table E.9-13). Increased entrainment for certain species during the fall months (such as Rock Bass or suckers and redhorse group) may indicate increased activity in response to cooling summer water temperatures, triggering the need for increased foraging in preparation for the winter season, or possibly increased activity following late-summer egg hatch and swim up stage.

The federally endangered Roanoke Logperch was given a low ranking throughout the year due to the habitat preferences of this species. Roanoke Logperch require shallow riffles (males) and deep runs (females) over gravel and small cobble during the reproductive season (USFWS 1992). Outside of this period, habitat selection is dependent on life stage, where young and juvenile Roanoke Logperch are found in slow runs and pools with clean bottoms. Adults are found primarily in runs, and deep fast

Table E.9-13. Qualitative* Monthly Turbine Entrainment Potential for Target Species and Species Groups at the Niagara Hydroelectric Project

Target Species	Qualitative Rating of Monthly Entrainment Potential*											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Largemouth Bass	L	L	L	L	L	L	L	L	L	L	L	L
Smallmouth Bass/Spotted Bass	L	L	L	L	L	L	L	L	L	L	L	L
Black Crappie	L	L	L	L	L	L	L-M	L-M	L	L	L	L
Rock Bass	L	L	L	L-M	L	L	L	L	L	M	L-M	L
Lepomis Sunfishes	L	L	L	L-M	L	L	L	L	L-M	L	L	L
Shiners, Chubs, and Minnows	L	L	L	L	L	L	L-M	L	L	L	L	L
Bullheads and Madtoms	L	L	L	L	L	L	L	L	L	L	L	L
Catfishes	L	L	L	L	M-H	M	M	L	L	L	L	L
Suckers and Redhorse	L	L	L	L	L	L	L	L	L	M	L	L
Darters	L	L	L	L	L-M	L	L	L	L	L	L	L
Roanoke Logperch	L	L	L	L	L	L	L	L	L	L	L	L
*L (low), L-M (low-moderate), M (moderate), M-H (moderate-high), H (high)												

habitats with exposed, silt-free gravel substrate, and occasionally in riffles. During winter, all life stages are found under boulders in deep pools. Generally, Roanoke Logperch have been identified in a variety of habitats, but consistently in silt-free, loosely embedded substrate (Rosenberger 2002). None of these habitats are found in the vicinity of the intake, and therefore likelihood of entrainment of this species is considered low.

Since most species are not expected to spawn in the vicinity of the intake or where eggs and larvae would be susceptible to intake flows, rankings for potential entrainment of early life stages were not elevated. However, currently there is uncertainty regarding the potential entrainment risk of larval Roanoke Logperch at the Project. Larvae of almost all members of the *Percina* genus drift for long distances downstream from their spawning habitats (Buckwalter et al. 2019). Genetic analysis (Roberts et al. 2013) of Roanoke Logperch indicated a dispersal extent of up to 80 kilometers (km); however, median lifetime dispersal distance is 6-24 km (Roberts et al. 2016). The potential for larval Roanoke Logperch spawned upstream of the Project to drift into the Project intake and through the turbines is unknown at this time. The Roanoke Logperch larval drift survey is scheduled to be completed in spring 2022 and is expected to determine whether larval Roanoke Logperch drift is occurring upstream of and near the Project intake where they could be susceptible to entrainment. Results of the larval drift study will be used to inform further evaluation of Project effects on Roanoke Logperch.

In addition to determining entrainment and impingement risk, a turbine blade strike evaluation was performed using the USFWS (2020) Turbine Blade Strike Analysis (TBSA) model and site-specific information (i.e., turbine type, number of units, bar rack spacing, etc.) and length distributions for target species. Using the model, fish can be subjected up to 20 hazards, or routes, including 3 turbine types and bypasses, incorporating the Franke et al. (1997) equations into a Monte Carlo simulation that produces estimates of blade strike (mortalities) and passage (survival) probabilities for turbine and non-turbine pathways.

The TBSA tool was used to model the downstream passage survival under two operational scenarios: 1) fish that are subject to dam passage through the powerhouse and turbines, and required bypass flow only, or 2) fish that are subject to dam passage through the powerhouse or the spillway leading into the bypass channel. The probability of a fish passing through a turbine or via spill was assumed to be in direct proportion to the volume of flow passing through each route. A spillway and bypass passage survival rate of 97 percent was assumed based on the average of 136 survival tests conducted with juvenile salmonids on the Columbia River (Amaral et al. 2013).

Flow exceedance percentile data were reviewed to determine the volume of spillage at the range of percentiles where river discharge exceeded turbine capacity. Downstream passage survival was estimated by the model for each spillage scenario.

Project-specific inputs were used in the TBSA model. Two scenarios were evaluated:

1. Typical/normal conditions (i.e., no spill beyond required bypass minimum flow)

    a. Routes: Unit 1 turbine (54.8 percent of flow), Unit 2 turbine (44.1 percent of flow) and required bypass flow (1.2 percent of flow).

    b. Fish size classes: 0-2 inch, 2.1-4 inches, 4.1-6 inches, 6.1-8 inches, 8.1-10 inches, 10.1-15 inches, 15.1-20 inches, 20.1 – 25 inches, and 25.1- 30 inches.

2. Spilling conditions - Flow exceedance percentile data were reviewed to determine the volume of spillage at the range of percentiles where river discharge exceeded turbine capacity. A downstream passage survival estimate was calculated for each spillage scenario. The fish length inputs (mean=4.0 inches and standard deviation= 0.0 inches) were taken from the Roanoke Logperch collected in the 2021 Roanoke Logperch Surveys performed in the Project area.

    a. Route: Unit 1 turbine (379 cfs), Unit 2 turbine (305 cfs), required bypass flow (8 cfs) and spillage at 20, 17, 15, 12, 10, 7, 5, 2, and 0.01 percent exceedance.

    b. Fish size class input: 4 inches, the typical size of Roanoke Logperch and the size class expected to be most commonly entrained at the Project (Froese and Pauly 2021).

Input parameters and detailed results for each of the model runs for the nine size classes for the “typical conditions” scenario are provided in the Niagara Fish Impingement and Entrainment Study Report as part of the Fish Community Study, which will be submitted following filing of the FLA. Blade strike probabilities at the Project ranged from 8.7 – 98.9 percent, with the probability of turbine blade strike positively correlated to fish length: smaller fish have lower risk and larger fish have greater risk of mortality due to blade strikes (Table E.9-14). During the 2020-2021 Fish Community Study, a total of 521 fish were measured, the average length was 3.1 inches. Eighty-one percent of the fish collected were less than four inches and ninety-four percent of fish collected were smaller than six inches. While larger fish theoretically have a greater potential for blade strike, they are more likely to be excluded by the trash racks and are not abundant in the Project area. The fish entrainment rate analysis using the EPRI (1997) database indicated fish less than six inches in length to be at greatest risk of entrainment; of those, up to 22.4 percent of fish entrained from 0-6 inches could experience mortality at the Project

based on the TBSA. Risk of mortality by passage through the bypass reach was low at 0.1 percent or less across all size classes. For the fish sizes most likely to be entrained at the Project, overall survival ranges 73.7 up to 91.3 percent.

Roanoke Logperch can grow up to 4.5 inches in length (USFWS 2010), though commonly are around 3.9 inches (Froese and Pauly 2021). Therefore, Roanoke Logperch risk of mortality due to turbine blade strike, under normal flow conditions, ranges generally up to 18.2 percent, but possibly up to 26.3 percent.

Table E.9-14. Estimated Blade Strike, Bypass Failure, and Survival Probabilities at Niagara Hydroelectric Project by Size Class

Size Class (inches)	Blade Strike Probability (%)	Bypass Failure Probability (%)	Survival Probability (%)
0-2	8.7	0.1	91.2
2.1-4	18.2	0.1	81.8
4.1-6	26.3	0.0	73.7
6.1-8	34.3	0.0	65.7
8.1-10	46.4	0.0	53.6
10.1-15	66.0	0.0	34.0
15.1-20	89.8	0.0	10.2
20.1-25	98.9	0.1	1.0
25.1-30	98.8	0.1	1.0

The TBSA was also used to estimate the downstream passage survival under a variety of spill conditions when total plant capacity has been exceeded. This approach allows for the inclusion of alternate routes such as the spillway, bypass and individual turbines to be combined into an overall passage survival estimate, which also incorporates potential fish mortalities from passage-related barotrauma or sheer stress. Spillage first occurs, based on the period of record at the Project, at an annual 20 percent exceedance flow. Several flow exceedance percentages, from 0.01 to 20 percent, were evaluated for Roanoke Logperch with average length of 4.0 inches and are summarized in Table E.9-15.

The percentage of 4.0-inch Roanoke Logperch, or other species of similar size, that would experience mortality due to blade strike, spillway passage, barotrauma or other passage-related causes is

summarized in Table E.9-15. Due to the assumed survival rate of 97 percent for spillway passage, the overall downstream passage survival rate increased with the increasing volume of spill for the range of flow percentiles evaluated. The percentage of Roanoke Logperch and other 4.0-inch sized fish that would survive downstream passage ranged from 81.4 to 96.0 percent.

Table E.9-15. Roanoke Logperch Downstream Passage Survival Estimates at Varying Amounts of Spill at Niagara Hydroelectric Project

Flow Data Period	Flow Exceedance (%)	Volume Spill (cfs)	Spill Route Selection Probability	Turbine Strikes (%)	Spillway Mortalities (%)	Downstream Passage (%)
Annual	20	13	0.018	18.4	0.2	81.4
Annual	17	88	0.113	16.4	0.3	83.3
Annual	15	153	0.181	13.7	0.7	85.7
Annual	12	288	0.294	11.9	1	87.1
Annual	10	398	0.365	13.6	1.1	85.2
Annual	7	678	0.495	9.4	1.5	89.1
Annual	5	1,008	0.593	6.7	1.3	92
Annual	2	2,218	0.762	4.1	2.4	93.5
Annual	0.01	18,109	0.963	0.8	3.2	96

While the greatest opportunity for fish mortality through a facility is typically attributed to potential contact with the turbine runner blades, injuries and mortalities can result from other mechanisms including barotrauma from extreme pressure changes, shear stress, water turbulence, cavitation, and grinding (Deng et al. 2005). A review of survival rates from the Electric Power Research Institute's (EPRI) entrainment survival database indicates that survival rates from comparable projects with similar turbine characteristics as Niagara were generally high (FERC 1995). Since no significant changes have occurred at the facility that would change these parameters since the last relicensing study effort (Appalachian 1991), injuries and mortalities caused by factors other than turbine strikes are expected to be negligible.

The findings of the fish impingement and entrainment study concur with the historical entrainment study completed for the prior relicensing (Appalachian 1991) in that effects to the fish community in the Project vicinity are expected to be minimal. Most fish would not be excluded by the intake trash racks; however, velocities in front of the intake are comparable to normal flow conditions of the Roanoke River and would therefore likely be navigable by most juvenile and adult fish in the area. Entrainment of early life stage fishes (eggs and larvae) is likely minimal given the life history characteristics of species known to occur near the Project. Susceptibility to entrainment is variable

depending on species and time period, however most target species and species groups have low entrainment potential for most of the year.

Benthic Aquatic Resources Study

A Benthic Aquatic Resources Study was performed as part of the current relicensing to document a comprehensive representation of the Project area and to correlate results with previous sampling efforts (Appalachian 1991) for comparison. The study included an Aquatic Macroinvertebrates Study as well as a Freshwater Mussel Survey. Macroinvertebrate and crayfish sampling efforts employed a variety of methods to target representative habitat at 10 sites throughout the Project area. Mussel sampling targeted representative habitat at 13 sites throughout the Project area (Figure E.9-8).

The Benthic Aquatic Resources Study was carried out with the following objectives:

- Quantify the amount of benthic habitat available for macroinvertebrates, crayfish, and mussels within the bypass reach;
- Collect a baseline of existing macroinvertebrate and crayfish communities in the vicinity of the Project using two temporally independent sampling efforts (fall 2020 index period and spring 2021 index period); and
- Identify potential habitat and characterize mussel communities within the Project area.

Aquatic Macroinvertebrates

Macroinvertebrate sampling locations are shown on Figure E.9-8. Macroinvertebrate and crayfish surveys were performed using sampling methods derived from the National Rivers and Streams Assessment Field Operations Manual and VDEQ Biological Monitoring Program Quality Assurance Project Plan and included quantitative and qualitative sampling methods that target different habitats (USEPA 2019; VDEQ 2008). Quantitative sampling methods targeted riffle/run habitats and qualitative sampling methods targeted available microhabitats in pools habitats. Sampling was performed by a state and federally permitted astacologist worked under Virginia Scientific Collecting Permit No. 068630 issued to Edge Engineering and Science, LLC (EDGE). All macroinvertebrate sites were sampled between September 15 and 16 and October 5, 2020, during the fall sample index period defined by VDEQ (September 1 – November 30) (VDEQ 2008).

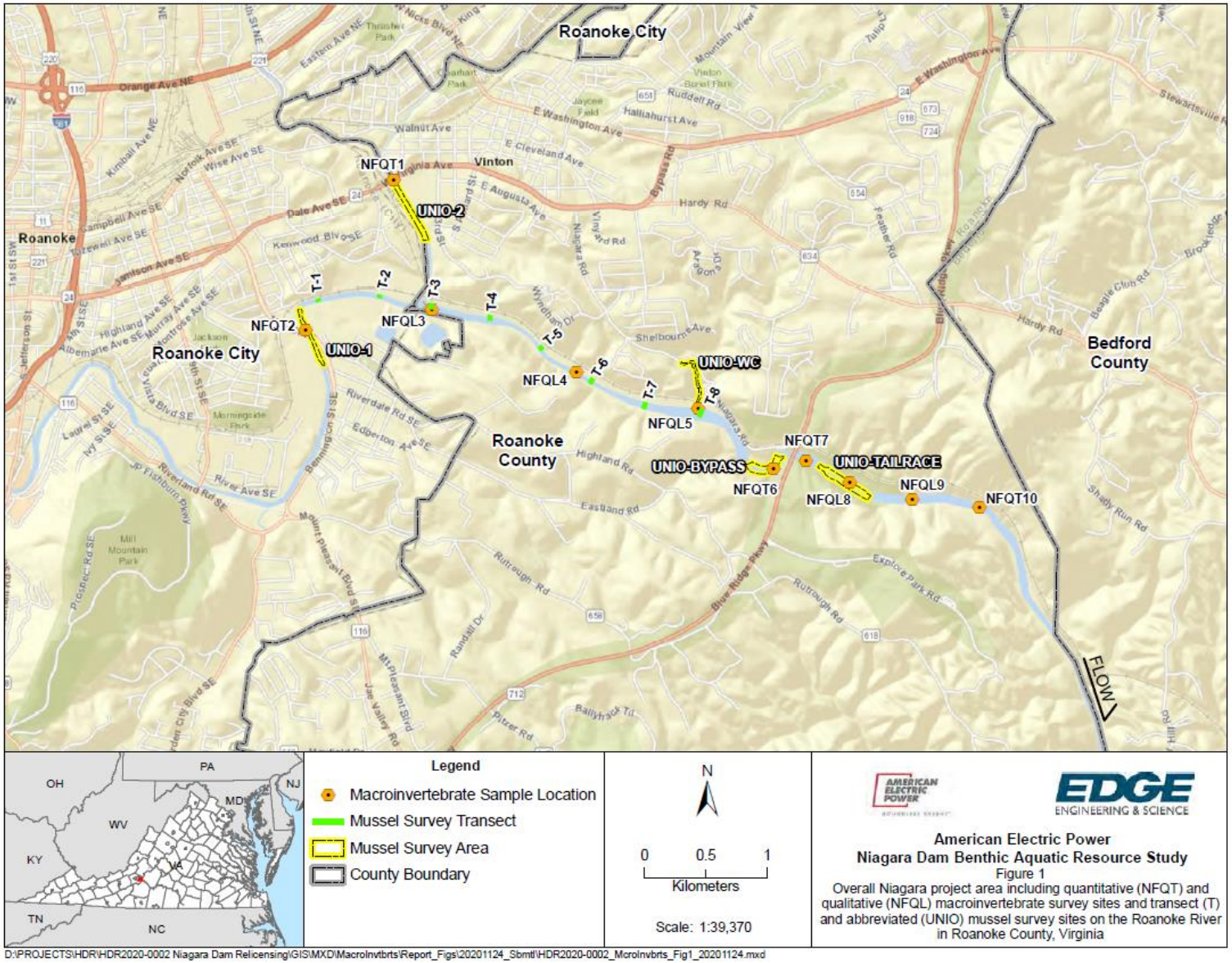


Figure E.9-8. Benthic Macroinvertebrate and Mussel Sampling Locations

Benthic macroinvertebrate and crayfish sampling were completed at five riffle/run sites along 100-m transects. Macroinvertebrate sampling was conducted holding the D-frame net on the bottom of the stream perpendicular to flow and kicking substrate to agitate and dislodge organisms, thus allowing dislodged organisms to flow into the net. A single quantitative sample consisted of a composite of six kick sets, each disturbing approximately 0.33 m² above the dip net for a duration of 30-90 seconds and totaled an area comprising 2.0 m². For quality assurance measures, replicate sampling was conducted at one quantitative site within close proximity (not in the same locations as the first set of samples) of the initial sampling area.

To assess the crayfish community, additional kick samples and seining efforts were performed following benthic macroinvertebrate sampling to ensure all crayfish habitat had been covered. Additionally, crayfish collected during backpack electrofishing efforts (completed as part of fall 2020 field efforts) were processed and added to crayfish data for inclusion as a qualitative data point at analogous sites.

Benthic macroinvertebrate and crayfish were also sampled at five qualitative sites (i.e., multi-habitat) along 100-m transects following guidelines defined by USEPA (2019) and VDEQ (2008). Sampling was conducted by performing 20 jabs with a D-frame net into suitable, stable habitats (snags, vegetation, banks, and substrate) 20 times. A single jab consists of forcefully thrusting the net into a microhabitat for a linear distance of 1.0 m, followed by 2-3 sweeps of the same area to collect dislodged organisms for 20-90 seconds per jab, sweep, or kick. Different types of habitat were sampled in rough proportion to their frequency within the reach. Sampling effort was proportionally allocated (20 jabs/sweeps/kicks) to shore-zone and bottom-zone, 20-90 seconds per jab, sweep, or kick.

The taxonomic results of macroinvertebrate collections are not yet available; however, on-site observations of macroinvertebrates indicate the potential for variability in abundance and community structure throughout the Project area. Five species of crayfish were collected and identified in the field during survey efforts at 8 of the 10 sites sampled: the Appalachian Brook Crayfish (*Cambarus bartoni bartoni*), Atlantic Slope Crayfish (*Cambarus longulus*), Ozark Crayfish (*Faxonius ozarkae*), Virile Crayfish (*Faxonius virilis*), and the Red Swamp Crayfish (*Procambarus clarkii*). The Appalachian Brook Crayfish and Atlantic Slope Crayfish are native to the Roanoke River while the Ozark Crayfish, Virile Crayfish, and Red Swamp Crayfish are considered invasive species in the state of Virginia.

Freshwater Mussels

Freshwater mussel sampling locations are shown on Figure E.9-8. Mussel surveys were performed October 6-8, 2020 following methodology derived from the Draft Freshwater Mussel Guidelines for Virginia (USFWS and VDGIF 2018) and performed by EDGE's state-permitted malacologist and a

commercial dive team under Virginia Scientific Collecting Permit No. 068630. Mussel surveys were carried out using habitat dependent methods (e.g., water depth, substrate, streamflow) and included snorkeling, viewscope, and/or Surface Supplied Air. Sampling dates were chosen within approved survey windows and occurred during relatively low flow and high visibility.

Sampling for freshwater mussels involved surveying along eight transects (from 30 to 75 m in length) placed every 500 m in the reservoir above Niagara Dam and the free-flowing reach near the upstream extent of the Project area. Divers searched transects using Surface Supplied Air methods at an approximate rate of one minute per square meter in heterogeneous substrates. Sampling for freshwater mussels also involved surveying five abbreviated sites outside the impounded area. Abbreviated mussel surveys were completed throughout the assigned survey reach using viewscopes, snorkeling, and Surface Supplied Air methods. Surveyors targeted habitat(s) suitable for the occurrence of freshwater mussels and searched those areas at an approximate rate of one minute per square meter in heterogeneous substrates.

Unionids were mostly absent throughout all 13 survey reaches. Eight transect surveys in the Niagara reservoir, totaling 430 m^2 of search effort, resulted in the collection of zero live or deadshell specimens. Abbreviated surveys at five locations, with a cumulative search effort of 1,335 minutes, resulted in the collection of four live unionids representing one species, Eastern elliptio (*Elliptio complanata*). The Eastern elliptio is native to the Roanoke River system and a common species in Atlantic Slope mussel assemblages. Additionally, a single notched rainbow (*Villosa constricta*) was observed as weathered deadshell material during quantitative macroinvertebrate and crayfish surveys near the Tinker Creek site. No live mussels or deadshell were collected downstream of Niagara Dam. None of the additional species identified by USFWS as potentially occurring in the vicinity of the Project (e.g., Atlantic pigtoe, green floater, or James spinymussel) were collected during the study.

The invasive Asiatic clam was present in relatively even densities throughout the mainstem Roanoke River (above and below Niagara Dam) with the higher densities occurring where suitable mollusk habitat was present. The highest density of Asiatic Clams in the Project area was noted in Tinker Creek. They were also noted at the mouth of Wolf Creek but did not persist beyond the confluence with the Roanoke River.

Invasive Benthic Aquatic Species

The Asiatic clam has historically occurred in the Roanoke River; however, it was previously unconfirmed within the Project Boundary prior to the completion of the Benthic Aquatic Resources Study conducted for this relicensing. In addition to the Asiatic clam, three other state-designated

invasive species (Ozark Crayfish, Virile Crayfish, and Red Swamp Crayfish) were identified within the Project Boundary during recent study efforts.

As described in the section above, the invasive Asiatic clam was noted at all sites in relatively consistent densities within the mainstem Roanoke River (above and below Niagara Dam) with slightly higher densities where suitable mollusk habitat was present. The highest density of Asiatic clams in the Project area was noted in Tinker Creek. The Asiatic clam is a small bivalve, which can be found at the streambed sediment surface (substrate) or slightly buried. It is a filter feeder and removes particles from the water column. It reproduces rapidly and is intolerant to cold temperatures, which can result in fluctuations in annual population sizes. The invasive clam substantially alters benthic substrate and competes with native species for limited resources. There have also been concerns associated with biofouling on power plant and industrial water systems (USGS 2017).

The invasive Ozark Crayfish and Red Swamp crayfish were collected both above and below the dam, whereas the Virile Crayfish was only collected below the dam (however there are records of Virile Crayfish in the Roanoke River above the Project [unpublished data presented in Edge 2020]).

E.9.2.2 Project Impacts on Aquatic Resources

The Licensee does not anticipate that operation and maintenance of the Project over the new license term will have any short- or long-term, unavoidable, adverse impacts on aquatic resources.

Aquatic resources (freshwater fish, mussels, and macroinvertebrates) in the Roanoke River near the Project are potentially affected by Project operations and maintenance. No concerning patterns or trends were identified through evaluation by Appalachian of recent and historical data on the mussel and macroinvertebrate communities in the Roanoke River near the Project.

In SD3, FERC staff identified the following environmental issues to be addressed in their NEPA document:

- Adequacy of the existing minimum flows for protecting aquatic habitat for resident fishes, including species of special concern (Orangefin Madtom), and other aquatic resources, including freshwater mussels, downstream of the powerhouse (50 cfs) and in the bypassed reach (8 cfs).

- Effects of continued project operation and maintenance on the federally listed Atlantic pigtoe, James spinymussel, and Roanoke Logperch.

- Effects of continued project operation and maintenance on aquatic resources, including entrainment and impingement mortality of resident fishes.

- Effects of continued project operation and maintenance on the movement of diadromous fish species (e.g., American eel).

Minimum Flows for the Protection of Aquatic Habitat

During evaluation of the minimum bypass flow for the previous relicensing (License Article 403), VDWR's (then VDGIF's) goals for the bypass reach were to provide enough flow to aid fish that have travelled into the bypass reach during spills over the dam in their return to the downstream channel, and to provide fresh flow through the pools that do develop in the bypass reach under low flow conditions (Appalachian 1990). The 8.0 cfs provided under the existing license was determined to meet these goals. An updated evaluation of the impacts of existing minimum flow in the bypass reach, and any proposed seasonal changes to the minimum flow, on aquatic resources and habitat is ongoing and will be further reported in the USR and summarized in the FLA.

Effects of Continued Project Operation on Federally Listed Aquatic Species

With respect to threatened or endangered aquatic species and aquatic species of special concern, preliminary findings by Appalachian are as follows:

- Roanoke Logperch were collected within the Project Boundary, upstream and downstream of Niagara Dam, during the prior relicensing effort (Appalachian 1991), and a single Roanoke Logperch was collected during the 2020 general fish community study at the furthest upstream sampling location, upstream of the confluence of Tinker Creek and the Roanoke River. Adult and juvenile Roanoke Logperch were also collected under existing Project operations, under a variety of stream flows (Table E.9-16), from snorkel survey sites located upstream of the Tinker Creek confluence with the Niagara River, in the bypass channel, and downstream of the bypass channel confluence with the powerhouse tailrace. These data show that Roanoke Logperch is well-distributed throughout the Project Boundary. Further, results from the targeted Roanoke Logperch sampling efforts indicate that population density and distribution within the Project Boundary is comparable or higher than reported in historical relicensing studies (Appalachian 1991).

- Additional details and discussion of Roanoke Logperch populations near the Project, and potential impacts of the Project on Roanoke Logperch life stages, will be provided in the final report submitted to FERC at the end of 2022 as additional information (Roanoke logperch larval drift study results) to support the FLA.

- Desktop research and communications with the VDWR and USFWS identified multiple mussel species with the potential to occur in the Project vicinity, including the Yellow Lance (Elliptio

lanceolata) federally listed as threatened) and Atlantic Pigtoe (Fusconaia masoni, federally listed as threatened), the Green Floater (Lasmigona subviridis, state listed as threatened) and James Spinymussel (Parvaspina collina, federal and state listed as endangered). However, none of these protected mussels are known from the Roanoke River within the Project boundary, and no evidence of these species was encountered during mussel surveys completed at the Project in 2020.

- The state threatened Orangefin Madtom is native to the Roanoke River, where it inhabits moderate to strong riffles and runs with little or no silt. Although Orangefin Madtom have previously been collected in Tinker Creek, none were collected during recent fish community sampling performed for the current relicensing effort. The continued operation of the Project is expected to have little to no adverse effects on the abundance or distribution of Orangefin Madtom in the Roanoke River near the Project.

Table E.9-16. Flows (cfs) documented in the Roanoke River Downstream of Niagara Dam during Roanoke Logperch Snorkel Surveys at the Niagara Hydroelectric Project

Date	Stream Flows (cfs)		
	Bypass	Powerhouse	Combined Downstream Flow
Aug-10-21	27.1	162.2	189.3
Aug-11-21	42.1	230.6	272.6
Oct-19-21	135.7	91.8	227.5
Oct-20-21	5.8	190.3	196.0
Oct-21-21	15.4	174.4	189.8
Oct-22-21	24.6	180.8	205.4

Entrainment and Impingement Mortality of Resident Fishes

Central Stoneroller and Rosefin Shiner were the most common fish species collected at riffle/run sites within the Project area, and Redbreast Sunfish, Golden Redhorse, and Bluegill were the most abundant species present at pool sites. Entrainment risk is expected to be low to medium for most species throughout the year with a medium to medium-high risk for Bluegill, Black Crappie, and catfishes.

Diadromous Fish Species

Fish passage facilities are not available at downstream barriers and diadromous fish are not present at the Smith Mountain Project (Appalachian 2008) located downstream of the Project; therefore, it is unlikely that diadromous fish are present downstream or upstream of the Project.

E.9.3 Protection, Mitigation, and Enhancement Measures Proposed by the Applicant, Resource Agencies, and/or Other Consulting Parties

Appalachian proposes to continue to operate the Project in the existing run-of-river mode for the protection of multiple resources. Based on the results of the studies described in the sections above, Appalachian recognizes a bypass reach flow of approximately 30 cfs would provide a significant incremental increase in overall bypass reach aquatic habitat compared to the existing 8 cfs minimum flow requirement. For the protection of water quality and aquatic resources and habitat, Appalachian is proposing to increase the required year-round minimum flow to the bypass reach from 8 cfs to 30 cfs over the new license term. Appalachian has carefully selected this minimum flow to balance power and non-power values at this small hydropower project. This proposal also responds to USFWS's stated interest (in comments submitted to FERC on December 14, 2021) in working with Appalachian to ensure sufficient flows are provided in the bypass reach "to support the full assemblage of native fish through the entire year, including the RLP."

During the new license term, activities performed under the Roanoke Logperch Plan, which Appalachian presently implements for the downstream Smith Mountain Project (FERC Project No. 2210), could potentially include enhancement projects or studies that would benefit this species at or in the vicinity of the Niagara Project. In their comments submitted to the FERC on December 14, 2021, USFWS noted that the Final Roanoke Logperch Plan developed by Appalachian in 2008 as part of the relicensing for the Smith Mountain Project has been an important mechanism for mitigating impacts from that project, requiring the Licensee to develop, fund, and complete projects annually, to facilitate the recovery of the RLP in the upper Roanoke River watershed. USFWS agreed that a similar approach could be utilized at the Niagara Project "to compensate for unavoidable impacts from Project operations." USFWS further recommended that Appalachian consider a similar approach at this Project. Appalachian expects to further consult with agencies regarding recommended or proposed PM&Es for Roanoke Logperch following and taking into consideration the results of the Roanoke Logperch larval drift study.

