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Via Electronic Filing   January 18, 2021

Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
888 First Street, N.E.
Washington, D.C. 20426

Subject: Byllesby-Buck Hydroelectric Project (FERC No. 2514-186)
Filing of Initial Study Report and Schedule for Virtual ISR Meeting

Dear Secretary Bose:

Appalachian Power Company (Appalachian or Licensee), a unit of American Electric Power (AEP), is the Licensee, owner, and operator of the two-development Byllesby-Buck Hydroelectric Project (Project) (Project No. 2514), located on the upper New River in Carroll 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.

Appalachian developed a Revised Study Plan (RSP) for the Project that was filed with the Commission and made available to stakeholders on October 18, 2019. On November 18, 2019 FERC issued the Study Plan Determination (SPD). On December 18, 2019, Appalachian filed a request for rehearing of the SPD. The SPD was subsequently modified by FERC by an Order on Rehearing dated February 20, 2020.

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. These delays pushed the start of the 2020 field season into early August 2020 and resulted in some of the spring and summer 2020 field work being rescheduled for 2021. 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 18, 2021.

During the restricted 2020 field season, Appalachian has conducted studies in accordance with 18 CFR §5.15, as provided in the RSP and as subsequently modified by FERC's SPD. In accordance with 18 CFR §5.15, Appalachian is hereby filing the ISR with the Commission. The ISR describes the Licensee's overall progress in implementing the study plan and schedule, summarizes available data, and describes any variances from the study plan and schedule approved by the Commission.

The Commission's regulations at 18 CFR §5.15(c) require Appalachian to hold a meeting with participants and FERC staff within 15 days of filing the ISR. **Accordingly, Appalachian will hold an ISR Meeting via Webex from 10 AM to 3 PM on Thursday, January 28, 2020.** An agenda for the ISR Meeting is provided in Attachment 2. Participants are free to join the meeting in part based on interests or availability, but please note that the agenda is intended as an approximation and more or less time may be spent on individual studies, as needed.

Appalachian respectfully requests that the stakeholders interested in participating in the Virtual ISR Meeting contact Maggie Yayac at maggie.yayac@hdrinc.com on or before close of business Tuesday, January 26, 2021 to obtain instructions to join the virtual meeting.

If there are any questions regarding this progress report, please do not hesitate to contact me at (540) 985-2441 or via email at ebparcell@aep.com.

Sincerely,

Elizabeth Parcell
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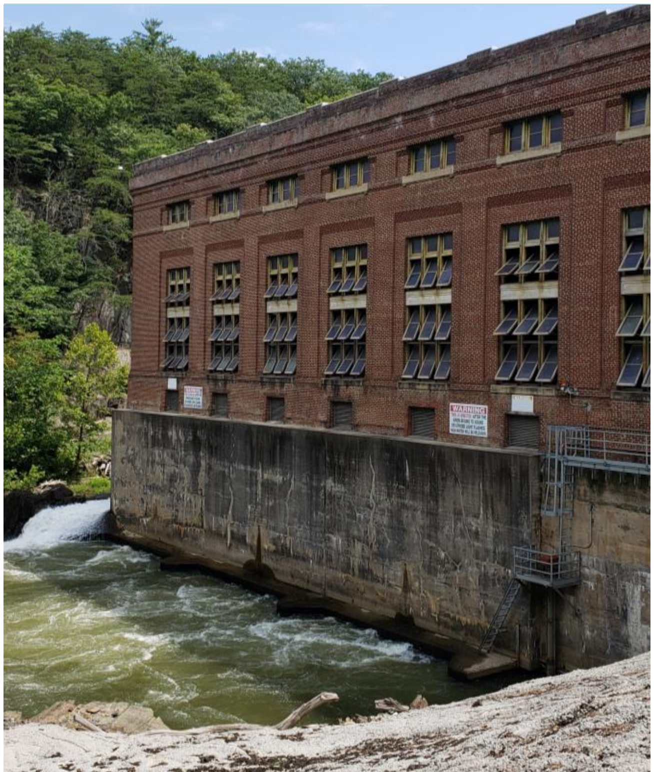

Initial Study Report

Byllesby-Buck Hydroelectric Project (FERC No. 2514)

January 18, 2021

Prepared by:

HDR

Prepared for:

Appalachian Power Company

APPALACHIAN POWER
An AEP Company
BOUNDLESS ENERGY

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Acronyms and Abbreviations

2-D	two-dimensional
Appalachian or Licensee	Appalachian Power Company
AEP	American Electric Power
APE	Area of Potential Effects
CFR	Code of Federal Regulations
cfs	cubic feet per second
DO	dissolved oxygen
EDGE	Edge Engineering and Science, LLC
EPRI	Electric Power Research Institute
FERC or Commission	Federal Energy Regulatory Commission
ft	foot/feet
fps	feet per second
GIS	Geographic Information System
HDR	HDR Engineering, Inc.
HSC	Habitat Suitability Criteria
Hydrolab	Hach Hydrolab® MS5
ICM	Integrated Catchment Model
ILP	Integrated Licensing Process
ISR	Initial Study Report
LPDA	Land Planning Design Associates
m	meter
mg/l	milligrams per liter
NOI	Notice of Intent
NRHP	National Register of Historic Places
PAD	Pre-Application Document
Project	Byllesby-Buck Hydroelectric Project
PM&E	protection, mitigation, and enhancement
PSP	Proposed Study Plan
RM	river miles
RSP	Revised Study Plan
SD	Scoping Document
SHPO	State Historic Preservation Office
SPD	Study Plan Determination
Stantec	Stantec Consulting Services, Inc.
Terracon	Terracon Consultants, Inc.
USR	Updated Study Report
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VDEQ	Virginia Department of Environmental Quality
VDHR	Virginia Department of Historic Resources
VDWR	Virginia Department of Wildlife Resources
YES	Young Energy Services

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1 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 two-development Byllesby-Buck Hydroelectric Project (Project) (Project No. 2514), located on the upper New River in Carroll County, Virginia. The Project is located approximately 60 miles south-southwest of the city of Roanoke. The Byllesby development is located about 9 miles north of the city of Galax, and the Buck development is located approximately 3 river miles (RM) downstream of Byllesby and 43.5 RM upstream of Claytor Dam.

The Project is currently licensed by the Federal Energy Regulatory Commission (FERC or Commission). The Project underwent relicensing in the early 1990s, including conversion to run-of-river operations and incorporating additional protection, mitigation, and enhancement (PM&E) measures. The current operating license for the Project expires on February 29, 2024. Accordingly, Appalachian is pursuing a subsequent license for the Project pursuant to the Commission's Integrated Licensing Process (ILP), as described at 18 Code of Federal Regulations (CFR) Part 5.

In accordance with 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 October 18, 2019. On November 18, 2019 FERC issued the Study Plan Determination (SPD). On December 18, 2019, Appalachian filed a request for rehearing of the SPD. The SPD was subsequently modified by FERC by an Order on Rehearing dated February 20, 2020.

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 18, 2021. These delays pushed the start of the 2020 field season into early August 2020 and resulted in some of the spring and summer 2020 field work being rescheduled for 2021. FERC letters of correspondence are included in Attachment 1.

Appalachian has conducted studies in accordance with 18 CFR §5.15, as provided in the RSP and as subsequently modified by FERC. This ISR describes the Licensee's overall progress in implementing the study plan and schedule, the data collected, and any variances from the study plan and schedule.

The Commission's regulations at 18 CFR §5.15(c) require Appalachian to hold a meeting with participants and FERC staff within 15 days of filing the ISR. Accordingly, **Appalachian will hold an ISR Meeting via Webex from 10 AM to 3 PM on January 28, 2021.** An agenda for the ISR Meeting is provided in Attachment 2. Participants are free to join the meeting in part based on interests or availability, but please note that the agenda is intended as an approximation and more or less time may be spent on individual studies, as needed.

Appalachian respectfully requests that those planning on joining the ISR Webex Meeting RSVP by emailing Maggie Yayac at maggie.yayac@hdrinc.com on or before close of business Tuesday, January 26, 2021. Additional information, including instructions to join the virtual meeting, will be provided in response to the RSVP.

1.2 Background

On January 7, 2019, Appalachian initiated the ILP by filing a Pre-Application Document (PAD) and Notice of Intent (NOI) with the Commission. Major ILP milestones to-date are presented in Table 1-1.

Table 1-1. Major ILP Milestones Completed

Date	Milestone
January 7, 2019	Appalachian Filed NOI and PAD (18 CFR §5.5, 5.6)
March 8, 2019	FERC Issued Notice of PAD/NOI and Scoping Document 1 (SD1) (18 CFR §5.8(a))
April 10-11, 2019	FERC Conducted Scoping Meetings and Site Visit (18 CFR §5.8(b) (viii))
May 7, 2019	Stakeholders Submitted Comments on the PAD, SD1, and Study Requests (18 CFR §5.9)
June 21, 2019	FERC Issued Scoping Document 2 (SD2) (18 CFR §5.10)
June 21, 2019	Appalachian Filed Proposed Study Plan (PSP) (18 CFR §5.11(a))
July 21, 2019	Appalachian Held Study Plan Meeting (18 CFR §5.11(e))
September 9, 2019	Stakeholders Submitted Comments on the PSP (18 CFR §5.12)
October 19, 2019	Appalachian Filed RSP (18 CFR §5.13(a))
November 3, 2019	Stakeholders Submitted Comments on the RSP (18 CFR §5.13(b))
November 18, 2019	FERC Issued the SPD (18 CFR §5.13(c))
July 27, 2020	Appalachian Submitted First Quarterly Report, ILP Study Update, and Request for Extension of Time File ISR
August 10, 2020	FERC Issued Order Granting Appalachian Extension of Time and Filing of ISR
August – November 2020	Appalachian Conducted First Season of Field Studies (18 CFR §5.15(a))
October 27, 2020	Appalachian Submitted Second Quarterly Progress Report (18 CFR §5.15(b))
December 23, 2020	FERC Issued Scoping Document 3 (SD3)
January 18, 2021	Appalachian Submitted ISR (18 CFR §5.15(c)(1))

Appalachian has continued consultation with stakeholders regarding approved studies as required by the Commission's SPD. In accordance with the schedule presented in the RSP, Appalachian has also provided stakeholders with Quarterly ILP Study Progress Reports that include a description of study activities conducted during the previous quarter, activities expected to occur in the next quarter, and identified variances from the approved study plan. The next quarterly progress report is expected to be filed with FERC in April 2021.

1.3 Study Plan Development and Implementation

On November 18, 2019, the Commission issued the SPD for the Project. The SPD directed Appalachian to conduct eight studies:

1. Bypass Reach Flow and Aquatic Habitat Study
2. Water Quality Study
3. Aquatic Resources Study
4. Wetlands, Riparian, and Littoral Habitat Characterization Study

5. Terrestrial Resources Study
6. Shoreline Stability Assessment Study
7. Recreation Study
8. Cultural Resources Study

Section 2 of this ISR describes Appalachian's overall progress in implementing the study plan and schedule, the data collected, and any variances from the study plan and schedule, including those previously reported by Appalachian in the ILP quarterly progress reports (July 27, 2020 and October 27, 2020). Technical reports for studies that have been completed or partially completed are included as appendices to this ISR. Note that the Cultural Resources Study Report (Appendix E) is being filed separately as Privileged pursuant to 18 CFR § 388.112(b) because this report contains information regarding the specific location and nature of historic and archaeological resources, which is not for public disclosure. Studies that have not yet commenced are discussed briefly in Section 2 and study reports will be included in the Updated Study Report (USR).

1.4 Proposals to Modify Ongoing Studies or for New Studies

At this time, Appalachian is not proposing any modifications to the studies approved and modified in the Commission's November 18, 2019 SPD or any new studies. Minor variances to the study plans have been previously reported in the ILP quarterly progress reports (July 27, 2020 and October 27, 2020) and are detailed in the sections that follow, as well as within the individual study reports provided as appendices.

2 Status and Summaries of Studies

This section describes Appalachian's overall progress in implementing the study plan and schedule, the data collected, and any variances from the study plan and schedule. Study methods and available study results are summarized for each of the eight studies approved in the Commission's SPD. An updated schedule for completed and remaining study activities is included in Table 2-1.

Table 2-1. Updated Study Schedule for the Byllesby-Buck Project (FERC No. 2514)

Study	Activities	Approved Timeframe for Completion (RSP and SPD)	July 2020 update	January 2021 update
Bypass Reach Flow and Aquatic Habitat Study	Topographic Mapping and Photogrammetry Data Collection	Fall 2019	Completed (January 2020)	Completed (January 2020)
	Desktop Habitat Assessment	November 2019 – March 2020	July – August 2020	Completed (August 2020)
	Mesohabitat Mapping and Substrate Characterization Field Data Collection	Summer 2020	August – September 2020	Buck Completed (September 2020) Byllesby June – August 2021
	Distribute Proposed Flow Test Scenario Framework to Interested Parties for Review	May 2020	August 2020	Completed (August 2020)
	Conduct Flow and Water Level Assessment and Hydraulic Modeling	June – October 2020	July – December 2020	Buck Completed (December 2020) Byllesby June – December 2021
	Distribute Draft Study Report with the ISR/USR	November 2020	January 2021	ISR Completed (January 2021) USR December 2021
Water Quality Study	Study Planning and Existing Data Review	January – March 2020	July 2020	Completed (July 2020)
	Continuous and Monthly Water Quality Monitoring (Dissolved Oxygen and Temperature)	May – September 2020	Late July* – September 2020 * Conditioned on completion of reinstallation of flashboards tripped during May 2020 high flow event	Buck Completed (August - October 2020) Byllesby July – September 2021
	Turbidity Monitoring Study	June – August 2020	August – September 2020	July – September 2021
	Distribute Draft Study Report with the ISR/USR	November 2020	January 2021	ISR Completed (January 2021) USR December 2021

Study	Activities	Approved Timeframe for Completion (RSP and SPD)	July 2020 update	January 2021 update
Aquatic Resources Study	Desktop Literature Review	January – March 2020	July – August 2020	Completed (August 2020)
	Macroinvertebrate and Crayfish Community Study	March – August 2020	August – September 2020 (target September), April – May 2021	Completed (October 2020) April – May 2021
	Fish Community Study	April – September 2020	September 2020, April – May 2021	Boat Electrofishing and Gill Netting Completed (September - October 2020) Boat, Backpack, and Gill Netting Scheduled for Spring 2021 (April – May 2021)
	Mussel Community Study	April – September 2020	August – September 2020	Completed (September - October 2020)
	Desktop Impingement and Entrainment Evaluation and Turbine Blade Strike Analysis	August – November 2020	September – December 2020	Impingement and Entrainment Evaluation Completed (December 2020) Turbine Blade Strike Analysis (July 2021)
	Distribute Draft Aquatic Resources Study Report with the ISR/USR	November 2020	January 2021/November 2021	ISR Completed (January 2021) USR December 2021
Wetlands, Riparian, and Littoral Habitat Characterization	Desktop Mapping of Wetland, and Riparian, and Littoral Habitats	January – March 2020	February – April 2021	February – April 2021
	Field Verification of Preliminary Maps and Wetland Delineations and Riparian and Littoral Habitat Characterizations	August 2020 – September 2020	Late July – August 2021	Late July – August 2021
	Distribute Draft Study Report with the USR	November 2020	November 2021	November 2021
Terrestrial Resources Study	Desktop Mapping and Study Planning	February – March 2020	February – April 2021	February – April 2021
	Field Verification	April – July 2020	April – July 2021	April – July 2021
	Distribute Draft Study Report with the USR	November 2020	November 2021	November 2021

Study	Activities	Approved Timeframe for Completion (RSP and SPD)	July 2020 update	January 2021 update
Shoreline Stability Assessment Study	Study Planning and Data Review	January – March 2020	February – April 2021	February – April 2021
	Shoreline Survey and Determination of Areas Potentially Needing Remediation	April – July 2020	April – July 2021	April – July 2021
	Distribute Draft Study Report with the USR	November 2020	November 2021	November 2021
Recreation Study	Study Planning and Existing Data Review	November 2019 – March 2020	Completed (November 2019)	Completed (November 2019)
	Trail Camera Data Collection	November 2019 – November 2020	November 2019 – November 2020	Completed (November 2020)
	Recreation Facility Inventory and Condition Assessment	November – December 2019	Completed (November 2019)	Completed (November 2019)
	Stakeholder Site Visit/Meeting	April 2020	October – November 2020*	Completed (October 2020)
	Recreation Visitor Use Online Survey	April – October 2020	April – October 2020	Completed (October 2020)
	Distribute Draft Study Report with the ISR	November 2020	January 2021	Completed (January 2021)
Cultural Resources Study	Determination of Area of Potential Effect (APE)	January – June 2020	July – September 2020	Completed (September 2020)
	Background Research and Archival Review	January – June 2020	August 2020 – November 2020	Completed (September 2020)
	Phase I Reconnaissance Survey of APE	May – October 2020	April – July 2021	Completed (October 2020)
	Inventory of Traditional Cultural Properties	October 2019 – October 2020	August 2020 – August 2021	August 2020 – August 2021
	Review and Updates to the Existing CRMP	November 2020	November 2021	November 2021
	Distribute Draft Study Report with the ISR/USR	November 2020	November 2021	ISR Completed (January 2021) USR December 2021

2.1 Bypass Reach Flow and Aquatic Habitat Study

2.1.1 Study Status

Appalachian has partially completed the Bypass Reach Flow and Aquatic Habitat Study in accordance with the RSP and the Commission's SPD. The technical report including the preliminary results of the Bypass Reach Flow and Aquatic Habitat Study is included in Appendix A.

2.1.2 Summary of Study Methods

In accordance with the RSP approved and modified in the Commission's SPD, Appalachian's consultant, HDR Engineering, Inc. [HDR], conducted a Bypass Reach Flow and Aquatic Habitat Study to:

- Delineate and quantify aquatic habitats and substrate types in the Byllesby and Buck bypass reaches.
- Identify and characterize locations of habitat management interest located within each bypass reach.
- Develop an understanding of surface water travel times and water surface elevation responses under variable base flow and spillway release flow combinations in the tailrace and bypass reach of each development to:
    - Demonstrate the efficacy of existing ramping rates required by the existing license.[1]
    - Demonstrate the efficacy of the existing powerhouse minimum flow requirement (i.e., 360 cubic feet per second [cfs] minimum flow to maintain aquatic resources, including resident fish species, downstream of each development consisting of the tailrace areas below each powerhouse and the bypass reaches below the main spillways).
    - Evaluate the impacts of providing seasonal minimum flows to the bypass reaches.

HDR reviewed the hydrologic record for the Project study reaches, spillway and trash sluice gate operating procedures and design capacity, existing topographic and geologic maps, and available recent and historical aerial imagery. Light detection and ranging data were collected to support development of comprehensive three-dimensional elevation and visual surface layers of the bypass reach. These data were used for desktop mesohabitat mapping of each bypass reach according to substrate size (e.g., sand, gravel, cobble, etc.), cover (e.g., no cover, overhead vegetation, etc.), and mesohabitat types (e.g., pools, riffles, runs, bedrock, shoals). The topographic information was then incorporated as a Geographic Information System (GIS) base layer to support field data collection and hydraulic modeling efforts.

[1] In accordance with existing FERC spillway gate operating requirements for the Buck development, Appalachian discharges flows through a 2-foot (ft) gate opening for at least three hours following any spills released through a gate opened 2 ft or more. Appalachian must then reduce the opening to 1 ft for at least an additional three hours, after which time the gate may be completely closed. The gradual reduction of flow allows time for fish to respond to the receding water levels, thus avoiding stranding that can occur with sudden flow discontinuation.

In 2020, field data was collected to support development of a two-dimensional (2-D) hydraulic model of the Buck tailrace and bypass reach. The hydraulic model is based on the Innovyze Infoworks Integrated Catchment Model (ICM) software (version 7.0), which is capable of simulating depth and velocities in a 2-D grid pattern over a wide range of flow conditions. Target model calibration/validation flows were released into the Buck bypass reach in September 2020 for purposes of collecting depth, water surface elevations, velocities, and wetted area data under various bypass flow regimes. For the Buck development, the target flow scenarios were designed to evaluate the effect of the existing ramping rate requirements. A detailed description of the Buck bypass reach ICM model development process and results is provided in Attachment 1 of the Bypass Reach Flow and Aquatic Habitat Study report (Appendix A).

Similar field data collection efforts under a range of proposed target flows will be conducted in the Byllesby bypass reach in 2021. For the Byllesby development, the target flow scenarios are designed to evaluate the effect of passing the entire minimum downstream flow requirement of 360 cfs through the bypass reach.

The mesohabitat mapping results and the 2-D model depth and velocity simulation results will be used in combination with aquatic species habitat suitability criteria (HSC) (i.e., using depth, velocity, and habitat preferences) to evaluate potential available aquatic habitat in each tailrace and bypass reach under each modeled flow scenario. Walleye was selected as a standalone target species for this study along with a total of eight species-guild representatives including three shallow-slow, one shallow-fast, two deep-slow, and two deep-fast guilds. Guild representatives were selected from a variety of regionally representative sources, represent a wide range of habitat characteristics, and were selected to represent a wide range of species. Aquatic habitat model results will be used to evaluate potential aquatic habitat availability over a range of simulated flows for Walleye and the eight guild representatives [to be determined in consultation with U.S. Fish and Wildlife Service (USFWS) and Virginia Department of Wildlife Resources (VDWR)].

2.1.3 Summary of Study Results for the Buck Development

2.1.3.1 Aquatic Habitat and Substrate Types

The Buck bypass reach consists of a complex assemblage of aquatic habitat and substrate types, dominated by angular bedrock. The key difference between the Buck upper reach versus the middle to lower reaches is that the orientation of the bedrock slabs is parallel to the flow, which facilitates scour and sediment transport, while the middle to lower reaches are dominated by bedrock slabs oriented perpendicular to streamflow, which facilitates sediment deposition (on the downstream side of the slab). As a result, the Buck upper reach is approximately 50 percent bedrock while the middle to lower reaches, while still dominated by bedrock, contain more smaller-sized particles. The middle to lower transects display zones of sediment deposition and lower-velocity shelters, which create a variety of aquatic habitat for a wider range of aquatic species and lifestages.

2.1.3.2 Surface Water Travel Times and Water Surface Elevation Responses

Flow releases from the right (looking downstream) side of the Buck spillway structure (via Tainter and/or Obermeyer gates) generally travel across the bypass reach toward the apex of the channel bend along the left descending bank. From there, the main flow path is along the left descending bank to the end of the bypass reach. As a result, water surface elevations spanning a large area of the upper bypass reach along the toe of the spillway from the center of the channel to the left abutment were not affected by the target flow releases. This is due to a large island of higher topography in this area. Bypass reach flow travel time (from the spillway to the downstream end of the reach) ranged from approximately 2 hours and 30 minutes at the low flow releases (i.e., 210.7 cfs) to approximately 1 hour at the high flow releases (i.e., 714 cfs). Depths increased approximately 1.0 - 1.5 ft (from leakage conditions) along the main flow path at the low flow release and were approximately 2.5 ft deeper at the high flow release.

2.1.3.3 Identify and Characterize Locations of Habitat Management Interest

The upper portion of the channel along the left descending bank is considered an area of concern from a potential fish stranding perspective. Two level loggers were placed along this channel to evaluate potential impacts to water surface elevations resulting from spillway gate operations. Several large rainfall runoff events occurred during the level logger deployment and it was determined that bypass reach flows need to reach at least 6,500 cfs to affect water surface elevations along this upper side-channel area. As a result, the existing ramping rate requirements have little to no effect on the upper portion of the left descending channel.

2.1.3.4 Efficacy of Existing Ramping Rate Requirements

During the target flow field measurements, level loggers captured the impact that the existing ramping rate requirements (described in Section 2.1.2, footnote 1) have on bypass reach water surface elevations. The decrease in water surface elevation from a 2-ft gate opening to a 1-ft gate opening was approximately 0.5 ft in the main flow path. From a 1-ft gate opening to a closed position, the water surface decreased an additional 1.5 – 2.0 ft in the main flow path. The seemingly disproportionate change in depth from a 2-ft to 1-ft gate opening, and a 1-ft to closed position is likely the result of the dominant bypass reach substrate type which is angled bedrock. These bedrock slabs block and trap flows in the bypass channel and their effect on water surface elevations is more pronounced at lower flows.

2.1.3.5 Efficacy of Existing Powerhouse Minimum Flow Requirement

The current FERC authorized minimum downstream flow requirement for the Project is 360 cfs. A review of the hydrologic record at the U.S. Geological Survey (USGS) 03165500 New River at Ivanhoe, Virginia flow gaging station from 1996 – 2020 determined that the minimum downstream flow requirement is rarely triggered, but did occur during this 25-year period of record in August 2002 (over a 6-day period) and August 2008 (over an 8-day period), corresponding to the two most severe droughts on record.

When the minimum downstream flow requirement is triggered, Project inflows at the Byllesby development are passed downstream to the bypass reach either via the trash sluice gate and/or one of the Tainter or Obermeyer gates. At the Buck development, the minimum flow can be passed through the trash sluice gate into the tailrace and/or through a Tainter or Obermeyer gate into the bypass reach. Because the minimum downstream flow requirement is rarely triggered and typically occurs only during August for about a week at a time, the effect on aquatic habitat is likely negligible at both the Byllesby and Buck developments.

2.1.3.6 Evaluate the Impacts of Seasonal Minimum Flows

Seasonal minimum flows were evaluated using the habitat modeling results provided in Attachment 3 of the Bypass Reach Flow and Aquatic Habitat Study (Appendix A) for the various habitat guilds and standalone Walleye species/lifestages. Spawning lifestages were of particular interest since there is a seasonal component to this lifestage.

Redbreast Sunfish spawning lifestage was used as one of the representative species for the Shallow-Slow Guild. The amount of potential spawning habitat available is similar under all four modeled flow scenarios (i.e., 17.1 cfs, 210.7 cfs, 354 cfs, and 714 cfs). The difference between modeled scenarios is the location of the potential habitat shifts from the main flow path under lower flow conditions to the stream margins, backwater areas, and behind velocity shelters created by rock outcrops as flows in the bypass reach increase.

Potential Walleye spawning habitat was also modeled for the four target flow scenarios. While the highest modeled flow (714 cfs) produced a minimal amount of potential habitat along the left descending channel in the lower portion of the bypass reach, the largest area of potential habitat is located just downstream of the tailrace/bypass reach confluence. Powerhouse flows of at least 2,700 cfs created the largest amount of potential available habitat in the area immediately below the confluence.

As a result, seasonal minimum flows in the bypass reach are not likely to provide a significant amount of additional available habitat for the target species/lifestages of interest.

2.1.4 Variances from FERC-Approved Study Plan

To date, the study has been conducted in accordance with the FERC-approved RSP, with the exception of the following variance:

- As a result of the delay to the start of the 2020 field season, higher than normal seasonal flow conditions in the New River, a broken section of spillway bay flashboards, and temporarily reduced unit generation capability at the Byllesby powerhouse, the Bypass Reach Flow and Aquatic Habitat Study fieldwork for the Byllesby development was postponed until 2021. Therefore, only the desktop habitat mapping results, proposed target flows (for the 2-D ICM model calibration/validation), and HSC information are provided in the preliminary study report (Appendix A) for the Byllesby development.

2.2 Water Quality Study

2.2.1 Study Status

Appalachian has partially completed the Water Quality Study in accordance with the RSP and the Commission's SPD. The technical report including the preliminary results of the Water Quality Study is included in Appendix B.

2.2.2 Summary of Study Methods and Results

In accordance with the RSP approved and modified in the Commission's SPD, HDR conducted a Water Quality Study to:

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

- Provide data (temperature and dissolved oxygen [DO] concentration) to determine the presence and extent, if any, of thermal or DO stratification in the Byllesby and Buck impoundments.
- Provide data to support a Virginia Water Protection Permit application (Clean Water Act Section 401 Certification).
- Provide information to support the evaluation of whether additional or modified PM&E measures may be appropriate for the protection of water quality at the Project's developments.

HDR deployed water quality instruments (i.e., DO and water temperature sondes) at Buck the week of August 17, 2020. This same week, due to high flow conditions and continuous flow release at the dam through the damaged flashboard section throughout Q3 2020, water quality instrumentation at Byllesby was only installed at the tailrace location. Therefore, there were five locations monitored at the Buck development (two locations in the forebay [one near surface and the other near bottom], one location in the tailrace, two locations in the bypass reach [upstream and downstream] and one location at the Byllesby development (one location in the tailrace). During the initial deployment and subsequent download events, discrete multi-parameter water quality measurements of temperature, DO concentration, pH, and specific conductivity were collected at each monitoring location using a Hach Hydrolab® MS5 (Hydrolab). For the tailrace and bypass reach monitoring locations, Hydrolab water quality data were collected at one location within the water column at a depth similar to the sondes. Profile data were collected at 1-ft intervals[2] using the Hydrolab for the Buck forebay monitoring location to document temperature and DO stratification at the time of the data sonde downloads. Discrete water quality data collections occurred concurrent with deployment and downloads of the continuous data loggers.

Data were downloaded from instrumentation at Buck during the field efforts from September 8 - 10, 2020, and at Byllesby and Buck from October 7 – 8, 2020, after which time data collection instruments were removed per the schedule in the RSP. Field staff downloaded data from sondes at each monitoring location using a data shuttle or directly to a laptop computer. Sondes were cleaned, checked for operation, calibration, and battery life; and adjusted as necessary based on manufacturer's specifications.

Continuous and discrete water temperature data at the forebay and tailrace locations at Buck are provided in the Preliminary Water Quality Study Report in Appendix B. Water temperatures at these locations were similar to those recorded at the Byllesby tailrace. The Buck forebay and tailrace monitoring locations were within 0.5ºC of each other for most of the study period, which is reflective of run-of-river operations. In the Buck bypass reach, daily temperature fluctuations at the downstream monitoring location were approximately twice that observed at the upstream monitoring location. While both monitoring locations are in relatively small pools, the upstream location is shaded more of the day compared to the downstream location, thus daily temperature cycles at the upper location are lower in magnitude.

[2] During the August 17, 2020 water quality sampling event, profile data were collected at 2-ft intervals; a 1-ft interval was used during subsequent water quality sampling events.

Continuous and discrete DO concentration data at the Buck forebay and tailrace monitoring locations are also included in Appendix B. All measurements were greater than the 5.0 mg/l daily average DO standard. Daily fluctuations in DO concentrations were less than 1.0 mg/l during the study except for September 4 – 11 when the daily fluctuation increased to the 1.0 – 2.0 mg/l range at the forebay monitoring locations[3]. Similar to water temperature, there is little (i.e., typically < 1.0 mg/l) to no difference in DO concentrations between the forebay surface and bottom locations; indicating little to no stratification of DO concentrations throughout the forebay water column. DO concentrations in the tailrace were generally higher (by up to 1.0 mg/l) compared to the forebay monitoring locations. This suggests that unit generation and the trash sluice gate operation increase aeration into the tailrace. Tailrace concentrations typically fluctuated approximately 0.25 mg/l between day and night. All Buck bypass reach DO concentrations were greater than the 5.0 mg/l daily average DO standard with daily fluctuations of up to 1.0 mg/l for the upstream location and up to 3.0 mg/l at the downstream location. DO concentrations are influenced by water temperatures and because the upstream monitoring location is shaded more of the day (compared to the downstream monitoring location), thus the daily fluctuation in DO concentrations is less at the upstream location.

At the Buck forebay monitoring location, the variation in pH (measured in standard units) was very small (between 7.3 and 7.7) and there was little to no stratification between the reservoir surface and bottom measurements. Discrete pH measurements at each monitoring location during the initial instrument deployment and two download events were between 7.2 and 8.9 which meets the state water quality standard.

Specific conductivity at the Buck forebay monitoring location varied each sampling event, but concentrations were typically the same from reservoir surface to bottom and ranged from 53 – 61 microsiemens per centimeter over three sampling events during the study period. While there is no state standard for specific conductivity, concentrations less than 500 microsiemens per centimeter are generally considered to be suitable for aquatic species in southern Appalachian streams (USEPA 2020). These results are consistent with specific conductivity measurements during the August 29, 2019 site visit and the results of other nearby historic studies and data collection efforts (NWQMC 2020; Stantec 2016) indicating a long-term, relatively consistent range of conductivity in the Project area.

Overall, water quality data collected during the August 29, 2019 site visit (at Byllesby and Buck) and 2020 study period (at Buck) indicated little to no thermal or DO stratification at the forebay monitoring locations. Water temperatures typically varied less than 0.5ºC from reservoir surface to bottom and DO concentrations typically varied less than 1.0 mg/l from reservoir surface to bottom. While the data sondes were not deployed until August 17, 2020, water temperature and DO concentrations were typical of warmer summer conditions[4]. Therefore, additional water quality data collection at Buck in 2021 would not likely yield significantly different results.

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[3] Flows recorded at the Ivanhoe USGS flow gaging station from September 4 – 11, 2020 were relatively low and stable (compared to the weeks preceding and following) which likely contributed to slightly increased fluctuations in DO concentrations during this period. Flows recorded at the Ivanhoe USGS flow gaging station are shown on Figure 4-1 of Attachment 4.

[4] Figure 4-2 of Attachment 4 provides a comparison of air temperature data at Fries and Ivanhoe, Virginia beginning approximately one month prior to (i.e., mid-July 2020) the water quality data sonde installation in mid-August 2020.

Based on the results of this water quality study, and in consideration of results of other nearby historic studies and data collection efforts, there is no need for additional PM&E measures to protect water quality at the Project.

2.2.3 Variances from FERC-Approved Study Plan

Appalachian expects to evaluate the need for additional data collection at the Byllesby-Buck Project in 2021 in the ISR and at the ISR meeting. Water Quality monitoring locations that have not been surveyed and are therefore variances from the RSP include:

- One location in the upstream extent of the Byllesby reservoir
- Two locations in the Byllesby forebay (upper and lower portion of the water column)
- One location in the Byllesby bypass reach (approximate mid-point)

It is anticipated that water quality data collection efforts will need to be repeated at Byllesby in 2021 with the full deployment of data sondes as proposed in the RSP (including the tailrace monitoring location which was sampled during the 2020 study period). The proposed deployment would be from July through September to capture the warmer, typically lower flow, summer months.

In addition, the RSP included the collection of chlorophyll a grab samples at a single depth of approximately one meter in the forebay of each development during the monthly discrete water quality sampling events[5]. Since forebay water quality monitoring was not conducted at the Byllesby development in 2020, chlorophyll a sampling in the Buck forebay was also delayed such that samples from both forebay monitoring locations would be collected during the same year. Therefore, monthly chlorophyll a grab samples will be collected at both the Buck forebay and Byllesby forebay monitoring locations during the same months (i.e., July, August, and September) in 2021.

Lower flow conditions are necessary to evaluate potential changes in turbidity levels that are the result of Project operations (i.e., and not caused by high background turbidity levels associated with rainfall runoff events and high baseflow conditions). Due to higher than normal Project inflows from the New River watershed in Q3 2020, the turbidity study will need to be rescheduled to Q2 or Q3 2021 which will allow data collection efforts to target conditions that are more representative of typical station operations during lower flows.

2.3 Aquatic Resources Study

The Preliminary Aquatic Resources Study consists of four separate studies prepared by HDR and Appalachian's sub-consultants (Edge Engineering and Science, LLC [EDGE] and Stantec Consulting Services, Inc. [Stantec]):

1. 2020 Fish Community Survey
2. Preliminary Fish Impingement and Entrainment Study
3. 2020 Macroinvertebrate and Crayfish Community Survey

Meteorological conditions in mid-August 2020 were similar to the prior month supporting the conclusion that water temperature and DO concentrations were typical of warmer summer conditions.

[5] The chlorophyll a grab samples will be analyzed at an off-site laboratory.

4. Freshwater Mussel Survey

These studies are included as Attachments 1 through 4 of the Preliminary Aquatic Resources Study Report provided in Appendix C.

2.3.1 Study Status

HDR with support from EDGE and Stantec have partially completed the Aquatic Resources Study in accordance with the RSP and the Commission's SPD. The technical reports including the preliminary results of each of the four studies comprising the Aquatic Resources Study is included in Appendix C.

Due to restrictions on non-essential travel and safety considerations in response to the COVID-19 pandemic, the spring and summer 2020 field sampling activities could not be completed as scheduled and the start of fall 2020 sampling activities was delayed. A summary of the study status for each of the four studies is provided below.

2.3.1.1 2020 Fish Community Survey

EDGE has partially completed the Fish Community Survey in accordance with the RSP and the Commission's SPD. Due to restrictions on non-essential travel and safety considerations in response to the COVID-19 pandemic, the spring 2020 field sampling activities could not be completed as scheduled and were rescheduled for spring 2021. Periodic weather delays and resulting unsafe stream conditions impacted the fall 2020 fish sampling efforts. Boat electrofishing and gill net sampling was completed during fall 2020, but the ongoing weather delays resulted in the fall 2020 backpack electrofishing methods being rescheduled for spring 2021. The technical report including the results of the fall 2020 sampling activities for the Fish Community Study is included in Attachment 1 of Appendix C.

2.3.1.2 Preliminary Impingement and Entrainment Study

HDR has partially completed the Fish Impingement and Entrainment Study in accordance with the RSP and the Commission's SPD. A preliminary assessment of entrainment and impingement potential at each of the Project developments has been completed; final results will be provided in the USR. A turbine blade strike evaluation will also be performed using the most recent version available of the USFWS Turbine Blade Strike Analysis Model, mean and standard deviation of fish lengths based on fish data collected during the 2020-2021 Fish Community Study, and site-specific inputs for required model parameters, as summarized in Attachment 2 of Appendix C.

2.3.1.3 2020 Macroinvertebrate and Crayfish Community Survey

Edge has partially completed the study activities for the Benthic Aquatic Resources Study in accordance with the RSP and the Commission's SPD. Due to delays related to weather and the COVID-19 pandemic, the spring 2020 sampling effort was rescheduled for the spring 2021 index period (March 1 – May 31) and will be completed at the same sites sampled during the fall index period (September 1 – November 30). The preliminary technical report includes study information based on fall 2020 sampling activities for the Benthic Aquatic Resources Study (Attachment 3 of Appendix C).

2.3.1.4 Freshwater Mussel Community Study

Stantec has completed all components of the Freshwater Mussel Survey in accordance with the RSP and the Commission's SPD; the study report is provided as Attachment 4 of Appendix C.

2.3.2 Summary of Study Methods and Results

In accordance with the RSP approved and modified in the Commission's SPD, HDR conducted an Aquatic Resources Study to:

- Collect a comprehensive baseline of the existing fish, mussel, crayfish, and benthic macroinvertebrate communities in the Project vicinity.
- Compare current aquatic resources data to historical data to determine any significant changes to species composition, abundance, or distribution.
- Confirm flow velocities at the intake structure to facilitate a desktop assessment of entrainment and impingement potential at Byllesby and Buck dams.
- Perform a desktop assessment of entrainment and impingement potential at the Byllesby and Buck intake structures including an assessment of mortality and survival of fish passage through turbines or other routes using the USFWS Turbine Blade Strike Analysis Model.

2.3.2.1 2020 Fish Community Survey

Boat electrofishing surveys were conducted between October 22, 24, and 25 and gillnet surveys were conducted between November 9-11 and 18-20, 2020 following methods outlined in the RSP during relatively low flow and low turbidity stream conditions. Sampling was performed by state permitted fish biologists under Virginia Scientific Collecting Permit No. 068630. Specific sampling dates were based on factors including (but not limited to) weather conditions, water temperatures, river flows and reservoir elevations, and safety of field staff and the public.

Sampling methods were derived from the National Rivers and Streams Assessment Field Operations Manual (USEPA 2019), which guides standardized electrofishing methods in lotic waterbodies of variable sizes. Gillnet methods were established in coordination with the VDWR. Within the constraints of the study objectives and the Project's geographic limits, boat electrofishing and gillnetting techniques were employed to most-effectively target specific sites based on the habitat types present in the Project area. Boat electrofishing was used to target near-shore pool habitats (i.e., non-wadeable) and gillnetting was used to target mid-channel pool habitats. Seven boat electrofishing sites were located in the Byllesby Pool and 10 were located in the Buck Pool. Six gillnetting sites were located in the Byllesby Pool to target Walleye (*Sander vitreus*).

The study collected 207 fish representing 23 species; boat electrofishing methods captured 170 of those fish (20 species) and gillnet survey methods captured 37 (representing 7 species). Sampling efforts at the seven boat electrofishing sites in the Byllesby Pool yielded a combined fifteen species. The ten boat electrofishing sites surveyed in the Buck Pool also yielded fifteen species. In the Byllesby Pool, Bluegill (*Lepomis macrochirus*), Common Carp (*Cyprinus carpio*), and Redbreast Sunfish (*Lepomis auritus*) were the most abundant species (21.9% [N=28], 16.4% [N=21], and 14.8% [N=19], respectively). Common Carp, Channel Catfish, and Walleye were the most abundant species collected via gillnet surveys in the Byllesby Pool (38% [N=14], 30% [N=11], and 16% [N=6], respectively). In the Buck Pool, Whitetail Shiner (*Cyprinella galactura*), Smallmouth Bass (*M.*

dolomieu), and Redbreast Sunfish were the most abundant species (36.7% [N=29], 15.2% [N=12], and 12.7% [N=10], respectively). Common Carp, Channel Catfish (*Ictalurus punctatus*), and Flathead Catfish (*Pylodictis olivaris*) were the most dominant species by weight in the Byllesby Pool (66.6%, 10.8%, and 5.9%, respectively) and Smallmouth Bass, Redbreast Sunfish, and Bigmouth Chub (*Nocomis platyrhynchus*) were the most dominant species by weight in the Buck Pool (25.8%, 23.6%, and 15.8%, respectively). Representative site and fish photos and raw data for fish collections are provided in Attachment 1 of Appendix C.

2.3.2.2 Preliminary Impingement and Entrainment Study

HDR has partially completed the Fish Impingement and Entrainment Study in accordance with the RSP and the Commission's SPD; the study report is provided as Attachment 2 of Appendix C. Results from the 2020 Fish Community Study are incorporated into the impingement and entrainment study, therefore, results are subject to change after fish community sampling is completed in 2021. Additionally, the assessment of turbine mortality using the USFWS Turbine Blade Strike Analysis Model will be performed in 2021 following the completion of field sampling activities.

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

With consideration of site-specific facility characteristics and fishery information, detailed entrainment data from 33 sites included in the Electric Power Research Institute (EPRI) (1997) entrainment database were applied in this analysis. Entrainment data were standardized to the number of fish/hour of unit capacity based on the site-specific hydraulic capacity of the sampled units and the number of hours sampling occurred during each study from the database, and then used to calculate fish entrainment rates (fish/hour) at maximum design turbine discharge at the Project (5,868 cfs for the Byllesby development and 3,540 cfs for the Buck development).

Using the Byllesby intake opening structure dimensions, the calculated approach velocity in front of the intake is approximately 2.0 ft per second (fps) (i.e., 5,868 cfs/(143 ft x 14 ft x 1.5)). This approach velocity is similar to those presented in the historical entrainment report (Appalachian 1991). 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. Using the Buck intake opening structure dimensions, the calculated approach velocity in front of the intake structure is approximately 1.6 fps (i.e., 3,540 cfs/(104 ft x 14 ft x 1.5)).

Fish swim burst speeds obtained from literature 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. Although most species were considered of entrainable size (i.e., smaller than the 2.28- inch clear-spacing width of the trash racks at both Byllesby and Buck), it is likely that juvenile and adult fish can avoid the intake.

According to the EPRI (1997) database, fish measuring less than six inches in length were the majority (88 percent) of entrained fish, and fish less than eight inches exhibit the highest entrainment rates throughout the year. Rock Bass (*Ambloplites rupestris*), catfishes, suckers and redhorses, *Lepomis* sunfishes, and Black Crappie, Largemouth Bass, darters and logperch, and shiners, chubs, and minnows represent the top 90 percent of target species and species groups potentially susceptible to entrainment at the Byllesby and Buck developments. Peak months of entrainment for these species and species groups varied. Smallmouth Bass, Walleye, and Muskellunge (*Esox masquinongy*), 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. Peaking months may correspond to spawning movements (April), recruitment to catchable size (July or October), or large storm/flow events. 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.

While the greatest opportunity for fish mortality through a facility lies in potential contact with the turbine runner blades, injuries and mortalities can result from other mechanisms including extreme pressure changes, shear stress, water turbulence, cavitation, and grinding (Deng et al. 2005); however, the historical study (Appalachian 1991) determined that these factors are minimal at the Project. Since no significant changes have occurred at the facility that would change these parameters since the last relicensing, injuries and mortalities caused by factors other than turbine strikes are expected to be negligible.

In summary, the findings of this study concur with the historical entrainment study completed for the prior relicensing in that effects to the fish community in the Project vicinity are expected to be minimal. Most fish would not be excluded by the intake trash racks at Byllesby and Buck intake structures; however, velocities in front of the intakes are comparable to normal flow conditions of the New River and would therefore likely be navigable by most juvenile and adult fish in the area. Entrainment of early life stage fishes (eggs and larvae) is likely minimal given the life history characteristics of species in the vicinity of the Project. Susceptibility to entrainment is variable depending on species and time period, however most target species and species groups have low entrainment potential for most of the year.

2.3.2.3 2020 Macroinvertebrate and Crayfish Community Survey

Stantec conducted a Benthic Aquatic Resources Study to document a comprehensive representation of the Project area and to correlate with previous sampling efforts (Appalachian 1991) for comparison. Macroinvertebrate and crayfish sampling efforts targeted representative habitat at 16 sites throughout the Project area using sampling methods derived from the National Rivers and Streams Assessment Field Operations Manual and Virginia Department of Environmental Quality (VDEQ) Biological Monitoring Program Quality Assurance Project Plan and included quantitative and qualitative sampling methods that target different habitats (USEPA 2019; VDEQ 2008). Quantitative sampling methods targeted riffle/run habitats and qualitative sampling methods targeted available microhabitats in pools habitats. Sampling was performed by an EDGE state and federally permitted astacologist under Virginia Scientific Collecting Permit No. 068630. All macroinvertebrate sites were sampled between October 6 and 8, 2020 during the fall sample index period defined by VDEQ (September 1 – November 30) (VDEQ 2008).

2.3.2.3.1 Quantitative Sampling Methods

Benthic macroinvertebrate and crayfish sampling efforts were completed at eight riffle/run sites along 100-meter (m) transects. Macroinvertebrate sampling was conducted holding the D-frame net on the bottom of the stream perpendicular to flow and kicking substrate to agitate and dislodge organisms, thus allowing dislodged organisms to flow into the net. A single quantitative sample consisted of a composite of six kick sets, each disturbing approximately 0.33 meters $(m)^2$ above the dip net for a duration of 30-90 seconds and totaled an area comprising 2.0 m^2. For quality assurance measures, replicate sampling was conducted at one quantitative site within close proximity (not in the same locations as the first set of samples) of the initial sampling area.

To assess the crayfish community, additional kick samples and seining efforts were performed following benthic macroinvertebrate sampling to ensure all crayfish habitat had been covered.

2.3.2.3.2 Qualitative Sampling Methods

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

2.3.2.3.3 Results

The taxonomic results of macroinvertebrate collections are not yet available; however, on-site observations of macroinvertebrates indicate the potential for variability in abundance and community structure throughout the Project area. Two species of crayfish were collected and identified in the field during survey efforts at six of the 16 sites sampled: the Conhaway Crayfish (*Cambarus appalachiensis*) and the Spiny Stream Crayfish (*Faxonius cristavarius*). Both species are native to the New River and no invasive species of crayfish were collected at any of the 16 sampled sites. Representative site and crayfish photos are provided in the study report in Attachment 3 of Appendix C.

2.3.2.4 Freshwater Mussel Survey

Methods used to survey mussels consisted of visually identifying potential mussel habitats within the approximately 3,000-m long reach between Byllesby Dam and the Buck Reservoir Islands as well as the tailrace of Buck Dam. These areas were chosen to fill information gaps based on available data from historic studies completed for the majority of the surrounding habitats (Pinder et al. 2002; Alderman 2008; Stantec 2018a, 2018b). This study did not examine the Buck or Byllesby impoundment pools due to the availability of data from recent studies completed during drawdown activities (Stantec 2018a, 2018b).

To assess the Buck Dam tailrace, exposed riverbanks were observed to identify any spent valves or evidence of suitable mussel habitat. The high velocities and unknown depths in the narrow channel were not conducive for safe in-water surveys such as wading, SCUBA, or snorkeling. Ten areas identified as potential mussel habitats in the reach between Byllesby Dam and Buck Reservoir Islands were assessed using wandering timed searches (two shallow shoals, three deep shoals, three pools, and two side channels). Surveyors used SCUBA, surface supplied air diving, and snorkeling to conduct 200-minute wandering searches of the substrates in each area. Searching tactics included moving cobble and woody debris, hand sweeping away silt, sand, and/or small detritus, and disturbing/probing the upper five centimeters (two inches) of substrate where possible. Total search time was 33.3 hours.

Nine *Cyclonaias tuberculata* were identified during the survey of the ten habitat units. Live mussels were only found in two of the ten surveyed areas and overall mussel densities were lower than the sites downstream of Buck Dam. Quality habitat within the survey area was limited as bedrock and overlying silt deposits were the most predominant substrate types. A reconnaissance level habitat assessment of the Buck Dam tailrace was also conducted. No evidence of spent valves or viable mussel habitat were observed within the Buck Dam tailrace, where high velocities resulting from a narrow, confined channel most likely preclude mussel occupancy.

Existing relevant and reasonably available studies of mussels within the Project area were reviewed and compared to results of summer 2020 field surveys. In total, data from six other mussel surveys conducted within the Project area between 1997 and 2018 were compiled to form a more comprehensive understanding of the mussel community in the vicinity of Project operations. Six species were observed within the Project area: *Cyclonaias tuberculata*, *Eurynia dilatata, Tritogonia verrucosa, Lampsilis fasciola, Lasmigona subviridis,* and *Lampsilis ovata.* Survey sites downstream of Buck Dam (downstream of the confluence of the tailrace and bypass channel) supported the highest density mussel habitats. *Cyclonaias tuberculata* and *Tritogonia verrucosa* were the most abundant species and mussel size data suggests that recent recruitment has occurred for these species. Results of 2020 field surveys are consistent with findings of historical surveys. High quality mussel habitat within the Project area is limited and does not support a diverse or abundant mussel community.

2.3.3 Variances from FERC-Approved Study Plan

The Aquatic Resources Study was conducted in accordance with the methods described in the RSP with the following exceptions:

- Restrictions on non-essential travel and safety considerations for field staff prohibited spring 2020 field efforts, therefore, spring aquatic species (i.e., fish, macroinvertebrates and crayfish) sampling will take place in 2021.
- Periodic weather delays and resulting unsafe stream conditions impacted the fall 2020 fish sampling efforts. Boat electrofishing and gill net sampling was completed during the fall 2020 sampling efforts, but the ongoing weather delays resulted in the fall 2020 backpack electrofishing methods being rescheduled for spring 2021.
- At the time of sampling, the habitat and stream conditions of the proposed sample site were not conducive to the pre-defined methods identified during the desktop-based site selection process. To provide the most representative data for the sites identified in the RPS, sampling methods for those locations were adjusted in the field. As such, two sites were sampled with boat electrofishing instead of backpack electrofishing and site used backpack methods instead of boat electrofishing methods.

- 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. During the 2020 field season, a combination of high flow events and inoperable units prevented field data collection efforts As a result, approach velocity for Byllesby and Buck dams was calculated using the intake structure and trash rack dimensions along with the design maximum flow capacity of the generating units at each development. Using this approach, the calculated velocities in front of the intakes is approximately 2.0 fps (Byllesby) and 1.6 fps (Buck), which is similar to the intake velocities for the two development Project presented in the historical entrainment report (Appalachian 1991). Further, a desktop evaluation using New River hydrologic and flow data from the nearest upstream gage (USGS 03165500 New River at Ivanhoe, Virginia) suggests that the streamflow in the vicinity of the Project is comparable to that estimated in front of the intakes at Byllesby and Buck dams. 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 intake structures at Byllesby and Buck dam and is used to support evaluations of impingement and entrainment at the Project.
- In accordance with the RSP, the Turbine Blade Strike Analysis will be completed using the USFWS model following completion of the 2021 Fish Community Study field sampling. The evaluation will be performed using the most recent version available of the USFWS Turbine Blade Strike Analysis Model, mean and standard deviation of fish lengths based on fish data collected during the 2020-2021 Fish Community Study, and site-specific inputs for required model parameters, as summarized in Attachment 2 of Appendix C.

2.4 Wetlands, Riparian, and Littoral Habitat Characterization Study

2.4.1 Study Status

The Wetlands, Riparian, and Littoral Habitat Characterization Study has been postponed until 2021. The technical report including the results of the Wetlands, Riparian, and Littoral Habitat Characterization will be included in the USR.

2.5 Terrestrial Resources Study

2.5.1 Study Status

The Terrestrial Resources Study has been postponed until 2021. The technical report including the results of the Terrestrial Resources Study will be included in the USR.

2.6 Shoreline Stability Assessment Study

2.6.1 Study Status

The Shoreline Stability Assessment Study Report has been postponed until 2021. The technical report including the results of the Shoreline Stability Assessment Study will be included in the USR.

2.7 Recreation Study

2.7.1 Study Status

Appalachian has completed the Recreation Study in accordance with the RSP and the Commission's SPD. The technical report including the preliminary results of the Recreation Study is included in Appendix D.

In accordance with the RSP approved and modified in the Commission's SPD, Appalachian's consultant conducted a Recreation Study to determine the need for enhancement to existing recreation facilities, or additional recreational facilities, to support the current and future demand for public recreation in the Project area. The approved study plan defines four primary tasks for the Recreation Study:

- Recreation Facility Inventory and Condition Assessment
- Site Visit with Stakeholders
- Recreation Use Visitor Online Survey
- Recreation Use Documentation

Appalachian expects to further consult with stakeholders at the ISR meeting and in 2021 to evaluate and propose potential recreational enhancements at the Project.

2.7.2 Summary of Study Methods and Results

2.7.2.1 Recreation Facility Inventory and Condition Assessment

Appalachian's sub-consultant, Land Planning Design Associates (LPDA), conducted a Recreation Facility Inventory and Condition Assessment of seven Project and Non-Project recreation facilities. LPDA staff conducted the site assessments on November 13, 2019 and as described in the RSP recorded the specific criteria for each facility and completed a qualitative assessment of the condition of the facilities.

LPDA observed several common themes among the recreation facilities (project and Non-Project) including:

- Lack of American's with Disabilities Act accessibility,
- Aging though functional furnishings, informally developed amenities, incomplete signage, and deferred maintenance.
- There is a high potential for increasing recreation value of the sites, both by improving the existing conditions and by developing related amenities.

The Recreation Facility Inventory and Condition Assessment is provided in Appendix D, Attachment 1.

2.7.2.2 Site Visit with Stakeholders

Appalachian convened a site visit with interested relicensing participants to discuss existing and future recreational opportunities at the Project on October 28, 2020. Prior to the site visit, Appalachian held a virtual meeting on October 21, 2020 with involved stakeholders to share preliminary recreation data. Meeting notes are provided in Appendix D, Attachment 2.

Global comments and recommendations were made for improved signage regarding intended use, restricted access areas (e.g. tailrace areas, dams), safety, and consistent FERC, regulatory, and identification signage. Upgrades and improvements at recreation facilities upstream of the Byllesby dam are limited due to localized flooding (Byllesby Boat Launch) and wetland impacts (Byllesby Canoe Portage).

2.7.2.3 Recreation Visitor Use Online Survey

HDR developed an online survey as described in the RSP. The online survey was administered through the Project's relicensing website and offered respondents the opportunity to provide survey responses electronically from April through November 2020.

Appalachian posted signs at the Project and Non-Project recreation facilities (except the Byllesby VDWR Boat Launch) providing a brief description of the purpose and intent of the survey and the website address. This allowed respondents to complete a survey onsite, or later upon returning home from their visit, or without visiting the Project if the link was identified through other (electronic) communications. Appalachian also contacted the USFWS, VDEQ, VDWR, Virginia Department of Conservation and Recreation, New River Conservancy, and Carroll County stakeholders at the beginning and end of the survey window to support distribution of the survey. Additionally, Appalachian notified relicensing participants that the online survey was available through the quarterly ILP study progress report. Notice of the survey was also posted on the Project's relicensing website and on a relevant social media outlet (i.e., Claytor Lake Facebook page) maintained by Appalachian.

The online survey provided a method for existing and potential recreation visitors to the Study Area to respond and provide feedback on recreation opportunities (Project and Non-Project facilities) at the Project. From April 21, 2020 to December 1, 2020, Appalachian received 142 responses to the online survey. Eighty-four percent of the responses came from four recreation facilities: Byllesby Boat Launch (VDWR), Buck Dam Canoe Portage, New River Canoe Launch, and New River Trail Picnic Area, indicating these sites were the most frequently utilized by online survey participants. The online survey resulted in positive feedback along with requests for more access and use of Loafer's Rest for fishing. Respondents also requested the reopening of the Thompson campground. The online survey respondents also reported a local interest in maintaining and improving the recreation facilities at the Project for the local economy.

Facility-specific summaries and verbatim user comments from the online survey are included in Appendix D, Attachment 3.

2.7.2.4 Recreational Use Documentation

HDR documented and reviewed over a full year of Project and Non-Project recreation facility usage with motion-activation trail cameras. The cameras were installed to collect site visitor data and document use patterns. Eight trail cameras were installed on October 15 and 16, 2019 and were removed on November 5, 2020. HDR downloaded data from the cameras on eight different occasions, capturing thousands of photos. All cameras recorded time, temperature, date, and vehicle usage. Review of the trail camera data indicates that the Study Area is well-used during the spring to fall months, which is attributed largely to the easy access along the entire left bank via the New River Trail.

The Project facilities most frequented by users are the Byllesby VDWR Boat Launch and the Byllesby Canoe Portage parking lot. These two Project facilities provide a range of recreation opportunities including boating, canoeing, fishing, walking, biking, and hiking. The Byllesby VWDR Boat Launch has the easiest boat access to the New River within the Study Area. Fishing is also popular along the shoreline at this facility. Based on the capacity assessed through the trail camera study the parking areas at the Project are sufficient to meet the current demand during a typical and peak recreation day. The Buck Dam Canoe Portage was the only Project recreation facility that saw very little recreation usage, likely because it is inaccessible except by canoe/kayak. The tailrace at Loafer's Rest is of interest to anglers but is often flooded by the trash gate; that camera station observed approximately two recreational users over the course of the trail camera study. Appendix D, Attachment 4 provides a representative photo for select seasonal days.

2.7.3 Variances from FERC-Approved Study Plan

The Recreation Study was conducted in conformance with the Commission's SPD.

2.8 Cultural Resources Study

2.8.1 Study Status

Appalachian has partially completed the Cultural Resources Study in accordance with the RSP and the Commission's SPD. The technical report including the preliminary results of the Cultural Resources Study is included in Appendix E (Privileged).

In accordance with the RSP approved and modified in the Commission's SPD, Appalachian began tasks associated with the Cultural Resources Survey in the late summer of 2020. Tasks initiated and/or completed to date include Consultation for the Area of Potential Effects (APE) Determination (Task 1), Background Research and Archival Review of the Study Area (Task 2), and a Phase I Reconnaissance Survey of the APE (Task 3). An Inventory of Traditional Cultural Properties (Task 4) and an update to the Project Cultural Resources Management Plan (Task 5) will take place during the second study season in 2021.

The preliminary Cultural Resources Survey Report and Attachments contain the locations of the referenced sites and as such are being filed with FERC as Privileged.

2.8.2 Summary of Study Methods and Results

The goal of the Cultural Resources Study is to collect additional information regarding cultural resources within the Project APE to assist in identifying Project effects on archeological and historic properties and developing appropriate management measures.

Concurrent with the January 7, 2019 PAD and NOI required by the ILP, Appalachian requested designation as the Commission non-federal representative for carrying out informal consultation pursuant to Section 106. The Commission granted Appalachian's request by notice dated March 8, 2019. Pursuant to 36 CFR §800.4(a)(1), in a letter dated September 1, 2020, Appalachian consulted with the Advisory Council on Historic Preservation, the U.S. National Park Service, Bureau of Indian

Affairs, Virginia Department of Historic Resources/State Historic Preservation Office (VDHR/SHPO), the Cherokee Nation, the Catawba Indian Nation, the Delaware Nation, the Pamunkey Indian Tribe, the Eastern Band of Cherokee Indians, and the Archaeological Society of Virginia, requesting concurrence on determining the APE for the Project defined as all lands necessary for Project operations (Appendix E, Attachment 1 Privileged). Responses from these stakeholders are included in Appendix E, Attachment 2.

In August 2020, Appalachian's sub-consultant [Terracon Consultants, Inc. (Terracon)] reviewed the Virginia Cultural Resource Information System (V-CRIS) to identify previously recorded cultural resources within a 0.5-mile radius of the Study Area. On September 10, 2020, Terracon staff traveled to the VDHR office in Richmond, VA to gather additional information otherwise unavailable in V-CRIS. The results of Terracon's research are presented in Appendix E (Privileged).

From October 19 to 22, 2020, Terracon conducted an archaeological assessment of portions of the Project APE. Areas south of Byllesby were accessed by boat, while areas north of Byllesby were accessed by land where possible. The riverbank and islands between Byllesby and Buck were generally not observed due to accessibility and safety concerns with rapidly flowing water and shoals. Terracon attempted to re-locate archaeological sites, although neither was observed during the field work, possibly due to high water levels. Archaeological and geomorphological investigations of the Project found that most of the APE is either steeply sloped or deeply buried in historic alluvium. In addition, there was very little erosion or other Project related effects in any portions of the APE.

The three above-ground historic resources are eligible for inclusion in the National Register of Historic Places (NRHP) and were revisited during the field work. All three remain eligible for listing in the NRHP.

Based on the initial background research and site investigations, and the fact that none of the properties eligible for listing in the NRHP are being impacted, it is Terracon's opinion that no historic properties are currently being affected by continued Project operations. However, Terracon recommended if new construction or significant ground disturbance occurs in areas that have the potential to contain archaeological resources (including areas with an unknown potential), additional archaeological investigations may be warranted and consultation with the SHPO would be necessary. Similarly, if there are any substantial changes to either the Byllesby or Buck facilities, consultation with the SHPO and other consulting parties would be required.

2.8.3 Variances from FERC-Approved Study Plan

The Cultural Resources Study has been and will continue to be conducted in conformance with the Commission's SPD. The schedule in Appalachian's July 27, 2020 updated ILP study schedule revised the Cultural Resources Study until 2021. Appalachian was able to adjust the schedule and begin the first three tasks outlined in the Cultural Resources RSP during the first field season and expects to complete the rest of the study during the second field season in 2021.

3 Upcoming ILP Milestones and Study Reporting

Table 3-1 presents upcoming ILP milestones.

Table 3-1. Upcoming Major ILP Milestones

Date	Milestone
January 28, 2021	Appalachian Host ISR Meeting (18 CFR §5.15(c)(2))
February 12, 2021	Appalachian File ISR Meeting Summary (18 CFR §5.15(c)(3))
March 14, 2021	Stakeholders File Disagreements with ISR Meeting Summary (18 CFR §5.15(c)(3)) (if necessary)
April 13, 2021	Appalachian File Response to ISR Meeting Summary Disagreements (18 CFR §5.15(c)(5)) (if necessary)
May 13, 2021	FERC Provide Determination on Disputes (18 CFR §5.15(c)(6)) (if necessary)
Spring – Fall 2021	Appalachian Conducts Second Year of Studies
October 1, 2021	Appalachian File Draft License Application (DLA) (18 CFR §5.16(a))
November 17, 2021	Appalachian File Updated USR (18 CFR §5.15(f))
December 2, 2021	Appalachian Host USR Meeting (18 CFR §5.15(f))
December 17, 2021	Appalachian File USR Meeting Summary (18 CFR §5.15(f))
December 30, 2021	Stakeholders File Comments on DLA (18 CFR §5.16(e))
January 16, 2022	Stakeholders File Disagreements with USR Meeting Summary (18 CFR §5.15(f)(4)) (if necessary)
February 15, 2022	Appalachian File Response to USR Meeting Summary Disagreements (18 CFR §5.15(f)(5)) (if necessary)
February 28, 2022	Appalachian File Final License Application (18 CFR §5.17)

4 Notice of Intent to File Draft License Application

As required by 18 CFR § 5.16(c), Appalachian hereby advises the Commission of its intent to file a Draft License Application, which will include the contents of a license application, rather than a Preliminary Licensing Proposal. The draft license application will be filed no later than October 1, 2021.

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Attachment 1

Attachment 1 – FERC Correspondence

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FEDERAL ENERGY REGULATORY COMMISSION
WASHINGTON, DC 20426
November 18, 2019

OFFICE OF ENERGY PROJECTS

Project No. 2514-186 Virginia
Byllesby-Buck Hydroelectric Project
Appalachian Power Company

VIA FERC Service

Ms. Elizabeth Parcell, Process Supervisor
American Electric Power Services Corporation
P.O. Box 2021
Roanoke, VA 24022-2021

Reference: Study Plan Determination for the Byllesby-Buck Hydroelectric Project

Dear Ms. Parcell:

Pursuant to 18 C.F.R. § 5.13(c) of the Commission's regulations, this letter contains the study plan determination for the Byllesby-Buck Hydroelectric Project (Byllesby-Buck Project) located on the New River in Carroll County, Virginia. The determination is based on the study criteria set forth in section 5.9(b) of the Commission's regulations, applicable law, Commission policy and practice, and the record of information.

Background

On June 21, 2019, Appalachian Power Company (Appalachian) filed its proposed plan for eight studies covering water quality, aquatic habitat and fishery resources, terrestrial resources, recreation resources, and cultural resources in support of its intent to relicense the project.

Appalachian held its initial Study Plan Meeting on July 18, 2019. Comments on the Proposed Study Plan (PSP) were filed by Commission staff, the U.S. Fish and Wildlife Service (FWS), and the Virginia Department of Game and Inland Fisheries (Virginia DGIF). Virginia Tech's College of Natural Resources and Environment (Virginia Tech) filed multiple study requests on March 15, 2019.

On October 18, 2019, Appalachian filed a Revised Study Plan (RSP) that includes revisions to five of the eight studies included in the PSP. Comments on the RSP were filed by Virginia DGIF and FWS.

Study Plan Determination

Appalachian's RSP is approved with the staff-recommended modifications discussed in Appendix B. As indicated in Appendix A, of the eight studies proposed by Appalachian, three are approved with staff-recommended modifications and five are approved as filed by Appalachian. This determination also addresses seven additional studies requested by stakeholders that were not adopted by Appalachian and are not required by this determination (see Appendix A). In Appendix B, we explain the specific modifications to the study plan and the bases for modifying, adopting, or not adopting requested studies. Although Commission staff considered all study plan criteria in section 5.9 of the Commission's regulations, staff only reference the specific study criteria that are particularly relevant to the determination.

Recommendations for protection, mitigation, and enhancement measures are not study requests, and therefore, are not discussed in this determination. Unless otherwise indicated, all components of the approved studies not modified in this determination must be completed as described in Appalachian's RSP. Pursuant to section 5.15(c)(1) of the Commission's regulations, the initial study report for all studies in the approved study plan must be filed by November 17, 2020.

Nothing in this study plan determination is intended, in any way, to limit any agency's proper exercise of its independent statutory authority to require additional studies. In addition, Appalachian may choose to conduct any study not specifically required herein that it feels would add pertinent information to the record.

If you have any questions, please contact Allyson Conner at allyson.conner@ferc.gov or (202) 502-6082.

Sincerely,

for
Terry L. Turpin
Director
Office of Energy Projects

Enclosures: Appendix A – Summary of determinations on proposed and requested study modifications and studies requested but not adopted by Appalachian
Appendix B – Staff's recommendations on proposed and requested study modifications and studies requested

APPENDIX A

SUMMARY OF DETERMINATIONS ON PROPOSED AND REQUESTED STUDY MODIFICATIONS AND STUDIES REQUESTED BUT NOT ADOPTED BY APPALACHIAN

Study	Recommending Entity	Approved	Approved with Modifications	Not Required
Flow and Bypass Reach Aquatic Habitat Study	Appalachian		X	
Water Quality Study	Appalachian		X	
Aquatic Resources Study	Appalachian		X	
Wetlands, Riparian, and Littoral Habitat Characterization Study	Appalachian	X		
Terrestrial Resources Study	Appalachian	X		
Shoreline Stability Assessment Study	Appalachian	X		
Recreation Study	Appalachian	X		
Cultural Resources Study	Appalachian	X		
Comprehensive Sediment Study to Develop a Sediment Management Plan	Virginia DGIF			X
Fish Protection and Downstream Passage Studies	FWS			X

Study	Recommending Entity	Approved	Approved with Modifications	Not Required
PCB Contamination and Pollution Minimization Plan	Virginia Tech			X
Water Willow Propagation, Rehabilitation, and Water Level Plan	Virginia Tech			X
Target Biological Community in the Two Bypass Reaches and Rehabilitation of the Foundational Plant, Riverweed	Virginia Tech			X
Survey of Rare Dragonflies and Multi Taxa Survey	Virginia Tech			X
Recreational Value and Access Development Mitigation	Virginia Tech			X

APPENDIX B

STAFF'S RECOMMENDATIONS ON PROPOSED AND REQUESTED STUDY MODIFICATIONS AND STUDIES REQUESTED

The following discusses staff's recommendations on studies proposed by Appalachian Power Company (Appalachian), requests for study modifications, and requests for additional studies. We base our recommendations on the study criteria outlined in the Commission's regulations [18 C.F.R. section 5.9(b)(1)-(7)].

I. General Issues

The Virginia Department of Game and Inland Fisheries (Virginia DGIF) and the U.S. Fish and Wildlife Service (FWS) submitted comments stating that the Byllesby-Buck Project impacts the New River for many miles both upstream and downstream of the project's dams and hydroelectric facilities. Both agencies identify multiple project-related impacts including influencing ambient New River water temperature and water quality parameters (habitat effects on resident coolwater flora and fauna), liberation of project sediment deposits during project operation resulting in increased downstream turbidity, placement of the dams causing inundation of historic New River walleye spawning habitat and blocking the upstream migration of walleye, and the loss of upstream mussel fauna due to the dams blocking migration of host fishes. Virginia DGIF and FWS state that the magnitude and spatial scale of the project's influence is not adequately addressed in the revised study plan (RSP) and that expanding the study area would help determine adequate reference conditions for ecological comparisons during multiple study efforts.

Generally, the geographic scope (or study area) of the required studies is established based on the anticipated extent of direct project-related effects. Neither agency identifies the specific studies that neglect to address potential direct project-related effects. Neither Virginia DGIF nor FWS state which studies should have extended geographic scopes beyond what Appalachian defines as the study area in the RSP. Further, the agencies have not provided an estimate of how far upstream or downstream they believe the geographic scope should be expanded or how the geographic scope of potential project effects should be determined for various resources. In the following sections, we address the geographic scope of individual studies to the extent that comments and requested study modifications specifically address this issue.

Regarding the recommendation that expanding the study area would help determine adequate reference conditions (i.e., a reference reach) for purposes of informing an analysis of project effects, we note that the environmental baseline for our effects analysis is the condition that exists at the time of relicensing, not pre-project conditions or a surrogate for pre-project conditions like a reference reach. Therefore, we do not recommend expanding the overall geographic scope or documenting reference conditions for the purposes of determining environmental effects.

II. Required Studies

Flow and Bypassed Reach Aquatic Habitat Study

Applicant's Proposed Study

Appalachian proposes to develop and calibrate a two-dimensional (2-D) hydraulic model that would be used in conjunction with an operations model [the Computerized Hydro Electric Operations Planning Software (CHEOPS) platform] to assess how aquatic habitat (depth and flow velocity) in each development's tailrace and bypassed reach varies across a range of flows and project operation scenarios. Hydrology data from the U.S. Geological Survey (USGS) gage (No. 03165500) at Ivanhoe, Virginia (years 1996 through 2019) would be used to develop the CHEOPS model, which is capable of simulating flow releases under various gate opening scenarios. For example, Appalachian plans to use the CHEOPS model to help determine which of the 10 total (six Tainter and four Obermeyer) spillway gates at the Buck Development should be used during down-ramping[1] to ensure a safe, continuously wetted and sufficiently deep, exit route for walleye or other spring-spawning fishes that may be attracted to intermittent spill events into the 4,100-foot-long Buck bypassed reach.[2] The results from the hydraulic model would be coupled with a Physical Habitat Simulation (PHABSIM) model to evaluate how aquatic habitat suitability varies as a function of flow for fish species of interest. The species and range of flows (calibration and test flows) to be evaluated at each development (Buck and Byllesby) would be determined through consultation with stakeholders and resource agencies and based on the management objectives for each bypassed reach. Appalachian would also measure leakage into each bypassed reach at the low end of the tested flow regime. Lastly, Wolman pebble counts would be conducted along at least three transects in each bypassed reach to characterize substrate type and size to aid in development of the PHABSIM model.

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[1] Following periods of spill into the Buck bypassed reach when a spillway gate has been opened 2 feet or more [corresponding to a release of at least 320 cubic feet per second (cfs)], Article 406 of the current license requires Appalachian to discharge flows through a 2-foot-wide gate opening for at least 3 hours. Appalachian is then required to reduce the gate opening to 1 foot for at least an additional 3 hours, after which time Appalachian may close the gate.

[2] On an annual basis, spillage into the Buck bypassed reach occurs 13 percent of the time on average, but spillage is most common in the spring (March through May). There is no existing minimum flow requirement for the Buck bypassed reach.

Ramping Rate Assessment

Comments on the Study

A study was conducted in 1997 to assess the effectiveness of the current ramping rates at the Buck development by electrofishing in the bypassed reach following three spill events that ranged from 4,300 cfs to 6,140 cfs (amount of spillage through the spillway gates). [3] In its comments on the RSP, Virginia DGIF states the results of that study may not apply to the current walleye population in the New River because the population is more robust today than it was 20 years ago due to an active stocking and management program. Virginia DGIF believes that it is reasonable to collect current information on walleye stranding in the Buck bypassed reach, particularly with regards to how such impacts vary in wet and dry versus average flow years during the spawning and post-spawning periods. In its comments on the RSP, FWS supports Virginia DGIF's request for current information on the likelihood of walleye stranding in the Buck bypassed reach and notes that fish serving as mussel hosts could also be impacted by stranding.

Discussion and Staff Recommendation

Neither Virginia DGIF or FWS explicitly recommend a methodology such as that used in the 1997 Ramping Rate study or an alternative methodology for assessing the likelihood of fish stranding in the Buck bypassed reach. As described above, the modeling efforts proposed by Appalachian as part of its Flow and Bypassed Reach Aquatic Habitat Study (Flow Study), will evaluate a range of gate opening and water release scenarios for the Buck spillway to help determine the optimal gate operation scenario(s) for minimizing walleye stranding risk during intermittent spill events. For example, output from the models will include the depths of various exit routes under different ramping rate and/or gate opening scenarios, which could be compared to the body depths of adult walleye (or other species of interest) to provide information on stranding risk under different operation scenarios. Therefore, because the Flow Study, as proposed, will inform the development of potential license requirements concerning project operation [section 5.9(b)(5)], we do not recommend that additional field studies of fish stranding be performed in the Buck bypassed reach.

[3] Ramping Rate Assessment. Appalachian Power Company Byllesby/Buck Hydroelectric Project FERC No. 2514. Filed on September 12, 1997. Accession No. 19970916-0311.

Substrate Sizes in a Reference Reach

Comments on the Study

In comments on the PSP and RSP, Virginia DGIF and FWS question how the sediment size data Appalachian proposes to collect in the bypassed reaches (at Byllesby and Buck) would be analyzed without an adequate reference data set from a free-flowing section of the New River.

In the RSP, Appalachian states that a suitable reference reach, with comparable high gradient and substrate conditions, proximate to the project for the purposes of study execution, is not reasonably available. Appalachian notes the river has a gradient of 6.3 feet per mile throughout the upper New River Basin, but within the Buck bypassed reach and just downstream (1 mile below) the gradient is higher, at 24 feet per mile and 20 feet per mile, respectively.

In its comments on the RSP, Virginia DGIF states that a reference reach (for the purpose of substrate size comparisons) is readily available in the New River upstream of the Byllesby impoundment.

Discussion and Staff Recommendation

In addition to depth and velocity, substrate type is one of the main input variables for PHABSIM modeling, which Appalachian proposes to use to determine how aquatic habitat suitability varies across a range of flows for fish species of interest. As such, the sediment size data (Wolman pebble counts) proposed to be collected in each bypassed reach is appropriate to inform and develop the PHABSIM model and to characterize existing sediment conditions in the bypassed reach.

As noted above, the Commission's long-standing baseline for environmental analysis at relicensing is the existing conditions, not pre-project conditions or a surrogate for pre-project conditions like a reference reach. Therefore, we do not recommend that Appalachian be required to collect sediment size data from a reference reach of the New River outside of the influence of the project.

Consultation on Leakage Measurements and Calibration Flows

Comments on the Study

In comments on the RSP, Virginia DGIF and FWS state that the proposed methodology for estimating leakage flows at each dam is unclear and request to be consulted prior to any measurements being made. In addition, these entities request to be included as an 'interested licensing participant' and consulted in regards to the selection of calibration and test flows for Appalachian's Flow Study.

Discussion and Staff Recommendation

In the RSP, Appalachian proposes to conduct leakage flow measurements at the 'low end of the flow regime.' It is unclear as to what constitutes the low end of the flow regime. Therefore, we recommend that Appalachian conduct leakage measurements at each dam under low-flow (e.g., summer) conditions when impoundment elevations are normal (i.e., within their respective 1-foot allowable fluctuation bands) and no spill is occurring. Further, we recommend that Appalachian consult with Virginia DGIF and FWS regarding its methodology for measuring leakage. With respect to the selection and development of calibration and test flow scenarios, Appalachian already proposes, in the RSP, to consult with interested stakeholders on this topic.

Water Quality Study

Applicant's Proposed Study

Appalachian proposes to conduct a Water Quality Study to assess the potential effects of project operation on water quality parameters, including water temperature and dissolved oxygen (DO). The single year study would be conducted from May 1, 2020 through September 30, 2020. Appalachian notes that if 2020 is not a suitable year for collecting water quality data, then the 2021 field season would be used. Continuously recording data sondes would be placed at eight sites to measure water temperature and DO at 15-minute intervals. These sites include the: (1) upper end of the Byllesby impoundment; (2) Byllesby forebay; (3) Byllesby bypassed reach; (4) Byllesby tailrace; (5) Buck forebay; (6) upper Buck bypassed reach; (7) lower Buck bypassed reach; and (8) Buck tailrace (see figures 5-3 and 5-4 of the RSP).

Two sondes would be deployed at discrete depths in each forebay to assess the extent of DO and temperature stratification in the project's impoundments. In the Byllesby forebay, which is about 35 feet deep, sondes would be deployed at depths of 12 feet and 24 feet; and at the Buck forebay, which is about 17 feet deep, sondes would be deployed at depths of 6 feet and 12 feet. Data would be downloaded from the sondes every month; during these monthly downloading events, surface measurements of water temperature, DO, pH, specific conductance, and turbidity would also be taken at each site. Additionally, monthly depth profiles of temperature and DO would be collected at each forebay site. Appalachian notes that, based on the results of the monthly depth profiles, it may adjust the deployment depths of the sondes in the forebays, if needed, as well as increase the frequency of depth profile collections, from monthly to bi-weekly, if stratification appears to be occurring based on a comparison of continuously recorded sonde data (temperature and DO) with vertical profile data.

Deployment Depths of Data Sondes in the Forebays

Comments on the Study

In comments on the PSP, Virginia DGIF and FWS suggest that vertical temperature and DO profiles may need to be conducted on at least a bi-weekly (rather than monthly) basis in the project's forebays to determine stratification depths prior to, or in concert with, deploying the data sondes. In response to this comment, Appalachian proposes (in the RSP, as described above) to potentially adjust the deployment depths of the sondes mid-study and increase the frequency of vertical profile sampling if stratification appears to be occurring. In comments on the RSP, both Virginia DGIF and FWS reiterated their earlier comments from the PSP concerning water quality sampling.

Discussion and Staff Recommendation

It is likely that the onset of stratification (to the extent stratification occurs in the impoundments) will not begin until well after the proposed start date (May 1) for the Water Quality Study, perhaps not until mid-summer. Therefore, conducting depth profiles prior to, or in concert with, sonde deployments, as suggested by Virginia DGIF and FWS, would not appear to inform decisions regarding the proper deployment depths of the sondes. Moreover, adjusting the depths of the sondes mid-study (e.g., based on bi-weekly vertical profiles) could bias and complicate interpretation of the study results.

The greatest (vertical) differences in temperature and DO in the forebays would be expected between the surface and bottom water rather than the middle portions of the water column within which Appalachian proposes to monitor via placement of the sondes at depths of 12 feet and 24 feet at Byllesby and 6 feet and 12 feet at Buck. As such, we recommend that, in each forebay, the sondes be placed as close to the surface and bottom of the water column as possible, and that their locations remain fixed, to ensure the data collected is representative of the maximal degree of stratification that occurs in the forebays. Placing sondes as vertically far apart as possible would obviate the need to continuously re-evaluate (e.g., on a bi-weekly basis during the 5 month study) and possibly re-adjust the location of the sondes to ensure they are above and below any thermoclines that develop. As such, we do not recommend that Appalachian be required to conduct bi-weekly depth profiles in the project's forebays as suggested by Virginia DGIF and FWS.

Turbidity Monitoring

Comments on the Study

In comments on the PSP, Virginia DGIF notes the Water Quality Study plan does not provide for assessing the effects of project operation on downstream turbidity. In response, Appalachian proposes to collect monthly surface samples of turbidity at the eight water quality monitoring sites described above. In comments on the RSP, Virginia DGIF and FWS state the inclusion of monthly turbidity sampling is an improvement to the RSP, but that their concern remains regarding the mobilization of impoundment sediment deposits during project operation, which could result in increased turbidity in downstream reaches that disrupts ecological processes and negatively affects angling and recreational use.

Discussion and Staff Recommendation

A drag rake is operated in each forebay (Byllesby and Buck) to remove and pass debris downstream of each development. The drag rake operates by extending outward (via a beam and cable) from each forebay and scraping along the bottom. The rake is then dragged upward along the face of the trashracks and collected debris passes downstream through a trash chute.[4] When the drag rakes are operated, sediment is likely re-suspended from the bottom (due to the scraping action of the rake) and passed downstream through the intakes, which may increase downstream turbidity and affect aquatic and recreation resources.

The frequency of operation of the drag rake depends on debris loading in the forebays, but it generally operates multiple times per day. Therefore, Appalachian's proposal to sample turbidity once per month at each water quality sampling site lacks the sampling frequency needed to properly assess the effects of project operation (drag rake) on downstream turbidity at each development. Accordingly, we recommend that Appalachian install continuously-recording turbidity sensors (with 15-minute measurement intervals) on each of the 10 multiparameter data sondes that would be deployed across the eight sampling sites described above. We also recommend that Appalachian maintain, and provide in the study report, a log of daily drag rake operations (e.g., daily start and stop times for the drag rakes). This operation log would allow upstream and downstream turbidity values to be compared between time periods when the drag rakes are operating and when they are not, which would facilitate an evaluation of the relative role of (natural) high-flow events versus drag rake operations in causing

[4] For a more detailed descriptions of the project's drag rakes, see letters filed by Appalachian on July 2, 1997 (Accession No. 19970716-0506) and July 6, 1998 (Accession No. 19980708-0258).

turbidity spikes. The results of this study could inform the development of potential license requirements (e.g., the optimal timing of drag rake operation in terms of maintaining desirable turbidity levels during prime angling periods) [section 5.9(b)(5)]. The cost would be minimal and largely depend on whether Appalachian currently has access to additional turbidity sensors or needs to purchase them (the approximate cost of the sensors is $10,000 to $15,000). Additional field efforts associated with staff's recommended turbidity monitoring would be minimal because the turbidity sensors would be added to the same sondes that would be used for continuous monitoring of temperature and DO.

Need for a Second Study Season

Comments on the Study

In the RSP, Appalachian indicates that if 2020 is not a suitable year for collecting water quality data, then the 2021 field season would be used. In comments on the RSP, Virginia DGIF and FWS state it is unclear what constitutes a "suitable year" for the collection of water quality data. Both entities request that more than one year of water quality data be collected given that water quality is likely to vary significantly with annual flow regimes.

Discussion and Staff Recommendation

If weather conditions in 2020 are unusually wet and cool, then the Water Quality Study may need to be repeated in 2021 as Appalachian notes in its RSP. On the other hand, if summer weather conditions are unusually dry and hot (e.g., a worst-case scenario for water quality parameters) and water quality parameters are consistent with state water quality standards, there would be no need to collect an additional year of data. The need for a potential second study season will be evaluated based upon review of the water quality study results presented in the Initial Study Report (due November 17, 2020). Therefore, at this time, it is premature to recommend a second study season.

Aquatic Resources Study

Applicant's Proposed Study

Appalachian proposes to conduct an Aquatic Resources Study that includes four main components or sub-studies,[5] including a: (1) Fish Community sub-study, (2)

[5] The term 'sub-study' is used herein by staff to help differentiate and describe the multiple studies contained within the broad Aquatic Resources Study. This term was not used by Appalachian in the RSP.

Macroinvertebrate and Crayfish Community sub-study, (3) Mussel Community sub-study, and (4) Impingement and Entrainment Desktop sub-study.

For the Fish Community sub-study, Appalachian proposes to conduct electrofishing surveys at each development during two seasons, in the: (1) late spring/early summer (April-May), and (2) late summer/early fall (August-September) of 2020. During each seasonal survey, daytime boat electrofishing would be conducted at 12 sites in each impoundment and backpack electrofishing would be conducted at 6 riverine (non-impoundment) sites located in riffle/run habitats at each development, including the tailrace and bypassed reach of each development (see figures 6-2 and 6-3 of the RSP). Appalachian does not plan on conducting gill net or hoop net sampling in the project's impoundments, similar to that conducted during fisheries surveys performed as part of the previous re-licensing (May-October 1990) due to concerns over gear fouling and potential theft (of gill nets) and sampling inefficiency (of hoop nets). In the Byllesby impoundment, six of the proposed boat electrofishing sites (below Chestnut Creek) are the same boat electrofishing sites that were used in the 1990 survey, and the remaining six boat electrofishing sites coincide with previous gill net and/or hoop net sites. Appalachian would enumerate, measure (total length), and weigh fish collected at each site and also measure temperature, DO, pH, specific conductance, and record Secchi disk depths at each sampling site.

For the Macroinvertebrate and Crayfish Community sub-study, Appalachian proposes to conduct two field sampling events, one in the spring (March 1 through May 31) and another in the fall (September 1 through November 30) of 2020. Crayfish would be targeted by sampling in appropriate habitats using kick-netting, seine hauling, and dip-netting techniques. Other macroinvertebrates (e.g., mayflies) would be collected according to the Virginia Department of Environmental Quality's "Methods for Habitat Assessment for Streams" protocol and the data analyzed using common indices to evaluate benthic macroinvertebrate community health and similarity (e.g., the Hilsenhoff Biotic Index,[6] percent intolerant species, etc.).

The Mussel Community sub-study would include a desktop literature review to compile and summarize existing mussel data (e.g., abundance and size data) that have been collected in the vicinity of the project. This sub-study would also include a two-phase field survey. The first phase would include a reconnaissance-level habitat survey to identify potentially suitable mussel habitat in the Buck tailrace and stretch of river between the Byllesby and Buck Dams (see figure 6-1 of the RSP)—this 'transition reach' has not been sampled previously but is thought to contain suitable mussel habitat (islands containing mixed sand/gravel substrates). Along the Buck tailrace, surveyors would walk

[6] The Hilsenhoff Biotic Index estimates the overall tolerance of the macroinvertebrate community in a sampled area by weighting the relative abundance of various taxonomic groups.

the length of the reach while looking for evidence of mussel presence such as live animals or spent valves. Surveyors would visually assess habitat characteristics such as substrate composition and record observations regarding habitat quality. In the transition reach between the dams, field personnel would conduct a reconnaissance-level field habitat assessment to verify or adjust the approximate geographic limits of the hydraulic habitat types (pool, deep shoal, shallow shoal, and side channel) that were preliminarily delineated (see figure 6-1 of the RSP) based on a review of existing aerial imagery. These results from phase one would be used to guide phase two, in which field personnel would survey representative hydraulic habitat types, based on their perceived potential to support mussels, within the geographic extent of each hydraulic habitat type. Mussel sampling (phase two) would be performed using snorkeling, tactile searches and/or viewing scopes in shallow water habitats; via SCUBA or surface supplied air in deeper water habitats (greater than 3 feet deep). Surveyors would conduct wandering timed searches of channel substrates for a minimum of 30 person-minutes per search, with two to three searches expected in each of the four, tentatively defined, hydraulic habitat types (pool, deep shoal, shallow shoal, and side channel; see figure 6-1 and table 6-2 of the RSP).

The Impingement and Entrainment desktop sub-study would include a standard desktop evaluation of entrainment and impingement risk, including blade strike mortalities, of selected target species—the list for which would be based on the results of the Fish Community sub-study (i.e., species common in the impoundments) and those species of conservation and management interest based on consultation with the resource agencies. In addition, approach velocities would be measured in front of each development's intakes with an Acoustic Doppler Current Profiler (transect sampling approach) when each development is operating at its maximum hydraulic capacity and when operating at their most efficient gate setting (as feasible based on project conditions).

Start Date of Spring Fish Sampling

Comments on the Study

In comments on the PSP, Virginia DGIF requests that spring fish collection efforts be commenced in April to ensure that the data collected are representative of the resident walleye population downstream of Buck Dam. In response to this comment, Appalachian shifted the sampling window for the late spring/early summer survey from May-June (in the PSP) to April-May in the RSP. In comments on the RSP, Virginia DGIF acknowledges Appalachian's change to the spring sampling schedule.

Discussion and Staff Recommendation

Appalachian does not explicitly state that it will commence sampling for the late spring/early summer survey in April, only that sampling for the spring/late summer seasonal survey would be conducted sometime during "April-May." In the RSP, Appalachian states that specific sampling dates within this timeframe would be determined based on factors including (but not limited to) weather conditions, water temperatures, river flows and impoundment elevations, and safety of field staff and the general public.

Walleye in the New River are known to start congregating at spawning areas (including just below Buck Dam) by mid-March and remain on or near spawning sites until late April, depending on water temperatures.[7] If spring sampling does not start until May, walleye may have dispersed from the spawning site, in which case sampling would occur too late to obtain representative information on the relative abundance and size structure of the walleye population that congregates downstream of Buck Dam in the spring and is sought after by recreational anglers. Therefore, we recommend that Appalachian commence sampling as early in April as possible, and choose sampling dates in consultation with Virginia DGIF, to ensure that representative data is collected for walleye, which is a focal management species in this portion of the New River.

Walleye Sampling in the Byllesby Impoundment

Comments on the Study

In its comments on the RSP, Virginia DGIF states that boat electrofishing (as proposed by Appalachian) is not an adequate means to assess the walleye population in the Byllesby impoundment. Virginia DGIF notes that it stocks walleye upstream of the Byllesby impoundment and that these fish seasonally use the impoundment. Virginia DGIF states that gill nets are a standard methodology for assessing reservoir walleye populations and should be used to assess the walleye population in the Byllesby impoundment. It also notes that gill nets would be effective in sampling resident catfish populations (flathead and channel catfish).

Discussion and Staff Recommendation

Virginia DGIF does not state why it believes daytime boat electrofishing would be an ineffective method for sampling walleye in the Byllesby impoundment, which is the

[7] Palmer, G.C., Murphy, B.R., and E.M. Hallerman. 2005. Movements of walleyes in Claytor Lake and the Upper New River, Virginia, indicate distinct lake and river populations. North American Journal of Fisheries Management 25:1448-1455.

most lentic-type environment in the project area, with a maximum depth of 35 feet. Virginia DGIF's rationale may stem from the fact that walleye have been shown, at least in lakes with relatively low turbidity (Secchi depths greater than 3 feet) to undergo diel vertical migrations, moving up in the water column at night to feed and down in the water column during the day to avoid high light levels,[8,9] thus rendering them less susceptible to capture during the day by electrofishing, which is most effective in shallow littoral zones along the shoreline rather than deeper habitats.[10] Accordingly, adding gill net sampling, which is standard sampling gear for walleye in lentic environments,[11] [section 5.9(b)(6)] would provide more accurate information on the current walleye population in the Byllesby impoundment than daytime boat electrofishing alone. Information obtained from gill net sampling would also inform Appalachian's impingement and entrainment sub-study and aid staff's analysis of project effects (e.g., entrainment mortality) [section 5.9(b)(5)] for this focal management species.

Virginia DGIF does not provide any specific recommendations for a gill net sampling methodology, such as the: (1) number and location of gill net samples, (2) frequency of sampling, (3) duration of sampling (i.e., gill net soak times), or (4) physical dimensions and specifications of the gill nets that would be used (e.g., panel mesh sizes, float line heights, etc.). Consequently, staff recommends that 6 of the 12 boat electrofishing sites proposed by Appalachian in its Fish Community sub-study be converted to gill net sites that would be sampled during each of the two seasonal surveys (described above). Specifically, the six gill-netting sites should coincide with sites at which gill nets and/or hoop nets were previously deployed (during the aforementioned 1990 fisheries survey). Appalachian should consult with Virginia DGIF to ensure the gill nets it deploys are of the appropriate dimensions and fished for sufficient durations to ensure representative sampling of the walleye population in the Byllesby impoundment.

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[8] Ryder, R. 1977. Effects of ambient light variations on behavior of yearling, subadult, and adult Walleyes (*Stizostedion vitreum vitreum*). Journal of the Fisheries Board of Canada 34:1481-1491.

[9] Kelso, J.R.M. 1978. Diel rhythm in activity of Walleye, *Stizostedion vitruem vitreum*. Journal of Fish Biology 12:593-599.

[10] Reynolds, J.B., and A.L. Kolz 2012. Electrofishing. Pages 305-361 *in* Zale, A.V., Parrish, D.L., and T.M. Sutton, editors. Fisheries Techniques, 3rd edition. American Fisheries Society, Bethesda, Maryland.

[11] Bonar, S.A., Hubert, W.A., and D.W. Willis, editors. 2009. Standard methods for sampling North American freshwater fishes. American Fisheries Society, Bethesda, Maryland.

The addition of gill net sampling would result in minimal additional cost or effort because the same total number of samples would be collected in the study, the only difference being that 6 of the 12 sampling sites in the Byllesby impoundment would be collected with a different gear type (gill nets instead of boat electrofishing).

Candy darter

Comments on the Study

Appalachian does not propose to conduct targeted sampling for candy darter[12] because this species is only known to occur in tributary streams and is therefore not anticipated to occur within the mainstem of the New River near the project. Nevertheless, Appalachian notes that should a candy darter specimen be collected, sampling would be halted and Virginia DGIF and FWS would be notified, with sampling being reinitiated only after consultation with the agencies and receipt of the necessary protected species permits.

In comments on the RSP, Virginia DGIF and FWS note that the species account for candy darter given in the book *Freshwater Fishes of Virginia*[13] suggests that candy darter habitat use "…extends into the large New River…" where it occupies runs, riffles, and swift pockets. Given the federally endangered status of the candy darter and unknowns regarding its distribution in the mainstem New River downstream from the project, both entities recommend that exploratory sampling be conducted downstream from Buck Dam in areas determined in discussion with the agencies' respective resource specialists. Virginia DGIF and FWS state that the river reach downstream from Buck Dam contains potential candy darter habitat and could be affected by project flows and downstream water quality and quantity impacts.

Discussion and Staff Recommendation

It is unclear what is meant by the "exploratory sampling" recommended by Virginia DGIF and FWS. As described above, Appalachian proposes to conduct backpack electrofishing at six riffle/run sites at each development. Candy darter are known to be habitat specialists and primarily occupy riffle habitats (especially as adults)

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[12] Candy darter is a federally endangered species; one area in which critical habitat has been designated for this species is the Cripple Creek tributary of the New River, which is 5 miles downstream of the Buck Dam.

[13] Jenkins, R.E., and N.M. Burkhead. 1993. Freshwater Fishes of Virginia. American Fisheries Society, Bethesda, Maryland. 1079 pp.

in the New River Basin.[14,15] Furthermore, backpack electrofishing has been shown to: (1) be an effective technique for determining the presence of this rare species, (2) not result in mortalities of candy darter, and (3) be superior to snorkeling in the shallow, fast habitats and turbid conditions expected at Appalachian's proposed riffle sampling sites.[16] Therefore, because Appalachian's sampling efforts would occur in the principal habitat of candy darter (riffles) using sampling gear (backpack electrofishing) that has been shown to be effective for detecting this species from spring through fall,[17] Appalachian's Fish Community sub-study, as proposed, should be adequate for determining the presence of candy darter in the project area and staff does not recommend the exploratory sampling recommended by Virginia DGIF and FWS.

Field Surveys for Mussels

Comments on the Study

In comments on the RSP, Virginia DGIF and FWS request that Virginia DGIF's mussel biologist be consulted regarding study design parameters if Appalachian determines that a survey is not needed based on the results of the phase one habitat assessment, that the agencies be consulted before a final decision is made as to whether to conduct phase two.

Discussion and Staff Recommendation

The agencies' requests for mussel field surveys contain little information regarding a suggested sampling methodology. The two-phase study protocol proposed by Appalachian is a reasonable and sufficient approach that uses generally accepted practices in the scientific community [section 5.9(b)(6)]; as such, we have no reason to modify Appalachian's proposed sub-study at this time. Therefore, although consultation could be beneficial, we do not recommend requiring Appalachian to consult with the agencies regarding the design of the study, because ideally such discussions pertaining to

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[14] Dunn, C.G., and P.L. Angermeier. 2016. Development of habitat suitability indices for the candy darter, with cross-scale validation across representative populations. Transactions of the American Fisheries Society 145:1266-1281.

[15] Dunn, C.G. 2013. Comparison of habitat suitability among sites supporting strong, localized, and extirpated populations of candy darter (*Etheostoma osburni*). Final Report submitted to Virginia DGIF. October 2013. 74 pp.

[16] *Ibid.*

[17] *Ibid.*

study design should have occurred prior to, or in concert with, the development and filing of the RSP under the ILP study plan development process. After the first year of studies are completed, following the Initial Study Report, entities may file requests for modifications of ongoing studies (such as the Mussel Community sub-study) pursuant to section 5.15(d) of the Commission's regulations.

III. Studies Requested but Not Adopted by Appalachian

Comprehensive Sediment Study to Develop Sediment Management Plan (Sediment Study)

Study Request

Virginia DGIF requests that Appalachian conduct a Sediment Study to assess the current sediment transport condition at the project to support the formulation of a sediment management plan to mitigate for the effects of sedimentation on fisheries and other aquatic life (e.g., macroinvertebrates and mussels) managed by the agency. Specific goals and objectives of the study include determining the volume of sediment deposited in the project's impoundments to date (i.e., since emplacement of the dams in 1912) and estimating annual sediment deposition rates (via topographic differencing)[18] to predict the remaining lifespan of the impoundments. In addition, the study would assess the extent of the coarse-substrate deficit in the project's bypassed reaches and mainstem channels downstream of the dams and powerhouses via comparisons to the historic rate of sediment transport and sediment-size distributions prior to construction of the project dams. Virginia DGIF indicates the study would inform the development of a sediment management plan for the project that could include activities such as scheduled dredging in the impoundments and coarse substrate (e.g., gravel) augmentation downstream of the project dams.

Discussion and Staff Recommendation

Appalachian does not propose to conduct the Sediment Study. It states that significant sedimentation does not appear to be occurring behind the Byllesby Dam because the river channel, which is 35 feet deep in the forebay, appears to be aligned with the spillway gates and that sediment removal via dredging has not been necessary since the installation of the drag rakes at the project, which in conjunction with the run-of-river operation of the project, appear to pass adequate amounts of fine and coarse-grained sediment downstream of the dams. Appalachian also notes that maintaining a supply of coarse sediment in the bypassed reaches is not feasible due to the turbulent and high

[18] Topographic differencing uses differences in bed topography and bathymetry between time periods of interest (e.g., pre-dam versus post-dam construction) to estimate sediment deposition rates in a waterbody.

velocity hydraulic conditions that occur as a result of the high gradient of the natural streambed in the vicinity of the project and periodic high-flow events. Appalachian believes that any gravel added to the system would likely be moved downstream during the next high-flow event under present-day conditions and that adding sediment in one-time, large volume applications has the potential to smother substrates that support mussels, macroinvertebrates, and provide spawning substrates for fish. Lastly, Appalachian does not believe that aquatic resources are being significantly impacted by current project operation.

As to Virginia DGIF's request that the sediment study be conducted, in part, to document the extent of the coarse-substrate deficit in the project's bypassed reaches and mainstem channels downstream of the dams and powerhouses relative to pre-project conditions, the Commission's long-standing baseline for the environmental effects analysis during relicensing is the existing conditions, not pre-project conditions.

Information to be collected as part of Appalachian's Flow Study—Wolman pebble counts in each bypassed reach—will be sufficient to describe the current sediment conditions at the project such that a sedimentation study is not needed; therefore, we do not recommend the Sediment Study.

Fish Protection and Downstream Passage Studies

Study Request

FWS states that because Appalachian has not proposed additional measures (other than its existing trash racks)[19] to ensure safe, timely, and effective downstream fish passage, it is requesting that downstream passage protection studies be undertaken. FWS indicates these studies should include a literature search of available passage designs for species of concern, such as smallmouth bass, walleye, white sucker, and northern hog sucker, as well as information on the relative effectiveness of each design. FWS also recommends that site-specific data (flows, velocities, water depths, and substrates) be collected to aid in the design of protection and passage facilities.

Appalachian states the potential for fish entrainment or impingement will be evaluated as part of the Aquatic Resources Study (Impingement and Entrainment Desktop sub-study, described above). Appalachian notes that, based on the results of that study, additional fish protection measures may be considered, but are not being proposed at this time.

[19] The existing trash racks at each development have 2.28-inch clear-bar-spacing and are inclined 15 degrees.

Discussion and Staff Recommendation

Once completed, the proposed desktop entrainment and impingement study would provide information on the magnitude of impingement and entrainment mortality of resident fishes[20] at the project. In addition, the information collected from the fish sampling survey would inform potential population-level effects of the project (e.g., a lack of particular size or age classes suggestive of reduced spawning success and/or failed recruitment of resident fishes). Therefore, until that study has been completed, it is premature, at this time, to explore additional downstream fish protection and passage options. As such, we do not recommend that Appalachian be required to conduct the Fish Passage and Downstream Protection Studies requested by FWS.

PCB Contamination and Pollution Minimization Plan (PCB Study)

Study Request

Virginia Tech requests a study to determine the PCB[21] concentrations of sediment accumulated behind the project dams. Virginia Tech indicates the study is needed because these sediments may be disturbed during potential maintenance dredging in the project impoundments, and the information gained from the study would help develop a plan for the removal and safe disposition of these dredged materials.

Appalachian states the following reasons for not adopting the PCB study: (1) a draft Total Maximum Daily Load (TMDL) developed for the New River in September 2018 indicates that PCB impairment occurs downstream of the project, (2) no dredging of impoundment sediment is proposed at this time, and (3) any future dredging and disposal would be coordinated with the U.S. Army Corps of Engineers and Virginia Department of Environmental Quality.

[20] No diadromous fishes (i.e., those fishes that must move between freshwater and saltwater for the purposes of reproduction to complete their life cycle, such as salmon and eels) are present in the project area.

[21] PCBs, or polychlorinated biphenyls, are an industrial contaminant whose use was banned in 1979 but are still present as legacy contaminants in some aquatic systems, where they associate with, and are bound to, sediments.

Discussion and Staff Recommendation

The Total Maximum Daily Load for PCBs developed for the New River[22] indicates that PCB-impairment is limited to the portion of the river downstream of the Interstate 77 Bridge crossing, which is approximately 10 miles downstream of the project. Thus, even if maintenance dredging were conducted at the project intakes (e.g., on an as-needed basis to remove accumulated sediment that could reduce generation potential), there is no reason to believe that such dredging would liberate or contain harmful levels of PCBs.[23] As such, there appears to be no nexus between project operation and potential effects (of PCBs) on aquatic resources [section 5.9(b)(5)]. Therefore, we do not recommend requiring the PCB Study.

Water Willow Propagation, Rehabilitation, and Water Level Plan

Study Request

Virginia Tech states that aerial photos provided in the Pre-Application Document (PAD) do not include vegetation mapping that sufficiently indicates current locations of American water willow. As such, Virginia Tech requests a survey to identify shoreline habitats within the project boundary that would be suitable for propagating and planting water willow. Specific goals and objectives include stabilizing banks from erosion, reducing sediment additions to the New River, creating nursery habitat for shoreline fish and other aquatic life, and enhancing fish and wildlife productivity and biological diversity. Public interest considerations include enhanced habitat for wildlife viewing and fishing and increasing water clarity in the New River. This request also calls for a water-level management plan to address concerns that water-level fluctuations and long periods of inundation will cause mortality of water willow.

Appalachian does not propose to conduct this study, but its planned Wetland and Riparian Habitat Characterization Study will include surveys for existing water willow within the study area and its planned Shoreline Stability Assessment Study will include surveys for shorelines that can potentially benefit from vegetative plantings (to reduce erosion).

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[22] https://www.deq.virginia.gov/Programs/Water/WaterQualityInformation TMDLs/TMDL/TMDLDevelopment/ApprovedTMDLReports.aspx

[23] Appalachian states in the RSP that it does not plan to conduct routine maintenance dredging at the project.

Discussion and Staff Recommendation

Once completed, the Wetland and Riparian Habitat Characterization Study and Shoreline Stability Assessment Study will identify current water willow locations and areas where future propagation and planting measures could provide potential erosion control benefits. The results from the Wetland and Riparian Habitat Characterization Study will also be used to evaluate the potential for project effects on study habitats, and the Shoreline Stability Assessment Study will be used to identify areas where remedial action or further assessment may be needed. Therefore, the information requested by Virginia Tech will be obtained from studies proposed by Appalachian. Therefore, we do not recommend Virginia Tech's requested study.

Target biological community in the two bypass reaches and rehabilitation of the foundational plant, riverweed

Study Request

Virginia Tech states that the aquatic community in the bedrock-dominated bypassed reaches of the project has been lost and needs to be rehabilitated. To support this effort, Virginia Tech requests a study to define the metrics for restorable biological communities in the bypassed reaches, develop minimum instream flow requirements for the bypassed reaches, and to propagate and replant the bypassed reaches with the foundational plant, Hornleaf riverweed. Appalachian did not adopt this study because bypassed reach flows and associated aquatic habitat would be evaluated as part of its Flow Study, and rehabilitation via plantings is not planned at this time.

Discussion and Staff Recommendation

Information from the Flow Study (described above) would be used to develop minimum flow recommendations and inform the development of potential license requirements [section 5.9(b)(5)] for the project's bypassed reaches that consider agency management goals (especially for the seasonally dewatered Buck bypassed reach). Thus, requiring an additional minimum flow study would be redundant. Regarding Hornleaf riverweed plantings, the Flow Study and Wetlands, Riparian, and Littoral Habitat Characterization Study will provide sufficient information to assess the feasibility of potential mitigation measures such as Hornleaf riverweed plantings. For these reasons, we do not recommend requiring the study.

Survey of rare dragonflies and multi taxa survey

Study Request

Virginia Tech requests a study to compare the occurrence and abundance of dragonflies and other taxa (crayfish and small fishes) in the project area to upstream and downstream reference locations. Virginia Tech recommends that species occurrence of dragonflies be inferred during adult, nymph, and exuviae[24] surveys. More specifically, Virginia Tech proposes the use of several metrics[25] that can be used as indicators of dragonfly residency in an area, including: (1) finding adults during at least four surveys, (2) finding tenerals[26] on two or more surveys, and (3) counting more than 20 adults on at least one survey.

Appalachian did not adopt this study because its proposed Aquatic Resources Study (Macroinvertebrate and Crayfish Community sub-study) would include fish and macroinvertebrate sampling; and information on dragonfly habitat (wetlands and riparian habitat) would be provided by its proposed Wetlands, Riparian, and Littoral Habitat Characterization Study.

Discussion and Staff Recommendation

Virginia Tech does not establish a clear connection between project operation and the resources (namely dragonflies) to be studied or explain how the study results would inform the development of license requirements. Therefore, the study results would not inform the development of license requirements [section 5.9(b)(5)], and we do not recommend requiring the study.

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[24] Exuviae are exoskeletons that remain intact after molting; as such can be used to document presence of dragonfly species of interest in a study area.

[25] Survey metrics defined further in: Bried, J.T., A.M. Dillon, B.J. Hager, M.A. Patten, and B. Luttbeg. 2015. Criteria to infer local species residency in standardized adult dragonfly surveys. *Freshwater Science* 34:1105-1113.

[26] A teneral insect is one that has recently molted and its exoskeleton has not hardened and is pale with little coloration.

Recreational Value and Access Development Mitigation

Study Request

Virginia Tech states that access to the New River is a principal barrier to participation in water-based recreation and requests that Appalachian determine what barriers exist that may inhibit access to the New River.

Discussion and Staff Recommendation

Appalachian proposes a Recreation Study to gather recreation-related information to describe current public use of six recreation sites that provide access to the New River.[27] The study includes a recreation facility inventory and condition assessment, a site visit with stakeholders, an online recreation visitor use survey, and recreation use documentation. These four study tasks are designed to help Appalachian gather information on recreation use, needs, and trends at the project facilities, including at both canoe portage trails. With this information, Appalachian could identify barriers affecting public access, water-based recreation in the New River, and portage use.

Appalachian recently installed trail cameras at both portages (and other locations) to begin data collection and document participant use at these facilities. The trail cameras continue taking time-stamped photos until movement at the portages is no longer detected. Images collected will show how often the portages are used and whether entrance/exits from the New River appear easy or challenging. The photos taken of each participant group will document how long it takes a person or group to enter/exit the water. This information will inform the current use of and potential need for improvements to the portages, which would satisfy Virginia Tech's study request. Therefore, we do not recommend an additional recreation access study at the project.

[27] The Byllesby Canoe Portage, the Buck Canoe Portage, and the New River Canoe Launch are owned and operated by Appalachian. The Byllesby Virginia DCR Boat Launch, New River Trail Picnic Area, and the Buck Dam Picnic Area are operated by the Virginia DCR; these facilities are outside of the project boundary but provide public access to the lands and waters near the project.

Document Content(s)

UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION

Appalachian Power Company) Project No. 2514-186

REQUEST FOR REHEARING OF OF STUDY PLAN DETERMINATION

Pursuant to Section 313(a) of the Federal Power Act[1] and Rule 713 of the Rules of Practice and Procedure of the Federal Energy Regulatory Commission ("FERC" or "Commission"),[2] Appalachian Power Company ("Appalachian"), licensee and potential applicant for new license for the Byllesby-Buck Hydroelectric Project No. 2514 ("Project"), hereby requests rehearing of the Study Plan Determination ("SPD") issued by the Commission's Director of the Office of Energy Projects ("Director") on November 18, 2019.[3] Specifically, Appalachian requests rehearing of the Director's determination that Appalachian's Water Quality Study must be expanded to include *continuous* turbidity monitoring during the study period.

As discussed herein, the Director's determination is in error, is arbitrary and capricious, and is not supported by substantial evidence in the record. While several agencies mentioned turbidity in passing, no agency, including FERC, filed a study or information request supported by the Commission's study criteria set forth in 18 C.F.R. § 5.9(b) for a turbidity monitoring component of the Water Quality Study. The Director also did not provide any additional information or evidence to support the need for a costly and unnecessary expansion of Appalachian's turbidity monitoring proposal. Further, the Director failed to explain why

[1] 16 U.S.C. § 825*l*(a).

[2] 18 C.F.R. § 385.713 (2019).

[3] Letter Order, Terry L. Turpin, Director, Office of Energy Projects, Study Plan Determination for the Byllesby-Buck Hydroelectric Project, Project No. 2514-186 (issued November 18, 2019), at pgs. B-7 to B-8.

Appalachian's proposed level of effort described in its revised Water Quality Study would not be sufficient to meet the purported information needs, failed to address the additional level of effort and cost to implement its determination, and made assertions regarding the purported purpose of the turbidity monitoring, the causes of turbidity, and the potential effects of turbidity that are unsupported by the record.

Accordingly, Appalachian respectfully requests the Commission to grant rehearing and remove from the SPD the requirement to conduct *continuous* turbidity monitoring. In the alternative, Appalachian requests the Commission to approve the revised Water Quality Study attached hereto as Appendix A, which includes redline additions to the revised Water Quality Study intended to provide further detail regarding Appalachian's monthly, multi-parameter data collection efforts. Appalachian's proposal set forth in Appendix A would gather sufficient information regarding potential turbidity effects as it relates to Project operations and would cost significantly less to implement than the *continuous* monitoring required by the Director in the SPD. Because the Director raised the issue of continuous turbidity monitoring *sua sponte*, and such a request was not made by any agency or by Commission staff previously, it is appropriate for Appalachian to offer Appendix A as an alternative to the Director's SPD in this request for rehearing.

I. STATEMENT OF ISSUES AND SPECIFICATIONS OF ERRORS

Pursuant to Rule 713(c)(2) of the Commission's Rules of Practice and Procedure,[4] Appalachian states that the matter raised herein presents the following issue:

> Whether the Director's modifications in the SPD to the turbidity monitoring component of the Water Quality Study are in error, unsupported by substantial evidence, arbitrary and capricious, and inconsistent with the Commission's regulations. 16 U.S.C. § 825*l*;

[4] 18 C.F.R. § 385.713(c)(2).

18 C.F.R. § 5.9(b)(1)-(7); *City of Centralia v. FERC*, 213 F.3d 742, 748 (D.C. Cir. 2000).

II. BACKGROUND

The Project is located on the New River in Carroll County, Virginia, and consists of two riverine developments: Byllesby and Buck. Each development includes a dam, powerhouse, forebay, tailrace, and bypassed reach. Appalachian is the owner and licensee of the Project, and the existing license expires on February 29, 2024.

A. Pre-Application Document

On January 7, 2019, Appalachian initiated the Integrated Licensing Process ("ILP"), pursuant to Part 5 of the Commission's regulations,[5] by submitting to FERC a Notice of Intent to seek a new license for the Project and a Pre-Application Document ("PAD"). The PAD included a brief description of Appalachian's proposed studies for the Project, which were based on the issues identified during consultation with resource agencies, tribes, and other stakeholders, and included a proposal to conduct a Water Quality Study to monitor dissolved oxygen ("DO"), water temperature, and water level at a location upstream of the Byllesby reservoir and at a location downstream of each powerhouse tailrace.[6] In addition, Appalachian proposed that the Water Quality Study would include depth profile measurements once per calendar month to measure temperature, DO, acidity ("pH"), and specific conductance using a portable Hydrolab or similar data sonde at three locations spaced evenly across the forebay of each development.[7]

On May 7, 2019, Virginia Department of Game and Inland Fisheries ("VDGIF") and U.S. Department of the Interior, Fish and Wildlife Service ("FWS") filed comments on the PAD and

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[5] 18 C.F.R. Part 5.

[6] Pre-Application Document for the Byllesby-Buck Hydroelectric Project, FERC Project No. 2514, at pgs. 6-3 to 6-4 (filed January 7, 2019).

[7] *Id.*

the proposed studies described therein. With respect to their comments on the proposed Water Quality Study, the full extent of VDGIF's and FWS's comments related to turbidity is the following:[8]

> In addition, the [water quality] study needs to examine turbidity effects of project operations.

Neither agency accompanied this information request with the study criteria itemized in 18 C.F.R. § 5.9(b), which are factors that Commission staff must consider *before* requiring a potential license applicant to develop any information or study requests.[9] Commission staff did not file comments on the PAD and did not inform Appalachian of the need for any information or study requests related to water quality.[10]

A. Proposed Study Plan

On June 21, 2019, Appalachian filed with FERC a Proposed Study Plan ("PSP") that included eight studies, including a Water Quality Study.[11] Appalachian's proposed Water Quality Study included two components, identified as "Tasks." Task 1 proposed continuous water

[8] VDGIF Comments on Pre-Application Document, Scoping Document 1, and Study Requests (filed May 7, 2019); FWS Review of Pre-Application Document, Scoping Document 1, and Request for Studies (filed May 7, 2019).

[9] 18 C.F.R. § 5.9(b) states as follows (emphasis added): "Any information or study request *must*:
(1) Describe the goals and objectives of each study proposal and the information to be obtained;
(2) If applicable, explain the relevant resource management goals of the agencies or Indian tribes with jurisdiction over the resource to be studied;
(3) If the requester Is not a resource agency, explain any relevant public interest considerations in regard to the proposed study;
(4) Describe existing information concerning the subject of the study proposal, and the need for additional information;
(5) Explain any nexus between project operations and effects (direct, indirect, and/or cumulative) on the resource to be studied, and how the study results would inform the development of license requirements;
(6) Explain how any proposed study methodology (including any preferred data collection and analysis techniques, or objectively quantified information, and a schedule including appropriate field season(s) and the duration) is consistent with generally accepted practice in the scientific community or, as appropriate, considers relevant tribal values and knowledge; and
(7) Describe consideration of level of effort and cost, as applicable, and why any proposed alternative studies would not be sufficient to meet the stated information needs."

[10] 18 C.F.R. § 5.9(a) states that comments on the PAD, "*including those by Commission staff*, must be accompanied by any information gathering and study requests." (emphasis added).

[11] Proposed Study Plan, at pgs. 40-46 (filed June 21, 2019).

temperature and DO monitoring for a five-month period (from May 1 to September 30, 2020) using multi-parameter water quality instrumentation (*i.e.*, sondes) at eight locations that encompassed the upper reaches of the Byllesby reservoir, locations near the Byllesby and Buck dams, locations in each tailrace below the Byllesby and Buck powerhouses, and two locations in each of the bypassed reaches.[12] Although Appalachian did not specify which model sonde it would use, Appalachian's consultant developed the Water Quality Study and associated cost estimate assuming the use of Onset HOBO Dissolved Oxygen Loggers ("HOBO logger") (or equivalent) at each monitoring location. The HOBO logger is the industry-standard for measuring water temperature and dissolved oxygen, and each unit has a list price of $1,250.[13] The HOBO logger is small and ranges in size from 1.56 inches to 10.5 inches, and therefore is capable of being placed *in situ* for the purpose of continuous monitoring, even if the logger must be collocated with a permanent structure (where feasible) or weighted to provide protection during high-flow events.

Task 2 proposed monthly monitoring during the same five-month period of temperature, DO, pH, and specific conductance using a single, portable, multi-parameter data sonde, such as an OTT HydroMet Hydrolab MS5 Multiparameter Mini Sonde ("Hydrolab MS5"), at three locations spaced evenly across the forebay of each reservoir above Byllesby and Buck dams.[14] In addition, to accommodate the agencies' one-sentence information requests regarding turbidity monitoring as part of the Water Quality Study, Appalachian added to Task 2 the measurement of chlorophyll a and turbidity in the forebay of each development.[15] A multi-parameter data sonde equivalent to the Hydrolab MS5 is the industry-standard for measuring water quality parameters beyond water

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[12] *Id.* at pgs. 42-43.
[13] Specifications and price information for the HOBO logger is provided in Appendix B hereto.
[14] Proposed Study Plan, at pg. 46 (filed June 21, 2019).
[15] *Id.*

temperature and dissolved oxygen.[16] Each Hydrolab unit costs approximately $10,000 to purchase, or a unit can be rented for approximately $1,500 per month.[17]

Although the Hydrolab MS5 is an excellent tool for multi-parameter water quality monitoring, it is undesirable for monitoring only water temperature and dissolved oxygen levels because it is significantly more expensive than other instruments (*e.g.*, the HOBO logger) that are capable of monitoring water temperature and dissolved oxygen levels. The Hydrolab unit is also much larger and more conspicuous than other instruments (at 30 inches long), and thus may be visible to members of the public, making it vulnerable to vandalism or theft. The size also makes the Hydrolab unit vulnerable to damage or displacement due to debris or high river flows. These factors are particularly concerning given the higher cost of replacing each unit.

In the PSP, Appalachian estimated that its level of effort to complete the Water Quality Study, inclusive of Tasks 1 and 2, would be approximately 400 hours and would cost approximately $60,000.[18]

On September 18, 2019, VDGIF filed comments on the PSP pursuant to 18 C.F.R. § 5.12, which requires that "[a]ny proposed modifications to the potential applicant's proposed study plan *must* address the criteria in § 5.9(b)." (emphasis added). VDGIF's comments on the PSP state *in full* with respect to comments on the Water Quality Study and the turbidity component thereof:[19]

> Finally, VDGIF staff mentioned concerns about downstream turbidity effects of the Project in our May 7 comments, but this study fails to provide a plan for assessing turbidity effects.

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[16] Specifications for the Hydrolab MS5 data sonde are included in Appendix B hereto.

[17] While price information for this multi-parameter logger is not listed online, Appalachian's estimates are based on past experiences of Appalachian personnel and consultants.

[18] Proposed Study Plan, at pg. 46 (filed June 21, 2019).

[19] VDGIF Comments on Proposed Study Plans, at pg. 2 (filed Sept. 18, 2019).

This comment was VDGIF's first reference to its desire to modify the Water Quality Study to gather information related to *downstream* turbidity effects. As with its prior comments, VDGIF did not provide supporting information based on the criteria set forth in 18 C.F.R. § 5.9 to support its new request for information related to *downstream* turbidity effects of Project operations. Neither FWS' nor FERC staff's comments on the PSP mention Appalachian's proposal to measure turbidity monthly as part of the Water Quality Study, nor did either request modifications to the Water Quality Study related to turbidity.[20]

B. Revised Study Plan

On October 18, 2019, Appalachian filed its Revised Study Plan ("RSP") with the Commission.[21] The revised Water Quality Study provided additional detail regarding Task 1 and Task 2, and expanded to ten the number of locations where sondes would be located for continuous temperature and DO monitoring (Task 1) and for monthly monitoring of other parameters, including turbidity (Task 2).[22] In the RSP, Appalachian provided a refined estimate for the level of effort to complete the revised Water Quality Study, including the expanded scope to conduct turbidity (and other) measurements monthly at all ten locations with a single, portable multi-parameter measuring device (*e.g.*, Hydrolab MS5), of approximately 500 hours and at an estimated cost of $110,000.

In response to the RSP, VDGIF's *only* comment on the revised Water Quality Study related to turbidity is the following statement:[23]

[20] *See* FWS Review of Proposed Study Plans (filed Sept. 18, 2019); FERC Staff Comments on the Proposed Study Plan and Additional Information Requests for the Byllesby-Buck Hydroelectric Project (issued Sept. 19, 2019).

[21] Revised Study Plan for the Byllesby-Buck Hydroelectric Project (No. 2514), Project No. 2514-186 (filed October 18, 2019).

[22] *Id.* at 63-67. Notably, the two additional locations did not include the downstream tailraces for the developments because those locations were already proposed as part of the original eight sampling locations.

[23] VDGIF Comments on Revised Study Plans, at pg. 3 (filed Nov. 4, 2019).

> Finally, we appreciate the inclusion of data collection on both turbidity and chlorphyll a at the Project reservoirs.

Similarly, FWS' only comment on the revised Water Quality Study related to turbidity is the following statement:[24]

> Data collection for both turbidity and chlorophyll a at the Project reservoirs are important improvements that have been made for the RSP.

C. Director's Study Plan Determination

On November 18, 2019, the Director issued the SPD. With respect to the Water Quality Study, the Director characterized the agencies' comments on the RSP as noting "improvement," but further explained that the agencies' "concern remains regarding the mobilization of impoundment sediment deposits during project operation, which could result in increased turbidity in downstream reaches that disrupts ecological processes and negatively affects angling and recreation use."[25] As recounted above, the topics encompassed by this quote are found in none of the agencies' comments on the Water Quality Study.

Based on this mischaracterization, the Director significantly expanded the scope and cost of the turbidity monitoring component of the revised Water Quality Study to require *continuous*, instead of monthly, monitoring of turbidity and to require Appalachian to maintain a log of daily drag rake operations to "facilitate an evaluation of the relative role of (natural) high-flow events versus drag rake operations in causing turbidity spikes."[26] The Director further states that the "results of this study could inform the development of potential license requirements (e.g., the optimal timing of drag rake operation in terms of maintaining desirable turbidity levels during

[24] FWS Review of Revised Study Plans, at pg. 3 (filed Nov. 4, 2019).
[25] SPD at pg. B-7.
[26] *Id.* at pgs. B-7, B-8.

prime angling periods)," and cites 18 C.F.R. § 5.9(b)(5), which requires an *agency* to explain the nexus between an information request or a study request and project operations.[27]

Finally, the Director concludes that the cost to conduct continuous turbidity monitoring at ten locations for the study period would be "minimal" and field efforts related to turbidity monitoring would be "minimal because the turbidity sensors would be added to the same sondes that would be used for continuous monitoring of temperature and DO."[28]

As explained below, the Director's conclusions regarding the informational value of continuous turbidity monitoring have no support in the record, fundamentally misunderstand the proposal and the technology necessary to conduct the study, and underestimates the level of effort and cost to conduct continuous turbidity monitoring.

III. REQUEST FOR REHEARING

Appalachian respectfully requests rehearing of the Director's SPD.[29] Actions of the Commission, including the Director's SPD, must be supported by substantial evidence and may not be arbitrary and capricious.[30] The Director's determination that Appalachian's revised Water Quality Study must be expanded to include *continuous* turbidity monitoring at ten sampling sites is in error, is arbitrary and capricious, and is not supported by substantial evidence.

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[27] *Id.*
[28] *Id.*
[29] Order No. 2002-A clarified that once the Director makes a study plan determination pursuant to 18 C.F.R. § 5.13(c), that determination may then be appealed to the Commission in a request for rehearing pursuant to Rule 713 of the Commission's Rules of Practice and Procedure (18 C.F.R. § 385.713). *Hydroelectric Licensing Under the Federal Power Act*, Order No. 2002-A, 106 FERC ¶ 61,037, at P 17 (2004). See *also Duke Power*, 117 FERC ¶ 61,303, at P 12 (2006).
[30] 16 U.S.C. § 825*l*(b); *City of Centralia v. FERC*, 213 F.3d 742, 748 (D.C. Cir. 2000); *Bangor Hydro-Electric Co. v. FERC*, 78 F.3d 659,663 (D.C. Cir. 1996).

A. The Record Does Not Include a Single Request to Include Continuous Turbidity Monitoring as an Element of the Water Quality Study

The record fails to support the basis for continuous turbidity monitoring because no agency, including FERC, requested continuous turbidity monitoring (and therefore no agency filed support for such a request based on the study criteria in 18 C.F.R. § 5.9). The Director's *sua sponte* inclusion of this requirement in the SPD is the first time that this element has been raised as a desired component of the Water Quality Study.

The Director also failed to provide adequate justification in accordance with the study plan criteria, as required by 18 C.F.R. § 5.9, to support the need for the information for which it seeks. The Director points to 18 C.F.R. § 5.9(b)(5) when explaining that the results of continuous monitoring of turbidity at ten locations (most of which are nowhere near the drag rakes) could be used to inform potential license conditions, including the timing of the operation of the drag rake.[31] However, the requirement in the regulations is for the Commission (or any agency that requests information or a study) to address *all* of the study criteria listed in 18 C.F.R. § 5.9(b). Since no agency had previously filed this information, and the SPD is the first time this issue is being raised, the Director was obligated to provide support for its new information or study request. Because it failed to do so, the turbidity monitoring requirement described in the SPD should be rejected on rehearing.

The Director also erred in its reliance on a number of assertions that are not supported by the record. First, the Director states that, while the agencies acknowledge the revised Water Quality Study is an "improvement," "concern remains regarding the mobilization of impoundment sediment deposits during the project operations."[32] This assertion has no support in the record.

[31] SPD at pg. B-8.
[32] *Id.* at pg. B-7

The *full extent* of VDGIF's and FWS' comments on the turbidity component of the Water Quality Study presented in the PAD, PSP, and RSP are as follows:

> VDGIF and FWS (PAD): "In addition, the [water quality] study needs to examine turbidity effects of project operations."
>
> VDGIF (PSP): "Finally, VDGIF staff mentioned concerns about downstream turbidity effects of the Project in our May 7 comments, but this study fails to provide a plan for assessing turbidity effects."
>
> VDGIF (RSP): "Finally, we appreciate the inclusion of data collection on both turbidity and chlorphyll a at the Project reservoirs."
>
> FWS (RSP): "Data collection for both turbidity and chlorophyll a at the Project reservoirs are important improvements that have been made for the RSP."

It is an extraordinary leap for the Director to deduce from the above quotes in the record that (1) "concern remains regarding the mobilization of impoundment sediment deposits during project operation," (2) "[t]he results of this study could inform the development of potential license requirements (e.g., the optimal timing of drag rake operation in terms of maintaining desirable turbidity levels during prime angling periods), (3) the cost of turbidity monitoring would be "minimal," and (4) the level of effort would be "minimal because the turbidity sensors would be added to the same sondes that would be used for continuous monitoring of temperature and DO."[33]

These assertions by the Director must be found to be arbitrary and capricious. As demonstrated by the agencies' above-quoted comments on Appalachian's Water Quality Study, the agencies never once mentioned the drag rake,[34] angling, turbidity spikes, continuous versus monthly monitoring, the number of locations to be monitored (other than a reference to "downstream"), the cost of the study, or the types of sensors to be used. While Appalachian

[33] *Id.* at pgs. B-7, B-8.
[34] Appalachian notes that the Director's references to filings that describe the Project's drag rakes are not part of the record of the current proceeding.

mentioned the general types of sensors it anticipated using, it made clear that the sensor used for temperature and DO is different and less costly than the sensor that is required for other parameters, including turbidity.

Moreover, in each iteration of the ILP study development process, Appalachian tried to respond to the agencies' one-sentence information requests on the Water Quality Study. In response to the agencies' comments on the PAD, Appalachian added monthly monitoring of turbidity to the forebays. In response to VDGIF's comments on the PSP, Appalachian added monthly monitoring of turbidity to all ten sampling sites, which included the previously identified downstream tailrace locations. In each case, Appalachian attempted to respond to the information provided in the agencies' comments on the Water Quality Study; however, because information and study criteria have never been submitted to support the request for turbidity monitoring as part of the Water Quality Study, Appalachian could only guess at what the agencies (and now the Director) is trying to understand by adding turbidity monitoring to the Water Quality Study.

For these reasons, the Director's unsupported requirement that Appalachian conduct continuous turbidity monitoring should be rejected on rehearing.

B. The Cost and Level of Effort Associated with the Continuous Turbidity Monitoring is Not "Minimal."

The Director also erred when it concluded that the cost and level of effort to conduct continuous turbidity monitoring would be minimal. As discussed above, to accomplish the goals of its Water Quality Study, Appalachian planned to deploy different monitoring instruments for different purposes. The less expensive HOBO loggers would be deployed at each of ten monitoring sites to record water temperature and dissolved oxygen levels, and a more expensive Hydrolab sonde would be moved from site to site to record additional water quality parameters, including turbidity, on a monthly basis. Thus, Appalachian's equipment needs for the revised Water Quality Study would be ten HOBO-type loggers and one Hydrolab sonde.

The SPD radically changed the instrument requirements for the Water Quality Study. Appalachian will no longer be able to use HOBO loggers at the ten monitoring sites, as those instruments can only measure water temperature and DO levels. Instead, to continuously monitor turbidity, Appalachian will be required to rent or purchase Hydrolab MS5 sondes for each of the ten sites. In addition, Appalachian has concerns that placing large sondes *in situ*, like the Hydrolab MS5, in a flashy river like the New River will result in higher rates of damage and other problems with the probes. Appalachian's additional cost to rent nine additional Hydrolab MS5 units for five months would be a cost of about $67,500, which is much more than the Director's estimate of $10,000 to $15,000.[35]

Moreover, these estimates do not address the additional level of effort and labor that will be required by Appalachian and its consultants to maintain these larger sondes *in situ* at various river levels, do not include the cost of lost or damaged sondes, and do not include the additional level of effort to address data gaps as a result of such issues. For these reasons, it was error for the Director to conclude that the added cost and level of effort to conduct continuous turbidity monitoring would be "minimal."

C. The Commission Should Adopt the Revised Water Quality Study Set Forth in Appendix A In Lieu of the Turbidity Monitoring Described in the SPD

Appendix A hereto is a redline version of Appalachian's revised Water Quality Study that includes additional detail regarding Appalachian's proposal to conduct monthly temperature monitoring. This additional detail addresses some of the topics mentioned by the Director, such as coordinating the operation of drag rakes with the monthly monitoring effort in order to capture

[35] SPD at B-8.

a representative range of powerhouse operations. However, as described herein, because neither Commission staff nor agencies have submitted a study or information request supported by the criteria set forth in 18 C.F.R. § 5.9(b), Appalachian's revisions are its best guess as to the study elements that address the Commission's and agencies' information needs. Appalachian is confident that its proposal would *more precisely* meet the information needs of FERC and the agencies.

IV. CONCLUSION

For the reasons set forth herein, the Director's significant expansion of Appalachian's proposed Water Quality Study to require *continuous* turbidity monitoring is in error, is arbitrary and capricious, and is not supported by the record. Therefore, the Commission should grant rehearing and reject this component of the SPD. In lieu of the Director's turbidity monitoring requirement, the Commission should accept the revised Water Quality Study set forth in Appendix A hereto.

Respectfully submitted,

/s/ Kimberly Ognisty

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Counsel to Appalachian Power Company

Dated: December 18, 2019

APPENDIX A

Revised Water Quality Study
(with redline)

5 Water Quality Study

5.1 Study Requests

The Commission's March 8, 2019 SD1 identified the following environmental resource issues to be analyzed in the EA for the Project relicensing.

- Effects of continued Project operation and maintenance on water quality, including dissolved oxygen (DO) and water temperature, upstream and downstream of each development, including the Buck bypass reach.
- Whether there is a need for an increase in minimum flow release requirements.

In Section 6.2.2 of the PAD, Appalachian proposed to conduct a Water Quality Study within the Study Area. More specifically, depending on sampling location, Appalachian proposed to monitor temperature, DO, water level, depth profiles, pH, and specific conductance. No formal study requests were received regarding water quality; however comments were received from VGDIF, USFWS, Virginia Tech, and NRC, which are summarized as follows:

- USFWS, VDGIF, and NRC recommended that this study include a thermal aspect that considers how the Project affects the thermal regime of the New River and potential effects on coolwater endemic fishes.
- USFWS, VDGIF, and NRC recommended that this study also consider turbidity and chlorophyll a.
- VDEQ and Virginia Tech recommended that PCB concentrations in sediment deposits behind the dams be investigated.
- Virginia Tech recommended that water level loggers be installed at several locations in the Project boundary (including above and below the powerhouses and in the bypass reaches) for continuous monitoring over a minimum one year period.

  Additional comments related to this study were received from USFWS and VDGIF in response to Appalachian's filing of the PSP. These comment are summarized as follows:

- The USFWS and VDGIF noted that vertical temperature and DO profiles may need to be completed bi-weekly and that one season of sampling within the tailrace may not adequately capture the highs and lows over the license terms, especially the dry years.

  In addition to the formal comments filed, the following points relevant to this study plan were discussed at the PSP meeting on July 18, 2019:

- VDGIF noted they would prefer that the level loggers are installed in the fall of 2019 to ensure the best data is gathered in case 2020 is too dry or too wet. Appalachian noted if

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2020 is not a suitable year for collecting water quality data, the 2021 field season would be used.

- FERC noted importance of annotating water quality results using summaries and graphs in study report to note project operations and inflow conditions.
- Discussion of drag rake operation relative to sediment disturbance/release. Clarify that the rake is not intended to clear sediment, but that some sediments are incidentally scraped/mobilized during operation.

On November 18, 2019, the Commission issued a Study Plan Determination for the Project, requiring modification of the Water Quality Study proposed by Appalachian in the RSP (October 18, 2019 version) as follows:

- In each forebay, data sondes are to be placed as close to the surface and bottom of the water column as poss ble, and their locations are to remain fixed to ensure the data collected is representative of the maximal degree of stratification that occurs in the forebays.
- Appalachian is to perform additional turbidity monitoring and logging of drag rake operations during any turbidity monitoring period, to assess the effects of drag rake operation on downstream turbidity at each development.

5.2 Goals and Objectives

Appalachian's proposed study employs standard methodologies that are consistent with the scope and level of effort of water quality monitoring conducted at hydropower projects in the region. Appalachian believes that this study will provide sufficient information to support an analysis of the potential Project-related effects on water quality. The goals and objectives of this study are to:

- Gather baseline water quality data sufficient to determine consistency of existing Project operations with applicable Virginia state water quality standards and designated uses.
- Provide data to determine if the Byllesby and Buck impoundments undergo thermal and/or DO stratification and, if so, determine the presence and location of the metalimnion.
- Provide data to support a Virginia Water Protection Permit application (Clean Water Act Section 401 Certification).
- Provide information to support the evaluation of whether additional or modified protection, mitigation, and enhancement measures may be appropriate for the protection of water quality at the Project's developments.

5.3 Study Area

The Study Area for the Water Quality Study is shown on Figure 1-4, and includes the reservoirs, bypass reaches, and tailwaters downstream of Byllesby and Buck dams.

5.4 Background and Existing Information

Existing relevant and reasonably available information regarding water quality in the Project vicinity was presented in Section 5.3 of the PAD (Appalachian 2019). The PAD included historical water quality data collected in support of the existing license and recent water quality data collected during mussel salvage and relocation efforts, and other data collection efforts. These data indicate that temperatures and DO concentrations did not differ between impoundments and tailraces, and no evidence of thermal stratification was observed in either impoundment. Data from the historical studies also demonstrated that the Project waters meet the state water quality standards, including temperature maximums and DO minimums.

On August 29, 2019, a site visit was conducted by HDR for Appalachian to attempt to collect pre-relicensing study season water quality data and evaluate field logistics associated with potential water quality monitoring locations for the Byllesby and Buck developments. During the site visit, a calibrated multiparameter water quality data sonde was used to collect depth profiles in each development's forebay and also spot measurements in each development's tailwater. These data are summarized on Figure 5-1 for Byllesby and Figure 5-2 for Buck. Flow during the site visit was approximately 1,500 cfs measured at the New River at Ivanhoe, Virginia USGS gage (03165500) which is typical of average flow conditions in August at this location (mean monthly discharge for August as shown in Table 4-2 is 1,495 cfs; 1929 – 2019).

During the site visit, the Byllesby forebay elevation was in the normal operating range,[3] however, the Buck forebay elevation was approximately 9 feet lower than the normal operating range[4] to facilitate construction activities associated with installation of the new Obermeyer gates.

All water quality measurements during the site visit were within applicable Virginia state water quality standards. As Figure 5-1 and Figure 5-2 indicate, the depth profiles in each forebay did not show any significant difference in water quality from top to bottom, or from side-to-side. Given that these depth profiles were collected during peak summer conditions and under a relatively low flow, it is not expected that there would be differences in water quality from side-to-side in the forebay areas during the summer months. The tailwater measurements were reflective of the water quality in each forebay.

[3] Normal operating range for he Byllesby impoundment is between 2,078.2 – 2,079.2 feet above mean sea level.

[4] Normal operating range for he Buck impoundment is between 2,002.4 – 2,003.4 feet above mean sea level. During the August 29, 2019 water quality sampling site visit, he forebay elevation was approximately 1994 feet above mean sea level; or approximately 9 feet below the normal operating range.

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Figure 5-1. Water Quality Parameters for Byllesby

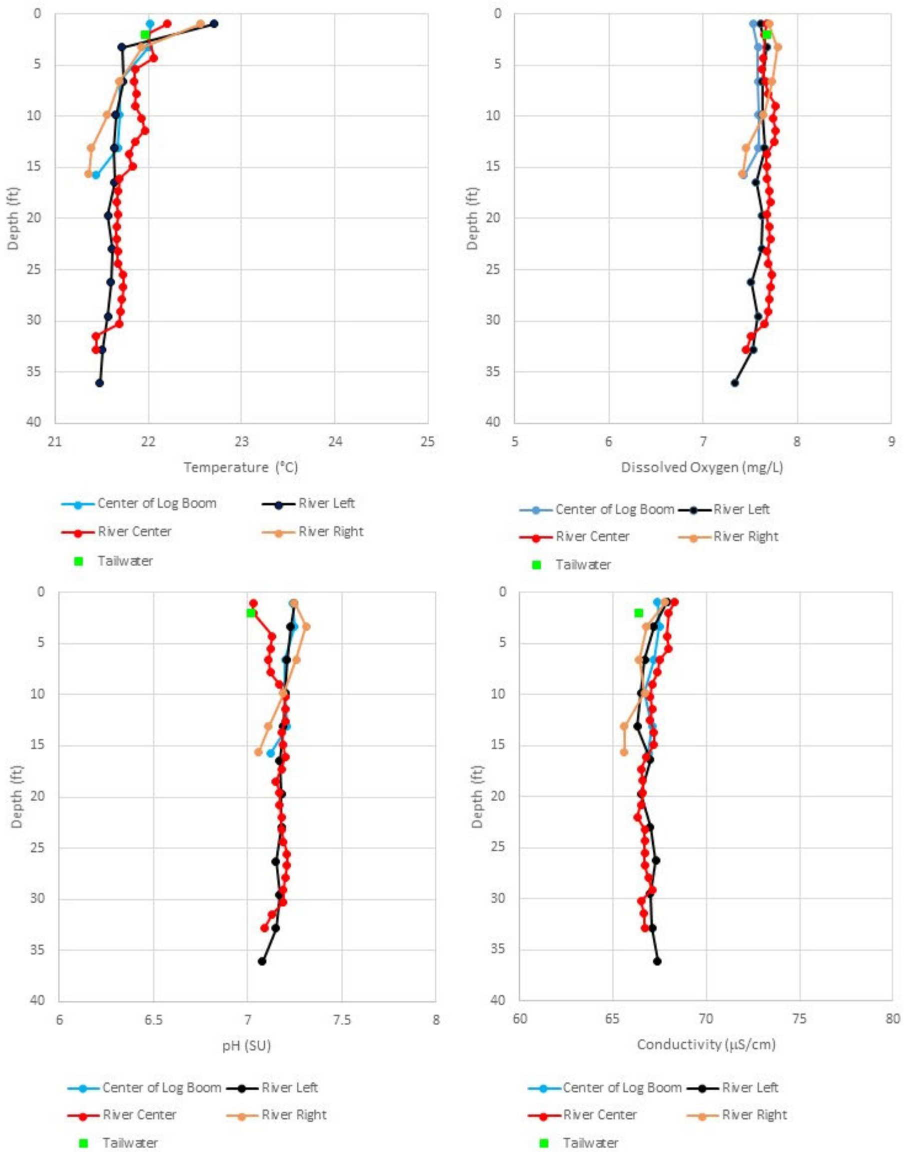
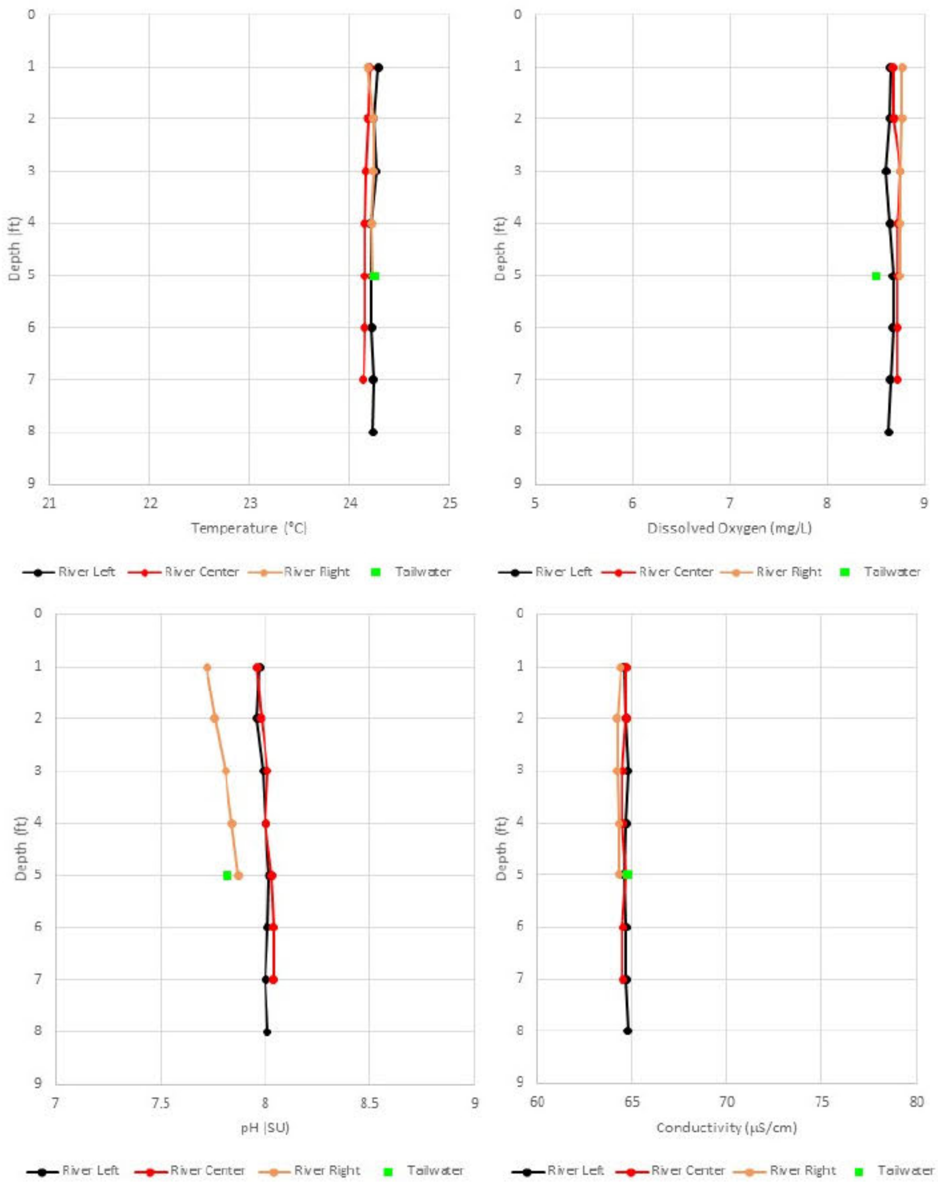


Figure 5-2. Water Quality Parameters for Buck



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Multiple segments of the New River are listed as impaired for aquatic life or recreation uses due to *E. coli* concentrations. However, the source of *E. coli* is not associated with the Project and it is expected that continued operation of the Project will have no effect on *E. coli* concentrations in the New River.

From 2003 to 2006, VDEQ collected 209 samples to evaluate organic chemicals in sediment (VDEQ 2018). A low percentage of stream miles had concentrations above the Probable Effects Concentration and sampling has since been suspended due to low concentrations and high sampling costs.

A TMDL study for PCBs was performed for VDEQ by Virginia Tech in the New River watershed and a draft TMDL was developed and last updated in September 2018. According to results of the TMDL study, the PCB impaired segment of the New River in Virginia is located downstream of the Project, beginning where U.S. Interstate 77 crosses the river, and continuing downstream to where the river crosses the Virginia/West Virginia state line (Virginia Tech 2018).

No dredging of reservoir sediment is proposed by Appalachian at this time, nor does Appalachian propose any construction or maintenance activities that could cause the mobilization of reservoir sediments. It is noted that prior dredging activities (1997 and 2014) and associated constituent testing received approval for placement of dredged sediments which were then used for the creation of an emergent wetland upstream of Byllesby and for offsite beneficial reuse.

FERC staff requested that Appalachian provide the results of any PCB testing conducted in support of previous sediment removal projects at the Project (1997 and 2014) in the RSP. Appalachian has reviewed available files and documentation for the Project and provides the following additional information.

Extensive sediment core sampling and testing was conducted during the 1997 dredging at Byllesby. Appalachian is unable to locate the original report or data for this testing; however, the Clean Water Act Section 404 permit issued by USACE for this project includes several agency letters and references to the 1997 toxicity testing, including VDEQ concurrence that the tested material was essentially clean. Documentation of agency consultation in this permit also notes that Appalachian was certain no dredging had been done within the 30 years prior to this effort. A copy of this permit and associated documentation was filed with FERC on October 21, 1997 and is available on FERC's eLibrary.[5]

Permits issued for the dredging conducted at Byllesby in 2014 did not include specific requirements to test the material. Appalachian did, however, perform testing according to the U.S. Environmental Protection Agency (USEPA) SW-846 Test Method 1311: Toxicity Characteristic Leaching Procedure on composite samples from within the forebay. While not specifically tested for PCBs, these tests resulted in no actionable levels for heavy

[5] Accession number 19971021-0377

metals (arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver). Furthermore, based on the material composition removed (sand, gravel, etc.), Appalachian does not believe PCB's would be present in the dredged material as PCB's do not have an affinity to bind to such coarse-grained material.

