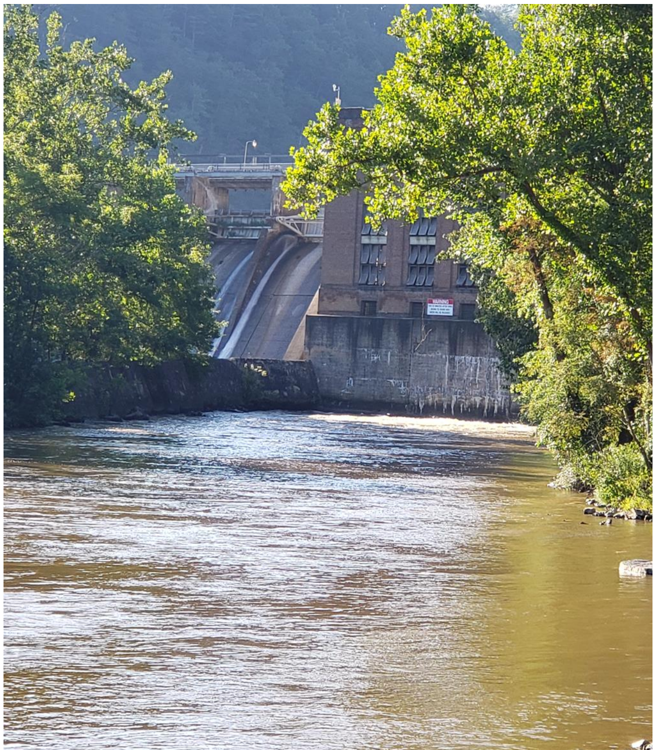

Fish Community Study Report

Niagara Hydroelectric Project (FERC No. 2466)

December 6, 2021

Prepared by:

HDR

Prepared for:

Appalachian Power Company

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Contents

Attachments

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1 Project Introduction and Background

Appalachian Power Company (Appalachian or Licensee), a unit of American Electric Power (AEP) is the Licensee, owner, and operator of the 2.4-megawatt (MW) run-of-river Niagara Hydroelectric Project (Project) (Project No. 2466), located on the Roanoke River (River Mile 355) in Roanoke County, Virginia.

The Project is currently licensed by the Federal Energy Regulatory Commission (FERC or Commission) 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 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), the licensee must file its final application for a new license with FERC no later than February 28, 2022.

In accordance with 18 CFR §5.11 of the Commission's regulations, Appalachian developed a Revised Study Plan (RSP) for the Project that was filed with the Commission and made available to stakeholders on November 6, 2019. The Commission issued the Study Plan Determination (SPD) on December 6, 2019.

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 Project 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. Appalachian conducted a virtual ISR Meeting on January 21, 2021 and filed the ISR Meeting summary with the Commission on February 5, 2021. Stakeholders provided written comments in response to Appalachian's filing of the ISR meeting summary, which are addressed in this Updated Study Report (USR) along with study methods and results.

Appalachian has conducted studies in accordance with 18 CFR §5.15, as provided in the RSP and as subsequently modified by FERC. This USR describes the methods and results of the Fish Community Study conducted in support of preparing an application for new license for the Project.

2 Study Goals and Objectives

The goal of the Fish Community Study is to obtain current information on the fish community in the Roanoke River in the vicinity of the Project to support an analysis of Project effects. The study includes a comparison of recently collected fish community data with historical fish community data collected in the Project area, a survey for Roanoke Logperch, and a desktop assessment of fish impingement and entrainment at the Project intake structure along with a turbine blade strike analysis.

To achieve the goals of the Fish Community Study, the following objectives were identified:

- Collect a comprehensive baseline of the existing fish community in the Project vicinity.
- Compare current fish community data to historical data to determine any significant changes to species composition, abundance, or distribution.
- Collect a comprehensive baseline (abundance and distribution) of the Roanoke Logperch population (including larval, young-of-year, and adults) in the vicinity of the Project.
- Confirm flow velocities at the intake to facilitate a desktop assessment of entrainment and impingement potential at the Project.
- Perform a desktop assessment of entrainment and impingement potential at Niagara, including an assessment of turbine mortality and survival using the U.S. Fish and Wildlife Service (USFWS) Turbine Blade Strike Analysis Model.

3 Study Status

The Fish Community Study consists of sub-studies designed to address each of the study objectives identified in the Niagara RSP and includes a:

- Fish Community Survey;
- Roanoke Logperch Survey; and
- Fish Impingement and Entrainment Study.

3.1 Fish Community Survey

Appalachian initiated and completed the Fish Community Survey in 2020 in accordance with the schedule provided in the RSP, with minor variances as previously noted in the ISR. A preliminary Fish Community Survey Report was filed with the ISR on January 11, 2021, and the results of this study were presented at the ISR meeting held on January 21, 2021. No study modifications were made or required by FERC subsequent to comments received at or following the ISR meeting.

The technical report including the results of the Fish Community Survey is included in Attachment 1 of Appendix C of this USR.

3.2 Roanoke Logperch Survey

The Roanoke Logperch Survey originally planned for completion in 2020 was rescheduled for 2021 in response to delays resulting from the onset of the COVID-19 global pandemic and higher-than-average precipitation in the Roanoke River watershed during fall 2020. Increased precipitation in the watershed resulted in prolonged high flow events that reduced the number of potential field sampling dates and delayed field sampling efforts due to safety risks and the decreased likelihood of collecting representative samples. Adult and young-of-year (YOY) Roanoke Logperch sampling activities were completed in 2021, generally consistent with the revised 2021 sampling schedule proposed to and approved by FERC, but with modifications to the field sampling methodology as described below.

The RSP proposed four paired sites (eight total) for adult Roanoke Logperch surveys, but the FERC Study Plan Determination (SPD) recommended eight independent sites to be located throughout the Project area. Additionally, the RSP proposed five YOY survey sites, but the SPD recommended seven sites including an additional site in both the bypass reach and further downstream of the tailrace. Along with the above recommendations, minor adjustments to survey sites also occurred based on target habitat availability at the time of sampling.

The field sampling methodology originally consisted of spring and summer backpack electrofishing for adult Roanoke Logperch in the bypass reach and summer backpack electrofishing at the seven other locations in the Project area. It was noted in the RSP that completion of spring backpack electrofishing efforts would require a waiver of the Virginia Department of Wildlife Resources (VDWR) Time-of-Year Restrictions (TOYR) for Roanoke Logperch and concurrence from the USFWS. On behalf of Appalachian, EDGE submitted a request to the services on March 26, 2021, for a TOYR waiver to complete the required spring sampling efforts in the Niagara Bypass Reach. A meeting (conference call) was held on Wednesday, May 5, 2021, between representatives from Appalachian, HDR, EDGE, Virginia Polytechnic Institute and State University (Virginia Tech), VDWR, and USFWS to discuss the TOYR waiver request. The meeting resulted in a recommendation to eliminate backpack electrofishing methodology for the spring Bypass Reach sampling effort during the TOYR. The agencies agreed that the use of snorkeling survey methods would reduce the risk to Roanoke Logperch to a “Not Likely to Adversely Affect” level while allowing the field team to collect necessary and requested baseline information on the Roanoke Logperch. The agencies concurred that the waiver of TOYR was granted with a change to snorkel survey methods and a commitment to minimize instream disturbance during the survey effort to the extent possible. Based on the success of the initial snorkel surveys of the Bypass Reach during the spring of 2021, and with concurrence from VDWR and Virginia Tech, the remaining adult Roanoke Logperch surveys (fall 2021) were performed using this methodology.

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.

3.3 Fish Impingement and Entrainment Study

Appalachian initiated the Fish Impingement and Entrainment Study in 2020 in accordance with the schedule provided in the RSP and completed the study in 2021. A preliminary Fish Impingement and Entrainment Study Report was filed with the ISR on January 11, 2021, and the results were presented at the ISR meeting held on January 21, 2021. No study modifications were made or required by FERC subsequent to comments received at or following the ISR meeting.

4 Study Components

The Fish Community Study report comprises the following sub-study reports:

1. Fish Community Survey Report (Attachment 1)
2. Preliminary Roanoke Logperch Survey Report (Attachment 2)
3. Impingement and Entrainment Study Report (Attachment 3)

Background information, study methods, and study results are provided in Attachments 1 through 3.

Germane correspondence is provided in Attachment 4 and includes the following:

- On December 22, 2020, HDR's sub-contractor (Edge Engineering and Science, LLC [EDGE]) submitted their application for federal recover permit to facilitate fish sampling for the federally endangered Roanoke Logperch (Percina rex) to the U.S. Fish and Wildlife Service (USFWS).
- On March 26, 2021, on behalf of Appalachian, HDR submitted a Self-Certification Letter for Time of Year Restrictions (TOYR) to the USFWS for the proposed 2021 field sampling efforts.
- On March 29, 2021, EDGE submitted a 2021 TOYR waiver request to the VDWR for the spring Roanoke Logperch sampling study and notified Virginia Tech of the study status via email.
- On April 12, 2021, HDR received approval of the TOYR waiver from USFWS via email.
- On April 27, 2021, EDGE received letter confirming receipt of the Federal Recover Permit application along with update on review status and timeline for completion.
- Between May 3, 2021 and May 26, 2021, additional coordination was required to finalize agreement between the USFWS and VDWR on preferred methods to facilitate spring macroinvertebrate data collection. On May 26, 2021, USFWS issued their determination that the proposed Macroinvertebrate Study sampling methods were not likely to affect Roanoke Logperch.
- On June 7, 2021, a conference call was held with stakeholders to discuss the proposed larval drift study component of the Fish Community Study proposed for spring 2022. A summary of the stakeholder call was submitted to stakeholders via email on July 14, 2021.
- On July 27, 2021, EDGE received the approved federal recovery permit authorizing take of larval Roanoke Logperch anticipated during the spring 2022 Roanoke Logperch Larval Drift study.
- On August 2, 2021, HDR on behalf of Appalachian submitted an update to project stakeholders on the status of the Roanoke Logperch study efforts and presented proposal to use snorkel methods to complete the fall Roanoke Logperch sampling in lieu of backpack electrofishing methods.
- On August 9, 2021, received concurrence emails from the USFWS and VDWR on the proposal to switch to snorkel methods for the summer 2021 Roanoke Logperch survey.

Attachment 1

Attachment 1 – Fish Community Survey Results

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Niagara Hydroelectric Project
(FERC Project No. 2466)

2020 Fish Community Survey Results, Virginia

January 4, 2021

Prepared for:

AMERICAN ELECTRIC POWER

BOUNDLESS ENERGY™

Niagara → HDR2020-0002

Prepared by:

EDGE ENGINEERING & SCIENCE further insight.

Edge Engineering and Science, LLC
Cincinnati, Ohio

Table of Contents

LIST OF TABLES

LIST OF FIGURES

APPENDICES

LIST OF ACRONYMS

AEP	American Electric Power – Client
Appalachian	Appalachian Power Company
CFS	Cubic feet per second
CPUE	Catch per unit effort
DCR	Department of Conservation and Recreation
DO	Dissolved oxygen
EDGE	Edge Engineering and Science, LLC
EF	Electrofishing
FERC	Federal Energy Regulatory Commission
HDR	HDR, Inc. – Client
LDB	Left descending bank
OFM	Orangefin Madtom
RDB	Right descending bank
RLP	Roanoke Logperch
RSP	Revised Study Plan
SAV	Submerged aquatic vegetation
TL	Total length
USFWS	U.S. Fish and Wildlife Service
VDCR	Virginia Department of Conservation and Recreation
VDEQ	Virginia Department of Environmental Quality
VDGIF	Virginia Department of Game and Inland Fisheries (now VDWR)
VDWR	Virginia Department of Wildlife Resources (formerly VDGIF)

1.0 INTRODUCTION

The Niagara Hydroelectric Project (Project) is a 2.4-megawatt hydroelectric generating facility located at river mile 355 of the Roanoke River in Roanoke County, Virginia. Appalachian Power Company (a unit of American Electric Power; AEP) is pursuing a new license from the Federal Energy Regulatory Commission (FERC or Commission) for the Project as their existing license (FERC No. 2466) expires in 2024. Aquatic biological studies were completed to support the existing license and results of these studies are ultimately used as a record and reference for current relicensing efforts. The Roanoke River, along with the approximately 2-mile-long reservoir resulting from the Niagara Dam, harbors a diverse community of aquatic biota including the federally endangered Roanoke Logperch (*Percina rex*; RLP). The state threatened Orangefin Madtom (*Noturus gilberti*; OFM) may also occur within two miles of the Project in the Roanoke River and Tinker Creek, a tributary to the Roanoke River within the Project boundary, as stated in a Project-specific letter from Virginia Department of Conservation and Recreation (VDCR) referencing Virginia Department of Game and Inland Fisheries (VDGIF [now Virginia Department of Wildlife Resources; VDWR]) (2009). However, previous relicensing studies did not collect Orangefin Madtom within the Project area and Jenkins and Burkhead (1994) established that Orangefin Madtom have likely been extirpated within the city of Roanoke. Aquatic biological studies are required to survey and document the contemporary community of organisms present within the Project area (Figure 1). The Roanoke River and lower reaches of tributary streams are included in the Project area. The information gained from these studies will document the current conditions of fish abundance, diversity, and distribution in the vicinity of the Project.

Study scoping with state and federal agencies resulted in the development and approval of a project-specific Revised Study Plan (RSP) that identified three objectives for Project studies (AEP 2019) pertaining to the fish community.

Goals and 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 Roanoke Logperch (including adults, young-of-year, and larvae) in the vicinity of the Project for the purpose of establishing a baseline

In accordance with the RSP, field sampling efforts were necessary to satisfy each of the three objectives. Some of the objectives were not accomplished during the 2020 calendar year due to delays resulting from unforeseeable circumstances including heavy precipitation and high flows and the COVID-19 global pandemic; therefore, this report herein serves as an interim, progress report of findings. Roanoke Logperch surveys were not completed in 2020; therefore, RLP-specific methods and results will not be discussed in this initial report. Additional field work is scheduled in 2021 and a comprehensive report of findings is planned for completion thereafter.

2.0 METHODS

The RSP provided guidance on the sampling framework for the Project that included general fish community and RLP-specific methodologies. Fish community sampling employs backpack and boat electrofishing (EF) methods to target representative fish habitats at seven and eight sites, respectively, throughout the Project area. The methods, including techniques, seasonality, and number and location of sample sites, were developed to document a contemporary representation of the Project area and correspond to previous sampling efforts for comparison.

2.1 Fish Community Sampling

General fish community sampling was completed in a single survey season (i.e., fall 2020) as prescribed in the RSP for the Project. Sampling methods were derived from National Rivers and Streams Assessment (NRSA) Field Operations Manual (USEPA 2019), which guides standardized electrofishing methods in lotic waterbodies of variable sizes. Within the constraints of the Project's objectives and geographic limits, electrofishing techniques were employed to most-effectively target specific sites based on the specific habitat types present in the Project area. Backpack electrofishing were used to target wadeable (riffle/run) habitats whereas boat electrofishing targeted deeper (i.e., non-wadeable) pool habitats. Two backpack electrofishing sites were located upstream, and five sites were located downstream of Niagara Dam while all boat electrofishing sites were in the Niagara impoundment upstream of the dam. Sampling techniques are further described in subsequent sections. Specific sampling dates are 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. Site naming conventions are as follows: Location-Seasonality-Method-Site Number. For example, NFBP1 = Niagara Fall Backpack Site 1 and NFB1 = Niagara Fall Boat Site 1.

2.1.1 Backpack Electrofishing

Backpack electrofishing surveys of the fish community occurred at seven riffle/run sites (i.e., backpack electrofishing; NFBP site names) along 100-meter transects. Upon arrival at wadeable sites (Figures 1-8), transects were delineated in riffle/run habitat and the start and endpoint coordinates were recorded. Site photos were taken in four directions (upstream, downstream, left descending bank [LDB], and right descending bank [RDB]; all 90 degrees to one another) and substrate, and field conditions were recorded (e.g., time, date, temperature, precipitation, cloudy/overcast, etc.). At each sample site, habitat characteristics (e.g., substrate, estimated water velocity, depth, and instream cover) and water quality parameters (e.g., pH, water temperature, dissolved oxygen [DO], and conductivity) were measured and recorded. Multiple points for habitat and water quality measurements were taken if there was large variation within a single site. Prior to initiating sample collection, electrofishing equipment was calibrated based on the conductivity of the water at each sample site. Sampling effort (i.e., time electrofishing) was also recorded during each sampling event.

Starting at the downstream end of the transect and moving upstream, all riffle/run habitats were candidates for sampling throughout the reach. All major habitat types identified within the transect were sampled and particular care was taken to thoroughly sample complex habitat and instream structures, while a netter(s) actively captured stunned fish with a dip net. In areas of elevated stream velocities (e.g., riffles/runs), a stationary seine (2.4 meters wide by 1.8 meters tall with 0.48-centimeter mesh) was positioned downstream of the sample location and perpendicular to stream flow and the operator of the backpack electrofishing unit simultaneously performing kicks/sweeps in a downstream manner toward the seine. Stunned fishes were driven into the net with the aid of stream currents and the seine was then swept upward and fish retrieved for processing. For each 100-meter transect, a minimum of five minutes EF time was expended, and more time may have been necessary depending on the complexity of the habitat. All collected fish were kept in aerated buckets and/or instream live wells during surveys and processing and then returned to the stream at the survey location.

Each fish was identified to the lowest taxonomic level practicable, enumerated, and examined for signs of external parasites, disease, or physical abnormalities. In addition, the total length (TL) and weight was recorded for the first 30 individuals of a species per sample site. All captured individuals were enumerated. In the event that more than 30 individuals of a single species were collected at a given sample site, the additional fish were counted, and length measurements were recorded for specimens that exceed the upper or lower maximum recorded lengths from the 30 individuals measured. Photos were taken in the field for a representative specimen of each fish taxon collected during the study and for those fish that could not be identified to species (e.g., minnows, juvenile *Moxostoma sp*.), representative specimens were preserved and identified in a laboratory setting based on sampling permit specifications. For RLP specimens collected during sampling efforts, a photo voucher was taken, a GPS data point was recorded, and client and agencies were notified according to permit specifications.

2.1.2 Boat Electrofishing

Boat electrofishing techniques were used to survey the fish community at eight pool sites (i.e., boat electrofishing; NFB site names) along 100-meter transects. Upon arrival at pool sites (Figure 1 and Figures 9-12), transects were delineated in pool habitat and the start and endpoint coordinates were recorded. Boat electrofishing becomes less effective in deeper water (i.e., greater than three meters), especially during daylight hours; therefore, sampling occurred within 30 meters of shore. Site photos, field conditions, habitat characteristics, and water quality parameters were recorded in the same manner as backpack electrofishing sites (see Section 2.1.1). In addition, a Secchi disk reading was taken at each sample site at the time of sampling. Multiple points for habitat and water quality measurements were taken if there was large variation within a single site. Prior to initiating sample collection, electrofishing equipment was calibrated based on the conductivity of the water at each sample site. Sampling effort (i.e., time electrofishing) was also recorded during each sampling event.

Starting at the downstream end of the transect and moving upstream, all available habitat types (i.e., shallow shoreline, deep shoreline, emergent vegetation, submerged wood, etc.) were candidates for sampling throughout the reach and particular care was taken to thoroughly sample complex habitat and instream structures. During sampling, a boat driver maneuvered the boat along each transect (nosing into and then away from the bank) while two field personnel or netters collected stunned fish in dip nets and one person guided the driver. For each 100-meter transect, a minimum of five minutes electrofishing was required, and more time may have been necessary depending on the complexity of the habitat. Fish were placed in live wells until sampling for that transect had concluded and then returned to the stream at the survey location. All samples were processed in the same manner as backpack methods (see Section 2.1.1).

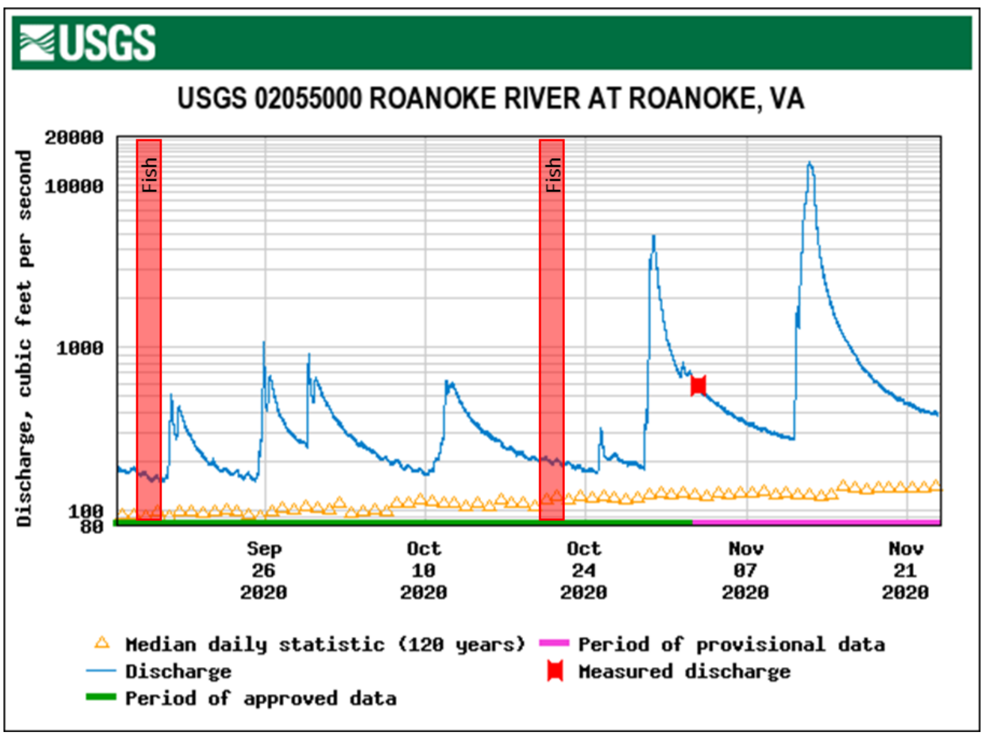
2.2 Deviations from Revised Study Plan

2.2.1 Covid-19 Delays

Initially, RLP sampling activities were proposed for completion in 2020, which included larval drift sampling during spring months, YOY and adult sampling during the fall, and an additional adult sampling event during the summer to specifically target habitats within the bypass reach. The spring larval and summer adult surveys were cancelled due to restrictions on non-essential travel and safety considerations in response to the Covid-19 pandemic. As a result, AEP requested and was granted an extension to accommodate the change in schedule as the VDCR, VDWR, United States Fish and Wildlife Service (USFWS), and Virginia Department of Environmental Quality (VDEQ) concurred with adaptable schedule revisions. EDGE was contracted and given notice to proceed with fieldwork at the beginning of September 2020. The remaining adult RLP study was also delayed and moved into 2021 due to weather delays and conflicts with overlapping efforts with the fall general fish community sampling effort. Roanoke Logperch sampling efforts are now scheduled to occur through the 2021 field season to accommodate the life stage-specific spring, summer and fall RLP survey timelines as originally proposed. All general fish community surveys were scheduled for the 2020 field season and were successfully completed. Thus, as part of the fish community studies, only RLP sampling (adult, YOY, and larvae) is scheduled for 2021.

2.2.2 Weather Delays

Periodic delays associated with weather and water conditions plagued the fall 2020 sampling season. Average annual rainfall for Roanoke, Virginia is approximately 105 centimeters (U.S. Climate Data 2021) and, as of December 1, 2020, Roanoke already accumulated over 157 centimeters of rain (National Weather Service 2020). Sampling efforts were completed at this year's assumed baseflow, which was likely around 150-200 cubic feet per second (CFS) during the sampling period. The 47 percent increase in average precipitation made it difficult to sustain contiguous field sampling efforts and did not allow the Roanoke River to reach average annual baseflow throughout the sampling period at the study location (see figure below).



3.0 RESULTS

All sample locations provided in the RSP were adhered to as closely as possible. Upon arrival at sample locations, biologists chose nearest locations that exhibited habitat required for sampling method efficacy, provided target habitats, and avoided exceptionally high flows. No notable or drastic changes were made to proposed sampling locations for fish community survey efforts. At three wadeable sites (NFBP1, 3, and 5), two separate transects totaling 100 meters were used to maximize sampling within target habitat (e.g., NFBP1 was made up of two 50-meter transects).

3.1 Fish Community Sampling

Fish community surveys were conducted between September 15 and 16 and October 20 and 21, 2020, following methods outlined in the RSP during relatively low flow and clear stream conditions. Sampling was performed by EDGE's state permitted fish biologist under Virginia Scientific Collecting Permit Nos. 068630 and 068631 (see Appendix A). As expected, there were clear differences in habitat type and substrates between wadeable and non-wadeable sites (Appendix B); however, differences in sampling dates, time of day, and low number of intra- and inter-site samples do not facilitate statistical comparison of physiochemical properties between riffle/run and pool sites. Dissolved oxygen and stream velocity were much greater at riffle/run sites (average 110% and 0.3 m/s, respectively) than pool sites (average 95% and 0.025 m/s, respectively), as expected, and are the only two physiochemical parameters that appear notably disparate between site types. Results of physiochemical data collected at sample sites met the state water quality standards established for the Roanoke River, indicating that water quality within the Project area is capable of supporting fish communities (this will be detailed further in the Project-specific water quality study report referencing Virginia Administrative Code [VAC] Chapter 260).

A total of 590 individuals were collected representing 32 species with backpack electrofishing surveys accounting for 525 individuals of 28 species and boat electrofishing surveys accounting for 65 individuals of 10 species. Twenty-six (26) species were collected upstream of Niagara Dam between two backpack electrofishing sites and all eight boat electrofishing sites while 23 species were collected downstream of the dam between five backpack electrofishing sites. Central Stoneroller (*Campostoma anomalum*), Rosefin Shiner (*Lythrurus ardens*), and Riverweed Darter (*Etheostoma podostemone*) were the most abundant species at riffle/run sites (27.4% [144], 25.5% [134], and 8.2% [43], respectively) while Redbreast Sunfish (*Lepomis auratus*), Golden Redhorse (*Moxostoma erythrurum*), and Bluegill (*Lepomis macrochirus*) were the most abundant species at pool sites (40.0% [26] 18.5% [12], and 16.9% [11], respectively) (Appendix C). Central Stoneroller, White Sucker (*Catostomus commersonii*), and Rock Bass (*Ambloplites rupestris*) were the most dominant by weight at riffle/run sites (28.0%, 11.7%, and 11.0%, respectively) and Golden Redhorse, Redbreast Sunfish, and V-lip Redhorse (*Moxostoma pappillosum*) were the most dominant by weight at pool sites (82.5%, 6.3%, and 3.3%, respectively). 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. Representative site and fish photos are provided in Appendix B and raw data for fish collections are provided in Appendix C. Site-specific information is provided below.

3.1.1 Backpack Electrofishing

Seven riffle/run sites were sampled as part of fish community studies including two sites upstream and five sites downstream of Niagara Dam (Figure 1; NFBP). Substrates at riffle/run sites consisted of bedrock, boulder, cobble, and gravel, but sites ranged from primarily homogenous bedrock substrate to relatively even heterogeneous substrates. Water quality parameters varied per site and ranged from 13.7 to 21.4 °C, pH 7.3 to 8.5, DO 8.55 to 12.60 mg/L and 96.9 to 130.3 percent saturation, velocity 0.13 to 0.45 m/s, and conductivity 390 to 478 µs/cm (Table 1).

Table 1: Water Quality at Backpack Electrofishing Sites

Date	Site #	Water Temp. (C)	pH	DO (mg/L)	DO (%)	Velocity (m/s)	Conductivity (us/cm)
9/15/2020	NFBP1	21.4	8.4	8.55	96.9	0.41	390
9/15/2020	NFBP2	19.6	8.5	12.02	130.3	0.40	478
9/16/2020	NFBP3	19.0	8.4	9.53	102.1	0.45	437
9/16/2020	NFBP4	20.8	8.5	9.64	103.3	0.13	444
9/16/2020	NFBP5	20.8	8.5	9.74	109.3	0.36	447
10/20/2020	NFBP6	13.7	7.3	11.04	103.4	0.15	421
10/20/2020	NFBP7	14.7	7.5	12.60	123.0	0.20	419

Above/below dashed line represents above/below Niagara Dam

Fish abundance at wadeable sites ranged from 35 to 109 individuals with an average of 75 (SD = 26.4) individuals per site (Table 2). Species richness ranged from 10 to 15 species with an average of 12 species per site. Species diversity ranged from 1.41 (0.52 evenness) to 2.14 (0.86 evenness). Evenness is a diversity index that indicates how equal the community is numerically. For example, a community with relatively equal abundance of each species has a higher evenness value than a community with one dominant species. Catch per unit effort (CPUE) ranged from 2.93 to 14.16 individuals per minute. The wide range of total electrofishing effort at each site resulted from and was dependent upon availability of different microhabitats and complexity of instream features; however, greater EF time did not necessarily result in greater abundance. For example, complexity of habitat at site NFBP1 was relatively low, which led to minimal EF time; however, this site exhibited the highest abundance and subsequent CPUE.

Table 2: Fish Community Results for Backpack Electrofishing Sites

Date	Site #	Abundance	Richness	Diversity (H’)	Evenness	EF Time (min)	CPUE (#/min)
9/15/2020	NFBP1	109	15	1.41	0.52	7.7	14.16
9/15/2020	NFBP2	35	11	2.04	0.85	11.3	3.10
9/16/2020	NFBP3	98	12	1.50	0.60	13.0	7.56
9/16/2020	NFBP4	49	12	2.14	0.86	16.7	2.93
9/16/2020	NFBP5	89	14	1.83	0.69	14.0	6.36
10/20/2020	NFBP6	70	12	1.94	0.78	12.2	5.75
10/20/2020	NFBP7	75	10	1.93	0.84	12.5	5.99

Above/below dashed line represents above/below Niagara Dam (H’ = Shannon Diversity and EF = Electrofishing)

Rosefin Shiner, Roanoke Darter (*Percina roanoka*), and Central Stoneroller were the most abundant species at riffle/run sites above the dam (60.4% [87], 6.3% [9], and 3.5% [5], respectively), whereas Central Stoneroller, Rosefin Shiner, and Riverweed darter were the most abundant species at riffle/run sites below the dam (36.5% [139], 12.3% [47], and 10.8% [41], respectively). Average abundance at riffle/run sites above the dam was 72 individuals with an average diversity of 1.73, average evenness of 0.69, and average CPUE of 8.63. Average abundance at riffle/run sites below the dam was 76 individuals with an average diversity of 1.87, average evenness of 0.75, and average CPUE of 5.72. Riffle/run sites above the dam were dominated by invertivore (13 species), omnivore-herbivore (4 species), and invertivore-piscivore (3 species) trophic guilds and by the benthic (11 species) and water column (9 species) habitat guilds (McCormick et al. 2001). Riffle/run sites below the dam were dominated by invertivore (15 species), invertivore-piscivore (4 species), and omnivore-herbivore (2 species) trophic guilds and by the water column (12 species) and benthic (9 species) habitat guilds. A single Roanoke Logperch individual (adult) was collected at the upstream-most riffle/run site (NFBP1) in the mainstem of the Roanoke River.

3.1.1.1 Roanoke River – NFBP1

Substrates at NFBP1 consisted of bedrock (35%), boulder (20%), cobble (25%), gravel (10%), and sand (10%). Habitat structure generally consisted of shallow sheets of bedrock riffles and glides with the other substrates lain overtop (Figure 2). The site is best classified as a riffle. Occasional patches of submerged aquatic vegetation (SAV) were present as well as filamentous algae. Survey efforts included 7.7 minutes of electrofishing along two 50-meter transects to maximize sampling within the target habitat. This site had the highest CPUE of any riffle/run site; however, it had the lowest diversity and evenness because Rosefin Shiner comprised 68% of all individuals collected followed by Central Stoneroller and Roanoke Darter at under 5% relative abundance each (Appendix C).

3.1.1.2 Tinker Creek – NFQT2

Substrates at NFQT1 consisted of sand (45%), gravel (35%), cobble (18%), and boulder (2%). Habitat structure generally consisted of a sand/gravel/cobble mix with occasional boulders; rootwads and undercut banks were prevalent (particularly along the LDB), and the site is best classified as riffle/run habitat (Figure 3). The site was strongly influenced by anthropogenic impacts and featured heavy trash deposits, human feces, and combined sewer outfalls. Survey efforts included 11.3 minutes of electrofishing starting downstream at the RDB and working upstream and across to the LDB. This site had the second lowest richness and CPUE; however, it had the second highest diversity and evenness. Rosefin Shiner was the most abundant at this site comprising 37% of individuals while all other species were relatively even between 3 and 11% relative abundance (Appendix C).

3.1.1.3 Roanoke River – NFBP3

Substrates at NFBP3 consisted of bedrock (50%), cobble (30%), boulder (10%), and gravel (10%). Habitat structure generally consisted of shallow sheets of bedrock riffles and glides with the other substrates lain overtop (Figure 4). The site is best classified as a riffle. Patches of SAV and filamentous algae were thick and covered most of the cobble and boulders. Survey efforts included 13 minutes of electrofishing performed along one 60- and one 40-meter transect to focus effort within the target habitat. This site had the second highest CPUE but the second lowest diversity. Central Stoneroller and Rosefin Shiner dominated this site comprising 56 and 20% relative abundance, respectively, followed Riverweed Darter and Cutlip Minnow (*Exoglossum maxillingua*) at 4% each (Appendix C).

3.1.1.4 Roanoke River – NFBP4

Substrates at NFBP4 consisted of bedrock (50%), boulder (30%), and cobble (20%). Habitat structure generally consisted of shallow sheets of bedrock riffles and glides with the other substrates lain overtop (Figure 5). The site is best classified as a riffle. Patches of SAV were present along the LDB. Survey efforts included 16.7 minutes of electrofishing, which was the highest of any site, because sampling was conducted along the LDB (as the thalweg was too deep and swift) where bedrock and boulder substrates made for relatively complex habitat and difficult sampling conditions. This site had the lowest CPUE but the highest diversity and evenness. Central Stoneroller was the most abundant species (22%) but there were 4 additional species having greater than 12% relative abundance (Appendix C).

3.1.1.5 Roanoke River – NFBP5

Substrates at NFBP4 consisted of bedrock (50%), boulder (30%), and cobble (20%). Habitat structure generally consisted of shallow sheets of bedrock riffles and glides with the other substrates lain overtop (Figure 6). The site is best classified as a riffle. Patches of SAV were present along the LDB. Survey efforts included 14 minutes of electrofishing, which was the second highest of any site, for similar reasons to those stated in Section 3.1.1.4 above. One 60- and one 40-meter transect were surveyed to focus efforts within target habitat. This site was about average for riffle/run sites regarding CPUE, diversity, and evenness. The most abundant species were Central Stoneroller, Rosefin Shiner, and Blacktip Jumprock (*Moxostoma cervinum*) with 42, 18, and 17% relative abundance, respectively. There were more Blacktip Jumprock collected at this site (15) than the rest of the riffle/run sites combined (14) (Appendix C).

3.1.1.6 Roanoke River – NFBP6

Substrates at NFBP6 consisted of bedrock (40%), slab boulder (20%), cobble (20%), and gravel (20%). Habitat structure generally consisted of shallow sheets of bedrock riffles and glides with the other substrates lain overtop (Figure 7). The site is best classified as a riffle. Large slab boulders were common near the shore. Survey efforts included 12.2 minutes of electrofishing along the RDB. This site was just below average CPUE and just above average in diversity and evenness compared to all other riffle/run sites. The most abundant species were Central Stoneroller, Riverweed Darter, and Fantail Darter (*Etheostoma flabellare*) with 29, 26, and 14% relative abundance, respectively (Appendix C). This site exhibited the highest CPUE of darters at 2.79, just ahead of NFBP7 at 2.56.

3.1.1.7 Roanoke River – NFBP7

Substrates at NFBP7 consisted of bedrock (30%), cobble (30%), slab boulder (20%), and gravel (20%). Habitat structure generally consisted of shallow bedrock and cobble riffles and glides with large boulder riffles at the downstream extent of the site (Figure 8). The site is best classified as a riffle overall with similar depths along the entire width of the stream. Survey efforts included 12.5 minutes of electrofishing starting downstream at the RDB and working upstream and across to the LDB. This site had the lowest species richness and was below average CPUE, but diversity was above average because species were present in relatively even abundance. Margined Madtom (*Noturus insignis*) had the highest relative abundance at 23% and more individuals were found here (17) than all other riffle/run sites combined (15). The next most abundant species were Central Stoneroller at 21% and Fantail Darter and Riverweed Darter at 17% relative abundance each (Appendix C). This site exhibited the second highest CPUE of darters just behind site NFBP6.

3.1.2 Boat Electrofishing

Eight pool sites were sampled as part of fish community studies, all of which were located in the impounded area above the Niagara Dam (Figure 1; NFB). Substrate composition varied from bedrock to silt, with a general longitudinal pattern observed in substrate sizes that decreased in the downstream direction towards the dam. Water parameters varied per site and ranged from 14.5 to 15.9 °C, pH 7.3 to 7.5, DO 9.23 to 10.02 mg/L and 94.6 to 96.9 percent saturation, velocity 0.02 to 0.04 m/s, and conductivity 405 to 436 µs/cm (Table 3).

Table 3: Water Quality at Boat Electrofishing Sites

Date	Site #	Water Temp. (C)	pH	DO (mg/L)	DO (%)	Velocity (m/s)	Conductivity (us/cm)
10/21/2020	NFB1 & 2	14.8	7.3	10.02	96.8	0.04	405
10/21/2020	NFB3 & 4	14.5	7.4	9.63	94.6	0.02	418
10/21/2020	NFB5 & 6	15.2	7.5	9.68	96.9	0.02	428
10/21/2020	NFB7 & 8	15.9	7.4	9.23	91.6	0.02	436
Sites are in order from upstream to downstream							

No fish were collected at the two most upstream pool sites (NFB1 & 2); therefore, survey results are not addressed below. Potential reasons for this are discussed in detail in Section 4.1. Fish abundance at non-wadeable sites ranged from 7 to 19 individuals with an average of 10 (SD = 4.8) individuals per site (Table 4). Species richness ranged from 3 to 5 species with an average of 4 species per site. Species diversity ranged from 0.54 (0.49 evenness) to 1.35 (0.98 evenness). Catch per unit effort (CPUE) ranged from 0.84 to 2.91 individuals per minute. Electrofishing time was relatively consistent between sites based on similarities in habitat complexity.

Table 4: Fish Community Results for Boat Electrofishing Sites

Date	Site #	Abundance	Richness	Diversity (H')	Evenness	EF Time (min)	CPUE (#/min)
10/21/2020	NFB3	14	5	1.13	0.70	8.5	1.65
10/21/2020	NFB4	7	4	1.35	0.98	8.3	0.84
10/21/2020	NFB5	10	4	1.22	0.88	8.6	1.17
10/21/2020	NFB6	8	4	1.07	0.77	8.0	1.01
10/21/2020	NFB7	19	3	0.54	0.49	6.5	2.91
10/21/2020	NFB8	7	4	1.28	0.92	6.8	1.03
Sites are in order from upstream to downstream (H’ = Shannon Diversity and EF = Electrofishing)							

Golden redhorse (9) was the most abundant species in the upper impoundment, Redbreast Sunfish (6) and Bluegill (6) were the most abundant species in the middle of the impoundment, and Redbreast Sunfish (16) was the most abundant species in the lower impoundment. Average abundance in the upper impoundment (NFB3 & 4) was 10 individuals with an average diversity of 1.24, average evenness of 0.84, and average CPUE of 1.25. Average abundance in the middle of the impoundment (NFB5 & 6) was 9 individuals with an average diversity of 1.15, average evenness of 0.83, and average CPUE of 1.09. Average abundance in the lower impoundment (NFB7 & 8) was 13 individuals with an average diversity of 0.91, average evenness of 0.71, and average CPUE of 1.97. Pool sites within the impoundment were dominated by invertivore (4 species), invertivore-piscivore (3 species), and omnivore-herbivore (2 species) trophic guilds and by the water column (6 species) and benthic (3 species) habitat guilds (McCormick et al. 2001).

3.1.2.1 Roanoke River – NFB3 & 4

Substrates at NFB3 & 4 consisted of bedrock (50%), cobble (30%), and silt (20%) with heavy amounts of leaf pack, rootwads, and snags along the shore. The banks were relatively steep with abrupt increases in depth occurring close to shore, thus confining sampling efforts to near-shore habitats (Figure 10). The site is best classified as a pool. Survey efforts included 8.5 and 8.3 minutes of electrofishing at NFB3 and NFB4, respectively. NFB3 had twice the CPUE but less diversity and evenness overall. Twice as many fish were captured at NFB3 (RDB) with Golden Redhorse having the highest relative abundance at 64%. There were zero Golden Redhorse collected at NFB4. Overall, eight out of 10 species collected via boat electrofishing were represented between these two sites with exception of Redear Sunfish (*Lepomis microlophus*) and Bluntnose Minnow (*Pimephales notatus*) (Appendix C).

3.1.2.2 Roanoke River – NFB5 & 6

Substrates at NFB5 & 6 consisted of sand (60%) and silt (40%) with heavy amounts of leaf pack and snags along the shore. The banks were relatively steep and quickly dropped off from shore, so sampling efforts were confined to near-shore habitats (Figure 11). The site is best classified as a pool. Survey efforts included 8.6 and 8.0 minutes of electrofishing at NFB5 and NFB6, respectively. Site NFB5 (RDB) had marginally greater CPUE, diversity, and evenness. Redbreast Sunfish had the highest relative abundance at NFB5 with 50% and Bluegill had the highest at NFB6 with 63% (Appendix C). NFB5 represented both water column and benthic habitat guilds whereas NFB6 only represented water column species. Overall, six out of 10 species collected via boat electrofishing were present between these two sites.

3.1.2.3 Roanoke River – NFB7 & 8

Substrates at NFB7 & 8 consisted of sand (70%) and silt (30%) with moderate amounts of leaf pack, snags, SAV, and rootwads along the shore. The banks were relatively steep with abrupt increases in depth occurring close to shore, thus confining sampling efforts to near-shore habitats (Figure 12). Wolf Creek enters the Roanoke River at the upstream extent of NFB8 resulting in a deep deposit of fine sediment at the confluence. The site is best classified as a pool. Survey efforts included 6.5 and 6.8 minutes of electrofishing at NFB7 and NFB8, respectively. Site NFB7 had the highest CPUE of any pool site by far but the lowest diversity and evenness. It was dominated by Redbreast Sunfish, which had a relative abundance of 84%, followed by Bluegill at 11% relative abundance (Appendix C). Overall, five out of 10 species collected via boat electrofishing were present between these two sites.

4.0 DISCUSSION

4.1 Fish Community

The Project is located within a relatively urban environment, which may contribute to potential issues pertaining to water quality and habitat degradation in this portion of the Roanoke River that are independent of the Project. The Project influences habitat availability through formation of a reservoir (creating pool habitat and eliminating riffle habitat), which dictates what species can inhabit the Project area; however, the habitats present within the Project area appear to harbor a relatively diverse fish community with little evidence of physical abnormalities or stressors.

Of the 32 total species of fish collected, 11 (34 %) are listed as tolerant species (McCormick at al. 2001), and 4 (13%) are listed as intolerant (i.e., Northern Hogsucker [*Hypentelium nigricans*], Blacktip Jumprock, Mimic Shiner [*Notropis volucellus*], and Roanoke Logperch). Three of these four intolerant species were captured during previous relicensing surveys for the Project (excluding Blacktip Jumprock) (Appalachian and AEP 1991). The continued presence over time of a diverse fish community, in addition to the continued presence of these intolerant species, indicate that water quality and available habitats in the Roanoke River within the Project Area continues to support a balanced and resilient fish assemblage.

Thirty-four (34) species were collected during historical sampling efforts by Appalachian and AEP (1991), compared to 32 species collected during this study, and they employed three different methods (boat electrofishing, gillnets, and hoop nets) over six discrete sampling efforts per site. In 2020, 15 species were collected in riffle/run habitat upstream of the dam (excluding Tinker Creek) via backpack electrofishing, and although species composition differed slightly, 15 species were collected during riffle/run electrofishing surveys upstream of the dam in the 1991 study. In 2020, 23 species were collected in riffle/run habitats downstream of the dam (five sites, sampled once each), compared to 22 species during riffle/run electrofishing downstream of the dam in the previous study (one site, sampled six times). In 2020, 10 species were collected in the impoundment, compared to a maximum of 11 species collected via electrofishing during historical sampling by Appalachian and AEP (1991). Therefore, potential methodological limitations of our study (less sampling events and fewer disparate methods) do not appear to have impacted the observed species richness. Further, although there were no fish captured (or even observed) at sites NFB1 and NFB2 (likely because it was early morning, and the habitats were still shaded rendering most fish inactive) it is reasonable to assume that detection of more species was not likely. Similarly, some species collected in the impoundment during Appalachian and AEP (1991) were only captured with hoop nets and gill nets (e.g., all six catfish/bullhead species), gears that were not employed during the 2020 study. At a high level, the results from the 1991 and 2020 studies indicate comparable species richness, and suggest that the use of the same sampling gears/methods in 2020 could have yielded a greater species richness than observed in the 1991 study.

Differences documented between the fish communities present above and below the dam are likely attributable to differences in available substrates and habitat in the two sections of the Project area. The main difference in available habitats within the Project area occurs at riffle/run sites directly below the dam where substrates undergo frequent scouring in response to the altered flow regime created by the dam. However, downstream from the dam, riffle/run habitat begins to more closely resemble that of riffle/run habitats upstream of the dam (e.g., NFBP6 and NFBP7). The pool habitat created by the Project impoundment is a clear modification to the instream habitat available in the free-flowing Roanoke River reaches in the Project area.

Preliminary results from fall 2020 samples collected within pool habitats of the impoundment indicate the prevalence of species within the water column and benthic habitat guilds that also occur throughout the Roanoke River. The species composition may differ slightly from previous studies but that is likely due to gear differences (prior study included hoop and gillnet surveys) and the limited efficacy of boat electrofishing at depths. The historical surveys were also completed during the least productive time periods in terms of species abundance, and the reported temporal differences in catch were attributed to turbid waters created by precipitation events (Appalachian and AEP 1991). The current study was able to complete single sampling surveys when the Roanoke River was near baseflow conditions and thus avoided sampling during turbid conditions.

This report provides preliminary results based on the partial completion of the study 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; and 3) collect information regarding the current status (abundance and distribution) of the Roanoke Logperch (including adults, young-of-year, and larvae) in the vicinity of the

Project for the purpose of establishing a baseline. The RLP-specific studies scheduled to be performed in 2021 will provide further insights regarding the fish community within the Project area using new and targeted methods (fixed area quadrat backpack electrofishing for adults, seine hauls for YOY, and drift nets for larvae). A final report detailing the conclusions of the general fish community and RLP sampling efforts with be provided in 2021 with the Updated Study Report.

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Figures

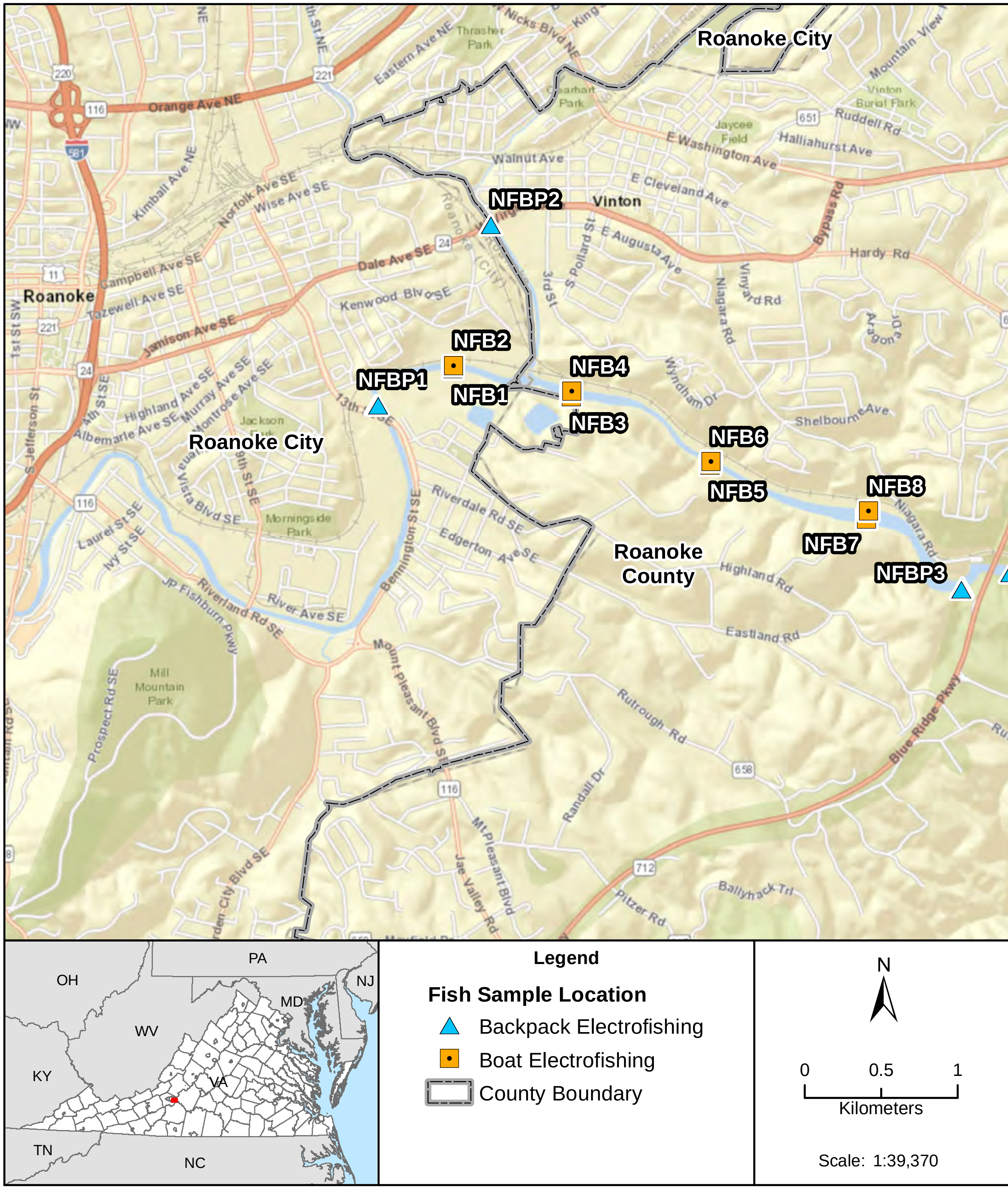

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Figure 1
Overall Niagara project area including backpack (NFBP) and boat (NFB) electrofishing survey sites on the Roanoke River in Roanoke County, Virginia

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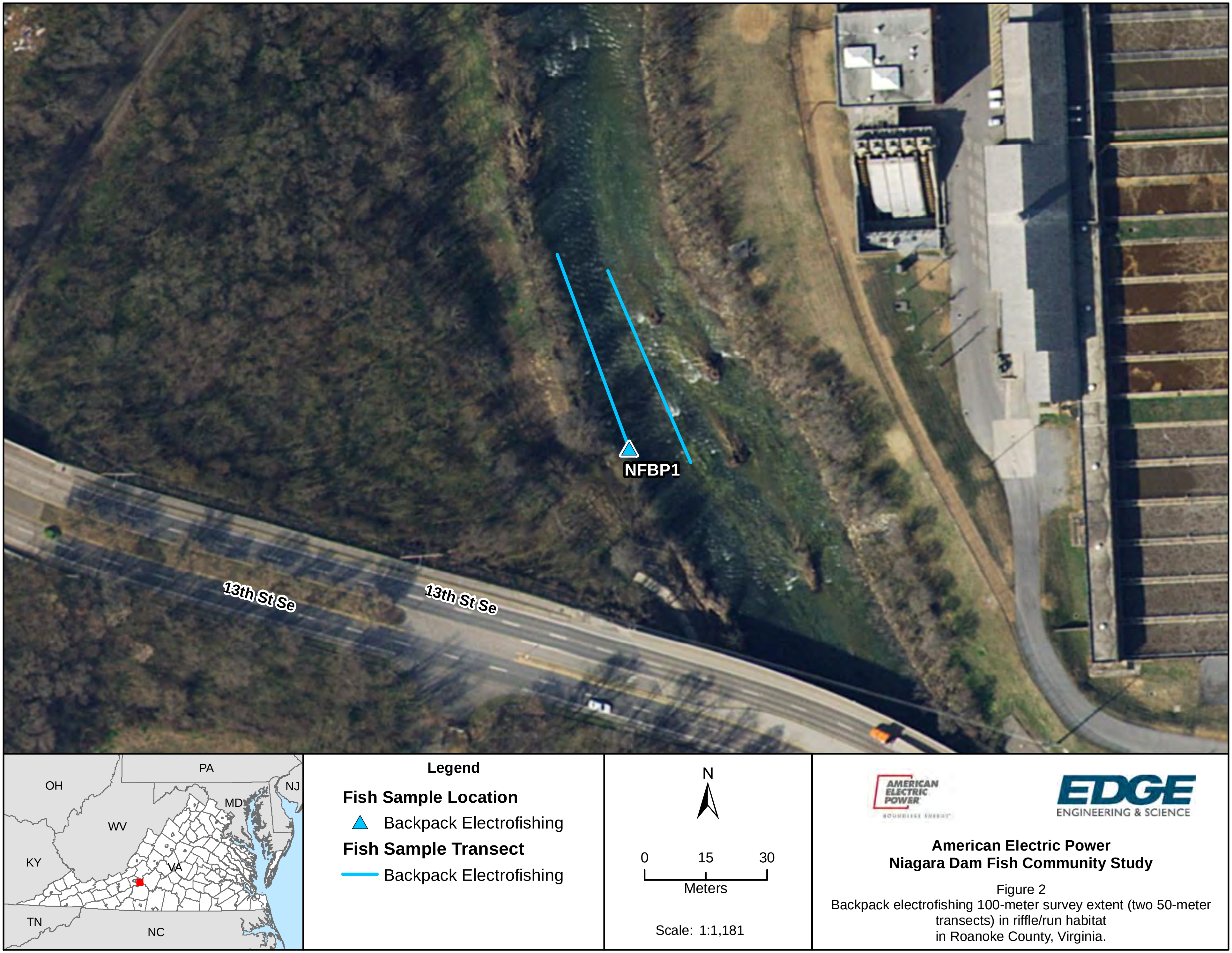

Legend

Fish Sample Location

Backpack Electrofishing

Fish Sample Transect

Backpack Electrofishing

N

0 15 30

Meters

Scale: 1:1,181

AMERICAN ELECTRIC POWER

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Figure 2
Backpack electrofishing 100-meter survey extent (two 50-meter transects) in riffle/run habitat in Roanoke County, Virginia.

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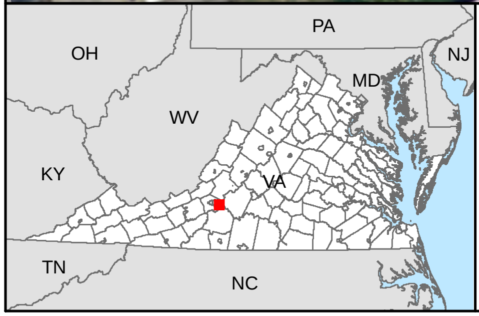

Legend

Fish Sample Location

Backpack Electrofishing

Fish Sample Transect

Backpack Electrofishing

N

0 15 30

Meters

Scale: 1:1,181

AMERICAN ELECTRIC POWER

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Figure 3
Backpack electrofishing 100-meter survey extent in riffle/run habitat in Roanoke County, Virginia.

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Legend

Fish Sample Location

Backpack Electrofishing

Fish Sample Transect

Backpack Electrofishing

N

0 15 30

Meters

Scale: 1:1,181

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Figure 4
Backpack electrofishing 100-meter survey extent (one 60- and one 40-meter transect) in riffle/run habitat in Roanoke County, Virginia.

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Legend

Fish Sample Location

Backpack Electrofishing

Fish Sample Transect

Backpack Electrofishing

N

0 15 30

Meters

Scale: 1:1,181

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Figure 5
Backpack electrofishing 100-meter survey extent in riffle/run habitat in Roanoke County, Virginia.

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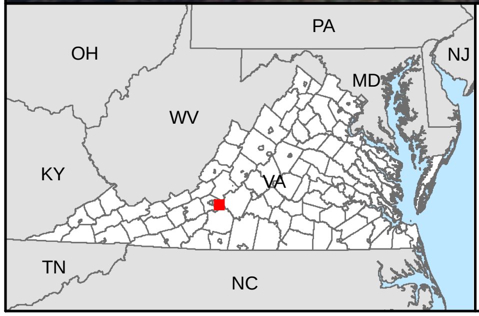

Legend

Fish Sample Location

Backpack Electrofishing

Fish Sample Transect

Backpack Electrofishing

N

0 15 30
Meters

Scale: 1:1,181

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Figure 6
Backpack electrofishing 100-meter survey extent (one 60- and one 40-meter transect) in riffle/run habitat in Roanoke County, Virginia.

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Legend

Fish Sample Location

Backpack Electrofishing

Fish Sample Transect

Backpack Electrofishing

N

0 15 30

Meters

Scale: 1:1,181

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Figure 7
Backpack electrofishing 100-meter survey extent in riffle/run habitat in Roanoke County, Virginia.

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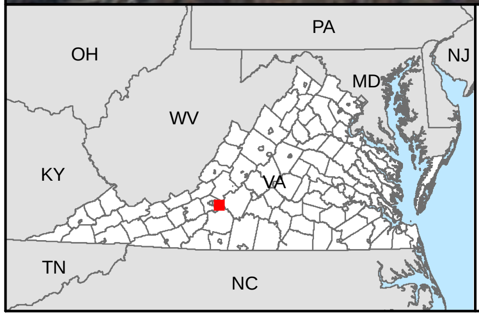

Legend

Fish Sample Location

Backpack Electrofishing

Fish Sample Transect

Backpack Electrofishing

N

0 15 30

Meters

Scale: 1:1,181

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Figure 8
Backpack electrofishing 100-meter survey extent in riffle/run habitat in Roanoke County, Virginia.

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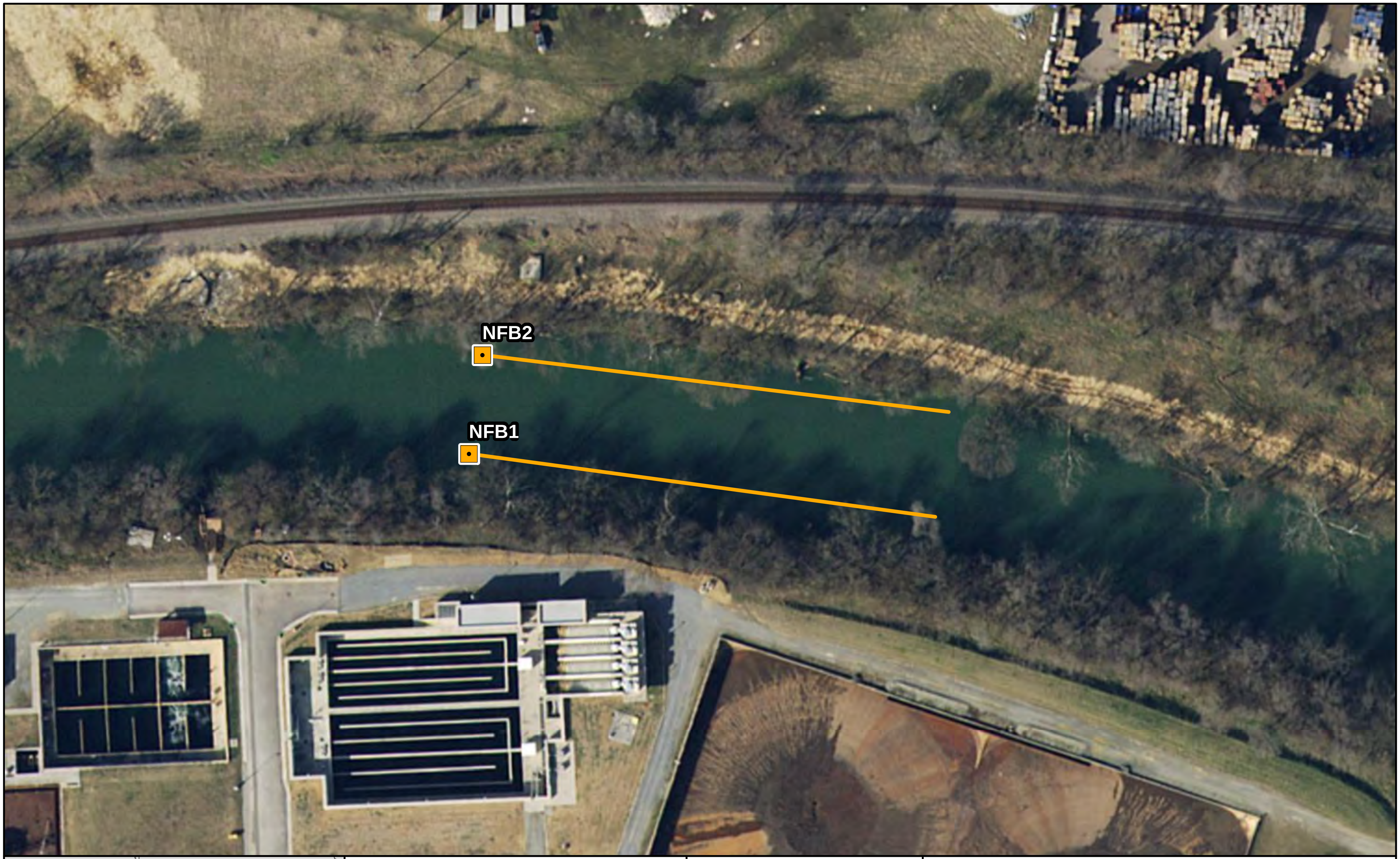

Legend

Fish Sample Location

Boat Electrofishing

Fish Sample Transect

Boat Electrofishing

N

0 15 30

Meters

Scale: 1:1,181

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Figure 9
Boat electrofishing 100-meter survey extents in pool habitat in Roanoke County, Virginia.

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Fish Sample Location

Boat Electrofishing

Fish Sample Transect

Boat Electrofishing

N

0 15 30

Meters

Scale: 1:1,181

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Figure 10
Boat electrofishing 100-meter survey extents in pool habitat in Roanoke County, Virginia.

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Legend

Fish Sample Location

Boat Electrofishing

Fish Sample Transect

Boat Electrofishing

N

0 15 30

Meters

Scale: 1:1,181

American Electric Power
Niagara Dam Fish Community Study

Figure 11
Boat electrofishing 100-meter survey extents in pool habitat in Roanoke County, Virginia.

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Legend

Fish Sample Location

Boat Electrofishing

Fish Sample Transect

Boat Electrofishing

N

0 15 30

Meters

Scale: 1:1,181

American Electric Power
Niagara Dam Fish Community Study

Figure 12
Boat electrofishing 100-meter survey extents in pool habitat in Roanoke County, Virginia.

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Appendix A

SCIENTIFIC COLLECTION PERMITS

Virginia Department of Game and Inland Fisheries

7870 Villa Park Drive, P.O. Box 90778, Henrico, VA 23228-0778
(804) 367-1000 (V/TDD)
Under Authority of § 29.1-412, § 29.1-417, & § 29.1-418 of the Code of Virginia

Scientific Collection Permit

Permit Type: **Renewal** Fee Paid: **$40.00** VADGIF Permit No. **068630**

Permittee: **Casey D Swecker**
Address: **4005 Ponder Drive**
Cincinnati, OH 45245
Email: **cdswecker@edge-es.com**

Home:
Office: **(304) 633-5808**
City/County: **Out of State**

Business: **Edge Engineering and Science, LLC**
4005 Ponder Drive
Cincinnati, OH 45245
City/County: **Out of State**

Contract Species Surveys/Research/Relocation

Authorized Collection Methods: By Hand/Dip Nets/Electrofishing/Gill Nets-Trawl Nets/Seine Nets/Snorkel/View Scope/Aquatic Kick Samples/Scuba/Nets-Traps (Fyke/Hoop/D-Frame)/Hooka (Third Lung)
All methods which are part of the project(s) outlined in the submitted and approved proposal.
Authorized Waterbodies: Blackwater River/New River/Banister River/Sandy River/North Fork Roanoke River/Little Creek/Crooked Creek/Roanoke River/Sinking Creek/North Fork Holston River/Mill Creek
Authorized Marking Techniques: N/A

SPECIAL CONDITIONS: It is recommended that the fish relocation best management practices be utilized while collecting fish for this project. Permittee is exempt from standard condition #11 (game fish creek limit) during gillnet sampling on the New River above Byllesby Dam.

PERMIT AMENDMENT 9/1/2020: The amendment changes the following: Principal Permittee & Authorized Subpermittees Affiliation FROM: ESI to Edge Engineering and Science, LLC
This amendment deletes the following:
Authorized Subpermittees: Kyle McGill/Greg Anderson/Robert Paul/Brandon Yates/Keith Gibbs/Kyle Price/Brandon Bassinger/Tyler Slagle
This amendment adds the following: Permittee is exempt from standard condition #11 (game fish creek limit) during gillnet sampling on the New River above Byllesby Dam.

Permittee MUST notify VDGIF a minimum of 7 days prior to each sampling event. Notification must be made via email to: collectionpermits@dgif.virginia.gov

Report Due: 31 January 2021, 31 January 2022

ANNUAL REPORTS MUST BE SUBMITTED VIA: https://vafwis.dgif.virginia.gov/collection_permits/

STANDARD CONDITIONS ATTACHED APPLY TO THIS PERMIT.

Authorized Counties / Cities:
Augusta
Bath
Brunswick
Buckingham
Carroll
Cumberland
Dinwiddie
Franklin
Giles
Greensville
Highland
Montgomery
Nelson
Nottoway
Pittsylvania
Prince Edward
Pulaski
Roanoke
Scott
Southampton
Radford
Statewide

Virginia Department of Game and Inland Fisheries

7870 Villa Park Drive, P.O. Box 90778, Henrico, VA 23228-0778
(804) 367-1000 (V/TDD)

Under Authority of § 29.1-412, § 29.1-417, & § 29.1-418 of the Code of Virginia

Scientific Collection Permit

Permit Type: **Renewal** Fee Paid: **$40.00** VADGIF Permit No. **068630**

Authorized Species:

Description	ID Number	Scientific Name
Aquatic Insects		
Aquatic Invertebrates (excluding aquatic mollusks)		
Crayfish		
Freshwater Fish		
Freshwater Mussels		
Spiny Riversnail		***Io fluvialis***

Annual Report Due End of Each Year

Authorized Sub-Permittees:
See Attached Sheet

Approved by: Randall T. Francis

Applicants may appeal permit decisions within 30 days of issuance. The appeal must be in writing to the Director, Department of Game and Inland Fisheries.

Title: **Randall T. Francis - Permits Manager** **Date: 4/21/2020**

20 Permit Effective **4/21/2020** through **12/31/2021** **21**

Virginia Department of Game and Inland Fisheries

7870 Villa Park Drive, P.O. Box 90778, Henrico, VA 23228-0778
(804) 367-1000 (V/TDD)

Under Authority of § 29.1-412, § 29.1-417, & § 29.1-418 of the Code of Virginia

Scientific Collection Permit

Permit Type:	**Renewal**	FeePaid:	**$40.00**	VADGIF Permit No.	**068630**

Authorized Sub-Permittees:

Dr. Tom Jones, Edge Engineering & Science, LLC
John Spaeth, Edge Engineering & Science, LLC
Aaron Prewitt, Edge Engineering & Science, LLC
Nancy Scott, Three Oaks Engineering
Adam Benshoff, Edge Engineering & Science, LLC
Dr. Art Bogan, NC Museum of Natural Sciences
Tom Dickinson, Three Oaks Engineering
Nathan Howell, Three Oaks Engineering
David Foltz, Edge Engineering & Science, LLC
Jonathan Studio, Edge Engineering & Science, LLC
Doug Locy, Edge Engineering & Science, LLC
Alyssa Brady, Edge Engineering & Science, LLC
Cody Parks, Three Oaks Engineering
Lizzy Stokes, Three Oaks Engineering
Tim Savage, Three Oaks Engineering
Mitchell Kriege, Edge Engineering & Science, LLC

Virginia Department of Game and Inland Fisheries

7870 Villa Park Drive, P.O. Box 90778, Henrico, VA 23228-0778
(804) 367-1000 (V/TDD)

Under Authority of § 29.1-412, § 29.1-417, & § 29.1-568 of the Code of Virginia & DGIF Policy E-1-90

Threatened/Endangered Species Permit

Permit Type: **Renewal** Fee Paid: **$20.00** VADGIF Permit No. **068631**

Permittee: **Casey D Swecker**
Address: **4005 Ponder Drive**
Cincinnati, OH 45245
Email:

Office: **(304) 633-5808**
City/County: **Out of State**

Business: **Edge Engineering and Science, LLC**
4005 Ponder Drive
Cincinnati, OH 45245

City/County: **Out of State**

Contract Species Surveys/Research/Relocation

Authorized Collection Methods: By Hand/Dip Nets/Seine Nets/Snorkel/View Scope/Aquatic Kick Samples/Scuba/Nets-Traps (Fyke/Hoop/D-Frame)/Electrofishing/Hooka (Third Lung)/Gill Nets-Trawl Nets
Authorized Waterbodies: Blackwater River/New River/North Fork Holston River/Roanoke River/Pigg River/Sandy River/North Fork Roanoke River/Little Creek/Crooked Creek/Roanoke River/Sinking Creek/Mill Creek
Authorized Marking Techniques: N/A

Special Conditions: No sampling in stocked trout waters from October 1st through June 15th. No sampling in tidal waters Auguststst 15th through November 30th per TOYR for sturgeon. No water bodies that have the potential for the Big Sandy Crayfish, unless added to the permit by amendment request.

Special Conditions: For the VDOT sampling on the North Fork Holston River permittee should attempt to use the least potentially lethal techniques first and then move onto other techniques. It is recommended that the fish relocation best management practices be utilized.

James Spinymussel (Parvaspina collina) – 1 foot tissue sample and 1 mantle tissue sample from DGIF dead specimen collected on 8/19/2015 from Little Oregon Creek, Craig County; provided by Brian Watson is authorized pursuant to this permit.

PERMIT AMENDMENT 9/14/2020: This amendment changes the permittee and several subpermittees affiliation from ESI to Edge Engineering and Services LLC. This amendment adds the following projects: Mill Lane Bridge Repair and Niagara Dam Hydro Project.

Permittee MUST notify VDGIF within the 7 day period prior to each sampling event. Notification must be made via email to: collectionpermits@dgif.virginia.gov

Report Due: 31 January 2020

ANNUAL REPORTS MUST BE SUBMITTED VIA: https://vafwis.dgif.virginia.gov/collection_permits/

Authorized Counties / Cities:

Augusta
Bath
Brunswick
Buckingham
Carroll
Craig
Cumberland
Dinwiddie
Franklin
Giles
Greensville
Highland
Montgomery
Nelson
Nottoway
Pittsylvania
Prince Edward
Pulaski
Roanoke
Scott
Southampton
Radford

Virginia Department of Game and Inland Fisheries

7870 Villa Park Drive, P.O. Box 90778, Henrico, VA 23228-0778
(804) 367-1000 (V/TDD)
Under Authority of § 29.1-412, § 29.1-417, & § 29.1-568 of the Code of Virginia & DGIF Policy E-1-90

Threatened/Endangered Species Permit

Permit Type: **Renewal** Fee Paid: **$20.00** VADGIF Permit No. **068631**

STANDARD CONDITIONS ATTACHED APPLY TO THIS PERMIT.

Authorized Species:

Description	ID Number	Scientific Name
Pistolgrip		*Quadrula (Tritogonia) verrucosa*
Spiny Riversnail		*Io fluvialis*
Threatened & Endangered Aquatic Mollusk Species		
Threatened & Endangered Crayfish		
Threatened & Endangered Fish Species		
Threatened & Endangered Freshwater Mussels		

Authorized Sub-Permittees:
See Attached Sheet

Approved by: Randall T. Francis

Applicants may appeal permit decisions within 30 days of issuance. The appeal must be in writing to the Director, Department of Game and Inland Fisheries.

Title: **Randall T. Francis - Permits Manager** **Date:** **4/21/2020**

20 Permit Effective **4/21/2020** through **12/31/2020** **20**

Virginia Department of Game and Inland Fisheries

7870 Villa Park Drive, P.O. Box 90778, Henrico, VA 23228-0778
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Under Authority of § 29.1-412, § 29.1-417, & § 29.1-568 of the Code of Virginia & DGIF Policy E-1-90

Threatened/Endangered Species Permit

Permit Type:	**Renewal**	FeePaid:	**$20.00**	VADGIF Permit No.	**068631**

Authorized Sub-Permittees:

Dr. Tom Jones, Edge Engineering & Science, LLC
John Spaeth, Edge Engineering & Science, LLC
Aaron Prewitt, Edge Engineering & Science, LLC
Nancy Scott, Three Oaks Engineering
Adam Benshoff, Edge Engineering & Science, LLC
Dr. Art Bogan, NC Museum of Natural Sciences
Tom Dickinson, Three Oaks Engineering
Nathan Howell, Three Oaks Engineering
David Foltz, Edge Engineering & Science, LLC
Jonathan Studio, Edge Engineering & Science, LLC
Doug Locy, Edge Engineering & Science, LLC
Alyssa Brady, Marshall University
Cody Parks, Three Oaks Engineering
Lizzy Stokes, Three Oaks Engineering
Tim Savage, Three Oaks Engineering
Mitchell Kriege, Edge Engineering & Science, LLC
Adam Mann, GAI Consultants, Inc.