While it is unlikely that diadromous fish are present downstream or upstream of the Project (see Section E.9.2.2), there are ongoing efforts on dams downstream of Smith Mountain Lake by the USFWS to pass American eels (*Anguilla rostrata*) and eventually pass anadromous fish (e.g.,

American shad [*Alosa sapidissima*]). Appalachian acknowledges that, as USFWS noted in comments submitted to FERC on December 14, 2021, in the event diadromous fish passage is provided to the Project during the upcoming licensing period, the Secretary of Interior, through the USFWS, will be reserving its authority under Section 18 of the Federal Power Act to prescribe fishways for upstream and downstream passage for diadromous fish species at the Project when it becomes warranted.

In their comments submitted to the FERC on December 14, 2021, the USFWS also provided comments on downstream fish passage as summarized herein. Resident fish move within the river either seasonally for spawning or during natural dispersal. Many of these resident fish species are hosts for freshwater mussels and their ability to disperse helps mussels recolonize new areas and allows better genetic exchange. No reliable safe downstream passage for fish is provided at the Project during low flow periods and the USFWS does not recognize passage through the turbine intakes as an acceptable downstream route for fish because fish that pass through the intake and turbines are subject to injury or mortality from entrainment. The only other viable downstream passage routes are through the Obermeyer gate at low flow and over the dam at high flow; fish that pass through the Obermeyer gate are subject to injury or mortality as there is no plunge pool and fish would impact bedrock/dam face before entering the pool at the base of the dam. In addition, any fish currently surviving passage through the Obermeyer gate may be subjected to low minimum flow, high temperature, and low dissolved oxygen within the bypass reach. Therefore, the USFWS has recommended that Appalachian develop PM&E measures to modify Project operations or Project components to provide safer downstream passage for fish during low flow periods including safer passage through the Obermeyer gate. USFWS further stated that a PM&E measure to provide higher minimum flows in the bypass reach is also needed to ensure water quality and flow is sufficient to allow safe downstream passage through the Project. Appalachian has not identified feasible modifications and does not propose modifications to Project facilities or structures to create a plunge pool below the Obermeyer gate release and does not believe that such a measure is warranted based on the conclusions of the General Fish Community Survey or Fish Impingement and Entrainment Study conducted for this relicensing.

E.10 Wetlands, Botanical, and Terrestrial Resources

E.10.1 Affected Environment

E.10.1.1 Ecoregions

The Niagara Project is located in the USEPA Level IV Southern Limestone/Dolomite Valleys and Low Rolling Hills ecoregion within the larger Ridge and Valley portion of the Appalachians. This lowland region consists of low ridges and broad valleys underlain mostly by limestone and dolomite, with small

amounts of interbedded shale and other rocks. Due to the solubility of these minerals, the region has karst topography, with sinkholes and underground streams. The presence of small amounts of impermeable but more easily-eroded shale imparts some diversity to the topography and soil types here. The region has fewer surface streams, and those that exist tend to have stable year-round flow, more neutral pH, and gentle gradients. The soils of this ecoregion tend to be nutrient-rich and ideal for western agriculture. This region was originally almost entirely forested, with Appalachian oak forest and mixed oak forest on drier upland sites, mesophytic forests on more mesic sites, and bottomland oak forests in lower, wetter areas and some cedar barrens in areas with exposed limestone outcroppings (Woods et al. 1999).

E.10.1.2 Botanical Resources

Around the Project reservoir, the valley walls are covered with a mixture of deciduous hardwoods and conifers, thus reducing erosion potential. Forest cover is of the oak-chestnut type, though there are many bare rock exposures in the rugged terrain. Pine is also abundant, along with other types of cover, such as maple, hickory, hemlock, locust, dogwood, and basswood (Appalachian 1991).

E.10.1.3 Wetlands, Riparian, and Littoral Habitats and Vegetation

Wetlands

Due to the relatively steep terrain along much of the Project's shorelines of the Roanoke River and Tinker Creek, there are limited areas in which wetlands may occur within the Project Boundary and would likely be confined to floodplain areas. Two wetland and deepwater types are currently mapped by the National Wetlands Inventory (NWI) within the Project Boundary: palustrine wetlands and riverine systems as defined by Cowardin et al. (1979). Palustrine wetlands are non-tidal wetlands dominated by trees, shrubs, and/or persistent plants/mosses, generally representing marsh, swamp, and small ponds. According to the NWI, the Roanoke River extending approximately one mile upstream of Niagara Dam is classified as a palustrine wetland with an unconsolidated bottom, with "permanently flooded" and "diked/impounded" modifiers (PUBHh). In addition to this area, three emergent wetlands (PEM1) in the floodplain, and one forested wetland (PFO1) associated with a shallow area of the main channel of the Roanoke River may also occur within the Project Boundary.

The main channel of the Roanoke River upstream of the one-mile stretch above Niagara Dam and downstream of the dam is classified as lower perennial riverine system with an unconsolidated bottom. There are also several intermittent tributary streams and one perennial tributary stream within the study area. Riverine systems include all wetlands and deepwater habitats contained in natural or artificial channels periodically or continuously containing flowing water or which forms a connecting

link between the two bodies of standing water (Cowardin et al. 1979). There are no other NWI-mapped wetlands associated with the Project. Refer to Section E.10.2.1 for detailed maps of field-verified and NWI wetlands and results of the Wetlands, Riparian, and Littoral Study carried out as a part of this relicensing.

Riparian Habitat

According to the USFWS (1998), riparian areas are plant communities contiguous to and affected by surface and sub-surface hydrologic features of perennial or intermittent lotic and lentic water bodies (rivers, streams, lakes, or drainage ways). Riparian areas have one or both of the following characteristics: (1) distinctively different vegetative species than adjacent areas; and (2) species similar to adjacent areas but exhibiting more vigorous or robust growth forms. Riparian areas are usually transitional between wetlands and upland. The extent of the riparian zone is influenced by stream gradient, bank height, valley form, and other floodplain characteristics. These seasonally flooded forests encompass most river floodplain habitats of the northern and western Piedmont and major mountain valleys, except those that are cleared (VDCR 2017a).

The majority of riparian habitat within the Project Boundary is located within the Deciduous Forest, Mixed Forest, and Developed, Low Intensity cover types (USGS 2016). These areas typically support forests dominated by silver maple (*Acer saccharinum*), sycamore (*Platanus occidentalis*), black walnut (*Juglans nigra*), hackberry (*Celtis occidentalis*), American elm (*Ulmus americana*), and boxelder (*Acer negundo var. negundo*). Herb layers in mixed floodplains/riparian areas are usually very lush with nutrient-demanding, early-season species such as Virginia bluebells (*Mertensia virginica*), Canada waterleaf (*Hydrophyllum canadense*), wild ginger (*Asarum canadense var. canadense*), yellow trout-lily *(Erythronium americanum ssp. americanum),* large solomon's-seal *(Polygonatum biflorum var. commutatum)*, and many others (VDCR 2017a).

A survey of the Project wetland, riparian, and littoral vegetation was performed in 1990 for the previous relicensing. This survey indicated the presence of several low, forested areas, which, based on their location several ft above the reservoir level on well-drained soil, appeared to be bottomland or riparian forest rather than forested wetland. These riparian forests were found to cover a total of approximately 20 acres (Appalachian 1991). The shoreline and lands surrounding the Project reservoir are mostly forested and undeveloped, except for the CSX Railroad tracks and right-of-way along the north shore. Within the Project Boundary, discernible riparian vegetation is located along the Roanoke River and Tinker Creek. Refer to Section E.10.2.1 for detailed maps of surveyed riparian habitat and results of the Wetlands, Riparian, and Littoral Study carried out as a part of this relicensing.

Littoral Habitat

Littoral vegetation (submerged aquatic or emergent) in the Project waters has historically been limited to a few and rooted plant species tolerant of urban contamination from upstream (Appalachian 1991). The littoral zone, in the context of a large river system, is the habitat between about a 0.5-m of depth and the depth of light penetration (Wetzel 1975). The littoral width varies based on the geomorphology and rate of sedimentation of the stretch of river (Wetzel 1983). Based on the NWI maps and a review of aerial photography of the study area, prior to the conduct of the surveys for the current relicensing, some potential littoral habitats for wildlife were identified by Appalachian in two locations: the upstream extent of the Project Boundary where the Roanoke River decreases in depth at the furthest upstream meander within the Project Boundary and near the confluence of the Roanoke River and Tinker Creek.

Aquatic vegetation in the Project waters has historically been noted to be limited to a few algal and rooted plant species tolerant of urban contamination from upstream (Appalachian 1991). Refer to Section E.10.2.1 for detailed maps of surveyed littoral habitat and results of the Wetlands, Riparian, and Littoral Study carried out as a part of this relicensing.

E.10.1.4 Invasive Botanical Species

The VDCR maintains a list of invasive plant species found within the State (VDCR 2017b). The list includes those species that pose a threat to Virginia's forests, marshes, wetlands, and waterways. They are ranked based on the level of threat they present to natural communities and species. There are close to 100 invasive plant species in Virginia (VDCR 2017b). Invasive botanical species that were observed in the study area during relicensing field efforts are included in Section E.10.2.1.

E.10.1.5 Wildlife Resources

The Project area supports a number of small mammals, avifauna, reptiles, and amphibians. Over 623 species were identified as potentially occurring within a three-mile radius of the Project per a geographic search using the Fish and Wildlife Information Service (VDGIF 2017). In the new license term, Appalachian expects to implement and develop a Terrestrial Resources Protection Plan, in part, for the protection of riparian forest habitat at the Project. A list of wildlife observed during the field assessment for the Wetlands, Riparian and Littoral Habitat Study is provided in Appendix D (Volume II).

Mammals

Mammals such as white-tailed deer (*Odocileus virginianus*), coyote (*Canis latrans*), red fox (*Vulpes vulpes*), and gray fox (*Urocyon cinereoargenteus*) are known to occur within the Project area (VDGIF 2017). Other smaller species such as the eastern chipmunk (*Tamias striatus*), red squirrel (*Tamiasciurus hudsonicus*), eastern gray squirrel (*Sciurus carolinensis*), and longtail weasel (*Mustela frenata*), common mink (*Neovison vison*), American beaver (*Castor canadensis*), striped skunk (*Mephitis mephitis*), raccoon (*Procyon lotor*), woodchuck (*Marmota monax*), muskrat (*Ondatra zibethicus*), meadow vole (*Microtus pennsylvanicus*), deer mouse (*Peromyscus maniculatus*), northern white-footed mouse (*Peromyscus leucopus*), and northern shorttail shrew (*Blarina brevicauda*) are also known to occur in the general vicinity of the Project (VDGIF 2017).

Reptiles and Amphibians

A variety of reptiles and amphibians has been known to occur in the general project vicinity. Common species may include the snapping turtle (*Chelydra serpentine*), painted turtle (*Chrysemys picta*), eastern garter snake (*Thamnophis sirtalis*), red-spotted newt (*Notophthalmus viridescens*), American toad (*Anaxyrus americanus*), spring peeper (*Pseudacris crucifer)*, gray tree frog (*Hyla versicolor*), green frog (*Lithobates clamitans*), American bullfrog (*Lithobates catesbeianus*), pickerel frog (*Lithobates palustris*), and wood frog (*Lithobates sylvaticus*) (VDGIF 2017).

Avifauna

Over 470 bird species have been documented in Virginia (Virginia Society of Ornithology 2017). Birds such as the northern cardinal (*Cardinalis cardinalis*), American crow (*Corvus brachyrhynchos*), mourning dove (*Zenaida macroura*), pileated woodpecker (*Dryocopus pileatus*), and wood duck (*Aix sponsa*) are some of those known to occur in the Project area (Virginia Society of Ornithology 2017).

E.10.1.6 Federally Listed Threatened, Endangered, and Candidate Species

The federally endangered Indiana bat (*Myotis sodalist*), as well as the federally threatened northern long-eared bat (*Myotis septentrionalis*), may occur within the Project's vicinity. Additionally, the monarch butterfly (*Danaus plexippus*), which was listed as a candidate species in December of 2020, has the potential to occur in the study area.

When a species is proposed for listing as endangered or threatened under the ESA, the USFWS must consider whether there are areas of habitat believed to be essential to the species' conservation. (Note that candidate species receive no statutory protection under the ESA). Those areas of habitat may be proposed for designation as critical habitat. Critical habitat is a specific geographic area(s) that contains features essential for the conservation of a threatened or endangered species and that may require special management and protection. Through consultation with the USFWS, no critical habitat has been designated under the ESA for species in the Project vicinity. Additionally, note that there are no primary transmission lines associated with the Project, therefore, there are no clearing or vegetation maintenance activities that would affect terrestrial species near the Project.

The sub-sections below provide a habitat description for three of the four protected species; see Section E.9.1.5 for discussion of protected aquatic species.

Indiana Bat

Indiana bats are found over most of the eastern half of the United States (USFWS 2016). The Indiana bat is a relatively small, dark-brown bat. Although they only weigh around one-quarter of an ounce, they have a wingspan of 9 to 11 inches (USFWS 2016).

Indiana bats hibernate during winter in caves or occasionally in abandoned mines. They hibernate in cool, humid caves with stable temperatures under 10°C, but above freezing. Very few caves are known to have these characteristics. The vast majority of these sites are caves located in karst areas of the east-central U.S.; however, Indiana bats also hibernate in other cave-like locations, including abandoned mines. Critical habitat for this species designated by USFWS includes 11 caves and 2

abandoned mines in Illinois, Indiana, Kentucky, Missouri, Tennessee, and West Virginia. No critical habitat is designated within the Project Boundary.

After hibernation, Indiana bats migrate, often long distances, to their summer habitat in wooded areas where they roost under loose tree bark on dead or dying trees. They forage in or along the edges of forested areas (USFWS 2016). Migratory females may migrate up to 357 miles to form (summer) maternity colonies to bear and raise their young, with each giving birth to just a single pup (USFWS 2016). In summer, most reproductive Indiana bat females occupy roost sites under the exfoliating bark of dead trees that retain large, thick slabs of peeling bark. Primary roosts usually receive direct sunlight for more than half the day. Roost trees are typically within canopy gaps in a forest, in a fence line, or along a wooded edge. Habitats in which maternity roosts occur include riparian zones, bottomland and floodplain habitats, wooded wetlands, and upland communities. Indiana bats typically forage in semi-open to closed (open understory) forested habitats, forest edges, and riparian areas (USFWS 2007). Both males and females return to hibernacula in late summer or early fall. Indiana bats mate during the fall before they enter hibernation, but fertilization is delayed until the spring after they emerge from the caves (USFWS 2007).

In the summer of 2017, the Virginia Department of Transportation conducted an acoustic bat survey along the eastern segment of the Roanoke River Greenway to determine if Indiana bats are present along the proposed corridor (VDOT 2017). The survey included areas in the Project vicinity. Overall 5,616 calls were recorded and classified to species over 20 detector nights at 9 survey locations. No Indiana bats were detected (VDOT 2017).

Multiple biological opinions have been developed for the Indiana bat (USFWS 2017). A draft recovery plan was issued for the Indiana bat in April 2007 (USFWS 2007). No official status reports exist for the Indiana bat; however, the general status of this species, the associated listing, fact sheets, range maps, and other important information are available on the USFWS website.

Northern Long-eared Bat

The northern long-eared bat is found across much of eastern and north-central United States and all Canadian provinces from the Atlantic Ocean west to the southern Yukon Territory and British Columbia (USFWS 2013). It is a medium-sized bat, measuring 3.0 to 3.7 inches, with a wingspan of 9 or 10 inches. The color of its fur can be medium to dark brown on the back and tawny to pale-brown on the underside. The bat is distinguished by its long ears relative to other bats in the genus *Myotis* (USFWS 2013).

The northern long-eared bat spends winters hibernating in caves and mines and prefers hibernacula with very high humidity. During the summer months, the northern long-eared bat prefers to roost singly or in colonies underneath bark, in cavities, or in the crevices of live or dead trees (USFWS 2013). Breeding begins in late summer or early fall when males swarm near hibernacula. After a delayed fertilization, pregnant females migrate to summer colonies where they roost and give birth to a single pup. Young bats start flying 18 to 21 days after birth, and adult northern long-eared bats can live up to 19 years (USFWS 2013).

Northern long-eared bats emerge at dusk and fly through the understory of forested hillsides feeding on moths, flies, leafhoppers, caddisflies, and beetles. They also feed by gleaning motionless insects from vegetation and water (USFWS 2013).

The most severe and immediate threat to the northern long-eared bat is white-nose syndrome. As a result of this disease, numbers have declined by 99 percent in the northeast. Other significant sources of mortality include impacts to hibernacula from human disturbance. Loss or degradation of summer habitat due to highway or commercial development, timber management, surface mining, and wind facility construction and operation also contribute to mortality (USFWS 2015).

The spatial distribution for the northern long-eared bat extends from Montana and Wyoming in the west, south to eastern Texas, across the northern portions of Mississippi, Alabama, Georgia, and North Carolina, north to Maine, and across the Great Lakes. As this species overwinters in local or regional hibernacula, it does not migrate extensive distances and, therefore, does not have significant temporal distribution (USFWS 2013). No critical habitat has yet been determined or designated by USFWS for this species.

Multiple biological opinions have been developed for the northern long-eared bat (USFWS 2017b). No official status reports exist for the northern long-eared bat; however, the general status of this species, the associated listing, fact sheets, range maps, and other important information are available on the USFWS website. A recovery plan has not yet been developed for the northern long-eared bat.

Monarch Butterfly

A recent (January 2022) review of the USFWS IPaC database indicates the monarch butterfly, which was listed as a candidate species in December of 2020, has potential to occur in the study area. In North America the eastern population of the monarch butterfly migrate north to the United States and Canada in March from the mountains of central Mexico. This species is typically found in open grass areas during the breeding season. Adult monarchs use a wide variety of flowering plants throughout migration and breeding. Important nectar sources during the spring migration typically include

tickseeds (*Coreopsis* spp.), Viburnum spp., Phlox spp., and early blooming milkweeds. Important nectar sources during fall migration include goldenrods (*Solidago* spp.), asters (*Symphyotrichum* spp. and *Eurybia* spp.), gayfeathers (*Liatris* spp.), and coneflowers (*Echinacea* spp.). The optimal survey window for this species is August-December (USFWS 2019).

A candidate species listing indicates that the USFWS has sufficient information on a species' biological status and threats to propose it as endangered or threatened, but for which development of a proposed listing regulation is precluded by other higher priority listing activities. Candidate species receive no statutory protection under the Endangered Species Act.

E.10.1.7 State-listed Threatened, Endangered, and Candidate Species

Table E.10-1 lists rare terrestrial species and historical records at or within the Project vicinity. For discussion of state-listed aquatic species, see Section E.9.1.5.

Table E.10-1. Rare Terrestrial Species with Historical Records at or within the Project Vicinity

Common Name	Scientific Name	Status*	Tier**
Amphibians			
Blue Ridge dusky salamander	*Desmognathus orestes*		IVc
eastern mud salamander	*Pseudotriton montanus montanus*		IVa
eastern spadefoot	*Scaphiopus holbrookii*		IVc
Jefferson salamander	*Ambystoma jeffersonianum*		IVa
Peaks of Otter salamander	*Plethodon hubrichti*		Ic
Arachnids			
wolf spider	*Lycosa lenta*		IVc
Birds			
American black duck	*Anas rubripes*		IIa
American woodcock	*Scolopax minor*		IIa
bank swallow	*Riparia riparia*		IIIc
barn owl	*Tyto alba pratincole*		IIIa
belted kingfisher	*Ceryle alcyon*		IIIb
black-and-white warbler	*Mniotilta varia*		IVa
black-billed cuckoo	*Coccyzus erythropthalmus*		IIb
black-crowned night-heron	*Nycticorax nycticorax hoactii*		IIIa
brown thrasher	*Toxostoma rufum*		IVa
Canada warbler	*Cardellina canadensis*		IVb
cerulean warbler	*Setophaga cerulea*		IIa

Common Name	Scientific Name	Status*	Tier**
chimney swift	*Chaetura pelagica*		IVb
common tern	*Sterna hirundo*		IIa
eastern wood pewee	*Contopus virens*		IVb
eastern kingbird	*Tyrannus tyrannus*		IVa
eastern meadowlark	*Sturnella magna*		IVa
eastern towhee	*Pipilo erythrophthalmus*		IVa
eastern whip-poor-will	*Antrostomus vociferous*		IIIa
field sparrow	*Spizella pusilla*		IVa
glossy ibis	*Plegadis falcinellus*		Ia
golden eagle	*Aquila chrysaetos*		Ia
golden-winged warbler	*Vermivora chrysoptera*		Ia
grasshopper sparrow	*Ammodramus savannarum pratensis*		IVa
gray catbird	*Dumetella carolinensis*		IVa
greater scaup	*Aythya marila*		IVa
green heron	*Butorides virescens*		IVb
Henslow's sparrow	*Ammodramus henslowii*	ST	Ia
Kentucky warbler	*Geothlypis Formosa*		IIIa
king rail	*Rallus elegans*		IIb
laughing gull	*Leucophaeus atricilla*		IVa
least bittern	*Ixobrychus exilis exilis*		IIIa
loggerhead shrike	*Lanius ludovicianus*	ST	Ia
marsh wren	*Cistothorus palustris*		IVa
migrant loggerhead shrike	*Lanius ludovicianus migrans*	ST	
northern rough-winged swallow	*Stelgidopteryx serripennis*		IVc
northern saw-whet owl	*Aegolius acadicus*		Ic
northern bobwhite	*Colinus virginianus*		IIIa
northern flicker	*Colaptes auratus*		IVb
northern harrier	*Circus cyaneus*		IIIa
peregrine falcon	*Falco peregrinus*	ST	Ia
red crossbill	*Loxia curvirostra*		IIIc
ruffed grouse	*Bonasa umbellus*		IIIa
rusty blackbird	*Euphagus carolinus*		IVb
short-billed dowitcher	*Limnodromus griseus*		IVa
Swainson's warbler	*Limnothlypis swainsonii*		IIc

Common Name	Scientific Name	Status*	Tier**
wood thrush	*Hylocichla mustelina*		IVb
yellow-billed cuckoo	*Coccyzus americanus*		IIIa
yellow-breasted chat	*Icteria virens virens*		IVa
yellow-crowned night-heron	*Nyctanassa violacea violacea*		IIa
Insects			
Appalachian grizzled skipper	*Pyrgus Wyandot*	ST	Ia
Diana fritillary	*Speyeria diana*		IVc
early hairstreak butterfly	*Erora laeta*		IVc
frosted elfin butterfly	*Callophrys irus*		IVc
hoary elfin butterfly	*Callophrys polius*		IVc
long dash butterfly	*Polites mystic*		IVc
monarch butterfly	*Danaus plexippus*	Candidate	IIIa
mottled duskywing butterfly	*Erynnis martialis*		IIIc
northern metalmark butterfly	*Calephelis borealis*		IVc
Persius duskywing butterfly	*Erynnis persius persius*		IIc
regal fritillary	*Speyeria idalia Idalia*		Ia
tawny crescent	*Phyciodes batesii batesii*		IIc
Mammals			
Allegheny woodrat	*Neotoma magister*		IVa
Appalachian cottontail	*Sylvilagus obscurus*		IVa
eastern red bat	*Lasiurus borealis borealis*		IVa
eastern small-footed myotis	*Myotis leibii*		Ia
eastern spotted skunk	*Spilogale putorius putorius*		IVc
hoary bat	*Lasiurus cinereus cinereus*		IVa
little brown bat	*Myotis lucifugus lucifugus*	SE	Ia
long-tailed shrew	*Sorex dispar dispar*		IVc
northern long-eared bat	*Myotis septentrionalis*	FTST	Ia
silver-haired bat	*Lasionycteris noctivagans*		IVa
tri-colored bat	*Perimyotis subflavus*	SE	Ia
Reptiles			
bog turtle	*Clemmys muhlenbergii*	FTSE	Ia
common ribbonsnake	*Thamnophis sauritus sauritus*		IVa
eastern hog-nosed snake	*Heterodon platirhinos*		IVc
queen snake	*Regina septemvittata*		IVa

Common Name	Scientific Name	Status*	Tier**
scarlet kingsnake	*Lampropeltis elapsoides*		IIIc
smooth greensnake	*Opheodrys vernalis*		IIIa
snapping turtle	*Chelydra serpentine*		IVb
southeastern crowned snake	*Tantilla coronate*		IVc
timber rattlesnake	*Crotalus horridus*	CC	IVa
woodland box turtle	*Terrapene carolina Carolina*		IIIa

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

****I=VA Wildlife Action Plan - Tier I – Critical Conservation Need; II=VA Wildlife Action Plan – Tier II – Very High Conservation Need; III=VA Wildlife Action Plan – Tier III – High Conservation Need; IV=VA Wildlife Action Plan – Tier IV – Moderate Conservation Need.

Virginia Wildlife Action Plan Conservation Opportunity Ranking:

a – On-the-ground management strategies/actions exist and can be feasibly implemented.

b – On-the-ground actions or research needs have been identified but cannot feasibly be implemented at this time.

c – No-on-the ground actions or research needs have been identified or all identified conservation opportunities have been exhausted.

In the summer of 2017, the Virginia Department of Transportation conducted an acoustic bat survey along the eastern segment of the Roanoke River Greenway to determine if protected bats were present along the proposed corridor (VDOT 2017). Activity of the state endangered little brown bat was confirmed during the survey (VDOT 2017). As opposed to roosting in trees, this species typically roost in caves, buildings, bridges, and other structures (VDOT 2017). A search using the Virginia Department of Game and Inland Fisheries Little Brown Bat and Tri-colored Bat Winter Habitat and Roosts Application displayed that the Project Boundary is outside the 5.5-mile buffer zone of the closest known little brown bat or tri-colored bat hibernaculum site (VDGIF 2018).

E.10.1.8 Other Species of Interest

The bald eagle (*Haliaeetus leucocephalus)* was delisted under the ESA on August 8, 2007 but has been conferred separate protection under the Federal Bald and Golden Eagle Protection Act (16 USC 668(a), 50 CFR Part 22) and the Migratory Bird Treaty Act (50 CFR §21.11). While no bald eagles or nests have been observed or reported at the Project, bald eagles may occur in Roanoke County. Suitable habitat for bald eagle bereding and foraging is present in the vicinity of the Project. National Bald Eagle Management Guidelines that provide recommendations to avoid disturbing nesting bald eagles were developed by USFWS in May 2007.

E.10.1.9 Existing Relevant License Requirements

Article 407 of the existing license requires Appalachian to implement the Wildlife Management Plan/Management Plan for Riparian Forest Wildlife Habitat/Wildlife Management Plan (WMP) filed with the Commission on February 25, 1993. Under the WMP, Appalachian consults with VDWR and the USFWS every five years regarding the WMP and files a report with FERC. The most recent WMP report was filed on November 5, 2015, documenting inspection reports for years 2010 through 2014. The existing WMP provides for the following measures:

- Conducting an annual visual inspection for evidence of increased human disturbance and, in the event of such disturbance, consulting with the VDWR;
- Consulting with VDWR about any planned activity that may affect the riparian forest areas;
- Monitoring the riparian forest areas for evidence of increased bank erosion and, in the event of increased erosion, consulting with VDWR; and
- Notifying VDWR if unanticipated impacts occur to the riparian forest areas.

E.10.2 Environmental Analysis

E.10.2.1 Studies in Support of the Current License

In support of the current relicensing, Appalachian conducted the Wetlands, Riparian, and Littoral Habitat Study. The goal of this study was to identify and characterize the existing wetlands, waterbodies, and riparian and littoral vegetative habitats (including emergent and submerged aquatic vegetation beds) in the study area. Specific study goals and objectives included:

- Perform a desktop characterization using the USFWS NWI, VDEQ Wetland Condition Assessment Tool (WetCAT) (VDEQ 2021b), and other resources such as Geographic Information Systems (GIS) based topographic maps, hydrography, aerial imagery, and soil surveys to identify and describe, approximate, and classify wetlands and waterbodies (i.e., streams, creeks, rivers) within the study area (including upland, littoral, and riparian zones);
- Perform a field verification survey to confirm the location, dominant vegetative community and vegetation classification identified in the desktop survey and resulting maps;
- The field verification will include identification of littoral and instream vegetation in the study area to characterize the availability of littoral, submerged, and emergent vegetative habitat;
- Document wildlife utilizing or present within observed areas during the field verification;

- Using the results of the desktop characterization and field verification, develop a GIS-based map identifying wetlands, waterbodies, and riparian, littoral, and instream vegetative community composition according to the Cowardin Classification System (Cowardin et al. 1979). The map will also identify the location and species of any invasive aquatic vegetation identified in the literature review or during the field verification effort;
- Riparian communities will be classified according to the VDCR Natural Communities of Virginia of Ecological Groups and Community Types Third Approximation (Version 3.3); and
- Using the results of the desktop and field verification efforts, evaluate the potential for Project effects on wetlands, riparian, and littoral habitat in the study area, and wildlife species that utilize these habitats.

The study area for this Wetlands, Riparian, and Littoral Habitat Characterization Study includes 129.6 acres of terrestrial and aquatic habitats shown including the reservoir, terrestrial areas adjacent to the study area boundary at the normal full pond elevation of the Project reservoir, the bypass reach, and the riverine section of the Roanoke River and its tributary streams within the study area (Figure E.10-1).