As stated in the PAD, any necessary future dredging and disposal would be coordinated with the U.S. Army Corps of Engineers and VDEQ pursuant to license Article 12 to obtain any required permits and approval. Although prior testing indicated the material was safe for other uses, Appalachian understands that proposed new dredging authorization may require additional testing for constituents of concern in the sediments being proposed for dredging prior to, and depending on the results of such testing, determining the appropriate fate of the material.

5.5 Project Nexus

The Byllesby and Buck developments are operated in a run-of-river mode under all flow conditions, with operation of the two developments closely coordinated. Due to the small size and short retention time of the Project reservoirs, the lack of thermal stratification demonstrated by past studies, and the mode of operation, Appalachian does not expect that operation of the Project affects ambient water quality in the New River above or below the Project.

The Project impounds water at the Buck and Byllesby dams. Meteorological and hydrological conditions (flow) and operation of the Project, including diversion of flows to the powerhouse for generation and resultant reduction of flows to the bypass reaches, may combine to impact water quality parameters such as temperature and DO in the Project reservoirs, powerhouse tailraces, and bypass reaches.

5.6 Methodology

5.6.1 Task 1 – Continuous Water Temperature and DO Monitoring

Appalachian proposes to monitor temperature and DO using multiparameter water quality instrumentation (i.e. sondes, e.g., Onset® HOBO® Dissolved Oxygen Logger (or equivalent) at the following locations:

- One location in the upstream extent of the Byllesby reservoir
- Two locations in the Byllesby forebay (upper and lower portion of the water column)
- One location in the Byllesby tailrace below the powerhouse
- One location in the Byllesby bypass reach (approximate mid-point)
- Two locations in the Buck forebay (upper and lower portion of the water column)
- One location in the Buck tailrace below the powerhouse
- Two locations in the Buck bypass reach (one upstream area and one downstream area)

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The approximate locations are depicted on Figure 5-3 and Figure 5-4. Appalachian expects to verify these locations during the initial field deployment and will communicate any substantive changes to the VDEQ and other interested relicensing participants.

All water quality monitoring locations will be geo-referenced using GPS. GPS locations will be included in a GIS database layer to support the documentation and reporting of collected data and to facilitate comparisons with future monitoring efforts.

Water temperature and DO data sondes will be deployed for a single season, from May 1, 2020 through September 30, 2020 and will collect data at 15 minute intervals. Each of the data sondes will be cleaned and calibrated prior to deployment and checked each month during data retrieval. As necessary, protective measures may be employed, such as weighting the data sondes or attaching them to permanent structures (where feasible) to maintain position during high flow events. Note the data sondes deployed in the tailwater and bypass reach locations will also collect temperature and DO data during the flow test events described in the Flow and Bypass Reach Aquatic Habitat Study (Section 4). If a data sonde is lost due to vandalism or a high flow event, Appalachian will replace the instrumentation one time only.

Data sondes deployed in the Byllesby and Buck forebays will be set at two discrete depths to determine the existence and extent, if any, of thermal and DO stratification. The upper data sonde will be placed approximately 3 feet below the surface of the reservoir and the lower data sonde will be placed approximately 3 feet above the bottom of the reservoir at each forebay monitoring location.

Deleted: Based on the August 29, 2019 site visit described above, the depth of the Byllesby forebay at approximately the mid-point of the spillway structure is approximately 35 feet. As a result, the upper data sonde will be placed approximately 12 feet below the surface and the lower data sonde will be placed approximately 24 feet below the surface. The depth of the Buck forebay near the center of the intake channel is approximately 17 feet.[6] As a result, the upper and lower data sondes will be placed at approximately 6 feet and 12 feet below the surface, respectively.

Figure 5-3. Byllesby Water Quality Study Locations

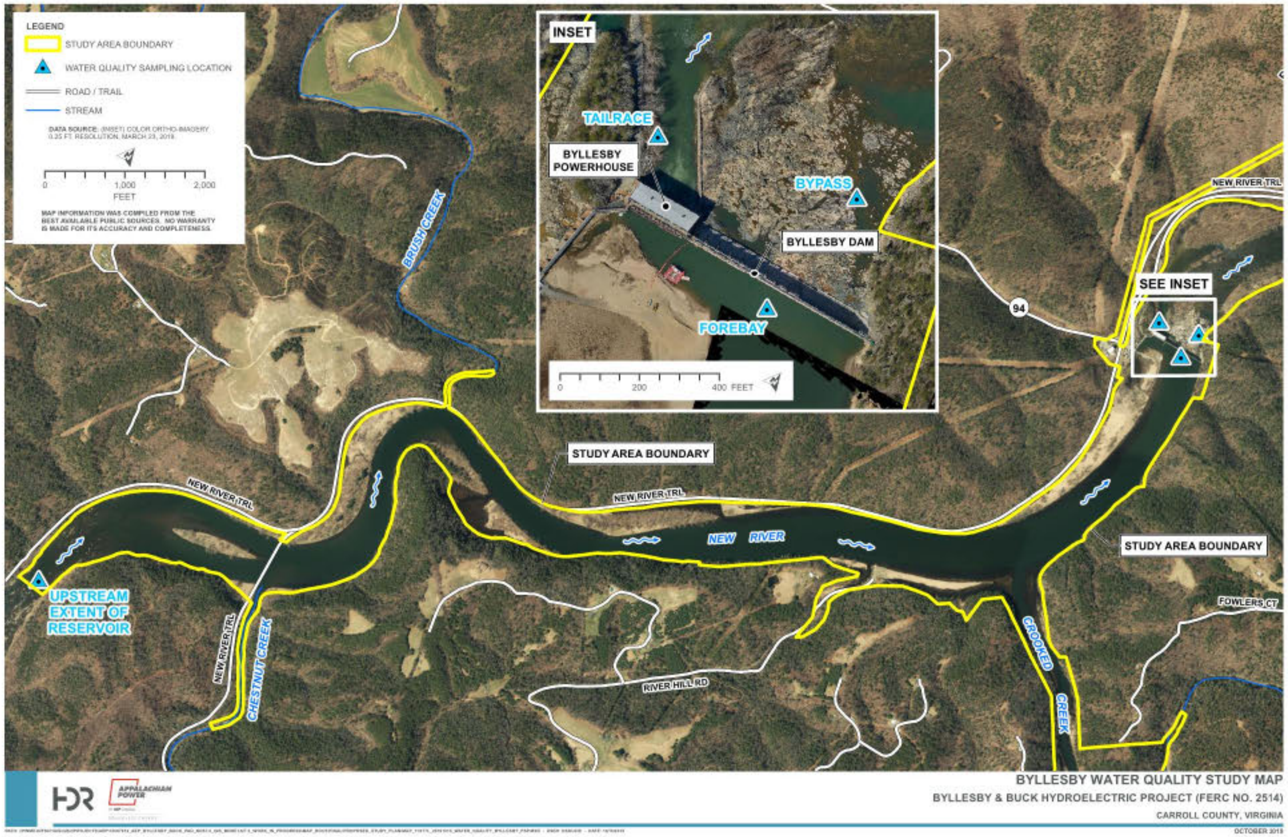

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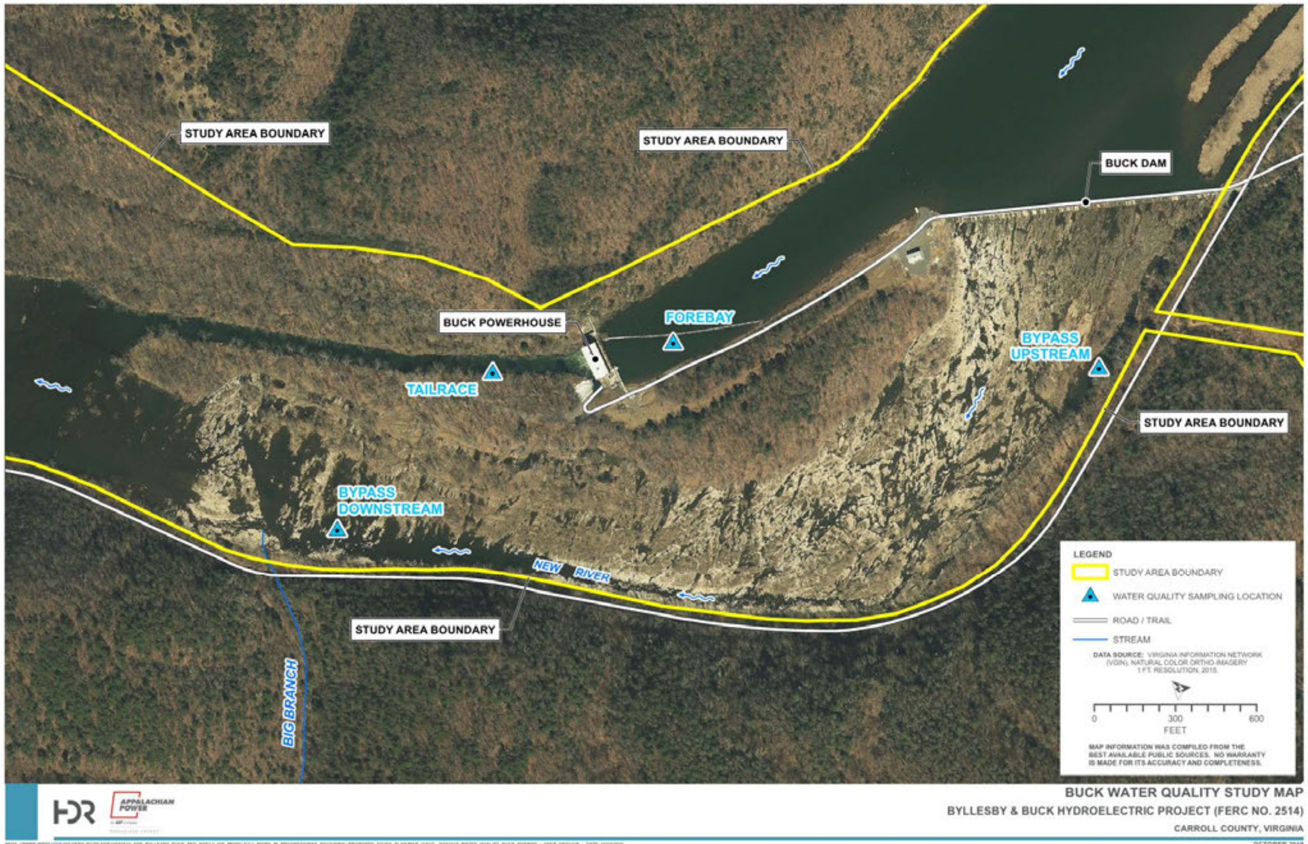
Figure 5-4. Buck Water Quality Study Locations



5.6.2 Task 2 – Monthly Water Quality Monitoring

In addition to continuous monitoring, once per calendar month (May through September), in situ water quality measurements of temperature, DO, pH, and specific conductance will be collected at each of the locations descr bed above with a Hydrolab (e.g., OTT HydroMet® Hydrolab® MS5 Multiparameter Mini Sonde, or equivalent) or similar data sonde. At the forebay monitoring locations, depth profiles will be collected each month. If it appears that brief periods of stratification may be occurring, collection of forebay depth profiles may be increased to bi-weekly.

Chlorophyll a will also be measured in the forebay of each development during the monthly sampling events. Chlorophyll a will be collected via grab samples at a single depth of approximately one meter and samples will be subsequently analyzed at an off-site laboratory.

Individual water quality measurements (temperature, DO, pH, conductivity) will also be collected during fisheries and macroinvertebrate field sampling events.

Deleted: Note the depths of the data sondes (used for continuous monitoring) may be adjusted, if necessary, during the study based on a comparison of the continuous temperature and DO results with the monthly depth profile measurements. In addition,

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Deleted: Turbidity will also be measured at a single depth of approximately one meter using a portable turbidity meter at each of the continuous water quality monitoring locations. Turbidity measurements will be recorded in Nephelometric turbidity units.¶

5.6.3 Task 3 – Turbidity Monitoring

Appalachian will conduct a study to evaluate the potential impact that Project operations, in particular drag rake operations, may have on turbidity concentrations in the Project tailraces. The study will be conducted over a two-day period under relatively low flow conditions. During this study period, a Hydrolab or similar data sonde equipped with a turbidity sensor will be installed at each of the locations listed below (which coincide with the continuous monitoring locations shown in Figures 5-3 and 5-4) to continuously record turbidity concentrations (in Nephelometric turbidity units) at 5-minute intervals.

- One location in the upstream extent of the Byllesby reservoir (to characterize background turbidity levels)
- One location in the Byllesby forebay (approximate mid-depth)
- One location in the Byllesby tailrace below the powerhouse
- One location in the Buck forebay (approximate mid-depth)
- One location in the Buck tailrace below the powerhouse

During this study period, Appalachian will operate the generating units and trash (drag) rakes at each Project under a pre-determined range of normal operating regimes. The timing of these operations will be recorded. Turbidity data collected will be evaluated against trash rake operation and powerhouse generation in an effort to help determine any differences in downstream turbidity concentrations resulting from station operations versus naturally occurring background conditions.

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5.7 Analysis and Reporting

Results of this study will be summarized in a final study report. Appalachian anticipates that the Water Quality Study report will include Project information and background, a depiction and descriptive narrative of the Study Area, methodology, results, analysis, and discussion. In addition, stakeholder correspondence and/or consultation will be included, as well as any literature cited. Raw data will be provided in appendices to the study report.

5.8 Schedule and Level of Effort

The preliminary schedule for this study is outlined in Table 5-1. The estimated level of effort for this study is approximately 500 hours. Appalachian estimates that the Water Quality Study will cost approximately $130,000 to complete. If the proposed study period is deemed anomalous due to abnormally wet and/or cool weather conditions, a second study year may be necessary to capture water quality conditions representative of typical summer conditions. Additionally, if the water quality data collected during the proposed study period does not meet the goals and objectives described in Section 5.2, a second year of data collection may be necessary.

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Table 5-1. Proposed Water Quality Study Schedule

Task	Proposed Timeframe for Completion
Study Planning and Existing Data Review	January – March 2020
Continuous and Monthly Water Quality Monitoring (DO and temperature)	May – September 2020
Distribute Draft Study Report with the ISR	November 2020

APPENDIX B

Water Quality Monitoring Equipment Specifications

ONSET®

HOBO Dissolved Oxygen Data Logger

Part # U26-001

$1250 USD

This item ships FREE!

This logger requires HOBOware Pro software and either a U-DTW-1 Waterproof Shuttle or the Base-U-4 Optic USB Base Station for configuration and data offload. Please see compatible items below.

Overview

Measure oxygen concentrations in lakes, streams, rivers, estuaries, and coastal waters with the HOBO U26 Dissolved Oxygen Data Logger. This affordable and precise data logger is recommended for aquatic biology and hydrology research projects. The HOBO U26 uses RDO® Basic (Rugged Dissolved Oxygen) optical DO sensor technology and is easy to maintain.

Includes:

- U26-001 data logger
- DO sensor cap
- Protective Guard
- Calibration Boot with sponge

Our HOBO U26 Dissolved Oxygen logger has been part of a multi-year evaluation of DO loggers and sensors by the Alliance for Coastal Technologies (ACT), and the results have been published online. This provides an un-biased report of how our U26 performs in lab and field conditions. Note that our response letter with our added recommendations is attached at the end of this report on pages 58 and 59.

Click here to read.

Highlighted Features

- Affordable, high performance dissolved oxygen (DO) monitoring with 0.2 mg/L accuracy

- Optical DO sensor technology for long-lasting calibration with less maintenance
- HOBOware Pro's Dissolved Oxygen Assistant software corrects for measurement drift from fouling; provides salinity-adjusted DO concentrations and percent saturation
- Optical USB interface for high-speed, reliable data offload
- Easy-to-replace DO sensor cap lasts six months

NOTE: For DO measurements in saltwater, an adjustment for salinity is required. For waters with small changes in salinity (<2 ppt), a salinity meter reading typically provides enough accuracy. For environments with greater salinity changes, we generally recommend the HOBO U24-002-C conductivity logger . If you need DO in Percent Saturation, barometric pressure data is required, which can be logged with a HOBO Water Level Data Logger (U20-001-04).

In what environment does this data logger operate?

This data logger operates in an underwater environment.

What measurements does this data logger support?

The U26-001 data logger supports the following measurements: Dissolved Oxygen and Temperature

Detailed Specifications

HOBO Dissolved Oxygen Data Logger

Dissolved Oxygen	
Sensor Type:	Optical
Measurement Range:	0 to 30 mg/L
Calibrated Range:	0 to 20 mg/L; 0 to 35°C (32 to 95°F)
Accuracy:	± 0.2 mg/L up to 8 mg/L; ± 0.5 mg/L from 8 to 20 mg/L
Resolution:	0.02 mg/L
Response Time:	To 90% in less than 2 minutes
DO Sensor Cap Life:	6 months, cap expires 7 months after initialization
Temperature	
Temperature Measurement/Operating Range:	-5 to 40°C (23 to 104°F); non-Freezing
Temperature Accuracy:	0.2°C (0.36°F)
Temperature Resolution:	0.02°C (0.04°F)
Response Time:	To 90% in less than 30 minutes
Logger	
Memory:	21,700 sets of DO and temperature measurements (64 KB total memory)
Logging Rate:	1 minute to 18 hours
Time Accuracy:	±1 minute per month at 0 to 50°C (32 to 122°F)
Battery:	3.6 V lithium battery; factory replaceable
Battery Life:	3 years (at 5 minute logging)
Download Type:	Optical

Depth Rating:	100 m (328 ft)
Wetted Materials:	Black Delrin®, PVC, EPDM o-rings, silicone bronze screws; rated for saltwater use
Size:	39.6 mm diameter x 266.7 mm length (1.56 x 10.5 inches)
Weight:	464 g (16.37 oz)
Environmental Rating:	IP68
CE	The CE Marking identifies this product as complying with all relevant directives in the European Union (EU).

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Hydrolab MS5 - Mulitparameter Mini Sonde

Lightweight multi-probe with four ports available for water quality sensors

The Hydrolab MS5 multiparamete
selection of Hydrolab sensors on
multiprobe designed for either prc
monitoring. Its compact housing f
space applications.

Product type:	Attended
Parameters measured:	Tempera Dissolvec Turbidity, Rhodamii Chloride
Product highlights:	The Hydr sensor pc well
Interface:	SDI-12, R!

Request a quote or advice

Advantages | Resources | Sensors | Accessories | Technical Data

Download PDF

Sensors	**Measures up to 10 parameters simultaneously**
Electrical	
Internal	8 AA batteries (with available internal battery pack option)
Communications	RS-232, SDI-12, RS-485
Memory	Up to 120,000 measurements
User Interface	
PC Software	Hydras3 LT
Pocket PC Software	(Optional) TDS Recon with Hydras 3 LT Pocket
General	
Sonde Depth Rating	200 m (656 ft)
Diameter	4.4 cm (1.75 in.)

CERTIFICATE OF SERVICE

I hereby certify that I have this day served the foregoing document upon each person designated on the official service list in this proceeding in accordance with the requirements of Rule 2010 of the Commission's Rules of Practice and Procedure.

Dated at Washington, D.C. this 18th day of December, 2019.

/s/ Carlos L. Sisco
Carlos L. Sisco
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Winston & Strawn LLP
1700 K Street, N.W.
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202-282-5000

170 FERC ¶ 61,108
UNITED STATES OF AMERICA
FEDERAL ENERGY REGULATORY COMMISSION

Before Commissioners: Neil Chatterjee, Chairman;
Richard Glick and Bernard L. McNamee.

Appalachian Power Company | Project No. 2514-188

ORDER ON REHEARING

(Issued February 20, 2020)

1. On November 18, 2019, the Director, Office of Energy Projects (Director), issued a study plan determination pursuant to the Integrated Licensing Process (ILP) for Appalachian Power Company's (Appalachian) proposed relicensing of the 30.1-megawatt Byllesby-Buck Hydroelectric Project No. 2514.[1] On December 18, 2019, Appalachian filed a request for rehearing objecting to one aspect of the required water quality study: the timing and scope of monitoring to gather data on turbidity. As discussed below, we grant in part and deny in part Appalachian's request for rehearing.

I. Background

2. The Byllesby-Buck Project consists of two developments, Byllesby and Buck, which are located on the New River in Carroll County, Virginia. The Byllesby development is located about nine miles north of the City of Galax, while the Buck development is located approximately three river miles downstream of Byllesby. Each development includes an impoundment, concrete gravity dam and spillway, and powerhouse.

3. On January 7, 2019, Appalachian initiated the ILP for relicensing the project pursuant to Part 5 of the Commission's regulations.[2] As part of the ILP, Appalachian is required to consult with resource agencies, tribes, and other stakeholders to develop and conduct studies that will inform Commission staff's environmental analysis and, ultimately, the Commission's decision on whether, and with what conditions, to issue a

[1] *Appalachian Power Co.*, Study Plan Determination for the Byllesby-Buck Hydroelectric Project (Nov. 18, 2019).

[2] 18 C.F.R. pt. 5 (2019).

new license for the project.[3] The studies also provide information that resource agencies can use to prepare comments, recommendations, and terms and conditions for inclusion in any license that may be issued for the project.

4. Any request for a particular study must address seven criteria[4] designed to ensure that the requested study is "not [] frivolous and would add some appreciable evidentiary value to the record."[5] The license applicant files a proposed study plan.[6] After a comment period, the applicant files a revised study plan for the Commission's approval.[7] The Director then issues a study plan determination that includes any modifications the Director determined necessary.[8]

A. <u>Appalachian's Pre-Application Document (PAD) and Proposed Study Plan</u>

5. In its PAD, Appalachian proposed to conduct a single-season water quality study,[9] in which it would monitor dissolved oxygen, water temperature, and water levels at 15-minute intervals and measure temperature, dissolved oxygen, pH, and specific conductance monthly.[10] This proposed water quality study did not include a component to study water turbidity.

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[3] *TransCanada Hydro Ne. Inc.*, 151 FERC ¶ 61,116, at P 4 (2015); *see also* 18 C.F.R. §§ 5.1, 5.6(b) (2019). The study plan development process is governed by sections 5.9 through 5.14 of the Commission's regulations. 18 C.F.R. §§ 5.9-5.14 (2019).

[4] 18 C.F.R. § 5.9(b).

[5] *Hydroelectric Licensing Under the Federal Power Act*, Order No. 2002, 104 FERC ¶ 61,109, at P 87 (2003) (discussing the purpose of the study criteria) (citing *Hydroelectric Licensing Under the Federal Power Act*, Notice of Proposed Rulemaking, 102 FERC ¶ 61,185, at P 67 (2003)).

[6] 18 C.F.R. § 5.11(a).

[7] *Id.* §§ 5.12, 5.13.

[8] *Id.* § 5.13(c).

[9] Appalachian January 7, 2019 Pre-Application Document at 6-3 to 6-4.

[10] *Id.* at 6-4.

6. At a public scoping held on April 11, 2019, participants, including the Virginia Department of Game and Inland Fisheries (Virginia DGIF), commented that the New River carries a heavy sediment and debris load. Appalachian stated that it takes actions to mitigate or prevent adverse effects caused by sedimentation and debris accumulation at the project.[11] For example, Appalachian stated it routinely uses a drag rake system installed at both developments in 1997, which "goes out into the forebay any distance you want, drops to the bottom, to the forebay bed, drags along that, and then comes up to the intake screen."[12] While larger debris collected by the drag rake is deposited into an above-water trash trough that sluices the debris downstream, material that is small enough to pass through the project's intake trash racks (i.e., re-suspended fine sediments) will pass downstream through the powerhouse.[13]

7. On May 7, 2019, Virginia DGIF filed comments on the PAD and Scoping Document 1, asserting that "[l]iberation of reservoir sediment deposits during operations result in increased turbidity in downstream reaches influenced by project flow, disrupting ecological processes, suspending contaminants like PCB's, and negatively affecting angling and recreational use."[14] The U.S. Fish and Wildlife Service (FWS) noted that the project is located on a stretch of the New River that is important for recreation[15] and, more specifically, mirrored Virginia DGIF's concerns about the increased turbidity negatively affecting angling and recreational use.[16] Both agencies also explicitly stated

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[11] Transcript of April 11, 2019 Public Scoping Meeting held in Galax, Virginia at 32-38.

[12] *Id.* at 35.

[13] *Id.* at 35-36.

[14] Virginia DGIF May 7, 2019 Comments at 2.

[15] FWS May 7, 2019 Comments at 4; *see also id.* at 8 (noting that there are desirable fishing locations at the tailrace areas of both dams). These comments are consistent with the PAD, which states that the upper New River is a popular sportfishing area and that the project area is specifically known for the quality of angling opportunities for several species of fish. Appalachian January 7, 2019 Pre-Application Document at 5-35.

[16] FWS May 7, 2019 Comments at 4. FWS also identified as a resource management goal "angling opportunities" when requesting a hydraulic and instream flow study. *See id.* at 12.

that the water quality study needs to "examine turbidity effects of project operations."[17] The New River Conservancy echoed these comments.

8. On June 21, 2019, Appalachian filed its proposed study plan. It proposed a water quality study consisting of Task 1 – Continuous Water Temperature and [Dissolved Oxygen] Monitoring and Task 2 – Monthly Water Quality Monitoring of temperature, dissolved oxygen, pH, specific conductance, chlorophyll a, and turbidity. Appalachian added that "[c]hlorophyll a and turbidity will also be measured in the forebay of each development during the monthly sampling events."[18] Appalachian stated that the estimated level of effort for the water quality study in total would be approximately 400 hours, at a cost of approximately $60,000.[19]

9. On June 21, 2019, Commission staff issued a revised scoping document. Responding to the comments by Virginia DGIF, FWS, and the New River Conservancy, the document stated that "turbidity could be affected by project operation and maintenance (e.g., by releasing sediment collected by the drag rake through the project intakes) . . . Accordingly, . . . our environmental analysis will include the effects of project operation and maintenance on turbidity levels . . . ."[20]

10. On September 18, 2019, Virginia DGIF commented on the proposed study plan, again noting that "[l]iberation of reservoir sediment deposits during Project operations result in increased turbidity in downstream reaches influenced by Project flow, disrupting ecological processes and negatively affecting angling and recreational use."[21] Virginia DGIF also stated that its "staff mentioned concerns about downstream turbidity effects of the Project in our May 7 comments, but this study fails to provide a plan for assessing turbidity effects."[22] On September 19, 2019, FWS commented that the proposed study plan "does not address the magnitude and spatial scale of Project influence. Determining

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[17] Virginia DGIF May 7, 2019 Comments at 5; FWS May 7, 2019 Comments at 7.

[18] Appalachian June 21, 2019 Proposed Study Plan at 7.6.2.

[19] *Id.* at 7.8.

[20] *Appalachian Power Co*., Scoping Document 2 for the Byllesby-Buck Hydroelectric Project at 7-8 (June 21, 2019).

[21] Virginia DGIF September 18, 2019 Comments at 1.

[22] *Id.* at 2.

the spatial scale of Project influence should include consideration of Project flow attenuation and downstream turbidity effects of Project operations . . . ."[23]

B. Appalachian's Revised Study Plan

11. On October 18, 2019, Appalachian filed a revised study plan, proposing, as relevant here, to add to Task 2 measuring turbidity monthly at each of the continuous water quality monitoring locations using a portable turbidity meter to measure turbidity at a single depth of approximately one meter.[24] Appalachian estimated the level of effort for the water quality study in total would increase to approximately 500 hours and the cost to approximately $110,000.[25] Appalachian also stated in the revised study plan that "the [drag] rake[s] [are] not intended to clear sediment, but that some sediments are incidentally scraped/mobilized during operation."[26]

12. On November 4, 2019, Virginia DGIF commented on the revised study plan, again noting that "[l]iberation of reservoir sediment deposits during Project operations result in increased turbidity in downstream reaches influenced by Project flow, disrupting ecological processes and negatively affecting angling and recreational use" and that "[d]etermining the downstream spatial influence will involve consideration of Project flow attenuation and downstream turbidity effects of Project operations."[27] Virginia DGIF also noted that it "appreciate[d] the inclusion of data collection on [turbidity] at the Project reservoirs."[28] On November 4, 2019, FWS provided a nearly identical comment.[29] It also added that "data collection for [turbidity] at the Project reservoir [is an] important improvement[]" to the revised study plan.[30]

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[23] FWS September 19, 2019 Comments at 1.

[24] Appalachian October 18, 2019 Revised Study Plan at 5.6.2.

[25] *Id.* at 5.8.

[26] *Id.* at 5.1.

[27] Virginia DGIF November 4, 2019 Comments at 1.

[28] *Id.* at 3.

[29] FWS November 4, 2019 Comments at 1.

[30] *Id.*

C. Director's Study Plan Determination Regarding Turbidity

13. The study plan determination rejected Appalachian's proposal to sample turbidity once per month as lacking the "frequency needed to properly assess the effects of project operation (drag rake) on downstream turbidity at each development" because the drag rake operation, while dependent on debris load, generally occurs multiple times per day.[31] The Director instead required Appalachian to "install continuously-recording turbidity sensors (with 15-minute measurement intervals) on each of the 10 multiparameter data sondes that would be deployed across . . . eight sampling sites."[32] The Director also required that Appalachian maintain a daily log of drag rake operations, reasoning that such a log would allow for turbidity values "to be compared between time periods when the drag rakes are operating and when they are not, which would facilitate an evaluation of the relative role of (natural) high-flow events versus drag rake operations in causing turbidity spikes."[33]

14. The determination referenced Virginia DGIF's and FWS's comments on turbidity[34] and explained that the drag rake operations in each forebay (Byllesby and Buck) cause resuspension of sediment from the bottom (due to the scraping action of the rake), which is then passed downstream through the intakes and could increase downstream turbidity and affect aquatic and recreation resources. Finally, the Director noted that the study results:

> could inform the development of potential license requirements (e.g., the optimal timing of drag rake operation in terms of maintaining desirable turbidity levels during prime angling periods) [section 5.9(b)(5)]. The cost would be minimal and largely depend on whether Appalachian currently has access to additional turbidity sensors or needs to purchase them (the approximate cost of the sensors is $10,000 to $15,000). Additional field efforts associated with staff's recommended turbidity monitoring would be minimal because the turbidity sensors would be added to the same sondes

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[31] *Appalachian Power Co.*, Study Plan Determination for the Byllesby-Buck Hydroelectric Project at B-7 (Nov. 18, 2019).

[32] *Id.* The eight sampling sites are: (1) upper end of the Byllesby impoundment; (2) Byllesby forebay; (3) Byllesby bypassed reach; (4) Byllesby tailrace; (5) Buck forebay; (6) upper Buck bypassed reach; (7) lower Buck bypassed reach; and (8) Buck tailrace.

[33] *Id.* at B-7 to B-8.

[34] *Id.* at B-7.

that would be used for continuous monitoring of temperature and [dissolved oxygen].[35]

D. Appalachian's Rehearing Request

15. On December 18, 2019, Appalachian requested rehearing of the Director's determination. Appalachian asks for the continuous turbidity monitoring requirement to be removed from the determination, or alternatively that the Commission accept a revised water quality study that includes continuous turbidity monitoring during a two-day period to address turbidity effects associated with drag rake operation.

II. Discussion

16. Appalachian argues that no participant in the proceeding requested continuous turbidity monitoring, the Director's determination relies on assertions not in the record, and the Director erroneously determined that the cost and level of effort associated with continuous monitoring would be minimal. Alternatively, Appalachian argues that should the Commission require continuous turbidity monitoring, it should adopt its proposed revised study parameters. We address these arguments below.

A. Continuous Monitoring Is Appropriate

1. Record Support

17. Appalachian contends that the Director's determination is unsupported by the record, first noting that neither Virginia DGIF nor FWS asked for continuous turbidity monitoring in their comments on the PAD.[36] Appalachian further states that it added monthly turbidity measuring in each development's forebay to its proposed study plan in response to agency comments that any water quality study should examine turbidity,[37] but that no reference to *downstream* turbidity was made until Virginia DGIF later commented on the proposed study plan.[38] Appalachian also points out that Virginia DGIF's comment lacked the study plan criteria required by section 5.9 of the

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[35] *Id.* at B-8.

[36] Appalachian Rehearing Request at 4, 10.

[37] *Id.* at 4-6.

[38] *Id.* at 6-7.

Commission's regulations. In addition, Appalachian cites to the agencies' approving comments regarding the proposed data collection in the revised study plan.[39]

18. We disagree. When read in their entirety, agency comments on the PAD, proposed study plan, and revised study plan all express concerns about downstream turbidity and potential negative effects on angling and recreation.[40] These comments, along with statements made at the scoping meeting, support the explanation in the determination that "concern remains regarding the mobilization of impoundment sediment deposits during project operation, which could result in increased turbidity in downstream reaches that disrupts ecological processes and negatively affects angling and recreational use."[41]

19. Moreover, notwithstanding Appalachian's suggestion to the contrary, section 5.9 of the Commission's regulations does not limit the Director to consider only requested studies. Under the Commission's regulations, the Director's determination may ultimately include "*any* modifications determined to be necessary in light of the record."[42] The Director's study plan determination is intended to require studies that will produce the information necessary to further shape both Commission staff's environmental analysis and the Commission's eventual legally enforceable license order.

20. Here, the Director determined that continuous turbidity monitoring is necessary because "Appalachian's proposal to sample turbidity once per month . . . lacks the sampling frequency needed to properly assess the effects of project operation (drag rake)

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[39] *Id.* at 10-11. Appalachian also notes that Commission staff did not file comments related to water quality on the PAD or proposed study plan or inform Appalachian of the need for information or study requests related to turbidity monitoring. *Id.* at 4, 7.

[40] *See, e.g.*, Virginia DGIF May 7, 2019 Comments at 2; FWS May 7, 2019 Comments at 4; Virginia DGIF September 18, 2019 Comments at 1; Virginia DGIF November 4, 2019 Comments at 1; FWS November 4, 2019 Comments at 1. We also note that Commission staff called out in the scoping document 2 that "turbidity could be affected by project operation and maintenance (e.g., by releasing sediment collected by the drag rake through the project intakes)" and noted that the forthcoming environmental analysis conducted under the National Environmental Policy Act would include effects of project operation and maintenance on turbidity levels. *See Appalachian Power Co.*, Scoping Document 2 for the Byllesby-Buck Hydroelectric Project at 7-8 (June 21, 2019).

[41] *Appalachian Power Co.*, Study Plan Determination for the Byllesby-Buck Hydroelectric Project at B-7 (Nov. 18, 2019).

[42] 18 C.F.R. § 5.13(c) (emphasis added).

on downstream turbidity at each development."[43] Because the drag rake may operate multiple times per day, depending on debris load, the Director required continuous monitoring to ascertain the effects of the operation of the drag rake on downstream turbidity. As discussed in more detail below, the required monitoring will help the Commission determine both project impacts and any necessary mitigation.[44]

2. **Information is Needed to Inform Potential License Conditions**

21. Appalachian questions how continuous turbidity monitoring could inform potential license conditions.[45] As indicated above, the Director, based on the stated concerns of the resource agencies, noted that operation of the project's drag rake may increase downstream turbidity and negatively affect angling and recreational use. Therefore, in order to identify and fully quantify the scope of the potential effect, turbidity data would need to be collected continuously during the period spanning from prior to commencement of the event (raking), for a sufficient enough duration to establish pre-raking turbidity levels at the monitoring sites, to when the raking has been completed and any increased turbidities caused by the event have subsided. Continuously recorded downstream values from the tailraces would be compared to those continuously recorded in each forebay as well as the monitoring location in the upper portion of Byllesby reservoir, which would provide information on background turbidity levels of waters entering the project. To the extent drag rake operations are found to increase downstream turbidity levels relative to background turbidity levels, continuous turbidity monitoring data collected during drag rake events could be used to inform the need for and identify potential license requirements for consideration to minimize downstream turbidity effects of drag rake operation on angling and recreational use (e.g., implementing a drag rake operation plan that involves shifting the operation of the drag rake to time periods outside of prime fishing hours, or limiting the duration of a drag rake event, or implementing

[43] *Appalachian Power Co*., Study Plan Determination for the Byllesby-Buck Hydroelectric Project at B-7 (Nov. 18, 2019).

[44] Appalachian's statement that the study plan determination must be supported by "substantial evidence," *see* Appalachian Rehearing Request at 9 (citing 16 U.S.C. § 825*l*(b) (2018); *City of Centralia*, 213 F.3d 742, 748 (D.C. Cir. 2000); *Bangor Hydro-Electric Co. v. FERC*, 78 F.3d 659, 663 (D.C. Cir. 1996)), is correct. Section 313(b) of the Federal Power Act states that the "finding of the Commission as to the facts, if supported by substantial evidence, shall be conclusive." 16 U.S.C. § 825*l*(b). As we demonstrate in P 21, *infra*, the monitoring study will yield information relevant to our consideration of Appalachian's license application, thus providing substantial evidence supporting the study requirement.

[45] Appalachian Rehearing Request at 10.

seasonal restrictions on when the drag rake is allowed to scrape the forebay bed). Spot sampling once per month as originally proposed by Appalachian would not necessarily result in the collection of turbidity data precisely during a drag rake operational event, let alone the collection of turbidity data during the full period of the event.

3. Costs

22. Appalachian also objects to the cost and level of effort associated with continuous turbidity monitoring, which the determination described as "minimal."[46] Appalachian explains that it planned to deploy a HOBO logger instrument[47] at each continuous monitoring location to record water temperature and dissolved oxygen levels, and a more expensive Hydrolab sonde instrument[48] would be moved from site to site to measure additional water quality parameters, including turbidity, on a monthly basis.[49] According to Appalachian, HOBO loggers can only measure water temperature and dissolved oxygen; thus, Appalachian would be required to rent or purchase Hydrolab MS5 sondes for each location to continuously monitor turbidity at a cost of $67,500, rather than the Director's estimate of $10,000 to $15,000.[50] Appalachian also states that additional effort and labor will be required to maintain the larger Hydrolab sondes at "various river levels [and] to address data gaps as a result of such issues."[51] Finally, Appalachian expresses concern that "placing large sondes *in situ* . . . will result in higher rates of damage and other problems with the probes,"[52] asserting that the larger Hydrolab sondes would be more visible to the public and thus more susceptible to vandalism or theft.[53]

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[46] *Id.* at 12.

[47] Appalachian states that the list price for a HOBO logger is $1,250. *See id.* at Appendix B.

[48] Appalachian estimates each Hydrolab sonde to cost $10,000 to purchase or $1,500 to rent per month based on "past experiences of Appalachian personnel and consultants." *Id.* at 6 & n.17.

[49] *Id.* at 12-13.

[50] *Id.* at 13.

[51] *Id.*

[52] *Id.*

[53] *Id.* at 6.

23. As indicated in the study plan determination, Commission staff inferred from the information in the record that the continuous turbidity sensors could be added to the same multiparameter sondes[54] that Appalachian would deploy to measure water temperature and dissolved oxygen, at a minimal additional cost.[55] Based on the additional information Appalachian provides in its rehearing request, we acknowledge that the instrument Appalachian would need to use for continuous turbidity monitoring would increase the cost beyond the Director's estimate. While we find continuous turbidity monitoring to be justified, as discussed above, given the additional level of effort and cost, we will reevaluate whether a refined scope and timing of turbidity monitoring would be sufficient to meet our information needs, as discussed below.

B. Alternative Water Quality Study Proposed by Appalachian

24. In its rehearing request, Appalachian proposes to conduct turbidity monitoring at five-minute intervals over a two-day period under relatively low-flow conditions using continuously-recording Hydrolab sondes deployed at five locations: (1) in the upstream extent of the Byllesby reservoir to characterize background turbidity levels; (2) in the Byllesby forebay at mid-depth; (3) in the Byllesby powerhouse tailrace; (4) in the Buck forebay at mid-depth; and (5) in the Buck powerhouse tailrace. Appalachian indicates the two-day monitoring effort would occur under a "predetermined range of normal operating regimes" for the drag rakes and generating units.[56] Appalachian estimates this modification will add $20,000 to the cost of the water quality study.[57]

25. We conclude that Appalachian's proposal for continuous turbidity monitoring is generally sufficient to provide information on the potential effects of drag rake operation on downstream turbidity and inform potential license conditions, except in the following respects. First, Appalachian does not specify what constitutes a "predetermined range of normal operating regimes." For instance, the effects of the drag rake on downstream

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[54] Some brands of multiparameter sondes include extra ports to which additional optical sensors, including those for turbidity, can be added. *See* https://www.ysi.com/products/multiparameter-sondes.

[55] *Appalachian Power Co*., Study Plan Determination for the Byllesby-Buck Hydroelectric Project at B-8 (Nov. 18, 2019). This determination was based on Appalachian's statements in its study plans that it would use "multiparameter water quality instrumentation (i.e., sondes)" to continuously monitor water temperature and dissolved oxygen. *See* Appalachian June 21, 2019 Proposed Study Plan at 7.6.1; Appalachian October 18, 2019 Revised Study Plan at 5.6.1.

[56] Appalachian Rehearing Request at Appendix A, 5.6.3.

[57] *Id.* at Appendix A, 5.8.

turbidity may depend on how far the drag rake extends into the forebay and scrapes along its bed, as turbidity values would be expected to increase with raking distance because more sediment would be disturbed. Second, it is unclear if the "relatively low flow conditions" under which Appalachian proposes to assess the potential effects of drag rake operation on turbidity would be representative of environmental conditions (background turbidity levels, river flows, etc.) under which the drag rake would still be operated. For instance, there may be some conditions (e.g., low flow and low background turbidity levels during mid-summer) under which the drag rake may otherwise have a measurable effect on downstream turbidity but would not typically operate under such conditions. Finally, it is unclear whether the two-day sampling window chosen would coincide with times and conditions under which both the drag rake would be operating and anglers would be fishing in the project's tailraces. Given that the potential negative effect of project (drag rake) operation on angling and recreational use in the project tailraces is an environmental concern raised in the proceeding, as indicated above, any turbidity monitoring should occur during the primary fishing season.

26. To address these concerns, we accept Appalachian's proposed alternative water quality study plan (alternative plan) with the following modifications. Rather than specifically limiting the continuous sampling window to two days, Appalachian must consult with the resource agencies (Virginia DGIF and FWS) to identify a sampling window that occurs: (1) during the fishing season; (2) when there is drag rake operation for the purposes of raking both the forebay bed and the trash rack; and (3) when flows and background turbidity are at levels such that drag rake operation would be expected to be representative of a worst-case scenario (i.e., low flows and low background turbidity levels) causing an effect on downstream turbidity. Regarding the second criterion, the drag rake should be extended various distances into the forebay up to the maximum distance and include a minimal distance scenario in which the drag rake would only clean the trash racks and not extend into the forebay. If one sampling window cannot accomplish all three criteria, then Appalachian should propose multiple sampling windows, as needed. Appalachian must file, in its study report, documentation of consultation with the agencies regarding the sampling window, as noted above.

27. The scope of this modified study is reduced relative to the prior determination (now, only five turbidity monitoring locations versus ten).[58] The expected sampling window would be on the order of about ten days, rather than continuously over a five-month period as previously required. Therefore, the expected cost to continuously monitor turbidity as specified in this modified study would be considerably less than that

[58] Continuous turbidity monitoring would occur at five-minute intervals at the five stations proposed by Appalachian in its Task 3 under 5.6.3 of the alternative plan.

required by the determination. Furthermore, the shorter sampling time frame reduces the likelihood that the Hydrolab instruments would be lost to high flows or vandalized.

III. Conclusion

28. Accordingly, we grant rehearing in part and approve Appalachian's proposed alternative plan, as modified above.

The Commission orders:

(A) The request for rehearing filed by Appalachian on December 18, 2019 is denied in part and granted in part.

(B) Appalachian's December 18, 2019 proposed Alternative Water Quality Study Plan is approved as modified by ordering paragraphs (C) and (D) of this order and replaces the Water Quality Study turbidity monitoring modifications in the Director's November 18, 2019 Study Plan Determination.

(C) The following recommendation, which was adopted in the Director's November 18, 2019 Study Plan Determination and which modified 5.6.1 Task 1 – Continuous Water Temperature and [Dissolved Oxygen] Monitoring of Appalachian's October 19, 2019 Revised Study Plan, is struck:

Accordingly, we recommend that Appalachian install continuously-recording turbidity sensors (with 15-minute measurement intervals) on each of the 10 multiparameter data sondes that would be deployed across the eight sampling sites described above. We also recommend that Appalachian maintain, and provide in the study report, a log of daily drag rake operations (e.g., daily start and stop times for the drag rakes).

(D) Appalachian will conduct a study to evaluate the potential effect of project operation (drag rake) on turbidity. During the study period, the timing of drag rake operation must be recorded and a Hydrolab or similar data sonde equipped with a turbidity sensor will be installed at each of the locations listed below to continuously record turbidity concentrations (in Nephelometric turbidity units) at 5-minute intervals:

- One location in the upstream extent of the Byllesby reservoir to characterize background turbidity levels
- One location in the Byllesby forebay at approximate mid-depth
- One location in the Byllesby powerhouse tailrace
- One location in the Buck forebay at approximate mid-depth
- One location in the Buck powerhouse tailrace

The study will be conducted during the study period identified by Appalachian, in consultation with Virginia DGIF and FWS, that meets the criteria set forth in the Commission’s February 20, 2020 order.

By the Commission.

(S E A L)

Kimberly D. Bose,
Secretary.

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July 27, 2020

VIA ELECTRONIC FILING

Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
888 First Street, N.E.
Washington, D.C. 20426

Subject: **Byllesby-Buck Hydroelectric Project (FERC No. 2514-186)**
First Quarterly Study Progress Report, Updated ILP Study Schedule, and Request for Extension of Time to File Initial Study Report

Dear Secretary Bose:

Appalachian Power Company (Appalachian or Applicant), a unit of American Electric Power (AEP) is the Licensee, owner, and operator of the 30.1 megawatt (MW) Byllesby-Buck Hydroelectric Project (Project No. 2514-186) (Project or Byllesby-Buck Project), located on the New River in Carroll County, Virginia. The Project is currently undergoing relicensing following the Federal Energy Regulatory Commission's (FERC's or Commission's) Integrated Licensing Process (ILP).

The purposes of this filing are to (1) inform FERC and Project stakeholders of revised timeframes for conducting certain field activities to be performed pursuant to the approved ILP Study Plan for the Project and (2) request Commission approval of a modification to the approved ILP Process Plan and Schedule that would extend the filing deadline for the Initial Study Report (ISR) for the Project from November 17, 2020 to January 18, 2021. As further explained below, these modifications are required in light of ongoing and presently anticipated resource and schedule challenges associated with the ongoing Novel Coronavirus Disease (COVID-19) pandemic and are not expected to impact Appalachian's ability to timely file an application for a new license by the statutory deadline (February 28, 2024).

This filing also serves as Appalachian's First Quarterly Study Progress Report for the Project. This progress report describes the activities performed since this Study Plan Determination (SPD), as well as ILP activities generally expected to be conducted in quarter 3 (Q3) of 2020.

Background

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 October 18, 2019. On November 18, 2019 FERC issued the Study Plan

Determination (SPD). On December 12, 2019, Appalachian filed a clarification letter on the SPD with the Commission. The SPD was subsequently modified by FERC by an Order on Rehearing dated February 20, 2020. The RSP, as subsequently approved and modified by the FERC, establishes Appalachian's proposed schedule to complete desktop and field activities and develop reports for the following studies. A proposed study schedule is included in the RSP for each of the studies listed below:

1. Flow and Bypass Reach Aquatic Habitat Study;
2. Water Quality Study;
3. Aquatic Resources Study;
4. Wetlands, Riparian, and Littoral Habitat Characterization Study;
5. Terrestrial Resources Study;
6. Shoreline Stability Assessment Study;
7. Recreation Study; and
8. Cultural Resources Study.

Updated Study Schedule and Study Progress

Appalachian's intent, at the time of filing the RSP, was to complete ILP study activities in the first ILP study season (2020) to the greatest extent possible. The study schedules were based on an expectation of commencing field work by early April and developing draft study reports and the ISR by mid-November 2020.

Appalachian commenced the Recreation Study in November 2019 and installed trail cameras to capture recreation use at Project facilities. Data from the installed cameras have been downloaded approximately monthly by Appalachian and Appalachian's consultant. Appalachian notes that Trail Camera #6, installed at the Buck Dam Picnic Area, has been out of service since May 18, 2020 due to the tree falling down and is expected to be reinstalled in a similar location on July 28, 2020. The Recreation Facility Inventory and Condition Assessment was completed in the fall of 2019. Additionally, Appalachian initiated the recreation visitor use online survey on April 27, 2020 and distributed notification of the availability of the online survey to interested agencies. Signs prompting visitors to complete the survey were installed at Appalachian's recreation facilities in May.

Due to prevailing restrictions on non-essential travel and safety considerations for staff who would be traveling for and performing fieldwork, Appalachian and Appalachian's consultants have not been able to commence fieldwork for the other studies (i.e., studies requiring intensive periods of fieldwork in the spring) as originally proposed in the RSP. Appalachian and Appalachian's consultants continue to monitor evolving conditions and presently anticipate commencing field study activities in early August 2020. As a result, conduct of several season-sensitive spring field studies will have to be deferred until the second (2021) study season, and the study period for the water quality study will be shortened (though notably is still expected to include the majority of the targeted low inflow and high temperature season). Other studies that would potentially have commenced in the spring or early summer are expected to be shifted to the mid- to late summer or fall seasons. On a resource allocation basis, Appalachian does not expect to be able to complete all of the required ILP study activities within the remaining study season. As such, Appalachian proposes to also shift the timing for conducting studies that are more baseline condition-characterization in nature to 2021.

A detailed schedule is attached (Attachment 1), which shows the schedule proposed in the RSP (as modified by the SPD and subsequent Order on Rehearing) alongside the revised proposed schedule.

Appalachian shared an earlier version of this table with the primary resource agencies (U.S. Fish and Wildlife Service, Virginia Department of Wildlife Resources, Virginia Department of Conservation and Recreation, and the Virginia Department of Environmental Quality) and conducted a conference call on June 30, 2020 to review the revised study schedule and solicit agency feedback and comments. Participants in this meeting concurred with Appalachian's proposed schedule revisions, and minor revisions to the schedule were made based on comments received during this meeting, as documented in the meeting summary included in Attachment 2.

Request for Extension of Time to File the ISR

Because the study delays forced by COVID-19 conditions are expected to lead to significant field study activities continuing through the fall of 2020, it will not be feasible to develop draft study reports and a comprehensive ISR by the November 17, 2020 deadline. Appalachian believes that a comprehensive ISR, inclusive of draft study reports where possible, will be to the benefit of the ILP process for this Project, as well as to Project stakeholders. As such, Appalachian is requesting that the deadline to file the ISR be extended to January 18, 2020. Appalachian does not propose and is not requesting any subsequent adjustment of the USR deadline (November 21, 2021).

Appalachian notified the agencies listed above of Appalachian's intention to file a request for extension of time to file the ISR (and the subsequent shift of the ISR meeting and comment deadline into early 2021) during the June 30, 2020 conference call. As indicated in the attached meeting summary, participants in this meeting did not express any opposition to or concerns with this request.

Appalachian notes the extraordinary circumstances that have shifted the ILP study schedule for the Project and believes this request is consistent with guidance from the Commission and

Commission staff regarding potential impacts of COVID-19 on non-statutory deadlines and required notifications to and approvals by FERC. Appalachian thanks the Commission staff for their consideration of this request and hopes that this filing finds Commission staff and Project stakeholders in good health.

If there are any questions regarding the proposed ILP study schedule changes, please do not hesitate to contact me at (540) 985-2441 or via email at ebparcell@aep.com.

Sincerely,

Elizabeth Parcell
Process Supervisor
American Electric Power Services Corporation

Attachments (2)

cc: Distribution list

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ATTACHMENT 1

ILP STUDY SCHEDULE UPDATE

Table 1. Proposed Changes to the 2020-2021 Study Plan Schedule for the Byllesby-Buck Project (FERC No. 2514)

Proposed Scheduling Changes to the 2020-2021 Study Plan Schedule for the Byllesby/Buck Project (FERC No. 2514)			
Study	**Activities**	**Approved Timeframe for Completion (RSP and SPD)**	**Proposed Timeframe for Completion (July 2020 update)**
Flow and Bypass Reach Aquatic Habitat Study	Topographic Mapping and Photogrammetry Data Collection	Fall 2019	Completed (January 2020)
	Desktop Habitat Assessment	November 2019 – March 2020	July – August 2020
	Mesohabitat Mapping and Substrate Characterization Field Data Collection	Summer 2020	August – September 2020
	Distribute Proposed Flow Test Scenario Framework to Interested Parties for Review	May 2020	August 2020
	Conduct Flow and Water Level Assessment and Hydraulic Modeling	June – October 2020	July – December 2020
	Distribute Draft Study Report with the ISR	November 2020	January 2021
Water Quality Study	Study Planning and Existing Data Review	January – March 2020	July 2020
	Continuous and Monthly Water Quality Monitoring (Dissolved Oxygen and Temperature)	May – September 2020	Late July* – September 2020 * Conditioned on completion of reinstallation of flashboards tripped during May 2020 high flow event
	Turbidity Monitoring Study	June – August 2020	August – September 2020
	Distribute Draft Study Report with the ISR	November 2020	January 2021

Proposed Scheduling Changes to the 2020-2021 Study Plan Schedule for the Byllesby/Buck Project (FERC No. 2514)			
Study	**Activities**	**Approved Timeframe for Completion (RSP and SPD)**	**Proposed Timeframe for Completion (July 2020 update)**
Aquatic Resources Study	Desktop Literature Review	January – March 2020	July – August 2020
	Macroinvertebrate and Crayfish Community Study	March – August 2020	August – September 2020 (target September), April – May 2021
	Fish Community Study	April – September 2020	September 2020, April – May 2021
	Mussel Community Study	April – September 2020	August – September 2020
	Desktop Impingement and Entrainment Evaluation	August – November 2020	September – December 2020
	Distribute Draft Aquatic Resources Study Report with the ISR/USR	November 2020	January 2021/November 2021
Wetlands, Riparian, and Littoral Habitat Characterization	Desktop Mapping of Wetland, and Riparian, and Littoral Habitats	January – March 2020	February – April 2021
	Field Verification of Preliminary Maps and Wetland Delineations and Riparian and Littoral Habitat Characterizations	August 2020 – September 2020	Late July – August 2021
	Distribute Draft Study Report with the USR	November 2020	November 2021
Terrestrial Resources Study	Desktop Mapping and Study Planning	February – March 2020	February – April 2021
	Field Verification	April – July 2020	April – July 2021
	Distribute Draft Study Report with the USR	November 2020	November 2021

Proposed Scheduling Changes to the 2020-2021 Study Plan Schedule for the Byllesby/Buck Project (FERC No. 2514)			
Study	**Activities**	**Approved Timeframe for Completion (RSP and SPD)**	**Proposed Timeframe for Completion (July 2020 update)**
Shoreline Stability Assessment Study	Study Planning and Data Review	January – March 2020	February – April 2021
	Shoreline Survey and Determination of Areas Potentially Needing Remediation	April – July 2020	April – July 2021
	Distribute Draft Study Report with the USR	November 2020	November 2021
Recreation Study	Study Planning and Existing Data Review	November 2019 – March 2020	Completed (November 2019)
	Trail Camera Data Collection	November 2019 – November 2020	November 2019 – November 2020
	Recreation Facility Inventory and Condition Assessment	November – December 2019	Completed (November 2019)
	Stakeholder Site Visit/Meeting	April 2020	October – November 2020* *Conditioned on no travel and meeting restrictions; if meeting not completed in the fall of 2020 will be rescheduled for spring 2021
	Recreation Visitor Use Online Survey	April – October 2020	April – October 2020
	Distribute Draft Study Report with the ISR	November 2020	January 2021
Cultural Resources Study	Determination of Area of Potential Effect (APE)	January – June 2020	July – September 2020
	Background Research and Archival Review	January – June 2020	August 2020 – November 2020
	Phase I Reconnaissance Survey of APE	May – October 2020	April – July 2021
	Inventory of Traditional Cultural Properties	October 2019 – October 2020	August 2020 – August 2021
	Review and Updates to the Existing CRMP	November 2020	November 2021
	Distribute Draft Study Report with the ISR/USR	November 2020	November 2021

ATTACHMENT 2

JUNE 30, 2020 MEETING SUMMARY

Subject: FW: Byllesby-Buck Project Relicensing Study Schedule Update Meeting Notes
Attachments: ByllesbyBuck ILP Study Schedule UPdate 06 22 2020.pdf

From: Elizabeth B Parcell [mailto:ebparcell@aep.com]
Sent: Friday, July 17, 2020 4:07 PM
To: John Copeland (John.Copeland@dgif.virginia.gov) <John.Copeland@dgif.virginia.gov>; Bill Kittrell (Bill.Kittrell@dgif.virginia.gov) <Bill.Kittrell@dgif.virginia.gov>; Norman, Janet <janet_norman@fws.gov>; Grist, Joseph <joseph.grist@deq.virginia.gov>; SAM.SWEENEY@DCR.VIRGINIA.GOV; JanNorman12@gmail.com
Cc: Yayac, Maggie <Maggie.Yayac@hdrinc.com>; Kulpa, Sarah <Sarah.Kulpa@hdrinc.com>; Jonathan M Magalski <jmmagalski@aep.com>
Subject: Byllesby-Buck Project Relicensing Study Schedule Update Meeting Notes

Good afternoon,

I hope you are well and ready for the weekend.

Attached please find the draft summary of our discussion from a couple of weeks ago regarding the updated ILP study schedules and request to FERC for extension of the deadline to file the ISR. We plan to include a copy of this summary in the upcoming FERC filing. Please provide any comments or questions on the attached summary as soon as you can get to it, or no later than the end of next week.

Thanks and have a great weekend.

Liz

AMERICAN ELECTRIC POWER
BOUNDLESS ENERGY
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Meeting Summary

Project:	Byllesby-Buck Hydroelectric Project (FERC No. 2514)
Subject:	Study Schedule Update
Date:	Tuesday, June 30, 2020
Location:	WebEx (2:00pm-3:00pm)
Attendees:	Bill Kittrell (VDGIF) John Copeland (VDGIF) Janet Norman (USFWS) Joe Grist (VDEQ) Jon Magalski (AEP) Liz Parcell (AEP) Sarah Kulpa (HDR) Maggie Yayac (HDR)

Introduction

Liz (AEP) thanked everyone for being available to discuss the Byllesby-Buck 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. AEP plans on filing the revised schedule with FERC, which will include an extension of time for the Initial Study Report (ISR) (January 18th) and ISR meeting (February 2nd).

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 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. Jon M. (AEP) also noted the extension of time

avoids a review period for the agencies over the holidays. There was no opposition to the proposed request for extension of time.

Flow and Bypass Reach Aquatic Habitat Study

- LiDAR data and orthoimagery have been captured at the Byllesby-Buck 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 scenarios will be developed and sent to agencies for review and comment in late July/early August. Janet noted that she will be out of office the last week of July and first week of August. AEP and HDR agreed to target the first week of August to get the flow test scenarios to this group, for a 2-week review and comment period.
- Flow tests are scheduled to take place in mid to late August/early September dependent on flow conditions. Sarah noted the test timing is dependent on no spill conditions at the developments. (Flashboard repairs are ongoing at Byllesby and currently scheduled to be completed within the next 3 weeks.)

Water Quality Study

- Sarah explained that the updated study schedule water quality monitoring (continuous and monthly sampling) is expected to begin in late July and continue through the end of September (can be continued into October if September is a hot/dry month). Agencies will have opportunity to review results of this monitoring in the ISR and provide feedback on the quality and quantity of the data at the ISR Meeting, with respect to whether the abbreviated water quality monitoring period is sufficient to meet the study objectives.
- VDGIF agreed that the revised timeframe for the Water Quality Study, while shorter, is the time to target (high temperature/lower inflow conditions) and noted that flows were high this spring.
- Sarah confirmed the turbidity monitoring study is still proposed for this study season (August-September). Discussion of timing of study given higher flows and more angling in May-July period. Jon M. explained the intent of the original schedule in the RSP, which was to try to capture incremental turbidity impacts of trashrake operation during lower flow (i.e., worse case) condition and during fishing season, as VDGIF had previously requested. John C. (VDGIF) agreed that the turbidity monitoring is preferred under a low flow condition and during fishing season and questioned whether adding an additional turbidity study in early July 2021 would be possible. Group agreed this would be evaluated at the ISR and based on the results of this year's study.

Aquatic Resources Study

- Sarah explained that the Fish Community Study will still be conducted in August or September. John C. agreed this time period is adequate since there will be some young-of-year fish.

- AEP is rescheduling the spring season of the fish community and macroinvertebrate and crayfish studies for 2021. No objections from agencies. John C. noted that based on his experiences with these sites, the survey scheduled for the spring (April-May) may have to be shifted to later in May or even June if high flow conditions prevail through the spring.
- The mussel survey is expected to be conducted in August or September, which is within the original timeframe. VDGIF noted Brian Watson (VDGIF) may typically do these surveys earlier in the year and that they'd like his concurrence with the August-September timeframe.
  - Action Item: AEP's consultant (Stantec) to follow up with Brian Watson to confirm the timing of the mussel survey. (Note Stantec sent e-mail to Brian Watson on 7/13, no response received yet.)
- 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.
- Janet (USFWS) would like AEP/HDR to consult with USFWS's fishway engineer to ensure parameters of blade strike analysis are sufficient prior to conducting. Action Item: Janet will connect Sarah to the USFWS fishway engineer.

Wetland, Riparian, and Littoral Habitat, Terrestrial Resources, Shoreline Stability and Cultural Studies

- Desktop and fieldwork rescheduled for spring-summer 2021.
- John C. questioned the timing of the field verification for the Wetland, Riparian and Littoral Habitat and noted VDGIF may prefer the survey take place in the late summer/early fall, which is the best time to survey for aquatic vegetation. Sarah reminded the group that the original schedule was intended to accommodate/overlap the Virginia spiraea flowering season, in the event any spiraea are present (none expected based on results of 2017 and prior surveys, as well as historical records). Janet agreed that the USFWS would like the survey to account for *Virginia spiraea*. Action Item: Check *Virginia spiraea* flowering and surveying timeframe as the group would like this to overlap with VDGIF request to identify aquatic vegetation. (Note AEP sent *Virginia spiraea* survey timeframes to Janet and has updated the survey window in the revised ILP study schedule to be filed with FERC to late July/August). VDGIF agreed that if the survey targeted late July, that should be sufficient to observe elodea and hydrilla.
- John C. noted preference that the Shoreline Stability Assessment take place in early spring (i.e. March to early April), if possible.

Recreation Study

- Trail camera observations have been on-going since November 2019 and are scheduled for completion this November. If any observations are obtained from the cameras that may be of interest to VDGIF (sited managed by VDGIF) but not directly relevant to the Recreation Study Report, AEP will share that information directly with VDGIF.

- AEP has begun the online survey data collection. It is presently expected to continue through this November. VDGIF asked about potential to extend the period of data collection through 2021. AEP and HDR agreed this would be a relatively incremental effort and may be reasonable to do so; issue to be reevaluated at ISR (or if/when online survey proposed to be taken offline).
- Stakeholder meeting and site visit is not yet scheduled. Agencies and AEP agreed that pushing the stakeholder site visit as far out as possible would be preferable. Schedule has been updated to October-November, with potential to reschedule for the spring of 2021 if needed due to travel restrictions or concerns.
- Bill noted this is an irregular recreation usage year due to COVID-19 and they have seen usage increase at their recreation facilities so far this spring and summer.

Other

- AEP plans on submitting an update to FERC shortly and would like to include a record of consultation with the agencies and verbal agreement that there was no opposition. This will also serve as the first ILP Quarterly Progress Report.
- Agency representatives on the call agreed that they are in agreement with the schedule adjustments and AEP’s request for extension of time to file the ISR.
- VDGIF noted the name of their agency is changing to the Virginia Department of Wildlife Resources (VDWR) as of 7/1/2020.

Document Content(s)

FEDERAL ENERGY REGULATORY COMMISSION
WASHINGTON, D.C. 20426
August 10, 2020

OFFICE OF ENERGY PROJECTS

Project No. 2514-186 – Virginia
Byllesby-Buck Hydroelectric Project
Appalachian Power Company

VIA Electronic Mail

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Subject: Revised Process Plan and Schedule for the Byllesby-Buck Hydroelectric Project No. 2514

Dear Ms. Parcell:

On June 21, 2019, the Commission issued a process plan and schedule under the Integrated Licensing Process (ILP) for Appalachian Power Company's (Appalachian) Byllesby-Buck Hydroelectric Project No. 2514 (Byllesby-Buck Project). The process plan and schedule set pre-filing milestones and deadlines for, among other things, filing study reports, requesting modifications to the approved study plan, filing a preliminary licensing proposal (or draft license application), and filing the final license application.

On October 18, 2019, Appalachian filed a revised study plan (RSP) that included eight proposed studies in support of its intent to relicense the project. On November 18, 2019, the Commission issued a study plan determination for the project approving Appalachian's RSP with staff-recommended modifications; the RSP was subsequently modified and approved by the Commission on February 20, 2020.

On July 27, 2020, Appalachian filed its first quarterly study progress report, an updated ILP study schedule, and a request for an extension of time to file the initial study report (ISR) to account for the effects of the Coronavirus pandemic. Appalachian states that current restrictions on non-essential travel and safety considerations for its staff, who would be travelling for and performing the fieldwork, have prevented several of the studies from taking place in the spring and summer of 2020, as originally scheduled in the RSP. Appalachian anticipates commencing fieldwork for a number of studies in the fall of 2020; however, multiple season-sensitive studies must be delayed until the spring of 2021.[1] On June 30, 2020, Appalachian consulted the U.S. Fish and Wildlife Service, Virginia Department of Wildlife Resources, Virginia Department of Conservation and Recreation, and the Virginia Department of Environmental Quality via conference call to discuss the revising the study schedule. All participants concurred with Appalachian's proposed schedule revisions.

Specifically, Appalachian requests that the Commission revise the process plan and schedule to allow Appalachian to file the ISR on January 18, 2021. Appalachian states that it would not be feasible to complete the study reports and ISR by the current November 17, 2020 deadline. Appalachian states that an extension would provide sufficient time to conduct the field studies that can be initiated this fall, to develop the associated draft study reports, and to finalize a comprehensive ISR. The process plan and schedule for the second study season in 2021 would remain unchanged.

To allow Appalachian additional time to complete the first season's field studies, develop the draft study reports, and complete the ISR, the request to extend the due date for filing the ISR to January 18, 2021 is granted. The revised process plan and schedule for the Byllesby-Buck Project is attached.

If you have any questions, please contact Allyson Conner at (202) 502-6082 or allyson.conner@ferc.gov.

Sincerely,

Vince Yearick
Director
Division of Hydropower Licensing

Attachment: Revised Process Plan and Schedule

[1] *See* Attachment 1, ILP Study Schedule Update, of Appalachian's request filed on July 27, 2020.

ATTACHMENT 1
BYLLESBY-BUCK PROJECT REVISED PROCESS PLAN AND SCHEDULE

Shaded milestones are unnecessary if there are no study disputes. If the due date falls on a weekend or holiday, the due date is the following business day. Early filings or issuances will not result in changes to these deadlines.

Responsible Party	Pre-Filing Milestone	Date	FERC Regulation
Appalachian	First Study Season	Spring - Fall 2020	5.15(a)
Appalachian	File Initial Study Report	1/18/2021	5.15(c)(1)
All Stakeholders	Initial Study Report Meeting	2/2/2021	5.15(c)(2)
Appalachian	File Initial Study Report Meeting Summary	2/17/2021	5.15(c)(3)
All Stakeholders	File Disagreements/Requests to Amend Study Plan	3/19/2021	5.15(c)(4)
All Stakeholders	File Responses to Disagreements/Amendment Requests	4/18/2021	5.15(c)(5)
FERC	Issue Director's Determination on Disagreements/Amendments	5/18/2021	5.15(c)(6)
Appalachian	Second Study Season	Spring - Fall 2021	5.15(a)
Appalachian	File Preliminary Licensing Proposal (or Draft License Application)	10/1/2021	5.16(a)-(c)
All Stakeholders	File Comments on Preliminary Licensing Proposal (or Draft License Application)	12/30/2021	5.16(e)
Appalachian	File Updated Study Report	11/17/2021	5.15(f)
All Stakeholders	Updated Study Report Meeting	12/2/2021	5.15(f)
Appalachian	File Updated Study Report Meeting Summary	12/17/2021	5.15(f)
Appalachian	File Final License Application	2/28/2022	5.17
All Stakeholders	File Disagreements/Requests to Amend Study Plan	1/16/2022	5.15(f)
Appalachian	Issue Public Notice of Final License Application Filing	3/14/2022	5.17(d)(2)
All Stakeholders	File Responses to Disagreements/Amendment Requests	2/15/2022	5.15(f)
FERC	Issue Director's Determination on Disagreements/Amendments	3/17/2022	5.15(f)

Document Content(s)

Yayac, Maggie

Subject: FW: Byllesby-Buck Hydroelectric Project (VA) -- Filing of ILP Study Progress Report
Attachments: ByllesbyBuck Second Quarterly Study Progress Report.pdf

From: Kulpa, Sarah <Sarah.Kulpa@hdrinc.com>
Sent: Tuesday, October 27, 2020 5:23 PM
To: ACHP - John Eddins <jeddins@achp.gov>; American Whitewater - Kevin Colburn <kevin@americanwhitewater.org>; Appalachian Trail Conservancy - Andrew Downs <adowns@appalachiantrail.org>; Carroll County - Rex Hill <rex.hill@carrollcountyva.gov>; Carroll County Administrator - Steve Truitt <steve.truitt@carrollcountyva.gov>; Cherokee Nation - Elizabeth Toombs <elizabeth-toombs@cherokee.org>; Fish and Wildlife Conservation - Caitlin Carey <cscarey@vt.edu>; Fish and Wildlife Conservation - Donald J. Orth <dorth@vt.edu>; Friends of the Rivers of VA - Bill Tanger <bill.tanger@verizon.net>; Harold Peterson <harold.peterson@bia.gov>; New River Conservancy - George Santucci <george@newriverconservancy.org>; New River Conservancy - Laura Walters <claytorlakegirl@gmail.com>; New River Outdoor Adventures - Tim Dixon <newriveroutdooradventures@yahoo.com>; New River Trail State Park - Sam Sweeney <Sam.Sweeney@dcr.virginia.gov>; Town of Fries - Scott McCoy <townoffries@friesva.com>; USFWS Chesapeake Bay Field Office - Janet Norman <janet_norman@fws.gov>; USGS - Mark Bennett <mrbennet@USGS.gov>; VADCR - Jimmy Elliott <james.elliott@dcr.virginia.gov>; VADCR - Lynn Crump <lynn.crump@dcr.virginia.gov>; VADCR - Robbie Ruhr <Robbie.Rhur@dcr.virginia.gov>; VADCR - Sharon Ewing <sharon.ewing@dcr.virginia.gov>; VADEQ <eir@deq.virginia.gov>; VADEQ - Bettina Rayfield <Bettina.rayfield@deq.virginia.gov>; VADEQ - Joe Grist <joseph.grist@deq.virginia.gov>; VADEQ - Matthew Link <matthew.link@deq.virginia.gov>; VADEQ - Scott Kudlas <scott.kudlas@deq.virginia.gov>; VADEQ - Tony Cario <anthony.cario@deq.virginia.gov>; Virginia Council on Indians - Emma Williams <emma.williams@governor.virginia.gov>; Virginia Department of Conservation and Recreation - Rene Hypes <rene.hypes@dcr.virginia.gov>; Virginia Department of Game and Inland Fisheries - John Copeland <John.Copeland@dgif.virginia.gov>; Virginia Department of Game and Inland Fisheries - William Kittrell <bill.kittrell@dgif.virginia.gov>; beth.taylor@wytheville.org
Cc: Jonathan M Magalski <jmmagalski@aep.com>; Elizabeth B Parcell <ebparcell@aep.com>; Yayac, Maggie <Maggie.Yayac@hdrinc.com>
Subject: Byllesby-Buck Hydroelectric Project (VA) -- Filing of ILP Study Progress Report

Byllesby-Buck Hydroelectric Project Stakeholders:

Appalachian Power Company (Appalachian), a unit of American Electric Power (AEP), is the licensee, owner and operator of the Byllesby-Buck Hydroelectric Project (FERC No. 2514) (Project) located on the New River in Carroll 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 second ILP Study Progress Report with the Commission today. 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/ByllesbyBuck) in the coming days.

Thank you for your continued attention to this Project and for your understanding as we navigated through a very challenging field season. Should you have any questions regarding this filing, please contact Liz Parcell with AEP at (540) 985-2441 or ebparcell@aep.com.

Thank you,

Sarah Kulpa
Project Manager

HDR

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Attachment 2

Attachment 2 – ISR Meeting Agenda

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Initial Study Report Meeting Agenda

Project:	Byllesby-Buck Hydroelectric Project
Subject:	Initial Study Report Meeting
Date:	Thursday, January 28, 2021
Location:	WebEx

The Initial Study Report (ISR) meeting is scheduled for January 28, 2021 from 10 a.m. to 3 p.m. The ISR meeting topics are currently scheduled for the following times:

Topic	Schedule
Welcome and Introduction	10:00 AM – 10:15 AM
Aquatic Resources Study • Fish Community • Impingement and Entrainment • Macroinvertebrate and Crayfish • Mussel Community	10:15 AM – 11:15 AM
Bypass Reach Flow and Aquatic Habitat Study	11:15 AM – 12:15 PM
Lunch Break	12:15 PM – 12:45 PM
Water Quality Study	12:45 PM – 1:30 PM
Recreation Study	1:30 PM – 2:30 PM
Afternoon Break	2:30 PM – 2:35 PM
Cultural Resources Study	2:35 PM – 2:50 PM
Discussion, Questions and Next Steps	2:50 PM – 3:00 PM

Participants are free to join the meeting in part based on interests or availability, but please note that the agenda is intended as an approximation and more or less time may be spent on individual studies, as needed.

Appendix A

Appendix A – Preliminary Bypass Reach Flow and Aquatic Habitat Study Report

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Appendix B

Appendix B – Preliminary Water Quality Study Report

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Appendix C

Appendix C – Preliminary Aquatic Resources Study Report

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Appendix D

Appendix D – Preliminary Recreation Study Report

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Appendix E

Appendix E – Preliminary Cultural Resources Study Report

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Appendix A

Appendix A – Preliminary Bypass Reach Flow and Aquatic Habitat Study Report

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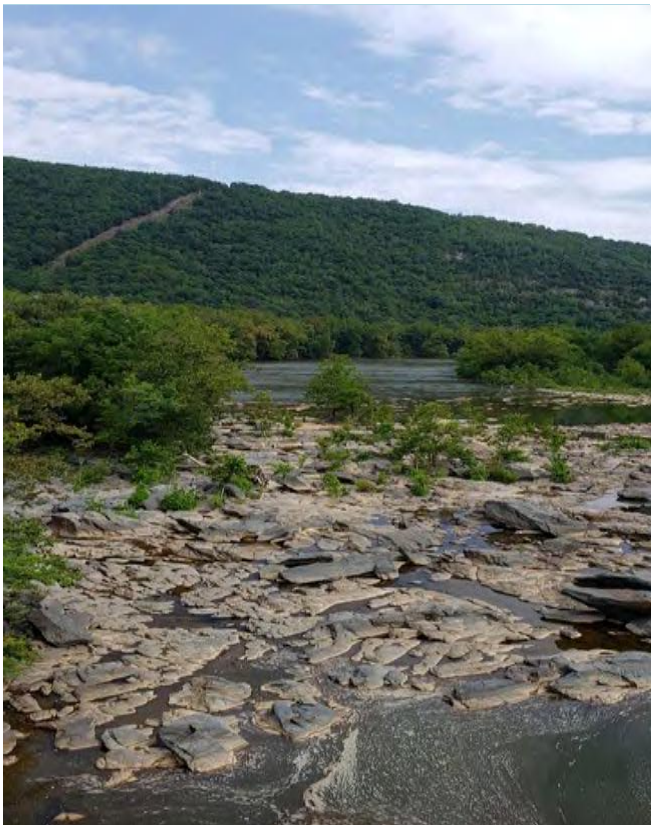

Preliminary Bypass Reach Flow and Aquatic Habitat Study Report

Byllesby-Buck Hydroelectric Project (FERC No. 2514)

January 18, 2021

Prepared by:

HDR

Prepared for:

Appalachian Power Company

APPALACHIAN POWER

An AEP Company

BOUNDLESS ENERGY

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Contents

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Acronyms and Abbreviations

1-D	one-dimensional
2-D	two-dimensional
3-D	three-dimensional
AEP	American Electric Power
Appalachian or Licensee	Appalachian Power Company
CFR	Code of Federal Regulations
cfs	cubic feet per second
FERC or Commission	Federal Energy Regulatory Commission
ft	feet/foot
HSC	habitat suitability criteria
HSI	habitat suitability index
LiDAR	light detection and ranging
mm	millimeter
NGVD	National Geodetic Vertical Datum of 1929
ICM	Integrated Catchment Model
ILP	Integrated Licensing Process
PM&E	protection, mitigation, and enhancement
POR	period of record
Project	Byllesby-Buck Hydroelectric Project
PSP	Proposed Study Plan
RSP	Revised Study Plan
SPD	Study Plan Determination
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VDGIF	Virginia Department of Game and Inland Fisheries
VDWR	Virginia Department of Wildlife Resources
WUA	weighted useable area

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 two-development Byllesby-Buck Hydroelectric Project (Project) (Project No. 2514), located on the upper New River in Carroll County, Virginia. The Project is located approximately 60 miles south-southwest of the city of Roanoke. The Byllesby development is located about 9 miles north of the city of Galax, and the Buck development is located approximately 3 river miles (RM) downstream of Byllesby and 43.5 RM upstream of Claytor Dam.

The Project is currently licensed by the Federal Energy Regulatory Commission (FERC or Commission). The Project underwent relicensing in the early 1990s, including conversion to run-of-river operations and incorporating additional protection, mitigation, and enhancement (PM&E) measures. The current operating license for the Project expires on February 29, 2024. Accordingly, Appalachian is pursuing a subsequent license for the Project pursuant to the Commission's Integrated Licensing Process (ILP), as described at 18 Code of Federal Regulations (CFR) Part 5.

In accordance with 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 October 18, 2019. On November 18, 2019 FERC issued the Study Plan Determination (SPD). On December 18, 2019, Appalachian filed a request for rehearing of the SPD. The SPD was subsequently modified by FERC by an Order on Rehearing dated February 20, 2020.

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 18, 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 Bypass Reach Flow and Aquatic Habitat Study conducted in support of preparing an application for new license for the Project.

2 Study Goals and Objectives

As described in the RSP and SPD, the objectives of this study are to conduct a flow and habitat assessment for each of the development's tailrace and bypass reaches (excluding the Byllesby auxiliary spillway channel) using a combination of desktop, field survey, and hydraulic modeling methodologies with the following goals:

- Delineate and quantify aquatic habitats and substrate types in the Byllesby and Buck bypass reaches.
- Identify and characterize locations of habitat management interest located within each bypass reach.
- Develop an understanding of surface water travel times and water surface elevation responses under variable base flow and spillway release flow combinations in the tailrace and bypass reach of each development to:
    - Demonstrate the efficacy of existing ramping rates required by the existing license.
    - Demonstrate the efficacy of the existing powerhouse minimum flow requirement (i.e., 360 cubic feet per second [cfs] minimum flow to maintain aquatic resources, including resident fish species, downstream of each development consisting of the tailrace areas below each powerhouse and the bypass reaches below the main spillways).
    - Evaluate the impacts of providing seasonal minimum flows to the bypass reaches.

3 Study Area

The Study Area for the Flow and Bypass Reach Aquatic Habitat Study includes the tailrace, bypass reach, and a short stream segment downstream of where the tailrace and bypass reach waters join (see Figure 3-1 for the Byllesby Study Area and Figure 3-2 for the Buck Study Area).

Figure 3-1. Byllesby Development Bypass Reach Study Area

Figure 3-2. Buck Development Bypass Study Area

4 Background and Existing Information

The Byllesby bypass reach is approximately 475 feet (ft) long, consisting primarily of exposed bedrock and rock outcroppings. The Buck bypass reach is approximately 4,100 ft long, with a steep gradient (approximately 24 ft per mile) and consisting primarily of exposed bedrock. Both bypass reaches normally receive seepage and leakage unless flows are being spilled at the dams or the flashboards are breached. Under Appalachian's normal operating conditions, the developments use available flows for powerhouse generation, maintaining the elevation of the Byllesby reservoir between 2,078.2 ft and 2,079.2 ft National Geodetic Vertical Datum (NGVD of 1929) and the Buck reservoir between 2,002.4 ft and 2,003.4 ft NGVD.

Under Article 403 of the current license, Appalachian is also required to maintain 360 cfs minimum flow release or inflow, whichever is less, downstream of the Project powerhouses. When inflow to either Project exceeds the powerhouse discharge capacity (5,868 cfs for Byllesby and 3,540 cfs for Buck), the Obermeyer and/or Tainter gates are opened to pass the excess flow into the respective bypass reaches (Figure 4-1 and Figure 4-2).

Monthly flow data from the U.S. Geological Survey (USGS) 03165500 New River at Ivanhoe, VA flow gaging station is provided in Table 4-1. This gage is located approximately 2.8 miles downstream of the Buck Development and reports daily average flow data starting in October 1929 through present, with a data gap from September 1978 to January 1996, providing a discontinuous 74-year period of record (POR). Monthly mean flow data, along with the 25th and 75th percentile flow data[1] is provided from January 1996 through December 2020 (a 25-year POR[2]) to put recent historic river flows in perspective with Byllesby and Buck maximum hydraulic capacities and current minimum downstream flow release requirements. For example, mean monthly flows recorded at the USGS 03165500 New River at Ivanhoe, VA gage are less than the hydraulic capacities of both the Byllesby and Buck developments. And while the monthly 75th percentile flows are less than the Byllesby powerhouse capacity, they exceed the smaller Buck powerhouse capacity. As a result, flow releases into the Buck bypass reach are more common than into the Byllesby bypass reach (see Table 4-2).

[1] A percentile is a value on a scale of one hundred that indicates the percent of a distribution that is equal to or below it. A flow percentile greater than 75 is considered to be wetter than normal; a flow percentile between 25 and 75 is considered normal; and a flow percentile less than 25 is considered to be drier than normal.

[2] The January 1996 – December 2020 POR is reflective of current land use and water use practices and uses more modern data collection and recording methods compared to the 1929 – 1978 POR. The more recent POR also contains a number of dry and wet periods that are sufficient for purposes of evaluating flow regimes relevant to the bypass reach flow and aquatic habitat study goals and objectives.

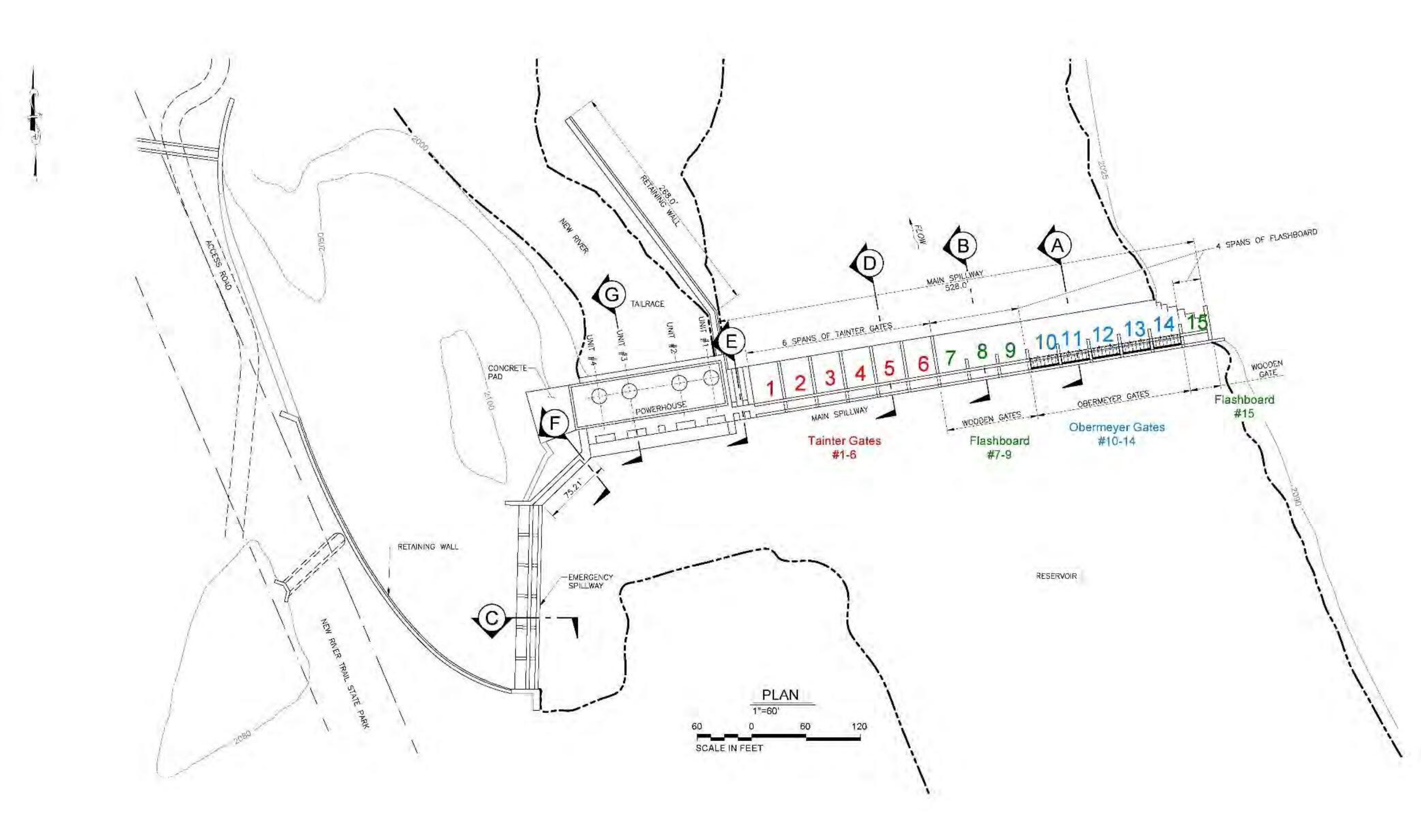


Figure 4-1. Byllesby Dam Spillway Gates

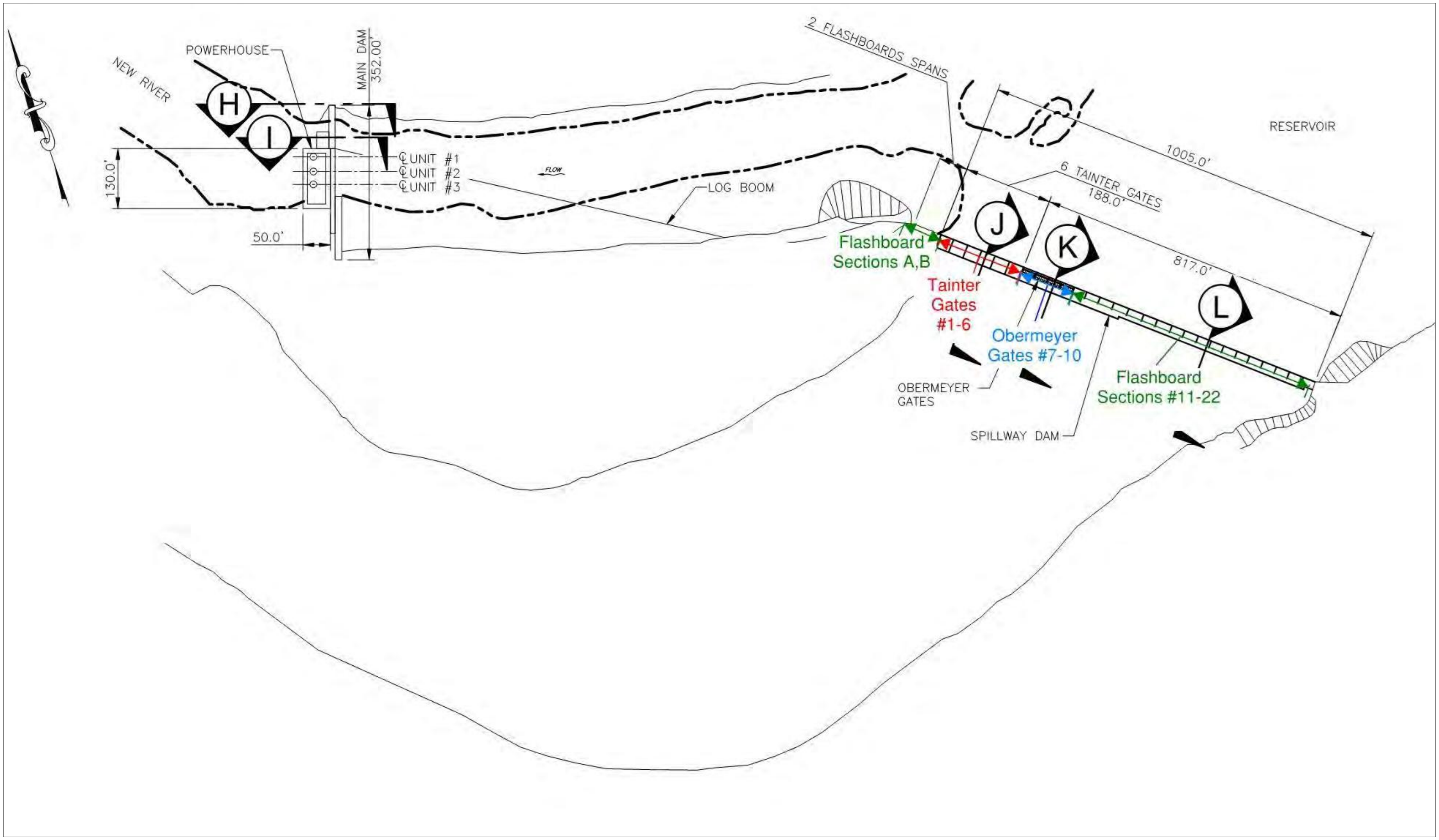


Figure 4-2. Buck Dam Spillway Gates

Table 4-1. USGS 03165500 New River at Ivanhoe, Virginia Monthly Flow Statistics, 1996 - 2020

Time Period	USGS 03165500 New River at Ivanhoe, VA		
	25th Percentile Flow (cfs)	Mean Monthly Flow (cfs)	75th Percentile Flow (cfs)
Annual	**1,331**	**2,275**	**2,774**
Jan	1,588	2,583	3,223
Feb	1,544	2,951	3,924
Mar	2,189	2,919	3,546
Apr	2,037	3,162	4,189
May	1,716	2,936	3,006
Jun	1,266	2,185	2,875
Jul	1,074	1,732	1,602
Aug	896	1,497	1,485
Sep	808	1,551	1,803
Oct	866	1,561	1,701
Nov	820	1,831	2,722
Dec	1,173	2,393	3,211

Table 4-2. Percentage of Days with Spillage to the Bypass Reaches for Byllesby and Buck Developments

Facility	Byllesby (powerhouse capacity) 5,868 cfs)			Buck ((powerhouse capacity) 3,540 cfs)		
Time Period	1996-2020	1999 (dry year)	2013 (wet year)	1996-2020	1999 (dry year)	2013 (wet year)
Annual	10.8	1.4	30.7	15.5	1.9	40.0
Jan	14.7	6.5	32.3	20.5	12.9	32.3
Feb	15.8	0.0	14.3	22.0	0.0	17.9
Mar	16.4	0.0	12.9	25.3	0.0	29.0
Apr	18.1	3.3	40.0	27.1	3.3	63.3
May	14.7	3.2	54.8	21.7	3.2	74.2
Jun	10.0	0.0	33.3	14.1	0.0	43.3
Jul	5.3	0.0	93.5	5.9	0.0	96.8
Aug	5.8	0.0	51.6	8.0	0.0	74.2
Sep	5.3	0.9	0.0	6.8	0.0	0.0
Oct	5.4	0.0	0.0	7.7	0.0	3.2
Nov	7.6	3.3	6.7	10.9	3.3	6.7
Dec	11.0	0.0	25.8	16.3	0.0	35.5

In addition to the minimum flow requirements, and to further protect fish communities, ramping rates are required for the Buck bypass reach. Appalachian is required to discharge flows through a 2-ft gate opening for at least three hours following any spills released through a gate opened 2 ft or more. Appalachian is then required to reduce the opening to 1 ft for at least an additional three hours, after which Appalachian may close the gate. The gradual reduction of flow allows time for fish to respond to the receding water levels, thus avoiding stranding that can occur with sudden flow discontinuation.

An assessment of the effectiveness of the ramping procedure for the protection of aquatic organisms in the Buck bypass was performed in 1997 (Appalachian 1997). Backpack electrofishing was conducted following the cessation of bypass releases in the range of 4,300 to 6,140 cfs. A total of 734 fish representing 24 species were collected. Several species, including Central Stoneroller (*Campostoma anomalum*), White Shiner (*Luxilus albeolus*), White Sucker (*Catostomus commersonii*), Northern Hogsucker (*Hypentelium nigricans*), darters, and Walleye (*Sander vitreus*) were collected in the flowing-water habitat immediately downstream of the spillway, whereas species such as Rock Bass (*Ambloplites rupestris*), Redbreast Sunfish (*Lepomis auritus*), Green Sunfish (*L. cyanellus*), and Bluegill (*L. macrochirus*) were collected in locations further downstream in habitat dominated by pools. The study concluded that fish stranding is not a substantial problem within the Buck bypass when ramping procedures are followed. On March 27, 1998, FERC approved Appalachian's ramping rate assessment report, which included recommendations for Appalachian to continue to retain the ramping rate protocol assessed in the 1997 study. The Virginia Department of Wildlife Resources (VDWR) (formerly the Virginia Department of Game and Inland Fisheries [VDGIF]) noted in comments on the PSP that this historical assessment may not apply under current Walleye population conditions.

5 Methodology

The USFWS requested an instream flow study with the goal of determining the impacts of modifying the discharge location and configuration (gate operation) on the current velocity and direction, sediment transport and deposition patterns, aquatic species and habitats, and recreation in the tailrace area and bypass reach below the Project dams.

Appalachian's goal in selecting a process for evaluating flows at the Project is to develop a technical basis for systematically evaluating and balancing the needs and priorities of the various flow-related resources. Therefore, the goal of this study is to characterize changes in habitat quantity over a range of flows and operational scenarios. There are several types or combinations of methodologies that could be used to meet the study objectives, ranging from very quantitative to relatively qualitative data. Appalachian believes that the approach used for this study (i.e., development of a two-dimensional [2-D] flow and habitat model) provides the requested information at an appropriate level of effort. This approach also allows for an assessment of potential Project protection, mitigation, and enhancement measures for the benefit of the range of resources in the bypass reaches.

5.1 Literature Review and Desktop Assessment

A literature review of available information was performed to support the study goals, methodologies, and planning of field portions of the study. This task included a review of the hydrologic record for the Project reaches, existing spillway gate operating procedures maintained by Appalachian, existing topographic and geologic maps, and available recent and historical aerial imagery.

Several pieces of information were considered in the field study planning process. First, a desktop analysis of mesohabitat (i.e., pools, riffles, runs, bedrock, shoals) mapping of the bypass reaches was completed using high-resolution aerial imagery and topographic contour data collected as described in Section 5.2. Second, species of interest were determined based on stakeholder consultation and an evaluation of management objectives (e.g., Walleye spawning, minimizing fish stranding, habitat availability under different flow regimes using guild curves to represent fish species that are or may be present in the bypass reaches, etc.). The life history characteristics and habitat preferences of selected species, as well distribution of mesohabitat types, were considered in the selection of targeted flows and locations for field data collection. GIS figures delineating mesohabitat types are provided in Section 6.3.

5.2 Topography Mapping and Photogrammetry Data Collection

Light detection and ranging (LiDAR) data were collected during a period of no releases at the dams and minimal water levels in the bypass reaches to support development of comprehensive three-dimensional (3-D) elevation and visual surface layers of each bypass reach. These data were used for desktop mesohabitat mapping as well as to produce a digital terrain map of each bypass reach. The topographic information was then incorporated as a base layer for subsequent field data collection and hydraulic modeling efforts. LiDAR data collection and digital terrain models are discussed further in Attachment 1 – Buck Bypass Reach ICM Model Development.

5.3 Desktop Mesohabitat Mapping

Using the high-resolution photogrammetry data (see Section 5.2), polygons were drawn in GIS to encompass the bypass study sites according to substrate size (e.g., sand, gravel, cobble, etc.), cover (e.g., no cover, overhead vegetation, etc.), and mesohabitat types (Table 5-1). Mesohabitats were delineated based on typical stream and river morphological, longitudinal sequences (i.e., riffle, run, pool, glide) (Wildland Hydrology 1996) and aerial signatures denoting flow and turbulence at leakage, low-flow, or moderate-flow conditions.

Table 5-1. Desktop Mesohabitat Delineation Codes Used for the Byllesby-Buck Flow and Aquatic Habitat Study

Substrate-Cover Classifications		
Code	**Cover**	**Substrate**
01	No Cover	and silt or terrestrial vegetation
02	No Cover	and sand
03	No Cover	and gravel
04	No Cover	and cobble
05	No Cover	and small boulder
06	No Cover	and boulder
07	No Cover	and mud or flat bedrock[1] (unsuitable as cover)
08	Overhead vegetation	and terrestrial vegetation
09	Overhead vegetation	and gravel
10	Overhead vegetation	and cobble
11	Overhead vegetation	and small boulder, angled bedrock[3], or woody debris
12	Instream cover	and cobble
13	Instream cover	and small boulder, angled bedrock[3], or woody debris
14	Proximal[2]	and cobble
15	Proximal[2]	and small boulder, angled bedrock[3], or woody debris
16	Instream or proximal[2]	and gravel
17	Overhead, instream, or proximal[2]	and silt or sand
18	Aquatic vegetation	and aquatic macrophytes
Mesohabitat Classifications		
Code	**Mesohabitat Type**	
00	Upland[4]	
01	Pool	
02	Riffle	
03	Run	
04	Glide	
05	Shoal	
06	Backwater	

[1] Flat bedrock consists of bedrock that is smooth, with or without crater-like divots, or otherwise unsuitable as instream cover.
[2] "Proximal" is defined as within four feet of suitable cover.

[3] Angled bedrock is angular, jutting or semi-vertical, slab-like bedrock. Angled bedrock was categorized as instream cover, regardless of presence of overhead vegetation.
[4.] Upland areas are areas that are inundated during spill events.

5.4 Field Data Collection

5.4.1 Flow and Water Level Assessment

In this task, field data was collected to support development of a 2-D hydraulic model of each development's tailrace and bypass reach. Calibration flows were released into the tailrace and bypass reaches for purposes of collecting water surface elevation, depth, velocity, and wetted area data under four bypass reach and tailrace flow regimes. The model enables a comparison between powerhouse operations (i.e., flow releases into the tailrace areas) and dam operations (i.e., flow releases into the bypass reaches via spillway gates).

A proposed framework for model scenarios was developed and the opportunity for agencies to review and comment was provided (prior to collecting data) in late August of 2020. The objective of the proposed flow test scenario study was designed to capture existing (baseline) Project operations and also to support the development and calibration of hydraulic models that allowed for visualization and evaluation of flow releases from set Tainter gate openings.

For the Byllesby development, the target flow scenarios (Table 5-2) were designed to evaluate the effect of passing the entire minimum downstream flow requirement of 360 cfs through the bypass reach. Tainter Gate #6 is the proposed gate to pass flows as it is near the center of the spillway structure and under existing operating procedures is the first gate operated for releases into the bypass reach (see Figure 4-1). The four target flows proposed in Table 5-2 would allow a hydraulic model simulation range from leakage up to approximately 500 cfs.

For the Buck development, the target flow scenarios (Table 5-2) were designed to evaluate the effect of the existing ramping rate requirements. Appalachian is required to discharge flows through a 2-ft gate opening for at least three hours following any spills released through a gate opened 2 ft or more. Appalachian must then reduce the opening to 1 ft for at least an additional three hours, after which time the gate may be completely closed. This gradual reduction of flow allows adequate time for fish that may have traveled upstream into the bypass reach to respond to receding water levels, reducing instances of fish stranding that can potentially occur with sudden flow discontinuation.

Tainter Gate #1 (see Figure 4-2) was utilized at the Buck development to pass the target flows since this reflects current operations (i.e., Tainter Gate #1 is first to open and last to close during high flow events where flows are routed into the bypass reach). Gate openings of 2 ft and 1 ft were evaluated (as per existing ramping rate operating protocols) as well as a gate opening of 0.5 ft to represent flows that would occur between a 1-ft gate opening and leakage conditions. The four target flows proposed in Table 5-2 allowed for a hydraulic model simulation range from leakage up to approximately 2,250 cfs.

Water level data loggers (pressure transducers that measure water stage changes) were strategically deployed in the tailrace, bypass, and downstream study reaches prior to releasing the calibration target flows. The instrumentation remained in place for several weeks afterwards to collect additional data during several rainfall runoff events, which captured depth and surface flow travel time information under a variety of flow regimes (i.e., powerhouse operations and spillway gate openings).

A level logger was also placed at the downstream end of the Buck study area to capture changes in water surface elevations created by Project operations. This downstream boundary was requested by the VDWR (formerly the VDGIF) to help better understand the potential effect Project operations may have on mussel habitat in this area.

Table 5-2. Byllesby-Buck Bypass Reach Aquatic Habitat Study proposed Flow Test Scenarios

Byllesby Bypass Reach				
Pool Range: 2078.2 - 2079.2 NGVD 29; Assume starting Pool Elevation is 2078.7 NGVD 29)				
Powerhouse Discharge Capacity: 5,868 cfs				
Powerhouse Minimum Discharge Capacity: 85 cfs/unit				
Tainter Gate #6				
Opening* (ft)	Proposed Target Flows (cfs)	Flow Test Duration (hours)	Volume (acre-ft)	Model Simulation Range (cfs)
0.0	Leakage	NA	0	Leakage ↓ 500
0.10	40	5	17	
0.25	105	5	43	
0.5	203	5	84	
Buck Bypass Reach				
Pool Range: 2002.4 - 2003.4 NGVD 29; Assume starting Pool Elevation is 2002.9 NGVD 29				
Powerhouse Discharge Capacity: 3,540 cfs				
Powerhouse Minimum Discharge Capacity: 73 cfs/unit				
Tainter Gate #1				
Opening* (ft)	Proposed Target Flows (cfs)	Flow Test Duration (hours)	Volume (acre-ft)	Model Simulation Range (cfs)
0.0	Leakage	NA	0	Leakage ↓ 2,250
0.5	224	8	148	
1.0	448	8	296	
2.0	897	8	593	

Notes: * Assume starting point is midpoint of operating range with adequate inflow to maintain pond levels during flow tests.

5.4.2 Particle Size Distribution

A Wolman pebble count (Wolman 1954) was performed along three transects in the Buck bypass reach to characterize the existing grain size distribution of substrate. The transects were located in the upper, middle, and lower portions of the bypass reach to evaluate differences in substrate between the three locations. Substrate particle sizes were plotted by size class and frequency to determine distributions within the mesohabitats of each of the bypass reaches; plots are shown in Section 6.4.2. Similar techniques will be performed to determine substrate characteristics in the Byllesby bypass reach in 2021.

5.5 Hydraulic Model Development

5.5.1 General Model Description

Development of a 2-D hydraulic model was carried out as part of the Bypass Reach Flow and Aquatic Habitat Study. A 2-D model incorporates detailed terrain data obtained by topographic mapping technologies and provides options for building one-dimensional (1-D) and 2-D geometries. It also utilizes a 1-D/2-D model development approach which optimizes the simulation of observed hydraulic behavior for specific project requirements. This study used the Innovyze Infoworks Integrated Catchment Model (ICM) software (version 7.0), which is capable of simulating depth and velocities in a 2-D grid pattern over a wide range of flow conditions.

The advantages of implementing a 2-D model provides more stable results over a wider range of flows than a 1-D model, thus reducing troubleshooting during model development; however, simulation speed is generally slower. The ICM software performs 2-D unsteady flow hydraulic calculations based on conservation of mass and momentum to dynamically route the spillway release flood wave downstream and uses a finite-volume solution algorithm to allow for 2-D cells to be wet or dry and handle a sudden rush of water, subcritical, supercritical, and mixed-flow regimes. For instance, a spillway release is a highly dynamic flood wave that rises and falls quickly; therefore, the 2-D unsteady flow calculation must use the full momentum form of the St. Venant equations (the full momentum equation accounts for the change in velocity both spatially and temporally).

The model geometry is defined by digital terrain model elevation values, user inputs based on Project drawings and survey information, and Manning's roughness coefficient inputs (used to establish terrain roughness) and calculates the flood wave hydrograph resulting from a spillway release based on input gate operation parameters. The ICM model is also capable of simulating reservoir inflow and rate of reservoir rise, dynamic gate operations scenarios, release travel times, and rates of rise at locations within and downstream of the bypass reach.

5.5.2 Buck Bypass Reach ICM Model Development

The morphology of the approximately 4,100-foot long Buck bypass reach extending from the spillway to the vicinity of the powerhouse tailrace is variable and includes deep and shallow pools, runs, shoals, steep cascades, and side channels with large boulders. This channel variability impacts flow travel times differently at varying flows and is most accurately represented by a 2-D model. Results of the modeling effort for the Buck Bypass are included in Attachment 1 (Buck Bypass reach ICM Model Development); this report presents the final 2-D Buck Bypass Reach model developed using the ICM software, which was used to predict hydraulic regimes in the bypass reach under varying flows and from varying spill locations.

Flow and water depth data collected at four target flows were used to calibrate and validate the hydraulic model to allow simulation of flow conditions and gate operations other than those that were explicitly sampled during data collection. Recorded gate operations (provided by Appalachian), flow, and level-logger data from each tailrace and bypass study reach will be processed to provide operation sequences and flow and elevation hydrographs used for the calibration of gate and bypass reach model hydraulic parameters. Operational procedures for spilling and ramping rates that affect upstream-downstream connectivity were also assessed. Analyzing the results of varying spill events and spill configurations can provide insight to potential adverse effects on the fish and mussel communities or recreational fishing opportunities in the bypass reach. Simulations were used to establish matrices of travel time, rise in water surface elevation, and velocities at locations of interest under the different flow regimes.

It is noted that any model is a representation of actual physical processes and has inherent uncertainty, especially when used to simulate conditions that were not explicitly observed and recorded. The level of model accuracy is influenced by the quality of data used to build the model, such as channel geometry, geometry and hydraulic parameters of controlling structures (i.e. gates and spillways), the quality of data used to calibrate the model, and choice of model (uncertainty inherent in numerical methods, flow calculation equations, etc.).

5.6 Aquatic Habitat Evaluation

Activities described above (i.e., literature review and desktop assessment, topographic mapping and photogrammetry, field data collection, and hydraulic model development) were used to develop a flow and aquatic habitat assessment of each tailrace and bypass reach. Specifically, for each flow scenario evaluated, incremental changes in depth and wetted area were determined. The water level logger data in combination with the 2-D model results were used to determine rate of rise and fall of water elevation (i.e., water depth) in the tailrace and bypass reach and evaluate flow patterns and hydraulic connectivity under each flow regime evaluated. In addition, substrate and mesohabitat mapping along with the 2-D model depth and velocity simulation results were used in combination with aquatic species habitat suitability criteria (HSC) (i.e., using depth, velocity, and habitat preferences) to evaluate potential available habitat under each modeled flow scenario in the study reach.

5.6.1 Target Species and Habitat Suitability Criteria

Walleye was selected as the target species for this study along with a total of eight species-guild representatives including three shallow-slow, one shallow-fast, two deep-slow, and two deep-fast guilds. Guild representatives were selected from a variety of regionally representative sources, represent a wide range of habitat characteristics, and were selected to represent a wide range of species. In some cases, general non-species-specific criteria were used. In other cases specific species were used to represent a guild category; these include Redbreast Sunfish (*Lepomis auritus*), Silver Redhorse (*Moxostoma anisurum*), and Shorthead Redhorse (*Moxostoma macrolepidotum*) (Table 5-3).

5.6.1.1 Target Species

Walleye is the largest member of the Percidae family and attains average adult sizes of 300-780 millimeters (mm) total length (Lee et al. 1980; Stauffer et al. 1995). The fish is native to most of North America, excluding the arid west where it has been widely introduced for its recreational importance (Lee et al. 1980). The species is a voracious predator that begins feeding solely on fish at the size of only 30 mm (Li and Mathias 1982). Walleye are yellow to green dorsally, slightly fade laterally, and become white ventrally. Dark bands across the dorsum can be present in some individuals. Fins are mostly clear with some spotting, but the posterior margin of the anterior dorsal fin has a dark blotch and the ventral tips of the caudal and anal fins are white (Stauffer et al. 1995).

Walleye are most commonly associated with large rivers in deep water habitat such as pools and runs. They only leave the protection of deep water at night when they feed in the shallows (Lee et. al. 1980; Stauffer et. al. 1995). Spawning takes place during early spring at temperatures ranging from 3-16^{o} C. Shallow gravel substrate is necessary for successful spawning (Lee et. al. 1980).

5.6.1.2 Guild Species

Redbreast Sunfish

As a representative of the deep/slow guild, the Redbreast Sunfish, is a Centrarchid. The redbreast is native along the Atlantic slope of the Appalachians from southern Canada to Florida west to the Apalachicola River (Lee et al. 1980). Like most sunfishes the Redbreast Sunfish is an opportunistic insectivore that incorporates smaller fish into its diet as it obtains larger sizes (Levine et al. 1986; Wallace 1984). Superficially, the Redbreast Sunfish resembles most other sunfish, particularly the bluegill (*Lepomis macrochirus*). However, unlike the bluegill, the redbreast lacks a black blotch on the dorsal fin and has shorter gill rakers. The redbreast can be distinguished from all other sunfish, except the bluegill, by black on the opercular flap that extends to the posterior margin. Adults range from 60-155 mm total length (Lee et. al. 1980).

More than any other sunfish, the Redbreast dwells almost entirely in lotic environments (Lee et al. 1980; Stauffer et al. 1995). Gravel spawning nests are constructed from spring through summer when water temperatures reach 23° C (Levine et al. 1986; Stauffer et al. 1995).

Redhorse

Representing both shallow/slow (i.e., young-of-year) and deep/fast (i.e., adults) guilds, Catostomidae are members of the genus *Moxostoma*, the redhorses. Specifically, Silver Redhorse and Shorthead Redhorse habitat suitability information is included in the guild habitat modeling.

The redhorses are indigenous to the Atlantic slope of the Appalachians, the Mississippi River Drainage, and the Great Lakes Basin. All the redhorses possess subterminal mouths used to forage the streambed for benthic macroinvertebrates. Like other catostomids, they are drab olive bronze dorsally and fade to white ventrally. They possess complete, well developed lateral lines and develop tubercles during breeding. These fish can attain lengths up to 600 millimeters standard length (Lee et al. 1980; Stauffer et al. 1995).

The redhorse can inhabit both lentic and lotic environments, but they prefer medium to large streams and rivers with clear water and assorted rock substrates. While they are usually associated with deep pools and backwaters, they spawn in spring and early summer on coarse gravel (Lee et al. 1980; Stauffer et al. 1995).

5.6.1.3 Habitat Suitability Criteria

HSC define the range of microhabitat variables that are suitable for a particular species and lifestage of interest. Variables typically defined with HSC include depth, velocity, instream cover, and bottom substrate. HSC provide the biological criteria input to the ICM 2-D model, which combines the physical habitat data and the habitat suitability criteria into a site-wide habitat suitability index (i.e., weighted usable area or WUA) over a range of simulation flows. The habitat suitability index (HSI) is a numerical scale that represents habitat suitability with values ranging from 0.0 to 1.0 indicating habitat conditions that are unsuitable to optimal, respectively. WUA is defined as the sum of stream surface area within a nodal area model domain or stream reach, weighted by multiplying area by habitat suitability variables (most often velocity, depth, and substrate or cover), which range from 0.0 to 1.0 each.

HSC for target species and lifestages were obtained from three previous instream flow investigations: (1) Sutton Hydroelectric Project, Elk River, WV (HDR 2010); (2) Smith Mountain Hydroelectric Project, Roanoke River, Va (TRPA & Berger 2007); and (3) Claytor Hydroelectric

Project, New River, Va (TRPA & Berger 2008). These three recent studies represent the best available sources for regionally applicable species information due to their close proximity to the study location, the similarity in river condition and species community modeled, and the collaborative HSC review process that each underwent.

Velocity, depth, and substrate HSC curves for Walleye, shallow water guilds, and fast water guilds are shown on Figure 5-1 through Figure 5-6. HSC data tables are included in Attachment 2 and habitat maps are presented in Attachment 3.

Table 5-3. Target Species Habitat and Suitability Criteria Source and Code Table

Species	Lifestage/ Category	Representative	Source Study	HSC Code
Walleye	Fry	--	Sutton Hydroelectric Project, Elk River, WV	WLEF
	Juvenile	--	Sutton Hydroelectric Project, Elk River, WV	WLEJ
	Adult	--	Sutton Hydroelectric Project, Elk River, WV	WLEA
	Spawning	--	Sutton Hydroelectric Project, Elk River, WV	WLES
Shallow-Slow Guild	Fine substrate, no cover	Redbreast Sunfish spawning	Smith Mountain Hydroelectric Project, Roanoke River, VA	RBSFS
	All substrate with aquatic vegetation	Silver Redhorse young-of-year	Sutton Hydroelectric Project, Elk River, WV	SRHAV
	Coarse substrate	Generic Shallow-Slow Guild	Sutton Hydroelectric Project, Elk River, WV	SHSLO
Shallow-Fast Guild	Moderate velocity with coarse substrate	Generic Shallow-Fast Guild	Claytor Hydroelectric Project New River, VA	SHFST
Deep-Slow Guild	Cover	Redbreast Sunfish adult	Smith Mountain Hydroelectric Project, Roanoke River, VA	RBSFA
	No cover	Generic Deep-Slow Guild	Sutton Hydroelectric Project, Elk River, WV	DSLON
Deep-Fast Guild	Slightly weighted for fine substrate, Cover	Silver Redhorse adult	Smith Mountain Hydroelectric Project, Roanoke River, VA	SRHAD
	Coarse-mixed substrate	Shorthead Redhorse adult	Smith Mountain Hydroelectric Project, Roanoke River, VA	SHRHA

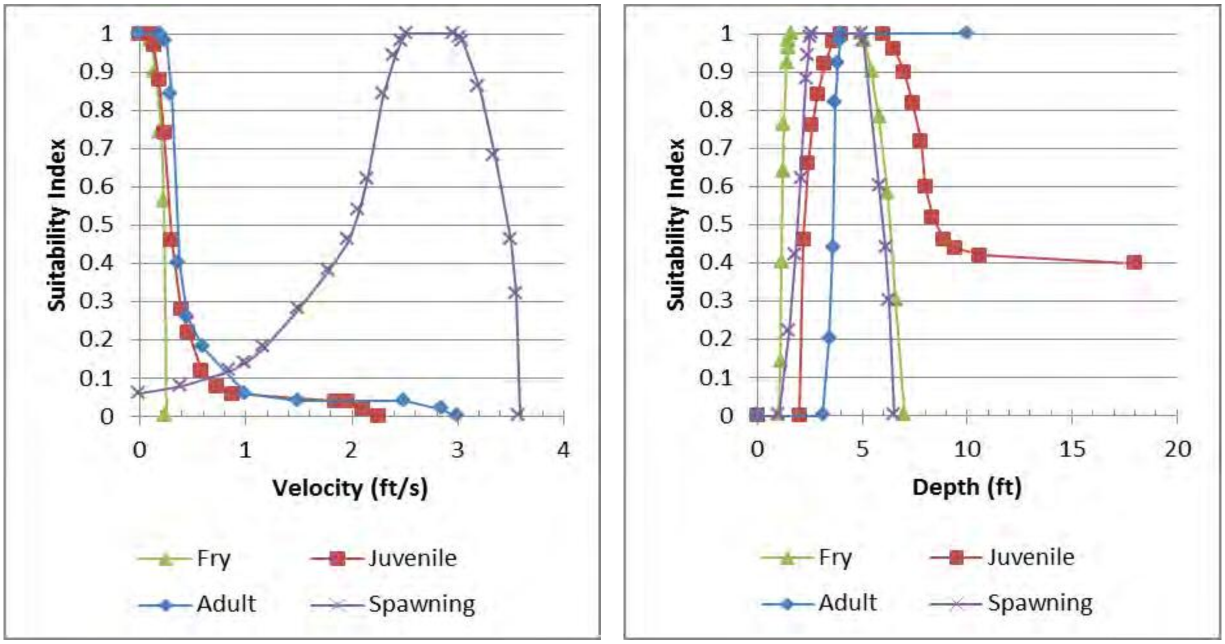


Figure 5-1. Velocity HSC (left) and Depth HSC (right) for Walleye

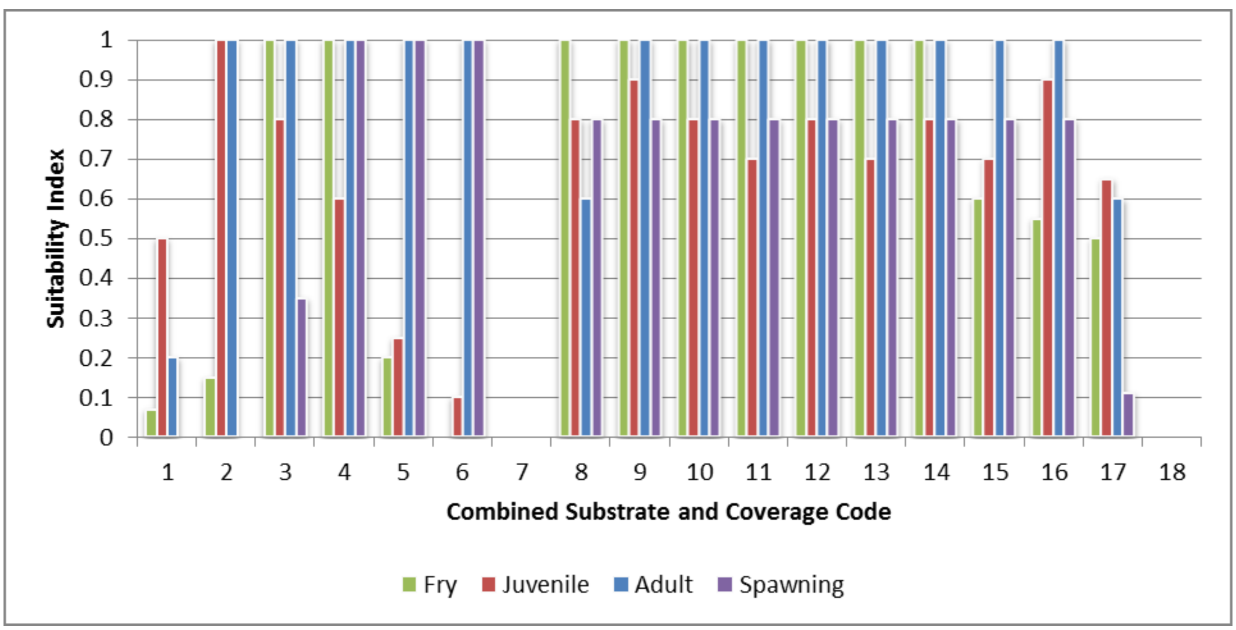


Figure 5-2. Substrate HSC for Walleye

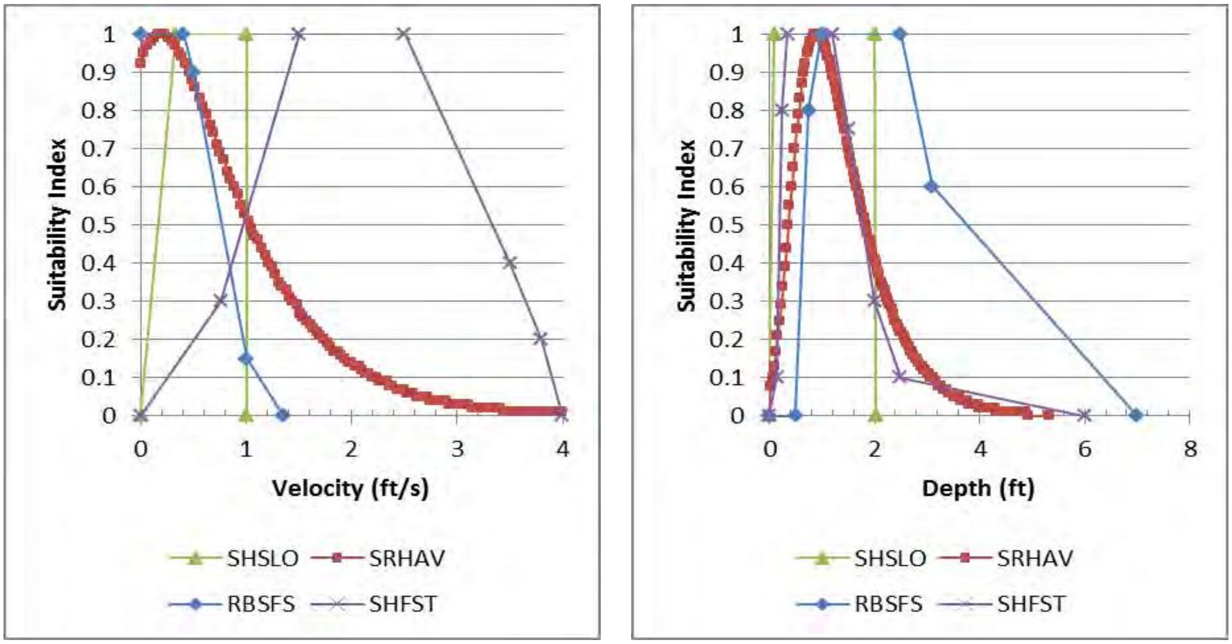


Figure 5-3. Velocity HSC (left) and Depth HSC (right) for Shallow Water Guilds

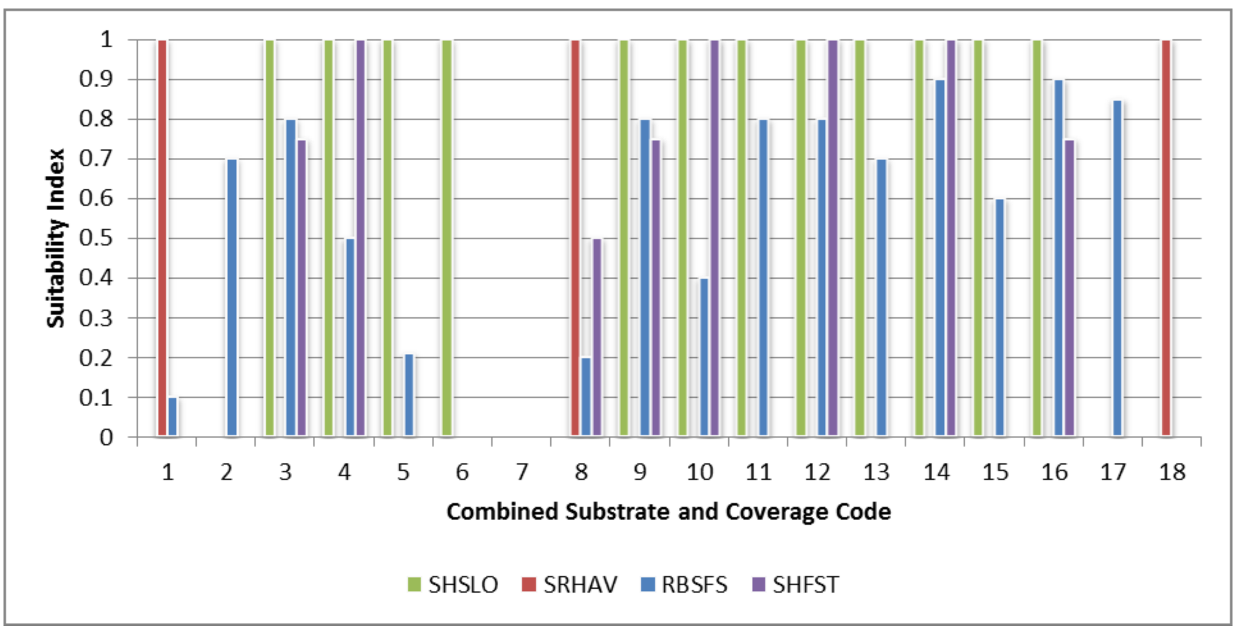
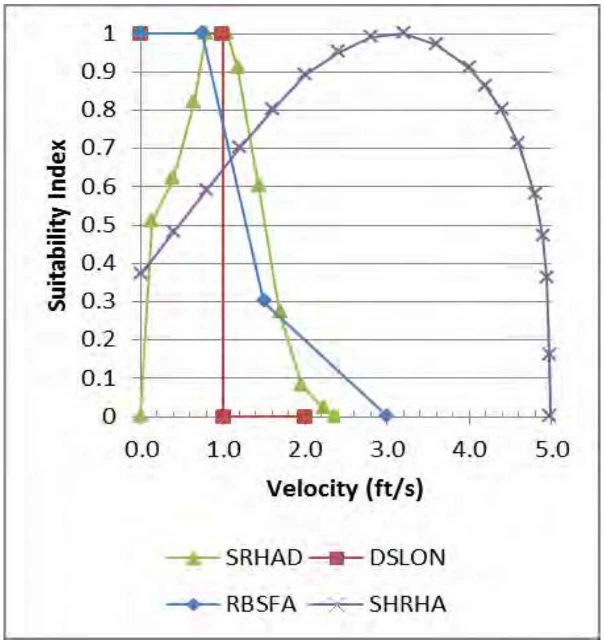


Figure 5-4. Substrate HSC for Shallow Water Guilds



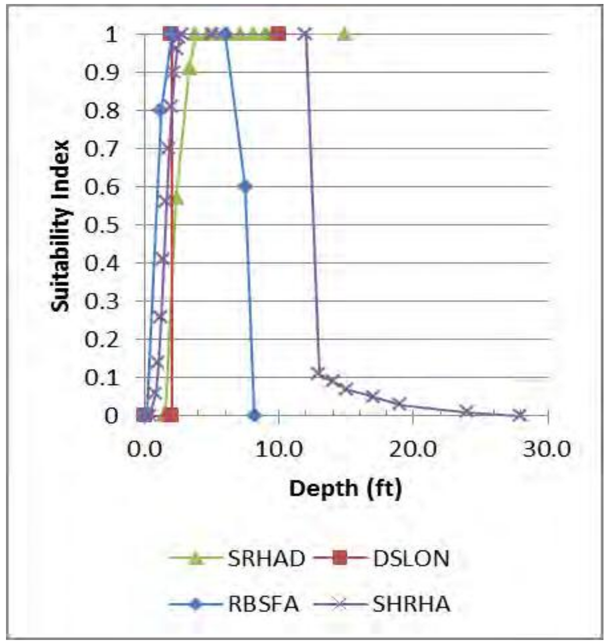


Figure 5-5. Velocity HSC (left) and Depth HSC (right) for Deep Water Guilds

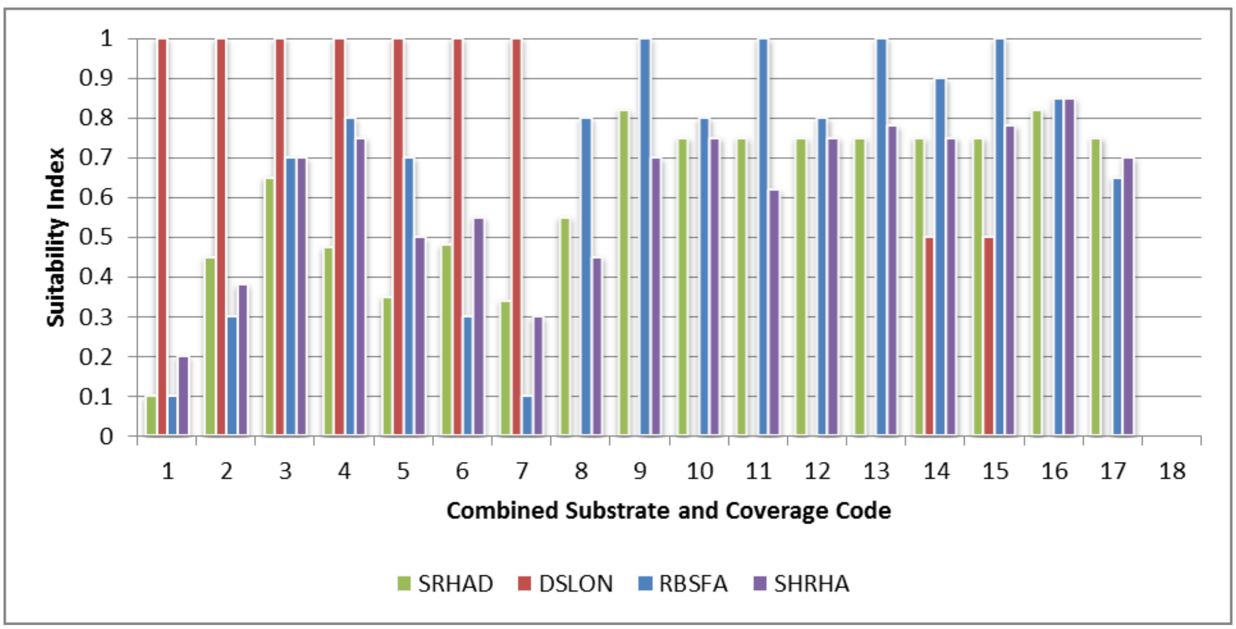


Figure 5-6. Substrate HSC for Deep Water Guilds

6 Study Results

6.1 Literature Review and Desktop Assessment Results

The literature review included several key reports and documents, which are included in the references section, as well as USGS and Project flow data as described in Section 5. The results of the desktop mesohabitat mapping of the bypass reaches, which was completed using high-resolution aerial imagery and topographic contour data, are included in Section 6.3. The 2-D hydraulic model results are included in Section 6.5 and Attachment 1. The aquatic habitat evaluation results including the life history characteristics and habitat preferences of selected species, as well distribution of mesohabitat types, are provided in Section 6.6.

6.2 Topography Mapping and Photogrammetry Data Collection Results

LiDAR data were collected during a period of no releases at the dams and minimal water levels in the bypass reaches to support development of comprehensive 3-D elevation and visual surface layers of each bypass reach. These data were used for desktop mesohabitat mapping as well as to produce a topographic map of each bypass reach. Maps of the mesohabitat modeling results are included in Attachment 3 (Habitat Suitability Maps) and digital terrain models are included in the Buck Bypass Reach ICM Model Development report (Attachment 1).

6.3 Desktop Mesohabitat Mapping Results

The habitat mapping codes described in Section 5.3 were used to delineate the Byllesby and Buck bypass reaches. Habitat types were verified and/or updated in GIS as necessary based on field observations. Substrate-cover and mesohabitat classifications were reviewed by a senior scientist and polygons were processed using quality control procedures to ensure data integrity throughout the aquatic habitat modeling process.

6.3.1 Byllesby Bypass Reach

The total area evaluated for the Byllesby bypass reach was 40.1 acres. The majority of the Byllesby bypass reach had some kind of cover as either instream cover or overhead vegetation (37.4 and 22.7 percent, respectively) (Table 6-1). Approximately half (48.1 percent) of the substrate characterizations were boulder or bedrock. Run and riffle habitats were the most common within bypass the reach (44.2 and 41.0 percent, respectively), followed distantly by shoal, glide, upland, pool, and backwater mesohabitats. A photo of the Byllesby bypass reach is presented below (Figure 6-1) and a figure depicting the habitat desktop delineation is shown on Figure 6-2.

Table 6-1. Summary of Habitat Characteristics of the Byllesby Bypass Reach

Habitat Characteristic	Area (acres)	Percent (%)
Cover		
No Cover	16.0	39.9
Instream Cover	15.0	37.4
Overhead Vegetation	9.1	22.7

Habitat Characteristic	Area (acres)	Percent (%)
Substrate		
Boulder, Bedrock, or Woody Debris	11.6	28.9
Sand	6.9	17.2
Silt or Sand	6.8	16.9
Mud or Flat Bedrock	5.8	14.6
Cobble	5.5	13.6
Boulder	1.9	4.6
Gravel	1.7	4.2
Mesohabitat		
Run	17.7	44.2
Riffle	16.4	41.0
Shoal	2.9	7.2
Glide	1.3	3.3
Upland	0.9	2.2
Pool	0.6	1.4
Backwater	0.5	0.7

Figure 6-1. Byllesby Bypass Reach at Byllesby-Buck Hydroelectric Project

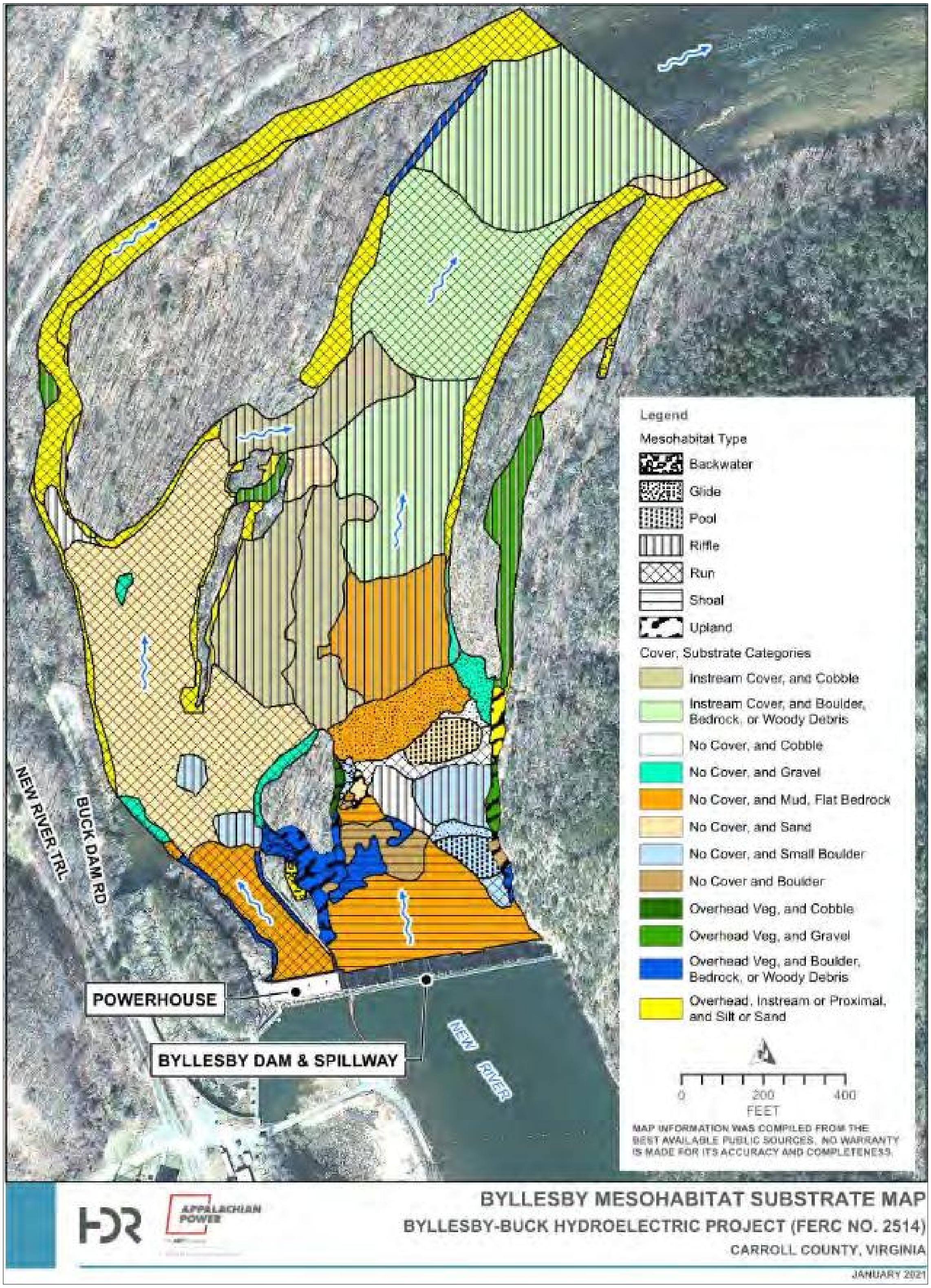


Figure 6-2. Byllesby Bypass Reach Desktop Habitat Delineation at Byllesby-Buck Hydroelectric Project

6.3.2 Buck Bypass Reach

The total area evaluated for the Buck bypass area was 99.4 acres. Most of the Buck bypass reach does not have any type of cover (63.2 percent); overhead vegetation accounts for approximately 28.4 percent of the total cover (Table 6-2). Concurrent with Wolman pebble count data (see Section 6.4.2), the majority of substrate identified through the desktop habitat analysis was designated as a cobble or larger (including bedrock) (84.9 percent).

The mesohabitat desktop mapping and field-verification showed that different shapes/sizes and orientation of bedrock exist between Byllesby and Buck bypass reaches. At Byllesby, flat bedrock with or without divots provides little or no instream cover (Figure 6-1); conversely at Buck, the bedrock is angular and vertically slanted, resulting in microhabitats as instream cover available for aquatic organisms. The bedrock slabs in the upper portion of the bypass reach are oriented parallel to flow resulting in scour of smaller substrate sizes, whereas in the middle-to-lower portion of the bypass reach, the bedrock is angled perpendicular to flow, resulting in substrate buildup (i.e., deposition) on the downstream side of the bedrock slabs. The difference in bedrock types is captured in the substrate-cover classifications below and is depicted in Figure 6-3 (i.e., the upper photograph is representative of the upper portion of the bypass reach and the lower photograph is representative of the mid-to-lower portion of the bypass reach). The desktop delineation of habitat types is presented in Figure 6-4 (upper bypass), Figure 6-5 (middle bypass), and Figure 6-6 (downstream of bypass reach).

Table 6-2. Summary of Habitat Characteristics of the Buck Bypass Reach

Habitat Characteristic	Area (acres)	Percent (%)
Cover		
Instream Cover	65.8	66.2
No Cover	24.5	24.7
Overhead Vegetation	9.1	9.1
Substrate		
Boulder, Bedrock, or Woody Debris	61.6	61.9
Cobble	15.0	15.1
Silt or Sand	8.0	8.1
Gravel	4.3	4.3
Small Boulder	3.8	3.8
Mud or Flat Bedrock	3.8	3.8
Sand	2.6	2.7
Boulder	0.4	0.4
Mesohabitat		
Run	31.1	31.2
Shoal	20.6	20.7
Riffle	20.2	20.4
Upland	14.5	14.6
Pool	12.6	12.7

Habitat Characteristic	Area (acres)	Percent (%)
Glide	0.4	0.4
Backwater	0.0	0.0

Figure 6-3. Buck Bypass Reach with Flow Arrows (upper photo = Upper transect, bottom photo = Lower and Middle transects)

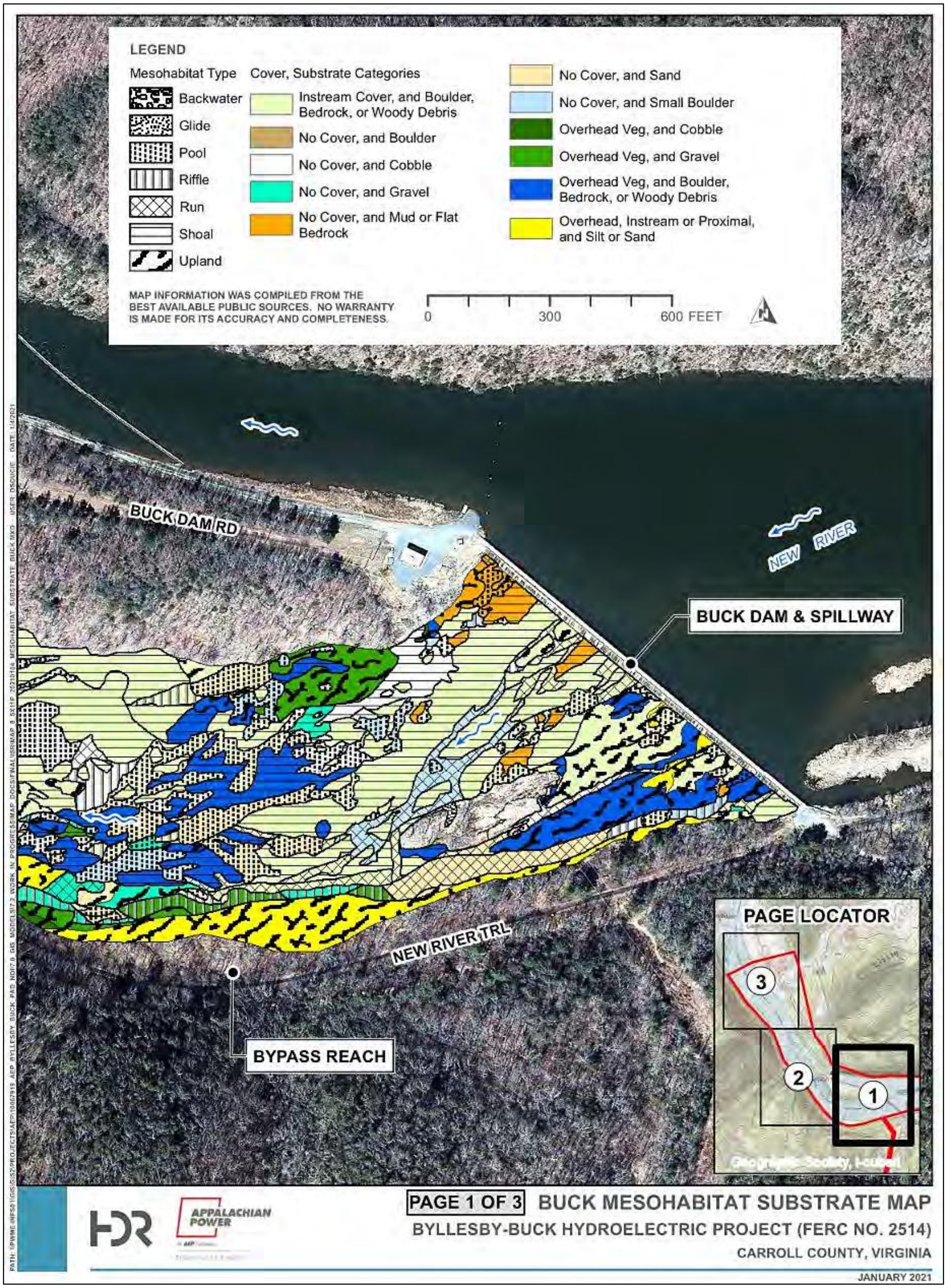


Figure 6-4. Desktop Habitat Delineation of the Upper Buck Bypass Reach

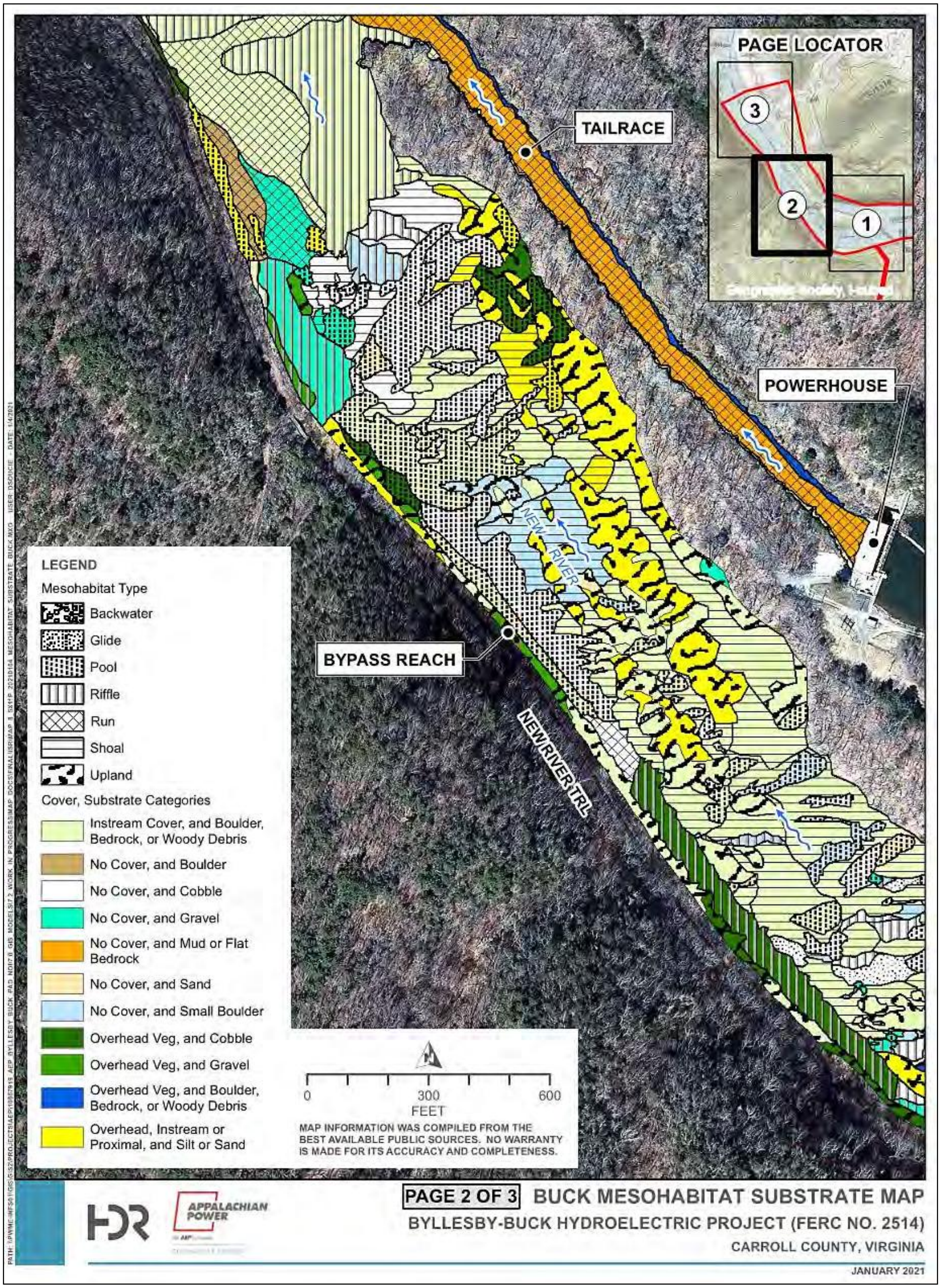


Figure 6-5. Desktop Habitat Delineation of the Middle Buck Bypass and Powerhouse Tailrace

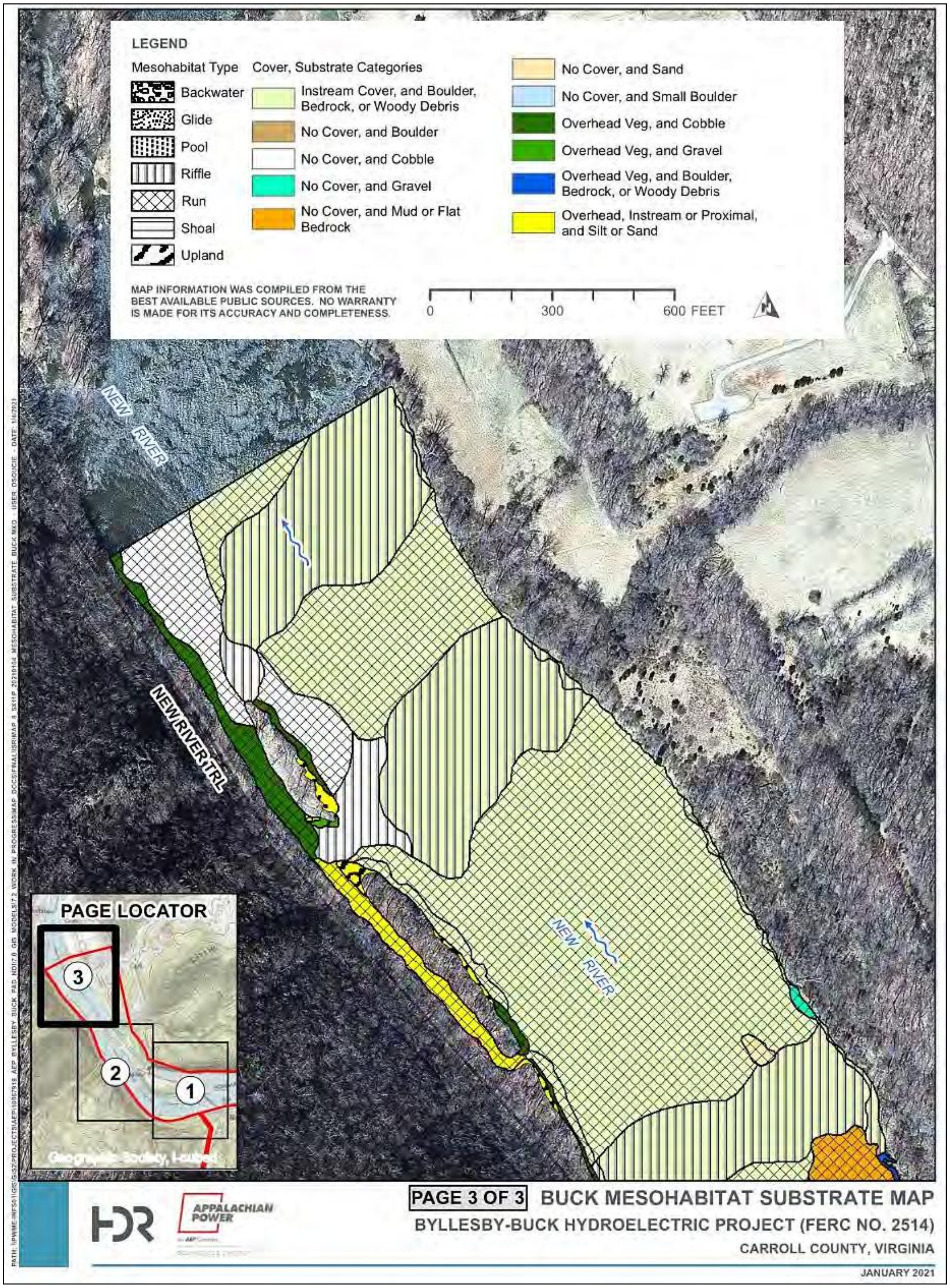


Figure 6-6. Desktop Habitat Delineation of the Lower Buck Reach (Downstream of Bypass Reach and Powerhouse Tailrace)

6.4 Field Collection Data Results

6.4.1 Flow and Water Level Assessment Results

Four target flow releases were performed over four days and two separate trips, September 8 – 10, 2020 and September 15 – 17, 2020. Each target flow was designed to capture a specific/stable flow in the bypass reach. Flow was delivered to the bypass reach via leakage through the closed spillway gates and flashboard bays and/or Tainter Gate #1. Total flows in the bypass reach were recorded using a handheld manual Swoffer® flow meter for the Day 1 (leakage) and Day 2 (0.5 ft gate opening) target flows and using an Acoustic Doppler current Profiler (ADCP) for the Day 3 and Day 4 (1 ft and 2 ft gate opening, respectively) target flows. Gate settings and resulting flows are provided in Table 6-3. Additional details on the target flow measurements (including location in the bypass reach) is provided in Attachment 1. The Proposed Flow Test Scenarios technical memo was emailed by Appalachian to key agency stakeholders on August 18, 2020. On August 25, 2020, VDWR requested a conference call with Appalachian and key agency stakeholders, which was held on August 28, 2020. The Proposed Flow Test Scenarios technical memo, the Bypass Flow Test Scenario meeting notes, and emails with agency concurrence are included in Attachment 4.