Appendix B

REPRESENTATIVE PHOTOGRAPHS

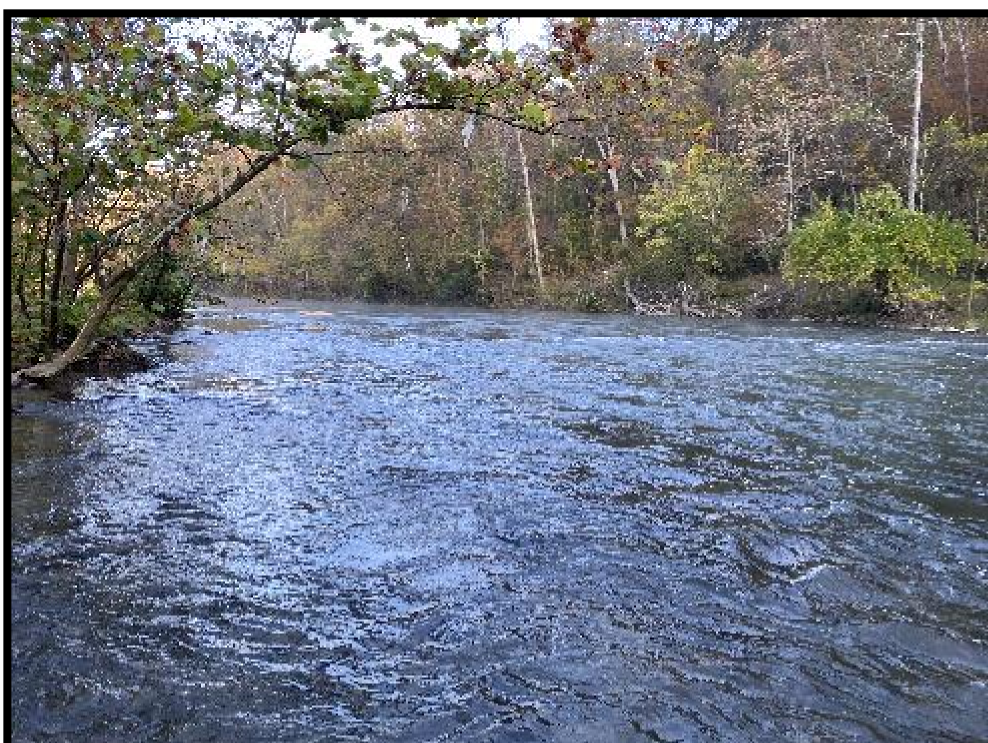
NFBP1 - Downstream
Backpack Electrofishing Sample Site

NFBP2 - Upstream
Backpack Electrofishing Sample Site

NFBP3 - Upstream
Backpack Electrofishing Sample Site

NFBP4 - Upstream
Backpack Electrofishing Sample Site

NFBP5 - Downstream
Backpack Electrofishing Sample Site



NFBP6 - Upstream
Backpack Electrofishing Sample Site

NFBP7 - Downstream
Backpack Electrofishing Sample Site

Rock Bass
(*Ambloplites rupestris*)

Central Stoneroller
(*Campostoma anomalum*)

White Sucker
(*Catostomus commersonii*)

Satinfin Shiner
(*Cyprinella analostana*)

Spotfin Shiner
(*Cyprinella spiloptera*)

Fantail Darter
(*Etheostoma flabellare*)

Johnny Darter
(*Etheostoma nigrum*)

Riverweed Darter
(*Etheostoma podostemone*)

Cutlip Minnow
(*Exoglossum maxillingua*)

Northern Hog Sucker
(*Hypentelium nigricans*)

Redbreast Sunfish
(*Lepomis auritus*)

Green Sunfish
(*Lepomis cyanellus*)

Bluegill
(*Lepomis macrochirus*)

Rosefin Shiner
(*Lythrurus ardens*)

Smallmouth Bass
(*Micropterus dolomieu*)

Blacktip Jumprock
(*Moxostoma cervinum*)

Bull Chub
(*Nocomis raneyi*)

Spottail Shiner
(*Notropis hudsonius*)

Swallowtail Shiner
(*Notropis procne*)

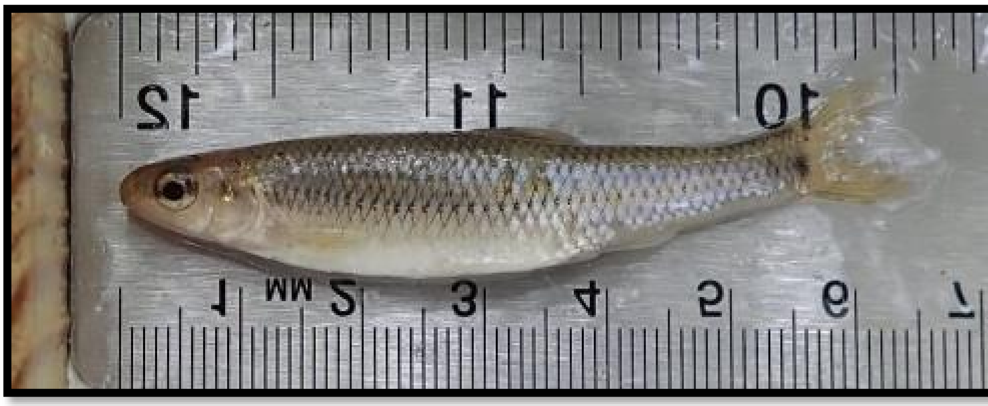
Mimic Shiner
(*Notropis volucellus*)

Margined Madtom
(*Noturus insignis*)

Chainback Darter
(*Percina nevisense*)

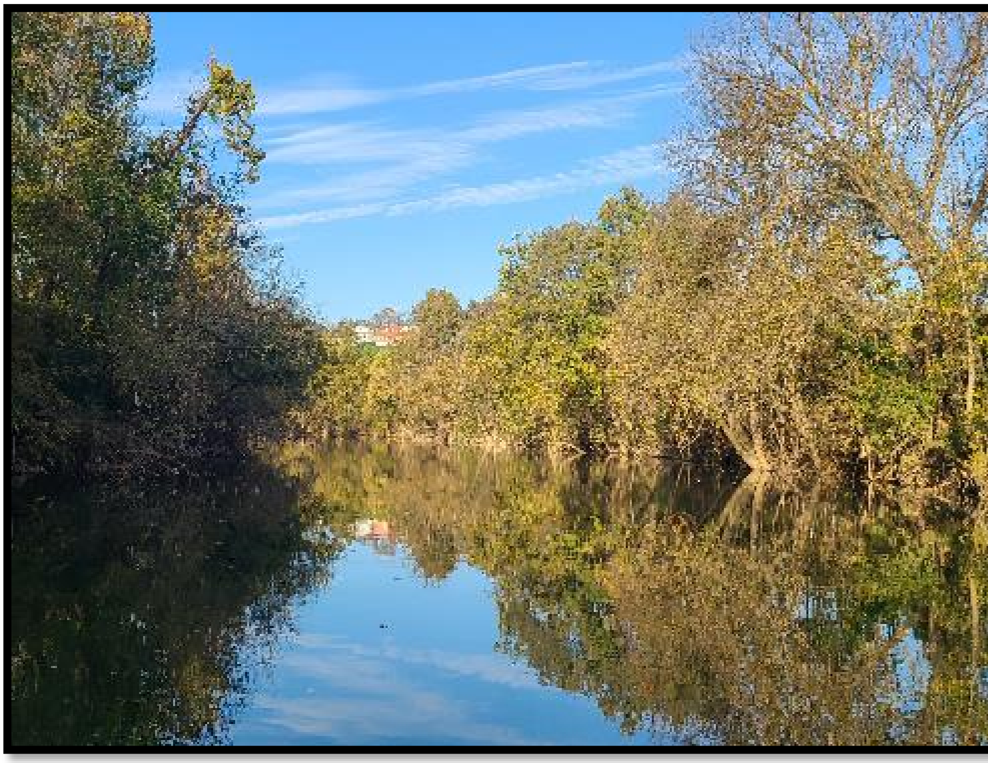
Roanoke Logperch
(*Percina rex*)

Roanoke Darter
(*Percina roanoka*)

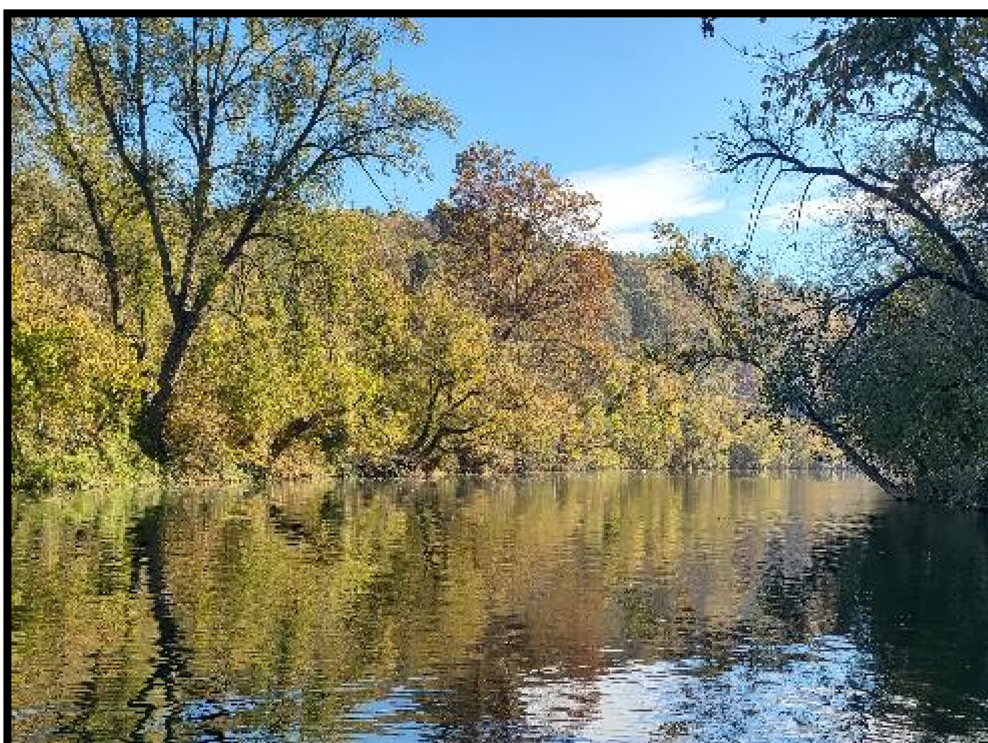


Bluntnose Minnow
(*Pimephales notatus*)

Blacknose Dace
(*Rhinichthys atratulus*)



NFB1 & 2 - Upstream
Boat Electrofishing Sample Site



NFBP3 & 4 - Downstream
Boat Electrofishing Sample Site

NFBP5 & 6 - Upstream
Boat Electrofishing Sample Site

NFBP7 & 8 - Downstream
Boat Electrofishing Sample Site

Redear Sunfish
(*Lepomis microlophus*)

Largemouth Bass
(*Micropterus salmoides*)

Golden Redhorse
(*Moxostoma erythrurum*)

V-lip Redhorse
(*Moxostoma pappillosum*)

Appendix C

RAW DATA

Backpack Electrofishing Data

Common Name	Species	NFBP1	NFBP2	NFBP3	NFBP4	NFBP5	NFBP6	NFBP7	Total	Rel. Abundance
Rock Bass	*Ambloplites rupestris*	1	3	-	-	1	1	-	6	1.1%
Central Stoneroller	*Campostoma anomalum*	5	-	55	11	37	20	16	144	27.4%
White Sucker	*Catostomus commersonii*	-	3	-	-	-	-	-	3	0.6%
Satinfin Shiner	*Cyprinella analostana*	2	-	3	1	-	-	1	7	1.3%
Spotfin Shiner	*Cyprinella spiloptera*	-	-	1	1	-	-	-	2	0.4%
Fantail Darter	*Etheostoma flabellare*	3	-	-	-	-	10	13	26	5.0%
Johnny Darter	*Etheostoma nigrum*	1	1	1	-	-	1	-	4	0.8%
Riverweed Darter	*Etheostoma podostemone*	2	-	4	2	4	18	13	43	8.2%
Cutlip Minnow	*Exoglossum maxillingua*	1	-	4	-	3	2	1	11	2.1%
Northern Hog Sucker	*Hypentelium nigricans*	-	2	3	-	-	1	-	6	1.1%
Redbreast Sunfish	*Lepomis auritus*	-	2	3	-	1	-	-	6	1.1%
Green Sunfish	*Lepomis cyanellus*	-	-	-	1	1	-	-	2	0.4%
Bluegill	*Lepomis macrochirus*	-	3	-	-	1	-	-	4	0.8%
Sunfish	*Lepomis sp.*	-	1	-	3	1	-	-	5	1.0%
Rosefin Shiner	*Lythrurus ardens*	74	13	20	6	16	1	4	134	25.5%
Smallmouth Bass	*Micropterus dolomieu*	1	-	1	-	-	1	1	4	0.8%
Blacktip Jumprock	*Moxostoma cervinum*	-	-	1	7	15	3	3	29	5.5%
Bull Chub	*Nocomis raneyi*	4	-	-	-	-	-	-	4	0.8%
Chub	*Nocomis sp.*	4	-	2	-	-	-	-	6	1.1%
Spottail Shiner	*Notropis hudsonius*	-	-	-	8	3	-	-	11	2.1%
Swallowtail Shiner	*Notropis procne*	-	-	-	1	-	-	-	1	0.2%
Mimic Shiner	*Notropis volucellus*	-	-	-	7	-	-	-	7	1.3%
Margined Madtom	*Noturus insignis*	4	-	-	-	4	7	17	32	6.1%
Chainback Darter	*Percina nevisense*	-	2	-	-	-	-	-	2	0.4%
Roanoke Logperch	*Percina rex*	1	-	-	-	-	-	-	1	0.2%
Roanoke Darter	*Percina roanoka*	5	4	-	1	1	5	6	22	4.2%
Bluntnose Minnow	*Pimephales notatus*	-	1	-	-	-	-	-	1	0.2%
Blacknose Dace	*Rhinichthys atratulus*	1	-	-	-	1	-	-	2	0.4%
	Total	109	35	98	49	89	70	75	525	
	Rel. Abundance	20.8%	6.7%	18.7%	9.3%	17.0%	13.3%	14.3%		

Boat Electrofishing Data

Common Name	Species	NFB1	NFB2	NFB3	NFB4	NFB5	NFB6	NFB7	NFB8	Total	Rel. Abundance
White Sucker	*Catostomus commersonii*	-	-	-	1	-	-	-	-	1	1.5%
Redbreast Sunfish	*Lepomis auritus*	-	-	2	2	5	1	16	-	26	40.0%
Bluegill	*Lepomis macrochirus*	-	-	1	-	1	5	2	2	11	16.9%
Redear Sunfish	*Lepomis microlophus*	-	-	-	-	-	1	-	-	1	1.5%
Sunfish	*Lepomis sp.*	-	-	-	2	-	1	-	-	3	4.6%
Smallmouth Bass	*Micropterus dolomieu*	-	-	1	-	-	-	-	-	1	1.5%
Largemouth Bass	*Micropterus salmoides*	-	-	-	2	2	-	1	1	6	9.2%
Golden Redhorse	*Moxostoma erythrurum*	-	-	9	-	2	-	-	1	12	18.5%
V-lip Redhorse	*Moxostoma pappillosum*	-	-	1	-	-	-	-	-	1	1.5%
Bluntnose Minnow	*Pimephales notatus*	-	-	-	-	-	-	-	3	3	4.6%
	Total	0	0	14	7	10	8	19	7	65	
	Rel. Abundance	0.0%	0.0%	21.5%	10.8%	15.4%	12.3%	29.2%	10.8%		

Attachment 2

Attachment 2 – Preliminary Roanoke Logperch Survey

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Niagara Hydroelectric Project
(FERC Project No. 2466)

Prepared for:

2021 Roanoke Logperch Survey Results, Virginia

November 23, 2021

Niagara → HDR2020-0002

Prepared by:

Edge Engineering and Science, LLC
Cincinnati, Ohio

Table of Contents

LIST OF MAPS

APPENDICES

LIST OF ACRONYMS

AEP	American Electric Power – Client
Appalachian	Appalachian Power Company
CPUE	Catch Per Unit Effort
DO	Dissolved Oxygen
EDGE	Edge Engineering and Science, LLC
FERC	Federal Energy Regulatory Commission
GIS	Geographic Information System
GPS	Global Positioning System
HDR	HDR, Inc. – Client
HSI	Habitat Suitability Index
IDW	Inverse Distance Weighting
LDB	Left Descending Bank
OFM	Orangefin Madtom
RDB	Right Descending Bank
RLP	Roanoke Logperch
RSP	Revised Study Plan
SPD	Study Plan Determination
TL	Total Length
TOYR	Time-of-Year Restriction
USFWS	U.S. Fish and Wildlife Service
USR	Updated Study Report
VDCR	Virginia Department of Conservation and Recreation
VDEQ	Virginia Department of Environmental Quality
VDGIF	Virginia Department of Game and Inland Fisheries (now VDWR)
VDWR	Virginia Department of Wildlife Resources (formerly VDGIF)
YOY	Young-of-Year

1.0 INTRODUCTION

The Niagara Hydroelectric Project (Project) is a 2.4-megawatt hydroelectric generating facility located at river mile 355 of the Roanoke River in Roanoke County, Virginia. Appalachian Power Company (a unit of American Electric Power; AEP) is pursuing a new license from the Federal Energy Regulatory Commission (FERC) for the Project as their existing license (FERC No. 2466) expires in 2024. The Roanoke River, along with the approximately 2-mile-long reservoir resulting from the Niagara Dam, harbors a diverse community of aquatic biota including the federally endangered Roanoke Logperch (*Percina rex*; RLP). The state threatened Orangefin Madtom (*Noturus gilberti*; OFM) may also occur within two miles of the Project in the Roanoke River and Tinker Creek, a tributary to the Roanoke River within the Project boundary (VDGIF 2009). Roanoke Logperch studies were completed in 1992 to support the existing license and results of these studies are used as a record and reference for current relicensing efforts. Although RLP were captured during previous relicensing studies, Orangefin Madtom were not collected within the Project area, and Jenkins and Burkhead (1994) established that Orangefin Madtom have likely been extirpated within the City of Roanoke. General fish community sampling efforts (completed in 2020) were deemed sufficient for OFM surveys, but none were collected in the Project area. The Roanoke River and lower reaches of tributary streams are included in the Project area (Map 1). The information gained from RLP-specific studies will document the current conditions of RLP abundance, density, and distribution in the vicinity of the Project.

Study scoping with state and federal agencies resulted in the development and approval of a Project-specific Revised Study Plan (RSP) that identified one objective for Project studies (AEP 2019) pertaining to Roanoke Logperch.

Goals and Objectives

1) Collect information regarding the contemporary status of Roanoke Logperch (including larval, young-of-year [YOY], and adults) in the vicinity of the Project for the purpose of establishing a baseline and to potentially support FERC's cumulative effects analyses.

In accordance with the RSP, field sampling efforts were necessary to satisfy this objective. Complete satisfaction of this objective was not able to be accomplished during the 2020 calendar year due to delays resulting from unforeseeable circumstances including the COVID-19 global pandemic. Additionally, because of the detailed process required to obtain permits for sampling larval RLP, only adult and YOY surveys were completed in 2021. This report serves as an interim study report until larval sampling is completed in spring 2022, at which point the final study report will be filed with FERC.

2.0 METHODS

The RSP provided guidance on the sampling framework for the Project that included RLP-specific methodologies. Any deviations from this initial guidance are described in Section 2.4.2. Snorkeling survey methods were used to target adult RLP in riffle/run habitat at eight sites and seining methods to target YOY in riffle-adjacent, low-velocity shoreline habitat at seven sites throughout the Project area. Larval sampling that is scheduled for spring 2022, will employ drift-net methods at five sites; the larval sampling methods are described in Section 2.3 and results will presented in final report during summer 2022. The methods, including gear-specific techniques, seasonality, and number and location of sample sites, were selected to document a contemporary representation of RLP in the Project area and correspond to previous sampling efforts for comparison. Field sampling was completed during suitable, low-flow stream conditions under VDWR Permit No. 070704 and U.S. Fish and Wildlife Service (USFWS) Permit No. ESPER0002735.

2.1 Adult Roanoke Logperch Sampling

Adult RLP sampling was completed twice in the Bypass Reach (once in early summer and once in late summer 2021) to identify any seasonal trends in habitat utilization within the direct Project footprint. Sampling at the other seven sites was completed once between late summer and fall 2021. Sampling methods were derived from the line-transect method and simple Emlen model described in Ensign et al. (1995), which are specific to RLP in the Roanoke River. Within the constraints of the Project's objectives and geographic limits, snorkeling techniques were employed to most-effectively target specific sites based on the habitat types present in the Project area. Upstream of the Niagara impoundment, three snorkeling sites were in the Roanoke River and one site was in Tinker Creek. Four sites were located downstream of the Niagara Dam, with one occurring in the Bypass Reach and the other three in the Roanoke River downstream of the tailrace. Sampling techniques are described further in subsequent sections. 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. Site naming conventions for adult snorkeling sites are as follows: RLP1 is the most upstream site and RLP8 is the most downstream site. Sampling occurred twice in the Bypass Reach, with the first sample named RLP5S and the second sample named RLP5F.

2.1.1 Snorkel Surveys

Snorkel surveys for adult RLP 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. Upon arrival at snorkel sites (see Maps 1-10), maximum visibility was determined by moving a Secchi disc away from the snorkeler underwater until it was no longer visible. A minimum visibility requirement for the completion of surveys was set at one meter in cooperation with species experts. 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. It is important to note that the characteristics of the portions of each survey site that lend themselves to snorkeling methodology also correspond to the preferred habitat characteristics of adult RLP. Site photos were taken in four directions (upstream, downstream, left-descending bank [LDB], and right-descending bank [RDB]; all 90 degrees to one another), and field conditions were recorded (e.g., time, date, temperature, precipitation, cloudy/overcast, etc.). At each sample site, water quality parameters (e.g., pH, water temperature, dissolved oxygen [DO], and conductivity) were measured and recorded. Sampling effort (i.e., time snorkeling and transect length) was also recorded for each sampling event.

As detailed in Ensign et al. (1995), transect lines (i.e., tape or rope) were to be physically stretched and followed by field teams during the snorkel surveys; however, accurately laying, stretching, and following transect lines was made difficult by the high velocity, large substrates, and variation in water depth within and between each site. This activity could have also caused a considerable disturbance to the target habitat and potentially alter the location and behavior of fishes within the stream reach. To make data collection as accurate as possible, while covering target habitat, 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

RLP directly in front and from side to side. The distance between the snorkeler's centerline and the point where the RLP 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 RLP 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.

2.1.2 Habitat Assessments

A quantitative assessment of RLP 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 adult RLP snorkeling site based on the Habitat Suitability Index (HSI) developed by Ensign and Angermeier (1994) and Ensign et al. (1998). Prior to field data collection, a field sampling grid was developed and georeferenced using GIS information. The grid consisted of a primary transect placed along the stream bank and parallel to stream flow; secondary transects were placed every 12 meters perpendicular to the primary transect (and perpendicular to stream flow). Along each secondary transect, within the wetted width of the stream, sample points were placed every three meters starting at a point 0.5 meter from the LDB. 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'). The amount of each habitat suitability category was then calculated per site and per transect snorkeled.

Subsequent habitat suitability mapping and analyses were completed for each adult RLP site using spatial interpolation procedures in ESRI ArcGIS software. Data interpolations were used to predict habitat values for unmeasured areas that occur between measured points using inverse distance-weighting (IDW) interpolation routine for the ordinal variable (i.e., silt-cover), and a universal kriging interpolation routine for continuous variables (i.e., depth, velocity, substrate). Interpolated cell size was set at 0.5 square meters, providing a reasonable trade-off between data-capture frequency, map resolution, and precision of the interpolation routine. An HSI value was calculated for each cell and assigned a suitability category (i.e., Unsuitable, Poor, Fair, Good, and Excellent). Using the cell values, the percentage of the cells in a site comprising each suitability category was calculated and the spatial distribution of each category was mapped for each adult RLP site.

2.1.3 Statistical Analyses

Adult RLP densities were calculated for each site using methods from Ensign et al. (1995); they found that density calculations can be accurately carried out using the number of RLP observed over a specific area (product of transect length and twice the maximum visibility) and the distance at which sighting probability of RLP is 1.0 (75 cm under low-turbidity conditions). Density estimates of adults are generally greater than catch per unit effort (CPUE) because density calculations consider the decreased probability of seeing RLP at greater distances. Data from this study was then compared to data from the historical RLP assessment (Appalachian and AEP 1992), as applicable. Temporal habitat availability/occupancy will also be evaluated at Site RLP5 (i.e., Bypass Reach) and reported in Appendix A of the Updated Study Report.

2.2 Young-Of-Year Roanoke Logperch Sampling

One young-of-year RLP 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 RLP. Within the constraints of the Project's objectives and geographic limits, seining techniques were employed to most-effectively target specific sites based on the habitat types present in the Project area. Upstream of the Niagara impoundment, two sites in the Roanoke River and one site in Tinker Creek were sampled using seining techniques. Four sites located downstream of the Niagara Dam were seined, two in the Bypass Reach and two in the Roanoke River downstream of the Niagara tailrace. Sampling techniques are described further in subsequent sections. 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. Site naming conventions for YOY seining sites are as follows: YOY1 is the most upstream site and YOY7 is the most downstream site.

2.2.1 Seine Surveys

Seine surveys for YOY RLP occurred at seven riffle-adjacent, low-velocity shoreline sites and included at least 20 seine hauls in target habitat. Upon arrival at seine sites (Maps 1 and 11-16), 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 (minimum of 20 seine hauls) 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.

At each site, a six-foot by eight-foot seine (1/16-inch mesh) was used to sample fishes in the upstream direction. A four-person crew (two holding the seine, one holding a dip net and bucket, and one recording habitat data) performed single seine hauls at approximately 10-meter intervals starting at the downstream end of the site and moving upstream. Within each 10-meter interval, each haul began approximately 2 meters from the bank and moved perpendicular to shore. Habitat patches were not sampled if water velocity was too swift or if bed sediments created an area that could not be sampled efficiently with a seine (e.g., root wads or boulders). Roanoke Logperch were the only species targeted in the seine hauls, but other observed species were noted as present. All fish were identified to the lowest taxonomic level practicable. Photo vouchers were taken in the field for a representative specimen of each fish taxon collected at each site during the study. Fish were kept in aerated buckets during sampling and released after sampling was completed.

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.

2.2.2 Habitat Assessments

Microhabitats within each habitat patch (i.e., 10-meter segment) were assessed and mapped using a submeter-accuracy GPS unit. Depth, velocity, percent silt cover, and five substrate measurements (on a modified Wentworth scale) were recorded, and a photo was taken for each 10-m habitat patch.

2.2.3 Analysis

No data analyses were required as no YOY RLP were collected during the sampling efforts; however, other observed species and habitat information is discussed qualitatively in Section 3.2. Potential reasons for negative YOY surveys are provided in Section 4.2.

2.3 Larval Roanoke Logperch Sampling

Larval RLP sampling will be completed at five sites between April and June 2022. Sampling methods were derived from methods described in Buckwalter et al. (2019), which are specific to larval RLP. Within the constraints of the Project's objectives and geographic limits, drift-net techniques will be employed according to equipment requirements to target specific sites in the Project area. Drift net set sites will include one site located upstream of the Niagara impoundment above the confluence of Tinker Creek with the Roanoke River, one site in Tinker Creek, one site in the Niagara impoundment directly upstream of the dam along the LDB, and two sites downstream of Niagara Dam, one of which is in the Bypass Reach and the other immediately downstream of the tailrace. Sampling techniques are described further in subsequent sections. Specific sampling dates will target the known spawning season of RLP but will ultimately be determined by multiple factors including (but not limited to) weather conditions, water temperatures, river flows and reservoir elevations, and safety of field staff and the public. Site naming conventions for larval drift-net sites are as follows: L1 is the most upstream site and L5 is the most downstream site.

2.3.1 Drift Net Surveys

RLP larvae will be sampled after dusk from April to June 2022 using two, 20-minute drift net sets (early and late) per site in riffle/run adjacent habitat. In total, 100 net sets will be completed (5 sites, two sets once a week for 10 weeks) using analogous studies as a methodological reference (Hallerman et al. 2017; Buckwalter et al. 2019). Site photos, field conditions, and water quality parameters will also be collected as stated in Section 2.2.1. Water velocity will be measured at the mouth of each net to determine water volume sampled with each net set. Each night, two teams will sample two sites and three sites, respectively. Drift nets will be staked into the substrate in a riffle or run mesohabitat. All solid material (i.e., fish larvae, debris) from each sample will be placed in labeled glass jars containing 95 percent ethanol and stored for laboratory processing. All survey protocols and methods were developed in coordination with appropriate state and federal agencies, stakeholders, clients, and RLP experts.

2.3.2 Identification and Statistical Analysis

The most critical components of the methodology for the larval drift study for Roanoke Logperch are the procedures and quality assurance steps implemented in the laboratory to produce results that will meet predefined data quality objectives and that can be repeated by independent taxonomists. As such, additional information is provided below detailing procedures for sample processing, preservation, storage, and quality control that will be implemented at a minimum to support the accuracy and quality of the results from the study.

Samples from the larval study will be transported to the qualified biological laboratory where they will be processed following procedures identified in Hallerman et al. (2017). Larval fish will be sorted from debris and then percid larvae will be separated from larvae from other fish families based on distinguishing characters, including vent location, yolk sac and oil globule characters, pectoral fin development, myomere count, and pigmentation patterns. Each larva will be photographed under magnification and stored in 95 percent ethanol in a 1- or 2-dram glass vial with Titeseal™ cap (Fisher Scientific) or comparable container and labeled with a unique identification number.

Numerous metrics will be collected on each specimen and used for taxonomic identification to the lowest practical taxonomic level. Pre-anal myomeres will be counted and total length (TL) will be measured along with seven other body measurements, which are then expressed relative to (i.e., ratio of) TL, including: preanal length (tip of snout to posterior margin of vent), head height (apex of optic lobe to ventral margin of head), head length (tip of snout to pectoral fin insertion), snout length (tip of snout to anterior margin of eye iris), eye diameter (longitudinal iris diameter), pectoral fin length (from foremost visible point of insertion to distal tip of the membranous edge), and caudal peduncle height (least peduncle height excluding finfold). All preanal myomeres will be counted between the anterior-most myoseptum and an imaginary vertical line drawn at the posterior margin of the vent, including any bisected by the line.

Larval RLP data will be analyzed for body condition, spatial distribution, and volumetric density. The total number of RLP will be used to calculate volumetric density and CPUE. These data will be used to identify the temporal and spatial distribution of RLP larvae within the Project area.

2.4 Deviations from Revised Study Plan

2.4.1 Covid-19 Delays

Initially, RLP sampling activities were proposed for completion in 2020, which included larval drift sampling during spring months, YOY and adult sampling during the fall, and an additional adult sampling event during the summer to specifically target habitats within the bypass reach. The spring larval and summer adult surveys were cancelled due to restrictions on non-essential travel and safety considerations in response to the COVID-19 pandemic. As a result, AEP requested and was granted an extension to accommodate the change in schedule as the VDCR, VDWR, USFWS, and Virginia Department of Environmental Quality (VDEQ) concurred with adaptable schedule revisions. EDGE was contracted and given notice to proceed with fieldwork at the beginning of September 2020. The adult RLP study was delayed and moved into 2021 due to weather delays and conflicts with overlapping efforts with the fall general fish community sampling effort. Roanoke Logperch sampling efforts were rescheduled to occur through the 2021 field season to accommodate the life stage-specific spring, summer and fall RLP survey timelines as originally proposed. Adult and YOY RLP sampling were completed in 2021 but delays in the permitting process has further delayed larval sampling to spring 2022.

2.4.2 Methodological Adjustments

The RSP proposed four paired sites (eight total) for adult RLP surveys, but the FERC Study Plan Determination (SPD) recommended eight independent sites to be located throughout the Project area. The RSP also proposed five YOY survey sites, but the SPD recommended seven sites including an additional site in both the Bypass Reach and further downstream of the tailrace. Along with the above recommendations, minor adjustments to survey sites also occurred based on target habitat availability at the time of sampling.

The field sampling methodology originally consisted of spring and summer backpack electrofishing for adult RLP in the Bypass Reach and summer backpack electrofishing at the seven other locations in the Project area. It was noted in the RSP that completion of spring backpack electrofishing efforts would require a waiver of the VDWR Time-of-Year Restrictions (TOYR) for RLP with concurrence from the USFWS. AEP submitted a request to the services for a TOYR waiver to complete the required RLP spring study in the Niagara Bypass Reach. A conference call was held on Wednesday, May 5, 2021, between AEP, HDR, EDGE, other experts, and representatives of VDWR and USFWS to discuss the TOYR waiver request. The call resulted in a recommendation to eliminate backpack electrofishing methodology for the spring Bypass Reach sampling effort during the TOYR. The agencies agreed that the use of snorkeling survey methods would pose less of a potential effect on RLP (Not Likely to Adversely Affect) while allowing the field team to collect necessary and requested baseline information for Project-specific RLP studies. The agencies concurred that the waiver of TOYR was granted with a change to snorkel survey methods and a commitment to minimize instream disturbance during the survey effort to the extent possible. The initial snorkel surveys were successful, and with concurrence from Mike Pinder (VDWR) and Dr. Paul Angermeier (Virginia Tech) that snorkel methods were an acceptable substitute for the proposed backpack sampling methods, the remaining adult RLP surveys were performed using this methodology.

3.0 RESULTS

3.1 Adult Roanoke Logperch Sampling

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 RLP 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 RLP per hectare (19.8 standard deviation). The mean density for sites within the Roanoke River above the dam (RLP1-3) and below the dam (RLP6-8) were similar at 23 and 24 RLP per hectare, respectively. This indicates that upstream and downstream of the Niagara dam exhibits similar RLP densities with sites RLP1-3 composed of habitats with Good (53%), Fair (44%), and Poor (3%) suitability scores and sites RLP6-8 composed of Good (65%), Fair (31%), and Poor (4%) habitat suitability scores. Mean density of RLP 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 RLP per hectare) documented within the Project area. There were no signs of external parasites, disease, or physical abnormalities. Representative site and fish photos are provided in Appendix B and raw data for fish collections are provided in Appendix C. Site-specific information is provided below.

3.1.1 Site RLP1

Site RLP1 was approximately 170 meters long and primarily comprised of well-developed riffle habitat including a relatively balanced mix of substrates from sand to boulder (Appendix B). This was the most upstream site within the Roanoke River at approximately 1.1 km upstream of the head of the Niagara impoundment. At the time of snorkel surveys (October 21, 2021), pH, temperature, DO, and conductivity were 8.6, 16.1 °C, 95.2%, and 218 µS/cm, respectively. The major HSI categories available within this site were Good (63%), Fair (36%), and Poor (1%) (see Map 2) based on 144 total habitat sample points; of the available habitats, the suitability of habitats snorkeled for RLP were Good (70%) and Fair (30%). The visibility during the time of survey was 2.1 meters. Four transects were snorkeled at a rate of 3.5 meters per minute resulting in approximately 700 meters of transects covering 2,942 square meters. Although the interpolation data shows overall HSI categories throughout the entire site, the exact points where RLP were observed were given HSI scores, which indicated the eight total RLP were observed in Excellent (2), Good (2), Fair (3), or Poor (1) habitat categories. Three juveniles and five adults were observed. The overall CPUE at RLP1 was 27 individuals per hectare and density was estimated at 33 individuals per hectare (Appendix C).

3.1.2 Site RLP2

Site RLP2 was approximately 75 meters long and primarily comprised of well-developed riffle habitat including a relatively balanced mix of substrates from sand to boulder (Appendix B). This was the second-most upstream site within the Roanoke River at approximately 775 meters upstream of the head of the Niagara impoundment. At the time of snorkel surveys (October 21, 2021), pH, temperature, DO, and conductivity were 8.7, 16.6 °C, 110.3%, and 222 µS/cm, respectively. The major HSI categories available within this site were Good (37%), Fair (55%), and Poor (8%) (see Map 3) based on 69 total habitat sample points; of the available habitats, the suitability of habitats snorkeled for RLP were Good (37%), Fair (53%), and Poor (10%). The visibility during the time of survey was 2.1 meters. Four transects were snorkeled at a rate of 4.5 meters per minute resulting in approximately 335 meters of transects covering 1,406 square meters. The exact points where RLP were observed were given HSI scores, which indicated Good habitat suitability where the single adult RLP was observed. The overall CPUE at RLP2 was 7 individuals per hectare and density was estimated at 10 individuals per hectare (Appendix C).

3.1.3 Site RLP3

Site RLP3 was approximately 100 meters long with the LDB comprised of well-developed riffle habitat including a relatively balanced mix of substrates from sand to boulder and the RDB primarily comprised of bedrock with gravel in the interstitial space (Appendix B). This was the first site directly upstream of the head of the Niagara impoundment in the Roanoke River. At the time of snorkel surveys (October 21, 2021), pH, temperature, DO, and conductivity were 7.8, 16.9 °C, 105.9%, and 242 µS/cm, respectively. The major HSI categories available within this site were Good (59%) and Fair (41%) (see Map 4) based on 100 total habitat sample points; of the available habitats, the suitability of habitats snorkeled for RLP were Good (56%), Fair (43%), and Poor (1%). The visibility during the time of survey was 1.9 meters. Five transects were snorkeled at a rate of 4.25 meters per minute resulting in approximately 511 meters of transects covering 1,943 square meters. The exact points where RLP were observed were given HSI scores, which indicated the six total RLP were observed in Excellent (3) or Good (3) habitat. All RLP observed at this site were adults. The overall CPUE at RLP3 was 31 individuals per hectare and density was estimated at 26 individuals per hectare (Appendix C). Additionally, one adult RLP was captured at this site during general fish community backpack electrofishing surveys in 2020.

3.1.4 Site RLP4

Site RLP4 was approximately 100 meters long and comprised of riffle and run habitat including relatively mobile sand and gravel amongst bedrock (Appendix B). This site was in Tinker Creek approximately 1.0 km upstream of its confluence with the Niagara impoundment. At the time of snorkel surveys (October 22, 2021), pH, temperature, DO, and conductivity were 8.4, 13.4 °C, 90.1%, and 286 µS/cm, respectively. The major HSI categories available within this site were Good (49%), Fair (50%), and Poor (1%) (see Map 5) based on 48 total habitat sample points; of the available habitats, the suitability of habitats snorkeled for RLP were Good (50%), Fair (49%), and Poor (1%). The visibility during the time of survey was 2.3 meters. Four transects were snorkeled at a rate of 5.2 meters per minute resulting in approximately 413 meters of transects covering 1,900 square meters. The habitat suitability at the exact points where each of six adult RLP were observed had HSI scores of Excellent (2) or Good (4). The overall CPUE at RLP4 was 32 individuals per hectare and density was estimated at 32 individuals per hectare (Appendix C).

3.1.5 Site RLP5

Site RLP5 was approximately 300 meters long and primarily comprised of high-gradient riffle habitat along the LDB and low-gradient glide habitat along the RDB and was dominated primarily by bedrock substrate with scattered, smaller substrates occurring in the interstitial spaces (Appendix B). This site was in the Bypass Reach immediately downstream of the Niagara Dam. At the time of snorkel surveys (June 30/August 10, 2021), pH, temperature, DO, and conductivity were 8.4/8.4, 27.0/13.4 °C, 102.1/90.1%, and 350/286 µS/cm, respectively. The major HSI categories available within this site were Fair (16%) and Poor (84%) (see Maps 6 and 7) based on 490 total habitat sample points; of the available habitats, the suitability of habitats snorkeled for RLP were Fair (27%) and Poor (73%). The visibility during the time of survey was 1.8 and 2.1 meters in June and August, respectively; and flows in the Bypass Reach were similar during each or the two seasonal snorkel sampling events. Nine transects were snorkeled during each sampling event and resulted in approximately 777 meters of transects at a rate of 1.94 meters per minute in June and 737 meters of transects at 2.46 meters per minute in August. The June and August snorkeling events covered 2,799 and 3,095 square meters, respectively. Although the interpolation data shows overall HSI categories throughout the entire site, the exact points where RLP were located were given HSI scores. Ten RLP (9 adults and 1 juvenile) were observed in June occupying Excellent (1), Good (5), or Fair (4) habitat. Sixteen RLP (13 adults and 3 juveniles) were observed in August occupying Good (4), Fair (11), or Poor (1) habitat. Seven individuals were observed congregating at the downstream portion of the Bypass Reach above its confluence with the tailrace (see Map 7 and Appendix B). The overall CPUE in June at RLP5 was 36 individuals per hectare and density was estimated at 43 individuals per hectare. The overall CPUE in August at RLP5 was 52 individuals per hectare and density was estimated at 72 individuals per hectare (Appendix C).

3.1.6 Site RLP6

Site RLP6 was approximately 205 meters long and primarily comprised of relatively deep runs with large substrate and bisected by swift, bedrock riffle chutes (Appendix B). This was the first site within the Roanoke River downstream of the Niagara tailrace and approximately 500 meters downstream of the powerhouse. At the time of snorkel surveys (August 10, 2021), pH, temperature, DO, and conductivity were 8.1, 25.8 °C, 96.7%, and 300 µS/cm, respectively. The major HSI categories available within this site were Good (74%), Fair (25%), and Poor (1%) (see Map 8) based on 163 total habitat sample points; of the available habitats, the suitability of habitats snorkeled for RLP were Good (83%) and Fair (17%). The visibility during the time of survey was 2.0 meters. Six transects were snorkeled at a rate of 4.8 meters per minute resulting in approximately 725 meters of transects covering 2,901 square meters. The exact points where RLP were observed were given HSI scores, which indicated the one adult RLP documented at the site was observed in Fair habitat. The overall CPUE at RLP6 was 3.4 individuals per hectare and density was estimated at 4.6 individuals per hectare (Appendix C).

3.1.7 Site RLP7

Site RLP7 was approximately 215 meters long and primarily comprised of relatively deep runs including a balanced mix of substrates from sand to boulder with sparse bedrock protruding throughout the site (Appendix B). This was the second site within the Roanoke River downstream of the Niagara tailrace and approximately 1 km downstream of the powerhouse. At the time of snorkel surveys (August 11, 2021), pH, temperature, DO, and conductivity were 8.15, 25.0 °C, 93.5%, and 295 µS/cm, respectively. The major

HSI categories available within this site were Good (56%), Fair (33%), and Poor (1%) (see Map 9) based on 272 total habitat sample points; of the available habitats, the suitability of habitats snorkeled for RLP were Good (64%), Fair (29%), and Poor (7%). The visibility during the time of survey was 1.8 meters. Four transects were snorkeled at a rate of 4.3 meters per minute resulting in approximately 856 meters of transects covering 3,082 square meters. The seven adult RLP observed at this site were in habitats classified by HSI scores as Excellent (1), Good (3), or Fair (3). The overall CPUE at RLP7 was 23 individuals per hectare and density was estimated at 27 individuals per hectare (Appendix C).

3.1.8 Site RLP8

Site RLP8 was approximately 125 meters long and primarily comprised of well-developed riffle habitat including a relatively balanced mix of substrates from sand to boulder with a swift, bedrock riffle chute at the downstream terminus (Appendix B). This was the third site within the Roanoke River downstream of the Niagara tailrace and approximately 2.6 km downstream of the powerhouse. At the time of snorkel surveys (October 22, 2021), pH, temperature, DO, and conductivity were 8.5, 17.1 °C, 103.0%, and 290 µS/cm, respectively. The major HSI categories available within this site were Excellent (1%), Good (63%), Fair (34%), and Poor (2%) (see Map 10) based on 142 total habitat sample points; of the available habitats, the suitability of habitats snorkeled for RLP were Excellent (1%), Good (82%), and Fair (17%). The visibility during the time of survey was 2.0 meters. Four transects were snorkeled at a rate of 3.1 meters per minute resulting in approximately 405 meters of transects covering 1,619 square meters. The exact points where six adult RLP were observed were classified as Good habitat. The overall CPUE at RLP8 was 37 individuals per hectare and density was estimated at 41 individuals per hectare (Appendix C).

3.2 Young-of-year Roanoke Logperch Sampling

Zero RLP YOY were collected during a total of 140 seine hauls performed throughout the Project area. Supplemental visual surveys at each site also resulted in zero RLP YOY observations. A total of 27 species of fish (none RLP) were collected during seine sampling efforts and primarily consisted of early life stage shiners, darters, sunfish, bass, and suckers (Appendix C). Representative site photos are provided in Appendix B and raw data for fish collections are provided in Appendix C. Site-specific information is provided below.

3.2.1 Upstream of Niagara Dam

Sites YOY1 and YOY2 were primarily comprised of glide habitat along a well-vegetated shoreline immediately downstream of Sites RLP1 and RLP2, respectively (Maps 11 and 12). These two sites were in the Roanoke River upstream of the Niagara impoundment. For the 20 seine haul locations at each site, average depth was 30 cm, average velocity was 4.5 cm/s, and substrates were composed of boulder (3%), cobble (22%), gravel (15%), sand (49%), and silt (11%) (Appendix C). At the time of seine surveys (October 19-20, 2021), pH, temperature, DO, and conductivity were approximately 8.7, 16.5 °C, 103.5%, and 245 µS/cm, respectively. Although no RLP were collected, 12 seine hauls resulted in zero fish and 28 seine hauls resulted in 14 species between these two sites (Appendix C).

3.2.2 Tinker Creek

Site YOY3 was in Tinker Creek, immediately downstream of site RLP4, and was primarily comprised of glide habitat along a well-vegetated but severely undercut shoreline (Map 13). For the 20 seine haul locations at this site, average depth was 34 cm, average velocity was 5.8 cm/s, and substrates were composed of cobble (18%), gravel (10%), sand (57%), and silt (15%) (Appendix C). At the time of seine surveys (October

20, 2021), pH, temperature, DO, and conductivity were 8.5, 16.5 °C, 97.3%, and 273 µS/cm, respectively. Although no RLP were collected, 3 seine hauls resulted in zero fish and 17 seine hauls resulted in 12 species at this site (Appendix C).

3.2.3 Bypass Reach

Sites YOY4 and YOY5 were in the Bypass Reach, and because of the lack of suitable YOY habitat and habitat suitable for seining methods, the sample sites were scattered throughout the Project area (Map 14). These sites were primarily comprised of shallow, slack-water habitat with relatively large substrate and aquatic vegetation. For the 40 seine haul locations within the Bypass Reach, average depth was 27 cm, average velocity was 2.2 cm/s, and substrates were composed of bedrock (11%), boulder (8%), cobble (18%), gravel (7%), sand (48%), and silt (8%) (Appendix C). At the time of seine surveys (October 20, 2021), pH, temperature, DO, and conductivity were 8.6, 18.3 °C, 103.6%, and 261 µS/cm, respectively. Although no RLP were collected, 17 seine hauls resulted in zero fish and 23 seine hauls resulted in 14 species between these two sites (Appendix C).

3.2.4 Downstream of Niagara Dam

Sites YOY6 and YOY7 were primarily comprised of glide habitat along a well-vegetated shoreline immediately downstream of Site RLP6 and upstream of site RLP7, respectively (Maps 15 and 16). These two sites were in the Roanoke River downstream of the Niagara tailrace. For the 20 seine haul locations at each site, average depth was 23 cm, average velocity was 6.4 cm/s, and substrates were composed of bedrock (4%), boulder (5%), cobble (22%), gravel (22%), sand (38%), and silt (9%) (Appendix C). At the time of seine surveys (August 11, 2021), pH, temperature, DO, and conductivity were approximately 8.2, 26.0 °C, 100.5%, and 288 µS/cm, respectively. Although no RLP were collected, 6 seine hauls resulted in zero fish and 34 seine hauls resulted in 19 species between these two sites (Appendix C).

4.0 DISCUSSION

4.1 Fish Community

The Project influences habitat availability through formation of a reservoir (creating pool habitat and eliminating riffle habitat), which influences the species presence and distribution within the Project area; however, the habitats present within the Project area are currently supporting a relatively diverse fish community with little evidence of physical abnormalities or stressors.

4.1.1 Adult Roanoke Logperch

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 RLP density estimates overall – indicating locally negligible differences in RLP 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 RLP habitat overall (Appendix C). 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 RLP.

4.1.2 Juvenile and Young-of-Year 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 (RLP1), 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 RLP 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 RLP 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 RLP should not be mistaken for a complete lack of YOY within the Project area. Visual surveys also resulted in zero YOY RLP, which likely indicates YOY had moved to different habitat by the time surveys took place.

4.1.3 Comparison to Previous Studies

Rosenberger and Angermeier (2002) found the mean density of adult RLP 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 RLP 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 RLP per hectare (site estimates ranging from 4.6 to 72.4 RLP per hectare).

Appalachian and AEP (1992) observed 10 total RLP using snorkeling and electrofishing methods downstream of Niagara Dam. They did not estimate density but stated RLP 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, RLP were observed at each of the sample locations throughout the Project area, including the sites where they were observed in 1992.

4.1.4 Conclusion

This report provides preliminary results based on the partial completion of the study objective: Collect information regarding the contemporary status of Roanoke Logperch (including larval, young-of-year [YOY], and adults) in the vicinity of the Project for the purpose of establishing a baseline and to potentially support FERC's environmental analysis. The RLP-specific larval studies scheduled to be performed in 2022 will provide further insights regarding RLP status within the Project area. A final report detailing the conclusions of the study will be provided in 2022.

5.0 LITERATURE CITED

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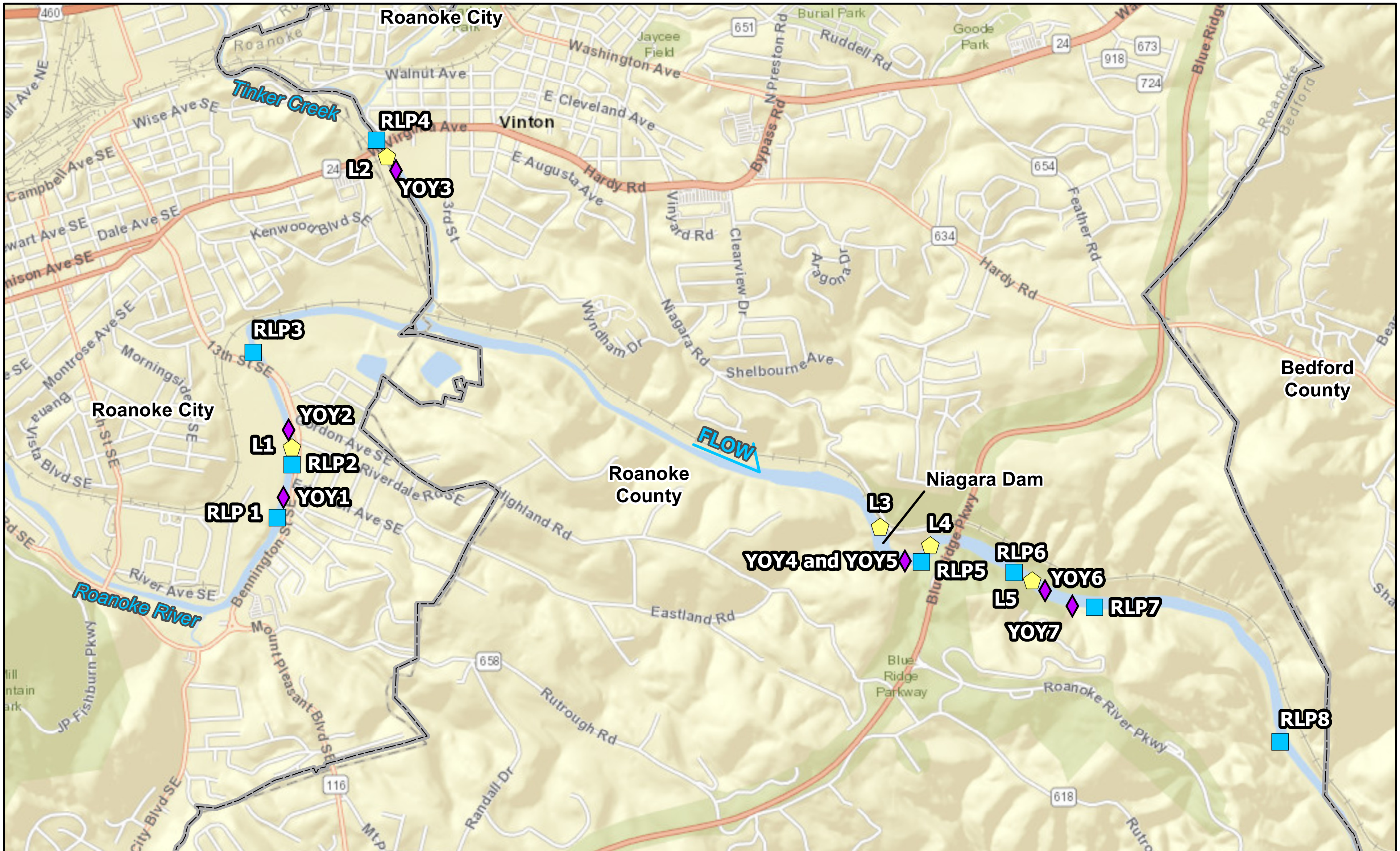
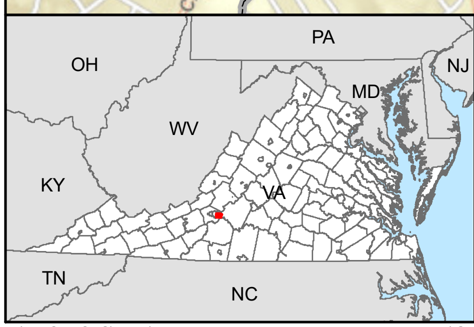
Maps





Legend

- Drift Net Survey
- Seine Survey
- Snorkel Survey
- County Boundary

N

0 400 800
Meters

Scale: 1:31,496

American Electric Power
Niagara Dam Roanoke Logperch Study

Map 1
Overall Niagara Project area including Adult (RLP), Young-of-Year (YOY), and Larval (L) survey sites on the Roanoke River in Roanoke County, Virginia.

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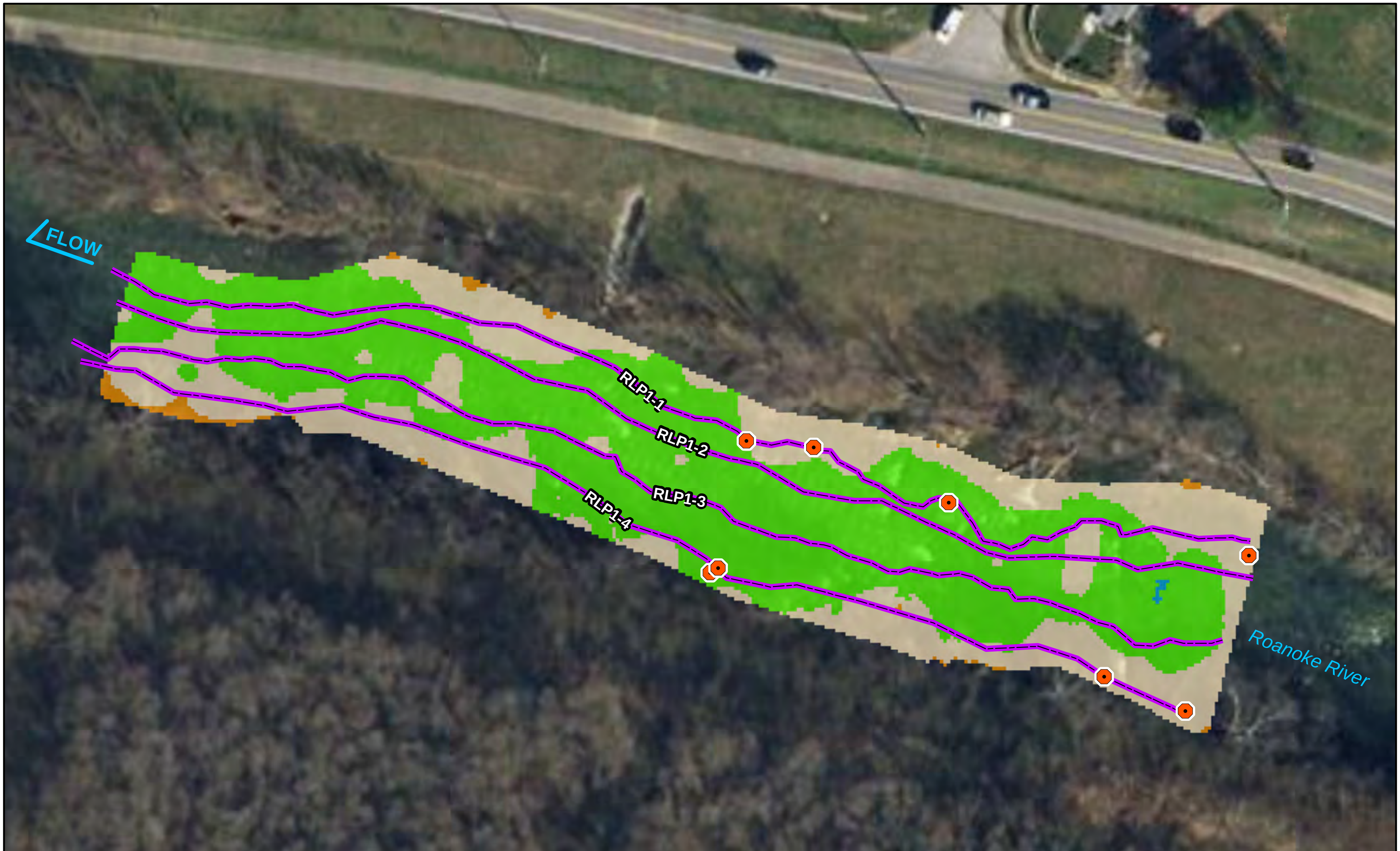

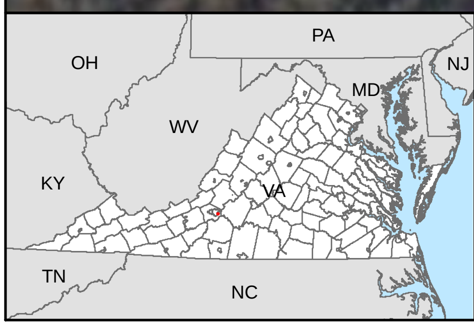

- Roanoke Logperch Sighting
- Snorkel Transect
- Excellent Habitat
- Good Habitat
- Fair Habitat
- Poor Habitat

N

0 10 20
Meters

Scale: 1:787

AMERICAN ELECTRIC POWER

EDGE ENGINEERING & SCIENCE

American Electric Power
Niagara Dam Roanoke Logperch Study

Map 2
Adult RLP snorkel survey extent including habitat suitability and RLP sighting locations in Roanoke, Virginia.

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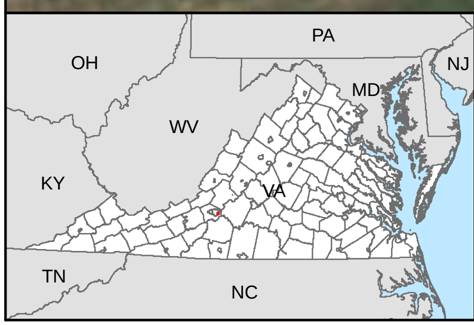

- Roanoke Logperch Sighting
- Snorkel Transect
- Good Habitat
- Fair Habitat
- Poor Habitat

N

0 10 20
Meters

Scale: 1:787

AMERICAN ELECTRIC POWER

EDGE ENGINEERING & SCIENCE

American Electric Power
Niagara Dam Roanoke Logperch Study

Map 3
Adult RLP snorkel survey extent including habitat suitability and RLP sighting locations in Roanoke, Virginia.

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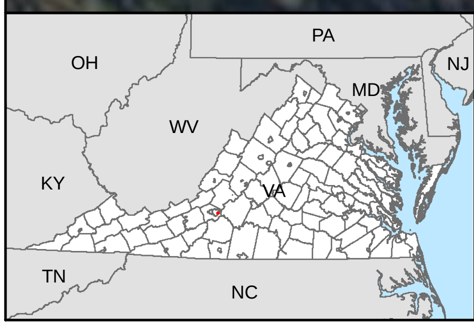

Roanoke Logperch Sighting

Snorkel Transect

Excellent Habitat

Good Habitat

Fair Habitat

Poor Habitat

N

0 10 20

Meters

Scale: 1:787

American Electric Power
Niagara Dam Roanoke Logperch Study

Map 4

Adult RLP snorkel survey extent including habitat suitability and RLP sighting locations in Roanoke, Virginia.

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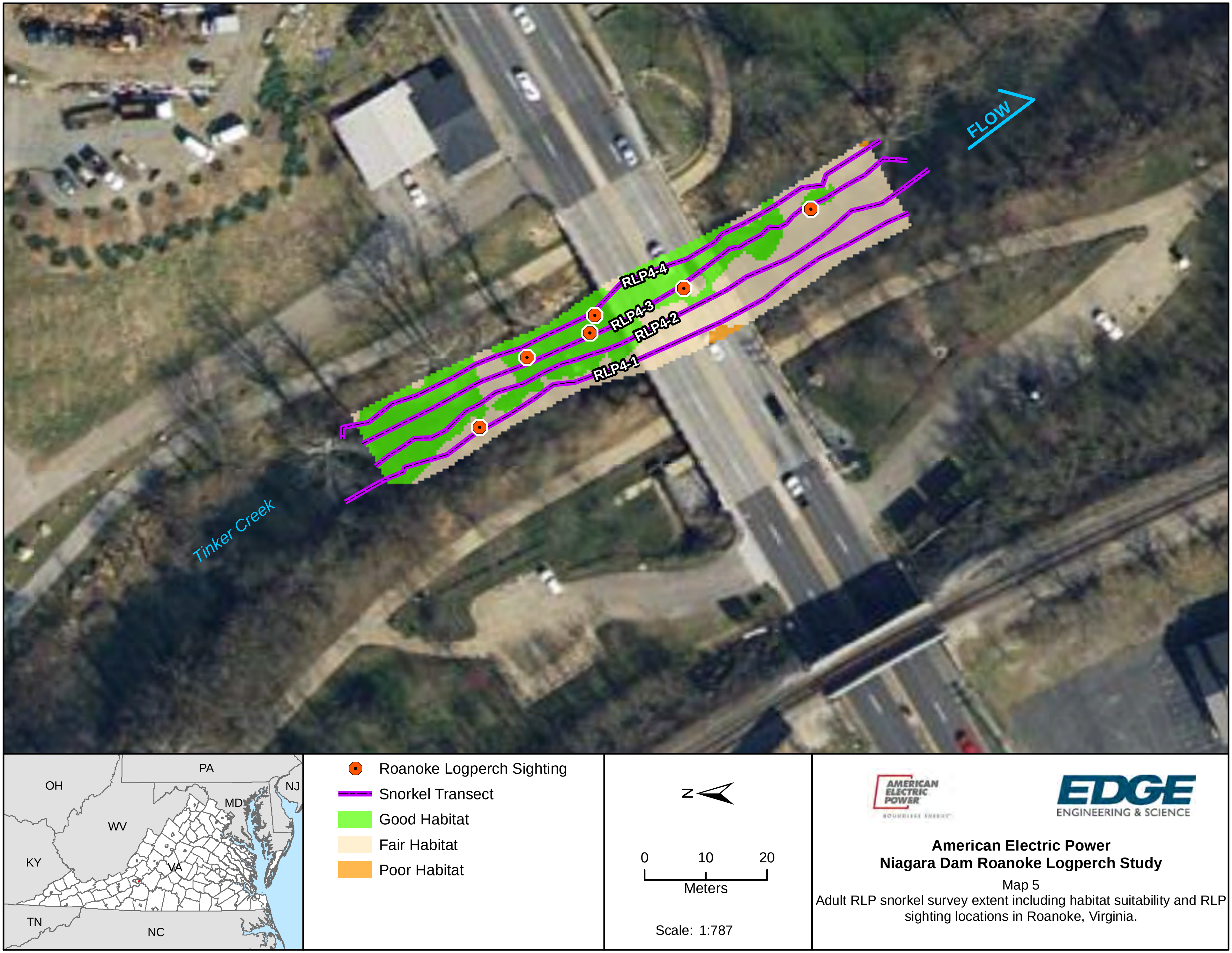

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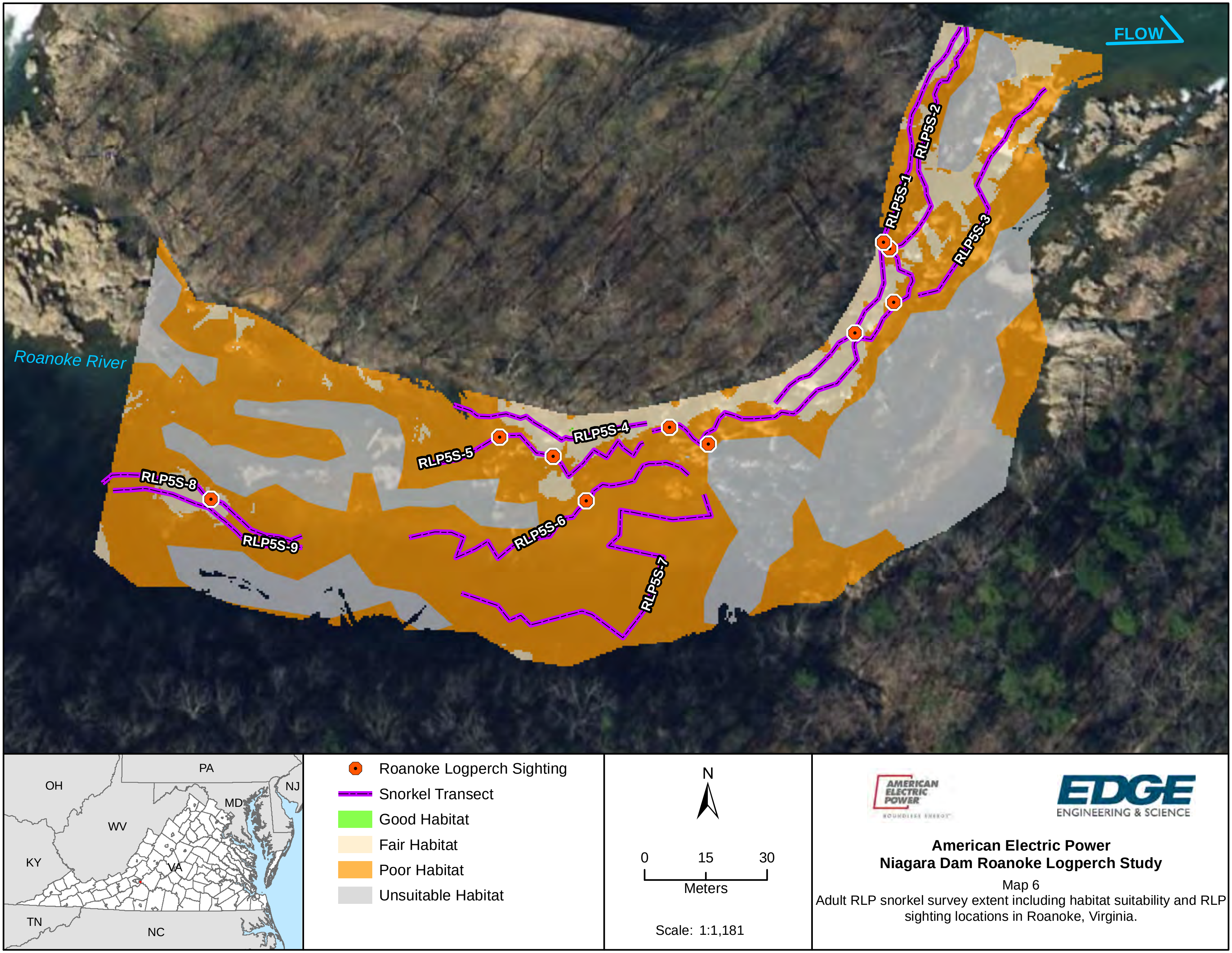

American Electric Power
Niagara Dam Roanoke Logperch Study

Map 6

Adult RLP snorkel survey extent including habitat suitability and RLP sighting locations in Roanoke, Virginia.

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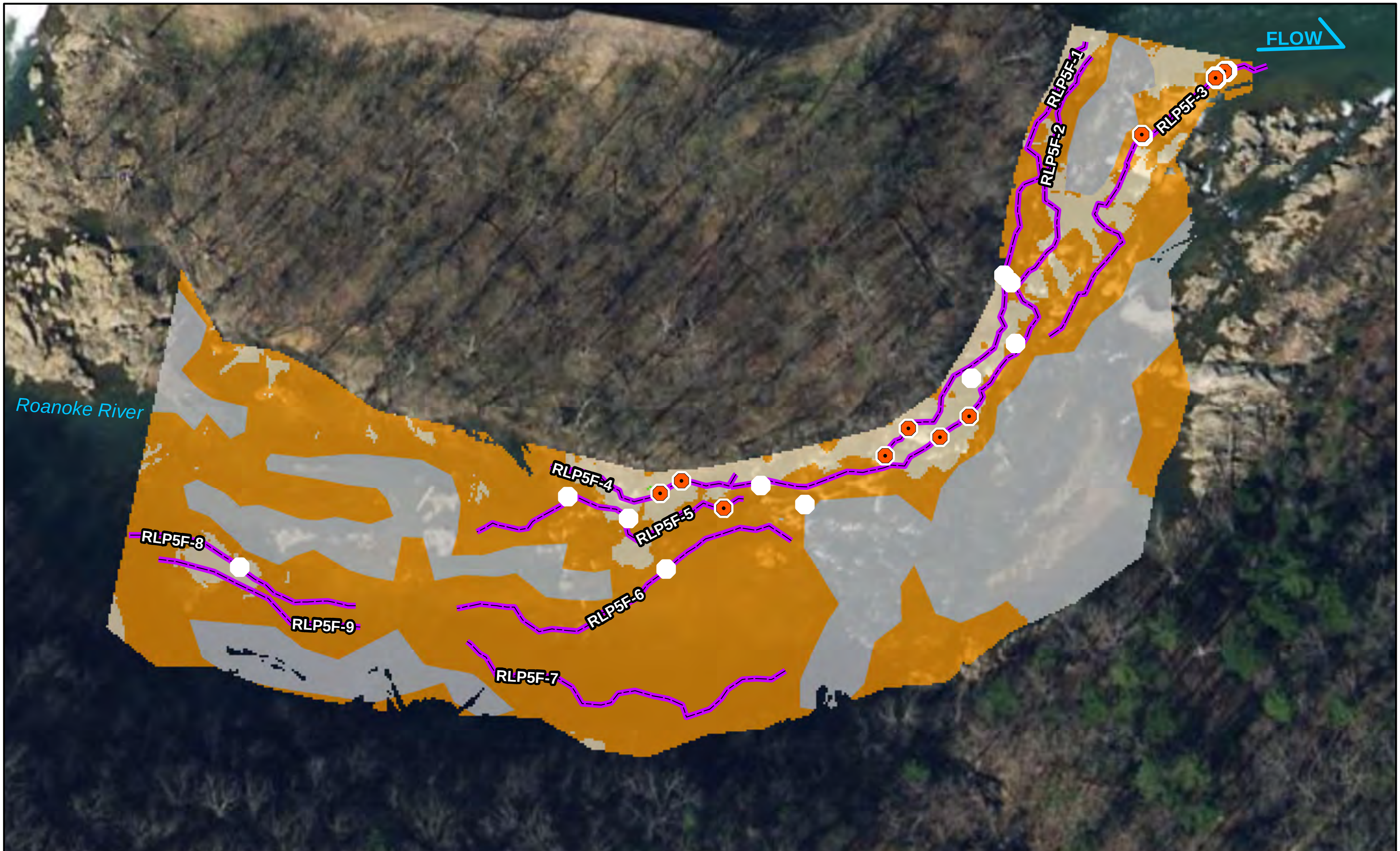

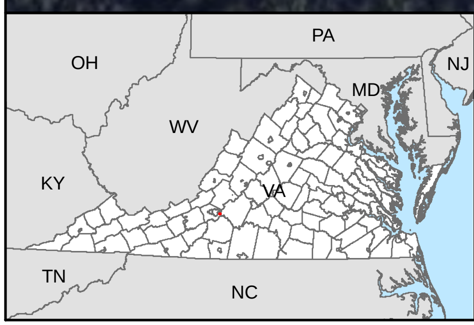

Roanoke Logperch Sighting
Snorkel Transect
Good Habitat
Fair Habitat
Poor Habitat
Unsuitable Habitat

N

0 15 30
Meters

Scale: 1:1,181

AMERICAN ELECTRIC POWER

EDGE ENGINEERING & SCIENCE

American Electric Power
Niagara Dam Roanoke Logperch Study

Map 7
Adult RLP snorkel survey extent including habitat suitability and RLP sighting locations in Roanoke, Virginia.

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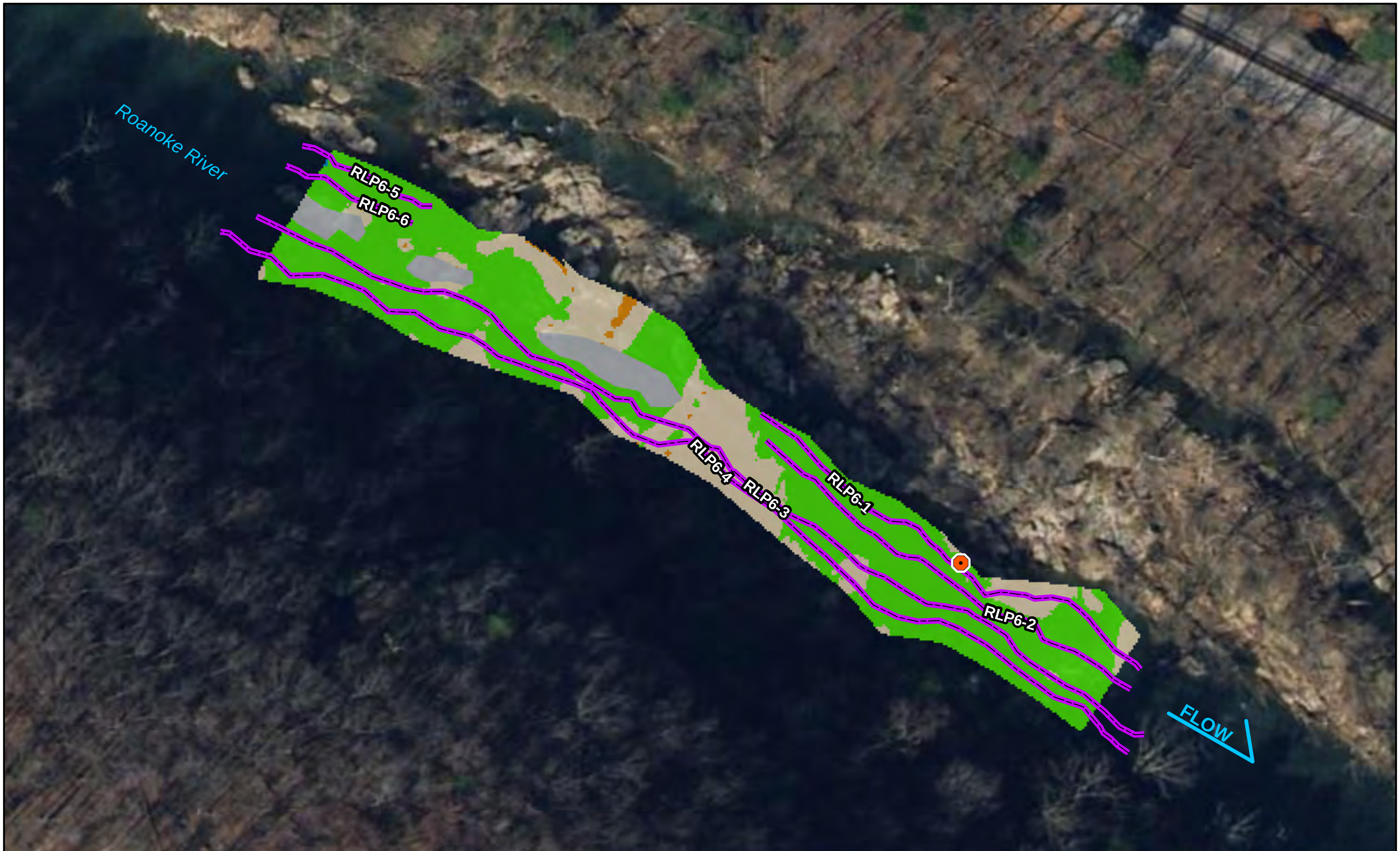

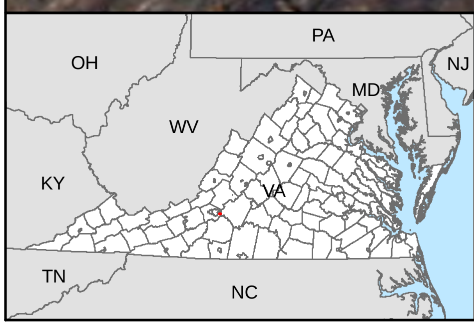

Roanoke Logperch Sighting
Snorkel Transect
Excellent Habitat
Good Habitat
Fair Habitat
Poor Habitat
Unsuitable Habitat

N

0 15 30
Meters

Scale: 1:1,181

AMERICAN ELECTRIC POWER
BOUNDLESS ENERGY

EDGE
ENGINEERING & SCIENCE

American Electric Power
Niagara Dam Roanoke Logperch Study

Map 8
Adult RLP snorkel survey extent including habitat suitability and RLP sighting locations in Roanoke, Virginia.

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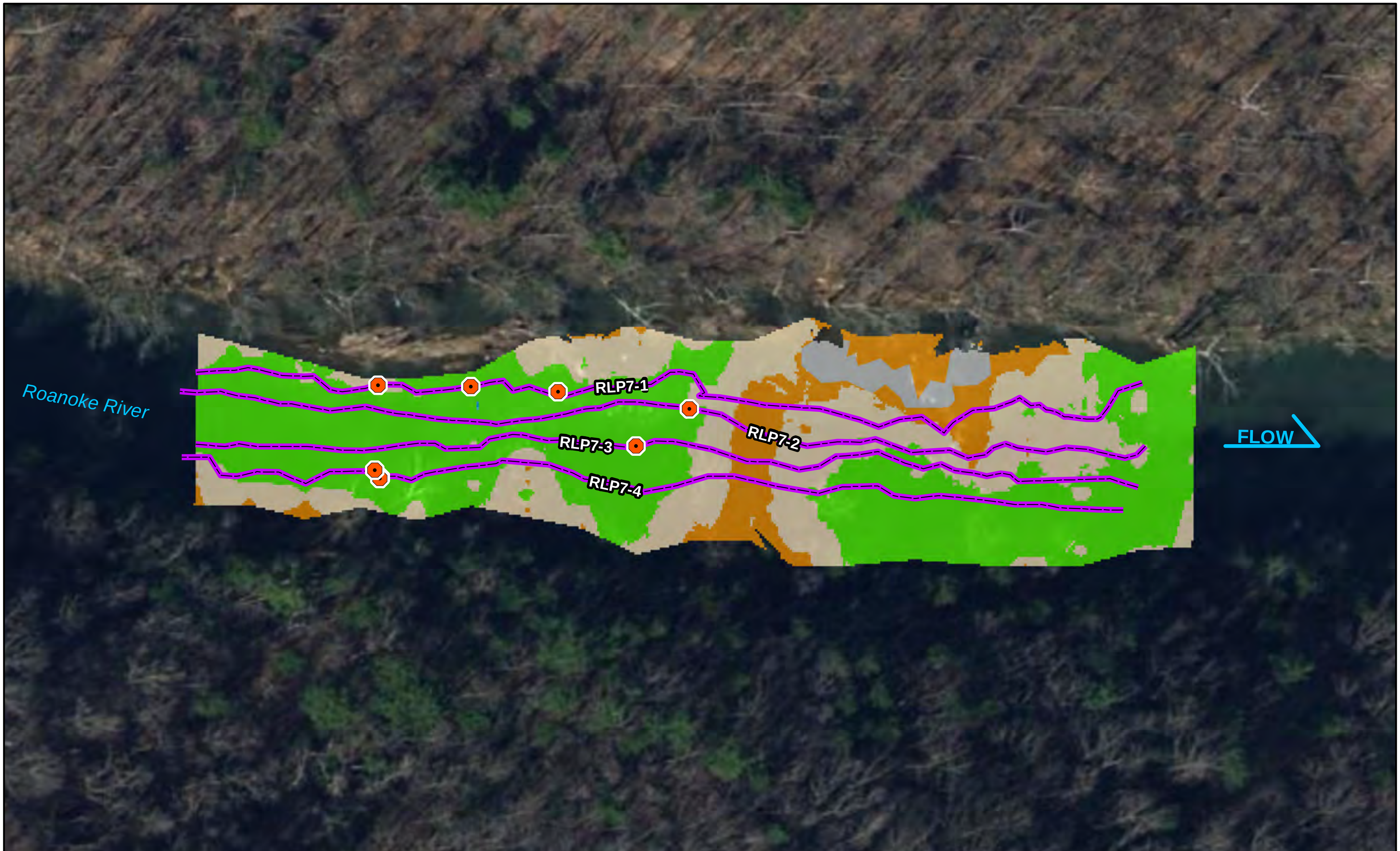

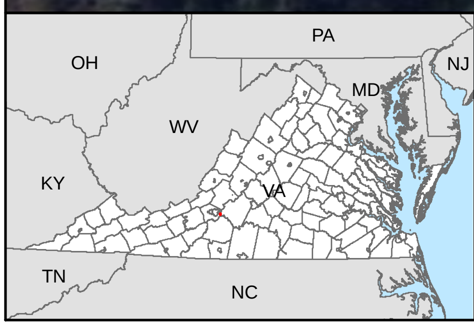

Roanoke Logperch Sighting
Snorkel Transect
Excellent Habitat
Good Habitat
Fair Habitat
Poor Habitat
Unsuitable Habitat

N

0 15 30
Meters

Scale: 1:1,181

AMERICAN ELECTRIC POWER

EDGE ENGINEERING & SCIENCE

American Electric Power
Niagara Dam Roanoke Logperch Study

Map 9
Adult RLP snorkel survey extent including habitat suitability and RLP sighting locations in Roanoke, Virginia.

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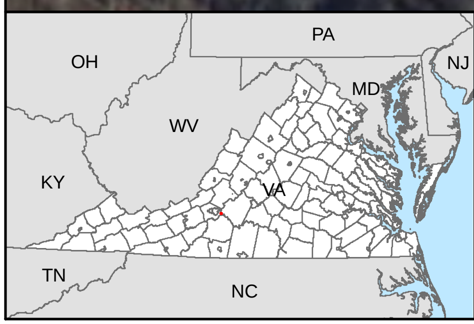

Roanoke Logperch Sighting
Snorkel Transect
Excellent Habitat
Good Habitat
Fair Habitat
Poor Habitat

N

0 10 20
Meters

Scale: 1:787

American Electric Power
Niagara Dam Roanoke Logperch Study

Map 10
Adult RLP snorkel survey extent including habitat suitability and RLP sighting locations in Roanoke, Virginia.

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Legend

Seine Survey

RLP Young-of-Year Sample Location

N

0 15 30
Meters

Scale: 1:1,181

American Electric Power
Niagara Dam Roanoke Logperch Study

Map 11
Young-of-year RLP seine survey extent in Roanoke, Virginia.