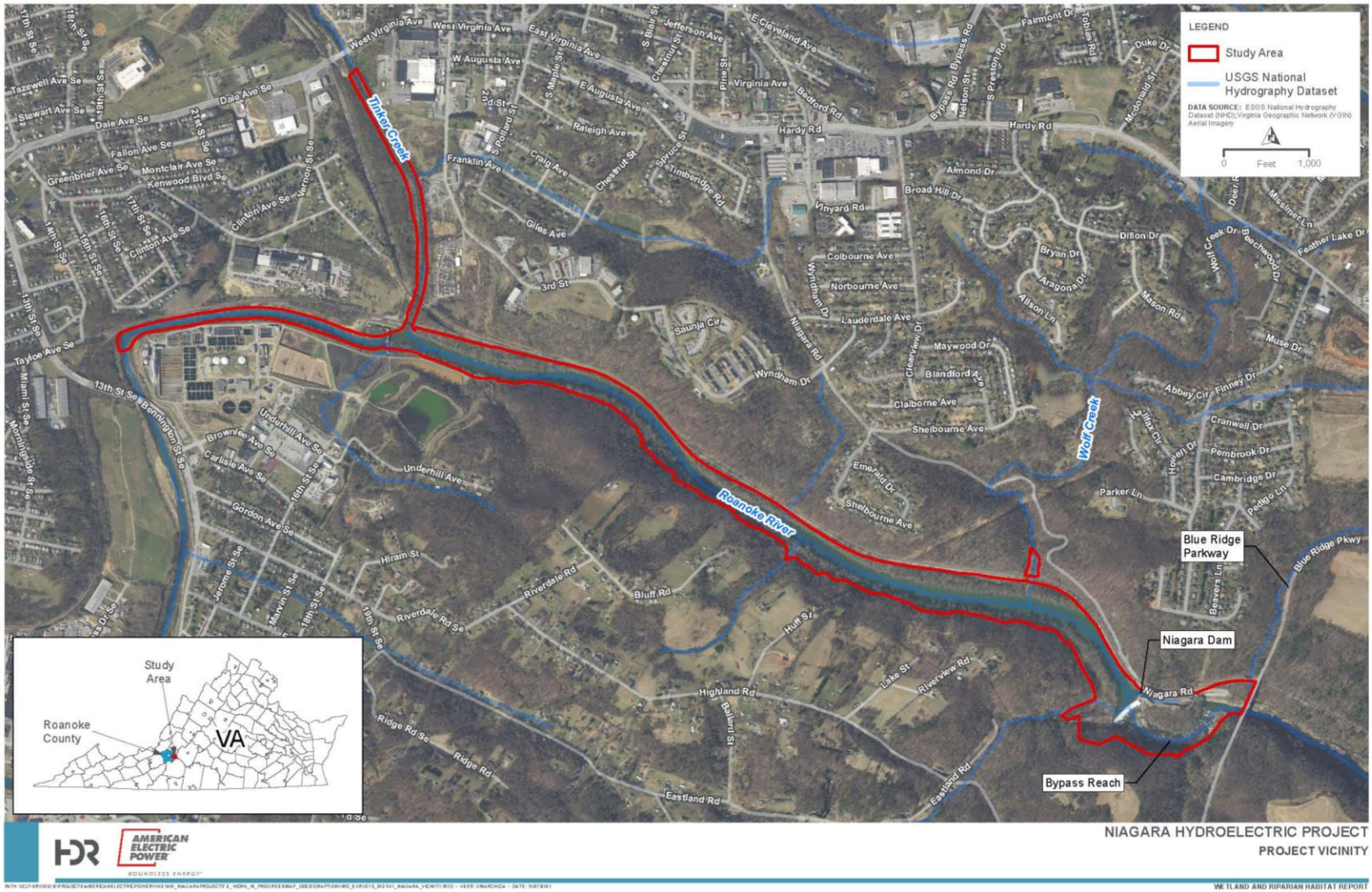


Figure E.10-1. Study Area for Wetlands, Riparian, and Littoral Habitat Study

Methods

An initial desktop study was carried out to identify areas likely to contain wetlands, riparian, and littoral habitat and estimate the amount of each resource area. Wetland areas and streams identified in the desktop study were field-verified, but not formally delineated (i.e., no flagging or boundary marking).

Data collected during the desktop study were used to create preliminary habitat characterization maps that were used to facilitate the field verification efforts. Information sources included the USFWS NWI, the VDEQ WetCAT, USGS topographic maps and National Hydrography Dataset, elevation data, and Natural Resources Conservation Service soil surveys. The VDEQ WetCAT was used to determine NWI habitat condition within the study area (VDEQ 2021b). WetCAT scores wetland types based on the habitat and water quality stressors associated with surrounding land use types; classifications include slightly stressed, somewhat stressed, somewhat severely stressed, and severely stressed.

Wetlands and Waterbodies

Potential streams and wetland areas not confirmed previously (i.e., through prior licensing studies or other sources) were field-verified by HDR Engineering, Inc. (HDR) wetland scientists between June 22nd and June 24th, 2021. A visual assessment and field evaluation of wetland hydrology, hydrophytic vegetation, and hydric soils was performed to identify wetlands. Wetland cover types were classified according to dominance by trees (palustrine forested), herbaceous species (palustrine emergent), open water (palustrine unconsolidated bottom), or riverine rocky outcrop/shore. For wetlands, once the approximate upland boundary of the resource was determined, field personnel identified the edges of the wetland habitat, creating a polygon. In some instances, it was determined that all or a portion of the wetland observed in the field was consistent with boundaries depicted by on the USFWS NWI as well as topography contours. In these instances, the confirmed desktop information including USFWS National Hydrography Dataset, USFWS NWI boundaries and topography contours were used to digitize stream and wetlands boundaries in GIS.

Littoral Zone

A visual assessment was performed to characterize the availability of littoral zone aquatic habitats including emergent aquatic vegetation and submerged aquatic vegetation beds within the bypass reach and reservoir. Spot-check based surveys were performed to characterize the availability of littoral zone aquatic habitats including emergent and submerged aquatic vegetation beds occurring within the study area. The species and general location of invasive aquatic vegetation and evident wildlife usage observed during the field assessment were also noted.

Transect-based surveys were performed to characterize the availability of littoral zone aquatic habitats within the Study area. Four transect lines were evaluated in the reservoir. Transects were oriented parallel to the shoreline in boat accessible areas, with transects distributed to represent both shorelines.

Each transect line was approximately 100 meters in length and 1.0 square meter areas spaced equally along the transect line at 10-meter intervals were surveyed. The survey at each of the 10-meter intervals consisted of a visual presence/absence assessment for emergent or visible submerged aquatic vegetation. A vegetation sampling throw rake was also deployed at each 10-meter sample point on transect lines to capture any non-visible submerged aquatic vegetation.

Riparian Zone

Data from the desktop review were used to perform the riparian habitat field verification. To facilitate the field verification of the preliminary vegetative cover maps, the riparian habitat within each vegetative community type was characterized by recording the dominant species of vegetation at three strata (tree, sapling/shrub, and herb). Invasive species identified during the assessment were also recorded. Field data was compared to the general vegetative community types identified in the preliminary map (developed during the desktop study) to verify their accuracy.

Results

Wetland and waterbody cover types were classified according to Cowardin et. al (1979) and included palustrine (emergent, forested, and unconsolidated bottom) and riverine systems. Cowardin et al. (1979) classifications (map codes) are directly related to NWI classifications (palustrine emergent = freshwater emergent; palustrine forested = freshwater forested; unconsolidated bottom = freshwater pond). These features were verified in the field and are depicted on Figure E.10-2 and Figure E.10-3 and listed in Table E.10-2. Appendix D (Volume II) includes a photolog of representative wetland cover types. A description of the general study-related wetland information is provided below.

Approximately 61.36 acres of wetlands and waterbodies identified during the desktop study using the USFWS NWI database were verified, and an additional 12.45 acres of features were observed in the field. A comparison of NWI-mapped and field verified wetlands is provided in Table E.10-3. A total of 10.37 acres of wetlands were palustrine forested, and 3.33 acres were palustrine emergent, 25.94 were palustrine unconsolidated bottom, and 34.16 acres were riverine.

WetCAT data determined that there is one NWI-mapped wetland in the study area that is severely stressed near the mouth of Tinker Creek, and two wetlands that are somewhat severely stressed near

the mouth of Wolf Creek. These wetlands may be considered stressed due to the flooding potential caused by the impounded Roanoke River. WetCAT scores for field verified wetlands are provided in Table E.10-2.

Table E.10-2. HDR Field Verified Wetlands and Waterbodies in Project Area

Feature ID	Cowardin Classification[1]	NWI Classification	Latitude (dd)	Longitude (dd)	Area (acres)	WetCat Level
Wetland 1	PFO1A	Freshwater forested	37.26356	-79.8955	3.5	N/A
Wetland 2	PFO1A	Freshwater forested	37.26109	-79.8902	2.1	N/A
Wetland 3	PFO1A	Freshwater forested	37.25898	-79.8878	1.28	N/A
Wetland 4	PFO1A	Freshwater forested	37.25774	-79.8833	0.23	N/A
Wetland 5	PEM1C	Freshwater emergent	37.25861	-79.8812	1.26	Somewhat Severely Stressed
Wetland 6	PEM1C	Freshwater emergent	37.25821	-79.8783	0.29	Somewhat Severely Stressed
Wetland 7	PFO1A	Freshwater forested	37.25549	-79.8772	2.93	N/A
Wetland 8	PEM1F	Freshwater emergent	37.25509	-79.8765	0.85	N/A
Stream 1	R5UBH	Riverine	37.25782	-79.8836	125 (linear feet)	N/A

[1]PFO1A= (P) Palustrine, (FO) Forested, (1) Broad-Leaved Deciduous, (A) Temporarily Flooded
PEM1C= (P) Palustrine, (EM) Emergent, (1) Persistent, (C) Seasonally Flooded
PEM1F= (P) Palustrine, (EM) Emergent, (1) Persistent, (F) Semi permanently Flooded
R5UBH= (R) Riverine, (5) Unknown Perennial, (UB) Unconsolidated Bottom, (H) Permanently Flooded

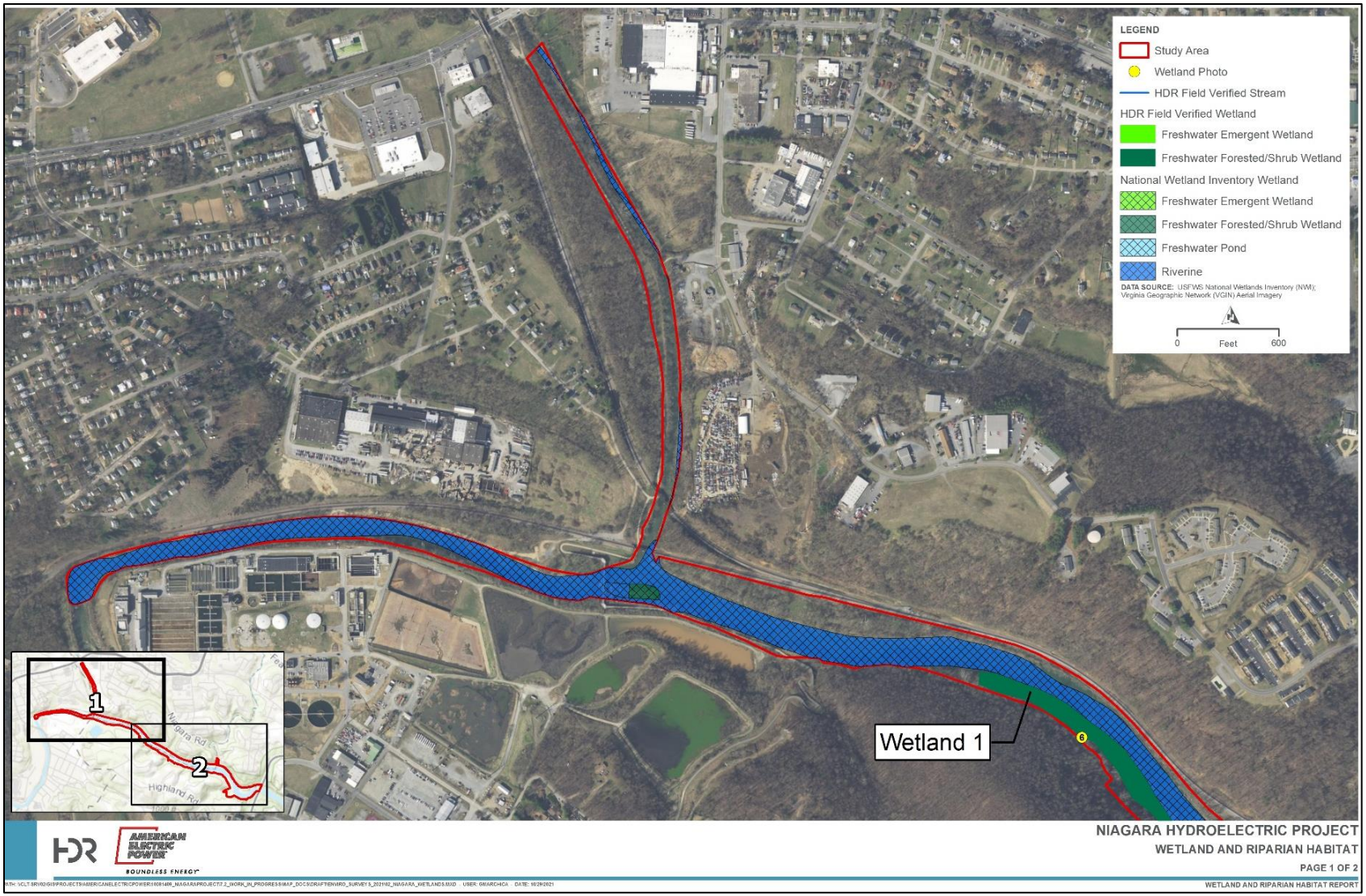


Figure E.10-2. Identified Wetlands in the Study Area (Map 1 of 2)

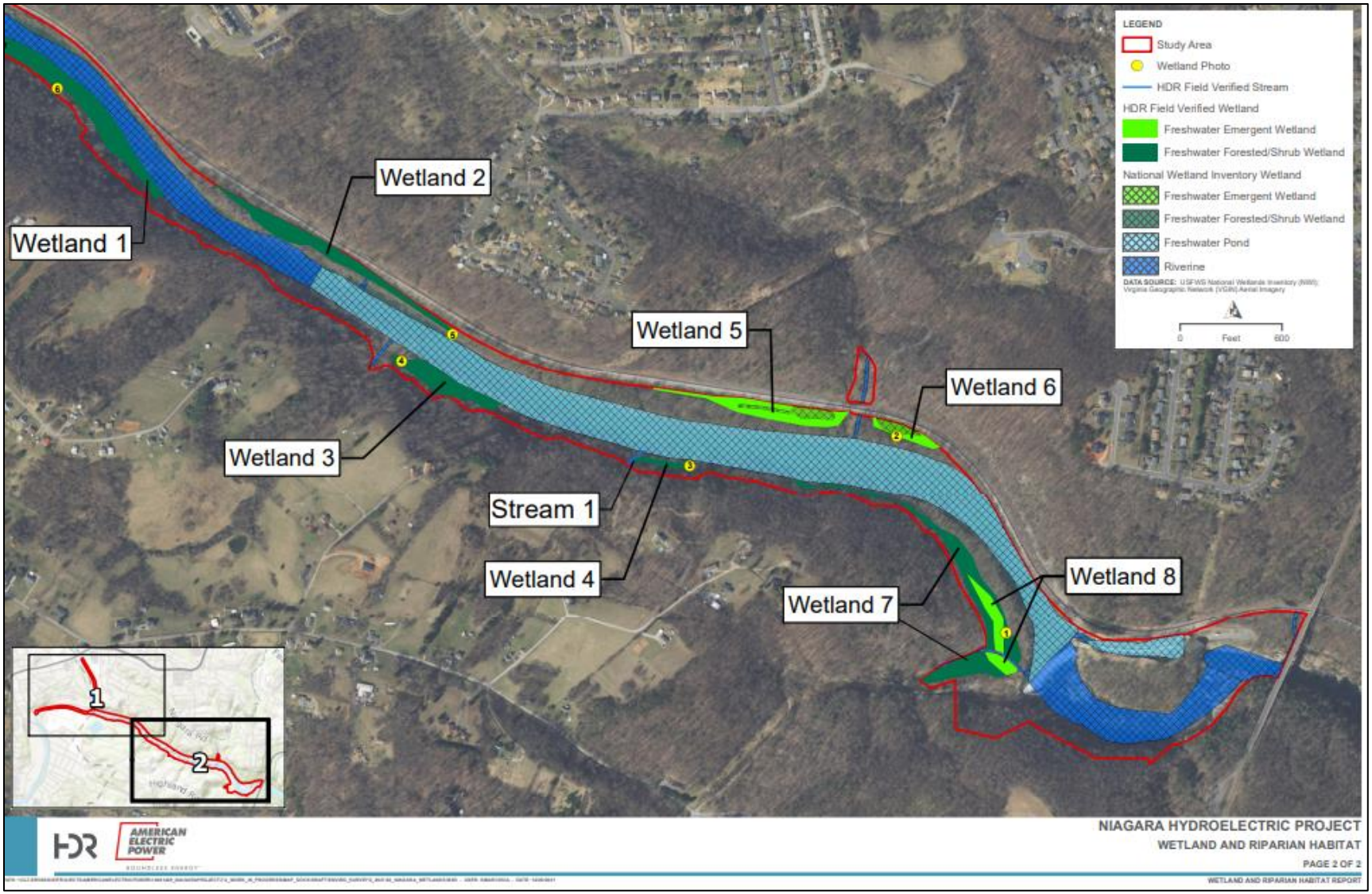


Figure E.10-3. Identified Wetlands in the Study Area (Map 2 of 2)

Table E.10-3. Wetlands in the Study Area

Map Code	System	Subsystem	Class	Subclass	Water Regime/ Chemistry/Special Modifiers	NWI Mapped Wetlands (acres)	Additional Field Mapped Wetlands (acres)
PEM1C	Palustrine	--	Emergent	Persistent	Seasonally Flooded	0.76	1.55
PEM1F	Palustrine	--	Emergent	Persistent	Semi permanently Flooded	0.17	0.85
PFO1A	Palustrine	--	Forested	Broad-Leaved Deciduous	Temporarily Flooded	0.33	10.04
PUBHh	Palustrine (Roanoke River)	--	Unconsolidated Bottom	--	Permanently Flooded, Diked/Impounded	25.94	
R2RSA	Riverine (Roanoke River)	Lower Perennial	Rocky Shore	--	Temporarily Flooded	5.96	
R2UBH	Riverine (Roanoke River)	Lower Perennial	Unconsolidated Bottom	--	Permanently Flooded	26.46	
R2USA	Riverine (Unnamed trib to Roanoke River)	Lower Perennial	Unconsolidated Shore	--	Temporarily Flooded	0.24	
R3UBH	Riverine (Tinker Creek)	Upper Perennial	Unconsolidated Bottom	--	Permanently Flooded	0.80	
R4SBC	Riverine (Wolf Creek)	Intermittent	Streambed	--	Seasonally Flooded	0.60	
R5UBH	Riverine (Unnamed trib to Roanoke River)	Unknown Perennial	Unconsolidated Bottom	--	Permanently Flooded	0.09	0.01
					Total	**61.36**	**12.45**

Palustrine Forested / Freshwater Forested Wetlands

Palustrine forested wetlands (PFO) (or Freshwater Forested Wetlands) within the study area occurred primarily on the higher floodplains and point bars of the Roanoke River. The vegetation found to be dominant in majority of these wetlands were American sycamore (*Platanus occidentalis),* box elder (*Acer negundo)*, black walnut (*Juglans nigra*), silver maple (*Acer saccharinum*), and tulip poplar (*Liriodendron tulipifera*). Majority of understory was comprised of spicebush, (*Lindera benzoin*), green ash (*Fraxinus pennsylvanica*) Japanese stilt grass (*Microstegium vimineum*), jewelweed (*Impatiens capensis*), false nettle (*Boehmeria cylindrica*), and wood nettle (*Laportea canadensis*). Canopy composition was moderately diverse with a cover percentage ranging from 10 to 70 percent. Saturation and high water tables were common throughout these wetlands with some standing water, typically near the toe of slope extent. Flooding in these wetlands seemed to be infrequent due to the higher elevation relative to the channels. Soils consisted mainly of silt and clay with hydric soil indicators such as depleted matrix and redox depressions.

Palustrine Emergent / Freshwater Emergent Wetlands

Palustrine emergent wetlands (PEM) (or Freshwater Emergent Wetlands) occurred primarily as fringe wetlands and floodplain wetlands along the shorelines of the Roanoke River. The largest and most representative example of these wetlands occurs upstream of the Niagara Dam across the river from the boat take-out. The dominant herbaceous species for this wetland included Japanese stilt grass (*Microstegium viminium*), falsenettle (*Boehmeria cylindrica*), and maypop (*Passiflora incarnata*). The percent cover of vegetation in these wetlands ranged from 5 to 90 percent with low diversity and had relatively uniform cover. Saturation and high water tables were common throughout these wetlands with many had surface water, particularly at the boundary of the wetland and the stream. Substrate consisted mainly of silt and clay with hydric soil indicators such as depleted matrix and depleted below dark surface.

Palustrine Unconsolidated Bottom / Freshwater Pond

Palustrine unconsolidated bottom (PUB) (or Freshwater Pond) in the study area are permanently flooded habitats with less than 30 percent vegetative cover. This is a result of a portion of the Roanoke River being impounded. Unconsolidated bottoms are characterized by the lack of large stable surfaces for plant and animal attachment and are typically associated with limited wave and current activity. They are usually found in areas with lower energy and may be very unstable (Cowardin et al. 1979).

Riverine

Riverine habitats in the study area include the Roanoke River and associated tributaries. The Roanoke River is riverine, lower perennial on the upstream and downstream limits of the Project Area. The impounded portion of the river in between is considered riverine, lower perennial, with unconsolidated bottom and PUB according to the NWI. Tinker Creek is an upper perennial stream that flows into the Roanoke River. The habitat in Tinker Creek included several areas of scour and dominant vegetation consisted of American sycamore, boxelder, spicebush, and river oats. The dominant substrate included cobble to boulder sized rock along with bedrock. Wolf Creek and four unnamed tributaries are intermittent streambeds that flow into the Roanoke River. There are also three confluences where tributaries join the Roanoke River in which it is unknown whether they are perennial streams. The flow ranged from high gradient in the intermittent streams, Tinker Creek and the upstream and downstream limit of the study area, to low-gradient in the impounded portion of the study area. Substrates within the impounded area were difficult to determine as depths made observations unattainable. In general, substrates of intermittent streams consisted of gravel and cobble and the streams contained eddy pools and swift currents that provided habitat for mussels and fish species.

Littoral Zone

The littoral zone contains seasonally flooded to intermittently exposed herbaceous vegetation of boulder and cobbly depositional bars, or less frequently bedrock exposures, on the shores and islands and in the bypass reach of the Roanoke River, though some were observed at the northern extent of the study area. The substrate of this zone consisted of angular bed rock and depositional bars of sand and organic material. Pools of surface water were present throughout the littoral zone with patchy vegetation growth in areas that were above water level. No submerged aquatic vegetation was collected in any of the four surveyed transects.

Littoral zone vegetation contains water willow, various terrestrial plants, and algae. The majority of the terrestrial plants observed in the bypass reach were located on floating islands that were likely formed from depositional bars in heavy flow events. Water willow was found to be the most abundant emergent aquatic vegetation throughout the bypass reach encompassing approximately 1.25 acres, or 2.1 percent of the submerged bottom. Water willow beds grew in low-flow pool areas close to the banks and between the rocky outcropping. Algae was sparse in the bypass reach and was primarily located in stagnant pools along the banks with low amounts of daily sunlight. Locations of littoral vegetation beds and representative photographs are included in Appendix D (Volume II of this FLA).

Riparian Zone

The riparian area consists of approximately 65 acres and is found along most of the shoreline of the Roanoke River (Figure 3). The riparian regions within the study area fall closely within the VDCR Piedmont/ Mountain Floodplain Forest and Swamps community type (VDCR 2021). Dominant vegetation in the over story includes butternut (*Juglans cinerea*), black walnut, catalpa (*Catalpa speciosa*), elm (Ulmus spp.), American sycamore, silver maple (*Acer saccharinum*), box elder, green ash, and swamp white oak (*Quercus bicolor*). The understory typically included white mulberry (*Morus alba*), pawpaw (*Asimina triloba*), elderberry (Sambucus nigra), and spicebush,.The herbaceous vegetation consisted of jewelweed, Japanese stiltgrass, poison ivy (*Toxicodendron radicans*), river oats (*Chasmanthium latifolium*), and wild geranium (*Geranium maculatum*). Several invasive species were noted within the riparian areas. Tree of heaven, mimosa, and amur honeysuckle (*Lonicera maackii*) were typically seen along the banks in recently disturbed area with open sunlight upstream from the Niagara Dam. Japanese knotweed was found primarily in the forested riparian area of the bypass reach and in several spots along the banks upstream of the dam. Japanese honeysuckle (*Lonicera japonica*) and Johnsongrass (*Sorghum halepense*) were seen in the herbaceous layer throughout the study area.

The majority of the riparian area appeared to be flooded on a seasonal or annual basis. The riparian areas surveyed ranged from early to mid-successional stage, with most trees at an intermediate age and height, between 20 and 70 ft. Diversity and patchiness were generally moderate. In some areas, particularly in the riparian islands, trees, limbs, and other debris washed in during high water events was abundant. Representative photographs and maps of the Project riparian zone habitat are included in Appendix D (Volume II).

Invasive Plant Species

Invasive vegetation was evident throughout the study area. The majority of observed invasive vegetation (Japanese knotweed [*Reynoutria japonica*], tree of heaven [*Ailanthus altissima*], honeysuckle [*Lonicera japonica*], amur honeysuckle [*Lovicera maackii*], Johnsongrass [*Sorghum halepense*] and mimosa [*Albizia julibrissin*]) were located along the margins of the Roanoke River, along disturbed areas, and within several habitat types within and outside of the study area. These results are reflective of the region-wide invasion of these invasive and non-native species in the eastern U.S.

E.10.2.2 Project Impacts on Botanical, Wetland, and Terrestrial Resources

In SD3, FERC identified the following environmental issues to be addressed in FERC's NEPA document:

- Effects of continued project operation and maintenance on riparian, wetland, and upland habitat and associated wildlife such as bald eagles.

- Effects of continued project operation and maintenance on the federally listed Indiana bat and northern long-eared bat.

There is limited terrestrial land within the Project Boundary, and resource agencies and other stakeholders have not identified potential Project-related impacts on botanical and wetland terrestrial resources within the vicinity of the Niagara Project. The Project has been in operation for over 100 years, and the existing terrestrial environment has developed in response to the current and proposed Project operations.

Resource agencies and other stakeholders have not identified any potential Project-related impacts to wildlife resources within the Project area. The occurrence and distribution of wildlife resources in the Project area is generally unrelated to Project operations, and Project operations have little potential to impact wildlife resources within and bordering the Project. Short-term minimal effects from normal maintenance, temporary construction (though none is presently proposed) and ongoing operations

may temporarily impact some generalist terrestrial wildlife species, however these species would likely move to adjacent habitat, returning once the activities are complete.

Federally endangered Indiana bat and the federally threatened northern long-eared bat may occur within the Project's vicinity. These species could potentially use the Project area for foraging corridors adjacent to the Roanoke River during the non-hibernating period. No impacts to foraging bats are anticipated from continued Project operation. Operation and maintenance of the Project does not currently affect bald eagles, because no individuals or nests have been observed or are known to occur within or adjacent to the Project and no removal of large trees that may provide nesting habitat is proposed to support the Applicant's relicensing proposal.

Appalachian conducts vegetation management activities on an as-needed basis using mostly mechanical vegetation removal techniques (e.g., mowing). The degree of impact resulting from this vegetation management is minor relative to other land uses that occur in the region (e.g., agricultural practices). The effects of these routine vegetation management activities are very minor in nature, and continued operation of the Project is not expected to have an adverse impact on botanical resources.

The types of wetlands bordering the Project generally reflect the expectations for the natural community in this area. The Project operates in a run-of-river mode and experiences seasonal and annual variations in flows based on natural hydrologic conditions in the Roanoke River Basin. Therefore, the proposed operation of the Project will have negligible effects on the flow regime and wetland and riparian habitats in Project area.

The Licensee does not anticipate that operation and maintenance of the Project over the new license term will have any short- or long-term, unavoidable, adverse impacts on botanical, wetland, and terrestrial resources.

E.10.3 Protection, Mitigation, and Enhancement Measures Proposed by the Applicant, Resource Agencies, and/or Other Consulting Parties

While the existing WMP has provided a general means for qualitatively (visually) monitoring land development and general habitat conditions over the term of the existing license, Appalachian does not believe that the process has yielded meaningful information or been necessary to inform decisions or manage limited lands within the Project Boundary. Occurrence and distribution of botanical resources in the Project area is generally unrelated to Project operations, and existing and planned Project operations have little potential to impact botanical and wetland terrestrial resources within and bordering the Niagara Project.

Appalachian does not have plans for improvements or activities at the Project that would require the clearing of roosting habitat or trees that may support maternity colonies for protected bat species (Indiana bat and northern long-eared bat). Appalachian recognizes that activities planned by others, and that may require authorization from Appalachian and FERC for non-project use of Project lands (e.g., Greenway expansion proposed by Roanoke County), are a source of potential disturbance over the existing and new license term.

For any future construction/maintenance activities at the Project, the USFWS recommended a specific PM&E measure be developed to require Appalachian to coordinate with the USFWS on any construction/maintenance activities that occur at the Project during the licensing period to ensure that impacts to federally proposed or listed species and proposed or designated critical habitat are avoided and minimized. USFWS further recommended that if FERC determines that proposed operation of the Project, including but not limited to activities proposed to be undertaken in the future in support of Project operation, modifications, or development of new recreational facilities, may affect federally proposed or listed species and/or proposed or designated critical habitat that may occur in the action area, FERC should request consultation with the Service pursuant to the ESA and its implementing regulations.