Table 6-3. Buck Tainter Gate #1 Settings and Measured Bypass Reach Flow

Tainter Gate 1 Opening (ft)	Bypass Reach Flow (cfs)
Day 1: Closed (Leakage Flow)	17.1
Day 2: 0.5 (Low Flow)	210.7
Day 3: 1.0 (Mid Flow)	354
Day 4: 2.0 (High Flow)	714

To aid calibration and validation of the ICM 2-D model in the Buck bypass reach, water surface elevations were collected during the target flow releases described in Section 5.4.1 using Onset U-20 level loggers set to record data at 5-minute intervals. This data was also used to determine flow travel times during the target flow releases to determine the amount of time required for each target flow to stabilize within the study area and also the amount of time it took for the target flow to recede once Tainter Gate #1 was closed. Locations of the deployed level loggers are shown in Figure 6-7 for the Buck bypass reach.

Level logger data during the two-week target flow field data collection period is shown on Figure 6-8 and the full period of level logger deployment (i.e., August 20 – October 6, 2020) is shown on Figure 6-9. Summary results/observations pertinent to the Bypass Reach Flow and Aquatic Habitat Study include:

- From the Leakage Flow to Low Flow range (17.1 cfs to 210.7 cfs), depths increased approximately 1.0 - 1.5 ft along the main flow path (i.e., center of upper reach and along the left descending bank in the lower portion of the reach). As the target flows increased to the Mid (354 cfs) to High (714 cfs) flow range, corresponding depths along the main flow path were approximately 2.5 ft deeper than at leakage flow.
- Target flow releases up to the High Flow range (714 cfs) did not influence water depth along the upper portions of the left descending side channel (BK_LL2); and resulted in a small

depth increase (< 0.5 ft) relative to leakage flows at BK_LL4 (which is just outside the main flow path).

- Depths along the left descending side channel were only impacted during rainfall runoff events that resulted in bypass reach flow releases that were much higher (i.e., at least 6,500 cfs) than the target flow scenarios (several flow events in this range are shown on Figure 6-9.

- Water depths at the downstream study area boundary were not influenced by the target flow releases as this location is downstream of the confluence of the tailrace and bypass reach. However, depths at this location are influenced by the overall magnitude of Project inflows. For example, as flows increased from approximately 2,000 cfs to 8,000 cfs, this resulted in a depth increase of approximately 2 ft at this location. As flows increased from approximately 2,500 cfs to 5,000 cfs resulted in a depth increase of approximately 0.75 ft (see Figure 6-9, location BK_LLDS).

- Water surface elevations in the lower portion of the bypass reach (i.e., near BK_LL10 and BK_LL11) are not influenced by flow releases from the spillway as the backwater effect from the New River extends upstream into this area.

- Flow travel time from the uppermost level logger (BK_LL1) to the most downstream level logger not influenced by the New River backwater effect (BK_LL8) ranged from approximately 1 hour (Low Flow release) to approximately 15 minutes (High Flow release). Time for flow stabilization at each location typically took less than 15 minutes once the flow arrived.

- Target flow releases were stable during the entire data collection period each day as evidenced by a steady water surface elevation for at least 8 – 10 hours each day.

- Once the target flow release stopped each day, water surface elevations in the Buck bypass reach dropped almost immediately and returned to leakage levels within approximately 2 hours.

- The existing ramping rate effect on bypass reach water surface elevations is clearly shown at the end of the Day 4 (High Flow) target flow release as the Tainter Gate #1 2-ft opening paused at a 1-ft opening for 3 hours before closing (Figure 6-8). This allowed water surface elevations in the bypass reach main flow path to decrease approximately 0.5 ft before the gate was closed completely.

- Tainter gate operations are evident during a rainfall runoff event that occurred between the two target flow measurement weeks (see September 13 – 15, 2020 on Figure 6-8).

Figure 6-7. Buck Bypass Reach Level Logger Locations

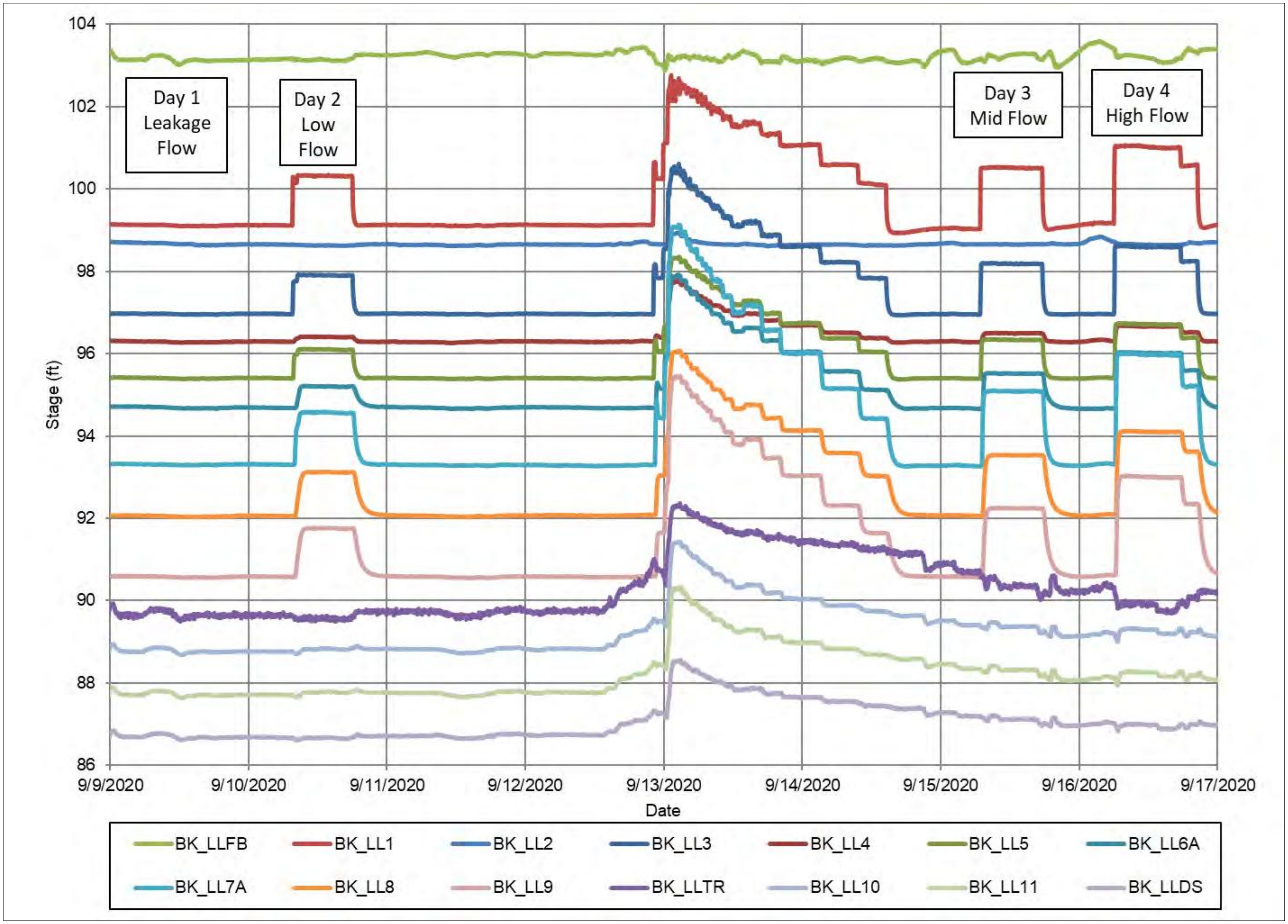


Figure 6-8. Buck Bypass Reach Level Logger Data during Target Flow Measurements

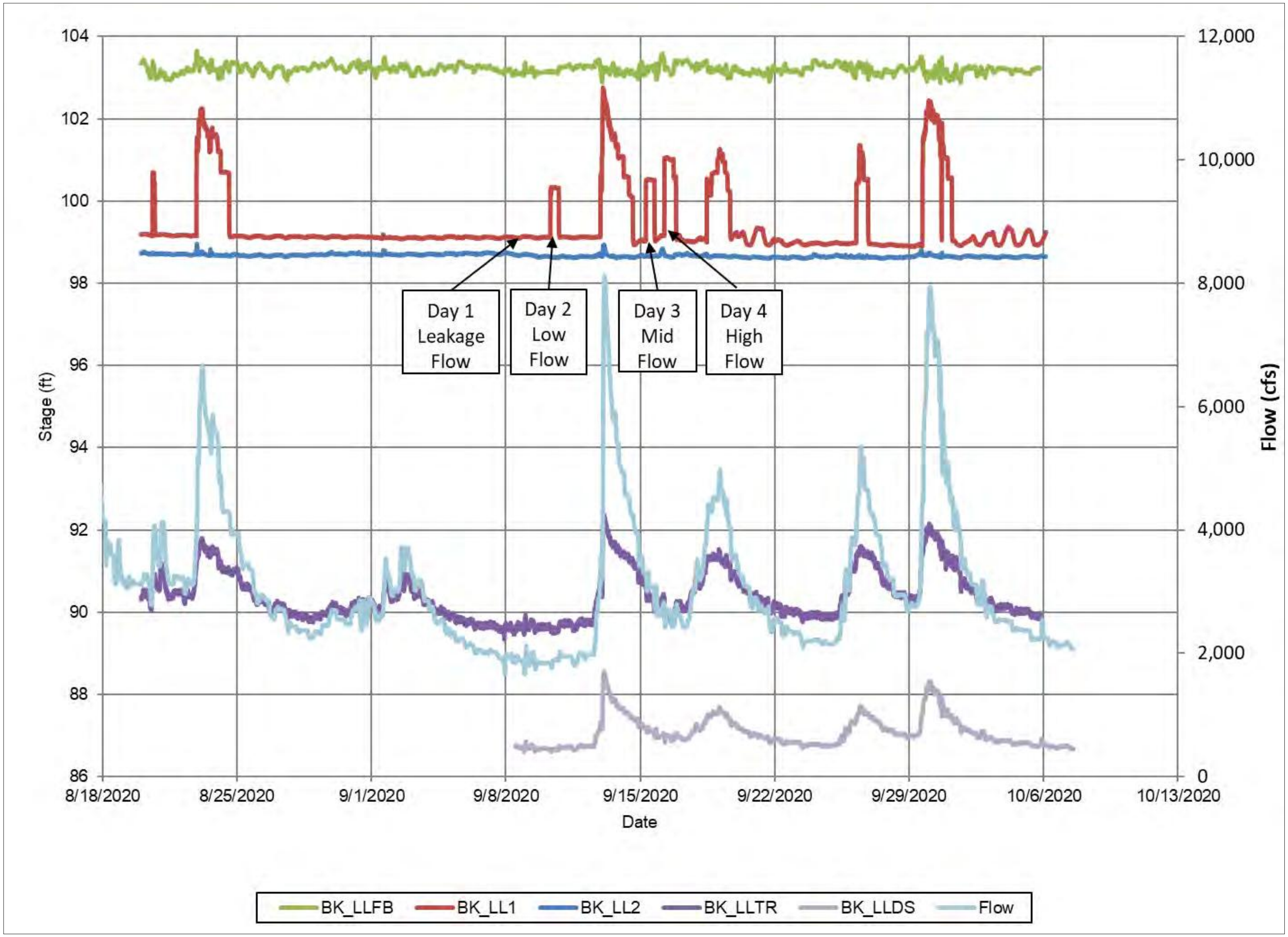


Figure 6-9. Buck Bypass Reach Level Logger Data during Study Period

6.4.2 Particle Size Distribution Results

6.4.2.1 Buck Bypass Reach

The locations of the three Wolman pebble count transects are shown on Figure 6-10. The transects were located in the upper, middle, and lower portions of the bypass reach to evaluate differences in substrate particle size distribution along the bypass reach. Substrate particle sizes are plotted by size class and frequency for each transect in Figure 6-11 (upper transect), Figure 6-12 (middle transect), and Figure 6-13 (lower transect).

The upper transect is dominated by bedrock, which covers approximately 50 percent of the width. Sand (<2.0 mm) is the second most abundant discrete size class along the upper transect (approximately 8 percent of the total) and particle sizes between 11.3 mm and 1,024 mm (i.e., medium gravel to medium boulders) are fairly evenly distributed, comprising the remaining 42 percent of the transect. There is a notable absence of particle sizes in the 0.5-mm to 11.3-mm range (clay/silt/sand/fine gravel) as those substrate sizes are likely scoured out during frequent high flow events. Most sediment of smaller particle size classes was wedged between the dominant angular bedrock slabs.

Bedrock was also the dominant substrate for the middle and lower reaches but comprised only 21 – 26 percent of the reach (compared to double that for the upper transect). Distribution of particle sizes between 11.3-mm and 1,024-mm was similar between the middle and lower transects. Similar to the upper transect, the overall substrate lacked particle sizes between 0.5-mm and 11.3-mm, which is likely due to scouring during high flow events; however, sand deposits (some large in surface area) were identified in velocity shelters downstream of bedrock slabs in the lower half of the bypass reach.

As described in Section 6.3.2, one of the major differences between the upper and middle-to-lower portions of the Buck bypass reach is the orientation of the angled bedrock. In the upper portion of the bypass reach, the bedrock is oriented parallel to flow resulting in scour of smaller substrate sizes, whereas in the middle-to-lower portion of the bypass reach, the bedrock is angled perpendicular to flow, resulting in sediment deposition on the downstream side of the bedrock slabs.

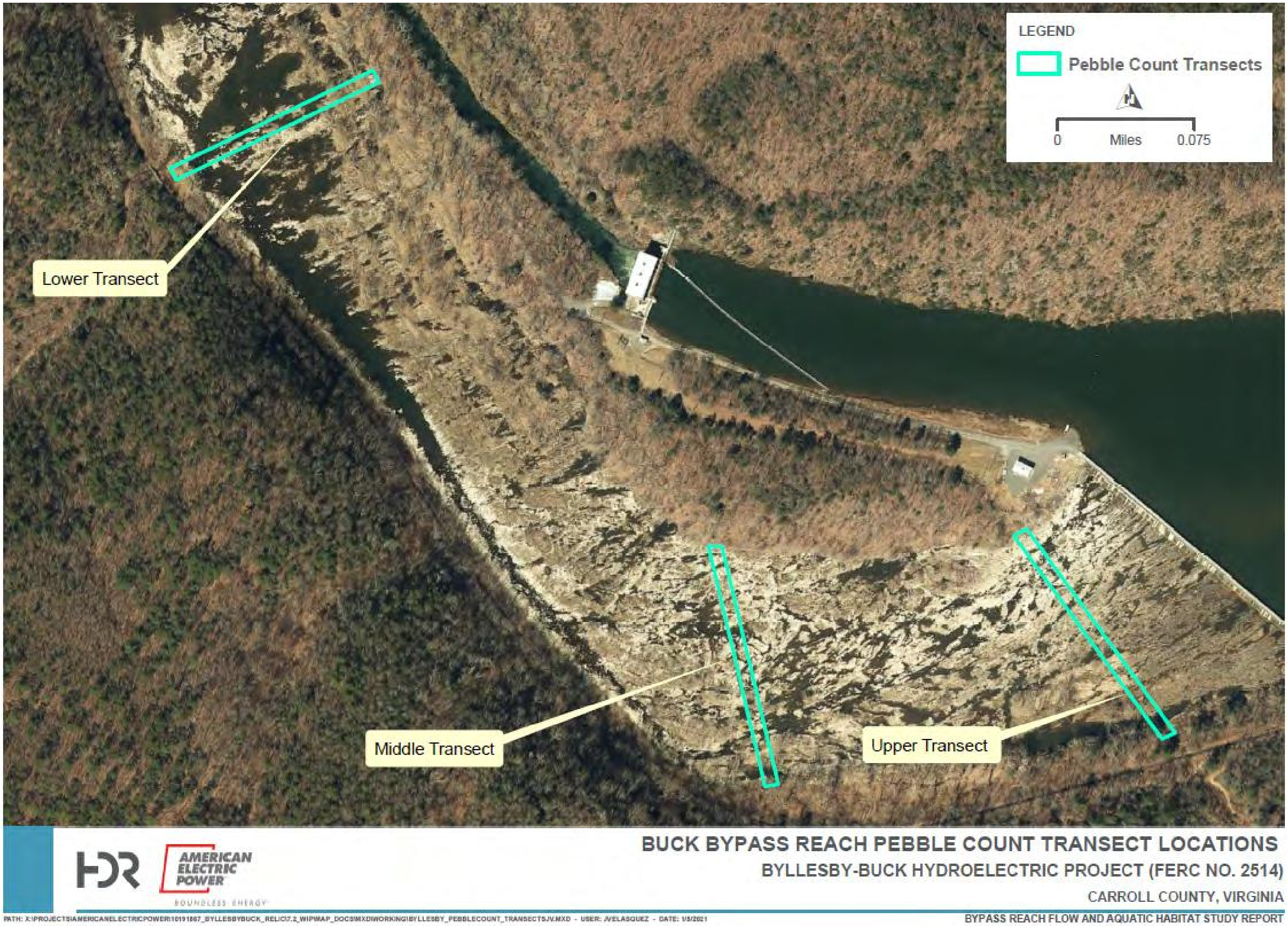


Figure 6-10. Buck Bypass Reach Pebble Count Transect Locations

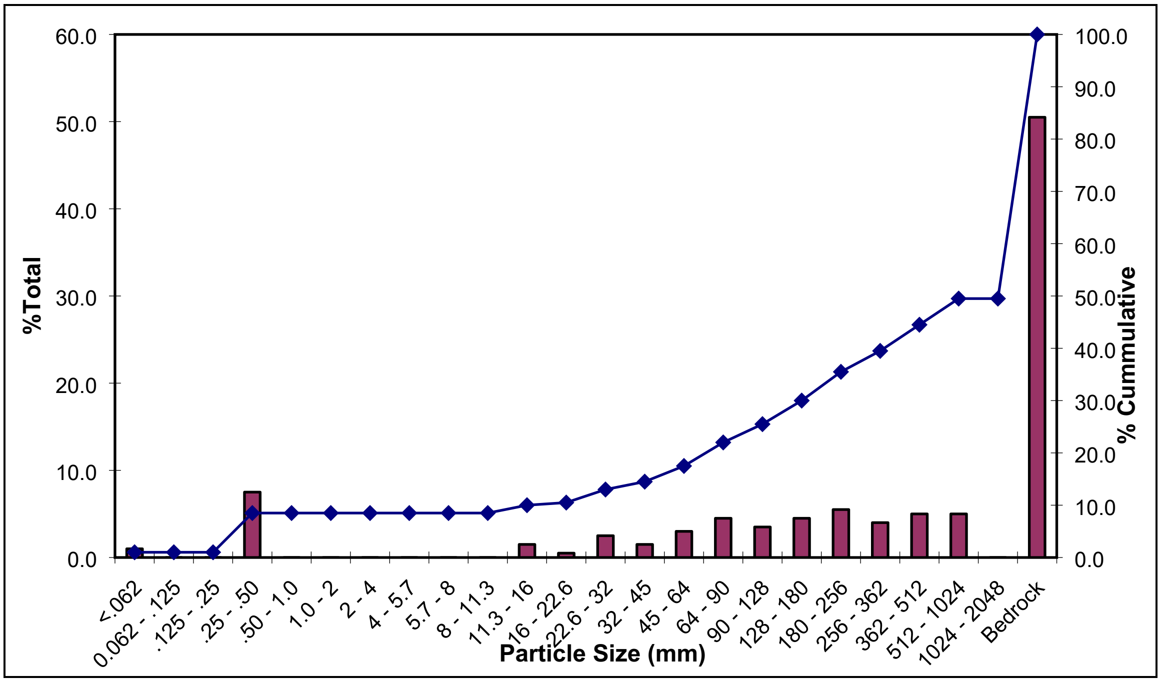


Figure 6-11. Pebble Count Particle Size Data at Upper Transect

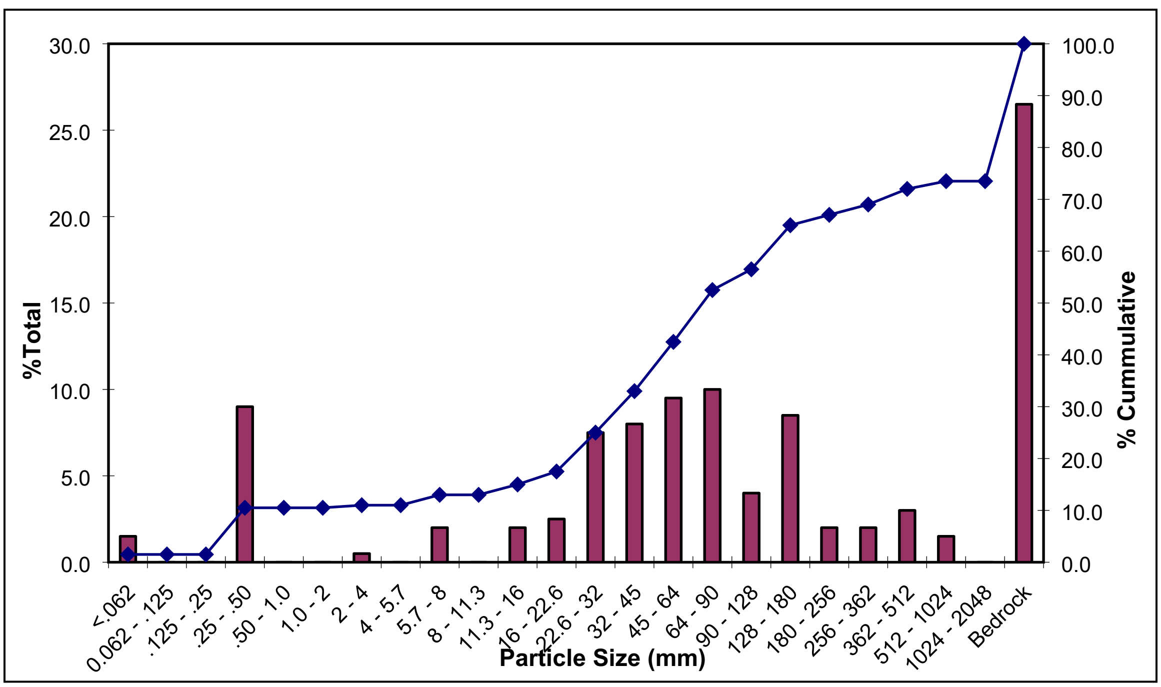


Figure 6-12. Pebble Count Particle Size Data at Middle Transect

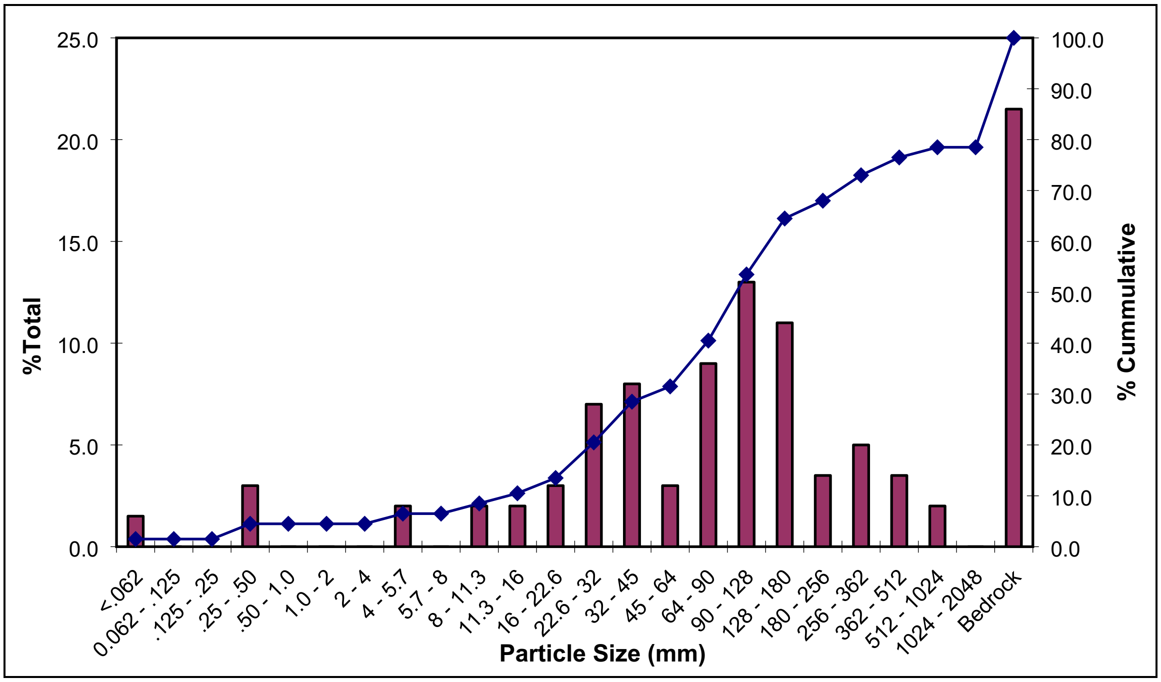


Figure 6-13. Pebble Count Particle Size Data at Lower Transect

6.5 Hydraulic Model Results

Results of the modeling effort for the Buck Bypass are included in Attachment 1 (Buck Bypass Reach ICM Model Development); this report presents the final 2-D Buck Bypass Reach model developed using the ICM software, which was used to predict hydraulic regimes in the bypass reach under varying flows and from varying spill locations.

6.6 Aquatic Habitat Evaluation Results

Habitat suitability maps under each modeled flow scenario are included in Attachment 3. Individual map series are provided for the eight species-guild representatives (i.e., two deep-fast, two deep-slow, one shallow-fast, and three shallow-slow) and Walleye (adult, fry, juvenile, and spawning lifestages). Potential available habitat under each modeled flow scenario (i.e., bypass flows of 17.1 cfs, 210.7 cfs, 354 cfs, and 714 cfs; and tailrace modeled flows of 1,700 cfs, 1,925 cfs, and 2,700 cfs) is described below.

Deep-Fast Guild

As expected, little to no potential habitat is available under leakage conditions in the Buck bypass reach for the Deep-Fast Guild. As bypass reach flows increase, potential habitat increases along the main flow pathway for both guild representatives (one that prefers finer substrate sizes with cover and the other that prefers coarse-mixed substrate). Between the two, more potential suitable habitat is available for the guild representative that prefers coarse-mixed substrate (i.e., Shorthead Redhorse adult) compared to the representative that prefers finer substrate sizes with cover (i.e., Silver Redhorse adult). The largest area of potential habitat is located at the confluence of the bypass reach and tailrace for both representatives.

Potential habitat is present in the tailrace at 1,700 cfs for Shorthead Redhorse but decreases at higher flows (i.e. 2,700 cfs). Potential habitat is available only along the tailrace margins for Silver Redhorse at the flows evaluated, which is likely the result of a preference for cover along the tailrace streambanks.

Deep-Slow Guild

Limited potential habitat is available for the Generic Deep-Slow Guild (i.e., no cover) at the flows evaluated. Small pockets of preferential habitat exist in the lower half of the Buck bypass reach on the downstream side of rock outcrops which provide a velocity shelter. Available habitat gradually increases with increasing flow and depth.

Significantly more potential habitat is available for the Deep-Slow Guild representative that prefers cover (i.e., Redbreast Sunfish adult) at all four flows evaluated. Preferred habitat is along the main flow pathway at lower flows and shifts to backwater areas as flows increase. A large area of potential habitat is present at the bottom end of the bypass reach (just upstream of the confluence with the tailrace) under all four flow scenarios.

No potential habitat exists in the tailrace for either Deep-Slow Guild representative as the velocities are too high in this area.

Shallow-Fast Guild

Minimal potential habitat is available for the Generic Shallow-Fast Guild in the bypass reach at leakage flow as this representative prefers moderate velocities with coarse substrate; however, potential habitat increases along the main flow pathway throughout the bypass reach as flows increase (including the relatively shallow shoal area near the end of the bypass reach). Preferred habitat also exists in the wide riffle/run area near the downstream end of the study area (i.e., below the confluence of the tailrace and bypass reach) under lower river flows (i.e., 1,700 cfs). Preference for habitat in this area decreases slightly as river flows increase (i.e., 1,925 cfs and 2,700 cfs)

Shallow-Slow Guild

The Shallow-Slow Guild includes three categories: 1) finer substrate sizes with no cover (represented by Redbreast Sunfish spawning), 2) all substrate sizes with aquatic vegetation (represented by Silver Redhorse young-of-year), and 3) coarse substrate (represented by Generic Shallow-Slow Guild). These three guild representatives exhibit widely varying potential available habitat under the four flow scenarios evaluated.

Of the three guild representatives, the Generic Shallow-Slow Guild (i.e., coarse substrate) exhibits the largest amount of potential available habitat, particularly at the lower end of the flow range (i.e., Leakage and Low target flows). Potential habitat is also well distributed throughout the bypass reach but shifts with increasing flow. As flow increases above 200 cfs, potential habitat shifts away from the main flow path to the stream margins, backwater areas, and behind rock outcrops that provide velocity shelters as areas in the main flow path become either too deep and/or too fast.

Potential habitat is available for the Redbreast Sunfish spawning representative (finer substrate sizes and no cover) throughout the bypass reach with a preference for the lower half. Similar to the

Generic Shallow-Slow Guild, potential habitat shifts to the stream margins, backwater areas, and behind velocity shelters as flow increases.

The Silver Redhorse young-of-year representative is not particular about substrate type but requires aquatic vegetation, which was not observed in the Buck bypass reach. As a result, potential habitat for this guild representative is not available regardless of bypass flow.

Walleye

Habitat modeling results indicate little to no suitable habitat for the Walleye adult lifestage under any of the target flow scenarios. This lifestage prefers relatively deep, slow-moving water and the only potential habitat in the Buck Bypass reach is located in very small, sporadic, and isolated areas. Model results also indicate little to no potential habitat in the tailrace under any of the target flow scenarios.

Walleye juvenile results are similar to the adult lifestage, but with a few more areas in the lower half of the bypass reach providing potential available habitat (e.g. along the edges of the main flow path and backwater areas) at the higher modeled flows (i.e., 354 cfs and 714 cfs). An area of potential habitat is also present along the backside of the island area near the downstream end of the study reach at all modeled flows. Walleye fry results are similar to the juvenile lifestage with a slight preference for potential available habitat at the lower two modeled flow scenarios (i.e., leakage and 210.7 cfs) as compared to the higher two modeled flow scenarios (i.e., 354 cfs and 714 cfs).

The Walleye spawning lifestage prefers higher velocities (i.e., > 2.0 fps), a depth range of 2 – 6 ft, and larger substrate sizes. While some potential Walleye spawning habitat is available in the main bypass flow channel along the left descending bank (at higher bypass flows), the largest area of potential spawning habitat is located just downstream from the confluence of the tailrace and bypass reach during higher powerhouse generation flows (i.e., > 1,925 cfs).

7 Summary and Discussion of the Buck Bypass Reach

7.1 Delineate and Quantify Aquatic Habitats and Substrate Types

The Buck bypass reach consists of a complex assemblage of aquatic habitat and substrate types, dominated by angular bedrock. The key difference between the Buck upper reach versus the middle to lower reaches is that the orientation of the bedrock slabs is parallel to the flow, which facilitates scour and sediment transport, while the middle to lower reaches are dominated by bedrock slabs oriented perpendicular to streamflow, which facilitates sediment deposition (on the downstream side of the slab). As a result, the Buck upper reach is approximately 50 percent bedrock while the middle to lower reaches, while still dominated by bedrock, contain more smaller-sized particles. The middle to lower transects display zones of sediment deposition and lower-velocity shelters, which create a variety of aquatic habitat for a wider range of aquatic species and lifestages.

7.2 Surface Water Travel Times and Water Surface Elevation Responses

Flow releases from the right (looking downstream) side of the Buck spillway structure (via Tainter Gate #1) generally travel across the bypass reach toward the apex of the channel bend along the left descending bank. From there, the main flow path is along the left descending bank to the end of the bypass reach (see flow direction arrows on Figure 3-2). As a result, water surface elevations spanning a large area of the upper bypass reach along the toe of the spillway from the center of the channel to the left abutment were not affected by the target flow releases. This is due to a large island of higher topography in this area. Because the island area separates the right and left channels in the upper portion of the bypass reach, flow releases from Tainter Gates 1 – 6 and Obermeyer Gates 7 – 10 would likely travel a similar path.

Bypass reach flow travel time (from the spillway to the downstream end of the reach) was approximately 2 hours and 30 minutes at Low Flow (210.7 cfs), 1 hour and 40 minutes at Mid Flow (354 cfs) and 1 hour at High Flow (714 cfs). Details are provided in Attachment 1 – Buck Bypass Reach ICM Model Development, Section 4.1.4.

From the Leakage Flow to Low Flow range (17.1 cfs to 210.7 cfs), depths increased approximately 1.0 - 1.5 ft along the main flow path (i.e., right descending channel in the upper portion of the bypass reach and along the left descending bank in the lower portion of the reach). As the target flows increased to the Mid (354 cfs) to High (714 cfs) flow range, corresponding depths along the main flow path increased an additional 1.0 ft; or a total of approximately 2.5 ft deeper than at leakage flow.

7.3 Identify and Characterize Locations of Habitat Management Interest

The upper portion of the channel along the left descending bank is considered an area of concern from a potential fish stranding perspective. Two level loggers were placed along this channel to evaluate potential impacts to water surface elevations resulting from Tainter gate operations (see BK_LL2 and BK_LL4 locations on Figure 6-7). Water surface elevations at BK_LL2 were not affected during the High Flow release of 714 cfs (which corresponds to a 2-ft opening at Tainter Gate #1). Water surface elevations at BK_LL4 increase approximately 0.13 ft at Low Flow (201.7 cfs), approximately 0.22 ft at Mid Flow (354 cfs), and approximately 0.37 ft at High Flow (714 cfs). While the water surface elevations at BK_LL4 were impacted, this area is not in the main flow path where much higher water surface elevation changes were recorded (see Figure 6-8).

During the level logger deployment, several large rainfall runoff events occurred which resulted in Tainter gate openings greater than 2-ft (the maximum target flow opening). Figure 6-9 shows that flows need to reach at least 6,500 cfs to affect water surface elevations at the BK_LL2 location. As a result, the existing ramping rate requirements have little to no effect on the upper portion of the left descending channel.

7.4 Efficacy of Existing Ramping Rate Requirements

Under the existing FERC operating license, ramping rates are required for the Buck bypass reach to help protect fish communities. Appalachian is required to discharge flows through a 2-ft gate opening for at least three hours following any spills released through a gate opened 2 ft or more. Appalachian is then required to reduce the opening to 1 ft for at least an additional three hours, after which Appalachian may close the gate. The gradual reduction of flow allows time for fish to respond to the receding water levels, thus avoiding stranding that can occur with sudden flow discontinuation.

During the target flow field measurements, level loggers (set to record at 5-minute increments) captured the impact that the existing ramping rate requirements have on bypass reach water surface elevations. The decrease in water surface elevation from a 2-ft gate opening (High Flow) to a 1-ft gate opening (Mid Flow) was approximately 0.5 ft in the main flow path. From a 1-ft gate opening to a closed position, the water surface decreased an additional 1.5 – 2.0 ft in the main flow path (see Figure 6-8, Day 4 High Flow event). The seemingly disproportionate change in depth from a 2-ft to 1-ft gate opening, and a 1-ft to closed position is likely the result of the dominant bypass reach substrate type which is angled bedrock. These bedrock slabs block and trap flows in the bypass channel and their effect on water surface elevations is more pronounced at lower flows.

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7.5 Efficacy of Existing Powerhouse Minimum Flow Requirement

The mean monthly average flow and 25th percentile monthly average flow for August (typically the lowest flow month of the year) at the USGS 03165500 New River at Ivanhoe flow gaging station from 1996 – 2020 are 1,497 cfs and 896 cfs, respectively (see Table 4-1). The mean monthly flow in August over the 1996 – 2020 POR is more than four times higher than the current FERC authorized minimum downstream flow requirement of 360 cfs and the 25th percentile flow for August is more than double the minimum downstream flow requirement.

As a result, the minimum downstream flow requirement is rarely triggered, but did occur during the POR evaluated for this study (i.e., 1996 – 2020). A review of daily average flow statistics over the POR resulted in 14 days (or 0.15 percent of total days in the POR) that Project inflows were less than or equal to 360 cfs. Six of these days occurred during August 2002 and the remaining eight occurred during August 2008, corresponding to the two most severe droughts on record. The average Project inflows during the six days in August 2002 were 354 cfs at the Byllesby development and 357 cfs at the Buck development. The average Project inflows during the eight days in August 2008 were 328 cfs at the Byllesby development and 331 cfs at the Buck development.

When the minimum downstream flow requirement is triggered, Project inflows at the Byllesby development are passed downstream to the bypass reach either via the trash sluice gate and/or one of the Tainter or Obermeyer gates. At the Buck development, the minimum flow can be passed through the trash sluice gate into the tailrace and/or through a Tainter or Obermeyer gate into the bypass reach.

At the Buck development, the minimum downstream flow requirement is rarely triggered and typically occurs only during August for about a week at a time; therefore, the effect on aquatic habitat is likely negligible when considering whether the flow is released to the tailrace and/or bypass reach. At Byllesby, the bypass reach is relatively small (compared to the Buck bypass reach) and from an aquatic habitat perspective, it likely makes no substantial difference which side of the spillway (i.e., Tainter gates, Obermeyer gates, or trash sluice gate) is used to provide the minimum flow release below the Project.

7.6 Evaluate the Impacts of Seasonal Minimum Flows

Seasonal minimum flows were evaluated using the habitat modeling results provided in Attachment 3 for the various habitat guilds and standalone Walleye species/lifestages. Spawning lifestages were of particular interest since there is a seasonal component to this lifestage.

Redbreast Sunfish spawning lifestage was used as one of the representative species for the Shallow-Slow Guild (i.e., finer substrate sizes and no cover). The amount of potential spawning habitat available is similar under all four modeled flow scenarios. The difference between modeled scenarios is the location of the potential habitat shifts from the main flow path under Leakage Flow conditions (i.e., 17.1 cfs) to the stream margins, backwater areas, and behind velocity shelters created by rock outcrops as flows in the bypass reach increase.

Potential Walleye spawning habitat was also modeled for the four target flow scenarios. While the High target flow (714 cfs) produced a minimal amount of potential habitat along the left descending channel in the lower portion of the bypass reach, the largest area of potential habitat is located just downstream of the tailrace/bypass reach confluence. Powerhouse flows of at least 1,925 cfs created the largest amount of potential available habitat in the area immediately below the confluence.

As a result, seasonal minimum flows in the bypass reach are not likely to provide a significant amount of additional available habitat for the target species/lifestages of interest.

8 Variances from FERC-Approved Study Plan

To date, the study has been conducted in accordance with the FERC-approved RSP, with the exception of the following variances:

- On July 27, 2020, Appalachian filed an updated ILP study schedule and a request for extension of time to file the 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. These delays pushed the start of the 2020 field season into late July 2020. FERC letters of correspondence are included in Attachment 1 of the ISR.
- As a result of the delay to the start of the 2020 field season, higher than normal seasonal flow conditions in the New River, flashboard damage, and temporarily reduced unit generation capability at the Byllesby Project, the Byllesby Bypass Reach Flow and Aquatic Habitat Study fieldwork was postponed until 2021. Therefore, only the Byllesby desktop habitat mapping results, proposed target flows (for the 2-D ICM model calibration/validation), and HSC information (which is the same for both Byllesby and Buck) is provided in this initial study report.

9 Germane Correspondence and Consultation

On July 27, 2020, Appalachian filed an updated ILP study schedule and a request for extension of time to file the 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 18, 2021. These delays pushed the start of the 2020 field season into late July 2020.

The Proposed Flow Test Scenarios technical memo was emailed by AEP to key agency stakeholders on August 18, 2020. On August 25, 2020, VDWR requested a conference call with Appalachian and key agency stakeholders, which was held on August 28, 2020. The Proposed Flow Test Scenarios technical memo, the Bypass Flow Test Scenario meeting notes, and emails with agency concurrence are included in Attachment 4.

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Attachment 1

Attachment 1 – Buck Bypass Reach ICM Model Development

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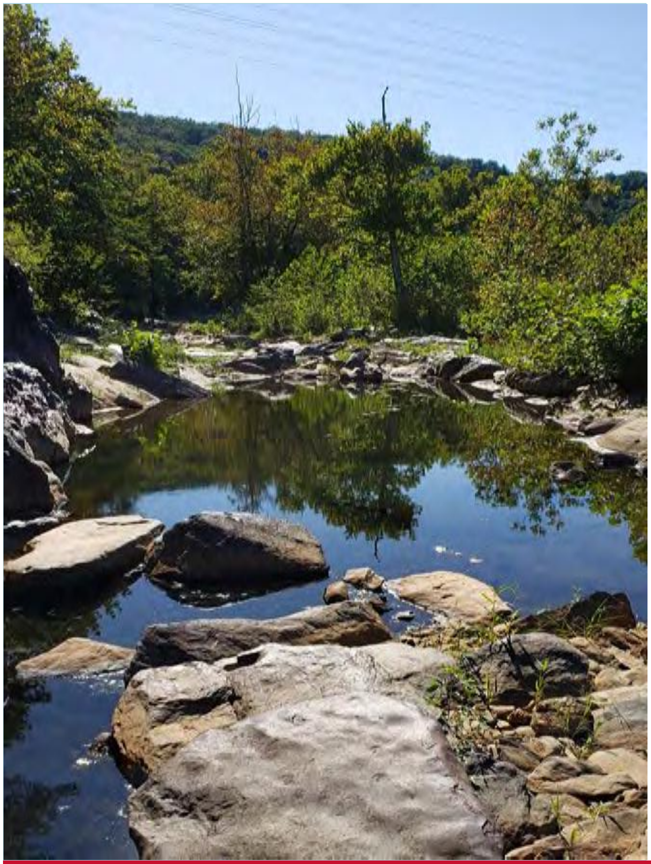

Buck Bypass Reach ICM Model Development

Byllesby-Buck Hydroelectric Project (FERC No. 2514)

January 18, 2021

Prepared by:

HDR

Prepared for:

Appalachian Power Company

APPALACHIAN POWER

An AEP Company

BOUNDLESS ENERGY

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Contents

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Tables

Acronyms and Abbreviations

2-D	2-Dimensional
ADCP	Acoustic Doppler current profiler
AEP	American Electric Power
cfs	cubic feet per second
DTM	Digital Terrain Model
ESRI	Environmental Systems Research Institute
ft	feet/foot
ft msl	feet above mean sea level (NGVD29)
GIS	Geographic Information Systems
GPS	Global Positioning System
ICM	Integrated Catchment Model
ICM Model	2-D Innovyze Infoworks Integrated Catchment Model
LiDAR	Light Detection and Ranging
Model	2-D ICM Model
NAD	North American Datum of 1983
NAVD88	North American Vertical Datum of 1988
QSI	Quantum Spatial, Inc.
Project	Byllesby-Buck Hydroelectric Project
R10	Trimble® R10 unit
TIN	Triangulated Irregular Network
VGIN	Virginia Geographic Information Network
WSEL	Water Surface Elevation

1 Project Background

1.1 Purpose and Scope

The purpose of this calculation is to present the final 2-Dimensional (2-D) Buck Bypass Reach model developed using Innovyze Infoworks Integrated Catchment Model (ICM) software. The 2-D Buck Bypass Reach ICM model (ICM Model) was used to predict hydraulic regimes in the bypass reach under varying flows and from varying spill locations. The results of the ICM Model were used in conjunction with habitat analysis presented in the Preliminary Bypass Reach Flow and Aquatic Habitat Study Report to develop habitat suitability maps under the various flow scenarios. These maps are presented in Appendix A, Attachment 3 of the Byllesby-Buck Initial Study Report.

1.2 Study Area

The Byllesby-Buck Hydroelectric Project (FERC Project No. 2514-VA) (Project) is owned and operated by Appalachian Power Company, a subsidiary of American Electric Power (AEP). The Project is located on the New River in Carrol County, Virginia and consists of the Byllesby and Buck Dams. Byllesby Dam is approximately 7.8 miles downstream Fries, Virginia and Buck Dam is approximately 2.5 miles downstream of Byllesby Dam.

2 Model Development

2.1 Flow Study Field Data Collection

To aid calibration and validation of the Model phased flow data collection was performed under varying flows. Eleven level loggers (Onset U-20 brand pressure transducers that measure water stage change with high precision) were deployed in the Buck Bypass reach prior to the target flow releases. The U-20 instrumentation documents a measured water level with an accuracy of ±0.01 feet (ft). Reference water elevations were collected using a staff gage at each level logger when installed. Level loggers recorded water surface elevation data at 5-minute intervals providing detail for travel time, and rates of rise estimations used in the Model calibration. Locations of the deployed level loggers are shown in Figure 2-1.

Four target flow releases were performed over four days and two separate trips, September 8th through 10th and September 15th through 17th. Each target flow was designed to capture a specific/stable flow in the bypass reach. Flow was delivered to the bypass reach via leakage through the closed spillway gates and flashboard bays and/or Tainter Gate 1. Total flows in the bypass reach were recorded using a handheld manual Swoffer flow meter for the Day 1 (leakage) and Day 2 (0.5 ft gate opening) target flows and using an Acoustic Doppler current profiler (ADCP) for the Day 3 and Day 4 (1 ft and 2 ft gate opening, respectively) target flows. Gate settings and resulting flows are provided in Table 2-1. Figure 2-2 shows the various flow measurement locations in the bypass reach and tailrace.

Table 2-1. Buck Tainter Gate 1 Settings and Bypass Reach Flow

Tainter Gate 1 Opening (ft)	Bypass Reach Flow (cfs)
Day 1: Closed (Leakage Flow)	17.1
Day 2: 0.5 (Low Flow)	210.7
Day 3: 1.0 (Mid Flow)	354
Day 4: 2.0 (High Flow)	714

In addition to the field data collected during the target flows, an Inspire 2 drone equipped with a Zenmuse X5S camera using a ground sample distance of 1-inch per pixel was used to capture an aerial imagery orthomosaic of the steady-state flow conditions for each target flow in the immediate vicinity of the bypass reach and tailrace. These orthomosaics are presented in Section 4.

A Trimble® R10 unit (R10) using Static Global Navigation Satellite System positioning with horizontal and vertical accuracies of 3 millimeter and 3.5 millimeter, respectively, was used to gather water surface elevation point data at various locations in the bypass reach during each target flow event. Due to time constraints and satellite coverage effects, a limited number of R10 data points were gathered during the Low target flow event on September 10th. The R10 data points are colored by target flow scenario and shown in Figure 2-3.

In conjunction with the level logger and R10 data recording, point velocity and depth measurements were collected using a Swoffer flow meter at various locations during the Day 1 (Leakage) and Day 2 (Low) target flows after steady-state river conditions were reached. Due to safety concerns, depth and velocity data was not captured for the Day 3 (Mid) and 4 (High) target flow scenarios. Figure 2-4 shows point velocity and depth measurement locations.

Steady-state conditions were verified in the field using temporary staff gages. All discharge measurements were made a minimum of three times or until there was less than 5 percent difference between measurements.

Upon completion of the target flow events, the level logger data were downloaded and the loggers were redeployed to collect depth data for an additional three weeks. Data from this long-term deployment was used to further characterize the hydraulics of the bypass reach under a larger range of flow/spill conditions present outside of the two-week target flow measurement period.

The data collection plan enabled correlation of gate openings, flow, and water surface elevations at select locations within the bypass reach. The data was used to enhance understanding of travel times and rates of rise under conditions experienced during the collection period.

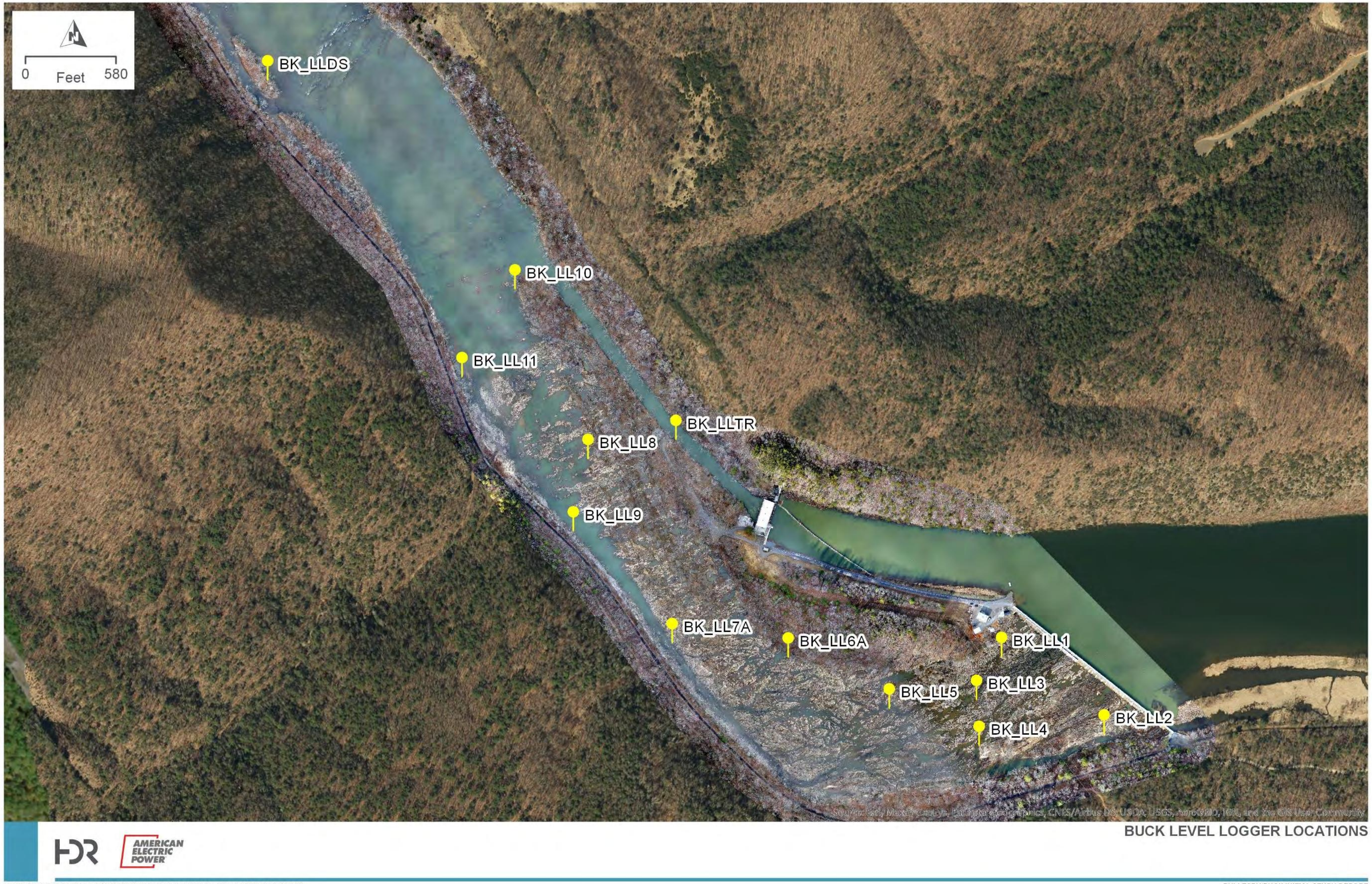

Figure 2-1. Buck Bypass Reach Level Logger Locations

Figure 2-2. Flow Measurement Transects

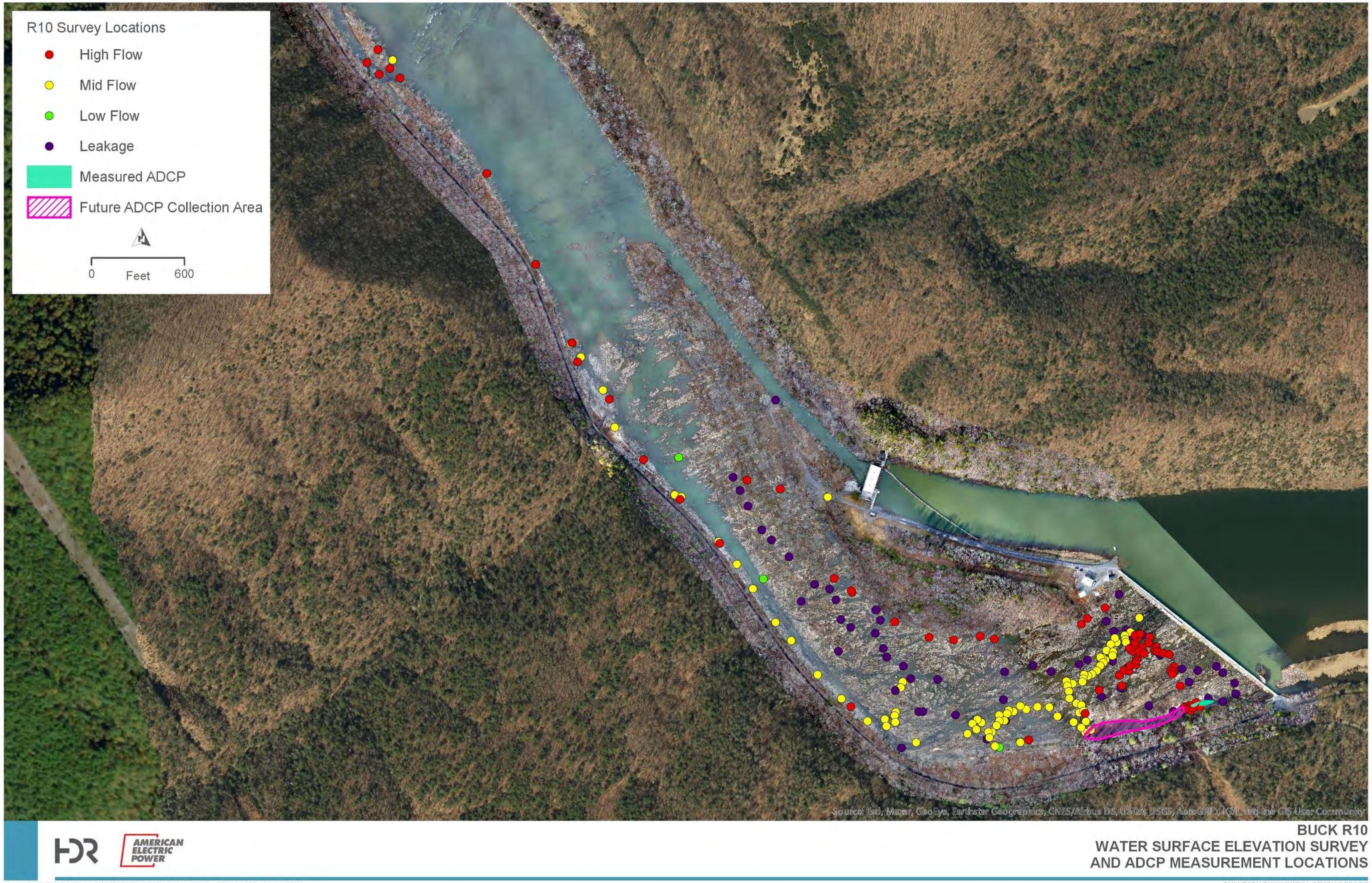

Figure 2-3. R10 Water Surface Elevation Points and ADCP Data Collection Areas

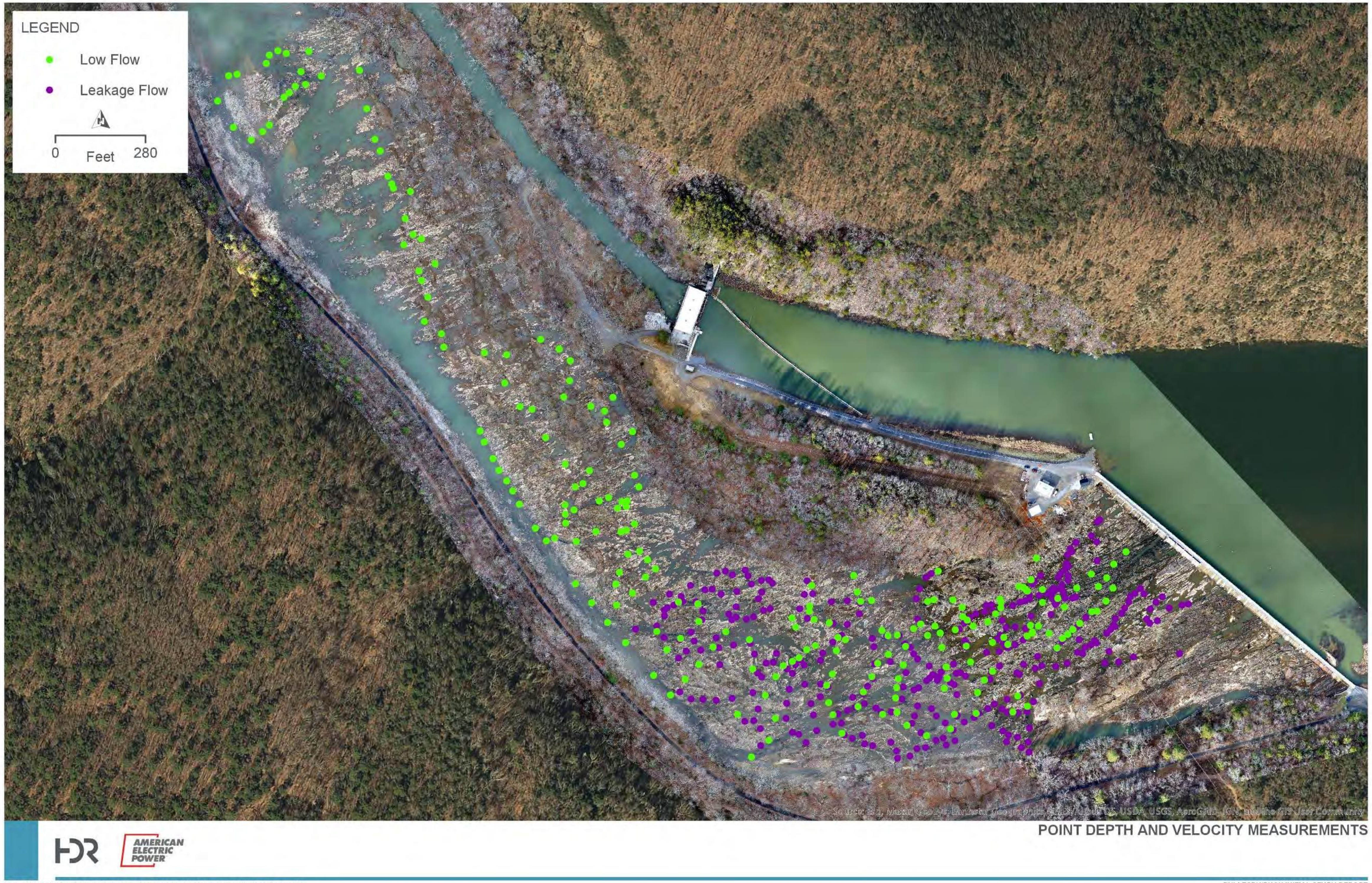

Figure 2-4. Manual Swoffer Flow Meter Depth and Velocity Point Measurements

2.2 Terrain Data

LiDAR data were collected for the entire Buck bypass reach from the spillway extending down past the confluence with the tailrace. HDR contracted with Quantum Spatial, Inc. (QSI) to collect and process LiDAR data at the lowest possible bypass channel flow (QSI 2020). Additionally, LiDAR data collected by the Virginia Geographic Information Network (VGIN) and available through the Virginia LiDAR web mapping application were downloaded. VGIN collected the data according to the United States Geological Survey (USGS) 3DEP specifications.

Bathymetry data collected during the target flow measurements were integrated into the LiDAR data in a common coordinate system and datum. Coincident with the target flow field effort, HDR used the ADCP connected to the Global Positioning System (GPS) network to define the bathymetry of two pools on the southwest side of the bypass reach. It is anticipated that additional bathymetry data in this area may need to be collected and incorporated into the model. Measured and anticipated ADCP bathymetry data is shown in Figure 2-3.

The additional bathymetric data was used to describe the channel below the water surface level present when the LiDAR was flown. The bathymetry was supplemented in pools by interpolating areas within the pools using professional judgment and field observed depths and elevations.

The Digital Terrain Model (DTM) used in the Buck Bypass Reach Hydraulic Model was developed by combining the three sources (QSI and VGIN LiDAR plus ADCP) of terrain/bathymetry data using professional judgment and field observations. Detailed information on DTM development is presented in Section 3.2.

2.3 Hydraulic Model Development

2.3.1 Conventions and Assumptions

The Digital Terrain Model (DTM) utilized in the ICM Model was referenced to the North American Vertical Datum of 1988 (NAVD88). The DTM was projected using the Virginia State Plane Coordinate System (i.e., U.S. Survey Foot) and horizontally referenced to the North American Datum (NAD) of 1983.

The ICM Model was developed with the following assumptions:

- In addition to LiDAR data, VGIN provides land cover data at 1-meter resolution. This dataset was used for the model Manning's *n* roughness. Detailed discussion of the Manning's roughness is provided in Section 3.
- Powerhouse outflows were measured in the tailrace using the ADCP for the Day 1 (Leakage) and Day 2 (Low) target flow events. An approximate flow of 1,700 cfs was used for the Leakage and Low flow scenarios. Due to safety concerns, tailrace flows were not measured for the Day 3 (Mid) and Day 4 (High) target flow scenarios. To determine the powerhouse outflow for these cases, the measured bypass reach flow was subtracted from the reported flow measured at the USGS New River at Ivanhoe, Virginia gage approximately 1.75 miles downstream of the Buck development.

On September 15th and 16th, the USGS gage reported mean flows of 3,060 cfs and 2,640 cfs in the New River, respectively. Flows of 2,700 and 1,925 cfs were then used as powerhouse outflows for the Day 3 (Mid) and Day 4 (High) target flow scenarios, respectively. Due to the close proximity of the USGS gage, accretion flow between the Buck development and gage was considered negligible. Additionally, due to the geometry of the bypass reach and tailrace, tailrace flows are expected to have negligible impact on bypass reach hydraulics thus an approximate powerhouse outflow is appropriate for this analysis.

- Day 1 (Leakage) flow was measured in the bypass reach using the Swoffer flow meter at three locations, one downstream location to capture the total bypass reach leakage flow, and two upstream locations. Using field observations and these flow measurements, the leakage flow was distributed among the various Tainter gates, Obermeyer gates, and flashboards according to Table 2-2. All scenarios used this setup as the base inflow condition.

Table 2-2. Gate Leakage Flows

Gate	Leakage Flow (cfs)
T2	1.0
T3	1.0
T4	1.0
T5	1.0
T6	1.0
FB6	1.0
FB7	1.0
FB8	2.0
FB9	2.0
FB10	2.0
FB12	0.75
FB15	0.75
FB17	2.15
FB18	2.15

2.3.2 Design Inputs

Additional design inputs include:

- Steady-state inflow hydrographs formed from the base Leakage flow presented in Section 2.3.1 adding 210.7, 354, and 714 cfs inflows at Tainter Gate 1 for the Low, Mid, and High flow scenarios, respectively.
- Roughness zones (Manning's *n*-values);
- Initial hydraulic conditions – the bypass reach and tailrace begin the simulation dry and are allowed to fill to steady state conditions.
- Boundary conditions (i.e., 2-D Zone boundary, inflow hydrographs, and downstream boundary conditions).

3 Methodology

3.1 ICM Model Development

Innovyze Infoworks ICM Version 7.5 (Innovyze 2016) was used to evaluate the hydraulics of the Bypass Reach. The ICM Model is a fully integrated 2-D hydrodynamic model which facilitates accurate representation of flow paths while enabling complex hydraulics and hydrology to be incorporated into a single model. ICM uses the shallow water equations to develop depth averaged hydraulics results. The 2-D model does not directly model turbulence, but accounts for energy losses due to turbulence due to bed resistance via the Manning's *n* roughness. The modeling domain extends approximately 1.25 miles downstream of the Buck spillway and includes Buck tailrace. The domain is modeled with ICM's 2-D surface flooding module. This portion of the modeling extent is known as the 2-D Zone. The ICM Model allows for detailed hydraulic results and provides a reasonable variability in average flow, depth, and velocity from one water column element to the next throughout the modeled area. The ICM Model is considered appropriate for the evaluation of the bypass reach hydraulics. See Section 4 for design inputs.

3.2 Digital Terrain Model Development

The DTM used in the ICM Model was constructed with data from several sources:

- Virginia State LiDAR data collected from the VGIN database;
- Supplemental site LiDAR data collected by QSI (QSI 2020); and
- Additional bathymetry measurements collected by HDR in September 2020.

The DTM was projected using the North Carolina State Plane Coordinate System (i.e., U.S. Survey Foot) and horizontally referenced to the North American Datum of 1983 and vertically referenced to the North American Vertical Datum of 1988.

LiDAR data points at two pools of concern on the south western edge of the bypass reach were discarded and bathymetry data in the pools was measured in 2020 using a Teledyne® Rio Grande Acoustic Doppler Current Profiler and a Trimble® AG_GPS receiver equipped with an Omnistar® real-time differential GPS correction. Water depths were converted to elevations using the water surface elevations recorded with the R10 unit at the time of data collection.

The three data sources were converted into triangulated irregular network (TIN) surface files and merged using Environmental Systems Research Institute (Esri™) ArcGIS version 10.3 Geographic Information System (GIS) software (ESRI 2017). The resulting DTM encompassed the entire study area and was used as the basis for developing the conceptual design for the Hydraulic & Hydrologic analysis and modeling discussed in this report.

Figure 3-1 shows the final DTM used in the model and the allocation of terrain data. Blue zones indicate contractor LiDAR data. Red zones indicate ADCP data. The reminder of the data is sourced from the VGIN LiDAR data.

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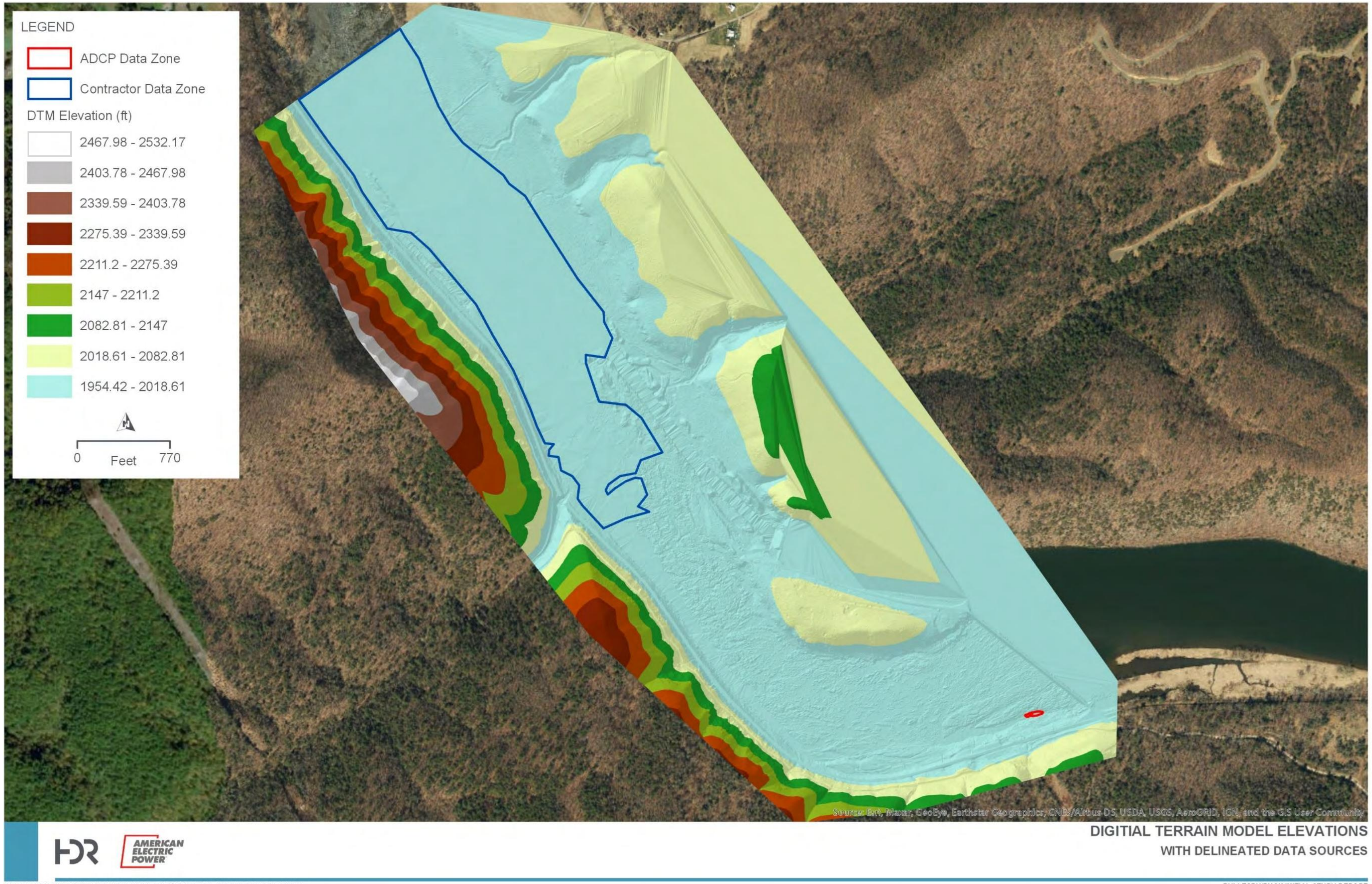

Figure 3-1. Buck Bypass Reach Digital Terrain Model and Data Sources

3.3 ICM Model

3.3.1 Site Topography

A TIN was created from the following topography data:

The 2-D Zone defining the ICM Model includes approximately 1.25 miles of the New River. Figure 3-2 provides a view of the maximum extent of the 2-D Zone.

For the 2-D simulation, ICM subroutines were used to perform a meshing of the 2-D Zone. The 2-D mesh is comprised of an irregular array of triangles. Descriptions of the user input 2-D Zone data fields that are pertinent to this analysis are as follows:

- Maximum triangle area – A measure of mesh resolution used when creating a 2-D mesh; maximum allowable triangle area for areas in the 2-D Zone that are not inside of a secondary mesh zone.
- Minimum element area – Minimum mesh element area used for calculating results. Mesh elements with area less than the minimum area specified are aggregated with adjoining elements until the minimum area is met. This is done for the purpose of calculating results to improve simulation stability and run time.
- Boundary points – Boundary condition for 2-D Zone.
- Terrain-sensitive meshing – Meshing is used to increase the resolution of the mesh in areas that have a large variation in height without increasing the number of elements in relatively flat areas.
- Maximum height variation – The maximum height variation that is permitted within a single triangle. Triangles with a height variation greater than the assigned value are split provided this would not result in a triangle smaller than the Minimum element area.
- Minimum triangle angle – Minimum allowable angle between triangle vertices when creating a 2-D mesh.
- Roughness – Manning's *n* roughness values, used when creating a 2-D mesh. The roughness value assigned to mesh elements in areas in the 2-D Zone that are not in a roughness zone. Roughness values were selected from published tables (Chow 1959).

Table 3-1 provides a summary of the selected user input values for the ICM meshing routine as well as the total 2-D Zone area.

Table 3-1. ICM Meshing User Inputs and Area Summary

2D zone Object Properties		
Polygon definition		
ID	Buck 2D Zone	
Area (acre)	131.698	#D
Maximum triangle area (ft2)	750.000	
Minimum element area (ft2)	2.500	
Boundary points	Vertical Wall	#D
Terrain-sensitive meshing	☒	
Maximum height variation (ft)	0.125	
Minimum angle (degree)	25.00	#D
Roughness (Manning's n)	0.0230	
Apply rainfall etc directly to mesh	☐	
Apply rainfall etc	everywhere	#D
Rainfall profile	1	#D
Infiltration surface ID		#D
Rainfall percentage	100.000	#D
Mesh summary	----> ...	
Mesh data	----> ...	
General properties		
Notes	...	
Hyperlinks	...	
User defined properties		

A section of the resulting mesh is shown in Figure 3-3. The model mesh contains 927,926 triangles and 926,440 elements. The approximate minimum, maximum, and average element areas are 0.23 square ft, 70 square ft, and 0.57 square ft, respectively

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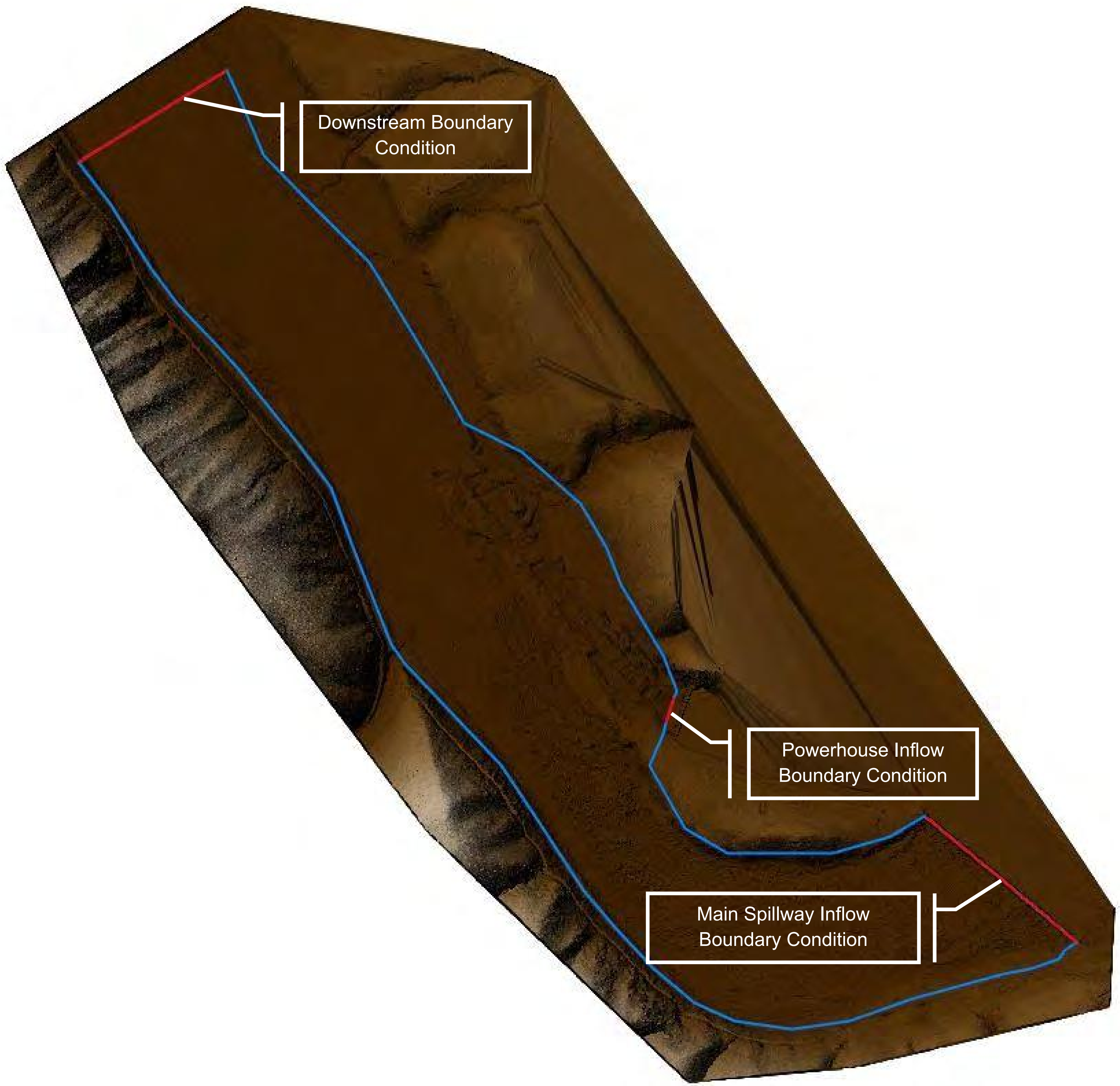

Figure 3-2. Extent of 2-D Zone and ICM Mesh (North is to the Top of the Figure)

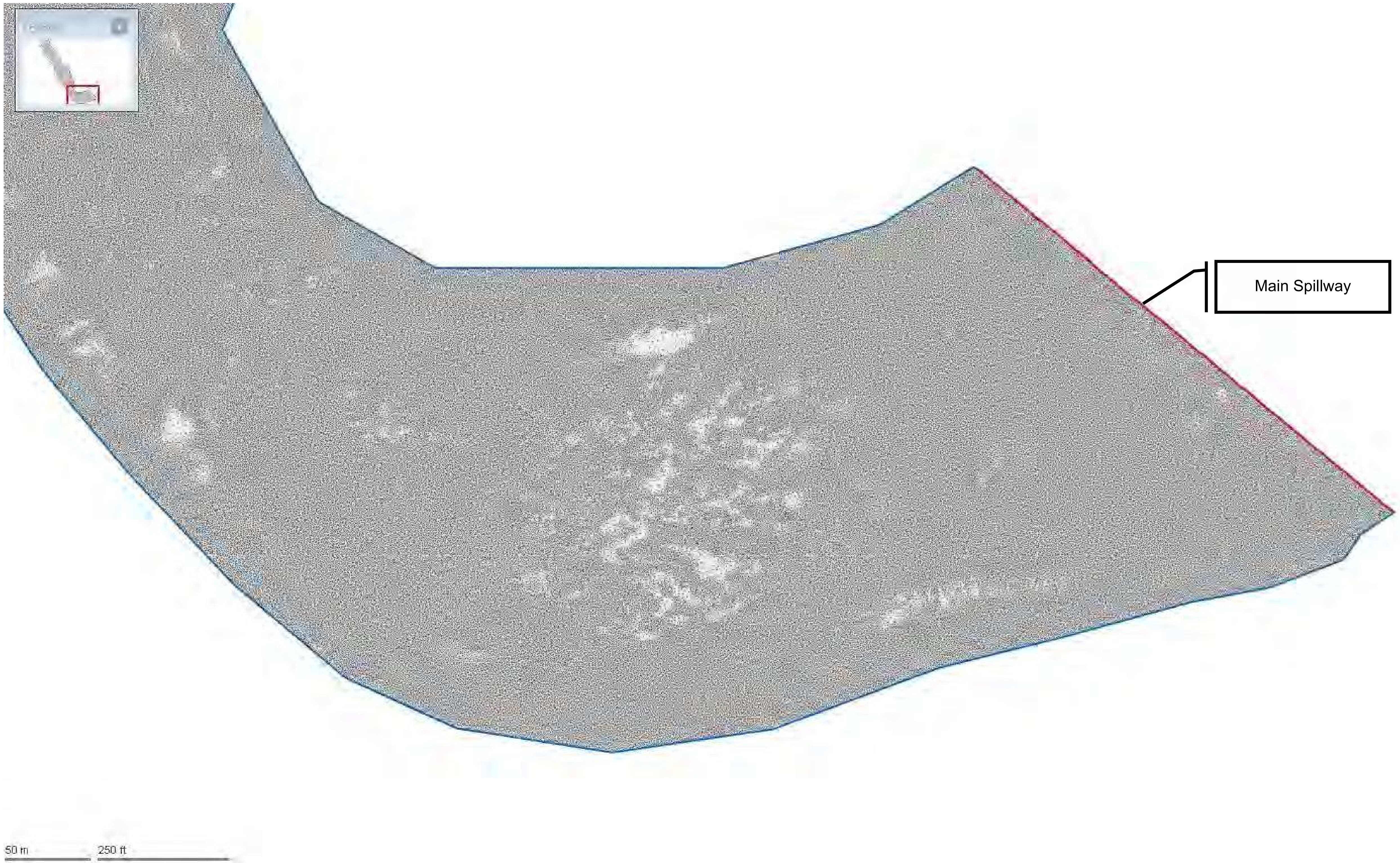

Figure 3-3. ICM Mesh Section (North is to the Top of the Figure)

3.3.2 Roughness Zones

Roughness Zones for the 2-D Zone were created in GIS using land cover data provided by VGIN. Roughness Zones were assigned a Manning's *n*-value indicated in Table 3-2 (Reference 1). Table 3-2 presents the roughness values used in the model. The land cover is shown in Figure 3-4.

Table 3-2. Manning's *n* Roughness Values

Description	Grid Code	Roughness
Open Water	11	0.040
Developed, Open Space	21	0.040
Developed, Low Intensity	22	0.100
Deciduous Forest	41	0.160
Evergreen Forest	42	0.160
Shrub/Scrub	52	0.100
Grassland/Herbaceous	71	0.035
Pasture/Hay	81	0.030

The Manning's n-values utilized for this analysis provide a reasonable assessment of current conditions at the site when evaluating the hydraulics of the bypass reach.

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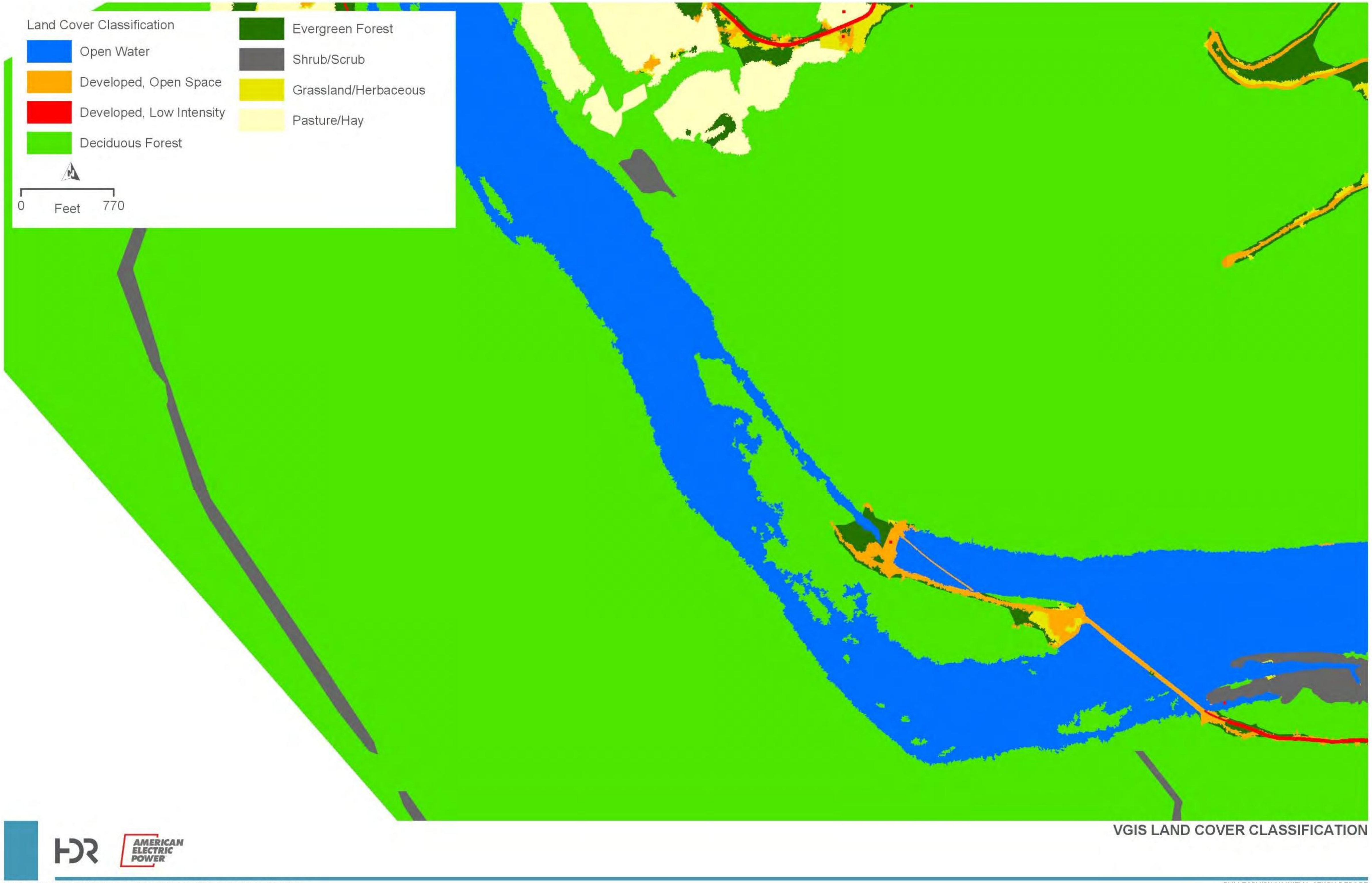

Figure 3-4. Land Cover Raster for Manning's *n* Roughness

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3.3.3 Mesh Zone

A single mesh zone representing the Buck tailrace was included in the ICM Model to represent the approximate slope of the tailrace as the tailrace water surface was not captured by the LiDAR survey. The mesh zone polygon was digitized in GIS from an aerial photograph which signifies the typical riverbank location.

3.3.4 Initial Hydraulic Conditions

Both the bypass reach and tailrace were allowed to start from a dry condition to allow the pools within the bypass reach to fill as they naturally would during a real-life spill event.

3.3.5 Boundary Conditions

The primary 2-D Zone boundary condition (i.e., “vertical wall” Boundary Point settings in Table 3-1) was selected based on the topography at the edge of the 2-D Zone. This boundary condition is considered to be an impermeable and infinitely high barrier that does not allow water to flow into or out of the 2-D Zone unless specified with another boundary condition.

In addition to the primary 2-D Zone boundary condition, three additional boundary conditions were incorporated into the ICM Model. An upstream boundary condition was defined at the spillway where the leakage and Tainter Gate inflow hydrographs were applied. A second upstream boundary condition was defined at the powerhouse outlet where the powerhouse flows were introduced. See Section 2 for discussion of the model inflows. The final boundary condition was located at the downstream end of the 2-D Zone on the New River and allows water to leave to 2-D Zone assuming normal depth. Under this condition it is assumed that slope balances friction forces (normal flow) i.e., depth and velocity are kept constant when water reaches the boundary, so water can flow out of the 2-D Zone without energy losses.

4 Calculations

The model inputs discussed above were used to set up four scenarios which represent the four target flows. Due to the complexity of the ICM Model and mesh representing the New River, ICM Model outputs presented in this calculation are limited to select locations and points of interest.

4.1 Model Calibration and Verification

Field data points collected during the target flow events, as well as timing of releases recorded by the level loggers in the bypass reach, were used to calibrate and verify the model setup.

4.1.1 Point Water Surface Elevations

Water surface elevations collected by the R10 unit were compared to water surface elevations predicted by the model. Figure 4-1 through Figure 4-4 show the water surface elevation comparisons for the four target flow scenarios. Field measurement data points are colored by magnitude of percentage difference between field and modeled water surface elevations. Figure 4-5 shows the correlation between field and model water surface elevation data for all points collected with the R10 unit during the four target flow days. The ranges of percentage difference and absolute difference for the four target flow scenarios are presented in Table 4-1.

Table 4-1. Point Water Surface Elevation Comparison

	Minimum Delta		Maximum Delta		Average Delta	
Flow	Percentage (%)	Magnitude (ft)	Percentage (%)	Magnitude (ft)	Percentage (%)	Magnitude (ft)
Day 1 (Leakage)	0.00	0.00	0.06	1.17	0.02	0.33
Day 2 (Low)	0.00	0.01	0.07	1.37	0.04	0.75
Day 3 (Mid)	0.00	0.00	0.12	2.30	0.02	0.38
Day 4 (High)	0.00	0.01	0.13	2.53	0.023	0.46

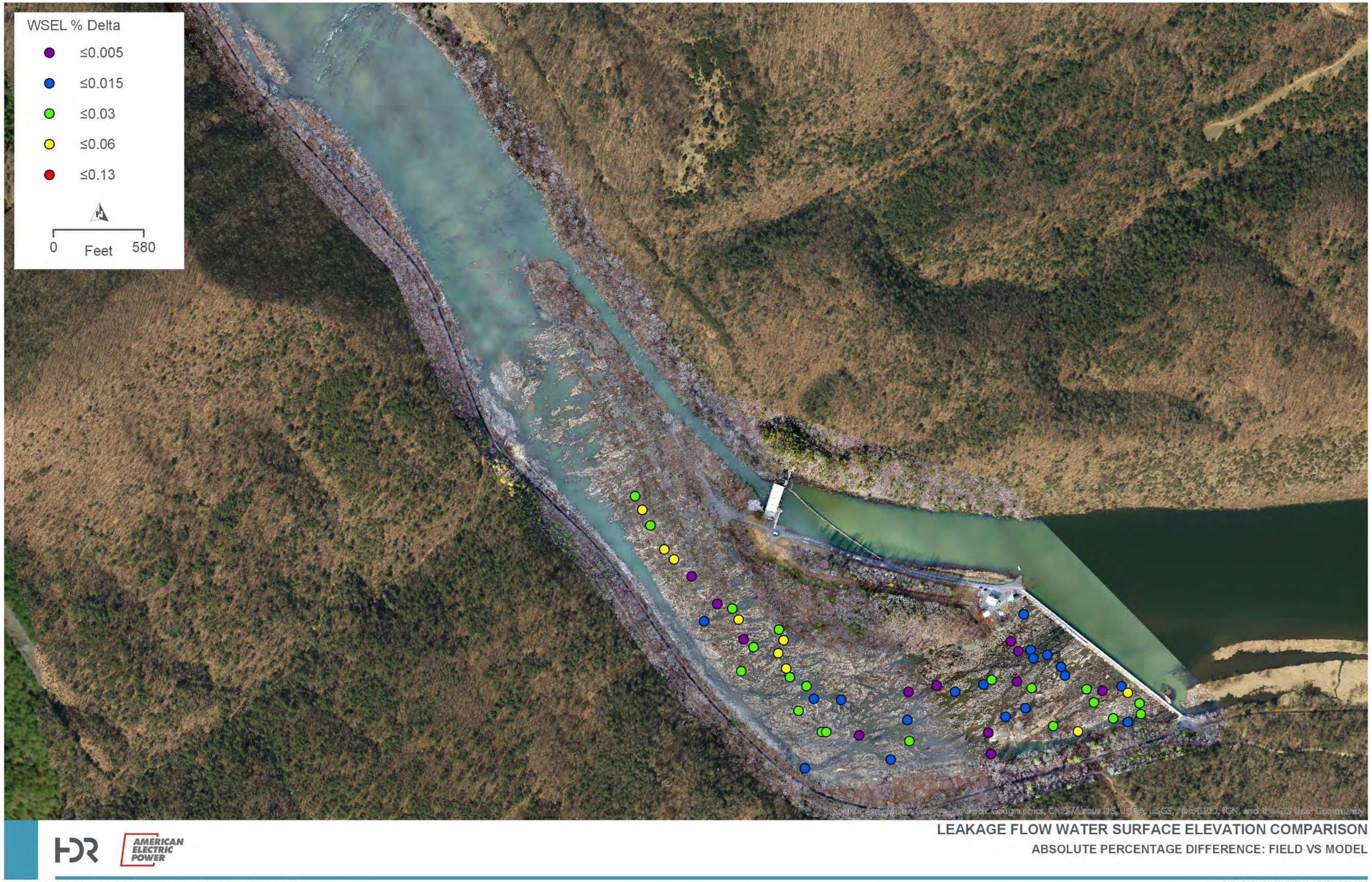

Figure 4-1. Field vs Modeled Water Surface Elevations – Day 1 (Leakage) Target Flow

Figure 4-2. Field vs Modeled Water Surface Elevations – Day 2 (Low) Target Flow

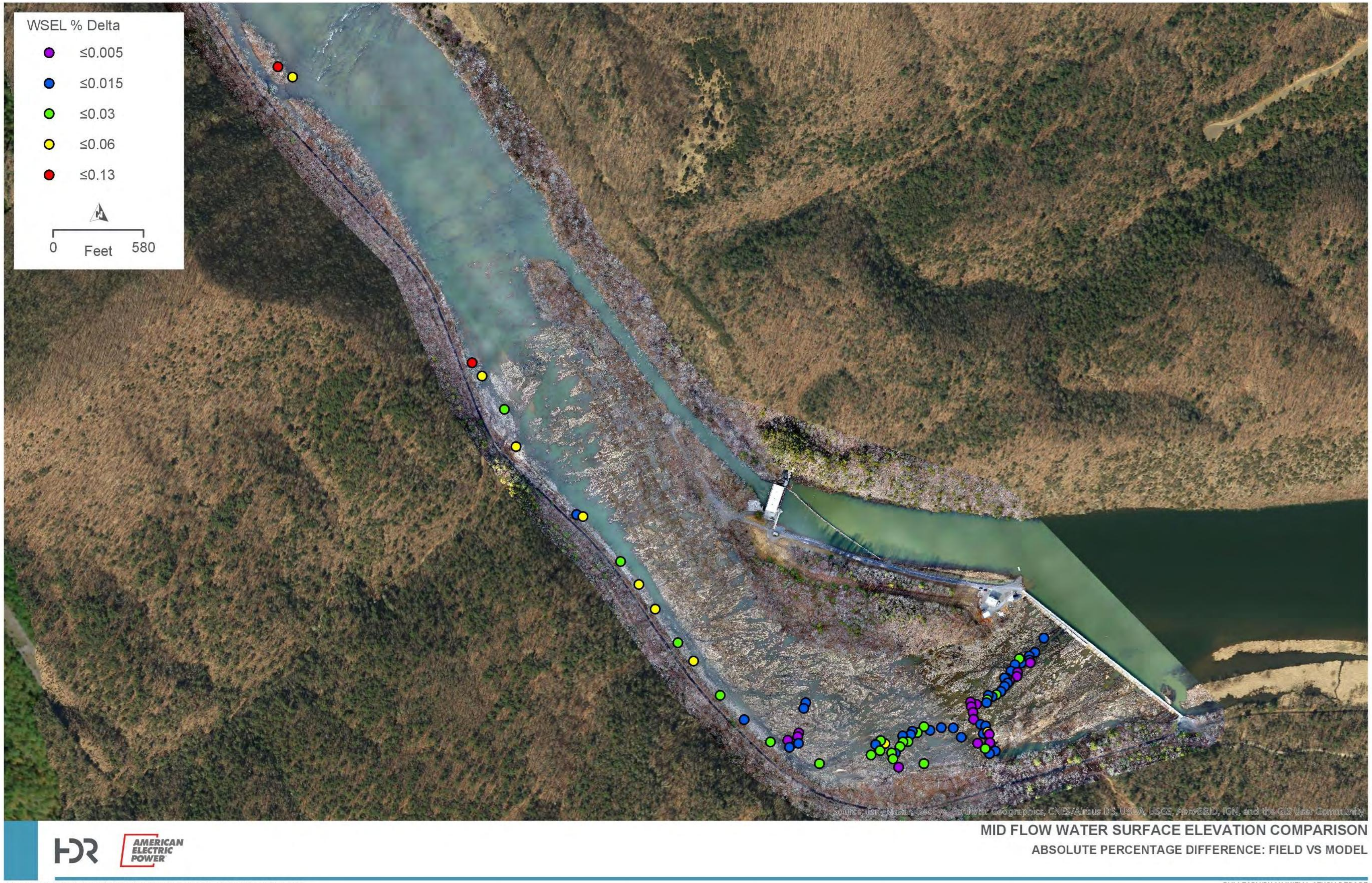

Figure 4-3. Field vs Modeled Water Surface Elevations – Day 3 (Mid) Target Flow

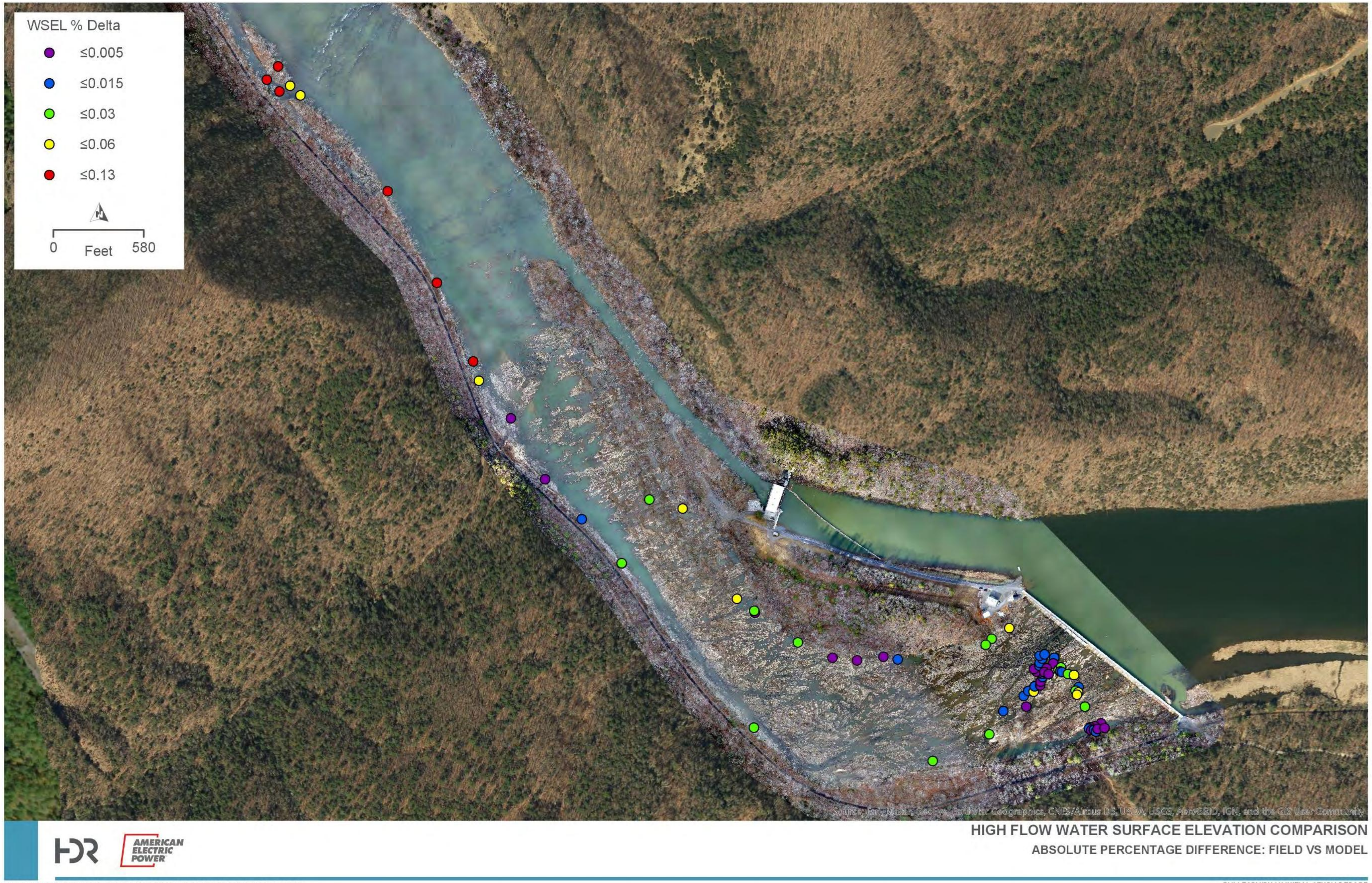

Figure 4-4. Field vs Modeled Water Surface Elevations – Day 4 (High) Target Flow

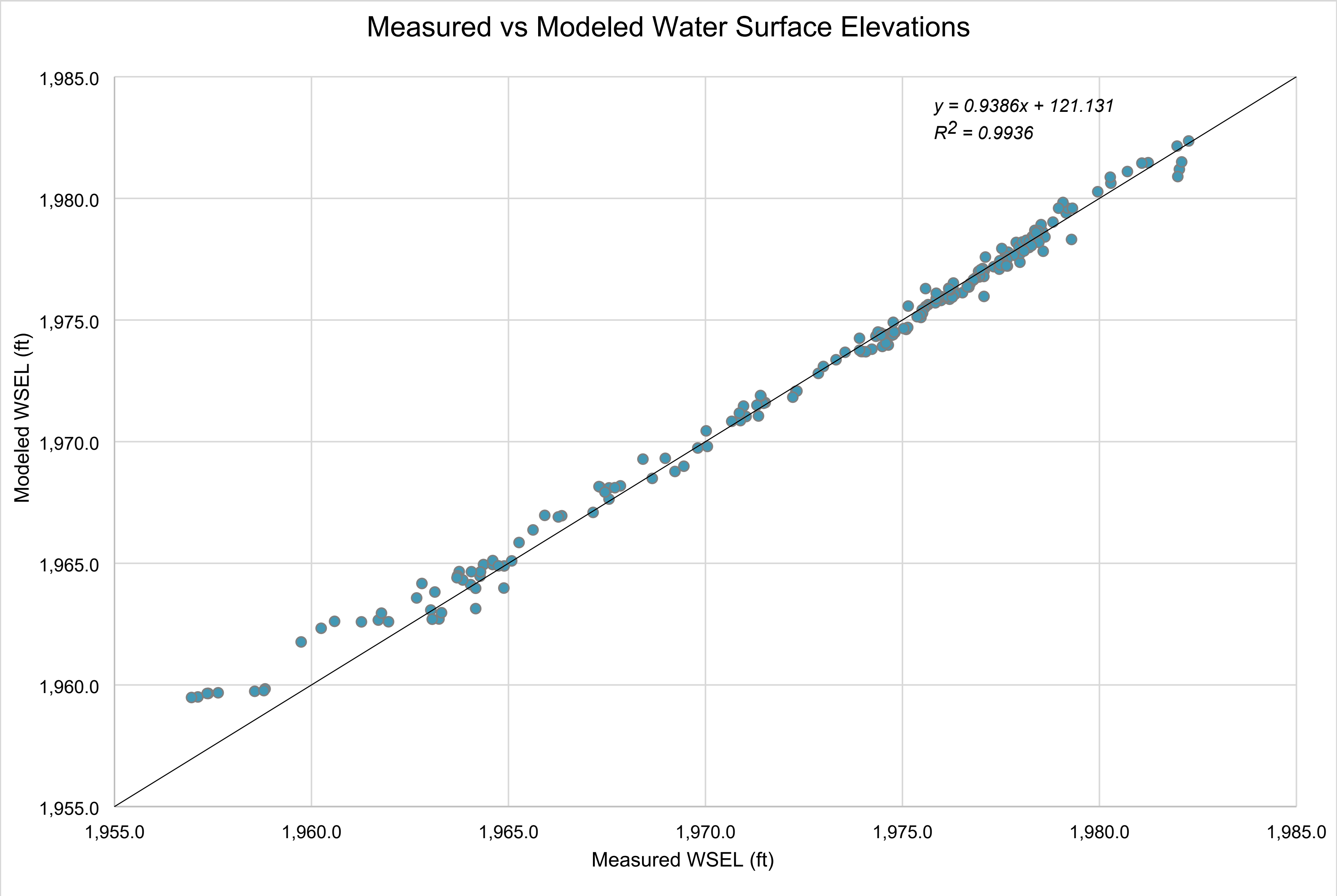

Figure 4-5. Field and Model Water Surface Elevation Correlation – All Flows

4.1.2 Point Velocity and Depth Measurements

Velocity point data collected for the Day 1 and 2 target flow scenarios were compared against velocities predicted by the model for those two scenarios. The comparison between measured field velocity data and modeled velocity for the Day 1 and 2 flow scenarios is presented in Table 4-2 and Figure 4-6 and Figure 4-7, respectively. Field velocity measurement points are colored by absolute difference from modeled velocities.

Due to the nature of a depth-averaged 2D model, matching point velocities measured within the water column is difficult as flow in the field rarely has a uniform velocity. Additional model limitations, including, but not limited to, mesh, Manning's *n* roughness polygon, and DTM resolutions reduce model accuracy near the edge of water. Section 4.1.4 discusses how average velocities across the bypass reach are modeled.

Table 4-2. Point Velocity Comparison

Flow	Field Range (ft/s)	Model Range (ft/s)	Minimum Delta (ft/s)	Maximum Delta (ft/s)	Average Delta (ft/s)
Day 1 (Leakage)	0.0 – 2.04	0.0 – 1.4	0.00	1.6	0.25
Day 2 (Low)	0.0 – 3.59	0.0 – 3.75	0.00	2.8	0.52

Due to the complex nature of the Buck Bypass reach, pool bathymetry was incorporated into the model only at the select locations shown in Figure 3-1. While LiDAR data was collected at leakage conditions, there is still significant standing water throughout the bypass reach that LiDAR cannot penetrate. Because of this, point depths were not compared between the model and data collected in the field.

Because the target flow and model scenarios were set up as steady-state analyses, these pools have very little effect on the overall model hydraulics. Velocities within pools will be slightly higher on average. The potential loss of storage volume within these pools is negligible, as they are filled under leakage flow.

Figure 4-6. Field versus Modeled Velocities – Day 1 (Leakage) Target Flow

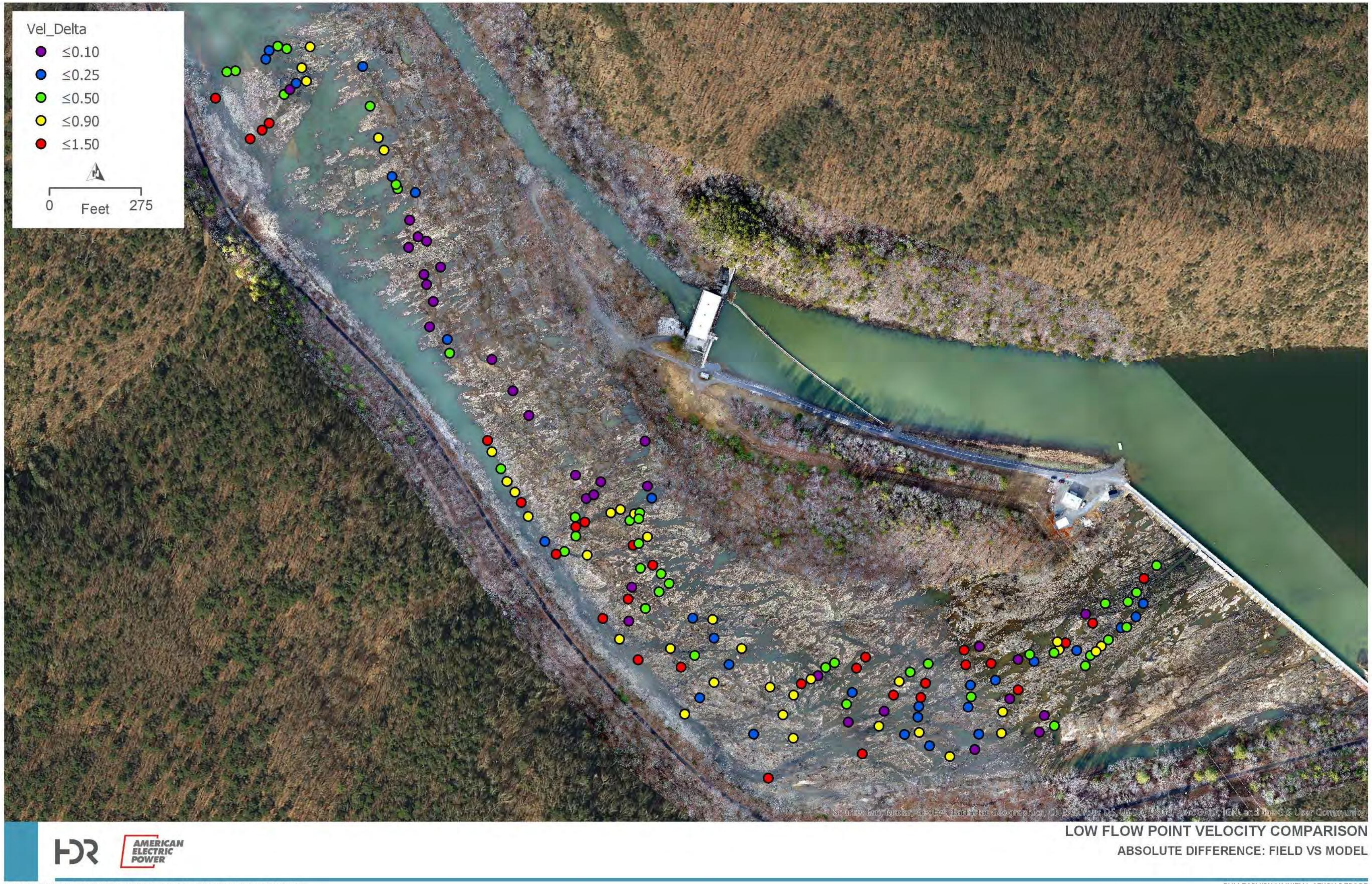

Figure 4-7. Field versus Modeled Velocities – Day 2 (Low) Target Flow

4.1.3 Wetted Area Comparison

The total wetted area in the bypass reach increases as flow increases. Table 4-3 presents the incremental differences predicted by the model of the total bypass reach wetted area between the various target flows. Table 4-4 and Table 4-5 present incremental differences of wetted area for the upper and lower sections of the bypass reach, respectively. The geology of the bypass reach bedrock can be broadly categorized as angular bedrock. This angular bedrock runs in a southeast to northwest direction and creates flow channels or pools depending on orientation. The layout of the bypass reach is such that at approximately 1/4 of the length of the bypass reach, the bedrock orientation transitions from parallel to perpendicular to the direction of flow. For this analysis, this transition area was used as the dividing line between the upper and lower sections of the bypass reach.

Table 4-3. Total Bypass Reach Wetted Area Comparison

Bypass Reach Flow	Total Wetted Area (Acres)	Percent Delta From Leakage	Incremental Area Increase (Acres)
Day 1 (Leakage)	69.6	N/A	N/A
Day 2 (Low)	78.7	113%	9.1
Day 3 (Mid)	83.4	120%	4.7
Day 4 (High)	86.5	124%	3.1

Table 4-4. Upper Bypass Reach Wetted Area Comparison

Bypass Reach Flow	Total Wetted Area (Acres)	Percent Delta From Leakage	Incremental Area Increase (Acres)
Day 1 (Leakage)	8.9	N/A	N/A
Day 2 (Low)	11.5	129%	2.6
Day 3 (Mid)	12.3	138%	0.8
Day 4 (High)	13.4	151%	0.9

Table 4-5. Lower Bypass Reach Wetted Area Comparison

Bypass Reach Flow	Total Wetted Area (Acres)	Percent Delta From Leakage	Incremental Area Increase (Acres)
Day 1 (Leakage)	60.7	N/A	N/A
Day 2 (Low)	67.2	111%	6.5
Day 3 (Mid)	71.1	117%	3.9
Day 4 (High)	73.1	120%	2.0

Figure 4-8 through Figure 4-11 present model results overlaid onto their respective target flow orthomosaic imagery. These figures provide a view of the model results that can be used as a qualitative check of the model's overall agreement with field conditions. For increased detail, only a portion of the upper section of the bypass reach is presented in these figures.

Results of the entire modeling domain are shown on Figure 4-12 through Figure 4-19. Figure 4-12 through Figure 4-15 are colored by velocity magnitude and Figure 4-16 through Figure 4-19 are colored by depth.

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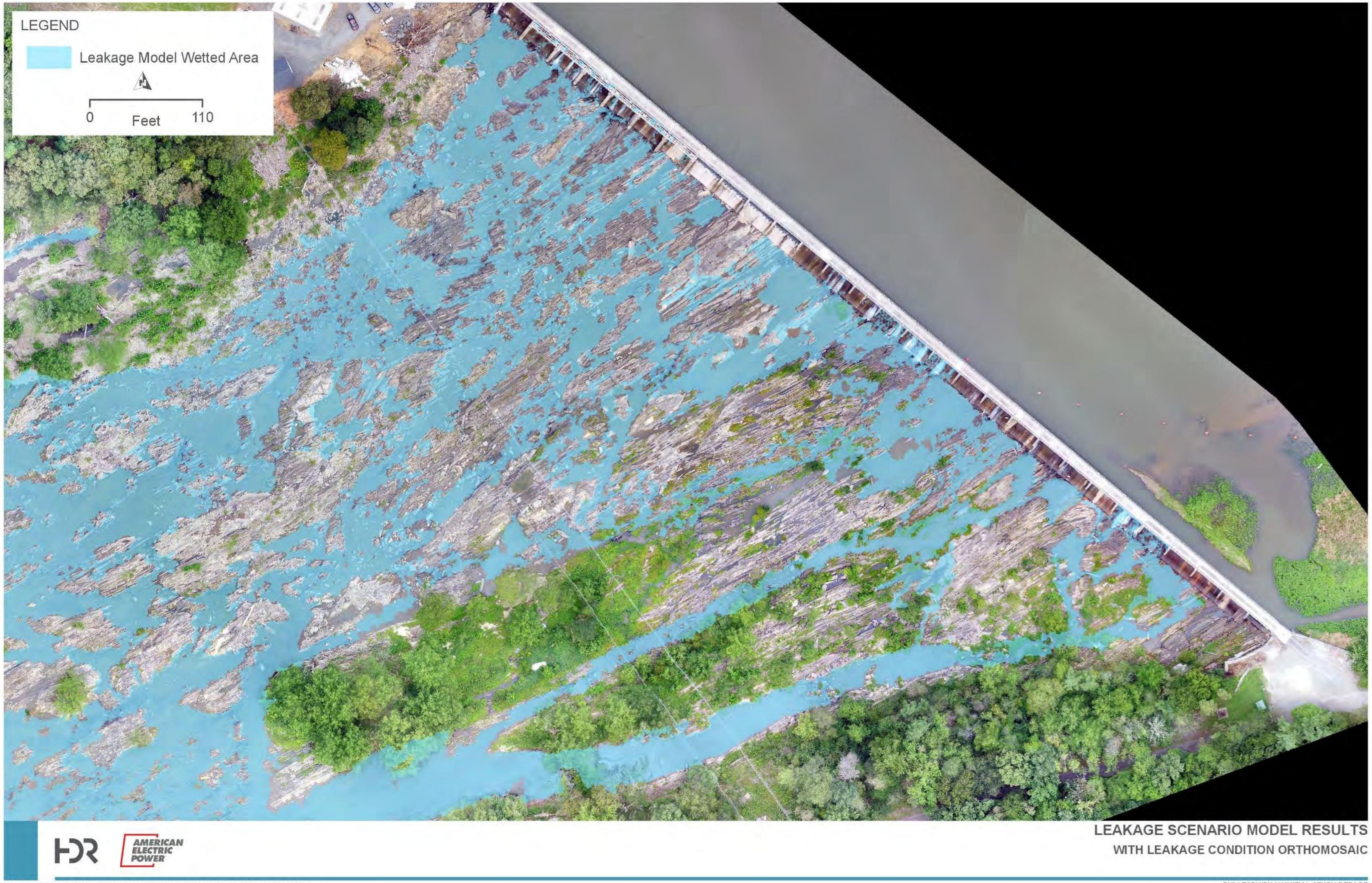

Figure 4-8. Model Results with Orthomosaic Imagery – Day 1 (Leakage) Target Flow

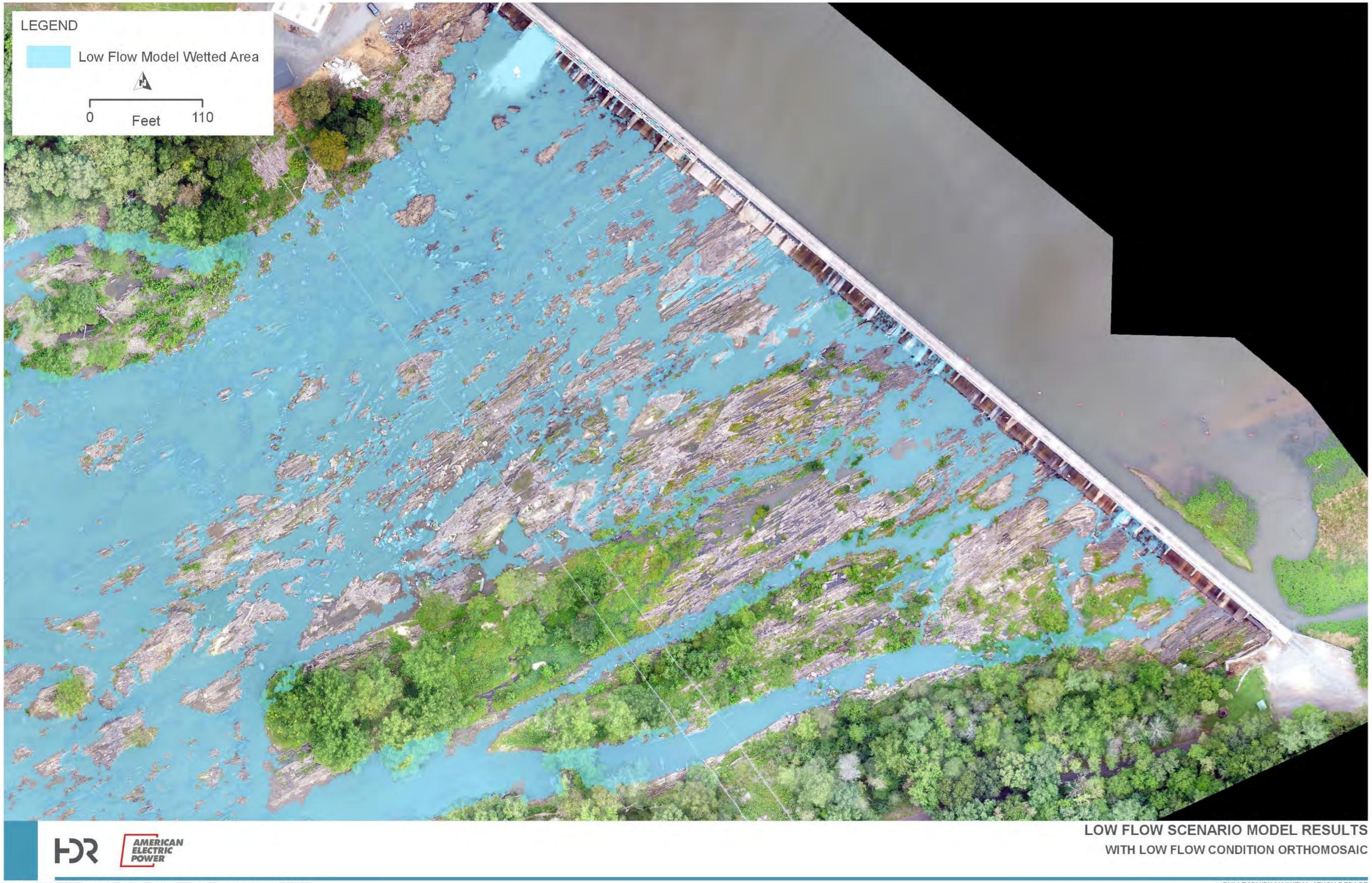

Figure 4-9. Model Results with Orthomosaic Imagery – Day 2 (Low) Target Flow

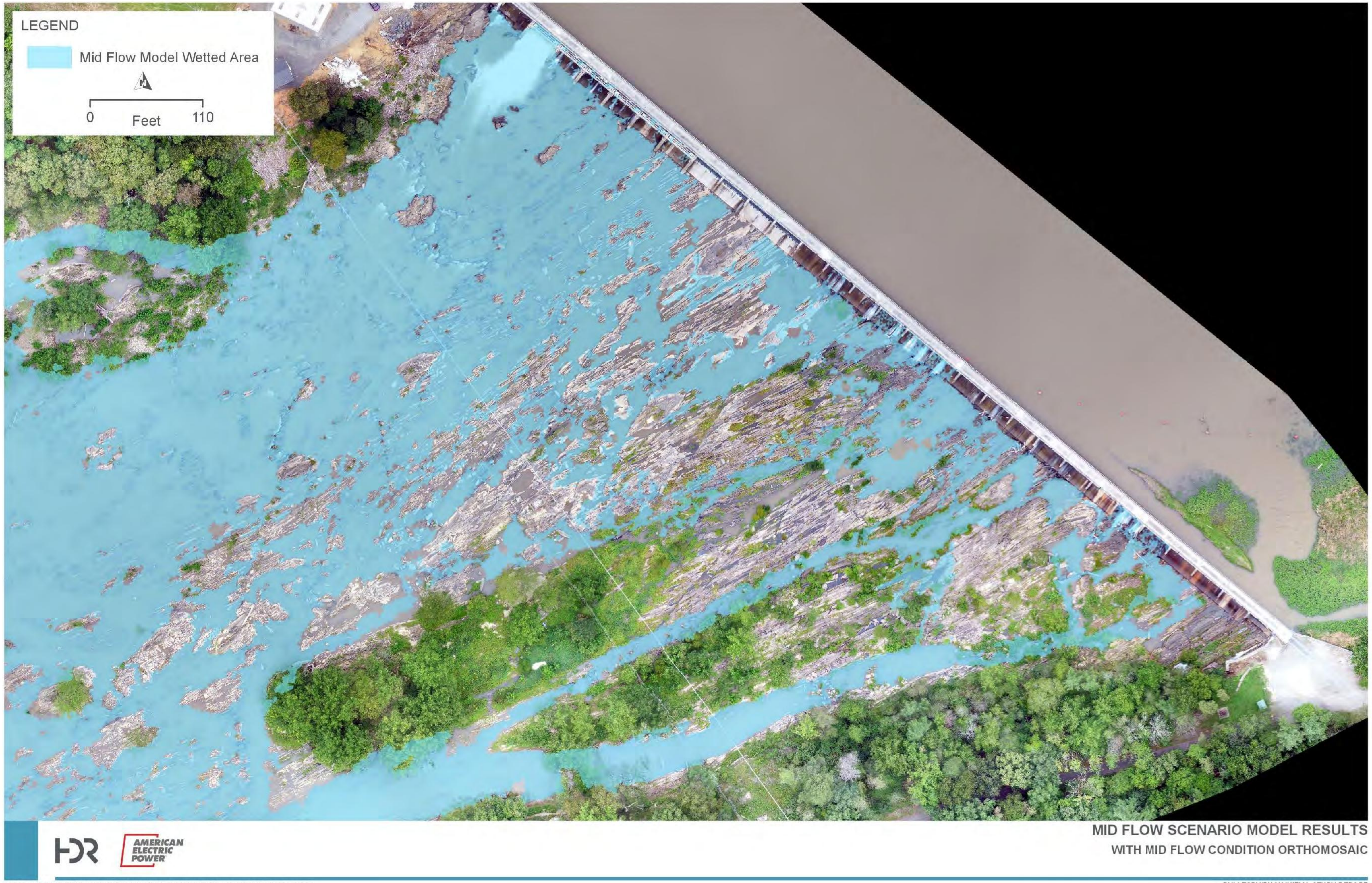

Figure 4-10. Model Results with Orthomosaic Imagery – Day 3 (Mid) Target Flow

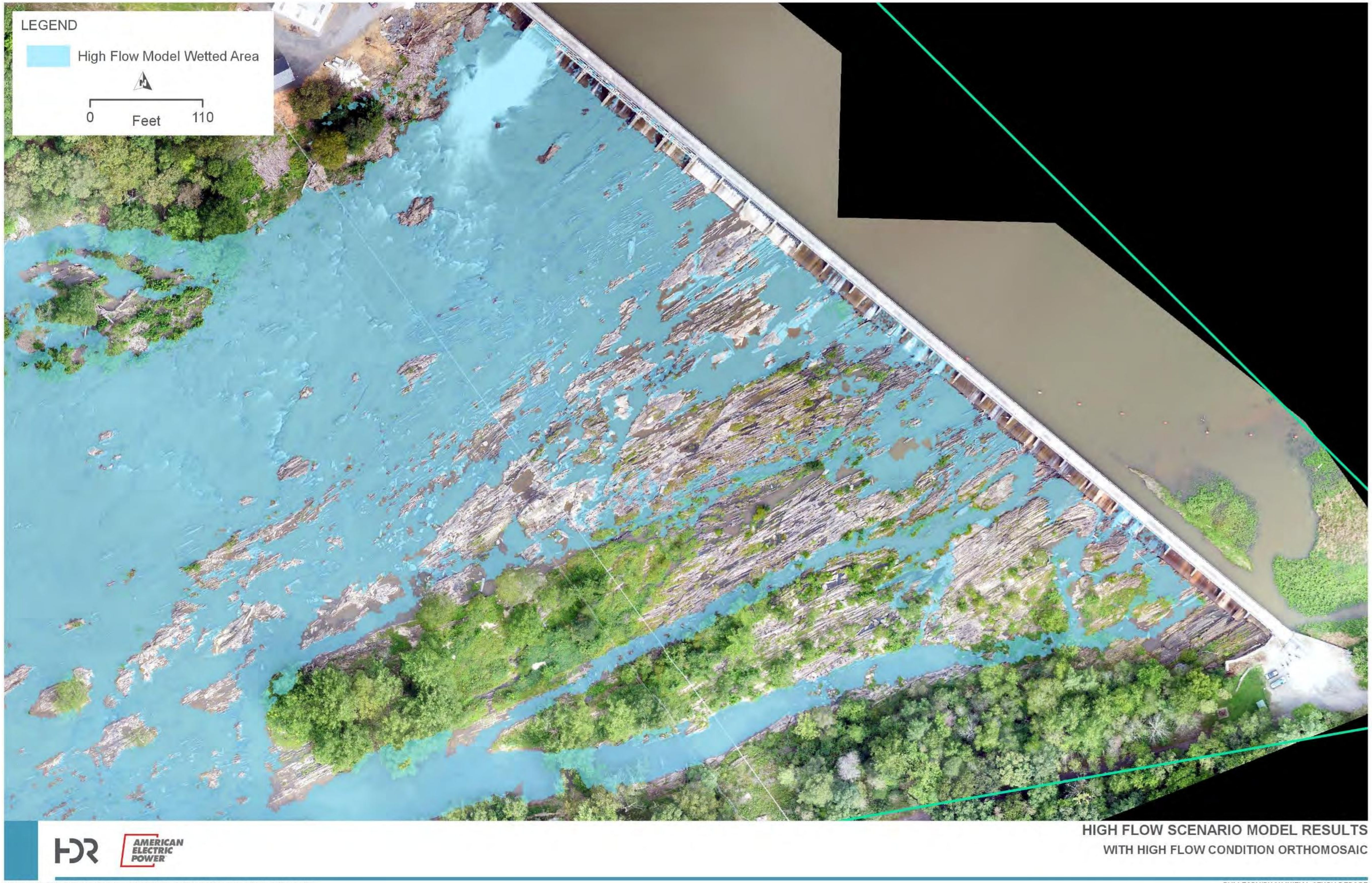

Figure 4-11. Model Results with Orthomosaic Imagery – Day 4 (High) Target Flow

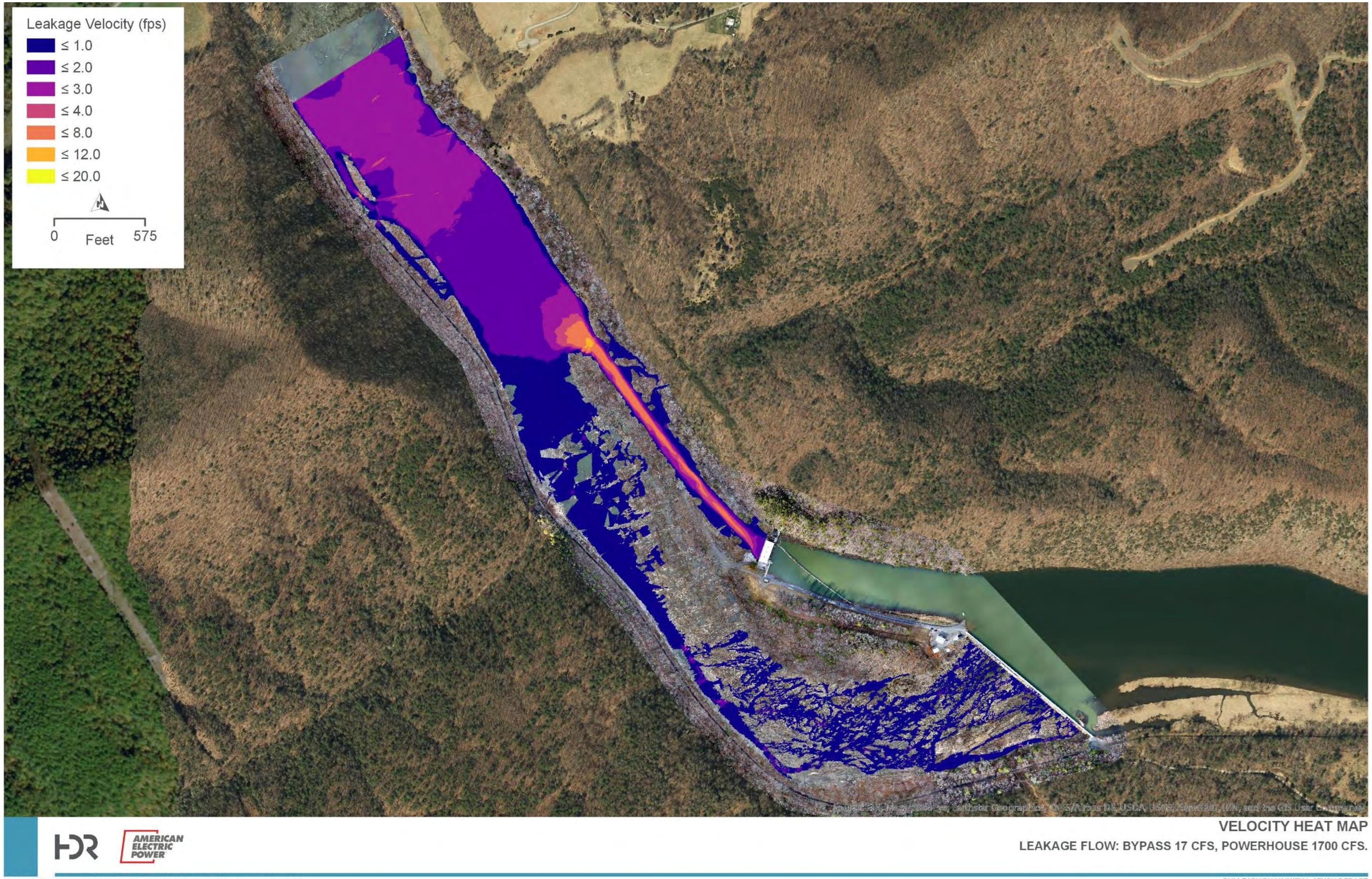

Figure 4-12. Velocity Heat Map – Day 1 (Leakage) Target Flow

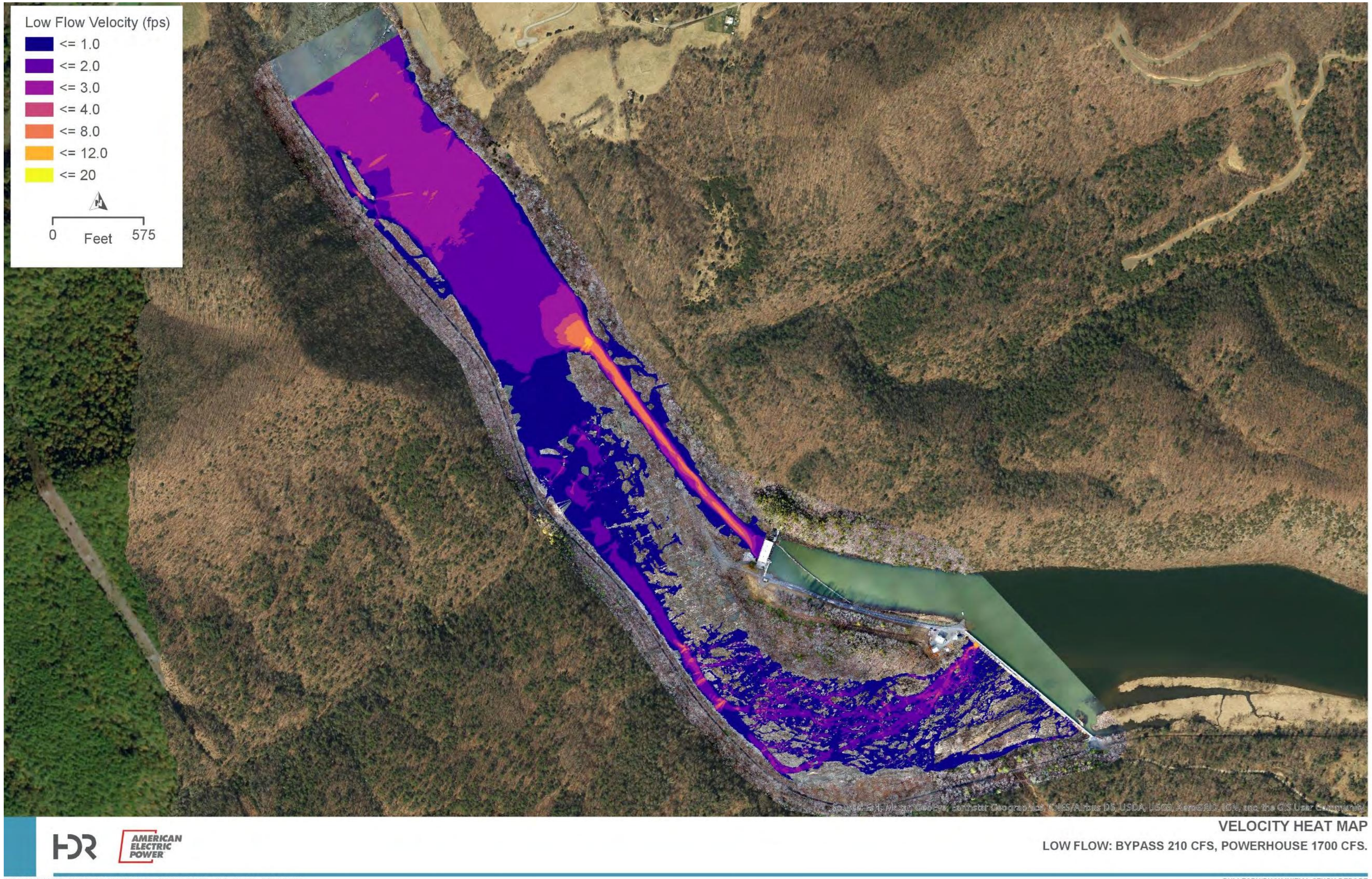

Figure 4-13. Velocity Heat Map – Day 2 (Low) Target Flow

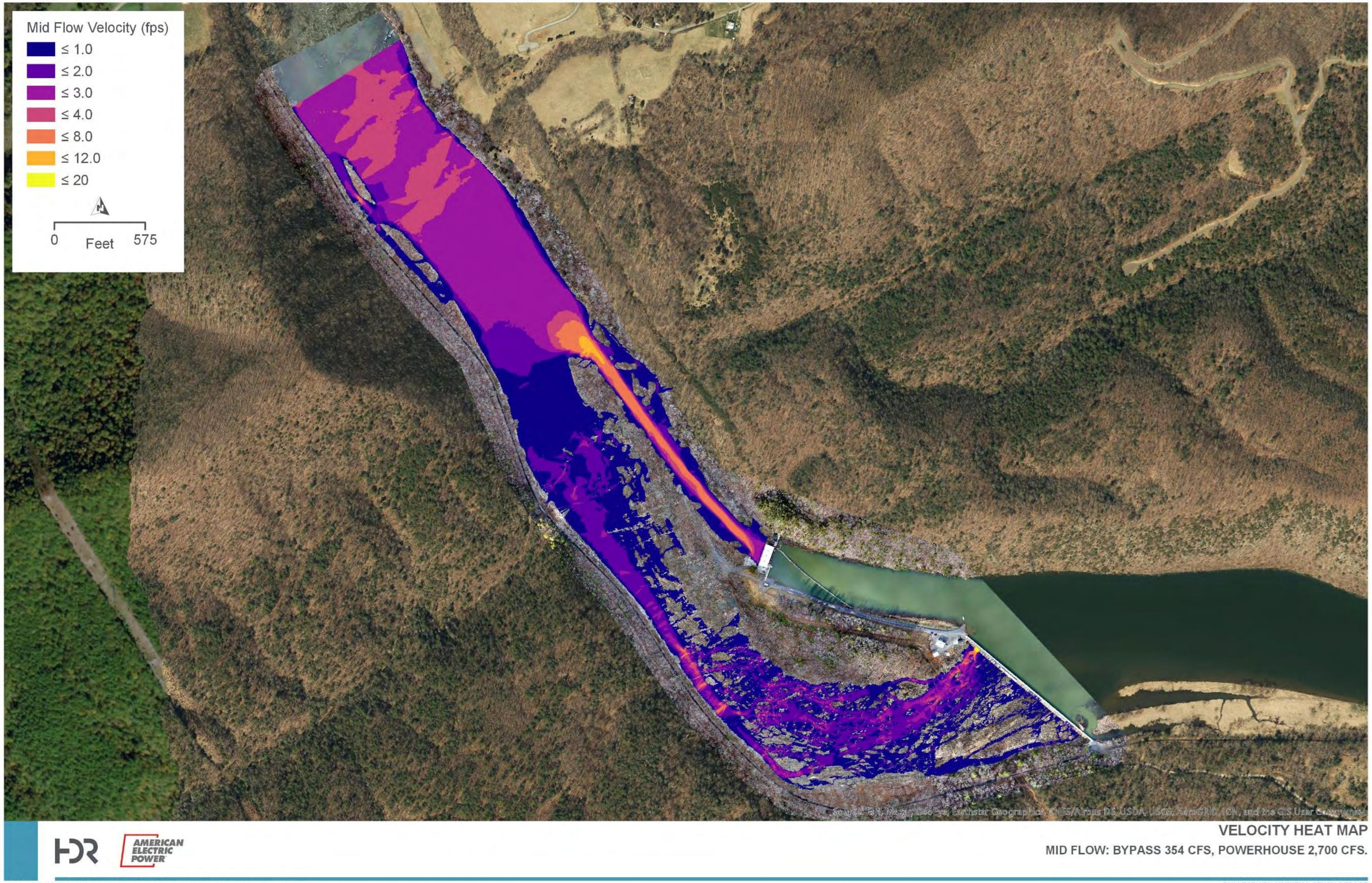

Figure 4-14. Velocity Heat Map – Day 3 (Mid) Target Flow

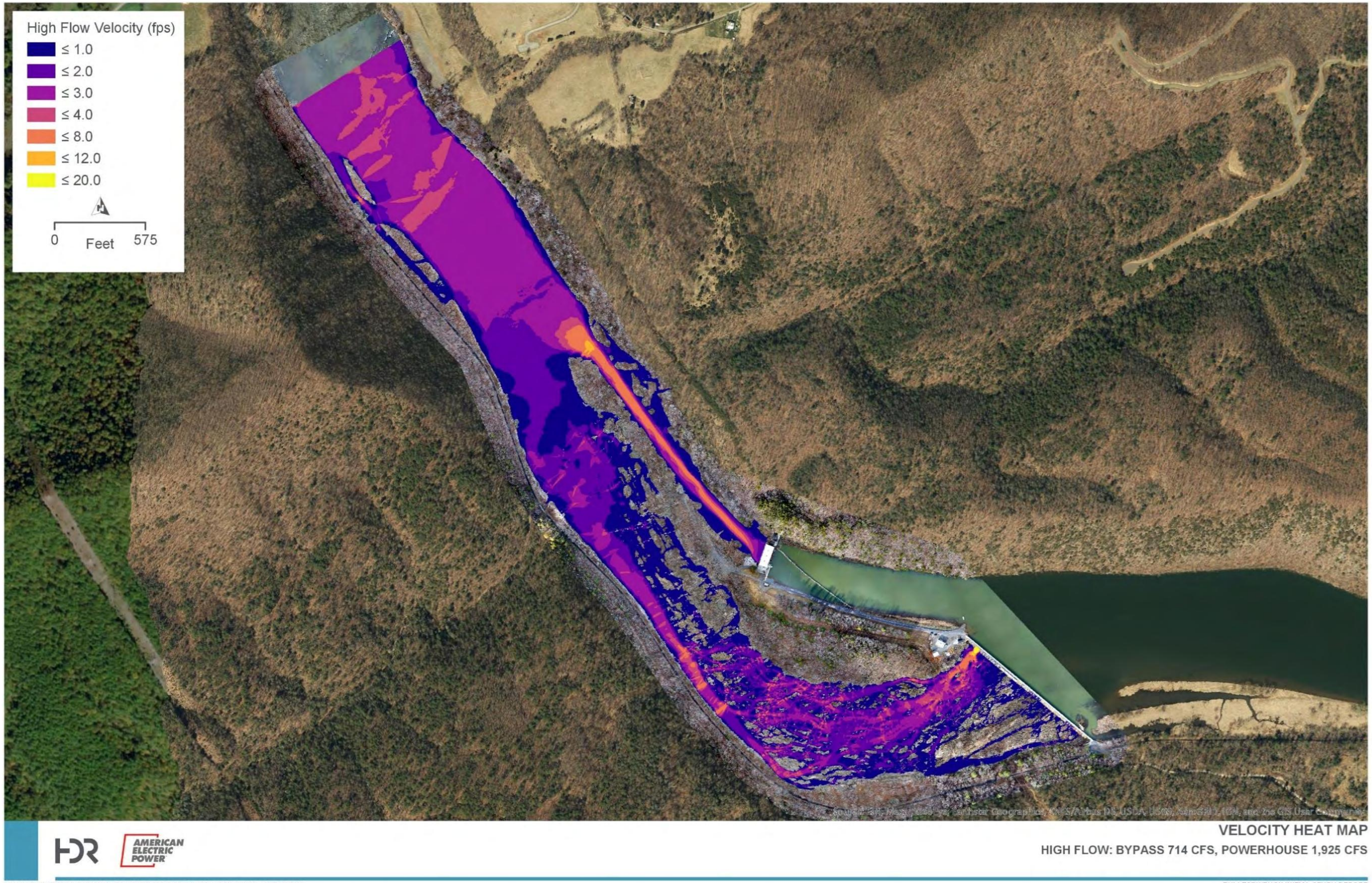

Figure 4-15. Velocity Heat Map – Day 4 (High) Target Flow

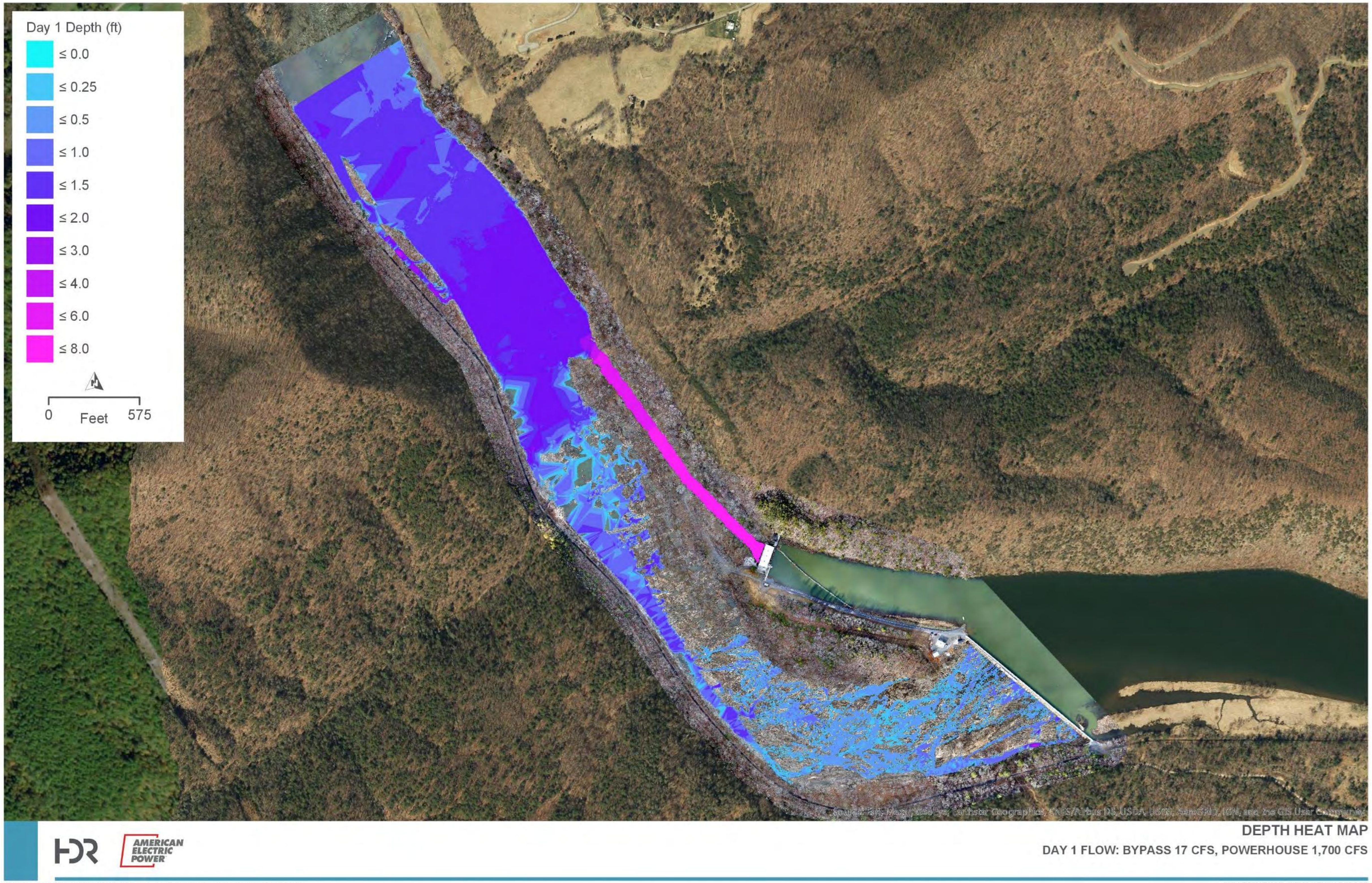

Figure 4-16. Depth Heat Map – Day 1 (Leakage) Target Flow

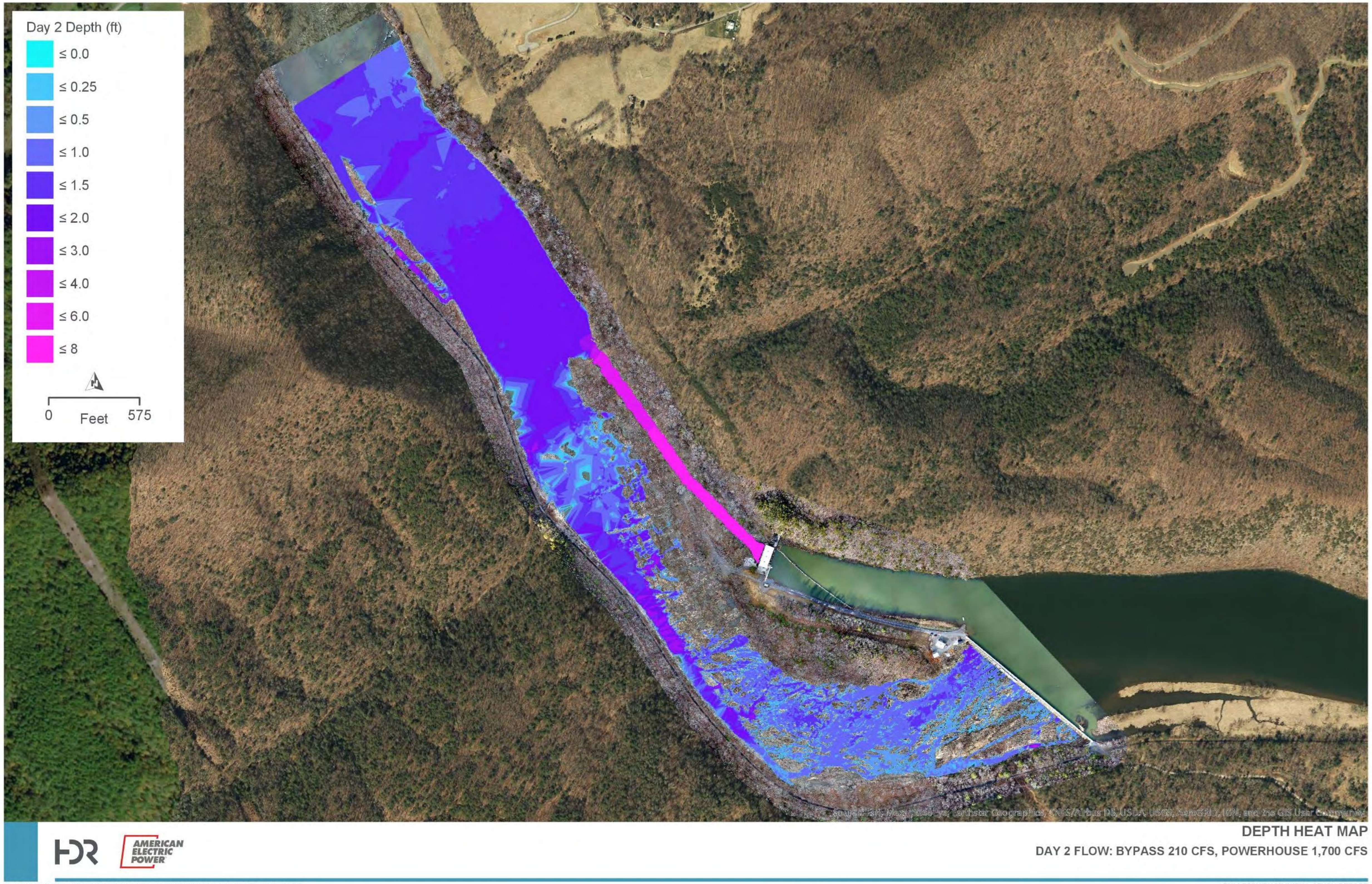

Figure 4-17. Depth Heat Map – Day 2 (Low) Target Flow

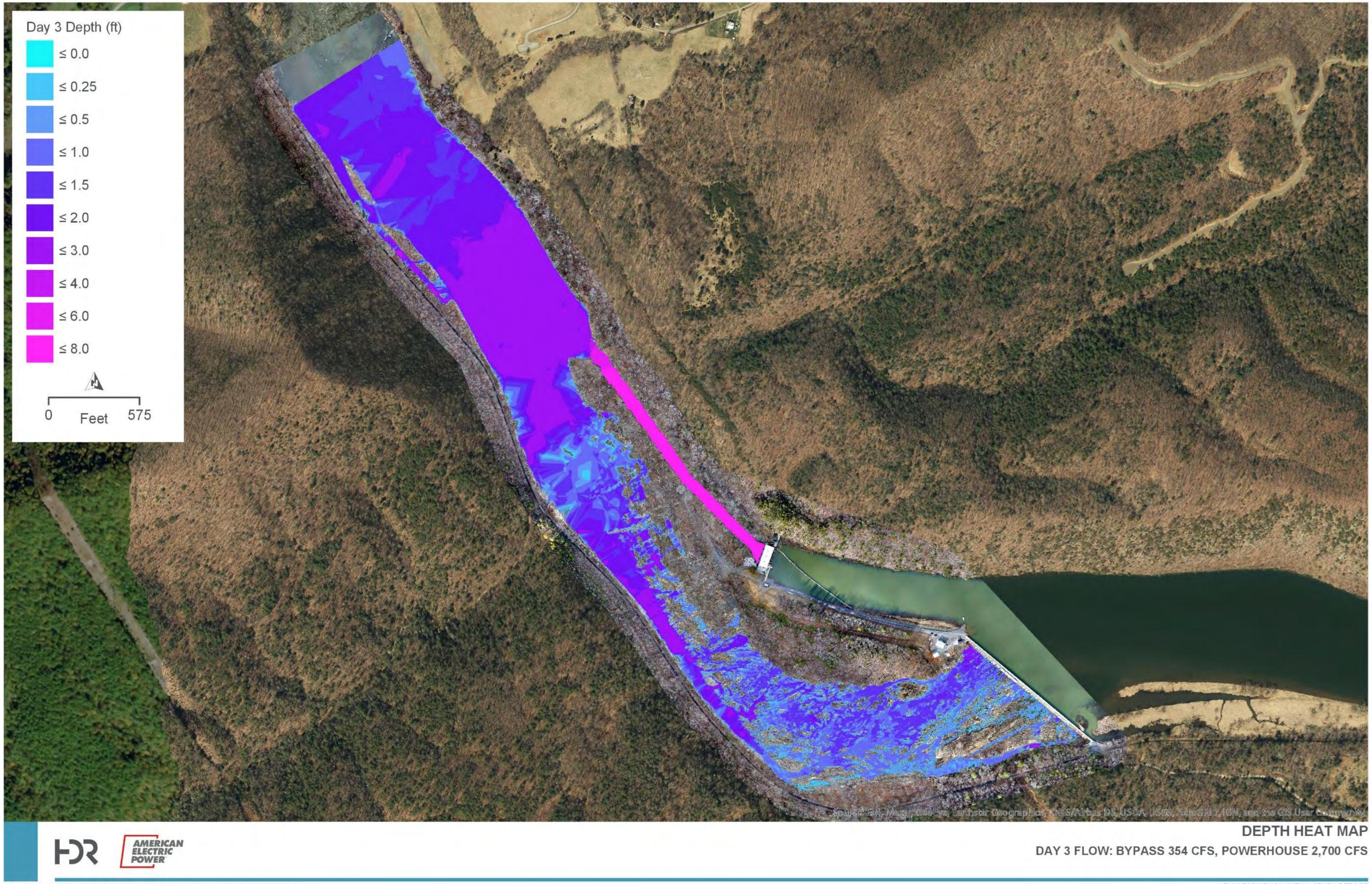

Figure 4-18. Depth Heat Map – Day 3 (Mid) Target Flow

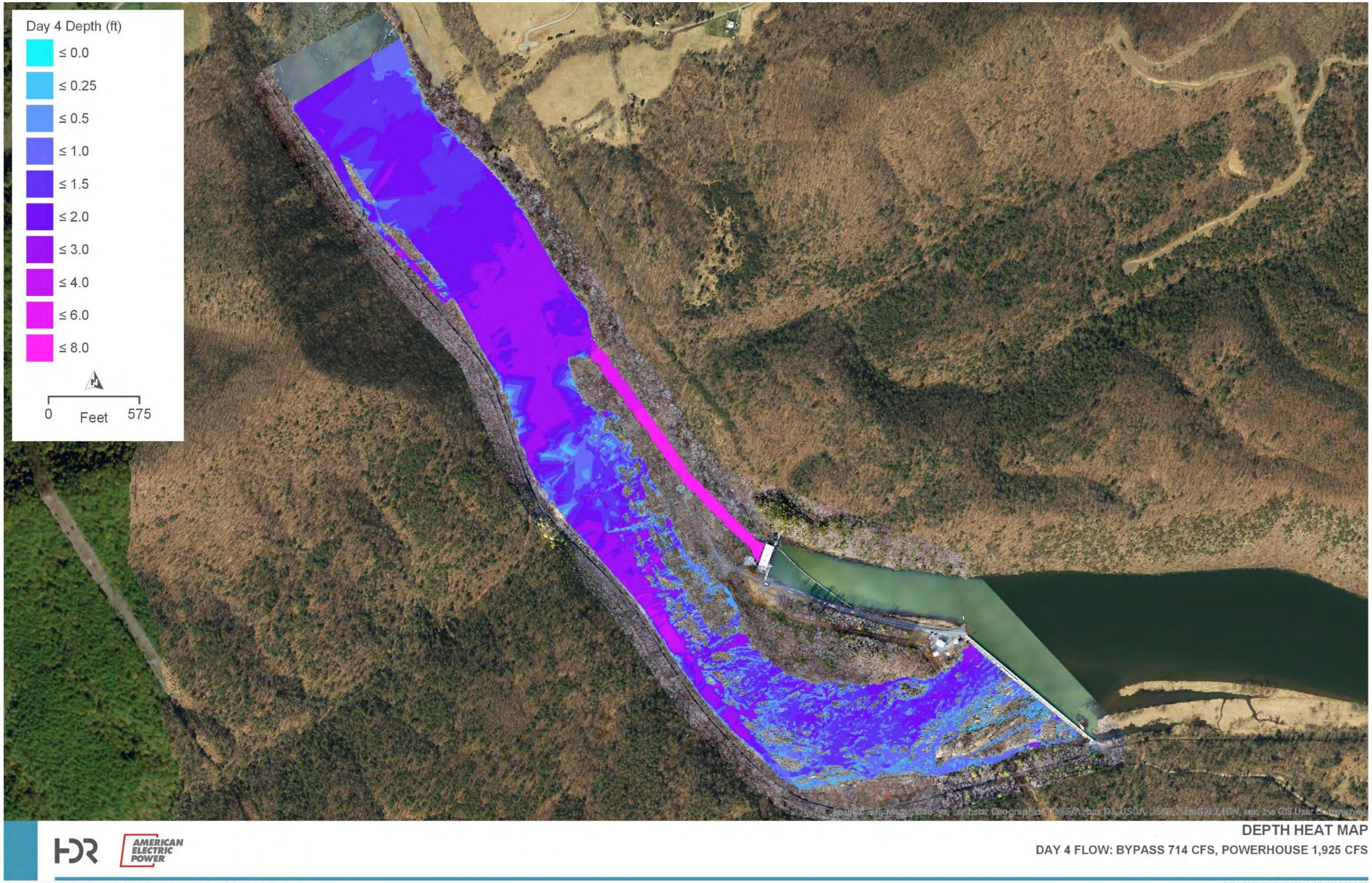

Figure 4-19. Depth Heat Map – Day 4 (High) Target Flow

4.1.4 Travel Time

Travel time measures the time it takes an inflow to travel between designated points in the bypass reach. This measurement is an important data point used for verifying a number of model inputs including the Manning's *n* roughness values presented in Section 3.3.2, inflow, and overall bypass reach slope from the LiDAR data/DTM are appropriate for the analysis. Additionally, it provides insight into model hydraulics, specifically the average velocity within the bypass reach. For this analysis, the travel time was measured between BK_LL1 and BK_LL10. For reference see Figure 2-1. Table 4-6 presents travel times measured by the level loggers and predicted by the model. As leakage is constant, travel times are not measured for that flow condition.