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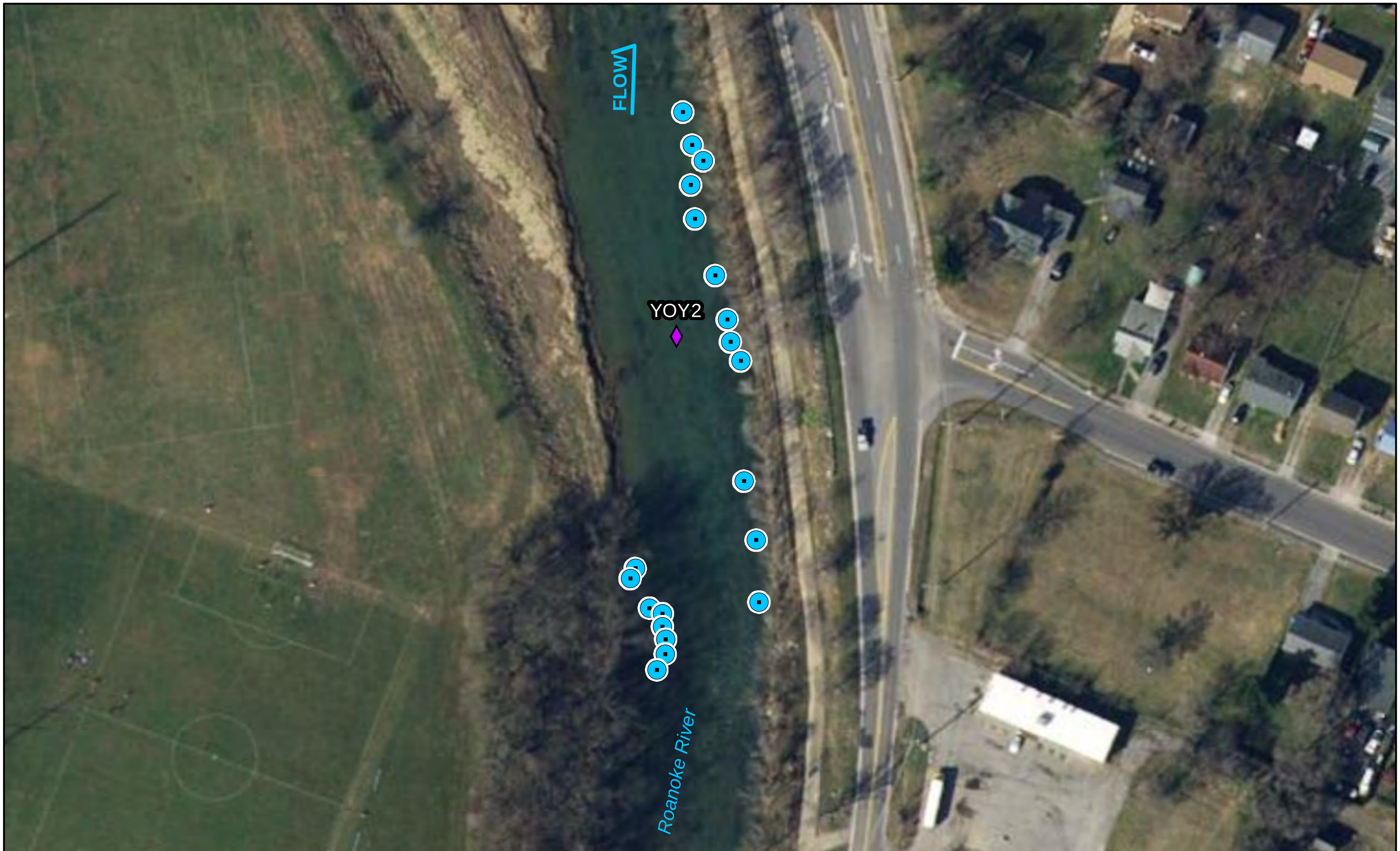

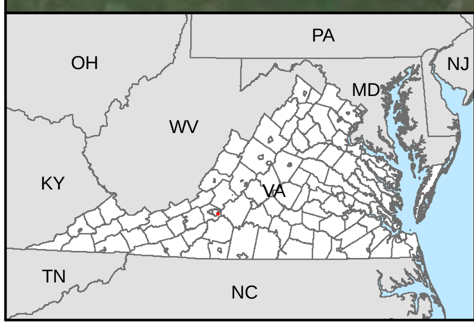

Legend

- Seine Survey
- RLP Young-of-Year Sample Location

N

0 15 30
Meters

Scale: 1:1,181

American Electric Power
Niagara Dam Roanoke Logperch Study
Map 12
Young-of-year RLP seine survey extent in Roanoke, Virginia.

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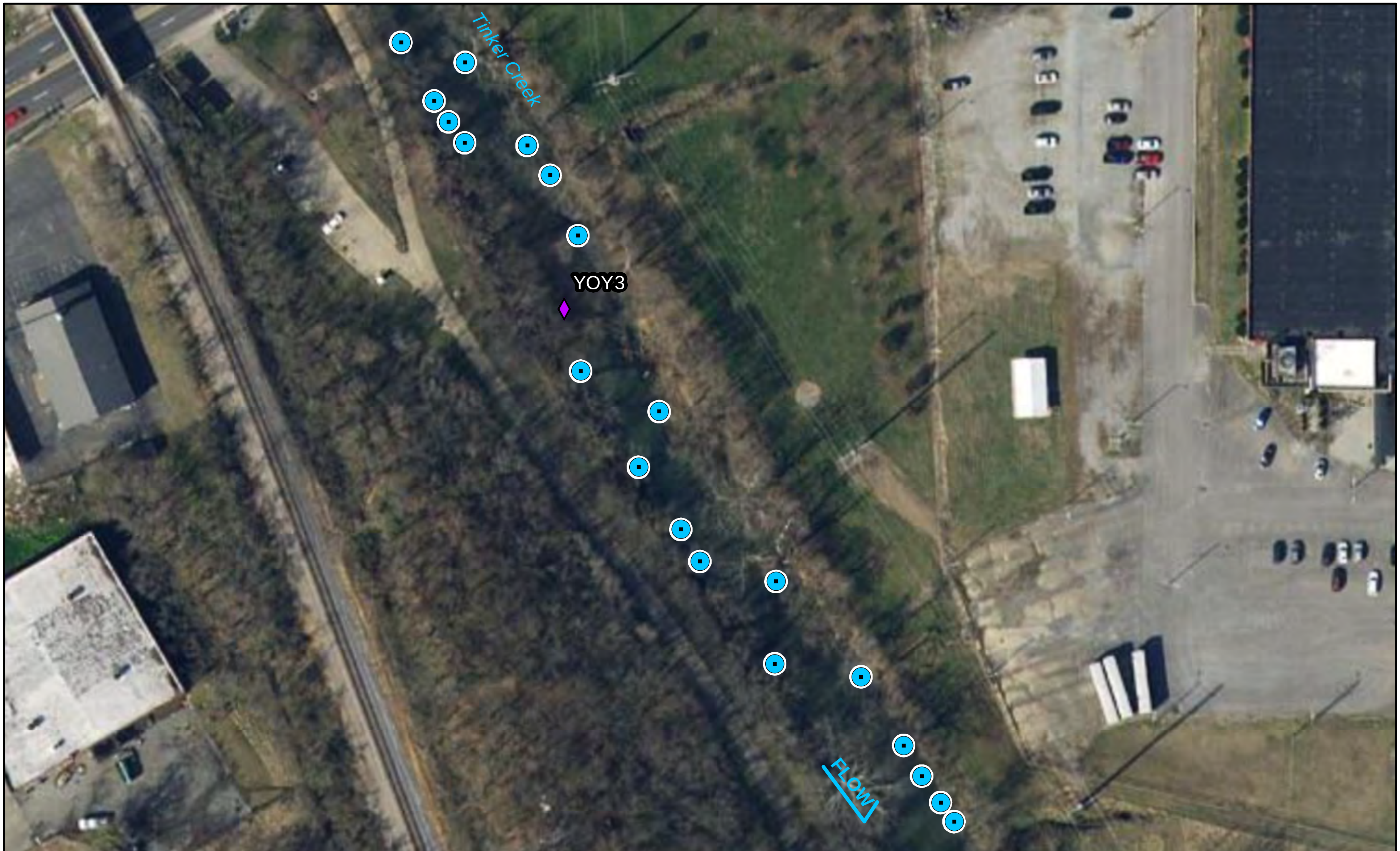

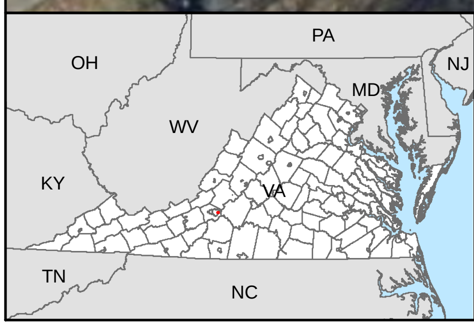

Legend

Seine Survey

RLP Young-of-Year Sample Location

N

0 15 30

Meters

Scale: 1:1,181

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EDGE ENGINEERING & SCIENCE

American Electric Power
Niagara Dam Roanoke Logperch Study

Map 13
Young-of-year RLP seine survey extent in Roanoke, Virginia.

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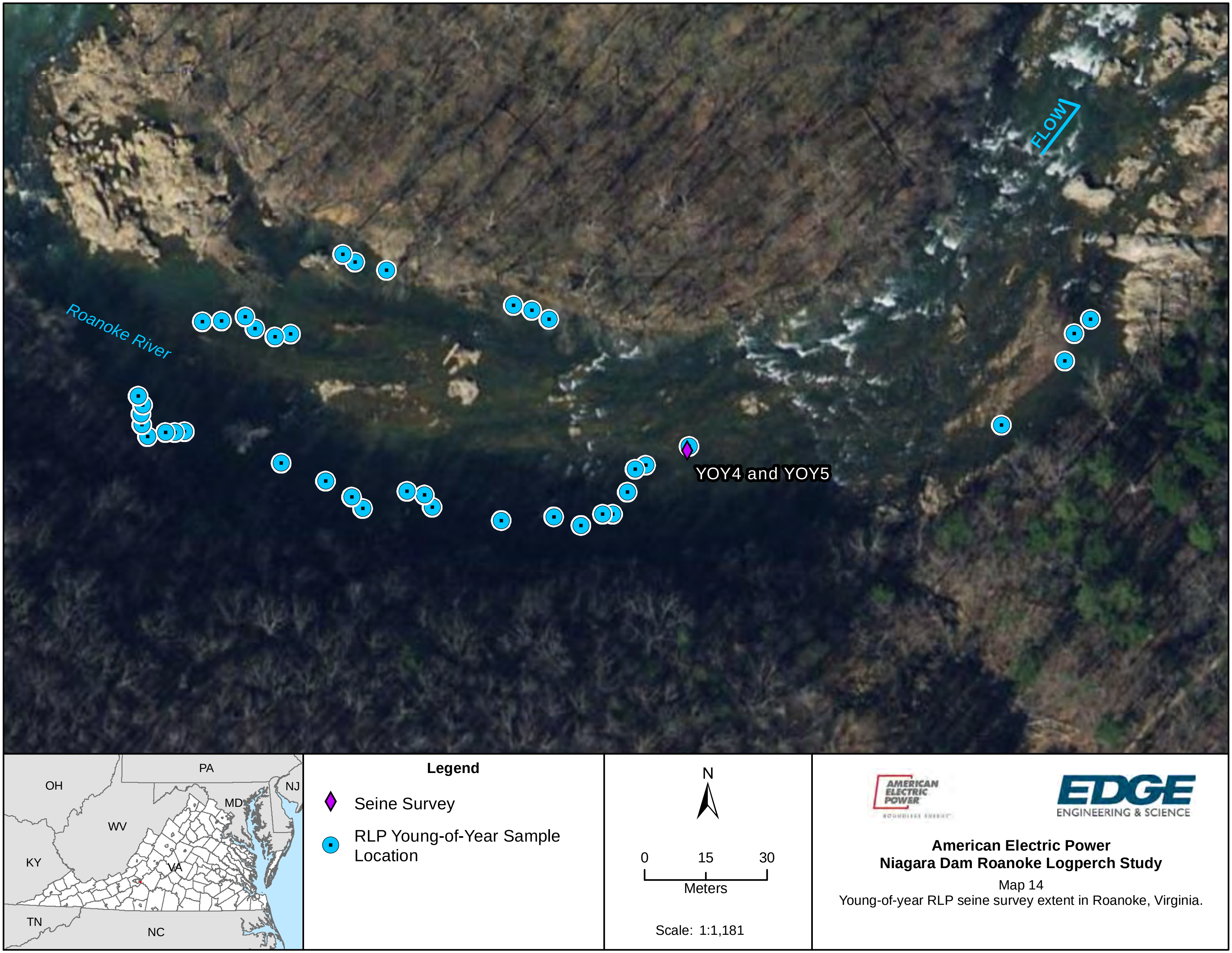

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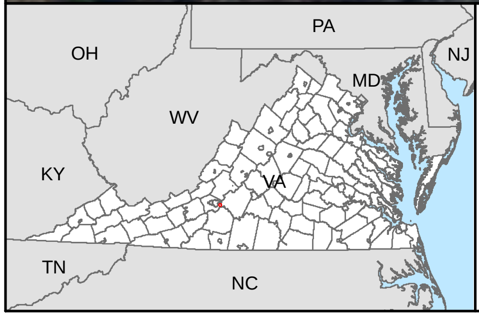

Legend

Seine Survey

RLP Young-of-Year Sample Location

N

0 15 30

Meters

Scale: 1:1,181

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EDGE ENGINEERING & SCIENCE

American Electric Power
Niagara Dam Roanoke Logperch Study

Map 15
Young-of-year RLP seine survey extent in Roanoke, Virginia.

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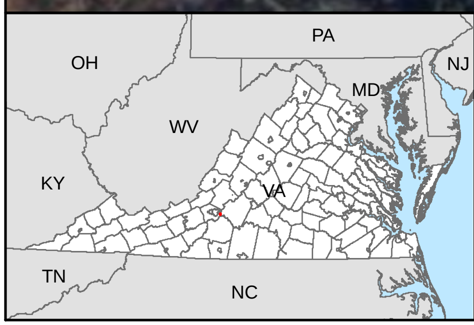


Legend

- Seine Survey
- RLP Young-of-Year Sample Location

N

0 15 30
Meters

Scale: 1:1,181

ENGINEERING & SCIENCE

American Electric Power
Niagara Dam Roanoke Logperch Study

Map 16
Young-of-year RLP seine survey extent in Roanoke, Virginia.

D:\PROJECTS\HDR\HDR2020-0002 Niagara Dam Relicensing\GIS\MXD\RLP_Data\20211109_Sbmtl\HDR2020-0002_RLP_Fig11_16_20211109.mxd

Appendix A

SCIENTIFIC COLLECTION PERMITS

Virginia Department of Game and Inland Fisheries

7870 Villa Park Drive, P.O. Box 90778, Henrico, VA 23228-0778

(804) 367-1000 (V/TDD)

Under Authority of § 29.1-412, § 29.1-417, & § 29.1-568 of the Code of Virginia & DGIF Policy E-1-90

Threatened/Endangered Species Permit

Permit Type: **New** Fee Paid: **$20.00** VADGIF Permit No. **070704**

Permittee: **Jonathan Studio**
Address:

Email:

Office: **(440) 413-4609**
City/County:

Business: **Edge Engineering & Science, LLC**
4005 Ponder Drive
Cincinnati, OH 45245

Niagara Hydroelectric Project (FERC Project No. 2466)

Authorized Collection Methods: By Hand/Dip Nets/Electrofishing/Seine Nets/Snorkel/View Scope/Drift Nets
Authorized Waterbodies: Roanoke River/Tinker Creek
Authorized Marking Techniques: N/A

SPECIAL CONDITION: No electrofishing in Roanoke Logperch TOYR unless requested and approved by both USFWS and DWR.

Permittee MUST notify DWR within the 7 day period prior to each sampling event. Notification must be made via email to: collectionpermits@dwr.virginia.gov

Report Due: 31 January 2022

ANNUAL REPORTS MUST BE SUBMITTED VIA: https://vafwis.dgif.virginia.gov/collection_permits/

STANDARD CONDITIONS ATTACHED APPLY TO THIS PERMIT.

Authorized Counties / Cities:
Roanoke

Authorized Species:

Description	ID Number	Scientific Name
Orangefin Madtom		***Noturus gilberti***
Roanoke Logperch *		***Percina rex***

Authorized Sub-Permittees:

Sarah Messer, Edge Engineering & Science, LLC
David Foltz, Edge Engineering & Science, LLC
Mitchell Kriege, Edge Engineering & Science, LLC
Alyssa Jones, Edge Engineering & Science, LLC

Approved by: Randall T Francis

Title: **Randall T. Francis - Permits Manager** **Date: 3/2/2021**

Applicants may appeal permit decisions within 30 days of issuance. The appeal must be in writing to the Director, Department of Game and Inland Fisheries.

Virginia Department of Game and Inland Fisheries

7870 Villa Park Drive, P.O. Box 90778, Henrico, VA 23228-0778

(804) 367-1000 (V/TDD)

Under Authority of § 29.1-412, § 29.1-417, & § 29.1-568 of the Code of Virginia & DGIF Policy E-1-90

Threatened/Endangered Species Permit

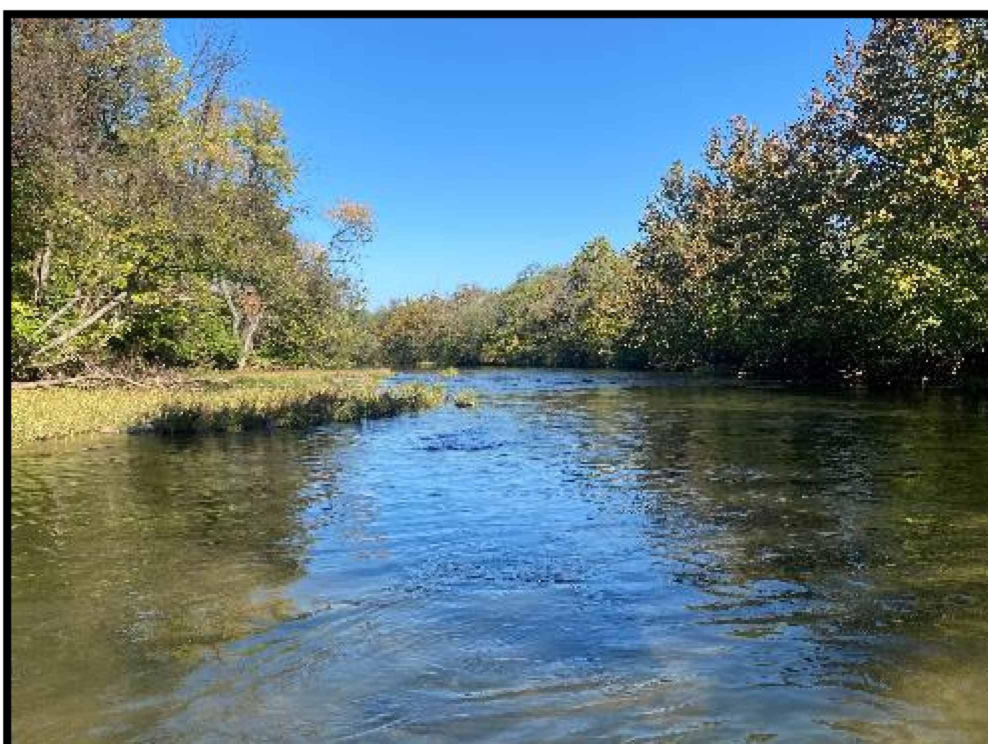
Permit Type:	**New**	Fee Paid:	**$20.00**	VADGIF Permit No.	**070704**

20 Permit Effective **3/2/2021** through **12/31/2021** **21**

Appendix B

REPRESENTATIVE PHOTOGRAPHS

RLP1 - Upstream
Adult Snorkel Survey Site



RLP2 - Downstream
Adult Snorkel Survey Site


RLP3 - Upstream
Adult Snorkel Survey Site


RLP4 - Upstream
Adult Snorkel Survey Site

RLP5 - Upstream
Adult Snorkel Survey Site

RLP6 - Downstream
Adult Snorkel Survey Site

RLP7 - Upstream
Adult Snorkel Survey Site

RLP8 - Upstream
Adult Snorkel Survey Site

Example of Adult RLP Sighting Location

Example of YOY Seine Survey Location

Adult RLP

Juvenile RLP

Group of Six RLP Observed Together

Appendix C

RAW DATA

RLP individuals and the Habitat Suitability Index (HSI) score of their immediate habitat. Upstream Sites (RLP1-3), Tinker Creek (RLP4), Bypass Reach (RLP5), and Downstream Sites (RLP6-8).

Site	Age Class	Depth (cm)	Velocity (cm/s)	Silt (%)	HSI Score	HSI Category
RLP1	Juvenile	51	21.3	1-25	42.2	Fair
RLP1	Juvenile	35	9.1	1-25	23.3	Poor
RLP1	Adult	54	15.2	1-25	42.7	Fair
RLP1	Adult	46	33.5	0	91.9	Excellent
RLP1	Juvenile	32	42.7	0	76.8	Excellent
RLP1	Adult	47	12.2	1-25	38.9	Fair
RLP1	Adult	28	48.8	0	57.6	Good
RLP1	Adult	39	36.6	0	74.0	Good
RLP2	Adult	35	18.3	0	57.3	Good
RLP3	Adult	29	21.3	0	54.6	Good
RLP3	Adult	39	48.8	0	78.5	Excellent
RLP3	Adult	39	42.7	0	69.2	Good
RLP3	Adult	39	42.7	0	75.8	Excellent
RLP3	Adult	58	42.7	0	74.6	Good
RLP3	Adult	48	33.5	0	82.5	Excellent
RLP4	Adult	68	48.8	0	67.1	Good
RLP4	Adult	65	27.4	0	77.3	Excellent
RLP4	Adult	43	33.5	0	85.5	Excellent
RLP4	Adult	36	42.7	0	69.8	Good
RLP4	Adult	62	21.3	0	67.9	Good
RLP4	Adult	53	36.6	0	68.9	Good
RLP5F	Juvenile	38	6.1	1-25	29.3	Fair
RLP5F	Adult	38	6.1	1-25	29.3	Fair
RLP5F	Adult	38	6.1	1-25	29.3	Fair
RLP5F	Adult	38	6.1	1-25	29.3	Fair
RLP5F	Adult	28	12.2	1-25	30.2	Fair
RLP5F	Adult	28	12.2	1-25	30.2	Fair
RLP5F	Adult	28	12.2	1-25	30.2	Fair
RLP5F	Juvenile	36	15.2	1-25	41.6	Fair
RLP5F	Adult	36	15.2	1-25	41.6	Fair
RLP5F	Adult	46	12.2	0	67.8	Good
RLP5F	Adult	51	33.5	0	74.6	Good
RLP5F	Adult	27	15.2	0	43.0	Fair
RLP5F	Juvenile	57	21.3	0	72.6	Good
RLP5F	Adult	37	61.0	0	71.0	Good
RLP5F	Adult	28	6.1	1-25	21.2	Poor
RLP5F	Adult	35	12.2	1-25	40.4	Fair
RLP5S	Adult	26	39.6	0	52.5	Good
RLP5S	Adult	37	21.3	1-25	46.1	Fair
RLP5S	Adult	39	12.2	1-25	40.4	Fair
RLP5S	Adult	47	12.2	0	68.6	Good
RLP5S	Adult	37	21.3	1-25	46.1	Fair
RLP5S	Adult	36	12.2	1-25	38.8	Fair
RLP5S	Juvenile	46	27.4	0	76.5	Excellent
RLP5S	Adult	42	15.2	0	63.9	Good
RLP5S	Adult	30	48.8	0	58.1	Good
RLP5S	Adult	28	27.4	0	52.2	Good
RLP6	Adult	30	18.3	0	44.8	Fair
RLP7	Adult	93	36.6	0	55.9	Good
RLP7	Adult	41	21.3	1-25	54.2	Good
RLP7	Adult	29	70.1	0	45.1	Fair
RLP7	Adult	43	21.3	1-25	52.3	Good
RLP7	Adult	30	15.2	1-25	27.4	Fair
RLP7	Adult	49	12.2	1-25	48.4	Fair
RLP7	Adult	43	27.4	0	81.3	Excellent
RLP8	Adult	45	36.6	1-25	54.2	Good
RLP8	Adult	40	64.0	0	70.9	Good
RLP8	Adult	27	48.8	0	55.1	Good
RLP8	Adult	37	61.0	0	69.9	Good
RLP8	Adult	34	85.3	0	68.4	Good
RLP8	Adult	44	42.7	1-25	60.2	Good

RLP individuals per Habitat Suitability Index (HSI) category and Catch Per Unit Effort (CPUE) and Density per site as number of individuals per hectare. Upstream Sites (RLP1-3), Tinker Creek (RLP4), Bypass Reach (RLP5), and Downstream Sites (RLP6-8).

Site ID	Excellent	Good	Fair	Poor	Total	CPUE	Density
RLP1	2	2	3	1	8	27	33
RLP2	-	1	-	-	1	7	10
RLP3	3	3	-	-	6	31	26
RLP4	2	4	-	-	6	32	32
RLP5S	1	5	4	-	10	36	43
RLP5F	-	4	11	1	16	52	72
RLP6	-	-	1	-	1	3.4	4.6
RLP7	1	3	3	-	7	23	27
RLP8	-	6	-	-	6	37	41
Total	9	28	22	2	61		

Habitat detail for YOY survey sites. Upstream Sites (YOY1-2), Tinker Creek (YOY3), Bypass Reach (YOY4-5), and Downstream Sites (YOY6-7).

Site ID	Avg. Depth (cm)	Avg. Velocity (cm/s)	Bedrock	Boulder	Cobble	Gravel	Sand	Silt
YOY1	22	6.9	0%	3%	26%	21%	43%	7%
YOY2	38	2.3	0%	4%	17%	9%	55%	15%
YOY3	34	5.8	0%	0%	18%	10%	57%	15%
YOY4	27	3.8	17%	8%	8%	8%	53%	6%
YOY5	27	0.6	5%	8%	27%	5%	44%	11%
YOY6	25	7.0	2%	5%	17%	23%	43%	10%
YOY7	22	5.8	6%	5%	29%	20%	32%	8%

Fish species collected by Project area during YOY seine surveys. Upstream Sites (YOY1-2), Tinker Creek (YOY3), Bypass Reach (YOY4-5), and Downstream Sites (YOY6-7).

Common Name	Scientific Name	Upstream Sites	Tinker Creek	Bypass Reach	Downstream Sites
Rock Bass	*Ambloplites rupestris*		X		
Central Stoneroller	*Campostoma anomalum*				X
White Sucker	*Catostomus commersonii*	X	X	X	
Satinfin Shiner	*Cyprinella analostana*			X	X
Spotfin Shiner	*Cyprinella spiloptera*				X
Fantail Darter	*Etheostoma flabellare*	X	X	X	
Johnny Darter	*Etheostoma nigrum*	X	X	X	X
Riverweed Darter	*Etheostoma podostemone*			X	X
Cutlip Minnow	*Exoglossum maxillingua*				X
Northern Hog Sucker	*Hypentelium nigricans*				X
Bluegill	*Lepomis macrochirus*			X	X
Sunfish	*Lepomis sp.*	X		X	X
White Shiner	*Luxilus albeolus*	X	X		
Rosefin Shiner	*Lythrurus ardens*	X	X	X	X
Smallmouth Bass	*Micropterus dolomieu*				X
Largemouth Bass	*Micropterus salmoides*				X
Blacktip Jumprock	*Moxostoma cervinum*	X		X	
Redhorse	*Moxostoma sp.*				X
Chub	*Nocomis sp.*	X			
Spottail Shiner	*Notropis hudsonius*	X	X	X	X
Swallowtail Shiner	*Notropis procne*	X	X	X	X
Shiner	*Notropis sp.*	X	X	X	X
Margined Madtom	*Noturus insignis*				X
Chainback Darter	*Percina nevisense*	X	X		X
Roanoke Darter	*Percina roanoka*	X	X		X
Bluntnose Minnow	*Pimephales notatus*	X	X	X	
Blacknose Dace	*Rhinichthys atratulus*			X	
	Total	14	12	14	19

Attachment 3

Attachment 3 – Fish Impingement and Entrainment Study Report

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Fish Impingement and Entrainment Study Report

Niagara Hydroelectric Project
(FERC No. 2466)

December 6, 2021

Prepared by:

HDR

Prepared for:

Appalachian Power Company

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Contents

Tables

Figures

Appendices

Acronyms and Abbreviations

ADCP	Acoustic Doppler Current Profiler
AEP	American Electric Power
Appalachian or Licensee	Appalachian Power Company
CFR	Code of Federal Regulations
cfs	cubic feet per second
EDGE	EDGE Engineering and Science, LLC
EPRI	Electric Power Research Institute
FERC or Commission	Federal Energy Regulatory Commission
fps	feet per second
ft	feet/foot
hr	hour
ILP	Integrated Licensing Process
ISR	Initial Study Report
m	meter
Project	Niagara Hydroelectric Project
RSP	Revised Study Plan
SPD	Study Plan Determination
TBSA	Turbine Blade Strike Analysis Model
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
USR	Updated Study Report
VDWR	Virginia Department of Wildlife Resources

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1 Project Introduction and Background

1.1 Introduction

Appalachian Power Company (Appalachian or Licensee), a unit of American Electric Power (AEP), is the Licensee, owner, and operator of the run-of-river, 2.4-megawatt Niagara Hydroelectric Project (Project) (Project No. 2466), located on the Roanoke River in Roanoke County, Virginia.

The Project is currently licensed by the Federal Energy Regulatory Commission (FERC or Commission). 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 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 18 CFR §5.11, Appalachian developed a Revised Study Plan (RSP) for the Project that 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).

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 Project 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.

Appalachian has conducted studies in accordance with 18 CFR §5.15, as provided in the RSP and as subsequently modified by FERC. This report describes the methods and results of the Fish Impingement and Entrainment Study conducted to support the preparation of an application for new license for the Project.

The findings described in this report are based on recent, site-specific general fish community data collected from a single fall 2020 sampling season (Attachment 1 of Appendix C to the USR) and Roanoke Logperch survey data (adult and young-of-year only) collected in spring and summer 2021 (Attachment 2 of Appendix C to the USR). A larval drift field study for Roanoke Logperch originally proposed for spring 2020 was subsequently rescheduled for spring 2022 due to the COVID-19 pandemic and delays in receiving the federal recovery permit required to complete the study. As such, the fish community data used to support this study is preliminary and does not include information on larval Roanoke Logperch. The Fish Community Study will be finalized in Summer 2022 after the completion of the Roanoke Logperch larval drift study planned for April through June 2022. Results presented in this desktop fish impingement and entrainment study are considered final and are not likely to change based on the conclusions of the planned 2022 larval drift study; however, this report will be updated should results of the larval drift study indicate revisions are warranted.

1.2 Background

A desktop entrainment study was conducted for the Project during the previous relicensing (Appalachian 1991). Electric Power Research Institute (EPRI) data, project characteristics and operations, as well as the behavioral and life history characteristics of the resident fish in the Roanoke River were used to assess entrainment potential. Appalachian notes that the intake (including trash racks) and generating equipment at the Project have not significantly changed since the time this desktop study was conducted.

Based on behavior, habitat preferences, and life-history characteristics of resident species, the desktop study indicated that the likelihood of substantial numbers of fish occurring in the forebay was expected to be low. The eggs of most species evaluated were adhesive and demersal, or were known to be deposited into nests, sheltered vegetation, or other substrate. Additionally, the larvae of most species would remain on the nest or in sheltered slackwater areas until they become free-swimming. Therefore, the evaluation suggests that only larvae of some of the cyprinids and Gizzard Shad (*Dorosoma cepedianum*) would be expected to enter the current in large numbers and may be susceptible to entrainment (Appalachian 1991).

In general, adult and juvenile fish differ in their susceptibility to entrainment because of differences in movement behaviors, depending on species. For example, taxa such as suckers (family Catostomidae), Flathead Catfish (*Pylodictis olivaris*), and centrarchids are unlikely to enter forebay areas in substantial numbers because of preference for sheltered areas with cover as opposed to deep, open-water habitat. Additionally, the desktop study indicated that these fish display sedentary behavior, except for short spawning migrations which are usually upstream (such as exhibited by suckers) rather than closer (downstream) to the forebay. Gizzard Shad, Common Carp (*Cyprinus carpio*) and shiners (*Cyprinella* spp., *Notropis* spp., etc.), White Catfish (*Ameiurus catus*), channel catfish (*Ictalurus punctatus*), bullheads (*Ameiurus* spp.), and Black Crappie (*Pomoxis nigromaculatus*) were determined to be more likely to be found in the forebay areas because of their greater mobility associated with feeding (Appalachian 1991).

The calculated intake velocities at upper and lower normal forebay operating elevations at the Project ranged from 0.9 to 1.2 feet (ft) per second (fps), which is similar to the present-day velocity of the free-flowing portion of the Roanoke River. Therefore, the intake velocities would be easily managed by most fish (Appalachian 1991).

In the event a fish enters the turbine, turbine passage effects are primarily restricted to contact with runner blades. The historical desktop assessment of the probability of contact for juvenile fish (with higher likelihood of entrainment than adult fish) was estimated to be less than 10 percent, with a subset of those individuals suffering mortality (Appalachian 1991). Pressure changes and barotrauma , cavitation, turbulence, and shear were not expected to be likely causes of substantial harm to fish at the Project. Due to low head and slow runner speed, blade contact was estimated to be minimal, and barotrauma or mortality would not exceed 10 percent. The study concluded impacts from turbine passage on fish populations in the vicinity of the Project were negligible.

Given this context and background, the Fish Impingement and Entrainment Study focused on reexamining and updating (as applicable) the prior evaluation of entrainment potential and turbine passage at the Project during operation.

2 Study Goals and Objectives

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 Project intake structure and examine entrainment potential at the Project. The study objectives are to:

- Confirm flow velocities at and near the Project intake 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 2020). 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.

3 Study Area

The study area for the Impingement and Entrainment Study includes the lower reach of the impoundment of the Roanoke River and the intake structure at the Project, as shown on Figure 3-1.

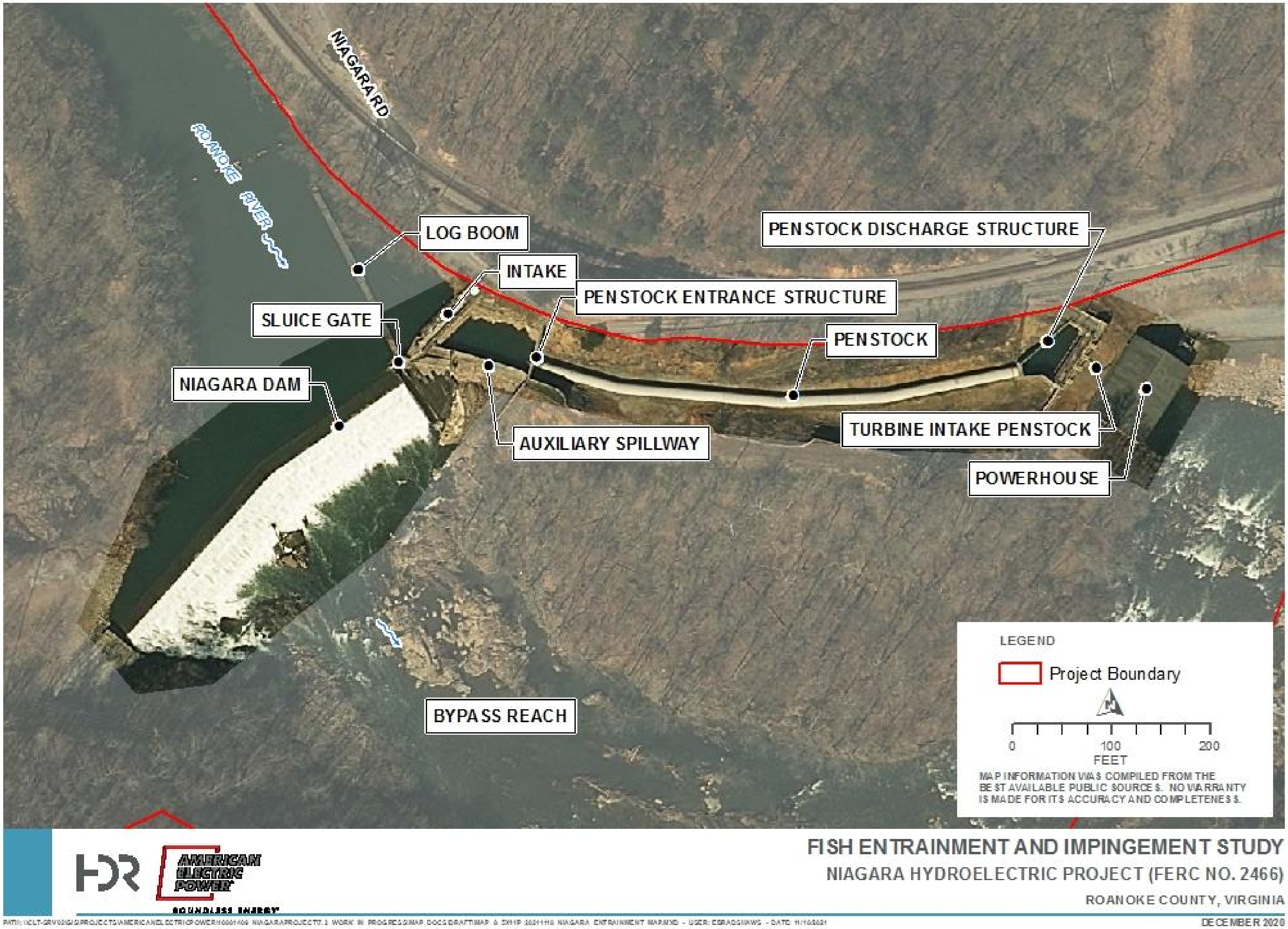

Figure 3-1. Fish Impingement and Entrainment Evaluation Study Area

4 Methodology

4.1 Intake Structure, Velocities, and Turbine Characteristics

Per the Project RSP and Commission's SPD, intake velocities were to be measured using an acoustic Doppler current profiler (ADCP) along the upstream face of the angled trash racks to determine the approximate approach velocity immediately upstream of the intake structure. However, during the 2020 field season, a combination of high flow events and inoperable units prevented field data collection efforts. As a result, approach velocity was calculated using the intake structure and trash rack dimensions along with the design maximum flow capacity of the existing generating units.

4.2 Desktop Review of Impingement and Entrainment Potential

The potential for fish to become entrained or impinged at a hydroelectric facility is dependent on a variety of factors such as fish life history, size and swimming ability, water quality, operating regimes, inflow, and intake/turbine configurations (Cada et al. 1997). Impingement occurs when a fish is held against or entrapped on the exterior intake structure screen (i.e., trash racks) due to forces created by the intake velocities. Entrainment occurs when the fish passes through the trash racks and is withdrawn into the intake structure.

The potential for fish entrainment is variable throughout a given year depending on species periodicity, life stage and body size, and project-specific operations. Early life stage and smaller-sized fish may be more abundant during certain portions of the year, thus increasing their susceptibility to entrainment. In addition, diurnal and seasonal movements of both small and large fish may bring them in close proximity to intake structures. Physical and operational characteristics of a given project, including trash rack bar spacing, intake velocities, intake depth, waterbody stratification, and intake proximity to feeding and rearing habitats also affect the potential for a fish to become entrained. These factors were used to make general assessments of entrainment and impingement potential at the Project using a desktop study approach.

A targeted species list was developed based on recent (Appalachian 2021) and historical (Appalachian 1991) fish community studies, as well as a species list developed by the former Virginia Department of Game and Inland Fisheries, recently renamed the Virginia Department of Wildlife Resources (VDWR), for the Roanoke River at the time of the historical fish community study (Appalachian 1991). The list includes consideration of fish community composition and abundance of the Roanoke River and any other species of interest due to state and/or federal protections, or with angler significance. Selected species were evaluated for potential of entrainment and impingement based on swim speed, behavior, habitat preferences, life stages, and seasonal or temperature-dependent behavioral changes in relation to Project design and operations.

4.2.1 Intake Avoidance and Impingement Risk

Impingement risk and intake avoidance at the Project were evaluated based on the 3.625-inch clear spacing at the Project by comparing fish swim speeds with calculated intake approach velocities, as well as estimating minimum fish lengths that would be excluded or impinged by the trash racks for each of the target fish species. A scaling factor relating fish length to body width was used for the impingement assessment to determine the minimum sizes of the target fish species that would physically be excluded or impinged on the trash racks (Smith 1985).

4.2.2 Fish Entrainment Potential

4.2.2.1 Fish Entrainment Rate Calculation

A database developed by EPRI (1997) provides detailed results of fish entrainment studies from 43 hydroelectric projects. This database was designed specifically to facilitate the desktop analysis of available data to assess entrainment and impingement impacts at a hydroelectric facility.

Although some facilities included in the EPRI database may not match the exact specifications of the developments at the Project, using as many data points as possible from the EPRI database allows the analysis to account for the natural variability of aquatic ecosystems and fish populations, while providing a robust dataset for calculating average monthly entrainment rates for a wide range of species. This is a commonly applied approach in desktop entrainment evaluations and has been readily accepted by FERC in relicensing efforts for other Projects.

Site characteristics (i.e., reservoir size, usable storage, plant capacity, operating mode, average velocity at trash racks, trash rack spacing) and available data (i.e., entrainment data, collection efficiency) were reviewed for applicability to the Project using the (EPRI 1997) database. Entrainment data from five facilities were eliminated for having trash rack clear bar spacing that was considerably wider (e.g., double the clear spacing) than specifications at the Project. Therefore, data from 33 facilities were retained for use in this analysis with the understanding that entrainment rates developed for the Project would be conservative (i.e., overestimated) since some fish species may be excluded by the trash racks at the Project, which have a narrower open bar spacing than many of the facilities in the EPRI database (see Appendix A).

The EPRI (1997) entrainment database provides results from field studies conducted at hydroelectric facilities using full-flow tailrace netting. This involves the placement of a conical net in the immediate tailrace to collect the entire discharge on a seasonal or monthly basis. This results in the calculation of entrainment rates (fish/volume of water if recorded, or fish/hour (hr)/cubic feet per second [cfs] of sampled unit capacity), including the number, species, and size of entrained fish.

The studies included in the EPRI (1997) database recorded number of hours sampled and hydraulic capacity of the sampled units. Using this information, data was standardized to the number of fish/hr of unit capacity, and then used to calculate fish entrainment rates (fish/hr) at maximum design turbine discharge at the Project (684 cfs). Entrainment rates were calculated and summarized by season (winter = December, January, and February; spring = March, April, and May; summer = June, July, and August; and fall = September, October, and November) and annually.

4.2.2.2 Qualitative Turbine Entrainment Risk

While the use of the EPRI database provides a means to quantitatively estimate entrainment risk at the Project at multiple time scales (i.e, month, season, year) based on empirical data collected at comparable hydroelectric projects; it is important to note that the resultant entrainment rate estimates do not consider the other site-specific factors likely to influence species-specific entrainment risk at the Project. Various comprehensive reviews of entrainment and mortality data (FERC 1995) as well as fish behavior relative to turbine passage (Coutant and Whitney 2000) suggest that one or more factors may influence the risk of turbine entrainment or mortality.

Therefore, an additional traits-based qualitative assessment modified from Cada and Schweizer (2012) of entrainment risk at the Project was performed that ranks entrainment risk as low, moderate, or high based upon break points in relative entrainment risk. The overall risk categories are defined as:

- Low: species-life stage is generally not present in the forebay; utilizes shallow, shoreline habitats away from the intake structures; and/or not susceptible to approach intake velocities
- Moderate: species-life stage may routinely or seasonally occupy the forebay or utilize habitats near the intake structures; and some life stages/ages may be susceptible to intake velocities
- High: pelagic species that reside or spawn in or near the forebay and intake structures and are susceptible to intake velocities, species with life stages that are expected to reside in the forebay or encounter intake structures during seasonal activities, and species-life stages that broadcast spawn buoyant eggs in open waters in lake or reservoir habitats

These qualitative risk categories were utilized to describe entrainment potential of the target fish species on a monthly basis. A matrix of monthly Project entrainment risk for the target species was constructed using the empirical seasonal entrainment rates estimated from the EPRI database using maximum turbine discharge frequency (full generation), swim burst speed comparison to intake velocities, size exclusion by trash racks, species periodicity, abundance, habitat utilization, migratory behavior, and expected distributions.

4.2.2.3 Turbine Blade Strike and Spillway Survival Assessment

The turbine blade strike evaluation used the most recent version of the Turbine Blade Strike Analysis (TBSA) Model created by the USFWS (2020), which 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, as well as through non-turbine routes. The TBSA tool allows for the estimation of turbine passage and survival based on mortality from blade strikes based on 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 as summarized in Table 4-1 were used in the TBSA model. The two scenarios that were evaluated were:

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: 2, 4, 6, 8, 10, 15, 20, 25, and 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).

Table 4-1. Unit Turbine Characteristics at Niagara Hydroelectric Project

Term	Description	Niagara Units[1]	
		Unit 1	Unit 2
Blades	Number of blades on the turbine runner	14	15
Type	Francis, Kaplan, propeller, or bypass	Vertical shaft Francis	Vertical shaft Francis
Net Head (ft)	Net head on the turbine; headwater to tailwater, less head loss through system	58.12	55.08
Runner Diameter at Discharge (ft)	Diameter at the outlet of the runner (typ. before the draft tube; see Figure 4.3.2-3 in Franke et al., 1997)	4.17	4.76
Runner Dia. at Inlet (ft)	Diameter at the intake of the runner (typ. beyond the guide vanes; see Figure 4.3.2-3 in Franke et al., 1997)	4.09	4.667
Runner Diameter (ft)	Nominal diameter of runner; maximum radius is assumed to be 1/2 of diameter	3.36	3.00
Runner Height (ft)	Runner height at inlet (see Figure 4.3.2-3 in Franke et al., 1997 for clarification)	1.75	1.803
Speed (rpm)	Runner revolutions per minute (model automatically converts to radians per second)	277	277

Term	Description	Niagara Units[1]	
		Unit 1	Unit 2
Swirl Coefficient	Ratio between Q with no exit swirl and Q_{OPT} (recommended x=1.1 for Francis turbines)	1.1	1.1
Turbine Discharge (cfs)	Turbine discharge	379	305
Turbine Efficiency	Ratio of output shaft power to input fluid power; typ. from vendor curves or index testing	86%	85%
Turbine Discharge (cfs)	Turbine discharge at optimal efficiency	326	280
Discharge at Optimal Efficiency	Ration of turbine discharge at best efficiency to hydraulic capacity	86.02%	91.80%
Model Routes	Unit 1, Unit 2, spillway/bypass channel		
Bypass/Spillway Mortality	Estimated as 3%[2]		

[1]Niagara Units 1 and 2 operate in run-of-river mode.
[2] Based on Amaral et al. 2013.

5 Study Results

5.1 Intake Structure Characteristics

Pursuant to the SPD, the key physical characteristics, operational information, and intake velocities associated with the Project intake structure were compiled from Project drawings, field data, and hydraulic calculations.

5.1.1 Intake Specifications

The intake structure at the Project (also referred to as the “upper intake”) is located immediately to the north of the main dam and downstream of the log boom (see Figure 3-1). Flow to the penstock is controlled by five inlets equipped with steel head gates, each 6.4-ft wide by 8.25-ft high. Steel trash racks with 3.625-inch clear bar spacing are inclined upstream of the head gates (Figure 5-1). An automated trash rake system (known as a “drag rake”) is utilized to clean the trash racks and prevent sediment and debris buildup in front of the intake (Appalachian 1991).

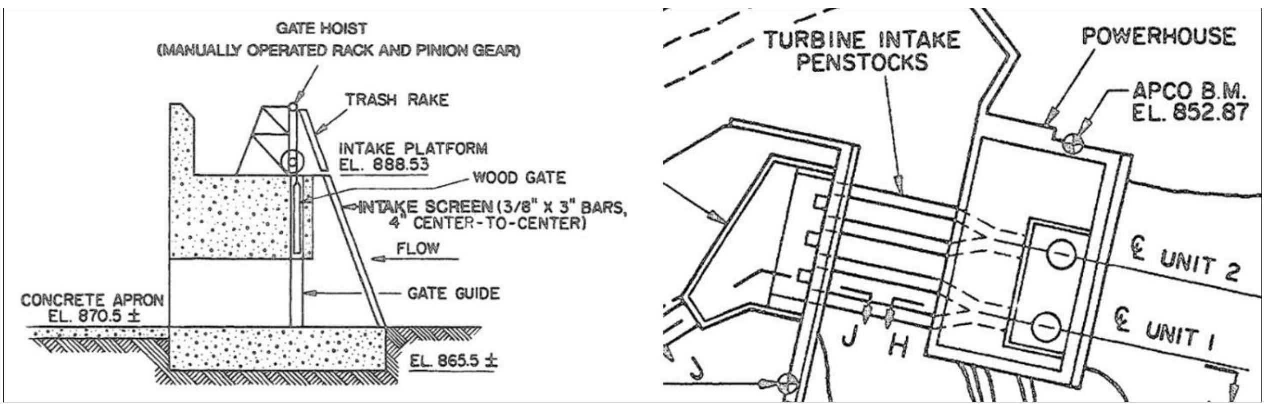

Figure 5-1. Intake Drawings of the Niagara Hydroelectric Project

A logboom consisting of interconnected floating platforms is used to direct larger floating objects away from the intake screens. The logboom 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.

5.1.2 Intake Flows

The design maximum flow capacity of the two generating units is 379 cfs for Unit 1 and 305 cfs for Unit 2, for a total plant capacity of 684 cfs. An evaluation of U.S. Geological Survey (USGS) gage data (USGS 02056000 Roanoke River at Niagara) from January 1990 to October 2020 showed that river flows exceeded total plant capacity an average of 3 months per year (Figure 5-2), indicating that the Project could theoretically operate at maximum turbine discharge approximately 29 percent of the time (particularly during the higher flow months of February, March, and April).

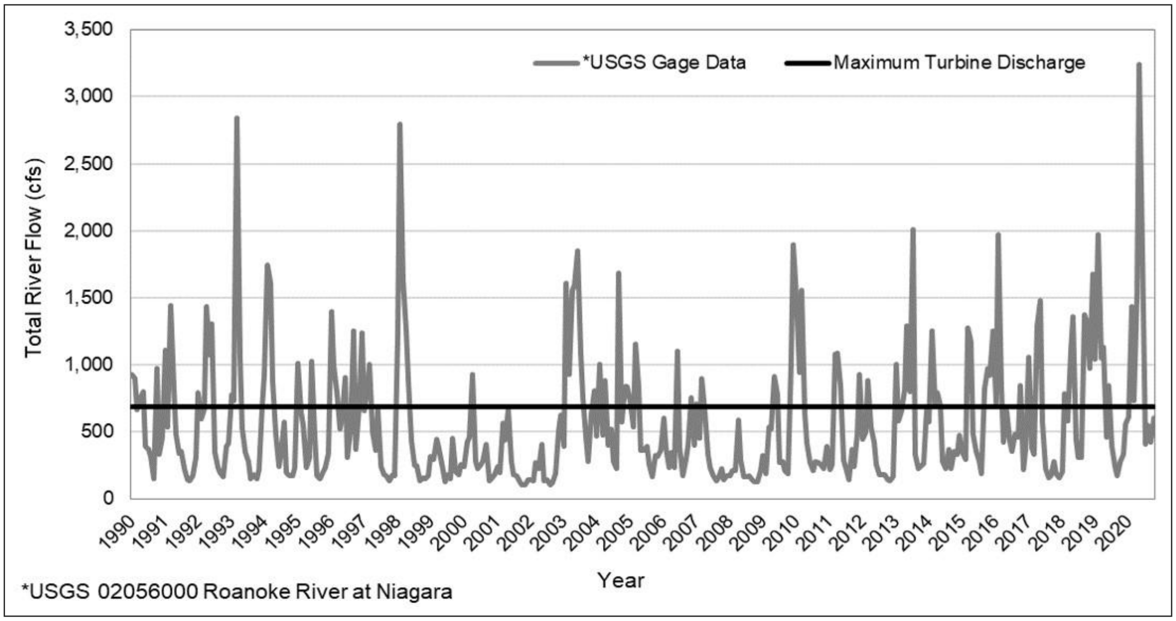

Figure 5-2. U.S. Geological Survey (USGS) Gage Data versus Maximum Turbine Discharge (684 cfs) at Niagara Hydroelectric Project

5.1.3 Intake Velocities

Using intake opening structure dimensions of 40-ft wide and 15.4-ft high[1], the calculated approach velocity in front of the intake is approximately 1.1 fps (i.e., 40 ft x 15.4 ft / 684 cfs). This approach velocity is similar to those presented in the historical entrainment report (Appalachian 1991).

A desktop evaluation using Roanoke River morphometrics and flow data from the nearest upstream gage (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 are able to navigate intake flows similar to normal river conditions.

5.2 Desktop Review of Impingement and Entrainment Potential

5.2.1 Fish Community and Target Species

A Fish Community Study was performed by EDGE Engineering and Science, LLC (EDGE) at the Project that consisted of a survey of the general fish community during the fall of 2020 and life stage-specific surveys for Roanoke Logperch in spring (adult and young-of-year in the bypass reach) and summer 2021 (adult and young-of-year throughout Project boundary). The locations sampled during the 2020 Fish Community Study are provided in Figure 5-3, which is also presented in Attachment 1 of Appendix to the USR. An assessment of larval Roanoke Logperch distribution and drift was scheduled for spring 2020 but was later rescheduled for spring 2022 in response to the COVID-19

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[1] The top of the normal reservoir operating band is 884.4 ft NGVD. At this reservoir level, the depth in front of the intake structure is approximately 13.9 ft. The trash racks are angled at a 15-degree slope from top to bottom, therefore wetted height of the trash racks is approximately 15.4 ft.

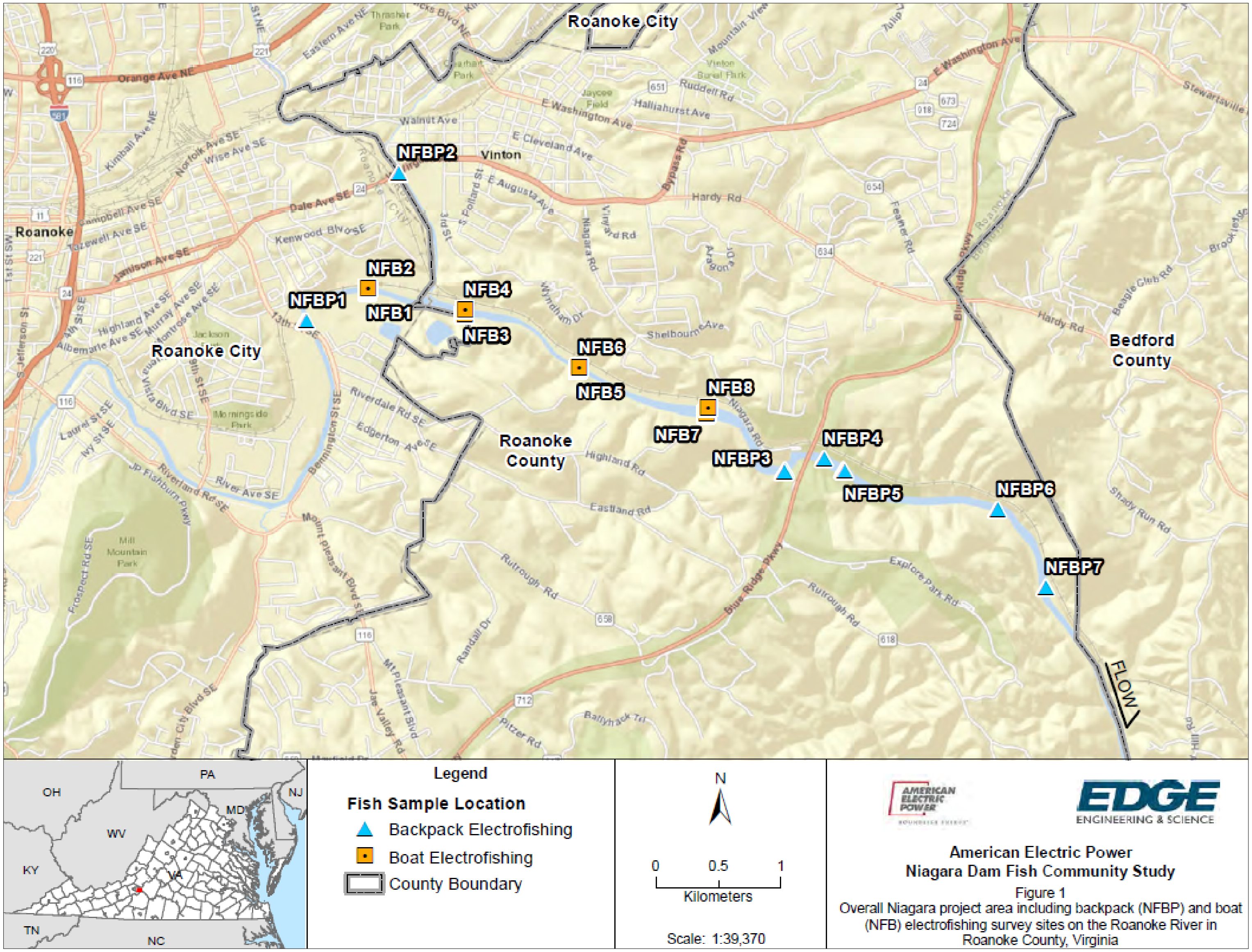


Figure 5-3. Backpack and Boat Electrofishing Sites Sampled during the 2020 Fish Community Study at Niagara Hydroelectric Dam

pandemic and delays in received the federal recovery permit needed to complete the field sampling effort. The goal of the Fish Community Study was to characterize the Roanoke River fishery in the vicinity of the Project. Details of the methods and results of the study are included in the Fish Community Study Report (Appalachian 2021) (Appendix C, Attachment 1 of this USR).

5.2.1.1 General Fish Community Results

A total of 15 sites were sampled for the Fish Community Study, including seven wadeable (i.e., backpack electrofishing) sites and eight non-wadeable (i.e., boat electrofishing) sites. For non-wadeable sites, the reservoir upstream of Niagara Dam was divided into three study reaches: Upper (sites NFB3, and NFB4), Middle (NFB5 and NFB6), and Lower reaches (sites NFB7 and NFB8). Two additional boat electrofishing transects were located in the Roanoke River upstream of its confluence with Tinker Creek (sites NFB1 and NFB2) but no fish were collected from those sites. Within each reach, two parallel 100-meter (m) transects were established along the shoreline (one on each side of the reservoir in representative habitat) for a total of eight, 100-m transects.

Three wadeable electrofishing locations were sampled above the dam: one at the 13th Street Bridge above the Roanoke River confluence with Tinker Creek, one located in Tinker Creek, and one located in the Niagara forebay. The remaining four locations were located downstream of the dam, including one in the bypass reach. A summary of the number and relative abundance of fish species collected by boat and backpack electrofishing are presented in Table 5-1 and Table 5-2, respectively.

Table 5-1. Number and Relative Abundance by Fish Species Collected from Non-wadeable (Boat) Electrofishing Sites in the Niagara Hydroelectric Project 2020 Fish Community Study

Common Name	Scientific Name	Impoundment Reach					
		Upper[1]		Middle[2]		Lower[3]	
		No.	RA[4] (%)	No.	RA[4] (%)	No.	RA[4] (%)
Bluegill	*Lepomis macrochirus*	1	4.8	6	33.3	4	15.4
Bluntnose Minnow	*Pimephales notatus*	--	--	--	--	3	11.5
Golden Redhorse	*Moxostoma erythrurum*	9	42.9	2	11.1	1	3.8
Largemouth Bass	*Micropterus salmoides*	2	9.5	2	11.1	2	7.7
Lepomis Sunfish	*Lepomis* spp.	2	9.5	1	5.6	--	--
Redbreast Sunfish	*Lepomis auritus*	4	19	6	33.3	16	61.5
Redear Sunfish	*Lepomis microlophus*	--	--	1	5.6	--	--
Smallmouth Bass	*Micropterus dolomieu*	1	4.8	--	--	--	--
V-lip Redhorse	*Moxostoma pappillosum*	1	4.8	--	--	--	--
White Sucker	*Catostomus commersonii*	1	4.8	--	--	--	--
	Total	**21**	**100**	**18**	**100**	**26**	**100**

1) Represents the combined results of sites NFB3 and NFB4.
2) Represents the combined results of sites NFB5 and NFB6.
3) Represents the combined results of sites NFB7 and NFB8.
4) Relative Abundance (RA)

Table 5-2. Number and Relative Abundance by Fish Species Collected from Wadeable (Backpack) Electrofishing Sites in the Niagara Hydroelectric Project 2020 Fish Community Study

Common Name	Scientific Name	Roanoke River at the 13th Street Bridge[1]		Tinker Creek[2]		Niagara Forebay[3]		Downstream of Niagara Dam[4]	
		N	RA[5] (%)	N	RA[5] (%)	N	RA[5] (%)	N	RA[5] (%)
Blacknose Dace	*Rhinichthys atratulus*	1	0.9	--	--	--	--	1	0.4
Blacktip Jumprock	*Moxostoma cervinum*	--	--	--	--	1	1.0	28	9.9
Bluegill	*Lepomis macrochirus*	--	--	3	8.6	--	--	1	0.4
Bluntnose Minnow	*Pimephales notatus*	--	--	1	2.9	--	--	--	--
Bull Chub	*Nocomis raneyi*	4	3.7	--	--	--	--	--	--
Central Stoneroller	*Campostoma anomalum*	5	4.6	--	--	55	56.1	84	29.7
Chainback Darter	*Percina nevisense*	--	--	2	5.7	--	--	--	--
Cutlip Minnow	*Exoglossum maxillingua*	1	0.9	--	--	4	4.1	6	2.1
Fantail Darter	*Etheostoma flabellare*	3	2.8	--	--	--	--	23	8.1
Green Sunfish	*Lepomis cyanellus*	--	--	--	--	--	--	2	0.7
Johnny Darter	*Etheostoma nigrum*	1	0.9	1	2.9	1	1.0	1	0.4
Lepomis sp.	*Lepomis* spp.	--	--	1	2.9	--	--	4	1.4
Margined Madtom	*Noturus insignis*	4	3.7	--	--	--	--	28	9.9
Mimic Shiner	*Notropis volucellus*	--	--	--	--	--	--	7	2.5
Nocomis Species	*Nocomis* spp.	4	3.7	--	--	2	2.0	--	--
Northern Hogsucker	*Hypentelium nigricans*	--	--	2	5.7	3	3.1	1	0.4
Redbreast Sunfish	*Lepomis auritus*	--	--	2	5.7	3	3.1	1	0.4
Riverweed Darter	*Etheostoma podostemone*	2	1.8	--	--	4	4.1	37	13.1
Roanoke Darter	*Percina roanoka*	5	4.6	4	11.4	--	--	13	4.6
Roanoke Logperch	*Percina rex*	1	0.9	--	--	--	--	--	--
Rock Bass	*Ambloplites rupestris*	1	0.9	3	8.6	--	--	2	0.7
Rosefin Shiner	*Lythrurus ardens*	74	67.9	13	37.1	20	20.4	27	9.5
Satinfin Shiner	*Cyprinella analostana*	2	1.8	--	--	3	3.1	2	0.7
Smallmouth	*Micropterus dolomieu*	1	0.9	--	--	1	1.0	2	0.7

Common Name	Scientific Name	Roanoke River at the 13th Street Bridge[1]		Tinker Creek[2]		Niagara Forebay[3]		Downstream of Niagara Dam[4]	
		N	RA[5] (%)	N	RA[5] (%)	N	RA[5] (%)	N	RA[5] (%)
Spotfin Shiner	*Cyprinella spiloptera*	--	--	--	--	1	1.0	1	0.4
Spottail Shiner	*Notropis hudsonius*	--	--	--	--	--	--	11	3.9
Swallowtail Shiner	*Notropis procne*	--	--	--	--	--	--	1	0.4
White Sucker	*Catostomus commersonii*	--	--	3	8.6	--	--	--	--
	Total	**109**	**100.0**	**35**	**100.0**	**98**	**100.0**	**283**	**100.0**

1) Site NFBP1 at the 13th street bridge above the confluence of the Roanoke River and Tinker Creek.
2) Site NFBP2 in Tinker Creek.
3) Site NFBP3 in the Niagara forebay.
4) Represents the combined results of sites downstream of Niagara Dam (NFBP4, NFBP5, NFBP6, and NFBP7).
5) Relative Abundance (RA)

5.2.1.2 Target Species Selected for Evaluations

An evaluation of the 2020 – 2021 Fish Community Study data, historical sampling data (Appalachian 1991), and VDWR list of Roanoke River fish species (Appalachian 1991) were used to determine the target species list representative of those species and species groups of management (i.e., state/federal protection), economic, and ecological interest (Table 5-3). The EPRI (1997) database was used to determine entrainment rates for the selected species and species groups (using surrogate species representatives where necessary). Additionally, where appropriate, representative or surrogate species were also used when evaluating other factors, such as swim burst speed and impingement potential.

Table 5-3. 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

Common Name[1]	Scientific Name	Surrogate Representation
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 (2020-2021) or historical fish studies (Appalachian 1991) in the Roanoke River or that are known to occur in Roanoke River in or near the Project area.

5.2.2 Intake Avoidance

Burst swim speeds for target or representative 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 2x critical swim speed based on Bell (1991).

As described in Section 5.1 of this study report, impingement and entrainment characterizations at the Project consider velocities under maximum turbine discharge of 684 cfs, corresponding to a maximum approach velocity of 1.1 fps. The burst speeds shown in Table 5-4 indicate that all target species and life stages evaluated, with the exception of eggs, larvae, and juvenile Spottail Shiner, would be able to avoid entrainment at the Project given that estimated swim burst speeds are greater than approach velocities at the intake.

Table 5-4. Average Burst Swim Speeds and Fish Sizes

Common Name	Scientific Name	Age	Length[1]	Burst Swim Speed (fps)[2]	Reference
Blacknose Dace[3]	*Rhinichthys atratulus*	Juvenile	1.69	2.54	Katopodis and Gervais 2016
Blacknose Dace[3]	*Rhinichthys atratulus*	Adult	1.60-1.74 (SL)	2.02-3.02	Nelson et al. 2003
Blacktail Shiner[3]	*Cyprinella venusta*	Adult	1.85	4.01	Katopodis and Gervais 2016
Bluegill[4]	*Lepomis macrochirus*	Juvenile	1.97	2.66	Katopodis and Gervais 2016
Bluegill[4]	*Lepomis macrochirus*	Adult	3.94-5.91	2.44	Gardner et al. 2006
Bullhead Minnow[3]	*Pimephales vigilax*	Adult	1.97	2.60	Katopodis and Gervais 2016
Central Stoneroller[3]	*Campostoma anomalum*	Juvenile/ Adult	1.42-4.33	1.84-3.52	Layher 1993

Common Name	Scientific Name	Age	Length[1]	Burst Swim Speed (fps)[2]	Reference
Central Stoneroller[3]	*Campostoma anomalum*	Juvenile	1.81	4.13	Katopodis and Gervais 2016
Channel Catfish x Blue Catfish[5]	*Ictalurus punctatus x I. furcatus*	Juvenile	6.30-9.06	7.88	Beecham et al. 2009
Darters[6]	*Etheostoma* spp.	Adult	1.42	2.62	Katopodis and Gervais 2016
Eastern Shiners[3]	*Notropis* spp.	Adult	1.65	3.38	Katopodis and Gervais 2016
Emerald Shiner[3]	*Notropis atherinoides*	Adult	2.5	4.00	Bell 1991
Fathead Minnow[3]	*Pimephales promelas*	Adult	1.85	2.16	Katopodis and Gervais 2016
Golden Shiner[3]	*Notemigonus crysoleucas*	Adult	1.54-4.33	2.02-4.68	Layher 1993
Greenside Darter[7]	*Etheostoma blennioides*	Adult	1.57-2.68	1.02-2.64	Layher 1993
Largemouth Bass	*Micropterus salmoides*	Juvenile	3.5-4.72 (FL)	2.32-3.28	Farlinger and Beamish 1977
Largemouth Bass	*Micropterus salmoides*	Juvenile	5.04	2.46	Katopodis and Gervais 2016
Longear Sunfish[4]	*Lepomis megalotis*	Juvenile/ Adult	2.20-5.35	1.24-2.56	Layher 1993
Longnose Sucker[7]	*Catostomus catostomus*	Juvenile/ Adult	3.9-16.0	4.0-8.0	Bell 1991
Mimic Shiner[3]	*Notropis volucellus*	Juvenile	1.38	2.86	Katopodis and Gervais 2016
Proserpine Shiner[3]	*Cyprinella proserpina*	Adult	1.57	3.99	Katopodis and Gervais 2016
Pumpkinseed[4]	*Lepomis gibbosus*	Adult	5	2.44	Brett and Sutherland 1965
Red Shiner[3]	*Cyprinella lutrensis*	Adult	1.69	4.67	Katopodis and Gervais 2016
Redbreast Sunfish[4]	*Lepomis auritus*	Juvenile	1.89	2.32	Katopodis and Gervais 2016
Redfin Shiner[3]	*Lythrurus umbratilis*	Adult	1.77	3.61	Katopodis and Gervais 2016
Ribbon Shiner[3]	*Lythrurus fumeus*	Juvenile	1.30	2.50	Katopodis and Gervais 2016
Robust Redhorse[7]	*Moxostoma robustum*	Larvae	0.51-0.8	0.46-0.76	Reutz and Jennings 2000
Satinfin Shiners[3]	*Cyprinella* spp.	Adult	2.09	4.44	Katopodis and Gervais 2016
Smallmouth Bass	*Micropterus dolomieu*	Larvae	0.55-0.98	1.2-1.74	Larimore and Deuver 1968
Smallmouth Bass	*Micropterus dolomieu*	Juvenile	3.58-3.66	2.6-3.6	Webb 1998

Common Name	Scientific Name	Age	Length[1]	Burst Swim Speed (fps)[2]	Reference
Smallmouth Bass	*Micropterus dolomieu*	Adult	10.3-14.9	3.2-7.8	Bunt et al. 1999
Smallmouth Bass	*Micropterus dolomieu*	Adult	11.81	5.77	Katopodis and Gervais 2016
Spottail Shiner[3]	*Notropis hudsonius*	Juvenile	2.01	1.44	Katopodis and Gervais 2016
Suckers[7]	*Catostomus* spp.	Adult	7.05	8.33	Katopodis and Gervais 2016
Sunfish Species[4]	*Lepomis* spp.	Adult	3.19	4.35	Katopodis and Gervais 2016
White Crappie[8]	*Pomoxis annularis*	Juvenile	3.03	0.36-1.04	Smiley and Parsons 1997
White Sucker[7]	*Catostomus commersonii*	Adult	6.69-14.57 (FL)	4.96	Hunter and Mayor 1986

[1] Lengths are Total Length (TL) unless otherwise noted (SL: standard length; FL: fork length)
[2] Burst swim speeds were calculated as 2x critical speed (Bell 1991), unless burst speed was provided in the literature.
[3] Used to represent the Shiners, Chubs, and Minnows group.
[4] Used to represent the *Lepomis* Sunfishes group.
[5] Used to represent the Catfishes group.
[6] Used to represent the Darters group, including the *Percina and Etheostoma* spp.
[7] Used to represent the Suckers and Redhorse group.
[8] Used to represent Black Crappie.

5.2.3 Impingement Assessment

Proportional estimates of body width to length (scaling factor) were compiled by Smith (1985) for all the target and representative species in this study. The scaling factor multiplied by the maximum recorded length for the species (Jenkins and Burkhead 1993), or maximum recorded length from field data collected during the Fish Community Study, resulted in a corresponding width which was then compared to the trash rack spacing at the Project (3.625 inch) (Table 5-5).

With the exception of Channel Catfish, all reported target and representative species would pass through the trash racks at the Project. The minimum size of channel catfish to be excluded by the trash racks would be 24 inches total length.

Table 5-5. Estimated Minimum Lengths (inches) of Target and Representative Species Excluded by Trash Racks at Niagara Hydroelectric Project

Common Name	Scaling Factor for Body Width[1]	Maximum Reported Length (inch)[2]	Corresponding Body Width (inch)	Minimum Size (inch) Excluded by Trash Racks at Niagara (3.625 inch)
River Chub	0.127	8.9	1.1	Not Excluded
Black Crappie	0.099	15.6	1.5	Not Excluded
Blacknose Dace*	0.132	1.8	0.2	Not Excluded
Blacknose Dace	0.132	2.8	0.4	Not Excluded
Bluegill*	0.132	6.5	0.9	Not Excluded
Bluegill	0.132	8.7	1.1	Not Excluded

Common Name	Scaling Factor for Body Width[1]	Maximum Reported Length (inch)[2]	Corresponding Body Width (inch)	Minimum Size (inch) Excluded by Trash Racks at Niagara (3.625 inch)
Bluntnose Minnow*	0.119	2.6	0.3	Not Excluded
Central Stoneroller*	0.126	7.5	0.9	Not Excluded
Central Stoneroller	0.126	5.9	0.7	Not Excluded
Channel Catfish	0.156	27.6	4.3	24
Golden Redhorse	0.127	14.8	1.9	Not Excluded
Golden Shiner	0.105	7.9	0.8	Not Excluded
Green Sunfish*	0.154	4.8	0.7	Not Excluded
Green Sunfish	0.154	7.1	1.1	Not Excluded
Greenside Darter	0.122	3.5	0.4	Not Excluded
Johnny Darter*	0.118	2.1	0.2	Not Excluded
Johnny Darter	0.118	1.6	0.2	Not Excluded
Largemouth Bass*	0.134	6.1	0.8	Not Excluded
Largemouth Bass	0.134	25.6	3.4	Not Excluded
Logperch	0.104	4.7	0.5	Not Excluded
Longear Sunfish	0.153	5.9	0.9	Not Excluded
Longnose Dace	0.139	3.3	0.5	Not Excluded
Mimic Shiner*	0.101	2.4	0.2	Not Excluded
Mimic Shiner	0.101	2.2	0.2	Not Excluded
Northern Hog Sucker*	0.146	4.6	0.7	Not Excluded
Northern Hog Sucker	0.146	11.8	1.7	Not Excluded
Pumpkinseed	0.124	6.3	0.8	Not Excluded
Rainbow Darter	0.134	2.0	0.3	Not Excluded
Redbreast Sunfish*	0.150	6.7	1.0	Not Excluded
Redbreast Sunfish	0.150	7.3	1.1	Not Excluded
Rock Bass*	0.155	7.0	1.1	Not Excluded
Rock Bass	0.155	7.9	1.2	Not Excluded
Smallmouth Bass*	0.128	6.7	0.9	Not Excluded
Smallmouth Bass	0.128	16.9	2.2	Not Excluded
Spotfin Shiner*	0.110	2.7	0.3	Not Excluded
Spotfin Shiner	0.110	2.8	0.3	Not Excluded
Spottail Shiner*	0.140	3.7	0.5	Not Excluded
Spottail Shiner	0.140	3.5	0.5	Not Excluded
Spotted Bass	0.128	15.0	1.9	Not Excluded
Warmouth	0.140	7.9	1.1	Not Excluded

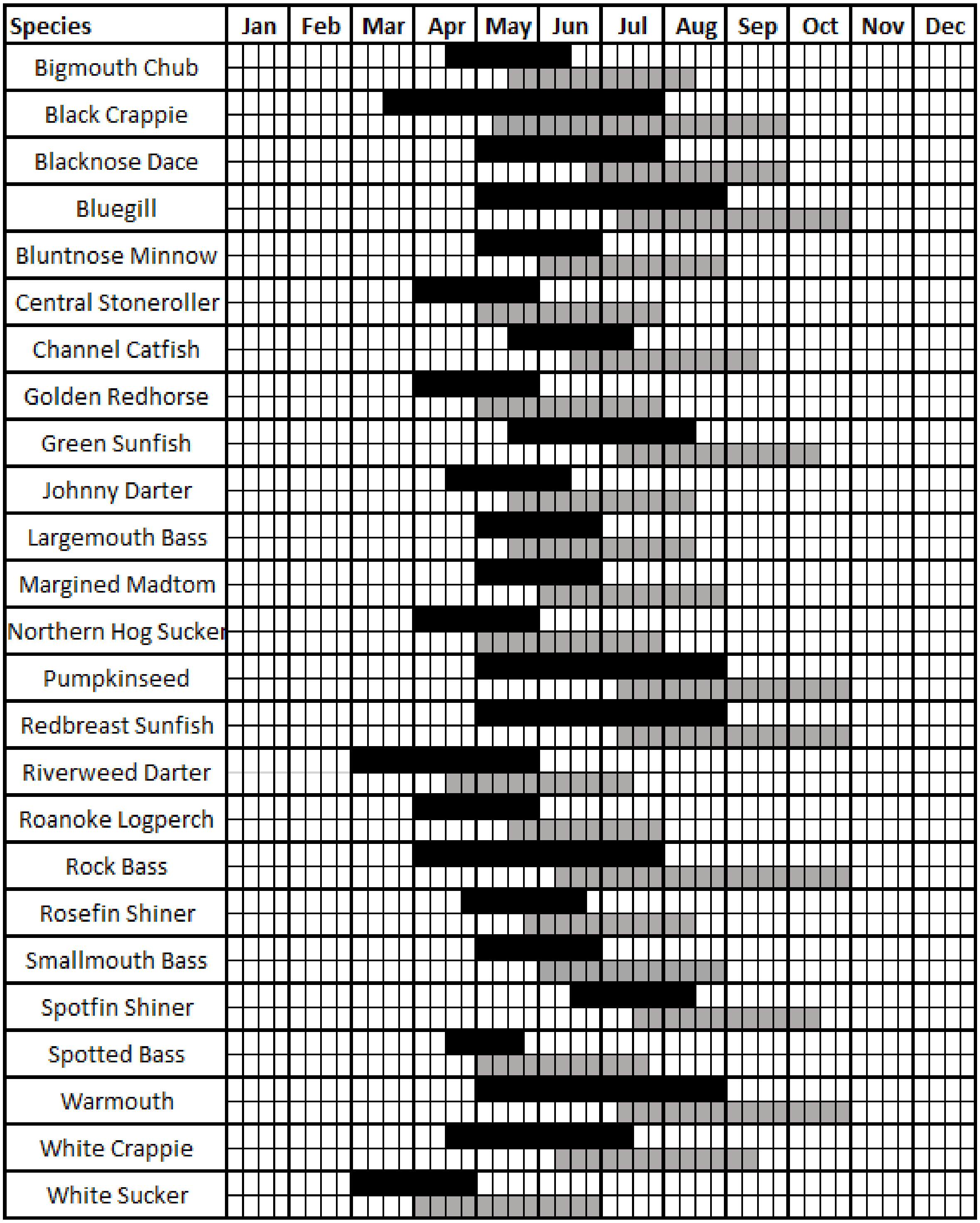
Common Name	Scaling Factor for Body Width[1]	Maximum Reported Length (inch)[2]	Corresponding Body Width (inch)	Minimum Size (inch) Excluded by Trash Racks at Niagara (3.625 inch)
White Crappie	0.085	15.7	1.3	Not Excluded
White Sucker*	0.146	10.9	1.6	Not Excluded
White Sucker	0.146	15.7	2.3	Not Excluded
Yellow Bullhead	0.172	11.8	2.0	Not Excluded

[1] Scaling factor (Smith 1985) expresses body width as a proportion of length based on proportional measurements.
[2] Maximum length reported by Jenkins and Burkhead (1993).
*Species and maximum length collected in the 2020 Fish Community Study

5.2.4 Early Life Stage Entrainment Susceptibility

The early life stages of fish (eggs and larvae) cannot move independently (eggs) or have limited swimming ability (larvae), and therefore are unable to overcome currents, thus leaving them susceptible to entrainment at the Project. An assessment of target and representative species shows that the majority of species present in the Roanoke River in the Project area have spawning periods around May and June, with eggs developing into larvae from June to August (Table 5-6). Some species or groups, such as *Lepomis* sunfish, have prolonged spawning periods followed by prolonged egg and larval development periods, thus increasing risk of entrainment. However, members of the genus *Lepomis*, like others in the Centrarchidae family, create nests along shorelines with preference for cover such as vegetation and woody debris; therefore, entrainment risk for these early life stages is low.