Based on this recommendation, as a condition of the new license, Appalachian proposes to develop a Terrestrial Resources Protection Plan in consultation with USFWS and VDWR, to include provisions, as suggested by USFWS, for Appalachian's coordination over the new license term with USFWS and VDWR prior to commencing or authorizing Project operation, modifications, or development of new recreational facilities that may disturb wildlife habitat. The new Terrestrial Resources Protection Plan will update and replace the existing Article 407 WMP and is expected to provide for the following measures:

- Maps and supporting information from the licensing process that identify potentially sensitive areas, as well as the limits of the Project Boundary and lands owned by Appalachian.
- Standard protection measures implemented by Appalachian.
- Appalachian's internal procedures for identifying and communicating activities that may disturb wildlife (including bats and bald eagles) or wildlife habitat, including identification of common operation and maintenance activities that are exempt from the consultation and coordination requirements of this plan.

- Provision for Appalachian to preliminarily identify any federally proposed or listed species and proposed or designated critical habitat that may occur in the study area using the USWFS project review process and IPaC tool (or other tools or processes that may replace these over the new license term).

- Communication protocol for Appalachian's coordination with USFWS and VDWR in advance of non-exempt activities.

- Provision for Appalachian to notify USFWS and VDWR if unanticipated impacts occur to wildlife habitat (including riparian forest areas).

E.11 Recreational Resources

E.11.1 Affected Environment

E.11.1.1 Background

The Roanoke River is an important recreation amenity and natural resource, providing opportunities for canoeing, kayaking, tubing, wading, viewing wildlife, fishing, hiking, biking and exploring nearby trails just outside of the City of Roanoke in Roanoke County, Virginia. Roanoke County is well-known for its recreational opportunities and prioritizes the growth of current and future recreational opportunities. The RRBC, appointed by the RVARC to facilitate the planning, development, and marketing of the Roanoke River Blueway[9], represents just one of the key stakeholders that has facilitated recreational improvements in the County. The Roanoke River Blueway offers a unique combination of urban, front country, and back country recreation opportunities in the upper Roanoke River watershed. Maps, trip planning, water level, and rental information are available on the Roanoke River Blueway website (Roanoke River Blueway n.d.). Additionally, RVGC has also facilitated improvements in the County, specifically focusing on building new greenways paths, implementing a greenway plan for the Roanoke Valley, advising and assisting participating governmental agencies, and facilitating cooperation among stakeholders.

The Blue Ridge Parkway, which is a National Parkway, crosses directly east of the Project's boundary near the tailrace. The NPS maintains a footpath, the Roanoke River Trail, and a roadside overlook on the Project-facing (i.e., west) side of the Blue Ridge Parkway. The Roanoke River Trail is a 0.5-mile-

[9] A blueway is water path made up of launch points to encourage recreation, ecological education, and preservation of wildlife resources.

long gravel hiking trail that provides views of the Roanoke River from the overlook and continues down into the gorge, providing river and fishing access (National Park Planner 2017).

The Project is set within the geographic context of Roanoke County's Blueways and Greenways and the Blue Ridge Parkway; however, recreational opportunities at the Project are limited due to limited land ownership by Appalachian, steep terrain, and the CSX Railroad tracks on the northern riverbank. The major recreational activities at the Project are boating, fishing, and sightseeing.

A Recreation Study has been conducted in accordance with the RSP and the Commission's SPD determining the need for enhancement to existing recreation facilities and for additional recreational facilities to support the current and future demand for public recreation in the study area. The study consisted of developing a Recreation Facility Inventory and Conditions Assessment, a Recreation Visitor Use Online Survey, Aesthetic Flow Documentation, and a Recreation Flow Desktop Evaluation. The study area for the Recreation Study is shown on Figure E.11-1.

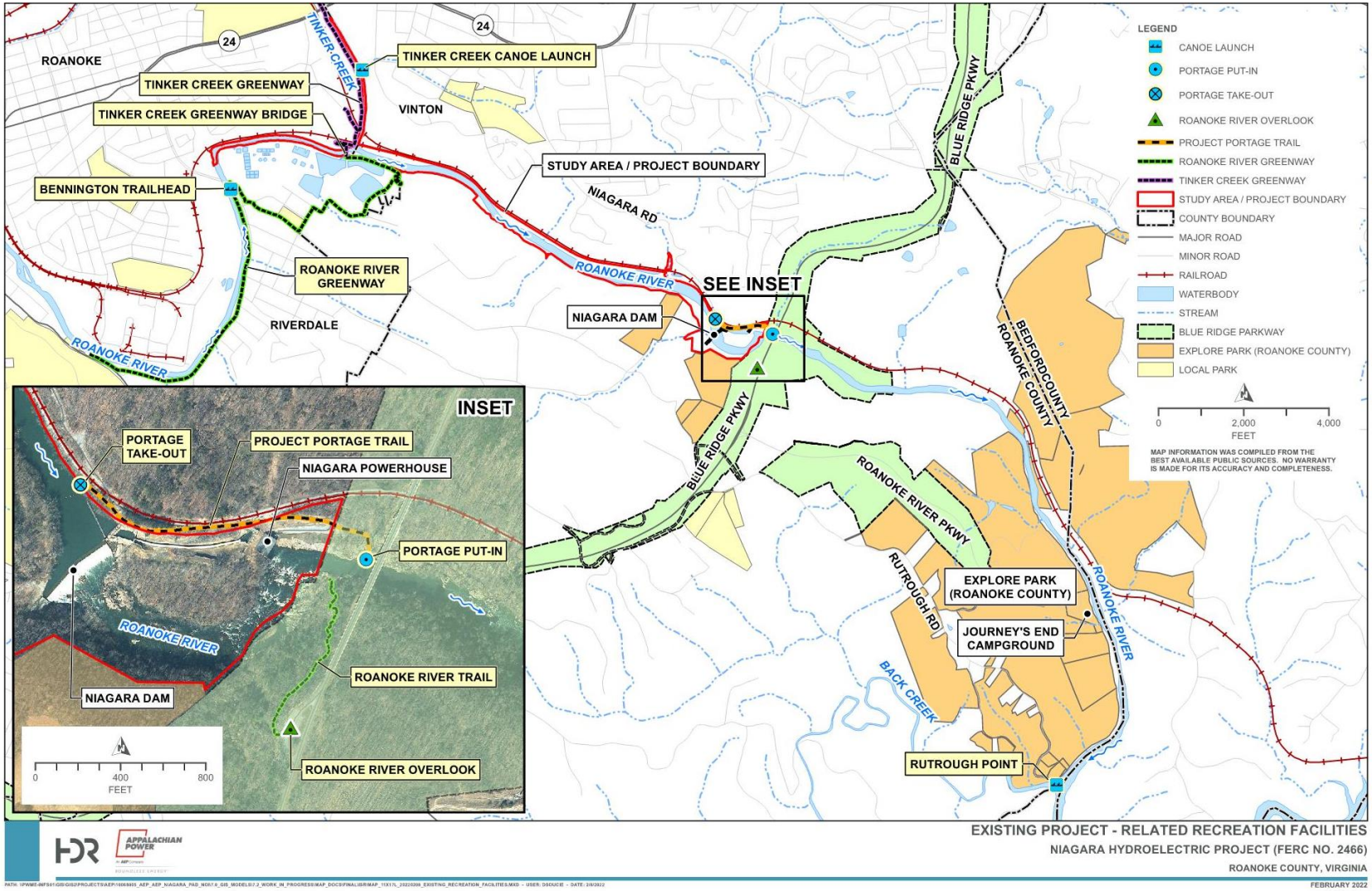


Figure E.11-1. Recreational Facilities Within and Adjacent to the Project Boundary

E.11.1.2 Recreational Facilities and Opportunities

The FERC-approved (i.e., "Project") public recreation facility is the Canoe Portage Take-Out and Trail. The take-out from the Roanoke River is located on the left bank, just upstream of the boat barrier. The take-out and 1,600-foot-long Canoe Portage Trail was constructed at the Project in 1996 by the VDWR and VDCR. The Canoe Portage Take-Out and Trail are maintained by Appalachian and include a take-out point consisting of steps installed by Appalachian in 2014, a crushed stone surface, and a gravel maintenance road connecting to the (Non-Project, also maintained by Appalachian but located on NPS lands) put-in point almost under the Blue Ridge Parkway Bridge. A portage sign is located at the take-out and at the beginning of the pathway leading to the downstream put-in point. These facilities are only accessible by water.

Opportunities for recreational paddling exist both upstream and downstream of the Project. Additional (i.e., "Non-Project") public recreation facilities nearby that provide recreational opportunities on the Roanoke River include:

1) A canoe launch located on Tinker Creek (Tinker Creek Canoe Launch), upstream of Niagara dam, which is maintained by the Town of Vinton. The launch provides a concrete boat ramp, canoe rack, informational kiosk, paved parking lot with handicapped spaces, and a picnic area.

2) The Roanoke River Overlook and Trail, which begins at the NPS Roanoke River Overlook and traverses into the Niagara bypass reach. It provides a short-inclined walk, bird watching, view of the dam and bypass, and access to fishing in the bypass reach.

3) A canoe/kayak launch/take-out located at the terminus of Rutrough Road (i.e. Rutrough Point), approximately three miles downstream of the Project powerhouse. Rutrough Point is located within the Project boundary for Appalachian's Smith Mountain Project.

Another notable opportunity for river-based recreation in the vicinity of the Project is the Roanoke Valley Greenways, in particular the existing 14.2-mile-long Roanoke River Greenway. Efforts are currently underway to complete an additional 25 miles of greenway from Green Hill Park in west Roanoke County, through the Cities of Salem and Roanoke, connecting to the Town of Vinton, and the back to western Roanoke County, the Blue Ridge Parkway, and Explore Park (Roanoke Valley Greenways 2021). The proposed Greenway extension would be located adjacent to and within (in some areas) the Project Boundary. Additional information and figures are presented later in this section.

E.11.2 Environmental Analysis

E.11.2.1 Studies in Support of the Current Relicensing

The Project and Non-Project Recreation Facilities and opportunities were evaluated by Appalachian over a two-year period in support of the Recreation Study. The goal of this study is to determine the need for enhancement to existing recreation facilities and for additional recreational facilities to support the current and future demand for public recreation in the study area. The study objectives are to:

- Gather information on the condition of the one FERC-approved public recreation facility at the Project and identify any need for improvement;
- Gather information on the condition and facilities provided at Non-Project recreation sites;
- Characterize current recreational use of the study area;
- Estimate future demand for public recreation at the Project;
- Evaluate opportunities, processes, and constraints related to short-term or temporary modifications to Project operation to facilitate downstream boating flows;
- Solicit comments from stakeholders on potential enhancements to existing facilities or adding new facilities; and
- Analyze the effects of Project operation on Project-related recreation facilities.

Recreation Facility Inventory and Condition Assessment

In 2020, HDR's sub-consultant, Young Energy Services (YES) completed an inventory and assessed the condition of the facilities for the four Project and Non-Project facilities discussed above (i.e., Canoe Portage Trail, Tinker Creek Canoe Launch, Roanoke Overlook and Trail, and Rutrough Point). Metrics used to evaluate the facilities include the type and location of the existing facility, the type of recreation provided by the facility, length(s), materials, existing signage, sanitation, type of parking access, and Americans with Disabilities Act (ADA) accessibility. YES also completed a qualitative assessment, rating each amenity on the following criteria: (N) Needs replacement (broken or missing components, or non-functional); (R) Needs repair (structural damage or otherwise in obvious disrepair); (M) Needs maintenance (ongoing maintenance issue, primarily cleaning); and (G) Good condition (functional and well-maintained). If a facility was given a rating of "N", "R", or "M", an explanation for the rating was provided.

YES observed several common themes among the recreation facilities and concluded that, overall, the facilities are in good condition. Common themes included:

- Each facility is well maintained with no trash or vandalism observed during the assessment.
- In general, signage is adequate and in good shape at the facilities, except for the Project-related Canoe Portage Trail, where some improvements could be made.
- Americans with Disabilities Act designated parking spots are provided only at the Tinker Creek Canoe Launch.
- Toilet facilities are not provided at any of the facilities.

Additional descriptions of the facilities are presented in the sections below.

Canoe Portage Trail (Project and Non-Project Facility)

Existing Project recreation amenities of the Canoe Portage Trail include timber steps at the take-out, boat barrier upstream of spillway, a portage trail that shares the Project access road (not publicly accessible otherwise) and signage at the take-out, put-in, and along the trail, all of which are located within the Project Boundary. The Non-Project facility consists of a rock outcrop at the put-in, which is located on lands outside of the Project Boundary and owned by the NPS. Conditions of the amenities at the Canoe Portage Trail are summarized below:

- Good condition portage path, 10 ft to 12 ft wide. Slope up to 10 percent. Primarily gravel surface.
- Take-out poorly signed and difficult to use. Debris and silt on steps.
- Put-in along rocks somewhat difficult to use.
- Number of signs adequate. Some signs are worn and faded and should be replaced.
- No sanitary facilities or trash receptacles.

Tinker Creek Canoe Launch (Non-Project Facility)

Existing amenities of the Tinker Creek Canoe Launch include parking for 23 vehicles (5 are for boaters; 1 is ADA), a concrete ramp into Tinker Creek that is 10 ft wide with 10 percent maximum grade, a timber storage rack that can accommodate six canoes or kayaks, and signage and postings. The Tinker Creek Canoe Launch is located partially within the Project Boundary.

Roanoke River Overlook and Trail (Non-Project Facility)

Existing amenities of the Roanoke River Overlook and Trail include asphalt-paved parking spaces for 35 vehicles. The upper 200 ft of the trail is paved with asphalt (3 ft wide), the mid-section is gravel (4 ft wide), and the lower section has 200 timber steps with gravel fill (4 ft wide). Additional amenities include a rock outcropping providing bank fishing at the end of the steps, a trash receptacle at the parking area, and informational signs and benches provided at observation sites along the steps. Additionally, the USGS gauge (USGS 02056000 Roanoke River at Niagara, Virginia) is located just downstream from the stair access to the river. The Roanoke River Overlook at Trail are located outside of the Project Boundary.

Rutrough Point (Non-Project Facility)

Existing amenities of Rutrough Point include 12 timber steps (8 ft. wide) at the put-in and take-out. There is a gravel surface parking lot for 12 vehicles and a gravel surface trail (75 ft. long and 2.5 ft. wide) from the parking area to the put-in and take-out. Additional amenities include bank fishing, access from the parking area to Explore Park (Figure E.11-1) trails, a picnic table, trash receptacles and numerous informational and directional signage. Rutrough Point is located outside of the Niagara Project Boundary but within the project boundary for Appalachian's downstream Smith Mountain Project.

Existing and Future Recreational Opportunities

The goal of the existing and future recreational opportunities task was to convene a meeting with interested relicensing participants (e.g., RRBC, RVGC, FORVA, and relevant state and federal agencies) for a focused discussion of existing and future recreational opportunities at or associated with the Project. On April 20, 2021, Appalachian, YES, HDR, RRBC, the Town of Vinton, FORVA, Roanoke County, Roanoke Valley Greenways, and Roanoke Regional Partnership participated in a virtual meeting. Roanoke County, RRBC, and Roanoke Valley Greenways shared presentations covering their existing recreational opportunities, goals, and future needs in the Roanoke valley region. Stakeholders also clarified recreational recommendations for improvements to the Project and Non-Project facilities. These suggestions included seasonal recreation flow releases, improvements to the Canoe Portage Trail, support for future greenways and access to the bypass on river-right (property access issues), general programmatic support from the Licensee, and trash clean-up.

As discussed during the call, YES and Appalachian evaluated the potential of a river-right canoe portage trail in the field in response to previous stakeholder discussions. They found that the lands adjacent to the south spillway abutment are very steep. Although it may be physically possible to

construct a trail around the spillway abutment that could be utilized as a canoe/kayak portage, the resulting trail would ultimately likely be longer than the existing portage and more difficult to traverse while carrying a canoe or kayak. Any trail constructed would be more conducive to be utilized for hiking and connecting to other trails in the area. It has been determined building a trail is infeasible due to trail length (i.e. longer than the existing trail on river-left), topography (i.e. steep terrain), and property constraints (i.e. landowners unwilling to allow access to their property that would preclude development of a parking area near the right abutment of the dam). Additionally, minimum flows to the bypass reach (existing or proposed by Appalachian) do not provide sufficient depth for navigation through the bypass reach in a canoe or kayak.

Recreation Visitor Use Online Survey

HDR developed an online survey from general concepts and guidance from the National Visitor Use Monitoring Handbook (USFS 2007) as well as from other FERC-approved relicensing studies for recreation visitor use surveys. On April 21, 2020, the online survey was administered through the Project's relicensing website and was available through October 31, 2021 to allow respondents the opportunity to provide survey responses electronically.

Appalachian posted signs including a brief description of the purpose and intent of the survey and website address on Appalachian-owned and/or operated facilities (Canoe Portage Trail and Tinker Creek Canoe Launch). Roanoke County also posted online survey signs at Rutrough Point and Explore Park kiosks near the Visitor Center and Journeys End (where the Blue Mountain Adventures river tubing program is located). Additionally, notice of the survey was posted on the Project's relicensing website and related Facebook pages (Smith Mountain and Claytor Lake), as well as the NextDoor application. The notice was sent to 19 Appalachian-serviced neighborhoods, translating to 3,600 customers in the area of the Niagara Dam and corresponding Project area. These notifications were posted on June 7, 2021. Appalachian also provided the online survey website address in 2020 and again in 2021 to the interested stakeholders, for further distribution of notice of the survey availability to potentially interested parties. Finally, Appalachian notified relicensing participants that the online survey was available through the quarterly ILP study progress reports.

The online questionnaire was designed to collect the following information:

- General user information;
- Resident/visitor;
- Purpose and duration of visit;
- Distance traveled;
- Day use/overnight lodging;

- History of visiting the site or area;
- Types of recreational activities respondents participated in during their visit, including primary and secondary recreation activities;
- General satisfaction with recreational opportunities, facility, and the respondents overall visit and/or areas that need improvement;
- Effects of Project operations on recreation use and access; and
- Accessibility of facilities.

From April 21, 2020 to October 27, 2021, Appalachian received 119 responses to the online survey. A high-level summary of all the recreation facility responses is provided below:

- Seventy-nine percent of the responses primarily came from three recreation facilities: Canoe Portage Trail (owned by Appalachian), Roanoke River Trail/Overlook (owned by NPS), and Rutrough Point (owned by Roanoke County), indicating these sites were the most frequently utilized by online survey respondents.
- Fifty-five percent of the survey respondents came from four zip code locations, averaging 9 miles from the Project. Eighty-three percent considered themselves to be regular visitors to the area (i.e., at least 3 or more visits per year) and stayed at the Project an average length of 4 hours per visit. Ninety-five percent of respondents did not stay overnight at the Project.
- Seventy-three percent of respondents were male.
- Forty-eight percent of respondents were between ages 40 and 59.
- The most frequent months visited were April to September, and April through June were the peak months (Figure E.11-2).
- As shown in Table E.11-1, canoe/kayaking/stand-up paddle boarding (SUP) and fishing were the most popular activities at the Project documented in the online survey.
- Visitors rated each recreational visit at the Project for its accessibility, parking, crowding, safety, condition, availability, and overall experience. The sliding scale rating system indicated that visitors generally found the individual metrics and overall experience “acceptable.” The only metric that was not rated highest in the acceptable category was the Available Facilities metric, which was rated neutral (Figure E.11-3).

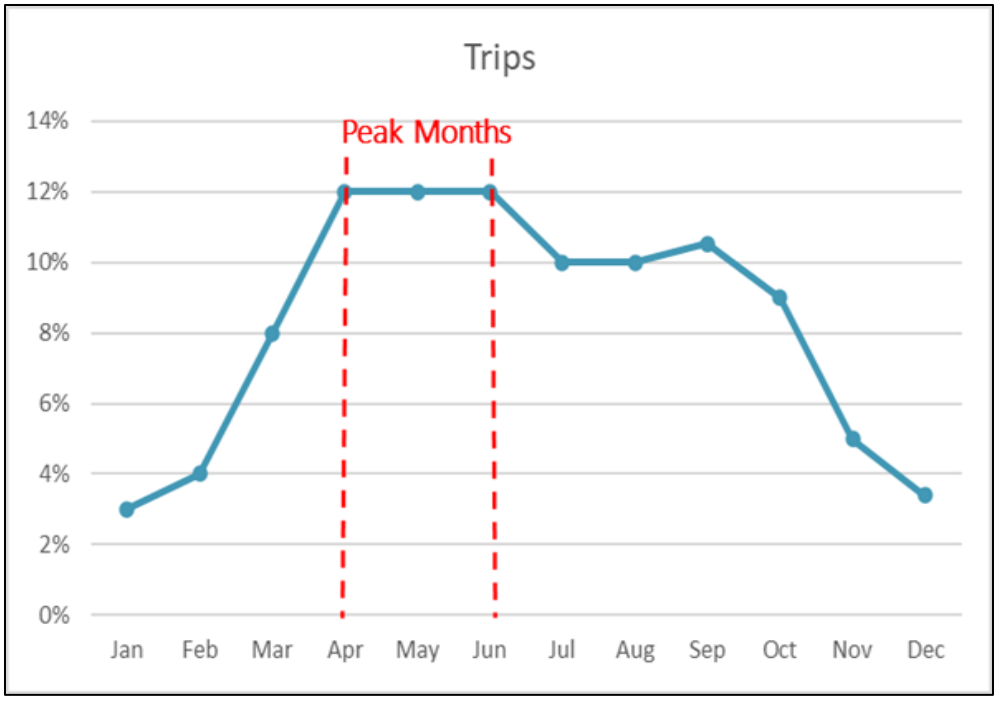


Figure E.11-2. Monthly Recreation Activity for Project and Non-Project Facilities

Table E.11-1. Online Survey Summary for Primary Recreation Activities at all Project and Non-Project Facilities

Primary Activity	Percent (%)
Canoeing/kayaking/SUP	65
Fishing	17
Hiking	8
Pleasure boating/Tubing/Wake Surfing	3
Sight-seeing/Wildlife Viewing	3
Swimming	2
Picnicking	1
Running	1

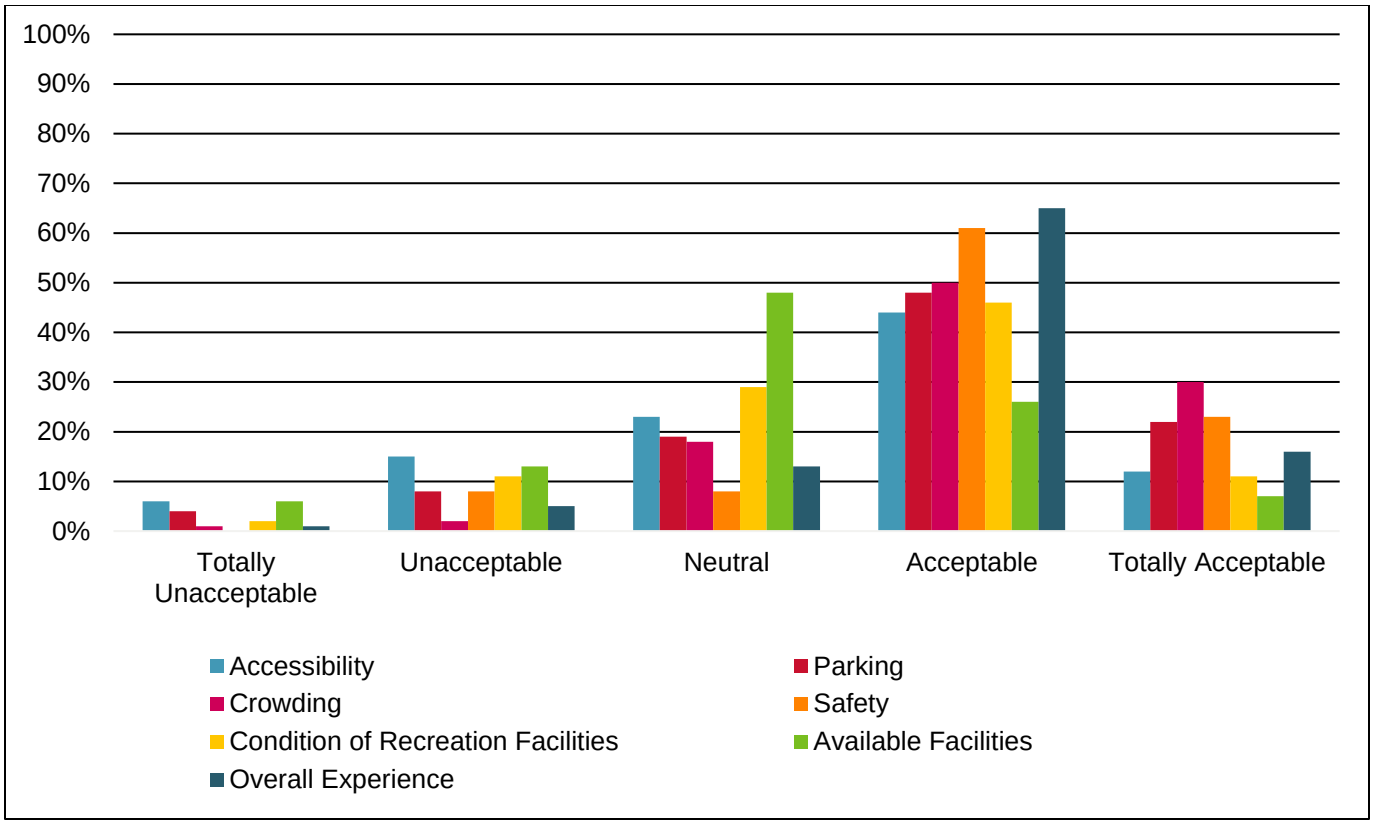


Figure E.11-3. Online Survey Summary for Overall Rating on All Visits at Project and Non-Project Facilities

The online survey resulted in 24 percent of respondents expressing enthusiasm for having the Niagara Project and Non-Project facilities studied. Several comments included requests or recommendations for recreational flow releases, which was analyzed as part of this study and the results are described above. There were also comments including requests for trash removal. The top two suggestions for improvement included better and more public access and improvements to portages.

Recreational Use Documentation

Recreation use monitoring was conducted at the Roanoke River Overlook and Trail, Tinker Creek Canoe Launch, Rutrough Point, and Canoe Portage Trail. For the first three sites referenced, monitoring was accomplished by documenting in the field the number of vehicles parked at the areas provided as well as the number of individuals observed during each visit. In addition, individuals were surveyed regarding their use of the recreation facilities along with opinions of the facilities provided and suggested improvements.

Usage of the Canoe Portage Trail was determined from field observations made from the Roanoke River Overlook and Trail, recordings from a trail camera placed along the portage route and discussions with Appalachian staff.

Roanoke River Overlook and Trail

The information obtained from the in-person surveys recorded at the Roanoke River Overlook and Trail indicate that those using that location primarily partake in bank fishing, hiking, and viewing of the Project spillway, bypass, and powerhouse. Individuals visiting the Roanoke River Overlook and Trail do so the entire year with most of the visits occurring from March through September.

Tinker Creek Canoe Launch

Individuals utilizing the Tinker Creek Canoe Launch consisted of canoeists, kayakers, paddle boarders, and persons participating in boat fishing. The general pattern of their activities is to launch at the Tinker Creek Canoe Launch and float down Tinker Creek to the Roanoke River. From that point, the trip continues either upstream toward the Bennington Canoe Launch or downstream toward the Project. The users return to the Tinker Creek Canoe Launch to end their trip.

Rutrough Point

Rutrough Point represents the normal endpoint for canoeists and kayakers who have floated through the rapids beginning at the Project put-in. Other activities observed at Rutrough Point include bank fishing and hiking the adjacent trails in Explore Park. Some kayaks and canoes launched from Rutrough Point float to the upper end of Smith Mountain Lake to fish and/or enjoy the still waters and then return to Rutrough Point. Others travel approximately five miles to the Hardy Ford Public Boat Access on Smith Mountain Lake.

Canoe Portage Trail

Review of the trail camera data indicates that the Canoe Portage Trail Put-In is used during the spring to fall months for non-motorized activity (i.e. kayaks, canoes), bank fishing, and observation of the facility and river. June through August were the most popular months for recreational activity to occur. Over the course of the study, the Project facility was used for its intended use (portaging) 21 times. Additionally, the facility/river was viewed/observed 21 times, however, the Project facility was most frequently used for bank fishing with 28 uses recorded. The frequency of visits while perhaps lower than other portages in the area, was higher than anticipated. It is unclear if individuals access the facility via portaging around the dam, or from nearby neighborhoods[10].

[10] There are informal trails from nearby subdivisions in the area that individuals could use to hike to the Canoe Portage Put-In. This is likely how users were accessing the Canoe Portage Trail Put-In during the trail camera assessment; in general the trail camera observed the same individuals using the facility. Appalachian believes that development of formal trails in this area are infeasible due to safety concerns associated with the existing CSX railroad, steep topography, and land ownership constraints.

Aesthetic Flow Documentation

The Project is located adjacent to the Blue Ridge Parkway and is visible from the Roanoke River Overlook and from the trail that extends down to the base of the dam area, making the Project an important aesthetic resource.

YES collected photo and video documentation from three key observation points (KOPs) to characterize and capture the appearance of the dam and bypass reach under a range of flows[11] including: 1) the NPS Roanoke River Outlook adjacent to the Blue Ridge parking lot, 2) a bench midway down the stairs to the bypass, and 3) the bank fishing area located at the end of the trail steps at the Roanoke River.