Table 4-6. Bypass Reach Travel Times

Bypass Reach Flow	Level Logger Time (hr:min)	Model Time (hr:min)	Delta (hr:min)
Day 1 (Leakage)	N/A	N/A	N/A
Day 2 (Low)	2:30	2:25	-0:05
Day 3 (Mid)	1:40	1:50	+0:10
Day 4 (High)	1:00	1:15	+0:15

At low flows, the model predicts slightly faster travel times than seen in the field while the opposite is true at higher flows. The small deltas between field and model data confirm the modeling inputs are appropriate and average velocities calculated are representative of field conditions.

5 References

Chow, Ven Te, "Open Channel Hydraulics," 1959.

Esri 2017. ArcGIS Desktop, Release 10.4.1 Redlands, CA: Environmental Systems Research Institute.

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Attachment 2

Attachment 2 – Habitat Suitability Criteria Tables

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Table 1. Walleye HSC Table

Lifestage	Velocity (ft/s)	Velocity (m/s)	Suitability Index	Depth (ft)	Depth (m)	Suitability Index	Channel Index	Suitability Index
Fry	0	0.00	1	0	0.00	0	1	0.07
	0.08	0.02	1	1	0.30	0	2	0.15
	0.11	0.03	0.98	1.1	0.34	0.14	3	1
	0.15	0.05	0.9	1.16	0.35	0.4	4	1
	0.2	0.06	0.74	1.2	0.37	0.64	5	0.2
	0.23	0.07	0.56	1.25	0.38	0.76	6	0
	0.25	0.08	0	1.4	0.43	0.92	7	0
	--	--	--	1.45	0.44	0.96	8	1
	--	--	--	1.5	0.46	0.98	9	1
	--	--	--	1.6	0.49	1	10	1
	--	--	--	4.9	1.49	1	11	1
	--	--	--	5.1	1.55	0.98	12	1
Fry	--	--	--	5.44	1.66	0.9	13	1
	--	--	--	5.8	1.77	0.78	14	1
	--	--	--	6.2	1.89	0.58	15	0.6
	--	--	--	6.6	2.01	0.3	16	0.55
	--	--	--	7	2.13	0	17	0.5
	--	--	--	--	--	--	18	0
Juvenile	0	0.00	1	0	0.00	0	1	0.5
	0.11	0.03	1	2	0.61	0	2	1
	0.13	0.04	0.97	2.2	0.67	0.46	3	0.8
	0.18	0.05	0.88	2.4	0.73	0.66	4	0.6
	0.23	0.07	0.74	2.6	0.79	0.76	5	0.25
	0.3	0.09	0.46	2.85	0.87	0.84	6	0.1
	0.39	0.12	0.28	3.2	0.98	0.92	7	0
	0.46	0.14	0.22	3.6	1.10	0.98	8	0.8
	0.58	0.18	0.12	4	1.22	1	9	0.9
	0.73	0.22	0.08	6	1.83	1	10	0.8
	0.88	0.27	0.06	6.5	1.98	0.96	11	0.7
	1.85	0.56	0.04	7	2.13	0.9	12	0.8
	1.95	0.59	0.04	7.4	2.26	0.82	13	0.7
	2.1	0.64	0.02	7.8	2.38	0.72	14	0.8
	2.25	0.69	0	8	2.44	0.6	15	0.7
	--	--	--	8.35	2.55	0.52	16	0.9
	--	--	--	8.9	2.71	0.46	17	0.65
	--	--	--	9.4	2.87	0.44	18	0
	--	--	--	10.6	3.23	0.42	--	--
	--	--	--	18	5.49	0.4	--	--
Adult	0.00	0.00	1.00	0.00	0.00	0.00	1	0.2
	0.20	0.06	1.00	3.10	0.94	0.00	2	1
	0.25	0.08	0.98	3.40	1.04	0.20	3	1
	0.30	0.09	0.84	3.60	1.10	0.44	4	1
	0.37	0.11	0.40	3.70	1.13	0.82	5	1
	0.45	0.14	0.26	3.80	1.16	0.92	6	1
	0.6	0.18288	0.18	3.95	1.20	0.98	7	0
	1	0.3048	0.06	4	1.2192	1	8	0.6
	1.5	0.4572	0.04	10	3.048	1	9	1
	2.5	0.762	0.04	--	--	--	10	1
	2.85	0.86868	0.02	--	--	--	11	1
	3	0.9144	0	--	--	--	12	1
	--	--	--	--	--	--	13	1
	--	--	--	--	--	--	14	1
	--	--	--	--	--	--	15	1
	--	--	--	--	--	--	16	1

Lifestage	Velocity (ft/s)	Velocity (m/s)	Suitability Index	Depth (ft)	Depth (m)	Suitability Index	Channel Index	Suitability Index
	--	--	--	--	--	--	17	0.6
	--	--	--	--	--	--	18	0
Spawning	0	0.00	0.06	0	0.00	0	1	0
	0.4	0.12	0.08	1	0.30	0	2	0
	0.85	0.26	0.12	1.5	0.46	0.22	3	0.35
	1	0.30	0.14	1.8	0.55	0.42	4	1
	1.17	0.36	0.18	2.06	0.63	0.62	5	1
	1.5	0.46	0.28	2.3	0.70	0.88	6	1
	1.78	0.54	0.38	2.4	0.73	0.94	7	0
	1.97	0.60	0.46	2.5	0.76	0.99	8	0.8
	2.07	0.63	0.54	2.6	0.79	1	9	0.8
	2.15	0.66	0.62	4.97	1.51	1	10	0.8
	2.3	0.70	0.84	5.05	1.54	0.98	11	0.8
	2.4	0.73	0.94	5.8	1.77	0.6	12	0.8
	2.47	0.75	0.98	6.1	1.86	0.44	13	0.8
	2.52	0.77	1	6.25	1.91	0.3	14	0.8
	2.97	0.91	1	6.5	1.98	0	15	0.8
	3.03	0.92	0.99	--	--	--	16	0.8
	3.05	0.93	0.98	--	--	--	17	0.11
	3.2	0.98	0.86	--	--	--	18	0
	3.35	1.02	0.68	--	--	--	--	--
	3.5	1.07	0.46	--	--	--	--	--
	3.55	1.08	0.32	--	--	--	--	--
	3.58	1.09	0	--	--	--	--	--

Table 2. Shallow Guild HSC Table

Lifestage	Velocity (ft/s)	Velocity (m/s)	Suitability Index	Depth (ft)	Depth (m)	Suitability Index	Channel Index	Suitability Index
RBSFS	0.0	0.00	1.00	0.0	0.00	0.00	1	0.1
	0.4	0.12	1.00	0.5	0.15	0.00	2	0.7
	0.5	0.15	0.90	0.8	0.23	0.80	3	0.8
	1.0	0.31	0.15	1.0	0.31	1.00	4	0.5
	1.3	0.41	0.00	2.5	0.76	1.00	5	0.21
	--	--	--	3.1	0.95	0.60	6	0
	--	--	--	7.0	2.13	0.00	7	0
	--	--	--	--	--	--	8	0.2
	--	--	--	--	--	--	9	0.8
	--	--	--	--	--	--	10	0.4
	--	--	--	--	--	--	11	0.8
	--	--	--	--	--	--	12	0.8
	--	--	--	--	--	--	13	0.7
	--	--	--	--	--	--	14	0.9
	--	--	--	--	--	--	15	0.6
	--	--	--	--	--	--	16	0.9
	--	--	--	--	--	--	17	0.85
	--	--	--	--	--	--	18	0
SRHAV	0.0	0.00	0.92	0.0	0.00	0.00	1	1
	0.0	0.01	0.95	0.0	0.01	0.08	2	0
	0.1	0.02	0.97	0.1	0.02	0.10	3	0
	0.1	0.03	0.98	0.1	0.03	0.13	4	0
	0.1	0.04	0.99	0.1	0.04	0.17	5	0
	0.2	0.05	1.00	0.2	0.05	0.21	6	0
	0.2	0.06	1	0.2	0.06	0.25	7	0
	0.2	0.07	1	0.2	0.07	0.29	8	1
	0.3	0.08	0.99	0.3	0.08	0.34	9	0
	0.3	0.09	0.98	0.3	0.09	0.39	10	0
SRHAV	0.3	0.10	0.97	0.3	0.10	0.44	11	0
	0.4	0.11	0.95	0.4	0.11	0.5	12	0
	0.4	0.12	0.94	0.4	0.12	0.55	13	0
	0.4	0.13	0.92	0.4	0.13	0.6	14	0
	0.5	0.14	0.9	0.5	0.14	0.65	15	0
	0.5	0.15	0.88	0.5	0.15	0.7	16	0
	0.5	0.16	0.86	0.5	0.16	0.75	17	0
	0.6	0.17	0.83	0.6	0.17	0.79	18	1
	0.6	0.18	0.81	0.6	0.18	0.83	--	--
	0.6	0.19	0.79	0.6	0.19	0.87	--	--
	0.7	0.20	0.76	0.7	0.20	0.90	--	--
	0.7	0.21	0.74	0.7	0.21	0.92	--	--
	0.7	0.22	0.71	0.7	0.22	0.95	--	--
	0.8	0.23	0.69	0.8	0.23	0.96	--	--
	0.8	0.24	0.67	0.8	0.24	0.98	--	--
	0.8	0.25	0.64	0.8	0.25	0.99	--	--
	0.8	0.26	0.62	0.8	0.26	1	--	--
	0.9	0.27	0.6	0.9	0.27	1	--	--
	0.9	0.28	0.58	0.9	0.28	1	--	--
	1.0	0.29	0.55	1.0	0.29	1	--	--
	1.0	0.30	0.53	1.0	0.30	0.99	--	--
	1.0	0.31	0.51	1.0	0.31	0.98	--	--
	1.0	0.32	0.49	1.0	0.32	0.97	--	--
	1.1	0.33	0.47	1.1	0.33	0.96	--	--
	1.1	0.34	0.46	1.1	0.34	0.94	--	--
	1.2	0.35	0.44	1.2	0.35	0.93	--	--

Lifestage	Velocity (ft/s)	Velocity (m/s)	Suitability Index	Depth (ft)	Depth (m)	Suitability Index	Channel Index	Suitability Index
	1.2	0.36	0.42	1.2	0.36	0.91	--	--
	1.2	0.37	0.4	1.2	0.37	0.89	--	--
	1.3	0.38	0.39	1.3	0.38	0.87	--	--
	1.3	0.39	0.37	1.3	0.39	0.85	--	--
	1.3	0.40	0.35	1.3	0.40	0.83	--	--
	1.3	0.41	0.34	1.3	0.41	0.81	--	--
	1.4	0.42	0.33	1.4	0.42	0.79	--	--
	1.4	0.43	0.31	1.4	0.43	0.77	--	--
	1.4	0.44	0.3	1.4	0.44	0.75	--	--
	1.5	0.45	0.29	1.5	0.45	0.72	--	--
	1.5	0.46	0.27	1.5	0.46	0.7	--	--
	1.5	0.47	0.26	1.5	0.47	0.68	--	--
	1.6	0.48	0.25	1.6	0.48	0.66	--	--
	1.6	0.49	0.24	1.6	0.49	0.64	--	--
	1.6	0.50	0.23	1.6	0.50	0.62	--	--
	1.7	0.51	0.22	1.7	0.51	0.6	--	--
	1.7	0.52	0.21	1.7	0.52	0.58	--	--
	1.7	0.53	0.2	1.7	0.53	0.56	--	--
	1.8	0.54	0.19	1.8	0.54	0.54	--	--
	1.8	0.55	0.18	1.8	0.55	0.52	--	--
	1.8	0.56	0.17	1.8	0.56	0.5	--	--
	1.9	0.57	0.17	1.9	0.57	0.48	--	--
	1.9	0.58	0.16	1.9	0.58	0.46	--	--
	1.9	0.59	0.15	1.9	0.59	0.45	--	--
	2.0	0.60	0.14	2.0	0.60	0.43	--	--
	2.0	0.61	0.14	2.0	0.61	0.41	--	--
	2.0	0.62	0.13	2.0	0.62	0.4	--	--
	2.1	0.63	0.13	2.1	0.63	0.38	--	--
SRHAV	2.1	0.64	0.12	2.1	0.64	0.37	--	--
	2.1	0.65	0.11	2.1	0.65	0.35	--	--
	2.2	0.66	0.11	2.2	0.66	0.34	--	--
	2.2	0.67	0.1	2.2	0.67	0.33	--	--
	2.2	0.68	0.1	2.2	0.68	0.31	--	--
	2.3	0.69	0.09	2.3	0.69	0.3	--	--
	2.3	0.70	0.09	2.3	0.70	0.29	--	--
	2.3	0.71	0.09	2.3	0.71	0.28	--	--
	2.4	0.72	0.08	2.4	0.72	0.27	--	--
	2.4	0.73	0.08	2.4	0.73	0.25	--	--
	2.4	0.74	0.07	2.4	0.74	0.24	--	--
	2.5	0.75	0.07	2.5	0.75	0.23	--	--
	2.5	0.76	0.07	2.5	0.76	0.22	--	--
	2.5	0.77	0.06	2.5	0.77	0.22	--	--
	2.6	0.78	0.06	2.6	0.78	0.21	--	--
	2.6	0.79	0.06	2.6	0.79	0.2	--	--
	2.6	0.80	0.05	2.6	0.80	0.19	--	--
	2.7	0.81	0.05	2.7	0.81	0.18	--	--
	2.7	0.82	0.05	2.7	0.82	0.17	--	--
	2.7	0.83	0.05	2.7	0.83	0.17	--	--
	2.7	0.84	0.04	2.7	0.84	0.16	--	--
	2.8	0.85	0.04	2.8	0.85	0.15	--	--
	2.8	0.86	0.04	2.8	0.86	0.15	--	--
	2.9	0.87	0.04	2.9	0.87	0.14	--	--
	2.9	0.88	0.04	2.9	0.88	0.13	--	--
	2.9	0.89	0.03	2.9	0.89	0.13	--	--
	2.9	0.90	0.03	2.9	0.90	0.12	--	--
	3.0	0.91	0.03	3.0	0.91	0.12	--	--

Lifestage	Velocity (ft/s)	Velocity (m/s)	Suitability Index	Depth (ft)	Depth (m)	Suitability Index	Channel Index	Suitability Index
	3.0	0.92	0.03	3.0	0.92	0.11	--	--
	3.1	0.93	0.03	3.1	0.93	0.11	--	--
	3.1	0.94	0.03	3.1	0.94	0.1	--	--
	3.1	0.95	0.03	3.1	0.95	0.1	--	--
	3.1	0.96	0.02	3.1	0.96	0.09	--	--
	3.2	0.97	0.02	3.2	0.97	0.09	--	--
	3.2	0.98	0.02	3.2	0.98	0.08	--	--
	3.3	0.99	0.02	3.3	0.99	0.08	--	--
	3.3	1.00	0.02	3.3	1.00	0.08	--	--
	3.3	1.01	0.02	3.3	1.01	0.07	--	--
	3.3	1.02	0.02	3.3	1.02	0.07	--	--
	3.4	1.03	0.02	3.4	1.03	0.07	--	--
	3.4	1.04	0.02	3.4	1.04	0.06	--	--
	3.4	1.05	0.01	3.4	1.05	0.06	--	--
	3.5	1.06	0.01	3.5	1.06	0.06	--	--
	3.5	1.07	0.01	3.5	1.07	0.05	--	--
	3.5	1.08	0.01	3.5	1.08	0.05	--	--
	3.6	1.09	0.01	3.6	1.09	0.05	--	--
	3.6	1.10	0.01	3.6	1.10	0.05	--	--
	3.6	1.11	0.01	3.6	1.11	0.04	--	--
	3.7	1.12	0.01	3.7	1.12	0.04	--	--
	3.7	1.13	0.01	3.7	1.13	0.04	--	--
	3.7	1.14	0.01	3.7	1.14	0.04	--	--
	3.8	1.15	0.01	3.8	1.15	0.04	--	--
	3.8	1.16	0.01	3.8	1.16	0.03	--	--
	3.8	1.17	0.01	3.8	1.17	0.03	--	--

Lifestage	Velocity (ft/s)	Velocity (m/s)	Suitability Index	Depth (ft)	Depth (m)	Suitability Index	Channel Index	Suitability Index
SRHAV	3.9	1.18	0.01	3.9	1.18	0.03	--	--
	3.9	1.19	0.01	3.9	1.19	0.03	--	--
	3.9	1.20	0.01	3.9	1.20	0.03	--	--
	4.0	1.21	0.01	4.0	1.21	0.03	--	--
	4.0	1.22	0.01	4.0	1.22	0.02	--	--
	4.0	1.23	0.01	4.0	1.23	0.02	--	--
	4.1	1.24	0	4.1	1.24	0.02	--	--
	--	--	--	4.1	1.25	0.02	--	--
	--	--	--	4.1	1.26	0.02	--	--
	--	--	--	4.2	1.27	0.02	--	--
	--	--	--	4.2	1.28	0.02	--	--
	--	--	--	4.2	1.29	0.02	--	--
	--	--	--	4.3	1.30	0.02	--	--
	--	--	--	4.3	1.31	0.02	--	--
	--	--	--	4.3	1.32	0.01	--	--
	--	--	--	4.4	1.33	0.01	--	--
	--	--	--	4.4	1.34	0.01	--	--
	--	--	--	4.4	1.34	0.01	--	--
	--	--	--	4.5	1.36	0.01	--	--
	--	--	--	4.5	1.37	0.01	--	--
	--	--	--	4.5	1.38	0.01	--	--
	--	--	--	4.6	1.39	0.01	--	--
	--	--	--	4.6	1.40	0.01	--	--
	--	--	--	4.6	1.41	0.01	--	--
	--	--	--	4.7	1.42	0.01	--	--
	--	--	--	4.7	1.43	0.01	--	--
	--	--	--	4.7	1.44	0.01	--	--
	--	--	--	4.8	1.45	0.01	--	--

Lifestage	Velocity (ft/s)	Velocity (m/s)	Suitability Index	Depth (ft)	Depth (m)	Suitability Index	Channel Index	Suitability Index
	--	--	--	4.8	1.46	0.01	--	--
	--	--	--	4.8	1.47	0.01	--	--
	--	--	--	4.8	1.48	0.01	--	--
	--	--	--	4.9	1.49	0.01	--	--
	--	--	--	4.9	1.50	0	--	--
	--	--	--	5.3	1.63	0	--	--
SHSLO	0.00	0.00	0	0.00	0.00	0	1	0
	0.33	0.10	1	0.10	0.03	1	2	0
	1.00	0.31	1	2.00	0.61	1	3	1
	1.00	0.31	0	2.03	0.62	0	4	1
	--	--	--	--	--	--	5	1
	--	--	--	--	--	--	6	1
	--	--	--	--	--	--	7	0
	--	--	--	--	--	--	8	0
	--	--	--	--	--	--	9	1
	--	--	--	--	--	--	10	1
	--	--	--	--	--	--	11	1
	--	--	--	--	--	--	12	1
	--	--	--	--	--	--	13	1
	--	--	--	--	--	--	14	1
	--	--	--	--	--	--	15	1
	--	--	--	--	--	--	16	1
	--	--	--	--	--	--	17	0
	--	--	--	--	--	--	18	0
SHFST	0.00	0.00	0	0.00	0.00	0	1	0
	0.76	0.23	0.3	0.15	0.05	0.1	2	0
	1.50	0.46	1	0.25	0.08	0.8	3	0.75
	2.50	0.76	1	0.35	0.11	1	4	1
	3.50	1.07	0.4	1.20	0.37	1	5	0
	3.80	1.16	0.2	1.50	0.46	0.75	6	0
	4.00	1.22	0	2.00	0.61	0.3	7	0
	--	--	--	2.50	0.76	0.1	8	0.5
	--	--	--	6.00	1.83	0	9	0.75
	--	--	--	--	--	--	10	1
	--	--	--	--	--	--	11	0
	--	--	--	--	--	--	12	1
	--	--	--	--	--	--	13	0
	--	--	--	--	--	--	14	1
	--	--	--	--	--	--	15	0
	--	--	--	--	--	--	16	0.75
	--	--	--	--	--	--	17	0
	--	--	--	--	--	--	18	0

Table 3. Deep Guild HSC Table

Lifestage	Velocity (ft/s)	Velocity (m/s)	Suitability Index	Depth (ft)	Depth (m)	Suitability Index	Channel Index	Suitability Index
RBSFA	0.0	0.00	1.00	0.0	0.00	0.00	1	0.1
	0.8	0.23	1.00	0.2	0.06	0.00	2	0.3
	1.5	0.46	0.30	1.2	0.37	0.80	3	0.7
	3.0	0.91	0.00	2.0	0.61	1.00	4	0.8
	--	--	--	6.0	1.83	1.00	5	0.7
	--	--	--	7.5	2.29	0.60	6	0.3
	--	--	--	8.2	2.50	0.00	7	0.1
	--	--	--	--	--	--	8	0.8
	--	--	--	--	--	--	9	1
	--	--	--	--	--	--	10	0.8
	--	--	--	--	--	--	11	1
	--	--	--	--	--	--	12	0.8
	--	--	--	--	--	--	13	1
	--	--	--	--	--	--	14	0.9
	--	--	--	--	--	--	15	1
	--	--	--	--	--	--	16	0.85
	--	--	--	--	--	--	17	0.65
	--	--	--	--	--	--	18	0
DSLON	0.0	0.00	1.00	0.0	0.00	0.00	1	1
	1.0	0.31	1.00	2.0	0.61	0.00	2	1
	1.0	0.31	0.00	2.0	0.61	1.00	3	1
	2.0	0.61	0.00	10.0	3.05	1.00	4	1
	--	--	--	--	--	--	5	1
	--	--	--	--	--	--	6	1
	--	--	--	--	--	--	7	1
	--	--	--	--	--	--	8	0
	--	--	--	--	--	--	9	0
	--	--	--	--	--	--	10	0
	--	--	--	--	--	--	11	0
	--	--	--	--	--	--	12	0
DSLON	--	--	--	--	--	--	13	0
	--	--	--	--	--	--	14	0.5
	--	--	--	--	--	--	15	0.5
	--	--	--	--	--	--	16	0
	--	--	--	--	--	--	17	0
	--	--	--	--	--	--	18	0
SRHAD	0.0	0.00	0.00	0.0	0.00	0.00	1	0.1
	0.1	0.04	0.51	1.5	0.46	0.00	2	0.45
	0.4	0.12	0.62	2.4	0.73	0.57	3	0.65
	0.6	0.20	0.82	3.3	1.02	0.91	4	0.475
	0.8	0.24	1.00	3.8	1.16	1.00	5	0.35
	1.0	0.32	1.00	4.8	1.45	1.00	6	0.48
	1.2	0.36	0.91	5.2	1.59	1.00	7	0.34
	1.4	0.44	0.6	6.2	1.88	1	8	0.55
	1.7	0.52	0.27	7.1	2.18	1	9	0.82
	2.0	0.60	0.08	8.1	2.47	1	10	0.75
	2.2	0.68	0.02	9.0	2.76	1	11	0.75
	2.4	0.719	0	9.5	2.90	1	12	0.75
	--	--	--	15.0	4.56	1	13	0.75
	--	--	--	--	--	--	14	0.75
	--	--	--	--	--	--	15	0.75
	--	--	--	--	--	--	16	0.82
	--	--	--	--	--	--	17	0.75
	--	--	--	--	--	--	18	0
SHRHA	0.0	0.00	0.37	0.0	0.00	0.00	1	0.2
	0.4	0.12	0.48	0.4	0.12	0.00	2	0.38

Lifestage	Velocity (ft/s)	Velocity (m/s)	Suitability Index	Depth (ft)	Depth (m)	Suitability Index	Channel Index	Suitability Index
	0.8	0.24	0.59	0.8	0.24	0.06	3	0.7
	1.2	0.37	0.70	1.0	0.31	0.14	4	0.75
	1.6	0.49	0.80	1.2	0.37	0.26	5	0.5
	2.0	0.61	0.89	1.4	0.43	0.41	6	0.55
	2.4	0.73	0.95	1.6	0.49	0.56	7	0.3
	2.8	0.85	0.99	1.8	0.55	0.7	8	0.45
	3.2	0.98	1	2.0	0.61	0.81	9	0.7
	3.6	1.10	0.97	2.2	0.67	0.9	10	0.75
	4.0	1.22	0.91	2.4	0.73	0.96	11	0.62
	4.2	1.28	0.86	2.6	0.79	0.99	12	0.75
	4.4	1.34	0.8	2.8	0.85	1	13	0.78
	4.6	1.40	0.71	5	1.52	1	14	0.75
	4.8	1.46	0.58	12	3.66	1	15	0.78
	4.9	1.49	0.47	13	3.96	0.11	16	0.85
	5.0	1.51	0.36	14	4.27	0.09	17	0.7
	5.0	1.52	0.16	15	4.57	0.07	18	0
	5.0	1.52	0	17	5.18	0.05	--	--
	--	--	--	19	5.79	0.03	--	--
	--	--	--	24	7.32	0.01	--	--
	--	--	--	28	8.53	0	--	--

Table 4. Target Species Habitat and Suitability Criteria source and Code Table

Species	Lifestage/ Category	Representative	Source Study	HSC Code
Walleye	Fry	--	Sutton Hydroelectric Project, Elk River, WV	WLEF
	Juvenile	--	Sutton Hydroelectric Project, Elk River, WV	WLEJ
	Adult	--	Sutton Hydroelectric Project, Elk River, WV	WLEA
	Spawning	--	Sutton Hydroelectric Project, Elk River, WV	WLES
Shallow-Slow Guild	Fine substrate, no cover	Redbreast Sunfish spawning	Smith Mountain Hydroelectric Project, Roanoke River, VA	RBSFS
	All substrate with aquatic vegetation	Silver Redhorse young-of-year	Sutton Hydroelectric Project, Elk River, WV	SRHAV
	Coarse substrate	Generic Shallow-Slow Guild	Sutton Hydroelectric Project, Elk River, WV	SHSLO
Shallow-Fast Guild	Moderate velocity with coarse substrate	Generic Shallow-Fast Guild	Claytor Hydroelectric Project New River, VA	SHFST
Deep-Slow Guild	Cover	Redbreast Sunfish adult	Smith Mountain Hydroelectric Project, Roanoke River, VA	RBSFA
	No cover	Generic Deep-Slow Guild	Sutton Hydroelectric Project, Elk River, WV	DSLON
Deep-Fast Guild	Slightly weighted for fine substrate, cover	Silver Redhorse adult	Smith Mountain Hydroelectric Project, Roanoke River, VA	SRHAD
	Coarse-mixed substrate	Shorthead Redhorse adult	Smith Mountain Hydroelectric Project, Roanoke River, VA	SHRHA

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Attachment 3

Attachment 3 – Combined Habitat Suitability Maps

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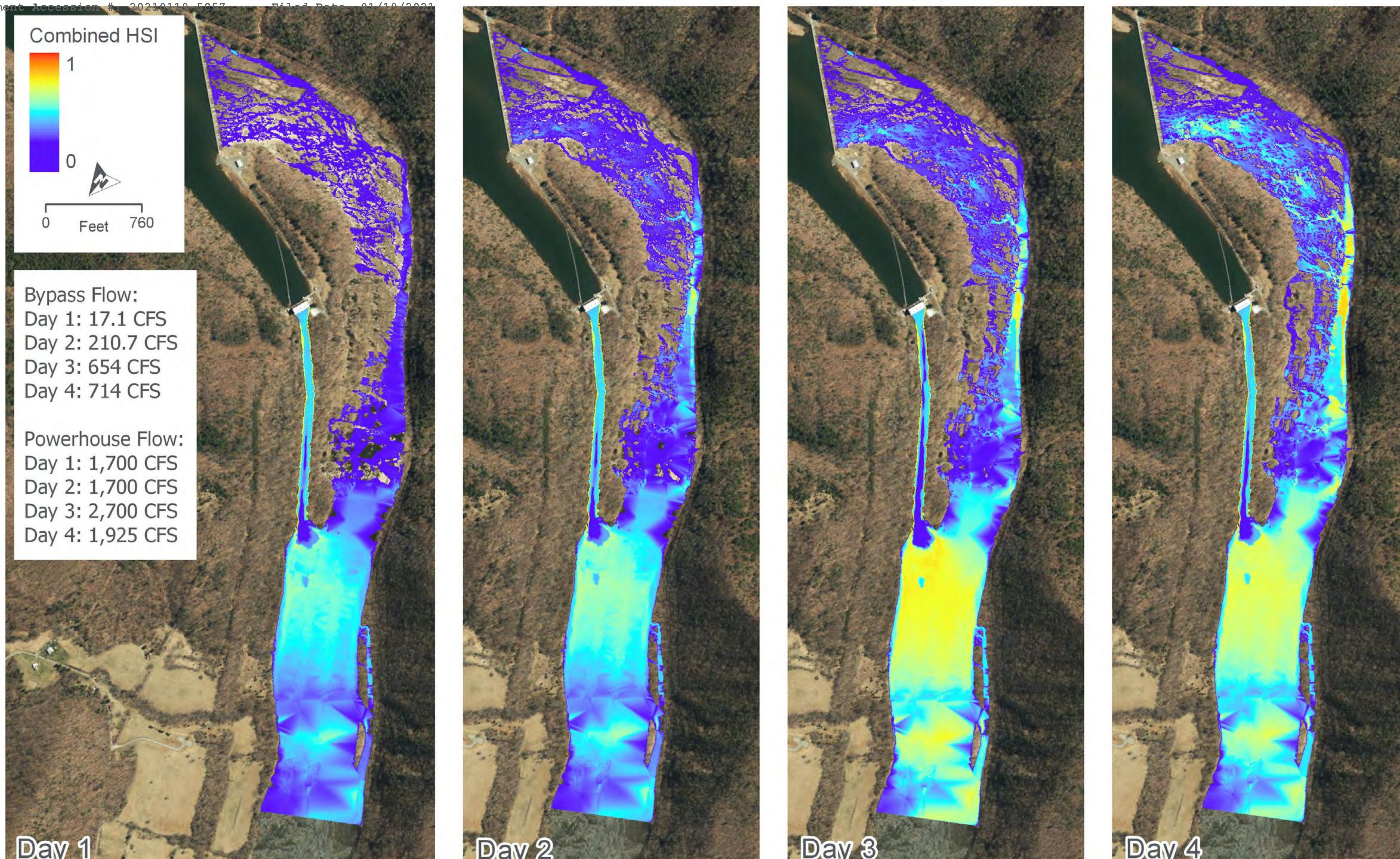
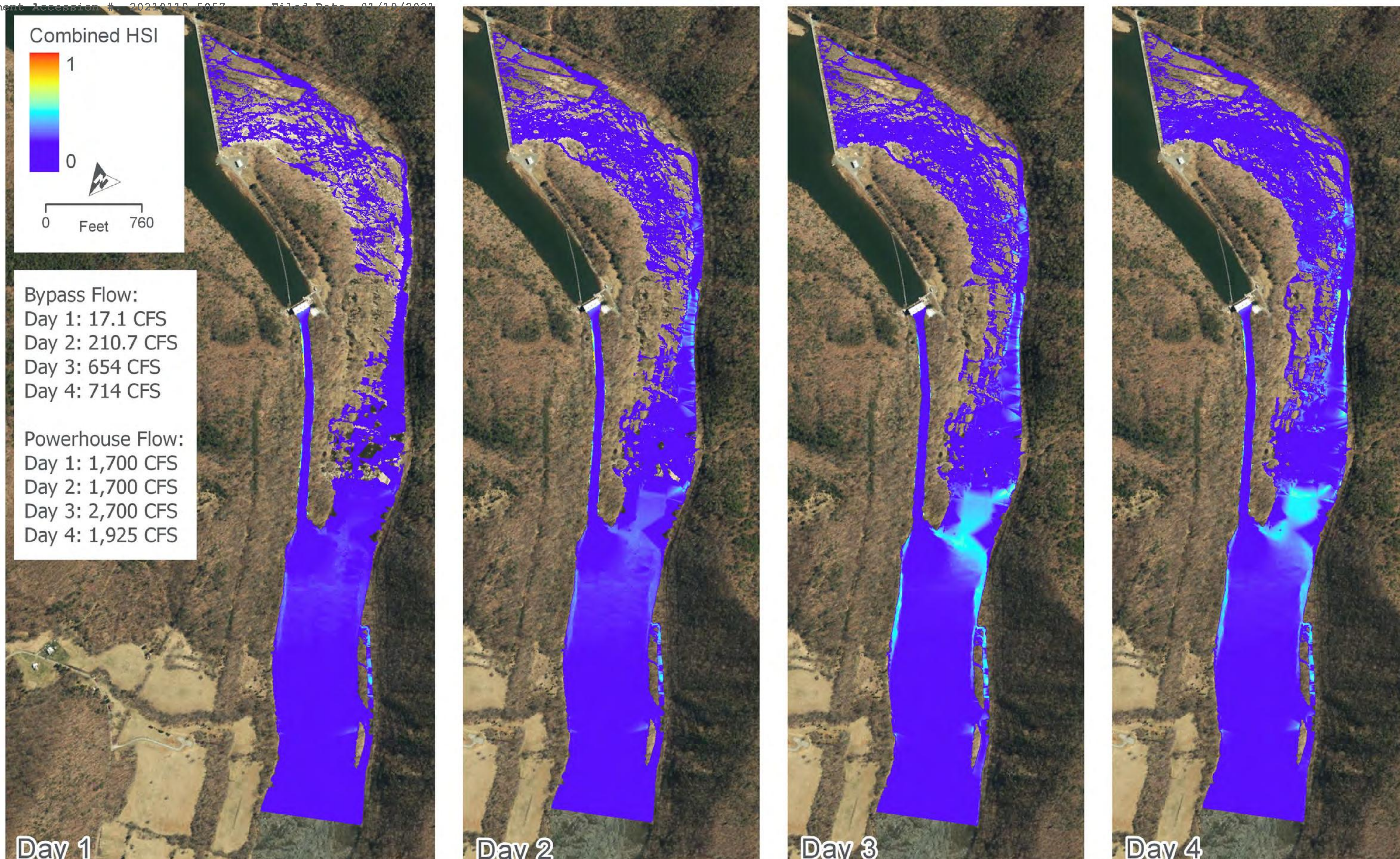


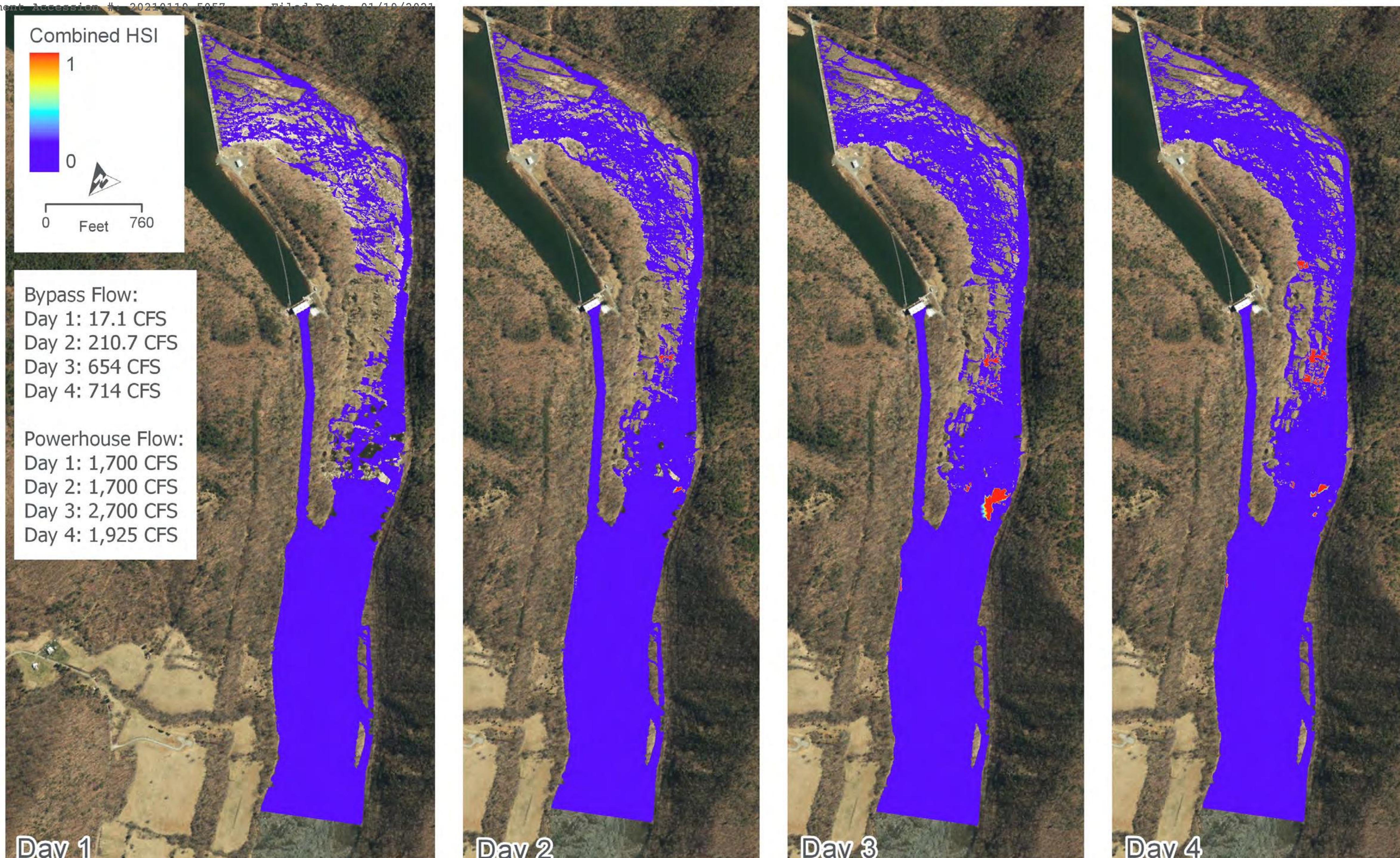
DEEP-FAST GUILD HABITAT SUITABILITY MAP

CATEGORY: COARSE-MIXED SUBSTRATE



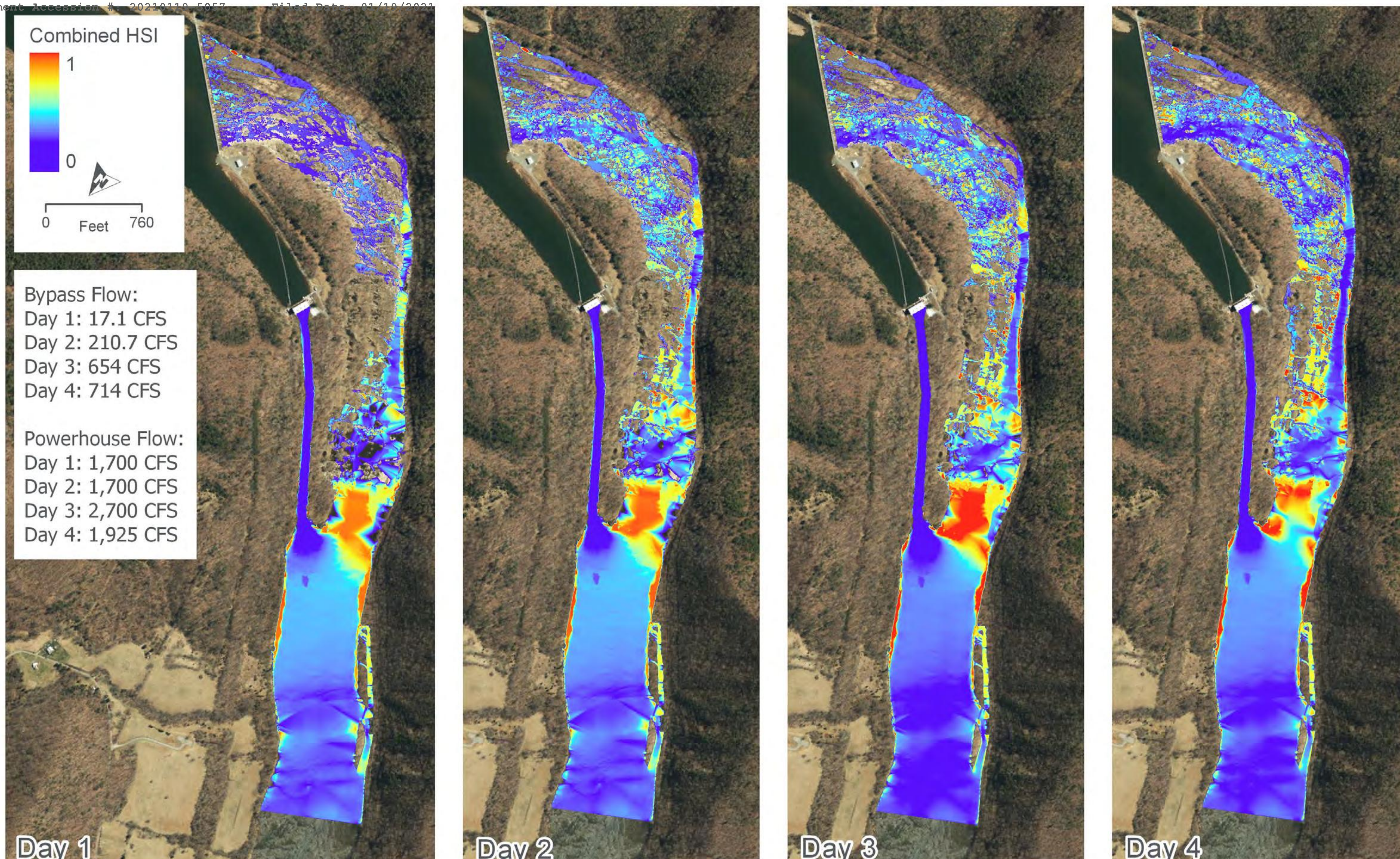
DEEP-FAST GUILD HABITAT SUITABILITY MAP

CATEGORY: SLIGHTLY WEIGHTED FOR FINE SUBSTRATE, NO COVER



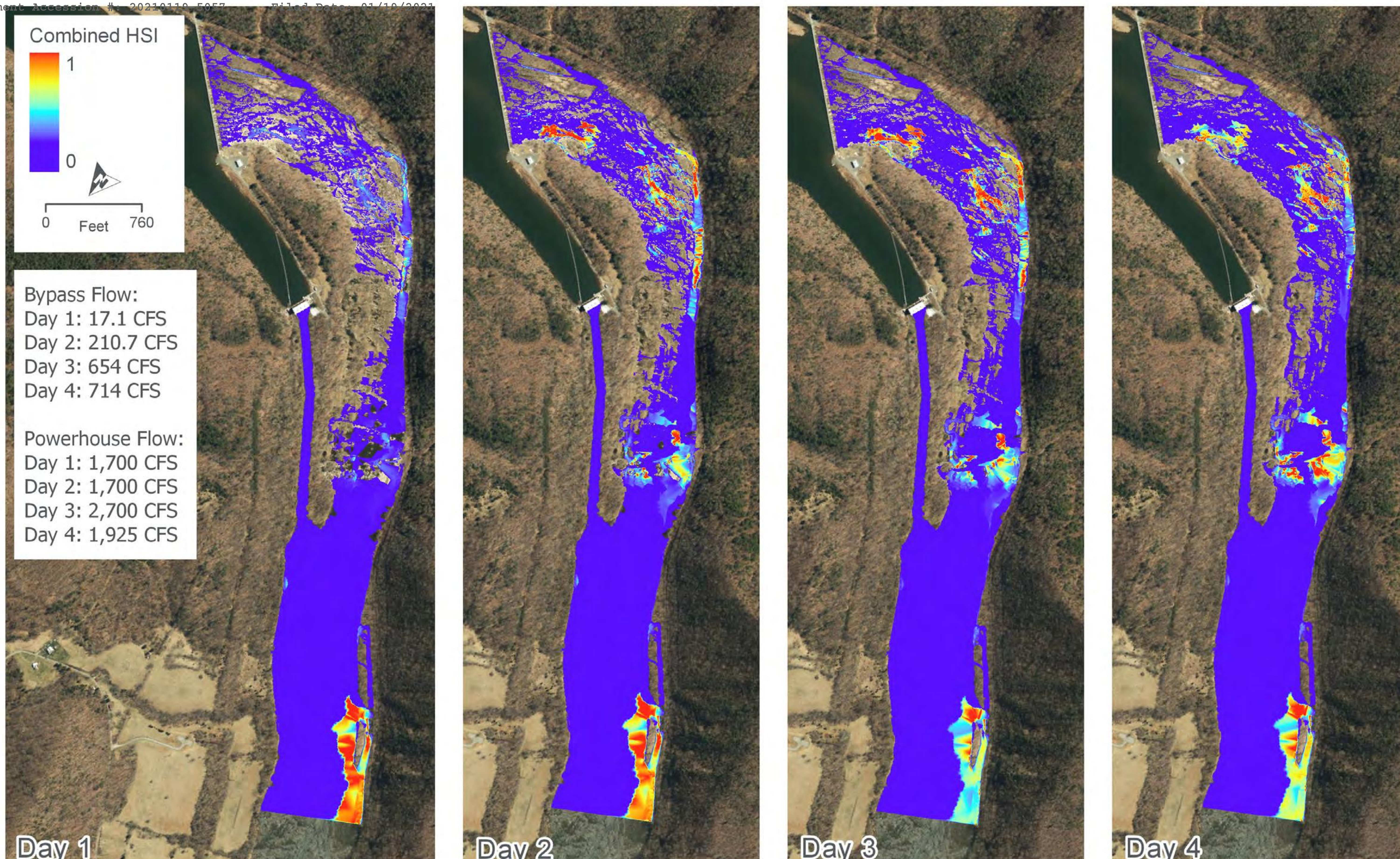
DEEP-SLOW GUILD HABITAT SUITABILITY MAP

CATEGORY: NO COVER



DEEP-SLOW GUILD HABITAT SUITABILITY MAP

CATEGORY: COVER

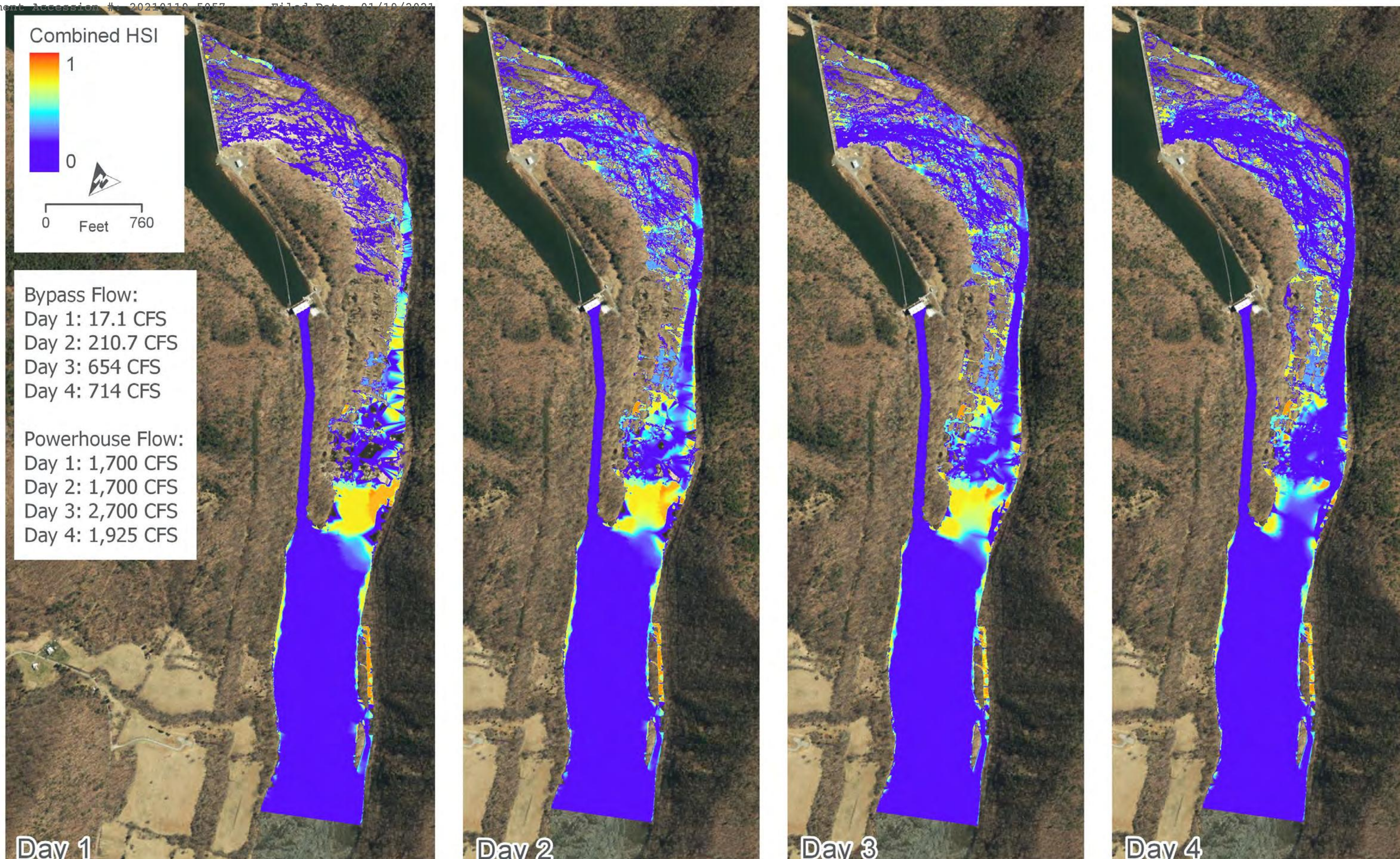


HDR AMERICAN ELECTRIC POWER

SHALLOW-FAST GUILD HABITAT SUITABILITY MAP

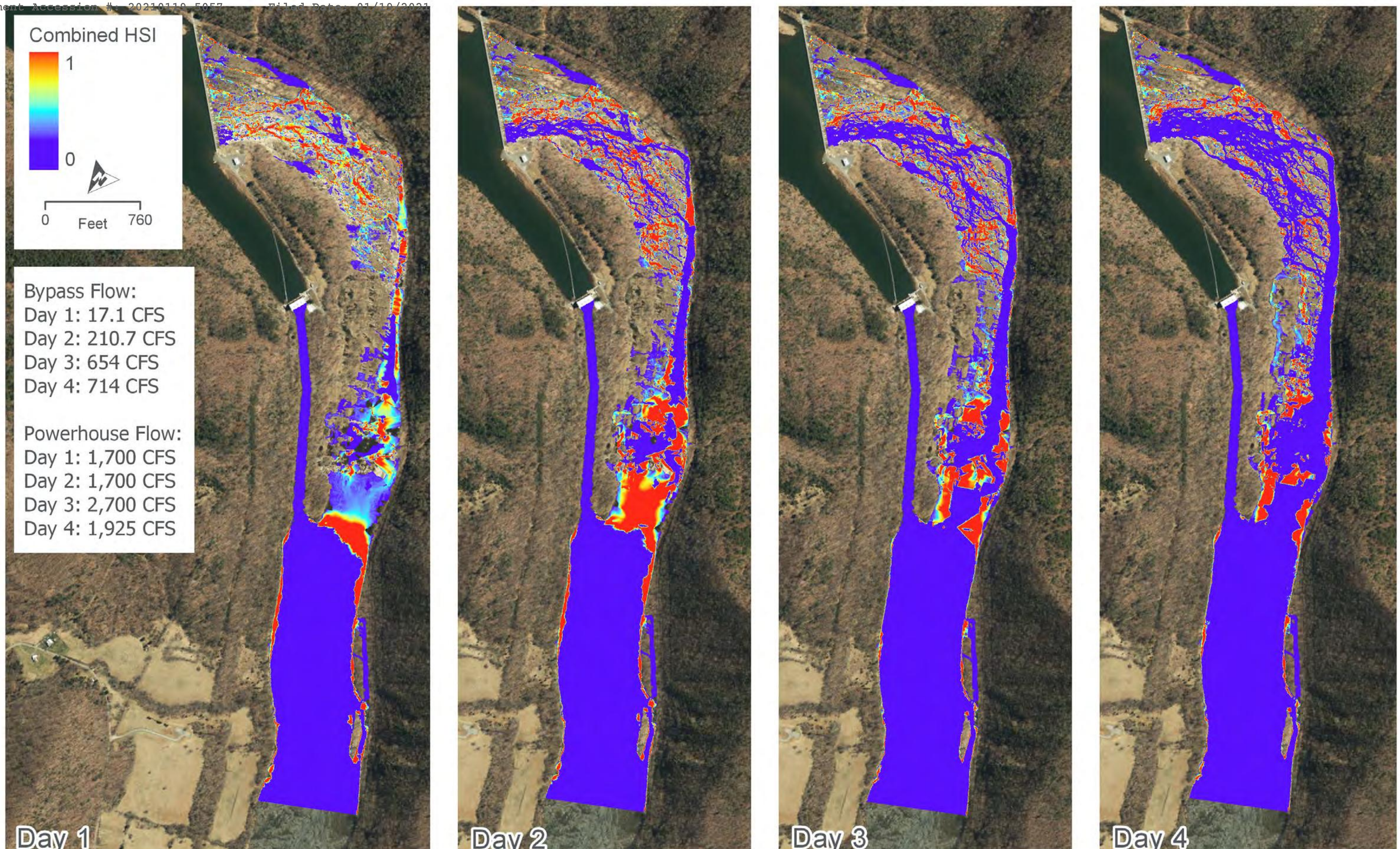
CATEGORY: MODERATE VELOCITY WITH COARSE SUBSTRATE

PATH: E:\AEP\RELICENSING_2DMODELS\BUCK\HABITAT\BUCK_HABITAT\BUCK_HABITAT.APRX - USER: JDVORAK - DATE: 1/14/2021



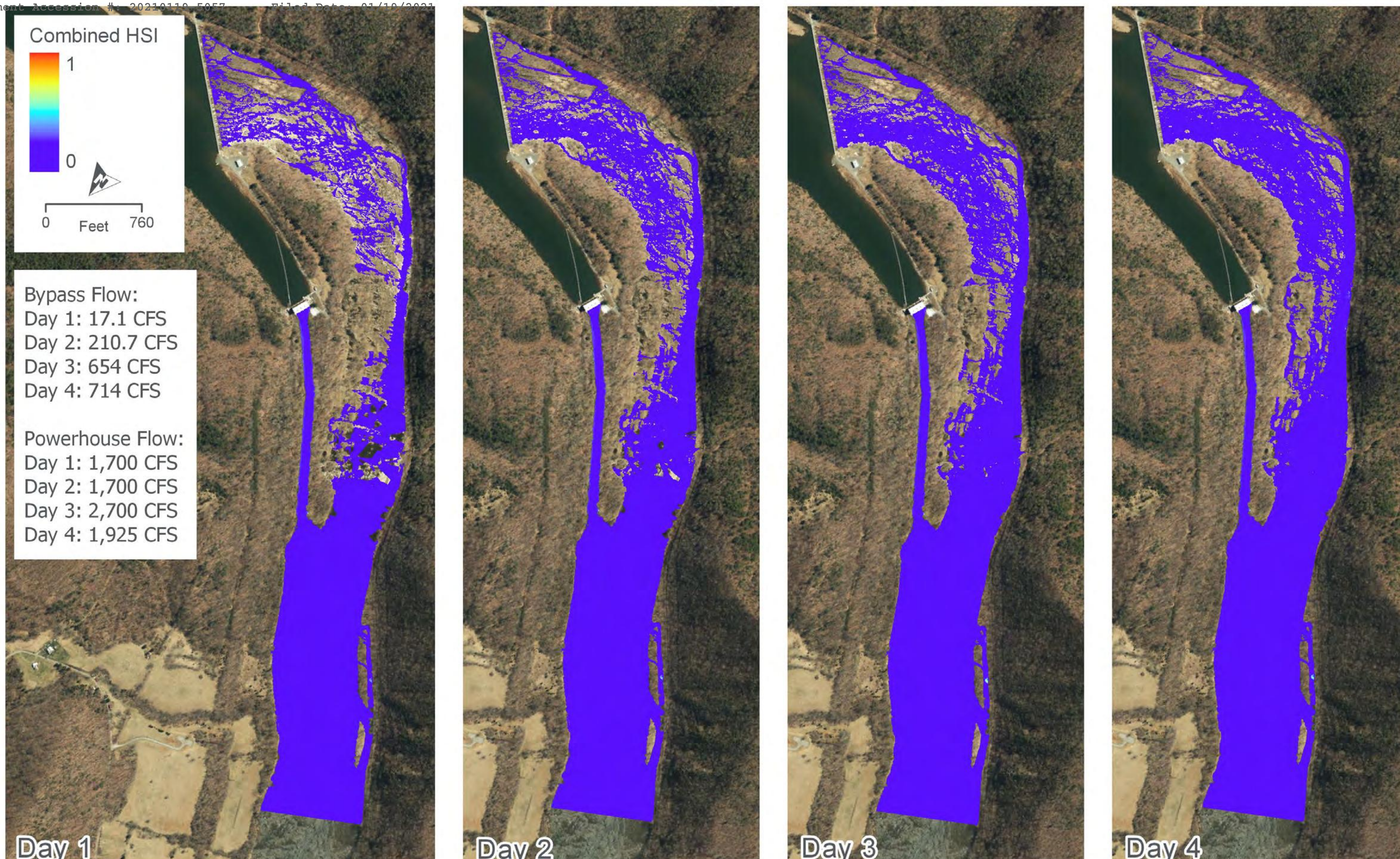
SHALLOW-SLOW GUILD HABITAT SUITABILITY MAP

CATEGORY: FINE SUBSTRATE, NO COVER



SHALLOW-SLOW GUILD HABITAT SUITABILITY MAP

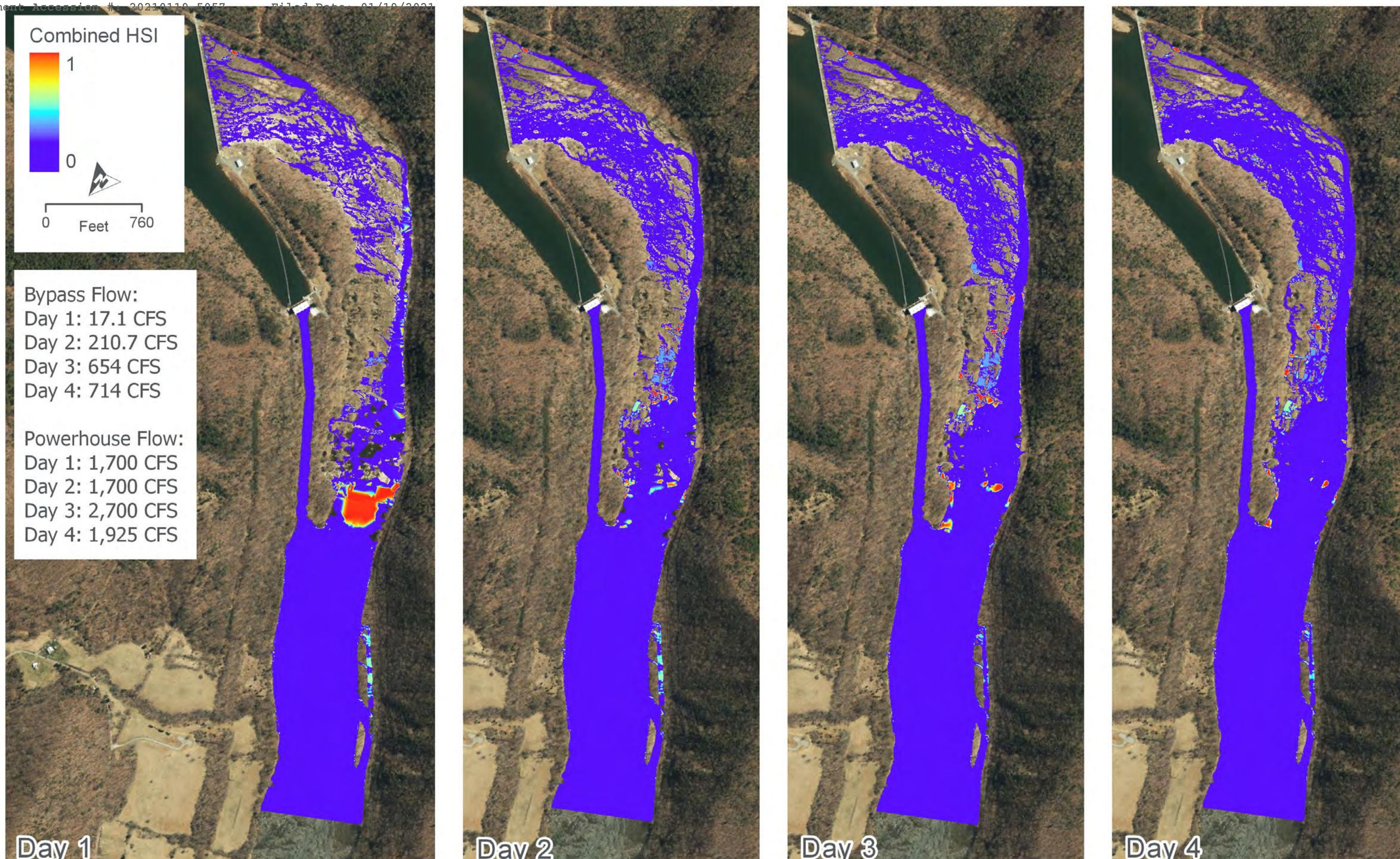
CATEGORY: COARSE SUBSTRATE



HDR AMERICAN ELECTRIC POWER

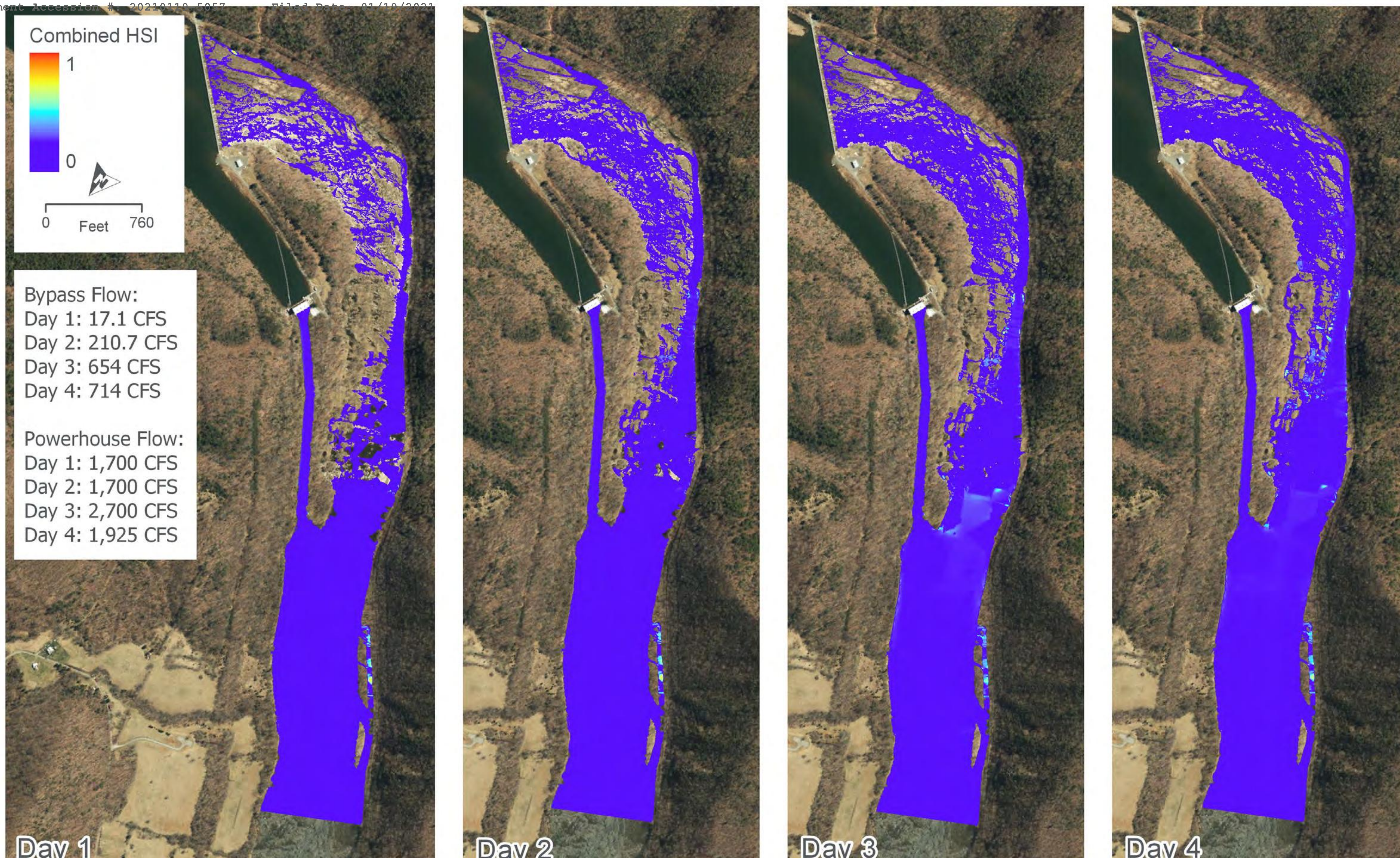
WALLEYE HABITAT SUITABILITY MAP

LIFESTAGE: ADULT



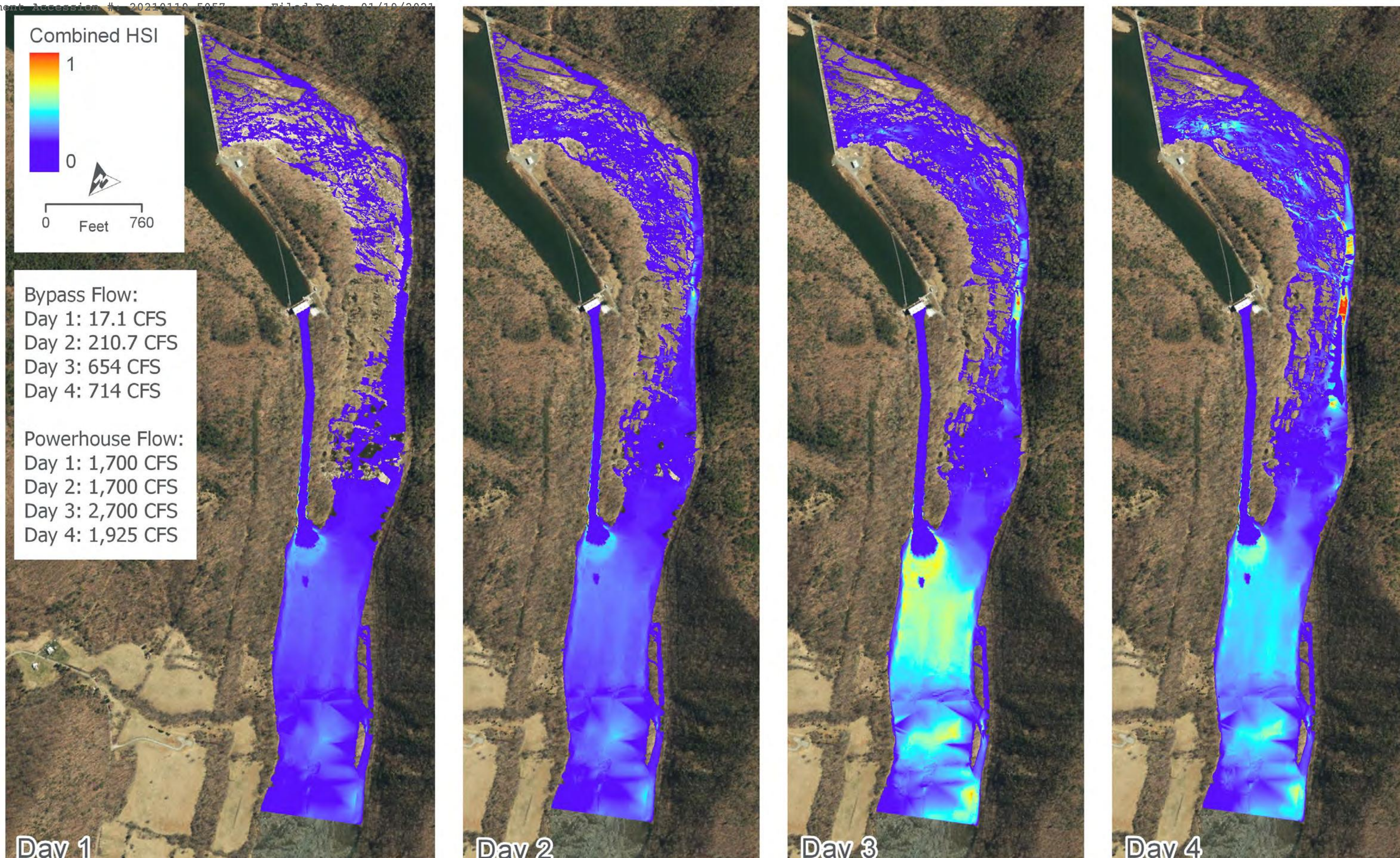
WALLEYE HABITAT SUITABILITY MAP

LIFESTAGE: FRY



WALLEYE HABITAT SUITABILITY MAP

LIFESTAGE: JUVENILE



WALLEYE HABITAT SUITABILITY MAP

LIFESTAGE: SPAWNING

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Attachment 4

Attachment 4 – Germane Correspondence

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Yayac, Maggie

Subject: FW: [EXTERNAL] Re: Byllesby-Buck Project: Flow and Bypass Reach Aquatic Habitat Study MEETING NOTES

From: Pica, Jessica E <jessica_pica@fws.gov>
Sent: Friday, September 18, 2020 4:17 PM
To: Norman, Janet <janet_norman@fws.gov>
Cc: Elizabeth B Parcell <ebparcell@aep.com>
Subject: Re: [EXTERNAL] Re: Byllesby-Buck Project: Flow and Bypass Reach Aquatic Habitat Study MEETING NOTES

Overall the notes look good. My main question was how confident are folks that calibrating the hydraulic model at lower flows could be extrapolated to higher flows. I think that's captured. I would change the word "why" to "where" in the sentence "Jessica also wanted to understand **where** additional bathymetry data were being collected."

Thanks and have a great weekend!
Jessica

From: Norman, Janet <janet_norman@fws.gov>
Sent: Friday, September 18, 2020 3:13 PM
To: Pica, Jessica E <jessica_pica@fws.gov>
Cc: Elizabeth B Parcell <ebparcell@aep.com>
Subject: Re: [EXTERNAL] Re: Byllesby-Buck Project: Flow and Bypass Reach Aquatic Habitat Study MEETING NOTES

Great, thanks! Sorry I didn't notice until now. Are you good with the depiction of our conference call in the notes?
Janet

Janet Norman
Fish and Wildlife Biologist
USFWS Chesapeake Bay Field Office
177 Admiral Cochrane Dr.
Annapolis, MD 21401
(O) 410-573-4533
(Fax) 410-269-0832
(cell) 410-320-5519

From: Pica, Jessica E <jessica_pica@fws.gov>
Sent: Friday, September 18, 2020 3:12 PM
To: Norman, Janet <janet_norman@fws.gov>
Cc: Elizabeth B Parcell <ebparcell@aep.com>
Subject: Re: [EXTERNAL] Re: Byllesby-Buck Project: Flow and Bypass Reach Aquatic Habitat Study MEETING NOTES

Hi Janet. Liz noticed that my email was wrong and forwarded me the information separately. Thanks for keeping me in the loop!

Yayac, Maggie

Subject: FW: [EXTERNAL] Re: Byllesby-Buck Project: Flow and Bypass Reach Aquatic Habitat Study MEETING NOTES

From: Norman, Janet <janet_norman@fws.gov>
Sent: Friday, September 18, 2020 2:49 PM
To: Kittrell, William <bill.kittrell@dwr.virginia.gov>; Elizabeth B Parcell <ebparcell@aep.com>; Pica, Jessica E <jessica_pica@fws.gov>
Cc: Copeland, John <john.copeland@dwr.virginia.gov>; Grist, Joseph <joseph.grist@deq.virginia.gov>; Brian Mcgurk <brian.mcgurk@deq.virginia.gov>; Smith, Scott (DGIF) <scott.smith@dwr.virginia.gov>; Kulpa, Sarah <Sarah.Kulpa@hdrinc.com>; Ziegler, Ty <Ty.Ziegler@hdrinc.com>; Jonathan M Magalski <jmmagalski@aep.com>; Yayac, Maggie <Maggie.Yayac@hdrinc.com>; Frederick A Colburn <facolburn@aep.com>; Dvorak, Joseph <Joseph.Dvorak@hdrinc.com>; Huddleston, Misty <Misty.Huddleston@hdrinc.com>
Subject: Re: [EXTERNAL] Re: Byllesby-Buck Project: Flow and Bypass Reach Aquatic Habitat Study MEETING NOTES

Hi Liz and team,
From my perspective, I think our discussion and questions on the Byllesby-Buck Project: Flow and Bypass Reach Aquatic Habitat Study conference call were well captured in your summary notes.
I am just noticing that there was unfortunately a typo in including our USFWS Fishway Engineer Jessica Pica on this email review routing, so I am including her in my response her.e I can't speak for her as to whether the notes captured her thoughts.

Thanks much for these efforts and the study plan ahead of us.
Janet

Janet Norman
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USFWS Chesapeake Bay Field Office
177 Admiral Cochrane Dr.
Annapolis, MD 21401
(O) 410-573-4533
(Fax) 410-269-0832
(cell) 410-320-5519

From: Smith, Scott <scott.smith@dwr.virginia.gov>
Sent: Friday, September 18, 2020 11:09 AM
To: Kittrell, William <bill.kittrell@dwr.virginia.gov>; Elizabeth B Parcell <ebparcell@aep.com>
Subject: Re: [EXTERNAL] Re: Byllesby-Buck Project: Flow and Bypass Reach Aquatic Habitat Study MEETING NOTES

None from me, either.

From: Kittrell, William <bill.kittrell@dwr.virginia.gov>
Sent: Friday, September 18, 2020 10:09 AM
To: Elizabeth B Parcell <ebparcell@aep.com>
Cc: Copeland, John <john.copeland@dwr.virginia.gov>; Grist, Joseph <joseph.grist@deq.virginia.gov>; Norman, Janet <janet_norman@fws.gov>; Brian Mcgurk <brian.mcgurk@deq.virginia.gov>; Smith, Scott (DGIF) <scott.smith@dwr.virginia.gov>; jennifer_pica@fws.gov <jennifer_pica@fws.gov>; Kulpa, Sarah <Sarah.Kulpa@hdrinc.com>; Ziegler, Ty <Ty.Ziegler@hdrinc.com>; Jonathan M Magalski <jmmagalski@aep.com>; Yayac, Maggie <Maggie.Yayac@hdrinc.com>; Frederick A Colburn <facolburn@aep.com>; Dvorak, Joseph (Joseph.Dvorak@hdrinc.com) <Joseph.Dvorak@hdrinc.com>; Huddleston, Misty <Misty.Huddleston@hdrinc.com>
Subject: Re: [EXTERNAL] Re: Byllesby-Buck Project: Flow and Bypass Reach Aquatic Habitat Study MEETING NOTES

Liz, Thanks for providing the summary of the August 28, 2020 conference call on the Byllesby-Buck Bypass Flow and Aquatic Habitat Study. I have no additional comments/concerns at this time. Thanks. Bill.

William B. Kittrell, Jr.
Regional Fisheries Manager
P 276.783.4860 / M 276.780.0458
Virginia Department of Wildlife Resources
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A 1796 Highway Sixteen, Marion, VA 24354
www.dwr.virginia.gov

On Thu, Sep 10, 2020 at 4:41 PM Elizabeth B Parcell <ebparcell@aep.com> wrote:

All,

Attached please find a meeting summary on the Byllesby-Buck Flow Study scenarios discussion held via conference call on August 28, 2020. Please let us know by the end of next week (9/18) if there are any comments.

Many thanks.

Liz

ELIZABETH B PARCELL | PROCESS SUPV
EBPARCELL@AEP.COM | D:540.985.2441 | C:540.529.4191
40 FRANKLIN ROAD SW, ROANOKE, VA 24011

Meeting Summary

Project:	Byllesby-Buck Hydroelectric Project (FERC No. 2514)
Subject:	Bypass Study Flow Test Scenarios Discussion with Stakeholders
Date:	Friday, August 28, 2020
Location:	WebEx (2:00pm-3:30pm)
Attendees:	Bill Kittrell (VDGIF) John Copeland (VDGIF) Janet Norman (USFWS) Jessica Pika (USFWS) Brian McGurk for Joe Grist (VDEQ) Scott Smith (VDWR) Jon Magalski (AEP) Liz Parcell (AEP) Fred Colburn (AEP) Sarah Kulpa (HDR) Misty Huddleston (HDR) Ty Ziegler (HDR) Joe Dvorak (HDR)

Introduction

On August 18, 2020, AEP submitted a proposed flow test scenario plan for Byllesby-Buck for stakeholder review based on mutually agreed timeline discussed on a June 30th call. The purpose of the call was to work through agency questions with AEP and HDR regarding the proposed flow test scenarios and how the bypass study model will be used to assess and inform downstream flow needs for providing fish habitat and maintaining connectivity in the bypass channels.

Flow and Bypass Study Flow Study Status Update

- Ty Ziegler (HDR) kicked off the call by providing a summary of the proposed test flow scenarios presented in the memo submitted on August 18th.
    - Model inputs consist of depth, flow, substrate, and topography.
    - Ty stated that the LiDAR data and orthoimagery have been captured at the Byllesby-Buck Project and were used to build a preliminary hydraulic model to support the Flow and Bypass Reach Aquatic Habitat Study and to perform a desktop GIS-based characterization of substrates in the bypass channel.
    - Preliminary substrate characterization was field confirmed on August 17 and 18.
    - Ty discussed the flow test scenarios and clarified that tests are scheduled to take place at Byllesby and Buck in mid to late September, but is dependent on instream flow conditions and station operations. Sarah Kulpa (HDR) noted the test timing is dependent on having no-spill conditions and no precipitation events at the developments in the days prior to the tests.
    - The next step is to collect additional bathymetry data in areas that were inundated during LIDAR data collection and collect water depths, and velocities at each of the test flows to support model validation.

- Ty clarified that proposed test flows were selected to capture the current operational scenarios and a range of flows based on what the projects are capable of passing, in addition to capturing the existing license requirements.
  - Byllesby 350 cfs minimum downstream flow requirement
  - Buck ramping rate when gates have been opened greater than 2-ft
  - [*AEP Clarification – information not provided during discussion: The 350 cfs minimum downstream flow requirement of License Article 403 pertains to both developments*].

Agency Questions/Responses

<u>Model Scenarios</u>

- Janet Norman (USFWS) expressed concern that the proposed scenarios did not propose a sufficiently wide range of scenarios to inform an adequate evaluation of the need for increased minimum flow requirements. Scott Smith (VDWR) agreed that a test scenario at higher flows may be ideal to help evaluate specific areas for potential to serve as Walleye spawning habitat during spring months in addition to evaluating connectivity.
- Jessica Pika (USFWS's fishway engineer) was interested in understanding which model type was being used, how it worked, and if we know or will be able to identify the flow level where connectivity starts/stops downstream of Buck. Jessica also wanted to understand why additional bathymetry data were being collected.
  - Ty stated that the model will be able to answer that question.
  - Ty also provided additional data, based on field observations, about how the channel topography appears to influence connectivity when the channel is watering up or drawing down. Group discussed how the natural topography and geology of the channel directs flows to the trail side of the river and how that likely contribute to the anecdotal observations of fish getting trapped in the disconnected pool just below the dam on the left side of the river (facing downstream).
  - Ty mentioned that there may be dam operation scenarios that would be capable of releasing sufficient flow in that portion of the channel to maintain connectivity, although they may require installation of new equipment/technology.
  - Bill Kittrell (VDGIF) stated that there may be potential for permitting some form of physical channel alteration that would help maintain channel connectivity to that left-side pool (trail side of river/downstream facing).
  - Ty suggested that an evaluation could be done of the impact on connectivity of altering flows at gates where flashboards are currently experiencing leakage. Bill emphasized that flashboards have historically been part of the problem. Group discussed the challenge that flashboards present to operations and modeling of scenarios due to impacts of flashboard operation and passage of larger flows downstream, or when they are newly installed may allow more leakage flows.

    - Ty explained that additional bathymetry data are needed for areas that were inundated during LIDAR collection to improve model accuracy.
    - Joe Dvorak (HDR) stated that we will be using the Innovyze ICM software to develop a 2-D type model for the flow study. ICM was selected over HEC-RAS because it is better for calculating hydraulics in complex channels, better at capturing the influence of vertical spillways, and better at modeling turbulent flows.
- In response to a question from Scott Smith, Joe Dvorak clarified that the model would allow identification of wetted area, specific flow release values, and velocities and depths in specific areas under specific flow scenarios. Janet, Jessica, and Scott each indicated that they were satisfied with the explanations and stated that they anticipate and hope the model will work well and help provide answers to their questions.
- The group discussed methods and challenges for addressing leakage flows in the models. Ty stated that we intend to try and measure those flows if possible, otherwise, an effort will be made to estimate those flows for inclusion in the model.
- Janet wanted to understand how leakage flows may change over time, is there seasonality to the leakage flows, how frequently do they need replaced, etc.
    - Ty indicated that leakage flows are impacted by flashboard condition (i.e., new versus old) and if they have had time to be silted in.

Model Outputs and HSI Curves

- John Copeland (VDGIF) noted that he would like to see how Walleye use the Buck reach under different flow scenarios, preferably via field observation.
    - Janet stated that evaluation should include a seasonality component to demonstrate availability of suitable conditions throughout the year.
    - Ty clarified that this is part of the evaluation.
        - [HDR *Clarification – while not specifically discussed during the call, as part of the study plan, Walleye habitat suitability curves will be used in conjunction with the hydraulic model results to evaluate potential suitable habitat under various model flow simulations*].

- In the study report, Janet requested additional information be provided to provide characterization of normal hydrological conditions and spilling operations at the developments. The group referred to Table 4-1 in the RSP during discussion. Janet specifically requested the 25th and 75th percentiles be added to the table and better labeling.
    - Sarah suggested that a line graph may be more appropriate for the information being presented.
    - All on call agreed that more information for Table 4-1 is needed **(Action Item)** in the future study report.

- Brian McGurk (VDEQ) asked if the existing license requires monitoring of flows and gate operations. Sarah clarified that this information is monitored and available and was used to create an operations model for the developments.

Based on this discussion, AEP and HDR are proceeding with the flow demonstration study as proposed in the memo, as soon as field conditions allow. The call wrapped up with all indicating they were satisfied with the information presented and AEP's and HDR's responses to questions. Call participants expressed their appreciation of the effort made to share information and improve understand regarding the study.

Yayac, Maggie

Subject: FW: Byllesby-Buck Project: Flow and Bypass Reach Aquatic Habitat Study

From: Copeland, John <john.copeland@dwr.virginia.gov>
Sent: Tuesday, August 25, 2020 1:11 PM
To: Elizabeth B Parcell <ebparcell@aep.com>
Cc: Grist, Joseph <joseph.grist@deq.virginia.gov>; Norman, Janet <janet_norman@fws.gov>; Kulpa, Sarah <Sarah.Kulpa@hdrinc.com>; Yayac, Maggie <Maggie.Yayac@hdrinc.com>; Jonathan M Magalski <jmmagalski@aep.com>; Ziegler, Ty <Ty.Ziegler@hdrinc.com>; Brian Mcgurk <brian.mcgurk@deq.virginia.gov>; Kittrell, Bill (DGIF) <bill.kittrell@dwr.virginia.gov>; John Copeland <john.copeland@dwr.virginia.gov>; Smith, Scott (DGIF) <scott.smith@dwr.virginia.gov>
Subject: Re: Byllesby-Buck Project: Flow and Bypass Reach Aquatic Habitat Study

Thank you for your email communication with this group about your plans to initiate flow release scenario tests for the Byllesby Buck Project starting Monday, August 31. Most of the agency people copied on your email had a conference call regarding this proposal yesterday. I had a brief discussion and email exchange with Joe Grist (Department of Environmental Quality) yesterday and today.

During our conversation yesterday, we concluded that our questions are numerous enough that we simply could work things out much better in a conference call. I have conferred with all the agency parties: Janet Norman (USFWS), Bill Kittrell (DWR), Scott Smith (DWR instream flow expert), as well as Joe Grist (DEQ - who has appointed Brian McGurk to participate) regarding a conference call this Friday afternoon (August 28). All parties are available.

We hereby request a conference call at your convenience on Friday afternoon, August 28.

FYI - Please note that our agency email extension has changed from DGIF to DWR, effective July 1, 2020. DGIF still works, but we are requesting use of the DWR extension. This email has the corrected email addresses.

Respectfully submitted,

John R. Copeland
Fisheries Biologist III

P 540.961.8397 / M 540.871.6064

Virginia Department of Wildlife Resources

CONSERVE. CONNECT. PROTECT.

A 2206 South Main Street, Suite C, Blacksburg, VA 24060

www.dwr.virginia.gov

On Tue, Aug 18, 2020 at 3:09 PM Elizabeth B Parcell <ebparcell@aep.com> wrote:

Good afternoon,

As we discussed in our June 30th ILP study update call for Appalachian's Byllesby-Buck Project, HDR has prepared a brief memo describing the flow release range and locations for the upcoming flow tests to be conducted as part of the Flow and Bypass Reach Aquatic Habitat Study. As this fieldwork is presently scheduled to begin as early as August 31, we would greatly appreciate receipt of any questions or comments on the attached by close of business Tuesday, August 25th. That will leave us time to schedule a conference call for later next week, if needed to further discuss.

Thank you for your support of this process.

Sincerely,

Liz

AMERICAN ELECTRIC POWER
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ELIZABETH B PARCELL | PROCESS SUPV
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40 FRANKLIN ROAD SW, ROANOKE, VA 24011

Memo

Date:	August 17, 2020
Project:	Byllesby-Buck Hydroelectric Project (FERC No. 2514)
To:	Bill Kittrell (VDWR) John Copeland (VDWR) Joseph Grist (VDEQ) Janet Norman (USFWS)
From:	Sarah Kulpa (HDR)
CC:	Liz Parcell (AEP) Jon Magalski (AEP) Ty Ziegler (HDR)
Subject:	**Flow and Bypass Reach Aquatic Habitat Study – Proposed Flow Test Scenarios**

Appalachian Power Company's (Appalachian's) Revised Study Plan (RSP), as approved and modified by the Federal Energy Regulatory Commission (FERC), for the Byllesby-Buck Hydroelectric Project (Project) includes a Flow and Bypass Reach Aquatic Habitat Study (Study). The Project includes the Byllesby development and the Buck development, both located on the New River in Carroll County, Virginia. The Buck development is located approximately three river miles downstream of the Byllesby development and 44 miles upstream of Claytor Dam. The objectives of this Study are to conduct a flow and habitat assessment in the tailwater area and bypass reach of both developments (excluding the Byllesby development auxiliary spillway channel) using a combination of desktop, field survey, and hydraulic modeling methodologies to achieve the following goals:

1. Delineate and quantify aquatic habitat and substrate types in the Byllesby and Buck developments' bypass reaches.
2. Identify and characterize locations of habitat management interest within the Byllesby and Buck bypass reaches.
3. Develop an understanding of streamflow travel times and water surface elevation responses under variable base flow and spillway release flow combinations in the tailwater and bypass reach of each development to:
    - Demonstrate the efficacy of ramping rates required by the existing license.
    - Demonstrate the efficacy of the existing powerhouse minimum flow requirement (i.e., 360 cubic feet per second (cfs) minimum flow to maintain aquatic resources, including resident fish species, downstream of each

440 S Church Street, Suite 1000, Charlotte, NC 28202-2075
(704) 338-6700

development consisting of the tailwater areas below each powerhouse and the bypass reaches below the main spillways).

- Evaluate the impacts of providing seasonal minimum flows to the bypass reaches.

Flow and Water Level Assessment - Proposed Flow Test Scenarios

The Flow and Water Level Assessment fieldwork included in Task 3 of the Flow and Bypass Reach Aquatic Habitat Study is presently scheduled to be conducted the weeks of August 31 and September 7, 2020 (suitable inflow and field condition-dependent). The proposed flow release quantities and locations are described below. The proposed flow test scenarios are designed to capture existing (baseline) Project operations and also support the development and calibration of hydraulic models that will allow for visualization and evaluation of flow releases from other gate openings (i.e., demonstration flows at a specific gate location are not required to model flows from that location).

For the Byllesby development, the target flow scenarios (see Table 1) are designed to evaluate the effect of passing the entire minimum downstream flow requirement of 360 cfs through the bypass reach. Tainter Gate #6 is the proposed gate to pass flows as it is near the center of the spillway structure and under existing operating procedures is the first gate operated for releases into the bypass reach (see Figure 1). The three target flows proposed in Table 1 will allow a hydraulic model simulation range from leakage up to approximately 500 cfs.

For the Buck development, the target flow scenarios (see Table 1) are designed to evaluate the effect of the existing ramping rate requirements. Appalachian is required to discharge flows through a 2-foot gate opening for at least three hours following any spills released through a gate opened 2 feet (ft) or more. They are required to reduce the opening to 1 ft for at least an additional three hours, after which time the gate may be completely closed. This gradual reduction of flow allows adequate time for fish that may have traveled upstream into the bypass reach to respond to receding water levels, reducing instances of fish strandings that can potentially occur with sudden flow discontinuation.

Tainter Gate #1 will be utilized at the Buck development to pass the target flows since this reflects current operations (i.e., Tainter Gate #1 is first to open and last to close during high flow events where flows are routed into the bypass reach) (see Figure 2). Gate openings of 2 ft and 1 ft will be evaluated (as per existing ramping rate operating protocols) as well as a gate opening of 0.5 ft to represent flows that would occur between a 1-foot gate opening and leakage conditions. The three target flows proposed in Table 1 will allow a hydraulic model simulation range from leakage up to approximately 2,250 cfs.

Table 1. Byllesby-Buck Bypass Reach Aquatic Habitat Study – Proposed Flow Test Scenarios

Byllesby Bypass Reach				
Pool Range: 2078.2 - 2079.2 NGVD 29; Assume starting Pool Elevation is 2078.7 NGVD 29)				
Powerhouse Discharge Capacity: 5,868 cfs				
Powerhouse Minimum Discharge Capacity: 85 cfs/unit				
Tainter Gate #6				
Opening* (ft)	Proposed Target Flows (cfs)	Flow Test Duration (hours)	Volume (acre-ft)	Model Simulation Range (cfs)
0.0	Leakage	NA	0	Leakage ↓ 500
0.10	40	5	17	
0.25	105	5	43	
0.5	203	5	84	
Buck Bypass Reach				
Pool Range: 2002.4 - 2003.4 NGVD 29; Assume starting Pool Elevation is 2002.9 NGVD 29				
Powerhouse Discharge Capacity: 3,540 cfs				
Powerhouse Minimum Discharge Capacity: 73 cfs/unit				
Tainter Gate #1				
Opening* (ft)	Proposed Target Flows (cfs)	Flow Test Duration (hours)	Volume (acre-ft)	Model Simulation Range (cfs)
0.0	Leakage	NA	0	Leakage ↓ 2,250
0.5	224	8	148	
1.0	448	8	296	
2.0	897	8	593	

Notes: * Assume starting point is midpoint of operating range with adequate inflow to maintain pond levels during flow tests.

Figure 1. Byllesby Dam Spillway Gates

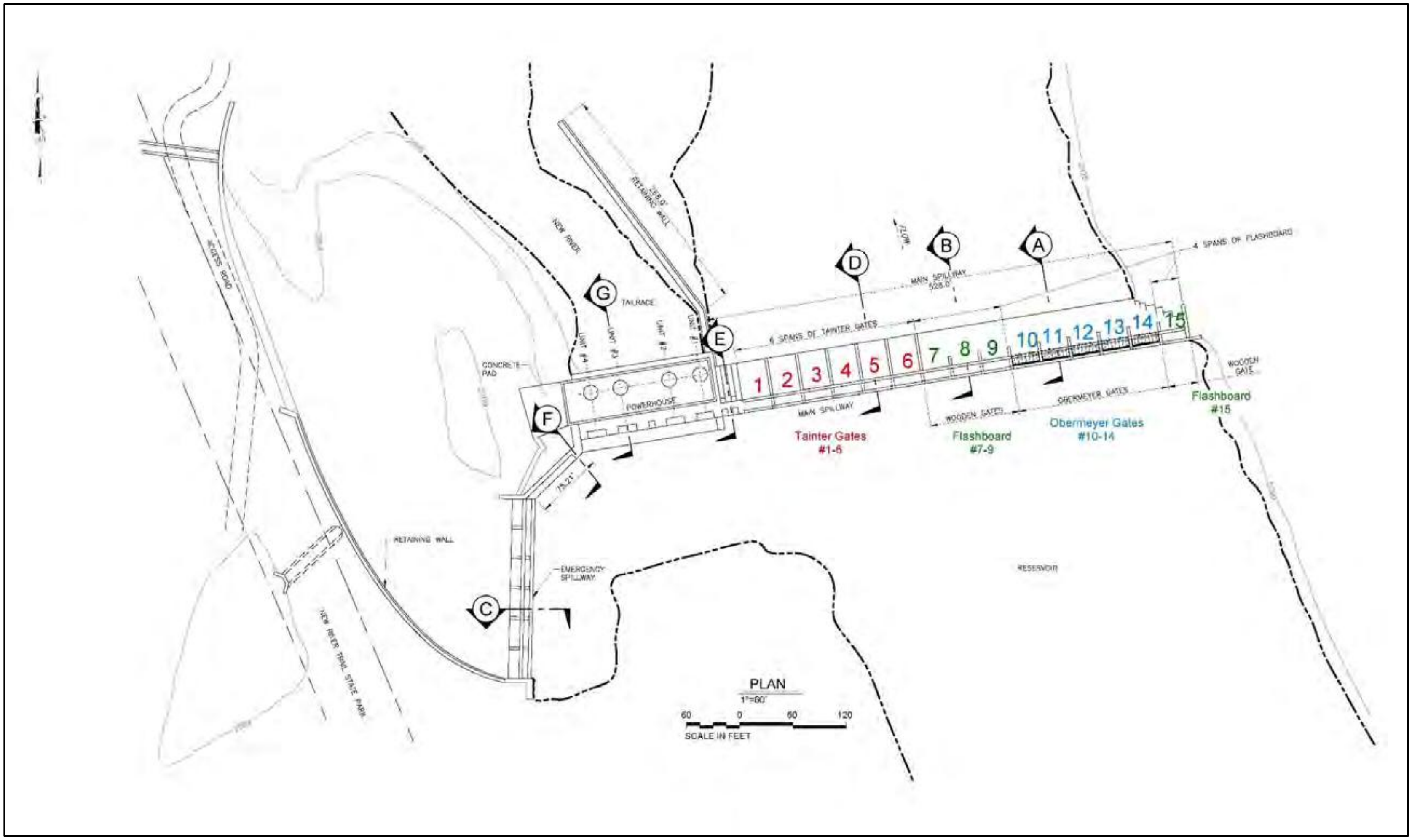
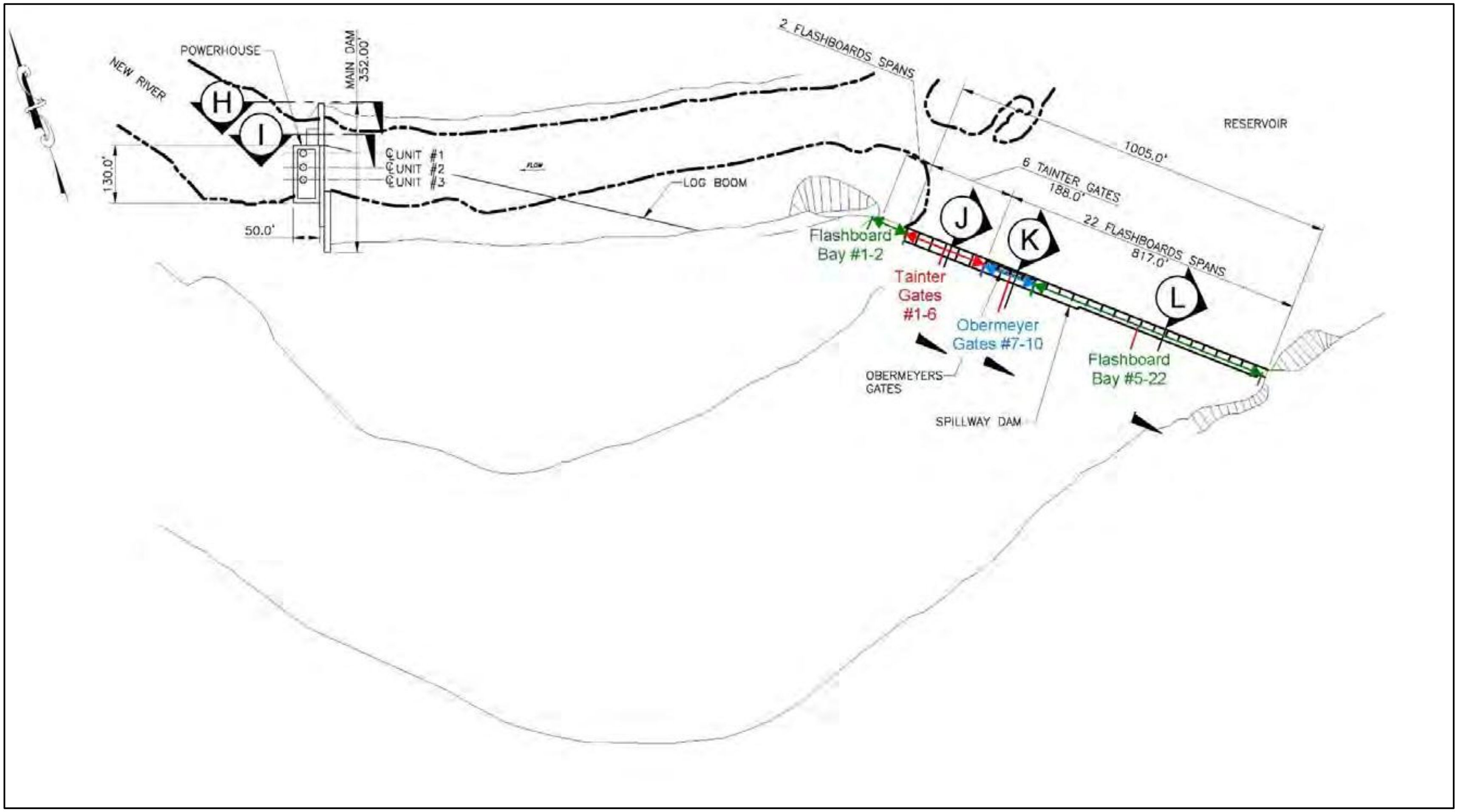


Figure 2. Buck Dam Spillway Gates



Appendix C

Appendix C – Preliminary Aquatic Resources Study Report

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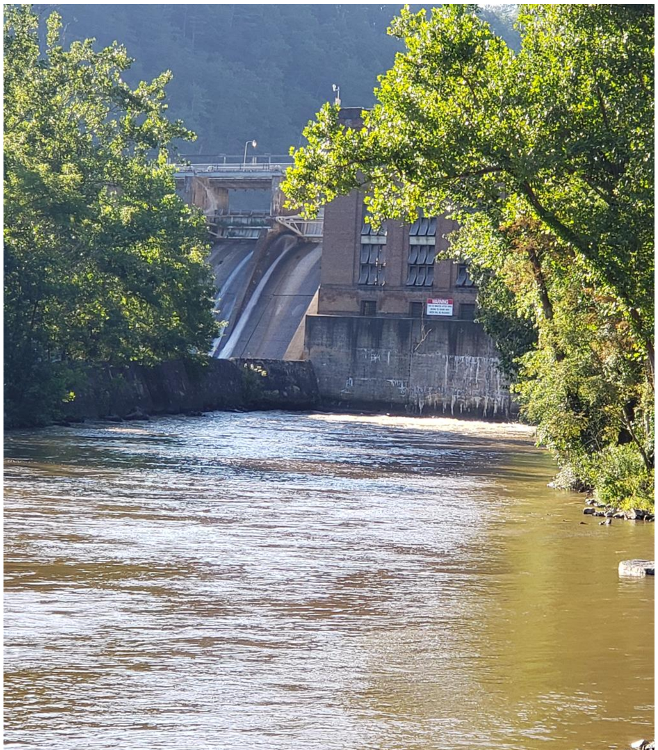

Preliminary Aquatic Resources Study Report

Byllesby-Buck Hydroelectric Project
(FERC No. 2514)

January 18, 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 two-development Byllesby-Buck Hydroelectric Project (Project) (Project No. 2514), located on the upper New River in Carroll County, Virginia. The Project is located approximately 60 miles south-southwest of the city of Roanoke. The Byllesby development is located about 9 miles north of the city of Galax, and the Buck development is located approximately 3 river miles (RM) downstream of Byllesby and 43.5 RM upstream of Claytor Dam.

The Project is currently licensed by the Federal Energy Regulatory Commission (FERC or Commission). The Project underwent relicensing in the early 1990s, including conversion to run-of-river operations and incorporating additional protection, mitigation, and enhancement (PM&E) measures. The current operating license for the Project expires on February 29, 2024. Accordingly, Appalachian is pursuing a subsequent license for the Project pursuant to the Commission's Integrated Licensing Process (ILP), as described at 18 Code of Federal Regulations (CFR) Part 5.

In accordance with 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 October 18, 2019. On November 18, 2019 FERC issued the Study Plan Determination (SPD). On December 18, 2019, Appalachian filed a request for rehearing of the SPD. The SPD was subsequently modified by FERC by an Order on Rehearing dated February 20, 2020.

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 18, 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 Aquatic Resources Study conducted in support of preparing an application for new license for the Project.

2 Study Goals and Objectives

The goals and objectives of the Aquatic Resources Study are to:

- Collect a comprehensive baseline of existing aquatic resources in the vicinity of the Project.
- Compare current aquatic resources data to historical data to determine any significant changes to species composition or abundance.
- Confirm intake velocities for fish entrainment potential.

3 Study Components

The Preliminary Aquatic Resources Study report comprises the following study reports:

1. 2020 Fish Community Survey Results – Attachment 1
2. Preliminary Impingement and Entrainment Study Report – Attachment 2
3. 2020 Macroinvertebrate and Crayfish Community Survey Results – Attachment 3
4. Mussel Community Study Report – Attachment 4

For existing background information, study methods, study results, and analyses, please refer to the individual study reports in Attachments 1 through 4.

Germane correspondence is provided in Attachment 5 and includes the following:

- On April 3, 2020, HDR's sub-contractor (Edge Engineering and Science, LLC [EDGE]) sent the tentative walleye gill net methods and sampling sites to the Virginia Department of Wildlife Resources (VDWR) (formally known as the Virginia Department of Game and Inland Fisheries) as a response to VDWR's request on March 31, 2020.
- On September 29, 2020, HDR's sub-contractor (Stantec Consulting services, Inc. [Stantec]) sent an e-mail to the VDWR confirming completed mussel survey locations and requesting advice on completing the survey. On October 8, 2020, the VDWR confirmed that Stantec should re-deploy and complete the surveyed locations.
- On October 8, 2020, EDGE sent notification to the U.S. Fish and Wildlife Service and VWDR indicating that while conducting the benthic macroinvertebrate survey, multiple freshwater mussels including Virginia state listed Pistolgrip (*Tritogonia verrucosa*) were discovered in the surveyed substrates.
- On November 4, 2020, HDR e-mailed the VDWR to provide an update on the Fish Community Study and to confirm that performing the gillnet survey in November would be acceptable to the agency. On November 9, 2020, the VDWR concurred with HDR and EDGE's plan of action and confirmed that gill net surveying could occur as late as early December. VDWR also concurred that backpack electrofishing could be postponed until August/September 2021.

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Attachment 1

Attachment 1 – 2020 Fish Community Survey Results

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Byllesby-Buck Hydroelectric Project (FERC Project No. 2514)

Prepared for:

AMERICAN ELECTRIC POWER

BOUNDLESS ENERGY™

2020 Fish Community Survey Results, Virginia

Byllesby-Buck → HDR2020-0001

January 12, 2021

Prepared by:

EDGE ENGINEERING & SCIENCE further insight.

Edge Engineering and Science, LLC
Cincinnati, Ohio

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LIST OF ACRONYMS

AEP	American Electric Power – Client
Appalachian	Appalachian Power Company
CFS	Cubic feet per second
CPUE	Catch per unit effort
DO	Dissolved oxygen
EDGE	Edge Engineering and Science, LLC
EF	Electrofishing
FERC	Federal Energy Regulatory Commission
HDR	HDR, Inc. – Client
LDB	Left descending bank
RDB	Right descending bank
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
VDWR	Virginia Department of Wildlife Resources (formerly VDGIF)

1.0 INTRODUCTION

The Byllesby and Buck Dams form the 30.1-megawatt Byllesby-Buck Hydroelectric Project (Project) located on the New River in Carroll 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 expires in 2024. Aquatic biological studies were completed to satisfy their existing FERC license and results of these studies are ultimately used as a record and reference for current relicensing efforts. The New River, along with the two contiguous impoundments resulting from the Project, harbors a diverse community of aquatic biota where aquatic biological studies are required to survey and document the contemporary community of organisms present within the Project area (Figure 1). The New River and lower reaches of tributary streams are included in the Project survey area. The information gained from the Fish Community Study will provide a comprehensive baseline of the current fish community (i.e., abundance, diversity, and distribution) near the Project. These resulting data will be compared to historical data to identify temporal trends in fish community abundance, diversity, or distribution near 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 two objectives for Project studies (AEP 2019) pertaining to the fish community.

Goals and Objectives

1) Collect a comprehensive baseline of existing aquatic resources in the vicinity of the Project
2) Compare current aquatic resources data to historical data to determine any significant changes to species composition or abundance

In accordance with the RSP, field sampling efforts were necessary to satisfy each of the two 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. Backpack electrofishing surveys were not completed in 2020; therefore, these 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 methodologies. Fish community sampling conducted in 2020 employed boat electrofishing and gillnetting methods to target representative fish habitats at 17 and six sites, respectively, throughout the Project area. The selected sampling methods include a combination of equipment, techniques, seasonality, and number and location of sample sites, to provide a contemporary representation of the Project area and correspond to previous sampling efforts (Appalachian and AEP 1991) for comparison.

2.1 Fish Community Sampling

The fish community study, detailed in the RSP, consists of two temporally independent efforts (one fall survey and one spring survey). Sampling methods were derived from the National Rivers and Streams

Assessment (NRSA) Field Operations Manual (USEPA 2019), which guides standardized electrofishing methods in lotic waterbodies of variable sizes. Gillnet methods were established in coordination with the Virginia Department of Wildlife Resources (VDWR). Within the constraints of the Project's objectives and geographic limits, boat electrofishing and gillnetting techniques were employed to most-effectively target specific sites based on the habitat types present in the Project area. Boat electrofishing was used to target near-shore pool habitats (i.e., non-wadeable) and gillnetting was used to target mid-channel pool habitats. Seven boat electrofishing sites were located in the Byllesby Pool and 10 were located in the Buck Pool. Six gillnetting sites were located in the Byllesby Pool to target Walleye (*Sander vitreus*). 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, BFB1 = Byllesby-Buck Fall Boat Site 1 and BFG1 = Byllesby-Buck Fall Gillnet Site 1.

2.1.1 Boat Electrofishing

Boat electrofishing techniques were used to survey the fish community at 17 pool sites (i.e., boat electrofishing; BFB site names) along 100-meter transects. Upon arrival at boat electrofishing sites (Figures 1-8), transects were delineated in pool habitat and the start and endpoint coordinates were recorded. The effectiveness of boat electrofishing is reduced in deeper water (i.e., greater than three meters), especially during daylight hours; therefore, sampling was performed within 30 meters of shore. 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. 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 water conductivity 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. 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 previously 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. When Spotted Bass (*Micropterus punctulatus*) and/or suspected Alabama Bass (*Micropterus henshalli*) were captured, a voucher photo was taken and a thumbnail-sized portion of one of the pelvic fins was clipped and stored dry in an envelope (along with length and weight) for VDWR notification.

2.1.2 Gillnetting

Gillnetting techniques were used to survey the fish community at six pool sites (i.e., BFG site names) with 36.5-meter-long by 2.4-meter-deep gillnets. Each gillnet was comprised of eight 4.6-meter-long panels with mesh sizes of 1.9, 2.5, 3.2, 3.8, 5.1, 6.4, 7.6, and 10.2 centimeters. Upon arrival at gillnet sites (Figure 1 and Figures 9-11), gillnets were anchored with a cinder block, so the top of the net was at least 0.5 meter below the surface. Starting on the shoreward side, and with the smallest mesh size, gillnets were pulled taught as the boat operator moved towards the channel and slightly downstream of and perpendicular to shore. The start and endpoint coordinates were recorded for each gillnet deployment. Site photos, field conditions, habitat characteristics, and water quality parameters were recorded in the same manner as boat electrofishing sites (see Section 2.1.1). Nets were set for 24 hours before they were retrieved with a grappling hook and checked for fish, which were placed in live wells for processing. Nets were reset in the same location and fish were processed in the same manner as boat electrofishing methods (see Section 2.1.1), except processed fish were released at least 100 meters from the site so they did not immediately become entangled when the gillnets were reset. Nets soaked for another 24 hours and were checked again and pulled from the location after a total of 48 hours of soak time per site.

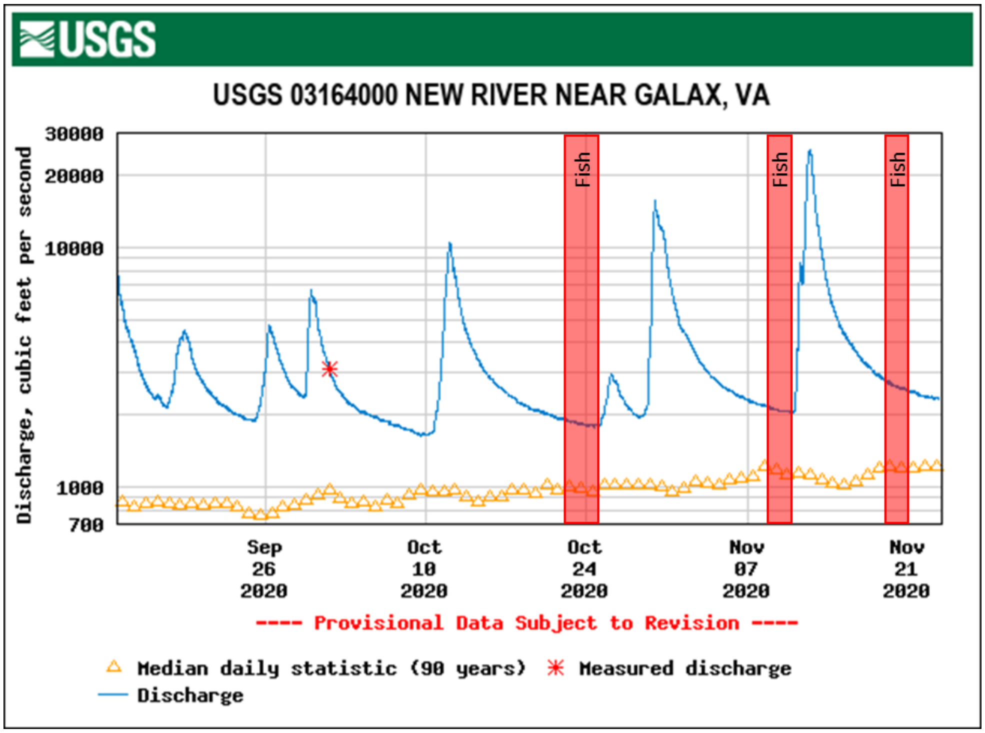
2.2 Deviations from Revised Study Plan

2.2.1 Covid-19 Delays

The initial field plan included spring and fall 2020 sampling events (backpack electrofishing, boat electrofishing, and gillnetting); however, the Covid-19 pandemic, and subsequent restrictions on non-essential travel and safety considerations for field staff, prohibited spring 2020 field efforts. As a result, AEP requested and was granted an extension to accommodate the change in schedule as VDWR, Virginia Department of Environmental Quality (VDEQ), U.S. Fish and Wildlife Service (USFWS), and Virginia Department of Conservation and Recreation (VDCR) all concurred with adaptable schedule revisions. EDGE was contracted and given notice to proceed with fieldwork at the beginning of September 2020 and was able to complete the fall 2020 boat electrofishing and gillnet sampling efforts. Fall 2020 backpack electrofishing methods were postponed due to weather delays.

2.2.2 Weather Delays

Periodic delays associated with weather and stream conditions plagued the fall 2020 sampling season. Average rainfall for Galax, Virginia is approximately 26 centimeters between September 1 and December 1 (US Climate Data 2020); yet during the same time period in 2020, Galax accumulated over 37 centimeters of rain (USGS 2020). Boat electrofishing and gillnet sampling efforts were completed at this year's assumed baseflow, which was likely around 2,000-2,500 cubic feet per second (CFS) during the sampling period. The 42 percent increase from average precipitation did not allow the New River, including the study area (see figure below), to reach average annual baseflow throughout the sampling period. The relatively high discharge did not impact boat electrofishing and gillnet methods, but riffle/run habitat within the Project area remained too swift and deep to effectively and safely sample using backpack electrofishing methods. Thus, the backpack electrofishing surveys that were proposed for completion in fall 2020 (along with boat electrofishing and gillnetting) will now occur in spring 2021.



2.2.3 Sampling Locations

At the time of sampling, multiple proposed locations did not correspond well with the habitat targets identified during the desktop-based site selection process. As such, sampling methods for those locations were adjusted in the field to provide the best possible sample collection effort from the sampling locations identified in the RSP. Two sites upstream of a high gradient riffle complex, located between Byllesby and Buck dams, and originally identified as boat electrofishing sites were switch to backpack electrofishing methods based on the presence of boulder habitat with swift currents. One proposed backpack electrofishing site (at the mouth of Crooked Creek in the Byllesby Pool) was replaced with boat electrofishing methods as the site consisted of pool habitat and was not conducive to backpack electrofishing methods.

3.0 RESULTS

All sample locations provided in the RSP were adhered to as closely as possible, with the exception of the changes described above. 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.

3.1 Fish Community Sampling

Boat electrofishing surveys were conducted between October 22, 24, and 25, and gillnet surveys were conducted between November 9-11 and 18-20, 2020, following methods outlined in the RSP and during relatively low flow and clear stream conditions. Sampling was performed by EDGE's state permitted fish biologist under Virginia Scientific Collecting Permit No. 068630 (Appendix A). There were differences in habitat type and substrates observed between 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 sites. Results of physiochemical data collected at sample sites met the state water quality standards established for the New 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 207 fish were collected representing 23 species with boat electrofishing surveys accounting for 170 fish of 20 species and gillnet surveys accounting for 37 fish representing 7 species. Fifteen (15) species were collected in the Byllesby Pool from seven boat electrofishing sites and all six gillnet sites. Fifteen (15) species were collected in the Buck Pool from ten boat electrofishing sites. In the Byllesby Pool, Bluegill (*Lepomis machrochirus*), Common Carp (*Cyprinus carpio*), and Redbreast Sunfish (*Lepomis auritus*) were the most abundant species (21.9% [28], 16.4% [21], and 14.8% [19], respectively). In the Buck Pool, Whitetail Shiner (*Cyprinella galactura*), Smallmouth Bass (*Micropterus dolomieu*), and Redbreast Sunfish were the most abundant species (36.7% [29], 15.2% [12], and 12.7% [10], respectively) (Appendix C). Common Carp, Channel Catfish (*Ictalurus punctatus*), and Flathead Catfish (*Pylodictis olivaris*) were the most dominant species by weight in the Byllesby Pool (66.6%, 10.8%, and 5.9%, respectively) and Smallmouth Bass, Redbreast Sunfish, and Bigmouth Chub (*Nocomis platyrhynchus*) were the most dominant species by weight in the Buck Pool (25.8%, 23.6%, and 15.8%, respectively). Representative site and fish photos are provided in Appendix B and raw data for fish collections are provided in Appendix C.

The Byllesby Pool was dominated by invertivore-piscivore (8 species), invertivore (2 species), and omnivore-herbivore (2 species) trophic guilds and by the water column (11 species) and benthic (1 species) habitat guilds (McCormick et al. 2001). In contrast, the Buck Pool was dominated by invertivore (8 species) and invertivore-piscivore (5 species) trophic guilds and by the water column (12 species) and benthic (1 species) habitat guilds. Site-specific information is provided below.

3.1.1 Boat Electrofishing

Seventeen (17) pool sites were sampled via boat electrofishing as part of fish community studies, with seven sites located in the Byllesby Pool and ten located in the Buck Pool. (Figure 1; BFB). Substrate composition varied from boulder to silt, with shoreline habitat ranging from vertical bedrock banks to grass-covered floodplain. Water quality parameters varied by site and ranged from 14.4 to 16.5 °C, pH 7.9 to 7.9, DO 8.57 to 10.80 mg/L and 87.3 to 107.2 percent saturation, velocity 0.02 to 0.09 m/s, and conductivity 51.6 to 67.1 µs/cm (Table 1).

Table 1: Water Quality at Boat Electrofishing Sites

Date	Site #	Water Temp. (C)	pH	DO (mg/L)	DO (%)	Velocity (m/s)	Conductivity (us/cm)
10/25/2020	BFB1	16.3	7.2	8.59	87.3	0.05	65.8
10/25/2020	BFB2	16.3	7.2	8.59	87.3	0.09	65.8
10/25/2020	BFB3	16.5	7.0	8.60	88.1	0.03	55.2
10/24/2020	BFB4	16.1	7.3	9.58	96.9	0.03	55
10/25/2020	BFB5	15.0	7.5	9.72	95.2	0.05	52.2
10/24/2020	BFB6	16.4	7.5	8.57	87.9	0.02	56.4
10/24/2020	BFB7	16.4	7.5	8.57	87.9	0.02	56.4
10/22/2020	BFB8	15.9	7.9	10.57	105.3	0.08	67.1
10/22/2020	BFB9	15.9	7.4	10.35	104.6	0.08	55.2
10/22/2020	BFB10	15.9	7.4	10.35	104.6	0.06	55.2
10/22/2020	BFB11	14.5	7.5	10.33	99.3	0.03	65.5
10/22/2020	BFB12	15.5	7.5	10.80	107.2	0.02	66.5
10/22/2020	BFB13	14.5	7.5	10.33	99.3	0.03	65.6
10/22/2020	BFB14	14.5	7.5	10.33	99.3	0.02	65.6
10/22/2020	BFB15	14.4	6.8	10.00	97.7	0.02	51.6
10/22/2020	BFB16	14.4	6.8	10.00	97.7	0.02	51.6
10/22/2020	BFB17	14.4	6.8	10.00	97.7	0.02	51.6

Above/below dashed line represents above/below Byllesby Dam

No fish were collected at two boat electrofishing sites (BFB3 & BFB17); therefore, survey results are not included below. Fish were observed on sonar in two meters of water approximately 30 meters from shore at site BFB3, while BFB17 was sampled early in the morning on a cloudy day and no fish were observed. Fish abundance at boat electrofishing sites in the Byllesby Pool ranged from 7 to 26 individuals with an average of 15 (SD = 8.0) individuals per site (Table 2). Fish abundance at boat electrofishing sites in the Buck Pool ranged from 3 to 18 individuals with an average of 9 (SD = 5.1) individuals per site. Species richness ranged from 2 to 7 species with an average of 5 species per site in the Byllesby Pool. Species richness ranged from 1 to 7 species with an average of 4 species per site in the Buck Pool. Species diversity ranged from 0.41 to 1.72 in the Byllesby Pool and from 0.56 to 1.79 in the Buck Pool. Catch per unit effort (CPUE) ranged from 1.03 to 4.03 individuals per minute in the Byllesby Pool and 0.61 to 2.73 in the Buck Pool. Electrofishing time was relatively consistent between sites based on similar habitat complexity. The following subsections are organized based on proximity of sampling sites, and subsequently, how they appear in Figures 2-11.

Table 2: Fish Community Results for Boat Electrofishing Sites

Date	Site #	Abundance	Richness	Diversity (H')	Evenness	EF Time (min)	CPUE (#/min)
10/25/2020	BFB1	26	7	1.69	0.87	6.5	4.03
10/25/2020	BFB2	22	7	1.18	0.61	6.7	3.28
10/24/2020	BFB4	8	5	1.49	0.93	6.8	1.19
10/25/2020	BFB5	7	2	0.41	0.59	6.8	1.03
10/24/2020	BFB6	10	4	1.17	0.84	6.9	1.46
10/24/2020	BFB7	18	7	1.72	0.88	6.8	2.64
10/22/2020	BFB8	9	6	1.58	0.88	6.7	1.35
10/22/2020	BFB9	18	7	1.69	0.87	6.6	2.73
10/22/2020	BFB10	6	6	1.79	1.00	6.5	0.93
10/22/2020	BFB11	7	3	0.80	0.73	7.7	0.91
10/22/2020	BFB12	4	2	0.56	0.81	6.5	0.61
10/22/2020	BFB13	16	4	1.22	0.88	6.9	2.34
10/22/2020	BFB14	9	4	1.15	0.83	6.7	1.34
10/22/2020	BFB15	7	1	NA	NA	6.3	1.11
10/22/2020	BFB16	3	3	1.10	1.00	6.2	0.49

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

3.1.1.1 Byllesby Pool – BFB1 & 2

Substrates consisted of sand (80%), gravel (10%), and silt (10%) at site BFB1 (RDB) and sand (75%), boulder (15%), and silt (10%) at site BFB2 (LDB) (Figure 2). Habitat structure at BFB1 generally consisted of a shallow sand/gravel bar that extended approximately 20 meters channelward before rapidly descending. Leaf packs and pockets of submerged aquatic vegetation (SAV) were present. Habitat structure at BFB2 generally consisted of near-shore boulders and woody debris and included the confluence of Brush Creek with the New River. These two sites combined to represent approximately 53% of the total abundance and 10 of 12 total species captured by boat electrofishing surveys in the Byllesby Pool. Survey efforts included 6.5 and 6.7 minutes of electrofishing at BFB1 and BFB2, respectively, and resulted in relatively similar CPUE between the sites (Table 2). Site BFB1 had greater diversity as a result of greater evenness because Bluegill exhibited 35% relative abundance at site BFB1 and 68% at site BFB2, although it was the most abundant species at both sites (Appendix C).

3.1.1.2 Byllesby Pool – BFB3 & 4

Substrates consisted of sand (80%) and silt (20%) at sites BFB3 (LDB) and BFB4 (RDB) (Figure 3). Habitat structure at BFB3 generally consisted of a well vegetated floodplain/bank (grass and trees) whereas habitat structure at BFB4 consisted of a steep bedrock bank descending vertically into pool habitat. No fish were captured at site BFB3 (although fish were observed on sonar as previously mentioned), which may be an artifact of boat electrofishing limitations where instream structure and stable banks are absent. Site BFB4 yielded five species with the most abundant being Redbreast Sunfish (3).

3.1.1.3 Byllesby Pool – BFB5

Substrates at site BFB5 consisted of sand (50%) and silt (50%) and habitat structure included woody debris and SAV along a flat bottom (Figure 4). This site was located at the confluence of Crooked Creek and the New River. Six of the seven Common Carp collected via boat electrofishing in the Byllesby Pool were captured at BFB5 as well as the only Black Crappie (*Pomoxis nigromaculatus*). Limitations of boat electrofishing in relatively shallow pool habitat where only the thalweg was accessible may have influenced the diversity at this site, which was the lowest of any in the Project area. Habitat and water quality parameters do not exhibit any limitations to fish colonization in this reach of stream.

3.1.1.4 Byllesby Pool – BFB6 & 7

Substrates consisted of sand (50%), silt (40%), and boulder (10%) at both BFB6 and BFB7 (Figure 5). Habitat structure at both sites consisted of a steep bedrock bank descending vertically into pool habitat. These two sites combined to represent approximately 31% of the total abundance and eight of 12 total species captured by boat electrofishing surveys in the Byllesby Pool. Site BFB7 had greater diversity and CPUE, but both sites were dominated by water column habitat guilds.

3.1.1.5 Buck Pool – BFB8, 9, & 10

Substrates consisted of sand (40%), silt (40%), and gravel (20%) at site BFB8 (LDB), sand (60%), gravel (20%), and boulder (20%) at site BFB9 (RDB), and sand (60%), silt (20%), and boulder (20%) at site BFB10 (RDB) (Figure 6). All three sites were located directly downstream of the high gradient riffle complex above the Buck Pool, which led to relatively high DO and water velocity. These sites exhibited similar species richness and diversity; however, BFB10 had the lowest CPUE. Site BFB10 yielded one individual of six different species whereas Whitetail Shiner was the most abundant species at BFB8 (4) and BFB9 (7). Fourteen species were represented between these three sites. Shiners comprised all six species collected at BFB8.

3.1.1.6 Buck Pool – BFB11, 12, 13, & 14

Substrates consisted primarily of sand (40%), boulder (30%), silt (20%), and gravel (10%) at sites BFB11, BFB13, and BFB14 (RDB) (Figure 7). Habitat at these three sites consisted of a relatively steep bedrock bank descending vertically into pool habitat. Substrates at site BFB12 (LDB) consisted of sand (50%) and silt (50%) and habitat structure was a well vegetated floodplain/bank (grass and trees) with low habitat complexity overall. As a result, site BFB12 had much lower diversity and CPUE than the other three sites.

3.1.1.7 Buck Pool – BFB15, 16, & 17

Substrates consisted primarily of sand (40%), boulder (30%), silt (20%), and gravel (10%) at all three sites (Figure 8). Habitat at these sites consisted of a relatively steep bedrock bank descending vertically into pool habitat. No fish were captured at site BFB17 which may be a result of sampling first thing on a relatively dark and cloudy morning. Site BFB15 yielded seven individuals of a single species (Whitetail Shiner) and site BF16 yielded one individual of three species (Redbreast Sunfish, Smallmouth Bass, and Largemouth Bass [*Micropterus salmoides*]). Site BFB15 had the lowest richness and BFB16 had the lowest CPUE.

3.1.2 Gillnetting

Six (6) gillnet sampling sites located in the Byllesby pool were sampled as part of fish community studies (Figure 1; BFG). Substrate composition varied from boulder to silt, with shoreline habitat ranging from vertical rock cliffs to grass-covered floodplain. Dissolved oxygen values were determined to be erroneous due to equipment malfunction and are therefore not reported. Conductivity values reported for sites BFG1, 3, and 5 are likely much lower as a result of decreased temperatures at the time of surveys. Water quality parameters varied by site and ranged from 6.0 to 11.4 °C, pH 6.8 to 7.6, velocity 0.13 to 0.37 m/s, and conductivity 36.7 to 62.6 µs/cm (Table 3).

Table 3: Water Quality at Gillnet Sites

Date	Site #	Water Temp. (C)	pH	Velocity (m/s)	Conductivity (us/cm)
11/18/2020	BFG1	6.5	7.1	0.37	37.7
11/9/2020	BFG2	10.8	7.2	0.16	62.4
11/18/2020	BFG3	6.6	7.3	0.18	37.5
11/9/2020	BFG4	10.9	6.8	0.14	62.6
11/18/2020	BFG5	6.0	7.6	0.13	36.7
11/9/2020	BFG6	11.4	6.8	0.13	61.5
All sites occur in Byllesby Pool					

No fish were collected at two of the gillnetting sites (BFG1 & 4); therefore, survey results are not included below. Site BFG1 exhibited relatively swift current as it was located within the thalweg of the river on the outside bank of a meander, which may not be suitable for consistent fish utilization. Although none of the habitat or water quality results at site BFG4 suggest lack of suitable fish habitat, the boat electrofishing survey near this site (BFB4) yielded a CPUE that was half of the average CPUE for Byllesby Pool sites. Further, the average CPUE of the four gillnet locations where fish were captured was 4.6 individuals per net set, which means a net set resulting in zero fish was not unreasonable.

Overall fish abundance at gillnetting sites in the Byllesby Pool ranged from 4 to 13 individuals with an average of 9 individuals per site (Table 4). Species richness ranged from 3 to 5 species with an average of 3.5 per site and diversity ranged from 0.57 to 1.04 with an average of 0.91. Catch per unit effort (CPUE) ranged from 2 to 6.5 individuals per net set in the Byllesby Pool. Common Carp, Channel Catfish, and Walleye were the most abundant species collected via gillnet surveys (38% [14], 30% [11], and 16% [6], respectively). The following subsections are organized based on proximity of sampling sites, and subsequently, how they appear in map Figures.

Table 4: Fish Community Results for Gillnet Sites

Date	Site #	Abundance	Richness	Diversity (H')	Evenness	Effort (net set)	CPUE (#/net set)
11/9/2020	BFG2	4	3	1.04	0.95	2	2.0
11/18/2020	BFG3	13	5	1.04	0.65	2	6.5
11/18/2020	BFG5	8	3	0.97	0.89	2	4.0
11/9/2020	BFG6	12	3	0.57	0.52	2	6.0
Site in order from upstream to downstream within Byllesby Pool (H' = Shannon Diversity and one net set = 24 hours)							

3.1.2.1 Byllesby Pool – BFG1 & 2

Substrates consisted of boulder (50%), gravel (30%), and sand (20%) at site BFG1 and sand (95%) and boulder (5%) at site BFG2 (Figure 9). Site details and potential reasons for collecting zero fish at site BFG1 was addressed in Section 3.1.2 above. Habitat structure at BFG2 generally consisted of a vegetated floodplain, high gradient sand banks, and sparse boulders and woody debris along the shore, which rapidly descended channelward. Site BFG2 had a total abundance of four and species richness of three. The most abundant species was Common Carp (2), and a single Walleye was also captured. This site had the lowest CPUE but the highest diversity, likely because the few individuals captured were relatively even in abundance (Appendix C).

3.1.2.2 Byllesby Pool – BFG3 & 4

Substrates consisted of sand (50%), silt (45%), and gravel (5%) at sites BFG3 and BFG4 (Figure 10). Site details and potential reasons for collecting zero fish at site BFG4 was addressed in Section 3.1.2 above. Habitat structure at BFG3 generally consisted of a vegetated floodplain, high gradient sand banks, and sparse woody debris along the shore, which rapidly descended channelward. Site BFG3 had a total abundance of 13 and species richness of 5 (Appendix C). The most abundant species was Common Carp (9) and a single individual of the other four species was captured (including Walleye). This site had the highest CPUE and the highest diversity regardless of the presence of a singularly dominant species.

3.1.2.3 Byllesby Pool – BFG5 & 6

Substrates consisted of sand (60%) and silt (40%) at site BFG5 and sand (50%), silt (40%), and boulder (10%) at BFG6 (Figure 11). Habitat structure at BFG5 generally consisted of a shallow sand bar that extended approximately 10 meters channelward before rapidly descending. Habitat structure at BFG6 consisted of a steep bedrock bank descending vertically into pool habitat. These two sites comprised 54% of the total abundance, and accounted for five of seven species, captured via gillnetting in the Byllesby Pool (Appendix C). Each of these sites yielded a species richness of three. Four Walleye were captured at site BFG5. The only Flathead Catfish and 10 of 11 total Channel Catfish were captured at site BFG6.

4.0 DISCUSSION

4.1 Fish Community

The Project is located within a rural area with a relatively large watershed, which may contribute to potential issues pertaining to water quality and habitat degradation in this portion of the New River that are independent of the Project. The Project influences habitat availability through formation of two reservoirs (creating pool habitat and eliminating riffle habitat), which dictates what species 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.

With regards to boat electrofishing results from 2020, average CPUE in the Byllesby and Buck Pools were 2.27 and 1.31 individuals per minute, respectively. Average species richness in the Byllesby and Buck Pools were 5.3 and 4, respectively. The Byllesby Pool exhibited a 73% greater CPUE and 33% greater species richness; however, the average diversity per site was only 3% greater. This implies that both pools are equally diverse, but the Byllesby Pool has a greater overall abundance of fish. Furthermore, the average abundance per site in the Byllesby (n = 6) and Buck (n = 9) Pools were 15.16 and 8.78, respectively (using sites where fish were captured). There were no distinct differences in habitat and water quality parameters between the Byllesby and Buck Pools that would drastically impact fish abundance.

In the Byllesby Pool, gillnetting methods accounted for Channel Catfish, Redhorse species (*Moxostoma sp*.), and Walleye, which were not captured during boat electrofishing surveys. Walleye were collected in the upper, middle, and lower portions of Byllesby Pool with the highest abundance occurring in the lower pool (BFG5, 4 individuals). Walleye collections throughout the entire pool indicate they utilize a variety of habitats ranging from shallow pools with higher velocity and larger substrate to deep pools with lower velocity and smaller substrate. Fish were captured via gillnetting near the site where none were captured during boat electrofishing (BFB3) and fish were captured via boat electrofishing near the sites where none were captured via gillnet (BFG1 and BFG4). Therefore, fish appeared to be utilizing habitats throughout the entirety of the Byllesby Pool during the 2020 survey window.

Because of differences in methods, sampling locations, and pending results of the spring 2021 sampling efforts, no conclusions between these and previous study results can be drawn at this time. During Appalachian and AEP (1991) fish community studies, fish abundance was not reported separately for electrofishing of pool and riffle habitats. Additionally, gill and hoop net results were not reported separately. For the purposes of this interim progress report, a comparison of species richness at boat electrofishing sites in 2020 and Appalachian and AEP (1991) was used to perform a preliminary comparison to identify any trends in the fish community within the Project area.

As previously stated, average species richness in the Byllesby and Buck Pools were 5.3 and 4, respectively, using boat electrofishing methods. During October, the same timeframe as 2020 surveys, Appalachian and AEP (1991) reported an average species richness of 7 in the Byllesby Pool and 9 in the Buck Pool. However, this apparent decrease in species richness over time at both Project areas is likely a result of differences in sampling methods. In Appalachian and AEP (1991), for each pair of sites, one was sampled during the day and the other at night, while the current study does not include nighttime electrofishing due to safety concerns. Boat electrofishing is known to be more productive at night and may account for this observed increase in species richness. Additional insight will be gained from the results of spring 2021 survey and will increase our understanding of the contemporary fish community in the Project area and facilitate comparisons to results from historical fish community studies.

This report provides preliminary results based on the partial completion of the study objectives: 1) collect a comprehensive baseline of existing aquatic resources in the vicinity of the Project; and 2) compare current aquatic resources data to historical data to identify any trends or changes in species composition or abundance. A final report detailing the conclusions of the general fish community sampling efforts with be provided in 2021 with the Updated Study Report.