Table 5-6. Spawning and Early Life Stage Periodicities for Target and Representative Fish Species in the Vicinity of Niagara Hydroelectric Project



Spawning Period (Stauffer et al. 1995; Jenkins and Burkhead 1993, USFWS 1992, USFWS 2007)
Eggs and larvae (estimated to begin two-thirds of the way through the spawning period and lasting 60 days post spawn)

Additionally, most freshwater fish species have demersal and/or adhesive eggs and larvae that remain close to areas with protective cover, which also lowers risk of entrainment (Cada 1991). Additional life history information for target and representative species is included in Appendix B.

Although some early life stage organisms may be swept from nesting areas during high flow events or from reservoir level fluctuations (which does not exceed 1.0 ft at the Project), it is expected that ichthyoplankton mortality resulting from turbine passage is low, at two to five percent (Cada 1991). Other sources of injury or mortality to early life stages such as pressure changes, cavitation, turbulence, and shear stress are limited at the facility based on the prior entrainment study (Appalachian 1991). As no significant changes have occurred at the facility since the last relicensing, impacts from these factors are also considered minimal.

5.2.5 Fish Entrainment Rates

Findings from FERC (1995) and Winchell et al. (2000) suggest that the majority of fish size classes entrained at hydroelectric projects is much smaller than the minimum length of fish physically excluded by a certain clear spacing, and that length frequencies of entrainment compositions are similar among sites with differing trash rack spacing. This indicates that the lack of larger fish may be related to their increased swimming performance and ability to avoid intake velocities as they approach the intake.

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 (Figure 5-4), and fish less than eight inches exhibit the highest entrainment rates throughout the year (Table 5-7). 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.

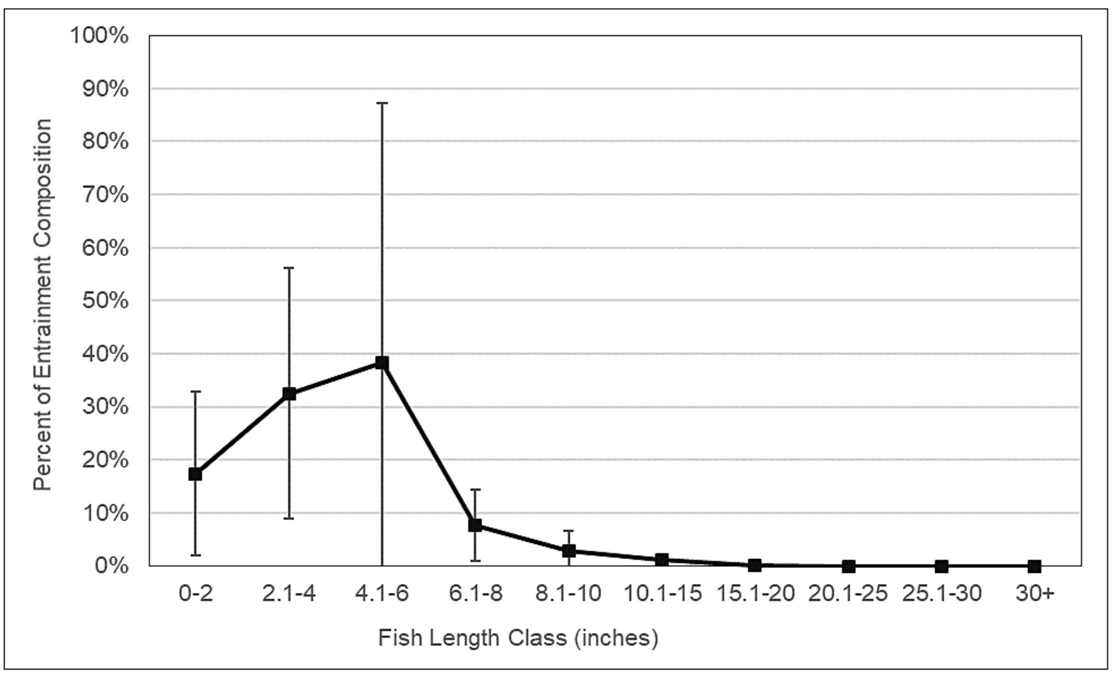


Figure 5-4. Mean Percent (standard deviation) of Entrainment Composition by Fish Size Class According to Target Species from 33 Hydroelectric Developments (EPRI 1997)

Table 5-7. Average Hourly Entrainment Rates of Target Species and Species Groups by Season and Fish Size Groups at Maximum and Optimal Turbine Discharge (cfs)

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

Seasonal entrainment rates from the EPRI (1997) database by target species and species groups is presented in Table 5-8 for maximum turbine discharge and Table 5-9 for optimal turbine discharge. These include all fish size classes combined for each species. Mean monthly seasonal target species entrainment rates for each of these size groups is provided in Appendix C.

Table 5-8. Average Hourly Entrainment Rates by Season and Target Species and Species Groups at Maximum Turbine Discharge (684 cfs)

Target Species/Species Group	Average Entrainment Rate (fish/hr) by Season				12- Month Average Entrainment Rate (fish/hr)
	Winter	Spring	Summer	Fall	
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
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 5-9. Seasonal and Annual Entrainment Rates for Target Species and Species Groups at Optimal Turbine Discharge (606 cfs)

Target Species/Species Group	Average Entrainment Rate (fish/hr) by Season				12- Month Average Entrainment Rate (fish/hr)
	Winter	Spring	Summer	Fall	
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**

Catfishes, Rock Bass, suckers and redhorses, *Lepomis* sunfishes, and Black Crappie have the highest entrainment rates of the target species and groups. Peaking months of entrainment for these species and species groups varied. Smallmouth and largemouth bass, species often sought after by anglers, have some of the lowest entrainment rates of the target species and groups. Entrainment rates were highest from April to October, with peaks in April, July, and October (Figure 5-5). Peaking months may correspond to spawning movements (April), recruitment to catchable size (July or October), or large storm/flow events.

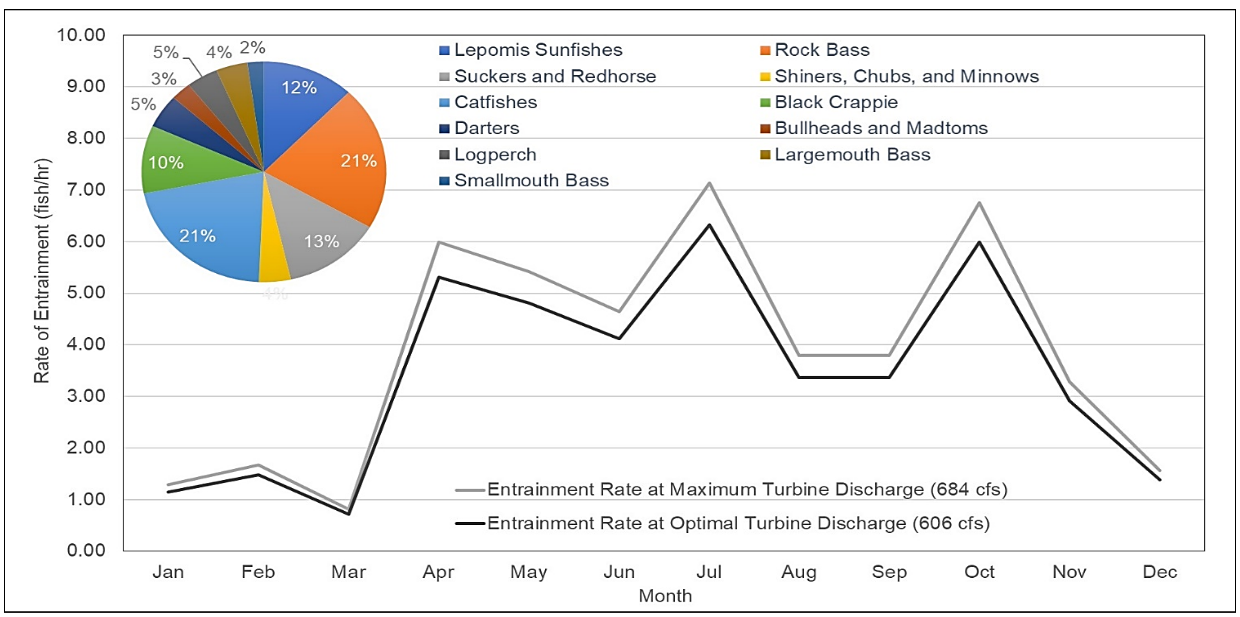


Figure 5-5. Average Monthly Entrainment Rate and Species Composition based on EPRI (1997) Entrainment Database Selections for the Niagara Hydroelectric Project

5.2.6 Relative Turbine Entrainment Risk

Several factors were considered in assigning Project target species a monthly qualitative entrainment risk category, including:

- Maximum turbine discharge frequency (see Section **Error! Reference source not found.**);
- Species composition and relative abundance near the Project (see Section **Error! Reference source not found.**);
- Comparison of burst swim speed versus intake velocity for likelihood of intake avoidance (see Section 5.2.2);
- Size exclusion (see Section 5.2.3).
- Life history characteristics, such as migratory behavior, habitat preferences, spawning behavior/requirements, and early life stage periodicity (see Section 5.2.4); and
- Entrainment rates for each species and species group estimated for the Project based on the EPRI (1997) entrainment database (see Section5.2.5);
- Blade Strike and mortality risk (see Section 0)

Although few fish species in the vicinity of the Project would be excluded by the trash racks, almost all juvenile and adult fish species could avoid the intake entirely based on approach velocity and associated swim burst speeds. Therefore, most target species with elevated qualitative risk rankings are due to increased entrainment rates based on the EPRI (1997) database. 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 (see Section 5.2.1 and Appendix B). 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 (see Appendix B); therefore, most species were given a low (L) ranking unless elevated entrainment rates were noted (Table 5-10).

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.

Roanoke Logperch, a federally endangered species, was given a low ranking throughout due to the habitat preferences of this species. As detailed in Appendix B, the Roanoke Logperch requires 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 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 found 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.

Table 5-10. 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)												

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.

5.2.7 Turbine Blade Strike and Spillway Mortality

Blade strike probabilities and associated survival rates were calculated for each of the nine size classes (see 4.2.2.3) used in the entrainment rate analysis. Input parameters and detailed results for each of the model runs for the nine size classes are provided in Appendix D. Probability of turbine blade strike is positively correlated to fish length: smaller fish have lower risk and larger fish have greater risk of mortality due to blade strikes (Table 5-11). Blade strike probabilities at the Project ranged from 8.7 – 98.9 percent. 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 (Section 5.2.5); 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 5-11. 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 conditions starting at 20 percent and lower, were evaluated and are summarized in **Error! Reference source not found.**. These spill scenarios were run for Roanoke Logperch and other fish measuring 4.0 inches in length.

The percentage of 4.0-inch sized fish, including Roanoke Logperch, that would experience mortality due to blade strike, spillway passage, barotrauma or other passage-related causes is summarized in Table 5-12 and complete output datasets are included in Appendix E. 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.

Table 5-12. 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 project with similar turbine characteristics as Niagara were generally high (FERC 1995). Further, the historical desktop entrainment study (Appalachian 1991) performed at the Project determined that the risk related to these factors is minimal. 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.

6 Summary

In summary, the primary findings of the Fish Impingement and Entrainment Study include:

- The findings of this study concur with the historical entrainment study completed for the prior relicensing in that adverse 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.
- Entrainment of early life stage fishes (eggs and larvae) is likely minimal given the life history and spawning characteristics of species in the vicinity of the Project and the habitat availability in the Project forebay.
- 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 based on species periodicity, swim speed, and habitat preferences.
- Turbine blade strike and spillway survival are high for the smaller sizes of fish that are most likely to pass through the powerhouse or over the spillway; while the large fish that would experience higher blade strike and spillway mortality are at a much lower risk of entrainment into the intake structure or over the spillway due to their ability to avoid approach velocities.
- The fish most likely to be entrained and passed through Project turbines, smaller size classes (6.0 inches or less), have lower risk of mortality due to turbine blade strikes.
- Roanoke Logperch survey data indicate the species is widespread through the Project boundary, including the bypass channel and Tinker Creek, but were not collected from the forebay of Niagara Dam (per results of the Fish Community Study). Given their current distribution and document habitat requirements, the Roanoke Logperch is expected to have very low risk of entrainment at the Project.
- Spillway mortality or mortality due to turbine blade strike would therefore be even less likely and is not expected to present a significant risk to the Roanoke Logperch.

7 Variances from FERC-Approved Study Plan

The Fish Impingement and Entrainment Study was conducted in full accordance with the methods described in the RSP.

As detailed in Section 4.1, per the Project RSP and Commission's SPD, intake velocities were to be measured using an ADCP along the upstream face of the angled trash racks to determine the approximate approach velocity immediately upstream of the intake structure; however, during the 2020 field season, a combination of high flow events and inoperable units prevented field data collection efforts. As a result, approach velocity was calculated using the intake structure and trash rack dimensions along with the design maximum flow capacity of the two generating units.

Using this approach, the calculated velocity in front of the intake is approximately 1.1 fps, which is similar to the intake velocities presented in the historical entrainment report (Appalachian 1991). Further, a desktop evaluation using Roanoke River morphometrics and flow data from the nearest upstream gage (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. Given this information, and since the design and the general operation of the facility have not changed since the prior license application, the calculated approach velocity is representative of actual conditions at the Niagara intake structure and is used to support evaluations of impingement and entrainment at Niagara.

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Appendix A

Appendix A – Site Characteristics of Hydropower Facilities from the EPRI (1997) Database

Table 1. Electric Power Research Institute Entrainment Database[1] Sites Used for the Niagara Hydroelectric Project Fish Impingement and Entrainment Study

No.	Site Name	State	River	Reservoir Area (ac)	Reservoir Volume (ac-ft)	Usable Storage (ac-ft)	Fluctuation Limits (ft)	Length (mi)	Width (ft)	Total Plant Capacity (cfs)	No. Units	Operating Mode[2]	Average Velocity at Trash Rack (fps)	Trash Rack Spacing (inch)
1	Belding	MI	Flat	-	-	-	-	-	-	416	2	-	-	2
2	Bond Falls	MI	W.B. Ontonagon	-	-	-	-	-	-	900	2	PK	-	3
3	Brule	WI	Brule	545	8880	530	1	5.2	340	1377	3	PK-partial	1	1.62
4	Caldron Falls	WI	Peshtigo	1180	-	-	-	-	-	1300	2	PK	-	2
5	Centralia	WI	Wisconsin	250	-	-	0	2	1400	3640	6	ROR	2.3	3.5
6	Colton	NY	Raquette	195	620	103	0.5	-	-	1503	3	PK	-	2
7	Crowley	WI	N.F. Flambeau	422	3539	-	1	-	-	2400	2	ROR	1.4	2.375
8	Feeder Dam	NY	Hudson	-	-	-	-	-	-	5000	5	PK	-	2.75
9	Four Mile Dam	MI	Thunder Bay	1112	2500		0.5	-	-	1500	3	ROR	-	2
10	Grand Rapids	MI/ WI	Menominee	250	-	-	0.5	-	-	3870	5	ROR	-	1.75
11	Herrings	NY	Black	140	-	-	-	-	-	3610	3	ROR	-	4.125
12	High Falls - Beaver River	NY	Beaver	145	1058	290	-	-	-	900	3	-	0.7	1.81
13	Higley	NY	Raquette	742	4446	-	1.5	-	-	2045	3	PK	-	3.63
14	Hillman Dam	MI	Thunder Bay	988	1600	-	-	-	-	270	1	ROR	-	3.25
15	Johnsonville	NY	Hoosic	450	6430	540	6.5	-	-	1288	2	PK	-	2
16	Kleber	MI	Black	270	3000	-	0	0.9	-	400	2	ROR	1.41	3
17	Lake Algonquin	NY	Sacandaga	-	-	-	-	-	-	750	1	-	-	1

18	Luray	VA	S.F. Shenandoah	-	-	-	-	-	-	1477	3	ROR	-	2.75
19	Minetto	NY	Oswego	350	4730	290	1.8	-	-	7500	5	PULSE	2.4	2.5
20	Moshier	NY	Beaver	365	7339	680	3	-	-	660	2	PK	-	1.5
21	Ninth Street Dam	MI	Thunder Bay	9884	2600	-	0.5	-	-	1650	3	ROR	-	1
22	Norway Point Dam	MI	Thunder Bay	10502	3800	-	0.5	-	-	1775	2	ROR	-	1.69
23	Potato Rapids	WI	Peshtigo	288	-	-	-	-	-	1380	3	ROR	-	1.75
24	Raymondville	NY	Raquette	50	264	-	1	-	-	1640	1	PK	-	2.25
25	Sandstone Rapids	WI	Peshtigo	150	-	-	-	-	-	1300	2	PK	-	1.75
26	Schaghticoke	NY	Hoosic	164	1150	120	6.5	-	-	1640	4	ROR	-	2.125
27	Sherman Island	NY	Hudson	305	6960	1060	3.7	-	-	6600	4	PK	-	3.125
28	Thornapple	WI	Flambeau	295	1000	295	1.5	4	600	1400	2	ROR-mod	1.22	1.69
29	Tower	MI	Black	102	620	-	0	0.9	-	404	2	ROR	0.82	1
30	Twin Branch	IN	St. Joseph	1065	-	-	-	8.75	-	3200	-	ROR	-	3
31	Warrensburg	NY	Schroon	-	-	-	-	-	-	1350	1	-	-	-
32	White Rapids	MI/WI	Menominee	435	5155	415	1	2.3	580	3994	3	PK-partial	1.9	2.5
33	Wisconsin River Division	WI	Wisconsin	240	1120	-	0	2.5	1000	5150	10	ROR	1.4	2.19

[1] Electric Power Research Institute. 1997. Turbine Entrainment and Survival Database. TR-108630. Palo Alto, CA.
[2] Operating Mode: peaking (PK), pulse, or run-of-river (ROR)
Notes: ac=acre; ac-ft=acre-ft; mi=mile; cfs=cubic ft per second; fps=feet per second

Appendix B

Appendix B – Life History Information for Target Fish Species and Species Groups

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Largemouth Bass – *Micropterus salmoides*

Largemouth Bass are native to the Great Lakes-St. Lawrence and Mississippi basins and the Gulf and south Atlantic slopes but has been widely introduced elsewhere in North America (Jenkins and Burkhead 1993). They are found in marshes, swamps, ponds, lakes, reservoirs, creeks, and large rivers. They feed on a wide array of aquatic animals.

Largemouth Bass spawn in May and June (Jenkins and Burkhead 1993). Males fans a nest area over a variety of substrates, and guards it against intruders. They may be found in open areas or associated with various cover, such as vegetation, ledges, or woody debris.

Smallmouth Bass/Spotted Bass - *Micropterus dolomieu/M. punctulatus*

Smallmouth Bass are native to Virginia (VDWR 2017a) and they are now abundant in most large rivers and lakes throughout the State. Smallmouth bass prefer slow-to-moderate current and select areas of rocky shorelines. They are most active in 19°C to 22°C water and are intolerant of silty, warm, polluted water.

Spawning usually occurs from late April to early June as temperatures exceed 16°C, in water depths of 2 to 4 feet. Males build a nest in sand, gravel, or rubble where they will guard the nest and fry (VDWR 2017b). Eggs hatch between 7 and 21 days after fertilization, depending on the water temperature (Smith 1985).

Black Crappie - P*omoxis nigromaculatus*

Black Crappie is native throughout the Great Lakes-St. Lawrence and Mississippi basins, Gulf slope, and Atlantic slope, and widely transplanted to other regions (Jenkins and Burkhead 1993). They are found in swamps, ponds, lakes, reservoirs, and slack water of low-to-moderate gradient, usually associated with vegetation or other structure such as woody debris and stumps. Young Black Crappie feed on microcrustaceans, insects, and larval fish; adults feed on fish, crustaceans, and insects.

Spawning occurs early, with nest construction beginning in March and continuing through July; however, most spawning occurs in April in Virginia (Jenkins and Burkhead 1993). Nests are excavated in shallow to moderately deep water associated with vegetation and may be crowded.

***Lepomis* Sunfishes - *Lepomis* spp.**

Lepomis are the largest genus of the Centrarchidae. All *Lepomis* in Virginia are found in pools and backwater areas of warm, clear creeks, streams, and rivers of low to moderate gradient, as well as lakes and ponds (Jenkins and Burkhead 1993). They feed on small prey such as aquatic insects, small fish and crustaceans, and incidentally, plant material.

Spawning begins in May with nests constructed in colonially in open, shallow areas on sand and small gravel (Jenkins and Burkhead 1993). Nests are constructed in water 2 meters deep or shallower and are defended by males.

Rosefin Shiner – *Lythrurus ardens*

Rosefin Shiner was the most common shiner collected in the 2020 Fish Community Study. Rosefin Shiner is widespread on the Atlantic slope, as well as the Ohio basin (Jenkins and Burkhead 1993). It is found in warm, large creeks and rivers of moderate gradient with clear or turbid waters. It is a surface feeder, feeding in terrestrial insects, as well as benthic aquatic insects, algae, and detritus.

Spawning extends from late April to mid-or-late June. Males congregate over nests with females on the periphery, spawning as they swim over the nest.

Margined Madtom – *Noturus insignis.*

Margined Madtom are indigenous to the Atlantic slope drainages, and introduced to northern drainages in New York, New Hampshire, Maryland, and Pennsylvania (Jenkins and Burkhead 1993). It is found in low and moderate-gradient areas of large creeks to large rivers, over soft and hard bottoms of pools, runs, and riffles. It feeds on a variety of aquatic invertebrates, fish and terrestrial insects. Margined Madtom spawn in May and June. They create nests underneath flat rocks in gentle runs and slow water above and below riffles.

Channel Catfish - *Ictalurus punctatus*

Channel Catfish are found in lakes and larger rivers with relatively clean sand, gravel, or stone substrate, over mud flats, and seldom in dense weedy areas. They live in deep, slow pools of swift, clear-running streams. They are often found below dams in large reservoirs (VDWR 2017b).

Spawning occurs from late May through July when water temperatures reach the mid-70s. Channel Catfish often deposit their eggs on rocky ledges, undercut banks, hollow logs, and other underwater structures. Males guard the nest and the eggs hatch in 7 to 10 days. The fry travel in schools, which are often herded and guarded by the male (VDWR 2017b).

Golden Redhorse – *Moxostoma erythrurum*

Golden Redhorse is widespread in the southern Great Lakes basin, Mississippi basin, and Mobile drainage; it is also found in the Potomac, James, Chowan, and Roanoke drainages of the Atlantic slope (Jenkins and Burkhead 1993). They are found across a large range of habitat types of any redhorse species, including large rivers, natural lakes and impoundments, montane and lowland areas. They are invertivores, seeking out aquatic insects and other invertebrates, with incidental algae and detritus.

Spawning occurs in mid-to-late spring in Virginia (Jenkins and Burkhead 1993) at sites with gravel beds in shallow runs and riffles. Males aggressively defending spawning sites. Repeated spawning sometimes results in a substrate depression.

Riverweed Darter – *Etheostoma podostemone*

Riverweed Darter was the most common darter collected in the 2020 Fish Community Study. Its distribution is limited to the upper and middle Roanoke drainage and extends into the North Carolina Dan River system (Jenkins and Burkhead 1993). It is found in cool and warm, moderate-gradient creeks, streams, and rivers. They feed almost entirely on benthic aquatic insects, including midge and caddisfly larvae.

Spawning occurs from March to late May (Jenkins and Burkhead 1993). Pairs spawn inverted on the underside of stones where adhesive eggs are laid in single-tiered clusters and guarded by males.

Roanoke Logperch - *Percina rex*

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 a large darter, which reaches lengths of about 6 inches. According to USFWS (1992), during the different phases of its life history and season, the majority 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 consistently in silt-free, loosely embedded substrate (Rosenberger 2002).

Rock Bass - *Ambloplites rupestris*

Rock Bass are native only to the Tennessee and Big Sandy drainages, but has been introduced to the major Atlantic slope drainages (Jenkins and Burkhead 1993). They are found in clear, cool and warm creeks, streams, and rivers with moderate gradient, as well as pools and backwater areas. They are strongly associated with shelter and avoid areas with heavy siltation and turbidity. Rock bass are generalist feeders and will eat a variety of microcrustaceans, insects, and other invertebrates when young, shifting to larger prey as adults such as fish and crayfish.

Spawning occurs from April to July (Jenkins and Burkhead 1993). Males fan out circular nests in shallow areas with coarse sand and large gravel substrates and defend them against other males.

Appendix C

Appendix C – Monthly Mean Entrainment Rates (Average Number of Fish/Hour of Unit Capacity) by Length Class for Target Species at Maximum Turbine Discharge (684 cfs)

Target Species/Group: Black Crappie

Month	0-2 in	2-4 in	4-6 in	6-8 in	8-10 in	10-15 in	15-20 in	20-25 in	25-30 in	30+ in
Jan	0.020	0.009	0.003	0.003	0.000	0.000	0.000	0.000	0.000	0.000
Feb	0.007	0.044	0.004	0.004	0.000	0.000	0.000	0.000	0.000	0.000
Mar	0.001	0.009	0.003	0.017	0.004	0.001	0.000	0.000	0.000	0.000
Apr	0.008	0.124	0.022	0.107	0.011	0.006	0.000	0.000	0.000	0.000
May	0.001	0.037	0.005	0.012	0.002	0.000	0.000	0.000	0.000	0.000
Jun	0.011	0.026	0.005	0.009	0.002	0.000	0.000	0.000	0.000	0.000
Jul	1.202	0.055	0.005	0.006	0.000	0.000	0.000	0.000	0.000	0.000
Aug	0.175	0.831	0.005	0.011	0.008	0.001	0.000	0.000	0.000	0.000
Sep	0.054	0.497	0.013	0.007	0.004	0.002	0.000	0.000	0.000	0.000
Oct	0.055	0.442	0.018	0.003	0.002	0.001	0.000	0.000	0.000	0.000
Nov	0.015	0.386	0.020	0.003	0.001	0.000	0.000	0.000	0.000	0.000
Dec	0.003	0.261	0.002	0.000	0.002	0.000	0.000	0.000	0.000	0.000
Grand Total	**0.145**	**0.263**	**0.010**	**0.017**	**0.003**	**0.001**	**0.000**	**0.000**	**0.000**	**0.000**

Target Species/Group: Bullheads and Madtoms

Month	0-2 in	2-4 in	4-6 in	6-8 in	8-10 in	10-15 in	15-20 in	20-25 in	25-30 in	30+ in
Jan	0.000	0.004	0.005	0.000	0.002	0.000	0.000	0.000	0.000	0.000
Feb	0.005	0.012	0.000	0.002	0.007	0.000	0.000	0.000	0.000	0.000
Mar	0.003	0.009	0.005	0.006	0.006	0.000	0.000	0.000	0.000	0.000
Apr	0.011	0.046	0.015	0.145	0.041	0.013	0.000	0.000	0.000	0.000
May	0.003	0.029	0.009	0.006	0.005	0.003	0.000	0.000	0.000	0.000
Jun	0.002	0.024	0.016	0.045	0.042	0.013	0.000	0.000	0.000	0.000
Jul	0.078	0.012	0.032	0.222	0.024	0.007	0.000	0.000	0.000	0.000
Aug	0.008	0.023	0.055	0.076	0.008	0.002	0.000	0.000	0.000	0.000
Sep	0.005	0.019	0.024	0.028	0.010	0.001	0.000	0.000	0.000	0.000
Oct	0.002	0.020	0.003	0.007	0.007	0.002	0.000	0.000	0.000	0.000
Nov	0.003	0.011	0.005	0.005	0.003	0.000	0.000	0.000	0.000	0.000
Dec	0.002	0.010	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000
Grand Total	**0.014**	**0.022**	**0.019**	**0.064**	**0.017**	**0.005**	**0.000**	**0.000**	**0.000**	**0.000**

Target Species/Group: Catfishes

Month	0-2 in	2-4 in	4-6 in	6-8 in	8-10 in	10-15 in	15-20 in	20-25 in	25-30 in	30+ in
Jan	0.022	0.026	0.006	0.000	0.000	0.004	0.000	0.000	0.000	0.000
Feb	0.066	0.048	0.016	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Mar	0.023	0.030	0.005	0.026	0.001	0.000	0.000	0.000	0.000	0.000
Apr	0.006	0.072	0.038	0.009	0.005	0.002	0.000	0.000	0.000	0.000
May	0.007	2.739	0.139	0.084	0.279	0.066	0.000	0.000	0.000	0.000
Jun	0.021	1.192	0.135	0.310	0.507	0.045	0.001	0.001	0.000	0.000
Jul	1.603	0.833	0.043	0.083	0.059	0.006	0.000	0.000	0.001	0.001
Aug	0.531	0.158	0.060	0.030	0.038	0.029	0.000	0.000	0.000	0.000
Sep	0.079	0.077	0.016	0.018	0.035	0.009	0.000	0.000	0.000	0.000
Oct	0.027	0.029	0.004	0.000	0.002	0.000	0.000	0.000	0.000	0.000
Nov	0.009	0.056	0.006	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Dec	0.000	0.012	0.005	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Grand Total	**0.253**	**0.556**	**0.047**	**0.058**	**0.098**	**0.017**	**0.000**	**0.000**	**0.000**	**0.000**

Target Species/Group: Darters

Month	**0-2 in**	**2-4 in**	**4-6 in**	**6-8 in**	**8-10 in**	**10-15 in**	**15-20 in**	**20-25 in**	**25-30 in**	**30+ in**
Jan	0.000	0.016	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Feb	0.030	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Mar	0.013	0.006	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Apr	0.191	0.686	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000
May	0.905	0.126	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Jun	0.105	0.031	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Jul	0.037	0.015	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Aug	0.011	0.006	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Sep	0.005	0.011	0.006	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Oct	0.004	0.026	0.005	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Nov	0.000	0.018	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Dec	0.002	0.008	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Grand Total	**0.248**	**0.185**	**0.002**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**

Target Species/Group: Largemouth Bass

Month	**0-2 in**	**2-4 in**	**4-6 in**	**6-8 in**	**8-10 in**	**10-15 in**	**15-20 in**	**20-25 in**	**25-30 in**	**30+ in**
Jan	0.000	0.039	0.010	0.000	0.000	0.000	0.002	0.000	0.000	0.000
Feb	0.000	0.011	0.009	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Mar	0.002	0.011	0.002	0.001	0.001	0.001	0.000	0.000	0.000	0.000
Apr	0.000	0.044	0.000	0.000	0.000	0.033	0.000	0.000	0.000	0.000
May	0.000	0.001	0.000	0.001	0.000	0.002	0.000	0.000	0.000	0.000
Jun	0.560	0.004	0.000	0.000	0.000	0.001	0.001	0.000	0.000	0.000
Jul	0.402	0.184	0.000	0.008	0.000	0.000	0.000	0.000	0.000	0.000
Aug	0.005	0.056	0.013	0.011	0.000	0.000	0.000	0.000	0.000	0.000
Sep	0.002	0.056	0.019	0.010	0.002	0.001	0.000	0.000	0.000	0.000
Oct	0.001	0.126	0.036	0.003	0.000	0.000	0.000	0.000	0.000	0.000
Nov	0.000	0.116	0.064	0.015	0.003	0.016	0.000	0.000	0.000	0.000
Dec	0.001	0.029	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Grand Total	**0.108**	**0.074**	**0.015**	**0.006**	**0.001**	**0.003**	**0.000**	**0.000**	**0.000**	**0.000**

Target Species/Group: *Lepomis* Sunfishes

Month	**0-2 in**	**2-4 in**	**4-6 in**	**6-8 in**	**8-10 in**	**10-15 in**	**15-20 in**	**20-25 in**	**25-30 in**	**30+ in**
Jan	0.036	0.013	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Feb	0.014	0.006	0.006	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Mar	0.007	0.005	0.051	0.005	0.000	0.000	0.000	0.000	0.000	0.000
Apr	0.026	0.473	0.542	0.007	0.000	0.000	0.000	0.000	0.000	0.000
May	0.013	0.257	0.081	0.013	0.000	0.000	0.000	0.000	0.000	0.000
Jun	0.063	0.088	0.147	0.028	0.001	0.000	0.000	0.000	0.000	0.000
Jul	0.115	0.038	0.219	0.017	0.000	0.000	0.000	0.000	0.000	0.000
Aug	0.026	0.032	0.563	0.025	0.001	0.000	0.000	0.000	0.000	0.000
Sep	0.060	0.045	1.369	0.024	0.000	0.000	0.000	0.000	0.000	0.000
Oct	0.089	0.116	0.726	0.001	0.000	0.004	0.001	0.000	0.000	0.000
Nov	0.097	0.082	0.027	0.001	0.000	0.000	0.000	0.000	0.000	0.000
Dec	0.003	0.053	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000
Grand Total	**0.054**	**0.123**	**0.433**	**0.014**	**0.000**	**0.001**	**0.000**	**0.000**	**0.000**	**0.000**

Target Species/Group: Logperch

Month	0-2 in	2-4 in	4-6 in	6-8 in	8-10 in	10-15 in	15-20 in	20-25 in	25-30 in	30+ in
Jan	0.000	0.046	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Feb	0.000	0.092	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Mar	0.000	0.128	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Apr	0.001	0.859	0.015	0.000	0.000	0.001	0.000	0.000	0.000	0.000
May	0.018	0.118	0.008	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Jun	0.009	0.135	0.006	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Jul	0.274	0.077	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Aug	0.008	0.012	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Sep	0.001	0.022	0.032	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Oct	0.001	0.021	0.011	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Nov	0.001	0.008	0.002	0.000	0.000	0.001	0.000	0.000	0.000	0.000
Dec	0.033	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Grand Total	**0.034**	**0.199**	**0.008**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**

Target Species/Group: Rock Bass

Month	0-2 in	2-4 in	4-6 in	6-8 in	8-10 in	10-15 in	15-20 in	20-25 in	25-30 in	30+ in
Jan	0.225	0.075	0.029	0.001	0.001	0.000	0.000	0.000	0.000	0.000
Feb	0.403	0.164	0.094	0.012	0.000	0.000	0.000	0.000	0.000	0.000
Mar	0.043	0.004	0.048	0.004	0.000	0.000	0.000	0.000	0.000	0.000
Apr	0.071	1.138	0.553	0.014	0.007	0.000	0.000	0.000	0.000	0.000
May	0.018	0.064	0.083	0.069	0.013	0.000	0.000	0.000	0.000	0.000
Jun	0.017	0.133	0.250	0.107	0.007	0.000	0.000	0.000	0.000	0.000
Jul	0.117	0.034	0.180	0.046	0.006	0.000	0.000	0.000	0.000	0.000
Aug	0.020	0.034	0.467	0.140	0.013	0.000	0.000	0.000	0.000	0.000
Sep	0.042	0.027	0.287	0.318	0.003	0.000	0.000	0.000	0.000	0.000
Oct	0.040	0.101	2.296	0.034	0.001	0.000	0.000	0.000	0.000	0.000
Nov	0.021	0.038	1.177	0.056	0.001	0.000	0.000	0.000	0.000	0.000
Dec	0.047	0.137	0.413	0.037	0.000	0.000	0.000	0.000	0.000	0.000
Grand Total	**0.054**	**0.184**	**0.585**	**0.095**	**0.006**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**

Target Species/Group: Shiners, Chubs, and Minnows

Month	0-2 in	2-4 in	4-6 in	6-8 in	8-10 in	10-15 in	15-20 in	20-25 in	25-30 in	30+ in
Jan	0.003	0.070	0.020	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Feb	0.006	0.173	0.045	0.010	0.009	0.000	0.000	0.000	0.000	0.000
Mar	0.006	0.093	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Apr	0.030	0.105	0.030	0.003	0.000	0.000	0.000	0.000	0.000	0.000
May	0.019	0.094	0.013	0.001	0.000	0.001	0.000	0.000	0.000	0.000
Jun	0.038	0.075	0.009	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Jul	0.113	0.167	0.008	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Aug	0.030	0.106	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Sep	0.031	0.209	0.005	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Oct	0.011	0.151	0.013	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Nov	0.007	0.165	0.009	0.003	0.000	0.000	0.000	0.000	0.000	0.000
Dec	0.003	0.035	0.005	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Grand Total	**0.031**	**0.121**	**0.013**	**0.001**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**

Target Species/Group: Smallmouth Bass

Month	0-2 in	2-4 in	4-6 in	6-8 in	8-10 in	10-15 in	15-20 in	20-25 in	25-30 in	30+ in
Jan	0.012	0.001	0.000	0.007	0.000	0.000	0.000	0.000	0.000	0.000
Feb	0.000	0.006	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Mar	0.000	0.009	0.003	0.002	0.000	0.000	0.000	0.000	0.000	0.000
Apr	0.000	0.005	0.000	0.000	0.000	0.008	0.001	0.000	0.000	0.000
May	0.000	0.001	0.001	0.001	0.003	0.015	0.003	0.000	0.000	0.000
Jun	0.047	0.027	0.002	0.003	0.004	0.008	0.001	0.000	0.000	0.000
Jul	0.270	0.028	0.005	0.004	0.002	0.003	0.000	0.000	0.000	0.000
Aug	0.028	0.040	0.016	0.010	0.006	0.008	0.000	0.000	0.000	0.000
Sep	0.004	0.139	0.083	0.033	0.008	0.003	0.000	0.000	0.000	0.000
Oct	0.006	0.064	0.021	0.005	0.002	0.004	0.000	0.000	0.000	0.000
Nov	0.000	0.011	0.008	0.001	0.000	0.001	0.000	0.000	0.000	0.000
Dec	0.005	0.007	0.005	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Grand Total	**0.047**	**0.041**	**0.018**	**0.008**	**0.003**	**0.006**	**0.001**	**0.000**	**0.000**	**0.000**

Target Species/Group: Suckers and Redhorse

Month	0-2 in	2-4 in	4-6 in	6-8 in	8-10 in	10-15 in	15-20 in	20-25 in	25-30 in	30+ in
Jan	0.005	0.102	0.181	0.138	0.087	0.061	0.000	0.000	0.000	0.000
Feb	0.005	0.064	0.163	0.114	0.013	0.000	0.002	0.000	0.000	0.000
Mar	0.005	0.024	0.088	0.074	0.007	0.007	0.000	0.000	0.000	0.000
Apr	0.022	0.119	0.053	0.036	0.047	0.142	0.042	0.000	0.000	0.000
May	0.003	0.017	0.005	0.003	0.007	0.016	0.003	0.000	0.000	0.000
Jun	0.277	0.041	0.006	0.003	0.001	0.006	0.001	0.000	0.000	0.000
Jul	0.430	0.050	0.008	0.002	0.001	0.005	0.001	0.000	0.000	0.000
Aug	0.032	0.010	0.002	0.001	0.002	0.001	0.001	0.000	0.000	0.000
Sep	0.004	0.018	0.006	0.007	0.004	0.010	0.000	0.000	0.000	0.000
Oct	0.002	0.035	1.917	0.096	0.124	0.029	0.009	0.000	0.000	0.000
Nov	0.001	0.026	0.050	0.432	0.276	0.025	0.000	0.000	0.000	0.000
Dec	0.006	0.010	0.056	0.287	0.078	0.001	0.000	0.000	0.000	0.000
Grand Total	**0.093**	**0.042**	**0.236**	**0.076**	**0.049**	**0.026**	**0.006**	**0.000**	**0.000**	**0.000**

Appendix D

Appendix D – USFWS Turbine Blade Strike Analysis Model Outputs by Size Class

Niagara Hydroelectric Project (FERC No. 2466) ARCHIVED RUN .N5000-L2-S91 10/25/2021
Normal Operations KESTLER
Release 201209

ROUTE SELECTION				TURBINE DATA														BYPASS
					D	N	B	Q	Q_{OPT}/Q	H	ω	ζ	λ	D_1	D_2	η		P_B
Route Name	Route Selection Prob.	Prob. Lower Bound	Calc. Type	Route Type	Runner Dia. (ft)	Blades (#)	Runner Height (ft)	Turbine Discharge (cfs)	Discharge at Opt. Eff. (%)	Net. Head (ft)	Speed (rpm)	Swirl Coeff. (-)	Correlation Coeff. (-)	Runner Dia. at Inlet (ft)	Runner Dia. at Disch. (ft)	Turbine Eff. (-)		Estimated Mortality (-)
Unit 1	0.548	0.000	1	Francis	3.36	14	1.75	379	86.0%	58.1	277.0	1.10	0.20	4.1	4.2	0.86		
Unit 2	0.441	0.548	1	Francis	3.00	15	1.80	305	91.8%	55.1	277.0	1.10	0.20	4.7	4.8	0.85		
Bypass	0.012	0.989	0	bypass														0.03

MODEL SIMULATION INPUT PARAMETERS		
n_f	5,000	Number of fish
μ	2.0	Mean length (inches)
σ	0.0	SD in length (inches)

BLADE STRIKE SIMULATION RESULTS		
Turbine Strikes:	436 of 5000 fish	8.7%
Bypass Failures:	3 of 5000 fish	0.1%
Passed:	4561 of 5000 fish	91.2%

Niagara Hydroelectric Project (FERC No. 2466) ARCHIVED RUN .N5000-L4-S82 10/25/2021
Normal Operations KESTLER
Release 201209

ROUTE SELECTION				TURBINE DATA														BYPASS
					D	N	B	Q	Q_{OPT}/Q	H	ω	ζ	λ	D_1	D_2	η		P_B
Route Name	Route Selection Prob.	Prob. Lower Bound	Calc. Type	Route Type	Runner Dia. (ft)	Blades (#)	Runner Height (ft)	Turbine Discharge (cfs)	Discharge at Opt. Eff. (%)	Net. Head (ft)	Speed (rpm)	Swirl Coeff. (-)	Correlation Coeff. (-)	Runner Dia. at Inlet (ft)	Runner Dia. at Disch. (ft)	Turbine Eff. (-)		Estimated Mortality (-)
Unit 1	0.548	0.000	1	Francis	3.36	14	1.75	379	86.0%	58.1	277.0	1.10	0.20	4.1	4.2	0.86		
Unit 2	0.441	0.548	1	Francis	3.00	15	1.80	305	91.8%	55.1	277.0	1.10	0.20	4.7	4.8	0.85		
Bypass	0.012	0.989	0	bypass														0.03

MODEL SIMULATION INPUT PARAMETERS		
n_f	5,000	Number of fish
μ	4.0	Mean length (inches)
σ	0.0	SD in length (inches)

BLADE STRIKE SIMULATION RESULTS		
Turbine Strikes:	908 of 5000 fish	18.2%
Bypass Failures:	3 of 5000 fish	0.1%
Passed:	4089 of 5000 fish	81.8%

Niagara Hydroelectric Project (FERC No. 2466) ARCHIVED RUN .N5000-L6-S74 10/25/2021
Normal Operations KESTLER
Release 201209

ROUTE SELECTION				TURBINE DATA														BYPASS
					D	N	B	Q	Q_{OPT}/Q	H	ω	ζ	λ	D_1	D_2	η		P_B
Route Name	Route Selection Prob.	Prob. Lower Bound	Calc. Type	Route Type	Runner Dia. (ft)	Blades (#)	Runner Height (ft)	Turbine Discharge (cfs)	Discharge at Opt. Eff. (%)	Net. Head (ft)	Speed (rpm)	Swirl Coeff. (-)	Correlation Coeff. (-)	Runner Dia. at Inlet (ft)	Runner Dia. at Disch. (ft)	Turbine Eff. (-)		Estimated Mortality (-)
Unit 1	0.548	0.000	1	Francis	3.36	14	1.75	379	86.0%	58.1	277.0	1.10	0.20	4.1	4.2	0.86		
Unit 2	0.441	0.548	1	Francis	3.00	15	1.80	305	91.8%	55.1	277.0	1.10	0.20	4.7	4.8	0.85		
Bypass	0.012	0.989	0	bypass														0.03

MODEL SIMULATION INPUT PARAMETERS		
n_f	5,000	Number of fish
μ	6.0	Mean length (inches)
σ	0.0	SD in length (inches)

BLADE STRIKE SIMULATION RESULTS		
Turbine Strikes:	1313 of 5000 fish	26.3%
Bypass Failures:	2 of 5000 fish	0.0%
Passed:	3685 of 5000 fish	73.7%

Niagara Hydroelectric Project (FERC No. 2466) ARCHIVED RUN .N5000-L8-S66 10/25/2021
Normal Operations KESTLER
Release 201209

	ROUTE SELECTION			TURBINE DATA													BYPASS
Route Name	Route Selection Prob.	Prob. Lower Bound	Calc. Type	Route Type	D Runner Dia. (ft)	N Blades (#)	B Runner Height (ft)	Q Turbine Discharge (cfs)	Q_{OPT}/Q Discharge at Opt. Eff. (%)	H Net. Head (ft)	ω Speed (rpm)	ζ Swirl Coeff. (-)	λ Correlation Coeff. (-)	D_1 Runner Dia. at Inlet (ft)	D_2 Runner Dia. at Disch. (ft)	η Turbine Eff. (-)	P_B Estimated Mortality (-)
Unit 1	0.548	0.000	1	Francis	3.36	14	1.75	379	86.0%	58.1	277.0	1.10	0.20	4.1	4.2	0.86	
Unit 2	0.441	0.548	1	Francis	3.00	15	1.80	305	91.8%	55.1	277.0	1.10	0.20	4.7	4.8	0.85	
Bypass	0.012	0.989	0	bypass													0.03

	MODEL SIMULATION INPUT PARAMETERS	
n_f	5,000	Number of fish
μ	8.0	Mean length (inches)
σ	0.0	SD in length (inches)

BLADE STRIKE SIMULATION RESULTS		
Turbine Strikes:	1715 of 5000 fish	34.3%
Bypass Failures:	0 of 5000 fish	0.0%
Passed:	3285 of 5000 fish	65.7%

Niagara Hydroelectric Project (FERC No. 2466) ARCHIVED RUN .N5000-L10-S54 10/25/2021
Normal Operations KESTLER
Release 201209

	ROUTE SELECTION			TURBINE DATA													BYPASS
Route Name	Route Selection Prob.	Prob. Lower Bound	Calc. Type	Route Type	D Runner Dia. (ft)	N Blades (#)	B Runner Height (ft)	Q Turbine Discharge (cfs)	Q_{OPT}/Q Discharge at Opt. Eff. (%)	H Net. Head (ft)	ω Speed (rpm)	ζ Swirl Coeff. (-)	λ Correlation Coeff. (-)	D_1 Runner Dia. at Inlet (ft)	D_2 Runner Dia. at Disch. (ft)	η Turbine Eff. (-)	P_B Estimated Mortality (-)
Unit 1	0.548	0.000	1	Francis	3.36	14	1.75	379	86.0%	58.1	277.0	1.10	0.20	4.1	4.2	0.86	
Unit 2	0.441	0.548	1	Francis	3.00	15	1.80	305	91.8%	55.1	277.0	1.10	0.20	4.7	4.8	0.85	
Bypass	0.012	0.989	0	bypass													0.03

	MODEL SIMULATION INPUT PARAMETERS	
n_f	5,000	Number of fish
μ	10.0	Mean length (inches)
σ	0.0	SD in length (inches)

BLADE STRIKE SIMULATION RESULTS		
Turbine Strikes:	2318 of 5000 fish	46.4%
Bypass Failures:	1 of 5000 fish	0.0%
Passed:	2681 of 5000 fish	53.6%

Niagara Hydroelectric Project (FERC No. 2466) ARCHIVED RUN .N5000-L15-S34 10/25/2021
Normal Operations KESTLER
Release 201209

	ROUTE SELECTION			TURBINE DATA													BYPASS
Route Name	Route Selection Prob.	Prob. Lower Bound	Calc. Type	Route Type	D Runner Dia. (ft)	N Blades (#)	B Runner Height (ft)	Q Turbine Discharge (cfs)	Q_{OPT}/Q Discharge at Opt. Eff. (%)	H Net. Head (ft)	ω Speed (rpm)	ζ Swirl Coeff. (-)	λ Correlation Coeff. (-)	D_1 Runner Dia. at Inlet (ft)	D_2 Runner Dia. at Disch. (ft)	η Turbine Eff. (-)	P_B Estimated Mortality (-)
Unit 1	0.548	0.000	1	Francis	3.36	14	1.75	379	86.0%	58.1	277.0	1.10	0.20	4.1	4.2	0.86	
Unit 2	0.441	0.548	1	Francis	3.00	15	1.80	305	91.8%	55.1	277.0	1.10	0.20	4.7	4.8	0.85	
Bypass	0.012	0.989	0	bypass													0.03

	MODEL SIMULATION INPUT PARAMETERS	
n_f	5,000	Number of fish
μ	15.0	Mean length (inches)
σ	0.0	SD in length (inches)

BLADE STRIKE SIMULATION RESULTS		
Turbine Strikes:	3298 of 5000 fish	66.0%
Bypass Failures:	1 of 5000 fish	0.0%
Passed:	1701 of 5000 fish	34.0%

Niagara Hydroelectric Project (FERC No. 2466) ARCHIVED RUN .N5000-L20-S10 10/25/2021
Normal Operations KESTLER
Release 201209

	ROUTE SELECTION			TURBINE DATA													BYPASS
Route Name	Route Selection Prob.	Prob. Lower Bound	Calc. Type	Route Type	D Runner Dia. (ft)	N Blades (#)	B Runner Height (ft)	Q Turbine Discharge (cfs)	Q_{OPT}/Q Discharge at Opt. Eff. (%)	H Net. Head (ft)	ω Speed (rpm)	ζ Swirl Coeff. (-)	λ Correlation Coeff. (-)	D_1 Runner Dia. at Inlet (ft)	D_2 Runner Dia. at Disch. (ft)	η Turbine Eff. (-)	P_B Estimated Mortality (-)
Unit 1	0.548	0.000	1	Francis	3.36	14	1.75	379	86.0%	58.1	277.0	1.10	0.20	4.1	4.2	0.86	
Unit 2	0.441	0.548	1	Francis	3.00	15	1.80	305	91.8%	55.1	277.0	1.10	0.20	4.7	4.8	0.85	
Bypass	0.012	0.989	0	bypass													0.03

MODEL SIMULATION INPUT PARAMETERS		
n_f	5,000	Number of fish
μ	20.0	Mean length (inches)
σ	0.0	SD in length (inches)

BLADE STRIKE SIMULATION RESULTS		
Turbine Strikes:	4489 of 5000 fish	89.8%
Bypass Failures:	1 of 5000 fish	0.0%
Passed:	510 of 5000 fish	10.2%

Niagara Hydroelectric Project (FERC No. 2466) ARCHIVED RUN .N5000-L25-S1 10/25/2021
Normal Operations KESTLER
Release 201209

	ROUTE SELECTION			TURBINE DATA													BYPASS
Route Name	Route Selection Prob.	Prob. Lower Bound	Calc. Type	Route Type	D Runner Dia. (ft)	N Blades (#)	B Runner Height (ft)	Q Turbine Discharge (cfs)	Q_{OPT}/Q Discharge at Opt. Eff. (%)	H Net. Head (ft)	ω Speed (rpm)	ζ Swirl Coeff. (-)	λ Correlation Coeff. (-)	D_1 Runner Dia. at Inlet (ft)	D_2 Runner Dia. at Disch. (ft)	η Turbine Eff. (-)	P_B Estimated Mortality (-)
Unit 1	0.548	0.000	1	Francis	3.36	14	1.75	379	86.0%	58.1	277.0	1.10	0.20	4.1	4.2	0.86	
Unit 2	0.441	0.548	1	Francis	3.00	15	1.80	305	91.8%	55.1	277.0	1.10	0.20	4.7	4.8	0.85	
Bypass	0.012	0.989	0	bypass													0.03

MODEL SIMULATION INPUT PARAMETERS		
n_f	5,000	Number of fish
μ	25.0	Mean length (inches)
σ	0.0	SD in length (inches)

BLADE STRIKE SIMULATION RESULTS		
Turbine Strikes:	4946 of 5000 fish	98.9%
Bypass Failures:	3 of 5000 fish	0.1%
Passed:	51 of 5000 fish	1.0%

Niagara Hydroelectric Project (FERC No. 2466) ARCHIVED RUN .N5000-L30-S1 10/25/2021
Normal Operations KESTLER
Release 201209

	ROUTE SELECTION			TURBINE DATA													BYPASS
Route Name	Route Selection Prob.	Prob. Lower Bound	Calc. Type	Route Type	D Runner Dia. (ft)	N Blades (#)	B Runner Height (ft)	Q Turbine Discharge (cfs)	Q_{OPT}/Q Discharge at Opt. Eff. (%)	H Net. Head (ft)	ω Speed (rpm)	ζ Swirl Coeff. (-)	λ Correlation Coeff. (-)	D_1 Runner Dia. at Inlet (ft)	D_2 Runner Dia. at Disch. (ft)	η Turbine Eff. (-)	P_B Estimated Mortality (-)
Unit 1	0.548	0.000	1	Francis	3.36	14	1.75	379	86.0%	58.1	277.0	1.10	0.20	4.1	4.2	0.86	
Unit 2	0.441	0.548	1	Francis	3.00	15	1.80	305	91.8%	55.1	277.0	1.10	0.20	4.7	4.8	0.85	
Bypass	0.012	0.989	0	bypass													0.03

MODEL SIMULATION INPUT PARAMETERS		
n_f	5,000	Number of fish
μ	30.0	Mean length (inches)
σ	0.0	SD in length (inches)

BLADE STRIKE SIMULATION RESULTS		
Turbine Strikes:	4945 of 5000 fish	98.9%
Bypass Failures:	4 of 5000 fish	0.1%
Passed:	51 of 5000 fish	1.0%

Appendix E

Appendix E – USFWS Turbine Blade Strike Analysis Model Outputs for Various Spill Volumes for Roanoke Logperch

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Niagara Hydroelectric Project

ARCHIVED RUN .N5000-L4-S81 — 10/26/2021

20% Exceedence Flow (13 CFS) — KESTLER

Release 201209

	ROUTE SELECTION			TURBINE DATA													BYPASS
					D	N	B	Q	Q_{OPT}/Q	H	ω	ζ	λ	D_1	D_2	η	P_B
Route Name	Route Selection Prob.	Prob. Lower Bound	Calc. Type	Route Type	Runner Dia. (ft)	Blades (#)	Runner Height (ft)	Turbine Discharge (cfs)	Discharge at Opt. Eff. (%)	Net. Head (ft)	Speed (rpm)	Swirl Coeff. (-)	Correlation Coeff. (-)	Runner Dia. at Inlet (ft)	Runner Dia. at Disch. (ft)	Turbine Eff. (-)	Estimated Mortality (-)
Unit 1	0.538	0.000	1	Francis	3.36	14	1.75	379	86.0%	58.1	277.0	1.10	0.20	4.1	4.2	0.86	
Unit 2	0.433	0.538	1	Francis	3.00	15	1.80	305	91.8%	55.1	277.0	1.10	0.20	4.7	4.8	0.85	
Bypass	0.011	0.971	0	bypass													0.03
Spill	0.018	0.982	0	bypass													0.03

	MODEL SIMULATION INPUT PARAMETERS	
n_f	5,000	Number of fish
μ	4.0	Mean length (inches)
σ	0.0	SD in length (inches)

	BLADE STRIKE SIMULATION RESULTS	
Turbine Strikes:	922 of 5000 fish	18.4%
Bypass Failures:	10 of 5000 fish	0.2%
Passed:	4068 of 5000 fish	81.4%

Niagara Hydroelectric Project

ARCHIVED RUN .N5000-L4-S83 — 10/26/2021

17% Exceedence Flow (88 CFS) — KESTLER

Release 201209

	ROUTE SELECTION			TURBINE DATA													BYPASS
					D	N	B	Q	Q_{OPT}/Q	H	ω	ζ	λ	D_1	D_2	η	P_B
Route Name	Route Selection Prob.	Prob. Lower Bound	Calc. Type	Route Type	Runner Dia. (ft)	Blades (#)	Runner Height (ft)	Turbine Discharge (cfs)	Discharge at Opt. Eff. (%)	Net. Head (ft)	Speed (rpm)	Swirl Coeff. (-)	Correlation Coeff. (-)	Runner Dia. at Inlet (ft)	Runner Dia. at Disch. (ft)	Turbine Eff. (-)	Estimated Mortality (-)
Unit 1	0.486	0.000	1	Francis	3.36	14	1.75	379	86.0%	58.1	277.0	1.10	0.20	4.1	4.2	0.86	
Unit 2	0.391	0.486	1	Francis	3.00	15	1.80	305	91.8%	55.1	277.0	1.10	0.20	4.7	4.8	0.85	
Bypass	0.010	0.877	0	bypass													0.03
Spill	0.113	0.887	0	bypass													0.03

	MODEL SIMULATION INPUT PARAMETERS	
n_f	5,000	Number of fish
μ	4.0	Mean length (inches)
σ	0.0	SD in length (inches)

	BLADE STRIKE SIMULATION RESULTS	
Turbine Strikes:	822 of 5000 fish	16.4%
Bypass Failures:	13 of 5000 fish	0.3%
Passed:	4165 of 5000 fish	83.3%

Niagara Hydroelectric Project

ARCHIVED RUN .N5000-L4-S86 — 10/26/2021 — KESTLER

15% Exceedence Flow (153 CFS)

Release 201209

ROUTE SELECTION				TURBINE DATA													BYPASS
Route Name	Route Selection Prob.	Prob. Lower Bound	Calc. Type	Route Type	D Runner Dia. (ft)	N Blades (#)	B Runner Height (ft)	Q Turbine Discharge (cfs)	Q_{OPT}/Q Discharge at Opt. Eff. (%)	H Net. Head (ft)	ω Speed (rpm)	ζ Swirl Coeff. (-)	λ Correlation Coeff. (-)	D_1 Runner Dia. at Inlet (ft)	D_2 Runner Dia. at Disch. (ft)	η Turbine Eff. (-)	P_B Estimated Mortality (-)
Unit 1	0.448	0.000	1	Francis	3.36	14	1.75	379	86.0%	58.1	277.0	1.10	0.20	4.1	4.2	0.86	
Unit 2	0.361	0.448	1	Francis	3.00	15	1.80	305	91.8%	55.1	277.0	1.10	0.20	4.7	4.8	0.85	
Bypass	0.009	0.809	0	bypass													0.03
Spill	0.181	0.818	0	bypass													0.03

MODEL SIMULATION INPUT PARAMETERS		
n_f	5,000	Number of fish
μ	4.0	Mean length (inches)
σ	0.0	SD in length (inches)

BLADE STRIKE SIMULATION RESULTS		
Turbine Strikes:	683 of 5000 fish	13.7%
Bypass Failures:	33 of 5000 fish	0.7%
Passed:	4284 of 5000 fish	85.7%

Niagara Hydroelectric Project

ARCHIVED RUN .N5000-L4-S87 — 10/26/2021 — KESTLER

12% Exceedence Flow (288 CFS)

Release 201209

ROUTE SELECTION				TURBINE DATA													BYPASS
Route Name	Route Selection Prob.	Prob. Lower Bound	Calc. Type	Route Type	D Runner Dia. (ft)	N Blades (#)	B Runner Height (ft)	Q Turbine Discharge (cfs)	Q_{OPT}/Q Discharge at Opt. Eff. (%)	H Net. Head (ft)	ω Speed (rpm)	ζ Swirl Coeff. (-)	λ Correlation Coeff. (-)	D_1 Runner Dia. at Inlet (ft)	D_2 Runner Dia. at Disch. (ft)	η Turbine Eff. (-)	P_B Estimated Mortality (-)
Unit 1	0.387	0.000	1	Francis	3.36	14	1.75	379	86.0%	58.1	277.0	1.10	0.20	4.1	4.2	0.86	
Unit 2	0.311	0.387	1	Francis	3.00	15	1.80	305	91.8%	55.1	277.0	1.10	0.20	4.7	4.8	0.85	
Bypass	0.008	0.698	0	bypass													0.03
Spill	0.294	0.706	0	bypass													0.03

MODEL SIMULATION INPUT PARAMETERS		
n_f	5,000	Number of fish
μ	4.0	Mean length (inches)
σ	0.0	SD in length (inches)

BLADE STRIKE SIMULATION RESULTS		
Turbine Strikes:	597 of 5000 fish	11.9%
Bypass Failures:	48 of 5000 fish	1.0%
Passed:	4355 of 5000 fish	87.1%

Niagara Hydroelectric Project

ARCHIVED RUN .N5000-L4-S85 — 10/26/2021 — KESTLER

10% Exceedence Flow (398 CFS)

Release 201209

ROUTE SELECTION				TURBINE DATA													BYPASS
Route Name	Route Selection Prob.	Prob. Lower Bound	Calc. Type	Route Type	D Runner Dia. (ft)	N Blades (#)	B Runner Height (ft)	Q Turbine Discharge (cfs)	Q_{OPT}/Q Discharge at Opt. Eff. (%)	H Net. Head (ft)	ω Speed (rpm)	ζ Swirl Coeff. (-)	λ Correlation Coeff. (-)	D_1 Runner Dia. at Inlet (ft)	D_2 Runner Dia. at Disch. (ft)	η Turbine Eff. (-)	P_B Estimated Mortality (-)
Unit 1	0.348	0.000	1	Francis	3.36	14	1.75	379	86.0%	58.1	277.0	1.10	0.20	4.1	4.2	0.86	
Unit 2	0.280	0.348	1	Francis	3.00	15	1.80	305	91.8%	55.1	277.0	1.10	0.20	4.7	4.8	0.85	
Bypass	0.007	0.628	0	bypass													0.03
Spill	0.365	0.635	0	bypass													0.03

MODEL SIMULATION INPUT PARAMETERS		
n_f	5,000	Number of fish
μ	4.0	Mean length (inches)
σ	0.0	SD in length (inches)

BLADE STRIKE SIMULATION RESULTS		
Turbine Strikes:	682 of 5000 fish	13.6%
Bypass Failures:	57 of 5000 fish	1.1%
Passed:	4261 of 5000 fish	85.2%

Niagara Hydroelectric Project

ARCHIVED RUN .N5000-L4-S89

10/26/2021
KESTLER

7% Exceedence Flow (678 CFS)
Release 201209

ROUTE SELECTION				TURBINE DATA													BYPASS
					D	N	B	Q	Q_{OPT}/Q	H	ω	ζ	λ	D_1	D_2	η	P_B
Route Name	Route Selection Prob.	Prob. Lower Bound	Calc. Type	Route Type	Runner Dia. (ft)	Blades (#)	Runner Height (ft)	Turbine Discharge (cfs)	Discharge at Opt. Eff. (%)	Net. Head (ft)	Speed (rpm)	Swirl Coeff. (-)	Correlation Coeff. (-)	Runner Dia. at Inlet (ft)	Runner Dia. at Disch. (ft)	Turbine Eff. (-)	Estimated Mortality (-)
Unit 1	0.277	0.000	1	Francis	3.36	14	1.75	379	86.0%	58.1	277.0	1.10	0.20	4.1	4.2	0.86	
Unit 2	0.223	0.277	1	Francis	3.00	15	1.80	305	91.8%	55.1	277.0	1.10	0.20	4.7	4.8	0.85	
Bypass	0.006	0.500	0	bypass													0.03
Spill	0.495	0.506	0	bypass													0.03

MODEL SIMULATION INPUT PARAMETERS		
n_f	5,000	Number of fish
μ	4.0	Mean length (inches)
σ	0.0	SD in length (inches)

BLADE STRIKE SIMULATION RESULTS		
Turbine Strikes:	470 of 5000 fish	9.4%
Bypass Failures:	75 of 5000 fish	1.5%
Passed:	4455 of 5000 fish	89.1%

Niagara Hydroelectric Project

ARCHIVED RUN .N5000-L4-S92

10/26/2021
KESTLER

5% Exceedence Flow (1008 CFS)
Release 201209

ROUTE SELECTION				TURBINE DATA													BYPASS
					D	N	B	Q	Q_{OPT}/Q	H	ω	ζ	λ	D_1	D_2	η	P_B
Route Name	Route Selection Prob.	Prob. Lower Bound	Calc. Type	Route Type	Runner Dia. (ft)	Blades (#)	Runner Height (ft)	Turbine Discharge (cfs)	Discharge at Opt. Eff. (%)	Net. Head (ft)	Speed (rpm)	Swirl Coeff. (-)	Correlation Coeff. (-)	Runner Dia. at Inlet (ft)	Runner Dia. at Disch. (ft)	Turbine Eff. (-)	Estimated Mortality (-)
Unit 1	0.223	0.000	1	Francis	3.36	14	1.75	379	86.0%	58.1	277.0	1.10	0.20	4.1	4.2	0.86	
Unit 2	0.179	0.223	1	Francis	3.00	15	1.80	305	91.8%	55.1	277.0	1.10	0.20	4.7	4.8	0.85	
Bypass	0.005	0.402	0	bypass													0.03
Spill	0.593	0.407	0	bypass													0.03

MODEL SIMULATION INPUT PARAMETERS		
n_f	5,000	Number of fish
μ	4.0	Mean length (inches)
σ	0.0	SD in length (inches)

BLADE STRIKE SIMULATION RESULTS		
Turbine Strikes:	335 of 5000 fish	6.7%
Bypass Failures:	64 of 5000 fish	1.3%
Passed:	4601 of 5000 fish	92.0%

Niagara Hydroelectric Project

ARCHIVED RUN .N5000-L4-S94 — 10/26/2021 — KESTLER

2% Exceedence Flow (2218 CFS)

Release 201209

Route Name	ROUTE SELECTION: Route Selection Prob.	Prob. Lower Bound	Calc. Type	TURBINE DATA: Route Type	D Runner Dia. (ft)	N Blades (#)	B Runner Height (ft)	Q Turbine Discharge (cfs)	Q_{OPT}/Q Discharge at Opt. Eff. (%)	H Net. Head (ft)	ω Speed (rpm)	ζ Swirl Coeff. (-)	λ Correlation Coeff. (-)	D_1 Runner Dia. at Inlet (ft)	D_2 Runner Dia. at Disch. (ft)	η Turbine Eff. (-)	BYPASS: P_B Estimated Mortality (-)
Unit 1	0.130	0.000	1	Francis	3.36	14	1.75	379	86.0%	58.1	277.0	1.10	0.20	4.1	4.2	0.86	
Unit 2	0.105	0.130	1	Francis	3.00	15	1.80	305	91.8%	55.1	277.0	1.10	0.20	4.7	4.8	0.85	
Bypass	0.003	0.235	0	bypass													0.03
Spill	0.762	0.238	0	bypass													0.03

	MODEL SIMULATION INPUT PARAMETERS	
n_f	5,000	Number of fish
μ	4.0	Mean length (inches)
σ	0.0	SD in length (inches)

	BLADE STRIKE SIMULATION RESULTS	
Turbine Strikes:	206 of 5000 fish	4.1%
Bypass Failures:	119 of 5000 fish	2.4%
Passed:	4675 of 5000 fish	93.5%

Niagara Hydroelectric Project

ARCHIVED RUN .N5000-L4-S96 — 10/26/2021 — KESTLER

0.01% Exceedence Flow (18109 CFS)

Release 201209

Route Name	ROUTE SELECTION: Route Selection Prob.	Prob. Lower Bound	Calc. Type	TURBINE DATA: Route Type	D Runner Dia. (ft)	N Blades (#)	B Runner Height (ft)	Q Turbine Discharge (cfs)	Q_{OPT}/Q Discharge at Opt. Eff. (%)	H Net. Head (ft)	ω Speed (rpm)	ζ Swirl Coeff. (-)	λ Correlation Coeff. (-)	D_1 Runner Dia. at Inlet (ft)	D_2 Runner Dia. at Disch. (ft)	η Turbine Eff. (-)	BYPASS: P_B Estimated Mortality (-)
Unit 1	0.020	0.000	1	Francis	3.36	14	1.75	379	86.0%	58.1	277.0	1.10	0.20	4.1	4.2	0.86	
Unit 2	0.016	0.020	1	Francis	3.00	15	1.80	305	91.8%	55.1	277.0	1.10	0.20	4.7	4.8	0.85	
Bypass	0.000	0.036	0	bypass													0.03
Spill	0.963	0.036	0	bypass													0.03

	MODEL SIMULATION INPUT PARAMETERS	
n_f	5,000	Number of fish
μ	4.0	Mean length (inches)
σ	0.0	SD in length (inches)

	BLADE STRIKE SIMULATION RESULTS	
Turbine Strikes:	38 of 5000 fish	0.8%
Bypass Failures:	161 of 5000 fish	3.2%
Passed:	4801 of 5000 fish	96.0%

Attachment 4

Attachment 4 – Germane Correspondence

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Yayac, Maggie

Subject: FW: Roanoke Logperch Take Application

Federal Permit Application

JS Jon Studio
To permitsR3ES@fws.gov; carlita_payne@fws.gov
Cc John Spaeth

Reply | Reply All | Forward | ...

Tue 12/22/2020 2:05 PM

Jon Studio 3-200-59 Application Package.pdf
2 MB

Jon Studio 3-200-59 Application Fee.pdf
876 KB

To whom it may concern:

My name is Jon Studio and I am applying for a Federal Permit in my name as I am currently permitted under Dr. Virgil Brack of Environmental Solutions & Innovations, Inc. (ESI) (Permit TE02373A-14). All required application documents are attached (Jon Studio 3-200-59 Application Package) along with payment in the amount $100 (Jon Studio 3-200-59 Application Fee) to cover the new permit application processing fee. Additionally, a hard copy of the application package and check have been mailed to the Region 3 Endangered Species Permit Office in Bloomington, MN. Please let me know if you have any questions or require additional information.

Thank you,

JON A. STUDIO
Avon, Ohio
M: 440.413.4609
edge-es.com

EDGE
ENGINEERING & SCIENCE
further insight.

Proof of Delivery

Dear Customer,

This notice serves as proof of delivery for the shipment listed below.

Tracking Number
1ZA2E5950384240025

Weight
0.80 LBS

Service
UPS Ground

Shipped / Billed On
12/23/2020

Delivered On
12/29/2020 10:21 A.M.

Delivered To
MINNEAPOLIS, MN, US

Received By
MAIL CENTER

Left At
Mail Room

Thank you for giving us this opportunity to serve you. Details are only available for shipments delivered within the last 120 days. Please print for your records if you require this information after 120 days.

Sincerely,

UPS

Tracking results provided by UPS: 12/30/2020 5:58 P.M. EST

-Jon
M: 440.413.4609
edge-es.com

Subject: FW: Self-Certification Letter - Niagara Hydroelectric Project (FERC No. 2466) 2021 Field Sampling TOYR

From: Huddleston, Misty <Misty.Huddleston@hdrinc.com>
Sent: Friday, March 26, 2021 4:01 PM
To: Virginia Field Office, FW5 <virginiafieldoffice@fws.gov>
Cc: Kulpa, Sarah <Sarah.Kulpa@hdrinc.com>; Jonathan M Magalski <jmmagalski@aep.com>; jon Studio (jastudio@edge-es.com) <jastudio@edge-es.com>
Subject: Self-Certification Letter - Niagara Hydroelectric Project (FERC No. 2466) 2021 Field Sampling TOYR

Good afternoon,

On behalf of American Electric Power (AEP), Edge Engineering and Science, LLC (EDGE) and HDR, Inc. (HDR) are providing field sampling services associated with relicensing activities for the Niagara Hydroelectric Project (Project) (FERC No. 2466). EDGE and HDR are requesting time-of-year restriction (TOYR) waivers for the Tinker Creek and Roanoke River in Roanoke County, Virginia within the Project area. Although current study plans do not extend to the Smith Mountain Lake, a TOYR waiver is also requested for the Smith Mountain Lake fish assemblage in the event that there is overlap with fish species protected as part of the Smith Mountain Lake fish assemblage and the assemblage of the mainstem Roanoke River, or that the proposed field effort is extended further downstream than the currently proposed Project extent in response to agency requests.

Aquatic biological studies were requested and refined during the development of the Project's Proposed Study Plan, Revised Study Plan, and Study Plan Determination that included coordination with VDWR, USFWS, and USEPA. Three of the requested studies occur during the recommended TOYRs (Table 1). Documents outlining agency requests and specific Project methodologies are located at http://www.aephydro.com/HydroPlant/Niagara, but general methods and rationale are provided below as a quick review. This information is provided in addition to the Self Certification Letter and Project Verification Package, as required per the Virginia TOYR guidance document dated February 2021.

This information is also being submitted to the Virginia Department of Wildlife Resources under separate cover.

The applicable TOYRs in the Project area occur in Roanoke River and Tinker Creek for Roanoke Logperch (*Percina rex*; RLP), stocked trout, and Orangefin Madtom (*Noturus gilberti*). Instream field sampling efforts will target RLP at various life stages and supplemental macroinvertebrate collections. Although additional survey efforts are proposed, those survey activities anticipated during TOYR's are described below.

RLP larvae: Drift net sampling methods include three biologists deploying two, 20-minute net sets at five sample sites in shallow water adjacent to riffle-run habitat once per week for a total of ten weeks (Figure 1). The ten consecutive weekly samples will occur between April 1 and June 30 to align with RLP spawning.

RLP adults and subadults: A three-day sampling period will occur between June 1 and June 30 to determine RLP occupancy of the Project's bypass reach below Niagara Dam during spring flows. Backpack electrofishing methods include two backpack electrofishing units to sample 64 quadrats (eight meters by four meters) in riffle-run habitat (Figure 1).

Macroinvertebrate Sampling: Macroinvertebrates will be collected in the Project area to investigate the temporal changes in macroinvertebrate community. A sampling event is anticipated to occur between March 1 and May 31 to align with Virginia Department of Environmental Quality (VADEQ) stream macroinvertebrate Spring sample index period. Sampling will involve kick net methods along 100-meter segments of habitat at five quantitative sites (riffle-run) and five qualitative sites (multihabitat) over a three-day period (Figure 1).

Table 1: Roanoke River and Tinker Creek Time-of-Year Restriction Waiver Requested Activity

State-Recommended TOYR	Waiver Activity Request	Activity Date Range
[a] March 15 – May 31	Kick Net - Macroinvertebrates	March 1 – May 31
	Drift Net - Larval RLP	April 1 – June 30
[b] March 15 – June 30	Kick Net - Macroinvertebrates	March 1 – May 31
	Drift Net - Larval RLP	April 1 – June 30
	Backpack Electrofishing - RLP	June 1 – June 30
[c] October 1 – June 15	Kick Net - Macroinvertebrates	March 1 – May 31
	Drift Net - Larval RLP	April 1 – June 30
	Backpack Electrofishing - RLP	June 1 – June 30
[d] February 15 – June 15	Kick Net - Macroinvertebrates	March 1 – May 31
	Drift Net - Larval RLP	April 1 – June 30
	Backpack Electrofishing - RLP	June 1 – June 30

[a] No sampling in orangefin madtom waters from March 15th through May 31st

[b] No sampling in Roanoke logperch waters from March 15th through June 30th

[c] No sampling in stocked trout waters from October 1st through June 15th

[d] No fish assemblage sampling in Smith Mountain Lake from February 15 – June 15

Misty Huddleston, PhD
Associate, SR. Environmental Scientist

HDR
440 S. Church Street, Suite 900
Charlotte, NC 28202-2075
D 704.248.3614 **M** 865.556.9153
Misty.Huddleston@hdrinc.com

Yayac, Maggie

Subject:	FW: Niagara Hydroelectric Project (FERC No. 2466) - 2021 Field Sampling TOYR Waiver Request
Attachments:	online_project_review_certification_SIGNED.pdf; USFWS Project Verification_Niagara_ 20210326.pdf

From: Jon Studio <jastudio@edge-es.com>
Sent: Monday, March 29, 2021 3:58 PM
To: amy.ewing@dwr.virginia.gov; collectionpermits@dwr.virginia.gov
Cc: Huddleston, Misty <Misty.Huddleston@hdrinc.com>; John Spaeth <jpspaeth@edge-es.com>
Subject: Niagara Hydroelectric Project (FERC No. 2466) - 2021 Field Sampling TOYR Waiver Request

To whom it may concern,

On behalf of American Electric Power (AEP), Edge Engineering and Science, LLC (EDGE) and HDR, Inc. (HDR) are providing field sampling services associated with relicensing activities for the Niagara Hydroelectric Project (Project) (FERC No. 2466). EDGE and HDR are requesting time-of-year restriction (TOYR) waivers for Tinker Creek and Roanoke River in Roanoke County, Virginia within the Project area. Although current study plans do not extend to the Smith Mountain Lake, a TOYR waiver is also requested for the Smith Mountain Lake fish assemblage in the event that there is overlap with fish species protected as part of the Smith Mountain Lake fish assemblage and the assemblage of the mainstem Roanoke River, or that the proposed field effort is extended further downstream than the currently proposed Project extent in response to agency requests.

Aquatic biological studies were requested and refined during the development of the Project's Proposed Study Plan, Revised Study Plan, and Study Plan Determination that included coordination with VDWR, USFWS, and USEPA. Three of the requested studies occur during the recommended TOYRs (Table 1). Documents outlining agency requests and specific Project methodologies are located at http://www.aephydro.com/HydroPlant/Niagara, but general methods and rationale are provided below as a quick review.

This information is provided in addition to the USFWS Self Certification Letter and Project Verification Package (attached), as required per the Virginia TOYR guidance document dated February 2021. This information was also submitted to the USFWS.

The applicable TOYRs in the Project area occur in Roanoke River and Tinker Creek for Roanoke Logperch (*Percina rex*; RLP), stocked trout, and Orangefin Madtom (*Noturus gilberti*). Instream field sampling efforts will target RLP at various life stages and supplemental macroinvertebrate collections. Although additional survey efforts are proposed, those survey activities anticipated during TOYR's are described below.