YES took photos and videos at these three KOPs on ten different occasions to gather comparable data for all four seasons under a range of flow conditions (including periods of spill over the spillway crest). As a result of the photograph and video documentation, YES found that in leaf-off months (approximately October to April), aesthetically pleasing views of the spillway, dam, and bypass reach are available from the Roanoke River Trail. In leaf-on months (approximately May to September) when recreation typically increases, the spillway is not easily viewed from KOP 2 due to vegetation. Overall, the optimal time for viewing the Project spillway and bypass reach appears to be late October and early November when leaves are changing colors and falling. The fall colors, along with the open views created by the leaf-fall, create optimal aesthetic conditions. In general, existing Project operations provide an appropriate aesthetic experience.

Recreational Flow Release Desktop Review

The objective of the Recreational Flow Release Desktop Evaluation was to evaluate the potential for controlled flow releases from the Project to support short-term enhancement of downstream flow conditions for recreational boating (i.e., primarily canoeing, kayaking, and other paddling activities). To address stakeholders' interests while recognizing Project constraints related to enhancement of downstream flow conditions, Appalachian conducted a desktop evaluation to assess the potential for Project operations to support short-term enhancement of flow conditions for downstream boating. The desktop study concluded that the potential for the short-term enhancement of downstream flow conditions to support recreation activities would be most advantageous during the typically lower flow late-summer/early-fall months (i.e., July through October). The distance between the Canoe Portage

[11] Article 403 of the current license requires a minimum flow of 8.0 cfs into the bypass reach, which is provided via the trash sluice gate. The trash sluice gate hoist operator system was not operational in 2020; as a result, bypass reach flows during 2020 were higher than the license requirement. The gate has been repaired and a new gate and operating system installed, which was operational in early 2021.

Trail Put-In and the downstream Explore Park/Rutrough Point canoe/kayak access area is approximately three river miles. Paddlers using this stretch of river may benefit the most from a potential short-term recreation flow release as a flow pulse between one hour and approximately 3.5 hours could be maintained depending on the number of units generating and the available reservoir storage volume. This run-time would likely allow paddlers enough time to navigate this stretch of river during lower flow months.

However, due to the nature of the run-of-river Project, Project operations, a limited reservoir operating band, and the risk of non-compliance with licensed minimum flow and reservoir limits due to peaking or pulsed operation required to provide a recreation flow release, regular recreation flow releases are not proposed by Appalachian.

Proposed Greenway Extension (Roanoke County)

Although not directly studied as part of the Revised Study Plan, the proposed greenway on river-right of the Project Boundary is of interest to the stakeholders as noted during the April 20, 2021 stakeholder call and in comments on the Initial and Updated Study Reports. Roanoke County and the Greenway Commission would like to construct an extension of the greenway that would begin at the existing Roanoke River Greenway and extend along the river-right shore to the Blue Ridge Parkway as shown on Figure E.11-4, Figure E.11-5, and Figure E.11-6. (Note: in these figures, the green line depicting the greenway represents the width of the proposed paved trail.)

The proposed Greenway extension is within and adjacent to the Project Boundary and Appalachian continues to work with Roanoke County in support of the proposed greenway as a Non-Project facility. As a part of the extension of the Roanoke Greenway along the Project shoreline, Roanoke County and the Greenway Commission are also interested in the construction of a parking area near the south abutment for the Project spillway. Appalachian currently has a construction laydown area located adjacent to the abutment that is of interest to stakeholders as the location for a potential parking area. Access to the laydown area is provided to Appalachian through an easement across private property and limited to Appalachian personnel and contractors. Concerns for public safety would need to be addressed due to the close proximity of the laydown area to the spillway. Appalachian understands that Roanoke County is pursuing property access to construct the greenway outside of the land owned by Appalachian. To date, Roanoke County has not been able to negotiate purchase or easement across this parcel, as would be required for the Greenway extension. At this time, the construction of the proposed greenway extension in the vicinity of the right abutment of the dam is not feasible due to landowner constraints outside of Appalachian's control.

Appalachian is supportive of the County's efforts to extend the Greenway as proposed and has and will cooperate to provide access or easement across lands owned or controlled by Appalachian, in accordance with existing License Article 202 (FERC's standard land use article). Additionally, under License Article 202, Appalachian's authorization of these development activities within the Project Boundary may require prior notification to and approval by FERC for non-project use of project lands (as well as other applicable federal, state, or local permits or approvals, to be pursued by the requesting party).

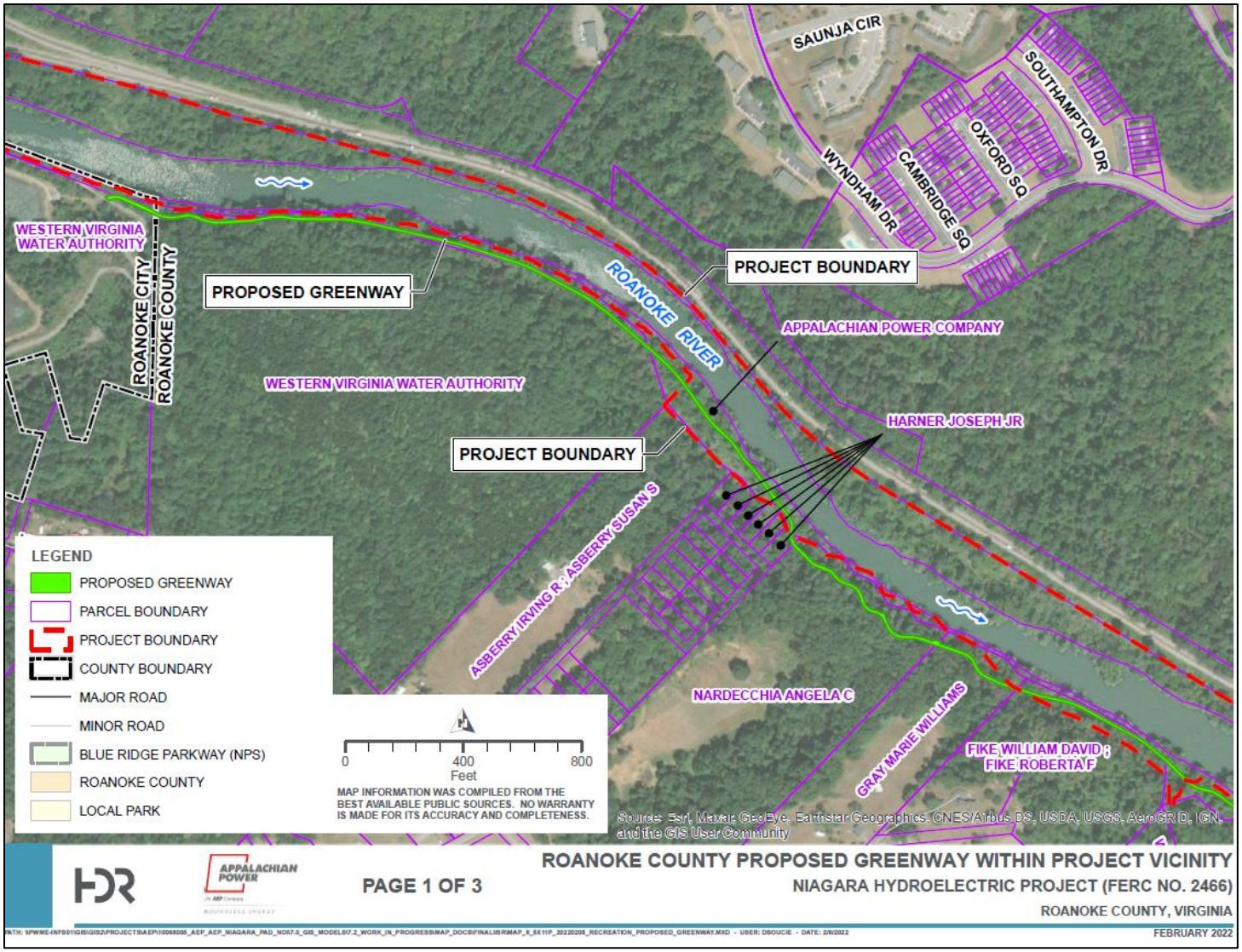
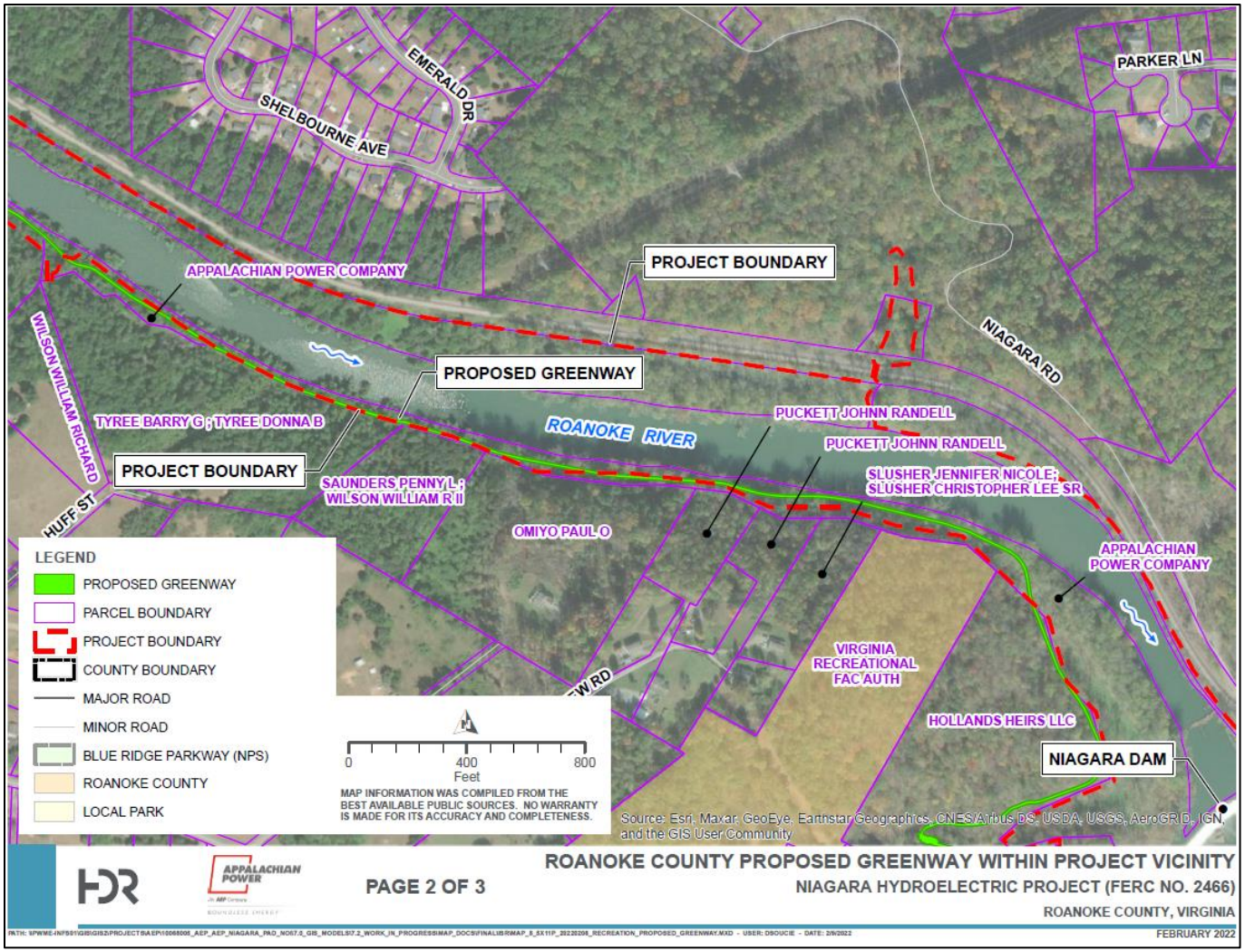


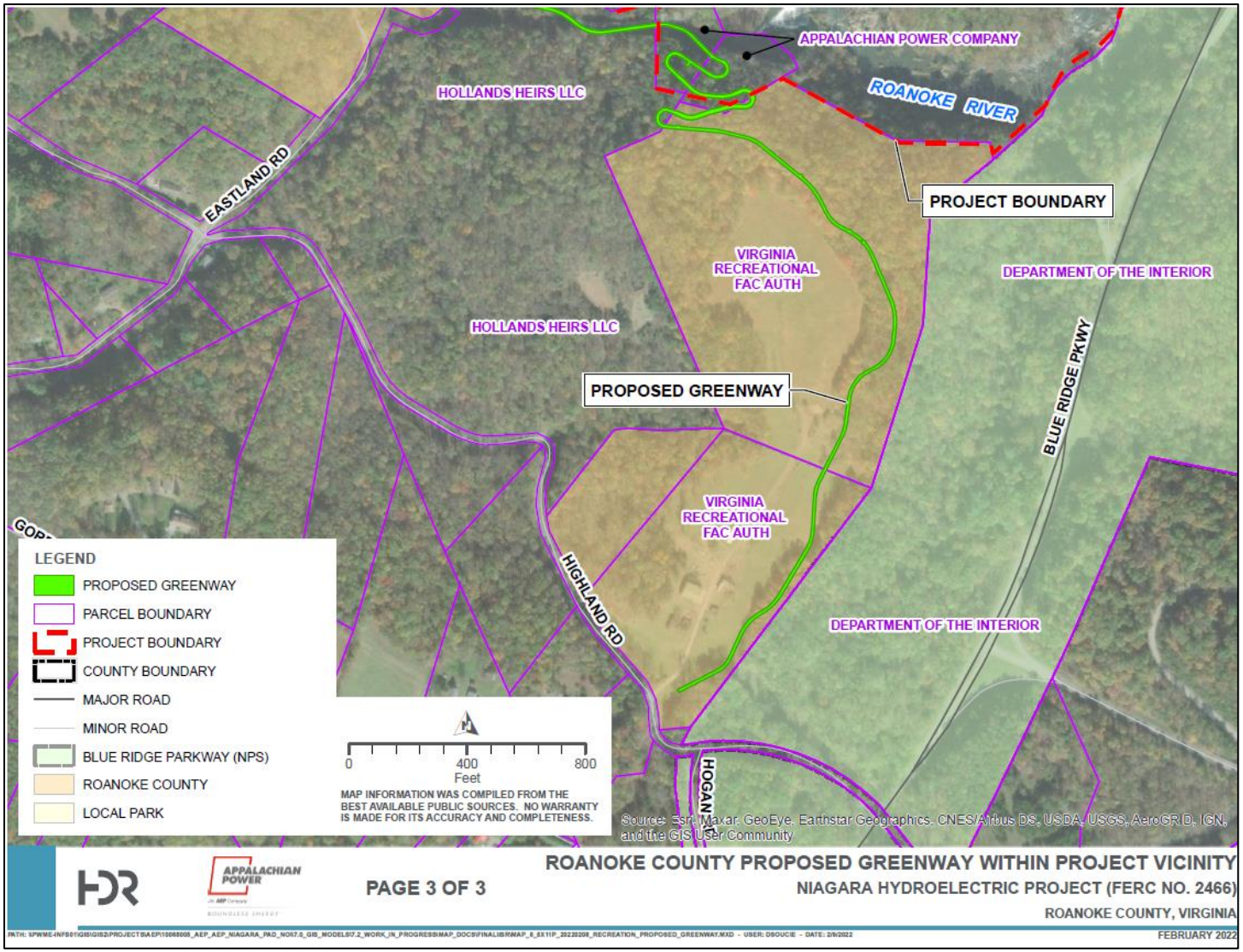
Figure E.11-4. Proposed Greenway within Project Vicinity (Map 1 of 3)

Note: Lands indicated as Appalachian Power Company may only be held in easement.



Note: Lands indicated as Appalachian Power Company may only be held in easement.

Figure E.11-5. Proposed Greenway within Project Vicinity (Map 2 of 3)



Note: Lands indicated as Appalachian Power Company may only be held in easement.

Figure E.11-6. Proposed Greenway within Project Vicinity (Map 3 of 3)

E.11.2.2 Project Impacts on Recreational Resources

In SD3, FERC identified the following environmental issues to be addressed in FERC's NEPA document:

- Effects of continued project operation and maintenance on recreation, land use, and aesthetics within the project area including the project impoundment, tailrace, and bypassed reach.
- Adequacy of existing recreational facilities and public access to the project to meet current and future recreational demand.

At this time, Appalachian is not proposing any changes to the Project or operations that would have any impacts on existing recreation facilities, land use, or aesthetics. The increased minimum flow (30 cfs, continuous) to the bypass reach proposed by Appalachian will indirectly benefit recreation and aesthetics by increasing and enhancing wetted area and aquatic habitat in the bypass reach.

In the future, if enhancements are made to Project facilities that would require land disturbance, Appalachian would coordinate with USFWS, VDEQ, VDWR, Virginia Department of Historic Resources and other applicable agencies to complete necessary permitting and other regulatory approvals, including wetland/waterbody delineation, any necessary resource surveys or identification of time of year restrictions for certain activities, and cultural resources consultation, prior to commencement of any construction in support of the recreation improvements.

The results of the Recreation Study suggest that demand for recreation is high in the Roanoke Valley, however, Appalachian's potential for enhancements within the Project Boundary are limited due to the steep nature of the surrounding terrain and landowner, railroad, and public access constraints. Appalachian understands stakeholders' interests to continue to improve outdoor recreation and river access to meet growing demand and user preferences but has not identified practicable enhancements (other than the Canoe Portage Trail and Take-Out Project facilities) to be included as part of the licensing proposal. As stated above, Appalachian is supportive of the County's efforts to extend the Greenway as proposed and has and will cooperate to provide access or easement across lands owned or controlled by Appalachian, in accordance with the standard land use license article.

The Licensee does not anticipate that operation and maintenance of the Project over the new license term will have any short- or long-term, unavoidable, adverse impacts on recreational resources or aesthetics.

E.11.3 Protection, Mitigation, and Enhancement Measures Proposed by the Applicant, Resource Agencies, and/or Other Consulting Parties

E.11.3.1 PM&E Measures Proposed by Licensee

Appalachian has evaluated the results of the Recreation Study and comments filed by recreation stakeholders in response to the DLA and the USR. These findings and comments will inform the new Recreation Management Plan (RMP), which Appalachian proposes to develop in consultation with recreation stakeholders following new license issuance. The RMP, including documentation of consultation, will be filed with FERC for approval. Appalachian expects the RMP to include provisions for the following:

- Description and location of Project Recreation Facilities;
- Map of Non-Project Recreation Facilities within or adjacent to the Project Boundary, with identifying information about ownership and management for each facility;
- Canoe portage take-out improvements (i.e. trail modifications, replacement of steps, installation of new or additional safety and directional signage);
- Design and installation of sign identifying the Canoe portage take-out area and associating it with the FERC license, project number, and Licensee;
- Design and installation of a new sign or content for existing kiosk at the Tinker Creek Canoe Launch about the Niagara Project Canoe Portage Trail and recreation opportunities associated with the Niagara Project;
- Future/conditional requirement to relocate the Canoe Portage Put-In to the Project tailrace area (requiring extensive modification due to steep rip-rapped banks in this area) in the event that portage put-in downstream of the Project Boundary on NPS-owned lands is no longer a viable option for recreational visitors;
- Mechanisms for Appalachian's participation in and promotion of periodic upstream water- or land-based river cleanups led by other organizations;
- Coordination and consultation measures for development of Non-Project Recreation Facilities (by Appalachian or others) within the Project Boundary over the new license term; and

- Development and maintenance of a public website for information related to river flows downstream of the run-of-river Project and recreational facilities (Project and Non-Project) at the Niagara Project.

E.11.3.2 Previously Identified Potential PM&E Measures Not Proposed by Licensee

Numerous potential PM&E measures for recreation were identified by stakeholders over the course of the Recreation Study. The most common ones are described below. Details of stakeholders' comments in response to the DLA follow in the next section.

As discussed, while some stakeholders have expressed interest in relocating the portage to the opposite side (i.e., southwest side) of the Niagara Dam, this is currently not feasible due to private land ownership near the abutment and steep slopes on the right-descending bank of the bypass reach. Additionally, the Canoe Portage put-in location is on NPS land and Appalachian proposes that it is a Non-Project facility, maintained by Appalachian. Appalachian has investigated moving the put-in location upstream onto lands owned by Appalachian and within the Project Boundary, however, the terrain is steep and the water is fast flowing in the tailrace and does not lead to a more desirable put-in location than what is presently passively provided over the NPS land.

Appalachian plans to include summary-level and location information in the proposed RMP about Non-Project Recreation Facilities.

Because the schedule and feasibility of development of the Greenway extension is and will continue to be driven by Roanoke County and by factors beyond Appalachian's control, and Appalachian understands that the County desires to advance this project prior to new license issuance expected in early 2024, Appalachian does not propose to include measures related to the Greenway extension in the RMP. Appalachian will instead continue to cooperate with Roanoke County to provide and obtain necessary authorizations and approvals for activities on lands controlled or owned by Appalachian and for activities within the Project Boundary, and in accordance with the requirements and protections of the standard land use article that will be included in the new license.

No agencies or stakeholders have requested modification of Project operations to benefit aesthetics. Appalachian does not propose any changes to Project operation for the enhancement of aesthetic resources.

Stakeholders have requested modification of Project operations by Appalachian to collect non-organic debris that enters the Roanoke River upstream of the Niagara reservoir. Appalachian does not have

an existing means for operations personnel to safely remove non-organic debris from the reservoir. Appalachian will continue to support and partner with regional organizations to support land- or river-based debris removal efforts within the watershed, such as trash cleanups and river sweeps, which Appalachian believes have proven effective in recent years.

Appalachian does not propose to include formal license provisions to augment recreational boating flows downstream of the Project. Operation of the Project in this manner would require a departure from the normal run-of-river licensed operating mode and result in greater impoundment drawdown over a shorter period than would typically occur. Drawing down the reservoir to its minimum required elevation would also present challenges for AEP operations to refill the reservoir to normal levels, depending on inflow conditions. Appalachian believes that operation in this manner, particularly during low-flow summer months, would create a risk for compliance with continuous minimum flow releases at the dam. As flows are passed over the Obermeyer gate in the trash sluice, they are variable with changes in reservoir surface elevation. Appalachian anticipates complying with proposed minimum flow requirements by setting the gate opening to provide the flow at the lowest normal reservoir operating level. Operating below this range may impact Appalachian's ability to comply with the minimum flow requirement, during or after the recreation release. Upgrade of the Obermeyer gate operating system would be required to allow for gate changes over a wider range of reservoir surface elevation.

E.11.3.3 PM&E Measures Proposed by Others

This section presents a summary of comments received from recreation stakeholders in response to the DLA. Appalachian's responses to each are provided in Table ES-1.

In their comments on the DLA submitted to the FERC on December 27, 2021, Roanoke County stated the following recommendations and requests:

- Roanoke County supports increased education and awareness efforts to better inform the public of the recreational opportunities allowed within the Project Boundary and requests to be included in any future stakeholder consultation activities related to outdoor recreation. In order to ensure that recreational use is monitored within the Project Boundary, Roanoke County requests that Appalachian consider conducting a Recreational Use Survey every six years in conjunction with its filing of the FERC Form 80 Recreation Report Survey to evaluate the adequacy of existing facilities and/or need for new or improved facilities.

- Roanoke County requests that proposed non-project recreational facilities be included in the FLA and RMP, such as the Roanoke River Greenway, Wolf Creek Greenway, Roanoke River

Blueway, and Explore Park. These projects are proposed within or adjacent to the Project Boundary and are publicly supported, as demonstrated in the Virginia Outdoors Plan, Roanoke County Strategic Plan, and the Explore Park Adventure Plan.

- Roanoke County is interested in developing a new portage on the south side of the river to enhance recreation and has acknowledged the challenges with this location; however, the County continues negotiating with the property owners of Tax Parcel ID 071.03-01-13.01-0000 located at 3124 Highland Road for the right-of-way needed to develop recreational improvements such as the Roanoke River Greenway, Roanoke River Blueway, and expansion of Explore Park. Roanoke County requests that Appalachian consider this parcel, as well as adjacent VRFA-owned parcels, in the RMP as a future opportunity to provide or enhance public access to the Niagara Project Boundary, should the right-of-way be acquired.

- The County also stated that the Project access road on the north side of the Roanoke River does not allow for public access and requests that Appalachian evaluate public access

- In support of improvements to the exiting portage around the Niagara Dam, Roanoke County requests that Appalachian consider installing a floating dock or platform with a ladder that would define the take-out location allow for fluctuation with the river levels, provide a place to moor boats, and provide stability for paddlers climbing out of the water. Additionally, if the put-in location is determined to be outside of the Niagara Project Boundary, Roanoke County requests that Appalachian coordinate with the adjacent property owner and the Roanoke River Blueway Committee for improvements that would better define the put-in location and make it more user-friendly. Roanoke County also requests that Appalachian confirm the location of the portage put-in to determine whether it is within or outside of the FERC Project Boundary. If the put-in location is determined to be outside of the Niagara Project Boundary, Roanoke County requested that Appalachian coordinate with the adjacent property owner (i.e., NPS/Blue Ridge Parkway) and the Roanoke River Blueway Committee for improvements that better define the put-in location and make it more user-friendly.

- Roanoke County requests that safety measures be considered to better educate and warn the public about the Project and the existing portage. Improvements such as relocating and updating the existing sign to direct boaters away from the dangerous spillway and replacing the faded boat barrier would be beneficial to the public.

- Furthermore, Project operations currently allow debris to overtop the spillway during high river flows, resulting in accumulations downstream of the Niagara Dam that negatively impact the

Blue Ridge Parkway, Explore Park, and the Smith Mountain Lake Hydroelectric project Boundary. Roanoke County acknowledges that Appalachian did not generate this debris and that Appalachian spends a considerable amount of resources removing debris from the Niagara and Smith Mountain Lake project boundaries. Roanoke County, along with other regional stakeholders, have organized community volunteer workdays to remove trash and debris along the Roanoke River; Roanoke County encourages Appalachian to continue evaluating trash and debris removal alternatives and support regional efforts to remove trash and debris from the Roanoke River.

- Additionally, Roanoke County requested that Appalachian reconsider the potential for short-term, scheduled recreational releases in support of the Roanoke River Blueway and Explore Park as controlled releases in late summer or early fall would allow paddlers the ability to navigate this stretch of river during lower flow months and enhance the future in-river whitewater park. They added that controlled releases would also support a public-private partnership in Explore Park that has been developed between Roanoke County and Blue Mountain Adventures to provide camping, mountain bike rentals, and canoe, kayak, and tubing programs along the Roanoke River.

In their comments on the DLA submitted to the FERC on December 28, 2021, the Roanoke River Blueway Committee (RRBC) stated the following recommendations and requests:

- The RRBC states that the future in-river kayak park is a key element of the Explore Park Master Plan and could generate as many as 15,000 trips a year, which would produce a significant boost to visits to the Explore Park and an accompanying boost in revenue. The RRBC believes that development of this park may be negatively impacted by the low flow downriver of the dam and requested further clarification on the impacts of recreational releases on Project function, and that Appalachian reconsider releases for special events during low flow summer months.

- The RRBC has concerns regarding the portage take-out in that it is poorly signed and difficult to use and their interest in collaborating with Appalachian for an improved port**a**ge. The Committee stated that **s**hould Appalachian determine that the ideal put-in location is outside of the FERC Project Boundary, access through Appalachian's property and the Project on the part of local stakeholders and the NPS would still be required to make improvements to the put-in location and should be included as a provision of the Recreation Management Plan.

- Additionally, the Roanoke River Blueway Committee expressed a desire for collaboration with Appalachian in order to investigate potential trash removal programs in the future and hopes that Appalachian will be amenable to working with the Blueway Committee and the Regional Commissions' member governments, as well as other stakeholders, when clean-up opportunities present themselves. It would be of great help to be able to access the Project area and the road into the Project Boundary in order to safely and efficiently remove trash from the reservoir and the spillway.

In their comments on the DLA submitted to FERC on December 22, 2021, the Roanoke Valley Greenways Commission (RVGC) stated the following recommendations/requests:

- The RVGC stated that the Recreation Study Report does not meet the needs of the Roanoke Valley and has too narrow a view of the Project's impacts and the omission of proposed greenway projects as being outside the scope of the Recreation Study ignores that the member localities of the Greenway Commission have long been in conversation with Appalachian Power to implement the Roanoke River Greenway. Additionally, the efforts to create a Roanoke River Blueway are acknowledged in the regional overview in the summary of the study, but not how the Blueway's creation would impact the existing project recreational facility and the two non-Project facilities (all included in the study area), therefore, the Roanoke Valley Greenways Commission requests that the recreation management plan be a condition of the relicensing of the Niagara Project.

- The RVGC believes that the Niagara recreation study report demonstrates the need for the proposed Roanoke River Blueway to improve recreation access along the Roanoke River at existing facilities and that better signage and improved, well defined portage route will improve the user experience and increase the overall participation numbers. They also request a commitment from Appalachian to discuss trash and debris collection at the facility and would look to the city and county of Roanoke for input and collaboration with Appalachian to develop an acceptable plan to begin to address the issues.

- The RVGC requested that (1) a recreational management plan be developed and completed prior to when the renewed license is issued, (2) a right-of-way be granted to Roanoke County for the Roanoke River Greenway on river right (on land owned by AEP), and (3) Appalachian work with localities to provide debris removal at the dam and sponsor periodic clean-ups of trash in the Project area.

In their comments on the DLA submitted to the FERC on December 30, 2021, the Roanoke Regional Partnership stated the following requests and recommendations:

- that a recreation management plan be a requirement in the issuance of the new license;
- that short-term scheduled recreational water releases be reconsidered by Appalachian in late summer and early fall to allow paddlers the ability to navigate this stretch of river during lower flow months and enhance the future in-river whitewater park;
- that improvements to the existing portage trail be made along with an evaluation of a new portage on north side of the river;
- that trash and debris removal alternatives be considered; and
- that Appalachian continue support of the greenway proposed within and adjacent to the Niagara Dam Project Boundary as FERC approval is required for non-project use of project lands and water to allow Appalachian to grant Roanoke County the right-of-way necessary to construct sections of the greenway in 2022-2023.