5.0 LITERATURE CITED

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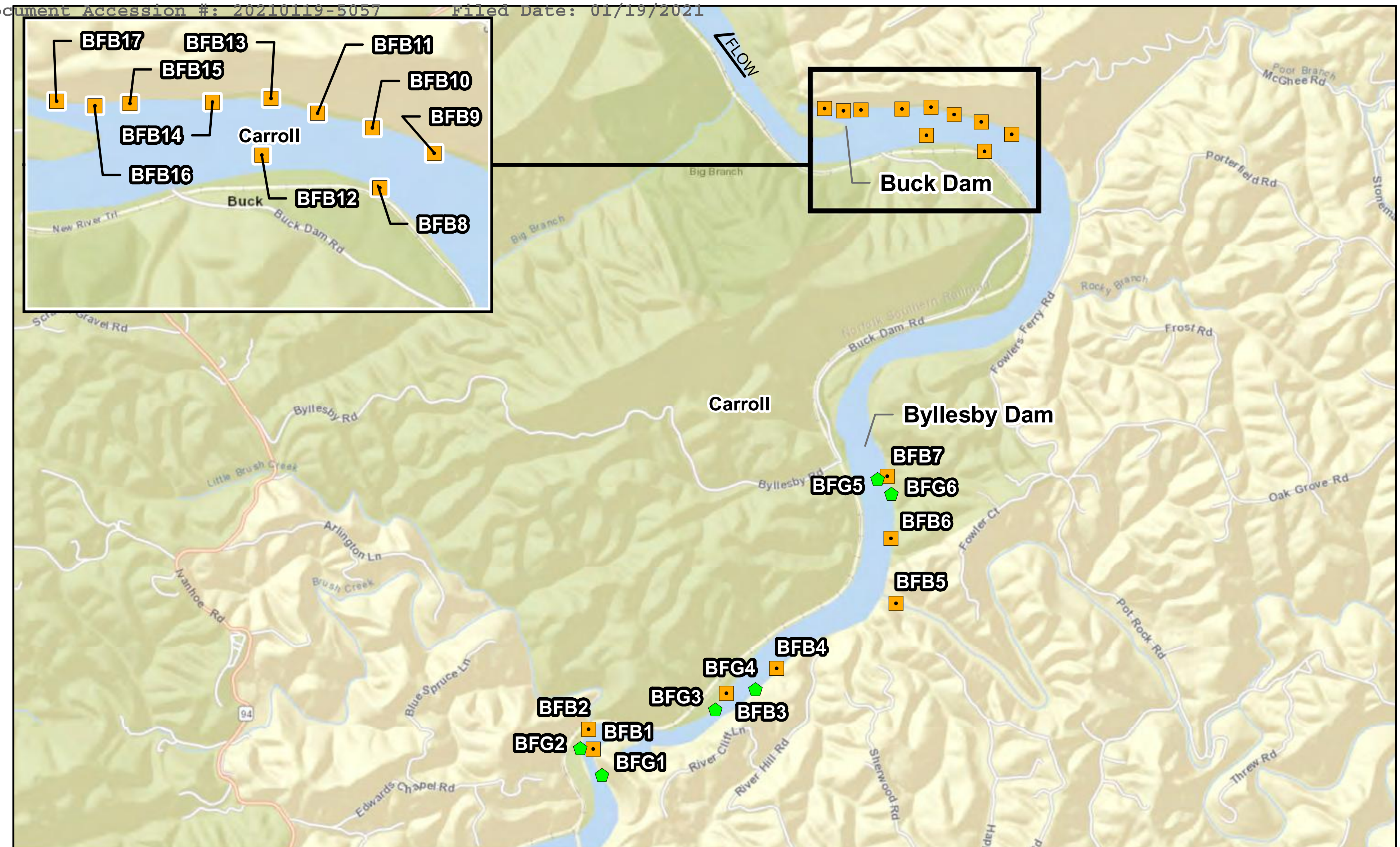
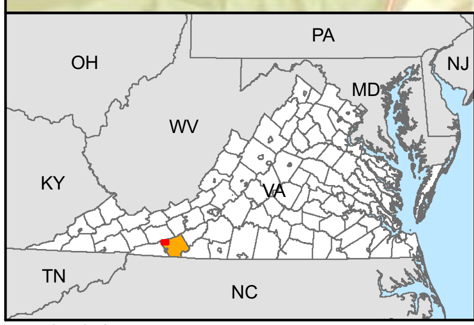
Figures





Legend

Fish Sample Location

- Boat Electrofishing - 100-meter survey extent
- Gillnet - 36.5-meter survey extent
- County Boundary

N

0 0.5 1

Kilometers

Scale: 1:39,370

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Byllesby-Buck Dam Fish Community Study

Figure 1
Overall Byllesby-Buck project area including boat electrofishing (BFB) and gillnet (BFG) survey sites on the New River in Carroll County, Virginia

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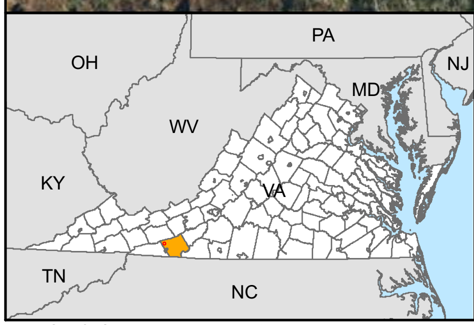

Legend

Boat Electrofishing - 100-meter survey extent

Boat Electrofishing - 100-meter survey extent

N

0 50 100

Meters

Scale: 1:3,937

American Electric Power
Byllesby-Buck Dam Fish Community Study

Figure 2
Boat electrofishing 100-meter survey extent in pool habitat in Carroll County, Virginia.

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Legend

- Boat Electrofishing - 100-meter survey extent (point)
- Boat Electrofishing - 100-meter survey extent (line)

N

0 50 100
Meters

Scale: 1:3,937

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Figure 3
Boat electrofishing 100-meter survey extent in pool habitat in Carroll County, Virginia.

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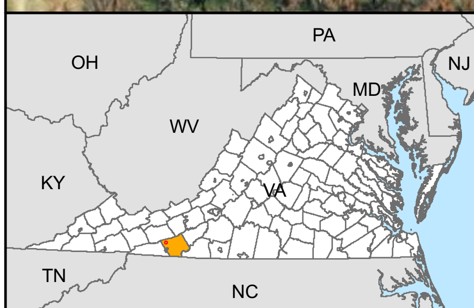

Legend

- Boat Electrofishing - 100-meter survey extent
- Boat Electrofishing - 100-meter survey extent

N

0 50 100
Meters

Scale: 1:3,937

American Electric Power
Byllesby-Buck Dam Fish Community Study

Figure 4
Boat electrofishing 100-meter survey extent in pool habitat in Carroll County, Virginia.

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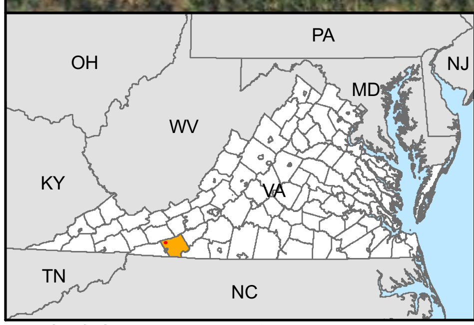

Legend

- Boat Electrofishing - 100-meter survey extent (point)
- Boat Electrofishing - 100-meter survey extent (line)

N

0 50 100
Meters

Scale: 1:3,937

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Figure 5
Boat electrofishing 100-meter survey extent in pool habitat in Carroll County, Virginia.

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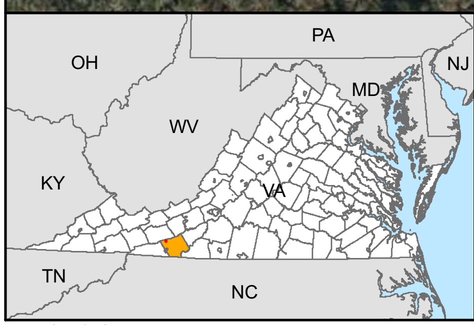

Legend

- Boat Electrofishing - 100-meter survey extent
- Boat Electrofishing - 100-meter survey extent

N

0 50 100
Meters

Scale: 1:3,937

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Figure 6
Boat electrofishing 100-meter survey extent in pool habitat in Carroll County, Virginia.

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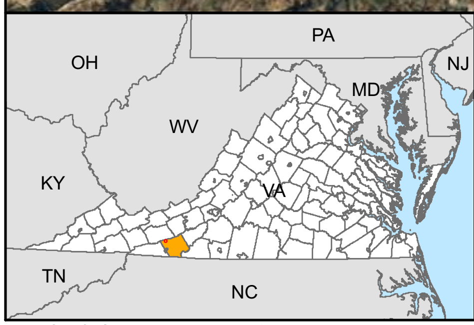

Legend

- Boat Electrofishing - 100-meter survey extent
- Boat Electrofishing - 100-meter survey extent

N

0 50 100

Meters

Scale: 1:3,937

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Figure 7
Boat electrofishing 100-meter survey extent in pool habitat in Carroll County, Virginia.

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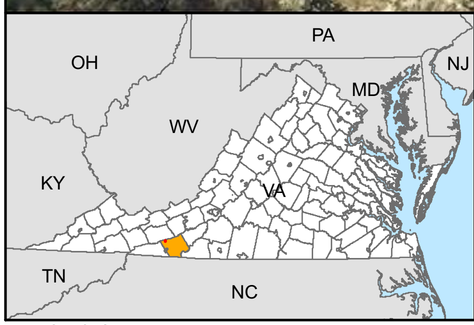

Legend

- Boat Electrofishing - 100-meter survey extent
- Boat Electrofishing - 100-meter survey extent

N

0 50 100

Meters

Scale: 1:3,937

American Electric Power
Byllesby-Buck Dam Fish Community Study

Figure 8
Boat electrofishing 100-meter survey extent in pool habitat in Carroll County, Virginia.

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Legend

- Gillnet - 36.5-meter survey extent (point)
- Gillnet - 36.5-meter survey extent (line)

N

0 50 100
Meters

Scale: 1:3,937

American Electric Power

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Figure 9
Gillnet 36.5-meter survey extent in pool habitat in Carroll County, Virginia.

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Legend

- Gillnet - 36.5-meter survey extent
- Gillnet - 36.5-meter survey extent

N

0 50 100
Meters

Scale: 1:3,937

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American Electric Power
Byllesby-Buck Dam Fish Community Study

Figure 10
Gillnet 36.5-meter survey extent in pool habitat in Carroll County, Virginia.

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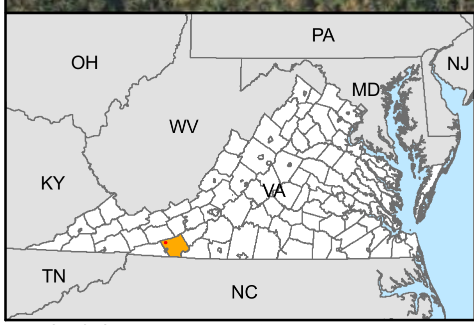

Legend

Gillnet - 36.5-meter survey extent

Gillnet - 36.5-meter survey extent

N

0 50 100

Meters

Scale: 1:3,937

AMERICAN ELECTRIC POWER

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Figure 11
Gillnet 36.5-meter survey extent in pool habitat in Carroll 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

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Appendix B

REPRESENTATIVE PHOTOGRAPHS

BFB1 - Downstream
Boat Electrofishing Sample Site

BFB2 - Downstream
Boat Electrofishing Sample Site

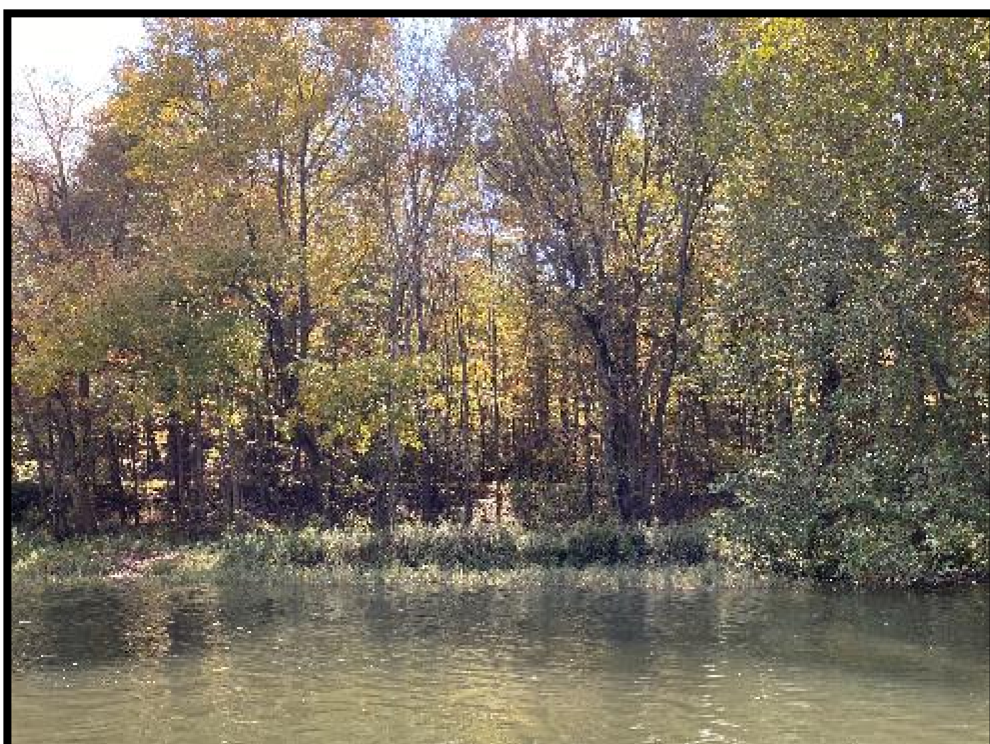
BFB3 - Upstream
Boat Electrofishing Sample Site

BFB4 - Right Descending Bank
Boat Electrofishing Sample Site

BFB5 - Upstream
Boat Electrofishing Sample Site

BFB6 - Right Descending Bank
Boat Electrofishing Sample Site

BFB7 - Downstream
Boat Electrofishing Sample Site



BFB8 - Left Descending Bank
Boat Electrofishing Sample Site

BFB9 - Upstream
Boat Electrofishing Sample Site

BFB10 - Upstream
Boat Electrofishing Sample Site

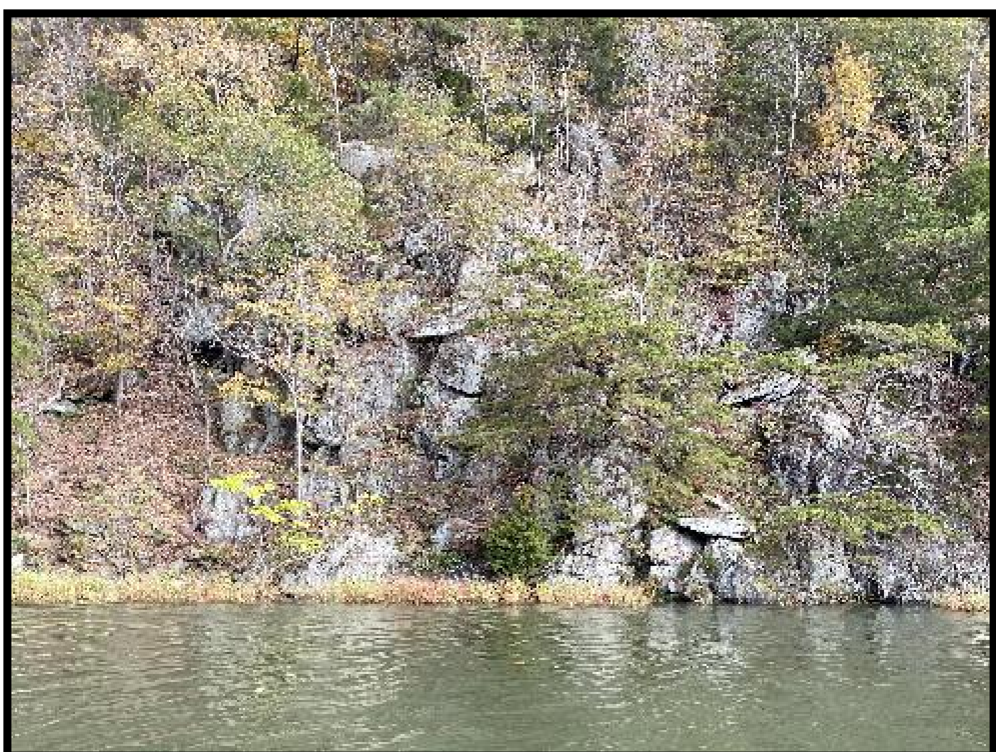
BFB11 - Upstream
Boat Electrofishing Sample Site

BFB12 - Upstream
Boat Electrofishing Sample Site

BFB13 - Downstream
Boat Electrofishing Sample Site

BFB14 - Right Descending Bank
Boat Electrofishing Sample Site

BFB15 - Downstream
Boat Electrofishing Sample Site



BFB16 - Right Descending Bank
Boat Electrofishing Sample Site

BFB17 - Downstream
Boat Electrofishing Sample Site

BFG1 – Upstream
Gillnetting Sample Site

BFG2 - Downstream
Gillnetting Sample Site

BFG3 - Left Descending Bank
Gillnetting Sample Site

BFG4 - Downstream
Gillnetting Sample Site

BFG5 - Right Descending Bank
Gillnetting Sample Site

BFG6 - Downstream
Gillnetting Sample Site

Rock Bass
(*Ambloplites rupestris*)

Whitetail Shiner
(*Cyprinella galactura*)

Spotfin Shiner
(*Cyprinella spiloptera*)

Common Carp
(*Cyprinus carpio*)

Northern Hog Sucker
(*Hypentelium nigricans*)

Channel Catfish
(*Ictalurus punctatus*)

Redbreast Sunfish
(*Lepomis auritus*)

Green Sunfish
(*Lepomis cyanellus*)

Bluegill
(*Lepomis macrochirus*)

Rosefin Shiner
(*Lythrurus ardens*)

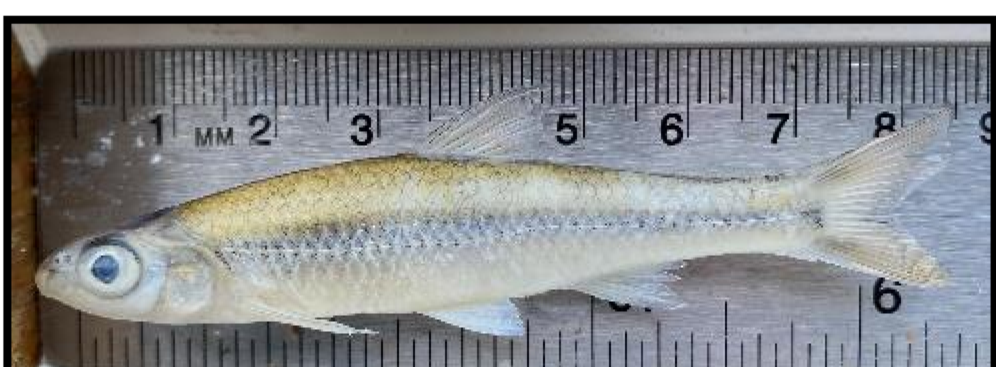
Smallmouth Bass
(*Micropterus dolomieu*)

Spotted Bass
(*Micropterus punctulatus*)

Largemouth Bass
(*Micropterus salmoides*)

Redhorse
(*Moxostoma sp.*)

Bigmouth Chub
(*Nocomis platyrhynchus*)



Spottail Shiner
(*Notropis hudsonius*)

Swallowtail Shiner
(*Notropis procne*)

New River Shiner
(*Notropis scabriceps*)

Black Crappie
(*Pomoxis nigromaculatus*)

Flathead Catfish
(*Pylodictis olivaris*)

Walleye
(*Sander vitreus*)

Appendix C

RAW DATA

Boat Electrofishing Data

Common Name	Species	BFB1	BFB2	BFB4	BFB5	BFB6	BFB7	BFB8	BFB9	BFB10	BFB11	BFB12	BFB13	BFB14	BFB15	BFB16	Total	Rel. Abund.
Rock Bass	*Ambloplites rupestris*	1	-	-	-	1	-	-	1	1	-	-	-	1	-	-	5	2.9%
Whitetail Shiner	*Cyprinella galactura*	1	1	-	-	-	4	4	7	-	-	-	6	5	7	-	35	20.6%
Spotfin Shiner	*Cyprinella spiloptera*	-	-	-	-	-	-	1	3	-	-	-	-	-	-	-	4	2.4%
Common Carp	*Cyprinus carpio*	-	1	-	6	-	-	-	-	-	-	-	-	-	-	-	7	4.1%
Northern Hogsucker	*Hypentelium nigricans*	-	-	-	-	-	-	-	3	1	-	1	-	-	-	-	5	2.9%
Redbreast Sunfish	*Lepomis auritus*	3	2	3	-	5	6	-	-	1	1	-	6	1	-	1	29	17.1%
Green Sunfish	*Lepomis cyanellus*	2	-	-	-	-	-	-	-	1	-	-	-	-	-	-	3	1.8%
Bluegill	*Lepomis macrochirus*	9	15	2	-	-	1	-	1	1	-	-	1	-	-	-	30	17.6%
Sunfish	*Lepomis sp.*	4	-	1	-	-	3	-	-	-	-	-	-	-	-	-	8	4.7%
Rosefin Shiner	*Lythrurus ardens*	-	-	-	-	-	-	1	-	-	-	3	-	-	-	-	4	2.4%
Smallmouth Bass	*Micropterus dolomieu*	6	1	1	-	3	2	-	1	-	5	-	3	2	-	1	25	14.7%
Spotted Bass	*Micropterus punctulatus*	-	1	-	-	-	1	-	-	-	-	-	-	-	-	-	2	1.2%
Largemouth Bass	*Micropterus salmoides*	-	1	-	-	1	1	-	-	1	-	-	-	-	-	1	5	2.9%
Bigmouth Chub	*Nocomis platyrhynchus*	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1	0.6%
Chub	*Nocomis sp.*	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	2	1.2%
Spottail Shiner	*Notropis hudsonius*	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	1	0.6%
Swallowtail Shiner	*Notropis procne*	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	1	0.6%
New River Shiner	*Notropis scabriceps*	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	1	0.6%
Black Crappie	*Pomoxis nigromaculatus*	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	1	0.6%
Flathead Catfish	*Pylodictis olivaris*	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	1	0.6%
	Total	26	22	8	7	10	18	9	18	6	7	4	16	9	7	3	170	
	Rel. Abund.	15.3%	12.9%	4.7%	4.1%	5.9%	10.6%	5.3%	10.6%	3.5%	4.1%	2.4%	9.4%	5.3%	4.1%	1.8%		

Gillnetting Data

Common Name	Species	BFG2	BFG3	BFG5	BFG6	Total	Rel. Abund.
Common Carp	*Cyprinus carpio*	2	9	3	-	14	37.8%
Channel Catfish	*Ictalurus punctatus*	-	1	-	10	11	29.7%
Bluegill	*Lepomis macrochirus*	-	1	-	-	1	2.7%
Smallmouth Bass	*Micropterus dolomieu*	1	-	-	-	1	2.7%
Redhorse	*Moxostoma sp.*	-	1	1	1	3	8.1%
Flathead Catfish	*Pylodictis olivaris*	-	-	-	1	1	2.7%
Walleye	*Sander vitreus*	1	1	4	-	6	16.2%
	Total	4	13	8	12	37	
	Rel. Abund.	10.8%	35.1%	21.6%	32.4%		

Attachment 2

Attachment 2 – Preliminary Fish Impingement and Entrainment Study Report

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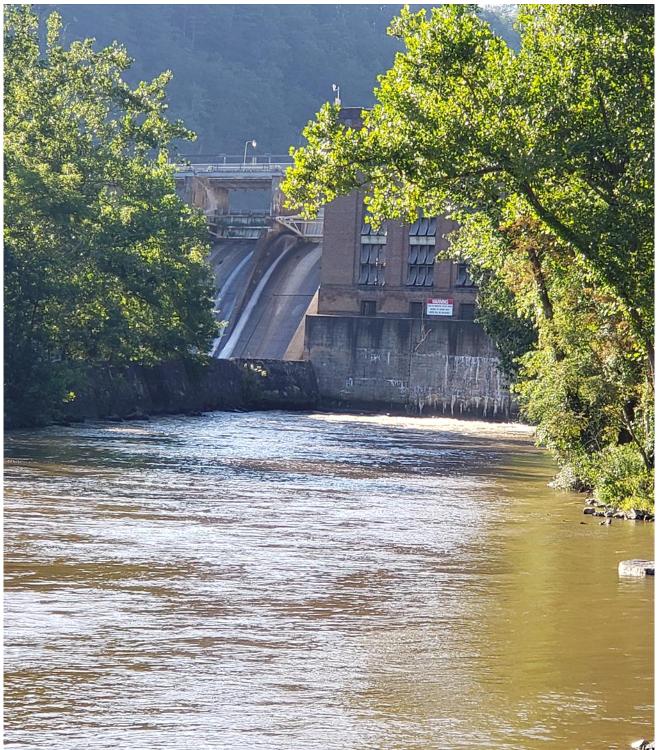

Preliminary Fish Impingement and Entrainment Study Report

Byllesby-Buck Hydroelectric Project (FERC No. 2514)

January 18, 2021

Prepared by:

HDR

Prepared for:

Appalachian Power Company

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Contents

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Appendices

Acronyms and Abbreviations

ADCP	Acoustic Doppler Current Profiler
AEP	American Electric Power
Appalachian or Licensee	Appalachian Power Company
AOI	Area of Influence
CFR	Code of Federal Regulations
cfs	cubic feet per second
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
PM&E	protection, mitigation, and enhancement
Project	Byllesby-Buck Hydroelectric Project
RM	river mile
RSP	Revised Study Plan
SPD	Study Plan Determination
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VDGIF	Virginia Department of Game and Inland Fisheries
VDWR	Virginia Department of Wildlife Resources

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 two-development Byllesby-Buck Hydroelectric Project (Project) (Project No. 2514), located on the upper New River in Carroll County, Virginia. The Project is located approximately 60 miles south-southwest of the city of Roanoke. The Byllesby development is located about 9 miles north of the city of Galax, and the Buck development is located approximately 3 river miles (RM) downstream of Byllesby development and 43.5 RM upstream of Claytor Dam.

The Project is currently licensed by the Federal Energy Regulatory Commission (FERC or Commission). The Project underwent relicensing in the early 1990s, including conversion to run-of-river operations and incorporating additional protection, mitigation, and enhancement (PM&E) measures. The current operating license for the Project expires on February 29, 2024. Accordingly, Appalachian is pursuing a subsequent license for the Project pursuant to the Commission’s Integrated Licensing Process (ILP), as described at 18 Code of Federal Regulations (CFR) Part 5.

In accordance with 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 October 18, 2019. On November 18, 2019 FERC issued the Study Plan Determination (SPD). On December 18, 2019, Appalachian filed a request for rehearing of the SPD. The SPD was subsequently modified by FERC by an Order on Rehearing dated February 20, 2020.

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 18, 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, filed as Attachment 2 to the Aquatic Resources Study Report, describes the methods and results of the Preliminary Fish Impingement and Entrainment Study conducted in support of preparing an application for new license for the Project.

1.2 Background

A desktop entrainment study was conducted for the Project during the previous relicensing (Appalachian 1991a). Electric Power Research Institute (EPRI) data, project characteristics, as well as the behavioral and life history characteristics and preferred habitat of the resident fish were used to assess entrainment potential. The fish species and life stages likely to be entrained are those most likely to occur in forebay areas within the area of influence of the intake structure.

Several of the species in the Centrarchidae family (black basses and sunfishes) and the Ictaluridae family (catfishes) prefer habitat types with structure and cover, such as rocks, logs, stumps, and aquatic vegetation. These species are also generally nest or cavity spawners, depositing adhesive or demersal eggs in beds created by males and often guarded until hatching. Unless these habitats are found within the forebay of the dams and near the intake structures, it is unlikely that these species, regardless of life stage, would occur in the vicinity of the Project intakes, thus minimizing their potential for entrainment. Exceptions to this may include White Crappie (*Pomoxis annularis*) or Black Crappie (*P. nigromaculatus*); which construct nests in the littoral zone, but developing larvae are pelagic until they mature into the juvenile stage and move inshore (Rohde et al. 2009). Habitat generalists, pelagic species, or benthic species may be more likely to occur within the forebay areas, such as clupeids (ex. Gizzard Shad [*Dorosoma cepedianum*]), cyprinids (shiners, minnows, chubs, or carp), catostomids (suckers), or moronids (temperate basses). Some of these species, such as clupeids and some cyprinids, are broadcast spawners. Broadcast spawners, unlike nesting centrarchids, scatter or release eggs in the water column where they can be carried into the intake, and thus are more susceptible to entrainment. However, even if fish larvae and eggs become entrained through the Project, it is unlikely that turbine passage would cause harm under optimal design conditions and if cavitation is not excessive (Appalachian 1991b).

Muskellunge (*Esox masquinongy*) is a popular game fish and a species of interest for the Virginia Department of Wildlife Resources (VDWR) in terms of stocking as well as scientific research (VDWR 2020). The susceptibility of Muskellunge to entrainment at the Project likely varies throughout the year due to variations in predatory behavior (Cook and Solomon 1987). Immediately following spawning in the spring and through midsummer, Muskellunge typically exhibit crepuscular prey-seeking behaviors at a variety of water depths and across a range of habitat types; as such, Muskellunge may enter the forebay area in pursuit of forage fish (i.e., pelagic species). In late summer, Muskellunge become sedentary ambush predators with a strong association with vegetated areas. Although Muskellunge may occur in the forebay area during certain times of year, the age and size (and subsequent swimming ability) at which they would be seeking forage fish (i.e., older/larger individuals), would likely allow them to avoid entrainment into the turbines (EPRI 2000).

If juvenile or larger fish are drawn into the facility turbines, Appalachian (1991b) determined that pressure changes, turbulence and shear effects, and cavitation would be minimal and unlikely to cause substantial harm. In addition, fish likely swim against the current as they enter through the stay vanes and wicket gates and, therefore, are unlikely to contact the vanes perpendicularly (Appalachian 1991b). The Appalachian (1991b) study also evaluated the probability of contact with a runner blade based on measurements of the Byllesby and Buck turbine dimensions. The study concluded that the probability of collision with runner blades was less than five percent for most species, particularly for the smaller species which have a higher likelihood of entrainment (Appalachian 1991b). Mortality would, therefore, be lower than five percent, assuming blade strikes can range from slight glancing blows to head-on collisions (Appalachian 1991b).

Angled-bar trash-racks with close spacing, such as those installed at the Project developments, are a common protection measure in place at hydroelectric projects to reduce entrainment. To the extent that the existing Project causes impingement or entrainment, such impacts would be expected to continue at their existing levels under the new license.

Based on the prior entrainment study (Appalachian 1991b) considering behavioral characteristics, habitat preferences (including spawning habitat), and life-history characteristics of resident fish species, the likelihood of substantial numbers of fish occurring in the forebays was determined to be minimal and the potential for entrainment effects was expected to be low. Based on the results of the previous entrainment study and accounting for the trash racks already installed at the Project intakes, Appalachian does not propose any additional measures to address impingement and entrainment. Appalachian expects to operate the Project in the existing run-of-river mode and with the existing minimum flows and ramping rate. Operating the Project in this manner provides a relatively stable reservoir elevation and protects shoreline stability and water quality for the benefit of fish and other resources.

Given this context and background, this preliminary study report presents a desktop evaluation of entrainment potential for the two-development Project that involves reexamining and updating (as applicable) certain aspects of the prior evaluations of entrainment potential at the intake structures and subsequent blade strike probabilities.

2 Study Goals and Objectives

In accordance with Appalachian's October 18, 2019 RSP and the Commission's November 18, 2019 SPD for the Project, the goal of this study is to verify or update certain aspects pertaining to the Project operations and to examine entrainment potential at the two-development Project. The study objectives are to:

- Confirm flow velocities at the Byllesby and Buck dam intake structures located 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 includes the lower reach of the Reservoir located just upstream of each of the two developments as shown in Figure 3-1 and Figure 3-2.

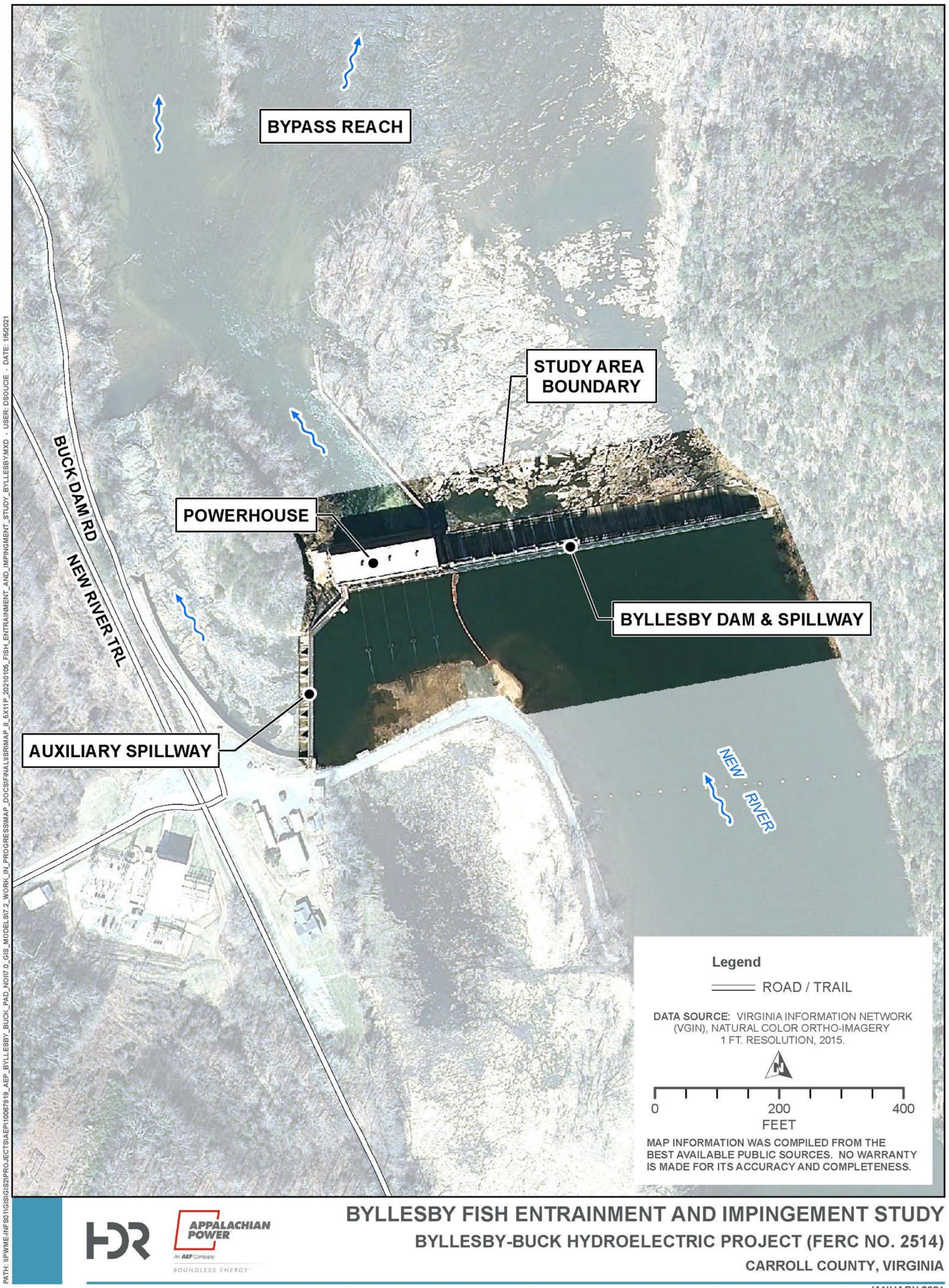


Figure 3-1. Fish Impingement and Entrainment Analysis Study Area for the Byllesby Development Intake at the Byllesby-Buck Hydroelectric Project

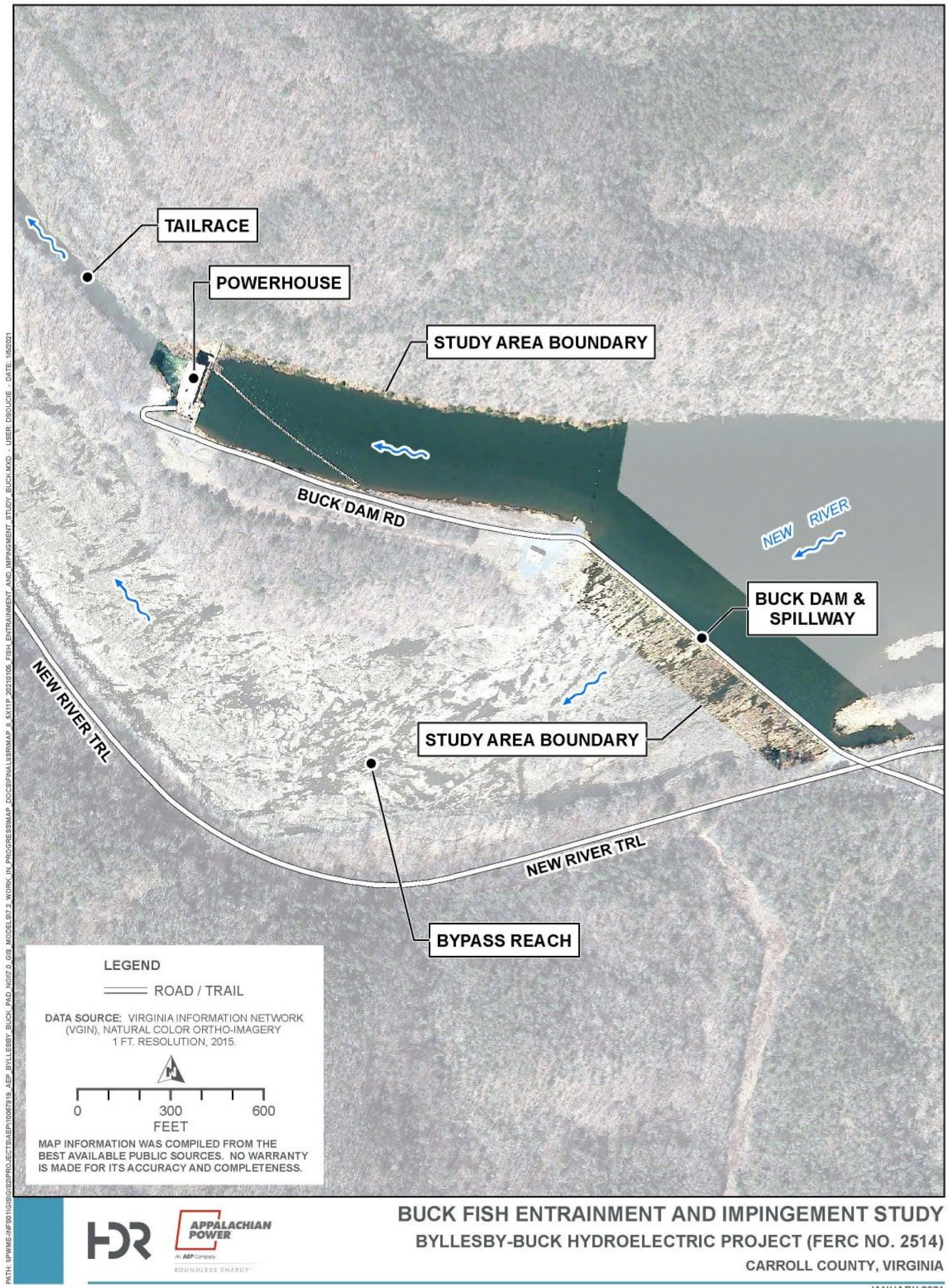


Figure 3-2. Fish Impingement and Entrainment Analysis Study Area for the Buck Development Intake at the Byllesby-Buck Hydroelectric Project

4 Methodology

4.1 Intake Characteristics and Velocities

The intake structure at the Byllesby development is located on river-left of the main dam and is equipped with steel trash racks with 2.28-inch clear spacing that slopes at 15 degrees from top to bottom. At the Buck development, the intake structure is located on river-right of the dam and also has trash racks with 2.28-inch clear spacing sloped at 15 degrees from vertical.

Per the Project RSP and Commission's SPD, intake velocities would 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. 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 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 life stage 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 2020) and historical (Appalachian 1991b) fish community studies, as well as a species list developed by the former VDGIF, recently renamed the Virginia Department of Wildlife Resources (VDWR), for the New River at the time of the historical fish community study (Appalachian 1991). The list includes consideration of fish community composition and abundance of the New River and any other species of interest due to state and/or federal protections, or angler significance. Selected species were evaluated for potential of entrainment and impingement based on swim speed, behavior, habitat preferences, life stages, and other life history characteristics. Risk assessment of impingement and entrainment potential also considered seasonal or temperature-dependent behavioral changes in fish species.

4.2.1 Assessment of Impingement Potential at the Intake

Intake avoidance and impingement was considered at both intakes based on the calculated approach velocities and 2.28-inch clear bar spacing of trash racks at the Project. This process involved comparing available target fish swim speeds with calculated intake 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 entrainment assessment to determine minimum sizes of the target fish species that would physically be excluded by the trash racks (Smith 1985).

4.2.2 Fish Entrainment Rates

4.2.2.1 EPRI Database and Data Selection

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 database for calculating average monthly entrainment rates for a wide range of species. This is a commonly applied approach in desktop entrainment evaluations.

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 wider than specifications at the Project. Several additional facilities also had trash rack spacing wider than those at the Project, however in order to maintain a large sample size, only those facilities with substantially wider trash racks (e.g., double) than specifications at the Project were excluded from the analysis. 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 more narrow open bar spacing than many of the facilities in the EPRI database (Appendix A).

4.2.2.2 Entrainment Rate Calculation

The EPRI (1997) entrainment database provides results from field studies conducted at hydroelectric facilities using full-flow tailrace netting by placing 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 (5,868 cfs for the Byllesby development and 3,540 cfs for the Buck development). Entrainment rates were compiled by month, season (winter = December, January, and February; spring = March, April, and May; summer = June, July, and August; and fall = September, October, and November) and annually.

With consideration of entrainment rates based on the EPRI (1997) database, ability of intake avoidance based on swim burst speed, size exclusion, and life history characteristics (i.e., migratory behavior, spawning periodicity, habitat preferences, etc.), a qualitative assessment of entrainment risk was made for each target species/group. These qualitative categories are used in this study to describe entrainment potential of the target fish species on a monthly basis.

4.2.3 Turbine Blade Strike Evaluation

This evaluation uses the most recent version of the Turbine Blade Strike Analysis Model (USFWS 2020) created by the USFWS, 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. This tool allows for the estimation of turbine passage and mortality (blade strikes) based on site-specific information (i.e., turbine type, number of units, bar rack spacing, etc.) and length distribution for target species used in this impingement and entrainment assessment. 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 a probabilistic model result for turbine and non-turbine mortality.

While the greatest opportunity for fish mortality through a facility lies in potential contact with the turbine runner blades, injuries and mortalities can result from other mechanisms including extreme pressure changes, shear stress, water turbulence, cavitation, and grinding (Deng et al. 2005). However, the historical study (Appalachian 1991) determined that these factors are minimal at the Project; and since no significant changes have occurred at the facility that would change these parameters since the last relicensing, injuries and mortalities caused by factors other than turbine strikes are expected to be negligible.

5 Study Results

5.1 Intake Structure Characteristics

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

5.1.1 Byllesby Development

5.1.1.1 Intake Specifications

The Byllesby intake, located immediately upstream of the powerhouse, consists of four inlet bays. Each bay has a 14-ft-high by 23-ft-wide headgate, which is used during maintenance periods. A 3-ft-wide, reinforced-concrete pier is set vertically in the middle of each inlet bay to support the headgate. Each headgate is closed and opened by a gear and screw lift shaft assembly powered by an electric motor. Each bay admits water to a concrete volute casing, which channels flow to a vertical-shaft Francis hydraulic turbine direct-connected to a generator on the upper level of the powerhouse. Flow through the four turbines passes to concrete draft tubes and into the New River on the downstream side of the powerhouse.

The intake structure at the Byllesby development is approximately 143 ft wide and is equipped with 3/8-inch by 3.5-inch rectangular steel bars. The bars are 47.5 ft long and are inclined toward the powerhouse at approximately 15 degrees. The bars are spaced 2.66 inches center-to-center and have a cleared space of 2.28 inches.

5.1.1.2 Intake Flows

The design maximum flow capacity of the four generating units at Byllesby development is 1,467 cfs each, for a total plant capacity of 5,868 cfs. An evaluation of U.S. Geological Survey (USGS) gage data (USGS 03165500 New River at Ivanhoe) from February 1996 to August 2020 showed that average monthly river flows rarely exceed total plant capacity (Figure 5-1); however, spillage to the bypass (reflecting opportunity for maximum operations) may occur up to eight percent of the time during winter and spring months (January to April) for average flow years, and up to 59 percent of the time during wet years (see Appendix A of the Initial Study Report [Preliminary Bypass Reach Flow and Aquatic Habitat Study Report] for additional spillage information).

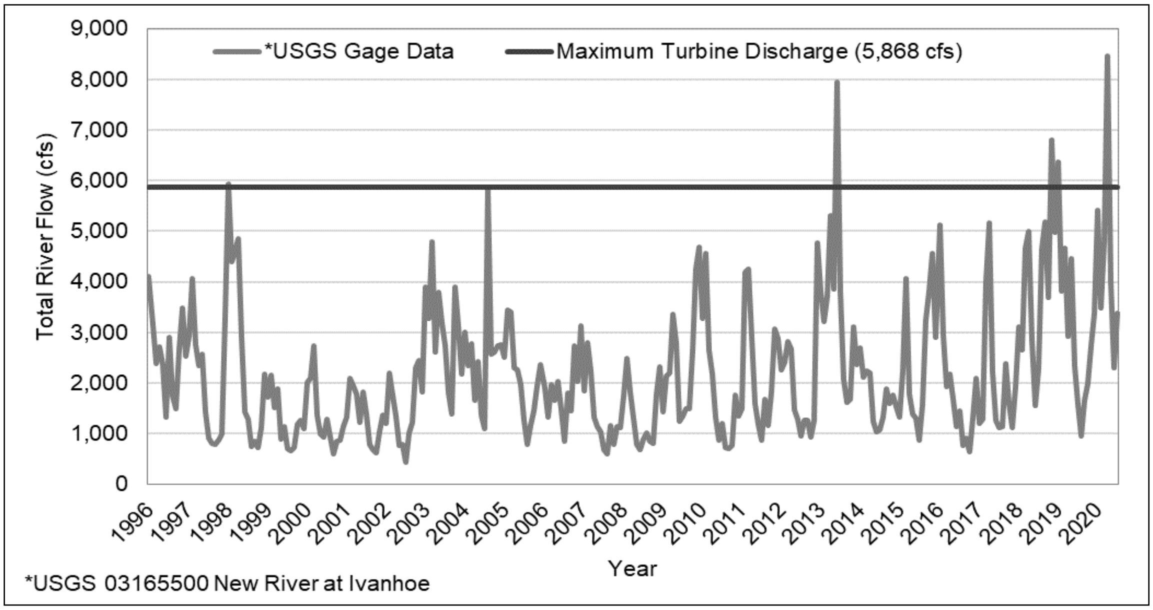


Figure 5-1.USGS 03165500 Gage Data versus Maximum Turbine Discharge (5,868 cfs) at Byllesby Development

5.1.1.3 Intake Velocities

The approach velocity was calculated by determining the area of influence (AOI) directly in front of the headgate opening and dividing that area into the maximum turbine discharge capacity. For Byllesby, it was assumed that the height of the AOI is approximately 150 percent of the headgate opening height (i.e., 14-ft x 1.5) and the width was based on the width of the intake structure (i.e., 143 ft). As a result, the calculated approach velocity in front of the intake structure is approximately 2.0 ft per second (fps) (i.e., 5,868 cfs / (143 ft x 14 ft x 1.5)). This approach velocity is within the range estimated for the previous relicensing effort (Appalachian 1991). This velocity is also comparable to the range of river velocities measured at riffle/run complexes above and below the project (Appalachian 1991). Because no substantial changes have occurred in this area of the New River since the last relicensing, flow conditions in these areas are expected to be the similar to historical conditions. Therefore, it is likely that fish in the vicinity of the intake can navigate intake flows similar to normal river conditions.

5.1.2 Buck Development

5.1.2.1 Intake Specifications

The Buck intake section, which is immediately upstream of the powerhouse, is of concrete construction and consists of three inlet bays. Each bay has a 14-ft-high by 23-ft-wide headgate which is used during maintenance periods. A 3-ft-wide, reinforced-concrete pier is set vertically in the middle of each inlet bay to support the headgate. Each gate is operated by a gear and threaded lift shaft assembly powered by an electric motor. The bays admit water to a concrete volute casing, which channels flow to a vertical-shaft Francis hydraulic turbine, direct-connected to a generator on the upper level of the powerhouse. Flow through the three turbines passes to concrete draft tubes and into the New River downstream of the powerhouse.

The Buck intake structure is approximately 104 ft wide and is equipped with 3/8-inch by 3.5-inch rectangular steel bars. The screen is 39.2 ft high and is inclined toward the powerhouse at approximately 15 degrees to the vertical. The bars are spaced 2.66 inches center-to-center and have a cleared space of 2.28 inches.

5.1.2.2 Intake Flows

The design maximum flow capacity of the three generating units at Buck development is 1,180 cfs each, for a total plant capacity of 3,540 cfs. An evaluation of USGS gage data (USGS 03165500 New River at Ivanhoe) from February 1996 to August 2020 showed that average monthly river flows regularly exceed plant capacity, indicating opportunity for maximum operation at Buck development. An evaluation of spillage to the bypass reach suggests that maximum operations could occur up to 25 percent of the time in an average year during the wetter months (January to May), and up to 98 percent of the time during wet years (see Appendix A of the ISR [Preliminary Bypass Reach Flow and Aquatic Habitat Study Report] for additional spillage information).

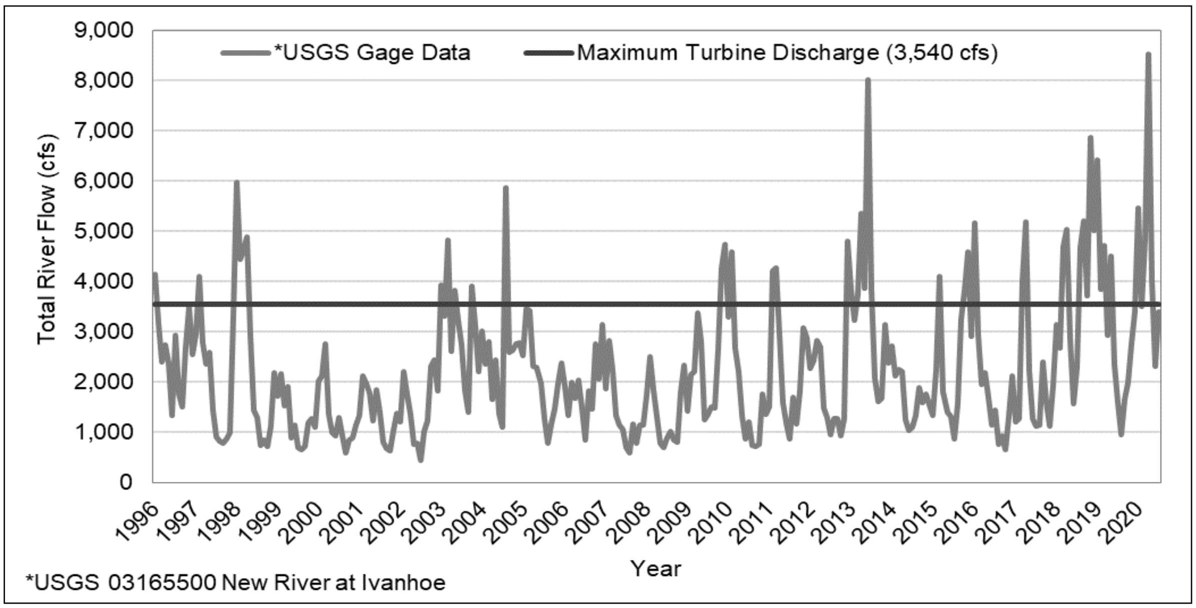


Figure 5-2. USGS 03165500 Gage Data versus Maximum Turbine Discharge (3,540 cfs) at Buck Development Hydroelectric Project

5.1.2.3 Intake Velocities

The approach velocity was calculated by determining the AOI directly in front of the headgate opening and dividing that area into the maximum turbine discharge capacity. For Buck, it was assumed that the height of the AOI is approximately 150 percent of the headgate opening height (i.e., 14-ft x 1.5) and the width was based on the width of the intake structure (i.e., 104 ft). As a result, the calculated approach velocity in front of the intake structure is approximately 1.6 fps (i.e., 3,540 cfs / (104 ft x 14 ft x 1.5)). This approach velocity is within the range calculated in the historical report (Appalachian 1991). This velocity is also within range of river velocities measured at various locations during the prior fish community study (Appalachian 1991). Because no substantial changes have occurred in this area of the New River since the last relicensing and conditions are not anticipated to have changed, it is likely that fish in the vicinity of the intake can navigate intake flows similarly as expected normal river conditions.

5.2 Desktop Review of Impingement and Entrainment Potential

5.2.1 Fish Community and Target Species

A Preliminary Fish Community Study was performed in 2020 to characterize the New River fishery in the vicinity of the Project; details of the methods and results of the study are presented in Attachment 1 of the Aquatic Resources Study Report for the ISR. Data presented here consists of boat electrofishing and gillnet sampling; no backpack electrofishing in non-reservoir areas was completed. Therefore, data are summarized on a by-impoundment basis.

5.2.1.1 Byllesby Development

Preliminary data from Fish Community Study for the Byllesby development includes results from seven boat electrofishing locations and six gillnet sampling locations (site numbers 4-16 as shown in the 2020 Fish Community Study Report). *Lepomis* sunfishes were the most abundant fish group collected during the fall sampling, representing 44.5 percent of collected fish (Table 5-1). Common Carp (*Cyprinus carpio*), black basses (*Micropterus* spp.), and catfishes (Ictaluridae) were the next-most abundant groups. The remaining species (Whitetail Shiner [*Cyprinella galactura*], Walleye [*Sander vitreus*], V-lip Redhorse [*Moxostoma pappillosum*], and Black Crappie) represented less than five percent each of the total fish collected.

Table 5-1. Fish Species Collected at Byllesby Reservoir during 2020 Sampling for the Preliminary Fish Community Study

Common Name	Scientific Name	No. Fish	Relative Abundance (%)
Bluegill	*Lepomis macrochirus*	28	21.9
Common Carp	*Cyprinus carpio*	21	16.4
Redbreast Sunfish	*Lepomis auritus*	19	14.8
Smallmouth Bass	*Micropterus dolomieu*	14	10.9
Channel Catfish	*Ictalurus punctatus*	11	8.6
Walleye	*Sander vitreus*	6	4.7
Whitetail Shiner	*Cyprinella galactura*	6	4.7
Bluegill/Green Sunfish Hybrid	*Lepomis macrochirus x L. cyanellus*	4	3.1
Largemouth Bass	*Micropterus salmoides*	3	2.3
Lepomis Sunfishes.	*Lepomis* spp.	3	2.3
V-lip Redhorse	*Moxostoma pappillosum*	3	2.3
Flathead Catfish	*Pylodictis olivaris*	2	1.6
Green Sunfish	*Lepomis cyanellus*	2	1.6
Rock Bass	*Ambloplites rupestris*	2	1.6
Spotted Bass	*Micropterus punctulatus*	2	1.6

Common Name	Scientific Name	No. Fish	Relative Abundance (%)
Bluegill/Redbreast Sunfish Hybrid	*Lepomis macrochirus x L. auritus*	1	0.8
Black Crappie	*Pomoxis nigromaculatus*	1	0.8
Total		**128**	**100.0**

5.2.1.2 Buck Development

In accordance with the RSP, no gillnet sampling was completed in the Buck Reservoir, therefore all sampling sites for the Fish Community Study in Fall 2020 were completed by boat electrofishing (10 sites; site numbers 23 through 32 as shown in the preliminary Fish Community Study Report – Attachment 1).

Results of the electrofishing effort in the Buck Reservoir showed a relatively different fish community than that observed in the Byllesby Reservoir, with the community dominated equally by *Lepomis* sunfishes and black basses, followed closely by multiple species of shiners (Leuciscinae) (Table 5-2).

Table 5-2. Fish Species Collected at Buck Reservoir during 2020 Sampling for the Preliminary Fish Community Study

Common Name	Scientific Name	No. Fish	Relative Abundance (%)
Whitetail Shiner	*Cyprinella galactura*	29	36.7
Smallmouth Bass	*Micropterus dolomieu*	12	15.2
Redbreast Sunfish	*Lepomis auritus*	10	12.7
Northern Hogsucker	*Hypentelium nigricans*	5	6.3
Rosefin Shiner	*Lythrurus ardens*	4	5.1
Spotfin Shiner	*Cyprinella spiloptera*	4	5.1
Bluegill	*Lepomis macrochirus*	3	3.8
Rock Bass	*Ambloplites rupestris*	3	3.8
Largemouth Bass	*Micropterus salmoides*	2	2.5
Nocomis spp.	*Nocomis* sp.	2	2.5
Green Sunfish	*Lepomis cyanellus*	1	1.3
New River Shiner	*Notropis scabriceps*	1	1.3
River Chub	*Nocomis micropogon*	1	1.3
Spottail Shiner	*Notropis hudsonius*	1	1.3
Swallowtail Shiner	*Notropis procne*	1	1.3
Total		**79**	**100.0**

An evaluation of the 2020 fish sampling data, historical sampling data (Appalachian 1991), historical VDGIF data of New River fishes (Appalachian 1991), and consideration of species of special interest (i.e., Walleye) were used to determine the target species list representative of those species of management (i.e., state/federal protection), economic, and ecological importance (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). Where appropriate, representative or surrogate species were 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 Byllesby-Buck Hydroelectric Project

Common Name	Scientific Name
Black Crappie	*Pomoxis nigromaculatus*
Bullheads and Madtoms	*Ameiurus* spp. and *Noturus* spp.
Catfishes	*Ictalurus* spp.
Common Carp	*Cyprinus carpio*
Darters and Logperch	*Etheostoma* and *Percina* spp.
Largemouth Bass	*Micropterus salmoides*
Lepomis Sunfishes	*Lepomis* spp.
Muskellunge	*Esox masquinongy*
Rock Bass	*Ambloplites rupestris*
Shiners, Chubs, and Minnows	Leuciscinae
Smallmouth Bass	*Micropterus dolomieu*
Spotted Bass	*Micropterus punctulatus*
Suckers and Redhorse	Catostomidae and *Moxostoma* spp.
Walleye	*Sander vitreus*
White Bass	*Morone chrysops*

5.2.2 Intake Avoidance

Burst swim speeds for target or representative species was 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 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 assumed velocities calculated under maximum turbine discharge (5,868 cfs at Byllesby development and 3,540 cfs at Buck development), corresponding to a maximum approach velocities of 2.0 fps and 1.6 fps at Byllesby and Buck developments, respectively. Burst swim speeds found in literature suggest that most fish species and life stages that may be in the vicinity of the intake would be able to avoid entrainment based on approach velocities at the Project (Table 5-4). The life stages most likely to be entrained are larvae, however the larvae of most species in the Project area are unlikely to occur near the intake based on their life history characteristics (i.e., appropriate spawning habitat requirements of adults such as low velocity, riffles, cover, substrate, vegetation, etc.).

Table 5-4. Summary of Fish Burst Swim Speeds by Species

Target Species/Group	Surrogate Species	Age	Length[1]	Burst Swim Speed (fps)[2]	Reference
Black Crappie	White Crappie	Juvenile	3.03	**1.04**	Smiley and Parsons 1997
	White Crappie	Juvenile/ Adult	6.7	**1.19**	Katopodis and Gervais 2016
Catfishes	Channel Catfish x Blue Catfish	Juvenile	6.30-9.06	7.88	Beecham et al. 2009
	Blue Catfish	Juvenile	2.05	**1.97**	Katopodis and Gervais 2016
Common Carp	Common Carp	Juvenile	6.02	2.76-4.59	Tsukamoto et al. 1975
Darters & Logperch	Darters (*Etheostoma* spp.)	Adult	1.42	2.62	Katopodis and Gervais 2016
	Greenside Darter	Adult	1.57-2.68	**1.02**-2.64	Layher 1993
Largemouth Bass	Largemouth Bass	Juvenile	3.5-4.72 (FL)	2.32-3.28	Farlinger and Beamish 1977
		Juvenile	5.04	2.46	Katopodis and Gervais 2016
Lepomis Sunfishes	Sunfish Species	Adult	3.19	4.35	Katopodis and Gervais 2016
	Bluegill	Adult	3.94-5.91	2.44	Gardner et al. 2006
		Juvenile	1.97	2.66	Katopodis and Gervais 2016
	Longear Sunfish	Juvenile/ Adult	2.20-5.35	**1.24**-2.56	Layher 1993
	Pumpkinseed	Adult	5.000	2.44	Brett and Sutherland 1965
	Redbreast Sunfish	Juvenile	1.890	2.32	Katopodis and Gervais 2016
Shiners, Chubs, and Minnows	Emerald Shiner	Adult	2.5	4	Bell 1991
	Golden Shiner	Adult	1.54-4.33	2.02-2.64	Layher 1993

Target Species/Group	Surrogate Species	Age	Length[1]	Burst Swim Speed (fps)[2]	Reference
	Blacknose Dace	Adult	1.60-1.74 (SL)	2.54	Nelson et al. 2003
		Juvenile	1.69	2.02-3.02	Katopodis and Gervais 2016
	Central Stoneroller	Juvenile	1.81	4.13	Katopodis and Gervais 2016
Smallmouth Bass, Spotted Bass	Smallmouth Bass	Larvae	0.55-0.98	**1.2**-1.74	Larimore and Deuver 1968
		Juvenile	3.58-3.66	2.6-3.6	Webb 1998
		Adult	10.3-14.9	3.2-7.8	Bunt et al. 1999
		Adult	11.81	5.77	Katopodis and Gervais 2016
Suckers and Redhorse	Longnose Sucker	Juvenile/ Adult	3.9-16.0	4.0-8.0	Bell 1991
	White Sucker	Adult	6.69-14.57 (FL)	4.96	Huner and Mayor 1986
	Robust Redhorse	Larvae	0.51-0.8	**0.46-0.76**	Reutz and Jennings 2000
	Suckers	Adult	7.05	8.33	Katopodis and Gervais 2016
Walleye	Walleye	Juvenile	6.3 (FL)	6.02 (S)	Peake et al. 2000
		Adult	13.78 (FL)	7.2 (S)	Peake et al. 2000
		Adult	22.44 (FL)	8.57 (S)	Peake et al. 2000
White Bass	Striped Bass	Larvae	0.51	**0.36-0.60**	Bell 1991
		Larvae	0.98	**0.52-1.00**	Bell 1991
		Juvenile	2.01	**1.10-2.00**	Bell 1991
		Juvenile	5.0	2.10-5.00	Bell 1991

[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. (S): startle speed.
Bold text indicates speeds at or below approach velocity at Byllesby (1.0 fps) or Buck (1.6 fps) developments.

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 2020 Preliminary Fish Community Study, resulted in a corresponding width which was then compared to the trash rack spacing at the Project (2.28 in) (Table 5-5).

Most smaller-sized species, such as shiners, darters, minnows, and sunfishes would be able to pass through the trash racks and become entrained at the Project. However, some larger-bodied fishes, including recreationally important species, may be excluded once they reach the minimum size depending on species-specific length-to-width ratios (Table 5-5). Channel Catfish (*Ictalurus punctatus*), Common Carp, Largemouth Bass (*Micropterus salmoides*), Walleye (*Sander vitreus*), and White Sucker (*Catostomus commersonii*) may all be excluded once they reach minimum size, which ranges from 14.5 inches up to 18.5 inches.

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

Common Name	Scaling Factor for Body Width[1]	Maximum Reported Length (in)[2]	Corresponding Body Width (in)	Minimum Size (in) Excluded by Trash Rack at the Project (2.28 in)
River Chub	0.127	8.9	1.1	Not Excluded
Black Crappie	0.099	15.6	1.5	Not Excluded
Blacknose Dace	0.132	2.8	0.4	Not Excluded
Bluegill*	0.132	6.7	0.9	Not Excluded
Bluegill	0.132	8.7	1.1	Not Excluded
Bluntnose Minnow	0.119	4.2	0.5	Not Excluded
Central Stoneroller	0.126	5.9	0.7	Not Excluded
Channel Catfish	0.156	27.6	4.3	14.5
Channel Catfish*	0.156	18.1	2.8	14.5
Common Carp	0.162	27.0	4.4	14.5
Common Carp*	0.162	30.5	4.9	14.5
Common Logperch	0.104	4.7	0.5	Not Excluded
Golden Redhorse	0.127	14.8	1.9	Not Excluded
Golden Shiner	0.105	7.9	0.8	Not Excluded
Green Sunfish*	0.154	5.3	0.8	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	1.6	0.2	Not Excluded
Largemouth Bass*	0.134	17.5	2.3	17.0
Largemouth Bass	0.134	25.6	3.4	17.0
Longear Sunfish	0.153	5.9	0.9	Not Excluded
Longnose Dace	0.139	3.3	0.5	Not Excluded

Common Name	Scaling Factor for Body Width[1]	Maximum Reported Length (in)[2]	Corresponding Body Width (in)	Minimum Size (in) Excluded by Trash Rack at the Project (2.28 in)
Mimic Shiner	0.101	2.2	0.2	Not Excluded
Northern Hog Sucker*	0.146	4.4	0.6	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	7.4	1.1	Not Excluded
Redbreast Sunfish	0.150	7.3	1.1	Not Excluded
Rock Bass*	0.155	4.4	0.7	Not Excluded
Rock Bass	0.155	7.9	1.2	Not Excluded
Smallmouth Bass*	0.128	13.0	1.7	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	3.3	0.5	Not Excluded
Spottail Shiner	0.140	3.5	0.5	Not Excluded
Spotted Bass*	0.128	2.7	0.3	Not Excluded
Spotted Bass	0.128	15.0	1.9	Not Excluded
Walleye	0.125	21.8	2.7	18.5
Walleye	0.125	15.4	1.9	Not Excluded
Warmouth	0.140	7.9	1.1	Not Excluded
White Crappie*	0.085	4.5	0.4	Not Excluded
White Crappie	0.085	15.7	1.3	Not Excluded
White Sucker	0.146	15.7	2.3	16.0
Yellow Bullhead	0.172	11.8	2.0	Not Excluded

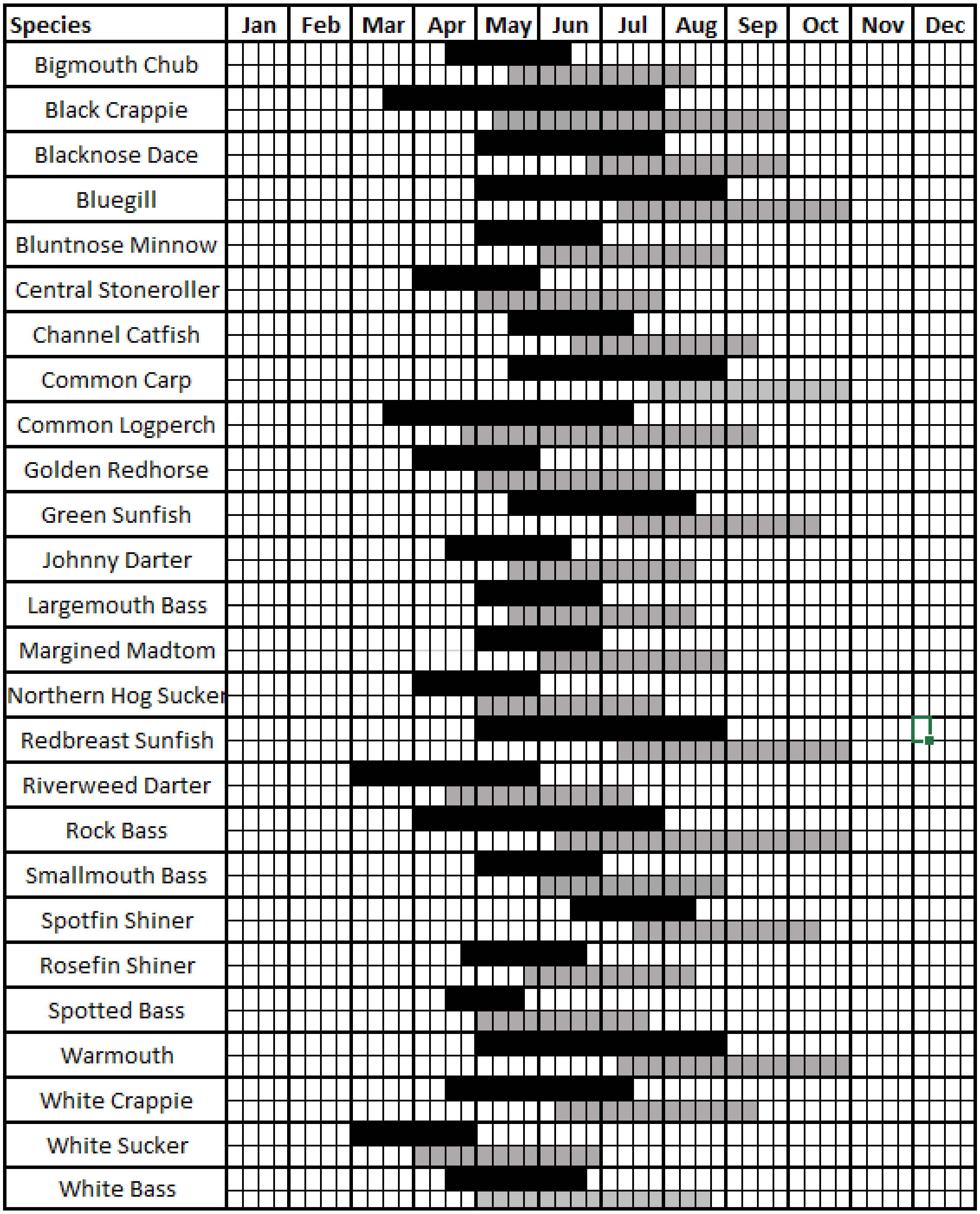
[1] Scaling factor (Smith 1985) expresses body width as a function of length based on proportional measurements.
[2] Maximum length reported by Jenkins and Burkhead (1993).
*Species and length collected in the Preliminary 2020 Fish Community Study.

5.2.4 Early Life Stage Entrainment Susceptibility

The early life stages of fish (eggs and larvae) are unable to move independently (eggs) or have limited swimming ability (larvae), and therefore are at the mercy of the current and susceptible to entrainment at the Project. An assessment of target and representative species shows that the majority of species have spawning periods from late April through June, with subsequent egg and larvae development from late May through August (Table 5-6). Some species or groups, such as *Lepomis* sunfish, have long spawning periods with corresponding prolonged windows of egg and larvae development, increasing their risk of entrainment. However, this group, like others in the Centrarchidae family, guard nests constructed in shallow areas with cover (i.e., vegetation, woody debris, etc.) and newly hatch larvae use the cover for protection from predation, which also helps reduce the risk of entrainment to early life stages. 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). A summary of 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 more than one foot at each development), 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.

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



Spawning Period (Stauffer et al. 1995; Jenkins and Burkhead 1993)

Eggs and larvae (estimated to begin two-thirds of the way through the spawning period and lasting 60 days post spawn)

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 substantially 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 six inches in length or smaller were the majority (88 percent) of entrained fish (Figure 5-3) overall, 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.

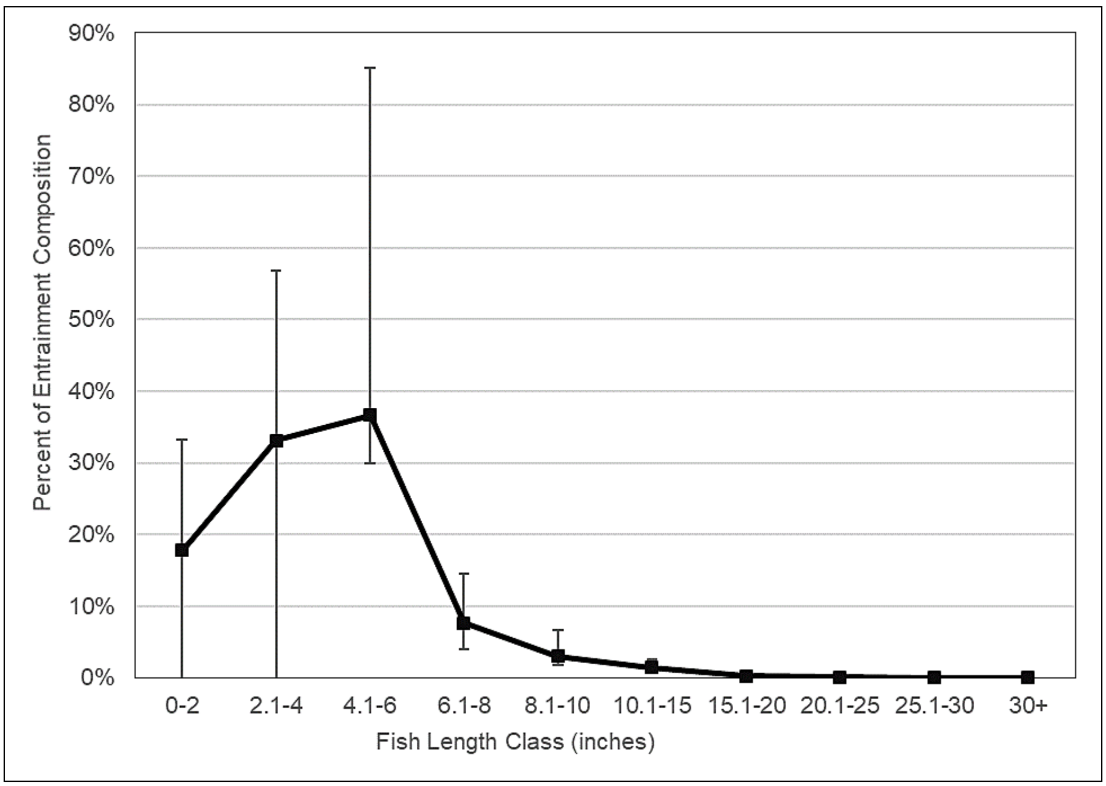


Figure 5-3. Mean Percent (standard deviation) of Entrainment Composition by Fish Size Class According to Target Species from 33 Hydroelectric Developments (EPRI 1997)

Table 5-7. Annual and Seasonal Entrainment Rates of Target Species and Species Groups by Fish Size Class

Fish Size (total length)	Average Monthly Entrainment Rate by Season (fish/hr)				
	Winter	Spring	Summer	Fall	Annual
Entrainment Rate (fish/hr) at Byllesby Development (5,868 cfs)					
<4 inch	0.35	0.85	0.98	0.58	**0.69**
4-8 inch	0.47	0.28	0.50	1.48	**0.68**
8-15 inch	0.07	0.06	0.06	0.08	**0.07**
>15 inch	0.00	0.00	0.00	0.00	**0.00**
Total	**0.88**	**1.21**	**1.54**	**2.14**	**1.44**
Entrainment Rate (fish/hr) at Buck Development (3,540 cfs)					
<4 inch	0.21	0.51	0.59	0.35	**0.42**
4-8 inch	0.28	0.17	0.30	0.89	**0.41**
8-15 inch	0.04	0.04	0.04	0.05	**0.04**
>15 inch	0.00	0.00	0.00	0.00	**0.00**
Total	**0.53**	**0.73**	**0.93**	**1.29**	**0.87**
Note: Values represent average fish/hr entrainment from 33 sites selected from the EPRI database and adjusted for maximum turbine discharge (cfs) at each Project development.					

Seasonal entrainment rates from the EPRI (1997) database by target species and species group is presented in Table 5-8 for Byllesby development and Table 5-9 for Buck development. These include average entrainment rates by fish species and size class, combined by month and averaged by season. Mean monthly seasonal entrainment rates by target species/group and size is provided in Appendix C for Byllesby development and Appendix D for Buck development.

Rock Bass (*Ambloplites rupestris*), catfishes, suckers and redhorses, *Lepomis* sunfishes, and Black Crappie, Largemouth Bass, darters and logperch, and shiners, chubs, and minnows represent the top 90 percent of target species and species groups entrained at the Byllesby and Buck developments based on the EPRI (1997) database (Table 5-8 and Table 5-9). Peaking months of entrainment for these species and species groups varied: Rock Bass, suckers and redhorse, and *Lepomis* sunfishes showed highest entrainment rates in fall; catfishes, Black Crappie, and Largemouth Bass entrainment rates were greatest during the summer season; darters and logperch peaked during spring months, and shiners, chubs, and minnows had relatively even entrainment rates throughout the year.

Entrainment rates were highest from April to October, with peaks in April, July, and October (Figure 5-4). Peaking months may correspond to spawning movements (April), recruitment to catchable size (July or October), or large storm/flow events.

Table 5-8. Seasonal and Annual Entrainment Rates for Target Species and Species Groups at Byllesby Development (5,868 cfs)

Target Species/Group	Average Monthly Entrainment Rate (fish/hr) by Season				
	Winter	Spring	Summer	Fall	Annual
Rock Bass	4.69	6.09	4.49	12.70	6.99
Catfishes	0.59	10.07	15.72	1.05	6.86
Suckers and Redhorse	3.93	2.06	2.52	8.78	4.32
Lepomis Sunfishes	0.40	4.24	3.90	7.55	4.02
Black Crappie	1.03	1.06	6.73	4.35	3.29
Largemouth Bass	0.32	0.37	4.27	1.71	1.67
Darters and Logperch	0.29	4.53	1.03	0.24	1.52
Shiners, Chubs, and Minnows	1.02	1.35	1.38	1.50	1.31
Walleye	0.71	0.37	3.03	0.63	1.19
Bullheads and Madtoms	0.15	1.01	1.98	0.44	0.89
Smallmouth Bass	0.12	0.15	1.47	1.13	0.72
White Bass	0.09	1.20	0.09	0.13	0.38
Muskellunge	0.11	0.55	0.53	0.22	0.35
Common Carp	0.03	0.04	0.10	0.04	0.05
Total	**13.48**	**33.09**	**47.24**	**40.47**	**33.56**

Top 90 percent of species by relative abundance on annual basis.

Table 5-9. Seasonal and Annual Entrainment Rates for Target Species and Species Groups at Buck Development (3,540 cfs)

Target Species/Group	Average Monthly Entrainment Rate (fish/hr) by Season				
	Winter	Spring	Summer	Fall	Annual
Rock Bass	2.83	3.67	2.71	7.66	4.22
Catfishes	0.36	6.08	9.48	0.64	4.14
Suckers and Redhorse	2.37	1.24	1.52	5.30	2.61
Lepomis Sunfishes	0.24	2.56	2.35	4.56	2.43
Black Crappie	0.62	0.64	4.06	2.63	1.99
Largemouth Bass	0.19	0.22	2.57	1.03	1.01
Darters and Logperch	0.17	2.73	0.62	0.15	0.92
Shiners, Chubs, and Minnows	0.62	0.81	0.84	0.91	0.79
Walleye	0.43	0.23	1.83	0.38	0.72
Bullheads and Madtoms	0.09	0.61	1.19	0.27	0.54
Smallmouth Bass	0.07	0.09	0.88	0.68	0.43
White Bass	0.06	0.72	0.05	0.08	0.23
Muskellunge	0.07	0.33	0.32	0.13	0.21
Common Carp	0.02	0.02	0.06	0.03	0.03
Total	**8.14**	**19.95**	**28.48**	**24.45**	**20.27**

Top 90 percent of species by relative abundance on annual basis.

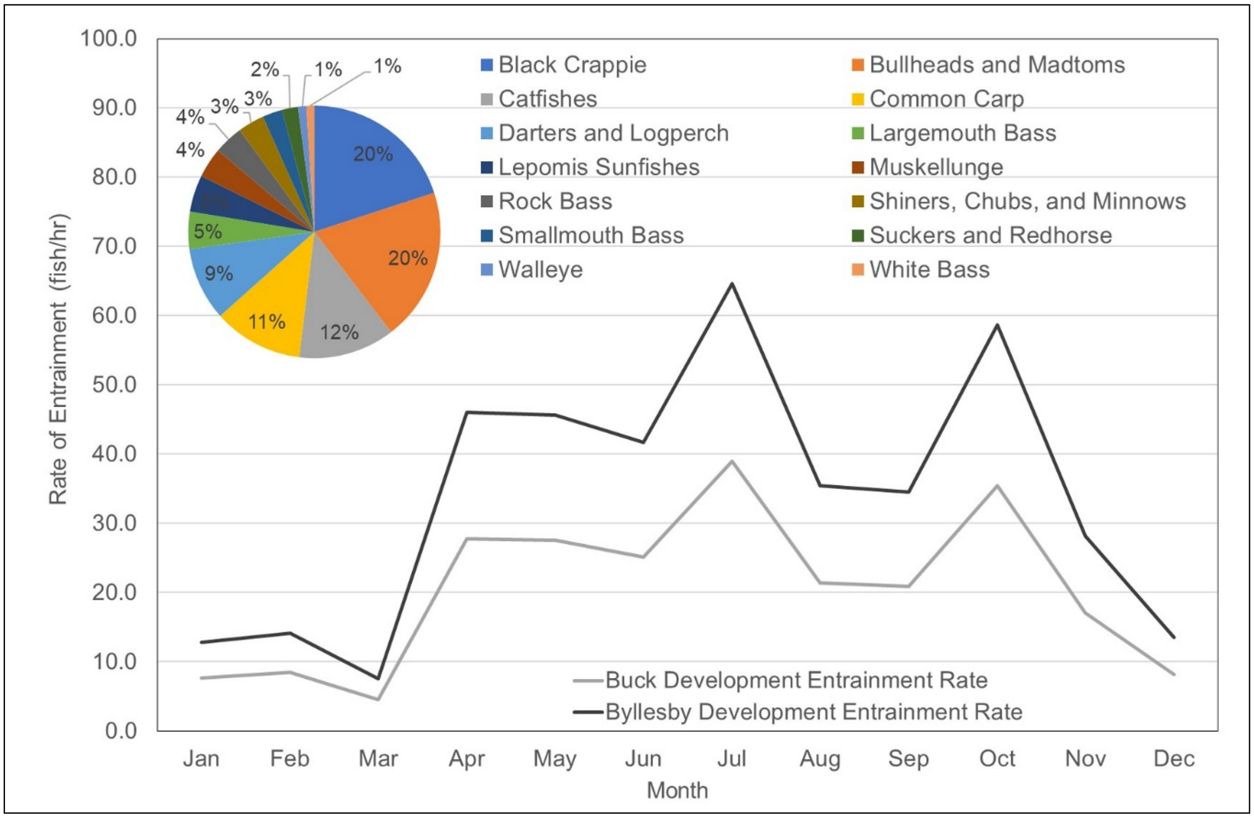


Figure 5-4. Average Monthly Entrainment Rate and Species Composition based on EPRI (1997) Entrainment Database Selections for the Byllesby-Buck Hydroelectric Project

5.3 Qualitative Assessment of Turbine Entrainment Potential

Several factors were considered for qualitative entrainment potential ratings for target species at the Project, including:

- Entrainment rates for each species and species group provided in the EPRI (1997) database;
- Maximum turbine discharge frequency (see Section 5.1);
- 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); and
- Life history characteristics, such as migratory behavior, habitat preferences, spawning behavior/requirements, and early life stage periodicity (see Section 5.2.4).

Although few fish species in the vicinity of the Project developments 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 rankings were driven by increased entrainment rates based on the EPRI (1997) database, which has limited velocity data for comparison.

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 5.2.4 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 and Table 5-11).

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.

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.

5.3.1 Species-specific Considerations

Since the same selection of data from the EPRI (1997) database was applied to both facilities, trends across species are similar, and therefore the considerations given below apply to both Byllesby and Buck developments (Table 5-10 and Table 5-11). However, slight differences in qualitative ratings may also be due to differences in total plant capacity.

The majority (59 percent) of catfishes entrained from May to July, based on the EPRI (1997) database, were of the 2-4-inch size class. Since swim burst speed data suggests that catfish of this size are able to swim faster than the intake velocity (1.97 fps [Katopodis and Gervais 2016] versus 1.0 fps; see Table 5-4), the qualitative rating for this species group was designated as moderate (M) for these months despite the relatively high entrainment rate in the EPRI (1997) database.

Similarly, the analysis indicated that Rock Bass have increased entrainment rates during the months of April, October, and November. Most fish estimated to be entrained in April were of the 2 to 4-inch size class, therefore this month was given an elevated entrainment potential rating. However, the majority of Rock Bass estimated to be entrained in October and November were larger in size (4-6 inches). Based on similar body size and shape as *Lepomis* species, swim burst speeds are likely similar and sufficient to also exclude them from susceptibility to entrainment at the Project. Therefore, the entrainment potential rating for Rock Bass was determined to be low-moderate (L-M).

Black Crappie exhibited higher entrainment rates in July and August based on the EPRI (1997) database; these fish were mostly 0-2 inches (60 percent) or 2-4 inches (39 percent) total length, and therefore likely juvenile fish. Black Crappie of this size (using White Crappie as a surrogate) do not have a swim burst speed substantially greater than the intake velocity, therefore the entrainment potential rating for Black Crappie was elevated to moderate-high (M-H).

Lepomis sunfish had higher entrainment rates for the months of April and September. In April, most of the fish were of the 2-4 and 4-6-inch size classes (45 and 52 percent, respectively). In October, 91 percent of *Lepomis* sunfish entrained were within the 4-6-inch size class. Since almost half of the sunfish collected in April were relatively small, and with consideration of swim burst speeds for juvenile fishes, the rating for April was elevated. However, since the sunfishes estimated for October are larger and likely able to navigate intake flows adequately to avoid entrainment, the entrainment potential rating was determined to be low-moderate.

While entrainment rates of darters and logperch were low throughout the year, rates were slightly elevated in April and May. However, based on the required habitat of most species in the *Etheostoma* and *Percina* genera, these taxa are not expected to be found in the vicinity of the intake and at risk of entrainment. Therefore, ratings for these months were determined to be low-medium or low.

Suckers and redhorse were another group with elevated entrainment rates, which peaked in October and November. The November data shows elevated entrainment rates reported from several facilities, however entrainment in October was primarily driven by fish within the 4 to 6-inch size class from one facility. This single report accounted for 98 percent of the estimated entrainment of 4 to 6-inch fish for that month. With this consideration and the high burst swim speeds exhibited by suckers and redhorse (Section 5.2.2), the qualitative entrainment potential rating was determined to be moderate (M).

Table 5-10. Range of Monthly Turbine Entrainment Potential for the Target Species at the Byllesby Development

Target Species/Group	Qualitative Rating of Monthly Entrainment Potential*											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Black Crappie	L	L	L	L	L	L	M-H	M	L-M	L-M	L-M	L
Bullheads and Madtoms	L	L	L	L	L	L	L-M	L	L	L	L	L
Catfishes	L	L	L	L	M	M	M	M	L	L	L	L
Common Carp	L	L	L	L	L	L	L	L	L	L	L	L
Darters and Logperch	L	L	L	L-M	L-M	L	L	L	L	L	L	L
Largemouth Bass	L	L	L	L	L	L-M	M	L-M	L-M	L	L	L
Lepomis Sunfishes	L	L	L	M-H	L-M	L	L-M	L-M	L-M	L-M	L	L
Muskellunge	L	L	L	L	L	L	L	L	L	L	L	L
Rock Bass	L	L-M	L	M	L	L-M	L-M	L-M	L-M	L-M	L-M	L-M
Shiners, Chubs, and Minnows	L	L	L	L	L	L	L	L	L	L	L	L
Smallmouth Bass	L	L	L	L	L	L	L	L	L	L	L	L
Suckers and Redhorse	L-M	L-M	L	L	L	L	L-M	L	L	M	M	L-M
Walleye	L	L	L	L	L	L-M	L-M	L	L	L	L	L
White Bass	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)												

Table 5-11. Range of Monthly Turbine Entrainment Potential for the Target Species at the Buck Development

Target Species/Group	Qualitative Rating of Monthly Entrainment Potential*											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Black Crappie	L	L	L	L	L	L	M-H	L-M	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	M	M	L-M	L	L	L	L
Common Carp	L	L	L	L	L	L	L	L	L	L	L	L
Darters and Logperch	L	L	L	L	L	L	L	L	L	L	L	L
Largemouth Bass	L	L	L	L	L	L	L-M	L	L	L	L	L
Lepomis Sunfishes	L	L	L	M	L	L	L	L-M	M	L-M	L	L
Muskellunge	L	L	L	L	L	L	L	L	L	L	L	L
Rock Bass	L	L-M	L	L-M	L	L	L	L-M	L-M	L-M	L-M	L-M
Shiners, Chubs, and Minnows	L	L	L	L	L	L	L	L	L	L	L	L
Smallmouth Bass	L	L	L	L	L	L	L	L	L	L	L	L
Suckers and Redhorse	L	L	L	L	L	L	L	L	L	M	L-M	L
Walleye	L	L	L	L	L	L	L	L	L	L	L	L
White Bass	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)

5.4 Turbine Blade Strike Analysis

As stated previously, the historical entrainment study completed for the prior license (Appalachian 1991a) concluded that impacts due to turbine passage on the fish population in the vicinity of the Project was negligible. A new turbine blade strike analysis will be performed for the Project in 2021 when the final results are available from the Preliminary Fish Community Study. The evaluation will be performed using the most recent version available of the Turbine Blade Strike model, mean and standard deviation of fish lengths based on fish data collected during the 2020-2021 Fish Community Study, and site-specific inputs for required model parameters, as summarized in Table 5-12.

Table 5-12. Unit Turbine Characteristics at Byllesby-Buck Hydroelectric Project

Term	Units	Description	Byllesby and Buck*	
			Byllesby	Buck
Turbines	*(#)*	Number of Turbines	4	3
Blades	*(#)*	Number of blades on the turbine runner	16	16
Type	*(-)*	Francis, Kaplan, propeller, or bypass	Vertical shaft Francis	Vertical shaft Francis
Net Head	*(ft)*	Net head on the turbine; HW to TW, less head loss through system	49	34
Runner Dia. 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)	9.833	9.833
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)	8.75	8.75
Runner Diameter	*(ft)*	Nominal diameter of runner; maximum radius is assumed to be 1/2 of diameter	7.521	7.521
Runner Height	*(ft)*	Runner height at inlet (see Figure 4.3.2-3 in Franke et al., 1997 for clarification)	3.0625	3.0625
Speed	*(rpm)*	Runner revolutions per minute (model automatically converts to radians per second)	116	97
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	1,420	1,050
Turbine Efficiency	*(-)*	Ratio of output shaft power to input fluid power; typ. from vendor curves or index testing	89%	85%
Turbine Discharge	*(cfs)*	Turbine discharge at optimal efficiency	1,120	955
Discharge at Opt. Efficiency	%	Ratio of turbine discharge at best efficiency to hydraulic capacity	78.9%	91.0%
Model Routes		Unit 1, Unit 2, bypass channel, main spillway		
Bypass/Spillway Mortality		Estimated as 20%		

*The Project operates in run-of-river mode.

6 Summary

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

- The preliminary findings of this study concur with the historical entrainment study completed for the prior relicensing in that effects to the fish community in the Project vicinity are expected to be minimal.
- Most fish would not be excluded by the intake trash racks, however velocities in front of the intake are comparable to normal flow conditions of the New River and would therefore likely be navigable by most juvenile and adult fish in the area.
- Entrainment of early life stage fishes (eggs and larvae) is likely minimal given the life history characteristics of species in the vicinity of the Project.
- Susceptibility to entrainment is variable depending on species and time of year, however most target species and species groups have low entrainment potential for most of the year.
- A blade strike analysis will be performed in 2021 with results to be provided with the Updated Study Report.

7 Variances from FERC-approved Study Plan

The Preliminary Fish Impingement and Entrainment Study was conducted in full accordance with the methods described in the RSP. In accordance with the RSP, the turbine blade strike analysis will be completed in 2021, following completion of the remaining field sampling efforts for the Fish Community Study, using the most recent USFWS Turbine Blade Strike Analysis model (USFWS 2020) described in Section 4.2.3.

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. 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.

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Appendix A

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

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Table 1. Electric Power Research Institute Entrainment Database[1] Sites Used for the Byllesby-Buck 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 (ft/sec)	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	1,377	3	PK-partial	1	1.62
4	Caldron Falls	WI	Peshtigo	1,180	-	-	-	-	-	1,300	2	PK	-	2
5	Centralia	WI	Wisconsin	250	-	-	0	2	1400	3,640	6	ROR	2.3	3.5
6	Colton	NY	Raquette	195	620	103	0.5	-	-	1,503	3	PK	-	2
7	Crowley	WI	N.F. Flambeau	422	3,539	-	1	-	-	2,400	2	ROR	1.4	2.375
8	Feeder Dam	NY	Hudson	-	-	-	-	-	-	5,000	5	PK	-	2.75
9	Four Mile Dam	MI	Thunder Bay	1,112	2,500		0.5	-	-	1,500	3	ROR	-	2
10	Grand Rapids	MI/ WI	Menominee	250	-	-	0.5	-	-	3,870	5	ROR	-	1.75
11	Herrings	NY	Black	140	-	-	-	-	-	3,610	3	ROR	-	4.125
12	High Falls - Beaver River	NY	Beaver	145	1,058	290	-	-	-	900	3	-	0.7	1.81
13	Higley	NY	Raquette	742	4,446	-	1.5	-	-	2,045	3	PK	-	3.63
14	Hillman Dam	MI	Thunder Bay	988	1,600	-	-	-	-	270	1	ROR	-	3.25
15	Johnsonville	NY	Hoosic	450	6,430	540	6.5	-	-	1,288	2	PK	-	2
16	Kleber	MI	Black	270	3,000	-	0	0.9	-	400	2	ROR	1.41	3
17	Lake Algonquin	NY	Sacandaga	-	-	-	-	-	-	750	1	-	-	1
18	Luray	VA	S.F. Shenandoah	-	-	-	-	-	-	1,477	3	ROR	-	2.75

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 (ft/sec)	Trash Rack Spacing (inch)
19	Minetto	NY	Oswego	350	4,730	290	1.8	-	-	7,500	5	PULSE	2.4	2.5
20	Moshier	NY	Beaver	365	7,339	680	3	-	-	660	2	PK	-	1.5
21	Ninth Street Dam	MI	Thunder Bay	9,884	2,600	-	0.5	-	-	1,650	3	ROR	-	1
22	Norway Point Dam	MI	Thunder Bay	10,502	3,800	-	0.5	-	-	1,775	2	ROR	-	1.69
23	Potato Rapids	WI	Peshtigo	288	-	-	-	-	-	1,380	3	ROR	-	1.75
24	Raymondville	NY	Raquette	50	264	-	1	-	-	1,640	1	PK	-	2.25
25	Sandstone Rapids	WI	Peshtigo	150	-	-	-	-	-	1,300	2	PK	-	1.75
26	Schaghticoke	NY	Hoosic	164	1,150	120	6.5	-	-	1,640	4	ROR	-	2.125
27	Sherman Island	NY	Hudson	305	6,960	1,060	3.7	-	-	6,600	4	PK	-	3.125
28	Thornapple	WI	Flambeau	295	1,000	295	1.5	4	600	1,400	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	1,065	-	-	-	8.75	-	3,200	-	ROR	-	3
31	Warrensburg	NY	Schroon	-	-	-	-	-	-	1,350	1	-	-	-
32	White Rapids	MI/ WI	Menominee	435	5,155	415	1	2.3	580	3,994	3	PK-partial	1.9	2.5
33	Wisconsin River Division	WI	Wisconsin	240	1,120	-	0	2.5	1,000	5,150	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-feet; mi=mile; cfs=cubic feet per second; ft/sec=feet per second

Appendix B

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

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Black Crappie - *Pomoxis 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.

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 (VDGIF 2017b). They live in deep, slow pools of swift, clear-running streams. They are often found below dams in large reservoirs.

Spawning occurs from late May through July when water temperatures reach the mid-70s (VDGIF 2017b). 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.

Common Carp – *Cyprinus carpio*

Common Carp are indigenous to Asia and was first introduced to Virginia in the 1870s (Jenkins and Burkhead 1993). It is an adaptable species found in a range of habitats except for high-gradient, small coldwater streams or habitats with extreme conditions, such as hot springs or very-low pH waters. It prefers sluggish pools with vegetation and soft bottoms. It is an omnivore and will feed on aquatic and terrestrial insects, small fish, plants, and organic matter.

Spawning occurs from late March to August, and possible into September (Jenkins and Burkhead). Common Carp spawn in backwaters and sloughs, and along shorelines of impoundments over vegetation or tree roots. Eggs are adhesive and demersal.

Common Logperch – *Percina caprodes*

Common Logperch are found throughout the Ohio basin and in several drainages of the southwestern Mississippi basin (Jenkins and Burkhead 1993). In Virginia, they are in the upper Tennessee drainage in the Valley and Ridge Province, but generally not found in the Blue Ridge. This species inhabits warm streams to large rivers with moderate gradient; it can also be found in lakes and reservoirs, however it is associated with gravels and cobble in riffles, runs, and pools. Common Logperch feed on a variety of insects and invertebrates, often by turning over stones.

Spawning occurs on sand or gravel in swift current of streams or near shores of lakes, from mid-March to mid-July (Jenkins and Burkhead 1993). It is not a territorial spawner and often forms spawning groups. Eggs are buried by the spawning act or otherwise eaten by logperches and suckers.

Johnny Darter – *Etheostoma nigrum*

The Johnny Darter is found throughout Hudson Bay, Great Lakes, Mississippi, and Mobile basins (Jenkins and Burkhead 1993). It inhabits warm, moderate-gradient creeks, streams, and rivers, and rarely in lacustrine habitats. It prefers pools and slow runs with rubble, gravel, sand, silt, or detritus substrates.

Johnny Darter spawn from mid-March to mid-May in shallow parts of streams in slow to moderate current (Jenkins and Burkhead 1993). Nests have cover consisting of shelving stones, wood, tiles and cans, or other shelf-like materials and cover. Eggs are attached in a single layer to the underside of the nesting cover and the nest is territorially defended by the male.

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.

***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.

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.

Muskellunge – *Esox masquinongy*

Muskellunge are native from the St. Lawrence to the Great Lakes, the upper Mississippi basin and Ohio basin (Jenkins and Burkhead 1993). It is unclear as to whether Muskellunge are native to Virginia. Muskellunge are found in lakes, reservoirs, and slow-moving parts of rivers. It prefers vegetative cover and structure such as brush piles, logs, bars, and rock outcrops. It is a voracious piscivore.

Spawning begins when water is between 49 and 60°F (Jenkins and Burkhead 1993). Muskellunge move to the shallows of streams and in lakes in northern areas, usually over detritus or living vegetation.

Northern Hogsucker – *Hypentelium nigricans*

Northern Hogsucker are widespread through the Great Lakes, upper Mississippi and Ohio basins, and present in certain drainages of the Gulf and south Atlantic slopes (Jenkins and Burkhead 1993). In Virginia, it is found in many of the major drainages. It is found in a range of habitats from large creeks to small rivers in upland and montane areas with cool or warm waters and gravelly or rocky bottoms. They feed on immature aquatic insects and microcrustaceans, small mollusks, and rarely, fish eggs. Spawning occurs in April and May, when they may or may not move into streams to reproduce. Northern Hogsucker prefers to spawn in gravelly tails of pools, riffles, or runs.

Rock Bass - *Ambloplites rupestris*

Rock Bass are native only to the Tennessee and Big Sandy drainages, but has been introduced to the New and all other 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.

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

Smallmouth Bass are native to Virginia (VDGIF 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 (VDGIF 2017a).

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 (VDGIF 2017b). Eggs hatch between 7 and 21 days after fertilization, depending on the water temperature (Smith 1985).

Walleye – *Sander vitreus*

Walleye are native from Canada to the Great Lakes and Mississippi basin, and widely introduced outside of its indigenous range (likely including those on the Atlantic slope south of the St. Lawrence) (Jenkins and Burkhead 1993). Walleye are found in a wide variety of habitats, including rivers with low to moderate gradient, lakes and impoundments greater than 400 acres in size. Bottom types include detritus, sand, gravel, rubble, and boulder. Walleye, like Muskellunge, are voracious predators, and are known to be cannibalistic.

Walleye spawning occurs within a three-week window from March to June, soon after ice-out (Jenkins and Burkhead 1993). They congregate and migrate short distances to spawning grounds. Spawning usually occurs at night over gravel or rock substrate in shallow areas of lakes and rivers.

They rarely spawn in vegetation or flooded areas. In rivers, spawning will take place in runs and reservoir tailwaters, but also in riffles. Eggs are broadcast over the bottom where they drop into crevices.

White Bass – *Morone saxatilis*

White Bass are native to the Atlantic Slope and was introduced across the U.S. (Jenkins and Burkhead 1993). It is an anadromous schooling fish that lives in large freshwater rivers, small and large estuaries, and the ocean. While many inland reservoirs support White Bass fisheries, these populations are generally stocked as they are not able to spawn naturally. They are predatory generalists and feed on open water species such as clupeids, and to a lesser extent littoral species such as black basses or crappies.

Whitetail Shiner – *Cyprinella galactura*

Whitetail Shiner was the most common shiner collected in the 2020 Fish Community Study. Whitetail Shiner is native to Tennessee and Cumberland drainages and part of the southern Ozarks (Jenkins and Burkhead 1993). It is considered native, though possibly introduced, to other drainages on the Atlantic slope. It feeds on a diverse array of allochthonous and benthic organisms such as worms, mites, insects, larval fish, and plant material.

Whitetail Shiners spawn from late May to August in Virginia (Jenkins and Burkhead 1993). Spawning occurs in shallow moderate-current runs and adjacent pools, where eggs are typically deposited above the bottom in crevices or underside of boulders, sticks, or trash. Males are territorial.

Yellow Bullhead – *Ameiurus natalis*

The Yellow Bullhead is commonly found in in shallow, soft-bottomed warm lakes, ponds, and reservoirs or slow-moving streams with emergent vegetation. This species lays eggs in saucer-shaped depressions beside or beneath banks, tree roots, logs, in burrows or along the bottom under debris (Becker 1983). Spawning occurs in spring and early summer, with eggs hatching out in 5-10 days. Nests and compact schools of young are guarded by parents until they reach approximately 50 mm in length. Sexual maturity for this species is believed to occur at age of 2-3 years.

Appendix C

Appendix C – Mean Monthly Entrainment Rates (Fish/Hour) for Target Species/Groups at Byllesby Development

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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	0.17	0.08	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00
Feb	0.06	0.38	0.03	0.03	0.00	0.00	0.00	0.00	0.00	0.00
Mar	0.01	0.08	0.03	0.15	0.03	0.01	0.00	0.00	0.00	0.00
Apr	0.07	1.06	0.19	0.92	0.10	0.05	0.00	0.00	0.00	0.00
May	0.01	0.32	0.04	0.10	0.02	0.00	0.00	0.00	0.00	0.00
Jun	0.09	0.22	0.04	0.08	0.02	0.00	0.00	0.00	0.00	0.00
Jul	10.31	0.47	0.04	0.05	0.00	0.00	0.00	0.00	0.00	0.00
Aug	1.50	7.13	0.04	0.10	0.06	0.01	0.00	0.00	0.00	0.00
Sep	0.47	4.27	0.11	0.06	0.03	0.01	0.00	0.00	0.00	0.00
Oct	0.47	3.79	0.15	0.03	0.02	0.01	0.00	0.00	0.00	0.00
Nov	0.13	3.31	0.17	0.03	0.01	0.00	0.00	0.00	0.00	0.00
Dec	0.03	2.24	0.02	0.00	0.01	0.00	0.00	0.00	0.00	0.00
Grand Total	**13.32**	**23.33**	**0.88**	**1.57**	**0.30**	**0.10**	**0.00**	**0.00**	**0.00**	**0.00**

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	0.00	0.04	0.04	0.00	0.02	0.00	0.00	0.00	0.00	0.00
Feb	0.04	0.10	0.00	0.02	0.06	0.00	0.00	0.00	0.00	0.00
Mar	0.03	0.08	0.04	0.05	0.05	0.00	0.00	0.00	0.00	0.00
Apr	0.09	0.39	0.13	1.25	0.35	0.11	0.00	0.00	0.00	0.00
May	0.03	0.25	0.08	0.05	0.04	0.03	0.00	0.00	0.00	0.00
Jun	0.01	0.21	0.14	0.39	0.36	0.11	0.00	0.00	0.00	0.00
Jul	0.67	0.10	0.28	1.91	0.21	0.06	0.00	0.00	0.00	0.00
Aug	0.07	0.20	0.47	0.66	0.07	0.02	0.00	0.00	0.00	0.00
Sep	0.04	0.16	0.20	0.24	0.09	0.01	0.00	0.00	0.00	0.00
Oct	0.01	0.18	0.03	0.06	0.06	0.01	0.00	0.00	0.00	0.00
Nov	0.02	0.10	0.04	0.04	0.03	0.00	0.00	0.00	0.00	0.00
Dec	0.02	0.09	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00
Grand Total	**1.04**	**1.89**	**1.46**	**4.66**	**1.33**	**0.35**	**0.01**	**0.00**	**0.00**	**0.00**

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	0.19	0.23	0.05	0.00	0.00	0.03	0.00	0.00	0.00	0.00
Feb	0.57	0.41	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mar	0.20	0.26	0.04	0.23	0.01	0.00	0.00	0.00	0.00	0.00
Apr	0.05	0.57	0.31	0.07	0.04	0.02	0.00	0.00	0.00	0.00
May	0.06	23.50	1.19	0.72	2.40	0.57	0.00	0.00	0.00	0.00
Jun	0.18	10.23	1.16	2.66	4.35	0.39	0.01	0.01	0.00	0.00
Jul	12.77	6.63	0.34	0.66	0.48	0.05	0.00	0.00	0.01	0.01
Aug	4.56	1.35	0.52	0.26	0.33	0.25	0.00	0.00	0.00	0.00
Sep	0.68	0.66	0.14	0.16	0.30	0.08	0.00	0.00	0.00	0.00
Oct	0.23	0.25	0.03	0.00	0.02	0.00	0.00	0.00	0.00	0.00
Nov	0.08	0.48	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dec	0.00	0.10	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Grand Total	**19.55**	**44.68**	**4.01**	**4.75**	**7.91**	**1.39**	**0.01**	**0.01**	**0.01**	**0.01**

Target Species/Group: Common Carp

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	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.00	0.00
Feb	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mar	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Apr	0.00	0.02	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00
May	0.00	0.01	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00
Jun	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00
Jul	0.05	0.07	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00
Aug	0.00	0.06	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sep	0.00	0.02	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00
Oct	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00
Nov	0.00	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dec	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Grand Total	**0.12**	**0.23**	**0.11**	**0.02**	**0.01**	**0.01**	**0.03**	**0.10**	**0.00**	**0.00**

Target Species/Group: Darters and 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	0.00	0.31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Feb	0.18	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mar	0.09	0.24	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Apr	1.02	6.45	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00
May	4.61	1.06	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Jun	0.49	0.69	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Jul	1.32	0.39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Aug	0.08	0.09	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sep	0.03	0.13	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Oct	0.02	0.20	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nov	0.01	0.10	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dec	0.07	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Grand Total	**7.92**	**9.96**	**0.40**	**0.00**	**0.00**	**0.01**	**0.00**	**0.00**	**0.00**	**0.00**

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	0.00	0.33	0.09	0.00	0.00	0.00	0.02	0.00	0.00	0.00
Feb	0.00	0.18	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mar	0.02	0.09	0.02	0.01	0.01	0.01	0.00	0.00	0.00	0.00
Apr	0.04	0.27	0.00	0.03	0.00	0.34	0.00	0.00	0.00	0.00
May	0.00	0.01	0.00	0.06	0.03	0.17	0.00	0.00	0.00	0.00
Jun	3.57	0.06	0.02	0.17	0.14	0.17	0.00	0.00	0.00	0.00
Jul	4.34	1.59	0.03	0.17	0.08	0.05	0.00	0.00	0.00	0.00
Aug	0.07	1.43	0.40	0.40	0.08	0.05	0.00	0.00	0.00	0.00
Sep	0.01	0.96	0.63	0.40	0.14	0.03	0.00	0.00	0.00	0.00
Oct	0.01	0.97	0.33	0.04	0.03	0.03	0.00	0.00	0.00	0.00
Nov	0.00	0.83	0.46	0.11	0.02	0.16	0.00	0.00	0.00	0.00
Dec	0.01	0.25	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Grand Total	**8.07**	**6.97**	**2.04**	**1.39**	**0.53**	**1.00**	**0.02**	**0.00**	**0.00**	**0.00**

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	0.31	0.11	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Feb	0.12	0.05	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mar	0.06	0.05	0.44	0.05	0.00	0.00	0.00	0.00	0.00	0.00
Apr	0.23	4.06	4.65	0.06	0.00	0.00	0.00	0.00	0.00	0.00
May	0.11	2.21	0.70	0.11	0.00	0.00	0.00	0.00	0.00	0.00
Jun	0.54	0.75	1.26	0.24	0.01	0.00	0.00	0.00	0.00	0.00
Jul	0.99	0.32	1.88	0.14	0.00	0.00	0.00	0.00	0.00	0.00
Aug	0.22	0.28	4.83	0.22	0.01	0.00	0.00	0.00	0.00	0.00
Sep	0.51	0.39	11.74	0.20	0.00	0.00	0.00	0.00	0.00	0.00
Oct	0.76	1.00	6.23	0.01	0.00	0.04	0.00	0.00	0.00	0.00
Nov	0.83	0.71	0.23	0.01	0.00	0.00	0.00	0.00	0.00	0.00
Dec	0.03	0.46	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00
Grand Total	**4.71**	**10.37**	**32.07**	**1.05**	**0.03**	**0.04**	**0.00**	**0.00**	**0.00**	**0.00**

Target Species/Group: Muskellunge

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	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Feb	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.00	0.00	0.00
Mar	0.00	0.00	0.00	0.11	0.13	0.15	0.00	0.00	0.00	0.00
Apr	0.00	0.00	0.02	0.03	0.11	0.37	0.23	0.36	0.00	0.00
May	0.00	0.02	0.01	0.02	0.04	0.02	0.00	0.00	0.00	0.00
Jun	0.03	0.14	0.07	0.01	0.07	0.01	0.01	0.00	0.00	0.00
Jul	0.01	0.13	0.45	0.28	0.03	0.03	0.00	0.00	0.00	0.00
Aug	0.00	0.00	0.11	0.16	0.03	0.01	0.00	0.00	0.00	0.00
Sep	0.00	0.00	0.01	0.01	0.00	0.06	0.15	0.00	0.00	0.00
Oct	0.00	0.00	0.01	0.01	0.01	0.06	0.15	0.00	0.00	0.00
Nov	0.00	0.00	0.01	0.03	0.00	0.13	0.00	0.00	0.00	0.00
Dec	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.07	0.00	0.00
Grand Total	**0.04**	**0.29**	**0.68**	**0.68**	**0.42**	**0.91**	**0.75**	**0.44**	**0.00**	**0.00**

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	1.93	0.65	0.25	0.01	0.01	0.00	0.00	0.00	0.00	0.00
Feb	3.46	1.41	0.81	0.10	0.00	0.00	0.00	0.00	0.00	0.00
Mar	0.37	0.04	0.41	0.03	0.00	0.00	0.00	0.00	0.00	0.00
Apr	0.61	9.76	4.75	0.12	0.06	0.00	0.00	0.00	0.00	0.00
May	0.16	0.55	0.72	0.59	0.11	0.00	0.00	0.00	0.00	0.00
Jun	0.15	1.14	2.15	0.92	0.06	0.00	0.00	0.00	0.00	0.00
Jul	1.00	0.29	1.55	0.39	0.05	0.00	0.00	0.00	0.00	0.00
Aug	0.17	0.29	4.01	1.20	0.12	0.00	0.00	0.00	0.00	0.00
Sep	0.36	0.23	2.46	2.73	0.03	0.00	0.00	0.00	0.00	0.00
Oct	0.34	0.87	19.70	0.29	0.01	0.00	0.00	0.00	0.00	0.00
Nov	0.18	0.33	10.10	0.48	0.01	0.00	0.00	0.00	0.00	0.00
Dec	0.40	1.17	3.54	0.32	0.00	0.00	0.00	0.00	0.00	0.00
Grand Total	**9.13**	**16.72**	**50.44**	**7.18**	**0.45**	**0.01**	**0.00**	**0.00**	**0.00**	**0.00**

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	0.02	0.61	0.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Feb	0.05	1.37	0.36	0.08	0.07	0.00	0.00	0.00	0.00	0.00
Mar	0.04	0.83	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Apr	0.56	1.09	0.23	0.02	0.00	0.00	0.00	0.00	0.00	0.00
May	0.34	0.79	0.08	0.01	0.00	0.01	0.00	0.00	0.00	0.00
Jun	0.28	0.59	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Jul	0.84	1.25	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Aug	0.23	0.81	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sep	0.22	1.46	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Oct	0.08	1.11	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nov	0.06	1.35	0.06	0.02	0.00	0.00	0.00	0.00	0.00	0.00
Dec	0.02	0.30	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Grand Total	**2.76**	**11.56**	**1.23**	**0.14**	**0.07**	**0.01**	**0.00**	**0.00**	**0.00**	**0.00**

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	0.11	0.01	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00
Feb	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mar	0.00	0.07	0.03	0.01	0.00	0.00	0.00	0.00	0.00	0.00
Apr	0.00	0.04	0.00	0.00	0.00	0.07	0.01	0.00	0.00	0.00
May	0.00	0.01	0.00	0.01	0.03	0.13	0.03	0.00	0.00	0.00
Jun	0.40	0.23	0.01	0.03	0.04	0.07	0.01	0.00	0.00	0.00
Jul	2.31	0.24	0.04	0.03	0.02	0.02	0.00	0.00	0.00	0.00
Aug	0.24	0.34	0.14	0.09	0.05	0.07	0.00	0.00	0.00	0.00
Sep	0.04	1.19	0.72	0.28	0.07	0.03	0.00	0.00	0.00	0.00
Oct	0.05	0.55	0.18	0.04	0.02	0.04	0.00	0.00	0.00	0.00
Nov	0.00	0.10	0.07	0.01	0.00	0.01	0.00	0.00	0.00	0.00
Dec	0.04	0.06	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Grand Total	**3.20**	**2.90**	**1.24**	**0.57**	**0.22**	**0.44**	**0.04**	**0.00**	**0.00**	**0.00**

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	0.04	0.87	1.55	1.18	0.74	0.52	0.00	0.00	0.00	0.00
Feb	0.05	0.55	1.39	0.98	0.11	0.00	0.02	0.00	0.00	0.00
Mar	0.05	0.21	0.75	0.64	0.06	0.06	0.00	0.00	0.00	0.00
Apr	0.19	1.02	0.45	0.31	0.40	1.22	0.36	0.00	0.00	0.00
May	0.02	0.15	0.04	0.03	0.06	0.14	0.02	0.00	0.00	0.00
Jun	2.37	0.35	0.05	0.02	0.01	0.05	0.01	0.00	0.00	0.00
Jul	3.69	0.43	0.07	0.02	0.01	0.04	0.01	0.00	0.00	0.00
Aug	0.28	0.09	0.02	0.01	0.02	0.01	0.01	0.00	0.00	0.00
Sep	0.03	0.16	0.05	0.06	0.03	0.08	0.00	0.00	0.00	0.00
Oct	0.02	0.30	16.45	0.82	1.06	0.25	0.08	0.00	0.00	0.00
Nov	0.01	0.23	0.43	3.71	2.37	0.22	0.00	0.00	0.00	0.00
Dec	0.05	0.09	0.48	2.47	0.67	0.01	0.00	0.00	0.00	0.00
Grand Total	**6.79**	**4.43**	**21.75**	**10.23**	**5.54**	**2.60**	**0.51**	**0.00**	**0.00**	**0.00**

Target Species/Group: Walleye

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	0.11	0.01	0.03	0.11	1.13	0.39	0.00	0.00	0.00	0.00
Feb	0.00	0.05	0.15	0.03	0.00	0.00	0.00	0.00	0.00	0.00
Mar	0.00	0.00	0.02	0.00	0.00	0.01	0.00	0.00	0.00	0.00
Apr	0.00	0.00	0.04	0.04	0.05	0.12	0.01	0.00	0.00	0.00
May	0.00	0.01	0.07	0.27	0.17	0.31	0.01	0.00	0.00	0.00
Jun	2.14	0.61	0.02	0.15	0.11	0.19	0.01	0.00	0.00	0.00
Jul	0.39	3.92	0.27	0.06	0.06	0.08	0.06	0.00	0.00	0.00
Aug	0.01	0.28	0.48	0.07	0.06	0.13	0.00	0.00	0.00	0.00
Sep	0.01	0.15	0.41	0.16	0.08	0.05	0.02	0.01	0.00	0.00
Oct	0.00	0.02	0.19	0.29	0.12	0.16	0.01	0.00	0.00	0.00
Nov	0.00	0.03	0.05	0.05	0.02	0.04	0.02	0.00	0.00	0.00
Dec	0.00	0.00	0.07	0.03	0.00	0.00	0.00	0.00	0.00	0.00
Grand Total	**2.67**	**5.10**	**1.79**	**1.26**	**1.80**	**1.47**	**0.13**	**0.01**	**0.00**	**0.00**

Target Species/Group: White 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	0.00	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Feb	0.00	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mar	0.01	0.81	0.08	0.15	0.03	0.01	0.00	0.00	0.00	0.00
Apr	0.01	0.22	0.02	0.07	0.02	0.00	0.00	0.00	0.00	0.00
May	0.00	1.55	0.09	0.25	0.23	0.05	0.00	0.00	0.00	0.00
Jun	0.00	0.01	0.01	0.13	0.05	0.01	0.00	0.00	0.00	0.00
Jul	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00
Aug	0.00	0.04	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00
Sep	0.00	0.01	0.11	0.02	0.00	0.00	0.00	0.00	0.00	0.00
Oct	0.00	0.04	0.11	0.01	0.00	0.00	0.00	0.00	0.00	0.00
Nov	0.00	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dec	0.00	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Grand Total	**0.02**	**3.04**	**0.43**	**0.62**	**0.35**	**0.07**	**0.00**	**0.00**	**0.00**	**0.00**

Appendix D

Appendix D – Mean Monthly Entrainment Rates (Fish/Hour) for Target Species/Groups at Buck Development

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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	0.10	0.05	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00
Feb	0.04	0.23	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00
Mar	0.01	0.05	0.02	0.09	0.02	0.01	0.00	0.00	0.00	0.00
Apr	0.04	0.64	0.11	0.55	0.06	0.03	0.00	0.00	0.00	0.00
May	0.01	0.19	0.02	0.06	0.01	0.00	0.00	0.00	0.00	0.00
Jun	0.06	0.13	0.02	0.05	0.01	0.00	0.00	0.00	0.00	0.00
Jul	6.22	0.29	0.02	0.03	0.00	0.00	0.00	0.00	0.00	0.00
Aug	0.91	4.30	0.02	0.06	0.04	0.00	0.00	0.00	0.00	0.00
Sep	0.28	2.57	0.07	0.04	0.02	0.01	0.00	0.00	0.00	0.00
Oct	0.28	2.29	0.09	0.02	0.01	0.00	0.00	0.00	0.00	0.00
Nov	0.08	2.00	0.10	0.02	0.01	0.00	0.00	0.00	0.00	0.00
Dec	0.02	1.35	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00
Grand Total	**8.04**	**14.08**	**0.53**	**0.95**	**0.18**	**0.06**	**0.00**	**0.00**	**0.00**	**0.00**

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	0.00	0.02	0.03	0.00	0.01	0.00	0.00	0.00	0.00	0.00
Feb	0.02	0.06	0.00	0.01	0.04	0.00	0.00	0.00	0.00	0.00
Mar	0.02	0.05	0.02	0.03	0.03	0.00	0.00	0.00	0.00	0.00
Apr	0.06	0.24	0.08	0.75	0.21	0.07	0.00	0.00	0.00	0.00
May	0.02	0.15	0.05	0.03	0.02	0.02	0.00	0.00	0.00	0.00
Jun	0.01	0.13	0.08	0.23	0.22	0.07	0.00	0.00	0.00	0.00
Jul	0.40	0.06	0.17	1.15	0.13	0.04	0.00	0.00	0.00	0.00
Aug	0.04	0.12	0.29	0.40	0.04	0.01	0.00	0.00	0.00	0.00
Sep	0.03	0.10	0.12	0.14	0.05	0.00	0.00	0.00	0.00	0.00
Oct	0.01	0.11	0.02	0.04	0.04	0.01	0.00	0.00	0.00	0.00
Nov	0.01	0.06	0.03	0.03	0.02	0.00	0.00	0.00	0.00	0.00
Dec	0.01	0.05	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00
Grand Total	**0.63**	**1.14**	**0.88**	**2.81**	**0.80**	**0.21**	**0.01**	**0.00**	**0.00**	**0.00**

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	0.11	0.14	0.03	0.00	0.00	0.02	0.00	0.00	0.00	0.00
Feb	0.34	0.25	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mar	0.12	0.16	0.02	0.14	0.01	0.00	0.00	0.00	0.00	0.00
Apr	0.03	0.34	0.19	0.04	0.02	0.01	0.00	0.00	0.00	0.00
May	0.04	14.17	0.72	0.44	1.45	0.34	0.00	0.00	0.00	0.00
Jun	0.11	6.17	0.70	1.60	2.62	0.23	0.00	0.00	0.00	0.00
Jul	7.70	4.00	0.20	0.40	0.29	0.03	0.00	0.00	0.00	0.00
Aug	2.75	0.82	0.31	0.15	0.20	0.15	0.00	0.00	0.00	0.00
Sep	0.41	0.40	0.08	0.09	0.18	0.05	0.00	0.00	0.00	0.00
Oct	0.14	0.15	0.02	0.00	0.01	0.00	0.00	0.00	0.00	0.00
Nov	0.05	0.29	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dec	0.00	0.06	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Grand Total	**11.79**	**26.95**	**2.42**	**2.87**	**4.77**	**0.84**	**0.01**	**0.00**	**0.00**	**0.00**

Target Species/Group: Common Carp

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	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00
Feb	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mar	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Apr	0.00	0.01	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00
May	0.00	0.01	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00
Jun	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00
Jul	0.03	0.05	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00
Aug	0.00	0.04	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sep	0.00	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00
Oct	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nov	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dec	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Grand Total	**0.07**	**0.14**	**0.07**	**0.01**	**0.01**	**0.01**	**0.02**	**0.06**	**0.00**	**0.00**

Target Species/Group: Darters and 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	0.00	0.18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Feb	0.11	0.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mar	0.05	0.14	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Apr	0.62	3.89	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00
May	2.78	0.64	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Jun	0.29	0.42	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Jul	0.80	0.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Aug	0.05	0.05	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sep	0.02	0.08	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Oct	0.01	0.12	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nov	0.00	0.06	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dec	0.04	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Grand Total	**4.78**	**6.01**	**0.24**	**0.00**	**0.00**	**0.01**	**0.00**	**0.00**	**0.00**	**0.00**

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	0.00	0.20	0.05	0.00	0.00	0.00	0.01	0.00	0.00	0.00
Feb	0.00	0.11	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mar	0.01	0.06	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00
Apr	0.02	0.16	0.00	0.02	0.00	0.21	0.00	0.00	0.00	0.00
May	0.00	0.00	0.00	0.04	0.02	0.10	0.00	0.00	0.00	0.00
Jun	2.15	0.04	0.01	0.10	0.09	0.10	0.00	0.00	0.00	0.00
Jul	2.62	0.96	0.02	0.10	0.05	0.03	0.00	0.00	0.00	0.00
Aug	0.04	0.86	0.24	0.24	0.05	0.03	0.00	0.00	0.00	0.00
Sep	0.01	0.58	0.38	0.24	0.09	0.02	0.00	0.00	0.00	0.00
Oct	0.01	0.58	0.20	0.02	0.02	0.02	0.00	0.00	0.00	0.00
Nov	0.00	0.50	0.27	0.07	0.01	0.09	0.00	0.00	0.00	0.00
Dec	0.01	0.15	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Grand Total	**4.87**	**4.20**	**1.23**	**0.84**	**0.32**	**0.60**	**0.01**	**0.00**	**0.00**	**0.00**

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	0.19	0.07	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Feb	0.07	0.03	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mar	0.04	0.03	0.27	0.03	0.00	0.00	0.00	0.00	0.00	0.00
Apr	0.14	2.45	2.81	0.04	0.00	0.00	0.00	0.00	0.00	0.00
May	0.07	1.33	0.42	0.06	0.00	0.00	0.00	0.00	0.00	0.00
Jun	0.33	0.45	0.76	0.15	0.01	0.00	0.00	0.00	0.00	0.00
Jul	0.60	0.20	1.13	0.09	0.00	0.00	0.00	0.00	0.00	0.00
Aug	0.14	0.17	2.92	0.13	0.00	0.00	0.00	0.00	0.00	0.00
Sep	0.31	0.23	7.09	0.12	0.00	0.00	0.00	0.00	0.00	0.00
Oct	0.46	0.60	3.76	0.01	0.00	0.02	0.00	0.00	0.00	0.00
Nov	0.50	0.43	0.14	0.01	0.00	0.00	0.00	0.00	0.00	0.00
Dec	0.02	0.28	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Grand Total	**2.84**	**6.25**	**19.34**	**0.63**	**0.02**	**0.02**	**0.00**	**0.00**	**0.00**	**0.00**

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	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Feb	0.00	0.48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mar	0.00	0.66	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Apr	0.00	4.45	0.08	0.00	0.00	0.01	0.00	0.00	0.00	0.00
May	0.09	0.61	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Jun	0.05	0.70	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Jul	1.42	0.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Aug	0.04	0.06	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sep	0.01	0.12	0.16	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Oct	0.00	0.11	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nov	0.01	0.04	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dec	0.17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Grand Total	**1.79**	**7.63**	**0.40**	**0.00**	**0.00**	**0.01**	**0.00**	**0.00**	**0.00**	**0.00**

Target Species/Group: Muskellunge

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	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Feb	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.00	0.00	0.00
Mar	0.00	0.00	0.00	0.07	0.08	0.09	0.00	0.00	0.00	0.00
Apr	0.00	0.00	0.01	0.02	0.07	0.22	0.14	0.22	0.00	0.00
May	0.00	0.01	0.00	0.01	0.03	0.01	0.00	0.00	0.00	0.00
Jun	0.02	0.08	0.04	0.01	0.04	0.01	0.00	0.00	0.00	0.00
Jul	0.01	0.08	0.27	0.17	0.02	0.02	0.00	0.00	0.00	0.00
Aug	0.00	0.00	0.07	0.10	0.02	0.01	0.00	0.00	0.00	0.00
Sep	0.00	0.00	0.00	0.01	0.00	0.03	0.09	0.00	0.00	0.00
Oct	0.00	0.00	0.00	0.01	0.01	0.04	0.09	0.00	0.00	0.00
Nov	0.00	0.00	0.01	0.02	0.00	0.08	0.00	0.00	0.00	0.00
Dec	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.04	0.00	0.00
Grand Total	**0.02**	**0.18**	**0.41**	**0.41**	**0.25**	**0.55**	**0.45**	**0.27**	**0.00**	**0.00**

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	1.17	0.39	0.15	0.01	0.01	0.00	0.00	0.00	0.00	0.00
Feb	2.09	0.85	0.49	0.06	0.00	0.00	0.00	0.00	0.00	0.00
Mar	0.22	0.02	0.25	0.02	0.00	0.00	0.00	0.00	0.00	0.00
Apr	0.37	5.89	2.86	0.07	0.04	0.00	0.00	0.00	0.00	0.00
May	0.10	0.33	0.43	0.36	0.06	0.00	0.00	0.00	0.00	0.00
Jun	0.09	0.69	1.30	0.55	0.04	0.00	0.00	0.00	0.00	0.00
Jul	0.60	0.17	0.93	0.24	0.03	0.00	0.00	0.00	0.00	0.00
Aug	0.10	0.18	2.42	0.72	0.07	0.00	0.00	0.00	0.00	0.00
Sep	0.21	0.14	1.48	1.64	0.02	0.00	0.00	0.00	0.00	0.00
Oct	0.20	0.53	11.88	0.18	0.01	0.00	0.00	0.00	0.00	0.00
Nov	0.11	0.20	6.09	0.29	0.00	0.00	0.00	0.00	0.00	0.00
Dec	0.24	0.71	2.14	0.19	0.00	0.00	0.00	0.00	0.00	0.00
Grand Total	**5.51**	**10.09**	**30.43**	**4.33**	**0.27**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

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	0.01	0.37	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Feb	0.03	0.83	0.21	0.05	0.04	0.00	0.00	0.00	0.00	0.00
Mar	0.03	0.50	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Apr	0.34	0.65	0.14	0.01	0.00	0.00	0.00	0.00	0.00	0.00
May	0.21	0.48	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Jun	0.17	0.36	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Jul	0.51	0.75	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Aug	0.14	0.49	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sep	0.13	0.88	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Oct	0.05	0.67	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nov	0.04	0.81	0.04	0.01	0.00	0.00	0.00	0.00	0.00	0.00
Dec	0.01	0.18	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Grand Total	**1.66**	**6.97**	**0.74**	**0.09**	**0.04**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

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	0.06	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00
Feb	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mar	0.00	0.05	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00
Apr	0.00	0.03	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00
May	0.00	0.01	0.00	0.00	0.02	0.08	0.02	0.00	0.00	0.00
Jun	0.24	0.14	0.01	0.02	0.02	0.04	0.00	0.00	0.00	0.00
Jul	1.40	0.14	0.03	0.02	0.01	0.01	0.00	0.00	0.00	0.00
Aug	0.15	0.21	0.08	0.05	0.03	0.04	0.00	0.00	0.00	0.00
Sep	0.02	0.72	0.43	0.17	0.04	0.02	0.00	0.00	0.00	0.00
Oct	0.03	0.33	0.11	0.03	0.01	0.02	0.00	0.00	0.00	0.00
Nov	0.00	0.06	0.04	0.01	0.00	0.01	0.00	0.00	0.00	0.00
Dec	0.03	0.03	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Grand Total	**1.93**	**1.75**	**0.75**	**0.34**	**0.13**	**0.27**	**0.03**	**0.00**	**0.00**	**0.00**

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	0.02	0.53	0.94	0.71	0.45	0.31	0.00	0.00	0.00	0.00
Feb	0.03	0.33	0.84	0.59	0.07	0.00	0.01	0.00	0.00	0.00
Mar	0.03	0.13	0.45	0.38	0.03	0.04	0.00	0.00	0.00	0.00
Apr	0.11	0.61	0.27	0.19	0.24	0.73	0.22	0.00	0.00	0.00
May	0.01	0.09	0.03	0.02	0.04	0.08	0.02	0.00	0.00	0.00
Jun	1.43	0.21	0.03	0.01	0.01	0.03	0.01	0.00	0.00	0.00
Jul	2.23	0.26	0.04	0.01	0.01	0.03	0.00	0.00	0.00	0.00
Aug	0.17	0.05	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00
Sep	0.02	0.09	0.03	0.03	0.02	0.05	0.00	0.00	0.00	0.00
Oct	0.01	0.18	9.92	0.50	0.64	0.15	0.05	0.00	0.00	0.00
Nov	0.01	0.14	0.26	2.24	1.43	0.13	0.00	0.00	0.00	0.00
Dec	0.03	0.05	0.29	1.49	0.40	0.01	0.00	0.00	0.00	0.00
Grand Total	**4.10**	**2.67**	**13.12**	**6.17**	**3.34**	**1.57**	**0.31**	**0.00**	**0.00**	**0.00**

Target Species/Group: Walleye

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	0.07	0.01	0.02	0.07	0.68	0.23	0.00	0.00	0.00	0.00
Feb	0.00	0.03	0.09	0.02	0.00	0.00	0.00	0.00	0.00	0.00
Mar	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Apr	0.00	0.00	0.02	0.03	0.03	0.07	0.01	0.00	0.00	0.00
May	0.00	0.01	0.04	0.16	0.10	0.19	0.00	0.00	0.00	0.00
Jun	1.29	0.37	0.01	0.09	0.07	0.12	0.01	0.00	0.00	0.00
Jul	0.23	2.37	0.16	0.03	0.03	0.05	0.04	0.00	0.00	0.00
Aug	0.01	0.17	0.29	0.04	0.04	0.08	0.00	0.00	0.00	0.00
Sep	0.01	0.09	0.25	0.10	0.05	0.03	0.01	0.01	0.00	0.00
Oct	0.00	0.01	0.12	0.18	0.08	0.09	0.00	0.00	0.00	0.00
Nov	0.00	0.02	0.03	0.03	0.01	0.02	0.01	0.00	0.00	0.00
Dec	0.00	0.00	0.04	0.02	0.00	0.00	0.00	0.00	0.00	0.00
Grand Total	**1.61**	**3.08**	**1.08**	**0.76**	**1.09**	**0.89**	**0.08**	**0.01**	**0.00**	**0.00**

Target Species/Group: White 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	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Feb	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mar	0.00	0.49	0.05	0.09	0.02	0.00	0.00	0.00	0.00	0.00
Apr	0.01	0.14	0.01	0.04	0.01	0.00	0.00	0.00	0.00	0.00
May	0.00	0.93	0.05	0.15	0.14	0.03	0.00	0.00	0.00	0.00
Jun	0.00	0.00	0.01	0.08	0.03	0.01	0.00	0.00	0.00	0.00
Jul	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Aug	0.00	0.02	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00
Sep	0.00	0.00	0.07	0.01	0.00	0.00	0.00	0.00	0.00	0.00
Oct	0.00	0.02	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nov	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dec	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Grand Total	**0.01**	**1.83**	**0.26**	**0.38**	**0.21**	**0.04**	**0.00**	**0.00**	**0.00**	**0.00**

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Attachment 3

Attachment 3 – 2020 Macroinvertebrate and Crayfish Community Survey Results

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Byllesby-Buck Hydroelectric Project
(FERC Project No. 2514)

2020 Macroinvertebrate and Crayfish Community Survey Results, Virginia

Prepared for:

American Electric Power
Boundless Energy

Byllesby-Buck → HDR2020-0001

January 12, 2021

Prepared by:

EDGE Engineering & Science
further insight.

Edge Engineering and Science, LLC
Cincinnati, Ohio

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LIST OF ACRONYMS

AEP	American Electric Power – Client
Appalachian	Appalachian Power Company
CFS	Cubic feet per second
CPUE	Catch per unit effort
DO	Dissolved oxygen
EDGE	Edge Engineering and Science, LLC
FERC	Federal Energy Regulatory Commission
HDR	HDR, Inc. – Client
LDB	Left descending bank
RDB	Right descending bank
RSP	Revised Study Plan
SAV	Submerged aquatic vegetation
USFWS	U.S. Fish and Wildlife Service
VDCR	Virginia Department of Conservation and Recreation
VDEQ	Virginia Department of Environmental Quality
VDWR	Virginia Department of Wildlife Resources (formerly VDGIF)
VISAC	Virginia Invasive Species Advisory Committee

1.0 INTRODUCTION

The Byllesby and Buck Dams form the 30.1-megawatt Byllesby-Buck Hydroelectric Project (Project) located on the New River in Carroll County, Virginia. Appalachian Power Company (a unit of American Electric Power; AEP) is pursuing a new license for the Project as their existing license (FERC Project No. 2514) expires in 2024. Aquatic biological studies were completed to support existing FERC license and results of these studies are ultimately used as a record and reference for current relicensing efforts. The New River, along with the two contiguous impoundments resulting from the Byllesby Dam and the Buck Dam, harbors a diverse community of aquatic biota where aquatic biological studies are required to survey and document the contemporary community of organisms present within the Project area (Figure 1). The New 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 macroinvertebrate and crayfish abundance, diversity, and distribution in the vicinity of the Project.

Pre-licensing consultation with state and federal agencies resulted in the development and approval of a project-specific Revised Study Plan (RSP) that identified two objectives for Project studies (AEP 2019) pertaining to the macroinvertebrate and crayfish community.

Goals and Objectives

1) Collect a baseline of existing macroinvertebrate and crayfish communities in the vicinity of the Project

2) Compare current aquatic resources data to historical data to determine any significant changes to species composition or abundance

In accordance with the RSP, field sampling efforts were necessary to satisfy each of the two objectives. Satisfaction of all objectives was not able to be accomplished during the 2020 calendar year; therefore, this report herein serves as an interim, progress report of findings. 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 biological sampling framework for the Project. Macroinvertebrate and crayfish sampling employ a variety of methods to target representative habitat at 16 sites throughout the Project area. The methods, number and location of sample sites, and seasonality were developed to document a comprehensive representation of the Project area and to correlate with previous sampling efforts for comparison.

2.1 Macroinvertebrate and Crayfish Community

The macroinvertebrate and crayfish study detailed in the RSP consists of two temporally independent efforts (one survey in fall and one survey in spring).Sampling methods were derived from National Rivers and Streams Assessment (NRSA) Field Operations Manual and Virginia Department of Environmental Quality (VDEQ) Biological Monitoring Program Quality Assurance Project Plan and include quantitative and qualitative sampling methods that target different habitats (USEPA 2019 and VDEQ 2008). Quantitative sampling targets riffle/run habitats and qualitative sampling targets available microhabitats in pools. Field sampling for the fall 2020 was completed according to the RSP. Spring 2021 sampling efforts are scheduled to be completed at the same sites during the sample index period defined by VDEQ (March 1 – May 31). Specific sampling dates within these timeframes are determined 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. A variety of sampling techniques were used to sample macroinvertebrates using quantitative and qualitative methods as described in subsequent sections. Site naming conventions are as follows: Location-Seasonality-Method-Site Number. For example, BFQT1 = Byllesby-Buck Fall Quantitative Site 1 and BFQL3 = Byllesby-Buck Fall Qualitative Site 3.

The methods used to quantify macroinvertebrates only allows for the presence of crayfish to be determined. To assess the crayfish community in the Project area, additional kick samples and seining efforts were performed following benthic macroinvertebrate sampling to ensure all crayfish habitat had been covered and that a broad representation of crayfish species available at each site was documented. The exact abundance of crayfish was not recorded because methods used are not crayfish specific and simply provide presence data.

2.1.1 Quantitative Sampling

Sampling benthic macroinvertebrates and crayfish occurred at eight riffle/run sites (i.e., quantitative; BFQT site names) along 100-meter transects following guidelines defined by USEPA (2019) and VDEQ (2008). Upon arrival at riffle/run sites (Figures 1-6), 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. Sampling effort (e.g., time, number of samples) was also recorded during each sampling event.

Starting at the downstream end of a transect and moving upstream, all riffle/run habitats were candidates for sampling throughout the reach. Sampling was conducted holding the D-frame net on the bottom of the stream perpendicular to flow and kicking substrate to agitate and dislodge organisms, thus allowing dislodged organisms to flow into the net. A single kick consists of disturbing the substrate upstream of the net by kicking with the feet and/or by using the hands to dislodge the cobble/boulder for 30-90 seconds. For example, a single sample was a composite of six kick sets, each disturbing approximately 0.33 m^2 above the dip net for a duration of 30-90 seconds and totaled an area comprising 2 m^2. The composited sample was washed by running clean stream water through the net 2-3 times and then transferred to a sieve (500 μm) if needed. For QA/QC measures, replicate sampling was conducted at one quantitative site within close proximity (not in the same locations as the first set of samples) of the initial sampling area.

2.1.2 Qualitative Sampling

Benthic macroinvertebrates and crayfish were also sampled at eight qualitative sites (i.e., multi-habitat) along 100-meter transects following guidelines defined by USEPA (2019) and VDEQ (2008). At pool sites (Figure 1 and Figures 7-13), transects were delineated in near-shore pool habitats and the start and endpoint coordinates were recorded. Site photos, field conditions, habitat characteristics, and water quality parameters were recorded in the same manner as quantitative sites (see Section 2.1.1). In addition, a Secchi disk reading was taken at each sample site at the time of sampling to assess water transparency. Multiple points for habitat and water quality measurements were taken if there was large variation within a single site.

A canoe was necessary to collect qualitative samples along each of the transects starting at the downstream end and moving upstream. Sampling was conducted by performing 20 jabs with a D-frame net into suitable, stable habitats (snags, vegetation, banks, and substrate). A single jab consists of forcefully thrusting the net into a microhabitat for a linear distance of 1.0 meter, followed by 2-3 sweeps of the same area to collect dislodged organisms for 20-90 seconds per jab, sweep, or kick. Multiple types of habitat were sampled in rough proportion to their frequency within the reach. Unique habitat types (i.e., those consisting of less than 5 percent of stable habitat within the sampling reach) were not sampled. Sampling effort was proportionally allocated (20 jabs/sweeps/kicks) to shore-zone and bottom-zone, 20-90 seconds per jab, sweep, or kick. Samples were cleaned and transferred to the sieve bucket at least every five jabs; or more often as necessary. At one qualitative site, replicate sampling was conducted within the initial sampling area in close proximity (not in the same locations as the first set of samples). All samples were preserved and processed in the same manner as quantitative methods (see Section 2.1.1).

2.1.3 Laboratory Processing

All field samples were preserved in 95% ethanol, placed in labeled jars, and sent to Civil & Environmental Consultants, Inc. (CEC) for processing and identification to the lowest practicable taxonomic level. Laboratory processing was performed in accordance with the VDEQ standard operating procedures “Methods for Laboratory Sorting and Subsampling of Benthic Macroinvertebrate Samples” (VDEQ 2008). Photo vouchers will be taken of all unique or rare species collected. At this time laboratory processing is ongoing and will be completed in the summer of 2021, after completion of the spring 2021 sampling event. At the completion of the study, a summary of species and numbers collected will be provided to VDWR in compliance with the scientific collection permit specifications.

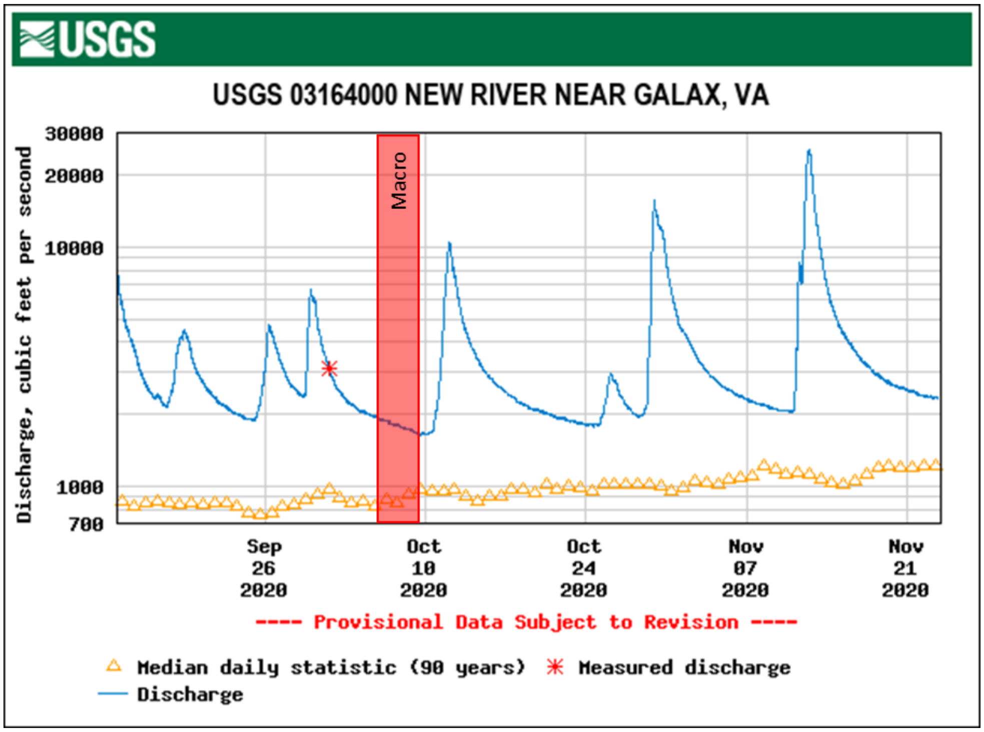
2.2 Deviations from Revised Study Plan

2.2.1 Covid-19 Delays

The initial field sampling plan called for spring and fall 2020 events; however, the Covid-19 pandemic, and subsequent restrictions on non-essential travel and safety considerations for field staff, prohibited spring 2020 field efforts. As a result, AEP requested and was granted an extension to accommodate the change in schedule as the VDEQ, U.S. Fish and Wildlife Service (USFWS), Virginia Department of Wildlife Resources (VDWR), and Virginia Department of Conservation and Recreation (VDCR) all concurred with adaptable schedule revisions. EDGE was contracted and given notice to proceed with fieldwork at the beginning of September 2020 and was able to complete the fall 2020 sampling event. Thus, spring macroinvertebrate and crayfish sampling is scheduled for completion during spring 2021.

2.2.2 Weather Delays

Periodic delays associated with weather and stream conditions plagued the Autumn of 2020. Average rainfall for Galax, Virginia is approximately 26 centimeters between September 1 and December 1 (US Climate Data 2020); yet during the same time period in 2020 Galax accumulated over 37 centimeters of rain (USGS 2020). Sampling efforts were completed at this year’s assumed baseflow, which was likely around 1,700-2,000 cubic feet per second (CFS) during the sampling period. The 68 percent increase from average precipitation did not allow the New River, including the study area (see figure below), to reach average annual baseflow throughout the sampling period.



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, met target sampling habitats, and avoided exceptionally high flows. No notable or drastic changes were made to proposed sampling locations for macroinvertebrate and crayfish survey efforts.

3.1 Macroinvertebrate and Crayfish Community

All 16 macroinvertebrate sites were sampled between October 6 and 8, 2020, during the fall sample index period defined by VDEQ (September 1 – November 30) (VDEQ 2008). Sampling was performed by EDGE's state and federally permitted astacologist under Virginia Scientific Collecting Permit No. 068630 (see Appendix A). The laboratory processing of samples is ongoing and thus taxonomic results of macroinvertebrate collections are not yet available, but the crayfish results are detailed below. On-site observations of macroinvertebrates are described and indicate potential variability in abundance and community structure throughout the Project area. Two species of crayfish were collected and identified in the field during survey efforts at six of the 16 sites sampled: the Conhaway Crayfish (*Cambarus appalachiensis*) and the Spiny Stream Crayfish (*Faxonius cristavarius*). Both species are native to the New River and no invasive species of crayfish were collected at any of the 16 sampled sites. Representative site and crayfish photos are provided in Appendix B. Site-specific information is provided below.

3.1.1 Quantitative Sampling

Eight quantitative sites were sampled for benthic macroinvertebrates and crayfish including two sites upstream of Byllesby Dam, four sites between Byllesby and Buck Dam, and two sites downstream of Buck Dam. Benthic macroinvertebrate and crayfish habitat consisted primarily of bedrock, boulder, cobble, and gravel substrates (relatively good habitat at seven of the eight sites [excluding BFQT2 which was heavily embedded]) (Figure 1). Crayfish were collected at four of eight (50%) quantitative sites. Two species of native crayfish including Conhaway Crayfish and Spiny Stream Crayfish were collected at quantitative survey locations. Neither of the species was collected upstream of Byllesby Dam, but both species were collected between Byllesby and Buck dam, and downstream of Buck Dam. Water parameters varied per site and ranged from 15.1 to 17.2 °C, pH 7.02 to 8.14, DO 9.75 to 10.52 mg/L and 104.8 to 115.7 percent saturation, and conductivity 57.7 to 69.9 µs/cm (Table 1).

Table 1: Macroinvertebrate and Crayfish Site Details

Date	Site #	Water Temp. (C)	pH	DO (mg/L)	DO (%)	Conductivity (us/cm)	Habitat
10/6/2020	BFQT1	15.6	8.1	10.39	113.9	66.2	Riffle
10/6/2020	BFQT2	15.7	8.0	10.15	109.9	64.5	Riffle/Run
10/6/2020	BFQL3	15.3	8.4	9.41	101.6	64.4	Pool
10/6/2020	BFQL4	15.1	8.3	8.76	91.4	65.5	Pool
10/6/2020	BFQL5	14.8	8.4	8.94	92.1	64.4	Pool
10/6/2020	BFQL6	27.3	7.2	7.32	84.3	44.9	Pool
10/7/2020	BFQT7	15.3	7.2	10.52	115.7	63.9	Riffle/Run
10/7/2020	BFQT8	15.7	7.2	10.49	114.9	64.0	Riffle
10/7/2020	BFQL9	17.3	7.3	9.69	101.8	63.8	Pool
10/7/2020	BFQT10	17.1	7.4	9.75	104.8	63.8	Riffle
10/8/2020	BFQT11	15.1	7.0	10.19	110.7	66.6	Riffle
10/7/2020	BFQL12	17.4	7.3	9.67	101.3	65.7	Pool
10/7/2020	BFQL13	16.7	7.5	8.71	92.7	65.1	Pool
10/7/2020	BFQL14	16.7	7.5	8.71	92.7	65.1	Pool
10/8/2020	BFQT15	17.2	7.7	10.14	108.1	57.7	Riffle
10/8/2020	BFQT16	16.4	7.0	10.04	107.3	69.9	Riffle
Above/below first dashed line represents above/below Byllesby Dam (followed by Buck Dam)							

3.1.1.1 New River – BFQT1

Substrates at BFQT1 consisted of boulder (40%), bedrock (30%), cobble (20%), gravel (5%), and sand (5%) (Figure 2). Habitat structure generally consisted of a deep riffle that gradually turned to rapids moving toward the channel and away from the shoreline. Based on field notes, benthic macroinvertebrates appeared diverse and contained multiple EPT taxa (*Ephemeroptera* [mayflies], *Plecoptera* [stoneflies], and *Trichoptera* [caddisflies]). No crayfish were collected at this site (Table 2).

Table 2: Crayfish Observations

Date	Site #	Conhoway Crayfish (*Cambarus appalachiensis*)	Spiny Stream Crayfish (*Faxonius cristavarius*)
10/6/2020	BFQT1		
10/6/2020	BFQT2		
10/6/2020	BFQL3		
10/6/2020	BFQL4		
10/6/2020	BFQL5		
10/6/2020	BFQL6		
10/7/2020	BFQT7	present	present
10/7/2020	BFQT8		
10/7/2020	BFQL9		present
10/7/2020	BFQT10		
10/8/2020	BFQT11		present
10/7/2020	BFQL12		present
10/7/2020	BFQL13		
10/7/2020	BFQL14		
10/8/2020	BFQT15	present	present
10/8/2020	BFQT16	present	present

Above/below first dashed line represents above/below Byllesby Dam (followed by Buck Dam)

3.1.1.2 New River – BFQT2

Substrates at BFQT2 consisted of boulder (45%), sand (25%), cobble (15%), bedrock (10%), and gravel (5%) (Figure 2). Habitat structure generally consisted of a deep riffle that rapidly descended into deep water. This site was greatly embedded with fine sediment and benthic macroinvertebrates appeared sparse and low in diversity. No crayfish were collected at this site

3.1.1.3 New River – BFQT7

Substrates at BFQT7 consisted of boulder (30%), cobble (30%), bedrock (20%), gravel (10%), and sand (10%) (Figure 3). Habitat structure generally consisted of a wide shoal that went over 20 meters channelward before becoming a deep riffle. Benthic macroinvertebrates appeared diverse and contained multiple EPT taxa. Both species were found at low abundances, with Conhoway Crayfish observed under large boulders both near the bank and further channelward while the Spiny Stream Crayfish were concentrated in the cobble. BFQT7 served as the quantitative replicate site for QA/QC purposes.