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	Drift Net - Larval RLP	April 1 – June 30
	Backpack Electrofishing - RLP	June 1 – June 30
[c] October 1 – June 15	Kick Net - Macroinvertebrates	March 1 – May 31
	Drift Net - Larval RLP	April 1 – June 30
	Backpack Electrofishing - RLP	June 1 – June 30
[d] February 15 – June 15	Kick Net - Macroinvertebrates	March 1 – May 31
	Drift Net - Larval RLP	April 1 – June 30

Backpack Electrofishing - RLP	June 1 – June 30

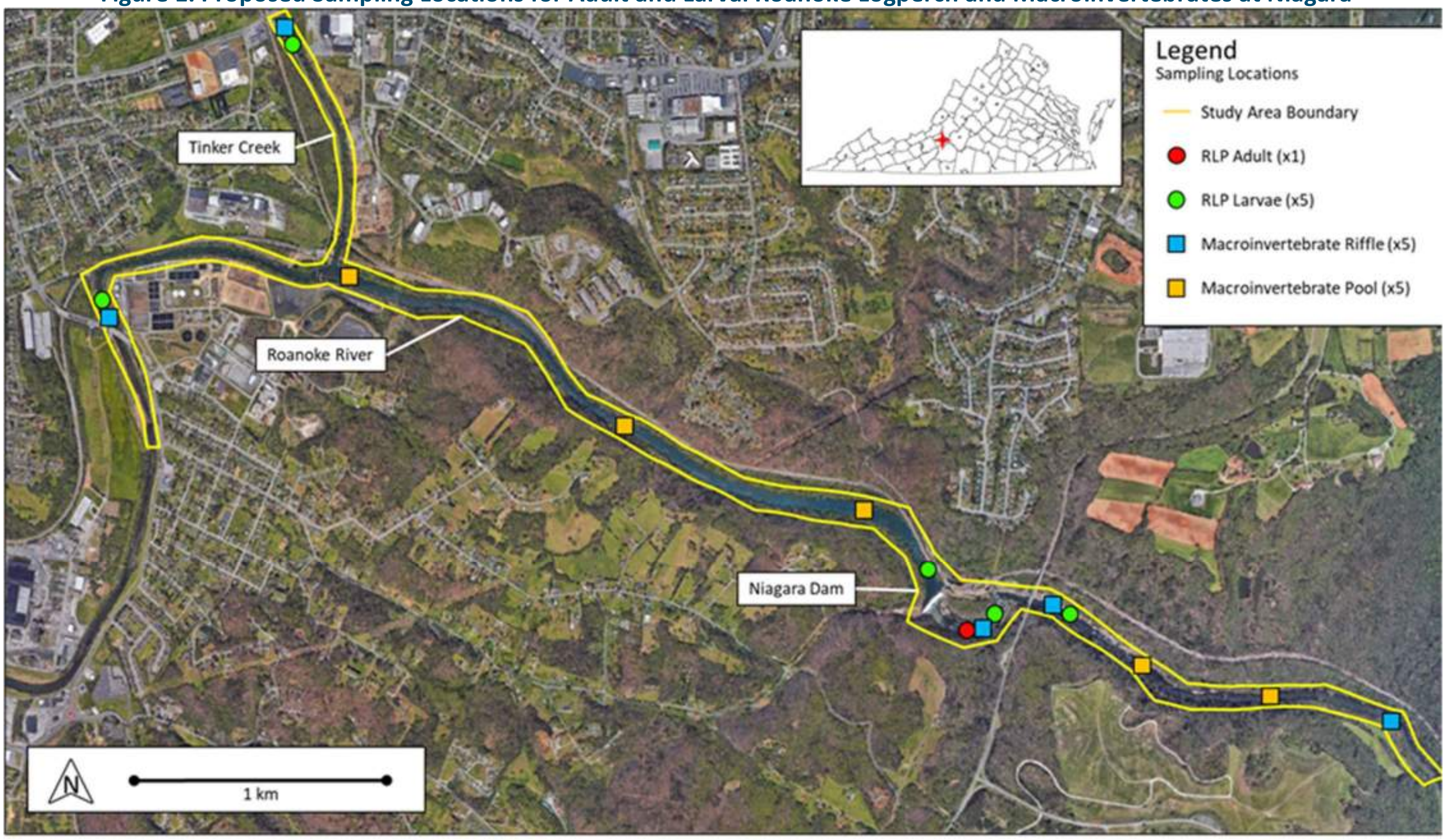
[a] No sampling in orangefin madtom waters from March 15th through May 31st

[b] No sampling in Roanoke logperch waters from March 15th through June 30th

[c] No sampling in stocked trout waters from October 1st through June 15th

[d] No fish assemblage sampling in Smith Mountain Lake from February 15 – June 15

Figure 1. Proposed Sampling Locations for Adult and Larval Roanoke Logperch and Macroinvertebrates at Niagara



We appreciate your consideration and request your concurrence on the information herein. Please contact Jon Studio (440-413-4609; jastudio@edge-es.com) or John Spaeth (513-377-0443; jpspaeth@edge-es.com) if you have any questions or require additional information regarding this request.

Thanks,

JON A. STUDIO
Avon, Ohio
M: 440.413.4609
edge-es.com

United States Department of the Interior

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

In Reply Refer To: March 24, 2021
Consultation Code: 05E2VA00-2021-SLI-2810
Event Code: 05E2VA00-2021-E-08113
Project Name: Niagara Hydroelectric Project (FERC No. 2466) 2021 Field Sampling TOYR Waiver Request

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

To Whom It May Concern:

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

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

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

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

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

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

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

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

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

Attachment(s):

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

Official Species List

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

This species list is provided by:

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

Project Summary

Consultation Code:	05E2VA00-2021-SLI-2810
Event Code:	05E2VA00-2021-E-08113
Project Name:	Niagara Hydroelectric Project (FERC No. 2466) 2021 Field Sampling TOYR Waiver Request
Project Type:	POWER GENERATION
Project Description:	Location: Tinker Creek and Roanoke River in Roanoke County, Virginia within the Niagara Hydroelectric Project FERC Project boundary. Scope: Requesting time-of-year-restrictions (TOYR) waiver for proposed field sampling activities for 2021. Although current study plans do not extend to the Smith Mountain Lake, a TOYR waiver is also requested for the Smith Mountain Lake fish assemblage in the event that there is overlap with fish species protected as part of the Smith Mountain Lake fish assemblage and the assemblage of the mainstem Roanoke River, or that the proposed field effort is extended further downstream than the currently proposed project extent in response to agency requests.

Aquatic biological studies were requested and refined during the development of the Project's Proposed Study Plan, Revised Study Plan, and Study Plan Determination that included coordination with VDWR, USFWS, and USEPA. Three of the requested studies occur during the recommended TOYRs (Table 1). Documents outlining agency requests and specific Project methodologies are located at http://www.aephydro.com/HydroPlant/Niagara.

Timing:
Table 1: Roanoke River and Tinker Creek Time-of-Year Restriction Waiver Requested Activity
State-Recommended TOYR Waiver Activity Request Activity Date Range
(a) March 15 – May 31 Kick Net - Macroinvertebrates March 1 – May 31
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(b) March 15 – June 30 Kick Net - Macroinvertebrates March 1 – May 31
Drift Net - Larval RLP April 1 – June 30
Backpack Electrofishing - RLP June 1 – June 30
(c) October 1 – June 15 Kick Net - Macroinvertebrates March 1 – May 31
Drift Net - Larval RLP April 1 – June 30
Backpack Electrofishing - RLP June 1 – June 30
(d) February 15 – June 15 Kick Net - Macroinvertebrates March 1 – May 31
Drift Net - Larval RLP April 1 – June 30
Backpack Electrofishing - RLP June 1 – June 30

(a) No sampling in orangefin madtom waters from March 15th through May 31st

(b) No sampling in Roanoke logperch waters from March 15th through June 30th
(c) No sampling in stocked trout waters from October 1st through June 15th
(d) No fish assemblage sampling in Smith Mountain Lake from February 15 – June 15

Project Location:

Approximate location of the project can be viewed in Google Maps: https://www.google.com/maps/@37.26009525,-79.887978906288,14z

Counties: Bedford, Roanoke, and Roanoke counties, Virginia

Endangered Species Act Species

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

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

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

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

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

Mammals

NAME	STATUS
Indiana Bat *Myotis sodalis* There is **final** critical habitat for this species. The location of the critical habitat is not available. Species profile: https://ecos.fws.gov/ecp/species/5949	Endangered
Northern Long-eared Bat *Myotis septentrionalis* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/9045	Threatened

Fishes

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

Critical habitats

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

USFWS National Wildlife Refuge Lands And Fish Hatcheries

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

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

Niagara Hydroelectric Project (FERC No. 2466) 2021 Field Sampling TOYR Waiver Request

Biological Assessment

Prepared using IPaC
March 26, 2021

The purpose of this Biological Assessment (BA) is to assess the effects of the proposed project and determine whether the project may affect any Federally threatened, endangered, proposed or candidate species. This BA is prepared in accordance with legal requirements set forth under Section 7 of the Endangered Species Act (16 U.S.C. 1536 (c)).

In this document, any data provided by U.S. Fish and Wildlife Service is based on data as of March 26, 2021.

Prepared using IPaC version 5.56.1

Niagara Hydroelectric Project (FERC No. 2466) 2021 Field Sampling TOYR Waiver Request Biological Assessment

Table Of Contents

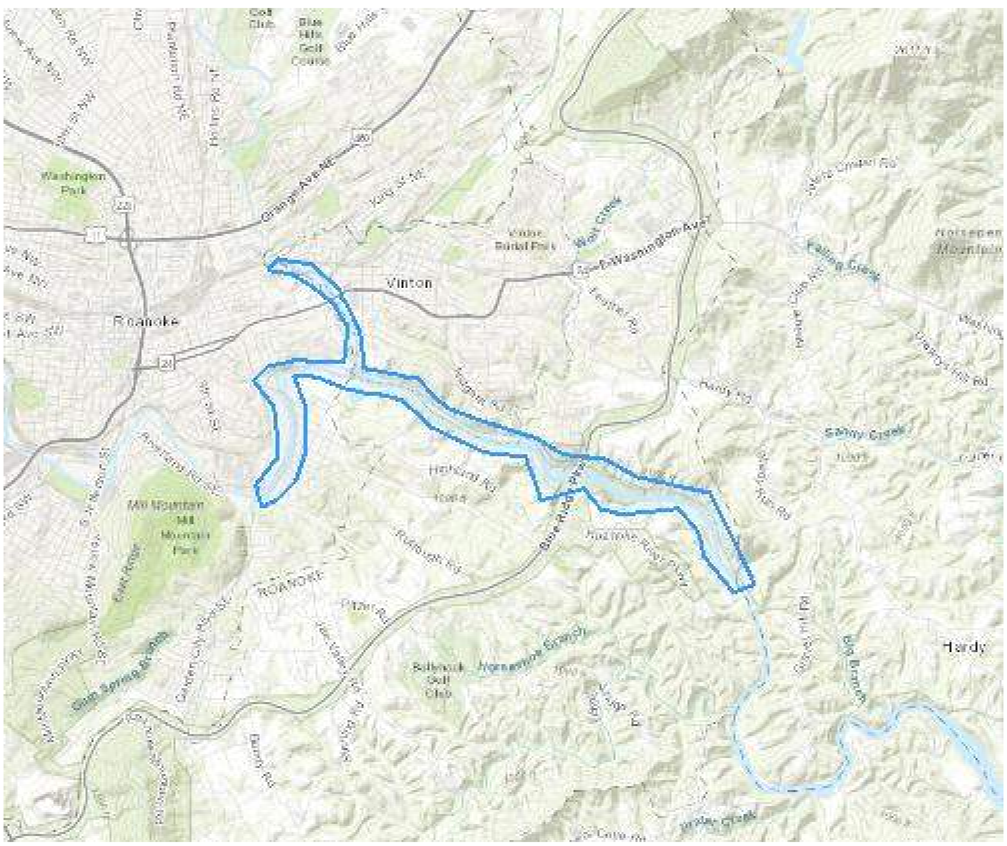
1 Description Of The Action

1.1 Project Name
Niagara Hydroelectric Project (FERC No. 2466) 2021 Field Sampling TOYR Waiver Request

1.2 Executive Summary
See attached Application Form/Package

Effect determination summary

1.3 Project Description

1.3.1 Location


LOCATION
Bedford, Roanoke, and Roanoke counties, Virginia

1.3.2 Description of project habitat

Habitat does exist within the Project boundary for Roanoke Logperch and we propose to perform field sampling activities (variety of methodologies) within these habitats, to target Roanoke Logperch specifically, at the request of Virginia Department of Wildlife Resources and US Fish and Wildlife Service (USFWS) in support of the Niagara Dam Hydroelectric Project relicensing activities. See attached Application Form (3-200-59) previously submitted to USFWS for the proposed field sampling activities for detailed information.

This consultation is being initiated to request waiver from the existing time-of-year-restrictions (TOYR) to facilitate completion of the field sampling activities described in the Project Description and in the attached USFWS Application Form (3-200-59).

Relevant documentation

- Jon Studio 3-200-59 Application Package

1.3.3 Project proponent information

Provide information regarding who is proposing to conduct the project, and their contact information. Please provide details on whether there is a Federal nexus.

Requesting Agency
HDR, Inc.

FULL NAME
Misty Huddleston

STREET ADDRESS
440 S. Church St., Ste 900

CITY	STATE	ZIP
Charlotte	NC	28202-2075

PHONE NUMBER	E-MAIL ADDRESS
(865) 556-9153	misty.huddleston@hdrinc.com

Lead agency
Federal Energy Regulatory Commission

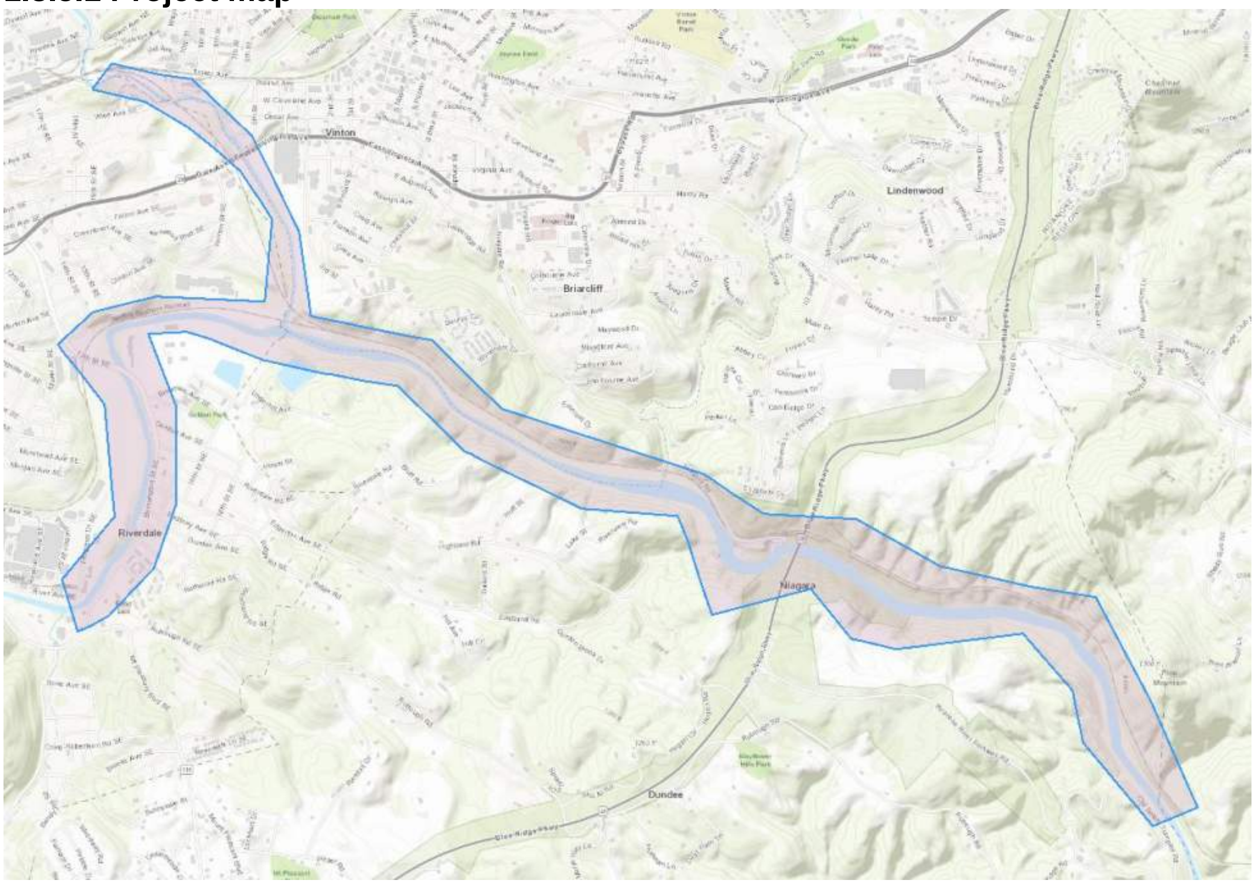
1.3.4 Project purpose

In response to stakeholder and agency requests, Appalachian proposes to perform surveys for Roanoke Logperch within the Project boundary using life stage-specific methodologies, as summarized in the attached Application Package (3-200-59).

1.3.5 Project type and deconstruction

This project is a field survey project.

1.3.5.1 Project map



LEGEND

Project footprint

Fish Community Study Area: Fish community field sampling

1.3.5.2 fish community field sampling

Activity start date
March 31, 2021

Activity end date
June 29, 2021

Stressors
This activity is not expected to have any impact on the environment.

Description
Aquatic biological studies were requested and refined during the development of the Project's Proposed Study Plan, Revised Study Plan, and Study Plan Determination that included coordination with VDWR, USFWS, and USEPA. Three of the requested studies occur during the recommended TOYRs (Table 1). Documents outlining agency requests and specific Project methodologies are located at http://www.aephydro.com/HydroPlant/Niagara, but general methods and rationale are provided below as a quick review.

The applicable TOYRs in the Project area occur in Roanoke River and Tinker Creek for Roanoke Logperch (Percina rex; RLP), stocked trout, and Orangefin Madtom (Noturus gilberti). Instream field sampling efforts will target RLP at various life stages and supplemental macroinvertebrate collections. Although additional survey efforts are proposed, those survey activities anticipated during TOYR's are described below.

RLP larvae: Drift net sampling methods include three biologists deploying two, 20-minute net sets at five sample sites in shallow water adjacent to riffle-run habitat once per week for a total of ten weeks (Figure 1). The ten consecutive weekly samples will occur between April 1 and June 30 to align with RLP spawning.

RLP adults and subadults: A three-day sampling period will occur between June 1 and June 30 to determine RLP occupancy of the Project's bypass reach below Niagara Dam during spring flows. Backpack electrofishing methods include two backpack electrofishing units to sample 64 quadrats (eight meters by four meters) in riffle-run habitat

1.3.6 Anticipated environmental stressors

Describe the anticipated effects of your proposed project on the aspects of the land, air and water that will occur due to the activities above. These should be based on the *activity deconstructions done in the previous section and will be used to inform the action area.*

1.3.6.1 Animal Features

Individuals from the Animalia kingdom, such as raptors, mollusks, and fish. This feature also includes byproducts and remains of animals (e.g., carrion, feathers, scat, etc.), and animal-related structures (e.g., dens, nests, hibernacula, etc.).

1.3.6.2 Plant Features

Individuals from the Plantae kingdom, such as trees, shrubs, herbs, grasses, ferns, and mosses. This feature also includes products of plants (e.g., nectar, flowers, seeds, etc.).

1.3.6.3 Aquatic Features

Bodies of water on the landscape, such as streams, rivers, ponds, wetlands, etc., and their physical characteristics (e.g., depth, current, etc.). This feature includes the groundwater and its characteristics. Water quality attributes (e.g., turbidity, pH, temperature, DO, nutrients, etc.) should be placed in the Environmental Quality Features.

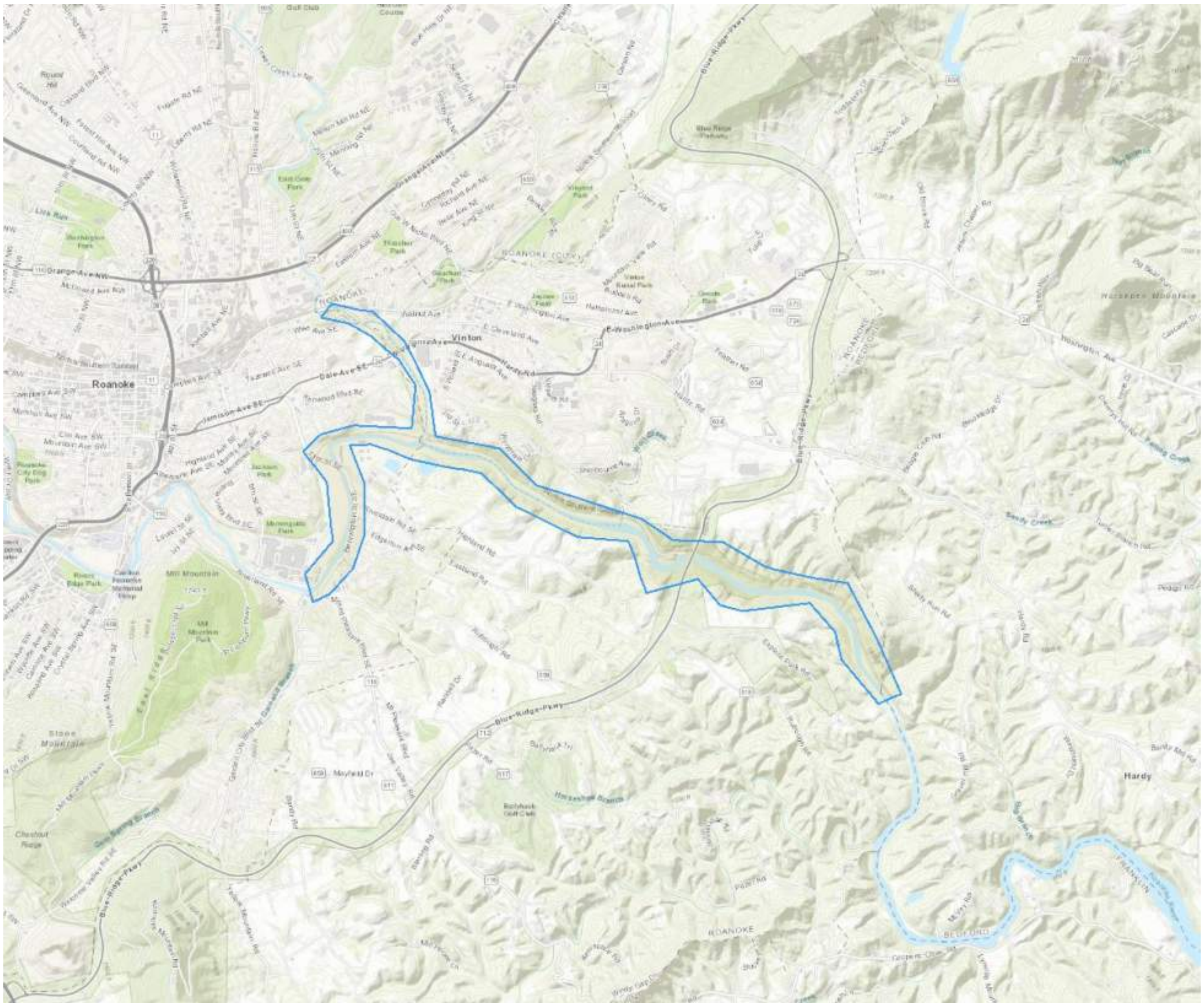
1.3.6.4 Environmental Quality Features

Abiotic attributes of the landscape (e.g., temperature, moisture, slope, aspect, etc.).

1.3.6.5 Soil and Sediment

The topmost layer of earth on the landscape and its components (e.g., rock, sand, gravel, silt, etc.). This feature includes the physical characteristics of soil, such as depth, compaction, etc. Soil quality attributes (e.g, temperature, pH, etc.) should be placed in the Environmental Quality Features.

1.4 Action Area



1.5 Conservation Measures

1.5.1 correct electrofishing techniques

Description
See attached Application Package.

Electrofishing will be used in life stage-specific habitats and when feasible, sampling will be performed using snorkel survey techniques.

Direct interactions
- electrocution

1.5.2 targeted sampling design

Description
Larval drift study was designed to use the minimum number of sampling events to confidently document drift of eggs and larvae within the Project area, while minimizing the numbers of organisms collected.

Direct interactions
- collection

1.6 Prior Consultation History

See attached Application Form/Package

July 2020 consulted on the proposed gate replacement project at Niagara Hydroelectric Project.

Project was approved and construction has been initiated.

1.7 Other Agency Partners And Interested Parties

Virginia Department of Wildlife

See list provided in attached Application Form/Package

1.8 Other Reports And Helpful Information

Project Pre-Application Document (http://www.aephydro.com/Content/documents/2019/NiagaraNoticeofIntentandPre-Application.pdf)

Project Revised Study Plan (http://www.aephydro.com/Content/documents/2019/NiagaraFilingofRevisedStudyPlanforRelicensingStudiesFERCNo2466.pdf)

Project Study Plan Determination (http://www.aephydro.com/Content/documents/2020/20191206_FERC_to_AEP_StudyPlanDetermination.pdf)

Project Initial Study Report (http://www.aephydro.com/Content/documents/2021/NiagaraInitialStudyReport01-11-2021.pdf)

Relevant documentation

- Jon Studio 3-200-59 Application Package

2 Species Effects Analysis

This section describes, species by species, the effects of the proposed action on listed, proposed, and candidate species, and the habitat on which they depend. In this document, effects are broken down as direct interactions (something happening directly to the species) or indirect interactions (something happening to the environment on which a species depends that could then result in effects to the species).

These interactions encompass effects that occur both during project construction and those which could be ongoing after the project is finished. All effects, however, should be considered, including effects from direct and indirect interactions and cumulative effects.

2.1 Indiana Bat

This species has been excluded from analysis in this environmental review document.

Justification for exclusion

Proposed action involves instream sampling for Roanoke Logperch and benthic macroinvertebrates during established TOYR periods. No upland work is proposed for this effort.

2.2 Northern Long-Eared Bat

This species has been excluded from analysis in this environmental review document.

Justification for exclusion

Proposed action involves instream sampling for Roanoke Logperch and benthic macroinvertebrates during established TOYR periods. No upland work is proposed for this effort.

2.3 Roanoke Logperch

2.3.1 Status of the species

This section should provide information on the species' background, its biology and life history that is relevant to the proposed project within the action area that will inform the effects analysis.

2.3.1.1 Legal status

The Roanoke Logperch is federally listed as 'Endangered' and additional information regarding its legal status can be found on the ECOS species profile.

2.3.1.2 Recovery plans

Available recovery plans for the Roanoke Logperch can be found on the ECOS species profile.

2.3.1.3 Life history information

The Roanoke logperch is a large darter, growing to about 6 inches long. It has a bulbous snout, lateral blotches, back is scrawled, and most fins are strongly patterned. First dorsal fin has an orange band, particularly vivid in mature males. It can be found in larger streams in the upper Roanoke, Smith, Pigg, Otter, Nottoway river systems, and Goose Creek in Virginia and in the Dan, Mayo, Smith river sytems and Big Beaver Island Creek in North Carolina. They prefer large sized warm clear streams and riffles, runs and pools with sand, gravel or boulder.

Identified resource needs

Dissolved oxygen

Concentration: normal

Invertebrates

Species: caddisfly larvae of the hydropsychidae and chironomids and other aquatic insects

Runs

Depth: moderate to deep, spatial arrangement: connected to shallow to moderate riffles (male spawning-period habitat) and time of year: april and may

Streamflow

Depth: 16- 30 cm, type: oxbows, backwaters and velocity: slow

Streamflow

Time of year: spring and velocity: fast-flowing

Substrate structure and characteristics

Percent silt: 0-25%, sediment/silt embededness: 0-25% embedded and substrate size: small gravel to boulders

Water temperature

Temperature: 12-14 deg c and time of year: april or may

Water temperature

Temperature: relatively warm

Woody debris

2.3.1.4 Conservation needs

In response to stakeholder and agency requests, Appalachian proposes to perform surveys for Roanoke Logperch within the Project boundary using life stage-specific methodologies, as summarized in the attached Application Package (3-200-59).

2.3.2 Environmental baseline

*The environmental baseline describes the species' health **within the action area only** at the time of the consultation, and does not include the effects of the action under review. Unlike the species information provided above, the environmental baseline is at the scale of the Action area.*

2.3.2.1 Species presence and use

See information summarized in the attached Application Package (3-200-59).

Relevant documentation

- Appalachian Historical Fisheries Surveys 1991 and 1992
- Jon Studio 3-200-59 Application Package

2.3.2.2 Species conservation needs within the action area

In response to stakeholder and agency requests, Appalachian proposes to perform surveys for Roanoke Logperch within the Project boundary using life stage-specific methodologies, as summarized in the attached Application Package (3-200-59).

2.3.2.3 Habitat condition (general)

http://www.aephydro.com/Content/documents/2021/NiagaraInitialStudyReport01-11-2021.pdf

Supporting documentation

- Appalachian Historical Fisheries Surveys 1991 and 1992
- Jon Studio 3-200-59 Application Package

2.3.2.4 Influences

In response to stakeholder and agency requests, Appalachian proposes to perform surveys for Roanoke Logperch within the Project boundary using life stage-specific methodologies, as summarized in the attached Application Package (3-200-59).

2.3.2.5 Additional baseline information

In response to stakeholder and agency requests, Appalachian proposes to perform surveys for Roanoke Logperch within the Project boundary using life stage-specific methodologies, as summarized in the attached Application Package (3-200-59).

2.3.3 Effects of the action

This section considers and discusses all effects on the listed species that are caused by the proposed action and are reasonably certain to occur, including the effects of other activities that would not occur but for the proposed action.

2.3.3.1 Indirect interactions

As part of your project description, you identified that there are no anticipated environmental stressors resulting from your proposed project. Because there are no stressors occurring, no resource needs will be exposed to or affected by changes in the environment. Therefore, no indirect interactions will occur that would result in effects to the Roanoke Logperch.

2.3.3.2 Direct interactions

DIRECT IMPACT	CONSERVATION MEASURES	INDIVIDUALS IMPACTED	IMPACT EXPLANATION
Collection	Targeted sampling design	Yes	See attached Application Package
Electrocution	Correct electrofishing techniques	No	Aquatic biological studies were requested and refined during the development of the Project's Proposed Study Plan, Revised Study Plan, and Study Plan Determination that included coordination with VDWR, USFWS, and USEPA. Three of the requested studies occur during the recommended TOYRs (Table 1). Documents outlining agency requests and specific Project methodologies are located at http://www.aephydro.com/HydroPlant/Niagara, but general methods and rationale are provided below as a quick review.

DIRECT IMPACT	CONSERVATION MEASURES	INDIVIDUALS IMPACTED	IMPACT EXPLANATION
			RLP adults and subadults: A three-day sampling period will occur between June 1 and June 30 to determine RLP occupancy of the Project's bypass reach below Niagara Dam during spring flows. Backpack electrofishing methods include two backpack electrofishing units to sample 64 quadrats (eight meters by four meters) in riffle-run habitat . Electrofishing equipment will be adjusted to function safely, providing minimum dose to facilitate collection while minimizing risks for fish damage or mortality.

2.3.4 Cumulative effects

http://www.aephydro.com/Content/documents/2021/NiagaraInitialStudyReport01-11-2021.pdf (http://www.aephydro.com/Content/documents/2021/NiagaraInitialStudyReport01-11-2021.pdf)

See attached Application Package

2.3.5 Discussion and conclusion

Determination: NLAA

Compensation measures

See attached Application Package

Relevant documentation

- Appalachian Historical Fisheries Surveys 1991 and 1992
- Jon Studio 3-200-59 Application Package

3 Critical Habitat Effects Analysis

No critical habitats intersect with the project action area.

4 Summary Discussion, Conclusion, And Effect Determinations

4.1 Effect Determination Summary

SPECIES (COMMON NAME)	SCIENTIFIC NAME	LISTING STATUS	PRESENT IN ACTION AREA	EFFECT DETERMINATION
Indiana Bat	Myotis sodalis	Endangered	No	NE
Northern Long-eared Bat	Myotis septentrionalis	Threatened	No	NE
Roanoke Logperch	Percina rex	Endangered	Yes	NLAA

4.2 Summary Discussion

See attached Application Form/Package

4.3 Conclusion

See attached Application Form/Package

Table of Contents:

1. Application Form (3-200-59)

FEDERAL FISH AND WILDLIFE PERMIT APPLICATION FORM
U.S. FISH AND WILDLIFE SERVICE

Return to: U.S. Fish and Wildlife Service (USFWS)
click here for return addresses

Type of Activity: Native Endangered and Threatened Species Scientific, Enhancement of Propagation, or Survival (i.e., Purposeful Take for Recovery)

Complete Sections A or B, and C, D, and E of this application. A U.S. physical address is required in Section C, see instructions for details.
Refer to the Application Form Instructions for information on how to make your application complete and help avoid unnecessary delays.

A. Complete if applying as an individual

1.a. Last name	1.b. First name	1.c. Middle name or initial	1.d. Suffix
Studio	Jonathan	Achille	NA

2. Date of birth (mm/dd/yyyy)	3. Occupation	4.a. Affiliation/Doing business as (see instructions)	4.b. Website URL (if applicable)
10/27/1992	Biologist/Ecologist	Edge Engineering and Science	NA

5.a. Telephone number	5.b. Alternate telephone number	6. E-mail address
(440) 413-4609	NA	jonstudio27@gmail.com

B. Complete if applying on behalf of a business, corporation, public agency, Tribe, or institution

1.a. Name of business, agency, Tribe, or institution	1.b. Doing business as (dba)
NA	NA

2. Tax identification no.	3.a. Description of business, agency, Tribe, or institution	3.b. Website URL (if applicable)
NA	NA	NA

4.a. Principal officer (P.O.) last name	4.b. P.O. first name	4.c. P.O. middle initial	4.d. P.O. e-mail address
NA	NA	NA	NA

5. P.O. title	6. Primary contact name
NA	NA

7.a. P.O. telephone number	7.b. Alternate phone no.	8.a. Primary contact telephone no.	8.b. Primary contact e-mail address
NA	NA	NA	NA

C. All applicants MUST complete

1.a. Physical address (U.S. Street address; Apartment #, Suite #, or Room #; ***no P.O. Boxes***)
36550 Chester Road; Apartment 4801

1.b. City	1.c. State	1.d. Zip code/Postal code	1.e. County/Province	1.f. Country
Avon	Ohio	44011	Lorain	United States

2.a. Mailing address (if different than physical address) and name of contact person (if applicable)
NA

2.b. City	2.c. State	2.d. Zip code/Postal code	2.e. County/Province	2.f. Country
NA	NA	NA	NA	NA

D. All applicants MUST complete

1. Attach the nonrefundable application processing (check or money order), payable to the U.S. FISH AND WILDLIFE SERVICE **in the amount indicated on page 3**. Federal, Tribal, State, and local government agencies, and those acting on behalf of such agencies, are exempt from the processing fee – ***attach documentation of fee exempt status as outlined in Application Form Instructions*** (50 CFR 13.11(d)).

2. Do you currently have or have you ever had any Federal Fish and Wildlife permits (includes named on permit or List of Authorized Individuals)?
   - ■ **Yes**. List the number of the most recent permit you have held, or that you are applying to renew or amend: TE02373A-14
   - **No.**

Certification: I hereby certify that I have read and am familiar with the regulations contained in ***Title 50, Part 13 of the Code of Federal Regulations*** and the other ***applicable parts in subchapter B of Chapter I of Title 50***, and I certify that the information submitted in this application for a permit is complete and accurate to the best of my knowledge and belief. I understand that any false statement herein may subject me to the criminal penalties of 18 U.S.C. 1001.

Jonathan Studio Digitally signed by Jonathan Studio
Date: 2020.12.21 10:04:22 -05'00'

12/21/2020

Original or electronic signature of individual applicant/Principal Officer (no photocopied or stamped signatures) **Date** (mm/dd/yyyy)

E. ALL APPLICANTS MUST COMPLETE.

Provide the information outlined in Section E. on the following pages. Be as complete and descriptive as possible. Please do not send pages that are over 8.5" x 11," videotapes, or DVDs. See page 9 for information on the Paperwork Reduction Act, Privacy Act, and Freedom of Information Act aspects of your application.

OTHER FEDERAL, TRIBAL, STATE, OR LOCAL APPROVALS OR AUTHORIZATIONS REQUIRED TO CONDUCT YOUR REQUESTED ACTIVITY

Please be aware that there may be other requirements necessary to conduct proposed activities such as obtaining permission to work on Federal or Tribal lands, a Federal bird banding permit, a Tribal, State, county or municipal permit, etc.

Have you obtained all required Federal, Tribal, State, county, municipal or foreign government approval to conduct the activity you propose?

☐ **Yes.** Provide a copy of the approval(s). List the Federal agency, tribe, State, county, and/or municipality involved and type of document required. Include a copy of these documents with the application.

☐ **I have applied.** List the Federal agency, tribe, State, county, and/or municipality involved, date of application(s), and type of permit(s). Provide the reasons why the authorizations/permits have not been issued.

■ **Not required.** The proposed activity does not require issuance of other approvals and/or authorizations.

No additional permissions are required, as the proposed is a scientific study and not a construction-related or other activity that would disturb additional resources. The study is being conducted in support of the FERC relicensing process for Appalachian Power Company's Niagara Hydroelectric Project. All access to the Roanoke River for study activities will be on lands owned by or covered by easement to Appalachian Power Company. Appalachian Power Company has consulted with federal and state agencies (including USFWS and the Virginia Department of Wildlife Resources) regarding the design of the study, and the study methodology and schedule have been approved by FERC.

APPLICATION TYPE AND PROCESSING FEES

Annual reports and any other required reports under your valid permit(s) must be on file before a permit will be considered for renewal or amendment. Check the appropriate box below for the activity that you are requesting.

☐ **Administrative change**: You may update your name, address, telephone number, fax number, or e-mail address in your current application package on file at any time. These changes are considered administrative changes, and an application processing fee is not required. If you wish to make an administrative change, please complete pages 1-4 and indicate the information you are updating (e.g., address, telephone number, etc.). Submit completed pages 1-4 to the appropriate Regional Office (see https://www.fws.gov/endangered/permits/recovery-permits-contacts.html).

Requests other than an administrative change require an application processing fee, as described below. Mark the appropriate box and enclose a check or money order payable to the *U.S. Fish and Wildlife Service* in the amount indicated. If you are ***fee exempt***, attach evidence or a justification and mark this box ☐ (see section D.1.).

■ **New.** $100 permit application processing fee

☐ **Renewal.** $100 permit application processing fee. If you are applying to renew a valid permit, your complete appl9ication package must be received at least **30 days** prior to the expiration of the valid permit (50 CFR 13.22) to avoid a lapse in permit coverage.

Renew my existing valid permit (***without changes***) using my current application on file. Permit no. __________________. Provide the required information under Option 1 below.

Renew my existing valid permit (***with changes***). Permit no __________________. Below, indicate your requested amendments(s) and provide the required information under Option 2.

☐ **Amendment.** $50 permit application processing fee: An amendment to a valid permit is requested at at time other than renewal. Permit no. ______________________.

When the information in your current application package on file has changed, then you must apply for an amendment to your valid permit. For example, **such changes may include the additions of species to the permit and/or changes in location or activities**. Please contact the Regional Recovery Permit Contact within the U.S. Fish and Wildlife Service Region of your proposed activity for technical assistance in making this determination (https://www.fws.gov/endangered/permits/recovery-permits-contacts.html). Provide the required information under Option 2 below. ☐ $0 to **transfer** my existing valid permit. Use Option IV. Below to provide the required information.

Please indicate the amendment(s) you are requesting:

☐ Add species (specify) ____

☐ Add new activity) ____

☐ Add a geographic area ____

☐ Change in personnel ____

☐ Other (specify) ____

REFERRAL OF A RECOVERY PERMITTEE'S CONTACT INFORMATION (OPTIONAL)

The U.S. Fish and Wildlife Service often receives requests for contact information Permittees who could conduct endangered and threatened species (e.g., presence/absence surveys) contract work. In accordance with our Privacy Act System of Records Notice (Permits System, Interior, FWS-21), we may release the name, business address, business email address or business telephone number of those who wish to be contacted by third parties to do commercial survey activities. Such information is not normally released under the Freedom of Information Act - unless a compelling need on the part of the general public can be cited.

Please be aware that provision of Permittee contact information does not represent an endorsement by the USFWS of any particular Permittee. A referral is provided at the discretion of each U.S. Fish and Wildlife Service Regional Office as time and workload allow.

Please indicate below your preference for the release of your contact information to third parties.

☒ **Yes**. The U.S. Fish and Wildlife Service may release my name, business address, business email address and/or business telephone number to third parties as a referral for endangered and threatened species contract work.

☐ **No.** The U.S. Fish and Wildlife Service may not release my name, business address, business email address, and/or business telephone number to third parties.

SEA TURTLES

If your application involves sea turtles, please be aware that we share jurisdiction with National Marine Fisheries Service (NMF)/National Oceanic and Atmospheric Administration (NOAA) Fisheries for **sea turtles**. We evaluate applications for permits to conduct activities impacting sea turtles on land, or when applicants are conducting activities both on land and in the marine environment, and NMFS/NOAA Fisheries evaluates applications for permits to conduct activities impacting sea turtles in the marine environment. To apply for a permit to conduct activities with sea turtles in the marine environment or other species under NMFS/NOAA Fisheries jurisdiction, please contact the NMFS via their permit web page at https://www.fisheries.noaa.gov/permits-and-forms.

DISQUALIFICATION FACTOR

A conviction, or entry of a plea of guilty or *nolo contendere*, for a felony violation of the Endangered Species Act, Lacey Act, Migratory Bird Treaty Act, or the Bald and Golden Eagle Protection Act disqualifies any such person from receiving or exercising the privileges of a permit, unless such disqualification has been expressly waived by the USFWS Director in response to a written petition (50 CFR 13.21(c)).

Have you or, if applying as a business, any of the owners of the business, been convicted, or entered a plea of guilty or *nolo contendere*, forfeited collateral, or are currently under charges for any violations of the Endangered Species Act, Lacey Act, Migratory Bird Treaty Act, or the Bald and Golden Eagle Protection Act?

☒ **No.**

☐ **Yes.** Provide the following (use a separate page(s) if needed to complete your response:

a) The individual's name:

b) Date of charge:

c) Location of incident:

d) Court:

e) Action taken for each violation:

SPECIFIC RELEVANT ACTIVITY REQUIRED INFORMATION: OPTION 1

Option 1. Renew an existing valid recovery permit *without* changes.

If you are applying to **renew an existing valid recovery permit without changes,** sign the following statement. The individual signing Section D. on page 1 of the application must also sign the following statement. This certification language is required under 50 CFR 13.22(a).

I certify that the statements and information submitted in support of my original application for a U.S. Fish and Wildlife Service Recovery permit no. TE_________________ are still current and correct and hereby request renewal of that permit without changes. I also certify that all annual reports and any additional reporting requirements have been submitted to the USFWS.

____

Original or electronic signature of individual applicant/Principal Officer

____

Please legibly write or type the Signatory's name

____

Date

Signing the above statement completes your renewal application. Please submit completed pages 1- 5 of this application to the Regional Office covering the location of your proposed activity (see https://www.fws.gov/endangered/permits/recovery-permits-contacts.html). Requests for permit renewal must be complete and received by the USFWS no later than 30 days prior to the permit expiration to ensure that your current permit remains in effect while we process your request.

SPECIFIC RELEVANT ACTIVITY REQUIRED INFORMATION: OPTION 2

Option 2. New Recovery Permit, *or* Renewal with Amendment, *or* Amendment of an Existing Permit

General permit regulations for the USFWS are found at 50 CFR 13. Regulations for Recovery permits under the Endangered Species Act (ESA) can be found at 50 CFR 17.22(a)(1) for endangered wildlife species, 50 CFR 17.32(a)(1) for threatened wildlife species, 50 CFR 17.62 for endangered plant species, and 50 CFR 17.72 for threatened plant species.

Applications for a recovery permit must provide the following specific information (relevant to the activity) in addition to the general information on the previous pages of this application form. Please attach separate pages as needed. In order to assist us in processing your application, please provide the item number (i.e., A.1.a., etc.) that corresponds to the required information before each of your responses.

A. **Identify species and activity:**

1. For a new Recovery Permit or Amendment of an Existing Permit:

   a. Provide the common and scientific names of the species being requested for coverage in the permit and their status (endangered (E) or threatened (T)). If you need to search for the scientific name of the species, please visit www.fws.gov/endangered/?ref=topbar. If you are requesting the addition of species to an existing permit, identify the species to be added to your valid permit.

   b. Provide the number, age, and sex of such species to the extent known.

   c. Identify the activity(ies) sought to be authorized (i.e., presence/absence survey, nest monitoring, bird banding, etc.) for each species. If you hold a valid permit and you are not requesting changes to authorized activities, indicate “No Changes”.

   d. Provide the project title and project duration (start date/completion date) along with a copy of the study proposal, project funding agreement(s), etc., if applicable.

   e. If you hold a valid permit and wish to amend it to delete species and/or activities, please identify activities and/or species to be deleted from your valid permit and the reason(s) for the deletion.

2. Also, for the collection of ***plants*** *from the wild on lands under Federal jurisdiction*:

   a. Describe the plant part(s), and the number(s) or other type(s) of indication of material you plan to collect (i.e., whole plant, leaves, pollen, seeds, etc.).

   b. If the proposed activity involves the collection of seeds from the wild, provide information that evaluates the effects of the seed collection on the reproductive potential of the species at the collection location.

B. Identify the location of the proposed activity:

1. Provide the name of each State, county, Tribal land, and the specific location of the proposed activity site(s) below. Include a formal legal description, section/township/range information, county tax parcel number, local address, or any other identifying property designation that will precisely place the location of the proposed activity site(s) below. Because the permit is enforceable; it is *required* that you list each specific State that you wish to work in.

Location	
State, county, tribal land, and the specific location of the proposed activity:	Roanoke, Virginia
Location Description:	Niagara Hydroelectric Project (FERC No. 2466-034). See Sections B.1. and B.2. in attached document.

2. If the specific study area is known at the time of application, attach a U.S. Geological Survey map of the study area in 7.5 minute quadrangle (1:24,000) scale, or other appropriately scaled map. If you plan to conduct surveys on a contract basis in the future, these maps can be provided once the specific area is known, however, the counties in which you propose to work in must be provided at this time, or at the very least, the State(s).

3. If your request is for aquatic species, identify the aquatic system (river/lake/stream name, river mile information, and drainage basin).

4. For plant species, identify the lands under Federal jurisdiction (name, address) where the proposed activities will be conducted.

C. Describe the proposed activity:

Provide a statement justifying the permit request, including the items listed below. A copy of the pertinent research or study proposal that provides the required information should be attached if available. Attach additional separate pages as necessary.

1. Describe how the activities or proposal will help recover each species.

    a. If there is an approved recovery plan, identify the recovery tasks by number and name, if applicable. Include any additional recovery tasks identified in a Spotlight Species Action Plan, if applicable, or in a 5-year status review of the species.

    b. Identify or provide copies of any previous or similar research conducted on this species.

    c. If this information exists, explain how the project will attempt to answer questions not answered by earlier research.

    d. Explain how you will coordinate your efforts with past and ongoing research studies.

2. Describe in detail the purpose(s) and objective(s) of the activities or project.

    a. Provide the study design, sampling methods and equipment to be used.

    b. Identify any null hypothesis or other anticipated results from the project that will support the reasoning that the project will enhance the propagation or survival of the affected species.

    c. Include planned disposition of specimens upon completion of project.

3. Can this activity or project result in the injury, death, or removal from the wild of any individuals of the species?

    a. If yes, describe all that apply (i.e., injury, death, removal from the wild).

    b. For each species, please state the maximum number of individuals that would be injured, killed, or removed from the wild: [*If applicable, please identify, based on a reasonable expectation, the number of individuals likely to be injured or killed per activity.]*

    c. Please state what will be done to minimize the possibility of injury to or death of individuals.

    d. If the proposed activity would cause the death of individuals from the wild or removal of individuals from the wild, describe your attempts to obtain the wildlife or plant specimens currently held in captivity/nurseries/museums, or produced in captivity. You must demonstrate conclusively that existing specimens are unavailable or your study objectives require new/additional specimens. *[Provide the identity and telephone number of each contact made in this regard.]*

4. Identify contracts and agreements held for the proposed activities (attach a copy or provide the title, funding organization name and address, date of signature, and duration of the contract).

    Indicate whether full funding will be available for the completion of the proposed activity. *[If you do not hold a contract at this time, but foresee receiving one, you may apply for a permit contingent upon receiving the contract(s).]*

5. If live wildlife or plants to be covered by the permit are to be held in captivity:

    [Note: Under regulations at 50 CFR 17.22(a)(3) and 17.32(a)(3), escape of wildlife held in captivity must be reported immediately to our appropriate Regional Office (see page 9 - USFWS Regional Contacts or www.fws.gov/endangered/regions/index.html).

    a. Provide a complete description, along with photographs and/or diagrams, of the area and facilities where wildlife or plant(s) will be held and/or maintained in captivity and describe arrangements for care during transportation and maintenance. Include the name and physical address of the area and facilities. *[A separate discussion specific for each species must be provided, when applicable.]*

    b. Provide the full name and contact information of the person(s) who will care for live specimens, and include a description of their experience in caring for these or similar species, including a resume of their experience in raising, caring for, and propagating these or similar wildlife or plants.

    c. Provide a copy of any contract or agreement you have secured for care of any live specimens collected under this permit request if the identified facility is not affiliated with you.

d. List mortalities and/or injuries resulting from your activities with these or similar species in the last 2 years.

e. Provide an explanation of each mortality event and the procedures employed or modified to eliminate any future mortality events.

f. Indicate your willingness to participate in a cooperative breeding or propagation program or to contribute data to a database or studbook. Holding wildlife and plants in captivity must comply with our Policy Regarding Controlled Propagation of Species Listed under the Endangered Species Act. This policy can be found on the USFWS Endangered Species web page at www.fws.gov/endangered/laws-policies/policy-controlled-propagation.html. Briefly describe how the proposed activity will comply with this policy.

g. State the planned disposition of the collected and/or propagated species after termination of the project/activity.

6. If working in multiple terrestrial and/or aquatic sites, provide the steps, protocols, and methodologies you will follow to prevent the spread of invasive species, infectious disease agents, and parasitic organisms, and to decontaminate vehicles and equipment.

D. Identify the persons who will conduct the proposed activity:

1. Provide the full name of all individuals, *including first name, middle initial, and last name,* who you propose will conduct activities under this permit (Please note that only those individuals who will be conducting the proposed activities independently without direct, and on-site supervision of an appropriately permitted individual need be included here).

a. If more than one activity is included in the permit application, indicate which activity(ies) will be completed by each individual.

b. For each listed individual, please provide a copy of each person's resume and/or curriculum vitae, in addition to specific information on previous professional training and experience conducting the proposed activities with the requested species or similar species. Information must include: dates and locations of previous activities involving these or similar species and the name of the supervising individual(s) under which such activities were conducted, and the approximate number of each species the applicant has worked with at each site.

c. For each listed individual, please provide at least two reference letters indicating the name, title, organization, email address, and telephone number preferably from federally permitted persons independent of each individual's place of employment, who can verify the individual's experience with the species.

END OF APPLICATION REQUIREMENTS

APPLICATION FORM INSTRUCTIONS

The following instructions pertain to U.S. Fish and Wildlife Service (USFWS) permit applications. The General Permit Procedures in 50 CFR 13 address the permitting process. For simplicity, all licenses, permits, registrations, and certificates are referred to as a permit.

GENERAL INSTRUCTIONS:

- Complete all relevant questions in Sections A or B, C, D, and E.
- **An incomplete application may cause delays in processing or may be returned to the applicant. Be sure you are completing in the appropriate application form for the proposed activity.**
- Print clearly or type the required response. Illegible applications may cause delays.
- Original or electronic signature of the application is required. Faxes or copies of the original signature will not be accepted.
- Mail the original application to the address at the top of page one of the applications or, if applicable, on the attached address list.
- **Keep a copy of your completed application.**
- **Please plan ahead. Allow at least 60 days for your application to be processed; however, some applications may take longer than 90 days to process (50 CFR 13.11).**
- Applications are processed in the order in which they are received.

SECTION A OR SECTION B:

Section A. **Complete if applying as an individual:**

- Enter the complete name of the responsible individual who will be the permittee if a permit is issued. Enter personal information that identifies the applicant.
- If you are applying on behalf of a client, the personal information must pertain to the client, and a document evidencing power of attorney must be included with the application.
- **Affiliation or Doing business as (dba)**: business, agency, organizational, Tribe, or institutional affiliation directly related to the activity requested in the application (e.g., a taxidermist is an individual whose business can directly relate to the requested activity).

Section B. **Complete if applying as a business, corporation, public agency, Tribe, or institution:**

- Enter the complete name of the business, agency, Tribe, or institution that will be the permittee if a permit is issued. Give a brief description of the type of business the applicant is engaged in. Provide contact phone number(s) of the business. If you are applying on behalf of a client, a document evidencing power of attorney must be included with the application.
- **Principal Officer** is the person in charge of the listed business, corporation, public agency, Tribe, or institution and who is responsible for the application and any permitted activities. Often the Principal Officer is a Director or President. The **Primary Contact** is the person at the business, corporation, public agency, Tribe, or institution who will be available to answer questions about the application or permitted activities. Often, it is the preparer of the application.

ALL APPLICANTS COMPLETE SECTION C:

- A physical U.S. address is required.
- **Mailing address** is the address to which communications from USFWS should be mailed if different from the applicant's physical address.

ALL APPLICANTS COMPLETE SECTION D:

Section D.1. **Application processing fee:**

- An application processing fee is required at the time of application, unless exempted under 50 CFR 13. The application processing fee is assessed to partially cover the cost of processing a request. **The fee does not guarantee the issuance of a permit, nor will fees be refunded for applications for which processing has begun.**
- **Documentation of fee exempt status is not required for applications submitted by Federal, Tribal, State, or local government agencies, but must be supplied by those applicants acting on behalf of such agencies**. Such applications must include a letter on agency letterhead and signed by the head of the unit of government for which the applicant is acting on behalf, confirming that the applicant will be carrying out the permitted activity for the agency.

Section D.2. **Federal Fish and Wildlife permits:**

- List the permit number of your most recently issued USFWS permit.

Section D.3. **CERTIFICATION:**

- **The individual identified in Section A, the principal officer named in Section B, or a person with a valid power of attorney (documentation must be included in the application) must sign and date the application using original or electronic signature.** This signature legally binds the applicant to the statement of certification. You are certifying that you have read and understand the regulations that apply to the permit. You are also certifying that all information included in the application is true to the best of your knowledge, as described under 50 CFR 13. Be sure to read the statement and re-read the application and your answers before signing.

NOTICES

PRIVACY ACT STATEMENT

Authority: The information requested is authorized by the following: the Bald and Golden Eagle Protection Act (16 U.S.C. 668), 50 CFR 22; the Endangered Species Act of 1973 (16 U.S.C. 1531-1544), 50 CFR 17; the Migratory Bird Treaty Act (16 U.S.C. 703-712), 50 CFR 21; the Marine Mammal Protection Act (16 U.S.C. 1361, et seq.), 50 CFR 18; the Wild Bird Conservation Act (16 U.S.C. 4901-4916), 50 CFR 15; the Lacey Act: Injurious Wildlife (18 U.S.C. 42), 50 CFR 16; Convention on International Trade in Endangered Species of Wild Fauna and Flora (TIAS 8249), 50 CFR 23; General Provisions, 50 CFR 10; General Permit Procedures, 50 CFR 13; and Wildlife Provisions (Import/export/transport), 50 CFR 14.

Purpose: The collection of contact information is to verify the individual has an eligible permit to conduct activities which affect protected species. This helps USFWS monitor and report on protected species and assesses the impact of permitted activities on the conservation and management of species and their habitats.

Routine Uses: The collected information may be used to verify an applicant's eligibility for a permit to conduct activities with protected species; to provide the public and the permittees with permit related information; to monitor activities under a permit; to analyze data and produce reports to monitor the use of protected species; to assess the impact of permitted activities on the conservation and management of protected species and their habitats; and to evaluate the effectiveness of the permit programs. More information about routine uses can be found in the System of Records Notice, Permits System, FWS-21.

Disclosure: Response to the information requested in this form is voluntary. However, submission of requested information is required to process applications for permits authorized under the listed authorities. Failure to provide the requested information may be sufficient cause for the U.S. Fish & Wildlife Service to deny the request.

PAPERWORK REDUCTION ACT STATEMENT

We are collecting this information subject to the Paperwork Reduction Act (44 U.S.C. 3501) to provide the U.S. Fish and Wildlife Service the information needed to decide whether or not to allow the requested use and to respond to requests made under the Freedom of Information Act and the Privacy Act of 1974. The information that you provide is voluntary; however, submission of the requested information is required to evaluate the qualifications, determine eligibility, and document permit applicants. Failure to provide all required information is sufficient cause for the U.S. Fish and Wildlife Service to deny a permit. We may not conduct or sponsor, and you are not required to respond to a collection of information, unless it displays a currently valid OMB control number. OMB has approved this collection of information and assigned OMB Control No. 1018-0094.

ESTIMATED BURDEN STATEMENT

Public reporting for this collection of information is estimated to average 3 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to the Service Information Clearance Officer, U.S. Fish and Wildlife Service, 5275 Leesburg Pike, MS: PRB (JAO/3W), Falls Church, VA 22041-3803, or via email at **Info_Coll@fws.gov**. Please do not mail your completed form to this address.

FREEDOM OF INFORMATION ACT NOTICE (FOIA)

For organizations, businesses, or individuals operating as a business (i.e., permittees not covered by the Privacy Act), we request that you identify any information that should be considered privileged and confidential business information to allow the USFWS to meet its responsibilities under FOIA. Confidential business information must be clearly marked "Business Confidential" at the top of the letter or page and each succeeding page and must be accompanied by a non-confidential summary of the confidential information. The non-confidential summary and remaining documents may be made available to the public under FOIA [43 CFR 2.23 and 43 CFR 2.24].

2. Introductory Statement and Application Form Supplement

December 17, 2020

To whom this may concern:

My name is Jonathan A. Studio and I work as an ecological consultant and fish biologist for Edge Engineering & Science, LLC (EDGE). I am applying for a new Federal Scientific Collector's Recovery permit for Roanoke Logperch (*Percina rex*; RLP), which I was previously permitted for while under Virgil Brack's permit (TE02373A-14) at Environmental Solutions & Innovations, Inc. (ESI). The following information is submitted to attain a Federal Scientific Collector's permit that will be used to conduct presence/absence and density surveys for Appalachian Power Company's Niagara Hydroelectric Project (FERC No. 2466-034, Project). The referenced surveys were requested by federal and state agencies to support the FERC relicensing process for the Project. All access to the Roanoke River for study activities will be on lands owned by or covered by easement to Appalachian Power Company. Appalachian Power Company has consulted with federal and state agencies (including U.S. Fish and Wildlife Service [USFWS] and Virginia Department of Wildlife Resources [VDWR]) regarding the design of the study, and the study methodology and schedule have been approved by FERC. All other future project details are unknown until proposed projects are requested, at which point all potential surveys will be coordinated with the proper USFWS Regional and/or Field Office and will receive approval before any work or surveys are conducted.

Before starting my career in environmental consulting, I developed an ichthyological knowledgebase during my undergraduate experiences at Kent State University (2011-2015) in Ohio. I then obtained a master's degree from James Madison University (2016-2018) where I investigated competition between American Eels (*Anguilla rostrata*) and Brook Trout (*Salvelinus fontinalis*) in Virginia streams. During this time, I gained experience leading field crews and conducting backpack electrofishing surveys for stream fishes in Shenandoah National Park and George Washington and Jefferson National Forests. I employed methods such as gastric lavage, PIT tagging, and drift netting that require increased caution and care to safely complete and assure minimal adverse impacts to organisms. I have extensive experience capturing, handling, and accurately identifying fishes in multiple watersheds of multiple states and notably including the Roanoke River.

While employed as an aquatic scientist at ESI, most of my time was spent conducting fish surveys in Virginia, primarily in the Roanoke River basin. I trained and supervised field crews while coordinating with clients and state agencies to successfully complete fish removals in dewatered stream sections for various projects where instream-disturbance activities occurred. I completed fish removals in streams of variable sizes, including many (5+) streams that have suitable habitat or known occupation of RLP, and identified thousands of fishes of more than 30 species. Prior to this Project, I have not handled RLP during project-related sampling efforts; however, I have performed observations of young-of-year, juvenile, and adult RLP on several occasions while snorkeling for mussel surveys. I also have experience collecting and safely handling a sister species, Common Logperch (*Percina caprodes*) in Ohio.

My role as a vital teammate responsible for drafting a Biological Assessment to comply with ESA Section 7 consultation on a large interstate pipeline project in Virginia required countless hours of research and synthesis of information on RLP from the available literature. This experience increased my familiarity with the autecology of RLP, including its associated assemblage (e.g., status and distribution, habitat requirements, ontogenetic habitat shifts, land-use impacts, effects analysis and determinations, etc.). More recently, I developed a Study Plan with an embedded experimental design for surveying adult, young-of-year, and larval RLP in association with the Niagara Hydroelectric Project on the Roanoke River (in cooperation with the Applicant, VDWR, U.S. Environmental Protection Agency [USEPA], Virginia Department of Environmental Quality [VDEQ], Virginia Tech [Dr. Paul Angermeier], and USFWS – Gloucester Field Office).

In my current role at EDGE, I have managed several hydroelectric relicensing projects (including Niagara) and served as field crew leader in the Roanoke River in Roanoke County, Virginia (September through October 2020). During general fish community backpack electrofishing surveys in September, we captured a single live RLP adult. I safely and successfully handled, evaluated, and returned this individual to the stream. Although I have conducted fish surveys for over seven years, this RLP collection represented a culmination of my experience and preparation**.**

Specific Relevant Activity Required Information: Option 2

A. Identify species and activity (page 6)**:**

A.1.a. *Percina rex* (Roanoke Logperch; RLP) (Endangered)

A.1.b. Although there is no estimate for abundance of RLP in the Niagara Dam Hydroelectric Relicensing Project (Project) area, Appalachian and AEP (1992) observed 10 RLP and estimated that 24% of the two-mile segment of the Roanoke River below Niagara Dam contained suitable RLP habitat. Further, USFWS (2007) states the upper Roanoke River is occupied by the largest population of RLP.

A.1.c. Activities include individualized survey techniques for each life stage. Survey methods are designed around identifying RLP presence/absence and determining RLP densities. RLP adults (Age 1+) are targeted with backpack electrofishing and seining methods, young-of-year (YOY) are targeted with seine hauls, and larvae are targeted with drift net sets (see Section C below for detailed methodologies).

A.1.d. Niagara Hydroelectric Project (FERC No. 2466-034). March 2021 – September 2021. Study plan and other Project materials can be found here: http://www.aephydro.com/HydroPlant/Niagara. All other potential surveys will be coordinated with the proper USFWS Field Office and will receive approval before any work or surveys are conducted. For the purposes of this permit application, Niagara Hydroelectric Dam Relicensing Project will be the focus of methods and requests.

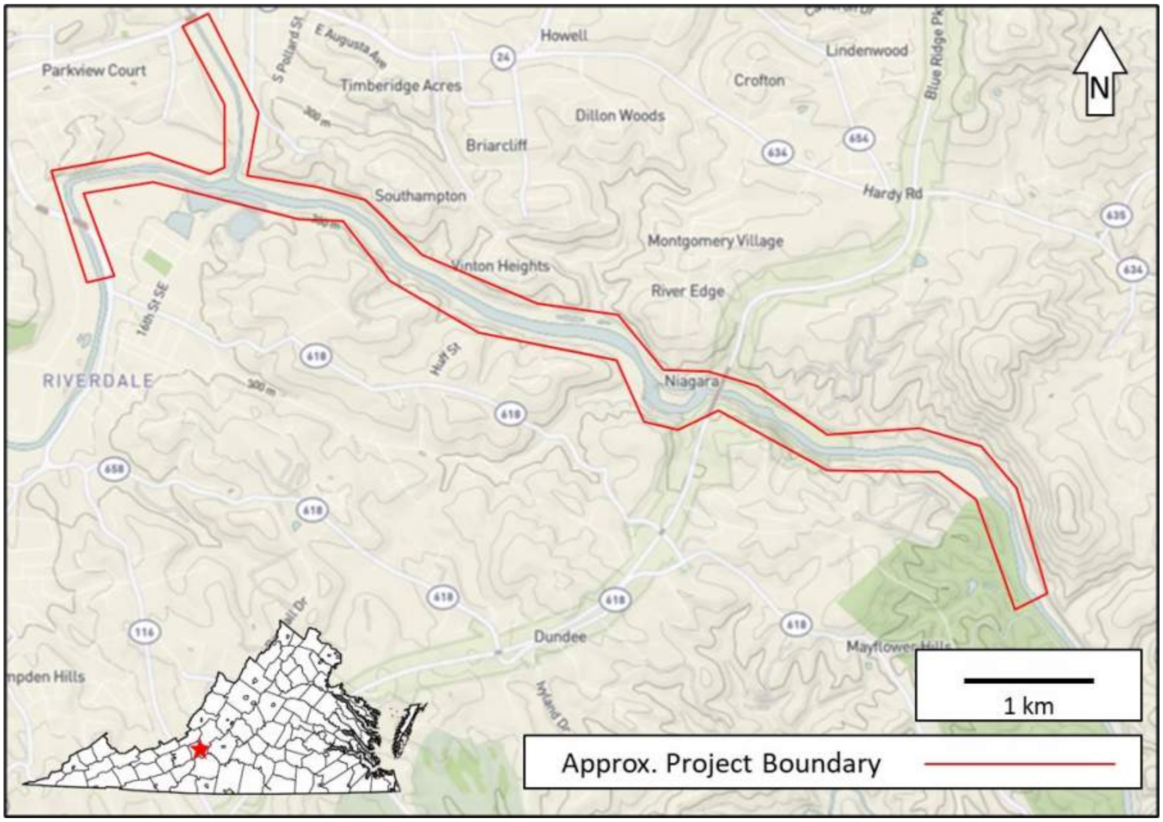
A.1.e. N/A. No deletions requested.

A.2. N/A for all subsections. No plants requested for addition to permit.

B. Identify location of the proposed activity (page 6)**:**

B.1. The Niagara Hydroelectric Project is located in Roanoke County, Virginia. If additional proposed projects are requested range wide for the species, presence/absence and density surveys may also be conducted elsewhere in Virginia and North Carolina throughout their known and historic range (e.g., Upper Roanoke and Dan Rivers and tributaries in the Roanoke River Drainage in Virginia and North Carolina. Nottoway River and tributaries in the Chowan River Drainage). Exact details are unknown until proposed projects are requested at which point all potential surveys will be coordinated with the proper USFWS Regional and/or Field Office and will receive approval before any work or surveys are conducted.

B.2. Current map below (Niagara Hydroelectric Project Area in the Roanoke River, Roanoke County, Virginia):



B.3. Upper Roanoke River system at river mile 355.

B.4. N/A. No plants requested for addition to permit.

C. Describe the proposed activity (page 7)**:**

C.1.a. Avoiding, minimizing, and/or mitigating impacts to RLP can be carried out through project-specific methods and surveys and may further aid in recovery of RLP. More specifically, item seven of 'Actions Needed' within the Roanoke Logperch Recovery Plan (USFWS 1992) reads "monitor population levels and habitat conditions", which will be augmented through Project and future surveys resulting from this permit. Additionally, 'Proposed Recovery Benchmarks' and 'Monitoring Recommendations' sections within An Update to the Roanoke Logperch Recovery Plan (Rosenberger 2007) and item five of 'Recommendations for Future Actions' within RLP 5-Year Review (USFWS 2007) support the need for monitoring to inform recovery of the RLP. Because RLP exhibit ontogenetic habitat shifts, survey efforts targeting various life stages are implemented using separate sampling methods.

Collecting data that helps inform population dynamics and site-specific habitat conditions of RLP through larval surveys in the Upper Roanoke River system may have a great positive impact on conservation because of how little data there currently is, especially with regards to how dams may potentially impact populations and habitat. Only two larval density studies have ever been completed using drift net methods (Hallerman et al. 2017; Buckwalter et al. 2019), thus there is a large knowledge gap in the early life-stages for this species. The proposed Niagara Hydroelectric Project relicensing studies may potentially lend insight into large-scale population dynamics as USFWS (2007) lists large dams and reservoirs as a potential threat to RLP. Sampling techniques will closely follow methods outlined in these two studies, which has been carefully coordinated with the authors and Virginia Polytechnic Institute and State University (Virginia Tech). Supplementary habitat and water quality parameters documented at the time of surveys will fill existing knowledge gaps and potentially facilitate decisions affecting the recommended actions of the RLP Recovery Plan (USFWS 1992), An Update to the Roanoke Logperch Recovery Plan (Rosenberger 2007), and RLP 5-Year Review (USFWS 2007).

(See Section C.1.c. and C.1.d. for further collaboration efforts)

C.1.b. There have been numerous studies identifying habitat suitability, population trends, and conservation needs of adult and young-of-year RLP (e.g., Anderson 2016, Ensign et al. 2000, Lahey and Angermeier 2007, Roberts et al. 2013, and Rosenberger and Angermeier 2002). However, there have only been two larval RLP studies conducted, both concerning drift timing and larval RLP identification methods (Buckwalter et al. 2019 and Hallerman et al. 2017). Drift nets are the most effective sampling methods for *Percina* (Buckwalter et al. 2019) and now that methods of larval RLP identification are being developed, research on this life stage is necessary to further address emergence timing and use of habitat within developed areas of stream ecosystems. Larval survival is a fundamental component in understanding population dynamics for the species and, at present, insufficient information or data are available.

C.1.c. Earlier research focuses on topics listed in Section C.1.b.

- The proposed study will supplement current data by applying previous research methods to analyze the abundance and density within the Upper Roanoke system, which is one of the more robust subpopulations (Lahey and Angermeier 2007).

- Studying relatively healthy populations and their habitat will lend insight to population structure and inform potential goals for increasing habitat and range.

- Understanding potential habitat use and movement through impoundments may be useful for informing operation and maintenance decisions for dams on the Roanoke River and throughout RLP range.

C.1.d. Coordination and cooperation with research entities drives project-specific experimental design and relevant data is disseminated whenever possible. For example, we have a working relationship with Dr. Paul Angermeier at Virginia Tech who is the leading expert on RLP and has provided invaluable insight to this study and the body of knowledge about the species. Our studies will fill gaps in the current body of research and allow his colleagues to identify and house larval specimens for continued research and educational purposes. Larval specimens will be sent to the lab responsible for publishing the majority of the existing RLP research. The Virginia Tech lab will help refine larval identification methods and add directly to the current knowledge base using the same methods and comparable sites, habitats, and locations. The following are just a few of the individuals who requested these studies and have reviewed and concurred with the proposed methodologies:

Mr. John McCloskey
Fish and Wildlife Biologist, Virginia Field Office
US Fish and Wildlife Service
John_mccloskey@fws.gov

Mr. Richard C. McCorkle
Fish and Wildlife Biologist, Pennsylvania Field Office
US Fish and Wildlife Service
richard_mccorkle@fws.gov

Mr. Scott Smith
Region 2 Fisheries Manager
Virginia Department of Wildlife Resources
scott.smith@dwr.virginia.gov

Mr. Brian McGurk
Water Withdrawal Permit Writer
Virginia Department of Environmental Quality
Brian.McGurk@deq.virginia.gov

C.2.a. Study-specific sampling methods for each life stage (adult, YOY, and larvae) are outlined below:

Sampling adult RLP will involve capturing stunned fish in a bag seine that is placed downstream of a backpack electrofishing unit at eight riffle/run sites. Fixed-area quadrat sampling design, which allows for RLP density calculations (Anderson 2016), will be used to sample sites varying from 500 to 5,000 square meters (1,640 to 16,404 square feet). All eight sites will be sampled between August and October 2021. One of these sites (bypass reach) will include an additional sampling event between May and June 2021, pending approval of a RLP time-of-year restriction waiver from VDGIF and USFWS, because it is hypothesized that more-suitable habitat may be available to RLP during elevated spring flows. A range of habitat parameters (i.e., depth, velocity, silt coverage, and pebble counts) will be measured at each sample site to calculate RLP habitat suitability index (HSI) (Ensign et al. 2000). If RLP are not captured during electrofishing surveys at any of the eight sites, biologists will spend a minimum of one-hour search time snorkeling or diving suitable RLP habitat to augment detectability and minimize false-negative survey efforts. Relative abundance, species richness, body condition, spatial distribution, density, and catch per unit effort will be calculated and compared to historical data and previous studies.

Young-of-year will be sampled between August and October 2021 using life-stage specific techniques outlined in Argentina and Roberts (2014) (i.e., using shoreward seine hauls (≥20 per site) in slow moving, shallow, shoreline habitat). Basic water quality and substrate measurements will be collected and recorded at each sample site. All RLP young-of-year individuals will be enumerated and measured for total length and weight. All data will be analyzed with the goal of direct comparison with previously completed YOY RLP studies (e.g., relative abundance, species richness, body condition, spatial distribution, and catch per unit effort).

For adults and young-of-year RLP sampling, the first 30 non-RLP individuals of each species (and all RLP individuals) will be measured for total length and weight. However, all captured individuals will be enumerated and identified to the lowest taxonomic level practicable and released at the location of capture.

RLP larvae will be sampled after dusk from April to June 2021 using two, 20-minute drift net sets per site in riffle/run adjacent habitat. In total, we propose 100 net sets (5 sites, two sets once a week for 10 weeks) using the same methods as Buckwalter et al. (2019). All samples will be preserved in 95% ethanol (resulting in Take) and stored before species identification via morphometric analysis and DNA barcoding at Virginia Tech. All survey protocols and methods were developed in coordination with appropriate state and federal agencies, stakeholders, clients, and RLP experts. Larval RLP data will be analyzed for body condition, spatial distribution, volumetric density, and site-specific habitat parameters will be measured and recorded.

C.2.b. Results will inform Project-specific objectives such as establishing a baseline characterization of presence, abundance, density, and distribution throughout this section of the Roanoke River, support cumulative effects analysis, and support/inform ESA Section 7 consultation. Results of the adult, YOY, and larval surveys may also potentially inform 'future research' needs posed by Buckwalter et al. (2019) by adding to limited understanding of RLP population demographics and year-class strength and recruitment.

C.2.c. Sampling efforts targeting adult and young-of-year RLP plans to catch and release all live specimens. However, accidental wounding or killing of an animal (e.g., crushing via substrate shifts or stepping on) could potentially happen due to the nature of sampling methods (e.g., electrofishing, kick sets, benthic seining). In the event an animal does expire during survey efforts, the appropriate state and federal agency offices will be notified within 24 hours and the animal is placed in ethanol before being deposited to the preferred repository per USFWS direction. In the case of drift net collections targeting larval RLP, all specimens collected in the drift net will be preserved, stored, sorted, identified, and deposited at Virginia Tech. Due to the nature of larval sampling and processing techniques, posthumous identifications of larval RLP will be made.

C.3.a. Injury, death, and removal from the wild are a possibility when conducting electrofishing, seining, and drift net surveys (see Section C.2.c). Survey activities will only be performed following coordination and approval by the appropriate USFWS Regional and/or Field Office.

C.3.b. Larval drift rates may be eruptive and/or pulsed and dependent upon environmental conditions during sampling events; therefore, the variance associated with larval capture rates is unknown, but may be wide. The estimated Take associated with proposed RLP larval sampling is based on the best available science (Buckwalter et al. 2019) in a single preceding study (U.S. Fish and Wildlife Service permit TE-697823). During 2015 and 2018 sampling efforts, a total of 18 sites were sampled via drift nets throughout the upper Roanoke River system and a total of 220 RLP larvae were captured in a total of 965 net sets (average CPUE is 0.228 including both survey years). The 75th percentile was 3.25 RLP per drift net set and maximum captured in one set was 9 (when drift net captured one or more larvae of a given species). We propose 100 total net sets (5 sites, two sets once a week for 10 weeks) using the same methods. Based on the aforementioned CPUE, our estimated Take would be 22 RLP larvae. If all net sets reached 75th percentile catch rate, Take would be 325. If all net sets captured the maximum, Take would be 900 RLP larvae. Based on the above information, for 100 proposed net sets, our estimated Take of larval RLP is 200 individuals. Due to the unknown variability in capture rates associated with drift net surveys, a conservative but reasonable approach has been taken that accounts for a

CPUE that is 8 times greater than previously observed. Adult and young-of-year will be released at the location of capture.

C.3.c. To minimize harm to adult RLP, electrofishing units will be calibrated to the conductivity of the water. Surveys will be limited to only what is deemed necessary to collect the data. Captured fish will be placed in large, instream cage nets (but outside of the sampling field) to allow for proper flow-through, temperature, and oxygenation. Care will be taken to minimize handling of specimens to reduce stress and each fish will be released immediately following the collection of morphometric data and photographic ID vouchers.

To minimize harm to young-of-year RLP, only three field personnel will conduct seining efforts to limit potential for trampling. Surveys will be limited to only what is deemed necessary to collect the data. Captured fish will be placed in large, instream cage nets (but outside of the sampling field) to allow for proper flow-through, temperature, and oxygenation. Care will be taken to minimize handling of specimens to reduce stress and each fish will be released immediately following the collection of morphometric data and photographic ID vouchers.

In the case of drift net collections for larval RLP, surveys will be limited to only what is deemed necessary to collect the data scoped by the aforementioned individuals that participated in the study scoping.

C.3.d. N/A. Activities requested under this permit are for required, Project-specific presence/absence and/or density surveys to characterize existing extant populations within the Project area. This information cannot be obtained previous research, museum specimens or captive populations.

C.4. A contractual agreement is in place as of September 2020 between EDGE Engineering & Science (employer) and HDR, Inc. (consultant to Project owner and operator) to complete this study in association with FERC relicensing and Section 7 obligations (prior to relicensing deadline in 2024). All funding is available to the completion of the proposed surveys. The Project owner and operator is currently coordinating a contract with Virginia Tech for the laboratory component of the study, which also includes funding through the conclusion of the study.
C.5. N/A for all subsections. No plants or animals collected under this permit will be held in captivity.

C.6. To prevent the spread of aquatic nuisance and/or invasive species/agents, proper decontamination will be a high priority before surveys begin and when moving between watersheds. Before mobilizing, all aquatic gear will be sprayed with a solution of diluted bleach, salt, or other appropriate decontamination solutions. When possible, all aquatics gear will also be left out to dry for extended periods of time to further prevent spread of invasive species through desiccation. For terrestrial gear, boot bottoms, buckets, etc. will also be sprayed with a bleach solution or other decontaminant. Vehicles will be run through a car wash to dislodge mud and seeds.

D. Identify the persons who will conduct the proposed activity (page 8)**:**

D.1.a. All surveys related to RLP will be completed by Jonathan A. Studio following coordination with the proper USFWS Regional and/or Field Office and will receive approval before any work or surveys are conducted.

D.1.b. I have enclosed my curriculum vitae, species experience spreadsheet, and letters of recommendation.

D.1.c. Contact information for my references attesting to competency with fish are listed below. Please also see the attached reference letters.

Casey Swecker
Protected Species Practice Leader
Edge Engineering & Science
(304) 633-5808
cdswecker@edge-es.com

Dr. Keith Gibbs
Assistant Professor
Department of Geosciences and Natural Resources
Western Carolina University
(828) 227-3817
wgibbs@wcu.edu

Literature Cited

Anderson, G.B. 2016. Assessment of apparent survival and abundance of Roanoke Logperch in response to short-term changes in river flow. Final Report to the Virginia Department of Game and Inland Fisheries, Blacksburg, VA.

Appalachian Power Company (Appalachian) and American Electric Power Service Corporation (AEP). 1992. An Assessment of the Roanoke Logperch in the Roanoke River Downstream of Niagara Hydroelectric Project. December 1992. 5 pp.