In their comments on the DLA submitted to the FERC on December 30, 2021, the VDWR indicated that they disagree with the Applicant that existing Project and Non-Project Recreation Facilities and public access to the Project are sufficient to meet the current recreational demand and while they acknowledge that practicable recreational enhancement options in the immediate project vicinity are limited, suggest that Appalachian explore options for working with stakeholders to enhance recreational opportunities on segments of the Roanoke River outside of the Project area to mitigate for lost opportunities associated with project operations and the development. Such options could include assisting localities and other stakeholders with greenway/blueway enhancements or other expansions to meet the high demand for Roanoke River access.

E.12 Historic and Archaeological Resources

In considering a new license for the Project, FERC has the lead responsibility for compliance with applicable federal laws, regulations, and policies pertaining to historic properties, including the NHPA, as amended.[12] Section 106 of the NHPA (Section 106)[13] requires federal agencies to take into account the effects of their undertakings on historic properties and to afford the Advisory Council on Historic Preservation a reasonable opportunity to comment.

The Section 106 process (defined at 36 CFR Part 800) is intended to accommodate historic preservation concerns with the needs of federal undertakings through a process of consultation with agency officials, the SHPO, federally recognized Indian Tribes, and other parties with a potential interest in an undertaking's effects on historic properties. The goals of the Section 106 process are to:

- Identify historic properties that may be affected (directly and/or indirectly) by an undertaking;
- Assess the effects of an undertaking on historic properties; and
- Seek ways to avoid, minimize, or mitigate adverse effects on historic properties through consultation.

Historic properties are defined in 36 CFR Part 800 as any pre-contact or historic period district, site, building, structure, or individual object listed in or eligible for inclusion in the NRHP. This term includes artifacts, records, and remains that are related to and located within historic properties, as well as properties of traditional religious and cultural importance (often referred to as "traditional cultural properties") that meet the NRHP criteria.

The Secretary of the Interior has established the criteria for evaluating properties for inclusion in the National Register (36 CFR Part 60). In accordance with the criteria, properties are eligible if they are significant in American history, architecture, archaeology, engineering, or culture. The quality of significance present in historic properties that possess integrity of location, design, setting, materials, workmanship, feeling, and association, and:

- Are associated with events that have made a significant contribution to the broad patterns of our history; or
- Are associated with the lives of persons significant in our history; or

[12] 54 USC §300101 et seq.
[13] 54 USC §306108

- Embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant or distinguishable entity whose components may lack individual distinction; or
- Have yielded or may be likely to yield information important in prehistory or history.

E.12.1 Affected Environment

E.12.1.1 Area of Potential Effect

An area of potential effect (APE) is defined as the geographic area or areas within which an undertaking may directly or indirectly cause alterations in the character or use of historic properties, if any such properties exist. The APE is influenced by the scale and nature of an undertaking and may be different for different kinds of effects caused by the undertaking. The Commission has not yet defined an APE for the Project. In the context of the relicensing process, FERC generally defines the APE as follows: “The APE includes all lands within the Project Boundary. The APE also includes any lands outside the Project Boundary where cultural resources may be affected by Project-related activities that are conducted in accordance with the FERC license.”

Because the Project Boundary encompasses all lands that are necessary for Project purposes, all Project-related operations, potential enhancement measures, and routine maintenance activities associated with the implementation of a license issued by the Commission are expected to take place within the Project Boundary. The proposed APE is consistent with the potential scope of Project effects and the manner in which the Commission has defined the APEs for similar hydroelectric relicensing projects in the region.

E.12.1.2 Existing Discovery Measures

Article 409 of the existing license for the Project includes measures to protect and manage historic properties:

> Article 409. If archeological or historic sites are discovered during project operation, the licensee shall: (1) consult with the Virginia State Historic Preservation Officer (SHPO); (2) prepare a cultural resources management plan and a schedule to evaluate the significance of the sites and to avoid or mitigate any impacts to any sites found eligible for inclusion in the National Register of Historic Places; (3) base the plan on the recommendations of the SHPO and the Secretary of the Interior's Standards and Guidelines for Archeology and Historic Preservation; (4) file the plan for Commission approval, together with the written comments of the SHPO on the plan; and (5) take the necessary steps to protect the discovered sites from further impact until notified by the Commission that all of these requirements have been

satisfied. The Commission may require cultural resources survey and changes to the cultural resources management plan based on the filings. The licensee shall not implement a cultural resources management plan or begin any land-clearing or land-disturbing activities in the vicinity of any discovered sites until informed by the Commission that the requirements of this article have been fulfilled.

E.12.2 Environmental Analysis

E.12.2.1 Identification of Archaeological and Historic Resources

Previous Cultural Resources Studies

The Phase IA Archaeological Investigation of the Roanoke Project in 1991 determined that there were no historic or prehistoric archaeological sites in the Project area. In FERC's environmental assessment for the previous relicensing, FERC determined that the Project had no effect on any archaeological or historic sites listed or eligible for inclusion in the NRHP; the Virginia SHPO concurred with FERC's assessment.

Archaeological Resources

In the early 1990s, Appalachian initiated an archaeological study at the Project. Research largely consisted of an examination of archaeological site files at the Virginia Department of Historic Resources in Richmond, Virginia. Attempts were made to determine previously recorded sites and studied areas within the Project area. Local and regional histories were studied at the Virginia State Library and Virginia State Archives (Appalachian 1991).

Louis Berger and Associates conducted a Phase IA Archaeological Investigation for Appalachian in association with the previous relicensing. The archaeological investigation concluded that there were no historic or prehistoric archaeological sites recorded for the Project site, but that a number of sites were recorded in the vicinity of the Project (Appalachian 1991).

Cultural resource studies previously carried out in the general vicinity of the Project reveal a high potential for prehistoric sites along the Roanoke River. However, urban and industrial development have resulted in repeated disturbance to the floodplain area, thereby greatly diminishing the potential for sites containing undisturbed deposits. It is noteworthy that the majority of sites identified along the Roanoke River in the general vicinity of the Project are surface sites. Archaeological potential for prehistoric resources at the Project is limited. Construction of the facility, as well as the railroad which traverses the plant's northern borders, has caused severe disturbance and has eliminated the potential for prehistoric archaeological resources on the northern banks of the river. Repair and maintenance activities at the facility have created further disturbance on both banks of the river (Appalachian 1991).

Historic Architectural Resources

The Project was previously evaluated for inclusion in the NRHP (also by Louis Berger and Associates, Inc., for the previous relicensing), and it was concluded that the Project does not meet National Register Criteria for Evaluation (36 CFR 60.4) because it lacked requisite integrity of design and workmanship as a result of modern alterations, as described below. Within the context of hydroelectric power development in Virginia, the Project dates from the first significant period of hydroelectric plant construction in the state (ca. 1895-1920) and, based on available information, appears to have been one of very few "medium-head" projects built during that time, as it was reported to have been built to operate at a head of about 60 ft (Appalachian 1991). The powerhouse was originally equipped with Victor turbine wheels, four 750-kW generators, and one 350-kW generator (Appalachian 1991). These elements appear to have been replaced, possibly prior to 1924, with four horizontal S. Morgan Smith turbines in steel pressure casings that were direct-connected to four generators. The potential importance of the Niagara powerhouse, however, is significantly diminished by alterations that have occurred since the 1950s. The major alterations are the 1954 reconstruction of the powerhouse floor for the two existing vertical generating units, whose type and placement have greatly changed the original character of the facility, and the installation, in 1988, of the steel penstock, with its associated intake and discharge structures, in the former headrace canal. While the modification of powerhouses for new generating equipment has historical precedent, the remodeling of the Niagara facility has occurred within the past 40 years and has largely obliterated structural evidence of the kind of equipment it was originally designed to contain. The Niagara Project thus does not possess the integrity of design and workmanship that would permit its physical remains to clearly represent its type or its association with the early years of the hydroelectric industry in the state (Appalachian 1991).

Studies in Support of Current Project Relicensing

In accordance with the RSP approved in the Commission’s SPD, Appalachian began tasks associated with the Cultural Resources Survey in the late summer of 2020. Tasks initiated and/or completed to date include Consultation for the APE Determination, Background Research and Archival Review of the Study Area, SHPO and Tribal Consultation, and a Phase I Reconnaissance Survey of the APE. No Traditional Cultural Properties (TCPs) were indicated through SHPO and Tribal consultation as being within the APE.

The goal of the Cultural Resources Study was to collect additional information regarding cultural resources within the Project APE to assist in identifying Project effects on archeological and historic properties and developing appropriate management measures.

In August 2020, HDR's sub-consultant, Terracon Consultants, Inc. (Terracon), reviewed the Virginia Cultural Resource Information System to identify previously recorded cultural resources within a 0.5-mile radius of the Study Area. On September 10, 2020, Terracon staff traveled to the Virginia Department of Historic Resources office in Richmond, VA to gather additional information. Terracon recommended that none of the resources identified, either within the APE and those within a 0.5-mile radius, will be affected by continued operation of the Project.

Archaeological and Geomorphological Survey Results

On October 13 and 14, 2020 Terracon conducted an archaeological assessment of the Project APE, including areas along Tinker Creek. Most areas were accessed by canoe except the areas immediately surrounding the dam, which were accessed by vehicle. Geomorphological investigations were conducted by Terracon's sub-consultant, Seramur & Associates, from April 20–22, 2021.

Background research indicated there was one previously recorded archaeological site located within or immediately adjacent to the Project Boundary, however it is recommended as being ineligible for inclusion in the NRHP. Archaeological and geomorphological investigations found that areas within the APE have a very low potential for containing archaeological resources due to prior disturbance, steep slopes, and/or the area being covered in recent alluvial deposits.

Detailed study results are included in the Cultural Resources Study Report included in Volume IV, which is filed as CUII//PRIVILEGED and is being provided to the SHPO and Tribes under separate cover, for their review and requested concurrence on the recommendations in the report.

Architectural Survey Results

The APE contained four aboveground historic-age resources – the Niagara Powerhouse Station and Dam, the Blue Ridge Parkway Historic District, the Blue Ridge Parkway Bridge and the Virginian Railroad.

The Blue Ridge Parkway and Blue Ridge Parkway Bridge are eligible for inclusion in the NRHP, the Virginian Railroad is potentially eligible, and the Niagara Powerhouse and Dam are ineligible. None of these resources are currently being affected by Project operations.

Detailed study results are included in the Cultural Resources Study Report in Volume IV (CUI/PRIV) of this FLA, as described above.

E.12.2.2 Project Impacts on Historic and Archaeological Resources

In SD3, FERC identified the following environmental issues to be addressed in FERC's NEPA document:

- Effects of project operation and maintenance on historic properties and archeological resources that are included in, eligible for listing in, or potentially eligible for inclusion in the NRHP.

- Effects of project operation and maintenance on any previously unidentified historic or archeological resources or traditional cultural properties that may be eligible for inclusion in the National Register of Historic Places.

Terracon's study report includes recommendation that no historic properties are being affected by the undertaking and that no additional cultural resource investigations are warranted. Based on these findings, at present, the ongoing operation and maintenance of the Project is not adversely affecting any historic properties. No archaeological sites have been identified within the APE, and Terracon's field investigations determined that the shoreline of the Project's impoundment is stable and not prone to erosion that could adversely affect the integrity of archaeological resources, should any be present. To the extent that high water or flooding events may cause periodic shoreline erosion, these events are beyond the control of Appalachian and are not related to Project operations. The continued operation and maintenance of Project facilities is consistent with their historic use and design. Appalachian is not currently proposing modifications to Project operations or Project-related land-clearing or land-disturbing development activities within the APE that would result in an impact to any historic properties. The continued operation of the Project as proposed by Appalachian is not expected to have any unavoidable adverse effects on historic or archaeological resources.

E.12.3 Protection, Mitigation, and Enhancement Measures Proposed by the Applicant, Resource Agencies, and/or Other Consulting Parties

No PM&E measures specific to Cultural Resources are proposed at this time.

If new construction were to occur in the areas outlined in the study report at a future point in the new license term, then additional archaeological investigations, consultation with the SHPO, and potential development of a Historic Properties Management Plan, would be necessary; however, at this time, a Historic Properties Management Plan is not warranted.

In the new license term, Appalachian proposes to consult with the Virginia SHPO if previously unidentified cultural resources are encountered during the term of any new license issued for the

project to ensure the proper treatment of these resources and discontinue all ground-disturbing activities until the proper treatment of the resources is established

E.13 Economic Analysis

This section of Exhibit E presents the estimated annual value of developmental resources associated with the Project under the current license, the cost of operating and maintaining the Project under the existing license, the cost of each PM&E measure proposed by Appalachian and stakeholders, and the reduction in the value of the developmental resources of the Project attributed to proposed PM&E measures.

E.13.1 Current Annual Value of the Developmental Resource

Appalachian operates the Project for the purposes of electrical power generation. In operating the Project, Appalachian also ensures dam safety, meets the requirements of the existing license, and implements required PM&E measures to provide for the protection of aquatic resources, water quality, and public recreation facilities and opportunities.

Consistent with the Commission's approach to economic analysis, the value of the Project's power benefits are determined by estimating the cost of obtaining the same amount of energy and capacity using likely alternative resources available in the region. This analysis is based on current costs and does not consider future escalation of fuel prices in valuing the Project's power benefits.

Appalachian sells all of the electricity generated at the Project into PJM. Based on average 2021 revenue for the Project of $34.45/MWh and generation in 2021 of 8,946 MWh, in 2021 the value of Project power was $308,171.

E.13.2 Current Annual Cost of Operations, Maintenance, Repairs, and Administration of the Project

Based on operations and maintenance costs for 2021, the estimated annual cost for the Niagara Project is presented in Table E.13-1.

Table E.13-1. Niagara Project Operating Cost for 2021

Description	Cost
Annual operation, maintenance, expenses, fees, insurance, overhead	$275,928
Depreciation and amortization	$855,066

Description	Cost
Local, state, and federal taxes	$57,408
Total	**$1,188,402**

E.13.3 Estimated Annual Costs of Proposed Resource Protection, Mitigation, and Enhancement Measures

Appalachian has proposed a number of measures for the protection, mitigation, and enhancement of environmental resources associated with the Project. The proposed environmental enhancements will not require any new lands or water rights for which Appalachian does not already have ownership or rights. The estimated capital and annual costs of PM&E measures proposed by Appalachian at the Project are presented in Table E.13-2.

Table E.13-2. Preliminary Cost Estimate of Resource PM&E Measures Proposed by Appalachian at the Niagara Project

Item	Capital Cost (2022 Dollars)	Incremental Operations & Maintenance or Annual Cost (2022 Dollars)
Release of 30 cfs continuous minimum flow to the bypass reach	$5,000	$27,500[1]
Continue funding of the USGS Roanoke River at Niagara gage	-	$16,200
Prepare Terrestrial Resources Protection Plan in consultation with VDWR and USFWS	$15,000	$5,000
Develop and implement Recreation Management Plan in consultation with Project stakeholders, to include improvements to canoe portage take-out and trail and development and maintenance of a public website for information related to river flows downstream of the run-of-river Project and recreational facilities (Project and Non-Project) at the Niagara Project	$75,000	$5,000
Total	**$95,000**	**$53,700**

[1] Approximately calculated as modeled lost generation (MWh) multiplied by average 2021 power revenue ($/MWh)

E.13.4 Resource Protection, Mitigation, and Enhancement Measures Proposed by Others

Appalachian has received preliminary requests for PM&E measures by agencies and other relicensing stakeholders, primarily through comments filed on the DLA. These requests are presented in Table

ES-1 in the Executive Summary. Appalachian notes that both USFWS and VDWR have noted they are deferring additional recommendations until completion of the Roanoke Logperch larval drift survey, for which Appalachian presently expects to file a revised study report by the end of 2022. Appalachian expects that resource agencies and Project stakeholders may also revise or make additional requests in response to the FLA, and that supplemental information provided by Appalachian after the FLA may serve to refine Appalachian's proposals. The estimated capital and annual costs of common and feasible (given the limits of Appalachian's land ownership) PM&E measures proposed by others at the Project to date and that are not presently proposed by the Licensee are presented in Table E.13-3.

Table E.13-3. Preliminary Cost Estimate of Resource PM&E Measures Proposed by Others at the Niagara Project

Item	Requested by	Capital Cost (2022 Dollars)	Incremental Operations & Maintenance or Annual Cost (2022 Dollars)
PM&E measures for Project impacts if the results of the RLP larval drift survey support a determination that Project operations have the potential to impact larval RLP from drifting into less suitable habitat in the impoundment and/or from entrainment.	USFWS, VDWR	Unknown	Unknown
Utilize a similar approach as the Smith Mountain Lake Article 408 Roanoke Logperch Plan, which requires the Licensee to develop, fund, and complete projects annually, to facilitate the recovery of the RLP in the upper Roanoke River watershed.	USFWS, VDWR	Unknown	Unknown
Modify Project operations or components to provide safer downstream passage for fish during low flow periods including safer passage through the Obermeyer gate.	USFWS, VDWR	$150,000	$5,000
Conduct a Recreational Use Survey every six years, as a requirement of the RMP	Roanoke County, Roanoke Regional Partnership	$10,000	$2,500
Install a floating dock or platform with a ladder that would define the take-out location, allow for fluctuation with the river levels, provide a place to moor boats, and provide stability for paddlers climbing out of the river	Roanoke County, Roanoke Regional Partnership	$100,000	$5,000
Provide short-term, scheduled, recreational releases during low flow summer months	Roanoke County, Roanoke River Blueway Committee, Roanoke Regional Partnership	$25,000	$7,500

Item	Requested by	Capital Cost (2022 Dollars)	Incremental Operations & Maintenance or Annual Cost (2022 Dollars)
Trash and debris removal	Roanoke County, Roanoke River Blueway Committee, Roanoke Valley Greenways, Roanoke Regional Partnership	$50,000	$25,000
Total (excluding still unknown additional RLP PM&E measures)		**$335,000**	**$45,000**

E.13.5 Reduction in the Annual Value of the Developmental Resource

Based on Appalachian's proposed environmental measures, particularly the increased minimum flow release to the bypass reach, the Niagara Project will experience an estimated annual reduction of generation of approximately 797 MWh compared to continued operation as currently licensed.

Based on the annual value of power presented in Section E.13.1, the PM&E measures proposed by Appalachian are expected to result in reduction in the annual value of power generated at the Project by approximately $53,700 (not including $95,000 additional capital costs).

The PM&E measures proposed by others to date (i.e., not yet including any PM&E measures that may be requested by USFWS or VDWR following completion of the Roanoke Logperch larval drift survey) would result in reduction in the annual value of power generated at the Project by an additional (approximately) $45,000 (not including additional $335,000 additional capital costs). If the measures proposed by Appalachian were also proposed by others, as Appalachian would expect them to be, the reduction in the annual value of power generated at the Project would be (approximately) $98,700 (not including a total of $410,000 capital costs).

E.14 Consistency with Comprehensive Plans

Section 10(a)(2) of the Federal Power Act (16 USC §803(a)(2)(A) requires the Commission to consider the extent to which a project is consistent with federal and state comprehensive plans for improving, developing, or conserving a waterway or waterways affected by a project.

Appalachian has no plans to modify existing Project facilities or operations which would impact existing comprehensive waterway plans on the Roanoke River. The Project facilities and operations described in this license application are compatible with the comprehensive waterway plans for the Roanoke River as defined in Section 10(a)(1) of the Federal Power Act. The comprehensive plan which affects the Niagara Hydroelectric Project is the 2018 Virginia Outdoors Plan (VDCR 2018c), which presents a recreational needs assessment and identifies recreational priorities for the Commonwealth.

As previously stated, Appalachian is not seeking any facility or operational modifications intended to increase Project capacity. In accordance with 18 CFR §5.6(d)(4)(III and IV), Appalachian has reviewed FERC's SD3 and the April 2021 FERC List of Comprehensive Plans applicable to Virginia and adopted by FERC under Section 10(a)(2)(A) of the Federal Power Act, 16 USC §803(a)(2)(A). Of the 62 comprehensive plans relevant to Virginia, four are considered applicable to the Project.

These potentially relevant comprehensive plans, listed by state, are presented in Table E.14-1. Based on a review of these comprehensive plans, and information collected by the Licensee to date, current and proposed operations of Project facilities have been determined to be consistent with these plans.

Table E.14-1. List of Qualifying Federal and State Comprehensive Plans Potentially Relevant to the Project

Comprehensive Plan
U.S. Fish and Wildlife Service. Canadian Wildlife Service. 1986. North American waterfowl management plan. Department of the Interior. Environment Canada. May 1986.
U.S. Fish and Wildlife Service. n.d. Fisheries USA: the recreational fisheries policy of the U.S. Fish and Wildlife Service. Washington, D.C.
Virginia Department of Conservation and Recreation. The 2018 Virginia outdoors plan (SCORP). Richmond, Virginia.
Virginia State Water Control Board. 1986. Minimum instream flow study – final report. Annadale, Virginia. February 1986.
National Marine Fisheries Services and U.S. Fish and Wildlife Service. 2016. Roanoke River Diadromous Fishes Restoration Plan. Raleigh, North Carolina. May 2016.
Virginia Department of Environmental Quality. 2015. Commonwealth of Virginia State Water Resources Plan. Richmond, Virginia. October 2015.

Comprehensive Plan
Virginia Department of Game and Inland Fisheries. 2015. Virginia's 2015 Wildlife Action Plan. Henrico, Virginia. September 1, 2015.
National Park Service. 2015. Roanoke Valley/Blue Ridge Parkway Trail Plan. Asheville, North Carolina. September 2015.
National Park Service. 2013. Blue Ridge Parkway Final General Management Plan/Environmental Impact Statement. Asheville, North Carolina. January 2013.
U.S. Fish and Wildlife Service. 1992. Roanoke Logperch Recovery Plan. Annapolis, Maryland. March 20, 1992.
Virginia Department of Conservation and Historic Resources. N.d. Virginia's Scenic Rivers. Richmond, Virginia.
National Park Service. The Nationwide Rivers Inventory. Department of the Interior, Washington, D.C. 1993.

E.15 Consultation Documentation

Through the pre-filing consultation stage of the ILP, Appalachian consulted with Federal, state, interstate and local resource agencies, Indian tribes, non-governmental organizations, and unaffiliated members of the public. A summary and copies of formal consultation correspondence is provided in Appendix H (Volume II of this FLA).

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FINAL LICENSE APPLICATION

NIAGARA HYDROELECTRIC PROJECT (FERC NO. 2466)

EXHIBIT F

General Design Drawings (18 CFR §5.18)

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Exhibit F General Design Drawings (18 CFR §4.61(e))

F.1 List of General Design Drawings

The General Design Drawings show overall plan views, elevations, and sections of the Niagara Hydroelectric Project (Project) works in sufficient detail to provide a complete understanding of the Project. In accordance with 18 CFR Part 388, Appalachian is requesting that the General Design Drawings for the Project be given privileged treatment because the drawings contain Critical Energy Infrastructure Information. This request for privileged treatment is being made to the Commission in accordance with the Final Rule (Order No. 630-A) issued by the Commission on July 23, 2003 (revised August 8, 2003). Therefore, in accordance with Order 630-A, the Exhibit F General Design Drawings listed below in Table F.1-1 are being filed under separate cover in Volume III of this FLA (CEII).

Table F.1-1. Niagara Project General Design Drawings

Drawing Number	Title
Sheet F-1	Plan, Elevation and Sections
Sheet F-2	General Design Drawing Sections

F.2 Supporting Design Report

18 CFR §4.41(g)(3) requires that an applicant for a new license file with the Commission two copies of a Supporting Design Report (SDR) when the applicant files a license application. An SDR summarizes the studies that have been performed to date and the assumptions that have been made related to the development of the existing Project. The information contained within the SDR demonstrates that the existing structures are safe and adequate to fulfill their stated functions. In conjunction with filing this License Application, the SDR is being filed with the Commission in Volume III (CEII).

Summary information is provided below for the public volume of this license application.

In 2002, FERC instituted a new program to be used in the context of the Part 12 Independent Consultant Safety Inspection Program entitled “Potential Failure Modes Analysis” (PFMA), which is a dam and project safety tool intended to broaden the scope of the safety evaluations to include potential failure scenarios that may have been overlooked in past investigations. A PFMA is an examination of potential failure modes (PFMs) for a dam or other water-retaining structure by a core team of qualified

persons including subject-matter experts in all relevant aspects of dams and dam safety. The PFMA is intended to enhance understanding of the dam or other water-retaining structures by the owner, identify those ways in which a dam might potentially fail, review the existing surveillance and monitoring program in light of the developed PFMs, and evaluate measures to reduce the risk of failure mode initiation and progression.

In conjunction with these endeavors, FERC also initiated a requirement for development of a Supporting Technical Information Document (STID) for sites subject to Part 12D. The purpose of the STID is to summarize those Project elements and details that do not change significantly between 5-year FERC Part 12 independent consultant safety inspections. The STID includes sufficient information to understand the design and current engineering analyses for the Project such as:

- A complete copy of the PFMA report,
- A detailed description of the Project and Project works,
- A summary of the construction history of the Project,
- Summaries of Standard Operating Procedures,
- A description of geologic conditions affecting the Project works,
- A summary of hydrologic and hydraulic information,
- Summaries of instrumentation and surveillance for the Project and collected data,
- Summaries of stability and stress analyses for the Project works, and
- Pertinent correspondence from the FERC and state dam safety organizations related to dam safety.

The initial PFMA for the Niagara Project was conducted on June 21 and 22nd of 2005; however, there have been three reviews of the PFMs for the Project since the initial PFMA, the most recent of which was conducted in March of 2021. The recent PFMA review report was developed in conjunction with the 2020 FERC Part 12D Independent Consultant safety inspection of the Niagara Hydroelectric Project (Project), Project No. 2466-VA, NATDAM ID # VA16101; it follows the guidance provided in Chapter 14 of the *FERC's Engineering Guidelines for the Evaluation of Hydropower Projects* (*FERC Engineering Guidelines*), last updated May 8, 2017 (Revision 3) and additional guidance developed as the FERC PFMA process has evolved since its initiation. The PFMA review reports are intended to be serve as addendums and are complementary to the initial 2005 PFMA report. Subsequent PFMA reviews are added to the Project's STID to document updated PFM reviews.

The Licensee includes the filing dates with the Commission of the most recent Part 12 Safety Inspection Report, the PFMA Review Memo, and the revised STID (which includes the PFMA Report) in Table F.2-1.

Table F.2-1. Filing Dates for the Most recent Part 12 Safety Inspection report, PFMA Report, and STID

Document	Commission Filing Date
PFMA Review Memo	March 1, 2021
9th Part 12 Safety Inspection Report	March 1, 2021
Updated STID	May 6, 2016

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FINAL LICENSE APPLICATION

NIAGARA HYDROELECTRIC PROJECT (FERC NO. 2466)

EXHIBIT G

PROJECT BOUNDARY MAPS

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Exhibit G Project Maps (18 CFR §4.61(f))

G.1 Project Maps

The existing Exhibit G Project Boundary Maps, prepared in accordance with the requirements of 18 CFR §§4.39 and 4.61(f), are attached hereto and incorporated herein. Appalachian possesses property or easement rights to all areas within the defined Project Boundary. The Project Boundary Maps show the Project vicinity, location, and boundary in sufficient detail to provide a full understanding of the Project and are listed in Table G.1-1. Electronic files are required by Sections 4.39 and 4.41(h) of the Commission's regulations and are being filed with FERC as part of this FLA.

Table G.1-1. Niagara Project General Design Drawings

Drawing Number	Title
Exhibit G – Sheet 1 of 2	Project Boundary Map
Exhibit G – Sheet 2 of 2	Project Boundary Map

At this time, the Licensee is not proposing any modifications to the existing Project Boundary.