3.1.1.4 New River – BFQT8

Substrates at BFQT8 consisted of cobble (40%), boulder (20%), gravel (20%), and sand (20%) (Figure 3). Habitat structure generally consisted of shallow juts of bedrock with the remaining substrates found in crevices between the bedrock creating protected, stable substrate. Benthic macroinvertebrates appeared diverse and contained multiple EPT taxa. No crayfish were collected at this site.

3.1.1.5 New River – BFQT10

Substrates at BFQT10 consisted of gravel (30%), bedrock (20%), sand (20%), cobble (15%), and boulder (15%) (Figure 4). Habitat structure generally consisted of a shallow riffle-run complex just upstream of rapids and a small waterfall. The coarse substrate was covered with dense filamentous algae. Benthic macroinvertebrates appeared diverse and contained multiple EPT taxa. No crayfish were collected at this site.

3.1.1.6 New River – BFQT11

Substrates at BFQT11 consisted of cobble (35%), gravel (30%), sand (20%), and boulder (5%) (Figure 4). Habitat structure generally consisted of a wide shallow shoal that went over 70 meters channelward. The habitat within the shoal was covered with dense filamentous algae. Benthic macroinvertebrates appeared diverse and contained multiple EPT taxa. The Spiny Stream Crayfish was collected at this site and typically found under large cobble substrate.

3.1.1.7 New River – BFQT15

Substrates at BFQT15 consisted of boulder (30%), cobble (30%), bedrock (20%), gravel (10%), and sand (10%) (Figure 5). Habitat structure generally consisted of shallow juts of bedrock with the remaining substrates found in crevices between the bedrock creating protected, stable substrate. Benthic macroinvertebrates appeared diverse and contained multiple EPT taxa. Crayfish collected include Conhoway Crayfish and Spiny Stream Crayfish. Both species were found at low abundances with Conhoway Crayfish observed under large boulders further channelward while the Spiny Stream Crayfish were concentrated in the cobble near shore.

3.1.1.8 New River – BFQT16

Substrates at BFQT16 consisted of bedrock (30%), gravel (25%), sand (20%), cobble (20%), and boulder (5%) (Figure 6). Habitat structure generally consisted of shallow juts of bedrock perpendicular to stream flow with the remaining substrates found in crevices between the bedrock creating protected, stable substrate. Benthic macroinvertebrates appeared diverse and contained multiple EPT taxa. Crayfish collected include Conhoway Crayfish and Spiny Stream Crayfish. Both species were found at low abundances with Conhoway Crayfish observed under large boulders further channelward while the Spiny Stream Crayfish were concentrated in the cobble near shore. A large female Conhoway Crayfish was collected with attached instars.

3.1.2 Qualitative Sampling

Eight qualitative sites were sampled for benthic macroinvertebrates and crayfish including four sites upstream of Byllesby Dam and four sites between Byllesby and Buck Dam. Benthic macroinvertebrate and crayfish habitat consisted primarily of sand, silt, and bedrock substrates (relatively poor habitat throughout all sites) (Figure 1). Crayfish were collected at two of eight (25%) sites and include one species of native crayfish, the Spiny Stream Crayfish, which was collected at qualitative survey locations between the Byllesby and Buck Dam. Water parameters varied per site and ranged from 14.8 to 27.3 °C, pH 7.17 to 8.39, DO 7.32 to 9.69 mg/L and 84.3 to 101.8 percent saturation, and conductivity 44.9 to 65.7 µs/cm (Table 1).

3.1.2.1 New River – BFQL3

Substrates at BFQL3 consisted of sand (80%), gravel (10%), and silt (10%) (Figure 7). Habitat structure generally consisted of a shallow sand/gravel bar that extended approximately 20 meters channelward before rapidly descending. Leaf packs and pockets of submerged aquatic vegetation (SAV) were present. Benthic macroinvertebrates appeared to exhibit low diversity, but mayflies were observed. No crayfish were collected at this site (Table 2).

3.1.2.2 New River – BFQL4

Substrates at BFQL4 consisted of sand (80%) and silt (20%) (Figure 8). Habitat structure generally consisted of a well vegetated bank that rapidly descended from shore. Benthic macroinvertebrates appeared to exhibit low diversity. No crayfish were collected at this site. BFQL4 served as the qualitative replicate site for QA/QC purposes.

3.1.2.3 New River – BFQL5

Substrates at BFQL5 consisted of sand (80%) and silt (20%) (Figure 8). Habitat structure generally consisted of a well vegetated bank that rapidly descended from shore. Benthic macroinvertebrates appeared to exhibit low diversity. No crayfish were collected at this site.

3.1.2.4 New River – BFQL6

Substrates at BFQL6 consisted of sand (60%) and silt (40%) (Figure 9). Habitat structure generally consisted of a shallow sand bar that extended approximately 10 meters channelward before rapidly descending. This site had the highest recorded temperature by far, which is likely a result of thermal absorption within shallow, slow-moving water. This site also contained considerable SAV. Benthic macroinvertebrates appeared to exhibit low diversity and no crayfish were collected at this site. Eastern Newts (*Notophthalmus viridescens*) were abundant and had to be removed from kick net samples regularly.

3.1.2.5 New River – BFQL9

Substrates at BFQL9 consisted of sand (80%) and silt (20%) (Figure 10). Habitat structure generally consisted of a shallow sand bar that extended approximately 2 meters channelward before rapidly descending. The bank was heavily lined with rootwads, which were the primary available habitat. Benthic macroinvertebrates appeared to exhibit moderate diversity and included dragonfly larva. Relatively small Spiny Stream Crayfish were present throughout rootwads at this site.

3.1.2.6 New River – BFQL12

Substrates at BFQL12 consisted of boulder (30%), cobble (30%), sand (20%), gravel (10%), and bedrock (10%) (Figure 11). Habitat structure generally consisted of a rocky bar that extends approximately 2 meters channelward before rapidly descending. The bank was heavily lined with rootwads, which were the primary available habitat. Benthic macroinvertebrates appeared to exhibit moderate diversity and included EPT taxa. Spiny Stream Crayfish were present in low density at this site.

3.1.2.7 New River – BFQL13

Substrates at BFQL13 consisted of sand (80%), gravel (10%), and silt (10%) (Figure 12). Habitat structure generally consisted of a shallow sand/ gravel bar that extends approximately 30 meters channelward before rapidly descending. This site also contained considerable SAV. Benthic macroinvertebrates appeared to exhibit low diversity and no crayfish were collected at this site.

3.1.2.8 New River – BFQL14

Substrates at BFQL14 consisted of bedrock (100%) (Figure 13). Habitat structure generally consisted of a bedrock descending vertically into relatively deep water (approximately two meters). This site also contained considerable SAV. Benthic macroinvertebrates appeared to exhibit low diversity and no crayfish were collected at this site.

4.0 DISCUSSION

4.1 Macroinvertebrate and Crayfish Community

Benthic macroinvertebrate and crayfish species diversity and abundance can be used as indicators of water quality, as these organisms often exhibit sensitivity to changing water quality conditions, and because they serve as a food resource for fish and other fauna in the riverine community. A healthy stream generally includes habitat diversity and limited pollution, often indicated by a high EPT metric score (indicative of an abundant and diverse community of pollution intolerant EPT taxa) and acceptable scores in other standard biological metrics. The Mustached Clubtail (*Gomphus adelphus*) and the Pygmy Snaketail (*Ophiogomphus howei*) were identified as species with potential to occur in the Project vicinity by VDCR in a letter dated September 23, 2017. The presence of these “species of greatest conservation need” would indicate relatively high water quality. The Fries Project, approximately 13 river kilometers upstream of the Byllesby-Buck Project, collected the Pygmy Snaketail in the New River (Carey et al. 2017), but there is no recent site-specific macroinvertebrate data for the Project area. Crayfish surveys were also completed as part of the Fries Project, where Spiny Stream Crayfish were the only species collected (Carey et al. 2017); however, there is no site-specific information available for crayfish in the vicinity of the Project. Virginia is known to harbor approximately 33 species of crayfish including non-indigenous and/or invasive species such as Virile Crayfish (*Orconectes virilis*) (VDGIF 2018; VISAC 2018), which was collected as part of the Claytor Project (DTA 2008) 70 river kilometers downstream of the Byllesby-Buck Project.

Macroinvertebrate taxonomic identification is currently in progress; therefore, only general observations are discussed below and a full discussion will be provided in the Updated Study Report in 2021.. Field observations suggest riffle/run sites (quantitative sampling) exhibited greater substrate heterogeneity and (anecdotally) more diverse macroinvertebrate communities than multi-habitat sites (qualitative sampling). These differences emphasize the importance of utilizing quantitative and qualitative methods to sample a diversity of habitat types to provide the most robust assessment of the macroinvertebrate and crayfish communities in the Project area. For example, quantitative surveys target riffle and run habitats that typically harbor coarser, complex substrates; thereby providing more stable conditions for macroinvertebrate colonization, and thus provides the ideal habitats for quantitative sampling, while qualitative methods target a diversity of habitats to capture the rare or less abundance taxa. Analysis of macroinvertebrates will include various methods (e.g., Hilsenhoff Biotic Index, percent intolerant species, percent EPT, etc.) once macroinvertebrate taxonomic data is available. Various metrics (e.g., taxonomic, ecological guilds) will also be used to compare macroinvertebrate community parameters and habitats, and their geographical relationship with the Project’s dams.

Quantitative sampling methods accounted for both crayfish species captured, whereas qualitative sampling methods accounted for only one. Stream morphology of quantitative sampling sites may be causing a discrepancy in crayfish collections as they are generally more accessible to field surveyors (i.e., shallower depths). There were zero crayfish capture at the two quantitative sites upstream of Byllesby

Dam and both species of crayfish were captured at both quantitative sites below Buck Dam. These sites had similar substrate and habitat composition and relatively similar physiochemical parameters, and spring 2021 sampling results may reveal more about this relationship. Overall, the presence of two relatively abundant native crayfish species and zero invasive crayfish species in the Project vicinity may indicate a healthy community.

The status of Objective One, “Collect a comprehensive baseline of existing aquatic resources in the vicinity of the Project” and Objective Two “Compare current aquatic resources data to historical data to determine any significant changes to species composition or abundance” are partially fulfilled until macroinvertebrate taxonomic identification and spring 2021 sampling events are complete.

5.0 LITERATURE CITED

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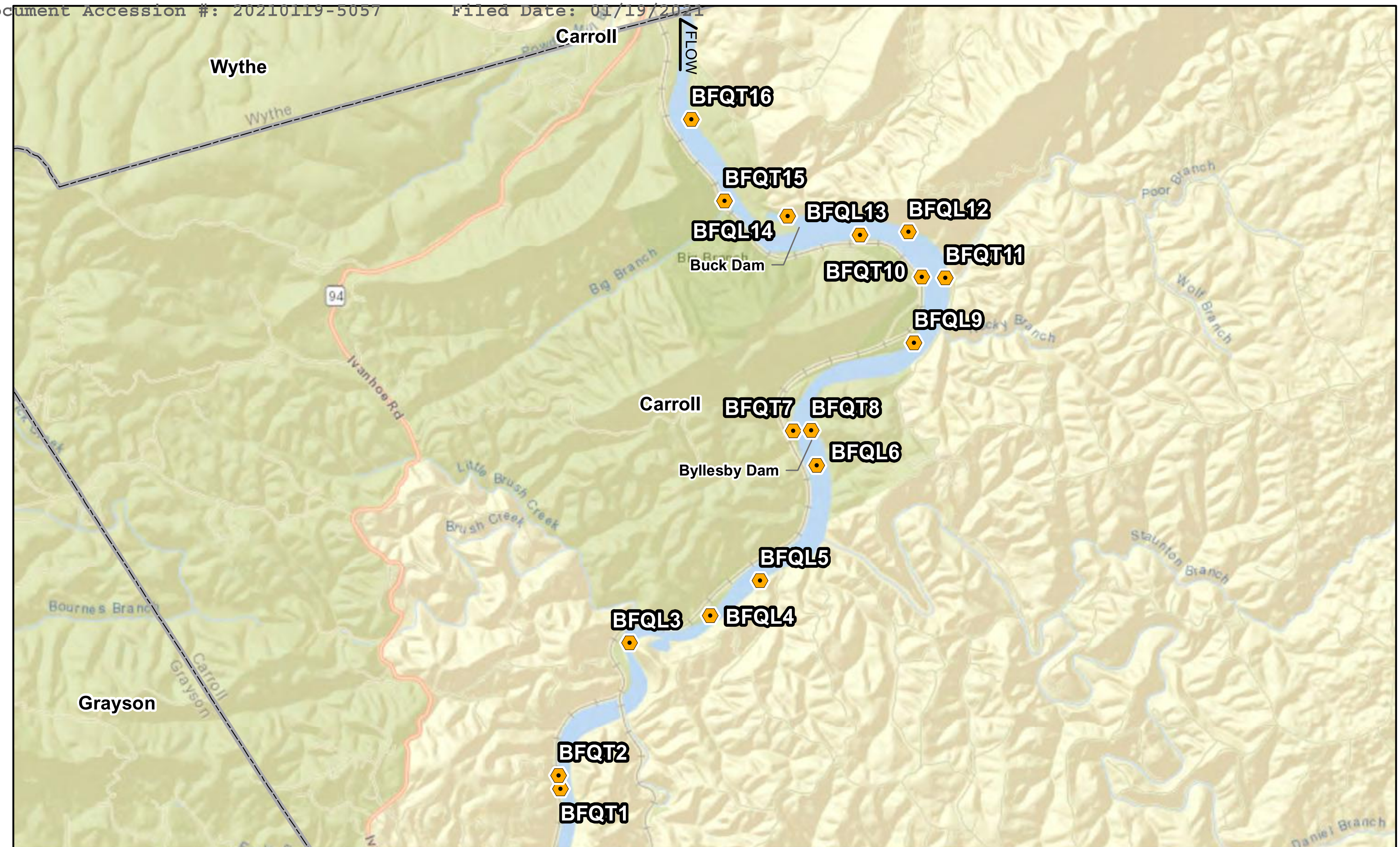
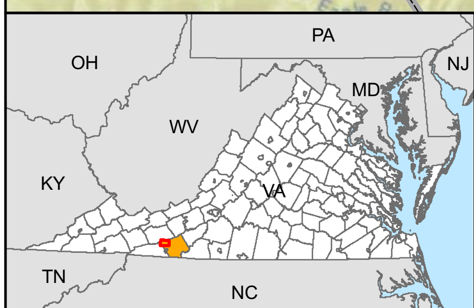
Figures





Legend

Macroinvertebrate Sample Location

County Boundary

N

0 0.75 1.5

Kilometers

Scale: 1:59,055

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Figure 1
Overall Byllesby-Buck project area including quantitative (BFQT) and qualitative (BFQL) macroinvertebrate survey sites on the New River in Carroll County, Virginia.

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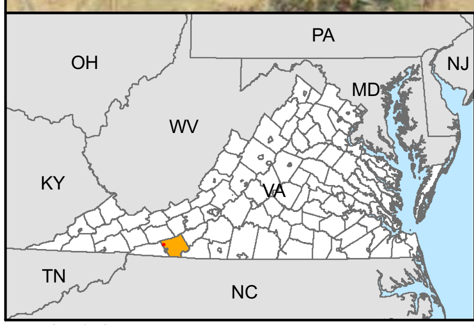

Legend

- Macroinvertebrate Sample Location
- Macroinvertabrate Sampling Transect

N

0 50 100

Meters

Scale: 1:3,937

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Figure 2
Quantitative macroinvertebrate and crayfish 100-meter survey extent in riffle/run habitat in Carroll County, Virginia.

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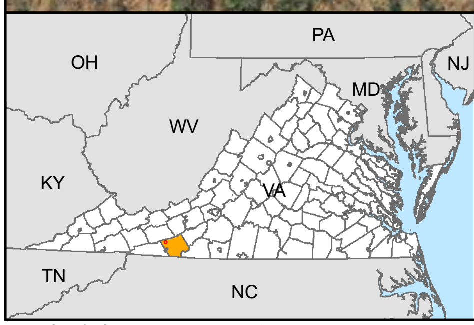

Legend

- Macroinvertebrate Sample Location
- Macroinvertabrate Sampling Transect

N

0 50 100
Meters

Scale: 1:3,937

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Figure 3
Quantitative macroinvertebrate and crayfish 100-meter survey extent in riffle/run habitat in Carroll County, Virginia.

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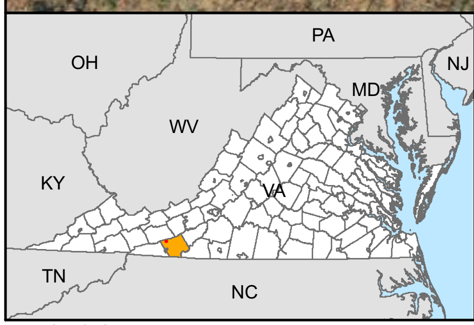

Legend

- Macroinvertebrate Sample Location
- Macroinvertabrate Sampling Transect

N

0 50 100

Meters

Scale: 1:3,937

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Figure 4
Quantitative macroinvertebrate and crayfish 100-meter survey extent in riffle/run habitat in Carroll County, Virginia.

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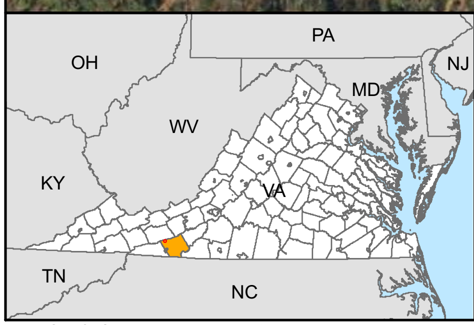

Legend

- Macroinvertebrate Sample Location
- Macroinvertabrate Sampling Transect

N

0 50 100
Meters

Scale: 1:3,937

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Figure 5
Quantitative macroinvertebrate and crayfish 100-meter survey extent in riffle/run habitat in Carroll County, Virginia.

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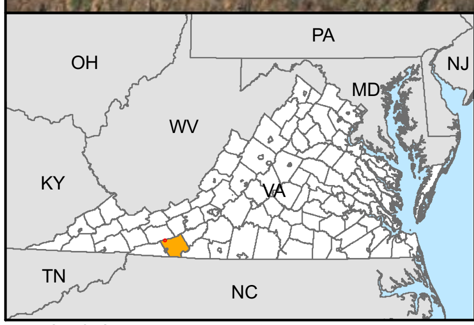

Legend

- Macroinvertebrate Sample Location
- Macroinvertabrate Sampling Transect

N

0 50 100
Meters

Scale: 1:3,937

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Figure 6
Quantitative macroinvertebrate and crayfish 100-meter survey extent in riffle/run habitat in Carroll County, Virginia.

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Legend

- Macroinvertebrate Sample Location
- Macroinvertabrate Sampling Transect

N

0 50 100

Meters

Scale: 1:3,937

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Figure 7
Qualitative macroinvertebrate and crayfish 100-meter survey extent in mixed habitat in Carroll County, Virginia.

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Legend

- Macroinvertebrate Sample Location
- Macroinvertabrate Sampling Transect

N

0 50 100

Meters

Scale: 1:3,937

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Figure 8
Qualitative macroinvertebrate and crayfish 100-meter survey extent in mixed habitat in Carroll County, Virginia.

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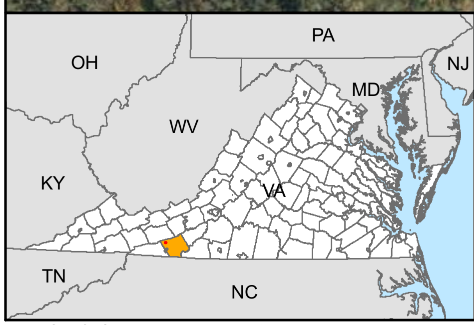

Legend

- Macroinvertebrate Sample Location
- Macroinvertabrate Sampling Transect

N

0 50 100

Meters

Scale: 1:3,937

American Electric Power
Byllesby-Buck Benthic Aquatic Resource

Figure 9
Qualitative macroinvertebrate and crayfish 100-meter survey extent in mixed habitat in Carroll County, Virginia.

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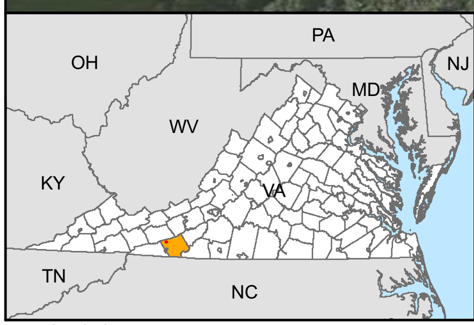


Legend

- Macroinvertebrate Sample Location
- Macroinvertabrate Sampling Transect

N

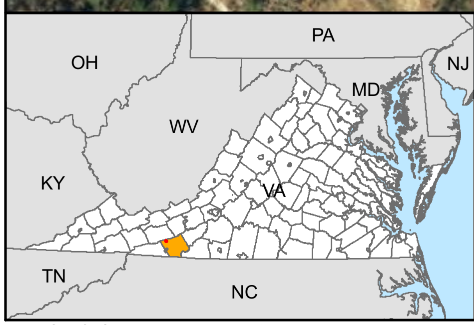
0 50 100
Meters

Scale: 1:3,937

American Electric Power
Byllesby-Buck Benthic Aquatic Resource

Figure 10
Qualitative macroinvertebrate and crayfish 100-meter survey extent in mixed habitat in Carroll County, Virginia.

D:\PROJECTS\HDR\HDR2020-0001 Byllesby-Buck Dam Relicensing\GIS\MXD\Macro_Surveys\Report_Figs\20201215\HDR2020-0001_Macro_Fig2_13_20201215.mxd



Legend

- Macroinvertebrate Sample Location
- Macroinvertabrate Sampling Transect

N

0 50 100
Meters

Scale: 1:3,937

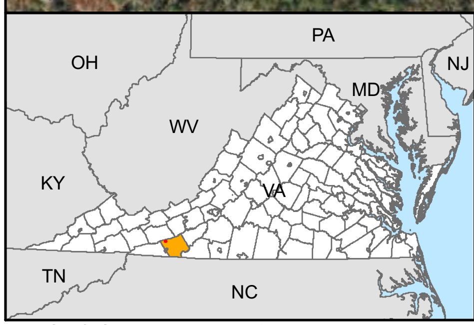
AMERICAN ELECTRIC POWER

EDGE ENGINEERING & SCIENCE

American Electric Power
Byllesby-Buck Benthic Aquatic Resource

Figure 11
Qualitative macroinvertebrate and crayfish 100-meter survey extent in mixed habitat in Carroll County, Virginia.

D:\PROJECTS\HDR\HDR2020-0001 Byllesby-Buck Dam Relicensing\GIS\MXD\Macro_Surveys\Report_Figs\20201215\HDR2020-0001_Macro_Fig2_13_20201215.mxd



Legend

- Macroinvertebrate Sample Location
- Macroinvertabrate Sampling Transect

N

0 50 100
Meters

Scale: 1:3,937

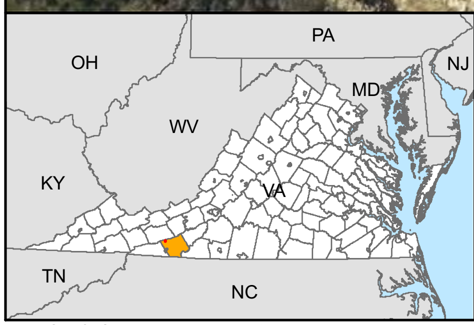
AMERICAN ELECTRIC POWER

EDGE ENGINEERING & SCIENCE

American Electric Power
Byllesby-Buck Benthic Aquatic Resource

Figure 12
Qualitative macroinvertebrate and crayfish 100-meter survey extent in mixed habitat in Carroll County, Virginia.

D:\PROJECTS\HDR\HDR2020-0001 Byllesby-Buck Dam Relicensing\GIS\MXD\Macro_Surveys\Report_Figs\20201215\HDR2020-0001_Macro_Fig2_13_20201215.mxd



Legend

- Macroinvertebrate Sample Location
- Macroinvertabrate Sampling Transect

N

0 50 100
Meters

Scale: 1:3,937

AMERICAN ELECTRIC POWER

EDGE ENGINEERING & SCIENCE

American Electric Power
Byllesby-Buck Benthic Aquatic Resource

Figure 13
Qualitative macroinvertebrate and crayfish 100-meter survey extent in mixed habitat in Carroll County, Virginia.

D:\PROJECTS\HDR\HDR2020-0001 Byllesby-Buck Dam Relicensing\GIS\MXD\Macro_Surveys\Report_Figs\20201215\HDR2020-0001_Macro_Fig2_13_20201215.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, & § 29.1-418 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

Appendix B

REPRESENTATIVE PHOTOGRAPHS

BFQT1 - Upstream
Quantitative Macroinvertebrate Sample Site

BFQT2 - Upstream
Quantitative Macroinvertebrate Sample Site

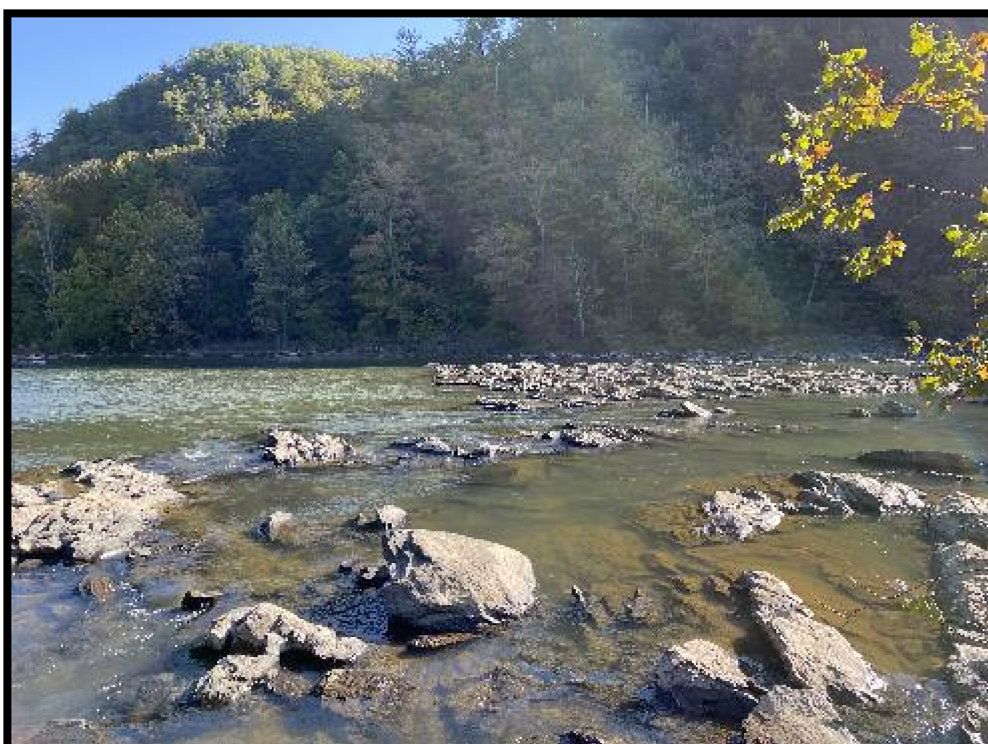
BFQL3 - Upstream
Qualitative Macroinvertebrate Sample Site

BFQL4 - Upstream
Qualitative Macroinvertebrate Sample Site

BFQL5 - Downstream
Qualitative Macroinvertebrate Sample Site

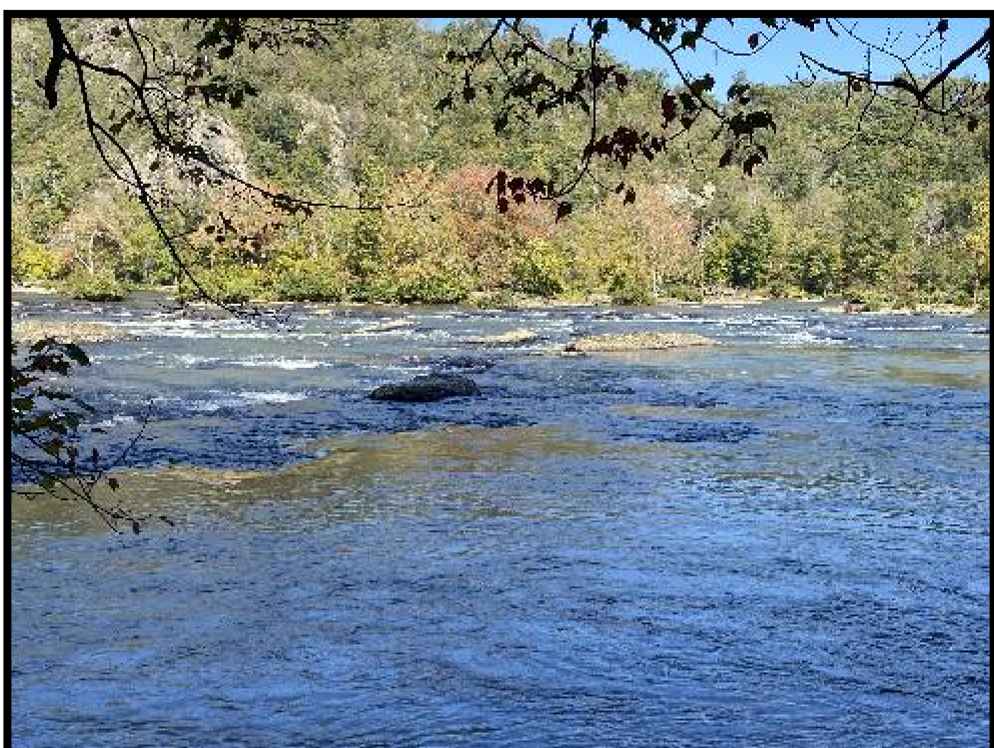
BFQL6 - Upstream
Qualitative Macroinvertebrate Sample Site

BFQT7 - Downstream
Quantitative Macroinvertebrate Sample Site



BFQT8 - Downstream
Quantitative Macroinvertebrate Sample Site

BFQL9 - Upstream
Qualitative Macroinvertebrate Sample Site



BFQT10 - Downstream
Quantitative Macroinvertebrate Sample Site

BFQT11 - Upstream
Quantitative Macroinvertebrate Sample Site

BFQL12 - Downstream
Qualitative Macroinvertebrate Sample Site

BFQL13 - Upstream
Qualitative Macroinvertebrate Sample Site

BFQL14 - Downstream
Qualitative Macroinvertebrate Sample Site

BFQT15 - Downstream
Quantitative Macroinvertebrate Sample Site

BFQT16 - Downstream
Quantitative Macroinvertebrate Sample Site

Conhaway Crayfish
(*Cambarus appalachiensis*)

Spiny Stream Crayfish
(*Faxonius cristavarius*)

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Attachment 4

Attachment 4 – Mussel Community Study Report

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Stantec

Prepared for Appalachian Power Company

Byllesby-Buck Hydroelectric Project Freshwater Mussel Survey (FERC No. 2514)

January 4, 2021

Prepared by:
Stantec Consulting Services Inc.
11687 Lebanon Road
Cincinnati, OH 45241

This document entitled *Byllesby-Buck Hydroelectric Project - Freshwater Mussel Survey* was prepared by Stantec Consulting Services ("Stantec") for the account of Appalachian Power Company (the "Client"). Any reliance on this document by any third party is strictly prohibited. The material in it reflects Stantec's professional judgment in light of the scope, schedule and other limitations stated in the document and in the contract between Stantec and the Client. The opinions in the document are based on conditions and information existing at the time the document was published and do not take into account any subsequent changes. In preparing the document, Stantec did not verify information supplied to it by others. Any use which a third party makes of this document is the responsibility of such third party. Such third party agrees that Stantec shall not be responsible for costs or damages of any kind, if any, suffered by it or any other third party as a result of decisions made or actions taken based on this document.

Prepared by Elizabeth Dilbone
Elizabeth Dilbone

Jane DeClerck
Jane DeClerck

Reviewed by Steve T. Bedross
Steve Bedross

Approved by Will Cody Fleece
Cody Fleece

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Executive Summary

As part of the ongoing Aquatic Resources Study being conducted for relicensing of the Byllesby-Buck Hydroelectric Project (Project), current and historical mussel surveys within the Project area were assessed to evaluate the status of the mussel community effected by Project operations. This report is intended to present data from surveys conducted in 2020 as well as review and summarize existing information regarding mussel assemblages in the Project area.

During September and October 2020, mussel surveys were conducted to assess mussel assemblages in the reservoir reach of the New River between the Byllesby and Buck Dams, as well as the tailrace of Buck Dam. Prior to mussel surveys, a desktop assessment of hydraulic habitat types within the study area was conducted to identify ten potential habitat units for survey. Theses ten habitats were then examined via boat to identify specific areas to target during in-water surveys. Nine *Cyclonaias tuberculata* were found during survey of the ten habitat units. Live mussels were only found in two of the ten surveyed areas and overall mussel densities were lower than other sites within the Project area (e.g. downstream of Buck Dam). Quality habitat within the survey area was limited, with bedrock and overlying silt deposits being the most prominent substrate types. A reconnaissance level habitat assessment of the Buck Dam tailrace was also conducted. No evidence of spent valves or viable mussel habitat were observed within the Buck Dam tailrace, where high velocities resulting from a narrow, confined channel most likely preclude mussel occupancy.

Existing relevant and reasonably available studies of mussels within the Project area were reviewed and compared to results of summer 2020 field surveys. In total, data from six other mussel surveys conducted within the Project area between 1997 and 2018 were compiled to form a more comprehensive understanding of the mussel community in the vicinity of Project operations. Six species were observed within the Project area: *Cyclonaias tuberculata*, *Eurynia dilatata, Tritogonia verrucosa, Lampsilis fasciola, Lasmigona subviridis,* and *Lampsilis ovata.* Survey sites downstream of Buck Dam (downstream of the confluence of the tailrace and bypass channel) supported the highest density mussel habitats. *Cyclonaias tuberculata* and *Tritogonia verrucosa* were the most abundant species and mussel size data suggests that recent recruitment has occurred for these species. Results of 2020 field surveys are consistent with findings of historical surveys. High quality mussel habitat within the Project area is limited and does not support a diverse or abundant mussel community.

Abbreviations

AEP	American Electric Power
°C	Celsius
µS	Microsiemens
CFS	Cubic feet per second
CPUE	Catch per unit effort
DO	Dissolved Oxygen
EA	Environmental Assessment
FERC	Federal Energy Regulatory Commission
Ft	Feet
hr	Hour
ILP	Integrated Licensing Process
M	Meter
m^2	Square meter
mi^2	Square mile
mg/L	Milligrams per liter
mm	Millimeters
NOI	Notice of Intent
NTU	Nephelometric Turbidity Units
PAD	Pre-Application Document
PSP	Proposed Study Plan
RSP	Revised Study Plan
SCUBA	Self-Contained Underwater Breathing Apparatus
USFWS	U.S. Fish and Wildlife Service
VDWR	Virginia Department of Wildlife Resources

1.0 INTRODUCTION

1.1 PROJECT BACKGROUND

The existing Federal Energy Regulatory Commission (FERC or Commission) license for the Byllesby-Buck Hydroelectric Project (FERC No. 2514) (Project) located on the New River in Carroll County, Virginia expires on February 29, 2024. Accordingly, Appalachian Power Company (Appalachian), the Licensee, owner and operator of the Project, is pursuing a subsequent license for the Project pursuant to the Commission's Integrated Licensing Process (ILP). The Appalachian Power Company submitted a Pre-Application Document (PAD) and Notice of Intent (NOI) for the Project to initiate the ILP on January 7, 2019. At this time, the Commission stated its intent to prepare an Environmental Assessment (EA) that evaluates the potential effects of issuing a subsequent license.

In accordance with 18 CFR §5.11, Appalachian developed a Proposed Study Plan (PSP) for the Project that recommended studies and approaches to addressing agency and stakeholder requests. A Revised Study Plan (RSP) was submitted in response to the comments on the PSP from the Commission, U.S. Fish and Wildlife Service (USFWS), and Virginia Department of Wildlife Resources (VDWR) on October 18, 2019. This RSP included provisions for an Aquatic Resources Study to examine multiple taxa within the New River, including a Mussel Community Sub-study. Due to the lack of mussel abundance found in existing data summarized in the PAD, the proposed mussel community study involved a two-stage approach that included 1) field surveys of the Buck Dam Tailrace channel and the reach of the New River between Byllesby Dam and Buck Reservoir Islands and 2) A desktop literature review of available data on the mussel communities in the Project vicinity. The goals of this study are to:

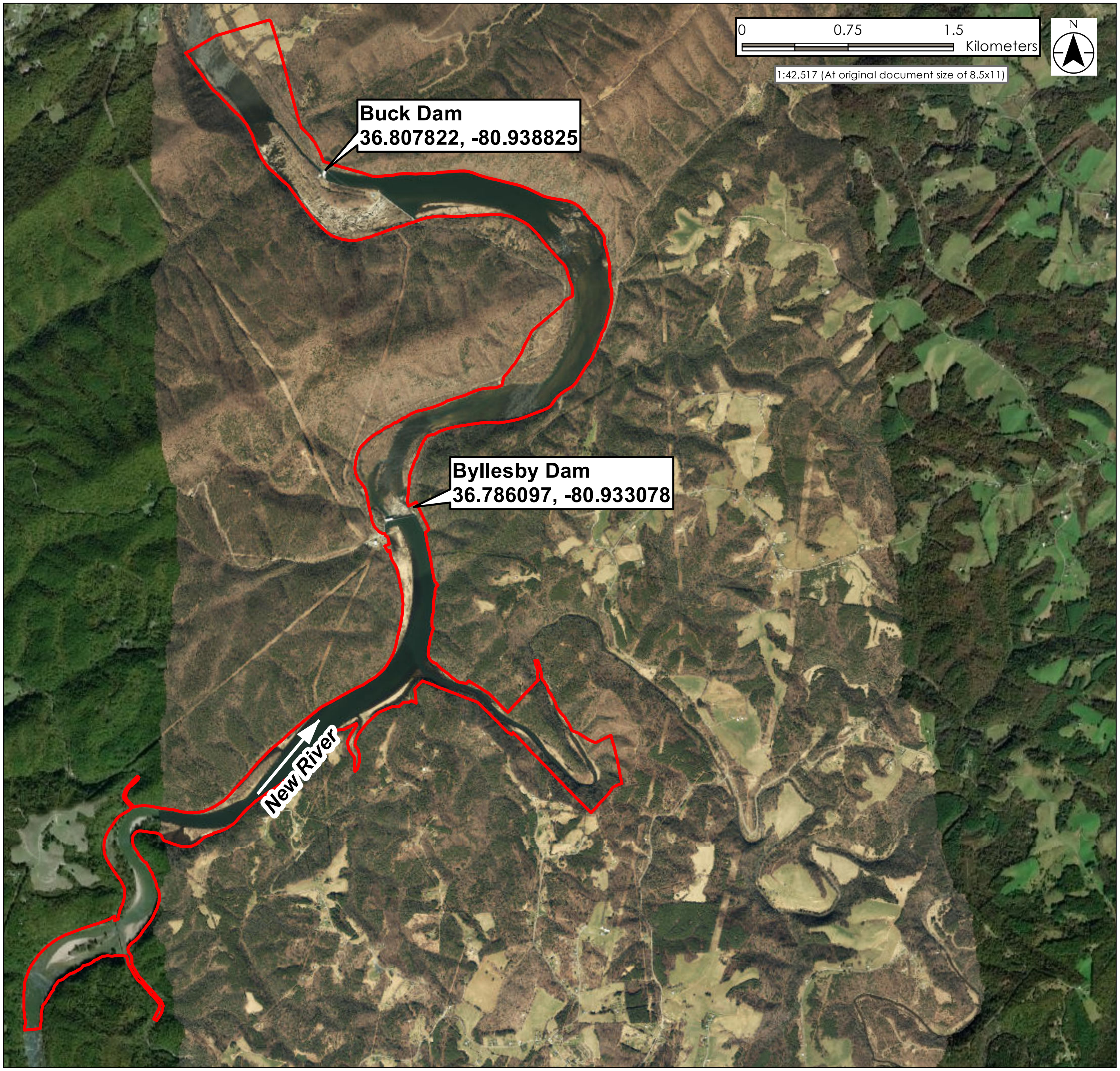
- Collect a more comprehensive baseline understanding of the mussel community within the Project area;
- Compare current mussel survey data to historical data to determine any significant changes in species composition or abundance; and
- Assess spatial distribution of mussel species within the Project area.

1.2 PROJECT AREA

The Project is located on the upper New River in Carroll County, Virginia. The Byllesby development is located about 9 mi north of the city of Galax, and the Buck development is located approximately 3 river miles (RM) downstream of Byllesby and 43.5 RM upstream of Claytor Dam (Figure 1). Each development consists of a reservoir, concrete gravity dam and spillway, and powerhouse. The Project area extends approximately 0.5 mi downstream of the Buck development. Figure 1 depicts the FERC project boundary and Project location.

1.3 STUDY OBJECTIVES

The Unionid fauna of the New River in the vicinity of the Project area has been studied at intervals beginning with Pinder et al. (2002) and most recently by Stantec (2020). Section 2.0 of this report presents the results of surveys completed in the un-impounded reach of the New River between Byllesby Dam and Buck Pool. Section 3.0 of the report presents a compilation and review of readily available studies of unionid mussels in the Project Area.

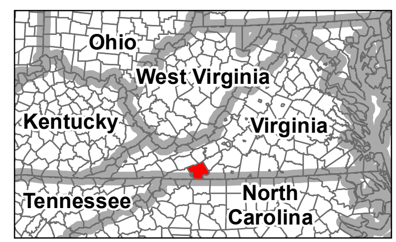


Stantec

Legend

Study Area Boundary

Notes
1. Coordinate System: NAD 1983 StatePlane Ohio North FIPS 3401 Feet
2. Base Imagery: ESRI Map Services.



Project Location
Carroll County, Virginia
New River

Prepared by EKD on 2020-11-24

Client/Project
Byllesby & Buck Hydroelectric Project
(FERC No. 2514)

Figure No.
1

Title
Byllesby - Buck Project Study Area

2.0 2020 MUSSEL SURVEY

2.1 METHODS

Methods consisted of visually identifying potential mussel habitats within the approximately 3,000 meter (m) long reach between Byllesby Dam and the Buck Reservoir Islands as well as the tailrace of Buck Dam. These areas were chosen for searching due to historic information already existing for the majority of the surrounding habitats (Pinder et al. 2002, Alderman 2008, Stantec 2018a, Stantec 2018b), as seen in Figure 2. These studies will be detailed in section 3.0. This study did not examine the Buck or Byllesby impoundment pools due to the recent studies done during drawdown activities (Stantec 2018a & 2018b).

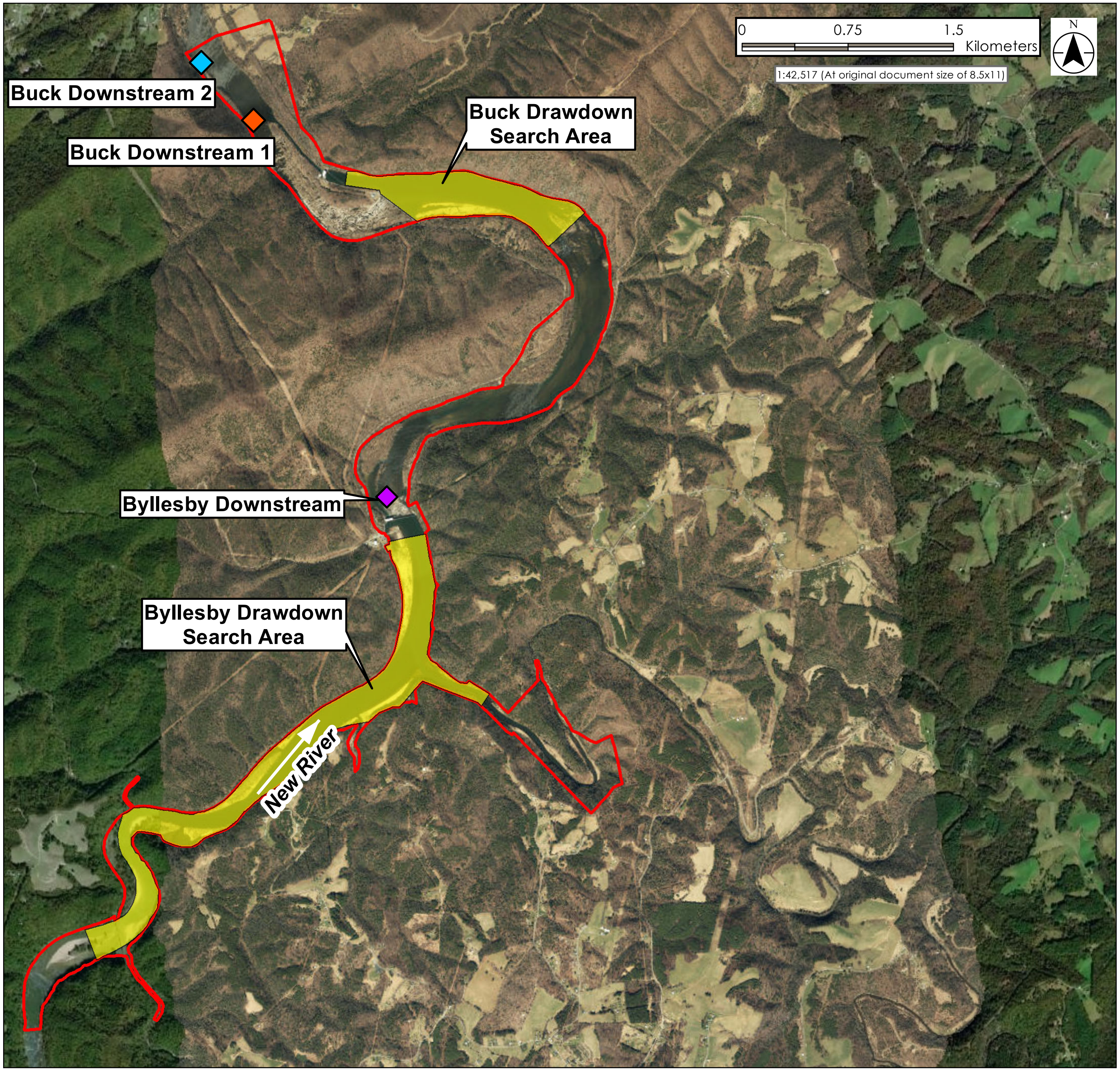
2.1.1 Agency Correspondence

A study plan outlining the proposed survey methodologies was submitted to Virginia Department of Wildlife Resources (VDWR) on September 8, 2020, with approval received from Mr. Brian Watson on September 21, 2020. Documentation of this approval can be found in Appendix A. Field surveys were led by Dan Symonds under Stantec's Scientific Collecting Permit (#605183) and Threatened and Endangered Species Permit (#067427) (Appendix B).

2.1.2 Unimpounded Reach Between Byllesby Dam and Buck Pool

Prior to field work, a desktop evaluation of hydraulic habitat types identified ten distinct habitats within the Project area. A boat-based habitat survey was performed to visually identify specific survey areas within the ten potential mussel habitats of varying hydraulic habitat types. The areas chosen for the wandering timed searches consisted of two shallow shoals, three deep shoals, three pools, and two side channels (Figure 3).

Qualitative surveys were conducted in the chosen survey areas when conditions were appropriate for detecting mussels as well as safe for divers to complete their work. Surveyors used SCUBA, surface supplied air diving, and snorkeling to conduct 200-minute wandering searches of the substrates in each area. Searching tactics included moving cobble and woody debris, hand sweeping away silt, sand, and/or small detritus, and disturbing/probing the upper five centimeters (two inches) of substrate where possible. Mussels were collected in mesh bags and brought to shore for identification and data collection. After data processing, mussels were hand placed on top of the substrate in the general area where they were found. Total search time was 33.3 hours. Turbidities rose higher than 21.6 NTU on the third day of surveying, inhibiting the visual searching techniques for the divers. Completion of the survey was postponed until October 21, 2020 when river conditions had improved. Photographs were taken of representative species (Appendix C).



Stantec

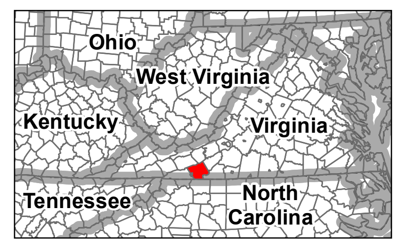
Legend

Study Area Boundary

Historical Survey Locations

- Stantec 2016, 2017, Alderman 2008, Pinder et al. 2002
- Stantec 2016, Alderman 2008
- Pinder et al. 2002
- Stantec 2018a, 2018b

Notes
1. Coordinate System: NAD 1983 StatePlane Ohio North FIPS 3401 Feet
2. Base Imagery: ESRI Map Services.



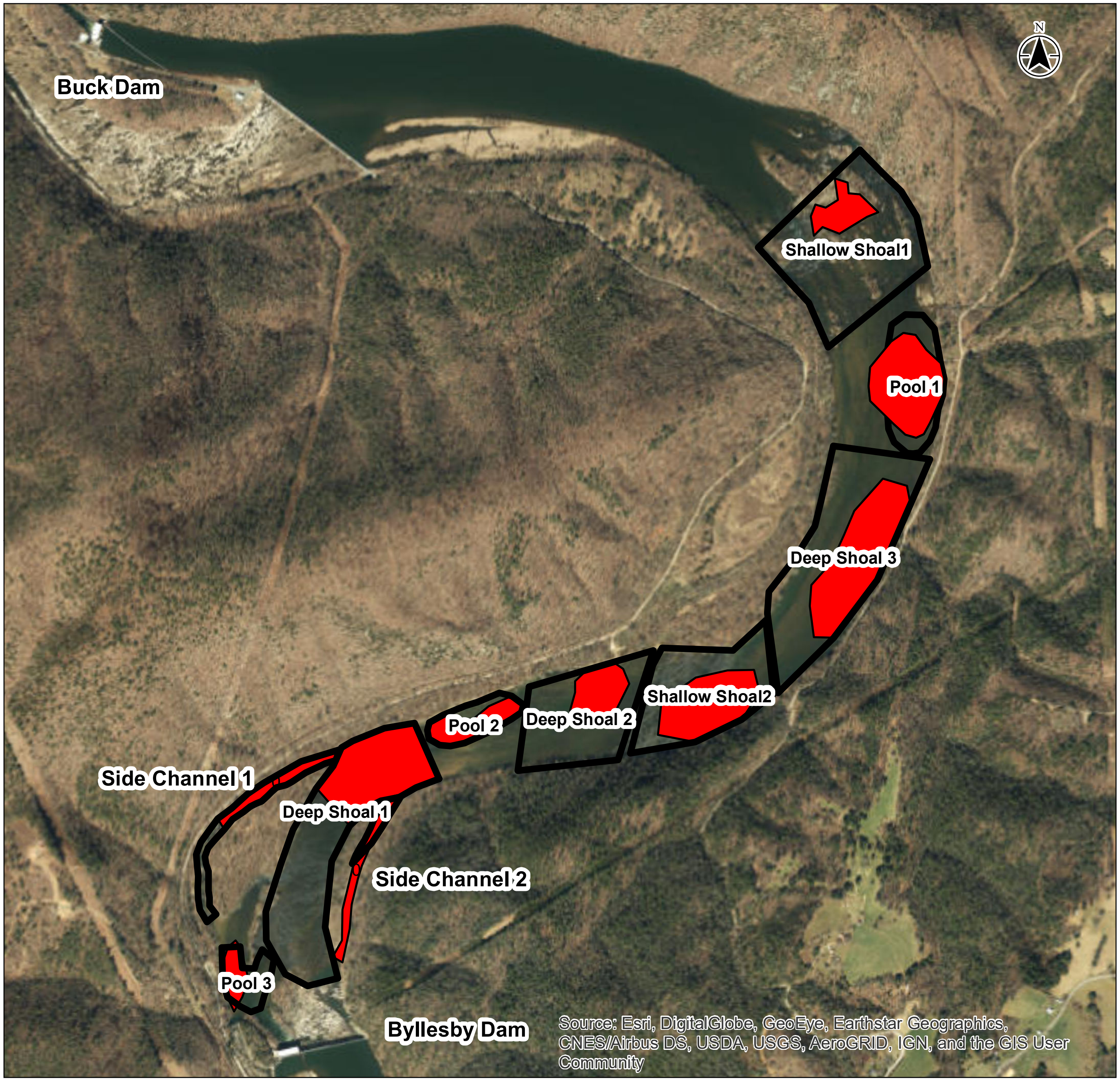
Project Location
Carroll County, Virginia
New River

Prepared by EKD on 2020-11-24

Client/Project
Byllesby & Buck Hydroelectric Project
(FERC No. 2514)

Figure No.
2

Title
Historical Survey Locations



Stantec

Legend

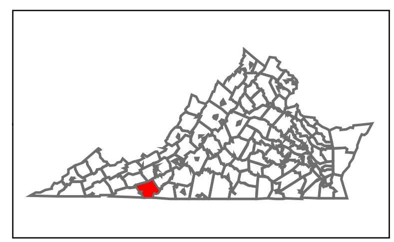
- Survey Areas
- Hydraulic Habitat Units

0 720 1,440 Feet

1:14,557 (At original document size of 8.5x11)

Notes

1. Coordinate System: NAD 1983 StatePlane Ohio North FIPS 3401 Feet
2. Base features: layer sources
3. Base Imagery: ESRI Map Services.



Project Location
Carroll County, Virginia

Prepared by DES on 2020-11-12

Client/Project
American Electric Power

Figure No.
1

Title
Buck/Byllesby Dam Mussel Survey Areas

2.1.3 Buck Dam Tailrace

A reconnaissance level habitat assessment of the Buck Dam tailrace was conducted. Surveyors walked approximately 500m along the stream bank adjacent to the tailrace channel to the point where it converges with the bypass channel (Figure 4). Visual searches were conducted of the exposed riverbanks to discern any spent valves or evidence of suitable mussel habitat. The high velocities and unknown depths in the narrow channel were not conducive for safe in-water surveys such as wading, SCUBA, or snorkeling.

2.2 RESULTS

2.2.1 Site Conditions

Surveys were conducted September 24-26, 2020 and October 21, 2020. Water quality data in the New River was recorded daily at the survey site (Table 1). Visibility was approximately 3-5 ft prior to higher turbidity observed on September 26. A midchannel turbidity reading on the 26th read 50 NTU's and surveys were discontinued. Water quality metrics were generally indicative of a site suitable for mussel occupancy. Discharge was higher than that of the seasonal daily median and varied between 1200 CFS and 1400 CFS (Figure 5).

Table 1. Water Quality

Date	Temperature (C°)	Turbidity (NTU)	pH	Conductivity (µS)	DO (% Sat)	DO (mg/L)
24-Sep	16.8	7.62	8.25	62	97.5	9.70
25-Sep	16.2	8.67	8.31	62	98.7	9.64
26-Sep	15.4	21.60	8.24	61	97.5	9.80
21-Oct	12.9	4.91	8.70	62	105.0	11.03

Stantec

Legend

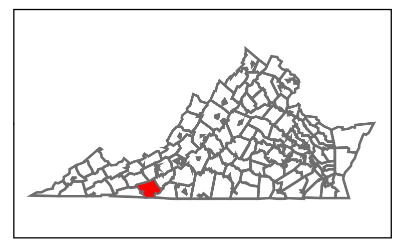
Tailrace

0 320 640 Feet

1:6,489 (At original document size of 8.5x11)

Notes

1. Coordinate System: NAD 1983 StatePlane Ohio North FIPS 3401 Feet
2. Base features: layer sources
3. Base Imagery: ESRI Map Services.



Project Location
Carroll County, Virginia

Prepared by DES on 2020-11-12

Client/Project
American Electric Power

Figure No.
2

Title
Buck Tailrace Survey Area

C:\Users\dsymonds\Documents\2020 Surveys\Byllesby-Buck_HDR_Mussels\GIS\Tailrace.mxd Revised: 2020-11-19 By: dsymonds

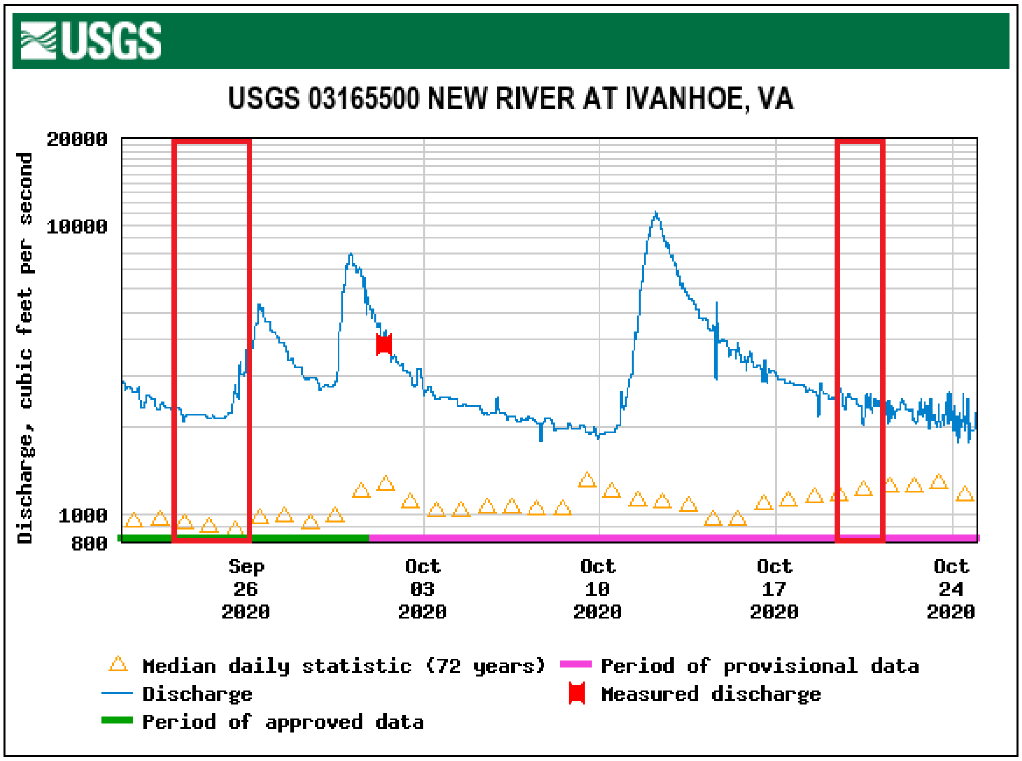


Figure 5. Discharge during time of site survey

Substrates in shallow shoals and deep shoals were predominantly bedrock and bedrock with silt on top. Bedrock and cobble were the dominant substrates in Pool 1, while Pool 2 and 3 were comprised primarily of sand. Substrates in the side channels were most suitable for mussel occupation with dominant substrates being gravel and cobble. Depths varied depending on the hydraulic habitat type with shallow shoals between 1 and 5 ft, deep shoals between 2 and 5 ft, and pools between 3 and 7ft with Pool 3 reaching a maximum depth of 24 ft (Table 2).

Table 2. Individual Site Characteristics

Survey Area	Effort (minutes)	Average Depth (feet)	Max Depth (feet)	Dominant Substrate
Shallow Shoal 1	200	1	3	Bedrock
Shallow Shoal 2	200	3	5	Bedrock
Pool 1	200	3	7	Bedrock/Cobble
Pool 2	200	5	7	Sand
Pool 3	200	10	24	Sand
Deep Shoal 1	200	2	4	Bedrock
Deep Shoal 2	200	3	4	Silt
Deep Shoal 3	200	3	5	Bedrock
Side Channel 1	200	1	2	Gravel
Side Channel 2	200	1	2	Cobble

2.2.2 Mussel Distribution and Abundance in Unimpounded Reach

Nine total live mussels were found all identified as *Cyclonaias tuberculata* (Purple Wartyback). The smallest of these was 48 mm and the largest was 95 mm in length. The mean length of live *Cyclonaias tuberculata* was 80 mm. One spent *Eurynia dilatata* (Spike) valve was found in weathered condition (Table 3).

Table 3. Mussels Found in Survey Area

Area	Species	Length (mm)	Condition
Shallow Shoal 1	*C. tuberculata*	48	Live
Shallow Shoal 1	*C. tuberculata*	87	Live
Shallow Shoal 1	*C. tuberculata*	-	Weathered
Deep Shoal 2	*C. tuberculata*	85	Live
Deep Shoal 2	*C. tuberculata*	84	Live
Deep Shoal 2	*C. tuberculata*	95	Live
Deep Shoal 2	*C. tuberculata*	85	Live
Deep Shoal 2	*C. tuberculata*	78	Live
Deep Shoal 2	*C. tuberculata*	91	Live
Deep Shoal 2	*C. tuberculata*	64	Live
Pool 1	*E. dilatata*	-	Weathered

2.2.3 Tailrace Findings

No evidence of freshwater mussels was found in the tailrace of Buck Dam. The exposed areas of the riverbanks were devoid of any spent valves. The velocity was high throughout the channel and visually estimated to be above 3.0 feet per second. Surveyors could not see or safely probe the bottom of the channel to gain information about substrate.

2.3 DISCUSSION

Overall mussel abundance and richness were low in the Project area. While the New River is not known as a productive mussel river, some reaches do support higher densities than observed in this study (See Section 3.0). 0.27 mussels per search hour is low relative to other freshwater mussel survey results, even within the New River Basin (See 3.2.6).

Most of the substrate was bedrock or a thin layer of sediment on top of bedrock. Impermeable bedrock can be inhabitable for burrowing invertebrates like freshwater mussels (Haag 2012). The West side channel contained the best substrate (Gravel/Cobble/Sand mixture). Combined with steady flow through a riffle/run complex, this was thought to be the best potential area for mussels. However, benthic macrofauna, unionid and non-unionid alike, were not encountered. While lack of quality habitat through the other survey areas is most likely dictating the lack of mussels, the absence in the side channel remains unexplained.

Similar findings were encountered during earlier studies by Stantec. In 2018 Stantec performed a mussel rescue during the Byllesby Dam drawdown necessary for scheduled repairs. This survey only collected 4 live mussels (3 *Cyclonaias tuberculata*, and 1 *Lasmigona subviridis* [Green floater]), and 20 spent valves (14 *Cyclonaias tuberculata*, 1 *Eurynia dilatata*, and 5 *Lasmigona subviridis*). That same year Stantec performed a mussel rescue during the Buck Dam drawdown necessary for scheduled repairs. This survey collected 2 live mussels (*Lampsilis fasciola* [Wavyrayed Lampmussel]) and 3 spent valves (2 *Lampsilis fasciola* and 1 *Cyclonaias tuberculata*).

The catch per unit of effort (CPUE) of the two 2018 studies and the current study were of similar low magnitude. The Byllesby Dam drawdown had 0.13 CPUE, the Buck Dam draw down had 0.15 CPUE, and this survey had 0.27 CPUE.

2.4 CONCLUSIONS

A total of nine live mussels were found during 33.3 diver-hours of surveying, representing one live species and one additional species solely by shell specimen. The total CPUE for this project was 0.27 mussels/hour. The mussels found did not represent any state or federal listed species. Overall, the Project area contains low numbers of mussels and shell specimens, which may be due to the overall lack of quality habitat through the riverine reach. The current results are consistent with results from recent survey efforts within the project area.

3.0 LITERATURE REVIEW

A literature review of available information regarding the freshwater mussel community in the Project area was performed to compile a baseline understanding of mussel resources within the Project area. All relevant and readily available studies regarding the mussel community in the Project vicinity were reviewed. This was combined with surveys conducted in 2020 to provide a complete picture of the status of freshwater mussel resources and their trends through time and across the Project area.

3.1 METHODS

For each study, survey methods, species composition, mussel abundance and density, and specimen length data (if available) was noted. CPUE was calculated as the number of mussels found per person-hour of searching using transect and timed search data. Mussel density was calculated for quantitative surveys as the number of mussels per m^2 of search area.

Survey methods, durations, and reported metrics differed substantially between studies (Table 4). However, qualitative comparison of reported data between survey sites and years allowed for assessment of potential spatial and temporal trends in species composition and abundance. Mussel locations relative to field-identified habitat types were also reviewed to help characterize the quality of mussel habitat within the Project area.

Table 4. Summary of Survey Methods

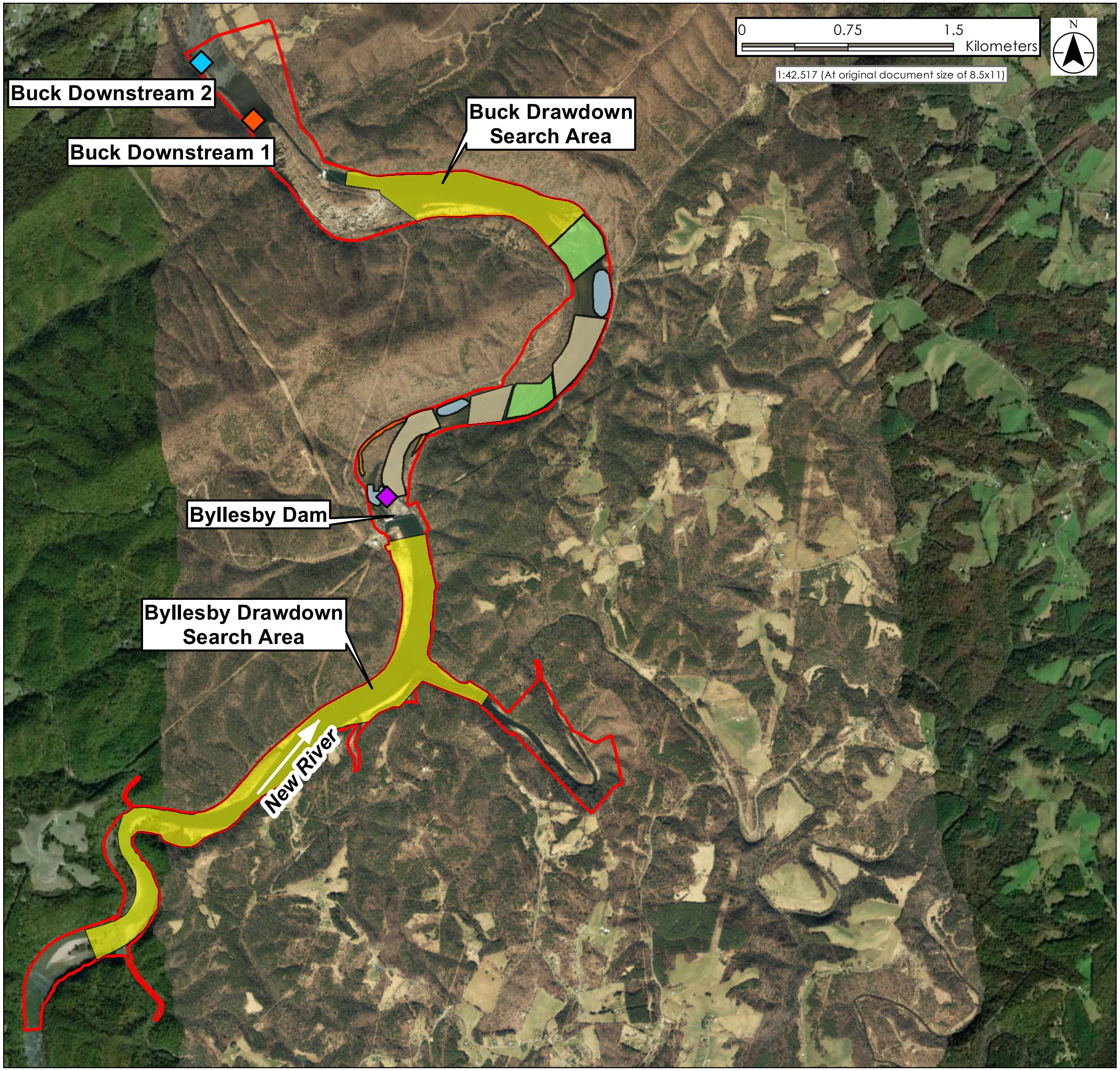
Study	Location	Methods	Site Search Time (Hours)	Total Search Time (hours)
Pinder et al. 2002	Buck 2 Bellow Byllesby	Wandering search - snorkel and/or viewscopes	1 - 4	5
Alderman 2008	Buck 2 Buck 1	Wandering search – snorkel, SCUBA and/or viewscopes	3.25 - 6	9.25
Stantec 2016	Buck 2 Buck 1	Transects – snorkel SCUBA Quadrat excavation	6.7	13.4
Stantec 2017	Buck 2	Transects – snorkel SCUBA Quadrat excavation	6.7	6.7
Stantec 2018a	Byllesby Drawdown Area	Wandering search – walking dewatered substrates	-	27.2
Stantec 2018b	Buck Drawdown Area	Wandering search – walking dewatered substrates	-	15.5
Stantec 2020	Un-impounded Reach	Wandering search – snorkel SCUBA	3.3	33.3

3.2 RESULTS

The following sections provide a summary of findings from freshwater mussel surveys identified by the RSP and Byllesby-Buck PAD as being located within the Project study area and relevant to Project operations (HDR 2019, Appalachian Power Company 2019). The GPS coordinates of each survey site assessed in this report are listed in Table 5. Survey site locations and their associated study are presented in Figure 6.

Table 5. Location of Historical Mussel Survey Sites

Site Name	Location
Buck Downstream 1	36.811950, -80.944339
Buck Downstream 2	36.815411, -80.948300
Buck Drawdown Area	0 - 2,700 m upstream of Buck Dam
Below Byllesby Dam	36.7875316, -80.934210
Byllesby Drawdown Area	0 - 5,000 m upstream of Byllesby Dam



Stantec

Legend

Study Area Boundary

Historical Survey Locations

Stantec 2016, 2017, Alderman 2008, Pinder et al. 2002

Stantec 2016, Alderman 2008

Pinder et al. 2002

Stantec 2018a, 2018b

2020 Survey Locations

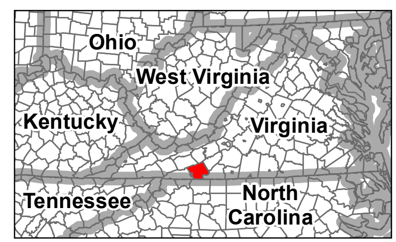
Shallow Shoal

Deep Shoal

Pool

Side Channel

Notes
1. Coordinate System: NAD 1983 StatePlane Ohio North FIPS 3401 Feet
2. Base Imagery: ESRI Map Services.



Project Location
Carroll County, Virginia
New River

Prepared by EKD on 2020-11-24

Client/Project
Byllesby & Buck Hydroelectric Project
(FERC No. 2514)

Figure No.
2

Title
Historical Survey Sites

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3.2.1 Historical Studies

3.2.1.1 Pinder et al. 2002

Pinder et al. (2002) conducted a drainage wide survey of the New River to assess the status and distribution of freshwater mussels within the basin. Mussel surveys were conducted between 1997 and 1998 at 134 sites (Note the report was written in 2002 and is cited accordingly within), including mainstem and tributaries within the basin. Surveys were conducted using timed searches and snorkel or viewscope methods. Two of the 134 sites were located within the Project area; Site 20 corresponds with Buck Downstream 2 and Site 25 is directly below Byllesby Dam (Figure 6). Search effort was four person-hours at Buck Downstream 2 and one person-hour below Byllesby Dam. Table 6 presents a count of live mussels by species found for each survey site within the Project area. A total of 26 live mussels from four species were found between both sites. The two most widely distributed species both within the New River basin and Project area were *Cyclonaias tuberculata* and *Eurynia dilatata* (Table 6). Pinder et al. (2002) did not report mussel lengths.

Table 6. Live Mussels by Species Found by Pinder et al. (2002) Within the Project area

Species	Buck Downstream 2	Below Byllesby
Cyclonaias tuberculata	15	1
Eurynia dilatata	6	-
Lampsilis ovata	2	-
Tritogonia verrucosa	2	-
Total	25	1

3.2.1.2 Alderman 2008

Alderman (2008) conducted mussel surveys within the New River between 2007 and 2008 in support of the FERC relicensing of the Claytor Hydroelectric Project (FERC No. 739). Sites 20080724.1 and 20080724.2 were located within the Project area directly downstream of Buck Dam (corresponding to Buck Downstream 1 and Buck Downstream 2 in Figure 6). Surveys at these sites were conducted on July 24, 2008 and consisted of timed searches. Search effort was six person-hours at Buck Downstream 1 and 3.25 person-hours for Buck Downstream 2.

The number of mussels by species found at Buck Downstream 1 and 2 is presented in Table 7. A total of 275 mussels from four species were found between both survey sites. Abundance at Buck Downstream 2 (n = 180, CPUE = 55.4) was almost double that of Buck Downstream 1 (n = 95, CPUE = 15.8) and almost four times greater CPUE. *Cyclonaias tuberculata* (n = 134) and *Tritogonia verrucosa* (Pistolgrip, n = 125) were the most abundant species (Table 7). Alderman (2008) noted that most of the *Tritogonia verrucosa* at Buck Downstream 2 were found along the island near the upstream limit of the survey area. The study did not report size data for mussels at sites within the Project area but did state that only relatively mature specimens of each species were found as evidenced by the lack of observed smaller individuals (e.g. < 40 mm) (Alderman 2008).

Table 7. Live Mussels by Species Found by Alderman (2008) Within the Project area

Species	Buck Downstream 1	Buck Downstream 2
Cyclonaias tuberculata	11	123
Eurynia dilatata	1	6
Lampsilis ovata	4	5
Tritogonia verrucosa	79	46
Total	95	180

3.2.2 Stantec 2015 and 2017 Surveys

During the fall of 2015 and 2017, Stantec conducted mussel surveys at seven sites in the New River for aquatic studies related to the Claytor Hydroelectric Project (Stantec 2016, 2017). Two of the sites surveyed for these studies were within the Byllesby-Buck Project area, corresponding to sites Buck Downstream 1 and 2 (Figure 6).

3.2.2.1 Stantec 2016

During October 2015, Stantec (2016) surveyed Buck Downstream 1 and 2 using a two-staged approach to focus on higher quality habitats. During Stage 1, ten 40-meter-long transects were divided into 10 m segments and surveyed at a rate of 1 minute per meter (m). Total search effort at each site was a minimum of 6.7 person-hours. Stage 2 sampling consisted of quantitative surveys targeting the best mussel habitat identified during Stage 1. Quadrat samples were excavated near the four transect segments with the highest mussel densities during Stage 1, resulting in a total quantitative survey area of 25 m^2 for each site (Stantec 2016).

Table 8 presents the total number of live mussels found by species during Stage 1 and 2 surveys of Buck Downstream 1 and 2 during October 2015. A total of 65 live mussels from three species were found downstream of Buck Dam. No additional species were found that differed from those found by Pinder et al. (2002) and Alderman (2008). As was the case for Alderman (2008), abundance was greater at Buck Downstream 2 (n = 52) than Buck Downstream 1 (n = 13). *Cyclonaias tuberculata* (n = 40) and *Tritogonia verrucosa* (n=24) were the most abundant species, with only one *Eurynia dilatata* specimen found (Table 8).

Table 8. Mussels Found at Buck Downstream 1 and 2 by Stantec (2016)

Species	Buck Downstream 1	Buck Downstream 2	Total
Cyclonaias tuberculata	1	39	40
Eurynia dilatata	1	-	1
Tritogonia verrucosa	11	13	24
Total	13	52	65

3.2.2.2 Stantec 2017

During September 2016, Stantec (2017) conducted additional mussel surveys at Buck Downstream 2 (Buck Downstream 1 was discontinued as a survey site after 2015 surveys). Survey methods followed the same two-staged approach used by Stantec (2017). A total of 82 mussels were found during transect and quadrat surveys, consisting of 49 *Cyclonaias tuberculata*, three *Eurynia dilatata*, and 30 *Tritogonia verrucosa*.

3.2.3 Impoundment Drawdowns

3.2.3.1 Byllesby Drawdown 2018

Mussel salvage and relocation was conducted within the Byllesby Dam impoundment from April 30 – May 1, 2018 during a planned reservoir drawdown for installation of Obermeyer crest gates. The dam pool was lowered approximately nine feet over a 48-hour (hr) period. Stantec (2018a) relocated freshwater mussels stranded on habitat exposed by the impoundment drawdown to outside the disturbance limits. The total search effort was 27.2 person-hours and covered approximately 5,000 linear meters of stream, focusing on exposed channel margins and islands towards the upstream end of the dam pool (Figure 6). Four live mussels were collected, consisting of three *Cyclonaias tuberculata* and one *Lasmigona subviridis*. *Lasmigona subviridis* is listed as threatened in the state of Virginia (VDWR 2020) and was a new finding within the Project area. All collected mussels, both shells and living, were observed at the upstream end of the impoundment, above the New River Trail foot bridge. Higher quality mussel habitat (e.g. sand, gravel, and cobble) was observed more frequently along the upstream end of the search area and silt deposits were common closer to the dam (Stantec 2018a).

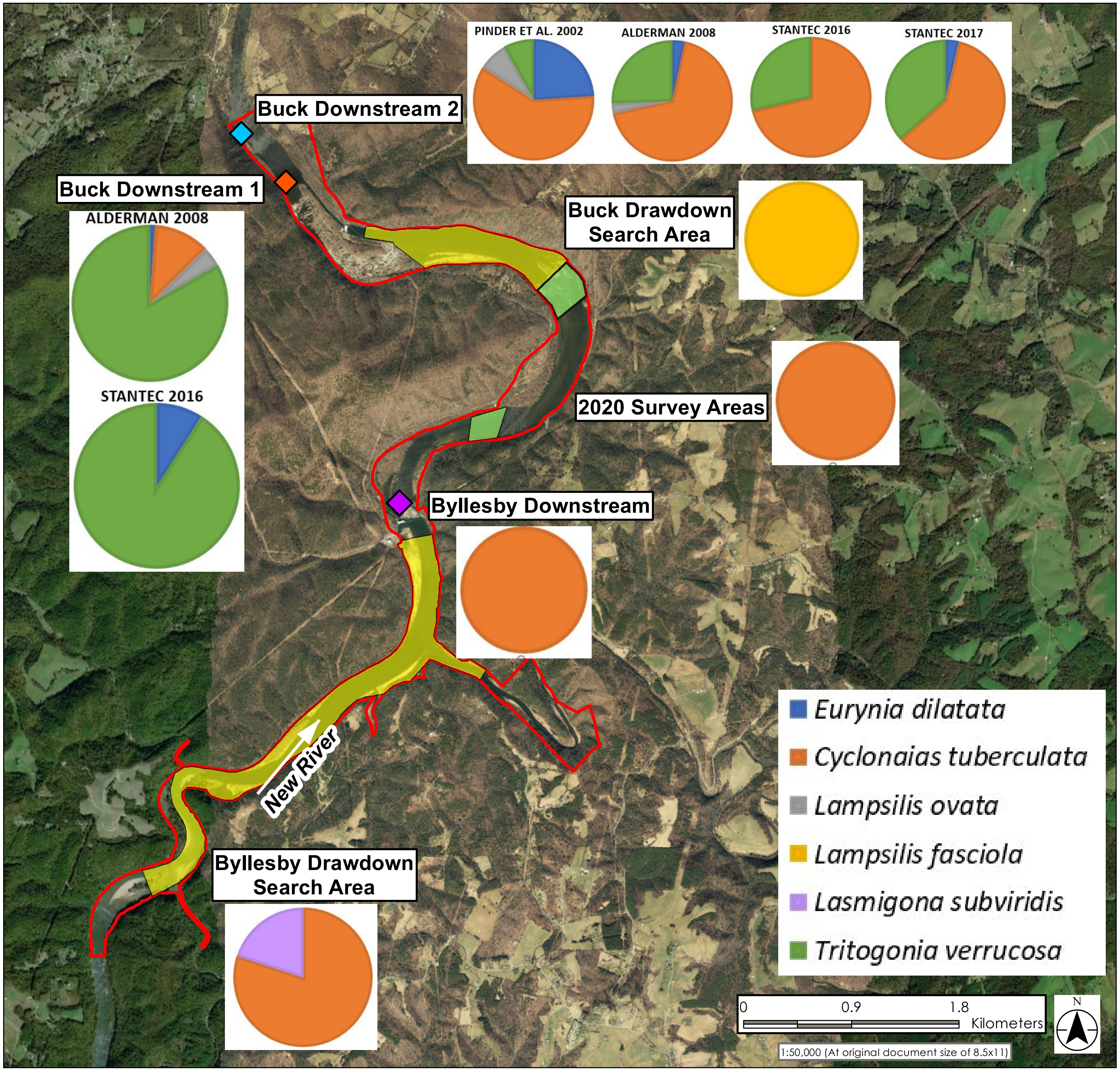
3.2.3.2 Buck Drawdown 2018

Between July 10 and July 11, 2018, Stantec (2018b) conducted a mussel salvage and relocation during a drawdown at the Buck Dam impoundment performed for installation of Obermeyer crest gates. The dam pool was lowered approximately nine feet over a 24-hr period. The search effort focused on potential mussel habitat along channel margins and islands above Buck Dam (Figure 6). The total search effort was 15.5 person-hours, covering approximately 2,700 linear meters of streambank upstream of Buck Dam. Two live mussels, both *Lampsilis fasciola*, were collected and relocated outside the dewatered area. Both specimens were found along the mid-channel island near the upstream limits of the impoundment. This area is slightly downstream of Shallow Shoal 1 from the Stantec 2020 survey (Section 2.0). The island contained pockets of flow refugia and gravel substrate which offered more suitable mussel habitat than the silt deposits that were dominate downstream of the island. *Cyclonaias tuberculata* was also found as a shell only (Stantec 2018b).

3.2.4 Mussel Abundance and Species Composition

A total of 452 live mussels from six species were found during mussel surveys within the Project area between 1997 and 2020 (Pinder et al. 2002, Alderman 2008, Stantec 2016, Stantec 2017, Stantec 2018a, Stantec 2018b, and Stantec 2020). The most widespread species across all survey years were *Cyclonaias tuberculata* (n = 242) and *Tritogonia verrucosa* (n = 179). These two species accounted for 421 of the 452 mussels found within the Project area. *Lampsilis ovata* (Pocketbook) was found in small numbers downstream of the Buck Dam during 1997 and 2008 surveys but was not found during more recent surveys between 2015 and 2020 (Pinder et al. 2002, Alderman 2008). The only *Lasmigona subviridis* found within the Project area was encountered along an island at the upstream limits of the Byllesby impoundment (Stantec 2018a). Likewise, *Lampsilis fasciola* was only found near an island upstream of Buck Dam (Stantec 2018b, Figure 7).

Overall, species richness and abundance were greater at sites downstream of Buck Dam than elsewhere in the Project area. Mussel densities within the dam impoundments were some of the lowest observed within the Project area. Mussel observations during drawdown surveys were limited to coarser habitats found along upstream islands. No federally listed threatened or endangered species were found within the Project area. *Tritogonia verrucosa* and *Lasmigona subviridis* are listed as threatened in Virginia (VDWR 2020).



Stantec

Legend

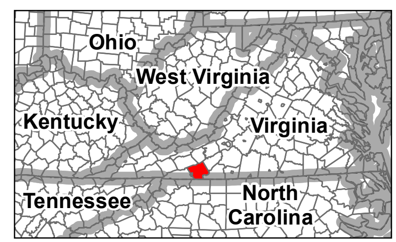
Study Area Boundary

Historical Survey Locations

- Stantec 2016, 2017, Alderman 2008, Pinder et al. 2002
- Stantec 2016, Alderman 2008
- Pinder et al. 2002
- Stantec 2018a, 2018b
- 2020 Survey Areas

Notes

1. Coordinate System: NAD 1983 StatePlane Ohio North FIPS 3401 Feet
2. Base Imagery: ESRI Map Services.



Project Location
Carroll County, Virginia
New River

Prepared by EKD on 2020-11-24

Client/Project
Byllesby & Buck Hydroelectric Project
(FERC No. 2514)

Figure No.
7

Title
Species Compostion by Survey Site

3.2.5 Mussel Lengths

Figures 8 and 9 show the distribution of mussel lengths for the two most abundant species within the Project area (*Cyclonaias tuberculata* and *Tritogonia verrucosa*) found during surveys at Buck Downstream 1 and 2 (Stantec 2016, 2017, and 2020). Pinder et al. (2002) and Alderman (2008) did not report mussel sizes, so data from these studies were not included in this length assessment. Both *Cyclonaias tuberculata* and *Tritogonia verrucosa* were collected across a wide range of size classes during 2015, 2017, and 2020 field surveys. Although the size distribution of *Cyclonaias tuberculata* is skewed towards larger individuals, the presence of smaller or younger individuals suggests recent recruitment has occurred downstream of Buck Dam (Figure 8). The three *Cyclonaias tuberculata* collected during the Byllesby drawdown were also a range of sizes (34 – 71 mm), further confirming the presence of a reproducing mussel population within the Project area (Stantec 2018a).

The four *Eurynia dilatata* specimens collected during 2015 and 2017 surveys were all larger individuals (85 – 95 mm) (Stantec 2016, 2017). The small sample size of *Lasmigona subviridis* (n = 1) and *Lampsilis fasciola* (n = 2) precluded a viable assessment of mussel size distribution and recruitment for these species within the Project area. The lone *L. subviridis* appeared to be approximately 8 years old based on growth rings, which would suggest recruitment in 2010. *Lampsilis ovata* was only found live during earlier studies that did not report length data (Pinder et al. 2002 and Alderman 2008).

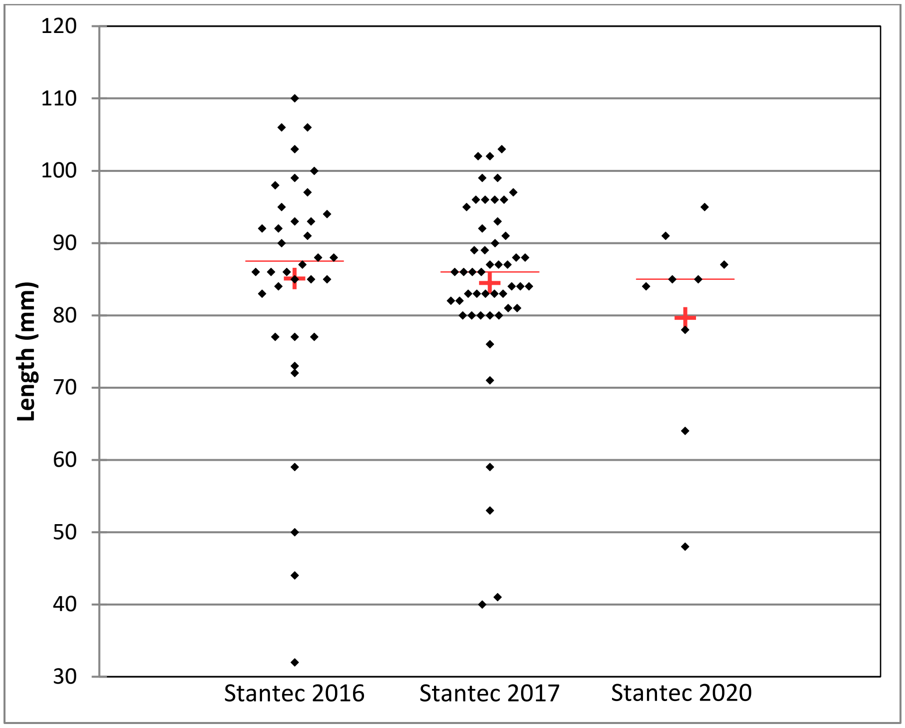


Figure 8. Shell lengths of *Cyclonaias tuberculata* Found Downstream of Buck Dam by Stantec (2016, 2017, 2020)

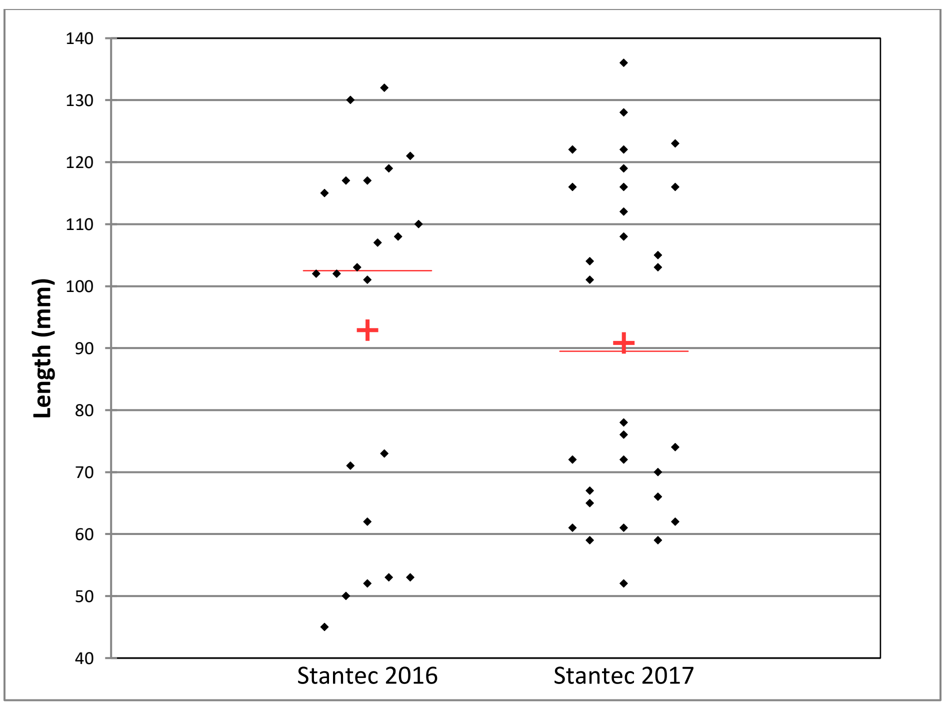


Figure 9. Shell lengths of *Tritogonia verrucosa* Found Downstream of Buck Dam by Stantec (2016, 2017)

3.2.6 Community Metrics

Table 9 presents a summary of mussel community metrics, including richness, abundance, Catch per Unit Effort (CPUE), and mussel density, for all studies assessed within the Project area. While direct comparison of mussel abundance and density between studies is difficult due to different survey methods, general observations about the quality of mussel habitat and composition of the mussel community can still be made.

Overall species richness within the Project area is low, with a maximum of four species found during any one survey. Richness was slightly higher for Pinder et al. 2002 and Alderman 2008 surveys than more recent surveys downstream of Buck Dam in 2015 and 2017 (Table 9). Abundance and CPUE was generally higher for survey sites directly downstream of Buck Dam, with the greatest abundance observed for Alderman (2008) (n = 275). For surveys within the dam pools (Stantec 2018a, 2018b), richness was limited to one or two species and CPUE was < 1.0 mussels/hr.

Table 9. Comparison of Mussel Community Metrics for Surveys within the Project area by Study Year Between 1997-2020

	Pinder et al. 2002	Alderman 2008	Stantec 2016	Stantec 2017	Stantec 2018a	Stantec 2018b	Stantec 2020
Species Richness	4	4	3	3	2	1	1
Abundance	26	275	53	82	5	1	9
Search effort (hours)	5	9.25	6.7	6.7	27.2	15.5	33.3
CPUE	5.2	29.7	3.9	11.0	0.18	0.13	0.27
Density (mussels/m^2)	-	-	0.24	0.32	-	-	-

Repeat surveys at Buck Downstream 1 and 2 allowed for assessment of potential temporal changes in the mussel community between survey dates. Table 10 compares species richness, CPUE, and mussel density for 2008 and 2015 surveys of Buck Downstream 1. While abundance was low for both survey years, both CPUE and richness were slightly higher in 2008 than 2015 (Table 10).

Table 10. Comparison of Mussel Community Metrics at Buck Downstream 1

Metric	Alderman 2008	Stantec 2016
Richness	4	2
CPUE	6.0	1.6
Density (mussels/m^2)	-	0.10

Buck Downstream 2 was surveyed during four different studies between 1997 and 2017. Table 11 compares richness, CPUE, and mussel density observed at Buck Downstream 2 for all four studies. CPUE ranged from 4.0 to 55 mussels per hour of searching among all survey dates. Species were limited for all survey years, with no more than four species observed during each survey (Table 11).

Table 11. Comparison of Mussel Community Metrics at Buck Downstream 2

Metric	Pinder et al. 2002	Alderman 2008	Stantec 2016	Stantec 2017
Richness	4	4	2	3
CPUE	4.0	55	6.3	11
Density (mussels/m^2)	-	-	0.4	0.32

Examining CPUE from downstream to upstream shows that the most mussels were found downstream of Buck Dam (Figure 10). Despite differences between the four surveys (some of which is due to different methods), the Buck Downstream 2 site has the greatest CPUE through time. Upstream of the Buck Dam and continuing to upstream of the Byllesby Dam shows low CPUE's throughout the Project area. Note that for display purposes this figure ignores the Buck Tailrace and eight hydraulic units that contained zero mussels.

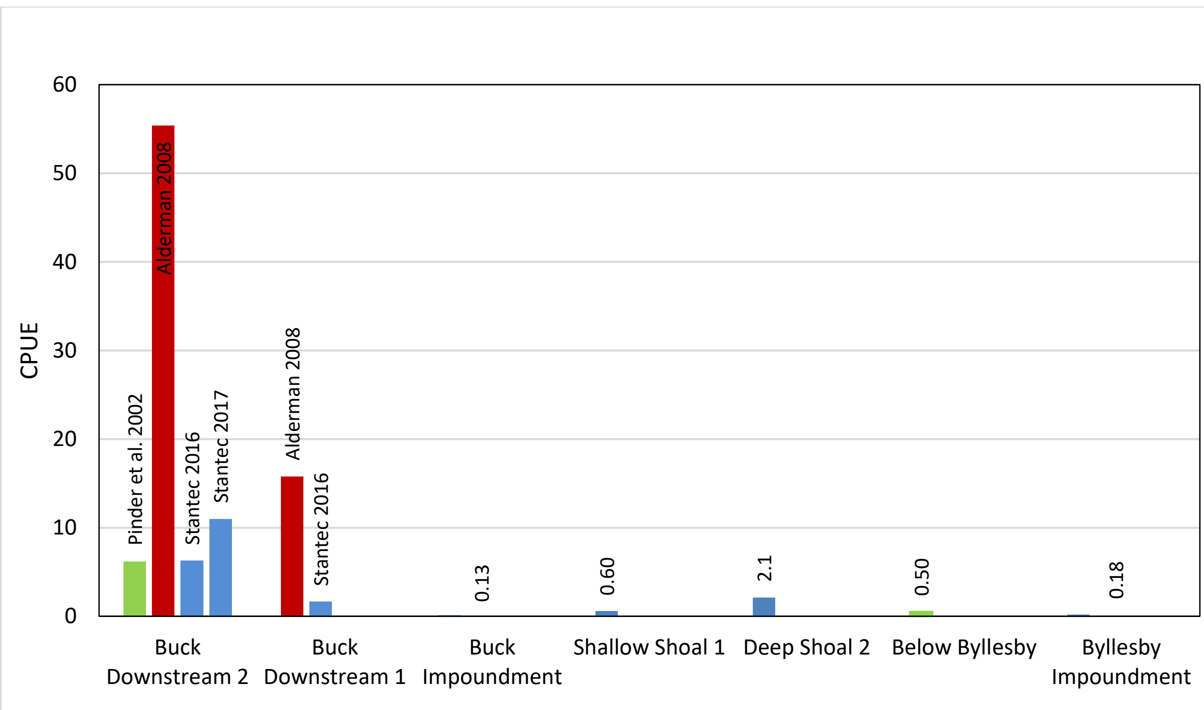


Figure 10. CPUE Across all Survey Sites from Downstream to Upstream.

Distinct differences in CPUE from downstream to upstream is further illustrated by averaging the CPUE's across all surveys (Figure 11). Downstream of Buck Dam is where mussel communities really become abundant enough for higher CPUE's.

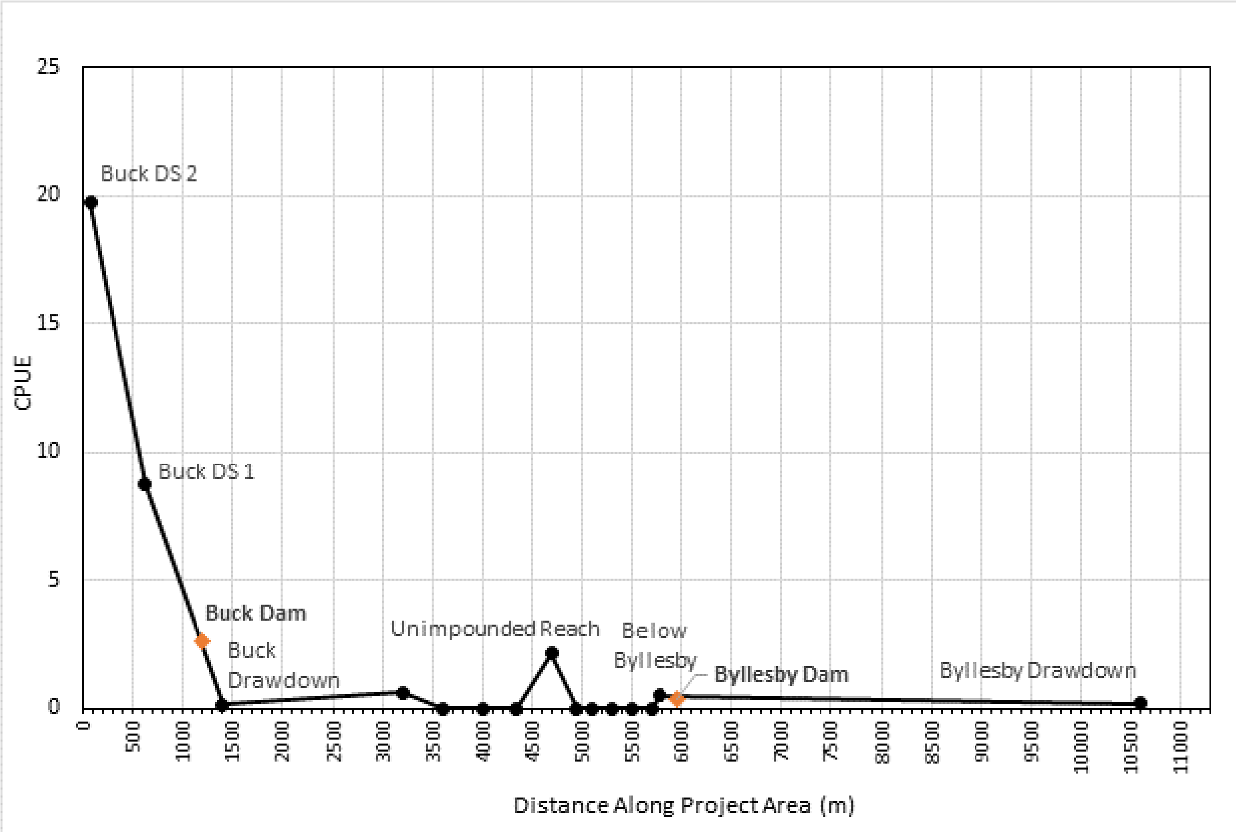


Figure 11. Average CPUE by Site from Downstream to Upstream Through the Project Area.

Four sampling periods at Buck Downstream 2 allows for temporal comparisons unavailable at other specific sites (Figure 12). CPUE's were similar between 1997 (4), 2015 (6.3), and 2017 (11) surveys, with the 2008 Alderman study being the outlier (55.4). Species richness varied between two and four species but may be tied to overall survey effort.

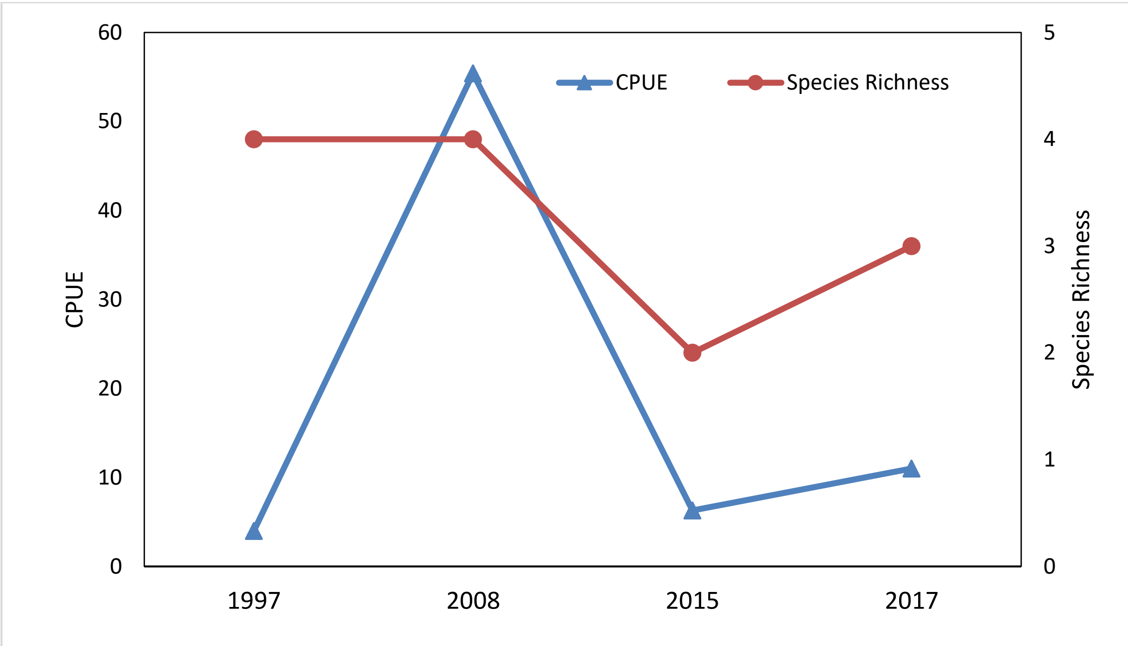


Figure 12. CPUE and Species Richness at Buck Downstream 2 (1997 – 2017)

3.3 DISCUSSION

Results of mussel surveys of the New River from 1997 to 2020 demonstrate that overall abundance and density of freshwater mussels within the Project area is low. Species rarity and the low number of collected mussels presents challenges for understanding population dynamics within the Project area. However, a broad assessment of the habitat quality and spatial distribution of aquatic resources within the Project area can still be made. Six species were observed in the Project area, with only *Cyclonaias tuberculata* and *Tritogonia verrucosa* found in large numbers. Quality mussel habitat within the Project area appears to be limited. Coarser substrates (e.g. cobble and boulder) were observed at Buck Downstream 2 where some of the highest densities of mussels were observed. Habitat at Buck Downstream 1 was not as productive as Buck Downstream 2 with large amounts of rubble noted at the site by Stantec (2016).

Some of the lowest observed mussel densities were encountered in the riverine reach between Buck and Byllesby facilities during surveys in 2020. Despite the targeted approach of surveying hydraulic habitat units, CPUE (0.27 mussels/hr) and abundance (n = 9) were still low and consistent with findings of historical studies. Much of the habitat in this reach consisted of silt deposits on top of bedrock. Pockets of more habitable substrate did not correspond to mussel abundance. The side channel near Byllesby Dam contained perceived high quality substrates of gravel/sand/cobble in a riffle/run sequence, however almost no invertebrate life was observed. This potentially could be due to these side channels being intermittent during summer but has not been directly observed by Stantec.

Within the dam impoundments, substrates were predominantly thick deposits of silt with some bedrock outcroppings. While such backwater habitat is often capable of supporting lentic species, such as *Pyganodon grandis* and *Utterbackia imbecillis*, none were observed and overall counts of both live animals and spent shells along the impoundments were low. The only mussels observed in the drawdown studies were found in flow refugia and coarser substrates along islands at the upper limits of the impoundments.

Different survey methods between studies make assessment of temporal trends in abundance and composition of the mussel community difficult. While slightly greater abundances were observed downstream of Buck Dam during earlier studies conducted in 1997 and 2008 than during more recent studies, this may be an artifact of survey methods and not necessarily an indication of mussel population declines. Surveys in 2015 and 2017 downstream of Buck Dam suggest that *Cyclonaias tuberculata* and *Tritogonia verrucosa* are still abundant and reproducing in these locations. *Eurynia dilatata, Lampsilis Fasciola,* and *Lasmigona subviridis* were not found in sufficient abundances to gain insights into population dynamics.

Spatial distribution of mussels appears to be concentrated downstream of Buck Dam (Figures 10 & 11). These figures suggest that the Byllesby-Buck Project may be influencing the mussel communities within the Project area, however the Buck Downstream 2 site is similar to those seen during the 2020 study between Buck and Byllesby Dams.

The decline in CPUE from 2008 to 2015-2017 at Buck Downstream 2 may be due to differences in survey methodologies, as Alderman's timed searches allow for locating and focusing on areas of high mussel concentrations, while Stantec (2016, 2017) used transects at fixed distances where all habitats were sampled regardless of quality. Species Richness was lower in 2015 (2) and 2017 (3) compared to 1997 and 2008 surveys, despite having higher effort than the 1997 survey. Surveys in 1997 (N = 2) and 2008 (N = 5) managed to locate *Lampsilis ovata*, which is uncommon throughout the basin and normally found in low numbers. Shifts in species richness over time may be due to the probability of detecting these rare species rather than shifts in the assemblage or local extirpation.

3.4 CONCLUSIONS

Since 1997, six species have been collected within the Project area: *Cyclonaias tuberculata*, *Eurynia dilatata, Tritogonia verrucosa, Lampsilis fasciola, Lasmigona subviridis,* and *Lampsilis ovata. Cyclonaias tuberculata* and *Tritogonia verrucosa* were observed most frequently within the Project area, particularly downstream of Buck Dam. The range of sizes recorded for these species demonstrates that juvenile recruitment is occurring for these species. Other species were observed in too low of abundances (e.g. < 10) to accurately depict assemblage status. *Lampsilis fasciola* and *Lasmigona subviridis* were the least abundant species and were only found along mid-channel islands upstream of the dams. As was demonstrated by 2020 field efforts and historical studies, quality mussel habitat is limited within the impounded portion of the Project area. Furthermore, areas with suitable habitat did not always support mussel inhabitance. Species composition and abundance were relatively consistent across survey years, with some rarer species not occurring during some surveys. However, low overall abundances throughout the Project area doesn’t mean these species are extirpated. The low number of shells observed within the Project area supports the conclusion that the mussel community has not undergone a significant die-off in recent years and abundances and species have always been low. Spatial trends within the Project area suggest that downstream of Buck Dam is the highest quality mussel community, having relatively high species richness and CPUE. Within the impoundments, reaches between the two dams, and upstream of Byllesby Dam are all seemingly lower quality mussel communities. The appearance of mussel declines at the Buck Downstream 2 site, which has been sampled four times over the past 23 years may simply be due to differences in survey methods, as project operations have not differed in this area during that time frame.

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Appendix A - AGENCY CORRESPONDENCE

From: Symonds, Daniel
To: Symonds, Daniel
Subject: RE: Buck/Byllesby Dam Mussel Survey Study Plan
Date: Wednesday, December 2, 2020 4:41:36 PM

From: Watson, Brian <brian.watson@dwr.virginia.gov>
Sent: Monday, September 21, 2020 2:05 PM
To: Symonds, Daniel <Daniel.Symonds@stantec.com>
Cc: Fleece, Cody <Cody.Fleece@stantec.com>; Kiser, James <James.Kiser@stantec.com>; brian.watson@dgif.virginia.gov
Subject: Re: Buck/Byllesby Dam Mussel Survey Study Plan

Dan,

I'm fine with the mussel survey plan. Let me know when you guys get out and I might be able to help if you need an extra set of eyes.

Brian

On Tue, Sep 8, 2020 at 2:37 PM Symonds, Daniel <Daniel.Symonds@stantec.com> wrote:

> Hello Brian,
> I'm sending this study plan on behalf of Cody, who is stuck driving today. Attached is our plan to sample for mussels between Buck and Byllesby Dams, as part of Appalachian Power
>
> Company's Revised Study Plan from 2019. We plan on conducting this survey sometime in the next month or so, pending your approval.
>
> Please let us know if you have any questions or comments.
>
> Thanks,
> Dan
> **Daniel Symonds**
>
> Aquatic Ecologist
> Direct: (614) 282-3215
>
> Daniel.Symonds@stantec.com

--
Brian T. Watson
Aquatic Resources Biologist/State Malacologist
Office: 434.525.7522, x 114
Mobile: 434.941.5990
Fax: 434.525.7720

Virginia Department of Wildlife Resources

CONSERVE. CONNECT. PROTECT.

1132 Thomas Jefferson Road
Forest, VA 24551
www.VirginiaWildlife.gov

Stantec

Stantec Consulting Services Inc.
1500 Lake Shore Drive Suite 100, Columbus OH 43204-3800

September 8, 2020
File: 173430067

Attention: Brian Watson
Virginia State Malacologist
Virginia Department of Wildlife Resources
1132 Thomas Jefferson Road
Forest, VA 24551
(434) 941-5990

Dear Brian Watson,

Reference: Byllesby-Buck Hydroelectric Project – Mussel Survey Study Plan

Stantec Consulting Inc. has been contracted by HDR, Inc. to conduct freshwater mussel surveys in the vicinity of Buck Dam and Byllesby Dam, Wythe and Carroll Counties, Virginia. These surveys are a component of Appalachian Power Company's Revised Study Plan (RSP) filed with the Federal Energy Regulatory Commission (FERC) on October 18, 2019. The RSP included provisions for an Aquatic Resources Study, including the freshwater mussel surveys that will be detailed in this study plan. Per conditions outlined in Stantec's Scientific Collecting Permit (#065183) and Threatened and Endangered Species Permit (#067427) this letter seeks Virginia Division of Wildlife Resource (VDWR) approval to conduct the work outlined below, with the overall goal to determine the distribution and abundance of freshwater mussels in the area.

FIELD SAMPLING

Due to historic documentation of mussels in large portions of the project area, this study will focus on the tailrace and approximately 3,000 meter long reach between Byllesby Dam and the Buck Reservoir Islands. By examining these two reaches, it should provide a more complete picture of the overall mussel community in this area of the New River.

Stantec proposes a two-step approach for surveying the Byllesby-Buck Project Area. Initially, a boat-based habitat survey will be performed to visually identify potential mussel habitats in the transition area between Byllesby Dam and the Buck Dam Reservoir. This will facilitate surveying in the best habitats within the survey area. Review of aerial photography shows a number of different hydraulic habitat types (e.g. fast velocity/deep depth, slow/shallow, etc., See Attachment A) that may yield different mussel community compositions. Initial boat surveys will choose specific locations within each of these hydraulic habitat types. A total of ten sites will be selected, one from each distinct hydraulic habitat area. Each area will be searched using wandering timed searches, a total of 200 person-minutes per area. This will result in a total of 33.3 person-hours of searching in the area between the two dams. These searches will involve snorkeling, tactile searches, or diving (SCUBA or surface supplied) depending on conditions in each habitat. Substrates will be searched by moving cobble and woody debris; hand sweeping away silt, sand

Reference: **Byllesby-Buck Hydroelectric Project – Mussel Survey Study Plan**

and/or detritus; and disturbing/probing the upper two inches of substrate to better view resident mussels. All mussels (live and shell) will be placed in a mesh bag, taken to the streambank/boat, and identified to species and sized for data collection. Mussels will be returned to the approximate location they were found. Each species will be photographed as vouchers.

An additional search will take place in the tailrace of Buck Dam, which has not previously been surveyed. This stretch of river extends approximately 500m along a vegetated island from the Buck Dam powerhouse until it reaches a wider channel with a wetted width more typical of the New River. This narrow cross sectional area and large volume of discharge suggests that the reach does not provide suitable habitat for freshwater mussels. Surveyors will conduct a reconnaissance level habitat assessment of the channel to assess potential freshwater mussel habitat. Notes will be taken about substrate composition and habitat quality. Shell and any live mussels encountered will be recorded. Due to the high flow’s normally encountered in this area, no diving is scheduled to take place during this search.

Upon completion of the survey a technical report will be prepared and submitted to FERC and VDWR. This project will be conducted under Senior Malacologist Cody Fleece’s Scientific Collecting permit (#065183, Attachment B) and Threatened and Endangered species permit (#067427, Attachment B).

Regards,

Stantec Consulting Services Inc.

Will Cody Fleece

W. Cody Fleece
Senior Malacologist
Phone: (513) 262-3994
Cody.Fleece@stantec.com

Attachment: A – Survey Area Figure
B – Collecting Permits

Appendix B - COLLECTING 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

VIRGINIA
Department of Game & Inland Fisheries

Threatened/Endangered Species Permit

Permit Type: **Renewal**   Fee Paid: **$20.00**   VADGIF Permit No. **067427**

Permittee: **William Cody Fleece**
Address: **11687 Lebanon Road**
Sharonville, OH 45241
Email:

Office: **(513) 262-3994**
City/County:

Business: **Stantec Consulting Services, Inc.**
11687 Lebanon Road
Sharonville, OH 45241

Biomonitoring/Contract Environmental Impact/Contract Species Surveys

Authorized Collection Methods: By Hand/Scuba/Snorkel/View Scope
Authorized Waterbodies: New River
Authorized Marking Techniques: N/A

NO LIVE MUSSELS MAY BE PRESERVED

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 2021

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

STANDARD CONDITIONS ATTACHED APPLY TO THIS PERMIT.

Authorized Counties / Cities:
Carroll
Giles
Montgomery
Pulaski
Wythe
Radford

Authorized Species:

Description	ID Number	Scientific Name
Threatened & Endangered Aquatic Mollusk Species		
Threatened & Endangered Freshwater Mussels		

Authorized Sub-Permittees:
Aaron Kwolek, Stantec
Daniel Symonds, Stantec
James Kiser, Stantec

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:** **3/20/2020**

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. **067427**

20   Permit Effective **3/20/2020** through **12/31/2020**   **20**

Virginia Department of Game and Inland Fisheries
P O Box 3337 Henrico, VA 23228-3337
(804) 367-6913

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

THREATENED/ENDANGERED SPECIES PERMIT -- STANDARD CONDITIONS

1. Permits are issued to permittees with the understanding that if the principal permittee leaves the project the permit will be null and void and anyone desiring to continue the activities must apply for a new permit.

2. This permit, or a copy, must be carried by the permittee(s) during collection activities.

3. Permittee MUST notify the Virginia Department of Game and Inland Fisheries (VDGIF) within the seven (7) day period prior to EACH sampling event. Notification must be made via email to: collectionpermits@dgif.virginia.gov.

4. The permittee is required to submit to VDGIF a report of all specimens collected under this permit by the report due date. Report form may be found https://vafwis.dgif.virginia.gov/collection_permits/.asp. FAILURE TO RETURN THIS REPORT WILL RESULT IN NON-ISSUANCE OF FUTURE PERMITS. If no activity occurs under this permit, an email should be sent to collectionpermits@dgif.virginia.gov containing the following statement: No activity occurred under Permit #*insert permitID* during insert year (i.e. 2017). Permit reports are due by January 31.

5. Permittees shall give any and all changes of name, address, and/or phone number to the VDGIF Permits Section within no more than seven (7) days of those changes. All permittees (to include sub-permittees) shall provide DGIF with a complete home address, contact telephone number (home or cellular), and a valid e-mail address.

6. This permit does not support any activities outside of those associated with the application and proposal submitted to and approved by DGIF.

7. If incidental death or injury of threatened or endangered species occurs, the permittee is required to notify VDGIF at collectionpermits@dgif.virginia.gov within twenty-four (24) hours of occurrence. The following information must be reported: collector, date, species, location (county, quad, waterbody, and latitude and longitude to nearest second), and number collected.

8. If incidental *collection and live release* of threatened or endangered species occurs *for species other than those authorized under this permit*, the permittee is required to notify VDGIF at collectionpermits@dgif.virginia.gov within four (4) working days. The following information must be reported: collector, date, species, location (county, quad, waterbody, and specific location, either in latitude and longitude to nearest second, or by way of a photocopied 7.5' topographic map), general habitat associations, and number collected.

9. No species may be retained unless specifically authorized by this permit.

10. All traps must be marked with the name and address of the trapper or an identification number issued by VDGIF (Code of Virginia §29.1-521.7). Steel foothold traps, Conibear-style body gripping traps, and snares must be marked with a nonferrous metal tag bearing this information (Virginia Administrative Code 4 VAC 15-40-170).

11. All traps must be checked at least once a day and all captured animals removed, except completely submerged body-gripping traps which must be checked at least once every 72 hours (Code of Virginia §29.1-521.9).

12. The permittee is required to report any incidences of wildlife deaths or diseases observed during the course of collection activities. Reports should be made to: collectionpermits@dgif.virginia.gov within four (4) working days.

13. This permit satisfies only VDGIF's requirement for collection permits and is issued with the understanding that no collections will be made on Federal, state, or private property without the prior approval and necessary permits from the landowners involved. The permittee is responsible for obtaining any additional permits required for collection.

14. Sampling gear, boats, or trailers which have been used in states harboring zebra mussels must be cleaned and prepared following the guidelines specified in the attached summary prior to use in waters in the Commonwealth.

15. For safety reasons, it is recommended that all permittees display at least 100 square inches of solid blaze orange material at shoulder level within body reach and visible from 360 degrees, especially during hunting season.

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. **065183**

Permittee: **William Cody Fleece**
Address: **Stantec Consulting Services, Inc.**
11687 Lebanon Road
Sharonville, OH 45241
Email: **cody.fleece@stantec.com**

Home:
Office: **(513) 842-8238**

Appalachian Power Company - Biomonitoring/Contract Environmental Impact/Contract Species Surveys

Authorized Collection Methods: By Hand/Scuba/Snorkel/Hooka
Authorized Waterbodies: New River
Authorized Marking Techniques: N/A

NO LIVE MUSSELS MAY BE PRESERVED

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, 31 January 2021

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

STANDARD CONDITIONS ATTACHED APPLY TO THIS PERMIT.

Authorized Counties / Cities:
Carroll
Giles
Montgomery
Pulaski
Wythe
Radford

Authorized Species:

Description	ID Number	Scientific Name
Freshwater Mussels		

Annual Report Due End of Each Year

Authorized Sub-Permittees:
James Kiser, Stantec
Dillon McNulty, Stantec
Aaron Kwolek, Stantec
Elizabeth Dilbone, Stantec
Daniel Symonds, Stantec

Approved by: Randall T. Francis

Title: **Randall T. Francis - Permits Manager** **Date: 4/29/2019**

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.

20 Permit Effective **4/29/2019** through **12/31/2020** **20**

Virginia Department of Game and Inland Fisheries
P O Box 3337 Henrico, VA 23228-3337
(804) 367-6913

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

SCIENTIFIC COLLECTION PERMIT – STANDARD CONDITIONS

1. Permits are issued to permittees with the understanding that if the principal permittee leaves the project the permit will be null and void and anyone desiring to continue the activities must apply for a new permit.

2. This permit, or a copy, must be carried by the permittee(s) during collection activities.

3. Permittee MUST notify the Virginia Department of Game and Inland Fisheries (VDGIF) within the seven (7) day period prior to EACH sampling event. Notification must be made via email to: collectionpermits@dgif.virginia.gov.)

4. The permittee is required to submit to this Department a report of all specimens collected under this permit by the report due date. Report form may be found at https://vafwis.dgif.virginia.gov/collection_permits/. FAILURE TO RETURN THIS REPORT WILL RESULT IN NON-ISSUANCE OF FUTURE PERMITS. If no activity occurs under this permit, an email should be sent to collectionpermits@dgif.virginia.gov containing the following statement: No activity occurred under Permit #*insert permit ID* during insert year (i.e. 2017). Permit reports are due by January 31.

5. Permittees shall give any and all changes of name, address, and/or phone number to the VDGIF Permits Section within no more than seven (7) days of those changes. All permittees (to include sub-permittees) shall provide DGIF with a complete home address, contact telephone number (home or cellular), and a valid e-mail address.

6. This permit does not support any activities outside of those associated with the application and proposal submitted to and approved by DGIF.

7. No species currently listed by the U.S. Fish and Wildlife Service or VDGIF as threatened or endangered may be intentionally collected under this permit. If incidental d*eath or injury* of threatened or endangered species does occur, the permittee is required to notify VDGIF at collectionpermits@dgif.virginia.gov within twenty-four (24) hours of occurrence. The following information must be reported: collector, date, species, location (county, quad, waterbody, and latitude and longitude to nearest second), and number collected.

8. If incidental *observation or collection and live release* of threatened or endangered species occurs, the permittee is required to notify VDGIF at collectionpermits@dgif.virginia.gov within four (4) working days, providing the same information as the Condition No. 7.

9. If incidental *mortality or injury of specimens intended to be taken live* occurs, the permittee is required to notify VDGIF at collectionpermits@dgif.virginia.gov within 48 hours, providing the same information as the above conditions. In addition, the permittee must provide the cause of mortality or injury and steps that are being taken to address the problem.

10. No species may be retained unless specifically authorized by this permit.

11. Game birds/game mammals/game fish protected by State and/or Federal laws must be taken during authorized hunting and trapping seasons and under applicable daily and seasonal bag/number limits by properly licensed persons unless otherwise specifically authorized. A valid Virginia fishing license is required for each person collecting samples by hook-and-line.

12. All traps must be marked with the name and address of the trapper or an identification number issued by VDGIF (Code of Virginia §29.1-521.7). Steel foothold traps, Conibear-style body gripping traps, and snares must be marked with a nonferrous metal tag bearing this information (Virginia Administrative Code 4 VAC 15-40-170).

13. All traps must be checked at least once a day and all captured animals removed, except completely submerged body-gripping traps which must be checked at least once every 72 hours (Code of Virginia §29.1-521.9).

14. The permittee is required to report any incidences of wildlife deaths or diseases observed during the course of collection activities. Reports should be made to: collectionpermits@dgif.virginia.gov within four (4) working days.

15. This permit satisfies only VDGIF's requirement for collection permits and is issued with the understanding that no collections will be made on Federal, state, or private property without the prior approval and necessary permits from the landowners involved. The permittee is responsible for obtaining any additional permits required for collection.

16. Sampling gear, boats, or trailers which have been used in states harboring zebra mussels must be cleaned and prepared following accepted guidelines for removal of zebra mussels, prior to being used in Virginia.

17. For safety reasons, it is recommended that all permittees display at least 100 square inches of solid blaze orange material at shoulder level within body reach and visible from 360 degrees, especially during hunting season.

Appendix C - SITE AND SPECIES PHOTOS

Stantec **Photographic Log**

Client:	**Appalachian Power Company**	**Project:**	**Buck/Byllesby Dam Mussel Survey**
Site Name:	**New River**	**Site Location:**	**Carroll County, Virginia**

Photograph ID: 1

Photo Location:
Shallow Shoal 1

Direction:

Survey Date:
9/24/2020

Comments:
Cyclonaias tuberculata (Purple Wartyback)

Photograph ID: 2

Photo Location:
Shallow Shoal 1

Direction:
East

Survey Date:
9/24/2020

Comments:
Both live and the shell specimen were found along the east bank of the river (left side of photo)

Client:	**Appalachian Power Company**	**Project:**	**Buck/Byllesby Dam Mussel Survey**
Site Name:	**New River**	**Site Location:**	**Carroll County, Virginia**

Photograph ID: 3	
Photo Location: Shallow Shoal 1	
Direction: South	
Survey Date: 9/24/2020	
Comments:	
Photograph ID: 4	
Photo Location: Shallow Shoal 1	
Direction: North	
Survey Date: 9/24/2020	
Comments:	

Client:	Appalachian Power Company	Project:	Buck/Byllesby Dam Mussel Survey
Site Name:	New River	Site Location:	Carroll County, Virginia

Photograph ID: 5 **Photo Location:** Shallow Shoal 1 **Direction:** Southwest **Survey Date:** 9/24/2020 **Comments:**	
Photograph ID: 6 **Photo Location:** Shallow Shoal 2 **Direction:** North **Survey Date:** 9/25/2020 **Comments:**	

Client:	Appalachian Power Company	Project:	Buck/Byllesby Dam Mussel Survey
Site Name:	New River	Site Location:	Carroll County, Virginia

Photograph ID: 7

Photo Location:
Shallow Shoal 2

Direction:
South

Survey Date:
9/25/2020

Comments:

Photograph ID: 8

Photo Location:
Deep Shoal 2 & Shallow Shoal 2

Direction:
East

Survey Date:
9/24/2020

Comments:

Client:	**Appalachian Power Company**	**Project:**	**Buck/Byllesby Dam Mussel Survey**
Site Name:	**New River**	**Site Location:**	**Carroll County, Virginia**

Photograph ID: 9	
Photo Location: Deep Shoal 2	
Direction: East	
Survey Date: 9/24/2020	
Comments:	
Photograph ID: 10	
Photo Location: Pool 2 & Deep Shoal 1	
Direction: Southwest	
Survey Date: 9/24/2020	
Comments:	

Client:	**Appalachian Power Company**	**Project:**	**Buck/Byllesby Dam Mussel Survey**
Site Name:	**New River**	**Site Location:**	**Carroll County, Virginia**

Photograph ID: 11

Photo Location:
Pool 2

Direction:
North

Survey Date:
9/24/2020

Comments:

Photograph ID: 12

Photo Location:
Pool 2

Direction:
East

Survey Date:
9/24/2020

Comments:

Client:	**Appalachian Power Company**	**Project:**	**Buck/Byllesby Dam Mussel Survey**
Site Name:	**New River**	**Site Location:**	**Carroll County, Virginia**

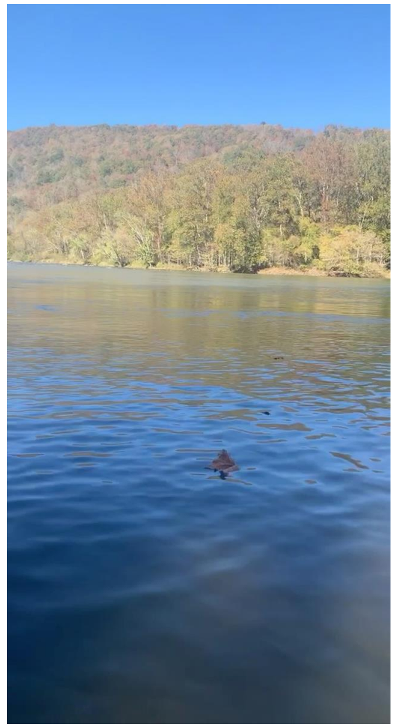
Photograph ID: 13

Photo Location:
Deep Shoal 3

Direction:
East

Survey Date:
10/21/2020

Comments:



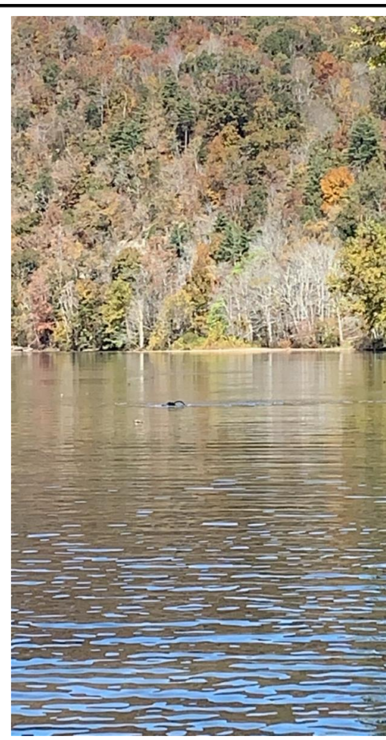
Photograph ID: 14

Photo Location:
Shallow Shoal 3

Direction:
East

Survey Date:
10/21/2020

Comments:



Client:	**Appalachian Power Company**	**Project:**	**Buck/Byllesby Dam Mussel Survey**
Site Name:	**New River**	**Site Location:**	**Carroll County, Virginia**

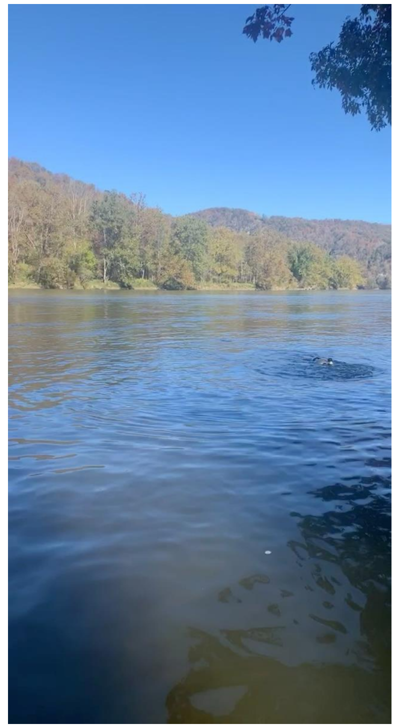
Photograph ID: 15

Photo Location: Deep Shoal 3

Direction: South East

Survey Date: 10/21/2020

Comments:



Photograph ID: 16

Photo Location: Deep Shoal 3

Direction: North

Survey Date: 10/21/2020

Comments:

Client:	**Appalachian Power Company**	**Project:**	**Buck/Byllesby Dam Mussel Survey**
Site Name:	**New River**	**Site Location:**	**Carroll County, Virginia**

Photograph ID: 17

Photo Location:
Pool 3

Direction:
East

Survey Date:
10/21/2020

Comments:

Photograph ID: 18

Photo Location:
West Side Channel

Direction:
South

Survey Date:
9/25/2020

Comments:

Client:	**Appalachian Power Company**	**Project:**	**Buck/Byllesby Dam Mussel Survey**
Site Name:	**New River**	**Site Location:**	**Carroll County, Virginia**

Photograph ID: 19

Photo Location: Downstream Extent of West Side Channel

Direction: Northwest

Survey Date: 9/25/2020

Comments:

Photograph ID: 20

Photo Location: Middle of West Side Channel

Direction: Southwest

Survey Date: 9/25/2020

Comments:

Client:	**Appalachian Power Company**	**Project:**	**Buck/Byllesby Dam Mussel Survey**
Site Name:	**New River**	**Site Location:**	**Carroll County, Virginia**

Photograph ID: 21

Photo Location:
East Side Channel

Direction:
South

Survey Date:
9/25/2020

Comments:

Photograph ID: 22

Photo Location:
East Side Channel

Direction:
West

Survey Date:
9/25/2020

Comments:

Client:	**Appalachian Power Company**	**Project:**	**Buck/Byllesby Dam Mussel Survey**
Site Name:	**New River**	**Site Location:**	**Carroll County, Virginia**

Photograph ID: 23

Photo Location:
Downstream Extent of East Side Channel

Direction:
Northwest

Survey Date:
9/25/2020

Comments:

Photograph ID: 24

Photo Location:
Tailrace

Direction:
Southeast

Survey Date:
9/24/2020

Comments:

Stantec **Photographic Log**

Client:	**Appalachian Power Company**	**Project:**	**Buck/Byllesby Dam Mussel Survey**
Site Name:	**New River**	**Site Location:**	**Carroll County, Virginia**

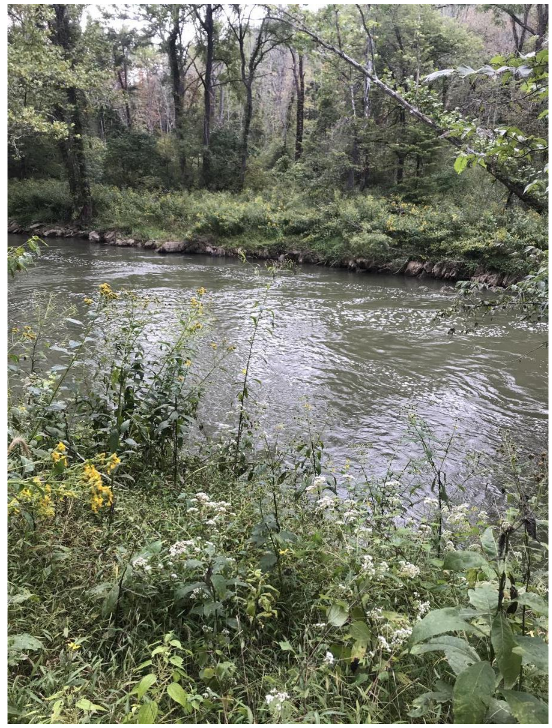
Photograph ID: 25

Photo Location:
Tailrace

Direction:
Northeast

Survey Date:
9/24/2020

Comments:



Photograph ID: 26

Photo Location:
Tailrace

Direction:

Survey Date:
9/24/2020

Comments:
Riprap lining edge of tailrace

Client:	Appalachian Power Company	Project:	Buck/Byllesby Dam Mussel Survey
Site Name:	New River	Site Location:	Carroll County, Virginia

Photograph ID: 27

Photo Location:
Tailrace

Direction:
Northwest

Survey Date:
9/24/2020

Comments:

Attachment 5

Attachment 5 – Germane Correspondence

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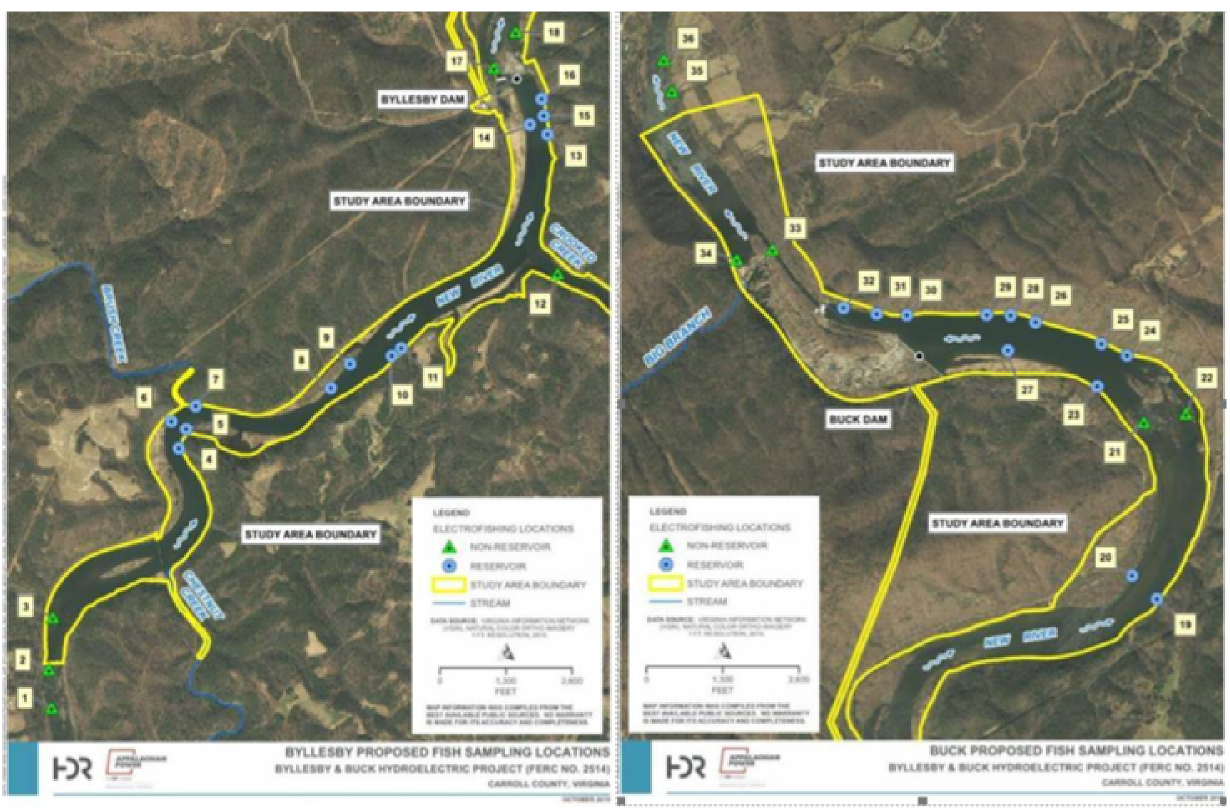
Yayac, Maggie

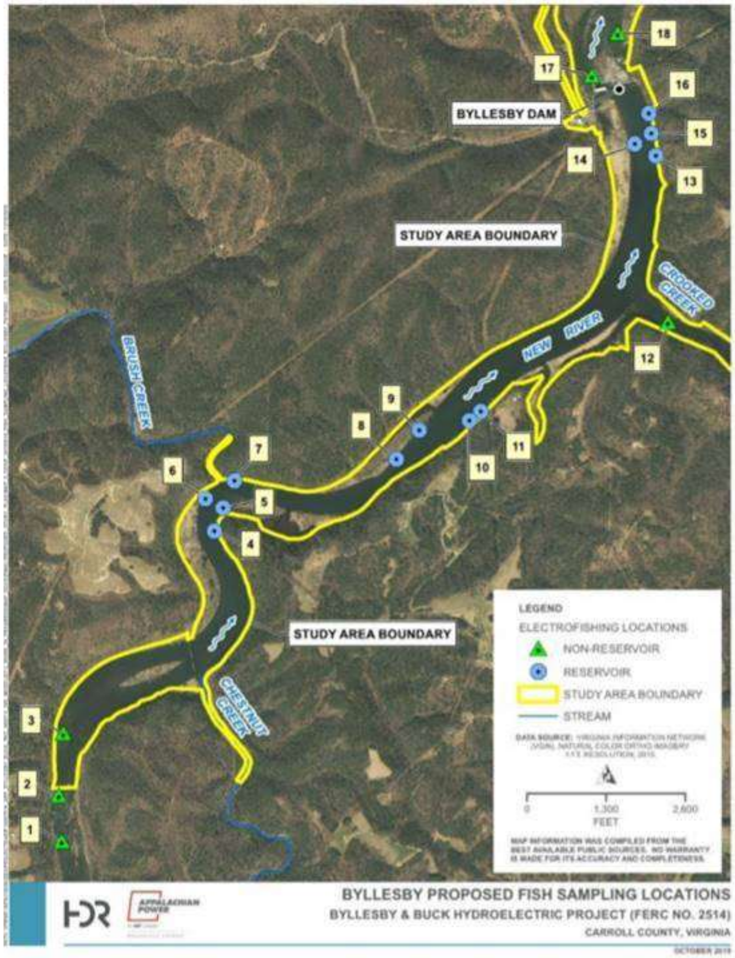
Subject: FW: Walleye gill net methods (Byllesby Reservoir)

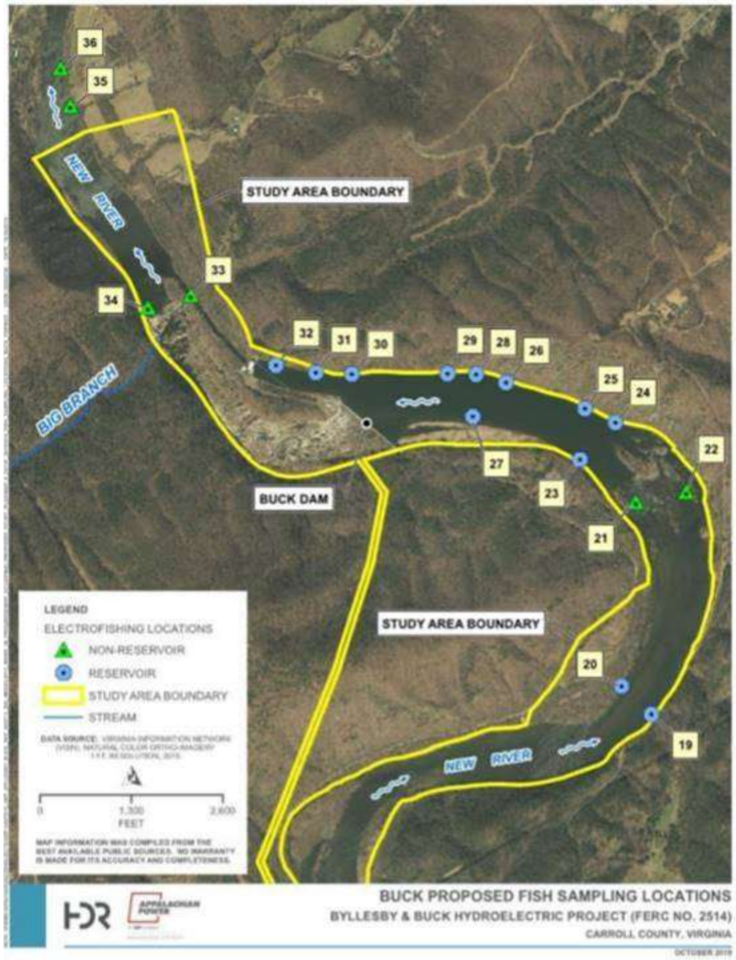
From: Jon Studio [mailto:JStudio@envsi.com]
Sent: Friday, April 3, 2020 2:23 PM
To: Copeland, John <john.copeland@dgif.virginia.gov>; Huddleston, Misty <Misty.Huddleston@hdrinc.com>
Cc: Bill.Kittrell@dgif.virginia.gov; John Spaeth <jspaeth@envsi.com>; Kulpa, Sarah <Sarah.Kulpa@hdrinc.com>; Jonathan M Magalski <jmmagalski@aep.com>; Elizabeth B Parcell <ebparcell@aep.com>
Subject: RE: Walleye gill net methods (Byllesby Reservoir)

John,

Below are the tentative field sampling sites. Non-reservoir (green; backpack electrofishing) and Reservoir (blue; boat electrofishing) sites are shown. Tentative gill net sites coincide with Figure 4 from the 1991 report. It was agreed upon during development of the Study Plan that hoop netting will not be used because hoop net methods did not yield novel information in the previous study. We will be in touch at the beginning of next week regarding gill net mesh sizes. Enjoy your weekend.




18
17
16
BYLLESBY DAM
15
14
13
STUDY AREA BOUNDARY
CROOKED CREEK
NEW RIVER
12
BRUSH CREEK
9
8
11
10
7
6
5
4
STUDY AREA BOUNDARY
CHESTNUT CREEK
3
2
1
LEGEND
ELECTROFISHING LOCATIONS
NON-RESERVOIR
RESERVOIR
STUDY AREA BOUNDARY
STREAM
0
1,300
2,600
FEET
HDR
APPALACHIAN POWER
BYLLESBY PROPOSED FISH SAMPLING LOCATIONS
BYLLESBY & BUCK HYDROELECTRIC PROJECT (FERC NO. 2514)
CARROLL COUNTY, VIRGINIA



Thank you,
Jon Studio

From: Copeland, John <john.copeland@dgif.virginia.gov>
Sent: Tuesday, March 31, 2020 1:00 PM
To: Huddleston, Misty <Misty.Huddleston@hdrinc.com>
Cc: Jon Studio <JStudio@envsi.com>; Bill.Kittrell@dgif.virginia.gov; John Spaeth <jspaeth@envsi.com>; Kulpa, Sarah <Sarah.Kulpa@hdrinc.com>; Jonathan M Magalski <jmmagalski@aep.com>; Elizabeth B Parcell <ebparcell@aep.com>; John Copeland <john.copeland@dgif.virginia.gov>
Subject: Re: Walleye gill net methods (Byllesby Reservoir)

I appreciate the summary Misty provided. In my earlier email I meant to say that **Walleye were NOT a factor** during the 1990 fisheries sampling. We did not start stocking New River strain Walleye intensively in the Upper New River area (including Byllesby Reservoir) until the early 2000's. I think Byllesby was experimentally stocked with Walleye from another source in the mid-late 1990's. Since we started our New River strain Walleye work, we have stocked Byllesby occasionally, but most of the Walleye using Byllesby are coming from stockings at the low water bridge downstream from Fries Dam, which we try to stock annually.

With this background in mind, take a look at the attached spreadsheet from Claytor Lake gill net surveys from 2010 to 2019. In order to collect the smaller size Walleye, the 3/4 in bar mesh net is important. As you can see, the 1.25 in bar mesh net is very important as well, so **I think adding these sizes (0.75 and 1.25 in bar mesh) to gill nets used in the current survey in addition to the ones proposed below by Misty Huddleston will provide better length data on Walleye in Byllesby Reservoir and not detract from collecting other species or comparisons to historic data.** At Claytor Lake, plenty of Walleye are collected in the 1.0, 1.5. 2.0, and 2.5 in bar mesh nets, but the smaller net sizes are important. We always get larger size Walleye in a variety of mesh sizes due to their propensity to get lip hung and roll in the nets, but collecting the smaller Walleye requires using smaller mesh sizes. I see you are planning for 120 foot nets with 6 panels, so adding panels will limit either the mesh sizes or the panel sizes. In the 1990 survey, each mesh size had 30 foot panels that were 6 feet deep (180 square feet of panel). Since you are planning 8 foot deep nets instead of the 6 foot deep nets used in the 1990 survey, if you employ 8 mesh sizes of 15 feet each (120 feet total length) it will still yield 120 square feet of each mesh panel, instead of what you propose with 6 mesh sizes of 20 feet each, which will yield 160 square feet of each mesh panel.

I would like to see the other planned methods for the 2020-2021 fisheries survey (electrofishing, hoop netting) and what sites will be sampled for each technique. I'm particularly interested in what reference sites will be sampled upstream and downstream from the Project. **If you are planning to replicate the 1990 fisheries study locations and techniques shown in Figure 4 of the 1991 report, then you can simply let me know that is your plan.**

If you think we need to resolve anything in a conference call, I am available tomorrow (Wednesday, April 1), but not Friday, April 3. We appreciate the coordination of this study in advance of sampling.

Thanks.

John R. Copeland
Fisheries Biologist III
P 540.961.8304
M 540.871.6064
Virginia Department of Game & Inland Fisheries
A **2206 South Main Street, Suite C, Blacksburg, VA 24060**
www.dgif.virginia.gov
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On Tue, Mar 31, 2020 at 9:31 AM Huddleston, Misty <Misty.Huddleston@hdrinc.com> wrote:

Jon/John,

Following up on the email chain below.

The 1991 fisheries study at Byllesby/Buck used electrofishing, gillnet, and hoop net gear types. No Walleye were collected during the study.

For the upcoming fisheries work at Byllesby/Buck it is important that we have parity with previous collection methods. However, there is room for deviation as long as the gear changes are not expected to decrease the representativeness of the fish community.

The 1991 study report does not clarify if the gillnet mesh used was bar or stretch measurements; however, the measurements are consistent with typical bar mesh sizes used in experimental gill nets.

I have summarized the information from the 1991 study, provided by John from Claytor Lake surveys, and for reference purposes included gillnet specifications used by the USGS National Water Quality Assessment.

At the bottom of the table, I have provided my thoughts on gillnet specifications that could be used to meet the fish community study goals and target Walleye.

Summary of gillnet information:

Gillnet Source	Depth (feet)	Width (feet)	Number and Width (feet) of Panels	Bar Mesh Size (inches)	Notes
1991 study	6	120	4 – 30'	1 to 4	
Claytor Lake	8	100	4 – 25'	0.5 to 2.5	Walleye collected on 0.75 in, 1.0 in, 1.25 in, 1.5 in, 2.0 in, and 2.5 mesh
NAWQA (for reference)	6	120	6 – 20'	0.5 to 4	0.5-in, 1.0-in, 1.5-in, 2.0-in, 3.0-in, 4.0
Potential Specifications for 2020-2021 Byllesby/Buck Sampling	**8**	**120**	**6 – 20'**	**1 to 4**	**Mesh sizes of 1.0-in, 1.5-in, 2.0-in, 2.5-in, 3.0-in, 4.0-in**

*NAWQA: US Geological Survey, National Water Quality Assessment Methodology

If we need to have a call to discuss further, I am available anytime on Wednesday, April 1st or Friday, April 3rd.

I have quite a bit of availability next week if we need to push a discussion to sometime next week.

Thanks,

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

hdrinc.com/follow-us

From: Jon Studio [mailto:JStudio@envsi.com]
Sent: Friday, March 27, 2020 2:46 PM
To: Copeland, John <john.copeland@dgif.virginia.gov>
Cc: Bill.Kittrell@dgif.virginia.gov; John Spaeth <jspaeth@envsi.com>; Huddleston, Misty <Misty.Huddleston@hdrinc.com>; Kulpa, Sarah <Sarah.Kulpa@hdrinc.com>; Jonathan M Magalski <jmmagalski@aep.com>; Elizabeth B Parcell <ebparcell@aep.com>
Subject: RE: Walleye gill net methods (Byllesby Reservoir)

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.