Argentina, J., and J.H. Roberts. 2014. Habitat associations for young-of-year Roanoke logperch in Roanoke River. Final Report to Virginia Department of Game and Inland Fisheries, Blacksburg, VA.

Buckwalter, J., Angermeier, P., Argentina, J., Wolf, S., Floyd, S., and E. Hallerman. 2019. Drift of Larval Darters (Family Percidae) in the Upper Roanoke River Basin, USA, Characterized Using Phenotypic and DNA Barcoding Markers. Fishes. (4)59: 1-16.

Ensign, W.E., P.L. Angermeier, B.W. Albanese, and G.H. Galbreath. 2000. Preconstruction monitoring of the endangered Roanoke logperch (Percina rex) for the Roanoke River Flood Reduction Project: Phase 3. Final report to the Wilmington District, U. S. Army Corps of Engineers, Wilmington, NC.

Hallerman, E., Wolf, S., Argentinia, J., Angermeier, P. and T. Grant. 2017. Phenology and habitat use of larval darters in the upper Roanoke River basin. Final Report to Virginia Department of Game and Inland Fisheries, Blacksburg, VA.

Lahey, A.M. and P.L. Angermeier. 2007. Range-wide assessment of habitat suitability for Roanoke logperch (Percina rex). Final report to the Virginia Transportation Research Council.

Roberts, J.H., P.L. Angermeier, and E.M. Hallerman. 2013. Distance, dams, and drift: what structures populations of an endangered, benthic stream fish? Freshwater Biology. 58: 2050-2064.

Rosenberger, A.E. 2007. An update to the Roanoke logperch Recovery Plan. Report from University of Alaska Fairbanks to U.S. Fish and Wildlife Service, Gloucester, Virginia.

Rosenberger, A.E., and P.L. Angermeier. 2002. Roanoke logperch (Percina rex) population structure and habitat use. Final report to Virginia Department of Game and Inland Fisheries, Blacksburg, VA.

U.S. Fish and Wildlife Service (USFWS). 1992. Roanoke Logperch (Percina rex) Recovery Plan. Newton Corner, Massachusetts. 34 pp.

U.S. Fish and Wildlife Service (USFWS). 2007. Roanoke logperch Percina rex: 5-year review: summary and evaluation. USFWS, Virginia Field Office, Gloucester, Virginia.

3. Species Experience Table

Roanoke Logperch (*Percina rex*) Experience

Waterbody	State	Date	Latitude	Longitude	Number Encountered	Survey Method	Supervisor
Roanoke River	VA	Summer 2018	37.277626	-80.110948	20*	Snorkeling while recording video and taking photographs	John Spaeth
Roanoke River	VA	Summer 2018	37.233402	-80.197942	20*	Snorkeling while performing mussel survey	John Spaeth
Roanoke River	VA	Summer 2018	37.233402	-80.197942	5*	Snorkeling while performing mussel survey	John Spaeth
Roanoke River	VA	09/15/2020	37.264589	-79.915833	1	Backpack electrofishing	Casey Swecker

* denotes approximation during non-tabulated surveys or observations

4. Letters of Recommendation

December 17, 2020

To whom it may concern,

I am writing in support of Mr. Jon Studio's request to obtain a 'new' Federal Scientific Collector's Recovery permit for Roanoke logperch (*Percina rex*; RLP). Jon is listed on an existing federal permit (#TE02373A-14) under his former employer and is currently requesting consideration to possess a federal permit in his own personal name. Before starting his career in environmental consulting, Jon was a master's student at James Madison University where he investigated competition between American eels and brook trout in Virginia streams. During this time, he gained experience leading field crews and conducting backpack electrofishing surveys for stream fish in Shenandoah National Park and George Washington and Jefferson National Forests. He also used methods such as gastric lavage and PIT tagging that require increased caution and care to be completed safely and with minimal adverse impacts to specimens. He has extensive experience capturing, handling, and accurately identifying fishes in multiple Virginia watersheds including the Roanoke River.

I have had the pleasure of working with Mr. Studio at two different entities where he served as a fisheries lead for the past two and a half years. Jon has an extensive background working across many drainages and on large projects dealing with complex issues surrounding endangered species compliance and addressing sedimentation issues. He is methodical in his approach to organization and it shows in his attention to detail when employing fish sampling protocols and addressing resource agency questions. Jon is advancing our understanding of larval fishes and beginning to answer questions that the fisheries community has been questioning for years. As a member of the scientific fisheries community, a qualified surveyor of endangered fishes in Virginia (including *Percina rex*), and someone who is critical in recommending only the best candidates to work with sensitive species; I could not think of a more passionate conservation fisheries biologist than Jon.

I can vouch firsthand in his abilities to correctly employ field protocols, handle and process rare, threatened, and endangered fishes, and retain taxonomic background and skillset necessary to work at a professional level.

Sincerely,

Casey D. Swecker
Email: cdswecker@edge-es.com
Mobile: 304.633.5808

Western Carolina UNIVERSITY

Department of Geosciences and Natural Resources
331 Stillwell Building
Cullowhee, NC 28723
(828) 227-7367

W. Keith Gibbs, Ph.D.
Department of Geosciences and Natural Resources
Western Carolina University
828-227-2817
wgibbs@wcu.edu

December 17, 2020

To whom it may concern,

I have been working with stream fishes, including rare and protected species, for over fifteen years. I have worked with and for many state and federal agencies, including the U.S. Fish and Wildlife Service, National Park Service, and Environmental Protection Agency, sampling and conserving aquatic resources. I am currently an Assistant Professor in the Department of Geosciences and Natural Resources at Western Carolina University. I am writing this letter in support of Jon Studio to obtain a federal collecting permit for Roanoke logperch (*Percina rex*) as it pertains to conservation and monitoring of this species with his employer, Edge Engineering & Science.

I worked with Jon during summer 2018 collecting and moving fish in the Roanoke River watershed during mitigation efforts related to pipeline installation. We used a variety of sampling gear, including backpack electrofishers, kick seines, and hand nets to collect and remove all fish from a construction right of way. We conducted dozens of fish removals during that time. We encountered a diversity of stream fishes, including many minnows, darters, and madtoms. Jon has substantial experience handling, identifying, releasing, and/or observing live fishes of numerous, and often, sensitive species. We also frequently observed many species, including Roanoke logperch, during snorkel-based mussel surveys.

From my experience with Jon, I am very comfortable recommending him for a Federal Scientific Collector's Recovery permit. He is a diligent, conscientious, and highly knowledgeable biologist who prioritizes fishes' wellbeing and safety. Please feel free to contact me through email or by phone if you have any additional questions.

Sincerely,

W. Keith Gibbs, Ph.D.
Assistant Professor – Dept. of Geosciences and Natural Resources
Western Carolina University

5. Curriculum Vitae

Jonathan A. Studio

Project Manager / Aquatic Scientist

Jon Studio is a Project Manager and Aquatic Scientist at Edge Engineering and Science, LLC (EDGE) located in Avon, Ohio and headquartered in Houston, Texas. Mr. Studio has been working with Threatened and Endangered (T&E) species since 2016 including more than 20 species of freshwater fish and mollusks, bumble bees, crayfish, birds, bats, and plants. He developed his knowledgebase through a broad range of concentrated coursework and research efforts during his undergraduate and graduate degree programs. Intensive organismal research and consulting project objectives incorporate competitive interactions, developmental stressors, habitat use, migration, population density, critical habitat, and environmental and anthropogenic impacts. As a result of these experiences, Mr. Studio has acquired a deep understanding of the Endangered Species Act (ESA) along with numerous species-specific permitting and field protocol procedures.

Mr. Studio's primary focus as a consultant has been composing Biological Assessments (BA) and Study Plans and completing subsequent field and reporting efforts. Projects include natural gas pipelines, electric transmission lines, hydroelectric dams, stream restoration sites, dredging sites, and barge facilities. Many of these projects required coordination with federal agencies such as Federal Energy Regulatory Commission (FERC), US Fish and Wildlife Service (USFWS), US Forest Service (USFS), and US Army Corps of Engineers (USACE), as well as individual state agencies such as Department of Transportation (DOT), Department of Environmental Quality (DEQ), Department of Wildlife Resources (DWR), and Division of Natural Resources (DNR). Mr. Studio has contributed to projects located in the following states: California, Illinois, Indiana, Kentucky, Maryland, Michigan, New York, North Carolina, Ohio, Oklahoma, Pennsylvania, Tennessee, Virginia, and West Virginia. Mr. Studio has gone above and beyond to advance research and conservation in his field as a Certified Associate Ecologist (The Ecological Society of America).

EDUCATION:

JAMES MADISON UNIVERSITY • HARRISONBURG, VA

Master of Science in Biology (2018)

Master's Thesis "Competition and Predation: Interactions between American eels (*Anguilla rostrata*) and Brook Trout (*Salvelinus fontinalis*) in Virginia Mountain Streams"

KENT STATE UNIVERSITY • KENT, OH

Bachelor of Science in Biology (2015)

AREAS OF EXPERTISE:

- Roanoke Logperch (*Percina rex*)
- Field Experiment and Survey Design
- Technical Writing
- Project Management
- Rusty-Patched Bumble Bee (*Bombus affinis*)
- Scientific Communication
- Statistical Analysis
- Agency and Permit Coordination

SELECTED PROJECT EXPERIENCE:

Field of Expertise

- **AEP, Niagara Hydroelectric Dam Relicensing (Virginia)**
  Serving as Project Manager for aquatic species field surveys. Completed 2020 general fish, mussel, macroinvertebrate, and crayfish surveys. Planned 2021 Roanoke Logperch (*Percina rex*) species-specific field surveys for larval, young-of-year, and adult life stages. Coordinating with federal and state agencies to satisfy permitting and dam relicensing requirements. (2020 – Present)

- **AEP, Byllesby-Buck Hydroelectric Dam Relicensing (Virginia)**
  Serving as Project Manager for aquatic species field surveys. Completed 2020 general fish, macroinvertebrate, and crayfish surveys. Planned 2021 general fish, macroinvertebrate, and crayfish surveys. Coordinating with federal and state agencies to satisfy permitting and dam relicensing requirements. (2020 – Present)
- **MVP – Mountain Valley Pipeline (Virginia and West Virginia)**
  Co-author of Biological Assessment, and Supplement to the BA, responsible for aquatic T&E Species and Critical Habitat, Effects Analysis, and Effects Determination sections for Roanoke Logperch (*Percina rex*), Candy Darter (*Etheostoma osburni*), Atlantic Pigtoe (*Fusconaia masoni*), James Spinymussel (*Parvaspina collina*), and Clubshell (*Pleurobema clava*). Section 7 ESA compliance and substantial coordination with USFWS were necessary for completion of this FERC regulated interstate natural gas pipeline BA. (2019 – 2020)
- **AEP, Niagara Hydroelectric Dam Relicensing (Virginia)**
  Co-author of Study Plan for aquatic species surveys and analysis (fish, mussels, macroinvertebrates, and crayfish) including adult, young-of-year, and larval Roanoke Logperch (*Percina rex*). Section 7 ESA compliance and substantial coordination with USFWS were necessary for completion of this FERC regulated hydroelectric dam SP. (2019 – 2020)
- **Rural Action – Walhonding River Purple Catspaw Surveys (Ohio)**
  Served as Field Technician responsible for freshwater mussel surveys and data collection for surveys looking to determine if there are unknown populations of Purple Catspaw (*Epioblasma obliquata*) in the Walhonding River in Coshocton County, Ohio. (2018)
- **Private Property, Reservoir Installation (Oklahoma)**
  Conducted presence/absence snorkel surveys for freshwater mussels including Ouachita Rock Pocketbook (*Arkansia wheeleri*) and Winged Mapleleaf (*Quadrula fragosa*) prior to dam/reservoir installation. (2019)
- **North Fork Holston, Bridge Construction (Virginia)**
  Monitored Spotfin Chub (*Erimonax monachus*) within bridge pillar coffer dam construction footprints in the North Fork Holston River. Backpack electrofishing techniques were used to fully deplete fish from breached coffer dams. Each coffer dam was also surveyed for Spiny River Snails (*Io fluvialis*). (2019)
- **Dominion, Atlantic Coast Pipeline (Virginia, West Virginia)**
  Served as Biologist for the ongoing Federally endangered Rusty-Patched Bumble Bee (RPBB, *Bombus affinis*) surveys along the route in Highland, Bath, and Augusta counties Virginia, and Pocahontas County, West Virginia. Surveys follow 2018 USFWS Survey protocols for the RPBB version 2.2 using non-lethal sampling techniques. One-hour surveys are completed for every three acres of potential habitat along the project. Surveys are completed up to four times per patch and, to date, resulted in surveys covering over 1000 3-acre patches. Survey collections to date include 26 RPBBs and over 1,000 bumble bees representing 11 species. Species collected include: *B. affinis, B. auricomus, B. bimaculatus, B. citrinus, B. fervidus, B. griseocollis, B. impatiens, B. pensylvanicus, B. perplexus, B. sandersoni*, and *B. vagans*. Surveys incorporate project review protocols and rapid assessment techniques. Bees are collected via netting and placed into glass vials for identification and photo voucher documentation. (2019)
- **MVP – Mountain Valley Pipeline (Virginia, West Virginia)**
  Serving as Field Supervisor for full fish depletions and relocations at all perennial streams along the multi-state pipeline in Virginia via backpack electrofishing and seining. Managed fish removal crews in coordination with environmental and construction leaders to ensure fish removal efforts are compliant with construction timelines. Managed and disseminated all subsequent data and safety information to environmental and construction leaders. (2018-Present)
- **ETC Northeast Pipeline – Revolution Pipeline (Pennsylvania)**
  Served as Team Leader assisting in delineating wetlands as post-construction QA/QC and pre-construction mapping in Pennsylvania. Used wetland plants, hydrology, and soil composition to locate and map wetlands. (2018)
- **Iberdrola – Deruyter Pipeline (New York)**
  Served as Team Leader assisting in delineating wetlands as post-construction QA/QC and pre-construction mapping in New York. Used wetland plants, hydrology, and soil composition to locate and map wetlands. (2018)

- **Mountain Valley Pipeline Southgate, Atlantic Coast Pipeline, USACE Open End, and CRH Barge Tie Mussel Survey**
  Served as Aquatic Scientist preparing and assisting with writing, statistical analysis, and figure generation on a variety of documents including field manuals, study plans, and final reports. (2018)
- **Dominion Energy– Atlantic Coast Pipeline (North Carolina)**
  Served as Field Technician completing snorkel surveys to collect, identify and relocate mussels outside of the limits of disturbance in five streams near Rocky Mount, North Carolina. (2018)
- **TransCanada – Line KA (West Virginia)**
  Served as Field Technician using view scope methods to collect, identify and relocate mussels outside of the limits of disturbance in a stream in Pineville, West Virginia. (2018)
- **MVP – Mountain Valley Pipeline (West Virginia)**
  Served as Field Technician using surface supply air methods to collect, identify and relocate mussels outside of the limits of disturbance in the Greenbrier River near Pence Springs, West Virginia. (2018)
- **Grand River Mussels (Ohio)**
  Served as Field Technician using view scope, snorkel, and surface supply air methods to collect, identify and relocate mussels outside of the limits of disturbance in the Grand River near Painesville, Ohio.
- **Harrison Hub Pipeline (Ohio)**
  Served as Field Technician using surface supply air methods to collect, identify and relocate mussels outside of the limits of disturbance in Wheeling Creek near Harrison County, Ohio.
- **TransCanada – Line KA (West Virginia)**
  Served as Field Technician collecting and identifying crayfish via seining methods for a pre-construction survey in Pineville, West Virginia. (2018)
- **MVP – Mountain Valley Pipeline (Virginia, West Virginia)**
  Served as Field Technician helping to conduct migratory bird point counts in near Roanoke, Virginia and Alderson, West Virginia. (2018)
- **AEP – Ohio Heft Station (Ohio)**
  Served as Field Technician helping to conduct bat emergence surveys in Lancaster, Ohio. (2018)
- **James Madison University Vivarium (Virginia)**
  Served as Trout Room Manager responsible for setting up and maintaining aquatic habitats holding tank and artificial stream channel systems based on the individual needs of a research project. (2016-2018)
- **James Madison University (Virginia)**
  Served as Research Field Assistant monitoring habitat use of endangered James spinymussel in Earlysville, Virginia using an HPR+ PIT tag reader and mark-recapture methods. Manage data, plan all sampling events, and train and supervise undergraduate field assistants. (2016-2018)
- **U.S. Forest Service – Shasta-Trinity National Forest (California)**Served as Field Assistant designing and implementing experimental transplant of freshwater mussels in collaboration with the Trinity River Restoration Program and the Yurok Tribe. (2017)
- **U.S. Forest Service (USFS) – George Washington and Jefferson National Forest (Virginia)**
  PIT tagged eels for a long-term mark-recapture study in cooperation with USFS and Virginia Tech. (2017)
- **James Madison University (Virginia)**
  Studied fish species richness with respect to stream acidification in Shenandoah National Park using a Smith-Root LR-24 Electrofisher and three pass depletion methods. (2016)
- **The De Wildt Shingwedzi Cheetah Ranch (Limpopo, South Africa)**
  As a volunteer, performed daily tasks pertaining to cheetahs, African wild dogs, vultures, and many other vulnerable creatures within 2,100-acre sanctuary. (2013)

TRAINING/CERTIFICATIONS:

- Associate Ecologist, Ecological Society of America, 2019
- OSHA 10 hour General Industry, 2019
- OSHA 40 hour HAZWOPER, 2018

- Institutional Animal Care and Use Committee (IACUC) Certified, 2018

PROFESSIONAL AFFILIATIONS:

- Ecological Society of America
- Association for the Sciences of Limnology and Oceanography
- American Fisheries Society
- Northeast Association of Fish and Wildlife Agencies

PUBLICATIONS/PRESENTATIONS:

Research Projects

- Thom D. Teears, Steve J. Baedke, Daniel M. Downey, Jonathan A. Studio & Christine L. May (2020) Water chemistry and light effects on survival of hatching salmonids in spring channels, Journal of Freshwater Ecology, 35:1, 13-28
- Studio, J.A., & C.L. May (2018-present) Competition between top predators in a small mountain stream: An investigation of Brook Trout and American Eels. (Manuscript in progress)
- Studio, J.A., & M.W. Kershner. 2015-present. Habitat Effects on Leaf Decomposition Rate: Implications for Species Diversity. (Independent undergraduate research project continued by lab associates)

Poster and Oral Presentations

- Virginia Chapter of American Fisheries Society, Blacksburg, VA. 'Competition and Predation: Interactions between American eels (Anguilla rostrata) and brook trout (Salvelinus fontinalis) in mountain streams' 2019.
- Association of the Sciences of Limnology and Oceanography, Victoria, BC. 'Competition and Predation: Interactions between American eels (Anguilla rostrata) and brook trout (Salvelinus fontinalis) in mountain streams' 2018.
- Perry Middle School 7th grade science seminar, Perry, Ohio. 2018. A Scientific Adventure.
- James Madison University BioSymposium, Harrisonburg, Virginia. 2018. Competition and Predation: Interactions between American eels (*Anguilla rostrata*) and brook trout (*Salvelinus fontinalis*) in mountain streams.
- Virginia Chapter of American Fisheries Society, Fredericksburg, Virginia. 2018. Competition and Predation: Interactions between American eels (*Anguilla rostrata*) and brook trout (*Salvelinus fontinalis*) in mountain streams.
- Virginia Sea Grant Graduate Research Symposium, Glen Allen, Virginia. 2018. American eels (*Anguilla rostrata*): Reconnecting Coastal and Inland Waters of Appalachia.
- Nature Camp, Vesuvius, Virginia. 2017. Competition and Predation: Interactions Between American Eels (*Anguilla rostrata*) and Brook Trout (*Salvelinus fontinalis*) in Mountain Streams.
- Northeast Association of Fish and Wildlife Agencies, Norfolk, Virginia. 2017. The Effect of Ultraviolet-B Radiation on Brook Trout (*Salvelinus fontinalis*) Eggs.
- Virginia Chapter of American Fisheries Society, Lexington, Virginia. 2017. The Effect of Ultraviolet-B Radiation on Brook Trout (*Salvelinus fontinalis*) Eggs.
- Freshwater Ecology Research Symposium, Harrisonburg, Virginia. 2016. The Effect of Ultraviolet-B Radiation on Brook Trout (*Salvelinus fontinalis*) Eggs.

EMPLOYMENT HISTORY:

- EDGE – Aquatic Scientist – June 2020 to Present
- Environmental Solutions & Innovations, Inc. – Aquatic Scientist – Ravenna, Ohio – May 2018 to June 2020

YEARS OF PROFESSIONAL EXPERIENCE:

- 2018 – Present (2.5 years)

E 3.3 Fish Resources

Because of the lack of data concerning the status of fish populations in the Niagara vicinity, fisheries surveys were conducted during June-October, 1990. A second objective of these surveys was to determine whether any project-related impact on the fish fauna is evident. A study plan for this work was submitted to appropriate fish and wildlife agency personnel and went forward subsequent to their input (Exhibit E, Consultation Documentation, Initial Stage Consultations, Fisheries Study Plan).

Adult and juvenile fish were sampled in the Niagara reservoir by electrofishing, hoop netting, and gill netting techniques. Upper, middle, and lower portions of the reservoir were sampled (Figure E-3). In addition, riffle/run habitat was sampled upstream and downstream of the project by electrofishing. Each station was sampled six times, during the periods June 4-6, June 25-27, July 24-26, September 4-6, September 25-

27, and October 16-18, 1990. A complete report of this study is provided in Appendix E-1.

This study collected a total of 1,936 fish representing 34 species (Table E-6). Redbreast sunfish and silver redhorse dominated the samples numerically; and common carp, white sucker, spottail shiner, and golden redhorse were also abundant. In terms of biomass, common carp and silver redhorse comprised the majority of the sample. White sucker, golden redhorse, redbreast sunfish, and channel catfish were also biomass dominants.

Overall, collected fish were relatively free of parasites and physical abnormalities (Table E-7), although certain species (e.g., carp, white sucker) exhibited a fairly high incidence of deformities and fin erosion. This condition is most likely related to the adverse effect on water quality of upstream inputs of urban contaminants, as documented in the SWCB 305(b) water quality assessment (Virginia State Water Control Board, 1988).

Table E-8 compares these survey data to historical data from the Virginia Department of Game and Inland Fisheries species list for this general region of the upper Roanoke River drainage. Listed species not collected in the Niagara survey are generally those typically found in stream or cold water habitats uncharacteristic of the riverine habitats sampled in this survey (e.g., trout, dace) or are associated with Smith Mountain Lake downstream of the project (e.g., striped bass, alewife). Species added to the list by the 1990 survey included grass carp and black bullhead.

One federally-listed endangered species was collected during these studies. Three specimens of the Roanoke logperch (Percina rex) were collected on September 25, 1990 and one specimen on October 16, 1990, all at the upstream riffle/run electrofishing site. The specimens were photographically documented and released. **Additional sampling was conducted by APCo and VDGIF on September 12, 1991 to determine if the Roanoke logperch occurred in areas downstream of the project that were not sampled during the 1990 survey. Approximately 0.25 mile of riffle/run habitat was sampled by electrofishing at a location approximately 0.5 mile downstream of the Niagara project. Three Roanoke logperch, each measuring approximately 110 mm in length were collected and released.** The other species of concern identified by the VDGIF during pre-consultation correspondence, the orangefin madtom (Noturus gilberti), was not collected during the survey and may, therefore, be considered extremely rare or absent from the Niagara vicinity. Continued operation of this facility should have no impact on these two species.

The Roanoke logperch is endemic to the Roanoke River drainage in Virginia and predominately occurs in those portions of the drainage within the Piedmont and Ridge and Valley provinces (Jenkins et al. 1978). Typical habitat for this species is riffles, runs, and pools with sandy to boulder-strewn bottoms, but not deep silt, in warm, usually clear, medium-sized streams. This species is not typically known from impoundments or other lentic environments (Jenkins, 1977a), although two specimens were collected in a cove of Leesville Reservoir in 1989 (VDGIF, 1989). According to Jenkins (1979), the healthiest populations of the Roanoke logperch are found in the upper Roanoke River drainage above Salem, Virginia (Figure E-4). These populations exist at fairly low densities that are apparently unchanged from surveys by Jordan in 1888 (Jenkins, 1977a). The range of the Roanoke logperch has been constricted within historical times, including depletion from the Roanoke River from the City of Roanoke to Smith Mountain Lake, a stretch that includes the Niagara project area, due to point and nonpoint municipal and industrial discharges (Jenkins, 1977a).

The orangefin madtom is a widely, but disjunctly, distributed endemic of the upper Roanoke River drainage of Virginia and North Carolina and the upper James River of Virginia (Figure E-5; Jenkins, 1978). This species occupies riffles and runs of cool-to-warm sections of usually clear, medium-to-large streams. It is another of the highly distinctive upper Roanoke River drainage assemblage and has a distribution above Niagara dam similar to that of the Roanoke logperch (Figure E-5). Recent collections of the orangefin madtom at or above Salem, Virginia, appear similar in abundance to older collections, whereas historical populations at the City of Roanoke now appear to be extirpated due to siltation, eutrophication, and chemical waste discharges (Jenkins, 1977b). According to Jenkins (1977b), this species may typically exist at low densities even in favorable habitat and is one of the most sensitive of the upper Roanoke River ichthyofauna to environmental degradation.

The database provided by the fishery study, along with detailed project design and operational data, can be used to analyze the potential for significant project impact on various aspects of the fishery. The Federal Energy Regulatory Commission (FERC, 1988), in its final environmental impact statement for the upper Ohio River basin, analyzed impact by analogy with available literature. The FERC analysis consisted of evaluating 1) the susceptibility of various organisms and life stages to entrainment, 2) the likelihood that damages would occur to entrained individuals and their populations, and 3) methods for preventing or reducing entrainment. Similar types of analyses were performed by WAPORA, Inc. (1987) to evaluate entrainment potential at the Racine and New Martinsville hydroelectric projects on the Ohio River. Cox Lake Carbonton Associates (1987) used a literature review and project and resident fish characteristics, combined with study findings at a similar project, to demonstrate minimal impact at the Carbonton Hydroelectric Plant on the

Deep River, North Carolina. The approach of analyzing indigenous biotic communities for the purpose of impact assessment has been routinely and successfully applied by governmental agencies, industries, and individual researchers (U.S. EPA, 1984; Karr et al., 1986; Van Hassel and Gaulke, 1986; Ohio EPA, 1987; Van Hassel et al., 1988).

Locational differences in the electrofishing catch-per-unit-effort (CPUE) identified during the 1990 survey are detailed in Table E-9. Of particular interest is the catch comparison between the two riffle/run sampling sites. The site located downstream of Niagara provides comparative data to determine whether the project influences fish assemblages there relative to those found upstream. The data show the catch rates of most species were statistically equivalent or greater than catch rates at the upstream riffle/run site. Gizzard shad, satinfin shiner, northern hog sucker, shorthead redhorse, v-lip redhorse, bluegill, and largemouth bass CPUE at the downstream site were the highest among all sites (pool and riffle/run). This finding would be expected based on the gradual improvement in water quality from the upstream to downstream site. Length frequency distributions of the dominant fish species at the riffle/run sites were very similar. The downstream riffle/run site, although located less than two miles below the Niagara powerhouse, exhibited no evidence of any increased incidence of turbine-related injuries to fish. Only 3.1% of the fish collected at this site bore any type of physical abnormality compared to 1.2-3.0% at the other sites (Table E-7).

Fish species richness and diversity were fairly similar among all pool and riffle/run sites except for the downstream riffle/run site. This site exhibited higher species' richness and diversity, most likely related to its being the furthest removed from upstream water quality impacts.

E 3.3.1 Entrainment Effects

Analyses were performed to evaluate specific project-related impacts. The potential for entrainment was evaluated based on the known behavioral characteristics and preferred habitat of resident fish species and the potential for adverse effects due to pressure changes, turbulence, shear, and physical contact for the egg-through-adult stages of these species. Other low head hydroelectric projects with many design and operation features similar to those of the Niagara Project have successfully used these types of analyses to evaluate entrainment potential. According to a review by Electric Power Research Institute (1987) of turbine mortality field studies, variability in such studies is too great to allow precise mortality estimates, even on a site-specific basis. Much of this variability can be attributed to unmeasurable factors such as test fish condition, holding and recovery conditions, and subtle environmental and operational effects. Even model experiments often produce unexplained variability. APCo concludes that the analysis of entrainment potential conducted herein, incorporating all of the above-listed factors and supported by field population data, provides a sound assessment of entrainment impact. Analyses were performed based on characteristics of both old turbine Unit 1 and replacement Unit 2, which is planned to be installed in late 1991 (see Exhibit A).

Life history and behavioral characteristics of fish species inhabiting the Niagara pool are important factors in evaluating entrainment potential. Fish species expected to spawn in the pool and their spawning characteristics are listed in Table E-10. Eggs of most of these species possess extremely low entrainment potential because of their adhesive, demersal characteristics and deposition into either nests or sheltered vegetation or other substrate. Similarly, the larvae of most species remain on nest or in sheltered slackwater areas until they become free-swimming. Only larvae of gizzard shad and the cyprinids can be expected to enter the current in large numbers.

Adult and juvenile fish species of the Niagara pool (Tables E-9 and E-11) differ greatly in their susceptibility to entrainment because of differences in movement behavior. Species such as suckers, flathead catfish, and centrarchids are very unlikely to enter the forebay area in substantial numbers because of their preference for much different habitat (sheltered areas with cover versus open-water habitat of the forebay) and their typically sedentary behavior (except for spawning migrations in some species, which are upstream rather than towards the forebay) (Becker, 1983; FERC, 1988; Scott and Crossman, 1973; WAPORA, 1987). Species that may be found more frequently in the forebay area because of their greater mobility, usually associated with feeding, include gizzard shad, common carp, shiners, white and channel catfish, bullheads, and black crappie.

Fish that approach the plant intake screen have been observed to easily negotiate the moderate current. Screen openings at Niagara are 3 5/8 in. wide. Intake velocities at the face of the intake screen and at the trailing edge of the screen were calculated. These determinations assumed a 600 cfs discharge (steady-state design capacity of the 11 ft.-0 in. ID penstock). Figure E-6 illustrates the component and resultant velocity vectors and how they were derived. Calculated intake screen flow velocities at the screen face and trailing edge are provided in Table E-12. Calculated normal velocities at forebay elevations 885 ft. NGVD and 884 ft. NGVD ranged from approximately 0.9-1.2 feet/sec. This range in intake velocity is very similar to typical current velocity of the free-flowing portion of the Roanoke River measured at the fish survey sites and represents flow conditions easily negotiated by resident species of adult and juvenile fish. Studies of fish swimming speeds have verified their ability to negotiate currents of this magnitude (WAPORA, Inc., 1987) In addition, similar intake screen standards of 1.5 feet/sec. and 2.5 in. spacing have been applied to low-head (<40 feet) hydros in piedmont and coastal North Carolina warmwater streams (North Carolina Wildlife Resources Commission, 1987).

In the event that a fish enters the penstock and turbine, the greatest opportunity for injury is from contact with a turbine runner blade. Normally, any losses due to turbine passage are due to this factor (Monten, 1985). Loss rates typically increase with fish length in relation to the width of the openings between runner blades. The water passage through the penstock and turbine is designed for smooth, unobstructed flow to the greatest degree possible. The only significant obstructions to flow are twelve stay vanes and twelve wicket gates arranged in a circular pattern preceding the turbine runner. The stay vanes are 21.52 in. in height and 2.25 in. thick at Unit 1, **and will be 22.02 in. in height and 2.00 in. thick at Unit 2.** The wicket gates are 21.45 in. in height and 3.06 in. thick at Unit 1, **and will be 21.48 in. in height and 2.88 in. thick at Unit 2.** The opening between fully-open wicket gates is 6.91 in. at Unit 1, **and will be 6.47 in. at Unit 2.** The relationship between flow rate and wicket gate position achieves smooth relative flow through the turbine. This relationship is essential to efficient unit operation.

Extensive studies of fish orientation to flow past stay vanes and wicket gates have demonstrated that the fish's center of gravity follows the flow line, with the rest of the body oriented to the direction of flow. Collisions of fish with stay vanes and wicket gates are, therefore, negligible (Monten, 1985), as the fish do not contact the vanes perpendicularly but are guided with the flow along the vane surface. As a fish is carried through the wicket gates, its longitudinal axis is most likely to be close to parallel to the gate surfaces, which means close to a zero angle to flow. Thus, as the fish passes the runner, the probability of striking the leading edge of the blade is dependent primarily upon its length and specific characteristics of the runner.

Probabilities of contact with a runner blade based on specific measurements of the Niagara turbine dimensions are provided in Table E-13 for all fish species of the pools, regardless of entrainment potential. The probability of physical contact of potentially-entrained fish with a turbine runner blade was calculated (Cada, 1990) using the equation

$$P = \frac{l \times n \times R \times a \times \cos\alpha}{f}$$

where P = the probability of blade contact (%)

l = fish length (cm)

n = number of runner blades

R = revolutions per second

a = cross-sectional area of water passage (M^2)

α = blade angle

f = discharge (M^3/sec).

Probability of contact is less than 10% for young individuals of all species, which would be more likely to be entrained. Mortality resulting from blade strikes would be much lower than this since contact with a blade would range from slight glancing blows to head-on collisions and because the flexibility of fish presents a smaller target than that predicted assuming rigid length (Cada, 1990). Potential increases in strike probability associated with reduced load would be cancelled out by the accompanying reduction in turbine flow velocity (Monten, 1985). Although early life stages are most likely to be entrained, Cada (1990) states that "turbine passage is not likely to harm fish eggs and larvae if hydroelectric facilities are operating at optimal design conditions and cavitation is not excessive."

Turbine mortality tests have been conducted at three facilities with turbine characteristics similar to Niagara (see below).

	Leaburg	Publishers	Sullivan	Niagara
Turbine Type	Francis	Francis	Francis	Francis
Discharge (cfs)	1,100	275	260	379 (Unit 1); 305 (Unit 2)
Head (ft)	89	42	42	61
Turbine Speed (rpm)	225	300	240	277
Blade Tip Velocity (ft/sec)	88	47	64	60 (Unit 1); 57 (Unit 2)
Location (river)	McKenzie	Willamette	Willamette	Roanoke

These tests at the Leaburg, Publishers, and Sullivan facilities resulted in 13-20% mortality (EPRI, 1987).

The low predicted mortality/blade contact for Niagara compared to many other facilities employing Francis-type units is associated primarily with the relatively low runner speed of the former units (blade tip velocity of 57-60 feet/sec compared to >80 feet/sec for most other units).

Pressure changes through the turbines are typically not problems for fish unless pressure reductions are substantial. This is particularly true for fish eggs and early larvae (Cada, 1990). Pressure gradients and pressure distribution of the flow through the project were calculated for APCo by Kvaerner Hydro Power, Inc., for Unit 1, **and American Hydro Corporation for Unit 2**, based on configuration and operational characteristics specific to the project. The points at which calculations were made are shown in Figure E-7. Figure E-8 illustrates pressure gradient calculations performed specifically for the Niagara turbines indicating that pressure changes associated with turbine passage are likely to be very small compared to pressure regimes tested in controlled experiments that resulted in little or no fish mortality.

Similarly, turbulence and shear effects are likely to be minimal at this project. A review by Cada (1990) of experimental studies of the effects of these stresses on entrained fish concluded that mortalities are unlikely. When the turbine functions at maximum efficiency, calm and relative turbulence-free conditions prevail (Monten, 1985). "Although fragile early life stages should be sensitive to shear damage, their small size apparently minimizes exposure to velocity changes and shear forces" (Cada, 1990).

Cavitation, if significant, can be a factor in fish survival of turbine passage (Turbak et al., 1981). The tendency toward cavitation is described by the plant sigma, a positive, dimensionless number that defines the required depth of the turbine setting in relation to the plant's net head. Assumptions and plant characteristics used in calculation of the cavitation coefficient are provided in Table E-14. The Niagara plant sigma (Figure E-9) and the absence of historical cavitation problems at this facility indicate that cavitation should not be a significant factor affecting fish survival of turbine passage.

The potential for significant entrainment effects at Niagara is extremely low. Behavioral (movement) characteristics and habitat preferences of resident species minimize the likelihood of substantial numbers of fish frequenting the project forebay. For those fish that do approach the project intake, intake velocities are low and easily negotiated by most fish. Turbine passage effects are likely to be restricted primarily to contact with runner blades. Pressure change, cavitation, turbulence, and shear are not likely to cause substantial harm to fish at Niagara. Because of the low head and relatively slow runner speed at this project, blade contacts should be minimal; and mortality should not exceed about 10%. Cada (1990) also finds that non-migratory fish are not likely to be exposed to turbine passage. Healthy adult and juvenile fish are strong swimmers, and the eggs of most sedentary species are found in nests or adhering to rocks and vegetation.

The predicted low number of fish passage and minimal associated mortality indicate a negligible impact from turbine entrainment on fish populations in the Niagara vicinity. The lack of turbine-induced injuries in the fish assemblage downstream of the project and the strong catches of fish upstream and downstream of Niagara support a conclusion of no adverse changes to fish productivity or aquatic ecosystem structure and function associated with this project.

E 3.3.2 Available Spawning Habitat in the Niagara Pool

Because the Niagara project is not peaked, pool fluctuations do not exceed normal river fluctuation levels. Spawning characteristics of fish species likely to use the Niagara pool for this purpose are provided in Table E-10. Based on these data, fish species were divided into two broad groups according to optimal spawning depth and spawning period. These groups included species spawning at 0.25-6 ft. during March-August (cyprinids, sunfish) and those spawning at 1-8 ft. during April -August (gizzard shad, ictalurids, black basses, black crappie). Spawning habitat available to each of these groups in the Niagara pool was then calculated using recent bathymetry mapping of the pool (Figure E-10) and assuming all areas of the pool at a given depth were usable for spawning. These areas varied by month according to mean monthly fluctuations in river elevation.

The maximum percentage of potential spawning habitat made unavailable due to river fluctuations is summarized in Table E-15 according to spawning group and month. Mean monthly river fluctuations are based on historical data at the Niagara gauge. This analysis indicates that <1-17% of available habitat is potentially exposed under natural riverine conditions. Highest percentages exposed were for the cyprinid/sunfish group because of their documented selection of often very shallow and easily exposed spawning sites.

No project-related impacts to available spawning habitat in the Niagara pool should occur.

E 3.3.3 Effects on Tailwater Habitat

Potential effects of Niagara operation on tailwater habitat were evaluated with respect to erosional/depositional considerations, spring spawning habitat of Roanoke River fishes potentially using the tailwater, and low-flow summer habitat of resident fishes. The Niagara tailwaters are depicted in Figures E-11, E-14, E-15, and E-17. Erosion and deposition impacts are considered negligible in the Niagara tailwaters because of the steep, rocky, and relatively straight river channel.

Fish species likely to spawn in or near the project tailwaters include white sucker, northern hog sucker, redhorses, and white bass. All of these species would be expected to spawn predominantly during the period March-May. According to FERC (1988), there should be little loss of spawning habitat below hydroelectric facilities in the spring because of typically elevated river flows. Monthly mean river flows (in cfs) at Niagara are as follows:

March	891
April	846
May	553

These compare to a mean annual flow of 510 cfs.

Measurement of tailwater characteristics at Niagara indicates that the river channel is approximately 100 feet in width, and depth of the channel downstream of the immediate vicinity of the powerhouse ranges from 6.5-21 feet. Current velocities in the Niagara tailwater at 275 feet downstream of the powerhouse ranged, in 1989 measurements, from 0.25-0.50 feet/sec across the channel at a gauge flow of 325 cfs, to 0.05-1.60 feet/sec at a discharge of 473 cfs. Fluctuations in tailwater elevations at the Niagara powerhouse during the months of March-May should correspond closely to natural river fluctuations (Table E-15) since, under the proposed mode of operation, the project will not autocycle at inflows above 100 cfs.

The combined characteristics of discharge volume, channel depth, current velocities, and tailwater fluctuations at the Niagara facilities should have no adverse effects on spring spawning habitat.

Many of the above considerations apply also to evaluating potential operational effects on tailwater fish habitat during the summer. Monthly mean river flows (in cfs) at Niagara during the summer are as follows:

June	394
July	281
August	352
September	308

Tailwater fluctuations likely closely match normal river fluctuations during this period of 0.4-1.7 feet.

Of greater interest with respect to fish habitat is potential low-flow effects. Under the proposed mode of operation, the Niagara units will discharge inflow to the project by adjusting wicket gate positions until flows fall below 100 cfs. Operations below 100 cfs inflow will be established upon completion of additional low-flow evaluations to be conducted with representatives of VDGIF.

To evaluate the possible effects of minimum flow releases on downstream habitat, visual evaluations were conducted on November 15, 1989. Virginia Department of Game and Inland Fisheries personnel were present for this evaluation. Downstream river conditions were observed at a 13-minute autocycle mode typical of operation at extreme low flow. Estimated average hourly flow in this mode of operation was 56 cfs. Flows stabilized at 28 cfs at the nearby USGS gauge during the non-generation portion of autocycle operation. It was apparent from this demonstration that river reaches downstream of the powerhouse were receiving adequate flow for fish habitat considerations. Follow-up visual evaluations have been requested by VDGIF **to observe low-flow discharge characteristics following installation of the new Unit 2.** This will be scheduled when river flow and operating conditions permit.

E 3.3.4 Effects of Spillway Use

When river flow exceeds the discharge capacity of the plant, excess flow passes over the spillway, which is a free-overflow structure. This event provides flow to a reach of approximately 1,250 feet of riverbed that normally receives only leakage flows from gated openings in the dam. A potential exists for fish to move up into the area below the spillway while flow is being passed and then to be stranded in this area when spilling ceases.

Spillway use is fairly infrequent at Niagara. Table E-16 indicates that plant discharge capacity was exceeded an average of 62 days per year from 1983-1990, mainly during the wet months of February-April. Because the river substrate in the reach downstream of the spillway is rough (Figures

E-14 and E-16), there is an opportunity for pockets of water to remain following cessation of spill, thereby creating the potential for stranding of fish.

To evaluate this situation, visual observations of flow through the bypass reach were made on November 14-15, 1989. Habitat conditions were observed under conditions of no spill, when flow to the bypass consists of low-level leakage and with flow augmented by lowering the sluice gate, located at the northeast end of the spillway, to a point that allowed a calculated 8 cfs flow to the bypass reach. It was concluded from this demonstration that 8 cfs should be adequate to prevent fish from being stranded in stagnant pools in the bypass.

Additional observations were conducted by APCo and VDGIF on September 12, 1991 to measure water temperature and dissolved oxygen in selected pools throughout the bypass reach. Flow through the bypass at the time of these measurements was estimated at 5-6 cfs. A summary of these measurements is provided in Exhibit E, Documentation of Consultations, Second Stage Consultations, Written Correspondence. Results indicated that summer temperature and dissolved oxygen conditions in the bypass reach should be sufficient for aquatic life using this area.

E 3.3.5 Upstream Fish Passage

The VDGIF indicated that a fish passage plan would need to be worked out in the event that oceangoing anadromous fishes reach the project in the future. The 1990 fish survey verified the fact that no fishes requiring upstream passage were present immediately downstream of the project. APCo believes that a standard FERC license article involving reservation of fishways authority is sufficient to address this concern.

E 3.4 Measures Recommended by Agencies

Consultation with agencies concerning possible impacts of the Niagara Hydroelectric Project have focused upon two issues: minimum flows through the turbines and potential fish stranding below the spillway (Exhibit E, Consultation Documentation, Initial and Second Stage Consultations, Written Correspondence and Meeting Notes).

With respect to minimum flow, agency personnel have requested additional visual evaluations of low-flow discharges, **once Unit 2 has been returned to service**, to determine minimum flow levels that are adequate to maintain fish habitat.

To lessen the potential for fish to become stranded in stagnant pools following spillway use, it was recommended that an 8 cfs flow be maintained in the bypass reach.

E 3.5 Measures Proposed by Applicant

APCo will initiate a measure to provide spill to the bypass reach to maintain flows of approximately 8 cfs. **APCo proposes to file a plan with the FERC detailing the methodology by which the 8 cfs will be maintained and monitored in the bypass subsequent to issuance of a new license for the Niagara Project. The plan will be prepared in consultation with VDGIF. Current concepts under consideration include the installation of a control system that would maintain a constant flow over the sluice gate at the spillway. At this time, a proposed monitoring plan would involve installation of a calibrated staff gauge located in the bypass reach. The location and pertinent details for the staff gauge will be finalized in consultation with VDGIF. Both the proposed sluice gate controls and staff gauge are intended to be operational within approximately two years from the date the new license is issued by FERC. Very preliminary estimates**

indicate the capital cost for these items to be approximately $49,200, in 1996 dollars, while the levelized annual cost is estimated at $6,770.

It is estimated that maintaining 8 cfs in the Niagara bypass reach will result in a loss of 200 MWh per year from the project. Based on the $55/MWh levelized cost of alternative source power, as presented in Exhibit H, this generation has a levelized cost to APCo of $11,000 per year over the term of a new license.

Installation of the new Unit 2 turbine is anticipated to eliminate the need to autocycle at inflows greater than approximately 100 cfs. Additional visual evaluations of low-flow turbine discharges will be conducted with representatives of VDGIF as soon as conditions at the project are conducive to this type of evaluation (See Exhibit A, Section A1.3).

E 3.6 Anticipated Continuing Impact

With the measures described in Section E 3.5, there should be no significant continuing impact on any aspect of fish, wildlife, or botanical resources. Following the change to enhance flow to the bypass reach, and pending the outcome of the additional low-flow discharge visual evaluations, no need has been identified for further modification of project operations or facilities.

E 3.7 Description of Proposed Operational Procedures

See Exhibit A, Section A 1.3 for a description of the proposed mode of operation.

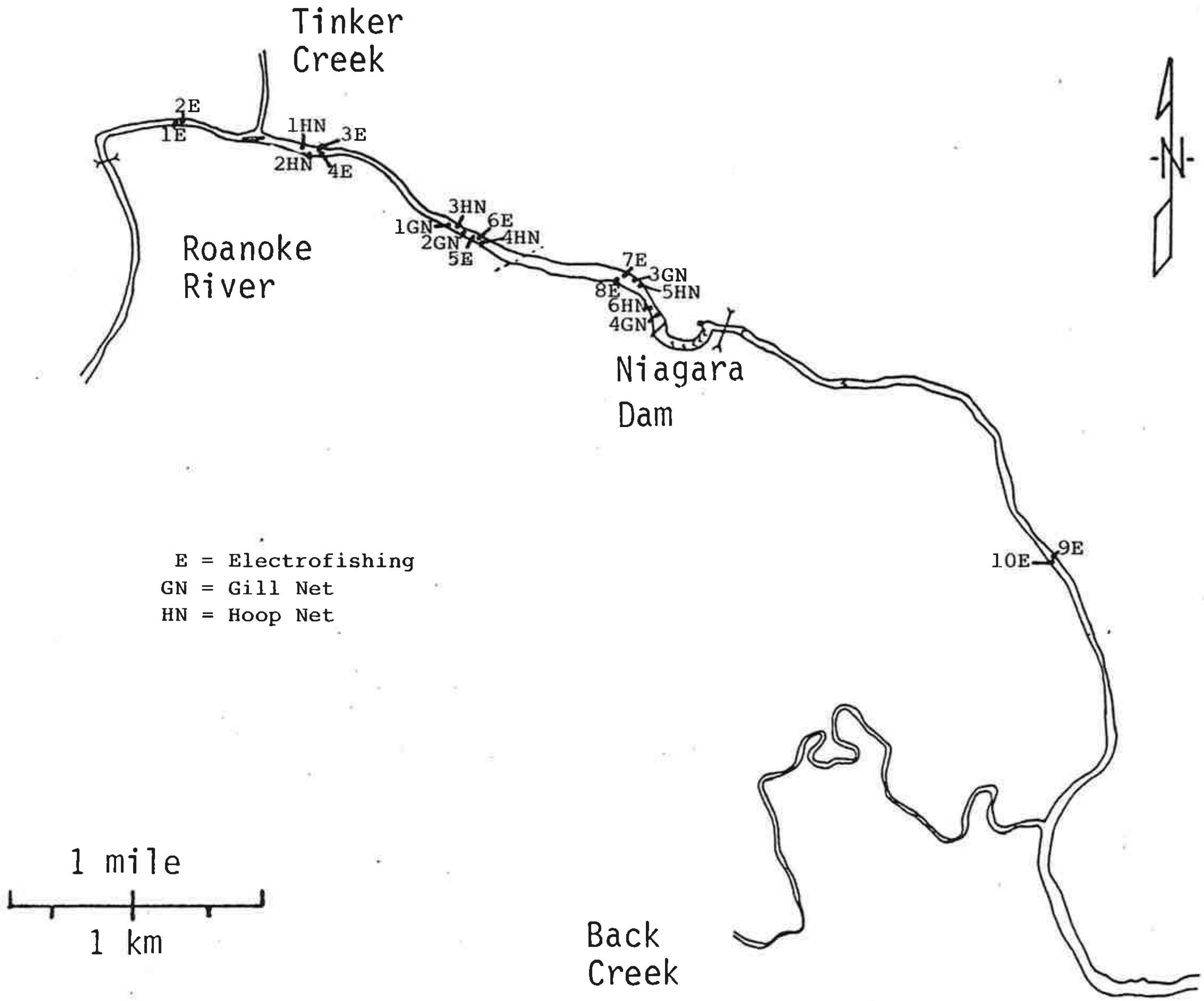


FIGURE E-3

FISH SAMPLING STATIONS IN THE VICINITY OF NIAGARA HYDROELECTRIC PROJECT, 1990.

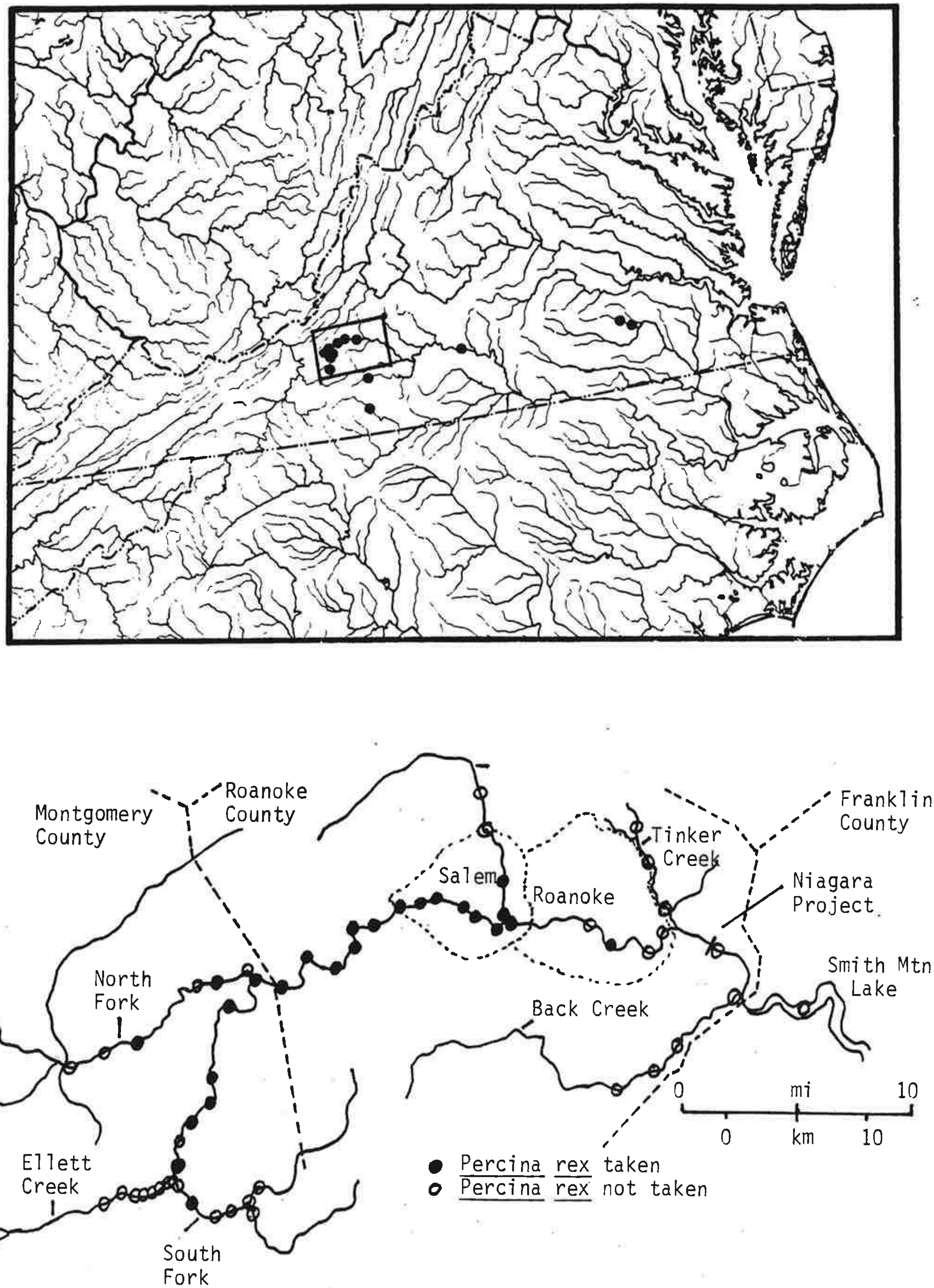
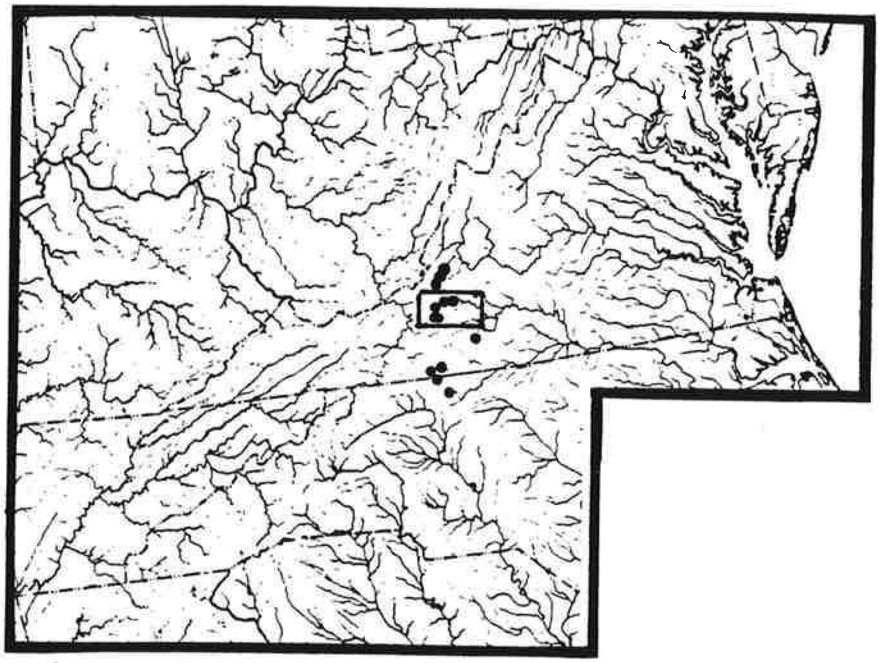


FIGURE E-4

Top: Distribution of the Roanoke logperch (adapted from Jenkins et al. (1978)).

Bottom: Collections of the Roanoke logperch in the upper Roanoke River drainage (boxed area of top map; adapted from Jenkins (1977a))



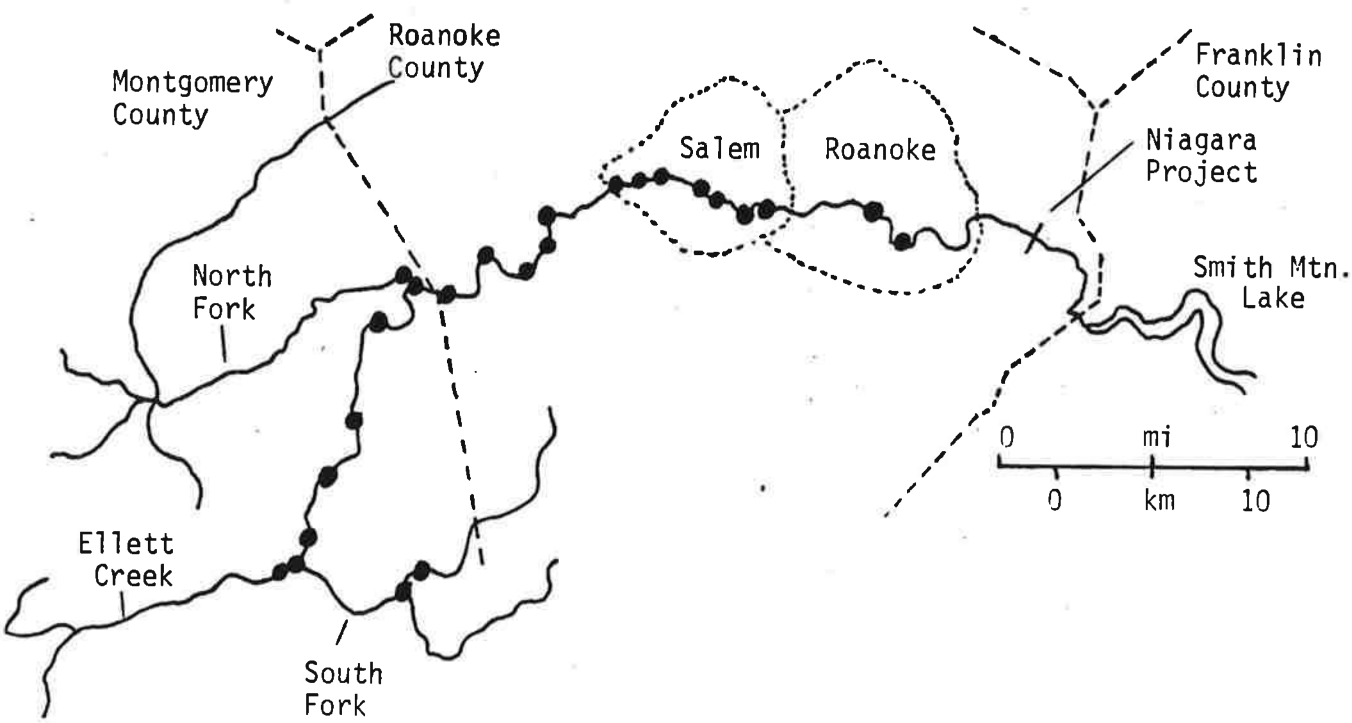
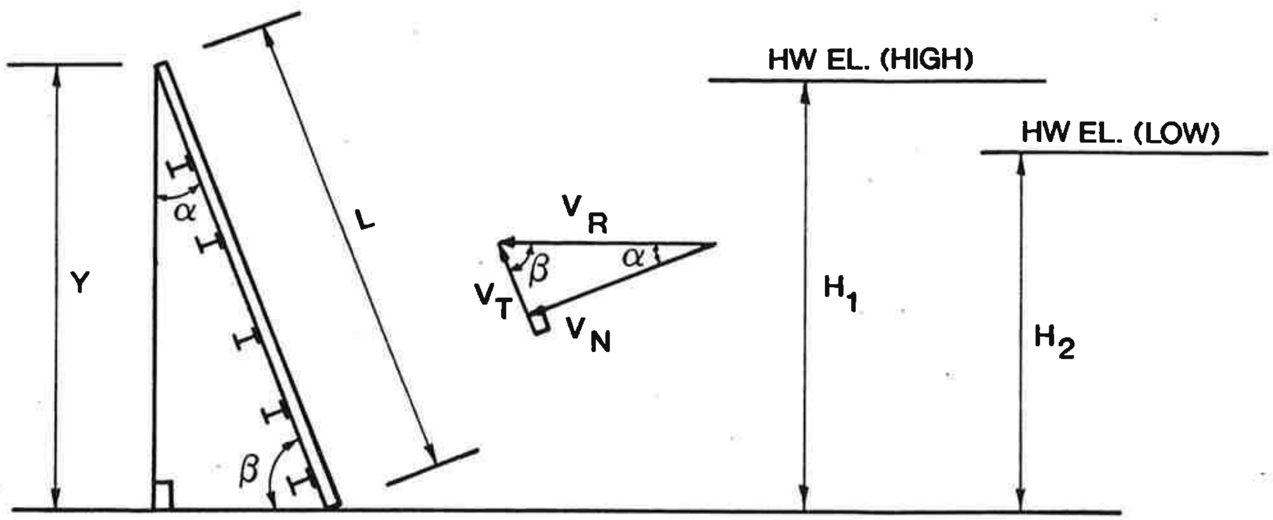


FIGURE E-5

Top: Distribution of the orangefin madtom (adapted from Jenkins 1978).

Bottom: Collections of the orangefin madtom in the upper Roanoke River drainage (boxed area of top map; adapted from Jenkins (1977b)).



$\cos\alpha = \frac{Y}{L}$, $\beta = 90° - \alpha$, W = WIDTH OF INTAKE. Q = FLOW IN CFS

EXAMPLE AT FULL POOL

AT SCREEN FACE:

INTAKE AREA = $A_1 = H_1 \times W$

$V_R = Q/A_1$

$V_T = V_R \sin\alpha$

$V_N = V_R \cos\alpha$

AT TRAILING EDGE:

BLOCKED AREA $\perp$ = BLOCKED AREA $\angle\alpha$ $\cos\alpha$

CONSTRICTED INTAKE AREA = $A_2 = A_1$ − BLOCKED AREA $\perp$

$V_R = V_R \frac{A_1}{A_2}$

$V_T = V_T \frac{A_1}{A_2}$

$V_N = V_N \frac{A_1}{A_2}$

VELOCITIES AT INTAKE SCREENS

FIGURE E-6

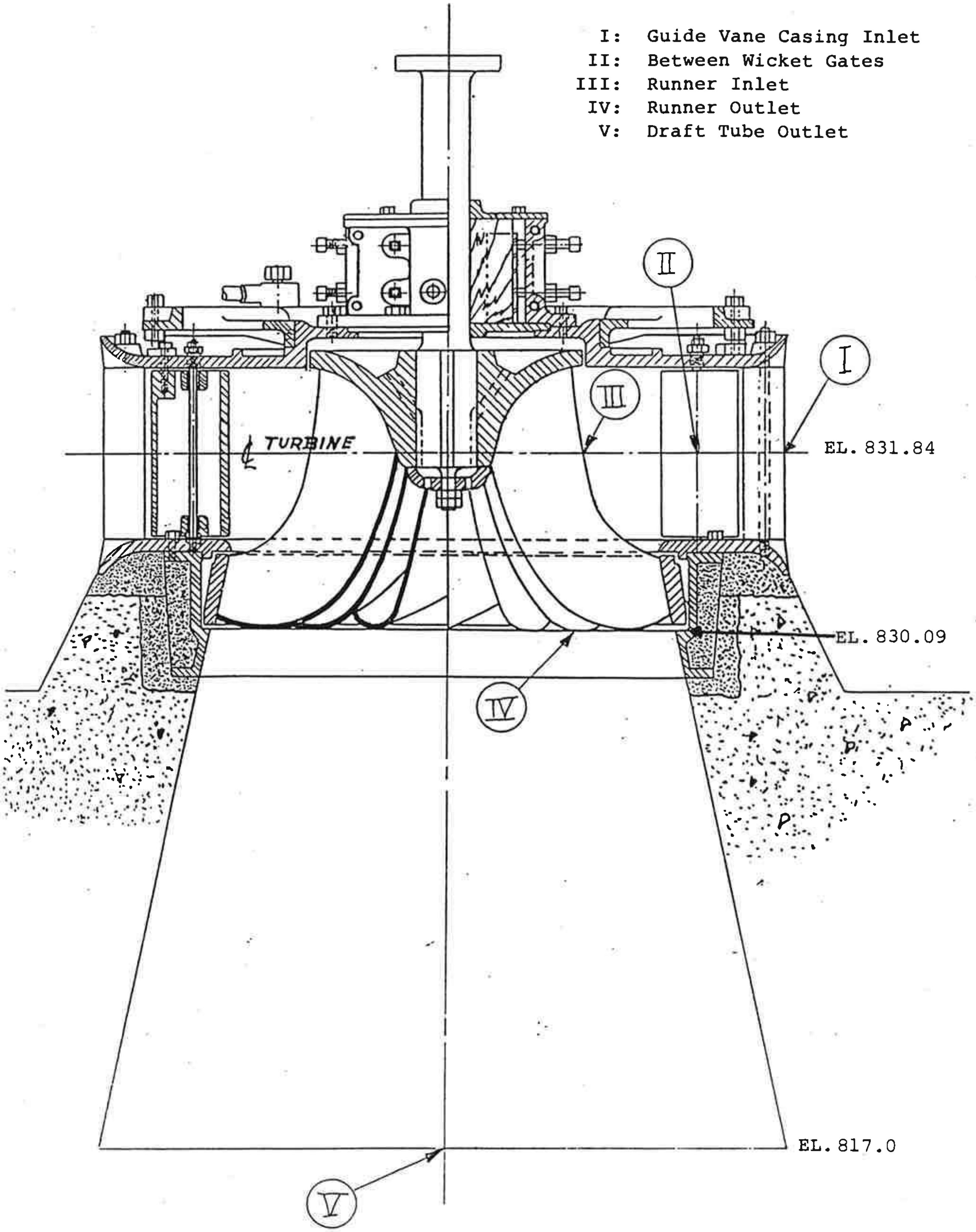


FIGURE E-7

POINTS AT WHICH PRESSURE WAS CALCULATED
FOR NIAGARA TURBINE.

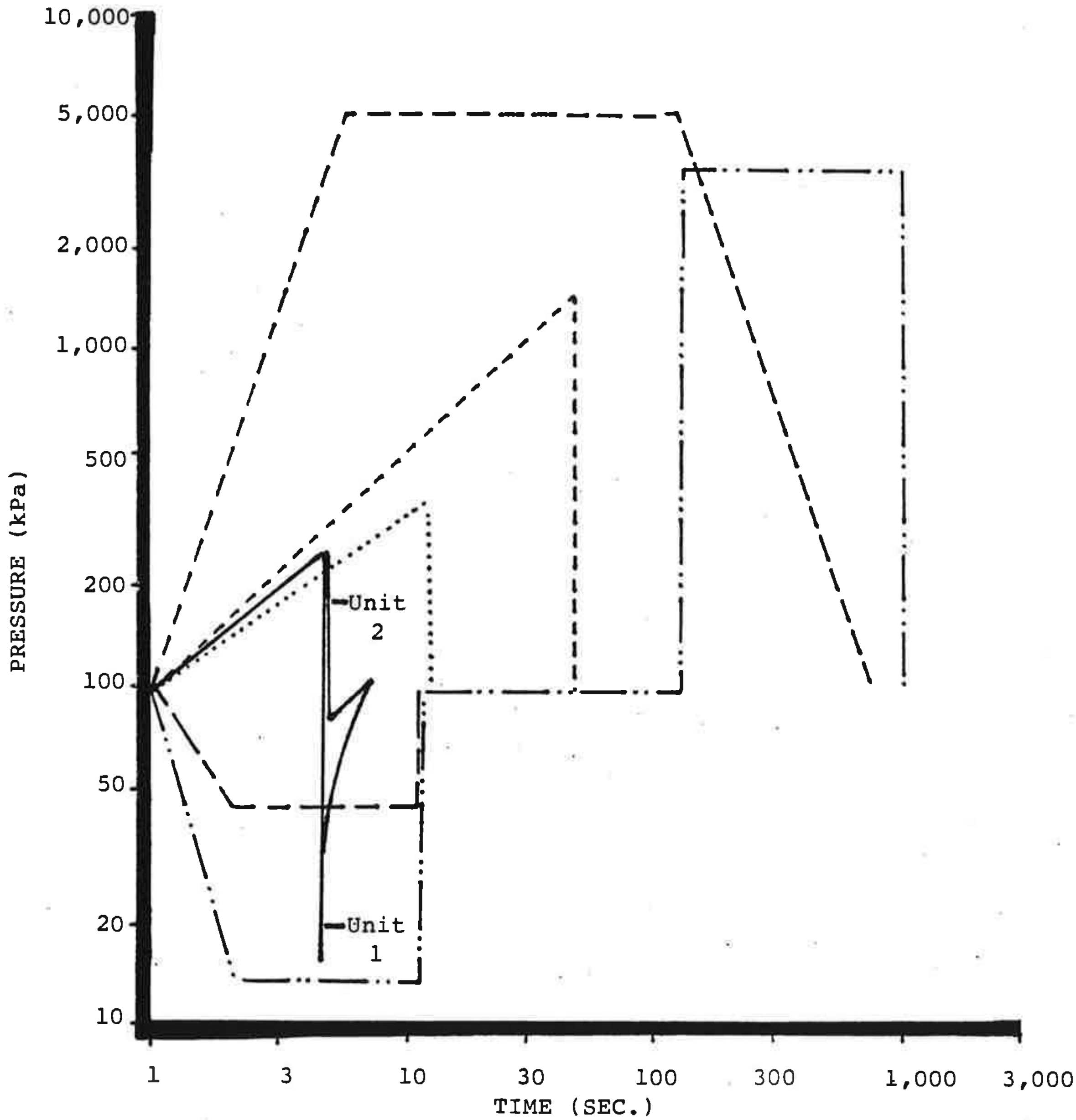


FIGURE E-8

ESTIMATED PRESSURE REGIME THROUGH NIAGARA TURBINE UNITS 1 AND 2 (SOLID LINE) COMPARED TO PRESSURE REGIMES IN EXPERIMENTAL STUDIES WITH FISH (Modified from Cada, 1990).

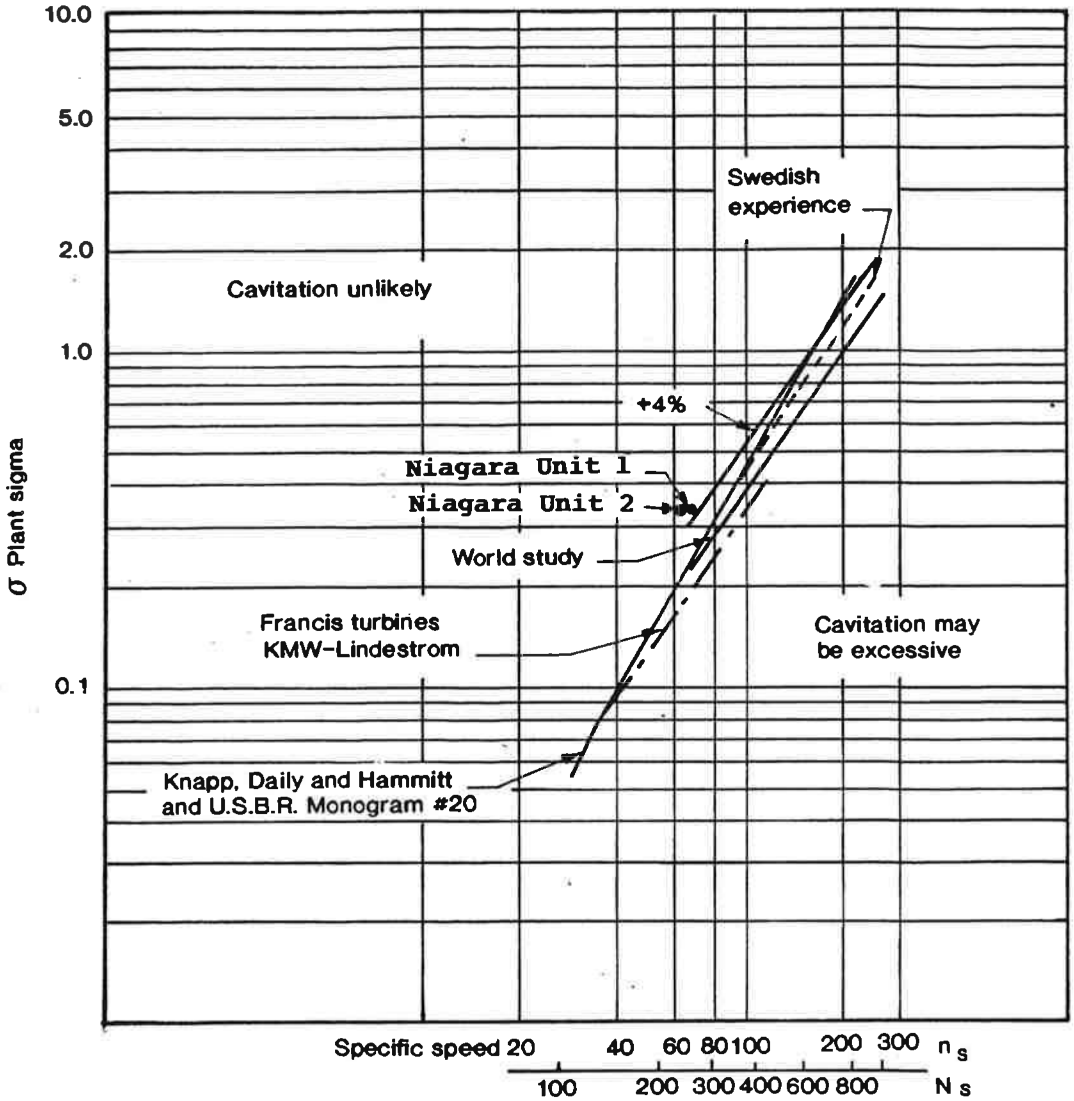
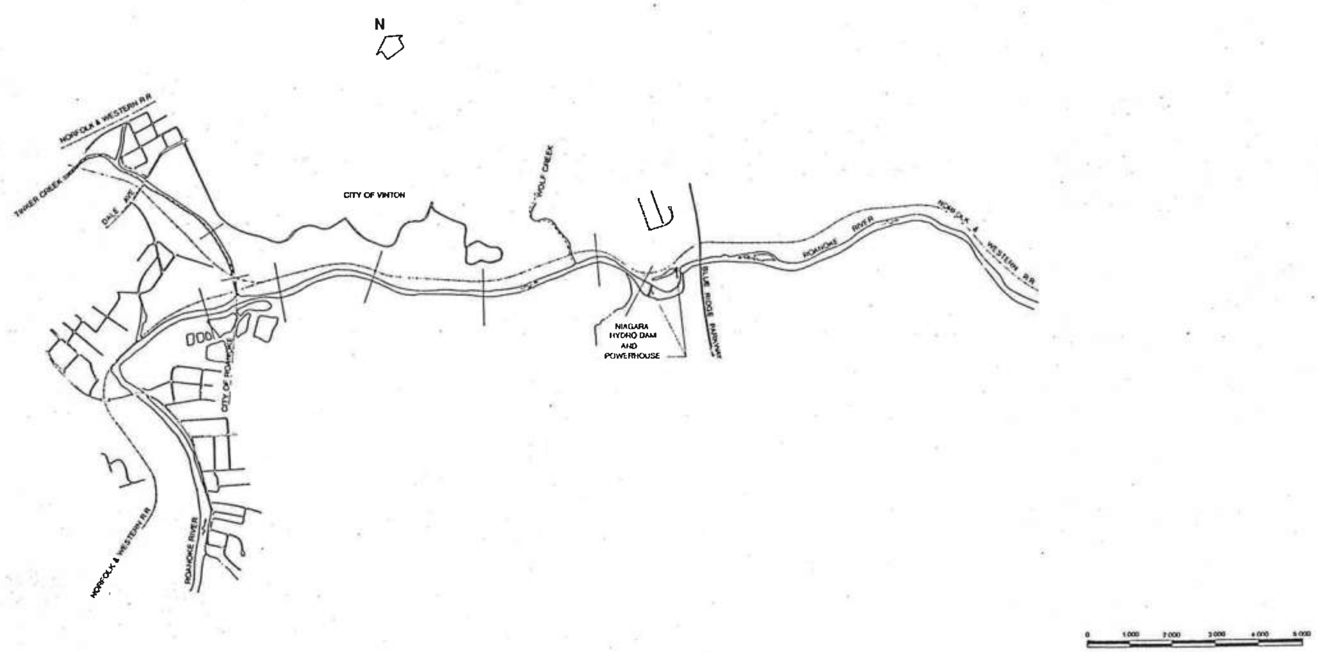


FIGURE E-9

Comparison of experience curves for cavitation coefficient. (Modified from Warwick et al. 1984)



APPALACHIAN POWER COMPANY
NIAGARA
HYDROELECTRIC PROJECT No. 2466
VIRGINIA

FIGURE E-10
TRANSECTS FLOWN FOR
ROANOKE RIVER BASIN
MAPPING, 1990

TABLE E-1
FLOOD FREQUENCY DATA

Return Interval (yrs)	Flow (cfs)
5	16,885
10	22,029
25	29,647
50	39,186
100	43,510
200	51,723
500	64,131

TABLE E-6
NUMBER AND BIOMASS OF FISH SPECIES COLLECTED NEAR THE NIAGARA HYDROELECTRIC PROJECT,
ROANOKE RIVER, JUNE - OCTOBER 1990

Common Name	Scientific Name	Number	Percent of Total Number	Weight (kg)	Percent of Total Weight
Gizzard Shad	Dorosoma cepedianum	36	1.9	3.81	0.6
Goldfish	Carassius auratus	1	<0.1	0.80	0.1
Grass Carp	Ctenopharyngodon idella	1	<0.1	3.95	0.6
Common Carp	Cyprinus carpio	186	9.6	281.07	42.3
Bluehead Chub	Nocomis leptocephalus	1	<0.1	<0.01	<0.1
Bull Chub	Nocomis raneyi	2	0.1	0.34	<0.1
White Shiner	Notropis albeolus	31	1.6	0.16	<0.1
Satinfin Shiner	Notropis analostanus	8	0.4	0.03	<0.1
Rosefin Shiner	Notropis ardens	1	<0.1	0.02	<0.1
Spottail Shiner	Notropis hudsonius	143	7.4	0.43	0.1
Mimic Shiner	Notropis volucellus	3	0.2	0.02	<0.1
Shiner	Notropis species	2	0.1	0.01	<0.1
Bluntnose Minnow	Pimephales notatus	21	1.1	0.06	<0.1
White Sucker	Catostomus commersoni	175	9.0	61.79	9.3
Northern Hog Sucker	Hypentelium nigricans	2	0.1	0.56	0.1
Silver Redhorse	Moxostoma anisurum	343	17.7	187.92	28.3
Golden Redhorse	Moxostoma erythrurum	106	5.5	27.55	4.1
Shorthead Redhorse	Moxostoma macrolepidotum	7	0.4	3.38	0.5
V-lip Redhorse	Moxostoma pappillosum	3	0.2	0.80	0.1
Torrent Sucker	Moxostoma rhothoecum	1	<0.1	1.30	0.2
White Catfish	Ictalurus catus	15	0.8	8.73	1.3
Yellow Bullhead	Ictalurus natalis	20	1.0	4.50	0.7
Brown Bullhead	Ictalurus nebulosus	12	0.6	3.56	0.5
Black Bullhead	Ictalurus melas	6	0.3	2.49	0.4
Channel Catfish	Ictalurus punctatus	18	0.9	19.80	3.0
Flathead Catfish	Pylodictis olivaris	1	<0.1	2.40	0.4
White Bass	Morone chrysops	4	0.2	0.59	0.1
Rock Bass	Ambloplites rupestris	26	1.3	1.34	0.2
Redbreast Sunfish	Lepomis auritus	555	28.7	24.54	3.7
Pumpkinseed	Lepomis gibbosus	48	2.5	0.61	0.1
Bluegill	Lepomis macrochirus	58	3.0	1.99	0.3
Hybrid Sunfish	Lepomis hybrid	1	<0.1	0.03	<0.1
Smallmouth Bass	Micropterus dolomieui	51	2.6	7.33	1.1
Largemouth Bass	Micropterus salmoides	28	1.4	9.49	1.4

TABLE E-6 (cont'd)

Common Name	Scientific Name	Number	Percent of Total Number	Weight (kg)	Percent of Total Weight
Black Crappie	Pomoxis nigromaculatus	16	0.8	3.20	0.5
Roanoke Logperch	Percina rex	4	0.2	0.01	<0.1
TOTALS		1,936		664.61	
Number of Species		34			

TABLE E-7

PARASITES AND ABNORMALITIES IN FISH COLLECTED NEAR THE NIAGARA HYDROELECTRIC PROJECT, ROANOKE RIVER, JUNE - OCTOBER 1990.