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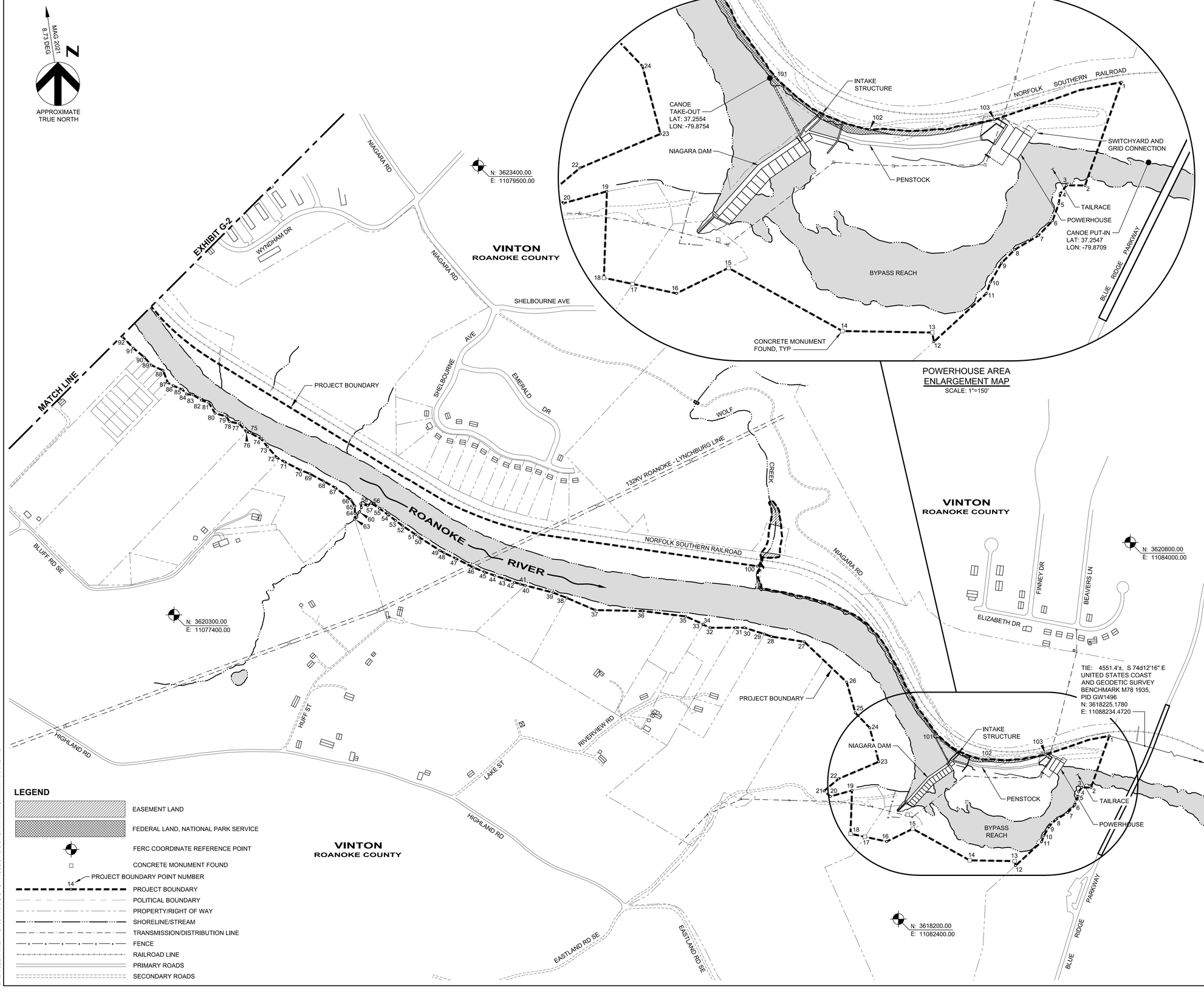
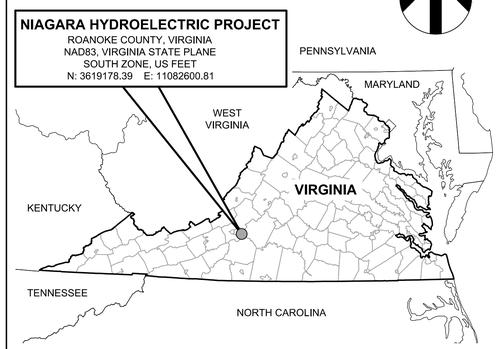
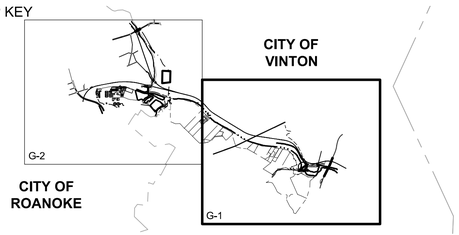


PROJECT LOCATION MAP



APPROXIMATE SCALE: 1"=75 MILES

MAP KEY



APPROXIMATE SCALE: 1"=4000 FEET

PROJECT BOUNDARY TIE DATA

THE PROJECT BOUNDARY IS TIED TO ROANOKE COUNTY NATIONAL GEODETIC SURVEY
BENCHMARK M78, 1935, PID GW1496: N: 3618225.1780 E: 11088234.4720
TIE POINT 1: 4551.4'±, S 74d12'16" E

REFERENCE COORDINATE METADATA

PROJECTION - VIRGINIA STATE PLANE
DATUM - NAD83, SOUTH ZONE
UNITS - U.S. SURVEY FEET

ELEVATIONS ARE REFERENCED TO NORTH AMERICAN VERTICAL DATUM OF 1988, NAVD88.

GEOREFERENCE SOURCE DATA

DIGITIZED DATA: PICTOMETRY HIGH ACCURACY ORTHOIMAGERY https://www.pictometry.com
REPORTED ACCURACY EXCEEDING NMAS (12.3FT) 1:4800

LIDAR ELEVATION DATA: VIRGINIA GEOGRAPHIC INFORMATION NETWORK (VGIN) LIDAR POINT CLOUD (LPC) . EXPECTED TO MEET USGS 3DEP, QL2 OR BETTER QUALITY LIDAR DATA WITH USGS BASE SPEC V1.2 PRODUCTS.

PROPERTY DATA: HURT & PROFFITT ENGINEERING AND SURVEY, EASTERN ROANOKE RIVER GREENWAY PROJECT, DATED MARCH 27, 2018.
ADDITIONAL DATA: ROANOKE COUNTY GIS, JULY 29, 2021 https://data.roanokecountyva.gov/
BOUNDARY DATA: FERC EXHIBIT G, NIAGARA HYDROELECTRIC PROJECT, PROJECT AREA & BOUNDARY MAP, 2466-002-3 AND 2466-002-4, NOVEMBER 4, 1991

NOTES

1. THE LICENSEE EITHER OWNS IN SIMPLE FEE OR POSSESSES FLOWAGE EASEMENTS OVER ALL LANDS WITHIN THE PROJECT BOUNDARY REQUIRED TO OPERATE THE FACILITY.
2. SEE EXHIBIT G-2 FOR PROJECT BOUNDARY TABLES.

SURVEYORS STATEMENT

I HEREBY CERTIFY TO THE FEDERAL ENERGY REGULATORY COMMISSION (FERC) THAT THIS PLAN MEETS THE CONDITIONS SET FORTH BY FERC FOR ITS EXPRESSED PURPOSE. THE PURPOSE OF THIS MAP IS TO PROVIDE A GEOREFERENCED VISUAL DEPICTION OF THE LOCATION OF PROJECT FEATURES AND BOUNDARIES BASED ON THE BEST AVAILABLE HISTORICAL DRAWINGS AND DIGITAL REFERENCE SOURCES INCORPORATED INTO THE GEOGRAPHIC INFORMATION SYSTEM (GIS). LOCATIONS HAVE NOT BEEN VERIFIED BY PHYSICAL FIELD SURVEYS AND THIS DRAWING SHOULD NOT BE USED FOR PURPOSES OF DEVELOPING PROPERTY BOUNDARY DESCRIPTIONS.

STATE OF MAINE
STEPHEN W. EVERETT 2161
PROFESSIONAL LAND SURVEYOR

LEGEND

- EASEMENT LAND
- FEDERAL LAND, NATIONAL PARK SERVICE
- FERC COORDINATE REFERENCE POINT
- CONCRETE MONUMENT FOUND
- PROJECT BOUNDARY POINT NUMBER (e.g. 14)
- PROJECT BOUNDARY
- POLITICAL BOUNDARY
- PROPERTY/RIGHT OF WAY
- SHORELINE/STREAM
- TRANSMISSION/DISTRIBUTION LINE
- FENCE
- RAILROAD LINE
- PRIMARY ROADS
- SECONDARY ROADS

EXHIBIT G-1 **SHEET 1 OF 2**

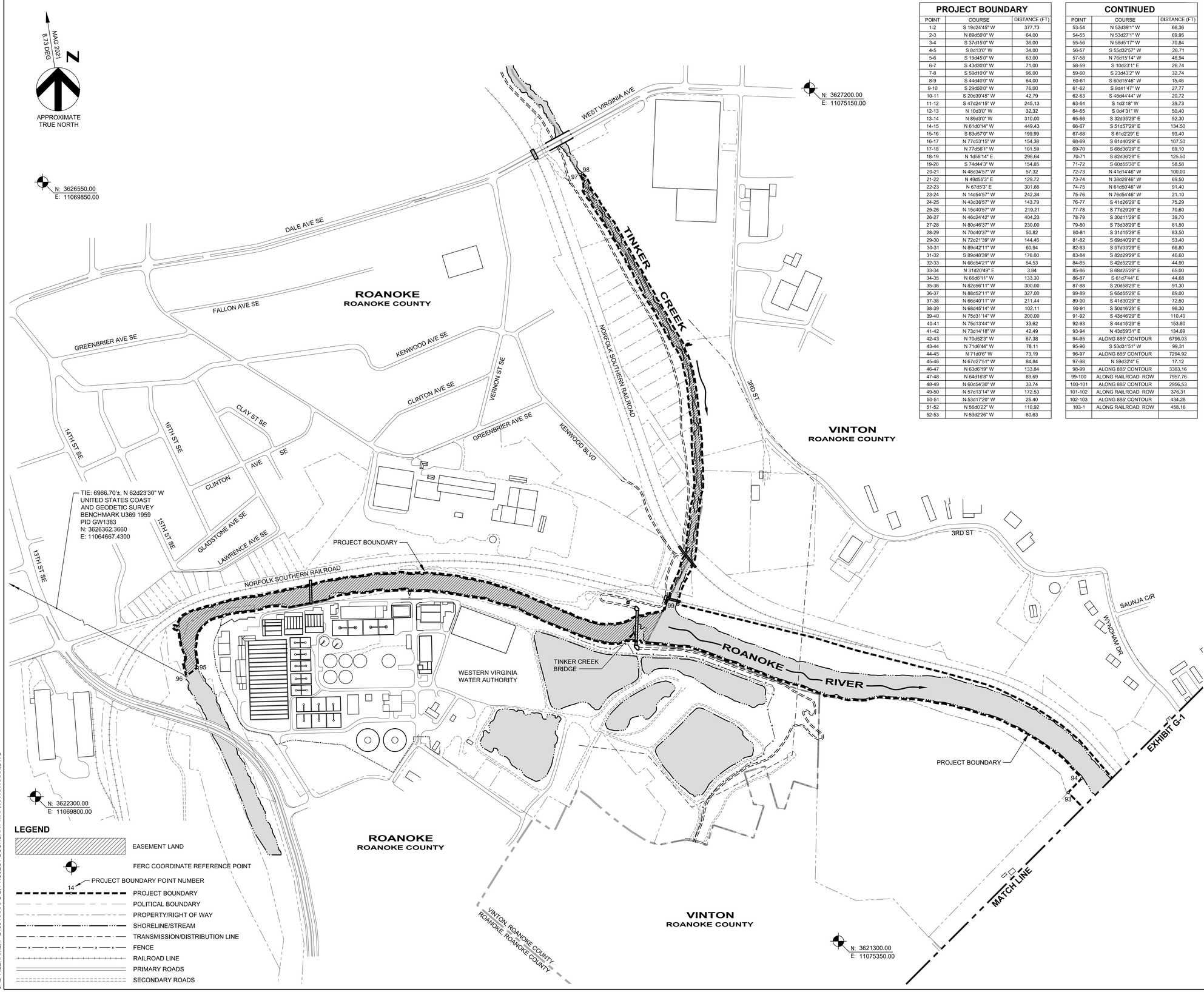
NIAGARA HYDROELECTRIC PROJECT
VIRGINIA
PROJECT BOUNDARY MAP

300 200 100 0 300 600 900 1200

APPALACHIAN POWER COMPANY **FERC No. 2466**

DATE:	SCALE:	APPROVED:
FEBRUARY 2022	1"=300'	PENDING

CAD FILENAME: P-2466-XXXX, G-1, PROJECT BOUNDARY MAP_XX-XX-XXXX.DWG



CAD FILENAME: P-2466-XXXX, G-2, PROJECT BOUNDARY MAP, XX-XX-XXXX.DWG

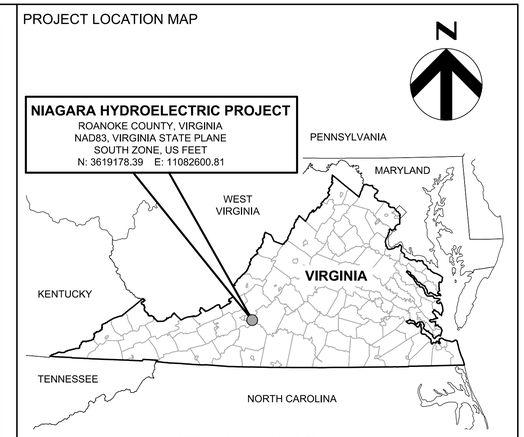
PROJECT BOUNDARY

POINT	COURSE	DISTANCE (FT)
1-2	S 19d24'45" W	377,73
2-3	N 89d50'0" W	64,00
3-4	S 37d15'0" W	36,00
4-5	S 8d13'0" W	34,00
5-6	S 19d45'0" W	63,00
6-7	S 43d30'0" W	71,00
7-8	S 59d10'0" W	96,00
8-9	S 44d40'0" W	64,00
9-10	S 29d50'0" W	76,00
10-11	S 20d39'45" W	42,79
11-12	S 47d24'15" W	245,13
12-13	N 10d3'0" W	32,32
13-14	N 89d3'0" W	310,00
14-15	N 61d0'14" W	449,43
15-16	S 63d57'0" W	199,99
16-17	N 77d53'15" W	154,38
17-18	N 77d56'1" W	101,59
18-19	N 1d58'14" E	298,64
19-20	S 74d44'3" W	154,85
20-21	N 48d34'57" W	57,32
21-22	N 49d55'3" E	129,72
22-23	N 67d5'3" E	301,66
23-24	N 14d54'57" W	242,34
24-25	N 43d38'57" W	143,79
25-26	N 15d40'57" W	219,21
26-27	N 46d24'42" W	404,23
27-28	N 80d46'37" W	230,00
28-29	N 70d40'37" W	50,82
29-30	N 72d21'39" W	144,46
30-31	N 89d42'11" W	60,94
31-32	S 89d48'39" W	176,00
32-33	N 66d54'21" W	54,53
33-34	N 31d20'49" E	3,84
34-35	N 66d6'11" W	133,30
35-36	N 82d56'11" W	300,00
36-37	N 88d52'11" W	327,00
37-38	N 66d40'11" W	211,44
38-39	N 68d45'14" W	102,11
39-40	N 75d31'14" W	200,00
40-41	N 75d13'44" W	33,62
41-42	N 73d14'18" W	42,49
42-43	N 70d52'3" W	67,38
43-44	N 71d6'44" W	78,11
44-45	N 71d0'6" W	73,19
45-46	N 67d27'51" W	84,84
46-47	N 63d6'19" W	133,84
47-48	N 64d16'8" W	89,69
48-49	N 60d54'30" W	33,74
49-50	N 57d13'14" W	172,53
50-51	N 53d17'20" W	25,40
51-52	N 56d0'22" W	110,92
52-53	N 53d2'26" W	60,63

CONTINUED

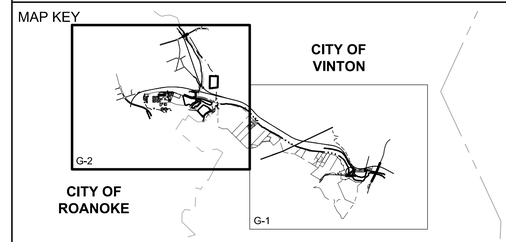
POINT	COURSE	DISTANCE (FT)
53-54	N 52d39'1" W	66,36
54-55	N 53d27'1" W	69,95
55-56	N 58d5'17" W	70,84
56-57	S 55d32'57" W	28,71
57-58	N 76d15'14" W	48,94
58-59	S 10d23'1" E	26,74
59-60	S 23d43'2" W	32,74
60-61	S 60d15'46" W	15,46
61-62	S 9d41'47" W	27,77
62-63	S 46d44'44" W	20,72
63-64	S 1d3'18" W	39,73
64-65	S 0d4'31" W	50,40
65-66	S 32d35'29" E	52,30
66-67	S 51d57'29" E	134,50
67-68	S 61d2'29" E	93,40
68-69	S 61d40'29" E	107,50
69-70	S 68d36'29" E	69,10
70-71	S 62d36'29" E	125,50
71-72	S 60d55'30" E	58,58
72-73	N 41d14'46" W	100,00
73-74	N 38d28'46" W	69,50
74-75	N 61d50'46" W	91,40
75-76	N 76d54'46" W	21,10
76-77	S 41d26'29" E	75,29
77-78	S 77d29'29" E	70,60
78-79	S 30d11'29" E	39,70
79-80	S 73d38'29" E	81,50
80-81	S 31d15'29" E	83,50
81-82	S 69d40'29" E	53,40
82-83	S 57d33'29" E	66,80
83-84	S 82d29'29" E	46,60
84-85	S 42d52'29" E	44,90
85-86	S 68d25'29" E	65,00
86-87	S 61d7'44" E	44,68
87-88	S 20d58'29" E	91,30
99-89	S 65d55'29" E	89,00
89-90	S 41d30'29" E	72,50
90-91	S 50d16'29" E	96,30
91-92	S 43d46'29" E	110,40
92-93	S 44d15'29" E	153,80
93-94	N 43d59'31" E	134,69
94-95	ALONG 885' CONTOUR	6796,03
95-96	S 53d31'51" W	99,31
96-97	ALONG 885' CONTOUR	7294,92
97-98	N 59d32'4" E	17,12
98-99	ALONG 885' CONTOUR	3363,16
99-100	ALONG RAILROAD ROW	7957,76
100-101	ALONG 885' CONTOUR	2956,53
101-102	ALONG RAILROAD ROW	376,31
102-103	ALONG 885' CONTOUR	434,28
103-1	ALONG RAILROAD ROW	458,16

PROJECT LOCATION MAP



APPROXIMATE SCALE: 1"=75 MILES

MAP KEY



APPROXIMATE SCALE: 1"=4000 FEET

PROJECT BOUNDARY TIE DATA

THE PROJECT BOUNDARY IS TIED TO ROANOKE COUNTY NATIONAL GEODETIC SURVEY BENCHMARK U369, 1959, PID GW1383: N: 3626362.3660 E: 11064667.4300
TIE POINT 96: 6966.7'±, N 62D23'30" W

REFERENCE COORDINATE METADATA

PROJECTION - VIRGINIA STATE PLANE
DATUM - NAD83, SOUTH ZONE
UNITS - U.S. SURVEY FEET

ELEVATIONS ARE REFERENCED TO NORTH AMERICAN VERTICAL DATUM OF 1988, NAVD88.

GEOREFERENCE SOURCE DATA

DIGITIZED DATA: PICTOMETRY HIGH ACCURACY ORTHOIMAGERY HTTPS://WWW.PICTOMETRY.COM
REPORTED ACCURACY EXCEEDING NMAS (12.3FT) 1:4800

LIDAR ELEVATION DATA: VIRGINIA GEOGRAPHIC INFORMATION NETWORK (VGIN) LIDAR POINT CLOUD (LPC) . EXPECTED TO MEET USGS 3DEP, QL2 OR BETTER QUALITY LIDAR DATA WITH USGS BASE SPEC V1.2 PRODUCTS.

PROPERTY DATA: HURT & PROFFITT ENGINEERING AND SURVEY, EASTERN ROANOKE RIVER GREENWAY PROJECT, DATED MARCH 27, 2018.
ADDITIONAL DATA: ROANOKE COUNTY GIS, JULY 29, 2021 HTTPS://DATA.ROANOKECOUNTYVA.GOV/
BOUNDARY DATA: FERC EXHIBIT G, NIAGARA HYDROELECTRIC PROJECT, PROJECT AREA & BOUNDARY MAP, 2466-002-3 AND 2466-002-4, NOVEMBER 4, 1991

NOTES

1. THE LICENSEE EITHER OWNS IN SIMPLE FEE OR POSSESSES FLOWAGE EASEMENTS OVER ALL LANDS WITHIN THE PROJECT BOUNDARY REQUIRED TO OPERATE THE FACILITY.
2. SEE EXHIBIT G-2 (THIS SHEET) FOR PROJECT BOUNDARY DESCRIPTION TABLES.

SURVEYORS STATEMENT

I HEREBY CERTIFY TO THE FEDERAL ENERGY REGULATORY COMMISSION (FERC) THAT THIS PLAN MEETS THE CONDITIONS SET FORTH BY FERC FOR ITS EXPRESSED PURPOSE. THE PURPOSE OF THIS MAP IS TO PROVIDE A GEOREFERENCED VISUAL DEPICTION OF THE LOCATION OF PROJECT FEATURES AND BOUNDARIES BASED ON THE BEST AVAILABLE HISTORICAL DRAWINGS AND DIGITAL REFERENCE SOURCES INCORPORATED INTO THE GEOGRAPHIC INFORMATION SYSTEM (GIS). LOCATIONS HAVE NOT BEEN VERIFIED BY PHYSICAL FIELD SURVEYS AND THIS DRAWING SHOULD NOT BE USED FOR PURPOSES OF DEVELOPING PROPERTY BOUNDARY DESCRIPTIONS.

STATE OF MAINE
STEPHEN W. EVERETT 2161
PROFESSIONAL LAND SURVEYOR

EXHIBIT G-2 **SHEET 2 OF 2**

NIAGARA HYDROELECTRIC PROJECT
VIRGINIA
PROJECT BOUNDARY MAP

300 200 100 0 300 600 900 1200

APPALACHIAN POWER COMPANY **FERC No. 2466**

DATE:	FEBRUARY 2022	SCALE:	1"=300'	APPROVED:	PENDING

FERC NO. P-2466-XXXX

FINAL LICENSE APPLICATION

NIAGARA HYDROELECTRIC PROJECT (FERC NO. 2466)

EXHIBIT H

PLANS AND ABILITY OF THE APPLICANT TO OPERATE THE PROJECT

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Exhibit H Plans and Ability of the Applicant to Operate the Project (18 CFR §5.18(c))

H.1 Licensee's Ability to Provide Efficient and Reliable Electric Service

As a result of the Electric Consumers Protection Act passed by Congress in 1986, the FERC requires that all existing licensees applying for a new license provide the information as described in the sections that follow.

H.1.1 Future Energy

Appalachian has 1 million customers in Virginia, West Virginia and Tennessee. It is part of AEP, which is focused on building a smarter energy infrastructure and delivering new technologies and custom energy solutions. AEP's more than 18,000 employees operate and maintain the nation's largest electricity transmission system and more than 219,000 miles of distribution lines to efficiently deliver safe, reliable power to nearly 5.4 million customers in 11 states. AEP is also one of the nation's largest electricity producers with approximately 32,000 MW of diverse generating capacity, including 5,300 MW of renewable energy.

Appalachian submitted its 2019 Integrated Resource Plan (IRP) on May 1, 2019 to the commonwealth of Virginia State Corporation Commission pursuant to § 56-599 of the Code of Virginia (Appalachian 2019b). The IRP provides a forecast (2019-2033) of its load obligations and a plan to meet those obligations by supply-side and demand-side resources to promote reasonable prices, reliable service, energy independence, and environmental responsibility based on current assumptions regarding customer load requirements, commodity price projections, supply-side alternative costs, demand-side management (DSM) program costs and analysis, and the effect of present-day environmental rules and guidelines. The 2019 IRP also addresses the mandates contained in Virginia's recently enacted Grid Transformation and Security Act, which became effective July 1,2018 (Virginia Act), as well as other legal requirements and regulations, and considers the potential cost associated with some form of future regulation of carbon emissions, during the planning period, even though there is considerable uncertainty as to the timing and form future carbon regulation may take. Finally, the 2019 IRP (Appalachian 2019b) addressed the mandates included in the 2018 Virginia Act including:

- The construction or acquisition by Appalachian of at least 200 MW of utility-owned solar located in Virginia prior to 2028;

- In future energy efficient (EE) rate adjustment clause proceedings, Appalachian is required to request State Corporation Commission approval of $140 million in EE programs from July 2018 to July 2027; and

- As part of a five-year battery pilot program deemed to be in the public interest, Appalachian may invest in up to l0 MWs of new battery storage installations.

To meet its customers' future capacity and energy requirements, Appalachian will continue the operation of, and ongoing investment in, its existing fleet of generation resources including the base-load coal units at Amos and Mountaineer, the natural gas combined-cycle (Dresden) facility, combustion turbine (Ceredo) units, and its two gas-steam units at Clinch River. The Company will also continue to operate its hydroelectric generators, including Smith Mountain Lake. The Company has a portfolio of 575 MW of purchase power agreements consisting of five wind farms and one hydro-electric facility. During the planning period, contracts covering 455 MW of that amount will expire. In addition, the Company has contracted for the output of the 15 MW Depot solar facility in Rustburg, VA., which it expects will be available in 2021. Another consideration in the IRP is the increased adoption of distributed rooftop solar resources by Appalachian's customers. While Appalachian does not have control over where, and to what extent, such resources are deployed, it recognizes that distributed rooftop solar will reduce Appalachian's growth in capacity and energy requirements to some degree. From a capacity viewpoint, the 2020/2021 planning year is when PJM's Capacity Performance construct will take full effect.

Appalachian has analyzed various scenarios that would provide adequate supply and demand resources to meet its projected peak load obligations, and reduce or minimize costs to its customers, including energy costs, for the next fifteen years. The key components of Appalachian's Preferred Plan, which is presented in the IRP is based upon these various analyses, are as follows:

- Adds at least 200 MW of large-scale solar resources, consistent with directives in the 2018 Virginia Act.

- Continues to diversify Appalachian's mix of supply-side resources through the addition of battery storage, wind and large-scale solar;

- Incorporates demand-side resources, including but not limited to additional energy efficiency programs and Volt VAR Optimization installations; and

- Recognizes that residential and commercial customers will add distributed resources, primarily in the form of residential and commercial rooftop solar).

H.1.2 Increase in Capacity or Generation

Appalachian does not plan to increase capacity or generation associated with the Project as a result of this relicensing proceeding. During the term of a new license, Appalachian will continue to regularly inspect and maintain the Niagara generating equipment to provide economical and reliable power to its customers from the Project.

H.1.3 Coordination of Operation with Upstream and Downstream Projects

There are a total of six impoundments on the Roanoke River; Niagara is the farthest upstream impoundment. The closest hydroelectric project to Niagara is the Smith Mountain Pumped Storage Project (FERC No. 2210), approximately 42 miles downstream. The Smith Mountain project is also operated by and licensed to Appalachian and uses the Leesville Reservoir (FERC Project No. 2210), located immediately downstream, for regulation of outflows and water as a pumped storage facility. The Leesville Dam is also used to produce hydroelectricity. Downstream of the Leesville project along the North Carolina border, the John H. Kerr Dam impounds Kerr Lake and in northeastern North Carolina, the river is impounded to form the Lake Gaston reservoir (FERC Project No. 2009) and Roanoke Rapids Lake. Because of the large distance separating the Project from the downstream projects and because of the run-of-river operation of Niagara, Project operations do not affect downstream projects, therefore, operational coordination is not necessary.

H.1.4 Coordination of Operation with Electrical Systems

The Project is integrated with the Appalachian transmission and distribution system and, through it, with the entire interconnected AEP System. The interconnected AEP System provides a means, not only for the delivery of Project power to serve local and system loads, but also for the transmittal of power to the local area when the plant is off the line during maintenance periods and emergencies.

If the Project were to be severed from the interconnected system, additional facilities would eventually need to be constructed to assure reliable and continuous service to Appalachian's customers. While the capacity and energy now being supplied by the Project could be replaced by output from a fossil-fueled, steam-electric generating plant, the distinctive characteristics of hydroelectric generation which contribute to flexible system operation could not be replaced by such an alternative.

The major advantages of a small hydroelectric generating plant over other types of electric generating plants are its ability to supply reactive voltamperes to the local system for voltage regulation, and to be electrically connected in close proximity to the load, thereby reducing energy losses on the transmission and distribution system.

Either a takeover of the Project by the Federal Government or a failure to issue a new license to Appalachian would have a detrimental effect upon Appalachian's system, since the capacity and energy lost due to these actions must be replaced by capacity and energy, potentially produced by higher-cost, fossil-fueled, generating units. If such replacement should become necessary, Appalachian would not have the ability to control the plant to optimize its support of the local transmission and distribution system.

H.2 Need for Project Power

Appalachian believes that for the foreseeable future, renewable and emission-free generation from the Project will be required to provide electricity, as well as support system reliability within the region. Should the Project not operate beyond the expiration of the current license, these Project benefits would no longer exist.

Energy and capacity from the Project make a small but important contribution to energy production in the state of Virginia and the regional power grid. Electric generation in Virginia is summarized in the U.S. Energy Information Administration's (EIA's) *State Profile* (EIA 2021) as follows:

> Natural gas (60%) and nuclear power (30%) accounted for 90% of Virginia's in-state electricity net generation in 2020. Renewable energy sources, including biomass (3%), hydroelectric power (2%), and solar (2%), accounted for almost 7%. Coal and, to a much lesser extent, petroleum together fueled less than 4% of in-state generation. (Coal-fired power plants supplied the largest share of the state's net generation until 2009, when coal's contribution fell below that of nuclear power. As coal-fired generation decreased, natural gas-fired generation increased.) In 2019, in-state electricity generation from renewable energy sources also exceeded coal's contribution for the first time.
>
> Virginia's in-state electricity generation increased by 40% between 2010 and 2020. However, electricity consumption in the state is still greater than generation, and Virginia receives additional power from two regional grids. One grid, the PJM Interconnection, supplies most of the state.
>
> In 2020, Virginia replaced its voluntary renewable portfolio goal with the Virginia Clean Economy Act. The Act requires the state's two largest investor-owned utilities, Dominion Energy Virginia and American Electric Power, to retire their carbon emitting electricity generating units and construct, acquire, or purchase Virginia generating

> capacity that uses solar and wind energy. Dominion Energy Virginia must obtain 100% of its electricity from renewable sources by 2045, and American Electric Power is to meet its 100% renewable target by 2050. The Act establishes an energy efficiency standard that requires that each utility achieve incremental annual energy efficiency savings.

The Project has been supplying power and energy to Appalachian's system since its acquisition in 1926, a period of about 95 years. Because Appalachian is an operating company of AEP, its generation and bulk power transmission facilities are planned and operated as integral parts of the overall AEP System. (Appalachian is part of the AEP System's East, or PJM, Zone). Therefore the adequacy and reliability of power supply in those portions of Virginia and West Virginia served by Appalachian are dependent not only on the generation and bulk power transmission facilities of Appalachian, but also on such facilities of the entire AEP System. When evaluating the need for generating capacity by Appalachian, this relationship must be recognized as well as the contribution to system generating capability by the Project. Since the electric energy requirements of Appalachian's customers are expected to increase over the foreseeable future, the need for the energy supplied by Project will continue.