John,

I appreciate your timely response. One objective of the fish community study for this project is "*Compare current aquatic resources data to historical data to determine any significant changes to species composition or abundance*." Using similar methods may allow us to make more direct comparisons (e.g., CPUE); however, it is also important to use the best methodology to sample and quantify the current aquatic resources.

Sarah and Misty, can you speak to the importance of parity with previous collection methods?

Attached is the 1991 fisheries study from the Byllesby-Buck Project Area. After looking over the paper, please propose a few times that work for you and I will try to make myself available for a phone conversation.

Thank you,

Jon Studio

From: Copeland, John <john.copeland@dgif.virginia.gov>
Sent: Friday, March 27, 2020 2:23 PM
To: Jon Studio <JStudio@envsi.com>
Cc: Bill.Kittrell@dgif.virginia.gov; John Spaeth <jspaeth@envsi.com>; Huddleston, Misty <Misty.Huddleston@hdrinc.com>; Kulpa, Sarah <Sarah.Kulpa@hdrinc.com>; Jonathan M Magalski

<jmmagalski@aep.com>; Elizabeth B Parcell <ebparcell@aep.com>; John Copeland <john.copeland@dgif.virginia.gov>
Subject: Re: Walleye gill net methods (Byllesby Reservoir)

Jon:

I think parity with previous collection methods is one factor to consider, but, since walleye were a developed fishery during the last relicensing studies, that's less of a concern for me for walleye.

Were walleye collected during the previous relicensing studies?

Do you know if the mesh sizes described in the previous methodology were bar mesh sizes or stretch mesh sizes?

If your gill netting is targeting fish across the fish community, then parity with previous collection methods is a good idea.

In annual sampling at Claytor Lake, I use 100 ft by 8 ft experimental nets with varying bar mesh sizes in 25 ft panels from 0.5 inch (1 inch stretch mesh) up to 2.5 inch bar mesh (5 inch stretch mesh). The mesh sizes include the following bar mesh sizes in inches: 0.5, 0.625. 0.75, 1.0, 1.25, 1.5, 2.0, and 2.5. Not all of these mesh sizes are useful for collecting walleye. Most of the Walleye I catch in those nets are in the 0.75 in, 1.0 in, 1.25 in, 1.5 in, 2.0 in, and 2.5 in mesh sizes, since the smaller mesh sizes are primarily catching gizzard shad and alewife.

Walleye could also be collected using night electrofishing, which could be effective in Byllesby Reservoir in April. At Claytor Lake, we also collect some walleye during day electrofishing, but not frequently, since they tend to be deeper during the day.

I'm not sure where to find the previous fisheries study in my files.

If you send me the previous fisheries study, I can take a look early next week and we can talk about it by phone.

John R. Copeland

Fisheries Biologist III
P 540.961.8304

M 540.871.6064

Virginia Department of Game & Inland Fisheries
A 2206 South Main Street, Suite C, Blacksburg, VA 24060
www.dgif.virginia.gov

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On Thu, Mar 26, 2020 at 10:27 AM Jon Studio <JStudio@envsi.com> wrote:

Good morning Bill and John,

Environmental Solutions & Innovations, Inc. (ESI) anticipates conducting gill net surveys targeting walleye in the Byllesby Reservoir at the dam relicensing Project Area (New River) during the 2020 field season. ESI understands you participated in Study Plan review for this Project. To obtain representative information on the relative abundance and size structure of the walleye population (per VDGIF requests), sampling as early in April as possible is necessary. ESI also requests your recommendations for the following gill net methods at the Byllesby Reservoir Project Area: 1) gill net length, height, and float line height, 2) gill net mesh sizes, and 3) gill net duration.

The following gill net methods were used in the fish community study in 1991: "*Gill nets were 6 ft x 120 ft monofilament, with four 30-ft panels of mesh size ranging from 1-4 inches. Net sets were placed at two sites each on the upper, middle, and lower portions of the Byllesby Reservoir… Each net was checked after 24 hours, reset, and checked and removed after 48 hours*". ESI requests your advice regarding the most effective methods/techniques for sampling walleye in the Byllesby Reservoir. Please feel free to contact us if you have questions or additional information is required. Thank you.

Kind regards,

Jon Studio
Aquatic Scientist
Environmental Solutions & Innovations, Inc.

4300 Lynn Road | Ravenna, OH 44266 | USA
office: 513.591.6134 **direct:** 440.413.4609
jstudio@envsi.com | www.envsi.com

Yayac, Maggie

Subject: FW: New River Update

From: Brian Watson <brian.watson@dwr.virginia.gov>
Sent: Thursday, October 8, 2020 11:01 AM
To: Fleece, Cody <cody.fleece@stantec.com>; Brian Watson <brian.watson@dgif.virginia.gov>
Cc: Kulpa, Sarah <Sarah.Kulpa@hdrinc.com>; Huddleston, Misty <Misty.Huddleston@hdrinc.com>; Symonds, Daniel <Daniel.Symonds@stantec.com>; Elizabeth B Parcell <ebparcell@aep.com>; Yayac, Maggie <Maggie.Yayac@hdrinc.com>
Subject: RE: New River Update

Cody,

I can see the notes now that I am back at my computer and not viewing the PDF thru my phone. Since two of the areas include shoal habitat, DWR does recommend surveying the 3 areas that were not surveyed in September due to rain and poor river conditions. Despite a low number of mussels being founds so far, DWR would prefer to see those areas surveyed to get a more complete assessment. If you have any questions, let me know. And if you need any assistance, let me know when you guys do the surveys as I may be able to make it out.

Brian

Brian T. Watson
Aquatic Resources Biologist/State Malacologist
P 434.525.7522, x114 / M 434.941.5990 / F 434.525.7720

Virginia Department of Wildlife Resources
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A 1132 Thomas Jefferson Road, Forest, VA 24551
www.VirginiaWildlife.gov

From: Fleece, Cody <Cody.Fleece@stantec.com>
Sent: Tuesday, September 29, 2020 1:05 PM
To: Brian Watson <brian.watson@dgif.virginia.gov>
Cc: Kulpa, Sarah <Sarah.Kulpa@hdrinc.com>; Huddleston, Misty <Misty.Huddleston@hdrinc.com>; Symonds, Daniel <Daniel.Symonds@stantec.com>; Elizabeth B Parcell <ebparcell@aep.com>; Yayac, Maggie

<Maggie.Yayac@hdrinc.com>
Subject: FW: New River Update

Brian

As discussed on the phone we were able to complete surveys in 8 of the 11 planned areas. Heavy rainfall and reduced visibility caused us to abandon the last day of survey (we completed 3 of 4). I attached a map with notes of what we found and how much time was spent searching. Dan Symond's initial survey summary is also presented below.

Based on what we're finding so far we have been wondering about the necessity of re-mobilizing to assess the 3 missing areas. Let us know if you think we need to get back out to finish the work or if the information in hand will suffice to inform decisions in the relicensing process.

Thanks for your time and attention.

Cody

From: Symonds, Daniel <Daniel.Symonds@stantec.com>
Sent: Monday, September 28, 2020 11:09 AM
To: Fleece, Cody <Cody.Fleece@stantec.com>
Subject: New River Update

We completed 8 of the 11 target areas on the New River (That's including the Buck Tailrace). We have surveyed at least one area of each type (shallow/deep shoal, pool, side channel). Six of the areas yielded zero mussels, and zero shells. Habitat varied from very poor (80-100% drifting sand) to very good (gravel/sand/cobble riffles) in the areas with no evidence of mussels.

Two live and one shell C. tuberculata were found in the most downstream shallow shoal. They were found in the flow refuge behind boulders, where sand/gravel accumulates in small amounts.

Six live C. tuberculata were found in the middle deep shoal. Similar story to the shallow shoal, the mussels were found in the silt that accumulated behind larger cobble/boulders.

To summarize, 25.3 people-hours of searching has occurred, with a catch-per-unit-effort of 0.35 mussels/hr and species diversity of one.

Daniel Symonds
Aquatic Ecologist

Direct: (614) 282-3215
Daniel.Symonds@stantec.com

Stantec
1500 Lake Shore Drive Suite 100
Columbus OH 43204-3800

Yayac, Maggie

Subject: FW: Fish Community Study at Byllesby/Buck Project (FERC No. 2514)

From: Copeland, John <john.copeland@dwr.virginia.gov>
Sent: Monday, November 9, 2020 8:32 AM
To: Huddleston, Misty <Misty.Huddleston@hdrinc.com>
Cc: Jonathan M Magalski <jmmagalski@aep.com>; Elizabeth B Parcell <ebparcell@aep.com>; jon Studio (jastudio@edge-es.com) <jastudio@edge-es.com>; John Spaeth <jpspaeth@edge-es.com>; Kulpa, Sarah <Sarah.Kulpa@hdrinc.com>; Yayac, Maggie <Maggie.Yayac@hdrinc.com>; John Copeland <john.copeland@dwr.virginia.gov>; Kittrell, Bill (DGIF) <bill.kittrell@dwr.virginia.gov>; Pinder, Mike (DGIF) <mike.pinder@dwr.virginia.gov>
Subject: Re: Fish Community Study at Byllesby/Buck Project (FERC No. 2514)

I understand your planned course of action for gill net sampling. If that sampling cannot be completed this week, it is acceptable to target Walleye with your gill net sampling as late as early December. Walleye will continue to move around when the water temperatures drop into the 50 degree range. Catch of other species (Catfish and other species) will likely not be as high if you delay into early December.

Regarding backpack electrofishing, deciding to postpone that work until August/September of 2021 is acceptable to us. The boat electrofishing and gill net sampling are targeting the reservoir habitat so the lack of overlap in sampling periods with the lotic areas sampled by backpack electrofishing is acceptable.

John R. Copeland

Fisheries Biologist III

P 540.961.8397 / M 540.871.6064

Virginia Department of Wildlife Resources

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A 2206 South Main Street, Suite C, Blacksburg, VA 24060

www.dwr.virginia.gov

Yayac, Maggie

Subject: FW: Notification of Collection of State Threatened Pistolgrip Mussel on AEP Byllesby-Buck project
Attachments: pistolgrips.jpg

From: David Foltz [mailto:dafoltz@edge-es.com]
Sent: Thursday, October 8, 2020 11:30 PM
To: Brian Watson <brian.watson@dwr.virginia.gov>; john_mccloskey@fws.gov; richard_mccorkle@fws.gov; janet_norman@fws.gov; collectionpermits@dgif.virginia.gov; scott.smith@dgif.virginia.gov
Cc: John Spaeth <jpspaeth@edge-es.com>; Jon Studio <jastudio@edge-es.com>; Casey Swecker <cdswecker@edge-es.com>; Huddleston, Misty <Misty.Huddleston@hdrinc.com>; Kay, Jenessa <Jenessa.Kay@hdrinc.com>
Subject: Notification of Collection of State Threatened Pistolgrip Mussel on AEP Byllesby-Buck project

All, Edge and HDR employees conducted benthic macroinvertebrate surveys approximately 1.35 kilometers downstream from the Buck Dam as part of the relicensing project today on 10/8/2020. During the survey efforts multiple freshwater mussels were discovered in the substrates sampled, including Virginia state listed Pistolgrip (*Tritogonia verrucosa*). Mussels were removed from the water briefly for photographic voucher (please see attachment) before being placed back in the substrates.

Please let us know if you need any further information on the animals or site.

Thank you.

DAVID A. FOLTZ II
Project Manager/ Senior Malacologist/ Astacologist
Weirton, West Virginia
D: 304.479.3268
edge-es.com

EDGE
ENGINEERING & SCIENCE
further insight.

On Wed, Nov 4, 2020 at 12:49 PM Huddleston, Misty <Misty.Huddleston@hdrinc.com> wrote:

Good afternoon John,

I wanted to follow up with you regarding the status of the data collection efforts for the Byllesby/Buck (FERC No. 2514) Fish Community Study and to request your input on the path forward for completing the study.

As Jon Studio (Edge Engineering) has previously discussed with you, the boat shocking portion of the study has been completed, but weather and high flows have prevented the field crews from completing the gillnet or backpack electrofishing samples at the site. Based on your conversations with Jon Studio, I understand that you support the collection of gillnet data in November as the target organism (Walleye) will still be mobile at that time.

Can you confirm that this is still acceptable and provide any additional criteria or threshold where you believe the collected data would no longer be valid?

Regarding backpack electrofishing efforts, recent weather forecasts indicate additional precipitation and cooler temps are present or moving into the watershed this week. Based on the predicted flows and colder temperatures, we believe that it is appropriate to move this sampling effort to August/September 2021. As a result, we will have boat electrofishing and gillnet samples (likely) collected in fall 2020 and backpack electrofishing samples collected in August/September 2021.

Do you foresee any issues or concerns with the proposed revised approach and the use of these data to support the relicensing effort at Byllesby-Buck?

Let us know if you have any other recommendations or concerns or if you would prefer to have a call to discuss this issue in further detail.

Thanks,

Misty

Misty Huddleston, PhD

Associate, SR. Environmental Scientist

HDR

Appendix B

Appendix B – Preliminary Water Quality Study Report

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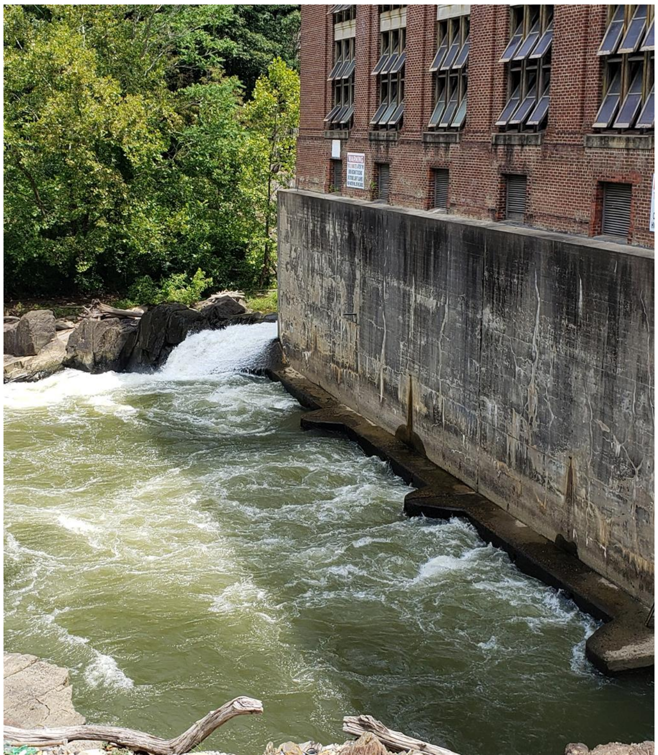

Preliminary Water Quality Study Report

Byllesby-Buck Hydroelectric Project (FERC No. 2514)

January 18, 2021

Prepared by:

HDR

Prepared for:

Appalachian Power Company

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Contents

Tables

Figures

Attachments

Acronyms and Abbreviations

°C	degrees Celsius
AEP	American Electric Power
Appalachian or Licensee	Appalachian Power Company
DO	dissolved oxygen
CFR	Code of Federal Regulations
CWA	Clean Water Act
FERC or Commission	Federal Energy Regulatory Commission
ft	feet/foot
mg/l	milligrams per liter
Hydrolab	Hach Hydrolab® MS5
ILP	Integrated Licensing Process
ISR	Initial Study Report
NGVD	National Geodetic Vertical Datum of 1929
PAD	Pre-Application Document
PM&E	protection, mitigation, and enhancement
Project	Byllesby-Buck Hydroelectric Project
RM	river miles
RSP	Revised Study Plan
SPD	Study Plan Determination
USGS	U.S. Geological Survey
VAC	Virginia Administrative Code
VDEQ	Virginia Department of Environmental Quality
μS/cm	microsiemens per centimeter

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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 two-development Byllesby-Buck Hydroelectric Project (Project) (Project No. 2514), located on the upper New River in Carroll County, Virginia. The Project is located approximately 60 miles south-southwest of the city of Roanoke. The Byllesby development is located about 9 miles north of the city of Galax, and the Buck development is located approximately 3 river miles (RM) downstream of Byllesby and 43.5 RM upstream of Claytor Dam.

The Project is currently licensed by the Federal Energy Regulatory Commission (FERC or Commission). The Project underwent relicensing in the early 1990s, including conversion to run-of-river operations and incorporating additional protection, mitigation, and enhancement (PM&E) measures. The current operating license for the Project expires on February 29, 2024. Accordingly, Appalachian is pursuing a subsequent license for the Project pursuant to the Commission's Integrated Licensing Process (ILP), as described at 18 Code of Federal Regulations (CFR) Part 5.

In accordance with 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 October 18, 2019. On November 18, 2019 FERC issued the Study Plan Determination (SPD). On December 18, 2019, Appalachian filed a request for rehearing of the SPD. The SPD was subsequently modified by FERC by an Order on Rehearing dated February 20, 2020.

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 18, 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 Water Quality Study conducted in support of preparing an application for new license for the Project.

2 Study Goals and Objectives

Appalachian's study employs standard methodologies that are consistent with the scope and level of effort of water quality monitoring conducted at hydropower projects in the region. This study is intended to provide sufficient information to support an analysis of the potential Project-related effects on water quality. The goals and objectives of this study are to:

- Gather baseline water quality data sufficient to determine consistency of existing Project operations with applicable Virginia state water quality standards and designated uses (Virginia Administrative Code [VAC] Chapter 260).
- Provide data (temperature and dissolved oxygen [DO] concentration) to determine the presence and extent, if any, of thermal or DO stratification in the Byllesby and Buck impoundments.
- Provide data to support a Virginia Water Protection Permit application (Clean Water Act [CWA] Section 401 Certification).
- Provide information to support the evaluation of whether additional or modified PM&E measures may be appropriate for the protection of water quality at the Project's developments.

3 Study Area

The study area for the Water Quality Study is shown on Figure 3-1 and includes the reservoirs, bypass reaches, and tailraces downstream of Byllesby and Buck dams. Appalachian established five water quality monitoring stations at the Buck development and one water quality monitoring station at the Byllesby development for approximately two months in 2020:

- **Buck development**
  - Two locations in the forebay (one near surface and the other near bottom)
  - One location in the tailrace
  - Two locations in the bypass reach (upstream and downstream)
- **Byllesby development**
  - One location in the tailrace

The delayed start to the study season, in combination with multiple high flow events on the upper New River resulting in operating constraints at the Byllesby development (including flashboard damage and reduced powerhouse generation) precluded Appalachian's ability to install monitoring stations at all of the locations proposed in the RSP. The following Water Quality monitoring locations proposed in the RSP were not surveyed in 2020 (see Section 8 for Appalachian's proposal to address these study gaps):

- One location in the upstream extent of the Byllesby reservoir
- Two locations in the Byllesby forebay (upper and lower portion of the water column)
- One location in the Byllesby bypass reach (approximate mid-point)

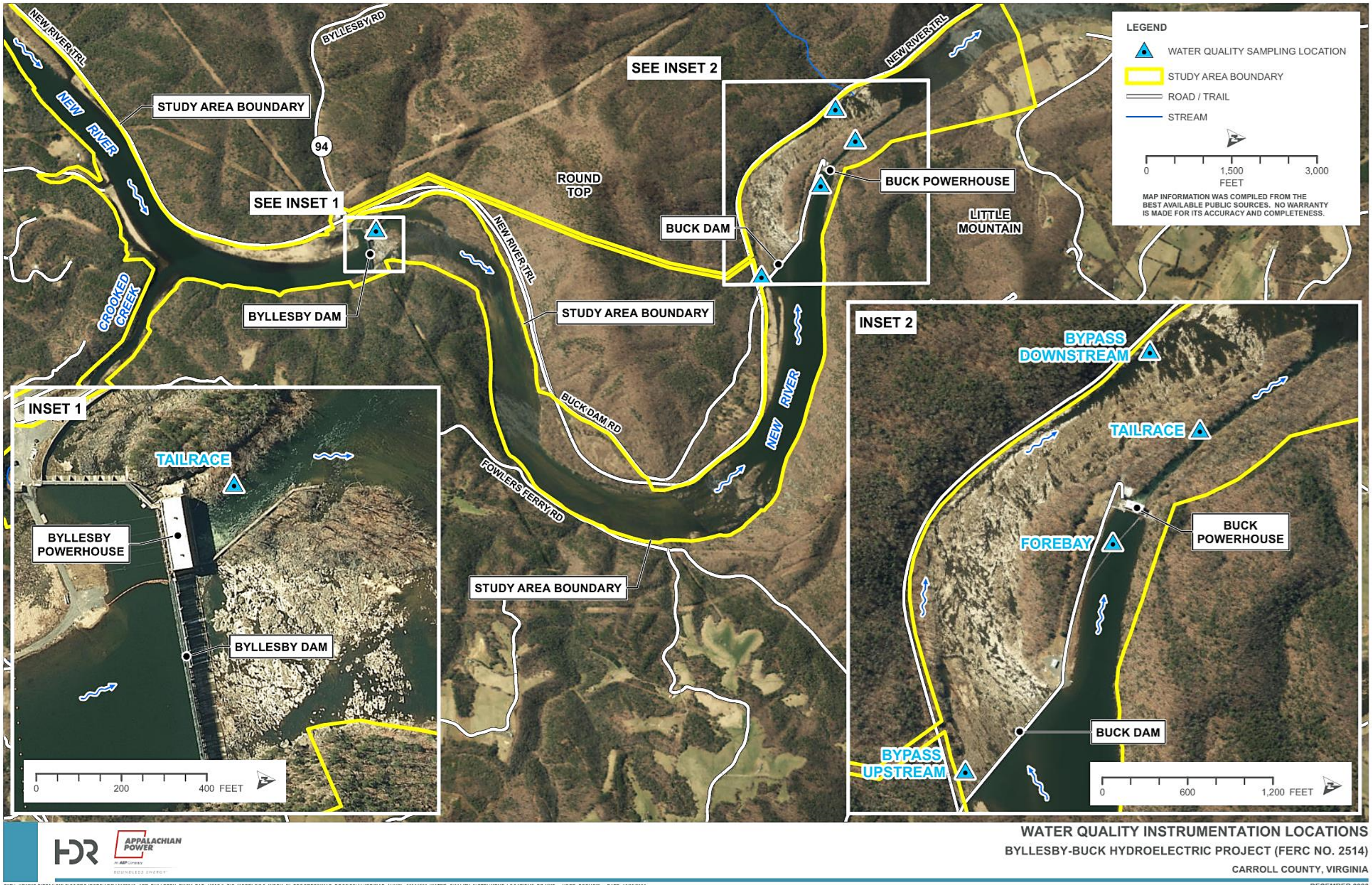

Figure 3-1. Byllesby-Buck Water Quality Study Locations

4 Background and Existing Information

4.1 Applicable Water Standards

Existing relevant and reasonably available information regarding water quality in the Project vicinity was presented in Section 5.3 of the Pre-Application Document (PAD) (Appalachian 2019). The PAD included historical water quality data collected by the U.S. Geological Survey (USGS) and the Virginia Department of Environmental Quality (VDEQ) (discussed in Section 4.2). The data presented in the PAD indicates that temperatures and DO concentrations did not differ between impoundments and tailraces during collection efforts, and no evidence of thermal stratification was observed in either impoundment. Data from the historical studies also demonstrated that the Project waters meet the state water quality standards, including temperature maximums and DO minimums.

The Virginia Department of Environmental Quality (VDEQ) is responsible for carrying out the mandates of the State Water Control Law as well as meeting federal obligations under the CWA (VDEQ 2017). Waters in the New River Basin are classified in Virginia Administrative Code (VAC) 9VAC25-260-540. The New River in the vicinity of the Project is designated as Class IV (Mountainous Zone) (Table 4-1). Numerical criteria for DO, pH, and maximum water temperature for these waters are identified in 9VAC25-260-50 and are summarized in Table 4-2. In accordance with 9VAC25-260-50, these water quality criteria do not apply when flows are below the lowest 7-day average flow expected to occur once every 10 years (i.e., the 7Q10 flow).

Table 4-1. Classification of Project Area Waters – New River

Section	Class	Special Standards	Section Description
2	IV	v, NEW-5	New River and its tributaries, unless otherwise designated in this chapter, from the Montgomery-Giles County line upstream to the Virginia-North Carolina state line.
2l	IV	PWS	New River and its tributaries inclusive of the Wythe County Water Department's Austinville intake near the Route 636 bridge, and the Wythe County Water Department's Ivanhoe intake on Powder Mill Branch just upstream of the Wythe-Carroll County line to points 5 miles above the intakes.

v – The maximum temperature of the New River and its tributaries (except trout waters) from the Montgomery-Giles County line upstream to the Virginia-North Carolina state line shall be 29 degrees Celsius (°C) (9VAC25-260-310).

NEW – nutrient-enriched waters; only includes New River and its tributaries, except Peak Creek above Interstate 81, from Claytor Dam upstream to Big Reed Island Creek (Claytor Lake) as per 9VAC25-260-350.

PWS – public water supply.

Table 4-2. Numeric Water Quality Criteria for Class IV Waters

Parameter	Standard
Minimum DO	4.0 milligram per liter (mg/l)
Daily Average DO	5.0 mg/L
pH	6.0 – 9.0
Maximum water temperature	29°C*

*The maximum temperature of the New River and its tributaries (except trout waters) from the Montgomery-Giles County line upstream to the Virginia-North Carolina state line shall be 29°C (9VAC25-260-310).

Multiple segments of the New River are listed as impaired for aquatic life or recreation uses due to *E. coli* concentrations. However, the source of *E. coli* is not associated with the Project and it is expected that continued operation of the Project will have no effect on *E. coli* concentrations in the New River.

4.2 Existing Water Quality Data

Water quality data have been collected approximately 3 RM downstream of the Buck dam at the U.S. Geological Survey (USGS) 03165500 New River at Ivanhoe, VA. Due to the proximity of this monitoring location to the Project, the water quality data is expected to be indicative of the characteristics of Project outflows. Daily mean water temperature and specific conductance data were collected from March 2007 to September 2008; daily mean water temperatures ranged from 0.3°C in to 28.9°C and were below the maximum state criterion. Daily mean specific conductance ranged from 55 microsiemens per centimeter (µS/cm) to 108 µS/cm.

The VDEQ has also collected water quality data approximately 2 RM downstream of Buck dam at Site 9-NEW127.49. Water temperature, DO, pH, and specific conductivity data were collected at a depth of approximately 0.3 meters from 1992 to 2017. Water temperatures ranged from 0.0 to 28.7°C and were below established state criterion. DO concentrations ranged from 5.3 mg/l to 14.8 mg/l and were well above the minimum state criterion. The pH ranged from 5.9 to 8.9 and were also within the state criteria range, except for a single day in December 1999. Specific conductivity ranged from 20 to 80 µS/cm.

On August 29, 2019, a site visit was conducted by HDR for Appalachian to collect water quality data and evaluate field logistics associated with potential water quality monitoring locations for the Byllesby and Buck developments. During the site visit, a calibrated multiparameter water quality data sonde was used to collect depth profiles in each development's forebay and discrete measurements were taken in each development's tailrace. Streamflow during the site visit was approximately 1,500 cubic feet per second (cfs) measured at USGS gage 03165500, which is typical of average flow conditions in August at this location. During the site visit, the Byllesby forebay elevation[1] was in the normal operating range,[2] however, the Buck forebay elevation was approximately 9 feet (ft) lower than the normal operating range[3] to facilitate construction activities associated with installation of the new Obermeyer gates.

All water quality measurements during the site visit were within applicable Virginia state water quality standards. As Figure 4-1 and Figure 4-2 indicate, the depth profiles in each forebay did not show any significant difference in water quality from top to bottom or laterally. The tailrace measurements were reflective of the water quality in each forebay.

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[1] Elevations in this report are referenced to National Geodetic Vertical Datum of 1929 (NGVD)

[2] Normal operating range for the Byllesby impoundment is between 2,078.2 – 2,079.2 ft NGVD.

[3] Normal operating range for the Buck impoundment is between 2,002.4 – 2,003.4 ft NGVD. During the August 29, 2019 water quality sampling site visit, the forebay elevation was approximately 1994 ft NGVD; or approximately 9 ft below the normal operating range.

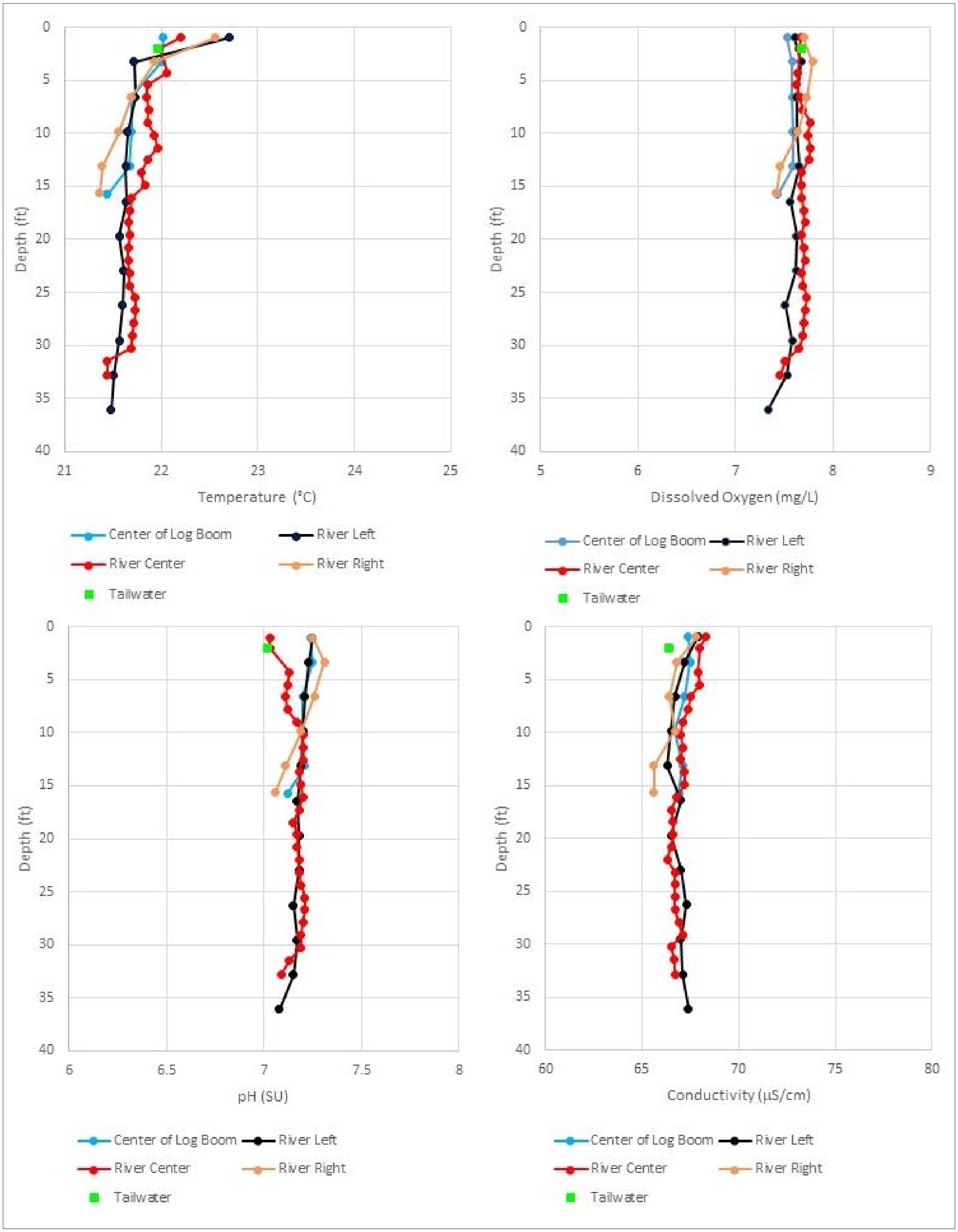

Figure 4-1. Water Quality Parameters for Byllesby (August 29, 2019)

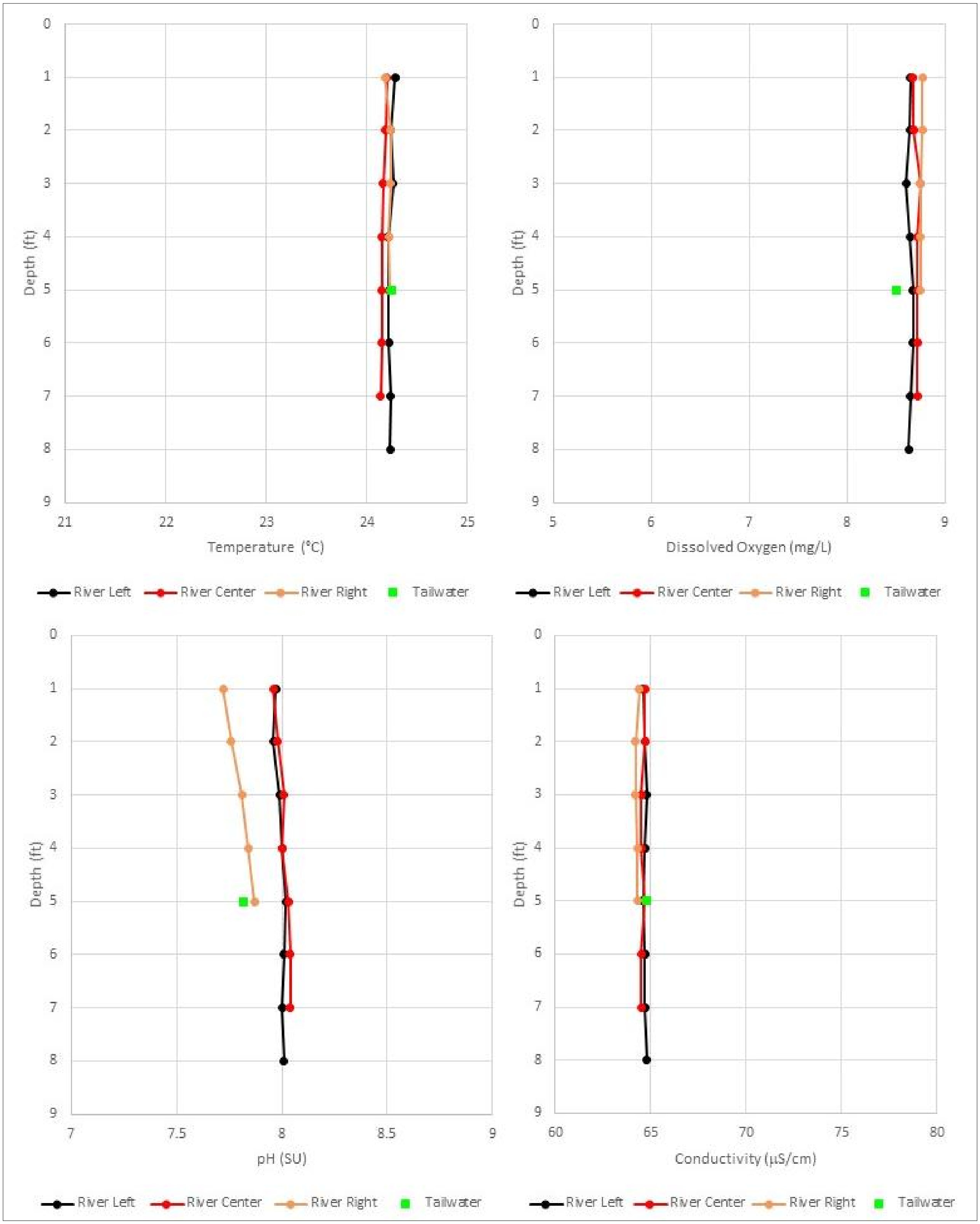

Figure 4-2. Water Quality Parameters for Buck (August 29, 2019)

5 Methodology

5.1 Data Collection

As described in the Second Quarterly Progress Report filed on October 27, 2020, Appalachian deployed water quality instruments (i.e., DO and water temperature sondes) at Buck the week of August 17, 2020. This same week, due to high flow conditions and continuous flow release at the dam through the damaged flashboard section throughout Q3 2020, water quality instrumentation at Byllesby was only installed at the tailrace location. The locations of the water quality instrumentation are shown on Figure 3-1. The equipment recorded data at 15-minute intervals.

Based on the August 29, 2019 site visit described in Section 4.2, the depth of the Buck forebay near the center of the intake channel is approximately 17 ft.[4] As a result, the upper and lower data sondes were be placed at approximately 3 ft and 14 ft below the surface, respectively.

Data were downloaded from instrumentation at Buck during the field efforts from September 8 - 10, 2020, and at Byllesby and Buck from October 7 – 8, 2020, after which time data collection instruments were removed per the schedule in the RSP. Field staff downloaded data from sondes at each monitoring location using a data shuttle or directly to a laptop computer. Sondes were cleaned, checked for operation, calibration, and battery life; and adjusted as necessary based on manufacturer's specifications. The cable, housing, and other installation materials were visually inspected for damage and repaired or replaced as necessary.

During the initial deployment and subsequent download events, discrete multi-parameter water quality measurements of temperature, DO concentration, pH, and specific conductivity were collected at each monitoring location using a Hach Hydrolab® MS5 (Hydrolab). For the tailrace and bypass reach monitoring locations, Hydrolab water quality data were collected at one location within the water column at a depth similar to the sondes. Profile data were collected at 1-ft intervals[5] using the Hydrolab for the Buck forebay monitoring location to document temperature and DO stratification at the time of the data sonde downloads. Discrete water quality data collections occurred concurrent with deployment and downloads of the continuous data loggers.

5.2 Data Analysis and Processing

Upon completion of the field data collection effort, data was checked for errors and omissions. Data that more closely matched the discrete measurement readings made in the field during download events were preferentially reported and analyzed for each monitoring location.

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[4] During the August 29, 2019 water quality sampling site visit, the Buck pool level was at approximately 1994 ft NGVD; or approximately 9 ft below the normal operating range of 2002.4 – 2003.4 ft NGVD (the impoundment was drawn down to facilitate construction activities at the spillway). At the time of the site visit, the depth measured near the center of the intake channel was approximately 8 ft. Therefore, at normal pool levels, the depth at the same location will be approximately 17 ft (i.e., 8 ft + 9 ft).

[5] During the August 17, 2020 water quality sampling event, profile data were collected at 2-ft intervals; a 1-ft interval was used during subsequent water quality sampling events.

Real-time flow data (15-minute) was obtained from the USGS New River at Ivanhoe, VA Gage (USGS 03165500), which is approximately 3 RM downstream of the Buck powerhouse and includes the combined flows from the powerhouse and bypass reach. Flows have been recorded since January 1996 at the USGS New River at Ivanhoe, VA Gage and corresponding stage from August 2020 to present.

5.3 Equipment Calibration and Quality Assurance

Prior to the first deployment, Onset HOBO® Model U26 DO/Temperature Loggers were initialized with a new DO sensor cap and calibrated. The Hydrolab multi-parameter water quality sonde was lab calibrated by the manufacturer. Prior to each instantaneous sample collection, the Hydrolab was checked against a suite of standards. A Hydrolab® Surveyor 4a (Surveyor) is the handheld display that connects to the Hydrolab sonde for attended monitoring applications. The Surveyor was sent to the manufacturer for calibration prior to the field deployment. The water quality sensor specifications as specified by the manufacturer are presented in Table 5-1.

Table 5-1. Water Quality Sensor Specifications

Water Quality Sensor Accuracy		
Sensor	Hydrolab® MS5[2]	Onset HOBO® Model U26[3]
Temperature	+/- 0.1°C	+/- 0.2°C
DO[1]	+/- 0.1 mg/l for 0 – 8 mg/l; +/- 0.2 mg/l for greater than 8 mg/l	+/- 0.2 mg/L for 0 – 8 mg/l; +/- 0.5 mg/L for greater than 8 mg/l
Specific conductivity	+/- 0.5 % of reading; +/- 0.001 millisiemens/centimeter	N/A
pH	+/- 0.2 units	N/A

Note:
[1] = Hach LDO® - Luminescent Dissolved Oxygen sensor or Onset RDO ® - Rugged Dissolved Oxygen. Both use light to optically measure dissolved oxygen.
[2]. Specifications for the Hydrolab® MS5: https://s.campbellsci.com/documents/ca/product-brochures/series_5_br.pdf
[3]. Specifications for the Onset HOBO® Model U26: https://www.onsetcomp.com/products/data-loggers/u26-001/

6 Study Results

6.1 Water Temperature

Figure 1-1 in Attachment 1 provides continuous and discrete water temperature data at the Byllesby tailrace location. Water temperatures measured in the 21-26ºC range for the first three weeks of the study. In mid-September 2020, the average temperature decreased over a one-week period by approximately 7ºC.

Figure 1-2 in Attachment 1 provides continuous and discrete water temperature data at the forebay and tailrace locations at Buck. Water temperatures at both of these locations were similar to those recorded at the Byllesby tailrace. The Buck forebay and tailrace monitoring locations were within 0.5ºC of each other for most of the study period, which is reflective of run-of-river operations.

Figure 1-3 in Attachment 1 provides continuous and discrete water temperature data at the Buck bypass reach monitoring locations. Daily temperature fluctuations at the downstream monitoring location were approximately twice that observed at the upstream monitoring location. While both monitoring locations are in relatively small pools, the upstream location is shaded more of the day compared to the downstream location, thus daily temperature cycles at the upper location are lower in magnitude.

Air temperature data is also included in Figures 1-1, 1-2, and 1-3 (Attachment 1) to put into context the larger daily air temperature fluctuations compared to the daily water temperature fluctuations.

Water temperature vertical profile data for the Buck forebay is presented in Figure 3-1 While water temperature varied seasonally, there was little (i.e., <0.7ºC) to no thermal stratification at the forebay monitoring location.

6.2 Dissolved Oxygen

Figure 1-4 provides continuous and discrete DO concentration data at the Byllesby tailrace monitoring location. All measurements were greater than the 5.0 mg/l daily average DO standard with daily fluctuations in the 0.5 – 1.5 mg/l range. DO concentrations generally increased over the course of the study period as water temperatures decreased[6].

Figure 1-5 provides continuous and discrete DO concentration data at the Buck forebay and tailrace monitoring locations. All measurements were greater than the 5.0 mg/l daily average DO standard. Daily fluctuations in DO concentrations were less than 1.0 mg/l during the study except for September 4 - 11 when the daily fluctuation increased to the 1.0 – 2.0 mg/l range at the forebay monitoring locations[7]. Similar to water temperature, there is little (i.e., typically < 1.0 mg/l) to no

[6] Generally, there is an inverse relationship between DO concentrations and water temperature. Colder water temperatures have a higher capacity for DO concentrations and vice versa.

[7] Flows recorded at the Ivanhoe USGS flow gaging station from September 4 – 11, 2020 were relatively low and stable (compared to the weeks preceding and following) which likely contributed to slightly increased fluctuations in DO concentrations during this period. Flows recorded at the Ivanhoe USGS flow gaging station are shown on Figure 4-1 of Attachment 4.

difference in DO concentrations between the forebay surface and bottom locations; indicating little to no stratification of DO concentrations throughout the forebay water column. DO concentrations in the tailrace were generally higher (by up to 1.0 mg/l) compared to the forebay monitoring locations. This suggests that unit generation and the trash sluice gate operation increase aeration into the tailrace. Tailrace concentrations typically fluctuated approximately 0.25 mg/l between day and night.

Figure 1-6 provides continuous and discrete DO concentration data at the bypass reach upstream and downstream monitoring locations. The overall trend in DO concentrations were similar between the two bypass reach monitoring locations. All measurements were greater than the 5.0 mg/l daily average DO standard with daily fluctuations of up to 1.0 mg/l for the upstream location and up to 3.0 mg/l at the downstream location. DO concentrations are influenced by water temperatures and as described in Section 6.1, the upstream monitoring location is shaded more of the day (compared to the downstream monitoring location), thus the daily fluctuation in DO concentrations is less at the upstream location.

DO vertical profile data is presented in Figure 3-1 of Attachment 3 for the Buck forebay monitoring location and similar to the water temperature profile data, there was no stratification of DO concentrations at this location.

6.3 pH

Vertical pH profile data are presented on Figure 3-2 of Attachment 3 for the Buck forebay monitoring location. The variation in pH was very small (between 7.3 and 7.7) and there was little to no stratification between the reservoir surface and bottom measurements. Discrete pH measurements at each monitoring location during the initial instrument deployment and two download events were between 7.2 and 8.9; these values meet state water quality standards for Class IV waters (see Table 4-2). Eleven of the fifteen readings were within the vertical profile range (7.3 and 7.7).

6.4 Specific Conductivity

Specific conductivity vertical profile data is presented in Figure 3-3 of Attachment 3 for the Buck forebay monitoring location. Specific conductivity at this monitoring location varied each sampling event, but concentrations were typically the same from reservoir surface to bottom and ranged from 53 – 61 µS/cm over three sampling events during the study period (see Figure 3-3). Discrete measurements of specific conductivity for all monitoring locations ranged from 52 – 62 µS/cm (see Table 2-1 of Attachment 2 for discrete sampling results). These results are consistent with specific conductivity measurements during the August 29, 2019 site visit and the results of other nearby historic studies and data collection efforts (NWQMC 2020; Stantec 2016) indicating a long-term, relatively consistent range of conductivity in the Project area.

7 Summary and Discussion

7.1 Consistency with Applicable Virginia State Water Quality Standards

Continuous and discrete water quality data collected during the 2020 study period met Virginia Class IV (New River) water quality standards for temperature (<29 ºC), DO (>4.0 mg/l instantaneous minimum; >5.0 mg/l daily average), and pH (range 6.0 – 9.0) at all monitoring locations during the study period.

7.2 Temperature and Dissolved Oxygen Stratification in the Byllesby-Buck Impoundments

Continuous and discrete water quality data collected during the August 29, 2019 site visit (at Byllesby and Buck) and 2020 study period (at Buck) indicated little to no thermal or DO stratification at the forebay monitoring locations. Water temperatures typically varied less than 0.5ºC from reservoir surface to bottom and DO concentrations typically varied less than 1.0 mg/l from reservoir surface to bottom. While the data sondes were not deployed until August 17, 2020, water temperature and DO concentrations were typical of warmer summer conditions[8]. Therefore, additional water quality data collection at Buck in 2021 would not likely yield significantly different results.

7.3 Need for Protection, Mitigation, and Enhancement Measures to Protect Water Quality

Water quality data collected in 2019 and 2020 at the Byllesby and Buck forebay areas, tailrace, and bypass reach are consistent with applicable Virginia state water quality standards for temperature, DO, and pH for Class IV (New River) surface waters. While there is no state standard for specific conductivity, concentrations less than 500 μS/cm are generally considered to be suitable for aquatic species in southern Appalachian streams (USEPA 2020). Based on the results of this water quality study, and in consideration of results of other nearby historic studies and data collection efforts, there is no need for additional PM&E measures to protect water quality at the Project.

7.4 Additional Future Water Quality Data Needs

Water quality data collected in 2019 and 2020 were consistent between years and with Virginia Class IV surface water criteria for water temperature, DO concentrations, and pH. While additional future water quality data collection is not warranted based on a nexus to Project operations, several

[8] Figure 4-2 of Attachment 4 provides a comparison of air temperature data at Fries and Ivanhoe, Virginia beginning approximately one month prior to (i.e., mid-July 2020) the water quality data sonde installation in mid-August 2020. Meteorological conditions in mid-August 2020 were similar to the prior month supporting the conclusion that water temperature and DO concentrations were typical of warmer summer conditions.

2020 study components were delayed to 2021. As described in Section 8, additional survey activities at select locations are proposed by Appalachian in 2021.

8 Variances from FERC-Approved Study Plan

Appalachian expects to evaluate the need for additional data collection at the Byllesby-Buck Project in 2021 in the ISR and at the ISR meeting. Water Quality monitoring locations that have not been surveyed and are therefore variances from the RSP include:

- One location in the upstream extent of the Byllesby reservoir
- Two locations in the Byllesby forebay (upper and lower portion of the water column)
- One location in the Byllesby bypass reach (approximate mid-point)

It is anticipated that water quality data collection efforts will need to be repeated at Byllesby in 2021 with the full deployment of data sondes as proposed in the RSP (including the tailrace monitoring location which was sampled during the 2020 study period). The proposed deployment would be from July through September to capture the warmer, typically lower flow, summer months.

In addition, the RSP included the collection of chlorophyll a grab samples at a single depth of approximately one meter in the forebay of each development during the monthly discrete water quality sampling events[9]. Since forebay water quality monitoring was not conducted at the Byllesby development in 2020, chlorophyll a sampling in the Buck forebay was also delayed such that samples from both forebay monitoring locations would be collected during the same year. Therefore, monthly chlorophyll a grab samples will be collected at both the Buck forebay and Byllesby forebay monitoring locations during the same months (i.e., July, August, and September) in 2021.

Lower flow conditions are necessary to evaluate potential changes in turbidity levels that are the result of Project operations (i.e., and not caused by high background turbidity levels associated with rainfall runoff events and high baseflow conditions). Due to higher than normal Project inflows from the New River watershed in Q3 2020, the turbidity study will need to be rescheduled to Q2 or Q3 2021 which will allow data collection efforts to target conditions that are more representative of typical station operations during lower flows.

[9] The chlorophyll a grab samples will be analyzed at an off-site laboratory.

9 Germane Correspondence and Consultation

On July 27, 2020, Appalachian filed an updated ILP study schedule and a request for extension of time to file the 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 18, 2021. These delays pushed the start of the 2020 field season into late July 2020. FERC letters of correspondence are included in Attachment 1 of the ISR.

10 References

Appalachian Power Company (Appalachian). 2019. Pre-Application Document. Byllesby-Buck Hydroelectric Project. January 2019.

National Water Quality Monitoring Council (NWQMC). 2020. Water Quality Portal. Accessed January 2021. [URL]: https://www.waterqualitydata.us/portal/#countrycode=US&statecode=US%3A51&countycode=US%3A51%3A035&siteid=21VASWCB-9-NEW128.97&mimeType=csv.

Stantec Consulting Services Inc. (Stantec). 2016. Final Report: Claytor Hydroelectric Project FERC No. 739 Mussel Survey. Prepared for Appalachian Power Company. June 17, 2016.

U.S. Environmental Protection Agency (USEPA). 2020. National Rivers and Streams Assessment 2013-2014: A Collaborative Survey. December 2020. EPA 841-R-19-001. Washington, DC. Accessed January 2021. [URL]: https://www.epa.gov/national-aquatic-resource-surveys/nrsa.

Virginia Department of Environmental Quality (VDEQ). 2017. Water Program. Accessed September 2017. [URL]: https://www.deq.virginia.gov/water/water-quality/-fsiteid-1

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Attachment 1

Attachment 1 – Continuous Temperature and Dissolved Oxygen Plots

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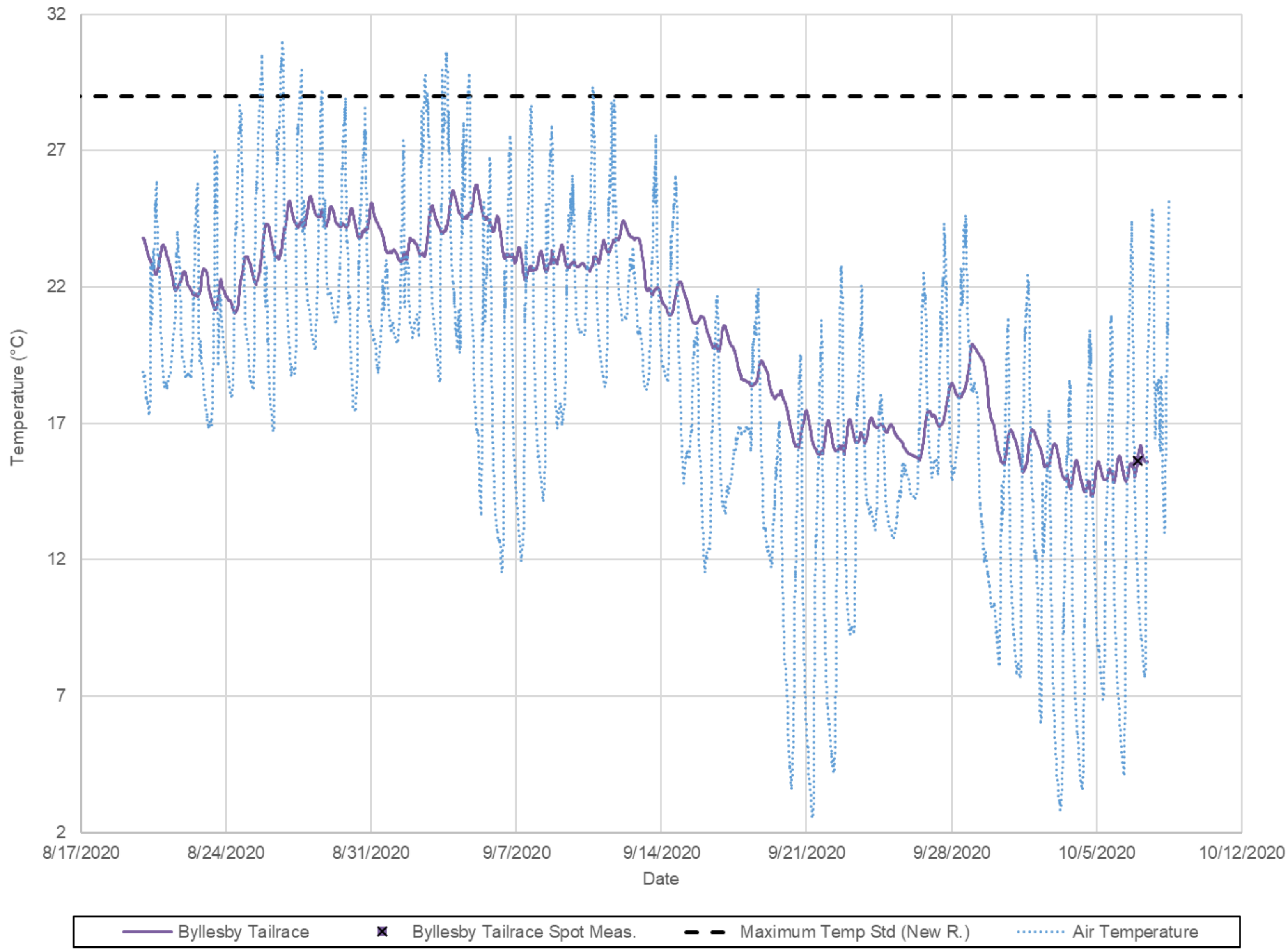

Figure 1-1. Continuous and Discrete Temperature Measurements at the Byllesby Tailrace Monitoring Location

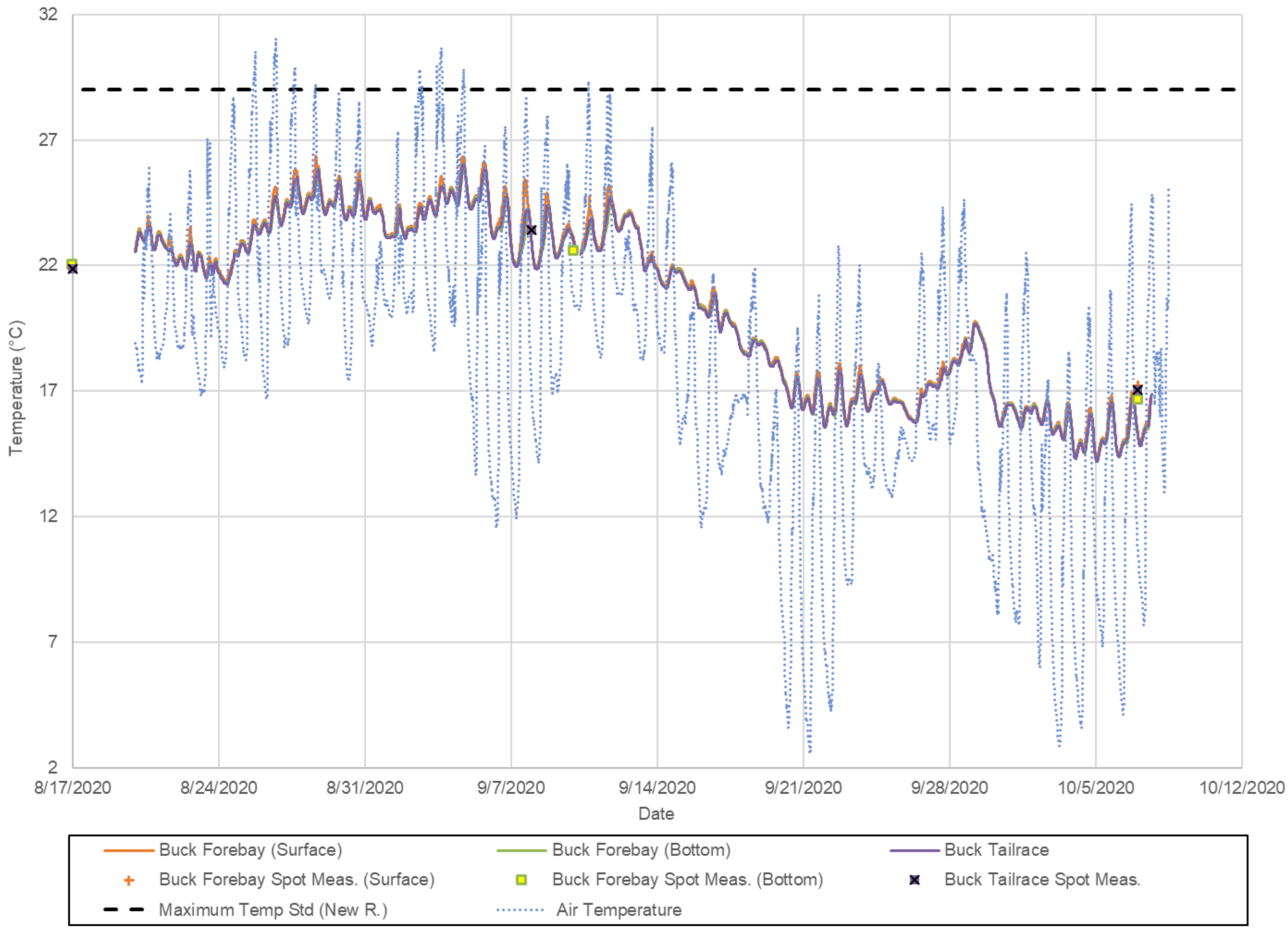

Figure 1-2. Continuous and Discrete Temperature Measurements at Buck Forebay and Tailrace Water Quality Monitoring Locations

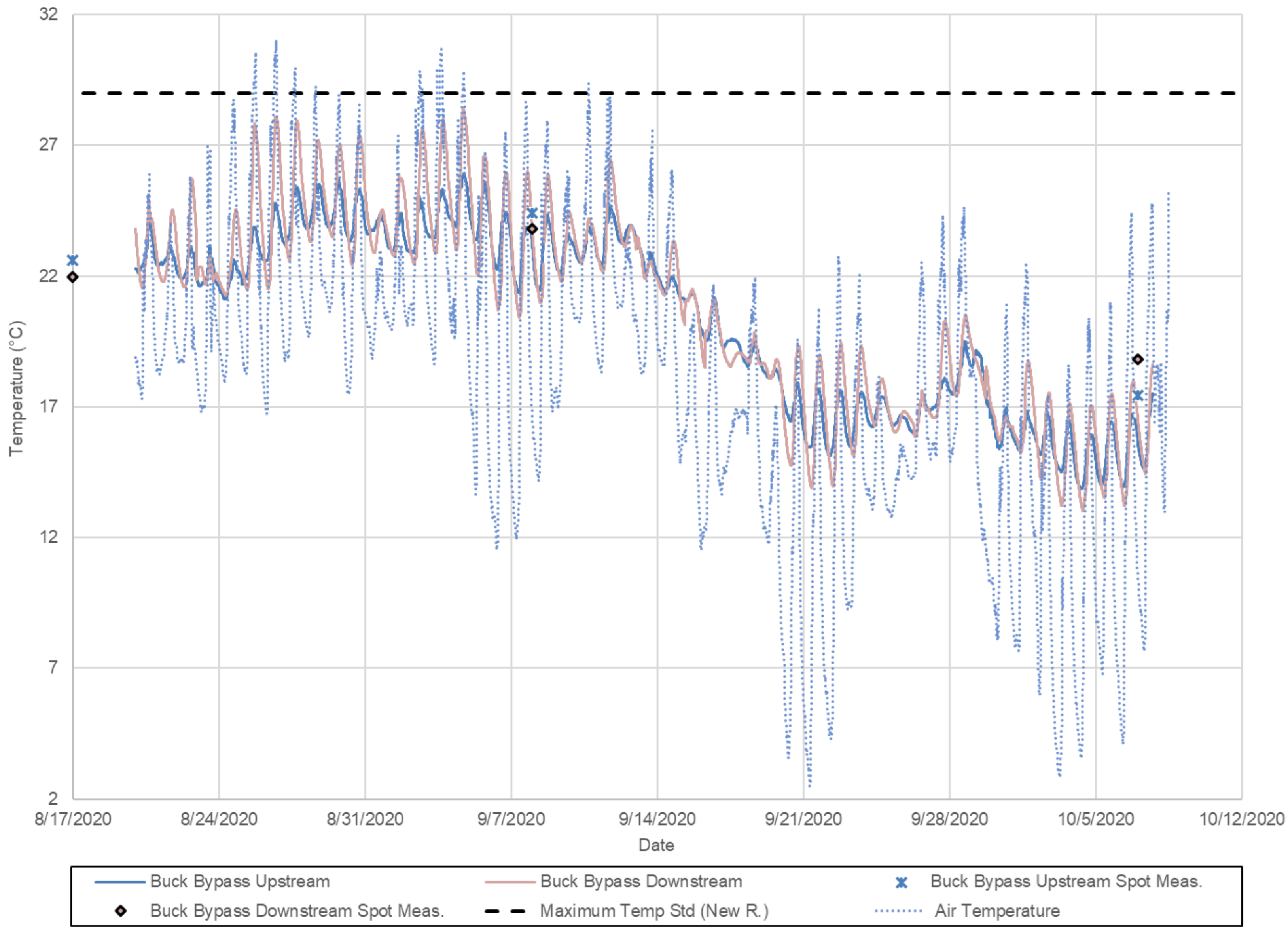

Figure 1-3. Continuous and Discrete Temperature Measurements at Buck Bypass Reach Water Quality Monitoring Locations

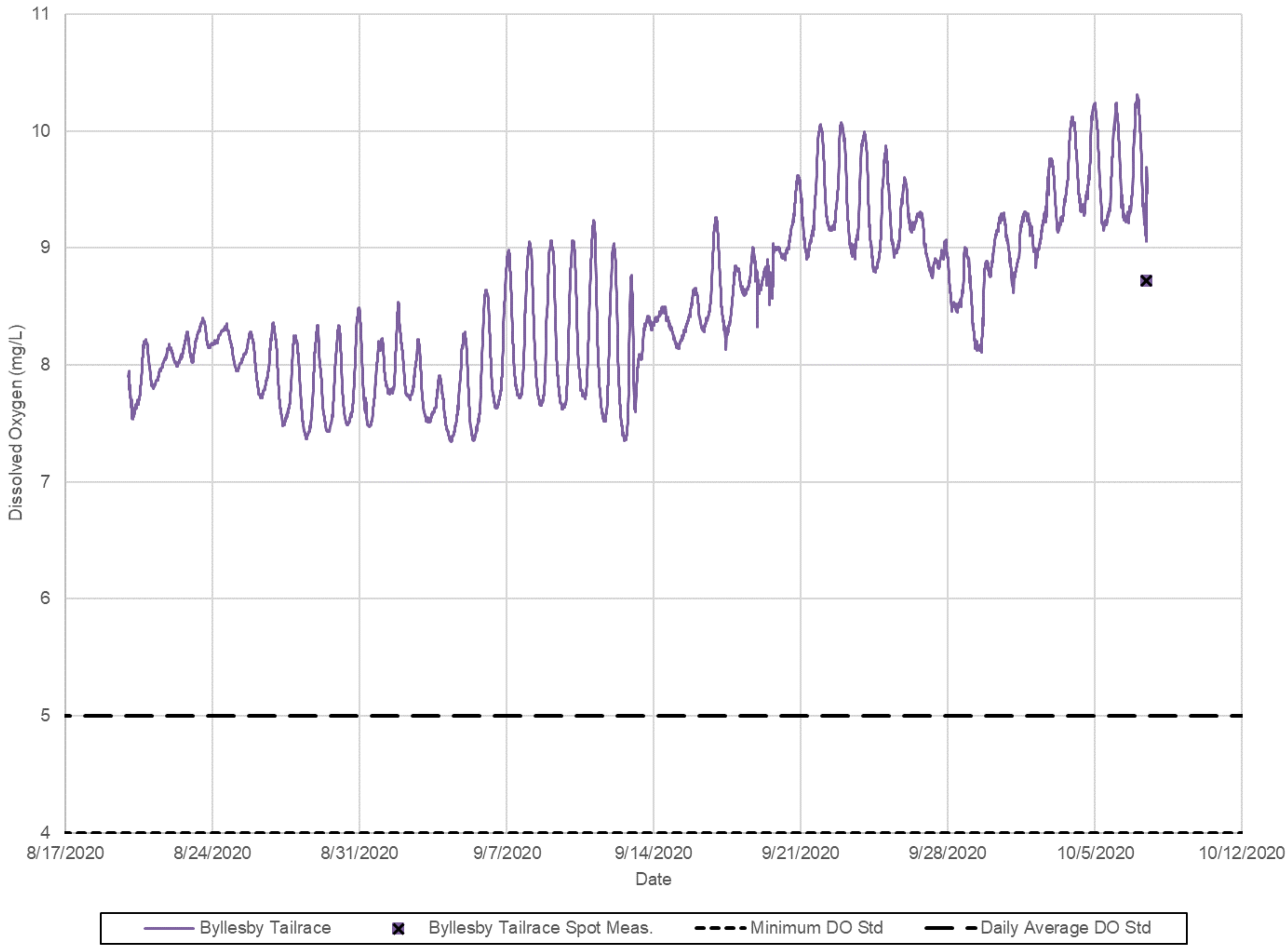

Figure 1-4. Continuous and Discrete Dissolved Oxygen Concentrations at Byllesby Water Quality Monitoring Locations

Figure 1-5. Continuous and Discrete Dissolved Oxygen Concentrations at Buck Forebay and Tailrace Water Quality Monitoring Locations

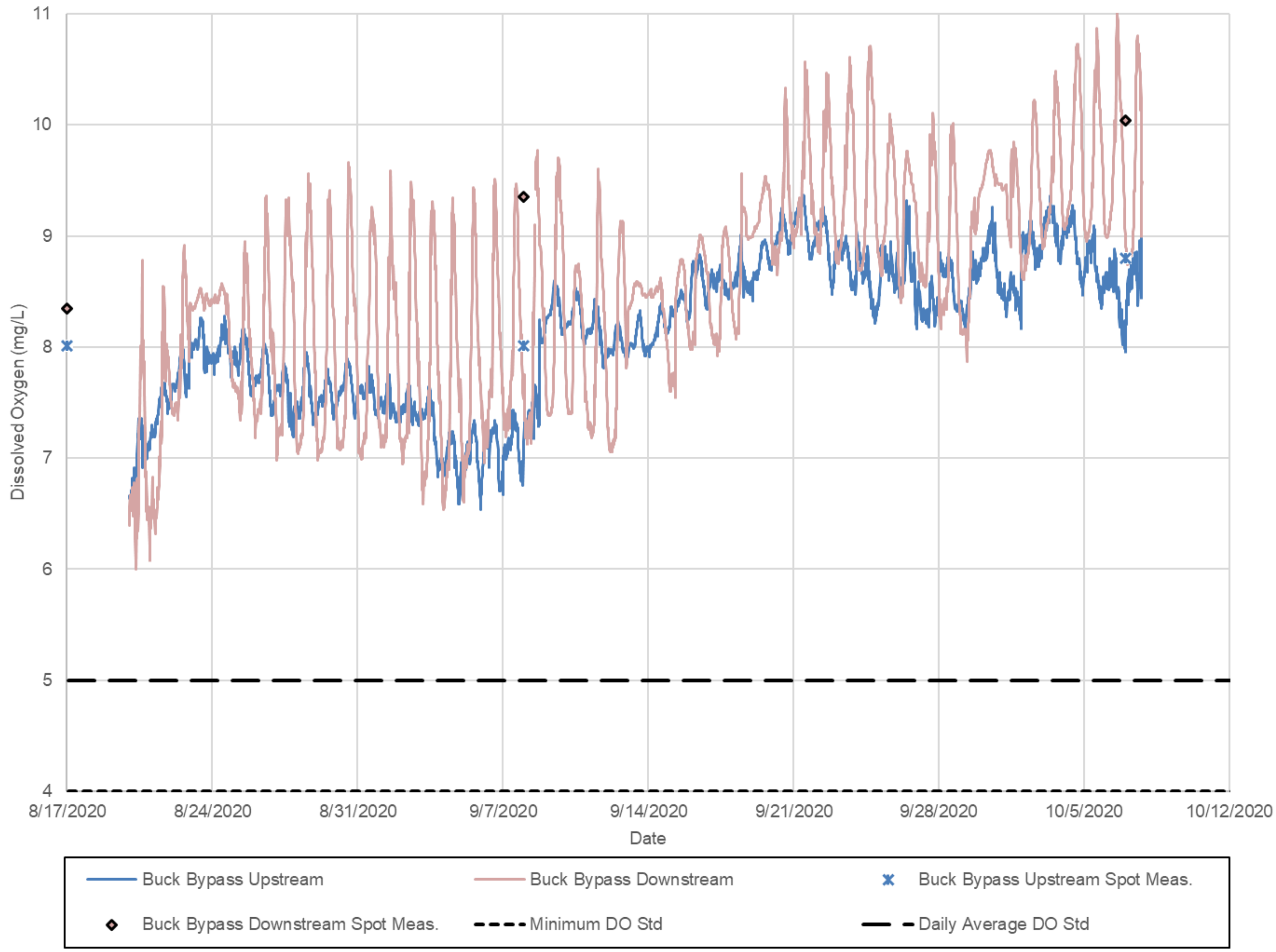

Figure 1-6. Continuous and Discrete Dissolved Oxygen Concentrations at Buck Bypass Reach Water Quality Monitoring Locations

Attachment 2

Attachment 2 – Discrete Measurement Tables

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Table 2-1. Discrete Measurements at Byllesby Quality Monitoring Location

Location	Date	Temperature (°C)	Dissolved Oxygen (mg/L)	pH (Standard Units)	Specific Conductance (μS/cm)
Tailrace	10/7/2020	15.64	8.72	7.13	60.9

Table 2-2. Discrete Measurements at Buck Quality Monitoring Locations

Location	Date	Temperature (°C)	Dissolved Oxygen (mg/L)	pH (Standard Units)	Specific Conductance (μS/cm)
Forebay (Surface)	8/17/2020	22.1	8.3	7.3	53
	9/10/2020	22.6	8.0	7.7	61
	10/7/2020	17.2	9.6	7.7	61
Forebay (Bottom)	8/17/2020	22.0	8.3	7.3	53
	9/10/2020	22.6	7.9	7.6	61
	10/7/2020	16.7	9.5	7.6	61
Tailrace	8/17/2020	21.9	8.6	7.3	52
	9/8/2020	23.4	8.4	8.3	61
	10/7/2020	17.0	9.4	7.6	60
Bypass Reach Upstream	8/17/2020	22.6	8.0	7.2	57
	9/8/2020	24.4	8.0	7.3	62
	10/7/2020	17.4	8.8	7.6	61
Bypass Reach Downstream	8/17/2020	22.0	8.4	7.2	51
	9/8/2020	23.8	9.4	8.2	62
	10/7/2020	18.8	10.0	8.9	59

Table 2-3. Buck Forebay Profile Data

	Temperature (°C)			Dissolved Oxygen (mg/L)			pH (Standard Units)			Specific Conductance (µS/cm)		
Depth	8/17/2020	9/10/2020	10/7/2020	8/17/2020	9/10/2020	10/7/2020	8/17/2020	9/10/2020	10/7/2020	8/17/2020	9/10/2020	10/7/2020
1	--	22.6	17.3	--	8.0	9.6	--	7.6	7.7	--	61	61
2	22.1	22.6	17.2	8.3	8.0	9.6	7.3	7.7	7.7	53	61	61
3	--	22.6	17.1	--	8.0	9.6	--	7.7	7.7	--	61	61
4	22.0	22.6	17.1	8.3	8.0	9.6	7.3	7.7	7.7	53	61	61
5	--	22.6	16.9	--	8.0	9.5	--	7.6	7.7	--	61	61
6	22.0	22.6	17.0	8.3	8.0	9.6	7.3	7.7	7.7	53	61	61
7	--	22.6	16.9	--	8.0	9.6	--	7.6	7.7	--	61	61
8	22.0	22.6	16.7	8.3	8.0	9.6	7.3	7.6	7.7	53	61	61
9	--	22.6	16.7	--	8.0	9.5	--	7.6	7.7	--	61	61
10	22.0	22.6	16.7	8.3	7.9	9.5	7.3	7.6	7.6	53	61	61
11	--	22.6	16.6	--	8.0	9.6	--	7.6	7.6	--	61	60
12	--	22.6	16.6	--	7.9	9.5	--	7.5	7.6	--	61	61
13	--	22.6	16.6	--	7.9	9.5	--	7.5	7.6	--	61	60
13.5	--	--	16.6	--	--	9.5	--		7.6	--	--	61
14	--	22.6	--	--	7.9	--	--	7.5	--	--	61	--
15	--	22.6	--	--	7.9	--	--	7.5	--	--	61	--
15.5	--	22.6	--	--	7.9	--	--	7.5	--	--	61	--

Attachment 3

Attachment 3 – Water Quality Vertical Profile Figures — Buck Development

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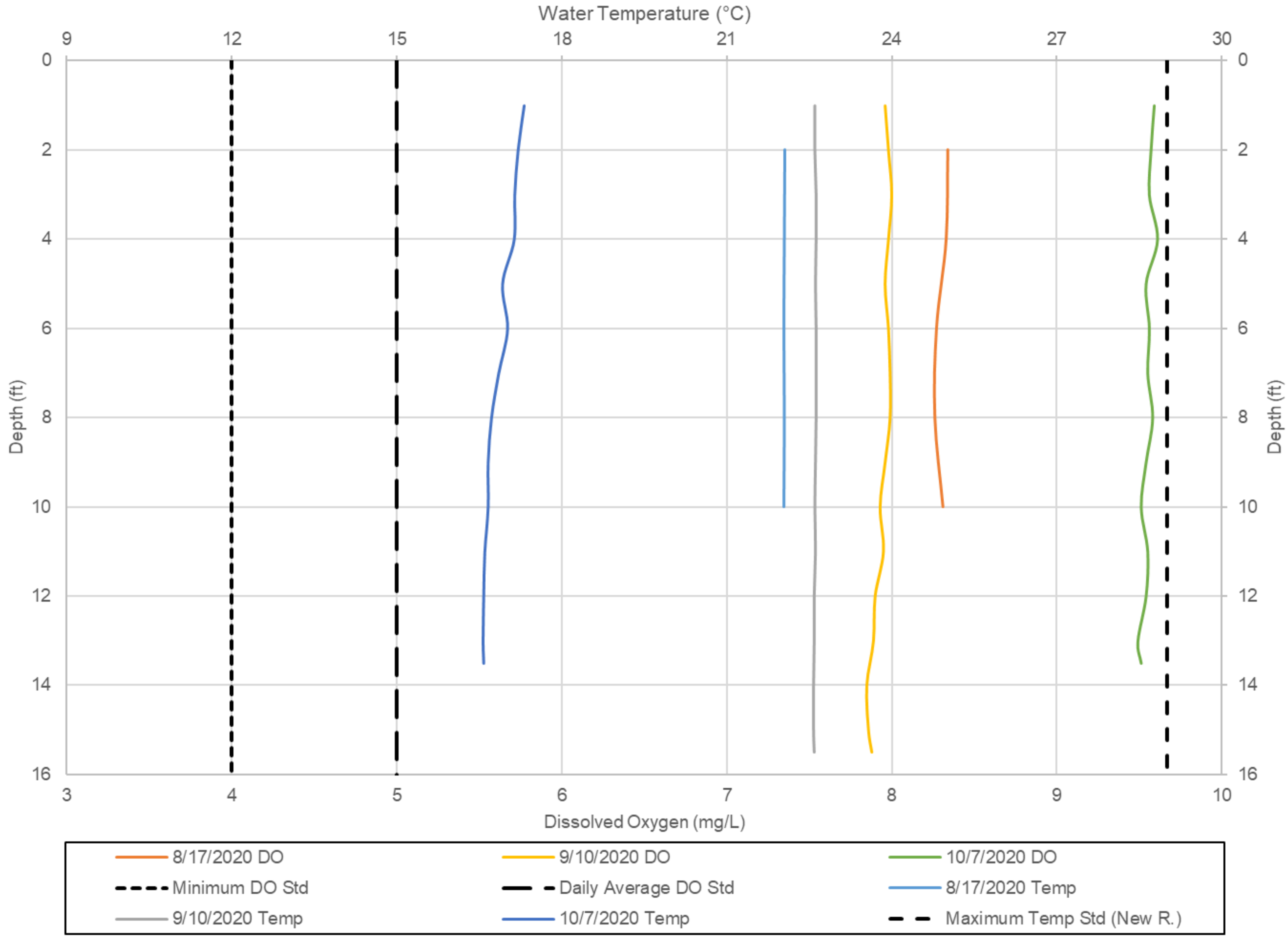

Figure 3-1. Forebay Vertical Profile —Temperature and Dissolved Oxygen Concentration

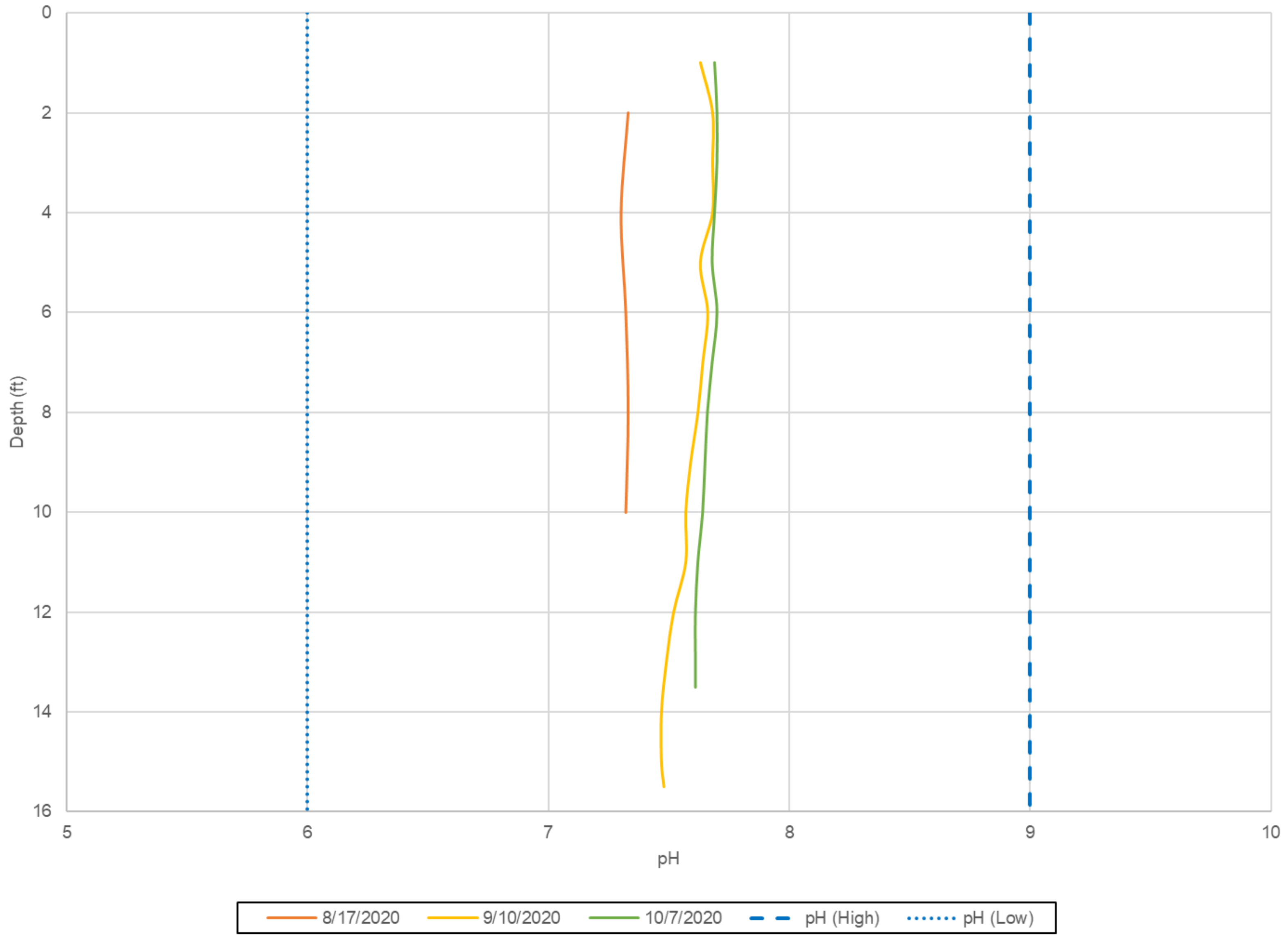

Figure 3-2. Forebay Vertical Profile — pH

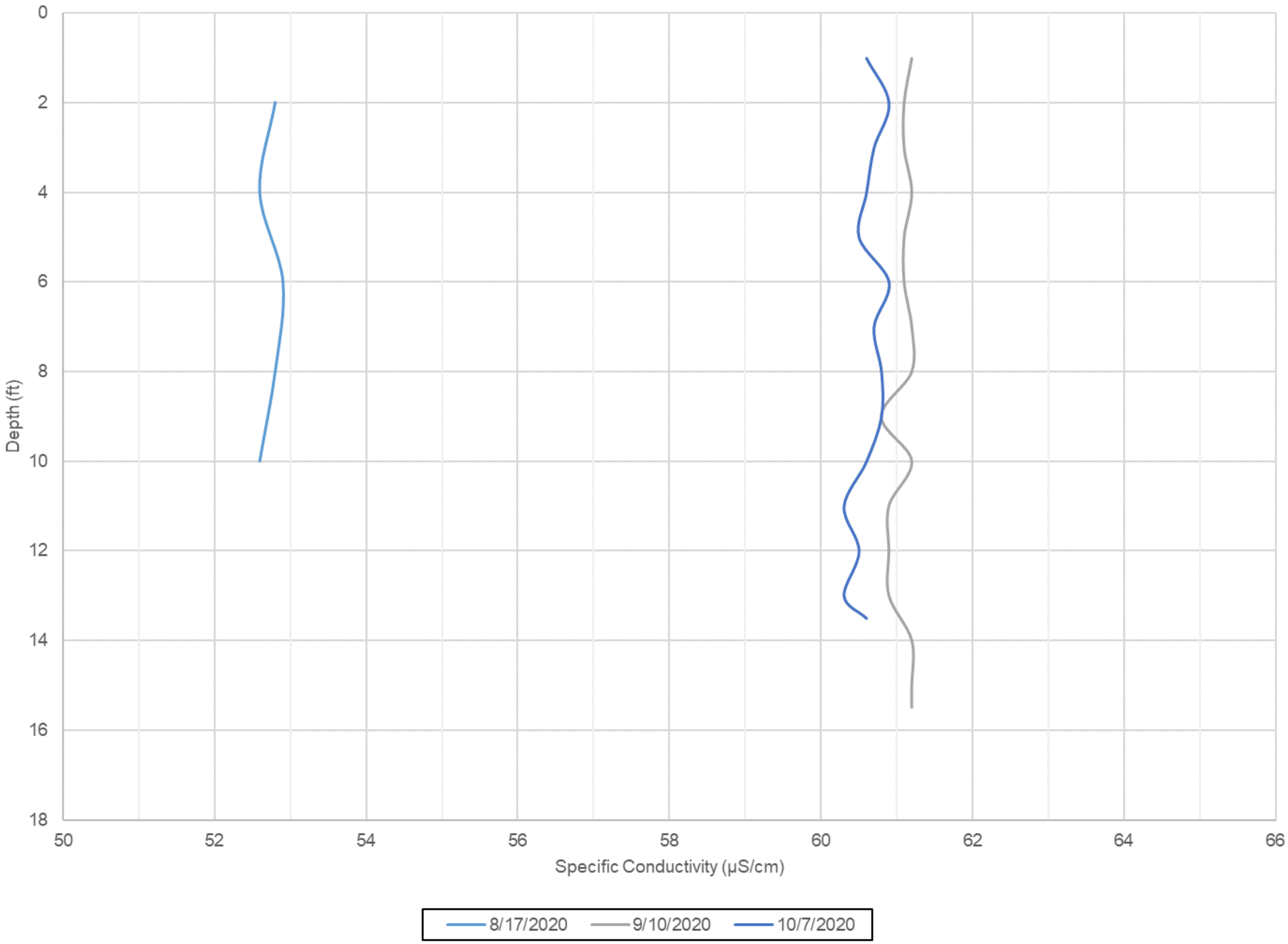

Figure 3-3. Forebay Vertical Profile — Specific Conductance

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Attachment 4

Attachment 4 – New River Flow and Meteorological Data

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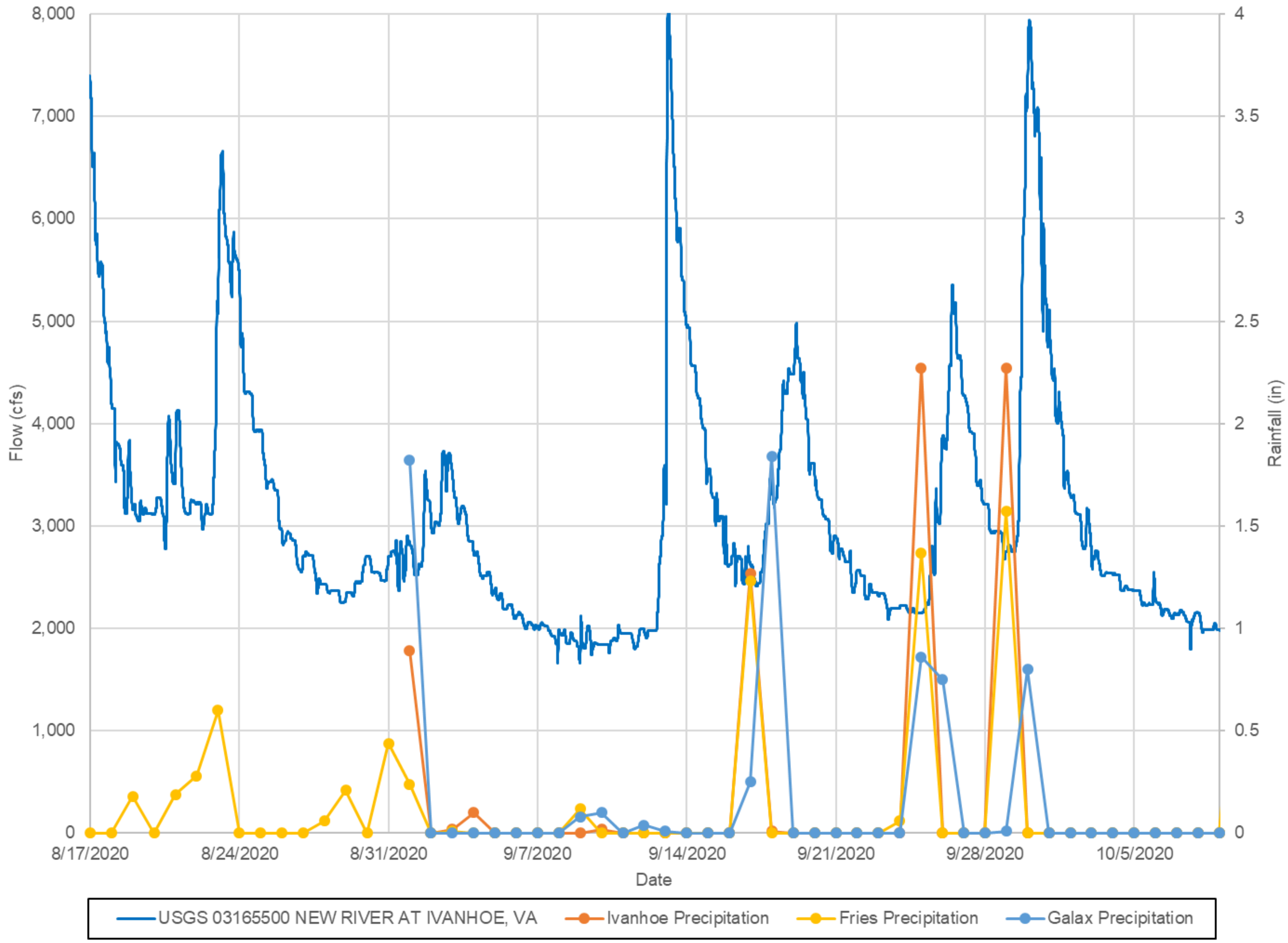

Figure 4-1. New River Flow (USGS 03165500) and Precipitation at Ivanhoe, Fries, and Galax, Virginia

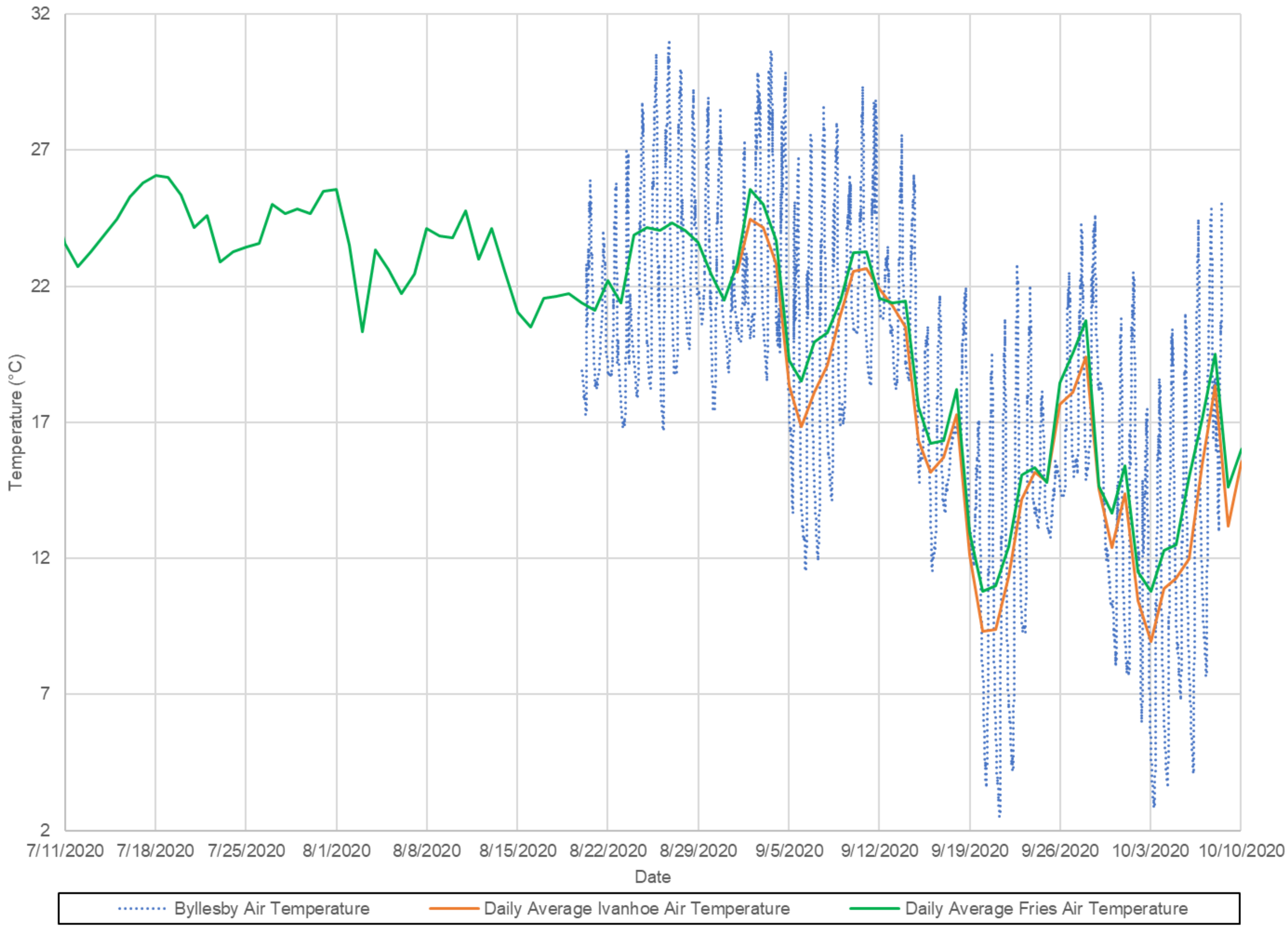

Figure 4-2. Air Temperature Comparison between Ivanhoe and Fries, Virginia

Appendix D

Appendix D – Preliminary Recreation Study Report

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HDR

Recreation Study Report

Byllesby-Buck Hydroelectric Project (FERC No. 2514)

January 18, 2021

Prepared by:

HDR

Prepared for:

Appalachian Power Company

APPALACHIAN POWER
An AEP Company
BOUNDLESS ENERGY

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Acronyms

ADA	Americans with Disabilities Act
AEP	American Electric Power
Appalachian or Licensee	Appalachian Power Company
CFR	Code of Federal Regulations
FERC or Commission	Federal Energy Regulatory Commission
Ft	foot
HDR	HDR Engineering, Inc.
ILP	Integrated Licensing Process
ISR	Initial Study Report
LPDA	Land Planning Design Associates
MOU	Memorandum of Agreement
NOI	Notice of Intent
PAD	Pre-Application Document
PM&E	protection, mitigation, and enhancement
PSP	Proposed Study Plan
Project	Byllesby-Buck Hydroelectric Project
RM	river miles
RSP	Revised Study Plan
SPD	Study Plan Determination
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
VDEQ	Virginia Department of Environmental Quality
VDWR	Virginia Department of Wildlife Resources
VDCR	Virginia Department of Conservation and Recreation

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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 two-development Byllesby-Buck Hydroelectric Project (Project) (Project No. 2514), located on the upper New River in Carroll County, Virginia. The Project is located approximately 60 miles south-southwest of the city of Roanoke. The Byllesby development is located about 9 miles north of the city of Galax, and the Buck development is located approximately 3 river miles (RM) downstream of Byllesby and 43.5 RM upstream of Claytor Dam.

The Project is currently licensed by the Federal Energy Regulatory Commission (FERC or Commission). The Project underwent relicensing in the early 1990s, including conversion to run-of-river operations and incorporating additional protection, mitigation, and enhancement (PM&E) measures. The current operating license for the Project expires on February 29, 2024. Accordingly, Appalachian is pursuing a subsequent license for the Project pursuant to the Commission's Integrated Licensing Process (ILP), as described at 18 Code of Federal Regulations (CFR) Part 5.

In accordance with 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 October 18, 2019. On November 18, 2019 FERC issued the Study Plan Determination (SPD). On December 18, 2019, Appalachian filed a request for rehearing of the SPD. The SPD was subsequently modified by FERC by an Order on Rehearing dated February 20, 2020.

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 18, 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 Recreation Study conducted in support of preparing an application for new license for the Project.

2 Study Goals and Objectives

The goal of this study is to determine the need for enhancement to existing recreation facilities, or additional recreational facilities, to support the current and future demand for public recreation in the Project area. The objectives of this study are to:

- Gather information on the condition of the six Project-related public recreation facilities and identify any need for improvement;
- Characterize current recreational use of the Study Area;
- Estimate future demand for public recreation at the Project;
- Solicit comments from stakeholders on potential enhancements or new facilities; and
- Analyze effects of continued Project operation on Project-related recreation facilities.

3 Study Area

The Study Area for the Recreation Study including the five Project-related recreational facilities within and adjacent to the Project boundary is shown on Figure 3-1. The Study Area is appropriate as it includes lands and recreation facilities managed by Appalachian under the existing license and other recreational opportunities that may potentially be affected by Project operations. At the request of stakeholders during the study planning phase of the ILP, the study area was extended beyond the Project boundary to include the shoreline and river reach upstream of the Buck reservoir, the previous U.S. Forest Service (USFS) campground, and the angler access locally known as Loafer's Rest downstream of Buck dam.

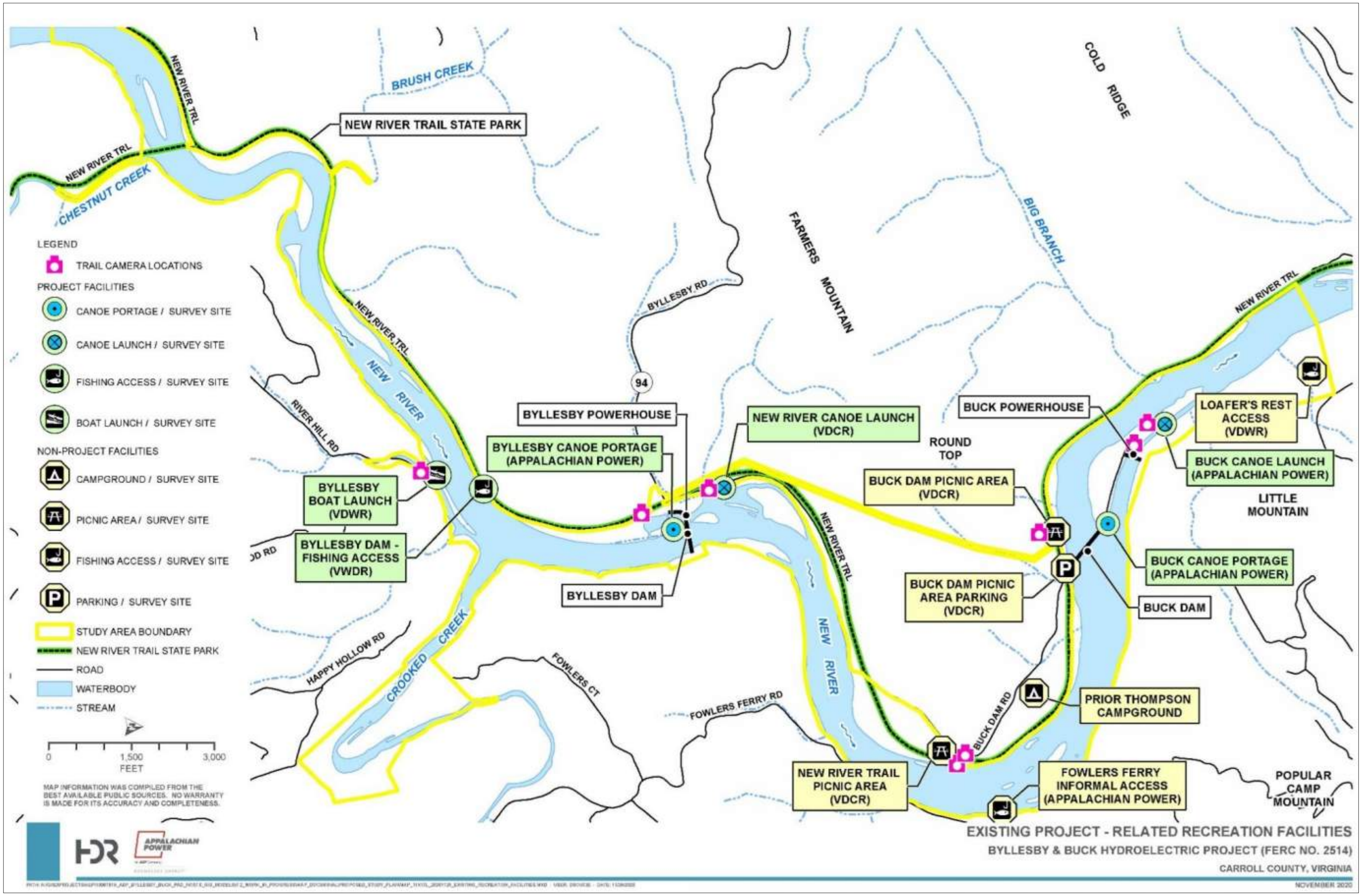

Figure 3-1. Recreational Facilities within the Study Area

4 Background and Existing Information

The Project is accessible by a remote secondary road and is located in a rural setting. The lands on both sides of the Project are steep, but there are some flat parcels along the river suitable for recreation. The former Norfolk & Western Railroad right-of-way extends along the western shore of the Project and has been converted to the New River Trail State Park, which is typically used for hiking, walking, biking and horseback riding. Most of the land to the west of the Project is owned by the USFS and consists of the George Washington and Jefferson National Forest. Recreation activities at the Project mostly consist of fishing, biking, hiking, and small craft boating. Section 5.8 of the Pre-Application Document (PAD) describes additional existing information about recreation facilities and opportunities in the Study Area.

In association with the previous relicensing effort, Appalachian, the Virginia Department of Wildlife Resources (VDWR) and the Virginia Department of Conservation and Recreation (VDCR) entered into a Memorandum of Understanding (MOU) signed on June 7, 1994 to provide public recreational access to various points along the New River (Appalachian 1994a). As documented in the Recreation Plan (Appalachian 1994b) required by Article 411 of the existing license, the Project supports five FERC-approved ("Project") public recreation facilities owned by Appalachian (Table 4-1). Two of these Project-related recreation facilities are solely operated by Appalachian and the remaining three sites are operated by VDCR or VDWR under the MOU and Revised Recreation Plan.

Additional ("Non-Project") public recreation facilities or informal access areas exist within the Study Area. Project and Non-Project recreation facilities and access areas within the Study Area that were identified as areas of interest by relicensing participants during the study planning phase of the ILP are listed and described in Table 4-1.

Table 4-1. Existing Recreation Facilities at Byllesby-Buck Project

Recreation Facility	Project or Non-Project Facility	Owner/Operator	Amenities	Relationship to Project Boundary
Byllesby Development				
Byllesby VDWR Boat Launch	Project Facility	Leased to and Operated by VDWR	Provides single-lane boat concrete boat launch with gravel parking area.	Within
Byllesby Canoe Portage	Project Facility	Owned and operated by Appalachian	Provides approximate 1,500-foot (ft) portage trail. Site consists of a hand-carry canoe take-out and an information trailhead kiosk for the New River Trail State Park.	Within
New River Canoe Launch	Project Facility	Leased to and Operated by VDCR	Provides small, gravel parking area with short trail leading to a hand-carry boat launch (also serves as put-in for the Byllesby Canoe Portage).	Adjacent to

Recreation Facility	Project or Non-Project Facility	Owner/Operator	Amenities	Relationship to Project Boundary
VWDR Fishing Site	Project Facility	Leased to and Operated by VDWR	Provides a stone embankment cleared for bank fishing and reservoir viewing. Approximately ¾ mile upstream of the Byllesby dam on the western shore.	Adjacent to
Buck Development				
Buck Dam Canoe Portage	Project Facility	Owned and operated by Appalachian	Provides crushed stone hand-carry take out and a hand-carry put in.	Within
Buck Dam Picnic Area	Non-Project Facility	Owned and operated by VDCR	Provides gravel parking for vehicles, information kiosk, and access to New River Trail. Also provides a picnic area with picnic table, trash can, portable restroom facility, and a hitching post for equestrian trail users.	Adjacent to
New River Trail Picnic Area	Non-Project Facility	Owned and operated by VDCR	Provides upper and lower recreation areas that include benches, picnic tables, bike rack, trash can, grill, and informal angling access to the Buck reservoir.	Adjacent to
Loafer's Rest	Non-Project Facility	Leased to and Operated by VDWR	Provides a parking area and walking trail to access the New River. Stakeholders are interested in angler access from the Loafer's Rest recreation area to the tailrace of Buck Dam.	Adjacent to

5 Methodology

In support of the FERC-approved Recreation Study, Appalachian and their consultants implemented a range of data collection techniques, including a Recreation Facility Inventory and Condition Assessment, a virtual meeting and in-person site visit with stakeholders, a recreation visitor use online survey, and trail camera installations. Data gathered from these methods collectively illustrate general trends of the Project.

The prevailing conditions from the COVID-19 pandemic throughout most of the study period and during the primary recreation season resulted in variations in recreation usage and ranged from periods of lockdown and relatively little non-essential travel to more typical summer recreation usage. Therefore, the recreation usage patterns of the last year (i.e., 2020) may be different from past years at the Project. Based on Appalachian's direct observations and anecdotal observations of recreation stakeholders in meetings, Appalachian believes that the 2020 study season represented high usage of the recreation facilities, as many nearby residents sought out recreation opportunities provided by the Project.

Table 5-1 provides an overview of the Project and Non-Project Recreation facilities studied in accordance with the FERC-approved Recreation Study plan.

Table 5-1. Project and Non-Project Recreation Facilities Studied

Recreation Facility	Recreation Facility Inventory and Condition Assessment	Site Visit with Stakeholders	Recreation Visitor Use Online Survey	Recreational Use Documentation - Trail Camera
Byllesby Development				
Byllesby VDWR Boat Launch	X	X	X	X
Byllesby Canoe Portage	X	X	X	X
New River Canoe Launch	X	X	X	X
VWDR Fishing Site	X			
Buck Development				
Buck Dam Picnic Area	X	X	X	X
New River Trail Picnic Area	X	X	X	X (Upper and Lower)
Buck Dam Canoe Portage	X	X	X	X
Loafer's Rest			X[1]	X (Buck tailrace)

[1] While Loafer's rest was not specifically identified in the list of recreation sites in the online survey, many stakeholder comments included discussion of this area; therefore, it was studied as part of the Visitor Use Online Survey.

5.1 Recreation Facility Inventory and Condition Assessment

Appalachian's sub-consultant (Land Planning Design Associates [LPDA]), conducted a Recreation Facility Inventory and Condition Assessment of seven sites, five of which are FERC-approved Project facilities (Table 4-1). LPDA staff conducted the site assessments on November 13, 2019 in association with a team Appalachian's consultant (HDR Engineering, Inc. [HDR]). LPDA recorded the following information for each recreational facility including:

- A description of the type and location of existing recreation facilities;
- The type of recreation provided (boat access, angler access, picnicking, etc.);
- Length and footing materials of any trails;
- Existing facilities, signage, and sanitation;
- The type of vehicular access and parking (if any);
- Suitability of facilities to provide recreational opportunities and access for persons with disabilities (i.e., compliance with current Americans with Disabilities Act (ADA) standards for accessible design); and
- Photographic documentation of recreation facilities and GPS location.

Additionally, a qualitative assessment of the condition of the recreation facilities was performed using a Facility Inventory and Condition Assessment Form. Using the Facility Inventory and Condition Assessment Form, the recreation amenities available at each facility were rated using the following criteria: (N) Needs replacement (broken or missing components, or non-functional); (R) Needs repair (structural damage or otherwise in obvious disrepair); (M) Needs maintenance (ongoing maintenance issue, primarily cleaning); and (G) Good condition (functional and well-maintained). If a facility is given a rating of “N”, “R”, or “M”, an explanation for the rating was provided.

5.2 Site Visit with Stakeholders to Discuss Existing and Future Recreational Opportunities

Appalachian convened a site visit with key relicensing stakeholders to discuss existing and future recreational opportunities at the Project on October 28, 2020. Prior to the site visit, Appalachian held a virtual meeting on October 21, 2020 with involved stakeholders to share preliminary recreation data.

5.3 Recreation Visitor Use Online Survey

HDR developed an online survey drawing from general concepts and guidance from the National Visitor Use Monitoring Handbook (USFS 2007) as well as from other FERC-approved relicensing studies for recreation visitor use surveys. The online survey was administered through the Project's relicensing website and offered respondents the opportunity to provide survey responses electronically from April through November 2020. Appalachian extended the online survey through the end of November 2020 (originally scheduled to end in October), at the request of stakeholders during the October 21, 2020 virtual meeting, to allow stakeholders additional time to respond. Stakeholders were able to provide a final distribution to remind users of the availability of the survey and the close of the survey period.

Appalachian posted signs at the Project and Non-Project recreation facilities (except the Byllesby VDWR Boat Launch) providing a brief description of the purpose and intent of the survey and the website address (Figure 5-1). This allowed respondents to complete a survey onsite, or later upon returning home from their visit, or without visiting the Project if the link was identified through other (electronic) communications. Appalachian also contacted the U.S. Fish and Wildlife Service (USFWS), Virginia Department of Environmental Quality (VDEQ), VDCR, VDWR, New River Conservancy, and Carroll County stakeholders at the beginning and end of the survey window to support distribution of the survey. Additionally, Appalachian notified relicensing participants that the online survey was available through the quarterly ILP study progress report. Notice of the survey was also posted on the Project's relicensing website and on a relevant social media outlet (ex: Claytor Lake Facebook page) maintained by Appalachian.

The online questionnaire was designed to collect information about:

- General user information;
- Resident/visitor;
- Purpose and duration of visit;
- Distance traveled;
- Day use/overnight lodging;
- History of visiting the site or area;
- Types of recreational activities respondents participated in during their visit, including primary and secondary recreation activities;
- Other recreational sites that respondents visited during their trip;
- General satisfaction with recreational opportunities, facilities, and the respondents overall visit and/or areas that need improvement;
- Effects of Project operations on recreation use and access; and
- Accessibility of facilities.

Figure 5-1. Recreation Use and Needs Survey Sign

5.4 Recreational Use Documentation

Appalachian documented usage of the recreational areas of interest through the installation of trail cameras. HDR deployed eight Browning Strike Force 2015 Edition HD Sub Micro Trail Game Cameras on October 15 and 16, 2019 at the locations listed in Table 5-2.

Table 5-2. Locations of Trail Cameras

Recreation Facility	Project or Non-Project Facility	Purpose	Number of Cameras
Byllesby VDWR Boat Launch (Camera 1)	Project Facility	Collect data on vehicles entering and exiting the parking area	1
Byllesby Canoe Portage (Camera 2)	Project Facility	Collect data on visitors utilizing New River Trail parking area and canoe portages	1
New River Canoe Launch (Camera 3)	Project Facility	Collect data on visitors utilizing canoe portage	1
Buck Dam Picnic Area (Camera 6)	Non-Project Facility	Collect data on visitors utilizing the picnic area, bike rack, and hitching post	1
New River Trail Picnic Area (Cameras 4 and 5)	Non-Project Facility	Collect data on visitors utilizing the picnic area, grill, informal angler location, and addition recreation features	2
Buck Dam Canoe Portage (Camera 8)	Project Facility	Collect data on visitors utilizing portage and tailrace	1

Recreation Facility	Project or Non-Project Facility	Purpose	Number of Cameras
Buck Tailrace – Fishing Access (Camera 7)	Non-Project Facility	Collect data on visitors utilizing Buck tailrace area for fishing; camera faces river-right to capture all types of recreation (of specific interest is fishing from Loafer's Rest)	1

The cameras were installed to collect site visitor data and document use patterns. When installed, the trail cameras were set to take photos when activated by motion. Before taking a second photo, the camera was set to wait a full minute, again requiring activation from motion. After the first trail camera data download in mid-November 2019, the settings of Camera 7 facing the Buck tailrace – Fishing Access (Loafer's Rest area of interest) were adjusted. This adjustment was necessary because discharge from the sluice adjacent to the powerhouse intakes repeatedly activated the motion sensor, potentially preventing the camera from capturing motion across the tailrace. The photo collection methodology for Camera 7 was thus revised to a video time lapse in which a photo was captured every 30 minutes; a daily video of the photos was created from compiling the lapsed images. Camera 7 also continued to be motion activated as well, although this did not occur often (and only from high waters) due to the lack of activity. All cameras recorded time, temperature, date, and vehicle usage.

6 Study Results

6.1 Recreation Facility Inventory and Condition Assessment

As stated in Section 5.1, LPDA performed a Recreation Facility Inventory and Condition Assessment to document usage conditions at seven existing Project and Non-Project related public recreation facilities (Table 4-1 and Table 5-1).

LPDA observed several common themes among the recreation facilities including lack of ADA accessibility, aging though functional furnishings, informally developed amenities, incomplete signage, and deferred maintenance. LPDA noted that the Project is set in scenic, natural surroundings and the historic dams provide cultural interest. LPDA recommended there is a high potential for increasing recreation value of the sites, both by improving the existing conditions and by developing related amenities.

The existing amenities and conditions for the recreation facilities assessed is summarized below. The Recreation Facility Inventory and Condition Assessment Report and corresponding maps are included in Attachment 1.

6.1.1 Byllesby VWDR Boat Launch (Project Facility)

Existing recreation amenities of the Byllesby VDWR Boat Launch include a 16-ft wide concrete boat ramp with a gentle slope, concrete walkway, crushed gravel parking area, 5-wheel stops, and signage. The Boat Ramp and other amenities are in good condition,

Potential enhancements identified for this site were as follows:

- Update and replace signage.

6.1.2 VDWR Fishing Site (Project Facility)

The VWDR Fishing Site was not included in the RSP but was evaluated since it is a Project facility as identified in the Recreation Plan (Article 411) (Appalachian 1994b).

Existing recreation amenities of the VDWR Fishing Site include a fire pit and grill, bench, lantern hook, and trash can. Access to the water is difficult with a very steep slope (too steep to launch a canoe). The trash can, bench, fire ring, lantern hook and grill are aged and there are no signs or maps at this facility. Parking for the fishing site is provided by the Byllesby Canoe Portage parking lot. The fishing site is accessed by the New River Trail and is 3,100 ft (0.59 miles) from the parking lot.

Potential enhancements identified for this site were as follows:

- Maintenance or replacement of amenities.
- Add signage.

6.1.3 Byllesby Canoe Portage (Project Facility)

Existing recreation amenities of the Byllesby Canoe Portage include a 1,235-ft-long (0.23 miles) portage path, a 12-space gravel parking area, large wetland area, and multiple signs. The portage take-out is poorly defined with limited amenities. The trash can is older but is being serviced and is lined. Signage is faded.

Potential enhancements identified for this site were as follows:

- Update and replace signage.

6.1.4 New River Canoe Launch (Project Facility)

Existing recreation amenities of the New River Canoe Launch include a 10-space gravel parking area, portage/no-fishing signs, a gate (dam maintenance access road) and a canoe portage in a relatively flat, sandy area where the water is shallow. A 125-ft-long portage trail connects the parking lot to the canoe portage. and the put-in location is 1,175 ft (0.22 miles) from the portage take-out above Byllesby dam. The signage at this facility is in good condition with adequate directional information.

No potential enhancements identified for this site.

6.1.5 New River Trail Picnic Area (Non-Project Facility)

The New River Trail Picnic Area has an upper area that includes a picnic table shelter, bike rack (up to four bikes), and hitching trail. The site primarily serves trail users, though there is an informal car pull-off and trail accessing the picnic area. The informal dirt trail is narrow and could be widened and surfaced, as could the informal parking area. The shelter is in good condition and is ADA accessible. The bike rack and hitching rail are in good condition.

The New River Trail Picnic Area also has a lower area which includes existing recreation amenities such as a trash can, barbeque grill, picnic table, bird nesting box, two lantern hooks, two fire rings, and three benches. The trash can is in good condition and is regularly serviced. One bench is missing a slat and the lantern hook is older but usable. The barbeque grill is severely corroded.

Potential enhancements identified for this site were as follows:

- Widen and surface informal dirt trail and informal parking area.
- Maintenance or replacement of amenities.

6.1.6 Buck Dam Picnic Area (Non-Project Facility)

Existing recreation amenities at the Buck Dam Picnic Area include a parking area with a trash can, kiosk with regulation signs and old machinery. The trash can is dented and aged, though usable and regularly serviced. From the parking area, there is a 650-ft-long crushed stone trail, a section of the New River Trail with No Trespassing Signs along the bank edge to a separate area that includes a picnic table shelter, bike rack, an accessible Porta Potty, and hitching rail. The picnic shelter is in good condition while the table is older but usable. Paint on the hitching rail and bike rack is chipped but the amenities are usable.

Potential enhancements identified for this site were as follows:

- Improved signage for educational and safety purposes.

6.1.7 Buck Dam Canoe Portage (Non-Project Facility)

Existing recreation amenities of the Buck Dam Canoe Portage includes a take-out above and a put-in below Buck Dam. The portage route between the take-out and put-in is via an asphalt maintenance road, gravel access road, and a gravel walking trail. The road surface is approximately 10 ft wide. The asphalt portion of the maintenance road is 820 ft long, the gravel portion is 570 ft long, and the walking trail is 50 ft long. The total portage route is 1,440 ft long. (0.27 miles). The gravel surface is rough and uneven, and the walking trail has not been graded or surfaced. There is an unlined trash can at the put-in. The signage is in good condition.

Potential enhancements identified for this site were as follows:

- Improved safety and regulatory signage are recommended at this site.

6.2 Site Visit with Stakeholders to Discuss Existing and Future Recreational Opportunities

Meeting notes documenting both the virtual meeting on October 21, 2020 and site visit on October 28, 2020 are included in Attachment 2. During the site visit, the Project and Non-Project recreation facilities visited by Appalachian, their consultants, and the stakeholders are noted in Table 5-1.

During these two meetings, an informal area known locally as Fowler's Ferry was identified as an area that agencies are potentially interested in developing for future recreational usage. Fowler's Ferry is located on river-right, upstream of Buck Dam (see Figure 3-1), off of Fowlers Ferry Road and provides informal recreation access for picnicking, camping, ATV, fishing, wading, and canoe/kayaking. This area was not specifically studied under other tasks for the Recreation Study. There are no formal recreation facilities at this site, but the VDWR has expressed interested in developing this area and controlling access from unauthorized users. Land in this area is owned by Appalachian but is not formally maintained.

6.3 Recreation Visitor Use Online Survey

The online survey provided a method for existing and potential recreation visitors to the Study Area to respond and provide feedback on recreation opportunities and [Project and Non-Project facilities] at the Project. From April 21, 2020 to December 1, 2020, Appalachian received 142 responses to the online survey. A high-level summary of all the recreation facility user responses is provided below:

- Eighty-four percent of the responses came from four recreation facilities: Byllesby Boat Launch (VDWR), Buck Dam Canoe Portage, New River Canoe Launch, and New River Trail Picnic Area, indicating these sites were the most frequently utilized by online survey participants.

- Forty-two percent of the survey respondents traveled from three nearby zip code areas, with 92 percent considering themselves to be regular visitors to the recreation facility (considered at least 3 or more times a year) and staying at the Project an average length of 5 hours per trip. Eighty-three percent of respondents did not stay overnight at the Project.

- Males made up 74 percent of the respondents, 49 percent were in their thirties and forties.
- Facility usage followed traditional seasonal recreation patterns with May, June, and July being the peak months (Figure 6-1).
- As shown in Table 6-1, fishing and canoe/kayaking were the most popular activities at the Project documented in the online survey.
- Visitors rated recreational facilities on the following metrics: accessibility, parking, crowding, safety, condition, availability, and overall experience. The sliding scale rating system indicated that visitors generally found the individual metrics and general overall experience "acceptable" (Figure 6-2). The only metric that was not rated highest in the acceptable category was the available facilities, which was rated neutral.

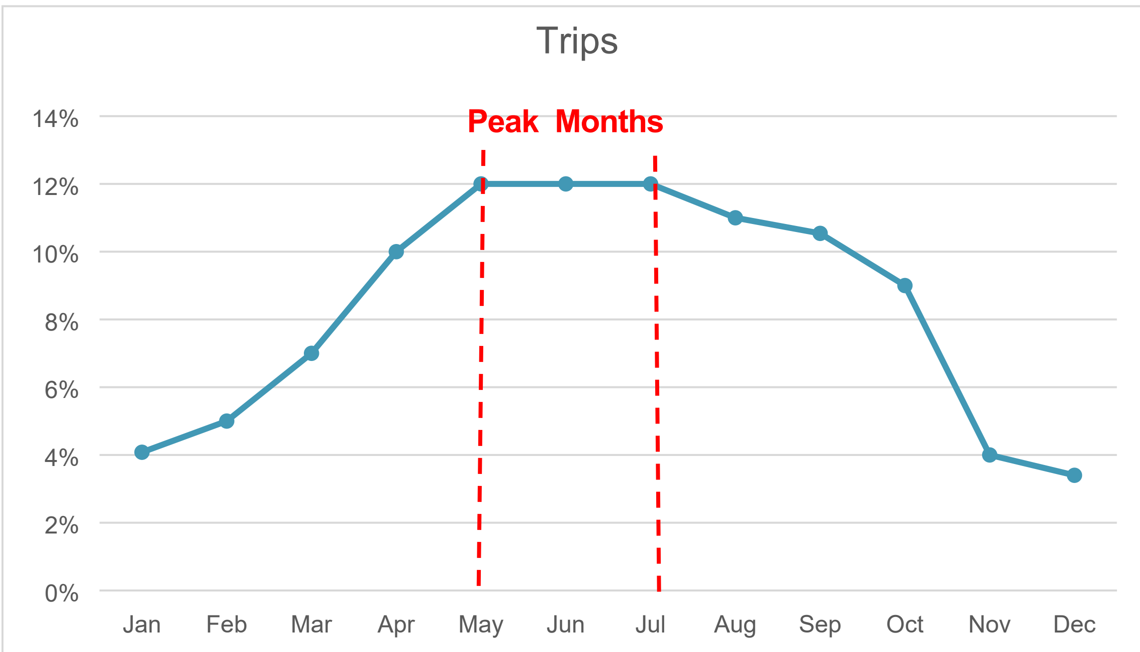

Figure 6-1. Monthly Recreation Activity for Project and Non-Project Facilities

Table 6-1. Online Survey Summary for Primary Recreation Activities at Project and Non-Project Facilities

Primary Activity	Use (%)
Fishing	48
Canoeing/kayaking	20
Sight-seeing	11
Biking	9
Picnicking	4
Hiking	2
Hunting	2
Wildlife Viewing	2
Swimming	1

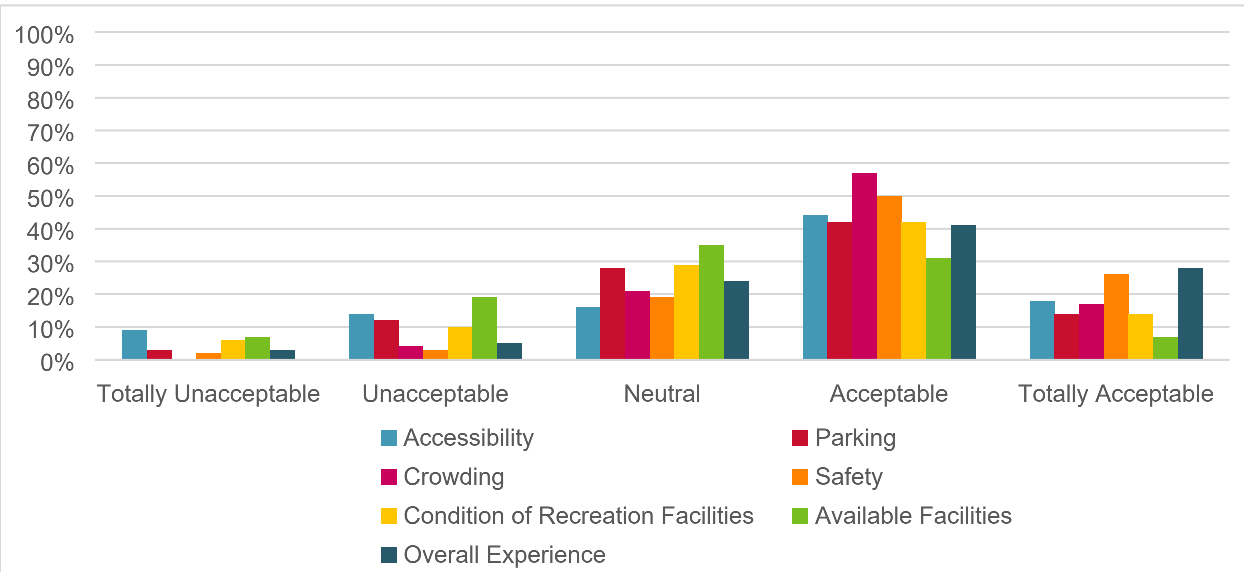

Figure 6-2. Online Survey Summary for Overall Rating on All Visits at Project and Non-Project Facilities

Facility-specific summaries and verbatim user comments from the online survey are included in Attachment 3.

The Thompson Campground located between Byllesby and Buck Dams was mentioned in the online survey comments frequently, however the VDCR explained during the recreation site visit that previous efforts (1990s and as recently as two years ago with an attempt to reach terms of a 99-year lease) by the VDCR to acquire the land from USFS were unsuccessful, reportedly due to unresolvable USFS interests pertaining to liability and insurance. This area is the most suitable area for a campground near the Project and has existing picnic areas, horse facilities, and general campground infrastructure. While there is still widespread interest in this development, the Project currently lacks an advocate at the federal level (legislative or agency). This area remains of interest to the VDCR and online survey users.

6.4 Recreational Use Documentation

As discussed in 5.4, HDR documented and reviewed over a full year of Project and Non-Project recreation facility usage with motion-activation trail cameras. Eight trail cameras were installed on October 15 and 16, 2019 and were removed on November 5, 2020[2]. During the trail camera component of the study, HDR downloaded data from the cameras on eight different occasions, capturing thousands of photos.

Review of the trail camera data indicates that the Study Area is well-used during the spring to fall months, which is attributed largely to the easy access along the entire left bank via the New River Trail. While some of the recreation facilities were used for their intended use, some were used differently than predicted, as further discussed below.

6.4.1 Project Facilities Trail Camera Assessment

The Project facilities most frequented by users are the Byllesby VDWR Boat Launch and the Byllesby Canoe Portage parking lot. These two Project facilities provide a range of recreation opportunities including boating, canoeing, fishing, walking, biking, and hiking. The Byllesby VWDR Boat Launch has the easiest boat access to the New River within the Study Area. Fishing is also popular along the shoreline at this facility.

As a note of clarification, the Byllesby Canoe Portage trail camera faced the associated parking lot and not the canoe take-out. HDR expected the parking lot would be used to transport canoes or kayaks after portaging, however this was not observed. The Byllesby Canoe Portage parking lot was largely used to access the New River Trail (including biking, hiking, and walking and dog walking).

The New River Canoe Launch is also a Project facility and was used as intended (canoe/kayak put-in), but more frequently used for bank fishing or relaxing along the sandy shore. This facility was not as popular as the Byllesby VDWR Boat Launch and the Byllesby Canoe Portage but generally had a consistent amount of foot traffic, especially during the warmer days.

The final Project facility assessed by the trail camera was the Buck Dam Canoe Put-In. This facility was seldomly used but when it was, it was used as a put-in or for bank fishing. Stakeholders noted during the October 28, 2020 site visit that users cross the Buck bypass to Mountain Island[3] to gain angler access further downstream. It is possible that use around this area is higher than observed on the trail cameras, but the Buck Dam Canoe Put-In itself was generally not used and the trail camera did not capture a high use. On approximately three occasions, the camera captured motorboats accessing the tailrace to fish.

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[2] Camera 1 and 8 did not collect data from July 28 through November 9, 2020 (equipment malfunction). Camera 5 did not collect data from May 27 through July 28 (theft). Camera 6 did not collect data from May 18 through July 28 (fallen tree).

[3] The Buck Dam Canoe Put-In is located on Mountain Island which is an island between the Buck powerhouse and the bypass (Figure 3-1).

6.4.2 Non-Project Facilities Trail Camera Assessment

Just upstream of the Buck Dam Canoe Put-In, HDR used a time lapse camera to record activity on the right bank of the tailrace. This area is referred to as Buck Dam – Fishing Access which is accessed from the VDWR's Loafer's Rest Non-Project facility. The general area of the Buck Dam – Fishing Access was understood by Appalachian to be of interest to the stakeholders during the development of the RSP; however the camera in this area recorded approximately two users during the entire survey window. At the October 28, 2020 site visit with the stakeholders, the VDWR noted that there is a No Trespassing sign (public access is prohibited proximate to the powerhouses and dams due to public safety and security concerns) and users are aware of this and avoid the area. Prior to the installation of the No Trespassing sign, this site was suggested to be popular for angler access.

The New River Trail Picnic Area is a Non-Project facility maintained and operated by the VDCR. The upper and lower access provides a wide range of recreational opportunities including picnicking, horseback riding, biking, walking (and dog walking), relaxing, grilling, fishing, observing wildlife and more. This area is accessed directly from the New River Trail and recorded consistent usage throughout the survey window, especially from spring to fall.

The final Non-Project recreation facility assessed with the trail cameras was the Buck Dam Picnic Area. This facility is just downstream of the New River Trail Picnic Area and is also on the New River Trail, therefore, the use was very similar and generally included picnicking, hiking, biking, horseback riding and walking (and dog-walking). This area has direct access from the New River Trail and saw consistent usage throughout the survey window especially from spring to fall.

6.4.3 Daily Counts

As a metric to provide specific user counts per day, HDR has chosen three representative spring, summer, and fall days over the weekend (Friday through Sunday), when recreation levels are typically higher[4]. FERC defines a recreation day as each visit by a person to a facility for recreational purposes during any portion of a 24-hour period. Table 6-2 provides a count of the number of vehicles or people observed on a given day (from dawn until dusk) as a method to quantify a recreation day through the three highest usage seasons.

At Cameras 1 and 2, the viewpoint of the camera showed mostly vehicles, and vehicles were counted in these instances as one count. For these two cameras, it is likely the recreation usage per person is higher than what is provided in Table 6-3. For the rest of the cameras (3 through 8), individual people were counted as one count. Table 6-2 also summarizes the primary activity(s) observed over the study period at each facility.

Attachment D provides a representative photo from each trail camera for each day denoted below. The date, time, and temperature are also provided in the information block at the bottom of each picture for each day.

[4] The authors of this report acknowledge that a holiday is typically also included for this type of analysis, but due to the loss of data explained in footnote 2, the dates selected here provide a more holistic summary of the usage.

Table 6-2. Trail Camera Primary Recreation and Usage Counts

Recreation Facility	Project or Non-Project Facility	Primary Recreation Activity(s) Observed	Representative Spring Count Sunday, May 10, 2020	Representative Summer Count Friday, July 24, 2020	Representative Fall Count Saturday, October 24, 2020	Additional Notes
Camera 1: Byllesby VWDR Boat Launch	Project Facility	Bank Fishing and Boating.	14 vehicles	16 vehicles	12 vehicles	Highest recreational usage noted at this facility over the trail camera study period.
Camera 2: Byllesby Canoe Portage	Project Facility	Parking lot used to walk, bike, or hike.	9 vehicles	6 vehicles	15 vehicles	No canoe portaging from the parking area was observed.
Camera 3: New River Canoe Launch	Project Facility	Bank Fishing.	10 people	2 people	4 people	Bank fishing was commonly seen, whereas the portage was seldom used.
Camera 4: New River Trail Picnic Area (Upper)	Non-Project Facility	Facilities (picnicking, bike rack, informal walking trail, and hitching post) enjoyed by New River trail users.	5 people	13 people	23 people	Usage Counts was calculated based on individual's using the recreation facilities, not only the New River Trail.
Camera 5: New River Trail Picnic Area (Lower)	Non-Project Facility	Bank Fishing and Observing/Relaxing.	6 people	7 people[1]	18 people	Frequently used to appreciate the New River from the New River Trail.
Camera 6: Buck Dam Picnic Area	Non-Project Facility	Facilities (picnicking, bike rack and hitching post) enjoyed by New River trail users.	6 people	7 people[1]	22 people	Usage Counts was calculated based on individual's using the recreation facilities, not only the New River Trail.
Camera 7: Buck Dam – Fishing Access (informal recreation facility)	Non-Project Facility	Bank Fishing and Canoe/Kayaking.	0 people	0 people	0 people	Two observed uses (fishing and observing) during the study, but overall, no primary recreation noted. High water from the trash gate restricts access to this area often.
Camera 8: Buck Dam Canoe Portage (Put-In)	Project Facility	None	0 people	0 people	0 people	Low overall usage of the recreation site.

6.4.4 Capacity

FERC defines peak weekend use as weekends when recreational use is at its peak for the season (i.e. July 4 weekend and other holiday weekends). On these instances, recreational use may exceed the capacity of the area to handle such use.

The Byllesby VDWR Boat Launch and the parking lot at the Byllesby Canoe Portage had the highest overall usage of the recreation facilities during the trail camera analysis. As provided in the Assessment Report (Attachment 1) the Byllesby VDWR boat launch has 18 parking spaces and 7 spaces for boat trailers. The Byllesby Canoe Portage parking area has 12 spaces. At these two facilities, there were approximately ten to fifteen days during peak weekends (e.g., holidays) or when weekend weather was optimal where the parking lot appeared to reach capacity. An example of Byllesby Canoe Portage parking area reaching the parking lot capacity is shown in Figure 6-3.

However, on non-peak weekends or a typical recreation day (i.e. non-holiday weekends or weekend's when weather was not optimal) these two facilities did not appear to reach parking capacity. The New River Canoe Launch also has a parking area; however, the viewpoint of the camera did not capture parking capacity, but instead the canoe put-in. Based on the generally lower recreational use of the canoe put-in, it is assumed the parking lot did not reach or exceed capacity. Lastly, the Buck Dam Picnic Area also has a parking lot; however, the viewpoint of the camera did not capture parking capacity, but instead the picnic area. Based on the remote location of the parking area and assumed access of the picnic area via the New River Trail it is also assumed that the parking lot generally did not reach or exceed capacity. The other facilities assessed by the trail cameras (i.e. the New River Trail Picnic Area, Buck Dam Fishing Access, and Buck Dam Canoe Portage Put-In) did not have an associated parking area but are accessed via the New River Trail or boat.

Based on the capacity assessed through the trail camera study the parking areas at the Project are sufficient to meet the current demand during a typical and peak recreation day.

Figure 6-3. Optimal Weather Weekend – Parking Capacity at Byllesby Canoe Portage

7 Summary and Discussion

The Recreation Study captured consistent recreation usage at most of the Project and Non-Project facilities, with usage peaking on the weekends, holidays, and warmer months, as anticipated. In general, the recreation facilities experienced similar types of recreational activities and consistent recreational usage over the study period, especially from May through October. The New River Trail provides a unique opportunity to access most of the recreation facilities in otherwise remote locations. The trail camera and online survey results indicated that fishing (and fishing via boating) and canoe/kayaking were the primary recreation activities at Project and Non-Project facilities. The Buck Dam Canoe Portage was the only Project recreation facility that saw very little recreation usage, likely because it is inaccessible except by canoe/kayak. The tailrace at Loafer's Rest is of interest to anglers but is often flooded by the trash gate; that camera station observed approximately two recreational users over the course of the trail camera study. The online survey resulted in positive feedback along with requests for more access and use of Loafer's Rest for fishing. Respondents also requested the reopening of the Thompson campground. The online survey respondents also reported a local interest in maintaining and improving the recreation facilities at the Project for the local economy.

Preliminary agency interests and recommendations to date are summarized in the meeting summaries in Attachment 2. At the October 28, 2020 site visit, improvements to the facilities were discussed. Global comments and recommendations were made for improved signage regarding intended use, restricted access areas (e.g. tailrace areas, dams), safety, and consistent FERC, regulatory, and identification signage. Upgrades and improvements at recreation facilities upstream of the Byllesby dam are limited due to localized flooding (Byllesby Boat Launch) and wetland impacts (Byllesby Canoe Portage). The stretch from Byllesby dam to Buck dam has more potential for facility improvements (New River Canoe Launch, New River Trail Picnic Area, and Buck Dam Picnic Area), and while these facilities do not have the highest usage (compared to the Byllesby Boat Launch and Byllesby Canoe Portage), they do have generally consistent usage due to access along the New River trail. The study results summarized in Section 6.0 do not directly support improvements to areas below Buck Dam to the Buck Dam Canoe Portage. However, at the October site visit, agencies did provide additional information about recreational use in this general area including the downstream Loafer's Rest Non-Project facility, which could provide improved angler access to the area below the Buck Dam.

HDR evaluated new and improved portage locations for both the Byllesby and Buck existing canoe portages, however due to undesirable terrain and wetland impacts, it is unlikely that a new portage at either location would provide better access.

Appalachian expects to further consult with stakeholders at the ISR meeting and in 2021 to evaluate and propose potential recreational enhancements at the Project.

8 Variances from FERC-Approved Study Plan

The Recreation Study was conducted in full conformance with the Commission's SPD.

9 Germane Correspondence and Consultation

Attachment 2 includes a list of correspondence between Appalachian, HDR and stakeholders (USFWS, VDWR, VDCR, Carroll County, and the New River Conservancy) with documentation from three key meetings:

- Recreation Study Update and Planning for Facilities Site Visit (October 2, 2020)
- Byllesby-Buck Recreation Study Update - Meeting Notes and Presentation (October 23, 2020)
- Byllesby-Buck Recreation Site Visit Meeting Summary (November 18, 2020)

10 References

Appalachian Power Company. 1994a. Revised Recreation Plan – Memorandum of Understanding. Byllesby-Buck Hydroelectric Project, FERC No. 2514-003, Virginia. June 7, 1994.

Appalachian Power Company. 1994b. Revised Recreation Plan, Byllesby-Buck Hydroelectric Project, FERC No. 2514-003, Virginia. August 30, 1994.

U.S. Forest Service (USFS). 2007. National Visitor Use Monitoring Handbook. National Visitor Use Monitoring Program, U.S. Forest Service, Washington, D.C

Attachment 1

Attachment 1 – Recreation Facility Inventory and Conditions Report

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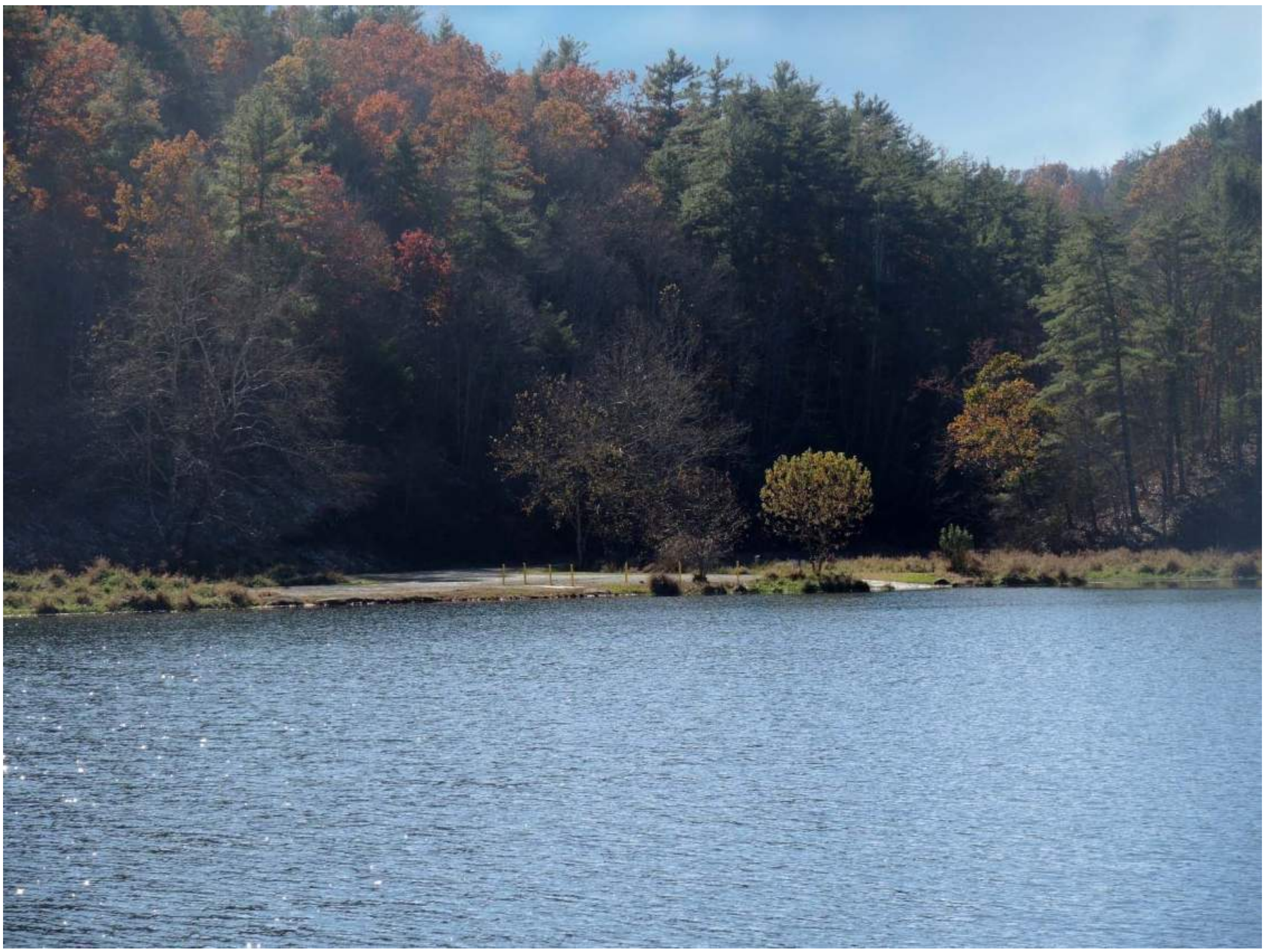
Document Accession #: 20210119-5057 Filed Date: 01/19/2021

Byllesby-Buck Hydroelectric Project

Carroll County, VA

Recreation Facility Inventory and Condition Assessment

Performed on November 13, 2019

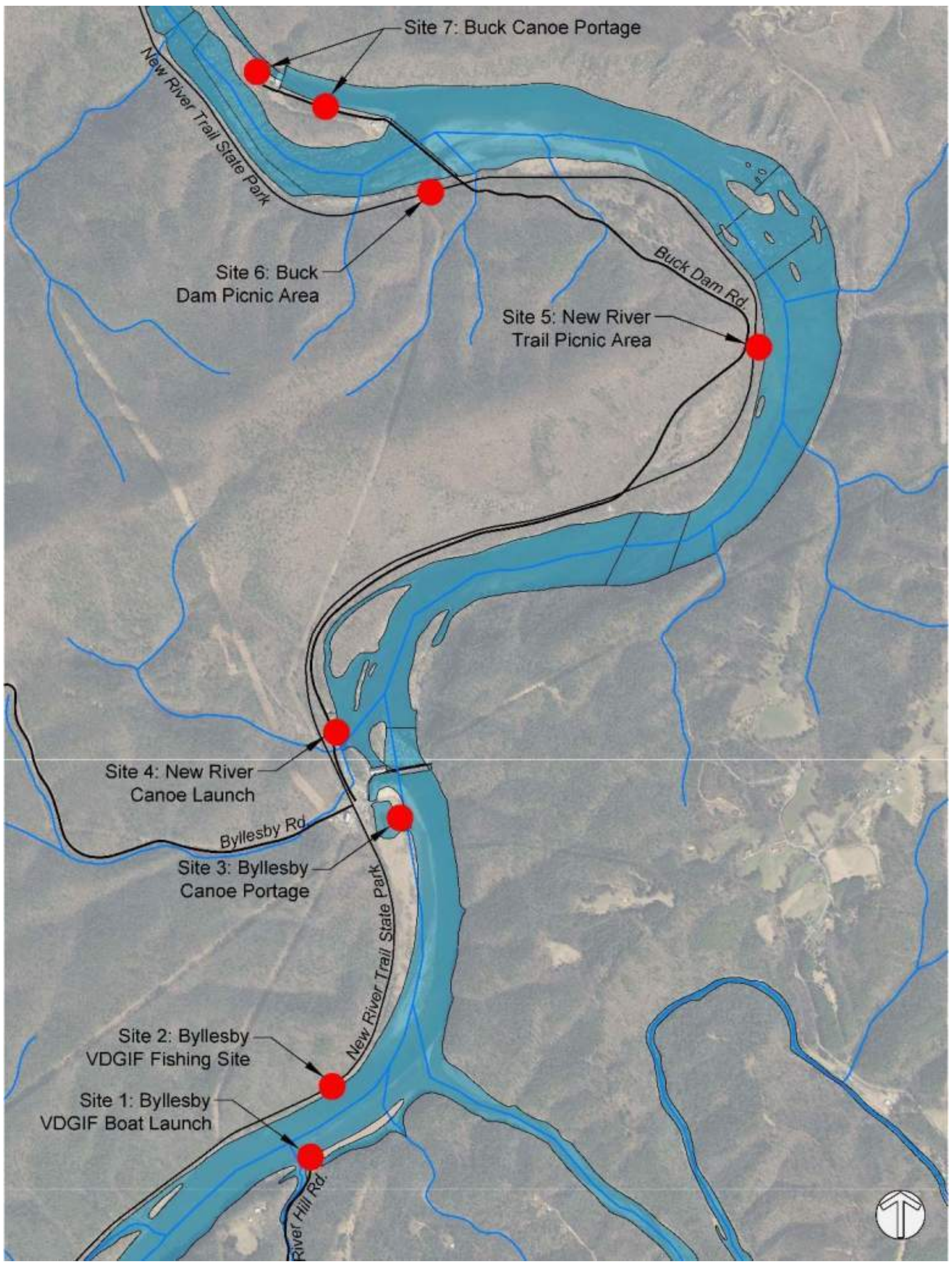


LPDA
LANDSCAPE ARCHITECTURE
LAND PLANNING

Summary:

LPDA conducted a recreation facility inventory and condition assessment of existing recreation facilities associated with the Byllesby-Buck Hydroelectric Project (FERC No. 2514-186) in support of the project's relicensing process. Condition assessment reports and maps for each site are included in this report.

LPDA observed several common themes between the sites. They include lack of ADA accessibility, aging though functional furnishings, informally developed amenities, incomplete and/or scattered signage, and deferred maintenance. The area is set in beautiful natural surroundings and the historic dams provide cultural interest. There is high potential for increasing the recreational value of the sites, both by improving the existing conditions and by developing related amenities like trails, boardwalks, fishing piers, and interpretive signage.



Area Map

Methodology

LPDA conducted a recreation site inventory and conditions assessment of seven sites total, six related to the Byllesby-Buck Hydroelectric project: the Byllesby VDGIF Boat Launch, Byllesby Canoe Portage, New River Canoe Launch, New River Trail Picnic Area, Buck Dam Picnic Area, and Buck Canoe Portage. LPDA evaluated an additional recreation site in the vicinity of the Byllesby Canoe Portage, the Byllesby VDGIF Fishing Site. LPDA staff conducted the site assessments on November 13, 2019 is association with a team from HDR. LPDA evaluated the type and condition of all amenities at each site, including parking, furnishings, access, and signage. LPDA also evaluated the suitability of facilities to provide recreational opportunities and access for persons with disabilities. Where appropriate, LPDA noted opportunities for improvements to existing facilities and opportunities to develop new amenities. LPDA evaluated the inventory and condition of amenities at each site using conditions evaluation forms, photo-documentation, and noted amenity location on GIS developed field maps. LPDA cross referenced the gathered data with georeferenced aerial imagery to develop a conditions assessment report and site layout map for each of the seven sites. The maps are sufficient for site inventory and planning. The sites will need to be surveyed in advance of developing construction plans for site improvement and development.

Site Conditions Assessments

The following are the assessment reports for the seven recreational sites.

RECREATION FACILITY INVENTORY AND CONDITION ASSESSMENT
Byllesby-Buck Hydroelectric Project (FERC No. 2514)

Location:	**Site 1: Byllesby VDGIF Boat Launch**		
Date:	**11/13/2019, 8:00 am**	**Surveyor:**	**Tristan Cleveland**
Photo Number(s):			**Map Sheet 1**

Type of Amenity	#	ADA	Condition	Notes
Boat Launch Ramp/Lane	1	no	N / R / M / G	16-ft wide concrete ramp with gentle slope. Can be used by canoe and kayak as well as boats.
Portage (put-in/take-out)	0		N / R / M / G	
Portage Trail/Walking Trail (include length and footing materials)	0		N / R / M / G	
Picnic Table	0		N / R / M / G	
Trash Receptacles	0		N / R / M / G	
Other			N / R / M / G	
Other			N / R / M / G	
Other			N / R / M / G	

PARKING		Condition
	Total Spaces: ___18__ Standard: __11___ ADA: __0___ Double (trailer): ___7__ Other: _____	
	Surface Type: *Asphalt* *Concrete* *Gravel* *Other:*___________ Edges are soft. Additional wheel stops are needed.	N / R / M / G

Signs	#	Size	Material	Condition	Comments
FERC Project	0		wood / metal / other	N / R / M / G	
Facility ID	0		wood / metal / other	N / R / M / G	
Regulations	4	36"x18" (2) 18"x12" (2)	wood / metal / other	N / R / M / G	A facility I.D. sign should be placed on the site. The red and the brown regulations signs and the no vehicles sign are damaged. All signs should be collected into a kiosk.
Directional	0		wood / metal / other	N / R / M / G	The only wayfinding sign directing visitors to the site is one sign at the intersection of Hebron Road and Glendale Road. Need more wayfinding signs along Hebron Road directing visitors to the site.
Interpretive	0		wood / metal / other	N / R / M / G	

N - Needs replacement (broken or missing components, or non-functional)
R - Needs repair (structural damage or otherwise in obvious disrepair)
M - Needs maintenance (ongoing maintenance issue, primarily cleaning)
G - Good condition (functional and well-maintained)
If a facility is given a rating of "N", "R", or "M", provide specific details.