Parasites[a]

Species	Riffle/Run Upstream No.	Riffle/Run Upstream % of Total	Upper Pool No.	Upper Pool % of Total	Middle Pool No.	Middle Pool % of Total	Lower Pool No.	Lower Pool % of Total	Riffle/Run Downstream No.	Riffle/Run Downstream % of Total
Common Carp	1	4.2	--	--	--	--	--	--	--	--
White Sucker	--	--	--	--	--	--	1	2.0	--	--
Golden Redhorse	--	--	1	14.3	--	--	--	--	--	--
Redbreast Sunfish	1	0.6	2	1.6	--	--	--	--	1	2.5
Pumpkinseed	--	--	--	--	--	--	--	--	1	20.0
Largemouth Bass	--	--	--	--	1	25.0	--	--	--	--
Black Crappie	--	--	--	--	--	--	1	33.3	--	--
TOTALS	2	0.5	3	0.8	1	0.2	2	0.6	2	0.7

Abnormalities[b]

Species	Riffle/Run Upstream No.	Riffle/Run Upstream % of Total	Upper Pool No.	Upper Pool % of Total	Middle Pool No.	Middle Pool % of Total	Lower Pool No.	Lower Pool % of Total	Riffle/Run Downstream No.	Riffle/Run Downstream % of Total
Common Carp	2	8.3	2	8.0	--	--	3	8.1	3	7.9
White Sucker	1	4.0	6	12.2	2	4.2	--	--	--	--
Northern Hog Sucker	--	--	--	--	--	--	--	--	1	50.0
Silver Redhorse	2	4.4	1	2.4	2	1.4	--	--	--	--
Golden Redhorse	3	6.0	--	--	--	--	--	--	--	--
Shorthead Redhorse	--	--	--	--	--	--	--	--	1	14.3
Black Bullhead	--	--	--	--	--	--	1	33.3	--	--
Yellow Bullhead	--	--	--	--	--	--	1	11.1	--	--
Channel Catfish	--	--	--	--	--	--	1	10.0	--	--
White Bass	--	--	--	--	--	--	--	--	1	25.0
Redbreast Sunfish	1	0.6	2	1.6	1	0.8	--	--	--	--

TABLE E-7 (continued)

Species	Riffle/Run Upstream No.	Riffle/Run Upstream % of Total	Upper Pool No.	Upper Pool % of Total	Middle Pool No.	Middle Pool % of Total	Lower Pool No.	Lower Pool % of Total	Riffle/Run Downstream No.	Riffle/Run Downstream % of Total
Pumpkinseed	--	--	--	--	--	--	--	--	1	20.0
Bluegill	--	--	--	--	--	--	--	--	1	2.4
Largemouth Bass	--	--	--	--	1	25.0	1	25.0	1	5.9
TOTALS	9	2.1	11	3.0	6	1.2	7	2.0	9	3.1

[a] Parasites recorded: fungus (30%), blackspot (20%), bacterial infection (20%), trematode (10%), leech (10%), anchor worm (10%)

[b] Abnormalities recorded: lesions (42.9%), deformities (23.8%), missing body parts (16.7%), eroded fins (14.3%), scars (2.4%)

TABLE E-8
COMPARISON OF FISH SPECIES COLLECTED FROM JUNE - OCTOBER 1990, NEAR THE NIAGARA HYDROELECTRIC PROJECT TO THE VIRGINIA DEPARTMENT OF GAME AND INLAND FISHERIES (VDGIF) SPECIES LIST FOR THE ROANOKE RIVER BASED ON PAST COLLECTIONS.

Family Species	Common Name	Roanoke River (VDGIF)	Niagara (1990)
Amiidae			
Amia calva	Bowfin	x	
Clupeidae			
Alosa aestivalis	Blueback Herring	x	
A. pseudoharengus	Alewife	x	
Dorosoma cepedianum	Gizzard Shad	x	x
Salmonidae			
Oncorhynchus mykiss	Rainbow Trout	x	
Salmo trutta	Brown Trout	x	
Salvelinus fontinalis	Brook Trout	x	
Esocidae			
Esox niger	Chain Pickerel	x	
Cyprinidae			
Campostoma anomalum	Stoneroller	x	
Carrassius auratus	Goldfish	x	x
Clinostomus funduloides	Rosyside Dace	x	
Ctenopharyngodon idella	Grass Carp		x
Cyprinus carpio	Common Carp	x	x
Exoglossum maxillingua	Cutlips Minnow	x	
Nocomis leptocephalus	Bluehead Chub	x	x
N. raneyi	Bull Chub	x	x
Notemigonus crysoleucas	Golden Shiner	x	
Notropis albeolus	White Shiner	x	x
N. altipinnis	Highfin Shiner	x	
N. amoenus	Comely Shiner	x	
N. analostanus	Satinfin Shiner	x	x
N. ardens	Rosefin Shiner	x	x
N. cerasinus	Crescent Shiner	x	
N. hudsonius	Spottail Shiner	x	x
N. procne	Swallowtail Shiner	x	
N. rubellus	Rosyface Shiner	x	
N. spilopterus	Spotfin Shiner	x	
N. volucellus	Mimic Shiner	x	x
Notropis sp.	Shiner sp.		x
Phoxinus oreas	Mountain Redbelly Dace	x	
Pimephales notatus	Bluntnose Minnow	x	x
P. promelas	Fathead Minnow	x	
Rhinichthys atratulus	Blacknose Dace	x	
R. cataractae	Longnose Dace	x	
Semotilus atromaculatus	Creek Chub	x	
S. corporalis	Fallfish	x	
Catostomidae			
Carpiodes cyprinus	Quillback	x	
Catostomus commersoni	White Sucker	x	x
Hypentelium nigricans	Northern Hog Sucker	x	x
H. roanokense	Roanoke Hog Sucker	x	

Table E-8 (cont'd)

Family Species	Common Name	Roanoke River (VDGIF)	Niagara (1990)
Moxostoma anisurum	Silver Redhorse	x	x
M. ariommum	Bigeye Jumprock	x	
M. cervinum	Black Jumprock	x	
M. erythrurum	Golden Redhorse	x	x
M. macrolepidotum	Shorthead Redhorse	x	x
M. pappillosum	V-lip Redhorse	x	x
M. rhothoecum	Torrent Sucker	x	x
Ictaluridae			
Ictalurus catus	White Catfish	x	x
I. melas	Black Bullhead		x
I. natalis	Yellow Bullhead	x	x
I. nebulosus	Brown Bullhead	x	x
I. platycephalus	Flat Bullhead	x	
I. punctatus	Channel Catfish	x	x
Noturus gilberti	Orangefin Madtom	x	
N. insignis	Margined Madton	x	
Pylodictis olivaris	Flathead Catfish	x	x
Percichthyidae			
Morone americana	White Perch	x	
M. chrysops	White Bass	x	x
M. saxatilis	Stiped Bass	x	
Centrarchidae			
Ambloplites cavifrons	Roanoke Bass	x	
A. rupestris	Rock Bass	x	x
Lepomis auritus	Redbreast Sunfish	x	x
L. cyanellus	Green Sunfish	x	
L. gibbosus	Pumpkinseed	x	x
L. gulosus	Warmouth	x	
L. macrochirus	Bluegill	x	x
L. microlophus	Redear Sunfish	x	
Lepomis hybrid	Hybrid Sunfish		x
Micropterus dolomieui	Smallmouth Bass	x	x
M. salmoides	Largemouth Bass	x	x
Pomoxis annularis	White Crappie	x	
P. nigromaculatus	Black Crappie	x	x
Percidae			
Etheostoma flabellare	Fantail Darter	x	
E. maculatum	Spotted Darter	x	
E. nigrum	Johnny Darter	x	
E. podostemone	Riverweed Darter	x	
E. vitreum	Glassy Darter	x	
Perca flavescens	Yellow Perch	x	
Percina peltata	Shield Darter	x	
P. rex	Roanoke Logperch	x	x
P. roanoka	Roanoke Darter	x	
Stizostedion vitreum	Walleye	x	
Cottidae			
Cottus bairdi	Mottled Sculpin	x	

TABLE E-9
MEAN CATCH PER UNIT EFFORT (CPUE) FOR ELECTROFISHING (NUMBER OF FISH)
NEAR THE NIAGARA HYDROELECTRIC PROJECT, ROANOKE RIVER, JUNE - OCTOBER 1990.
FOR SPECIES WITH SIGNIFICANTLY DIFFERENT CATCHES AMONG LOCATIONS (IDENTIFIED BY ASTERISKS),
CPUE VALUES FOLLOWED BY THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT (P>0.10).

	Electrofishing CPUE (No./Minute)					
Species	Riffle/Run Upstream	Upper Pool	Middle Pool	Lower Pool	Riffle/Run Downstream	P-Value**
Gizzard Shad*	0A	0A	0A	0.02A	0.61B	0.01
Common Carp*	0.40B	0.16AB	0.39B	0.07A	0.71B	<0.01
Bluehead Chub	0	0	0	0	0.01	0.41
Bull Chub	0.02	0	0	0	0.02	0.54
White Shiner	0.14	0.24	0.07	0.09	0.02	0.45
Satinfin Shiner*	0A	0A	0A	0A	0.15B	<0.01
Rosefin Shiner	0	0	0	0.01	0	0.41
Spottail Shiner	1.04	0.56	0.31	0.10	0.25	0.21
Mimic Shiner	0	0	0	0.02	0.01	0.54
Bluntnose Minnow	0	0.07	0.11	0.03	0.01	0.28
White Sucker*	0.38B	0.54B	0.39B	0.33B	0.06A	0.02
Northern Hog Sucker*	0A	0A	0A	0A	0.04B	0.08
Silver Redhorse	0.73	0.49	0.49	0.18	0.50	0.18
Golden Redhorse*	0.92B	0.12A	0.03A	0.07A	0.35AB	<0.01
Shorthead Redhorse*	0A	0A	0A	0A	0.16B	0.08
V-lip Redhorse*	0A	0A	0A	0A	0.07B	0.01
White Bass	0	0	0	0	0.05	0.41
Rock Bass*	0.10B	0.01A	0.05AB	0.04AB	0A	0.03
Redbreast Sunfish*	2.45B	1.87AB	1.88AB	1.35AB	0.77A	0.09
Pumpkinseed	0.02	0.27	0.20	0.15	0.11	0.14
Bluegill*	0.03A	0.02A	0.03A	0.18B	0.80C	<0.01
Hybrid Sunfish	0.01	0	0	0	0	0.41
Smallmouth Bass*	0.38B	0.10A	0.08A	0.02A	0.08A	<0.01
Largemouth Bass*	0A	0.03A	0.06A	0.04A	0.33B	<0.01
Black Crappie	0.01	0.02	0	0	0.05	0.11
Roanoke Logperch*	0.08B	0A	0A	0A	0A	0.08

* Species with significantly different catches among locations (P≤0.10).

** Significance value for chi-square approximation of Kruskal-Wallis test statistic.

TABLE E-10
SPAWNING CHARACTERISTICS OF FISH SPECIES OF THE NIAGARA HYDROELECTRIC PROJECT RESERVOIR*.

Species	Spawning Period	Spawning Habitat	Spawning Depth (ft)	Egg Deposition	Egg Type
Gizzard Shad	April-August	Vegetation/Margins	1-8	Broadcast	Adhesive, Semi-buoyant
Goldfish	March-August	Vegetation	0.5-6	Broadcast	Adhesive-Demersal
Common Carp	May-August	Vegetation	0.25-6	Broadcast	Adhesive Demersal
Spottail Shiner	May-August	Sandy Shoals	0.25-1.5	Broadcast	Adhesive Demersal
Mimic Shiner	May-July	Vegetation	15-20	Broadcast	Demersal
Bluntnose Minnow	May-July	Sand/Gravel	0.25-8	Nest	Adhesive Demersal
Creek Chub	April-June	Gravel	0.25-6?	Nest	Demersal
White Catfish	May-July	Crevices	1-8?	Nest	Adhesive Demersal
Yellow Bullhead	May-July	Crevices	1-8?	Nest	Adhesive
Brown Bullhead	April-July	Crevices	0.5-8	Nest	Adhesive Demersal
Black Bullhead	May-July	Crevices	2-4	Nest	Adhesive
Channel Catfish	May-July	Crevices	1-8	Nest	Adhesive Demersal
Flathead Catfish	June-July	Crevices	1-8	Nest	Adhesive Demersal
Rock Bass	May-June	Sand/Gravel	0.25-3.5	Nest	Adhesive Demersal
Redbreast Sunfish	May-June	Sand/Gravel	1-5?	Nest	Adhesive Demersal
Green Sunfish	May-August	Sand/Gravel	0.25-1.5	Nest	Adhesive Demersal
Pumpkinseed	May-August	Sand/Gravel	1-2.5	Nest	Adhesive Demersal
Bluegill	May-August	Sand/Gravel	1-5	Nest	Adhesive Demersal
Smallmouth Bass	April-July	Sand/Gravel	1-5	Nest	Adhesive Demersal
Largemouth Bass	April-July	Sand/Gravel	1-5	Nest	Adhesive Demersal
Black Crappie	May-June	Sand/Gravel	1-8	Nest	Adhesive Demersal

* Information consolidated from Becker (1983), Carlander (1969, 1977), and WAPORA, Inc. (1978, 1987).

TABLE E-11

MEAN CATCH PER UNIT EFFORT (CPUE) FOR COMBINED GILL AND HOPP NETTING (NUMBER OF FISH) IN THE NIAGARA HYDROELECTRIC PROJECT RESERVOIR, ROANOKE RIVER, JUNE - OCTOBER 1990. FOR SPECIES WITH SIGNIFICANTLY DIFFERENT CATCHES AMONG LOCATIONS (IDENTIFIED BY ASTERISKS), CPUE VALUES FOLLOWED BY THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT (P>0.10).

	Gill/Hoop Netting CPUE (No./Net/Day)			
Species	Upper Pool	Middle Pool	Lower Pool	P-Value**
Goldfish	0	0	0.02	0.41
Grass Carp	0	0	0.02	0.41
Common Carp	0.58	0.69	0.65	0.86
White Sucker	0.50	0.48	0.58	0.92
Silver Redhorse*	0.54A	2.34B	1.48AB	0.02
Golden Redhorse*	0A	0.33B	0.15AB	0.01
Torrent Sucker	0.02	0	0	0.41
White Catfish	0.29	0.08	0.04	0.19
Black Bullhead	0.08	0.02	0.06	0.42
Yellow Bullhead	0.13	0.06	0.19	0.37
Brown Bullhead	0.18	0.02	0.08	0.30
Channel Catfish*	0.04A	0.06A	0.21B	0.06
Flathead Catfish	0	0	0.02	0.41
Rock Bass*	0A	0.19B	0.06AB	<0.01
Redbreast Sunfish	0.17	0.10	0.04	0.17
Smallmouth Bass	0.04	0.04	0.10	0.24
Largemouth Bass	0.04	0	0.04	0.24
Black Crappie	0.08	0.13	0.06	0.17

* Species with significantly different catches among locations (P≤0.10).

** Significance value for chi-square approximation of Kruskal-Wallis test statistic.

TABLE E-12

NIAGARA HYDRO PROJECT
UPPER INTAKE SCREEN FLOW VELOCITIES
(FPS).

V_R = resultant velocity, V_T = tangential velocity, and
V_N = normal velocity

	V_R	V_T	V_N
At Screen Face			
HW El. 885 NGVD	1.013	0.405	0.929
HW El. 884 NGVD	1.087	0.434	0.996
At Trailing Edge:			
HW El. 885 NGVD	1.214	0.485	1.113
HW El. 884 NGVD	1.296	0.518	1.188

TABLE E-13

PROBABILITY (%) OF FISH CONTACT WITH TURBINE BLADES AT NIAGARA HYDROELECTRIC PROJECT FOR YOUNG-OF-YEAR AND AVERAGE-SIZED ADULT[a]

Species	Length (mm)[b]	Probability Unit 1	Probability Unit2
Gizzard Shad	85	9	8
	250	27	23
Goldfish	45	5	4
	250	27	23
Common Carp	80	9	7
	350*	37	32
White Shiner	25	3	2
	90	10	8
Rosefin Shiner	25	3	2
	65	7	6
Spottail Shiner	30	3	3
	60	6	5
Mimic Shiner	20	2	2
	50	5	5
Bluntnose Minnow	25	3	2
	65	7	6
White Sucker	40	4	4
	240	26	22
Silver Redhorse	40	4	4
	300	32	27
Golden Redhorse	40	4	4
	300	32	27
White Catfish	70	7	6
	275*	29	25
Yellow Bullhead	60	6	5
	250	27	23
Brown Bullhead	60	6	5
	250	27	23
Black Bullhead	50	5	5
	225	24	21
Channel Catfish	70	7	6
	275*	29	25
Flathead Catfish	75	8	7
	275*	29	25
Rock Bass	30	3	3
	175	19	16
Redbreast Sunfish	30	3	3
	125	13	11
Pumpkinseed	30	3	3
	150	16	14
Bluegill	30	3	3
	150	16	14
Smallmouth Bass	60	6	5
	275	29	25
Spotted Bass	60	6	5
	240	26	22
Largemouth Bass	60	6	5
	275	29	25
Black Crappie	50	5	5
	210	22	19

Table E-13 (cont'd)

a) Turbine measurements used in calculations:
Number of runner blades = 14
RPM = 277
Runner diameter = 53.25 (Unit 1), 52 in. (Unit 2)
Blade angle = 29.2° (Unit 1), 63° (Unit 2)
Turbine discharge = 379 cfs (Unit 1), 305 cfs (Unit 2)

b) * indicates maximum-size fish estimated to pass 3 5/8-inch opening of intake screens

TABLE E-14

DATA USED FOR CALCULATION OF NIAGARA CAVITATION COEFFICIENT

RPM - 277
Runner Diameter (max. - ft.) = 4.17 (Unit 1); 3.94 (Unit 2)
Circumference (ft.) = 13.09 (Unit 1); 12.37 (Unit 2)
Velocity (blade tip - fps) = 60.43 (Unit 1); 57.11 (Unit 2)
Headwater elevation (norm. max. - ft.) = 884.4
Turbine runner elevation (ft.) = 831.97
Tailwater elevation (min. - ft.) = 820.5
Plant sigma = 0.32
Specific speed = 71.9 (Unit 1); 63.4 (Unit 2)

TABLE E-15

AVAILABLE SPAWNING HABITAT ACREAGE AND MAXIMUM % EXPOSED BY RIVER FLUCTUATION AT NIAGARA HYDROELECTRIC PROJECT.

Month	Spawning Group [a]	Habitat Available (acres)	Mean River Fluctuation (ft) [b]	% Habitat Exposed
March	A	38.4	2.4	17
April	A	37.9	2.3	17
	B	42.4		9
May	A	34.0	1.2	10
	B	38.5		2
June	A	28.9	0.4	2
	B	35.1		<1
July	A	29.4	0.5	3
	B	35.6		<1
August	A	35.7	1.7	13
	B	40.7		5

a) Spawning Groups
A: Cyprinids, sunfish
B: Gizzard shad, ictalurids, black bass, black crappie

b) Difference between mean maximum and mean minimum Roanoke River gage height at Niagara, 1983-1988.

TABLE E-16

RECORDED RIVER FLOWS EXCEEDING NIAGARA PLANT HYDRAULIC CAPACITY, 1983-1990

Number of Days Plant Hydraulic Capacity Exceeded

Month	1983	1984	1985	1986	1987	1988	1989	1990	Monthly Mean
January	0	0	1	0	6	3	0	21	4
February	13	13	6	2	15	1	2	28	10
March	19	15	0	4	17	0	9	20	11
April	28	24	0	0	27	1	1	16	12
May	1	9	3	3	7	0	17	10	6
June	0	0	0	0	0	0	12	4	2
July	0	0	0	0	0	0	13	3	2
August	0	5	6	1	0	0	0	3	2
September	0	0	0	1	4	0	14	0	2
October	2	0	0	0	0	0	14	16	4
November	0	0	12	1	2	0	7	1	3
December	12	0	4	10	1	0	1	7	4
Annual Total	75	66	32	22	79	5	90	129	

An Assessment of the Roanoke Logperch
in the Roanoke River Downstream of
Niagara Hydroelectric Project

Appalachian Power Company
40 Franklin Road, S.W.
Roanoke, VA 24011

and

American Electric Power Service Corporation
1 Riverside Plaza
Columbus, OH 43216

December 1992

TABLE OF CONTENTS

Introduction

An application for new license for the Niagara Hydroelectric Project (FERC Project No. 2466) was filed with the Federal Energy Regulatory Commission (FERC) in December 1991. Subsequently, the U. S. Fish and Wildlife Service (USFWS) submitted a Request for Additional Studies to the FERC that requested additional surveys to determine the distribution and abundance of the Roanoke logperch *(Percina rex)* (Photograph 1) in the approximately two-mile stretch of free-flowing Roanoke River from the Niagara powerhouse to the head of the Smith Mountain Lake pool (Figure 1). This request was based on a previous survey conducted in 1991 by Appalachian Power Company (APCo) and American Electric Power Service Corporation (AEPSC), in cooperation with the Virginia Department of Game and Inland Fisheries (VDGIF), reported in the license application, that verified the presence of this federallylisted endangered species in this downstream segment of the river, thereby representing an extension of the known range of the Roanoke logperch. The FERC acted on this request in its May 22, 1992 letter to AEPSC, asking that a study be conducted to assess the population of Roanoke logperch downstream of the Niagara project. A study plan (see Appendix) was developed to include the following objectives:

1) systematically survey the Roanoke River for the Roanoke logperch from the Niagara powerhouse to the head of the Smith Mountain Lake pool;

2) characterize the type and location of habitat being used by any collected logperch; and

3) estimate the amount and identify the location of available habitat in this river segment that is of the type used by Roanoke logperch.

A draft study plan was reviewed and approved by both VDGIF and USFWS. The study plan called for completion of field work by September 15, 1992, with a final report to the FERC by

November 16, 1992. However, scheduled sampling on August 27, 1992, was prevented by heavy rain, allowing only gross habitat characterization to be conducted on that date. All potential participants were aware that successful completion of the survey was dependent upon suitable flow conditions, and thus could be subject to short-notice scheduling. Because of continuing wet weather, that resulted in turbid river conditions downstream of the Niagara Project, sampling was delayed until October 22, 1992, when the survey was completed under ideal flow (105 cfs at the Niagara gauge) and water clarity (5 NTU) conditions.

Methodology

Fish Sampling. Roanoke logperch were surveyed on October 22, 1992. Present at the survey were Arthur LaRoche, Bob Albrecht, Scott Smith, and Michael Duval (VDGIF), Jerry Zwart (APCo), and John Van Hassel and Ken Wood (AEPSC). USFWS was notified of the planned survey by telephone on October 19, but was unable to send a representative because of schedule conflicts. The area surveyed consisted of a 1 1/4-mile segment of the Roanoke River directly downstream of the Niagara powerhouse. Habitat characterization of the two-mile, free-flowing segment of the river between the powerhouse and the Smith Mountain Lake headwaters on August 27 had determined that the upper 1 1/4 miles of the segment were predominately riffle/run habitat where logperch might be found, while the lower 3/4 mile of the free-flowing segment was dominated by long, silty pools where logperch would not be expected (see Appendix for summary of August 27 activities).

Logperch were surveyed in the river segment by systematic searching of all riffle/run areas characterized by gravel or cobble substrate by two AEPSC snorkelers. Follow-up backpack electrofishing was conducted by VDGIF personnel for species verification, and to sample areas of sub-optimal habitat that were not searched by snorkeling.

__Habitat Characterization__. A gross determination of the location of riffle/run and pool habitats in the two-mile free-flowing segment of the river was made by canoe on August 27, 1992. On October 22, in conjunction with the logperch survey, the following data were recorded at each location where a log-perch was captured: water temperature (YEW Model SC51 meter), surface and bottom current velocity (Marsh-McBirney Model 201D meter, 5 cm below water surface and 5 cm above bottom), turbidity (Bausch & Lomb nephelometer), depth, direction of flow (compass), substrate composition (visual estimate), and an estimate of the total area of similar habitat surrounding the capture location. Additionally, photographs were taken to provide a general profile of the location of riffle/run/pool habitats in the surveyed segment.

Results

__Fish Sampling__. A total of ten Roanoke logperch were observed, nine by snorkeling and one (129 mm total length) by electrofishing. Figure 2 depicts the locations where the log-perch were found. Other species observed during the survey included gizzard shad (*Dorosoma cepedianum*), goldfish (*Carrassius auratus*), common carp (*Cyprinus carpio*), shiners (*Notropis* spp.), bluntnose minnow (*Pimephales notatus*), black jumprock (*Moxostoma cervinum*), channel catfish (*Ictalurus punctatus*), margined madtom (*Noturus insignis*), redbreast sunfish (*Lepomis auritus*), fantail darter (*Etheostoma flabellare*), riverweed darter (*E. podostemone*), and Roanoke darter (*Percina roanoka*).

Three specimens of the Roanoke logperch collected by electrofishing in September 1991 by VDGIF and AEPSC personnel were from the same area as those observed in the 1992 survey. No other collections of this species are known from this segment of the Roanoke River.

Habitat Characterization. Table 1 provides habitat measurements for each of the nine locations where a logperch was observed by snorkeling. Water temperatures during the survey ranged from 12.6-13.5 C, and turbidity from 5.2-9.7 NTU. Logperch were most often observed on the bottom in locations where the surface current velocity was approximately 0.40 m/sec, and bottom current velocity slightly less. Preferred substrate was cobble/gravel at depths $\leq$ 51 cm. These measurements agree with previous habitat characterizations for this species (Burkhead 1983; Simonson and Neves 1986). There appeared to be no predominate preference for location within a riffle or for the size of the riffle. All of the suitable habitat in the surveyed stretch occurred in eastward-flowing segments of the river channel.

Table 2 provides a general profile of habitat for the surveyed stretch of river. Habitat suitable for the Roanoke logperch was confined to a 2,500-foot segment of the river beginning about 0.5 mile downstream of the Niagara powerhouse (Figure 2: Zones 4-8), and totalling approximately 21,500 ft^2.

Summary

A survey of the Roanoke River for 1 1/4 miles downstream of Niagara Hydroelectric Project on October 22, 1992, found ten specimens of the federally endangered Roanoke logperch (*Percina rex*) using snorkeling and electrofishing techniques. The logperch were most often observed on cobble/gravel riffles less than 51 cm in depth, with current velocities near 0.40 m/sec. The logperch appeared to be confined to a 2,500-foot segment of the river that begins about 0.5 mile downstream of the Niagara powerhouse, and which contains approximately 21,500 ft^2 of available logperch habitat. Based on this survey and the documented habitat specificity of this species, the Roanoke logperch is not likely to populate areas within the two-mile reach of the Roanoke River between Niagara and the head of the Smith Mountain Lake pool that are outside of the 2,500-foot segment where they were collected.

References Cited

Burkhead, N. M. 1983. Ecological studies of two potentially threatened fishes (the orangefin madtom, *Noturus gilberti*, and the Roanoke logperch, *Percina rex*) endemic to the Roanoke River drainage. Report prep. for U.S. Army Corps of Eng., Wilmington Dist., Wilmington, N.C.

Simonson, T.D., and R. J. Neves. 1986. A status survey of the orangefin madtom (*Noturus gilberti*) and Roanoke logperch (*Percina rex*). Report prep. for Virginia Comm. Game Inland Fish., Richmond.

FIGURES AND TABLES

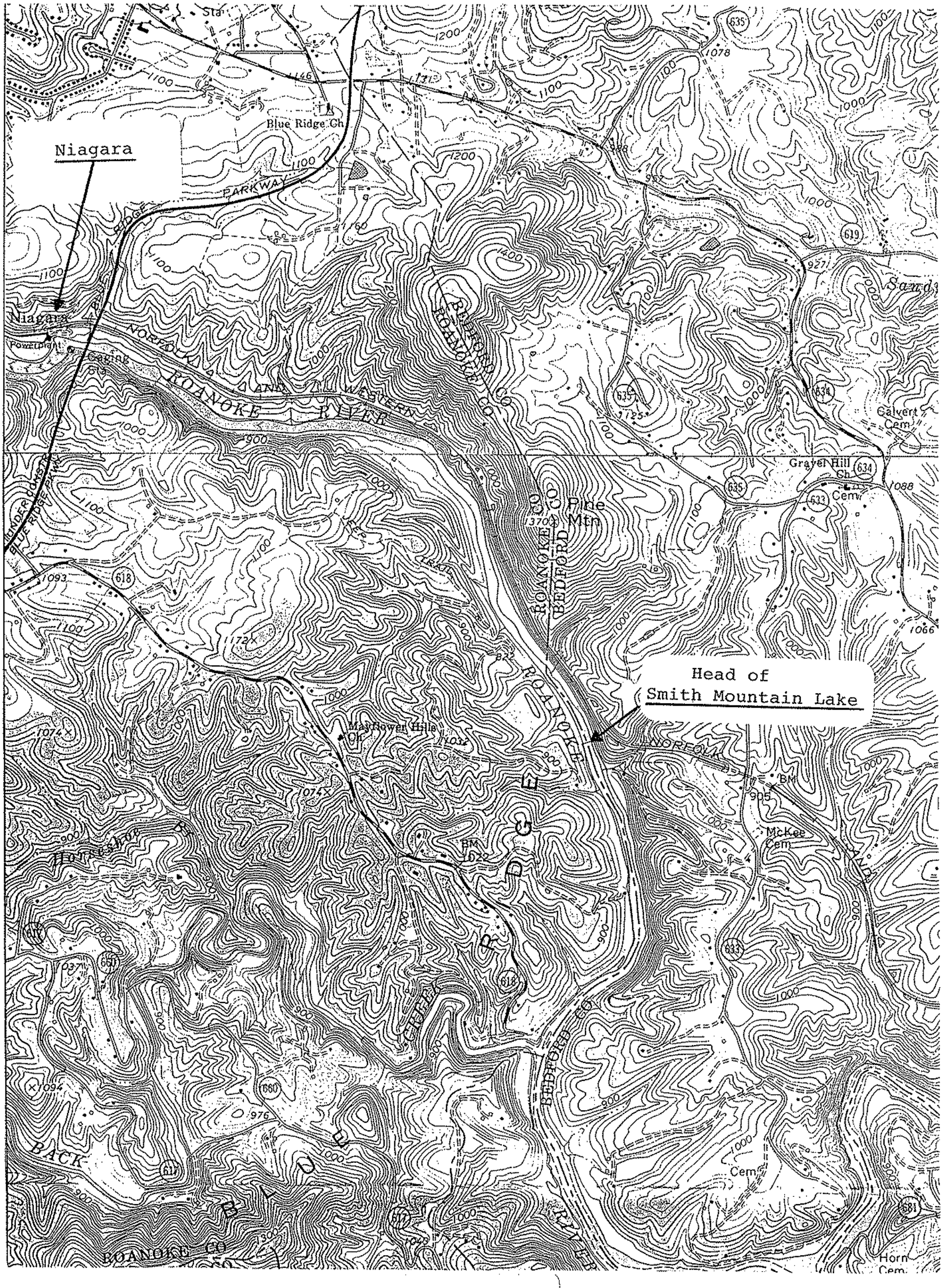

Niagara
Head of
Smith Mountain Lake
Blue Ridge Ch
PARKWAY
Niagara
Powerplant
Gaging Sta
NORFOLK AND WESTERN
ROANOKE RIVER
BEDFORD CO
ROANOKE CO
Fire Mtn
ROANOKE CO
BEDFORD CO
Mayflower Hills Ch
Horseshoe
BACK
CREEK
BLUE RIDGE
ROANOKE RIVER
BEDFORD CO
ROANOKE CO
McKee Cem
Calvert Cem
Gravel Hill Ch
Cem
Horn Cem
Sands

Figure 1

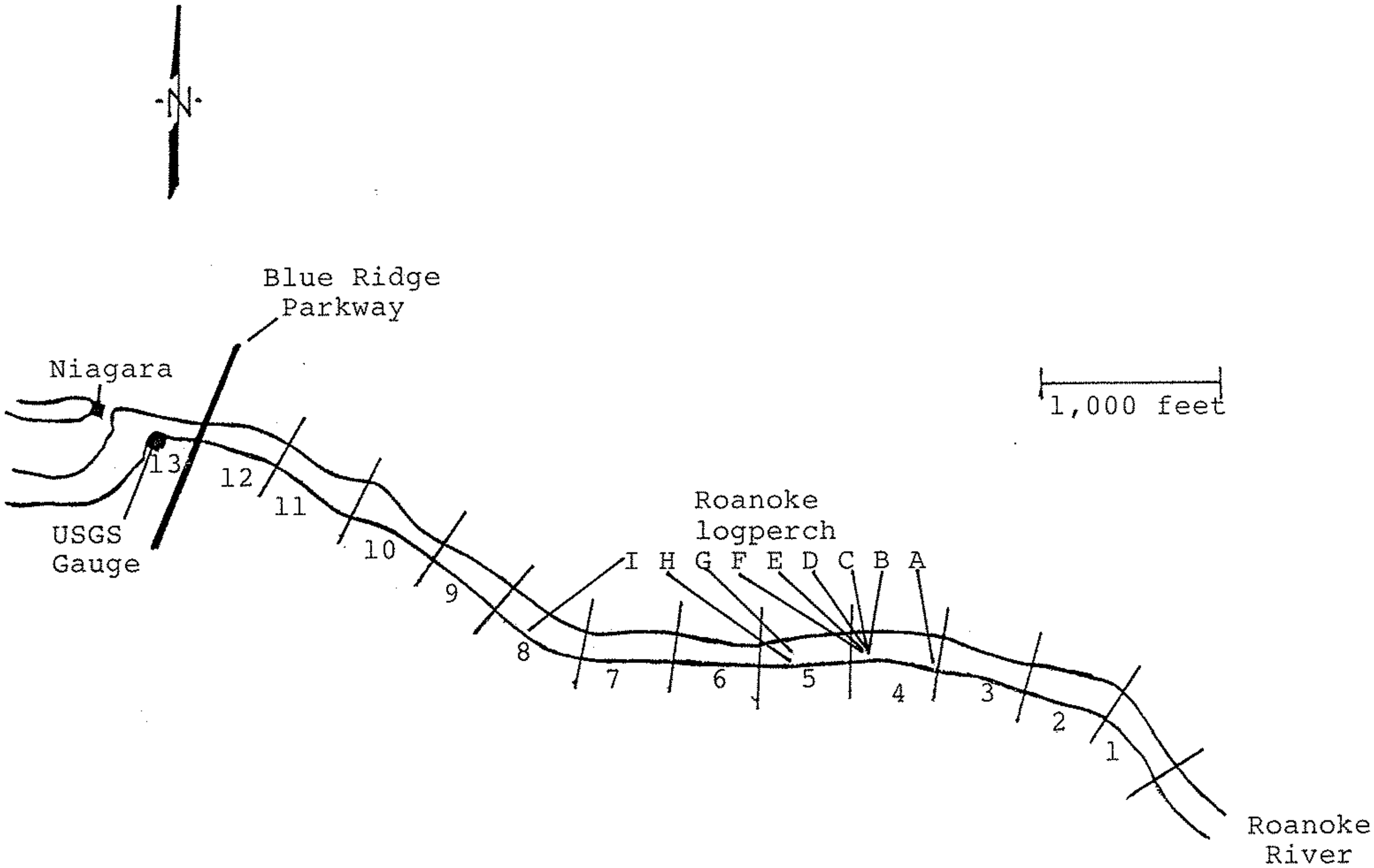


Figure 2

Location of survey zones and Roanoke logperch observations,
October 22, 1992

Table 1. Habitat measurements at Roanoke logperch collection locations (see Figure 2).

Logperch*	Water Temperature(C)	Current Velocity (Surface) (m/sec)	Current Velocity (Bottom) (m/sec)	Turbidity(NTU)	Depth(cm)	Direction of Flow**	Substrate	Similar Habitat at Capture Location(m^2)
A	12.6	0.38	0.24	5.2	40	96°E, 105°ESE	large cobble	20
B	12.6	0.40	0.10	5.2	20	90°E, 113°ESE	cobble/gravel	710
C	12.6	0.40	0.24	5.2	10	90°E, 113°ESE	cobble/gravel	710
D	12.6	0.41	0.34	5.2	10	90°E, 129°SE	cobble/gravel	710
E	12.6	0.35	0.21	5.2	10	90°E, 80°E	cobble/gravel	710
F	12.6	0.66	0.66	5.2	10	90°E, 95°E	cobble/gravel	710
G	12.7	0.18	0.30	5.2	40	85°E, 50°NE	cobble over bedrock	240
H	12.7	0.46	0.38	5.2	51	85°E, 75°ENE	cobble/sand over bedrock	240
I	13.5	0.60	0.63	9.7	9	112°ESE, 150°SSE	cobble over bedrock	50

* see Figure 2 for capture location

** Readings are: Channel orientation, current bearing at capture location

Table 2. General profile of habitat for the Roanoke River from Niagara Hydro downstream for a distance of 1.25 miles.

Zone*	Photograph	Description of Habitat	Roanoke logperch Occurrence
1	none	predominately pool	unlikely
2	none	predominately pool	unlikely
3	none	predominately pool	unlikely
4	#2	cobble/gravel riffles at upper and lower ends, shallow run in-between	six observed
5	#3	cobble over bedrock riffle at upper end, shallow run below	two observed, one collected
6	#4	shallow run, predominately bedrock	unlikely
7	#5	riffle and run of cobble over bedrock	possible in riffle
8	#6	riffle and run of cobble over bedrock	one observed
9	#7	riffle and deep pool, swift current, boulders and bedrock	unlikely
10	#8	swift, deep chute through boulders and bedrock	unlikely
11	#9	swift, deep chute through boulders and bedrock	unlikely
12	#10	deep run through boulders and bedrock	unlikely
13	#11	deep run through boulders and bedrock (project tailwaters)	unlikely

* See Figure 2 for location

Photographs

No.	Description*
1	Roanoke logperch collected by electrofishing, September 12, 1991
2	Roanoke River Survey Zone 4, looking upstream
3	Roanoke River Survey Zone 5, looking upstream
4	Roanoke River Survey Zone 6, looking upstream
5	Roanoke River Survey Zone 7, looking upstream
6	Roanoke River Survey Zone 8, looking upstream
7	Roanoke River Survey Zone 9, looking upstream
8	Roanoke River Survey Zone 10, looking downstream
9	Roanoke River Survey Zone 11, looking upstream
10	Roanoke River Survey Zone 12, looking downstream from the Blue Ridge Parkway
11	Roanoke River Survey Zone 13 (tailwaters), looking upstream from Blue Ridge Parkway

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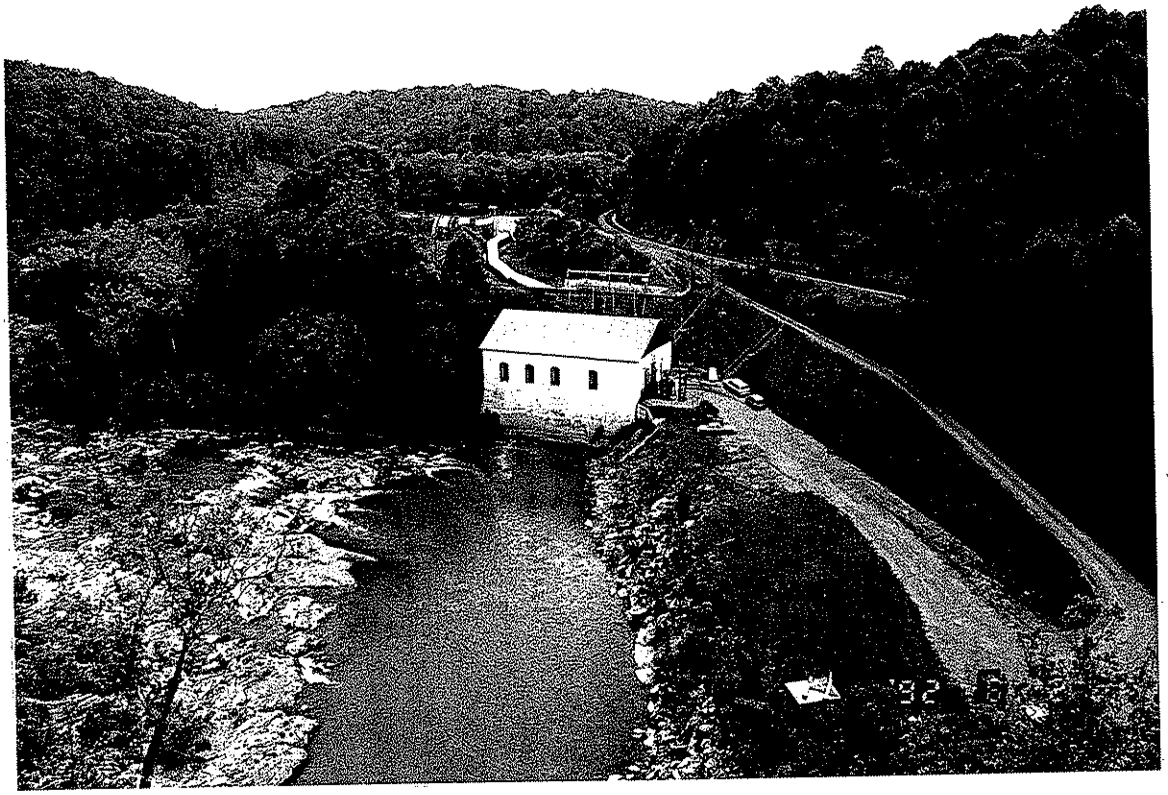
* See Figure 2 for location of survey zones



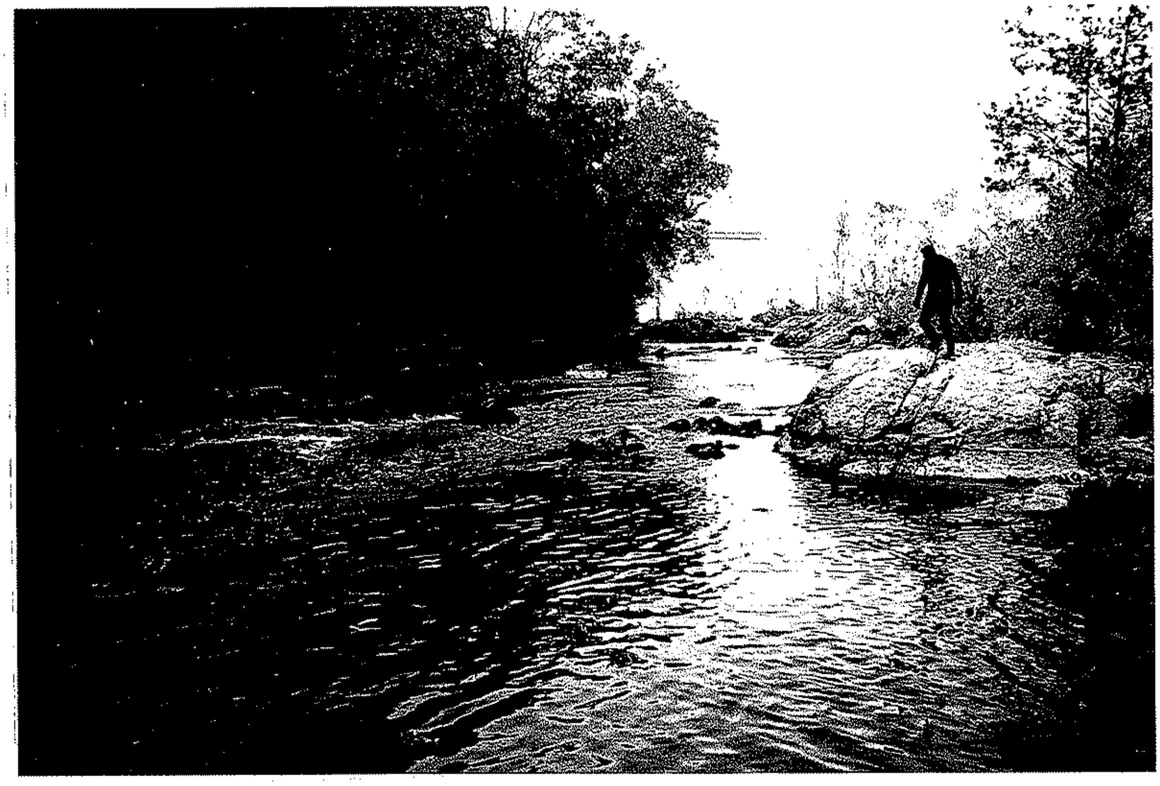
11 - Roanoke River Survey Zone 13 (tailwaters), looking upstream from Blue Ridge Parkway

3

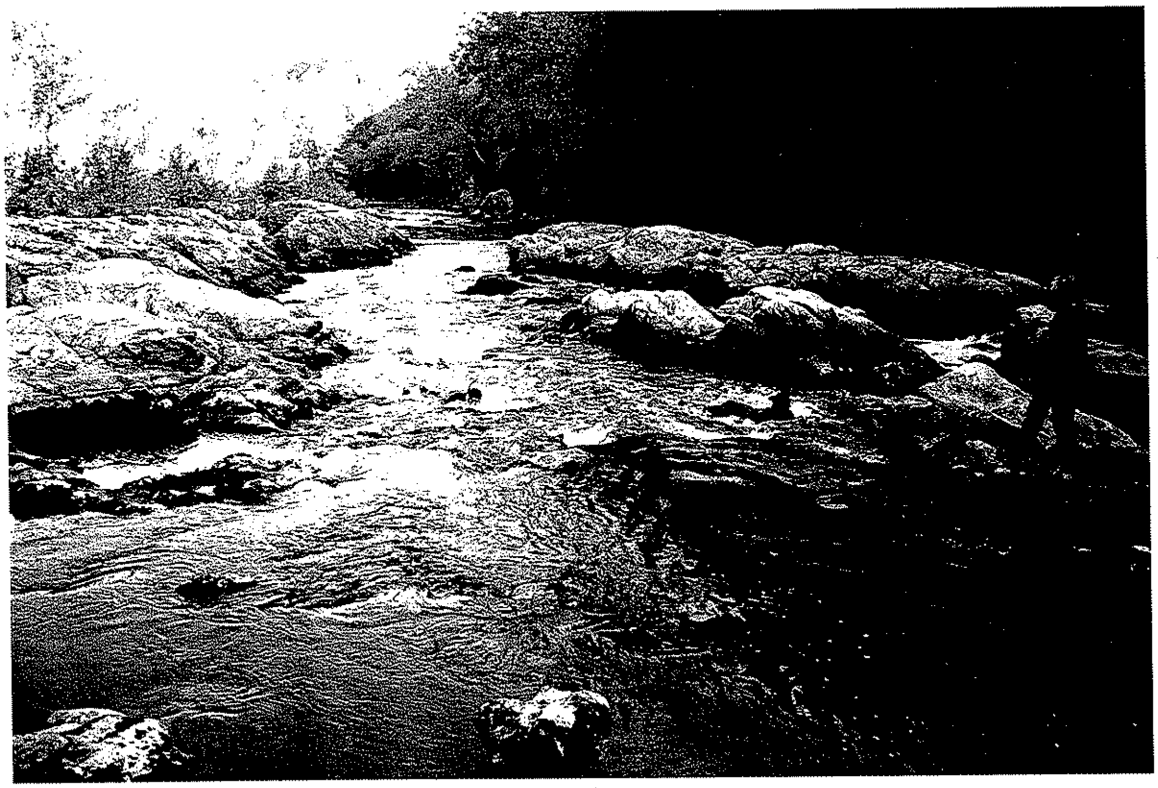
Roanoke River gorge from atop Parkway bridge (opposite of Niagara). Note people at Parkway overlook on right side of river.

9 - Roanoke River Survey Zone 11, looking upstream

10 - Roanoke River Survey Zone 12, looking downstream from the Blue Ridge Parkway



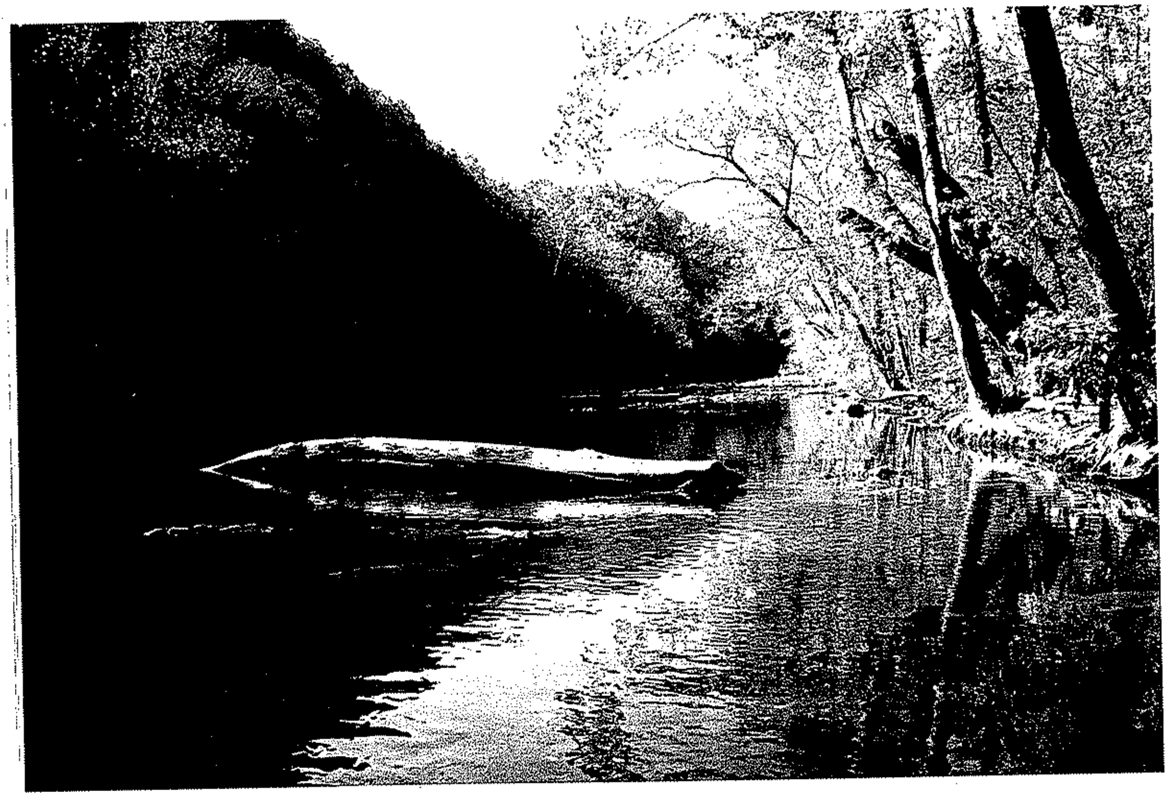
7 - Roanoke River Survey Zone 9, looking upstream



8 - Roanoke River Survey Zone 10, looking downstream

5 - Roanoke River Survey Zone 7, looking upstream

6 - Roanoke River Survey Zone 8, looking upstream



3 - Roanoke River Survey Zone 5, looking upstream

4 - Roanoke River Survey Zone 6, looking upstream

1 - Roanoke logperch collected by electrofishing, September 12, 1991

2 - Roanoke River Survey Zone 4, looking upstream

APPENDIX

STUDY PLAN

An Assessment of the Roanoke Logperch in the Roanoke River Downstream of Niagara Hydroelectric Project

Appalachian Power Company
40 Franklin Road, SW
Roanoke, Virginia 24011

and

American Electric Power Service Corporation
1 Riverside Plaza
Columbus, Ohio 43215

June 1992

Introduction

An application for new license for Niagara Hydroelectric Project (FERC Project No. 2466) was submitted to the Federal Energy Regulatory Commission (FERC) in December 1991. Subsequently, the U.S. Fish and Wildlife Service (USFWS) submitted a Request for Additional Studies to the FERC that requested additional surveys to determine the distribution and abundance of the Roanoke logperch (*Percina rex*) in the approximately two-mile stretch of free-flowing Roanoke River from the Niagara powerhouse to the head of the Smith Mountain Lake pool (Fig. 1). This request was based on a survey conducted in 1991 by Appalachian Power Company (APCo) and American Electric Power Service Corporation (AEPSC), in cooperation with the Virginia Department of Game and Inland Fisheries (VDGIF), reported in the license application, that verified the presence of this federally-listed endangered species in this downstream segment of the river, thereby representing an extension of the known range of the Roanoke logperch. The FERC acted on this request in its May 22, 1992 letter to AEPSC, asking that a study be conducted to assess the population of Roanoke logperch downstream of the Niagara project. The following study plan was developed to include these objectives:

(1) systematically survey the Roanoke River for the Roanoke logperch from the Niagara powerhouse to the head of the Smith Mountain Lake pool;

(2) characterize the type and location of habitat being used by any collected logperch; and

(3) estimate the amount and identify the location of available habitat in this river segment that is of the type used by Roanoke logperch.

Methodology

Fish Sampling. AEPSC/APCo or their hired consultant will coordinate sampling with VDGIF and USFWS. The segment of the Roanoke River from the Niagara powerhouse to the head of the Smith Mountain Lake pool will be surveyed using a small boat during a low-flow period in late summer-early fall of 1992. All riffle/run areas characterized by gravel or cobble substrate in the segment will be thoroughly sampled using backpack electrofishing equipment. The size (total length), condition, and location of all collected Roanoke logperch will be recorded, and all specimens will be returned to the river.

Habitat Characterization. At each location where a logperch is captured, the following data will be recorded: water temperature, surface and bottom current velocity, turbidity, depth, direction of flow, substrate composition (visual estimate), and an estimate of the total area of similar habitat surrounding the capture location. Additionally, a general profile of the location of riffle/run/pool habitats in the entire segment and the prevalent substrate type in each area will be prepared.

Study Schedule

Activity	Deadline
Complete field work	September 15, 1992
Final report submitted for agency review	September 30, 1992
Agency comments on report due	October 30, 1992
Final report and agency comments submitted to FERC	November 16, 1992

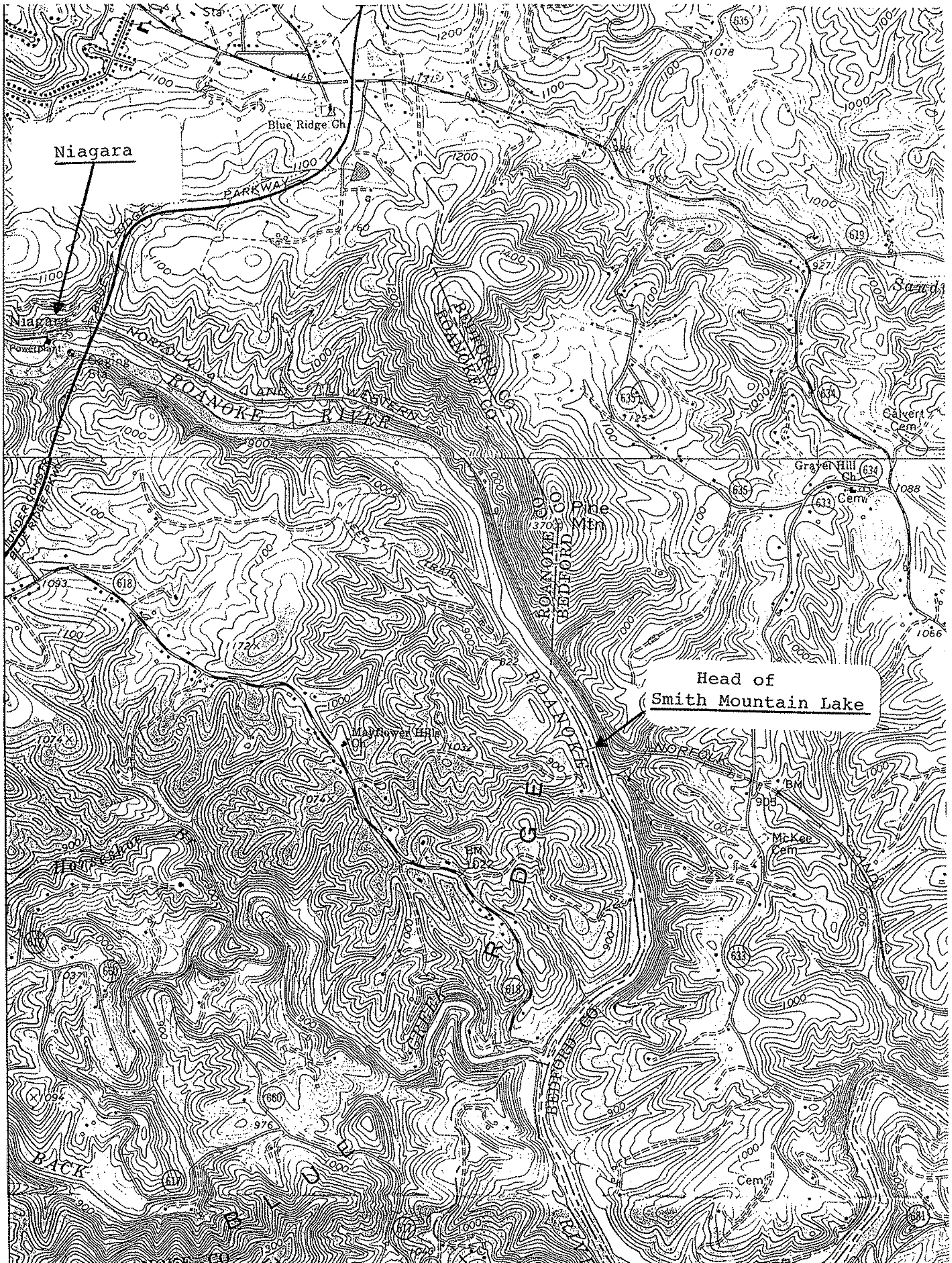

Niagara
Head of
Smith Mountain Lake
Niagara
Powerplant
ROANOKE RIVER
NORFOLK AND WESTERN
Blue Ridge Ch
PARKWAY
Pine Mtn
ROANOKE CO
BEDFORD CO
Gravel Hill Ch
Calvert Cem
McKee Cem
Mayflower Hills Ch
BACK
BLUE RIDGE
CREEK
Cem
Horn Cem

Figure 1

American Electric Power
Service Corporation
1 Riverside Plaza
Columbus, OH 43215
614 223 1000

AMERICAN
ELECTRIC
POWER

TO LIST ATTACHED:

September 9, 1992

Dear Sir:

Re: Applachian Power Company
Niagara Hydroelectric Project
FERC Project No. 2466
Roanoke Logperch Survey and Visual Evaluation of Powerhouse Discharges

Attached is a summary of the activities and discussion that took place on August 27-28 at the referenced project. Representatives of Virginia Department of Game and Inland Fisheries, U.S. Fish and Wildlife Service, Appalachian Power Company, and American Electric Power Service Corporation were in attendance.

It is requested that those in attendance at the Niagara Project on August 27-28 notify me in writing of their concurrence with the attached summary or of any comments related to the summary. Please let me know at (614) 223-1249 if you have any questions.

Sincerely,

John H Van Hassel

John H. Van Hassel
Environmental Engineering Group

JHV/wfv/02/1E
Enclosure
cc: Dean Shumway - FERC

bcc: J. D. Zwart/J. L. Fariss
K. V. Wood
R. W. Harmon
M. Karas

Mr. Arthur LaRoche
Department of Game and Inland Fisheries
209 East Cleveland Avenue
Vinton, Virginia 24179

Mr. Scott Smith
Department of Game and Inland Fisheries
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Forest, Virginia 24551

Mr. Bob Albrecht
Department of Game and Inland Fisheries
Route 6, Box 410
Forest, Virginia 24551

Mr. Robert D. Kelsey
U.S. Department of the Interior
Fish and Wildlife Service
Division of Ecological Services
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Annapolis, Maryland 21401

Mr. Andy Moser
U.S. Department of the Interior
Fish and Wildlife Service
1825 Virginia Street
Annapolis, Maryland 21401

Mr. Neal Emerald, Second Vice President
Virginia Wildlife Federation
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Regional Director
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Conservation Chairman
Coastal Canoeists
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Mr. Dennis H. Treacy
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Commonwealth of Virginia
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Richmond, Virginia 23219

Mr. Bud Bristow, Executive Director
Virginia Department of Game and Inland Fisheries
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Richmond, Virginia 23230

Mr. Anthony R. Conte
Regional Solicitor, Northeast Region
U.S. Department of the Interior
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Suite 612
Newton Corner, Massachusetts 02158

Appalachian Power Company
Niagara Hydroelectric Project
FERC No. 2466

Roanoke Logperch Survey and Visual Evaluation of
Powerhouse Discharges

August 27-28, 1992

ATTENDEES:

Bud LaRoche (8/28 only)	Virginia Department of Game and Inland Fisheries (VDGIF)
Scott Smith	VDGIF
Bob Albrecht (8/27 only)	VDGIF
Robert Kelsey	U.S. Fish & Wildlife Service (USFWS)
Andy Moser	USFWS
Jerry Zwart	Appalachian Power Company (APCo)
John Van Hassel	American Electric Power Service Corporation (AEPSC)
Ken Wood	AEPSC

The meeting took place at the Niagara Hydroelectric Project to assess the population of the federally endangered Roanoke logperch downstream of the project, and to conduct visual evaluations of the adequacy of turbine discharge practices for protecting downstream aquatic habitat when project inflows are less than 100 cfs. These evaluations were to be performed in response to USFWS and VDGIF comments during second stage relicensing consultations, and to a subsequent request for additional information under Schedule A by the FERC.

1. Roanoke Logperch Survey

Sampling of Roanoke logperch was to have been conducted on August 27 by either snorkeling or electrofishing. A heavy rain shower in the upper Roanoke River watershed during the previous afternoon caused a large increase in suspended solids in the river as compared to the clear, low-flow conditions that had been present. The participants agreed that neither snorkeling nor electrofishing for logperch would be effective under these turbid conditions, which were likely to continue to be present in the river for at least a few days. The participants then decided to traverse the two-mile segment of river from the Niagara powerhouse downstream to the Smith Mountain Lake headwaters by canoe in order to obtain a preliminary assessment of available habitat where

Roanoke logperch could be expected to be found. This survey determined that the upper 1¼ miles of the segment were predominately riffle-run habitat where logperch might be found, while the lower 3/4 mile of the free-flowing segment and an additional 3/4 mile of headwater habitat that was transversed was dominated by long, silty pools where logperch would not be expected. John Van Hassel of AEPSC proposed that the logperch survey should concentrate on the upper, riffle-run portion of the segment. Other attendees indicated that this approach would be acceptable.

The participants agreed that a representative of APCo would track river conditions, and notify the attendees when conditions for sampling logperch were present. This notification would include as much lead time as possible, but it was agreed among the participants that a lead time as short as a day or two could occur if only a brief period of optimum river conditions was expected.

2. Turbine Discharge Observations

Additional rainfall on August 28, when visual evaluations were to be conducted, caused the demonstration to be cancelled. Based on inservice performance tests of the new Unit 2, Jerry Zwart of APCo recommended that any proposals to autocycle a unit at project inflows below 100 cfs be abandoned, and that the project be operated to continuously pass flow either through the turbines or over the spillway.

Bud LaRoche of VDGIF suggested that this would be the preferred alternative, and that visual observation of the low-flow discharge would no longer be necessary. He indicated, however, that the demonstration probably still needs to be videotaped in order to satisfy the FERC request for additional studies. Mr. LaRoche indicated that his major remaining concern was that there be no downstream flow lag between unit shutdown and spill flow reaching the river below the powerhouse via the bypass, and suggested that a demonstration of how APCo will handle this situation would be useful. Jerry Zwart of APCo indicated that this could be done by specifying a minimum flow at the downstream Niagara gage of 50 cfs (10% MAF) or inflow, whichever is less, during this transition period. This transition flow would be provided through the overflow sluice gate located at the main spillway. The participants agreed that this was the only remaining issue to be resolved regarding discharge at river flows below 100 cfs.

Robert Kelsey of USFWS then asked whether ramping of flows when going from two-unit operation to one-unit operation (assuming a 700 cfs discharge with two units versus 350 cfs with one unit) would be necessary to minimize any impact on downstream aquatic habitat. After some discussion, the participants agreed that the likelihood of any impact associated with this situation is very small, but that the issue probably needs to be evaluated. This will be accomplished when the low-flow evaluations are rescheduled.

Subject: FW: FW: Niagara Hydroelectric Project (FERC No. 2466) - ESSLog 23405- TOYR Waiver Request

Attachments: 23405_NiagaraProjectRelicensingStudyScheduleUpdateMeetingNotes_20200629usfws.pdf; Niagara Project Study Plan Coordination Call with Services_20190925.pdf; USFWS Project Verification_Niagara_20210326.pdf

From: Huddleston, Misty <Misty.Huddleston@hdrinc.com>
Sent: Monday, April 12, 2021 4:23 PM
To: Aschenbach, Ernst <ernie.aschenbach@dwr.virginia.gov>; rr dgif-Collection Permits <collectionpermits@dwr.virginia.gov>; jastudio@edge-es.com; jpspaeth@edge-es.com; Amy Ewing <amy.ewing@dwr.virginia.gov>; Scott Smith <scott.smith@dwr.virginia.gov>; Pinder, Mike (DGIF) <mike.pinder@dwr.virginia.gov>; Watson, Brian (DGIF) <brian.watson@dwr.virginia.gov>; McCloskey, John <john_mccloskey@fws.gov>; Harris, Johnathan (DGIF) <johnathan.harris@dwr.virginia.gov>; ProjectReview (DGIF) <projectreview@dwr.virginia.gov>; Sumalee Hoskin <sumalee_hoskin@fws.gov>; McCorkle, Richard <richard_mccorkle@fws.gov>; shirl.dressler@dwr.virginia.gov
Cc: Fernald, Ray (DGIF) <ray.fernald@dwr.virginia.gov>; Kulpa, Sarah <Sarah.Kulpa@hdrinc.com>; Jonathan M Magalski <jmmagalski@aep.com>
Subject: RE: FW: Niagara Hydroelectric Project (FERC No. 2466) - ESSLog 23405- TOYR Waiver Request

Ernie,

Thanks for speaking with me last Friday regarding the request for a time-of-year-restriction (TOYR) waiver that HDR and Edge Engineering and Science (EDGE) submitted on behalf of Appalachian Power Company (Appalachian), a unit of American Electric Power for the Niagara Hydroelectric Project (Project; FERC # 2466), located on the Roanoke River in Roanoke County, Virginia. Based on our discussion, I am providing additional background information to support the waiver request.

Background:
Appalachian is pursuing a license renewal under the FERC Integrated Licensing Process. Detailed information on the proposed sampling methods for both the macroinvertebrate and adult RLP studies are provided in the Project Revised Study Plan and the FERC Study Plan Determination; available on the FERC e-library under Project No. 2466 or at the Appalachian Project website: http://www.aephydro.com/HydroPlant/Niagara.

Appalachian coordinated with Virginia Department of Wildlife Resources (VDWR) and U.S. Fish and Wildlife Service (USFWS) for the proposed studies during development of the Proposed Study Plan, scoping, and development of the Revised Study Plan. During a September 25, 2019 scoping call (see attachment dated 9/25/2019), Rick McCorkle (USFWS), Scott Smith (VDWR), and Paul Angermeier (Virginia Tech University) agreed that a spring survey for adult RLP in the bypass reach would help determine:

1. Presence of suitable habitat for adult RLP use during higher spring flows; and
2. Utilization of available habitat by adult RLP during higher spring flows.

Based on input during that call, the group agreed that the use of snorkeling methods to perform the adult RLP survey within the bypass reach would present safety risks, as the study goal is to determine if adult RLP are moving into and utilizing potential habitat created by Project spill into the bypass reach during spring months. The flows that we need to evaluate within the bypass reach in order to answer the study questions are likely not conducive to completing a safe and effective snorkel survey. As such, the need for a TOYR waiver was discussed during the September 25, 2019 coordination call, and the Revised Study Plan indicated that completion of spring sampling for the macroinvertebrate study and adult RLP study were contingent on receiving a waiver of the TOYR.

Purpose and Need:
The TOYR waiver is needed to support spring field sampling efforts for:

1. A benthic macroinvertebrate study; and
2. Field sampling of the bypass reach to determine if adult Roanoke Logperch (RLP) are moving into and potentially using the bypass reach during this higher flow period.

Methods:

1. The proposed benthic macroinvertebrate sampling effort would:
   a. Consist of qualitative and quantitative sample collection;
   b. Use sampling equipment and techniques that are consistent with Virginia Department of Environmental Quality (2008) sampling protocols; and
   c. Be performed according to the Revised Study Plan (including revisions based on the FERC Study Plan Determination and input from VDWR and USFWS).
2. The proposed adult RLP sampling effort would:
   a. Target the Niagara bypass reach during higher spring flows;
   b. Target available RLP habitat located in the lower portion of the bypass reach;
   c. Utilize backpack electrofishing methods;
   d. Include fish standard length and a photograph of collected RLP, followed by their immediate release as near as possible to the site of collection.

Let me know if there is interest/need for a group call to discuss this topic or if there is additional information that is needed to respond to our request for a TOYR waiver for either the macroinvertebrate study or the adult Roanoke Logperch sampling effort.

Thanks,
Misty

Misty Huddleston, PhD
Associate, SR. Environmental Scientist
D 704.248.3614 **M** 865.556.9153

hdrinc.com/follow-us

From: Aschenbach, Ernst <ernie.aschenbach@dwr.virginia.gov>
Sent: Friday, April 9, 2021 2:10 PM
To: Huddleston, Misty <Misty.Huddleston@hdrinc.com>; rr dgif-Collection Permits <collectionpermits@dwr.virginia.gov>; jastudio@edge-es.com; jpspaeth@edge-es.com; Amy Ewing <amy.ewing@dwr.virginia.gov>; Scott Smith <scott.smith@dwr.virginia.gov>; Ernst Aschenbach <ernie.aschenbach@dwr.virginia.gov>; Pinder, Mike (DGIF) <mike.pinder@dwr.virginia.gov>; Watson, Brian (DGIF) <brian.watson@dwr.virginia.gov>; McCloskey, John <john_mccloskey@fws.gov>; Harris, Johnathan (DGIF) <johnathan.harris@dwr.virginia.gov>; ProjectReview (DGIF) <projectreview@dwr.virginia.gov>; Sumalee Hoskin <sumalee_hoskin@fws.gov>
Cc: Fernald, Ray (DGIF) <ray.fernald@dwr.virginia.gov>
Subject: Re: FW: Niagara Hydroelectric Project (FERC No. 2466) - 2021 Field Sampling TOYR Waiver Request

ESSLog 23405; Niagara Study relicensing study schedule

Misty et al.,

Hello!

I forwarded via separate email a recent email update was forwarded to me. Some of you may have already received this information.

Via (that separate) email clarifying that USFWS has not issued a waiver -- the USFWS recommendation regarding FESE Roanoke logperch TOYR and electroshocking is:

- **Electroshocking for adults** – should only occur after they have first started with snorkeling and RLP have not been caught or they can provide evidence that snorkeling is not working. No electroshocking within the RLP time-of-year restrictions (March 15-June30).
- Based on this recent update, DWR supports this recommendation.
- DWR-Collection Permits, Shirl Dressler-Setzer also notified you not to proceed.

If the DWR-collection permittees, DWR- and/or USFWS staff have additional questions, clarification, or comments pertaining to the proposed study schedule, please advise (by responding to all and forwarding as appropriate). This will help ensure pertinent information reaches those who need it. Any remaining concerns will need to be addressed as appropriate.

I do not recall being part of the previous discussions pertaining to the proposed study and schedule. Nevertheless, after receiving additional information, I will continue to try to help facilitate resolution, if necessary. I will try to call you.

Thanks.

Please note the Department of Wildlife Resources (DWR) new email addresses end in @dwr.virginia gov*

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Virginia Department of Wildlife Resources
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www.dwr.virginia.gov

Meeting Summary

Project:	Niagara Hydroelectric Project (FERC No. 2466)
Subject:	ILP Study Schedule Update
Date:	Monday, June 29, 2020
Location:	WebEx (10:00am-11:00am)
Attendees:	Scott Smith (VDGIF) Rick McCorkle (USFWS) John McCloskey (USFWS) Brian McGurk (VDEQ) Jon Magalski (AEP) Liz Parcell (AEP) Sarah Kulpa (HDR) Maggie Yayac (HDR)

Introduction

Liz (AEP) thanked everyone for being available to discuss the Niagara Project and explained that the purpose of the meeting would be to discuss the changes to the ILP study schedule due to COVID-19 travel restrictions and related concerns. Liz noted that a revised schedule was provided in the meeting invite.

Study Schedule Update

- Sarah (HDR) explained that AEP is currently planning on initiating field studies in July and expects to continue field work through the fall, potentially into November if needed. Time-sensitive spring studies that were not able to be completed due to travel restrictions have been re-scheduled for the spring of 2021. AEP is aiming to collect field data this year in support of the bypass reach, aquatic resources, and water quality studies, where doing so is compatible with the remaining study season, and studies that are more baseline characterization in nature are being postponed to 2021. This will allow AEP and their consultants to appropriate allocate resources to priority studies.
- AEP plans on filing the revised schedule with FERC and will also be requesting an extension of time to file the Initial Study Report (from December 6, 2020 to January 11, 2021) and to conduct the Initial Study Report meeting. Sarah noted that this schedule change will not affect the schedule for filing of the Updated Study Report in 2021 or the overall licensing schedule. The extension is being requested to provide more time for AEP and their consultants to develop preliminary or draft study reports for filing with the ISR, following the completion of field activities this fall.
- AEP hopes to file the study schedule update and request for extension of time to file the ISR as soon as possible and is seeking agency feedback on the revised schedule and the request during this call.

- Sarah provided a high level overview of the revised schedule for ILP study activities, as described in the table distributed with the meeting invite and that will be filed with FERC.

Flow and Bypass Reach Aquatic Habitat Study

- LiDAR data and orthoimagery have been captured at the Niagara Project and HDR will be using this information to begin building the hydraulic model to support the Flow and Bypass Reach Aquatic Habitat Study (i.e. identify level logger placement, flow test scenarios, etc.). Additionally, the flow test scenario will be developed and sent to agencies for review and comment in August. Flow tests are scheduled to take place in October as long as the sluice gate replacement construction is complete by that time.

Sluice Gate Replacement/ Draft Non-Capacity Amendment

- The existing sluice gate operating system (hoist) is presently not operational, so the gate is being maintained in an open position to pass a minimum flow of 50 cfs at all times. Minimum flow (i.e., 8 cfs) conditions and the ability to control the release through the sluice gate are required to complete fieldwork for the Flow and Bypass Reach Aquatic Habitat Study. This will be achieved through replacement of the existing bottom-hinged leaf-type gate with a pneumatic Obermeyer gate in the existing sluice structure. This maintenance activity is the subject of the draft non-capacity amendment application that AEP distributed to agencies for review in May.
- Construction cannot begin on the replacement sluice gate until FERC has approved the non-capacity amendment. If the sluice gate replacement is not completed as scheduled this fall, fieldwork for the Flow and Bypass Reach Aquatic Habitat Study will be postponed until 2021 (as soon as feasible given Project inflow conditions).
- Sarah noted that to date AEP had received VDEQ and VDGIF's comments on the draft application. USFWS and VDEQ briefly discussed previous intent to perform internal modeling with respect to potential flow releases for the relicensing study, however VDEQ noted that was no longer planned. Liz forwarded to USFWS (Rick and John) a copy of VDEQ's comments on the draft application for reference.
- Rick asked about the capacity of the new Obermeyer gate and if it would be able to provide an appropriate range of minimum flows that may be tested or recommended through the relicensing.
    - Sarah noted that the Obermeyer gate is quite versatile and will be able to release the full range of the existing sluice gate, though likely in a more precise manner, particularly at the low end of flow releases. As shown in the combined minimum flow release plan and report included in the draft non-capacity amendment application, the capacity of the gate goes up to about 300 cfs under the normal reservoir range.
    - Action Item: USFWS will provide comments regarding the replacement of the gate within the week. (Note comments were provided by email July 2, 2020.)

- John (USFWS) explained that the threatened and endangered species portion of the Service's review would be best completed by AEP proceeding through the Virginia Field Office's online review process. Action Item: John to send the link for the online project review process. (Note link was provided after the call).
    - John explained that this process expedites projects that result in determinations of no effect or not likely to adversely affect listed species.
    - Sarah stated that AEP will initiate the online review process and may file the non-capacity amendment with FERC while this process and any response required from USFWS is pending.
- Scott (VDGIF) and Brian (VDEQ) recommended building more flexibility into the schedule for the Bypass Reach Study due to potential for delay of the fieldwork due to installation of the new gate. Action Item: HDR/AEP to update the revised schedule and/or include footnote regarding timing of studies conditioned on sluice gate replacement.

Water Quality Study

- Sarah reviewed the Revised Study Plan (RSP) requirements of the Water Quality Study for the Project (continuous and monthly monitoring at 7 locations).
- Sarah explained that under the updated study schedule water quality monitoring is expected to begin in late July and would proceed through October. HDR and AEP believe this will still sufficiently capture the low flow and high temperature period of the year.
- Discussion of whether the abbreviated monitoring period will be sufficient to complete the Water Quality Study. Scott noted that if would depend on the outcome of the data as to whether or not the shortened period would be representative and useful. Brian asked if the initial year was not sufficient would it be reasonable to do additional field data collection next year. Jon (AEP) noted that the second study season is available through the ILP and that the need for additional data collection would be evaluated and discussed in the ISR and during the ISR Meeting.
- The group concurred it is worthwhile to collect as much data as feasible for the remaining field season.

Fish Community Study

- Sarah explained that the Fish Community Study would still be conducted sometime in August or September (into October if needed). The schedule has not changed. Generally, agencies are interested in the cooler water temperatures and would appreciate AEP targeting a fall study.
- AEP plans on conducting the fall adult Roanoke logperch surveys within the same general timeframe as originally approved in the RSP. However, the time-sensitive spring/early summer adult Roanoke logperch survey would be pushed into next year.