Overall, the usefulness of the Project has been demonstrated by its operating history. The Project itself is located very near the areas served by its electric output. This favorable location has enabled Appalachian to use short transmission lines with low transmission costs, higher transmission reliability and higher control flexibility. In addition, the Project uses renewable primary energy resources and produces no atmospheric pollution. The energy production costs for the Project are lower than the replacement energy costs from available sources.

Power produced at the Project is used to meet demand in the PJM region. North American Electric Reliability Corporation (NERC) annually forecasts electrical supply and demand nationally and regionally for a 10-year period. According to NERC's 2019 forecast, the peak season (summer) demand for the PJM region is expected to grow at an annual rate of 0.4 percent from 2020 to 2029 (NERC 2019). The Project serves a role in the regional energy market by providing 2.1 MW of generation capacity. In addition, the 2019 Virginia State Energy Plan sets forth a goal for state utilities to source 30 percent of their electricity from renewable energy sources by 2030 and 100 percent of their electricity from carbon-free sources by 2050. Power from the project would continue to help meet a need for power in the PJM region and the renewable energy goals of the state. The Project would continue to provide low-cost power that displaces generation from non-renewable sources.

The Project's two generating units have an authorized installed capacity of 2.4 MW, compared to a total generating capacity owned by Appalachian of over 6,600 MW. The net energy generated by the

Project in 2021 was 8,946 MWh. The continued operation of the Project is based primarily on the usefulness to Appalachian and its customers and on the Project's low energy production costs, as well as Appalachian's overall need for capacity and energy.

H.2.1 Alternative Sources of Power

The AEP System and its customers have a need for generating capacity, and continued operation of existing renewable generating capacity is necessary to meet established decarbonization targets in AEP's territories. If the System could not rely on the capacity of the Project, it would need to find alternate sources. A comparison of supply-side options is presented in Table H.2-1. In this table, several baseload, peaking, and intermittent options are shown, with the final column representing the levelized busbar cost of energy based on the capacity factors shown here, in current dollars. Capacity and generation to replace the Project may be from any of these resources. This replacement capacity and energy would be developed by Appalachian or purchased from the PJM. If the Project were not relicensed, Appalachian and Appalachian's ratepayers would incur significant additional costs associated with Project decommissioning, which is not considered a relicensing alternative for the purposes of this license application.

Table H.2-1. AEP System - New Generation Technologies, Key Supply-Side Resource Option Assumptions [(a)(b)(c)(d)]

Type	Capability (MW) (e)			Capital Cost (d,f) ($/kW)	Installed Cost (d,f) ($/kW)	Full Load Heat Rate (HHV,Btu/kWh)	Fuel Cost ($/MBtu)	Variable O&M ($/MWh)	Fixed O&M ($/kW-yr)	Emission Rates			Capacity Factor (%)	LCOE (g) ($/MWh)
	Std. ISO	Summer	Winter							SO2 (Lb/mmBtu	NOx (Lb/mmBtu)	CO2 (Lb/mmBtu)		
Base Load														
SMALL MODULAR REACTOR NUCLEAR POWER PLANT, 600 MW	600	600	600	6,500	7,300	10,000	0.96	3.18	100.91	0.000	0.000	0.0	90	129.0
ULTRA-SUPERCRITICAL COAL WITH 90% CO2 CAPTURE, 650 MW	650	630	690	6,300	7,200	12,500	1.97	11.52	62.55	0.013	0.057	20.5	75	170.5
COMB TURBINE H CLASS, COMB-CYCLE SINGLE SHAFT W/90% CO2 CAPTURE, 430 MW	380	370	390	2,500	2,600	7,100	2.89	6.13	28.95	0.001	0.008	11.7	75	84.1
COMB TURBINE H CLASS, 1100-MW COMBINED CYCLE	1,030	1,010	1,070	1,100	1,100	6,400	2.89	1.96	11.82	0.001	0.008	117.1	75	54.5
COMB TURBINE H CLASS, COMBINED-CYCLE SINGLE SHAFT, 430 MW	420	410	440	1,100	1,200	6,400	2.89	2.68	14.80	0.001	0.008	117.1	75	57.9
Peaking														
COMB TURBINE F CLASS, 240-MW SIMPLE CYCLE	230	230	250	800	800	9,900	2.89	0.63	7.34	0.001	0.008	117.1	25	93.5
COMB TURBINES AERODERIVATIVE, 100-MW SIMPLE CYCLE	110	100	110	1,300	1,300	9,100	2.89	4.93	17.11	0.001	0.008	117.1	25	126.9
INTERNAL COMBUSTION ENGINES, 20 MW	20	20	20	2,000	2,100	8,300	2.89	5.97	36.91	0.000	0.020	117.0	25	172.6
Intermittent														
BATTERY ENERGY STORAGE SYSTEM, 50 MW / 200 MWH	50	50	50	1,500	1,470			0	21.69				25	157.0
ONSHORE WIND, LARGE PLANT FOOTPRINT, 200 MW(h)	200	200	200	1,300	1,310			0	23.52				31	31.9
SOLAR PHOTOVOLTAIC, 150 MWAC(i)	150	150	150	1,300	1,200			0	9.91				21	53.0
SOLAR PHOTOVOLTAIC WITH BATTERY ENERGY STORAGE SYSTEM, 150 MWx200 MWh (i)	150	150	150	1,800	1,610			0	30.29				20	85.6

Notes:

(a) Costs and performance data informed by EIA report Capital Cost and Performance Characteristic Estimates for Utility Scale Electric Power Generating Technologies (Feb 2020)
(b) Installed cost, capability and heat rate numbers have been rounded
(c) All costs in 2021 dollars, except as noted. Costs adjustments made based on EIA report Cost and Performance Characteristics of New Generating Technologies, Annual Energy Outlook 2020 (Region 11-PJMW)
(d) $/kW costs are based on summer capability.
(e) All Capabilities adjusted by the Performance Adjustment Factors defined in the reference report (a)
(f) Total Plant Investment Cost w/AFUDC (AEP rate of 6.41%,site rating $/kW)
(g) Levelized cost of energy based on capacity factors shown in table
(h) System in service (COD) 2022, Costs shown in 2022$
(i) System in service (COD) 2021, Costs shown in 2021$

H.2.2 Need, Reasonable Cost and Availability of Alternative Sources of Power

H.2.2.1 Average Annual Cost of Project Power

This section describes the annual costs of the Project as proposed. The estimated average cost of the total Project is approximately $2,055,038 a year, based on data available to Appalachian through the end of 2021. The estimated annual costs for the Project are presented in Table H.2-2.

Table H.2-2. Niagara Project Current Average Annual Cost

Description	Cost
Cost of capital (equity and debt)	$866,636
Local, state, and federal taxes	$57,408
Depreciation and amortization	$855,066
Operation and maintenance expenses, including interim replacements, insurance, administrative and general expenses, and contingencies	$275,928
Total	**$2,055,038**

H.2.2.2 Projected Resources Required by the Licensee to Meet Short- and Long-Term Capacity and Energy Requirements

As previously discussed, the evaluation of the adequacy and reliability of generating capability to meet the current and projected power demands of Appalachian's customers must also take into account the total generating capability of the AEP System in relation to the aggregate AEP System load (including relevant contractual arrangements with non-affiliated systems).

Currently the Appalachian has adequate generation resources to meet its customer's load requirements. Through 2026, Appalachian has capacity resources to meet its forecasted internal demand. In 2027, Appalachian anticipates experiencing a slight capacity shortfall, 75 MW, based upon its assumption regarding the retirement of Clinch River Units 1 and 2 in 2026, and the expiration of wind and hydro contracts totaling 455 MW (nameplate) of renewable generation, during the 2027-2030

timeframe. By 2033, Appalachian has a capacity deficit of approximately 200 MW (Appalachian 2019a).

Recognizing its modest capacity deficit position over the planning period, ~200 MW in 2033, Appalachian considered the impact of the resource additions required by the 2018 Virginia Act and resources necessary to satisfy Virginia's voluntary Renewable Portfolio Standard goals. These additions, which include solar, energy storage and energy efficiency resources, are expected to eliminate most of the capacity deficit through the planning period. The solar resources are assumed to provide PJM capacity equal to 51.1 percent of their nameplate rating (or 102 MW for 200MW of nameplate solar). Energy storage will provide 10 MW, and EE will provide approximately 20MW of planning capacity. Taking these resources into account, a resource plan that meets the 2018 Virginia Act would also be compliant with Virginia's voluntary Renewable Portfolio Standard goals, if the plan adds 300 MW of wind resources in 2023 (Appalachian 2019b).

H.3 Power Supply at Industrial Facility

Since the Project is not used to supply power to an applicant-owned and operated industrial facility, this section is not applicable.

H.4 Native American Tribe as Applicant

Since the Applicant is not a Native American Tribe, this section is not applicable.

H.5 Impacts of Receiving or not Receiving a License on Licensee's Operations of the Transmission Facility

Either a takeover of the Project by the Federal Government or a failure to issue a new project license to Appalachian would have a detrimental effect upon Appalachian's transmission and distribution system. Consequently, the capacity and energy lost due to either of the two actions would most likely be replaced by the generation from higher-cost, fossil-fueled, steam-electric generating plants, located many miles from the local load area. Some adverse effects of the alternative would include: an increase in line loading; an increase in loading on the transformers; an increase in energy losses; and increased operating expenses. The power that would have been produced from the Project's renewable resource will have to be replaced by power generated by other resources, likely requiring the consumption of non-renewable fuels.

At the Project, a suspension of generation would result in less desirable voltage regulation. Transmission facilities at the Project consist of the 50-ft-long 2.4-kV generator leads, approximately 50 ft in length, and a 3-phase, 2.4/12-kV, 2500 kVA step-up transformer and appurtenant facilities.

If the Project were relicensed, Appalachian would not be required to reinforce or upgrade its transmission system. Conversely, if the license were not renewed, higher line and transformer loadings would occur on Appalachian's transmission system, resulting in the eventual advancement of infrastructure required to reinforce that system. Dependent on the area's load growth rate and pattern, as well as the outcome of the relicensing application of other hydroelectric projects, additional transmission, distribution, and station facilities would be required to serve the area load sooner than if the project were relicensed.

H.5.1 Single Line Diagrams

The single-line diagrams for the Project, which present system transmission elements in relation to the Project, is provided in Volume III of this FLA (filed as CEII).

H.6 Modifications to Project Facilities and Consistency with Comprehensive Plans

Appalachian has no plans to modify existing Project facilities or operations which would impact existing comprehensive waterway plans on the Roanoke River. The Project facilities and operations described in this license application are compatible with the comprehensive waterway plans for the Roanoke River as defined in Section 10(a)(1) of the Federal Power Act. The comprehensive plan which affects the Niagara Hydroelectric Project is the 2018 Virginia Outdoors Plan (VDCR 2018c), which presents a recreational needs assessment and identifies recreational priorities for the Commonwealth.

As previously stated, Appalachian is not seeking any facility or operational modifications intended to increase Project capacity. In accordance with 18 CFR §5.6(d)(4)(III and IV), Appalachian has reviewed FERC's SD3 and the April 2021 FERC List of Comprehensive Plans applicable to Virginia and adopted by FERC under Section 10(a)(2)(A) of the Federal Power Act, 16 USC §803(a)(2)(A). Of the 62 comprehensive plans relevant to Virginia, four are considered applicable to the Project.

These potentially relevant comprehensive plans, listed by state, are presented in Table H.6-1. Based on a review of these comprehensive plans, current and proposed operations of Project facilities have been determined to be consistent with these plans.

Table H.6-1. List of Qualifying Federal and State Comprehensive Plans Potentially Relevant to the Project

Comprehensive Plan
U.S. Fish and Wildlife Service. Canadian Wildlife Service. 1986. North American waterfowl management plan. Department of the Interior. Environment Canada. May 1986.
U.S. Fish and Wildlife Service. n.d. Fisheries USA: the recreational fisheries policy of the U.S. Fish and Wildlife Service. Washington, D.C.
Virginia Department of Conservation and Recreation. The 2018 Virginia outdoors plan (SCORP). Richmond, Virginia.
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H.7 Financial and Personnel Resources

Appalachian is dedicated to operating the Project in a safe and reliable manner to provide clean renewable electric energy to the electricity grid. As demonstrated under the existing license, Appalachian has the financial resources to meet the operation, maintenance, and capital requirements of the Project.

Operations, maintenance, environmental and license compliance, modification, technical and administrative activities required for the Project are performed and supported by employees and contractors of Appalachian. Appalachian has available a complete staff of operators and mechanics who are trained and experienced in the operation of hydroelectric projects. Plant operation is automated and can be controlled from the COC. The Niagara powerhouse is normally attended by one plant operator on the day shift from Monday to Thursday to perform routine maintenance activities. Dedicated personnel include supervisory (1), instrumentation and controls (3), and maintenance (1) staff. Operations personnel can be called in from nearby AEP hydroelectric facilities for additional support. If required, Appalachian can contract with consultants and contractors to undertake larger scale maintenance projects. Additionally, Appalachian has available the administrative, licensing, and support personnel that are needed to maintain compliance with the terms of the license.

H.8 Expansion of Project Lands

Appalachian is not presently proposing any expansion of Project lands (Project Boundary) associated with this license application; therefore property owner notification is not required. Consistent with FERC guidance, an electronic version of the Project maps is being filed with this FLA under Exhibit G.

H.9 Electricity Consumption Efficiency Improvement Program

The planning philosophy of the AEP System has recognized for many years the need to develop both the System's supply and its demand in a compatible manner to optimize the utilization of the System's investment in power supply facilities, and to thereby reduce, to the greatest extent possible, the cost of electric power and energy to the consumer. Appalachian is actively engaged in administering various commission approved DSM and Energy Efficiency (EE) programs which would further accelerate the adoption of energy efficient technology within its service territory.

The 2019 IRP integrates supply- and demand-side resources. Broadly speaking, DSM involves matching customer consumption patterns of electricity as closely as possible to the capabilities of the power supply facilities, while recognizing the customer's desire for the end product, i.e., air

conditioning, heating, etc. The principal objective is to reduce the cost of electricity to the consumer through a better utilization of existing power supply facilities; thus delaying the need for such facilities in the future. Appalachian's long term load forecast models account for trends in EE both in the historical data as well as the forecasted trends in appliance saturations as the result of various legislated appliance efficiency standards (Energy Policy Act of 2005, Energy independence and Security Act of 2007, etc.) modeled by the Energy Information Administration. In addition to general trends in appliance efficiencies, the Company also administers multiple DSM programs that the state commissions approve as part of its DSM portfolio. The load forecast utilizes the most current DSM programs, which either have been previously approved by or are pending currently before the Commission, at the time the load forecast is created to adjust the forecast for the impact of these programs. For the recent IRP, DSM/EE programs have been embedded into the load forecast (Appalachian 2019b).

DSM programs continue to encourage the wise and prudent use of electricity, stressing activities that are cost-effective, promote efficiency, conserve, and alter consumption patterns. These programs are intended to benefit the consumer and conserve natural resources. To be effective, programs must be tailored to meet local and regional needs. Several specific objectives of DSM programs include:

- Promote energy conservation;
- Strive for retention of existing customers;
- Encourage new off-peak electrical applications
- Promote electrical applications that improve system load

H.10 Names and Addresses of Native American Tribes with land on Which the Project is located or Tribes that May Be Affected by the Project as Proposed

The Project is not located on Native American lands. Appalachian and the Commission consulted with the following federally recognized Native American tribes that may be affected by the Project throughout the relicensing process and in support of cultural resource studies. Points of contact (names) associated with each of these Native American tribes is presented in the Initial Statement of this application and the associated distribution list.

- Catawba Indian Nation
- Delaware Nation
- Monacan Indian Nation
- Pamunkey Indian Tribe

H.11 Safe Management, Operation, and Maintenance of the Project

H.11.1 Operating During Flood Conditions

The Project has no spillway gates and the main spillway is an uncontrolled overflow structure that discharges at a headwater at EL. 885 ft. Water begins to spill over the auxiliary spillway when headwater reaches EL. 886 ft. The generating units are shut down when the tailwater level at the powerhouse reaches EL. 832.0 ft (river flow of 35,000 cfs). During high water events, both the upper and lower intake gates are left in the open position. The Project is abandoned when the headpond reaches EL. 895.0 ft.

The Project facilities were constructed prior to 1924, when Appalachian Power and American Gas & Electric Company acquired the Project. Therefore, Appalachian has no data related to flood elevations prior to Project construction. Since its acquisition, Appalachian has made no changes to the spillway that would affect spillway capacity. Thus, flood levels that have been experienced in the past will not be increased or decreased due to relicensing of the Project.

H.11.2 Flood History

The flood of record occurred on November 4, 1985, resulting in a flow of 52,300 cfs at USGS 02056000 located downstream of powerhouse, a headwater of 895 ft, and a tailwater EL. 845.65 ft at the location of the USGS gauge. The flood of record overtopped the right non-overflow section by 9.8 ft and caused its partial failure. Table H.11-1 summarizes this flood and other significant floods at the site.

Table H.11-1. Significant Flood Events

Date	Peak Flow (cfs)	Peak Headwater (ft)	% of PMF
August 14, 1940	35,000	893.5	12
April 27, 1978	29,300	892.5	10
November 4, 1985	52,300	895	18

H.11.3 Emergency Action Plan

The Project was classified as a low-hazard facility until 1994, when it was designated a high-hazard dam by the FERC based on the results of a dam break analysis calibrated to the 1985 flood. Therefore, an EAP was developed and is updated annually in compliance with FERC guidelines. Copies of the

EAP are posted in the powerhouse and at AEP's COC. AEP conducts an annual exercise to ensure that personnel understand the requirements of the EAP.

The EAP states that COC shall monitor upper and lower forebay elevations at all times and seasons (normal flows, flood, fall leaf season). COC shall notify plant personnel when the head differential between upper and lower forebay elevations reaches and/or exceeds 5 ft. When the reservoir reaches EL. 886.0 ft, the water begins to spill over the auxiliary spillway. Forebay metering may not remain accurate as the water level rises above 889.0 ft. When tailwater at the powerhouse reaches EL 832.0 ft the generating units are taken off-line. When the reservoir reaches EL. 890.0 ft, staff must de-energize powerhouse. When the reservoir reaches EL. 890.0 ft, plant personnel should move to high ground and continue to monitor the situation. At reservoir EL. 897.0 ft, the left abutment begins to overtop and the National Weather Service must be notified at that time that the dam is overtopping.

H.11.4 Warning Devices for Downstream Public Safety

Appalachian maintains public safety measures at the Project for public safety upstream, in the vicinity of, and downstream of the Project pursuant to FERC's regulations at Part 12 and a Public Safety Plan on file with the FERC Atlanta Regional Office. Installed measures include a siren at the dam that sounds for two minutes when the spillway is activated.

The plant operators are trained to notify the COC in the event of an emergency. The COC monitors forebay, tailwater, and generation conditions at the dam on a 24-hour basis. The COC responds to observations from the plant personnel and conditions they detect through monitoring devices or alarms, such as:

1. An unexplained rapid decrease in forebay elevation.

2. An unexplained rapid increase in tailwater elevation.

3. An unexplained reduction in load of any generating unit at the plant.

The EAP was last revised and reprinted in December 2019. An up-to-date copy of the EAP is kept in the powerhouse office. The EAP includes the necessary notifications to alert and warn the downstream populace, state, and local governments of possible flood conditions. The notifications to the downstream populace are issued by the National Weather Service.

H.11.5 Monitoring Devices

The Project is maintained by Appalachian in accordance with industry standards and monitored as described in the Dam Safety Surveillance and Monitoring Plan that is maintained for the Project and is on file with FERC's Division of Dam Safety and Inspections – Atlanta Regional Office.

Monitoring devices at the Project includes instrumentation and controls associated with powerhouse operations, water level sensors, and deformation monitoring survey monuments.

- The headwater and tailwater are monitored by radar transducers in the forebay and the tailrace. This data is continuously monitored by the COC and can also be viewed with monitoring equipment at the powerhouse.

- Survey monuments are installed for measuring vertical and horizontal (upstream-downstream) deformation. Object points are installed on the spillway crest, intake deck, downstream wall of the penstock discharge structure, and on the powerhouse. A network consisting of two horizontal control points and five vertical benchmarks that are located off of the structure are used for survey control.

H.11.6 Employee Safety and Public Safety Record

Appalachian manages the Project consistent with its long-standing commitment to employee safety. This commitment begins with compliance with applicable local, state, and federal regulations regarding the safe operation of industrial and electrical facilities.

As a result of the safety program implemented by Appalachian, no Project personnel or contractors have incurred critical injuries at the Project. The Project has operated without an Occupational Safety and Health Administration-reportable incident. There have been no reported public safety incidents associated with Project operations or structures.

H.12 Current Operation of the Project

The Project has been operated in a manner consistent with the requirements of the current license. Details regarding operation and constraints of the Project are discussed in Exhibit A of this application. The Project will continue to operate in a manner consistent with the requirements of the current license until the new license is issued, after which time the Project will be operated in accordance with the requirements and conditions of the new license.

H.13 Project History

The Roanoke Water Power Company began construction of a concrete dam and powerhouse (now known as the Niagara Hydroelectric Project) on the Roanoke River in 1906. Water flowed from intakes located at the main dam through a 750-ft long open headrace channel to the powerhouse intakes. Within the powerhouse, the original generating units consisted of three horizontal Victor waterwheels, probably rope or belt connected to four 750 kW and one 350 kW generators. In 1908, the Roanoke Railway and Electric Company took over the project.

In 1924, the Project was purchased by Appalachian and American Gas & Electric Company and incorporated under the laws of Virginia in 1926. Apparently, sometime prior to 1924, the original generating equipment in the powerhouse was replaced by four horizontal S. Morgan Smith turbines enclosed in steel pressure casings. Four steel penstocks carried flow from the powerhouse intakes to the turbines, which were direct-connected to four generators, two rated at 880 kW, one of 600 kW and the remaining one at 400 kW. In 1949, a drop sluice gate was installed at the main spillway, adjacent to the upper intakes.

In 1953-54, the horizontal generating units were replaced by two 2,200 horsepower vertical shaft Francis turbines manufactured by James Leffel & Company. Each turbine was direct-connected to a1,400 kW Elliot generator located in the superstructure of the powerhouse. The four steel penstock pipes which directed flow to the horizontal turbines were merged by pairs into two larger penstocks within the powerhouse. These two penstocks channeled flow to two cylindrical steel wheel pits which housed the vertical turbines. Accommodating the new generating equipment involved major reconstruction of the powerhouse floor and upstream wall, along with modifications to the discharge chambers.

In November 1985, a flood of record caused a breach of the south abutment of the main spillway. Repairs to this breach involved the installation of sheet piling, rock fill, and a concrete wingwall. During a flood in April 1987, a 100-ft-long section of the right headrace embankment failed. A 500 ft. long, 11-ft inner diameter corrugated metal pipe penstock and associated reinforced concrete intake and discharge structures were installed in the former headrace canal. This penstock arrangement became available for service in September 1988.

On July 30, 1990, irreparable damage was sustained to the Niagara Unit 2 turbine. The damage assessment concluded that a wicket gate pin failed, destroying runner blades, wicked gate casing, and guide vanes. Appalachian replaced the Unit 2 turbine in 1991 with a similar (but not identical) Francis turbine.

On November 30, 1990, a plug in one of the six original diversion channels at the base of the main spillway failed. An adjacent channel was discovered to also be leaking. The reservoir elevation was lowered, a cofferdam was constructed, and a concrete seal was placed at the upstream end of the free-flowing diversion channel by the end of December 1990. A drilling and grouting program was undertaken and completed to permanently seal all six diversion channels.

Programs relating to the operations and maintenance of the Project include regular inspections of the generating units, diving inspections as needed, annual structural inspections and reports, and routine monitoring and calibrating of recording equipment. Any required major repairs or modifications identified during these inspections are coordinated with AEP Service Corporation which provides engineering support.

Major milestones, repairs, and upgrades that have occurred at the Project since the last relicensing are listed in Table H.13-1.

Table H.13-1. Major Repairs and Upgrades Since Previous (1991) Relicensing

Timeframe	Upgrade / Repair/ Milestone
1991	One of the original diversion conduit bulkheads failed and as a result all five were grouted.
1991	Unit 2 replacement
1994	The FERC reclassified the Project as "high" hazard based on the results of a dam break analysis calibrated to the 1985 flood.
1994	The FERC issued a thirty-year operating license for the Project.
1997-1998	Remediation of the main spillway dam by placing RCC. An RCC buttress was added with a concrete facing, rebuilt crest and un-tensioned bar anchors Additional remedial work was performed on the right abutment and the auxiliary spillway. The abutment work included removal of existing riprap and replacement with grouted riprap as well as construction of a new concrete crest. A reinforced concrete wall was constructed adjacent to the inside face of the auxiliary spillway.
1998	A horizontal and vertical deformation program was established.
2001	Annual precision survey of the corrugated penstock, upper and lower intake structures and powerhouse was terminated.
2003	Installed drag rake at intake.
2004	Removed trash rakes and trashrack at the lower penstock reservoir.

Timeframe	Upgrade / Repair/ Milestone
2016-2017	Power canal bank stabilization
2018	Installation of five new headgates at intake screens in upper forebay; new actuators
2019	Recoating of insides of unit penstocks; maintenance (disassembly and cleaning) of all units; installation of six steel bands on corrugated penstocks
2020	Obermeyer gate installed in the sluice structure

H.14 Summary of Generation Lost at the Project Due to Unscheduled Outages

A summary of unscheduled total station outages for the Project over the past five years is provided in Table H.14-1.

Table H.14-1. Unscheduled Total Station Outages (2017-2021)

Outage Start Date	Outage End Date	Duration (Hours)	Cause
05/18/2018 11:33:00	05/21/2018 14:57:00	75.4	Lack of head/ high water
09/17/2018 06:12:00	09/18/2018 16:03:00	33.8	Flooding/trash
09/23/2018 08:17:00	09/24/2018 17:01:00	32.7	High water
10/11/2018 14:22:00	10/15/2018 09:28:00	91.1	High water
12/17/2018 10:27:00	12/17/2018 15:07:00	4.7	Exciter testing
02/20/2019 15:00:00	02/20/2019 16:38:00	1.6	Plant forced outage, due to transmission issue
02/24/2019 15:31:00	02/25/2019 10:12:00	18.7	plant forced outage, high winds caused the transmisson to lose power to plant and plant to trip offline
04/26/2019 06:40:00	04/26/2019 08:41:00	2.0	Plant tripped offline. Reason unknown at this time.
10/31/2019 20:49:00	11/02/2019 20:16:00	47.5	Plant unavailable due to loss of power to site, #2 tripped @ 20:48
02/07/2020 14:16:00	02/10/2020 11:15:00	69.0	Line outage, plant tripped offline. Power restored 15:35. Left offline due to high water / low head
02/14/2020 15:19:00	02/15/2020 09:10:00	17.9	Plant outage, distribution wire down

Outage Start Date	Outage End Date	Duration (Hours)	Cause
03/29/2020 17:51:00	03/30/2020 09:19:00	15.5	Forced plant outage - DDC transmission issue
03/30/2020 16:59:00	03/30/2020 19:15:00	2.3	Forced plant outage -Possible DDC transmission issue. Cause unknown
04/07/2020 10:45:00	04/07/2020 13:50:00	3.1	Distribution line operation
04/13/2020 14:50:00	04/16/2020 15:28:00	72.6	High water
04/30/2020 10:58:00	05/04/2020 14:54:00	99.9	Unit 1, 2 high water / trash
05/20/2020 16:16:00	05/23/2020 17:00:00	72.7	Plant offline, high water
05/23/2020 17:00:00	05/26/2020 13:04:00	68.1	Plant offline, high water
06/09/2020 12:53:00	06/09/2020 15:18:00	2.4	Transmission Issue
06/17/2020 14:48:00	06/23/2020 10:25:00	139.6	High water
01/26/2021 08:24:00	01/26/2021 11:40:00	3.3	Tripped offline due to DDC emergency line switching
01/26/2021 11:40:00	01/27/2021 10:31:00	22.9	Blocked intakes
02/17/2021 16:58:00	02/20/2021 10:16:00	65.3	Units offline due to storm
04/27/2021 01:17:00	04/29/2021 15:32:00	62.3	Plant tripped off, broken shear pin & dowel rod U2. Both units dewatered due to shared penstock.
08/13/2021 05:59:00	08/13/2021 08:48:00	2.8	Unknown
08/13/2021 13:41:00	08/13/2021 16:35:00	2.9	Loss of auxiliary power
08/17/2021 19:06:00	08/18/2021 07:55:00	12.8	Unit trip due to line operation
11/12/2021 15:30:00	12/07/2021 15:48:00	600.3	Intakes blocked, damaged trash rake

H.15 Record of Compliance

To the best of Appalachian's knowledge and based on a review of historical records, Appalachian has been and continues to be in compliance with the applicable terms and conditions of the FERC license, and there have been no license violations or recurring situations of non-compliance over the license term.

H.16 Actions that Affect the Public

Appalachian holds that past actions and future actions related to the Project will not adversely affect the public. To the contrary, Appalachian believes that actions by the Licensee are favorable to the public in that the Project provides clean, renewable electric energy as well as other non-power benefits associated with the Project.

H.17 Ownership and Operating Expenses Affected by Transfer of License

The Licensee is applying for a long-term license to continue to maintain and operate the Project. Additionally, there is no competing application to take over the Project. Because there is no proposal to transfer the Project license, this section is not applicable to the Project.

H.18 Annual Fees Under Part I of Federal Power Act

Given that there are no federal or Indian lands associated with the Project under the existing license, the Licensee does not pay any annual fees under Part I of the Federal Power Act.

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