- The young-of-year Roanoke logperch survey is proposed to be completed in the same timeframe as approved in the RSP (August-October 2020). USFWS and VDGIF agreed that minimum (i.e. 8 cfs) flow conditions are not required to complete this survey and that higher bypass reach flows may be more appropriate for this survey. Therefore the gate replacement is not a critical path activity for the aquatic surveys scheduled for this fall.
- The larval Roanoke logperch survey has been rescheduled for next spring.
- HDR plans on providing 2020 results in a preliminary study report that would also include a preliminary desktop impingement and entrainment study. The final Fish Community study report would be prepared at the end of 2021 as part of the Updated Study Report.
- Brief discussion in response to question raised by John (USFWS) about how the larval study results would be integrated into the desktop impingement and entrainment study. Methods for evaluating the results of the larval study have not been determined, as this is not a common licensing study. HDR and AEP do not expect to use USFWS's blade strike model or the larger methodology proposed for the desktop impingement and entrainment study to evaluate larval entrainment.
- Also in support of the desktop impingement and entrainment study, intake velocity measurements are scheduled for completion in 2020.

Benthic Aquatic Resources Study

- The Macroinvertebrate and Crayfish Study will proceed with the fall sampling this year, and the spring survey sampling season is being shifted to 2021.
- The mussel habitat and community survey window has been tightened up (still within the original timeframe proposed in the RSP), scheduled for completion in August – October 2020.

Wetland, Riparian, and Littoral Habitat, Shoreline Stability and Cultural Studies

- Desktop and fieldwork rescheduled for spring-summer 2021.

Recreation Study

- AEP began the online survey data collection in late April 2020 and it will likely extend through the 2021 recreation season.
- In-person observations will be postponed until 2021 to avoid close contact with recreation users and adhere to social distancing guidelines.
- Discussion of how this is likely an irregular recreation usage year (potentially a combination of higher and lower recreation use levels) due to the COVID-19.
- Desktop activities including the recreation flow release assessment are still expected to be completed this year for preliminary reporting in the ISR.
- AEP has an ongoing aesthetic flow documentation task that will wrap up in November.

Other

- AEP plans on submitting an update to FERC shortly and would like to mention that they've consulted with the agencies and that there was verbal agreement that there was no opposition.
- The agencies all agreed that they are in agreement with the schedule adjustments and AEP's request for extension of time to file the ISR.

Meeting Summary
Project: Niagara Hydroelectric Project (FERC No. 2466)
Subject: Fish Community and Roanoke Logperch Study Plan
Date: Wednesday, September 25, 2019 Location: WebEx (1:00pm-2:30pm)
Attendees: Jon Magalski (AEP), Liz Parcell (AEP), Scott Smith (VDGIF), Paul Angermeier (VA Tech), Rick McCorkle (USFWS), John McCloskey (USFWS), John Spaeth (ESI), Jon Studio (ESI), Brian McGurk (VDEQ), Sarah Kulpa (HDR), Misty Huddleston (HDR).

Misty reviewed the methodology for the fish community study (Task 1a of the Revised Study Plan)

- Rick, Scott, and Paul agreed that a spring survey for Roanoke Logperch would be beneficial.
- Action Item: Scott is going to check with VDGIF environmental group to see if they can waive the time-of-year-restrictions and approve a collector's permit to allow an electrofishing survey of the bypass reach (where Roanoke Logperch are not known to occur) during the spring months. Also, will need to coordinate and receive approval from USFWS.

Discussion of whether a single sampling event would be sufficient for Roanoke Logperch. Paul stated that he can't say so definitively, but it is possible and likely based on his experiences, particularly if survey done during late summer/low-flow period. Young-of-year (YOY) are more easily observed later in the year as they attain larger body size. Sample during that period increases odds of documenting multiple life stages (if present).

- Brian asked about sampling in the bypass reach during this same period. Discussion of whether Roanoke Logperch could occur in bypass reach during the spring when flows are higher and then move out of area as flows recede. Scott will talk internally about spring sampling in the bypass reach. Group agreed that it would be ideal to survey for Roanoke Logperch in the bypass reach in the spring and summer/late fall (2 times/year), pending VDGIF/USFWS approval to remove time-of-year restriction (if/as applicable). Snorkeling may not be possible during the higher/swifter flow conditions. The rest of the survey locations will just be surveyed in the late summer/fall timeframe.

→ Below are direct quotes (and table) from RSP, reviewed by agencies:

- Adult Roanoke Logperch sampling events will occur at each of the four locations between August-October 2020 during suitable stream flow conditions that align with previous studies done within the study area. Subject to approval by VDGIF and USFWS as noted below, one additional sampling event will occur in the bypass reach (i.e., RLP3A/RLP3B) between May-June 2020 because it is hypothesized that more-suitable habitat will be available to Roanoke Logperch during the spring (elevated river flows) rather than the fall (reduced river flows). The spring sampling event may allow for determination of differences in habitat availability and occupation during discrepant flow regimes. It is important to note that the spring sampling event will require a Roanoke Logperch time-of-year restriction waiver from VDGIF and USFWS and safe flow conditions to conduct the surveys within the bypass reach, if waived.

Table 6-1. Proposed Fish Community Study Schedule

Task	Proposed Timeframe for Completion
Study Planning and Existing Data Review	September 2019 – April 2020
Fish Community Study	August – October 2020
Roanoke Logperch Adult Surveys	May – June[1], August – October 2020
Roanoke Logperch Young-of-Year Surveys	August – October 2020
Roanoke Logperch Larval Surveys	April – June 2020
Desktop Impingement and Entrainment Evaluation	December 2019 – November 2020
Distribute Draft Study Report with the ISR	December 2020

[1]Spring sampling will only be performed in the bypass reach, assuming a waiver is granted from the USFWS and VDGIF for sampling within the time-of-year restriction period.

United States Department of the Interior

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

In Reply Refer To: March 24, 2021
Consultation Code: 05E2VA00-2021-SLI-2810
Event Code: 05E2VA00-2021-E-08113
Project Name: Niagara Hydroelectric Project (FERC No. 2466) 2021 Field Sampling TOYR Waiver Request

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

To Whom It May Concern:

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

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

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

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

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

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

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

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

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

Attachment(s):

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

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DEPARTMENT OF THE INTERIOR

Fish and Wildlife Service

[FWS–R5–ES–2021–N004; FXES11130500000–212–FF05E00000]

Endangered Species; Receipt of Recovery Permit Application

AGENCY: Fish and Wildlife Service, Interior.

ACTION: Notice of receipt of permit applications; request for comments.

SUMMARY: We, the U.S. Fish and Wildlife Service, have received applications for permits to conduct activities intended to enhance the propagation or survival of endangered species under the Endangered Species Act. We invite the public and local, State, Tribal, and Federal agencies to comment on these applications. Before issuing the requested permits, we will take into consideration any information that we receive during the public comment period.

DATES: We must receive your written comments on or before **[INSERT DATE 30 DAYS AFTER THE DATE OF PUBLICATION IN THE *FEDERAL REGISTER*]**.

ADDRESSES: Use one of the following methods to request documents or submit comments. Requests and comments should specify the applicant name and application number (e.g., **PER0001234**):

- *Email:* permitsR5ES@fws.gov.
- *U.S. Mail:* Abby Gelb, Ecological Services, U.S. Fish and Wildlife Service, 300 Westgate Center Dr. Hadley, MA 01035.

FOR FURTHER INFORMATION CONTACT: Abby Gelb, 413–253–8212 (phone), or permitsR5ES@fws.gov (email). Individuals who are hearing or speech impaired may call the Federal Relay Service at 1–800–877–8339 for TTY assistance.

SUPPLEMENTARY INFORMATION: We, the U.S. Fish and Wildlife Service, invite the public to comment on applications for permits under section 10(a)(1)(A) of the Endangered Species Act of 1973, as amended (ESA; 16 U.S.C. 1531 *et seq.*). The requested permits would allow the applicants to conduct activities intended to promote recovery of species that are listed as endangered under the ESA.

Background

With some exceptions, the ESA prohibits activities that constitute take of listed species unless a Federal permit is issued that allows such activity. The ESA's definition of "take" includes such activities as pursuing, harassing, trapping, capturing, or collecting, in addition to hunting, shooting, harming, wounding, or killing.

A recovery permit issued by us under section 10(a)(1)(A) of the ESA authorizes the permittee to conduct activities with endangered or threatened species for scientific purposes that promote recovery or for enhancement of propagation or survival of the species. Our regulations implementing section 10(a)(1)(A) for these permits are found at 50 CFR 17.22 for endangered wildlife species, 50 CFR 17.32 for threatened wildlife species, 50 CFR 17.62 for endangered plant species, and 50 CFR 17.72 for threatened plant species.

Permit Applications Available for Review and Comment

We invite local, State, and Federal agencies; Tribes; and the public to comment on the following applications.

Application Number	Applicant	Species	Location	Activity	Type of Take	Permit Action
PER0002181	Paul L. Angermeier, dba USGS/Virginia Tech, Blacksburg, VA	Candy darter (*Etheostoma osburni*)	Virginia	Electrofish, survey, collect larvae	Capture, collect, lethal take	New
PER0002735	Jonathan Studio, dba Edge Engineering and Science, Avon, OH	Roanoke logperch (*Percina rex)*	Virginia, North Carolina	Presence/absence surveys, electrofish, collect larvae	Capture, collect, lethal take	New
PER0009349	Maine Cooperative Fish and Wildlife Unit (USGS), Orono, ME; PO: Joseph Zydlewski	Atlantic salmon (*Salmo salar)*	Maine	Telemetry, research	Capture, collect, lethal take	New
PER0007027	Mark J Hepner, Morgantown, WV	Rusty patched bumble bee (*Bombus affinis)*	Add locations: Illinois, Indiana, Iowa, Maine, Maryland, Massachusetts, Minnesota, Ohio, Virginia, Wisconsin	Presence/absence survey, research	Capture, collect	Amend

Public Availability of Comments

Written comments we receive become part of the administrative record associated with this action. Before including your address, phone number, email address, or other personal identifying information in your comment, you should be aware that your entire comment—including your personal identifying information—may be made publicly available at any time. While you can request in your comment that we withhold your personal identifying information from public review, we cannot guarantee that we will be able to do so. Moreover, all submissions from organizations or businesses, and from individuals identifying themselves as representatives or officials of organizations or businesses, will be made available for public disclosure in their entirety.

Next Steps

If we decide to issue a permits to the applicant listed in this notice, we will publish a notice in the *Federal Register*.

Authority: Section 10(c) of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq*.).

Martin Miller
Manager, Division of Endangered Species,
Ecological Services,
North Atlantic-Appalachian Region.
[FR Doc. 2021-08811 Filed: 4/27/2021 8:45 am; Publication Date: 4/28/2021]

Salazar, Margaret

Subject: FW: [EXTERNAL] RE: FW: Niagara Hydroelectric Project (FERC No. 2466) - ESSLog 23405- TOYR Waiver Request

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From: Huddleston, Misty <Misty.Huddleston@hdrinc.com>
Sent: Monday, May 3, 2021 4:12 PM
To: McCloskey, John <john_mccloskey@fws.gov>
Cc: Fernald, Ray (DGIF) <ray.fernald@dwr.virginia.gov>; Kulpa, Sarah <Sarah.Kulpa@hdrinc.com>; Jonathan M Magalski <jmmagalski@aep.com>
Subject: RE: [EXTERNAL] RE: FW: Niagara Hydroelectric Project (FERC No. 2466) - ESSLog 23405- TOYR Waiver Request

John,

Thank you for the update on the waiver request. I will get started on coordinating a call with the individuals copied on this email correspondence, Dr. Paul Angermeier, and Jon Studio (Edge Engineering and Science).

I will be sending along an email sometime tomorrow with suggested time slots for this week as potential options for a group call.

Thanks,
Misty

Misty Huddleston, PhD
Associate, SR. Environmental Scientist
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From: McCloskey, John <john_mccloskey@fws.gov>
Sent: Monday, May 3, 2021 3:37 PM
To: Huddleston, Misty <Misty.Huddleston@hdrinc.com>
Cc: Fernald, Ray (DGIF) <ray.fernald@dwr.virginia.gov>; Kulpa, Sarah <Sarah.Kulpa@hdrinc.com>; Jonathan M Magalski <jmmagalski@aep.com>
Subject: Re: [EXTERNAL] RE: FW: Niagara Hydroelectric Project (FERC No. 2466) - ESSLog 23405- TOYR Waiver Request

Hi Misty,

The resource agencies are requesting a call to discuss the request for a TOYR waiver to conduct benthic macroinvertebrate samples and perform spring adult RLP surveys in the bypass reach using electrofishing. The RLP experts with the resource agencies had a call on April 23, and we have reached an agreement on a path forward. We would appreciate if you could set up a call for everyone to talk so we can reach resolution on this issue. The resource agencies ask that Dr. Paul Angermeier (copied) also be included on the invite because of his expertise in RLP surveys.

Thanks, John.

****

John McCloskey

Fish and Wildlife Biologist

U.S. Fish and Wildlife Service

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Visit us at http://www.fws.gov/northeast/virginiafield
****

From: Huddleston, Misty <Misty.Huddleston@hdrinc.com>
Sent: Monday, April 12, 2021 4:23 PM
To: Aschenbach, Ernst <ernie.aschenbach@dwr.virginia.gov>; rr dgif-Collection Permits <collectionpermits@dwr.virginia.gov>; jastudio@edge-es.com <jastudio@edge-es.com>; jpspaeth@edge-es.com <jpspaeth@edge-es.com>; Amy Ewing <amy.ewing@dwr.virginia.gov>; Scott Smith <scott.smith@dwr.virginia.gov>; Pinder, Mike (DGIF) <mike.pinder@dwr.virginia.gov>; Watson, Brian (DGIF) <brian.watson@dgif.virginia.gov>; McCloskey, John <john_mccloskey@fws.gov>; Harris, Johnathan (DGIF) <johnathan.harris@dwr.virginia.gov>; ProjectReview (DGIF) <projectreview@dwr.virginia.gov>; Hoskin, Sumalee <sumalee_hoskin@fws.gov>; McCorkle, Richard <richard_mccorkle@fws.gov>; shirl.dressler@dwr.virginia.gov <shirl.dressler@dwr.virginia.gov>
Cc: Fernald, Ray (DGIF) <ray.fernald@dwr.virginia.gov>; Kulpa, Sarah <Sarah.Kulpa@hdrinc.com>; Jonathan M Magalski <jmmagalski@aep.com>
Subject: [EXTERNAL] RE: FW: Niagara Hydroelectric Project (FERC No. 2466) - ESSLog 23405- TOYR Waiver Request

This email has been received from outside of DOI - Use caution before clicking on links, opening attachments, or responding.

Ernie,

Thanks for speaking with me last Friday regarding the request for a time-of-year-restriction (TOYR) waiver that HDR and Edge Engineering and Science (EDGE) submitted on behalf of Appalachian Power Company (Appalachian), a unit of American Electric Power for the Niagara Hydroelectric Project (Project; FERC # 2466), located on the Roanoke River in

Roanoke County, Virginia. Based on our discussion, I am providing additional background information to support the waiver request.

Background:

Appalachian is pursuing a license renewal under the FERC Integrated Licensing Process. Detailed information on the proposed sampling methods for both the macroinvertebrate and adult RLP studies are provided in the Project Revised Study Plan and the FERC Study Plan Determination; available on the FERC e-library under Project No. 2466 or at the Appalachian Project website: http://www.aephydro.com/HydroPlant/Niagara.

Appalachian coordinated with Virginia Department of Wildlife Resources (VDWR) and U.S. Fish and Wildlife Service (USFWS) for the proposed studies during development of the Proposed Study Plan, scoping, and development of the Revised Study Plan. During a September 25, 2019 scoping call (see attachment dated 9/25/2019), Rick McCorkle (USFWS), Scott Smith (VDWR), and Paul Angermeier (Virginia Tech University) agreed that a spring survey for adult RLP in the bypass reach would help determine:

1. Presence of suitable habitat for adult RLP use during higher spring flows; and
2. Utilization of available habitat by adult RLP during higher spring flows.

Based on input during that call, the group agreed that the use of snorkeling methods to perform the adult RLP survey within the bypass reach would present safety risks, as the study goal is to determine if adult RLP are moving into and utilizing potential habitat created by Project spill into the bypass reach during spring months. The flows that we need to evaluate within the bypass reach in order to answer the study questions are likely not conducive to completing a safe and effective snorkel survey. As such, the need for a TOYR waiver was discussed during the September 25, 2019 coordination call, and the Revised Study Plan indicated that completion of spring sampling for the macroinvertebrate study and adult RLP study were contingent on receiving a waiver of the TOYR.

Purpose and Need:

The TOYR waiver is needed to support spring field sampling efforts for:

1. A benthic macroinvertebrate study; and
2. Field sampling of the bypass reach to determine if adult Roanoke Logperch (RLP) are moving into and potentially using the bypass reach during this higher flow period.

Methods:

1. The proposed benthic macroinvertebrate sampling effort would:
    a. Consist of qualitative and quantitative sample collection;
    b. Use sampling equipment and techniques that are consistent with Virginia Department of Environmental Quality (2008) sampling protocols; and
    c. Be performed according to the Revised Study Plan (including revisions based on the FERC Study Plan Determination and input from VDWR and USFWS).
2. The proposed adult RLP sampling effort would:
    a. Target the Niagara bypass reach during higher spring flows;

b. Target available RLP habitat located in the lower portion of the bypass reach;
c. Utilize backpack electrofishing methods;
d. Include fish standard length and a photograph of collected RLP, followed by their immediate release as near as possible to the site of collection.

Let me know if there is interest/need for a group call to discuss this topic or if there is additional information that is needed to respond to our request for a TOYR waiver for either the macroinvertebrate study or the adult Roanoke Logperch sampling effort.

Thanks,

Misty

Misty Huddleston, PhD

Associate, SR. Environmental Scientist
D 704.248.3614 **M** 865.556.9153

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From: Aschenbach, Ernst <ernie.aschenbach@dwr.virginia.gov>
Sent: Friday, April 9, 2021 2:10 PM
To: Huddleston, Misty <Misty.Huddleston@hdrinc.com>; rr dgif-Collection Permits <collectionpermits@dwr.virginia.gov>; jastudio@edge-es.com; jpspaeth@edge-es.com; Amy Ewing <amy.ewing@dwr.virginia.gov>; Scott Smith <scott.smith@dwr.virginia.gov>; Ernst Aschenbach <ernie.aschenbach@dwr.virginia.gov>; Pinder, Mike (DGIF) <mike.pinder@dwr.virginia.gov>; Watson, Brian (DGIF) <brian.watson@dwr.virginia.gov>; McCloskey, John <john_mccloskey@fws.gov>; Harris, Johnathan (DGIF) <johnathan.harris@dwr.virginia.gov>; ProjectReview (DGIF) <projectreview@dwr.virginia.gov>; Sumalee Hoskin <sumalee_hoskin@fws.gov>
Cc: Fernald, Ray (DGIF) <ray.fernald@dwr.virginia.gov>
Subject: Re: FW: Niagara Hydroelectric Project (FERC No. 2466) - 2021 Field Sampling TOYR Waiver Request

ESSLog 23405; Niagara Study relicensing study schedule

Misty et al.,

Hello!

I forwarded via separate email a recent email update was forwarded to me. Some of you may have already received this information.

Via (that separate) email clarifying that USFWS has not issued a waiver -- the USFWS recommendation regarding FESE Roanoke logperch TOYR and electroshocking is:

- **Electroshocking for adults** – should only occur after they have first started with snorkeling and RLP have not been caught or they can provide evidence that snorkeling is not working. No electroshocking within the RLP time-of-year restrictions (March 15-June30).
- Based on this recent update, DWR supports this recommendation.
- DWR-Collection Permits, Shirl Dressler-Setzer also notified you not to proceed.

If the DWR-collection permittees, DWR- and/or USFWS staff have additional questions, clarification, or comments pertaining to the proposed study schedule, please advise (by responding to all and forwarding as appropriate). This will help ensure pertinent information reaches those who need it. Any remaining concerns will need to be addressed as appropriate.

I do not recall being part of the previous discussions pertaining to the proposed study and schedule. Nevertheless, after receiving additional information, I will continue to try to help facilitate resolution, if necessary. I will try to call you.

Thanks.

Please note the Department of Wildlife Resources (DWR) new email addresses end in @dwr.virginia gov*

Ernie Aschenbach
Environmental Services Biologist
P 804.367.2733
Email: Ernie.Aschenbach@dwr.virginia gov
Virginia Department of Wildlife Resources
CONSERVE. CONNECT. PROTECT.
A 7870 Villa Park Drive, P.O. Box 90778, Henrico, VA 23228-0778
www.dwr.virginia.gov

FEDERAL ENERGY REGULATORY COMMISSION
WASHINGTON, DC 20426
May 10, 2021

OFFICE OF ENERGY PROJECTS

Project No. 2466-034 – Virginia
Niagara Hydroelectric Project
Appalachian Power Company

VIA Electronic Mail

Mr. Jonathan Magalski
Environmental Specialist Consultant
American Electric Power
jmmagalski@aep.com

Reference: Determination on Requests for Study Modifications for the Niagara Hydroelectric Project

Dear Mr. Magalski:

Pursuant to 18 C.F.R. § 5.15 of the Commission's regulations, this letter contains the determination on requests for modifications to the approved study plan for Appalachian Power Company's (Appalachian) Niagara Hydroelectric Project No. 2466 (Niagara Project). The determination is based on the study criteria set forth in sections 5.9(b) and 5.15(d) and (e) of the Commission's regulations, applicable law, Commission policy and practice, and Commission staff's review of the record of information.

Background

The study plan determination (SPD) for the project, issued on December 6, 2019, required Appalachian to conduct eight studies and file an initial study report on those studies. On January 11, 2021, Appalachian filed the initial study report. As required by the regulations, the report describes the progress made in implementing the study plan and includes an explanation of reported variances from the study plan and schedule. On January 21, 2021, Appalachian held an Initial Study Report meeting and filed a summary of the meeting on February 5, 2021. Comments on the meeting summary and Initial Study Report were filed by: Roanoke County on March 4, 2021; Roanoke Regional Partnership and Roanoke River Blueway Committee on March 5, 2021; and Roanoke Valley Greenway Commission, Virginia Department of Environmental Quality (Virginia

DEQ), and the U.S. Fish and Wildlife Service (FWS) on March 8, 2021. Appalachian filed reply comments on April 6, 2021.

Comments

Some of the comments received do not specifically request modifications to the approved studies or new studies. This determination does not address these types of responses, which include comments on the presentation of data and results; comments disputing the interpretation of study results; recommendations for protection, mitigation, or enhancement measures; and comments on issues that Commission staff previously addressed in the December 6, 2019 SPD. This determination only addresses specific recommendations to modify the approved study plan.

Study Plan Determination

Pursuant to section 5.15(d) of the Commission's regulations, any proposal to modify a required study must be accompanied by a showing of good cause, and must demonstrate that: (1) the approved study was not conducted as provided for in the approved study plan, or (2) the study was conducted under anomalous environmental conditions or that environmental conditions have changed in a material way. As specified in section 5.15(e), requests for new information gathering or studies must include a statement explaining: (1) any material change in law or regulations applicable to the information request, (2) why the goals and objectives of the approved study could not be met with the approved study methodology, (3) why the request was not made earlier, (4) significant changes in the project proposal or that significant new information material to the study objectives has become available, and (5) why the new study request satisfies the study criteria in section 5.9(b).

As indicated in Appendix A, modifications to two studies were requested; one of the requested modifications is approved and one is not required. The bases for modifying the study plan are explained in Appendix B (Requested Modifications to Approved Studies). Commission staff considered all study plan criteria in section 5.9 of the Commission's regulations; however, only the specific study criteria particularly relevant to the study in question are referenced in Appendix B.

Please note that nothing in this determination is intended, in any way, to limit any agency's proper exercise of its independent statutory authority to require additional studies.

If you have any questions, please contact Allyson Conner at allysonconner@ferc.gov or (202) 502-6082.

Sincerely,

Terry L. Turpin
Director
Office of Energy Projects

Enclosures: Appendix A – Summary of determinations on requested modifications to approved studies

Appendix B – Commission staff's recommendations on requested modifications to approved studies and new study requests

APPENDIX A

SUMMARY OF DETERMINATIONS ON REQUESTED MODIFICATIONS TO APPROVED STUDIES (see Appendix B for discussion)

Study	Recommending Entity	Approved	Approved with Modifications	Not Required
Requested Modifications to Approved Studies				
Water Quality Study	FWS, Virginia DEQ		X	
Benthic Aquatic Resources Study	FWS			X

APPENDIX B

STAFF RECOMMENDATIONS ON REQUESTED MODIFICATIONS TO APPROVED STUDIES AND NEW STUDY REQUESTS

Water Quality Study

Background

Appalachian conducted a water quality study to assess the effects of project operation on parameters including temperature and dissolved oxygen (DO). Continuously recording data sondes were placed at eight sites to measure temperature and DO at 15-minute intervals from July 29 through November 10, 2020. These sites included: (1) upstream of the confluence of the Roanoke River with Tinker Creek; (2) Tinker Creek; (3) the upper end of the impoundment; (4) the forebay (surface and bottom); (5) the upper bypassed reach; (6) the lower bypassed reach; and (7) the tailrace (see figure 3-1 of the *Preliminary Water Quality Study Report*). In addition, during the initial deployment and subsequent data download events, discrete multi-parameter water quality measurements of temperature, DO, pH, and specific conductivity were collected at each monitoring location, including vertical profiles at the sites in the impoundment and forebay.

Due to higher than average flows for much of the 2020 study season, which could have led to atypical temperature and DO conditions, Appalachian proposes to reinstall two continuously recording sondes in the bypassed reach and one sonde in the tailrace to measure temperature and DO from July through September of 2021.

Requested Study Modifications

Study modification requests were filed by the U.S. Fish and Wildlife Service (FWS) and by the Virginia Department of Environmental Quality (Virginia DEQ). We address the requested modifications separately below.

1. *Additional study season*

Requested Study Modification

In its comments on the Initial Study Report (ISR) meeting summary, FWS recommends that the entire Water Quality Study be repeated in 2021. FWS states that an additional study season is needed because data were not collected or available for approximately 50% of the planned 2020 study period, data that were collected are not representative of normal conditions at the project because precipitation and flow conditions were higher than average in 2020, and the data that were collected for approximately 2 months (September 8 through November 10) cannot be used to assess project operational effects on water quality because the project was not operating during this period.

Comments on Requested Study Modification

In its reply comments, Appalachian states that it agrees that flow conditions in 2020 were wetter than normal, but that the wetter than normal conditions only affected temperature and DO in the bypassed reach and tailrace, but not in the forebay, impoundment, and upstream of the impoundment.

Regarding the forebay water quality monitoring, Appalachian asserts that the 2020 forebay water quality data represent water quality for the "worst-case" scenario, because 100 percent of the inflow to the project in the late summer/fall of 2020 was routed into the bypassed reach rather than through the forebay and powerhouse. Therefore, the forebay was stagnant and subject to poor water quality caused by water temperature and DO stratification. Appalachian asserts that during a more typical year when the units are operating, temperature and DO stratification in the forebay area is minimized because flow is routed to the powerhouse. Therefore, in lieu of conducting additional continuous monitoring in the forebay, Appalachian proposes to collect water quality profile data (temperature, DO, pH, and specific conductivity) at the forebay monitoring location when it conducts equipment checks and data downloads for the bypassed reach and tailrace monitoring locations (i.e., approximately every 2 weeks).

Regarding the need for additional monitoring in the impoundment and further upstream, Appalachian states that it reviewed the historical water quality record for the U.S. Geological Survey (USGS) gage on the Roanoke River at Thirteenth Street Bridge (No. 02055080), which is at the upstream end of the project impoundment. Appalachian observed that since at least 2008, which was the third driest year on record, water quality has been relatively constant regardless of flow and precipitation. Appalachian therefore concludes that water quality data collected in the impoundment and further upstream in 2020 are representative of water quality at and near the project under very low- and high-flow conditions. In lieu of reinstalling continuously recording sondes in the upper end of the impoundment, Tinker Creek, and the Roanoke River upstream of the confluence with Tinker Creek, Appalachian proposes to include 2021 water quality data (temperature, DO, pH, and specific conductivity) recorded at both the Thirteenth Street Bridge USGS gage and USGS gage at Tinker Creek above Glade Creek (USGS 0205551614) in the Updated Study Report (USR).

Discussion and Staff Recommendation

Additional water quality monitoring in the project tailrace and bypassed reach is warranted given the abnormal flow conditions downstream of the project dam during the

2020 study season as described above. The additional continuous DO and temperature monitoring proposed for the tailrace and bypassed reach should provide sufficient information on the effects of project operation on bypassed reach and tailrace DO and temperature.

Regarding the need to resample the forebay in 2021, data provided in the ISR demonstrates that while the project was operating, temperature and DO were similar at the surface and bottom of the forebay confirming Appalachian's assertion that little to no temperature and DO stratification occurs while the project is generating. The data also show that during the first week of the powerhouse outage, DO decreased in the forebay, particularly at the bottom confirming that DO stratification occurs when the project does not operate for an extended period as occurred in 2020. Therefore, the forebay water quality data gathered in 2020 during an extended period of powerhouse shutdown does represent the "worst-case" scenario, and therefore, another full season of continuous water quality monitoring in the forebay is unnecessary. The proposed discrete, biweekly collection of water quality data in the forebay in 2021 would require relatively low effort and could be used to confirm the aforementioned conclusions reached from the 2020 data collection.

Due to the proximity of the USGS gages to the upper extent of the project impoundment, Appalachian's proposal to analyze 2021 continuous monitoring data from the USGS gages rather than re-installing its own sondes at the three most upstream locations is reasonable, particularly since the powerhouse outage is unlikely to have influenced water quality at the upstream locations as demonstrated above by Appalachian. Therefore, we concur with Appalachian's proposal to include 2021 water quality monitoring data from the two upstream USGS gages in the USR in lieu of conducting additional water quality monitoring in the impoundment and further upstream.

In summary, we recommend that Appalachian conduct the proposed continuous monitoring in the bypassed reach and tailrace in 2021, as well as the discrete, biweekly collection of water quality data in the forebay. Therefore, we do not recommend modifying the study plan to repeat continuous water quality monitoring at the three upstream or forebay monitoring locations.

2. *Length of study season*

<u>Requested Study Modification</u>

Virginia DEQ and FWS recommend that temperature and DO monitoring in the bypassed reach be extended through October 2021 to ensure that water quality during low-flow periods is captured.

Comments on Requested Study Modification

In its reply comments, Appalachian states that due to the effort and costs associated with extending the field sampling for an additional month, it proposes to only extend the sampling through October if water temperatures do not begin decreasing by the end of September. Appalachian further states that it does not believe that continued sampling in the bypassed reach beyond September is needed unless no water temperature and DO data are collected at the currently required bypassed reach minimum flow of 8 cfs during the July through September period and weather forecasts indicate that bypassed reach flows of about 8 cfs are likely in October.

Discussion and Staff Recommendation

The study plan determination (SPD) required water quality monitoring through October 31, 2020, based on historical data indicating that low-flow conditions in the Roanoke River often extend into October. As Appalachian acknowledges, flows in the bypassed reach during the 2020 water quality study season were not representative of typical conditions at the project, in part due to the inoperability (i.e., held in constant open position) of the trash sluice gate and the extended powerhouse outage. Therefore, monitoring through October would ensure that Appalachian captures the entire period where low flows and/or high temperatures may occur, which is necessary to inform potential license requirements. Therefore, consistent with the SPD, we do not agree with the triggers for monitoring through October as proposed by Appalachian and instead recommend that the continuous monitoring in the bypassed reach and tailrace continue through October 31 during the 2021 study season.

3. *Equipment maintenance*

Requested Study Modification

FWS recommends that Appalachian check and clean data sondes weekly during the 2021 study season to avoid the loss of water quality data from biofouling.

Comments on Requested Study Modification

Appalachian proposes to download the data and check and clean the data sondes at approximately 2-week intervals and would adjust accordingly depending on the degree of biofouling observed in the field. In its reply comments, Appalachian states that the chosen frequency of equipment checks is based on observations during the 2020 field season. Biofouling was less prevalent at the non-impoundment monitoring locations during the 2020 data collection, and performing cleaning on a weekly basis is unnecessary and would result in a significant increase in cost and effort.

Discussion and Staff Recommendation

While biofouling of the data sondes resulted in some data loss in 2020, as Appalachian noted, it was less of an issue at the downstream locations that Appalachian is required to study again in 2021. Appalachian's proposal to check and clean the data sondes at 2-week intervals and to adjust as needed is reasonable and should be frequent enough to ensure the data sondes continue to operate. We recommend that Appalachian increase the frequency to weekly only if biofouling is found to hamper data collection.

Benthic Aquatic Resources Study

Freshwater Mussel Survey

Background

As part of the Benthic Aquatic Resources Study, Appalachian conducted a freshwater mussel survey to characterize mussel habitat and community composition in the project area in the fall of 2020. A combination of transect and abbreviated surveys were conducted following methods modified from the "Draft Freshwater Mussel Guidelines for Virginia."[1,2] Transect surveys were performed at eight sites spaced every 500 meters within the impoundment and immediately upstream of the impoundment. Linear transects were established across the width of the impoundment, perpendicular to stream flow, and ranged from 30 to 75 meters in length. Surveyors searched transects for mussels at an approximate rate of one minute per square meter in heterogeneous substrates. Methods used to locate mussels included wafting and raking sediment, searching through aquatic vegetation, and overturning cobble, boulder, and woody debris. No live mussels were recorded in the transect surveys.

Surveys were also conducted in five reaches of riffle and/or run habitats ranging from 315 to 500 meters in length in: (1) Tinker Creek, (2) Wolf Creek, (3) the Roanoke River upstream of the impoundment, (4) the bypassed reach, and (5) below the tailrace using viewscopes, snorkeling, and surface supplied air.[3] Surveyors targeted habitat(s)

[1] FWS and Virginia DGIF. 2018. Draft Freshwater Mussel Guidelines for Virginia. Virginia Field Office, Gloucester, Virginia.

[2] Transect surveys were conducted in pool habitats and include searching all habitat along the entire length, while abbreviated surveys were conducted at sites with mixed habitat and included searching for mussels in suitable habitat throughout the site.

[3] The use of surface supplied air is a sampling technique whereby the diver is supplied breathing gas from the surface, either from the shore or from a diving support vessel.

suitable for the occurrence of freshwater mussels and searched those areas at an approximate rate of one minute per square meter in heterogeneous substrates using similar methods as those used in the transect surveys. A total of four Eastern Elliptio (*Elliptio complanata*) were observed and collected during the abbreviated surveys in Tinker Creek and the Roanoke River upstream of the impoundment.

Requested Study Modification

In its comments on the ISR meeting summary, FWS notes that there is a large riffle at the lower extent of the most downstream survey area ("UNIO-Tailrace Survey Area") that includes a continuous area of stable gravel/cobble substrate and may represent the beginning of suitable mussel habitat that was not surveyed. In addition, FWS states that the location of the UNIO-Tailrace Survey Area differs from the location proposed in the approved study plan. Specifically, the UNIO-Tailrace Survey Area was to start 500 meters downstream of the tailrace and extend a distance of 500 meters to a point 1,000 meters downstream of the tailrace. However, figure 1 in the Benthic Aquatic Resources Study Report shows the UNIO-Tailrace Survey Area started approximately 375 meters rather than 500 meters downstream of the tailrace with the result that the survey ended 875 meters instead of 1,000 meters downstream of the tailrace. FWS states that this appears to have resulted in the first area of suitable mussel habitat not being surveyed and recommends that an additional 500 meters of area below that which was surveyed in 2020 be surveyed for freshwater mussels in 2021.

Comments on Requested Study Modification

In its reply comments, Appalachian states that the figure in the ISR illustrating the UNIO-Tailrace Survey Area contained an outdated shapefile created during the study planning process and did not accurately represent the area that was actually surveyed. In its response comments, Appalachian provided new figures illustrating the correct location and extent of the UNIO-Tailrace Survey Area that was evaluated during the 2020 field effort. The revised figures show that the survey was initiated approximately 500 meters downstream of the tailrace and extended 500 meters downstream, thereby covering the full extent delineated in the approved study plan. Appalachian states that it is not proposing to conduct additional mussel surveys as requested by FWS because the sampling locations and survey methodology were developed in consultation with staff from the Virginia Department of Wildlife Resources, the results of the 2020 survey indicate mussel density and diversity in the Roanoke River near the project is very low, and that the requested expanded area is beyond the extent of hydraulic influence of project operations.

Discussion and Staff Recommendation

The additional information provided by Appalachian in its reply comments indicates that it surveyed the full extent of the survey area as proposed in the approved study plan. In addition, while additional suitable mussel habitat may be located further downstream than the area surveyed in 2020, there is no reason to conclude that project operation would affect areas more than 1,000 meters downstream of the tailrace. FWS does not demonstrate the nexus between project operation and freshwater mussel resources in the Roanoke River more than 1,000 meters downstream of the tailrace or explain how the additional mussel survey would inform potential license requirements [section 5.9(b)(5)]. Therefore, we do not recommend modifying the study to require Appalachian to conduct an additional freshwater mussel survey downstream of the project.

Yayac, Maggie

Subject: FW: [EXTERNAL] RE: RSVP for May 25 Racine Updated Study Report Meeting

From: McCloskey, John <john_mccloskey@fws.gov>
Sent: Thursday, May 13, 2021 1:20 PM
To: Jonathan M Magalski <jmmagalski@aep.com>
Cc: McCorkle, Richard <richard_mccorkle@fws.gov>
Subject: Re: [EXTERNAL] RE: RSVP for May 25 Racine Updated Study Report Meeting

Hi Jon,

I am still working on the waiver. It is more complicated than I thought it would be. I hope to get this issue resolved soon. When I do, I will let you know.

John.

****

John McCloskey

Fish and Wildlife Biologist

U.S. Fish and Wildlife Service

6669 Short Lane

Gloucester, VA 23061

T: (804) 824-2404

F: (804) 693-9032

Work cell (while teleworking): 757-378-8410

Visit us at http://www.fws.gov/northeast/virginiafield
****

From: Jonathan M Magalski <jmmagalski@aep.com>
Sent: Thursday, May 13, 2021 11:15 AM
To: McCloskey, John <john_mccloskey@fws.gov>
Cc: McCorkle, Richard <richard_mccorkle@fws.gov>
Subject: [EXTERNAL] RE: RSVP for May 25 Racine Updated Study Report Meeting

This email has been received from outside of DOI - Use caution before clicking on links, opening attachments, or responding.

Thanks, John. I'll add you to the meeting invite.

On another note, has any additional consideration been given to the TOYR for the macroinvertebrate sampling at Niagara? HDR and Edge are looking at scheduling the sampling in conjunction with some sampling at another project. Confirmation of the waiver for the macroinvertebrate sampling is much appreciated. Please let me know if you have questions or would like to have a call to discuss.

From: McCloskey, John <john_mccloskey@fws.gov>
Sent: Thursday, May 13, 2021 10:15 AM
To: Jonathan M Magalski <jmmagalski@aep.com>
Cc: McCorkle, Richard <richard_mccorkle@fws.gov>
Subject: [EXTERNAL] RSVP for May 25 Racine Updated Study Report Meeting

This is an **EXTERNAL** email. **STOP**. **THINK** before you CLICK links or OPEN attachments. If suspicious please click the **'Report to Incidents'** button in Outlook or forward to incidents@aep.com from a mobile device.

Jon,

Confirming that I am planning to participate in the May 25 Racine USR WebEx Meeting from 1-4 p.m.

John.

****

John McCloskey

Fish and Wildlife Biologist

U.S. Fish and Wildlife Service

6669 Short Lane

Gloucester, VA 23061

T: (804) 824-2404

F: (804) 693-9032

Work cell (while teleworking): 757-378-8410

Visit us at http://www.fws.gov/northeast/virginiafield
****

From:	Hoskin, Sumalee
To:	Huddleston, Misty
Cc:	Andersen, Troy M; McCloskey, John; McCorkle, Richard; Jon Studio; Kulpa, Sarah; Jonathan M Magalski; Yayac, Maggie
Subject:	RE: [EXTERNAL] RE: Macroinvertebrate Study at Niagara Hydro Project during RLP TOYR
Date:	Wednesday, May 26, 2021 1:00:07 PM

Misty,
To clarify, there is no such thing as a "TOYR waiver" your project, as described, is not likely to adversely affect the Roanoke logperch therefore it can proceed.
Sumalee

Sumalee Hoskin
US Fish & Wildlife Service
6669 Short Lane
Gloucester, VA 23061

sumalee_hoskin@fws.gov
Tel: 804-693-6694 ex. 2414
Fax: 804-693-9032
Visit us at http://www.fws.gov/northeast/virginiafield/

From: Huddleston, Misty <Misty.Huddleston@hdrinc.com>
Sent: Wednesday, May 26, 2021 12:55 PM
To: Hoskin, Sumalee <sumalee_hoskin@fws.gov>
Cc: Andersen, Troy M <troy_andersen@fws.gov>; McCloskey, John <john_mccloskey@fws.gov>; McCorkle, Richard <richard_mccorkle@fws.gov>; Jon Studio <jastudio@edge-es.com>; Kulpa, Sarah <Sarah.Kulpa@hdrinc.com>; Jonathan M Magalski <jmmagalski@aep.com>; Yayac, Maggie <Maggie.Yayac@hdrinc.com>
Subject: [EXTERNAL] RE: Macroinvertebrate Study at Niagara Hydro Project during RLP TOYR

Sumalee,
Thank for the information.

Can you confirm that this email transmittal serves as the "waiver of TOYR" for Roanoke Logperch

and that we are allowed to proceed with the macroinvertebrate sampling effort? Thanks,
Misty

Misty Huddleston, PhD
Associate, SR. Environmental Scientist
D 704.248.3614 M 865.556.9153

hdrinc.com/follow-us

From: Hoskin, Sumalee <sumalee_hoskin@fws.gov>
Sent: Wednesday, May 26, 2021 12:51 PM
To: Huddleston, Misty <Misty.Huddleston@hdrinc.com>
Cc: Andersen, Troy M <troy_andersen@fws.gov>; McCloskey, John <john_mccloskey@fws.gov>; McCorkle, Richard <richard_mccorkle@fws.gov>; Jon Studio <jastudio@edge-es.com>; Kulpa, Sarah <Sarah.Kulpa@hdrinc.com>; Jonathan M Magalski <jmmagalski@aep.com>; Yayac, Maggie <Maggie.Yayac@hdrinc.com>
Subject: Macroinvertebrate Study at Niagara Hydro Project during RLP TOYR

Misty,
We have reviewed your request to conduct a benthic macroinvertebrate survey. The following comments are provided under provisions of the Endangered Species Act of 1973 (16 U.S.C. 1531-1544, 87 Stat. 884), as amended.

The proposed benthic macroinvertebrate sampling includes 10 sites. Seven sites are in the mainsteam of the Roanoke River, habitat occupied by the federally listed endangered Roanoke logperch (*Percina rex*). Sampling follows the 2008 Virginia Department of Environmental Quality methodology; per the methodology the sampling period ends May 31. The proposed sampling will occur over a 2-day period during the Roanoke logperch time-of-year restriction (March 15- June 30). Sampling may include standard aquatic dip net (approximately 1-foot wide), kick nets and rock picking. Only one person will be in the water. Travel between sampling sites will occur by canoe or on shore to avoid disturbing the streambed. The approximate width of the Roanoke River at the sampling sites is 115 feet.

Based on the expected amount of streambed that will be disturbed, the short duration of disturbance and the small amount of sediment that will be generated, we believe the effects of the survey on the Roanoke logperch will be insignificant and discountable and the proposed survey is not likely to adversely affect this species.
Sumalee

Sumalee Hoskin
US Fish & Wildlife Service
6669 Short Lane
Gloucester, VA 23061

sumalee_hoskin@fws.gov

Tel: 804-693-6694 ex. 2414
Fax: 804-693-9032
Visit us at http://www.fws.gov/northeast/virginiafield/

From:	McCloskey, John
To:	Huddleston, Misty
Cc:	Kulpa, Sarah; jon Studio (jastudio@edge-es.com); Jonathan M Magalski; Yayac, Maggie
Subject:	Re: [EXTERNAL] RE: TOYR Waiver for Macroinvertebrate Study at Niagara Hydroelectric Project
Date:	Wednesday, May 26, 2021 8:56:50 AM

Misty,

Can you provide clarification on the statement that limited seine hauls may be used to collect crayfish? You state that only one person will be in the water during sampling. However, the use of a seine would generally require multiple people to use.

John.

****
John McCloskey
Fish and Wildlife Biologist
U.S. Fish and Wildlife Service
6669 Short Lane
Gloucester, VA 23061
T: (804) 824-2404
F: (804) 693-9032
Work cell (while teleworking): 757-378-8410
Visit us at http://www.fws.gov/northeast/virginiafield
****

From: Huddleston, Misty <Misty.Huddleston@hdrinc.com>
Sent: Friday, May 21, 2021 5:41 PM
To: McCloskey, John <john_mccloskey@fws.gov>
Cc: Kulpa, Sarah <Sarah.Kulpa@hdrinc.com>; jon Studio (jastudio@edge-es.com) <jastudio@edge-es.com>; Jonathan M Magalski <jmmagalski@aep.com>; Yayac, Maggie <Maggie.Yayac@hdrinc.com>
Subject: RE: [EXTERNAL] RE: TOYR Waiver for Macroinvertebrate Study at Niagara Hydroelectric Project

John,
Thank you for the follow-up email.
See below for responses to the questions your provided.

- How often will sampling occur? Sampling will occur over a two day period as soon as we have the TOYR waiver approval.
- How much foot traffic along the streambed is expected? During sampling, only one person will be in the water.
- How many people will be walking through the habitat? Only one person. All travel between

sites will occur on shore or by canoe to avoid disturbing the streambed to the maximum extent possible.

- How many sites will be sampled? 10 total sites (100 meter transect each) with 5 located in riffle/run (quantitative) habitat and 5 in pool (qualitative) habitat. See attached Figure illustrating proposed sampling locations.
- Exactly what methods they're using? Sampling will be performed following methods detailed in the Virginia Department of Environmental Quality (VDEQ). 2008. Biological Monitoring Program Quality Assurance Project Plan for Wadeable Streams and Rivers. Quantitative and Qualitative methods may include kick nets, dipnets, rock picking, and limited seine hauls to target crayfish.

Additional details regarding the Project and the proposed sampling effort can be found in the Revised Study Plan at the follow link: http://www.aephydro.com/HydroPlant/Niagara

Let us know if there is anything else needed to process this request.
Thanks and have a nice weekend,
Misty

Misty Huddleston, PhD
Associate, SR. Environmental Scientist
D 704.248.3614 **M** 865.556.9153

hdrinc.com/follow-us

From: McCloskey, John <john_mccloskey@fws.gov>
Sent: Friday, May 21, 2021 1:10 PM
To: Huddleston, Misty <Misty.Huddleston@hdrinc.com>
Cc: Kulpa, Sarah <Sarah.Kulpa@hdrinc.com>; jon Studio (jastudio@edge-es.com) <jastudio@edge-es.com>; Jonathan M Magalski <jmmagalski@aep.com>; Yayac, Maggie <Maggie.Yayac@hdrinc.com>
Subject: Re: [EXTERNAL] RE: TOYR Waiver for Macroinvertebrate Study at Niagara Hydroelectric Project

Misty,

I discussed the benthic macroinvertebrate study with the endangered species lead for the Roanoke logperch and she needs additional information to determine whether the benthic sampling is likely or not likely to adversely affect RLP. Her request is below:

Understanding the specific project details such as the magnitude, timing, and duration of the impact will help us with our determination. If you have the answers to questions below that will help us understand the impact and ensure a LAA determination is appropriate.

How often will sampling occur?

- How much foot traffic along the streambed is expected?
- How many sites will be sampled?
- How many people will be walking through the habitat?
- Exactly what methods they're using?

Once you have provided this additional information, she will make a determination on whether or not the sampling is likely to adversely affect RLP and decide whether a waiver can be granted.

John.

****

John McCloskey
Fish and Wildlife Biologist
U.S. Fish and Wildlife Service
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Gloucester, VA 23061
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F: (804) 693-9032
Work cell (while teleworking): 757-378-8410
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****

From: Huddleston, Misty <Misty.Huddleston@hdrinc.com>
Sent: Monday, May 10, 2021 4:42 PM
To: McCloskey, John <john_mccloskey@fws.gov>
Cc: Kulpa, Sarah <Sarah.Kulpa@hdrinc.com>; jon Studio (jastudio@edge-es.com) <jastudio@edge-es.com>; Jonathan M Magalski <jmmagalski@aep.com>; Yayac, Maggie <Maggie.Yayac@hdrinc.com>
Subject: [EXTERNAL] RE: TOYR Waiver for Macroinvertebrate Study at Niagara Hydroelectric Project

Mr. McCloskey,

Good afternoon.
Based on discussions during our group call last week, the Virginia Department of Wildlife Resources and US Fish and Wildlife Service were in agreement that there were no concerns with Appalachian completing the spring benthic macroinvertebrate sampling activities at the Niagara Project. At the end of the call, you took the action item to send over something to Appalachian and HDR that provides documentation of the Service's waiver of the time-of-year-restrictions for Roanoke River

instream work during the Niagara Logperch spawning season. If there is not a formal document that is required, can you provide confirmation via email?

The spring index period for benthic macroinvertebrate sampling in Virginia ends on May 31st, so we would like to get the field team scheduled to get in the field as soon as possible.
Can you provide an update on the status of the waiver request? Alternatively, can you reply with your concurrence that Appalachian is granted a waiver of the time-of-year-restrictions on instream work and can move forward with completing the benthic macroinvertebrate spring field sampling, as proposed in the Niagara Project Revised Study Plan?

Again we appreciate the great discussion on the call last week and look forward to hearing from you.

Regards,
Misty

Misty Huddleston, PhD
Associate, SR. Environmental Scientist

HDR
440 S. Church Street, Suite 900
Charlotte, NC 28202-2075
D 704.248.3614 **M** 865.556.9153
Misty.Huddleston@hdrinc.com

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From: Kulpa, Sarah
Sent: Wednesday, July 14, 2021 12:21 PM
To: McCloskey, John
Cc: Jonathan M Magalski; Elizabeth B Parcell; scott.smith@dwr.virginia.gov; ernie.aschenbach@dwr.virginia.gov; McCorkle, Richard
Subject: RE: [EXTERNAL] AEP Niagara Hydroelectric Project (FERC No. 2466) -Summary of RLP larval drift study conference call

Thanks, John, for USFW's timely review and feedback. We look forward to further consultation with this group working toward the draft and final license applications for this project.

Sarah Kulpa
D 704.248.3620 **M** 315.415.8703

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From: McCloskey, John <john_mccloskey@fws.gov>
Sent: Wednesday, July 14, 2021 10:08 AM
To: Kulpa, Sarah <Sarah.Kulpa@hdrinc.com>
Cc: Jonathan M Magalski <jmmagalski@aep.com>; Elizabeth B Parcell <ebparcell@aep.com>; scott.smith@dwr.virginia.gov; ernie.aschenbach@dwr.virginia.gov; McCorkle, Richard <richard_mccorkle@fws.gov>
Subject: Re: [EXTERNAL] AEP Niagara Hydroelectric Project (FERC No. 2466) -Summary of RLP larval drift study conference call

Hi Sarah,

The U.S. Fish and Wildlife Service has reviewed the draft summary of the conference call held on June 7, 2021 to discuss the Roanoke Logperch larval drift study planned to be conducted in support of the relicensing of Appalachian Power Company's Niagara Hydroelectric Project (FERC No. 2466). We have no comments or suggested edits on the meeting summary. The meeting summary accurately reflects what was discussed on the call. We appreciate your efforts to address our concerns on this project.

John.

****

John McCloskey

Fish and Wildlife Biologist

U.S. Fish and Wildlife Service

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****

From: Kulpa, Sarah <Sarah.Kulpa@hdrinc.com>
Sent: Wednesday, June 30, 2021 12:32 PM
To: McCloskey, John <john_mccloskey@fws.gov>; McCorkle, Richard <richard_mccorkle@fws.gov>; scott.smith@dwr.virginia.gov <scott.smith@dwr.virginia.gov>; ernie.aschenbach@dwr.virginia.gov <ernie.aschenbach@dwr.virginia.gov>; ernie.aschenbach@dwr.virginia.gov <ernie.aschenbach@dwr.virginia.gov>
Cc: Allyson Conner <Allyson.Conner@ferc.gov>; John Smith <John.Smith@ferc.gov>; Laurie Bauer <Laurie.Bauer@ferc.gov>; Jonathan M Magalski <jmmagalski@aep.com>; Elizabeth B Parcell <ebparcell@aep.com>
Subject: [EXTERNAL] AEP Niagara Hydroelectric Project (FERC No. 2466) -Summary of RLP larval drift study conference call

This email has been received from outside of DOI - Use caution before clicking on links, opening attachments, or responding.

Good afternoon,

A draft summary of the conference call to discuss the Roanoke Logperch larval drift study planned to be conducted in support of the relicensing of Appalachian Power Company's Niagara Hydroelectric Project (FERC No. 2466) is attached. Please send comments and any suggested edits back to me by COB Wednesday, July 14. HDR will then work with Appalachian to finalize the meeting summary for inclusion in the consultation record for the Fish Community Study.

On behalf of Appalachian, thank you for your attention to this project, and we look forward to future discussions with this group related to this resource issue.

And have a safe holiday weekend!

Sarah Kulpa
D 704.248.3620 **M** 315.415.8703

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-----Original Appointment-----
From: Allyson Conner <Allyson.Conner@ferc.gov>
Sent: Thursday, June 3, 2021 12:50 PM
To: Allyson Conner; McCloskey, John; McCorkle, Richard; Jon Magalski; Elizabeth B Parcell; Kulpa, Sarah; scott.smith@dwr.virginia.gov; ernie.aschenbach@dwr.virginia.gov; John Smith; Laurie Bauer
Subject: Niagara Project RLP larval drift study conference call
When: Monday, June 7, 2021 3:00 PM-4:00 PM (UTC-05:00) Eastern Time (US & Canada).
Where: Webex

CAUTION: [EXTERNAL] This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

Everyone was available Monday at 3pm and no schedules needed to be adjusted. Just click the link below and we should all be able to talk and/or see one another – should you choose that option 😊

-- Do not delete or change any of the following text. --

When it's time, join your Webex meeting here.

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Meeting password: G3Npe3ATxg2

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Join by phone
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Join using Microsoft Lync or Microsoft Skype for Business

Dial 1995778734.ferc@lync.webex.com

If you are a host, click here to view host information.

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From: Kulpa, Sarah
Sent: Tuesday, July 27, 2021 6:27 AM
To: ACHP - John Eddins; Catawba Indian Nation - Wenonah Haire; County of Roanoke - David Henderson; County of Roanoke - Lindsay Webb; County of Roanoke - Michael Clark; County of Roanoke - Richard Caywood; Delaware Nation - Eric Paden; Friends of the Blue Ridge Parkway - Audrey Pearson; Friends of the Rivers of Virginia - Bill Tanger; Harold Peterson; Kevin Colburn - American Whitewater (kevin@americanwhitewater.org); Monacan Indian Nation - Kenneth Branham; NPS - Dawn Leonard; Roanoke County Parks - Doug Blount; Roanoke Regional Partnership - Pete Eshelman; Roanoke River Blueway; Roanoke Valley Alleghany Regional Commission - Amanda McGee; Roanoke Valley Greenway - Liz Blecher; Smith Mountain Lake Assn - Lorie Smith; Town of Vinton - Anita McMillan; Town of Vinton - Bo Herndon; Town of Vinton - Kenny Sledd; Town of Vinton - Nathan McClung; Tri-County Lakes Administrative Commission - Paula Shoffner; USEPA - Matthew Lee; USFWS; USFWS - John McCloskey; USGS - Mark Bennett; VA Cooperative Fish and Wildlife Research Unit - Paul Angermeier; VADCR - Jennifer Wampler; VADCR - Natural Heritage; VADCR - Robbie Ruhr; VADEQ - Andrew Hammond; VADEQ - Anthony Cario; VADEQ - Brian McGurk; VADEQ - Matthew Link; VADEQ - Scott Kudlas; Virginia Council on Indians - Emma Williams; Virginia Department of Conservation and Recreation - Rene Hypes; Virginia Department of Game and Inland Fisheries - Scott Smith
Cc: Jonathan M Magalski; 'ebparcell@aep.com'; Salazar, Maggie; Hanson, Danielle
Subject: Niagara Hydroelectric Project (VA) -- Filing of ILP Study Progress Report
Attachments: Niagara Fourth Quarterly Progress Report_July 2021.pdf

Niagara Hydroelectric Project Stakeholders:

Appalachian Power Company (Appalachian), a unit of American Electric Power (AEP), is the licensee, owner and operator of the Niagara Hydroelectric Project (FERC No. 2466) (Project) located on the Roanoke River in Roanoke County, Virginia. The Project is operated under a license issued by the Federal Energy Regulatory Commission (FERC). The existing FERC license for the Project expires on February 29, 2024. Appalachian is pursuing a new license for the continued operation of the Project in accordance with FERC's Integrated Licensing Process (ILP).

Pursuant to the ILP, Appalachian filed the fourth ILP Study Progress Report with the Commission on Thursday, July 22. We are notifying stakeholders and distributing an electronic copy of this submittal (attached). The filing can also be viewed online at FERC's eLibrary and will be added to the Project's public relicensing website (http://www.aephydro.com/HydroPlant/Niagara) in the coming days.

Thank you for your continued interest in this Project. Should you have any questions regarding this filing, please contact Jon Magalski with AEP at (614) 716-2240 or jmmagalski@aep.com.

Thank you,

Sarah Kulpa
Project Manager

HDR
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D 704.248.3620 **M** 315.415.8703
sarah.kulpa@hdrinc.com

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American Electric Power
1 Riverside Plaza
Columbus, OH 43215
aep.com

July 22, 2021

VIA ELECTRONIC FILING

Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
888 First Street, N.E.
Washington, D.C. 20426

Subject: Niagara Hydroelectric Project (FERC No. 2466-034)
Fourth Quarterly Study Progress Report – Summer 2021

Dear Secretary Bose:

Appalachian Power Company (Appalachian or Applicant), a unit of American Electric Power (AEP) is the Licensee, owner, and operator of the run-of-river 2.4 megawatt (MW) Niagara Hydroelectric Project (Project No. 2466) (Project or Niagara Project) located on the Roanoke River in Roanoke County, Virginia. The Project is currently undergoing relicensing following the Federal Energy Regulatory Commission's (FERC or Commission) Integrated Licensing Process (ILP).

This Fourth Quarterly Study Progress Report describes the activities performed since the Third Quarterly Study Progress Report which was filed on April 30, 2021, and includes activities expected to be conducted in quarter 3 (Q3) of 2021. Unless otherwise described, all relicensing studies are being conducted in conformance with the approved Revised Study Plan (RSP) and the Commission's Study Plan Determination (SPD).

Bypass Reach Flow and Aquatic Habitat Study

- Field data collection was completed during the weeks of June 28 and July 5. Once the field data has been analyzed, a two-dimensional (2D) aquatic habitat model will be developed. Preliminary modeling results, conclusions, and recommendations will be provided in the Updated Study Report (USR).

Water Quality Study

- Appalachian's consultant, HDR, reinstalled two continuous temperature and dissolved oxygen (DO) data sondes in the bypass reach (one at the upstream monitoring location and the other at the downstream monitoring location) and a continuous temperature and DO data sonde in the tailrace during the week of June 28th. HDR has completed one download on July 8 and a second download on July 20. HDR presently plans to download measurements from the equipment approximately every other week through October 2021.

- Appalachian plans to collect discrete water quality profile data at the forebay monitoring location during equipment checks and data downloads for the continuous monitoring instrumentation.
- Additional water quality data collected during the 2021 field season will be summarized, along with any conclusions or recommendations, in the USR in Q4 2021.

Fish Community Study

- As reported in Appalachian's previous progress report, a Larval Drift Study was planned for early spring 2021 to coincide with the Roanoke Logperch (*Percina Rex*) spawning window. Data collection efforts were scheduled to start at the beginning of April 2021 and continue for 10 consecutive weeks, ending in mid-June. The study requires (prior to field data collection) a Section 10(a)(1)(A) permit from the U.S. Fish and Wildlife Service (USFWS) regional office. An application for the federal recovery permit was submitted in December 2020 by Edge Engineering & Science, LLC (EDGE) on behalf of Appalachian (Application ID: CS0003751, Permit ID:PER0002735). The timing of this application filing was discussed during the ISR, including with representatives of USFWS. The 30-day public comment period for the permit application was initiated by USFWS via public notice published in the Federal Register on April 28, 2021. The permit has not yet been issued.
- Due to this permit delay, Appalachian's subconsultant, EDGE, was unable to complete the Larval Drift Study as scheduled. On June 7, an informal conference call was held among FERC Division of Hydropower Licensing staff, staff from USFWS and the Virginia Department of Wildlife Resources (VDWR), and representatives from Appalachian and HDR, to discuss process considerations for delaying the study until the spring of 2022 (i.e., after the filing of the final license application) or alternative approaches or measures. As follow-up to this discussion, and based on findings from adult and juvenile Roanoke Logperch surveys at the Project scheduled for completion this summer, Appalachian plans to further consult with the agencies regarding the Larval Drift Study in advance of or in conjunction with the filing of the draft license application.
- Appalachian did not receive approval from the USFWS to complete the adult Roanoke Logperch electrofishing sampling efforts in the Niagara bypass channel as presented in the RSP. In lieu of and in consultation with USFWS and VDWR, Appalachian completed the spring adult Roanoke Logperch survey in the bypass channel using snorkeling methodologies. The snorkel surveys and habitat assessment efforts in the bypass channel

were completed the week of June 28. Additional field sampling for adult and young-of-year Roanoke Logperch in the vicinity of the Project as presented in the RSP will be completed between August and October 2021.

- Appalachian will initiate the Turbine Blade Strike Evaluation for Niagara using the most recent version of the USFWS Turbine Blade Strike Analysis Model[1] and will also incorporate available historical information. A tentative list of species collected at the site to be used in the analysis was presented in the ISR. The analysis and reporting will be continued to be performed in Q3 2021 and results will be included in the USR.

Benthic Aquatic Resources Study

- Field data collection for the macroinvertebrate and crayfish community was completed between September and October 2020. A second benthic macroinvertebrate and crayfish field sampling effort was completed on June 2-4, 2021. The benthic macroinvertebrate and crayfish sampling is complete. While this sampling was initially scheduled for completion by May 31, prior to the end of the spring macroinvertebrate index period (May 31) as defined by VDEQ 2008, scheduling of the fieldwork was delayed due to the need to obtain a not likely to adversely affect determination (which was received on May 26, 2021) for the protection of Roanoke Logperch from USFWS, which extended to this sampling effort as well.
- Results of the laboratory processing, taxonomic identification, and data processing will be provided in the USR.

Recreation Study

- The Recreation Visitor Use Online Survey is on-going and will continue to be available in support of the Recreation Use Documentation survey. Appalachian provided minor updates to the online survey based on recent stakeholder feedback and included the most up to date Project map. Appalachian reshared the survey link with stakeholders in May, so that they could distribute to their users/groups. Appalachian also posted the survey link on the Claytor Lake and Smith Mountain Facebook pages, as well as the NextDoor application. (The notification was sent to 19 Appalachian serviced neighborhoods, translating to about 3,800 customers in the area of the Niagara Dam and corresponding Project area. These postings were done on June 7, 2021).

[1] U.S. Fish and Wildlife Service (USFWS). 2020. TBSA Model: A Desktop Tool for Estimating Mortality of Fish Entrained in Hydroelectric Turbines. Excel file dated December 9, 2020.

- As described in the previous progress report, driven by the then-pending closure of the Blue Ridge Parkway, Appalachian's sub-consultant, Young Energy Services (YES) was able to complete seven days of in-person survey (weekdays and weekends included) between the time period March 20 and May 11, resulting in twenty in-person surveys. The remainder of the facilities included in Recreation Use Documentation task began being surveyed by YES in May 2021, according to the schedule presented in the RSP.
    - Also as described in the previous progress report, as the alternative to in-person periodic observation of the portage from across the river, Appalachian installed a trail camera on May 26, 2021 in the vicinity of the portage put-in location to record activity during the Recreation Use Documentation timeframe. One download of the trail camera has occurred at the time of this progress report.
- Appalachian is presently evaluating recreation facility enhancements to be included in Appalachian's licensing proposal and plans to conduct additional stakeholder consultation related to potential enhancements in advance of or concurrent with the filing of the Draft License Application.

Wetlands, Riparian, and Littoral Habitat Characterization Study and Shoreline Stability Assessment

- The field work in support of the Wetlands, Riparian, and Littoral Habitat Characterization Study and the Shoreline Stability Assessment was completed during the week of June 21st and results will be provided in the USR.

Cultural Resources Study

- All field investigations for this study have been completed. Final results of the Cultural Resources Study will be filed with the USR.

If there are any questions regarding this progress report, please do not hesitate to contact me at (614) 716-2240 or via email at jmmagalski@aep.com

Sincerely,

Jonathan M. Magalski
Environmental Specialist Consultant
American Electric Power Services Corporation

Subject: FW: Niagara Hydroelectric Project Roanoke Logperch Update
Attachments: RLP Method Update Memo_20210802.docx

From: Huddleston, Misty <Misty.Huddleston@hdrinc.com>
Sent: Monday, August 2, 2021 2:51 PM
To: Kulpa, Sarah <sarah.kulpa@hdrinc.com>
Subject: FW: Niagara Hydroelectric Project Roanoke Logperch Update

FYI

Misty Huddleston, PhD
Associate, SR. Environmental Scientist
D 704.248.3614 **M** 865.556.9153

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From: Jon Studio <jastudio@edge-es.com>
Sent: Monday, August 2, 2021 2:50 PM
To: richard_mccorkle@fws.gov; McCloskey, John <john_mccloskey@fws.gov>; Norman, Janet <janet_norman@fws.gov>; Pinder, Mike (DGIF) <mike.pinder@dwr.virginia.gov>; scott.smith@dgif.virginia.gov; Copeland, John <john.copeland@dwr.virginia.gov>; Angermeier, Paul <biota@vt.edu>
Cc: Huddleston, Misty <Misty.Huddleston@hdrinc.com>; John Spaeth <jpspaeth@edge-es.com>
Subject: Niagara Hydroelectric Project Roanoke Logperch Update

Good afternoon,

The attached memo (on behalf of EDGE [project consultant], HDR [project manager], and AEP [project owner]) provides a complete description of an updated survey method for the Niagara Hydroelectric Project. This methodological adjustment only pertains to 2021 Roanoke Logperch adult surveys and is contingent on approval from the Project's dive coordinator. Please respond with any questions or comments you may have. We appreciate your time.

Thank you,

JON A. STUDIO
Avon, Ohio
M: 440.413.4609
edge-es.com

EDGE ENGINEERING & SCIENCE
further insight.

Memo

Date:	Monday, August 02, 2021
Project:	Niagara Hydroelectric Project
To:	Richard McCorkle, USFWS John McCloskey, USFWS Janet Norman, USFWS Mike Pinder, VDWR Scott Smith, VDWR John Copeland, VDWR Paul Angermeier, Virginia Tech
From:	Jon Magalski, AEP Jon Studio, Edge Engineering and Science Misty Huddleston, HDR Sarah Kulpa, HDR
Subject:	<u>Update to Summer RLP Adult Survey Methods</u>

Appalachian Power Company (a unit of American Electric Power; AEP) is pursuing a new license from the Federal Energy Regulatory Commission (FERC) for the Niagara Dam Hydroelectric Project (Project) as their existing license (FERC No. 2466) expires in 2024. Roanoke Logperch (RLP) specific studies were developed in coordination with the U.S. Fish and Wildlife Service (USFWS) and the Virginia Department of Wildlife Resources (VDWR) during the scoping process and presented in the Revised Study Plan (RSP) and approved by FERC in the Study Plan Determination. The field sampling methodology originally consisted of spring and summer backpack electrofishing for RLP in the Bypass Reach of the Roanoke River (below Niagara Dam) and summer backpack electrofishing at seven other locations in the Project area. It was noted in the RSP that completion of spring backpack electrofishing efforts would require a waiver of the VDWR Time-of-Year Restrictions (TOYR) for RLP with concurrence from the USFWS.

AEP, through their consultants HDR Engineering, Inc. (Project manager; HDR) and Edge Engineering and Science, LLC. (Project consultant; EDGE), submitted a request to the services for a TOYR waiver to complete the required RLP spring study in the Niagara Bypass Reach. A conference call was held on Wednesday, May 5, 2021, between AEP (Project owner), HDR, EDGE, other experts, and representatives of VDWR and USFWS to discuss the TOYR waiver request. The call resulted in a recommendation to eliminate backpack electrofishing methodology for the spring Bypass Reach sampling effort during the TOYR. The agencies agreed that the use of snorkeling survey methods would pose less of a potential effect on RLP (Not Likely to Adversely Affect) while allowing the field team to collect necessary and requested baseline information for Project-specific RLP studies. The agencies concurred that the waiver of TOYR was granted with a change to snorkel survey methods and a commitment to minimize instream disturbance during the survey effort to the extent possible.

The following snorkel methods were sent to Mike Pinder (VDWR) and Dr. Paul Angermeier (Virginia Tech) and agreed upon as an acceptable substitute. These methods were used to successfully complete spring adult RLP sampling in the Bypass Reach between June 28 and 30, 2021, where 9 adult and 1 juvenile RLP were observed.

Survey Methods

The general snorkeling survey methods are based on the line-transect methods and simple Emlen model described in Ensign et al. (1995), which are specific to RLP in the Roanoke River. The Bypass Reach sample location includes line transects running parallel to flow during typical seasonal flows. Roanoke Logperch are the only target species in the snorkel survey, but other fish species observed are noted as present.

Maximum visibility is determined by moving a Secchi disc away from a snorkeler underwater until it is no longer visible. Parallel lines are laid on the stream bed (spaced a minimum distance of 1.5 times the maximum visibility) so that full coverage is achieved, and overlap is reduced. Snorkelers begin searching at the downstream end of the reach and proceed slowly upstream, with the transect line in the center of their body, performing visual searches by looking from side to side for RLP. When an RLP is observed, a weighted marker is placed where the observation initially occurred. The spotter records juvenile, adult, or male adult (orange strip in first dorsal). Areas along each transect where habitat is deemed unsuitable (based on stream velocity, depth, and substrate size) will be skipped. After one full pass of each transect, the perpendicular distance between the transect line and each marker is measured and recorded. Further, the location of each marker is recorded with a sub-meter accuracy GPS unit along with depth, velocity, silt cover, and pebble counts.

Habitat assessment methods employed in the Bypass Reach and other sites follow those outlined in the RSP. A map of documented RLP sightings is overlain by habitat suitability data to identify the areas/habitats within the Bypass Reach that are being utilized by RLP adults during the spring and summer.

Update to Summer RLP Adult Survey Methods

Through coordination with and recommendations from the USFWS and VDWR personnel, the spring field sampling plan was amended to use snorkel methods in lieu of backpack electrofishing to survey for RLP in the Niagara bypass reach. In consideration of the initial approval by species experts, and successful employment of these methods in the Bypass Reach (June 2021), AEP is planning to use the snorkel methodology to complete the summer (August – October) 2021 adult RLP surveys in lieu of backpack electrofishing methods[1]. No other deviations from the RSP are proposed at this time and the field effort will include snorkel surveys at a total of 8 sites – including the Bypass Reach. The change to the snorkel survey method is expected to improve our ability to locate adult RLP in the study boundary while minimizing stress to these federally protected fish.

Literature Cited

Ensign, W.E., P.L. Angermeier, and C.A. Dolloff. 1995. Use of line transect methods to estimate abundance of benthic stream fishes. Canadian Journal of Fisheries and Aquatic Sciences. 52: 213-222.

[1] The switch to snorkel methodology is contingent upon approval of the dive plan by AEP's dive coordinator.

From:	McCloskey, John
To:	Angermeier, Paul; Jon Studio; McCorkle, Richard; scott.smith@dgif.virginia.gov; John Copeland; Michael Pinder
Cc:	Huddleston, Misty; John Spaeth
Subject:	Re: [EXTERNAL] RE: Niagara Hydroelectric Project Roanoke Logperch Update
Date:	Monday, August 9, 2021 2:35:32 PM

Jon,

The U.S. Fish and Wildlife Service supports the switch from electrofishing to snorkeling for RLP surveys of the Roanoke River associated with the relicensing of the Niagara Hydroelectric Project as this should result in less risk to RLP. However, we agree with Paul that a minimum visibility criterion for snorkeling is recommended to ensure effective snorkeling surveys. The USFWS will defer to Mike and Paul to determine the minimum visibility criterion for snorkeling surveys. If the minimum visibility criterion cannot be met, either surveys should be delayed until water clarity improves or the survey method should be switched to electrofishing.

Thanks, John.

****

John McCloskey
Fish and Wildlife Biologist
U.S. Fish and Wildlife Service
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Gloucester, VA 23061
T: (804) 824-2404
F: (804) 693-9032
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****

From: Angermeier, Paul <biota@vt.edu>
Sent: Wednesday, August 4, 2021 8:39 AM
To: Jon Studio <jastudio@edge-es.com>; McCorkle, Richard <richard_mccorkle@fws.gov>; McCloskey, John <john_mccloskey@fws.gov>; Norman, Janet <janet_norman@fws.gov>; scott.smith@dgif.virginia.gov <scott.smith@dgif.virginia.gov>; John Copeland <john.copeland@dwr.virginia.gov>; Michael Pinder <Mike.Pinder@dwr.virginia.gov>
Cc: Huddleston, Misty <Misty.Huddleston@hdrinc.com>; John Spaeth <jpspaeth@edge-es.com>
Subject: [EXTERNAL] RE: Niagara Hydroelectric Project Roanoke Logperch Update

Hi Jon
Thanks for forwarding this. I support your proposed switch to snorkeling surveys, provided water clarity holds up. Snorkeling certainly is less risky w/r/t RLP injury. And when visibility is good, the risk of false absences may be lower than for e'fishing. Back in the 1990s we often paired e'fishing and snorkeling surveys for our RLP monitoring. The main reason we adopted an e'fishing-only protocol is that water clarity sometimes limited our ability to do surveys in the designated time windows. That is, e'fishing was more reliably operable. I don't recall the exact minimum-visibility cutoff we used (it might say in Ensign et al. 1995) to ensure effective snorkeling surveys. However, if visibility is <1m, significant fright bias can occur because RLP are often skittish as snorkelers approach. This promotes underestimates of presence and abundance.
Bottom line: you need to establish a minimum-visibility criterion for snorkeling, and plan to use e'fishing if it isn't met.

Glad to discuss further as needed.   Paul

From: Michael Pinder <Mike.Pinder@dwr.virginia.gov>
Sent: Monday, August 2, 2021 4:23 PM
To: Jon Studio <jastudio@edge-es.com>; richard_mccorkle@fws.gov; McCloskey, John <john_mccloskey@fws.gov>; Norman, Janet <janet_norman@fws.gov>; scott.smith@dgif.virginia.gov; John Copeland <john.copeland@dwr.virginia.gov>; Angermeier, Paul <biota@vt.edu>
Cc: Huddleston, Misty <Misty.Huddleston@hdrinc.com>; John Spaeth <jpspaeth@edge-es.com>
Subject: RE: Niagara Hydroelectric Project Roanoke Logperch Update

Jon,

Looks acceptable to me.

Thanks,

Mike

From: Jon Studio <jastudio@edge-es.com>
Sent: Monday, August 2, 2021 2:50 PM
To: richard_mccorkle@fws.gov; McCloskey, John <john_mccloskey@fws.gov>; Norman, Janet <janet_norman@fws.gov>; Pinder, Mike (DGIF) <mike.pinder@dwr.virginia.gov>; scott.smith@dgif.virginia.gov; Copeland, John <john.copeland@dwr.virginia.gov>; Angermeier, Paul <biota@vt.edu>
Cc: Huddleston, Misty <Misty.Huddleston@hdrinc.com>; John Spaeth <jpspaeth@edge-es.com>
Subject: Niagara Hydroelectric Project Roanoke Logperch Update

Good afternoon,

The attached memo (on behalf of EDGE [project consultant], HDR [project manager], and AEP [project owner]) provides a complete description of an updated survey method for the Niagara Hydroelectric Project. This methodological adjustment only pertains to 2021 Roanoke Logperch adult surveys and is contingent on approval from the Project's dive coordinator. Please respond with any questions or comments you may have. We appreciate your time.

Thank you,

JON A. STUDIO
Avon, Ohio
M: 440.413.4609
edge-es.com

EDGE
ENGINEERING & SCIENCE
further insight.

From: Smith, Scott
To: McCloskey, John
Cc: Angermeier, Paul; Jon Studio; McCorkle, Richard; scott.smith@dgif.virginia.gov; John Copeland; Michael Pinder; Huddleston, Misty; John Spaeth
Subject: Re: [EXTERNAL] RE: Niagara Hydroelectric Project Roanoke Logperch Update
Date: Monday, August 9, 2021 4:07:23 PM

Jon,

VDWR concurs with the recommendations put forth by USFWS.

Scott

On Mon, Aug 9, 2021 at 2:35 PM McCloskey, John <john_mccloskey@fws.gov> wrote:

> Jon,
>
> The U.S. Fish and Wildlife Service supports the switch from electrofishing to snorkeling for RLP surveys of the Roanoke River associated with the relicensing of the Niagara Hydroelectric Project as this should result in less risk to RLP. However, we agree with Paul that a minimum visibility criterion for snorkeling is recommended to ensure effective snorkeling surveys. The USFWS will defer to Mike and Paul to determine the minimum visibility criterion for snorkeling surveys. If the minimum visibility criterion cannot be met, either surveys should be delayed until water clarity improves or the survey method should be switched to electrofishing.
>
> Thanks, John.
>
> **
> John McCloskey
> Fish and Wildlife Biologist
> U.S. Fish and Wildlife Service
> 6669 Short Lane
> Gloucester, VA 23061
> T: (804) 824-2404
> F: (804) 693-9032
> Work cell (while teleworking): 757-378-8410
> Visit us at http://www.fws.gov/northeast/virginiafield
> ******************************
>
> ---
>
> **From:** Angermeier, Paul <biota@vt.edu>
> **Sent:** Wednesday, August 4, 2021 8:39 AM
> **To:** Jon Studio <jastudio@edge-es.com>; McCorkle, Richard <richard_mccorkle@fws.gov>;

McCloskey, John <john_mccloskey@fws.gov>; Norman, Janet <janet_norman@fws.gov>; scott.smith@dgif.virginia.gov <scott.smith@dgif.virginia.gov>; John Copeland <john.copeland@dwr.virginia.gov>; Michael Pinder <Mike.Pinder@dwr.virginia.gov>
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ENGINEERING & SCIENCE
further insight.

--

Scott M. Smith

Regional Fisheries Manager

P **434**.525.7522 / M **434**.907.2793

Virginia Department of Wildlife Resources

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