ADDITIONAL COMMENTS/NOTES: *Note the age of the facilities (if known) as well as any signs of overuse.*
With birds, beavers and wildlife habitat next to the site, there is opportunity to include a walking trail with interpretive signage. Opportunity exists for an ADA accessible fishing pier as well. Recommend adding a picnic table and several trash receptacles, provided that the trash will be serviced regularly. If trash will not be serviced, it should not be added as receptacles will overflow, and signs instructing users to pack out their trash should be placed instead.

Site Photos:

Photo 1-1: Entrance into parking lot

Photo 1-2: Boat Ramp

Photo 1-3: Parking along entrance into the site. There are currently five wheel stops; one more should be added. Possible trailhead access for interpretive trail.

Photo 1-4: Soft dirt edge along parking lot

Photo 1-5: Damaged Sign

Photo 1-6: Damaged Sign

Photo 1-7: Damaged Sign

RECREATION FACILITY INVENTORY AND CONDITION ASSESSMENT
Byllesby-Buck Hydroelectric Project (FERC No. 2514)

Location:	**Site 2: Byllesby VDGIF Fishing Site**		
Date:	**11/13/2019, 11:15 am**	**Surveyor:**	**Tristan Cleveland**
Photo Number(s):			**Map Sheet 2**

Type of Amenity	#	ADA	Condition	Notes
Boat Launch Ramp/Lane	0		N / R / M / G	
~~Portage (put-in/take-out)~~ Water Access	1	no	N / R / M / G	Appears to be an informal fishing area. The riverbank to access the water is very steep – too steep to launch a canoe.
Portage Trail/Walking Trail (include length and footing materials)	0		N / R / M / G	
Picnic Table	0		N / R / M / G	
Trash Receptacles	1	no	N / R / M / G	Trash can is old and dented, but has a liner and is being serviced.
Bench	1		N / R / M / G	Old, rough hand-built wood bench without a back.
Fire ring with grill	1		N / R / M / G	Fire ring and grill are old and outdated.
Lantern hook	1		N / R / M / G	Lantern hook is old and has chipped, peeling paint.

PARKING	Total Spaces: _n/a_ Standard: _____ ADA: _____ Double (trailer): _____ Other: _____ Parking served by Byllesby trailhead	Condition
	Surface Type: *Asphalt* *Concrete* *Gravel* *Other:___________*	N / R / M / G

Signs	#	Size	Material	Condition	Comments
FERC Project	0		wood / metal / other	N / R / M / G	
Facility ID	0		wood / metal / other	N / R / M / G	A sign identifying the fishing site is needed.
Regulations	0		wood / metal / other	N / R / M / G	A sign with fishing and general site use regulations should be posted on the site.
Directional	0		wood / metal / other	N / R / M / G	
Interpretive	0		wood / metal / other	N / R / M / G	

N - Needs replacement (broken or missing components, or non-functional)
R - Needs repair (structural damage or otherwise in obvious disrepair)
M - Needs maintenance (ongoing maintenance issue, primarily cleaning)
G - Good condition (functional and well-maintained)
If a facility is given a rating of "N", "R", or "M", provide specific details.

ADDITIONAL COMMENTS/NOTES: *Note the age of the facilities (if known) as well as any signs of overuse.*
The site is accessed by walking upriver on the NR Trail and is approximately half a mile from the Byllesby parking lot. There is no signage or maps at the trailhead informing users of the site's existence.
Note: The Fishing Trail was not part of the relicensing Recreation Study Plan, but was evaluated due to its proximity to other recreation sites and the potential to develop the site as a recreational amenity.

Site Photos:

Photo 2-1: Fishing site with fire ring/grill, bench and lantern hook.

Photo 2-2: Looking across the river to Byllesby boat launch.

Photo 2-3: Trash can across the trail from the fishing site. Can has a dent at the bottom.

Photo 2-4: Rough wood bench and lantern hook with chipping paint.

RECREATION FACILITY INVENTORY AND CONDITION ASSESSMENT
Byllesby-Buck Hydroelectric Project (FERC No. 2514)

Location:	**Site 3: Byllesby Canoe Portage**		
Date:	**11/13/2019, 10:00 am**	**Surveyor:**	**Tristan Cleveland**
Photo Number(s):			**Map Sheet 3**

Type of Amenity	#	ADA	Condition	Notes
Boat Launch Ramp/Lane	0		N / R / M / G	
Portage (put-in/take-out)	1	no	N / R / M / G	Portage take-out site is poorly defined with limited amenities
Portage Trail/Walking Trail (include length and footing materials)	1	no	N / R / M / G	The trail to the portage/river access is gravel and fades out with vegetation growing over it for the last section leading to the river. Trail is in poor condition and there is limited signage. Trail length from the river access gate to the portage is 775 ft. It is 460 ft from the parking lot to the river access gate.
Picnic Table	0		N / R / M / G	
Trash Receptacles	1	no	N / R / M / G	Trash can is old and has holes in it, but has a liner and is being serviced.
Other			N / R / M / G	
Other			N / R / M / G	
Other			N / R / M / G	

PARKING	Total Spaces: 12 Standard: 12 ADA: 0 Double (trailer): 0 Other: _____	Condition
	Surface Type: *Asphalt* *Concrete* *Gravel* *Other:* Edges could be graveled. Bollards are aging but in decent condition.	N / R / M / G

Signs	#	Size	Material	Condition	Comments
FERC Project	1	24"x36"	wood / metal / other	N / R / M / G	FERC sign is at portage gate.
Facility ID	3	18"x24" 12"x18"	wood / metal / other	N / R / M / G	The free-standing red and white Byllesby Reservoir sign is very dirty and should be cleaned or replaced. At the portage gate is a sign for the hydroelectric plant. There is a facility I.D. sign on the water for boats as well.
Regulations	3	18"x24" (3)	wood / metal / other	N / R / M / G	
Directional	5	12"x18" 18"x24" 24"x24" (2) 48"x48"	wood / metal / other	N / R / M / G	The portage sign at the gate is very small and cracked/peeling and the dam ahead sign is faded. The portage directional sign along the trail and river is very small and attached to the bottom of a large post. Additional and larger directional/wayfinding signs are needed.
Interpretive	0		wood / metal / other	N / R / M / G	
Other	2	30"x30" 18"x24"	wood / metal / other	N / R / M / G	At the parking lot there is a wood kiosk containing a sign for New River Trail State Park and several small informational posts. There is a sign along the trail and river bank the reads "Danger – Dam Ahead." The sign is orientated toward the water to warn boats that they are approaching the dam. The sign is very faded and should be replaced.

N - Needs replacement (broken or missing components, or non-functional)
R - Needs repair (structural damage or otherwise in obvious disrepair)
M - Needs maintenance (ongoing maintenance issue, primarily cleaning)
G - Good condition (functional and well-maintained)
If a facility is given a rating of "N", "R", or "M", provide specific details.

ADDITIONAL COMMENTS/NOTES: *Note the age of the facilities (if known) as well as any signs of overuse.*
There is nice wetland area along the river, making a good opportunity for a boardwalk with interpretive signage.

Site Photos:

Photo 3-1: Parking Lot and portage sign

Photo 3-2: Kiosk with New River Trail Sate Park sign and informational posts. The Byllesby Reservoir sign is very dirty.

Photo 3-3: Dirty sign

Photo 3-4: Trash can with holes and old wood post

Photo 3-5: Gate to canoe portage with FERC, regulatory, and directional signage.

Photo 3-6: Portage sign on gate is very small and cracking/peeling

Photo 3-7: Portage sign along trail and river is small, does not fit posts and needs replaced


Photo 3-8: Trail leading from gate toward the river and portage

Photo 3-9: Trail following the river leading to the portage

Photo 3-10: Looking back toward Byllesby Dam. The dam ahead warning sign is very faded and the trail has grass growing in the center.

Photo 3-11: Section of trail near the portage take-out is grown over with vegetation and needs to be resurfaced to provide sufficient walking surface and to clarify trail route.

Photo 3-12: Canoe portage/river access and sign for the portage path. Portage take-out has no supporting infrastructure and the site is poorly maintained.

RECREATION FACILITY INVENTORY AND CONDITION ASSESSMENT
Byllesby-Buck Hydroelectric Project (FERC No. 2514)

Location:	**Site 4: New River Canoe Launch**		
Date:	**11/13/2019, 2:30 pm**	**Surveyor:**	**Tristan Cleveland**
Photo Number(s):			**Map Sheet 4**

Type of Amenity	#	ADA	Condition	Notes
Boat Launch Ramp/Lane	0		N / R / M / G	
Portage (put-in/take-out)	1	no	N / R / M / G	Portage is a relatively flat, sandy area. Water is shallow. Put-in has no improvements.
Portage Trail/Walking Trail (include length and footing materials)	1	no	N / R / M / G	Short gravel road leads from the parking area down the hill to the portage. It is 125 ft. from the gate at the dam maintenance road. It is 1,175 ft from the portage take-out gate to the portage put-in gate.
Picnic Table	0		N / R / M / G	
Trash Receptacles	0		N / R / M / G	
Other			N / R / M / G	
Other			N / R / M / G	
Other			N / R / M / G	

PARKING	Total Spaces: 10 Standard: 10 ADA: 0 Double (trailer): 0 Other: No marked parking spaces	Condition
	Surface Type: *Asphalt* *Concrete* *Gravel* *Other:* There is a flat area adjoining the parking area along the road that - could potentially be surfaced and used for additional parking.	N / R / M / G

Signs	#	Size	Material	Condition	Comments
FERC Project	0		wood / metal / other	N / R / M / G	
Facility ID	1	24"x48"	wood / metal / other	N / R / M / G	Portage sign at the parking area with arrow pointing down the gravel road to the portage. (also serves as a directional sign to the portage)
Regulations	2	10"x12" (2)	wood / metal / other	N / R / M / G	No Fishing and No Trespassing signs nailed to tree.
Directional	0		wood / metal / other	N / R / M / G	The portage sign at the parking lot has an arrow pointing down the gravel road to the portage.
Interpretive	0		wood / metal / other	N / R / M / G	

N - Needs replacement (broken or missing components, or non-functional)
R - Needs repair (structural damage or otherwise in obvious disrepair)
M - Needs maintenance (ongoing maintenance issue, primarily cleaning)
G - Good condition (functional and well-maintained)
If a facility is given a rating of "N", "R", or "M", provide specific details.

ADDITIONAL COMMENTS/NOTES: *Note the age of the facilities (if known) as well as any signs of overuse.*
Portage put-in is informal, but functional. Proximity of parking to the put-in and arrangement of put-in site makes this portage site comfortable to use.

Site Photos:

Photo 4-1: Parking lot and portage sign


Photo 4-2: Flat area adjacent to road and parking lot that could potentially be graveled and used for additional parking

Photo 4-3: Canoe portage put-in and maintenance road accessing it from the parking area

Photo 4-4: Canoe portage put-in

Location:	Site 5: New River Trail Picnic Area		
Date:	11/13/2019, 2:00 pm	Surveyor:	Tristan Cleveland
Photo Number(s):			Map Sheet 5

Type of Amenity	#	ADA	Condition	Notes
Boat Launch Ramp/Lane	0		N / R / M / G	
Portage (put-in/take-out)	0		N / R / M / G	
Portage Trail/Walking Trail (include length and footing materials)	1	no	N / R / M / G	Narrow dirt path leads from the road down to the picnic area. The path should be widened and surfaced to make it more defined and walkable. Ideally reroute the path so it is ADA accessible.
Picnic Table	2	1	N / R / M / G	The upper picnic table is under a small shelter. The shelter is in good condition; the table is ADA accessible and has chipped paint on the metal legs but is otherwise fine. The lower table has some wear but is still usable.
Trash Receptacles	1		N / R / M / G	Old metal trash can in good condition except for several holes in the side. Has a liner and is being serviced.
Bike Rack	1		N / R / M / G	Parks four bikes and recently painted.
Hitching Rail	1		N / R / M / G	Recently painted
Benches	3		N / R / M / G	One bench has a missing slat
Lantern Hooks	2		N / R / M / G	Old with chipping paint, but usable
Fire ring with grill	2		N / R / M / G	
BBQ Grill	1		N / R / M / G	Grill bottom is rusted out. Grill is unusable and needs to be replaced.

PARKING	Total Spaces: 0 Standard: 0 ADA: 0 Double (trailer): 0 Other: Can park two cars in informal pull-off along road	Condition
	Surface Type: *Asphalt* *Concrete* *Gravel* *Other:*	N / R / M / G

Signs	#	Size	Material	Condition	Comments
FERC Project	0		wood / metal / other	N / R / M / G	
Facility ID	0		wood / metal / other	N / R / M / G	A sign should be placed along the road at the pull-off area identifying the picnic area below.
Regulations	0		wood / metal / other	N / R / M / G	A sign with fishing regulations and general site use rules should be posted within the picnic site.
Directional	0		wood / metal / other	N / R / M / G	The picnic area I.D. sign should point to the path the leads down to the picnic area.
Interpretive	0		wood / metal / other	N / R / M / G	
Other	3	6"x6" 3"x4" 8"x10"	wood / metal / other	N / R / M / G	There is an emergency contact sign and a dedication plaque attached to the picnic shelter post and a bear warning sign on the picnic table under the shelter.

N - Needs replacement (broken or missing components, or non-functional)
R - Needs repair (structural damage or otherwise in obvious disrepair)
M - Needs maintenance (ongoing maintenance issue, primarily cleaning)
G - Good condition (functional and well-maintained)
If a facility is given a rating of "N", "R", or "M", provide specific details.

ADDITIONAL COMMENTS/NOTES: *Note the age of the facilities (if known) as well as any signs of overuse.*
Lower picnic area has cleared bank for fishing access and a shallow slope with shallow water. Could possibly be used for wading. There is a bird nesting box near the riverbank at the edge of the lower picnic area.

Site Photos:

Photo 5-1: Informal parking pull-off and path leading down to picnic area

Photo 5-2: Picnic shelter, bike rack and hitching rail

Photo 5-3: Path from picnic shelter down to lower picnic area and river

Photo 5-4: Lower picnic area

Photo 5-5: Benches, fire rings and lantern hooks along the riverbank.

Photo 5-6: BBQ grill with rusted out bottom

Photo 5-7: Trash can with holes in the side

Photo 5-8: Bird nesting box

Photo 5-9: Bench with missing slat

Photo 5-10: Steep path leading from picnic area back up to road

Location:	**Site 6: Buck Dam Picnic Area**		
Date:	**11/13/2019, 1:15 pm**	**Surveyor:**	**Tristan Cleveland**
Photo Number(s):			**Map Sheet 6**

Type of Amenity	#	ADA	Condition	Notes
Boat Launch Ramp/Lane	0		N / R / M / G	
Portage (put-in/take-out)	0		N / R / M / G	
Portage Trail/Walking Trail (include length and footing materials)	1	yes	N / R / M / G	New River Trail State Park leads from the parking area to the porta toilet and picnic shelter. Distance is 650 ft and the surface is crushed stone.
Picnic Table	1	no	N / R / M / G	Picnic table under a small shelter. The shelter is in good condition. The table is old but usable.
Trash Receptacles	1		N / R / M / G	Old metal trash can with minor dents in the side and chipped/faded paint on the lid. Has a liner and is being serviced.
Porta Potty	1	yes	N / R / M / G	Located along the gravel road by the picnic shelter. Has a screening panel.
Hitching Rail	1		N / R / M / G	Has faded paint and a chipped post, but is usable.
Bike Rack	1		N / R / M / G	Old rack with chipped paint, but it usable. Parks four bikes.

PARKING	Total Spaces: 5 Standard: 5 ADA: 0 Double (trailer): 0 Other:	**Condition**
	Surface Type: *Asphalt* *Concrete* *Gravel* *Other:*	N / R / M / G

Signs	#	Size	Material	Condition	Comments
FERC Project	0		wood / metal / other	N / R / M / G	
Facility ID	1	18"x24"	wood / metal / other	N / R / M / G	Sign identifies the Byllesby/Buck Hydroelectric Plant but not the picnic area. There should be a sign at the parking lot identifying and directing visitors to the picnic area and another identification sign at the picnic area as well.
Regulations	5	24"x24" 18"x24" (2) 12"x18" (2)	wood / metal / other	N / R / M / G	The no trespassing sign is very faded and unreadable. The "do not block gate" sign is faded and chipped and the "park at your own risk" sign has small dents. All other signs are in good condition.
Directional	0		wood / metal / other	N / R / M / G	A sign at the parking area is needed directing visitors to the picnic area down the trail and stating how far it is.
Interpretive	0		wood / metal / other	N / R / M / G	Interpretive signage could be added for the dam, river, and the metal machinery piece.
Other	4	30"x30" 12"x18" 10"x8" 6"x6"	wood / metal / other	N / R / M / G	Kiosk at parking area with a sign for New River Trail State Park, a bear warning sign, and several informational posts. There is a bear warning sign on the picnic table and an emergency contact sign and dedication plaque on the picnic shelter.

N - Needs replacement (broken or missing components, or non-functional)
R - Needs repair (structural damage or otherwise in obvious disrepair)
M - Needs maintenance (ongoing maintenance issue, primarily cleaning)
G - Good condition (functional and well-maintained)
If a facility is given a rating of "N", "R", or "M", provide specific details.

ADDITIONAL COMMENTS/NOTES: *Note the age of the facilities (if known) as well as any signs of overuse.*

Site Photos:

Photo 6-1: Parking lot at the dam

Photo 6-2: Dam gate with regulatory signs

Photo 6-3: Kiosk at parking area displays New River Trail State Park map and posted regulations


Photo 6-4: Old piece of machinery

Photo 6-5: Trash can at parking lot with dents and faded lid

Photo 6-6: Faded regulations sign

Photo 6-7: New River Trail State Park leading from parking area to picnic shelter

Photo 6-8: Picnic shelter with bike rack and hitching post

Photo 6-9: Portable toilet near picnic shelter

Photo 6-10: Hitching rail with chipped post and faded paint

RECREATION FACILITY INVENTORY AND CONDITION ASSESSMENT
Byllesby-Buck Hydroelectric Project (FERC No. 2514)

Location:	**Site 7: Buck Canoe Portage**		
Date:	**11/13/2019, 11:45 am**	**Surveyor:**	**Tristan Cleveland**
Photo Number(s):			**Map Sheets 7, 8, 9**

Type of Amenity	#	ADA	Condition	Notes
Upper Portage (take out)	1	no	N / R / M / G	Takeout has been improved recently with new sign, graded access, and aggregate surfacing.
Lower Portage (put-in)	1	no	N / R / M / G	Steep and rocky with limited access, water is deep.
Portage Trail/Walking Trail (include length and footing materials)	1	no	N / R / M / G	The portage route between the take-out and put-in sites is via an asphalt maintenance road, gravel access road, and an informal gravel walking trail. The road surface is approximately 10 ft wide. The route on asphalt is 820 ft, the route on the gravel road is 570 ft, and the walking trail is 50'. The total portage route is 1,440 ft. (0.27 miles). The gravel surface is rough and uneven, and the walking trail has not been graded or surfaced.
Picnic Table	0		N / R / M / G	
Trash Receptacles	1		N / R / M / G	Trash can at the lower portage put in is an old rusted 55-gallon drum tied to a tree. There is a lid but no liner. Trash can is used; unsure if it is being serviced.
Other			N / R / M / G	
Other			N / R / M / G	
Other			N / R / M / G	

PARKING	Total Spaces: 0 Standard: 0 ADA: 0 Double (trailer): 0 Other: Public vehicular access is not available at this portage.	Condition
	Surface Type: *Asphalt* *Concrete* *Gravel* *Other:*	N / R / M / G

Signs	#	Size	Material	Condition	Comments
FERC Project	0		wood / metal / other	N / R / M / G	
Facility ID	1	24"x48"	wood / metal / other	N / R / M / G	Sign at the upper portage has some minor dents but is otherwise in good condition. There needs to be a sign identifying the lower portage put-in point.
Regulations	0		wood / metal / other	N / R / M / G	
Directional	3	20"x20" 48"x48" (2)	wood / metal / other	N / R / M / G	20"x20" portage 500 ft sign has peeling lettering and the length is wrong (620 ft, not 500 ft). There is a 48"x48" sign just past the powerhouse directing users to the lower portage path and another 48"x48" sign across the river that says "Portage left bank" directing boats to the portage downriver.
Interpretive	0		wood / metal / other	N / R / M / G	
Other	1	18"x24"	wood / metal / other	N / R / M / G	There is an ID sign on the gate at the powerhouse for Byllesby/Buck Hydroelectric Plant. The sign is in good condition except the emergency phone number is faded/covered up and unreadable.

N - Needs replacement (broken or missing components, or non-functional)
R - Needs repair (structural damage or otherwise in obvious disrepair)
M - Needs maintenance (ongoing maintenance issue, primarily cleaning)
G - Good condition (functional and well-maintained)
If a facility is given a rating of "N", "R", or "M", provide specific details.

ADDITIONAL COMMENTS/NOTES: *Note the age of the facilities (if known) as well as any signs of overuse.*
Portage is open to the public by water access only. No public parking is available, which limits the usability of the facility. Note that water elevation was low during site visit.

Site Photos:

Photo 7-1: Upper canoe portage take-out. Note that water elevation was low when picture was taken, so the put-out length is not usually this long.


Photo 7-2: Upper canoe portage take-out/water access

Photo 7-3: Sign at upper portage take-out has minor dents

Photo 7-4: Directional sign for lower portage has peeling letters and advertises incorrect distance

Photo 7-5: Non-readable phone number

Photo 7-6: Gravel road/trail leading to the lower portage put-in

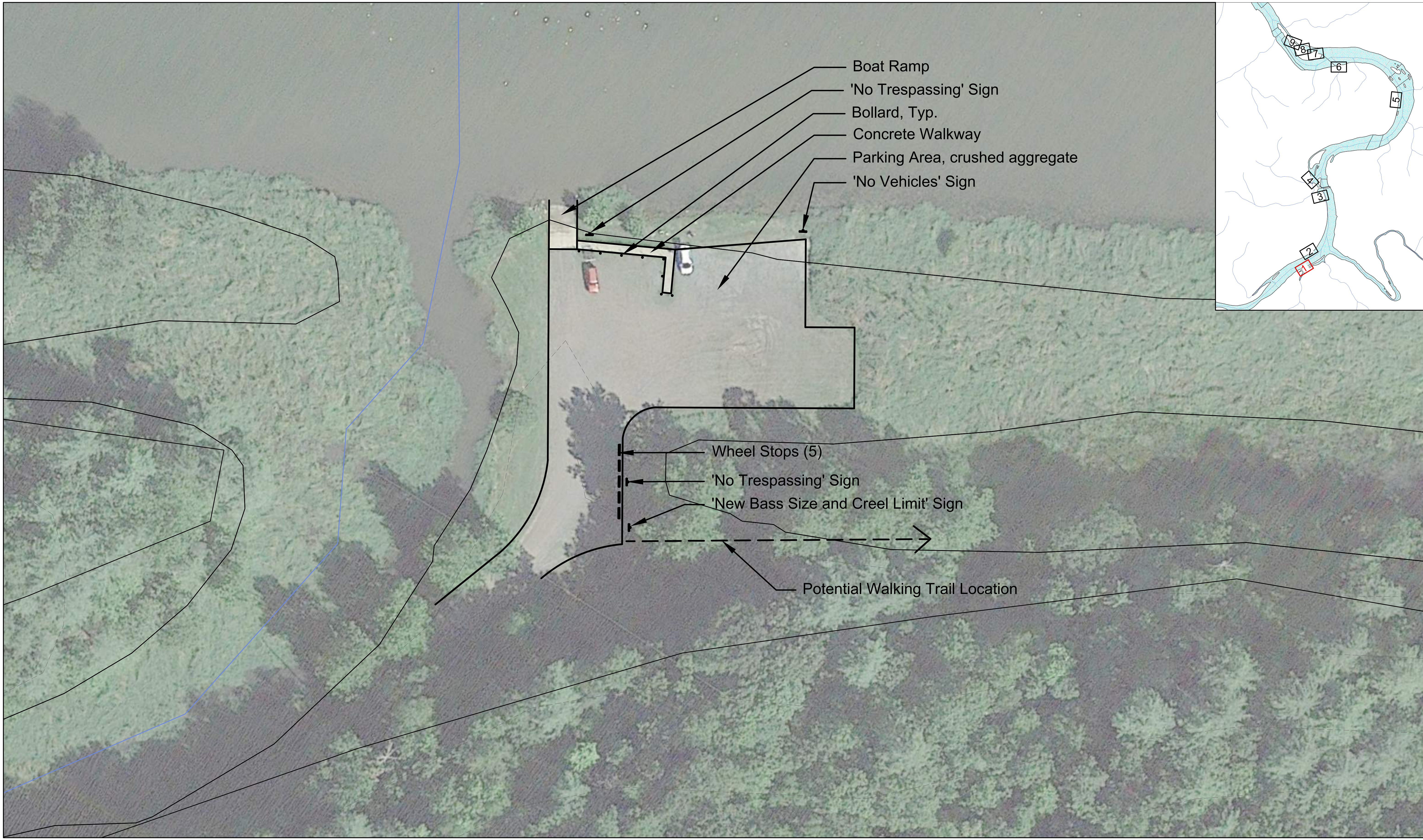
Photo 7-7: Arriving at the lower portage area

Photo 7-8: Lower portage put-in, facing upstream

Photo 7-9: Water access at put-in location facing downstream. Note the steep access, deep water, and narrow land strip.

Photo 7-10: Trash can at lower portage (put-in).

Photo 7-11: Directional sign to portage across the river from the road and portages



LPDA
LANDSCAPE ARCHITECTURE
LAND PLANNING

BYLLESBY-BUCK HYDROELECTRIC PROJECT

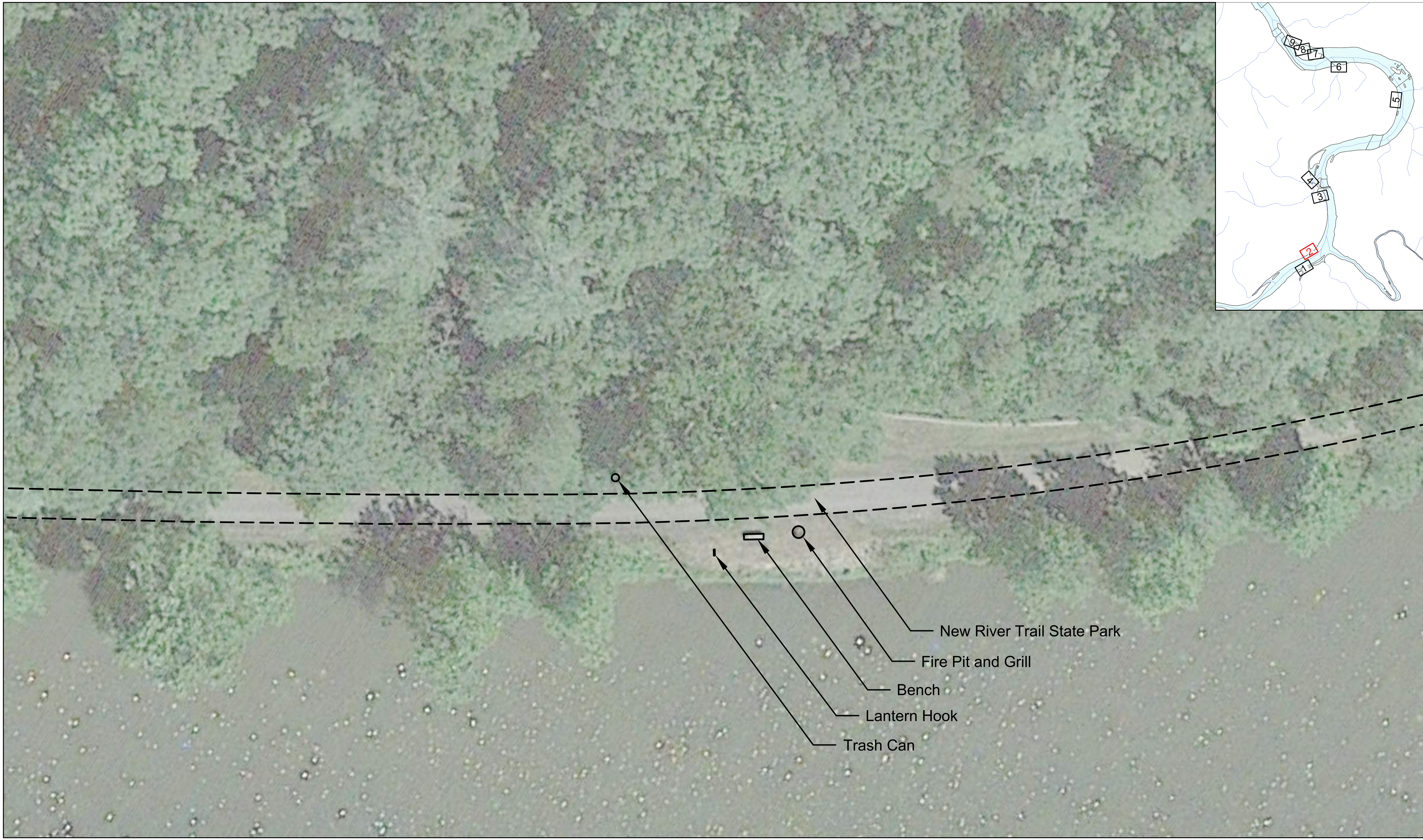
Carroll County, VA

Site 1: Byllesby VDGIF Boat Launch

Sheet 1

Scale: 1"=50'-0"

0'   50'



LPDA
LANDSCAPE ARCHITECTURE
LAND PLANNING

BYLLESBY-BUCK HYDROELECTRIC PROJECT

Carroll County, VA

Site 2: Byllesby VDGIF Fishing Site

Sheet 2

Scale: 1"=30'-0"
0' 30'

LPDA
LANDSCAPE ARCHITECTURE
LAND PLANNING

BYLLESBY-BUCK HYDROELECTRIC PROJECT

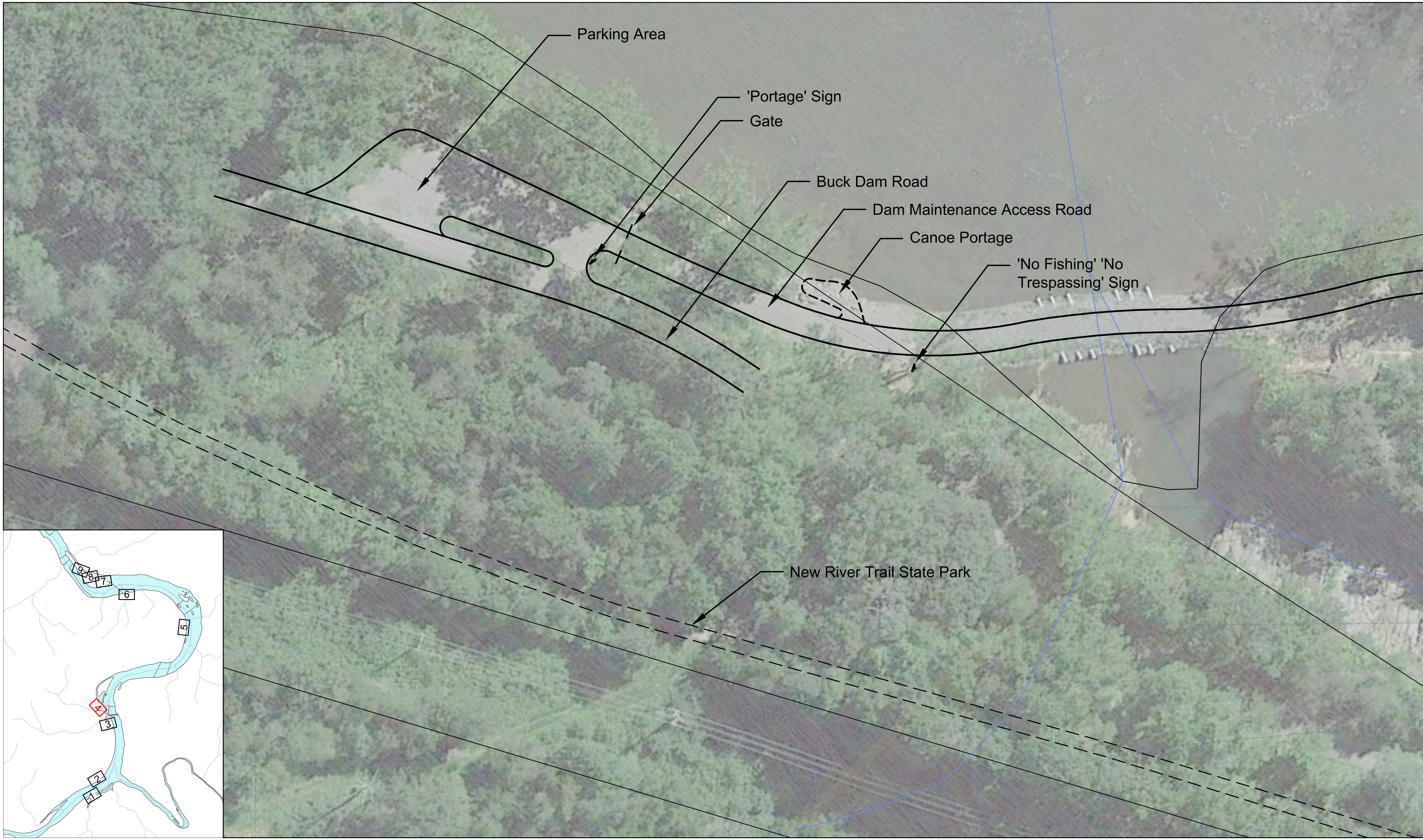
Carroll County, VA

Site 3: Byllesby Canoe Portage

Sheet 3

Scale: 1"=50'-0"

0'   50'



LPDA
LANDSCAPE ARCHITECTURE
LAND PLANNING

BYLLESBY-BUCK HYDROELECTRIC PROJECT

Carroll County, VA

Site 4: New River Canoe Launch

Sheet 4

Scale: 1"=50'-0"
0' 50'

LPDA
LANDSCAPE ARCHITECTURE
LAND PLANNING

BYLLESBY-BUCK HYDROELECTRIC PROJECT

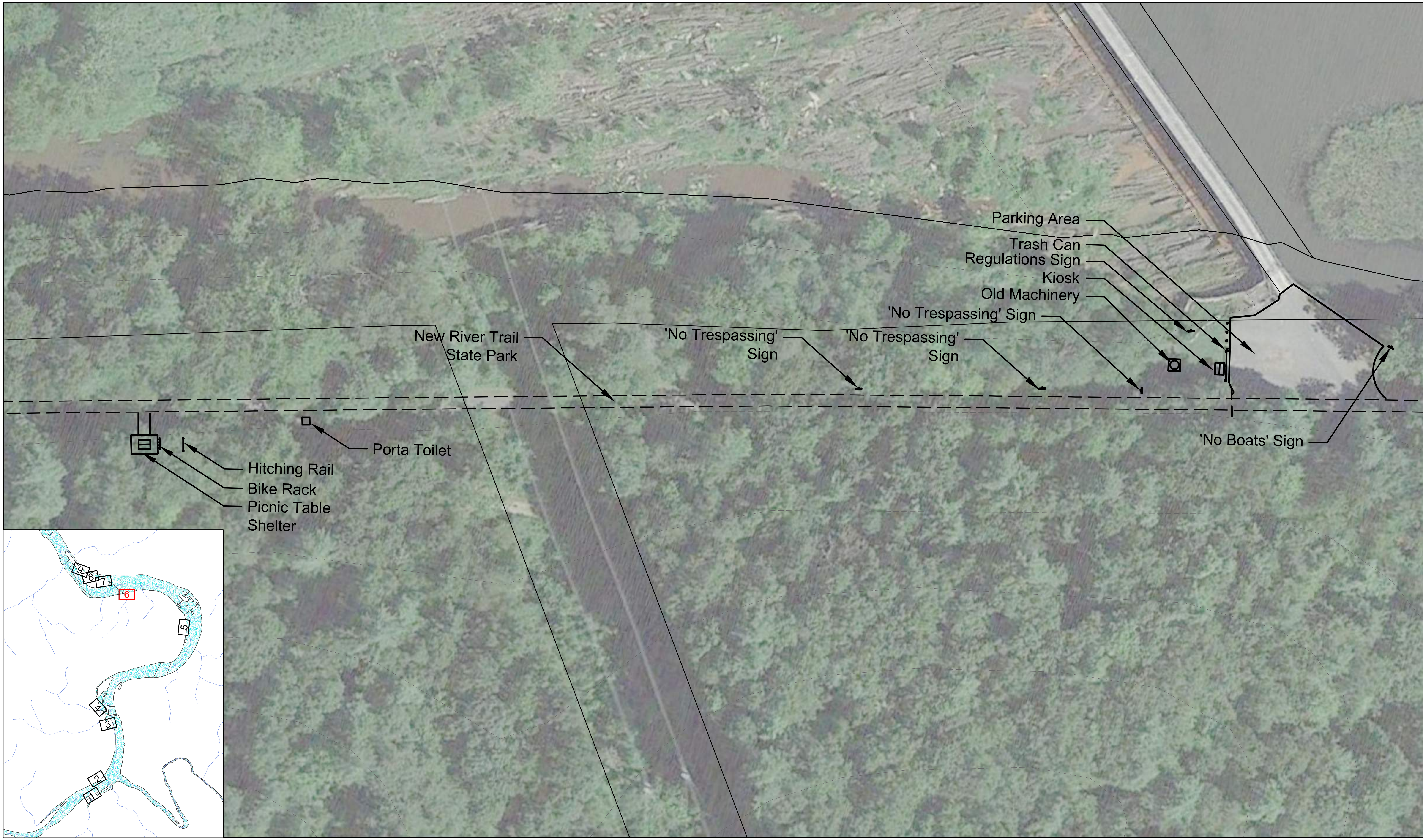
Carroll County, VA

Site 5: New River Trail Picnic Area

Sheet 5

Scale: 1"=50'-0"

0'   50'



LPDA
LANDSCAPE ARCHITECTURE
LAND PLANNING

BYLLESBY-BUCK HYDROELECTRIC PROJECT

Carroll County, VA

Site 6: Buck Dam Picnic Area

Sheet 6

Scale: 1"=60'-0"

0' 60'

LPDA LANDSCAPE ARCHITECTURE LAND PLANNING

BYLLESBY-BUCK HYDROELECTRIC PROJECT

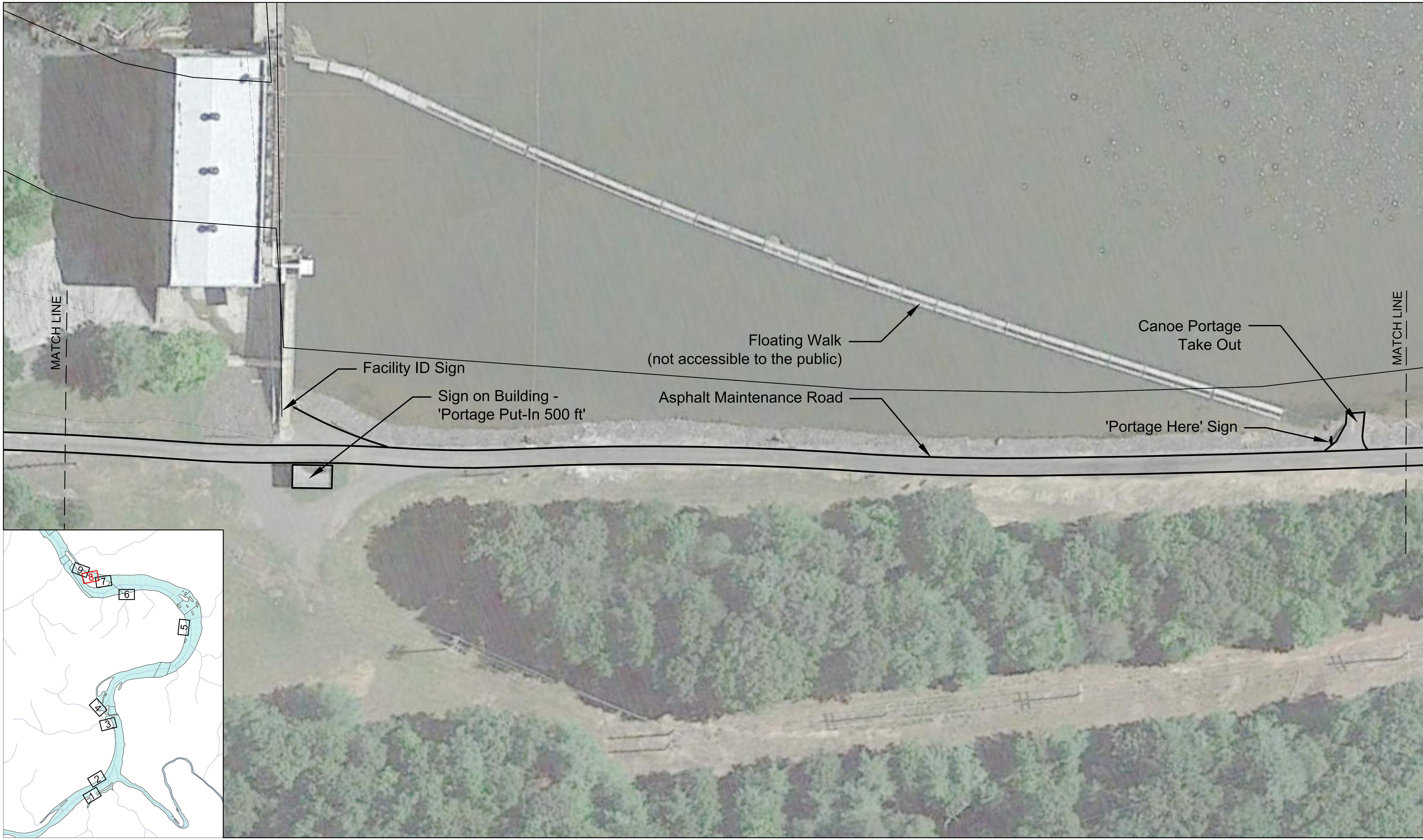
Carroll County, VA

Site 7: Buck Canoe Portage (south)

Sheet 7

Scale: 1"=50'-0"

0' 50'



LPDA
LANDSCAPE ARCHITECTURE
LAND PLANNING

BYLLESBY-BUCK HYDROELECTRIC PROJECT

Carroll County, VA

Site 7: Buck Canoe Portage (center)

Sheet 8

Scale: 1"=50'-0"

0' 50'

LPDA LANDSCAPE ARCHITECTURE LAND PLANNING

BYLLESBY-BUCK HYDROELECTRIC PROJECT

Carroll County, VA

Site 7: Buck Canoe Portage (north)

Sheet 9

Scale: 1"=50'-0"

0' 50'

Attachment 2

Attachment 2 – Stakeholder Recreation Meeting Notes

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Yayac, Maggie

Subject: FW: AEP Byllesby-Buck Relicensing: Recreation Study Update and Planning for Facilities Site Visit

From: Elizabeth B Parcell <ebparcell@aep.com>
Sent: Friday, October 2, 2020 2:51 PM
To: joseph.grist@deq.virginia.gov; sharon.ewing@dcr.virginia.gov; claytorlakegirl@gmail.com; janet_norman@fws.gov; rex.hill@carrollcountyva.gov; james.elliott@dcr.virginia.gov; Bill.Kittrell@dgif.virginia.gov; John.Copeland@dgif.virginia.gov; SAM.SWEENEY@DCR.VIRGINIA.GOV
Cc: Jonathan M Magalski <jmmagalski@aep.com>; Yayac, Maggie <Maggie.Yayac@hdrinc.com>; Kulpa, Sarah <Sarah.Kulpa@hdrinc.com>
Subject: AEP Byllesby-Buck Relicensing: Recreation Study Update and Planning for Facilities Site Visit

Happy October!

As you may recall from this past spring, the recreational site visit planned under the Byllesby-Buck Project's Revised Study Plan had to be rescheduled due to COVID-19 travel restrictions. Appalachian Power Company would still like to convene a 2020 site visit with interested relicensing participants to discuss existing and potential recreation facilities and enhancements at the Project.

Prior to meeting at the site, we would like to convene a conference call (Webex) with this group. We can use the call to coordinate logistics and safety planning for the site visit, and we will also plan to provide a Recreation Study update, including preliminary trail camera and online survey results. We are looking to block out 2 hours on folks' calendars for this meeting. Please let me know if you have availability at 9-11 a.m. or 2-4 p.m. **Wednesday, October 21st** for this call; if this day doesn't work for most we'll find an alternative time.

The site visit will allow time to visit each recreation facility. We propose to begin the day at the VDGIF Boat Launch on river-right at 9 a.m. We will continue to the Byllesby dam and work our way towards the Buck dam to view all six recreation facilities. We are presently targeting **Wednesday, October 28th** to complete the site visit, weather permitting. Please let me know at your earliest convenience if you are interested in/available to participate or have any questions, or if you would like to suggest additional potential participants.

Please don't hesitate to contact me with any questions or concerns, and thanks in advance for your participation in this process.

Liz

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ELIZABETH B PARCELL | **PROCESS SUPV**
EBPARCELL@AEP.COM | D:540.985.2441 | C:540.529.4191
40 FRANKLIN ROAD SW, ROANOKE, VA 24011

Yayac, Maggie

Subject: FW: Byllesby-Buck Recreation Study Update - Meeting Notes and Presentation
Attachments: AEP Byllesby-Buck Recreation Stakeholder Virtual Mtg_10212020.docx; AEP Recreation Stakeholder Presentation.pdf

From: Yayac, Maggie
Sent: Friday, October 23, 2020 12:35 PM
To: ben.boyette@dwr.virginia.gov; Kittrell, Bill (DGIF <bill.kittrell@dwr.virginia.gov>; Hampton, Tom (DGIF <tom.hampton@dwr.virginia.gov>; John Copeland <john.copeland@dwr.virginia.gov>; sam.sweeney@dcr.virginia.gov; joseph.grist@deq.virginia.gov; claytorlakegirl@gmail.com; janet_norman@fws.gov; rex.hill@carrollcountyva.gov; james.elliott@dcr.virginia.gov
Cc: David Keene <david.keene@dwr.virginia.gov>; sharon.ewing@dcr.virginia.gov; Kulpa, Sarah <sarah.kulpa@hdrinc.com>; Elizabeth B Parcell <ebparcell@aep.com>; Jonathan M Magalski <jmmagalski@aep.com>; Tristan Cleveland <tristan@lpda.net>
Subject: Byllesby-Buck Recreation Study Update - Meeting Notes and Presentation

Good afternoon,

Thank you to those of you who joined us on the conference call on Wednesday. Attached are the meeting notes from the call, please let us know if you have any comments. Additionally, the presentation is included as an attachment for those of you who were unable to make it.

We look forward to seeing some of you next Wednesday, October 28th for the site visit. If you have not RSVP'd to the meeting invitation please do so at your earliest convenience.

Have a great weekend!

Maggie Yayac
Regulatory Specialist

HDR
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Maggie.Yayac@hdrinc.com

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HDR

Meeting Summary

Project:	Byllesby-Buck Hydroelectric Project (FERC No. 2514) - Relicensing
Subject:	Byllesby-Buck Recreation Study Update and Site Visit Planning
Date:	Wednesday, October 21, 2020
Location:	WebEx
Attendees:	Laura Walters (New River Conservancy) Janet Norman (USFWS) Bill Kittrell (VDWR) Ben Boyette (VDWR) Tom Hampton (VDWR) John Copeland (VDWR) Sam Sweeney (New River Trail State Park) Joe Grist (VDEQ) Jon Magalski (AEP) Liz Parcell (AEP) Tristan Cleveland (LPDA) Sarah Kulpa (HDR) Maggie Yayac (HDR)

- **Introductions/welcome/meeting purpose**
- **Recreation Study Plan** – Maggie (HDR) provided overview of the Recreation Study Plan as described in the Revised Study Plan (Tasks 1 through 4).

  Throughout the meeting general questions about the Recreation Study methods were discussed and are summarized below:

- **Quantifying recreational use**: Discussion of the relationship between number of respondents and number of users. Appalachian/HDR are unable to develop any statistical relationship to compare to similar comparable studies, but there does appear to be a relationship and themes that have emerged (i.e., Byllesby Boat Ramp had highest number of visitors and survey respondents).

- **Online Survey**: The Online Survey was advertised primarily via signage at the Project recreation facilities (QR Code not included; only full link). This is a potential limitation of this study, though Appalachian/HDR expect that sufficient input was captured from motivated visitors and visitors who frequent the area. Demographic information about survey respondents (age and gender) was collected in the Online Survey and will include additional information in the study report.

- **Trail cameras**: Trail cameras provide better information than the online survey about the number of users during representative periods. The number of photos is related to the how often a site is visited, but not a direct indication of how many people visited (because multiple images may be captured of the same user or other motions can activate the camera). The intent of the study was not to inventory and count recreation users over a continuous period, but rather to characterize usage levels, identify recreation patterns, and develop estimates for representative periods. Maggie (HDR) explained that the trail cameras are motion activated and set to record a next motion after 5 minutes (default setting). The cameras are not recording every 5 minutes if no motion is detected. Data was from trail cameras collected from November 2019 through present, unless otherwise noted as there are minor data gaps at specific locations due to issues with individual trail cameras. The methodology, data gaps, and results will be presented in the study report.

- **Review of Recreation Facilities –** Maggie (HDR) provided an overview of the Recreation Study Area and the formal recreation facilities it encompasses. Sarah (HDR) noted the Study Area encompasses the full reach of the river between Byllesby and Buck Dams, although the FERC Project boundary does not encompass the entire contiguous area. Additional informal facilities, as well as facilities associated with the New River Trail State Park, may occur in or near the FERC Project boundary.

  John Copeland (VDWR) raised question about Loafer's Rest area and noted that it may not be encompassed by the online survey. Land on the right bank of the Buck tailrace is leased by VDWR from Appalachian Power Company (lease extends through 2023). VDWR noted that in the past many anglers did access the Buck tailrace, but security and public safety concerns now prohibit and discourage access in that area. There is a no trespassing sign currently posted and this likely discourages tailrace fishing. Maggie (HDR) explained this was consistent with the results of the trail camera data facing the Buck tailrace, as there were only two instances of recreational activity at this location. No trail cameras or other monitoring have focused on Loafer's Rest (downstream of Buck tailrace), but this site can be added to the facility inventory and discussed during the site visit as requested.

- **Overview of Preliminary Study Results by Location –** Maggie (HDR) and Tristan (LPDA) reviewed results and findings of the Recreation Study tasks (Recreation Facilities Inventory and Condition Assessment, Online Survey, Trail Camera Monitoring) to date, for each facility. Refer to attached PowerPoint presentation for additional information and details.

  – **Byllesby VDWR Boat Launch** – Based on the online survey and trail camera monitoring, this site receives high volume of use relative to the other facilities, primarily from local residents/regional visitors. Individuals who completed the survey provided generally favorable feedback about this facility.

    Boating appears to be dominant use from trail camera, while online survey respondents indicated fishing as the primary activity. Bill (VDWR) noted that he expect the primary use is fishing, and boating is the means of doing so.

  – **Byllesby Canoe Portage -** This site was anomalous in that only one online survey response was received. Trail camera monitoring indicates that portage of canoe/kayak is not common, though the parking area is busy and provides access to the New River Trail, particularly for biking.

  – Janet (USFWS) asked whether trashed fishing lines are a concern at any of the sites and whether there is a need to consider signage and disposal facilities. Janet noted USFWS has good signage to encourage responsible disposal, if helpful.

  – **New River Canoe Launch** - Visitors to this site are primarily from local area and considered themselves regular visitors. Fishing and canoeing/kayaking were reported as the primary activities in the online survey, which the trail camera data confirmed, however fishing was more likely to be observed than use of the portage.

- **New River Trail Picnic Area –** Recreation site has two parts, an upper and lower, so there are two trail cameras at this location. The upper is consistently used for biking and picnicking and the lower for fishing.

- Ben (VDWR) noted he was surprised only one camera was stolen and explained the cameras generated a lot of curiosity and questions from the public.

- Ben (VDWR) asked whether any formal or informal usage monitoring had been focused on the area on the opposite bank of the river and Maggie (HDR) confirmed none to date. Sam Sweeney (New River Trail State Park) noted that the area Ben mentioned is relatively popular for fishing and camping. Group discussed that this area does attract a different user base than the other recreation facilities and they see a higher percentage of illegal activities. This area (Laurel/Woodlawn) is informally referred to as Fowlers Ferry, and Fowlers Ferry Road provides access.

- **Buck Dam Picnic Area (off the Buck bypass) -** VDWR noted surprised that online survey respondents indicated canoeing/kayaking and fishing as primary activities since banks are steep and access is limited. Maggie agreed as there are no formal canoeing/kayaking or fishing recreational access points at this recreational facility. It was assumed respondents may have been visitors to the broader Project area/downstream of recreation site.

- **Buck Dam Canoe Portages –** Online survey responses were higher than expected for an area that is only accessed by canoe/kayak. This area had a higher percent of respondents who were not satisfied with the recreational facilities, likely attributed to a high interest in fishing but no formal angling facilities on Mountain Island. Trail camera observations and recreational use were low.

- **Buck Dam Fishing Access (informal) –** A trail camera was added to this informal recreation spot as a result of agency request/interest in the area for fishing in the tailrace. A time-lapse video was used instead of motion-activated at this site only. Only two instances of bank fishing in this area were recorded.

  Ben (VDWR) noted this area has a high degree of interest by the public. Bill (VDWR) noted that primary access is at the end of the island and anglers are crossing from the other side of the island via wading or canoe/kayak or users access the area downstream of Buck and travel up in boat/canoe/kayak. If the camera had been pointed downriver, additional activity may have been captured. Safety is a concern to AEP in this area (high flows as units come on, access across bypass reach, deep water, and steep banks).

- **Site Visit Planning for Wednesday October 28th –** Maggie (HDR) reviewed plan and agenda for Wednesday’s site visit, including meeting time by 9:30 a.m. at VDWR Byllesby Boat Ramp. If practical and individuals are comfortable doing so, it may be necessary to consolidate cars at points along the way due to limited parking on the New River Trail side.

Based on VDWR's suggestion and discussion by this group, we will plan to visit (drive by/hop out of vehicles to view site/take photos) the Fowlers Ferry area after the Byllesby Boat Ramp.

Action Items

Owner	Action Item	Target Date
HDR/AEP	Send copy (pdf) of the PowerPoint presentation to the group on this call or post to public relicensing website, in advance of the site visit.	10/26/2020
VDWR	Ben to send photographs of Fowlers Ferry area to (Maggie) for distribution to this group	10/26/2020
HDR	Send confirmation email day before site visit confirming site visit is a go (or providing alternative plan if bad weather is forecasted)	10/27/2020
All	Accept/decline meeting invite for next Wednesday 10/28 to provide HDR and AEP with an expected participant list and headcount	10/27/2020
HDR	Provide participants with summary of online survey respondents' comments on specific areas, during site visit	10/28/2020
HDR/AEP	Send reminder with link to Online Survey and notice of survey period close/deadline approaching to group on this call to share on Social Media or other outlets (and AEP post to Claytor Lake social media).	10/23/2020

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Byllesby-Buck Hydroelectric Project Relicensing

Recreation Study

Virtual Check-In: October 21, 2020

Site Visit: October 28, 2020

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Project Overview

- Licensee is Appalachian, a unit of American Electric Power (AEP).
- The Byllesby-Buck Hydroelectric Project (FERC No. 2514) is a 30.1-MW, two-development Project on the upper New River in Carroll County, Virginia.
- Project constructed in 1912.
- Current FERC license expires February 29, 2024.
- Upcoming dates:
  - Appalachian to file Initial Study Report (ISR) on January 18, 2021
  - ISR Meeting by February 2, 2021

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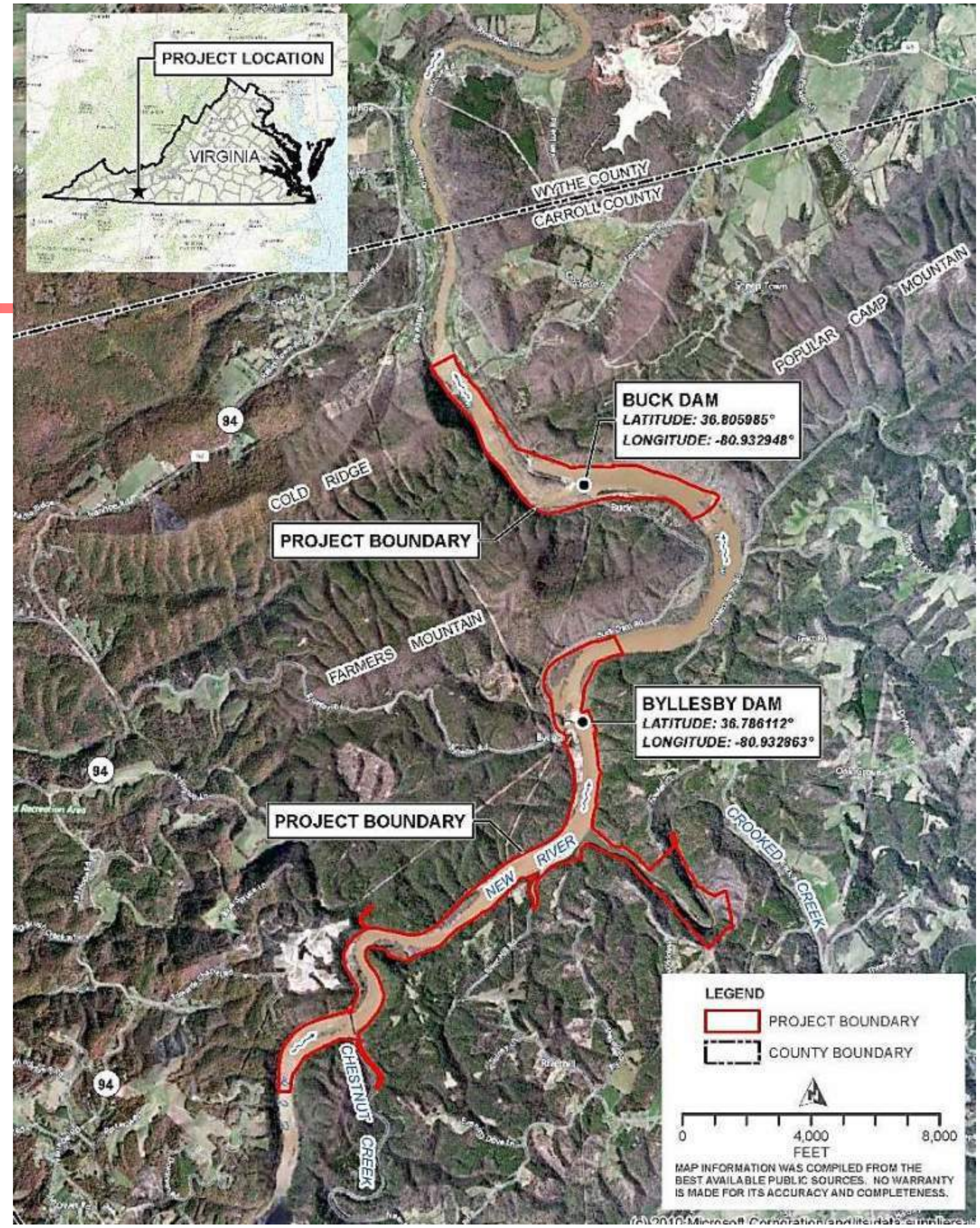
Project Location

- The Byllesby dam is approximately 8 river miles downstream of the Fries dam.
- The Buck dam is approximately 3 river miles downstream of Byllesby and 43.5 river miles upstream of Claytor dam.



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Agenda

- Recreation Study Plan
- Review of Recreation Facilities
- Review Recreation Inventory, Online Survey, Trail Camera Results for the following:
  - Byllesby VDWR Boat Launch
  - Byllesby Canoe Portage
  - New River Canoe Launch
  - New River Trail Picnic Area
  - Buck Dam Picnic Area
  - Buck Dam Canoe Portages
  - Buck Dam Fishing Access (informal)
- Site Visit Planning for Wednesday October 28th

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Recreation Study Plan: Goals and Objectives

- **Study Goal:** Determine the need for enhancement to existing recreation facilities, or additional recreational facilities, to support the current and future demand for public recreation in the Project area.
- **Specific Objectives:**
  - Gather information on the condition of six Project-related public recreation facilities and identify any need for improvement
  - Characterize current recreational use of the study area and estimate future demand
  - Solicit comments from stakeholders regarding potential enhancement opportunities
  - Analyze effects of continued Project operation on recreation facilities

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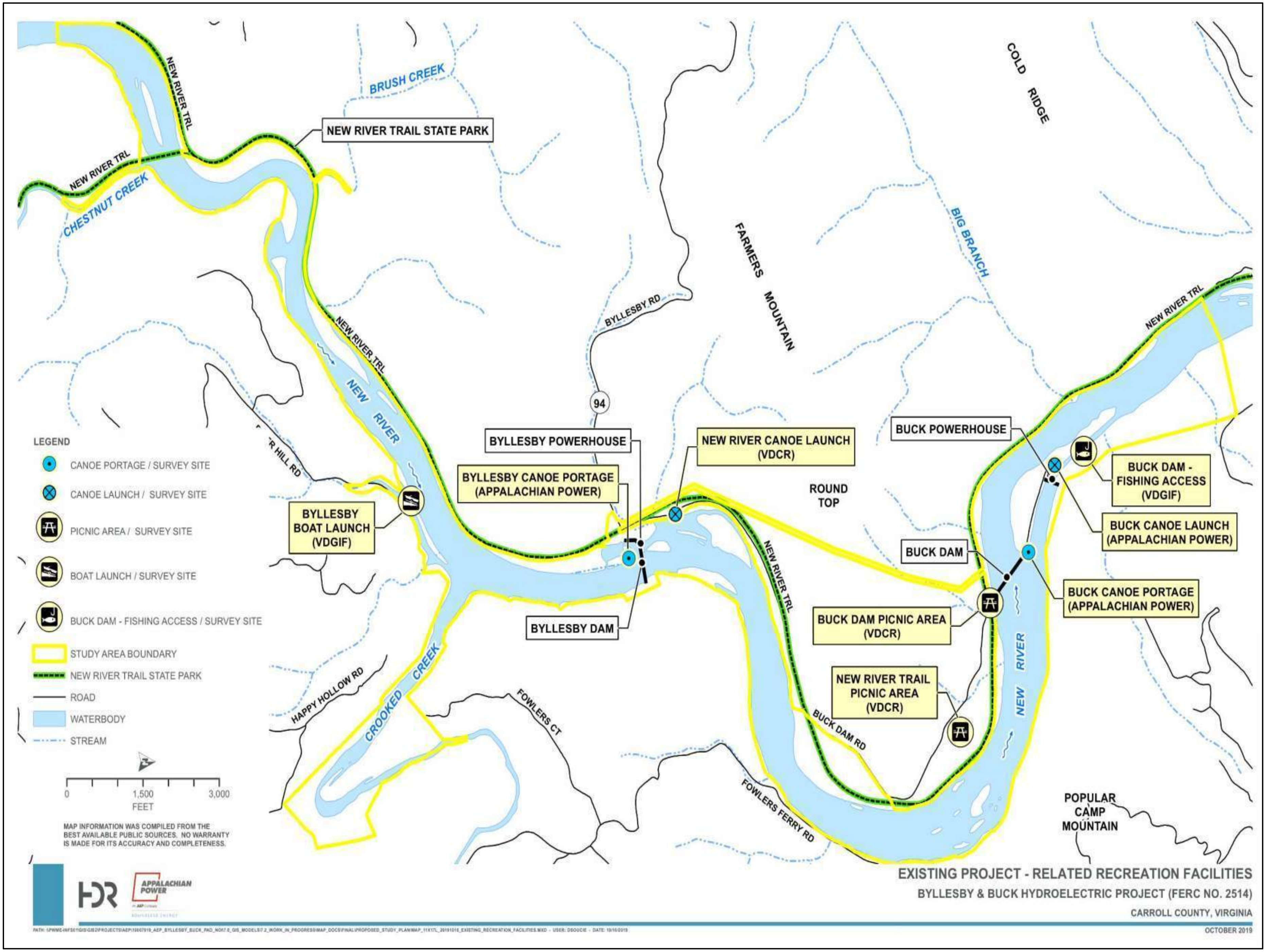
Formal Recreation Facilities

Recreation Facility	Owner / Operator	Amenities	Relationship to Project Boundary
Byllesby Development			
Byllesby VDGIF Boat Launch	Leased and Operated VDGIF	Provides single-lane boat concrete boat launch with gravel parking area.	Within
Byllesby Canoe Portage	Owned and operated by Appalachian	Provides approximate 1,500-foot portage trail. Site consists of a hand-carry canoe take-out and an information trailhead kiosk for the New River Trail State Park.	Within
New River Canoe Launch	Owned and operated by VDCR	Provides small, gravel parking area with short trail leading to a hand-carry boat launch (also serves as put-in for the Byllesby Canoe Portage).	Adjacent to
Buck Development			
Buck Dam Picnic Area	Owned and operated by VDCR	Provides gravel parking for vehicles, information kiosk, and access to New River Trail. Also provides a picnic area with picnic table, trash can, portable restroom facility, and a hitching post for equestrian trail users.	Adjacent to
New River Trail Picnic Area	Owned and operated by VDCR	Provides upper and lower recreation areas that include benches, picnic tables, bike rack, trash can, grill, and informal angling access to the Buck reservoir.	Adjacent to
Buck Dam Canoe Portage	Owned and operated by Appalachian	Provides crushed stone hand-carry take out and a hand-carry put in.	Within


NEW RIVER TRAIL STATE PARK
BRUSH CREEK
CHESTNUT CREEK
NEW RIVER TRL
COLD RIDGE
FARMERS MOUNTAIN
BIG BRANCH
BYLLESBY RD
94
NEW RIVER
BYLLESBY POWERHOUSE
NEW RIVER CANOE LAUNCH (VDCR)
BUCK POWERHOUSE
BYLLESBY CANOE PORTAGE (APPALACHIAN POWER)
ROUND TOP
BUCK DAM - FISHING ACCESS (VDGIF)
BYLLESBY BOAT LAUNCH (VDGIF)
BUCK CANOE LAUNCH (APPALACHIAN POWER)
BUCK DAM
BUCK CANOE PORTAGE (APPALACHIAN POWER)
BYLLESBY DAM
BUCK DAM PICNIC AREA (VDCR)
NEW RIVER TRAIL PICNIC AREA (VDCR)
HAPPY HOLLOW RD
CROOKED CREEK
FOWLERS CT
BUCK DAM RD
FOWLERS FERRY RD
POPULAR CAMP MOUNTAIN
LEGEND
CANOE PORTAGE / SURVEY SITE
CANOE LAUNCH / SURVEY SITE
PICNIC AREA / SURVEY SITE
BOAT LAUNCH / SURVEY SITE
BUCK DAM - FISHING ACCESS / SURVEY SITE
STUDY AREA BOUNDARY
NEW RIVER TRAIL STATE PARK
ROAD
WATERBODY
STREAM
0
1,500
3,000
FEET
MAP INFORMATION WAS COMPILED FROM THE BEST AVAILABLE PUBLIC SOURCES. NO WARRANTY IS MADE FOR ITS ACCURACY AND COMPLETENESS.
HDR
APPALACHIAN POWER
EXISTING PROJECT - RELATED RECREATION FACILITIES
BYLLESBY & BUCK HYDROELECTRIC PROJECT (FERC NO. 2514)
CARROLL COUNTY, VIRGINIA
OCTOBER 2019

Recreation Study: Task 1

<table>
<tr><th colspan="2">Task 1</th></tr>
<tr><td rowspan="2">Recreation Facility Inventory and Condition Assessment</td><td>Field inventory:
• Recreation site type and location
• Length and type of trails
• Existing facilities, signage, and sanitation
• Type of vehicular access and parking (if any)
• Compliance with Americans with Disabilities Act standards
• Photographic documentation</td></tr>
<tr><td>Qualitative condition assessment:
• Each recreation facility will be rated with condition criteria, and explanations provided</td></tr>
</table>

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Recreation Study: Task 2 and 3

Task 2	
Site Visit with Stakeholders to Discuss Existing and Future Recreational Opportunities	• Appalachian and primary stakeholders will visit the existing Project-related recreation facilities • Discuss potential conceptual-level enhancement and improvements
Task 3	
Recreation Visitor Use Online Survey	• Provide online survey information to stakeholders as well as recreationists who do not frequent the Project regularly

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Online Survey

- Online survey notice posted at recreation facilities
- 73 visitors completed the survey, as of October 12, 2020
- Boating and bank fishing have been documented as the primary activities
- Survey live from April – October 2020

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Recreation Study: Task 4

Task 4	
Recreational Use Documentation	*Trail camera installation* • Eight cameras placed at the six Project-related public recreation facilities • November 2019 – November 2020 • Motion activated, date and time stamped

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BOUNDLESS ENERGY

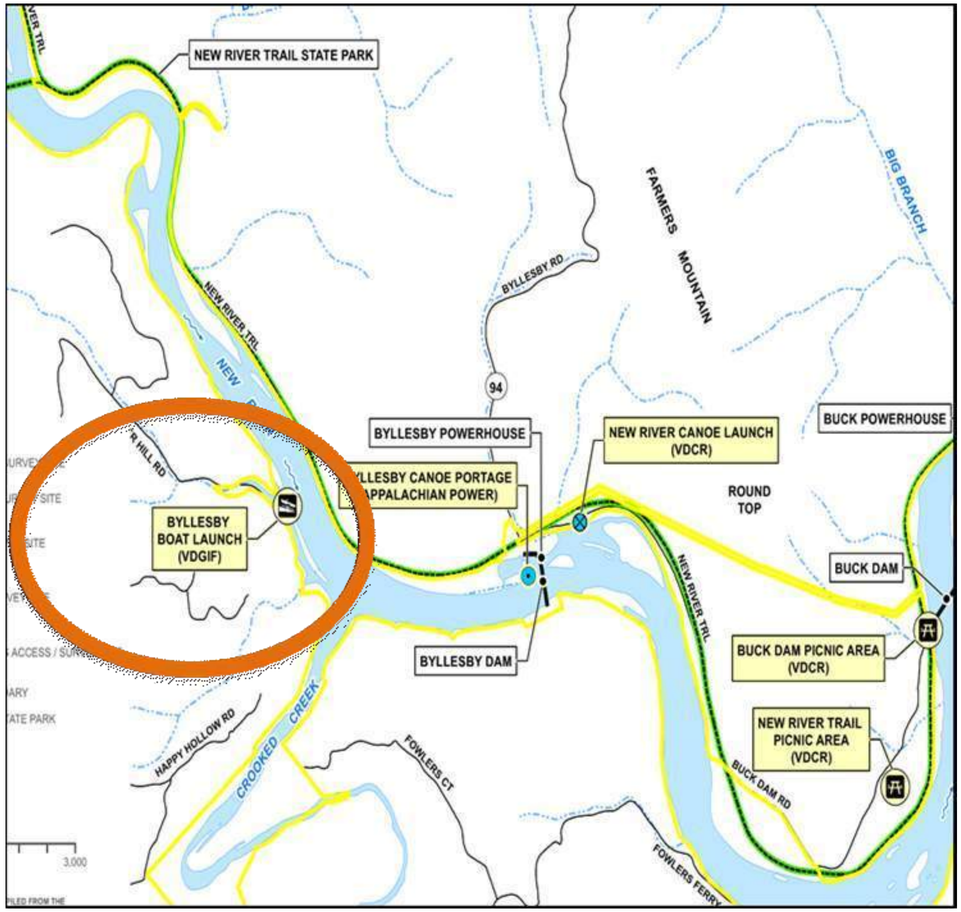
Recreation Study: Analysis and Reporting

An analysis of the current and future recreational facilities usage and needs

BOUNDLESS ENERGY

Byllesby VDWR Boat Launch

- Leased and Operated by VDGIF (now VDWR) and located within the Project Boundary
- Provides single-lane concrete boat launch with gravel parking area.



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Byllesby VDWR Boat Launch: Inventory Conditions Assessment

<u>Condition:</u>

- Boat launch/ramp in good condition
- Site is clean
- Gravel parking surface
- Undefined parking
- No site furnishings (i.e. picnic tables, trash cans) or restroom facilities
- Varying site and directional signage.
- No ADA facilities

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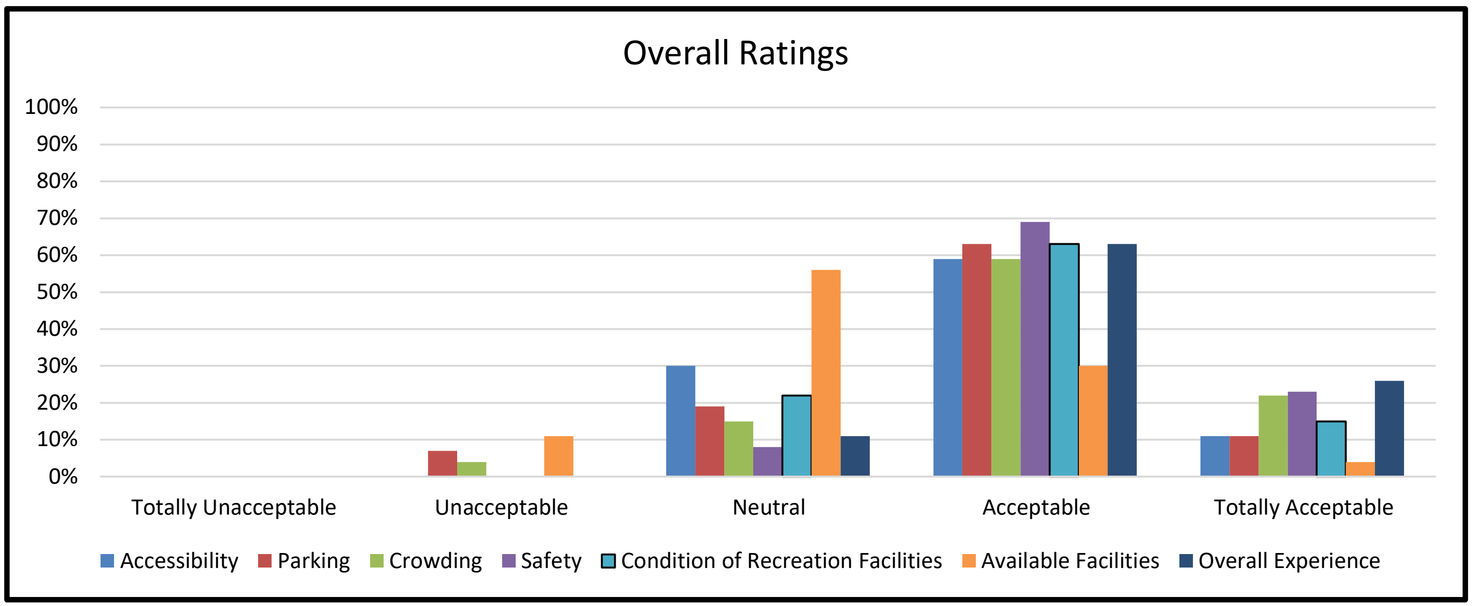
Byllesby VDWR Boat Launch: Online Survey

- Between May 2020 to September 2020 there have been 37 visitors from Byllesby Boat Launch that responded to this survey.
- 22 miles is the average traveled by visitors as day trips (frequently from zipcodes 24330, 24333 & 24381).
- 93% of respondents consider themselves to be regular visitors to the area with at least 3 or more times a year with an average length of stay being 5 hours.

Primary Activity	Percent
Fishing	69%
Canoeing/Kayaking	23%
Boating	4%
Picnicking	4%



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Byllesby VDWR Boat Launch: Trail Camera Results

- As of September 9, 2020, Appalachian has gathered approximately 10,000 photos.
- Significant uptick in recreation activities between the end of May and early August.
- Out of the recreation facilities this one sees the most traffic and generally consistent throughout the week (small uptick on weekends/holidays).
- Boating and bank fishing are the most popular recreational activities.

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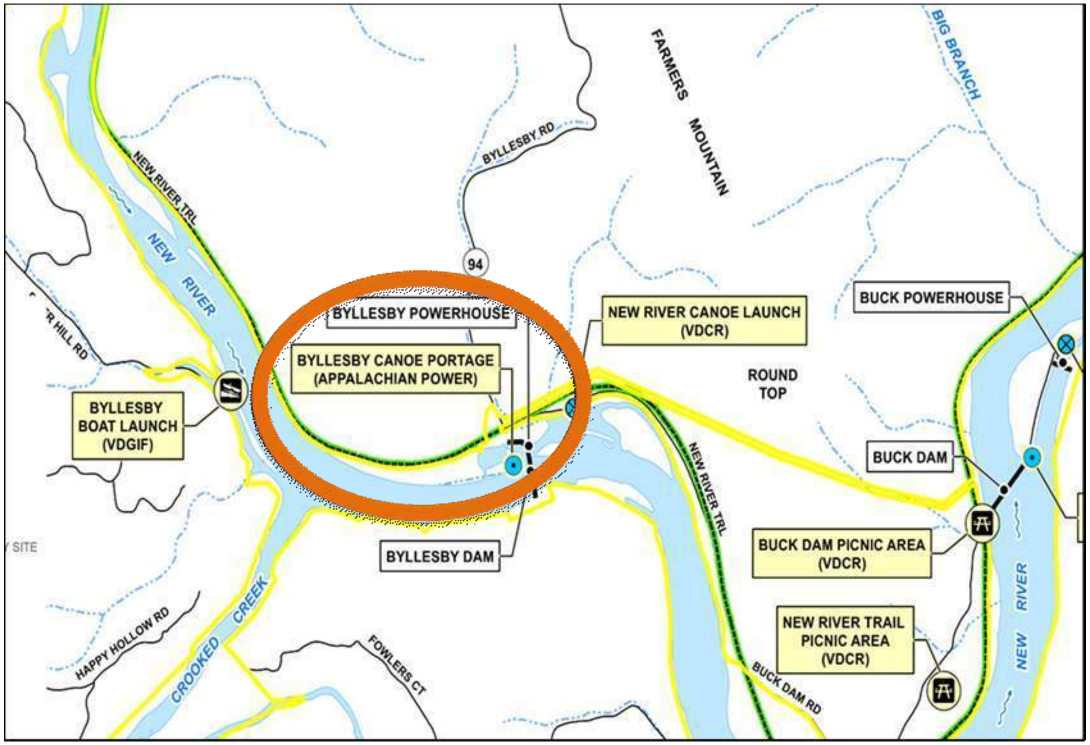
BOUNDLESS ENERGY

Byllesby Canoe Portage

- Owned and operated by Appalachian within the Project Boundary
- Provides approximate 1,500-foot portage trail. Site consists of a hand-carry canoe take-out and an information trailhead kiosk for the New River Trail State Park by a gravel parking area.



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BOUNDLESS ENERGY

Byllesby Canoe Portage: Inventory Conditions Assessment

- Rustic portage take-out; large and level for easy transfer
- Portage is 775 ft from parking lot
- Trashcan at parking lot is aged but functional and is regularly serviced
- Varying site and directional signage
- No ADA amenities

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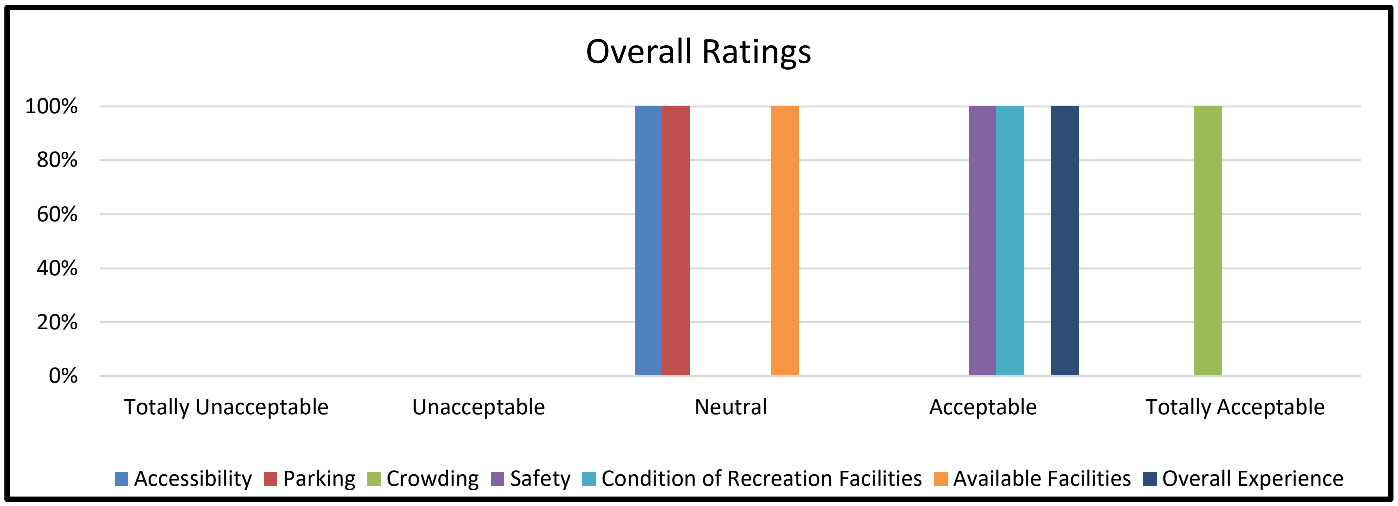
BOUNDLESS ENERGY

Byllesby Canoe Portage: Online Survey

- Between May 2020 to September 2020 there has been 1 visitor from Byllesby Canoe Portage that responded to this survey.
- 200 miles is the estimated distance traveled by this visitor and as day trips.
- Considers himself to be regular visitors to the area with at least 3 or more times a year with an average length of stay being 4 hours.
- The months visited are May, July, and August primarily to canoe.



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Byllesby Canoe Portage Trail Camera Results

- As of September 9, 2020, Appalachian has gathered approximately 10,000 photos.
- Parking at this location to bike, hike, or walk are the most popular recreational activities.

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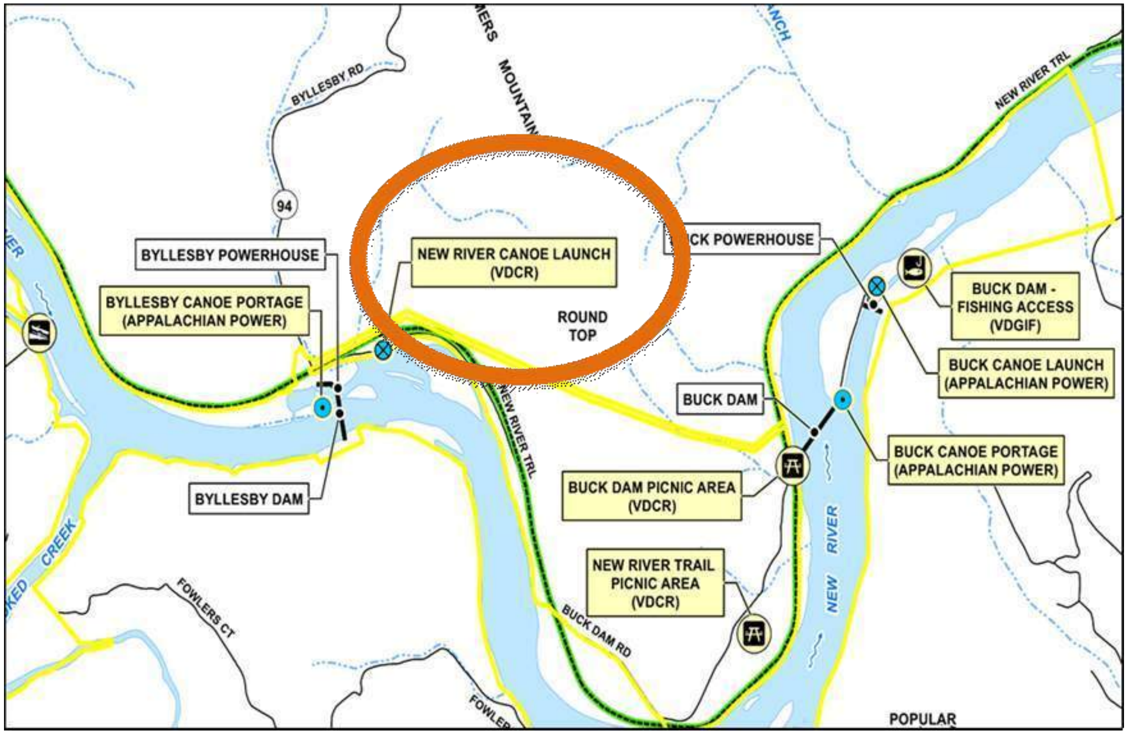
New River Canoe Launch

- Owned and operated by VDCR adjacent to the Project Boundary
- Provides small, gravel parking area with short trail leading to a hand-carry boat launch (also serves as put-in for the Byllesby Canoe Portage).



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BOUNDLESS ENERGY

New River Canoe Launch: Inventory Conditions Assessment

- Rustic portage put-in is functional
- Large level sandy surface at portage makes transfer easy
- Gravel parking area for approximately 10 cars
- Canoe put-in is 125 ft from parking area and 1,175 ft (0.22 miles) from take-out
- Clear directional signage
- No site furnishings
- No ADA amenities

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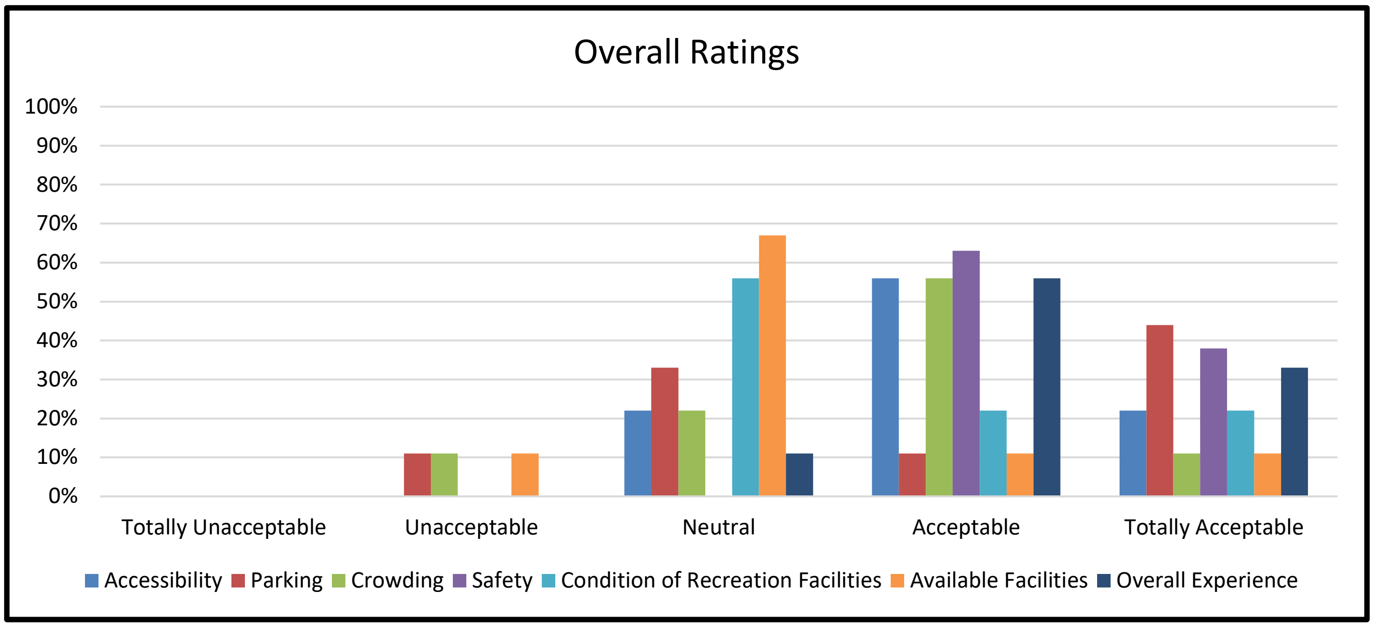
BOUNDLESS ENERGY

New River Canoe Launch: Online Survey

- Between May 2020 to September 2020 there have been 14 visitors from New River Canoe Launch that responded to this survey.
- 7.5 miles is the average traveled by visitors (frequently from zipcodes 24330 & 24333).
- 100% of respondents consider themselves to be regular visitors to the area with at least 3 or more times a year with an average length of stay being 4.5 hours.

Primary Activity	Percent
Fishing	67%
Canoeing/kayaking	22%
Sight-seeing	11%



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New River Canoe Launch: Trail Camera

- As of September 9, 2020, Appalachian has gathered approximately 2,800 photos.
- Bank fishing and relaxing (i.e. chairs, cooler, hanging out for the day) are the most common.

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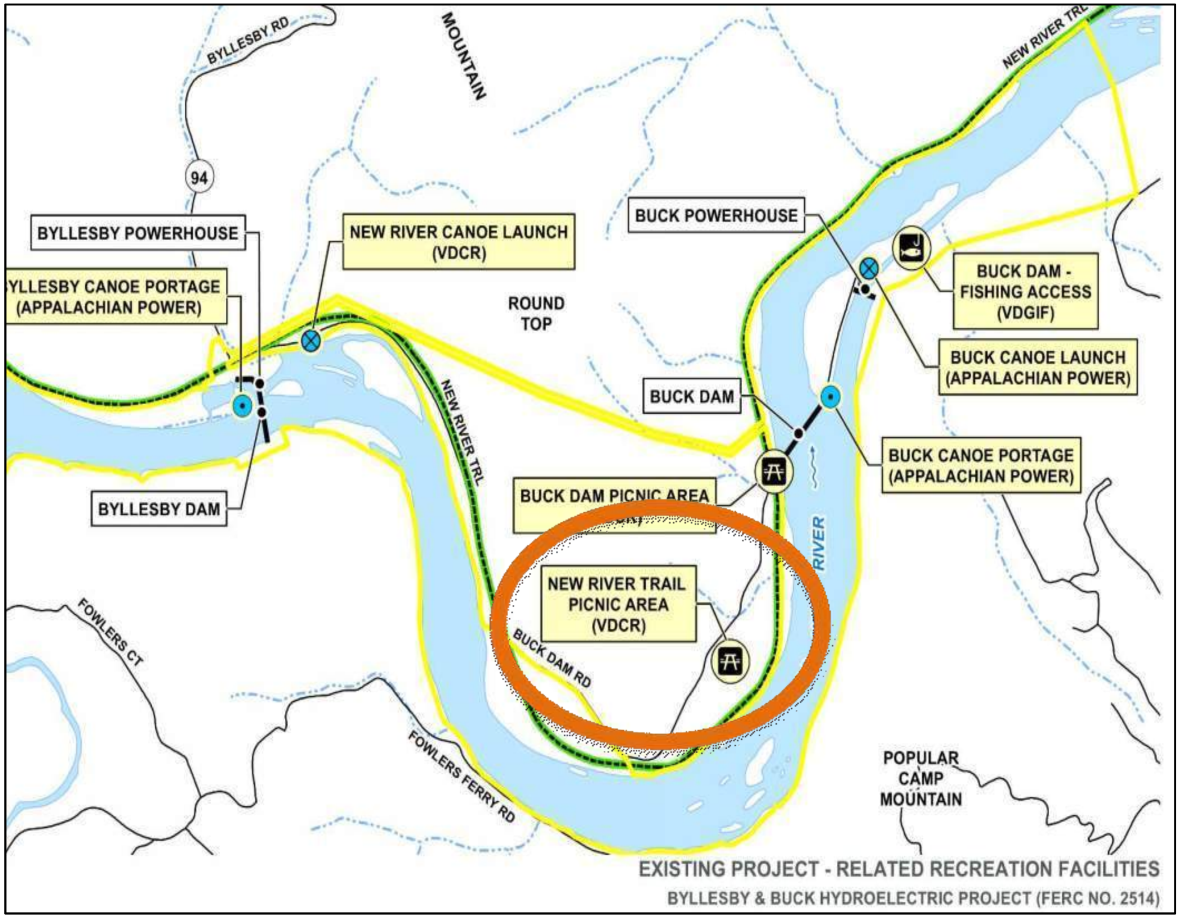
New River Trail Picnic Area

- Owned and operated by VDCR adjacent to the Project Boundary
- Provides upper and lower recreation areas that include benches, picnic tables, bike rack, trash can, grill, and informal angling access to the Buck reservoir



BOUNDLESS ENERGY

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New River Trail Picnic Area: Inventory Conditions Assessment

- Informal parking on shoulder off of road.
- Informal unsigned path leads down hill to upper picnic area off New River trail.
- Upper picnic area amenities are in good/serviceable condition. Picnic table is ADA accessible.
- Lower picnic area furnishings (bench, trash can) require maintenance. Grill is older and could be replaced.
- Some degree of site and directional signage.

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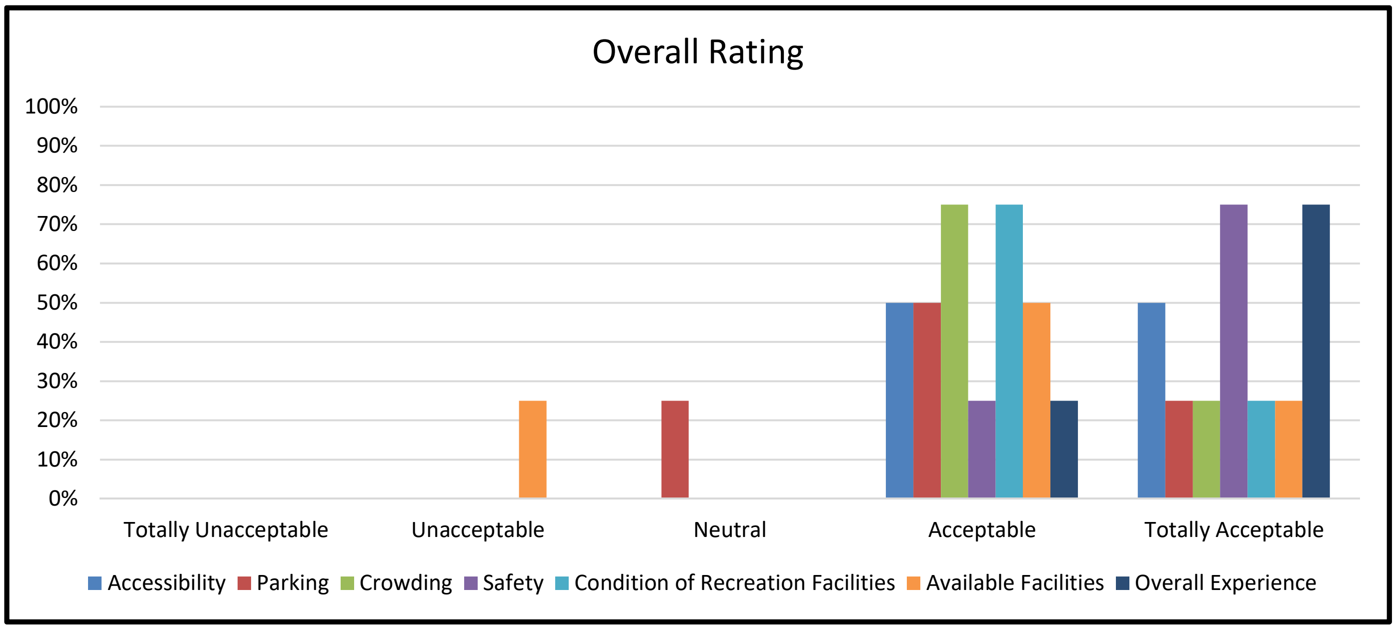
New River Trail Picnic Area: Online Survey

- Between May 2020 to September 2020 there have been 8 visitors from the New River Trail Picnic Area that responded to this survey.
- 12 miles is the average traveled by visitors (frequently from zipcodes 24330).
- 75% of respondents consider themselves to be regular visitors to the area with at least 3 or more times a year with an average length of stay being 3.5 hours.

Primary Activity	Percent
Biking	75%
Fishing	25%



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New River Trail Picnic Area: Trail Camera (Upper)

- As of September 9, 2020, Appalachian has gathered approximately 5,930 photos.
- Consistent use of recreation features (picnic shelter, bike rack and hitching post).

NR Trail Picnic Area (Upper)

New River Trail Picnic Area: Trail Camera (Lower)

- As of September 9, 2020, Appalachian has gathered approximately 3,220 photos.
- This trail camera was stolen and then replaced. Data was lost from May 27 – July 28th.
- Bank fishing and relaxing (i.e using picnic tables, setting up chairs/tents for the day) are also common.
- Recreational users also enjoy this as a stop off the New River trail for sight-seeing.

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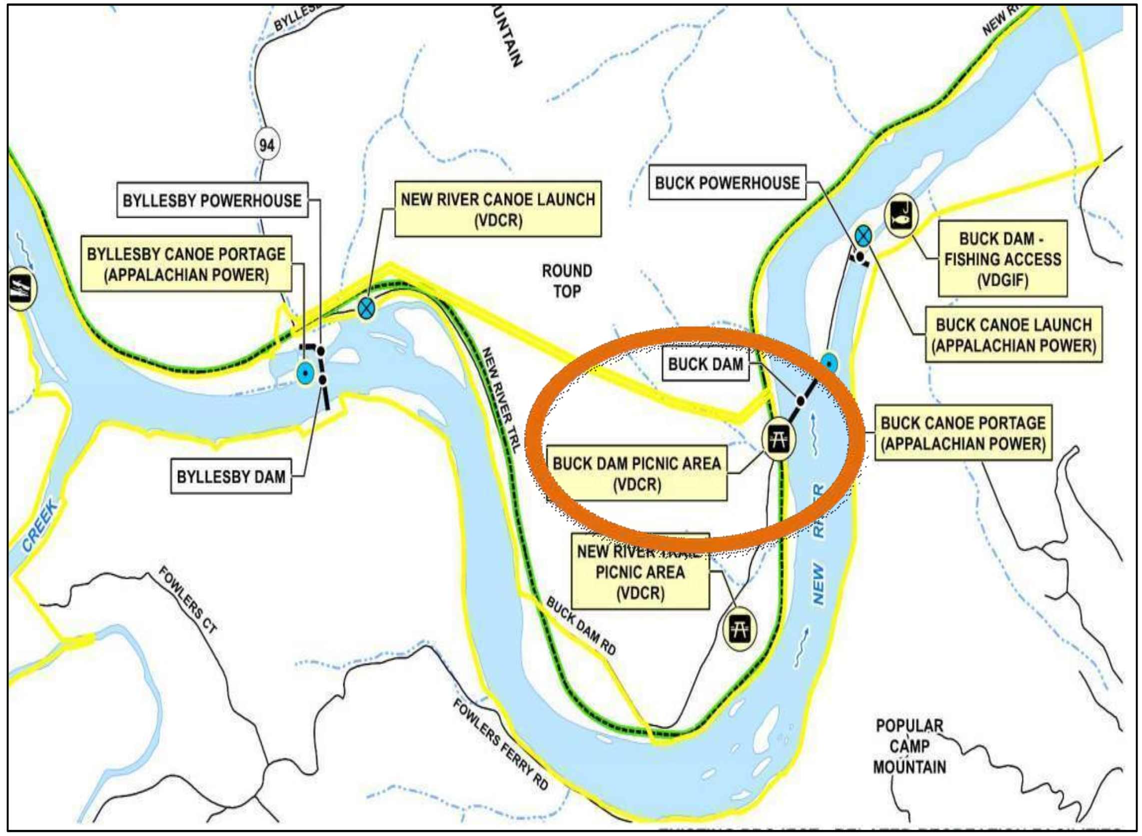
Buck Dam Picnic Area

- Owned and operated by VDCR adjacent to the Project Boundary
- Provides gravel parking for vehicles, information kiosk, and access to New River Trail. Also provides a picnic area with picnic table, trash can, portable restroom facility, and a hitching post for equestrian trail users.



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Buck Dam Picnic Area: Inventory Conditions Assessment

- Picnic site along the New River Trail, approx. 650 ft from parking area.
- Gravel parking for approx. 5 cars, needs light maintenance.
- Portable restroom is ADA accessible.
- An industrial artifact is located by parking area.
- Some degree of site and directional signage, in varying conditions.

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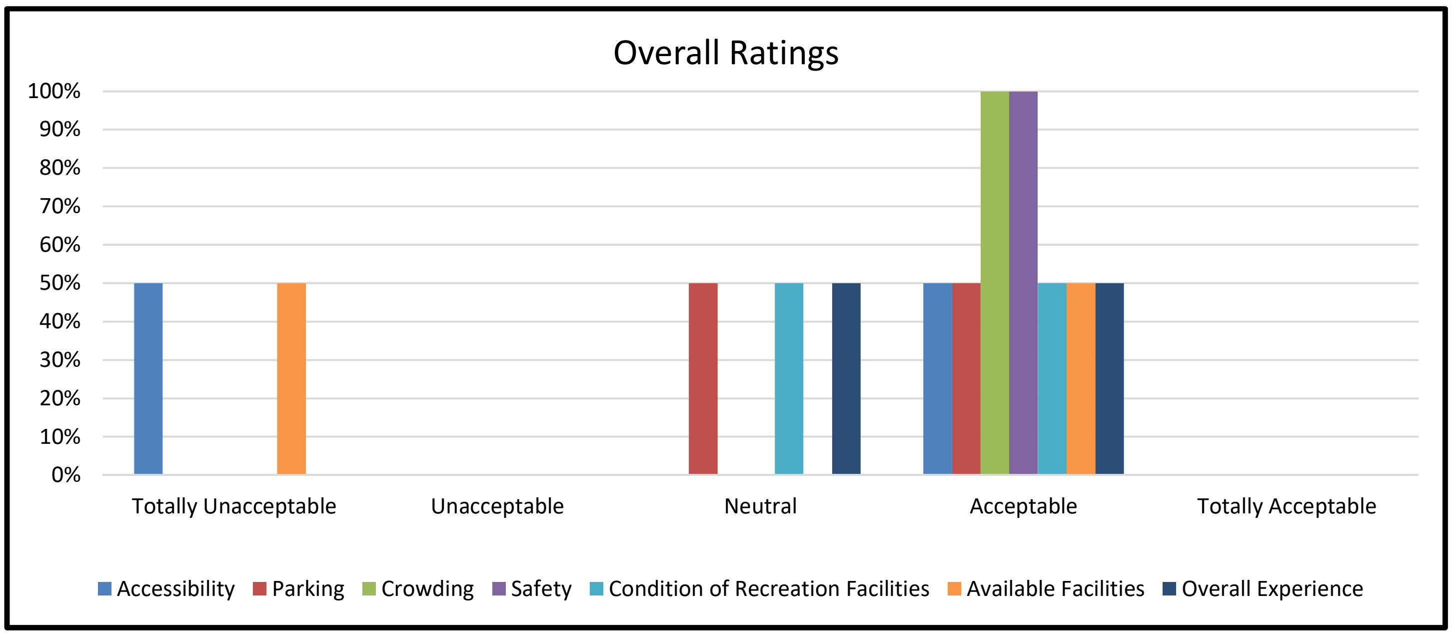
Buck Dam Picnic Area: Online Survey

- Between May 2020 to September 2020 there have been 4 visitors from the New River Trail Picnic Area that responded to this survey.
- 12.5 miles is the average traveled by visitors (frequently from zipcodes 24330).
- 100% of respondents consider themselves to be regular visitors to the area with at least 3 or more times a year with an average length of stay being 4 hours.

Primary Activity	Percent
Canoe/Kayaking	50%
Fishing	50%



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Buck Dam Picnic Area: Trail Camera Results

- As of September 9, 2020, Appalachian has gathered approximately 3,120 photos.
- The tree this trail camera was located on fell down, but was re-installed in a similar location. Data was lost from May 18 – July 28th.
- Consistent use of recreation features (picnic shelter, bike rack and hitching post).

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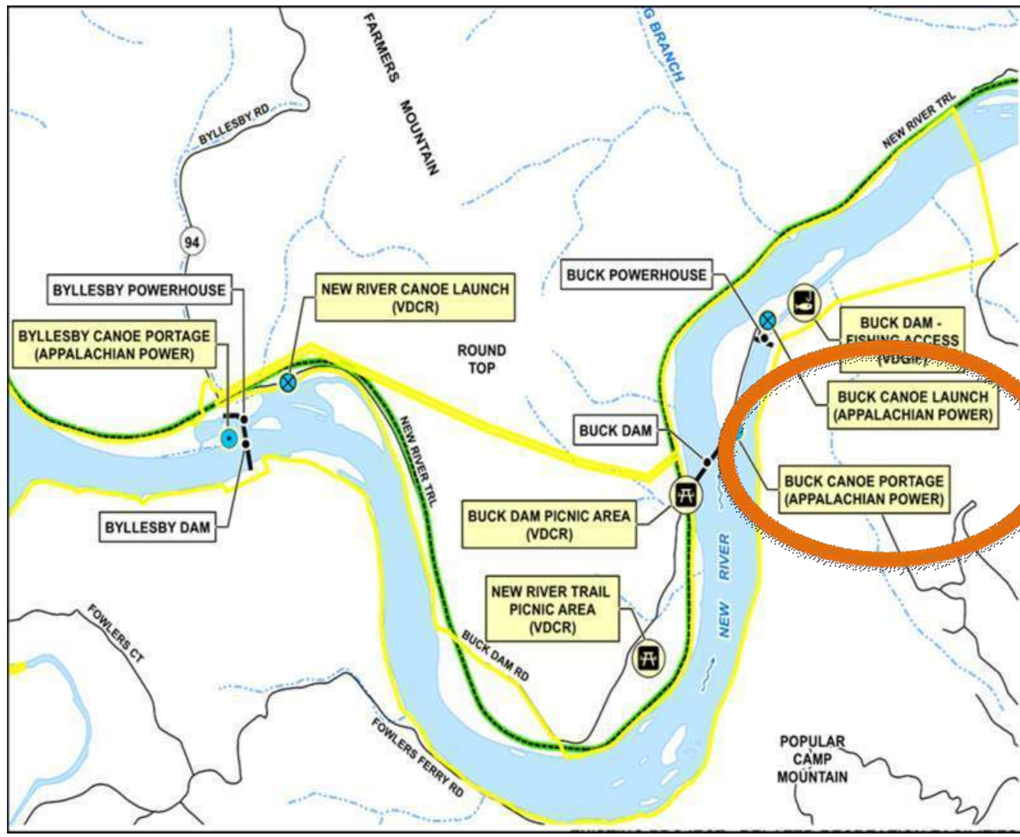
Buck Dam Canoe Portage and Launch

- Owned and operated by Appalachian within the Project Boundary.
- Provides crushed stone hand-carry take out and a hand-carry put in above and below the dam.



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Buck Dam Canoe Portage and Launch: Inventory Conditions Assessment

- Sites accessible to public by water only.
- Crushed stone portage take-out, in good condition.
- Rustic put-in; small area with drop off to water surface.
- Portage route is 1,440 ft (0.27 miles). Surface type varies, some sections are eroded.
- Informal trash can.
- Some degree of site and directional signage, in varying conditions.
- No ADA amenities.

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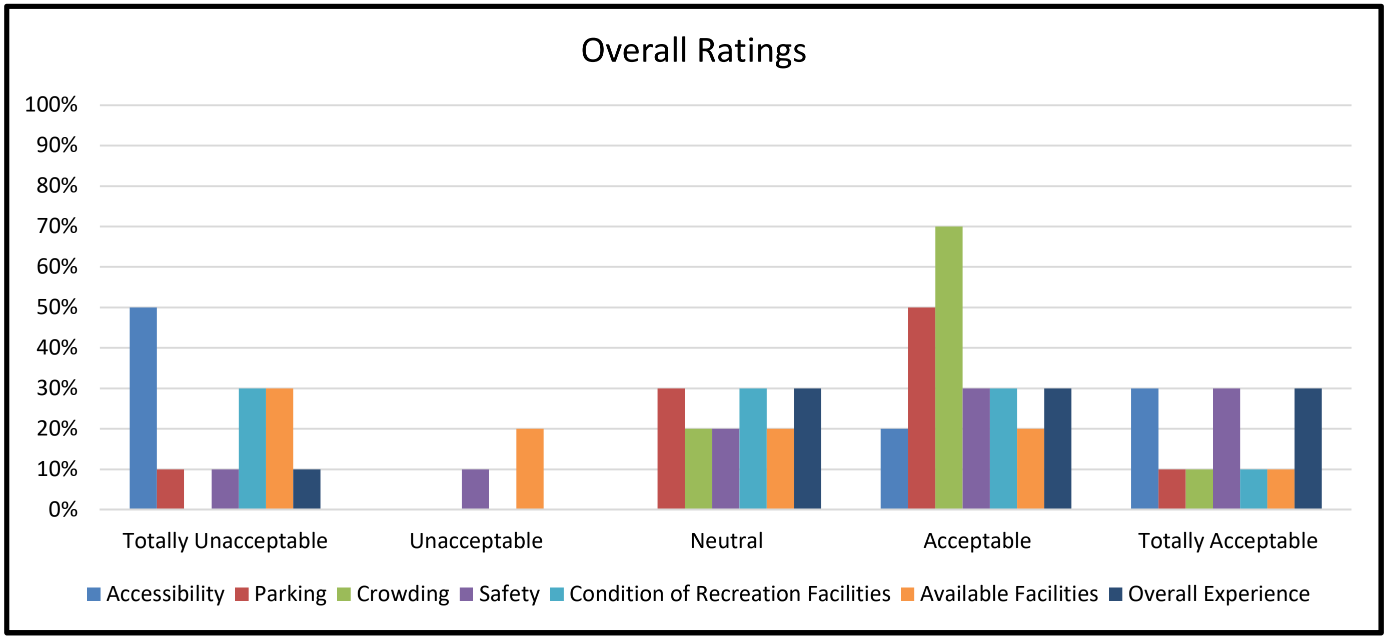
Buck Dam Canoe Portage and Launch: Online Survey

- Between May 2020 to September 2020 there have been 13 visitors from Buck Dam Canoe Portage that responded to this survey.
- 42 miles is the average traveled by visitors with 40% noting they were staying overnight (frequently from zipcodes 24333, 24348 & 24350).
- 100% of respondents consider themselves to be regular visitors to the area with at least 3 or more times a year with an average length of stay being 2.6 hours.

Primary Activity	Percent
Fishing	38%
Biking	25%
Canoeing/kayaking	25%
Kayak Fishing	13%



Buck Dam Canoe Portage and Launch: Trail Camera Results

- As of September 9, 2020, Appalachian has gathered approximately 100 photos.
- Low recreational usage compared to other sites
- Bank fishing, canoe/kayaking, and motorized boat fishing into tailrace are the only activities observed.

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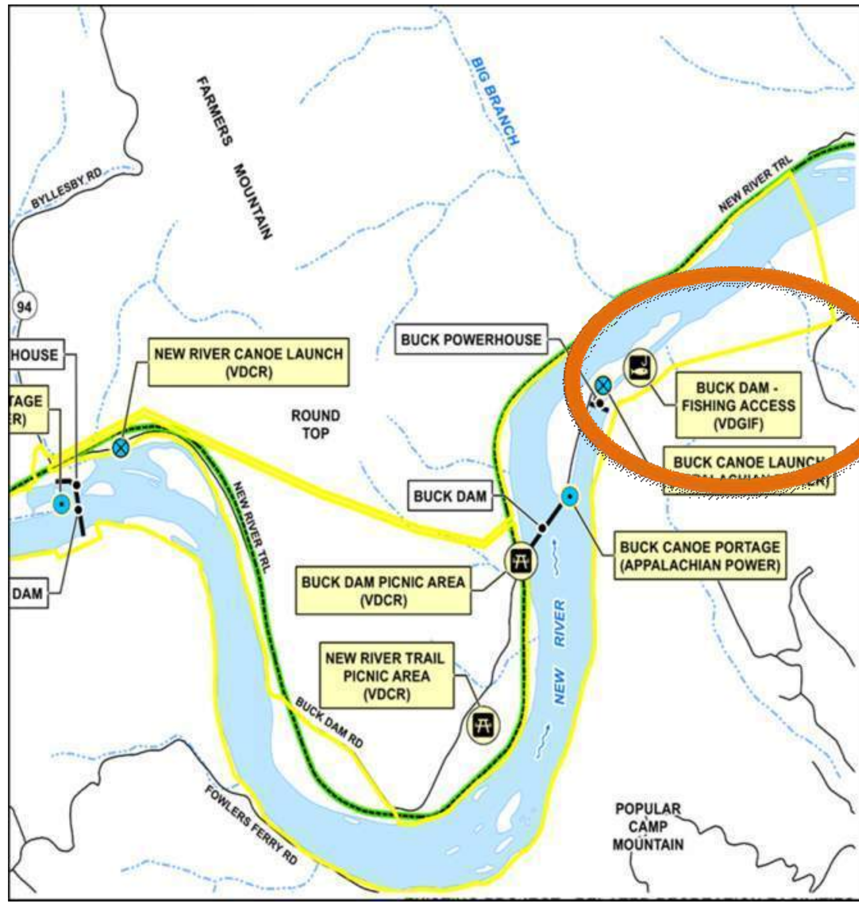
Buck Dam – Fishing Access (informal recreation)

Trail Camera goal:

- Collect data on visitors utilizing tailrace area for fishing; camera faces river-right to capture all recreation



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Buck Dam – Fishing Access Trail Camera Results

- As requested by stakeholders during the preparation of the Revised Study Plan, Appalachian added a 7th location for the trail cameras to determine bank fishing at Loafer's Rest.
- Two occurrences of recreational activity.

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Site Visit Planning

Wednesday, October 28th
9:30a.m. – 3:00 p.m

A reminder that cell phone service is limited at these sites. My cell phone number is 610-299-0959. Please plan to be outside all day and dress accordingly.

Also, bring a face covering or mask, as these will be required throughout the site visit.

Tentative agenda:

- 9:30am – 10:30am – Meet at VDWR Byllesby Boat Ramp on river-right for a safety briefing and to discuss the recreation site.
- 10:30am – 11:15am – Drive to Byllesby dam and meet in parking lot. Can follow HDR/Appalachian to Byllesby or directions provided.
- 11:30am-12:30pm – Drive to and discuss Buck Canoe Portage and Buck Canoe Launch/Fishing Access
- 12:30pm-1:30pm – Have lunch and discuss recreation site at the Buck Dam Picnic Area. We ask that you bring your own lunch, snacks, and water.
- 1:30pm-2:00pm – Drive to and discuss New River Trail Picnic Area
- 2:00pm-2:30pm – Drive to and discuss New River Canoe Launch
- 2:30pm-3:00pm – Drive to and discuss Byllesby Canoe Portage

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Closing

BOUNDLESS ENERGY

Yayac, Maggie

Subject: FW: Byllesby-Buck Recreation Site Visit Meeting Summary
Attachments: AEP Byllesby-Buck Recreation Stakeholder Site Visit Summary_10282020.pdf

From: Yayac, Maggie
Sent: Wednesday, November 18, 2020 9:20 AM
To: Kittrell, Bill (DGIF <bill.kittrell@dwr.virginia.gov>; John Copeland <john.copeland@dwr.virginia.gov>; sam.sweeney@dcr.virginia.gov; rex.hill@carrollcountyva.gov; Boyette, Benjamin <benjamin.boyette@dwr.virginia.gov>; toby.mcclanahan@dwr.virginia.gov; james.elliott@dcr.virginia.gov
Cc: David Keene <david.keene@dwr.virginia.gov>; Hampton, Tom (DGIF <tom.hampton@dwr.virginia.gov>; joseph.grist@deq.virginia.gov; sharon.ewing@dcr.virginia.gov; claytorlakegirl@gmail.com; Kulpa, Sarah <sarah.kulpa@hdrinc.com>; Elizabeth B Parcell <ebparcell@aep.com>; Tristan Cleveland <tristan@lpda.net>; Jonathan M Magalski <jmmagalski@aep.com>; Bill.Kittrell@dgif.virginia.gov; janet_norman@fws.gov
Subject: Byllesby-Buck Recreation Site Visit Meeting Summary

Good morning,

Attached is the meeting summary documenting the recreation site visit at Byllesby-Buck. I've also cc'd the stakeholders that weren't able to make the trip so they would have the latest summary. Please let me know if you have any questions or comments. I hope you all have enjoyable, safe holidays if we don't talk before!

Thanks,

Maggie Yayac
Regulatory Specialist

HDR
440 South Church Street, Suite 900
Charlotte, NC 28202
D 704.248.3666 **M** 610.299.0959
Maggie.Yayac@hdrinc.com

hdrinc.com/follow-us

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HDR

Meeting Summary

Project:	Byllesby-Buck Hydroelectric Project (FERC No. 2514) - Relicensing
Subject:	Byllesby-Buck Recreation Site Visit
Date:	Wednesday, October 28, 2020
Location:	Byllesby-Buck
Attendees:	Bill Kittrell (VDWR) Ben Boyette (VDWR) Toby McClanahan (VDWR) John Copeland (VDWR) Sam Sweeney (New River Trail State Park - VDCR) Jimmy Elliott (New River Trail State Park - VDCR) Rex Hill (Carroll County) Liz Parcell (AEP) Tristan Cleveland (LPDA) Sarah Kulpa (HDR) Maggie Yayac (HDR)

General Comments:

- At each recreation facility, HDR reviewed the trail camera findings, online survey results and presented the recreation features that were studied in support of the Recreation Study Plan.
- Virginia Department of Wildlife Resources (VDWR) explained their recreation goals are to support fishing, hunting, boating, and wildlife viewing. VDWR does not promote primitive camping on its lands.
- Tom Hampton is the VDWR lead for the Memorandum of Agreement with Appalachian that governs the land lease and terms of the Byllesby Boat Launch.
- Thompson Campground site – Sam Sweeney explained that the New River Trail State Park is still very interested in acquiring, re-developing, maintaining, and operating the former Thompson Campground, located between Byllesby and Buck Dams. Previous efforts (1990s and as recently as two years ago with an attempt to reach terms of a 99-year lease) by the State Park to acquire the land from USFS were unsuccessful, reportedly due to unresolvable USFS interests pertaining to liability and insurance. This area is the most suitable area for a campground near the Project and has existing picnic areas, horse facilities, and general campground infrastructure. While there is still widespread interest in this development, the project currently lacks a champion at the federal level (legislative or agency).
- Primitive camping is not encouraged on State Park or VDWR lands but is known to occur. There is little to no posted signage about whether and where camping is allowed.
- Posting a 911 address at formal recreation sites could aid in emergency response. Lack of cell phone coverage is also a safety concern at nearly all of the recreation areas at the project.

- Global comments and recommendations for improved signage regarding intended use, restricted access areas (e.g. tailrace areas, dams), and consistent FERC, regulatory, and identification signage.

- Photos of each recreation facility discussed in this meeting summary are included.

Recreation Facilities (in order of visitation)

- **Byllesby Boat Launch** – VDWR noted that the only approved use of this facility is for boating and fishing. The site is also used for duck hunting access in the winter months. All other use is technically considered trespass. Site is open at all hours for these recreation activities only.

  – VDWR performs site maintenance once a month at a minimum. VDWR contracts with a vendor for regular mowing and trash pickup.

  – The access road to the site is on the list (i.e., Carroll County 6-year plan) to be paved by Virginia Department of Transportation. VDWR noted that they do not control the fabrication or placement of the “trailblazer” signs on public roads.

  – The boat ramp is not usable when the reservoir is drawn down (e.g., for dam maintenance). Appalachian pointed out that the frequency of drawdowns has and is expected to continue to decrease due to operation of the inflatable crest gates preventing flashboard failure.

  – The facility is generally subject to flooding during periods of high inflow.

    - VDWR reported that the area appears to be subject to larger and more frequent flood events over recent years (due to precipitation events).

    - Because of flood siltation deposits, the parking area must be regularly scraped and new aggregate placed.

  – Concerns: Unauthorized uses (including nighttime parking not for fishing access), congestion along the bank (greatest fishing pressure is summer months), and flooding. Other resident comments to VDWR include request for lighting and restrooms. It was noted that any amenities such as lighting, restrooms, benches, etc. would be difficult to maintain due to the flooding. The existing paved walkway near the bank is sloped (shifted) to the extent that it may not conform to ADA requirements for grade.

    - VDWR noted it is common not to have restroom facilities at remote sites such as this.

    - The site may not have a 911 address (Rex Hill to confirm).

  – Potential improvements: concrete paving of parking lot (though significant cost) and/or paved accessible parking spot, extension of bank fishing (if feasible due to floodplain development and wetland impacts), solar-powered dusk to dawn light (near main sign), and facilities to promote wildlife viewing.

- **Fowlers Ferry (informal)**: Appalachian owns the land on the river side of the road (confirmed on Carroll County GIS map). There are a few informal recreation spots along the river, but one larger area unseen from the road. Ben Boyette explained that known/observed uses include picnicking, primitive camping, ATV, fishing, wildlife viewing wading, and canoe/kayaking. A large informal road through the area creates a loop, and there are numerous informal road/trail spurs. Ben also confirmed that this area saw the highest usage of illegal activity within/adjacent to the Project Boundary. The site provides a unique viewing perspective and reservoir access for this side of the river. The County Sheriff Deputy patrols the area but relies heavily on VDWR Conservation Officers to do so.
  - Concerns:
    - Illegal uses, trash, unauthorized and uncontrolled vehicle access.
    - Lack of signage regarding land ownership or authorized uses (if any).
    - ATV use is not compatible with VDWR site uses but would be difficult to prevent.
    - Large area that is largely out of sight from the road.
  - Opportunities:
    - The agencies would like to control (or at a minimum have grounds to enforce) usage and access.
    - Bill mentioned that VDWR has a grant to lease land from private owners for long term fishing and boating access that may apply to a site such as this. VDWR has interest in acquiring the site from Appalachian.
    - Potential to serve as (hand) launch area for canoes and kayaks (although not much river reach to paddle before Buck dam).
    - Barriers could be placed to prevent vehicle access and a designated parking area established near the road.
    - Potential to formalize foot path.
- **Buck Dam Picnic Area**: Users access the Buck bypass via the New River trail informally to bank fish around this facility. The State Park maintains the site and the restroom (portable toilet, not ADA accessible). The New River Trail State Park right of way is 40 ft from the center of the trail (in both directions). Agencies noted it is unclear how far away users are required to stay from the dam.
  - Opportunities:
    - Clear signage below the dam demarcating point at which access is prohibited (difficult for VDWR to enforce no access to the dam without this).

- Additional signage and audible alarm warning of dam operations and rising water levels.

- **Buck Dam Canoe Portage/Downstream Fishing Access**:
  - Canoe portage is not heavily used. Put-in to the tailrace below the dam and powerhouse is steep and the current is swift, making it hard to put a canoe in. Canoe take-out commonly accumulates debris and is also relatively steep. This portage is unlikely to be widely used because the user base/craft type is very different for the reservoir and the downstream river reach. Use would likely be to connect the reservoir and downstream reach for continuity by very motivated paddlers.
  - Agencies noted that access to the island across the bypass reach for fishing is by boat (traveling upstream) or wading (less often due to challenging terrain and flows).
  - VDWR noted that they have not issued as many tickets to trespassers near the Buck powerhouse/tailrace channel in recent years and No Trespassing signage has likely deterred users. Usage has gone down over the recent years, however from an angler perspective it is still a desirable fishing location because the tailrace channel attracts fish.
    - Discussion of origins of 200-yard setback from dam or powerhouse rule (Appalachian and VDWR to confirm this)[1].
  - Opportunities:
    - Agencies suggest a more level portage or a step-down launch, though noted that installed at Foster Falls would likely receive much more use than this site.
    - Installation of clear usage signage below the dam and emergency contact signage should a user access the portage outside of station work hours and need help.
    - There is little signage on the island between the dam and powerhouse, including for trespassing or fishing setbacks making it difficult for VDWR to enforce use of the area.
  - HDR/LPDA investigated other portage opportunities on river-left in the bypass off the New River trail. Upstream of the dam is a large wetland blocking access and below the dam has geology unsuitable to canoeing or kayaking.

- **Loafer's Rest (informal area) –** Group did not visit Loafer's Rest, but discussed it from Buck Dam Put-In. Parcels of land in this area are presently leased from Appalachian to VDWR

[1] Based on further review after the site visit, the 200-yard setback is not universal/state-wide but applicable only to Kerr Dam and Leesville Dam. 4VAC15-370-40. Vessels prohibited within certain areas below John H. Kerr Dam and Leesville Dam. Appalachian to evaluate appropriate public safety setback requirement(s) and implement related measures as appropriate.

under a separate agreement from 2000. VDWR noted that this area provides the best river access downstream of Buck Dam and supports a broad user base.

- Opportunity:
    - Formalize as a VDWR river access, improve unmaintained trail to Buck tailrace, install signage, locate parking area closer to river (especially to improve access for senior citizens).

- **New River Trail Picnic Area –** VDCR maintains the area and noted the amenities (grill, benches, picnic table, etc.) have likely been there for well over 10 years. There is a trash can at this location (trash pickup done by State Park). They do not maintain the trail from Buck Dam Rd or the informal parking area. Does not appear the parking area could be expanded immediately adjacent to the picnic area (currently space for 2 vehicles). The road and shoulder is U.S. Forest Service land.
    - Opportunities:
        - Additional identifying signage and posted rules for use
        - Repair/update existing amenities such as bench and fire pit.

- **New River Canoe Launch (downstream of Byllesby Dam)** – Discussion of the temporary access road Appalachian periodically replaces for vehicle/equipment access to the lower level of the powerhouse and whether it will become permanent in the future. Bill expressed concern that the temporary access road washes away and deposits culverts and other materials downstream and noted that if the road is to be made permanent a bottomless culvert may be necessary. No specific recreational improvements were noted or discussed at this site. There is clear signage denoted trespassing and fishing access boundaries along the bank, though no formal FERC recreation sign. There is also no boating/fishing boundary signage from the water. The group discussed that the area is used more for fishing/river access than canoe or kayak launch.

- **Byllesby Canoe Portage -** VDWR noted that the portage take-out used to be along the left bank close to the parking area. However, when the wetland was created following dredging in the late 90's, the portage was moved to the current location. VDWR is concerned that the linear distance to walk between the take-out and parking lot is far and creates a barrier to use. The group discussed the potential of cutting a channel through the wetland or adding a boardwalk, but these may not be feasible due to wetland impacts and the probability of the channel silting in during frequent flood events.
    - VDWR noted that in the past they've tried to use the portage for emergency boat access to Byllesby reservoir (significantly reduces travel time if don't have to drive to the opposite side of the river to launch), but they were only able to launch the boat near the buoy line since the portage was heavily silted and the water depth was nearly too shallow. VDWR inquired about the potential for an emergency-use only boat access in the Byllesby reservoir to allow them to gain access to the river faster.

    – HDR/LPDA walked the New River trail upstream of the site to assess potential for portage take-out above the wetland, however the portage route would be even longer if that was implemented. Desktop estimates of trail length are provided:

        - Portage take-out to access gate: 775 feet
        - Access gate to parking lot: 460 feet
        - Top of wetland to parking lot: 2,400 feet

- **Closing** – Brief discussion/recap of major observations at each site. Appalachian/HDR to develop meeting summary and distribute to this group for review (copy others invited to meeting but who were unable to attend, for awareness). Meeting participants agreed that the trail camera monitoring had proven effective with only one camera lost to vandalism/theft and had captured data from a peak recreation season. The group supported removal of the trail cameras at the end of the month, in accordance with the schedule proposed in the approved Revised Study Plan.

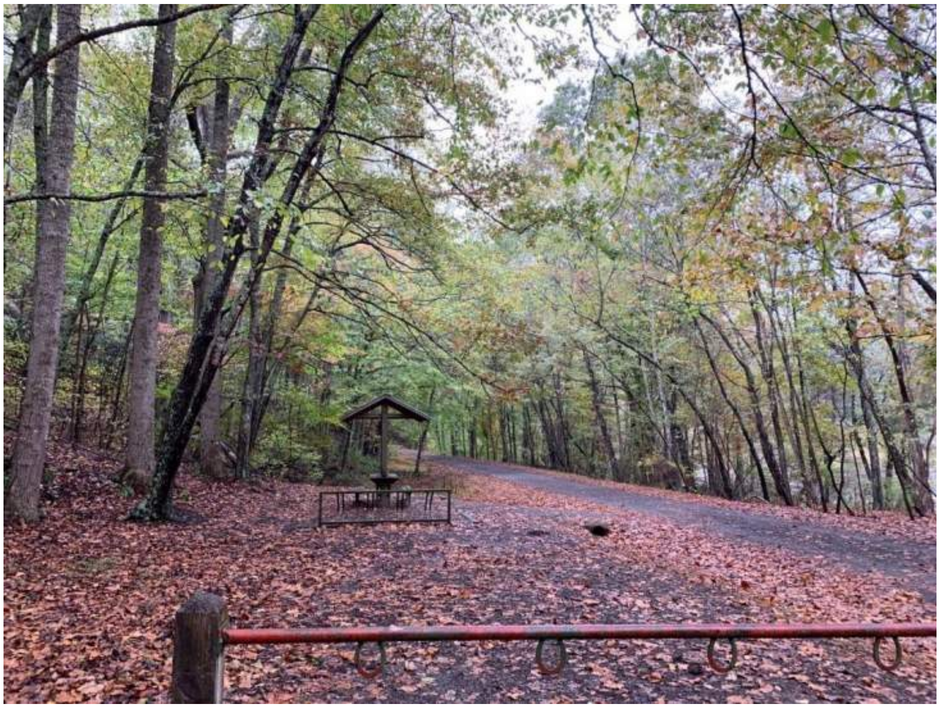
Photos of Recreation Facilities

Byllesby VWDR Boat Launch

Byllesby VWDR Boat Launch Parking Area

Fowlers Ferry (informal)

Buck Dam Picnic Area



Buck Dam Canoe Portage Take-Out

Buck Dam Canoe Portage Put-In

Interested Buck Angler Access from Loafer's Rest

New River Trail Picnic Area Lower Area

New River Trail Picnic Area Upper Area

New River Canoe Launch

Byllesby Canoe Portage Take-Out

Byllesby Canoe Portage Parking Lot

Thompson Campground site

Attachment 3

Attachment 3 – Visitor Online Survey Results

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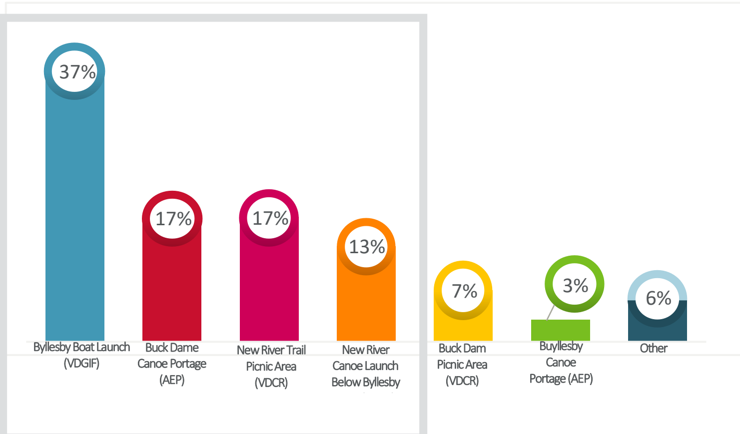
Byllesby-Buck Recreation – *Overall Summary Results*

Survey Locations:



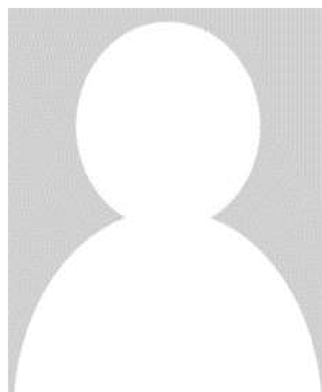
From **April 2020 to December 2020** there have been **142** respondents at various locations within the Byllesby-Buck Recreation Project Area who completed this online survey. During this timeframe **84%** of the responses primarily came from four locations: Byllesby Boat Launch (VDWR), Buck Dam Canoe Portage, New River Trail Picnic Area, and New River Canoe Launch Below Byllesby Dam.

These respondents answered questions about their use of the recreation facilities. This data is collected to support the Federal Energy Regulatory Commission (FERC) relicensing process.

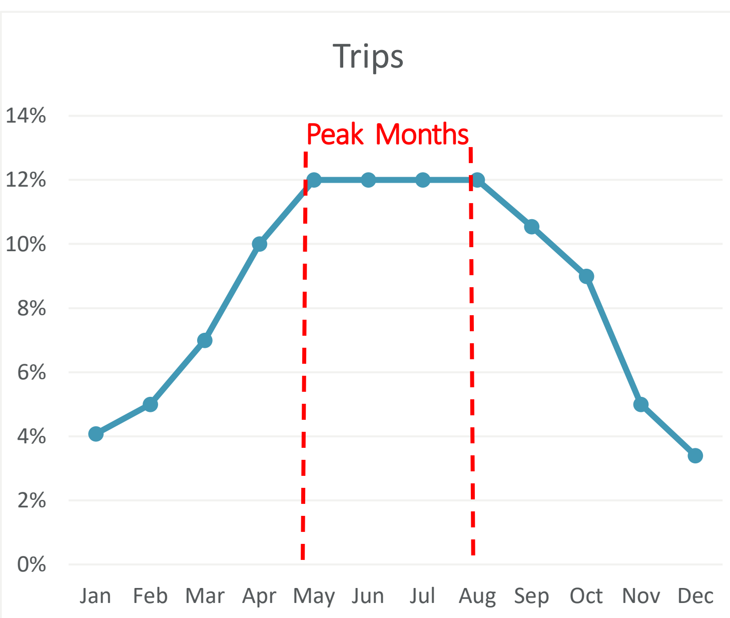
Predominately **42%** of the survey respondents come from three zip code locations, which are on average **18** miles away from Byllesby – Buck Recreation. **92%** consider themselves to be regular visitors to the area with at least 3 or more times a year with an average length of stay being **5** hours.

Males made up **74%** of the respondents, **49%** in their thirties and forties.

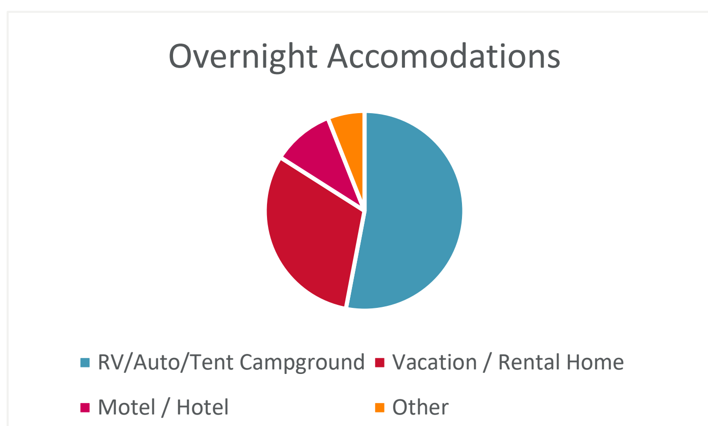
The most frequent months visited are from April to September, with May, June, July, and August being the peak months.



- Zip codes of most frequent visitors: **24330, 24333 & 24382**
- Average # of visits per year are **18**
- Average miles traveled: **34**

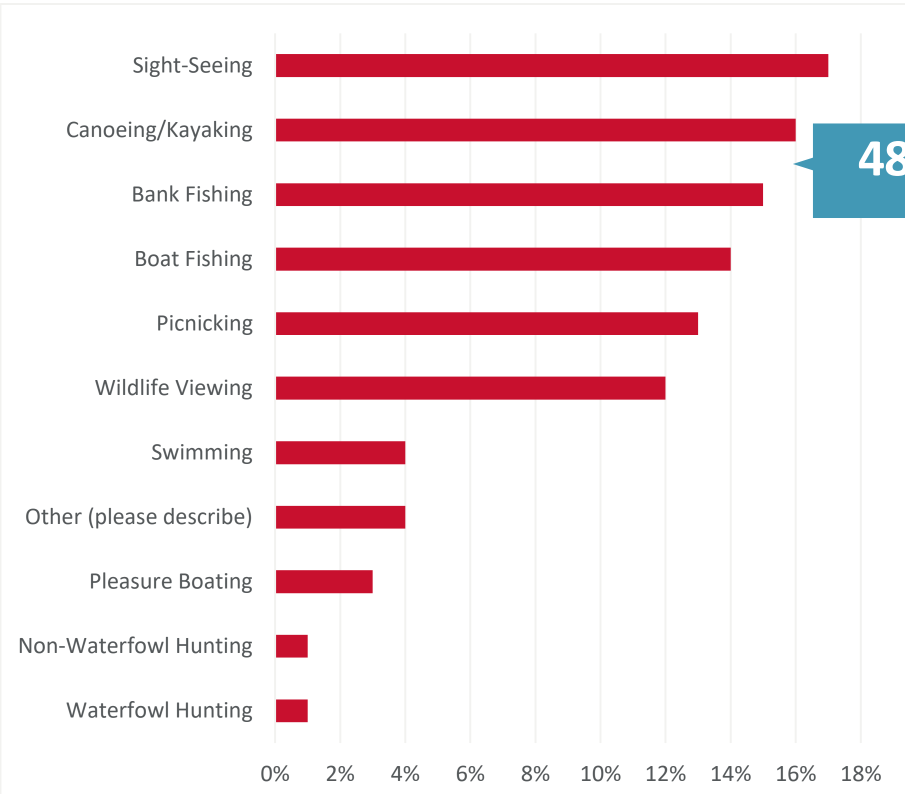


83% of respondents were not staying overnight in the Byllesby-Buck Project area. Of the **17%** that were staying overnight a breakdown of the accommodations used is shown:



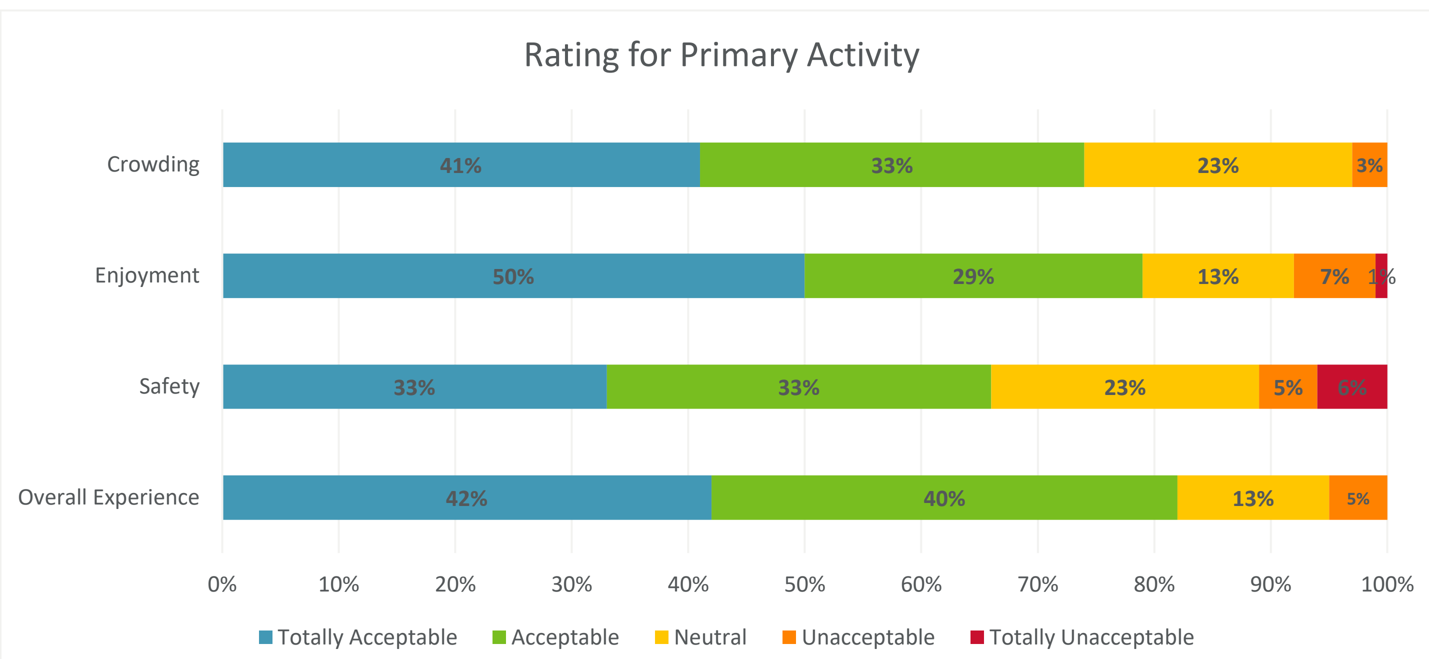
Byllesby-Buck Recreation – *Overall Summary Results*

Activities Participated on Trip:

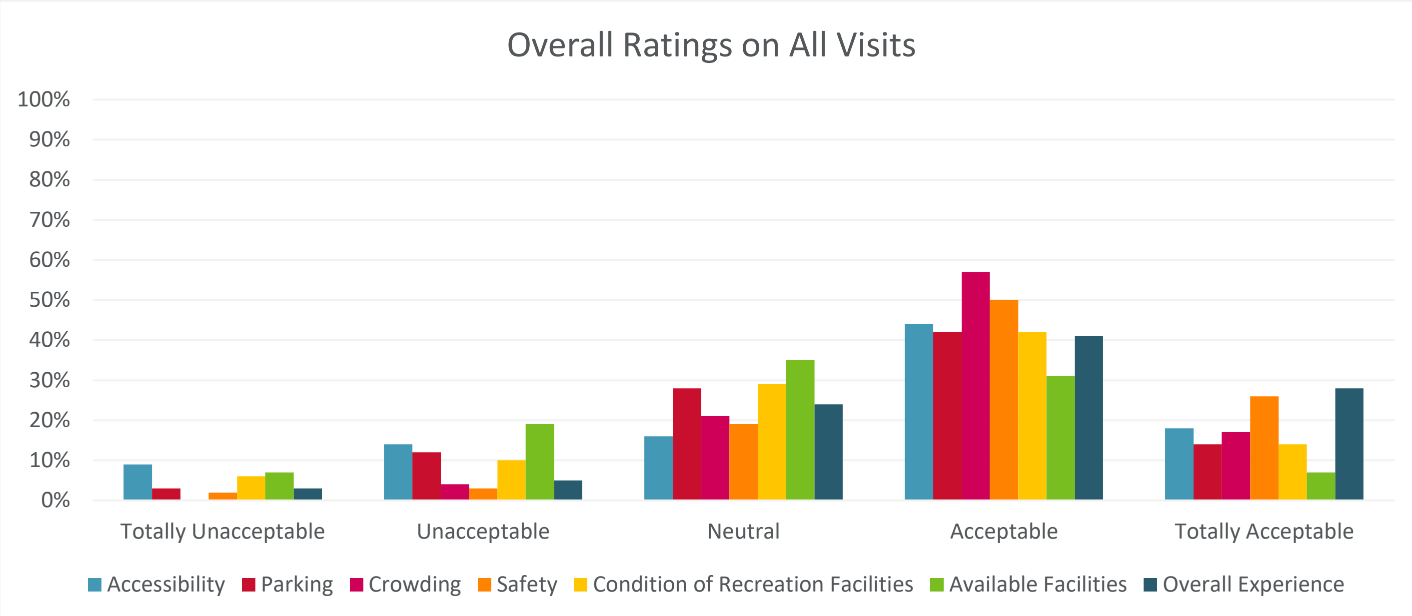


48% fishing is the primary activity

Primary Activity	Percent
Fishing	48%
Canoeing/kayaking	20%
Sight-seeing	11%
Biking	9%
Picnicking	4%
Hiking	2%
Hunting	2%
Wildlife Viewing	2%
Swimming	1%



Byllesby-Buck Recreation – *Overall Summary Results*



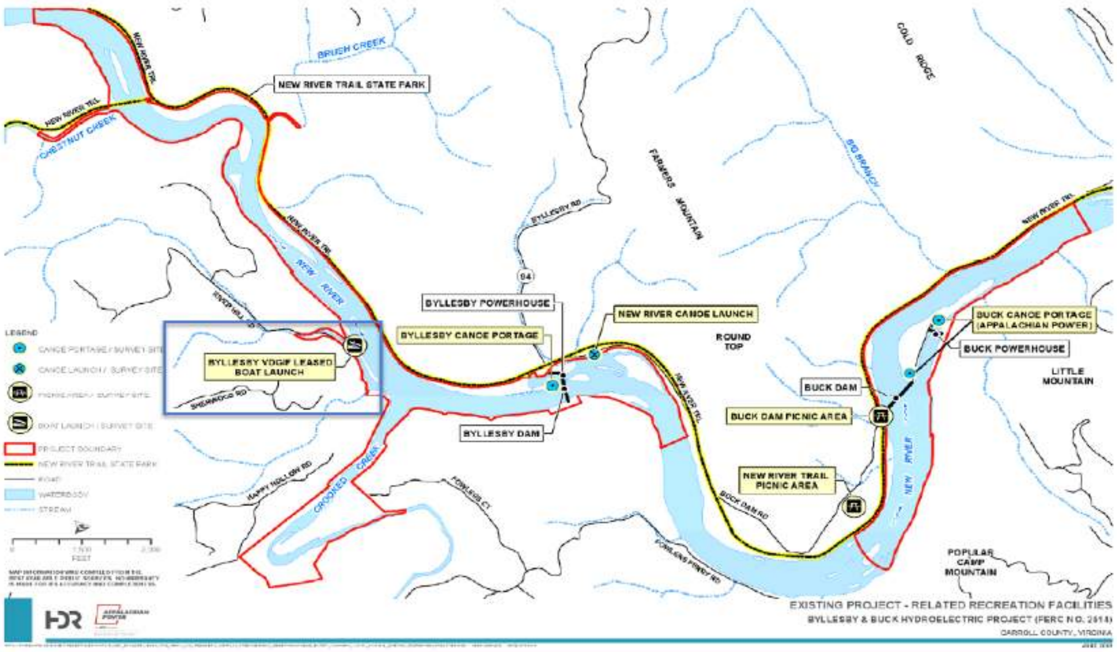
Improvement Suggestions	Count
Improved or additional boat access	31
Restrooms	15
Maintain a full, stocked pond w/ Clear water	13
Better parking	8
Re-open campgrounds	8
Covered shelter	3
Drinking water available	3
Regular patrols / VDGIF presence	3
Better handicap accessibility / signage	2
Fishing piers	2
Light pole @ boat ramp	2
Wider access road	1

Overall the comments from the respondents show that nearly half view Byllesby-Buck as a beautiful & unique place to visit.

The top **3** suggestions for improvement include improve/ additional boat access, adding restrooms, have better parking available. The biggest impact would be improvement to portage at the dam.

Byllesby-Buck Recreation – *Cumulative Results for Byllesby Boat Launch*

Survey Locations:



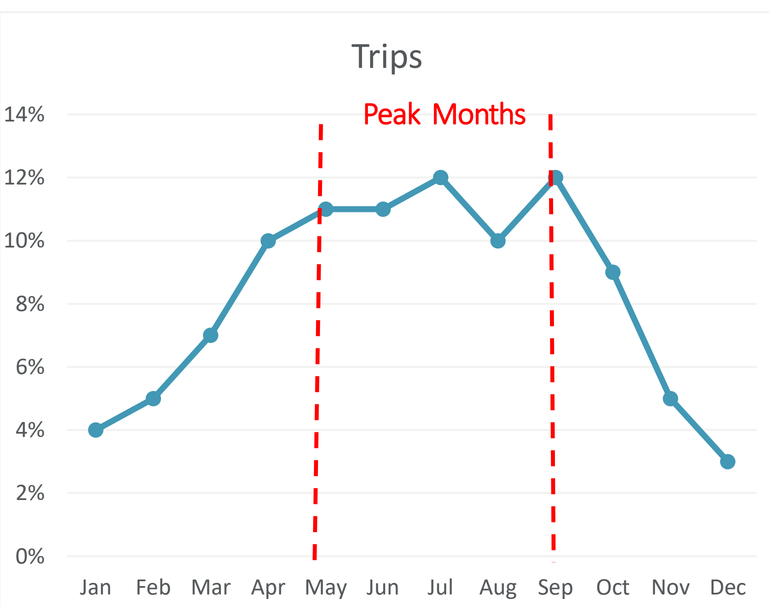
From **April 2020 to December 2020** there have been **52** respondents from the **Byllesby Boat Launch**. Overall, **37%** of the responses came from this location.

These respondents answered questions about their use of the recreation facilities. This data is collected to support the Federal Energy Regulatory Commission (FERC) relicensing process.

Predominately **49%** of the survey respondents come from three zip code locations, which averages about **16** miles away from the Project. **93%** of respondents consider themselves to be regular visitors to the area with at least 3 or more times a year with an average length of stay being **4** hours.

Males made up **90%** of the respondents, **51%** in their thirties and forties.

The most frequent months visited are May through September with June and July being the highest visited months.

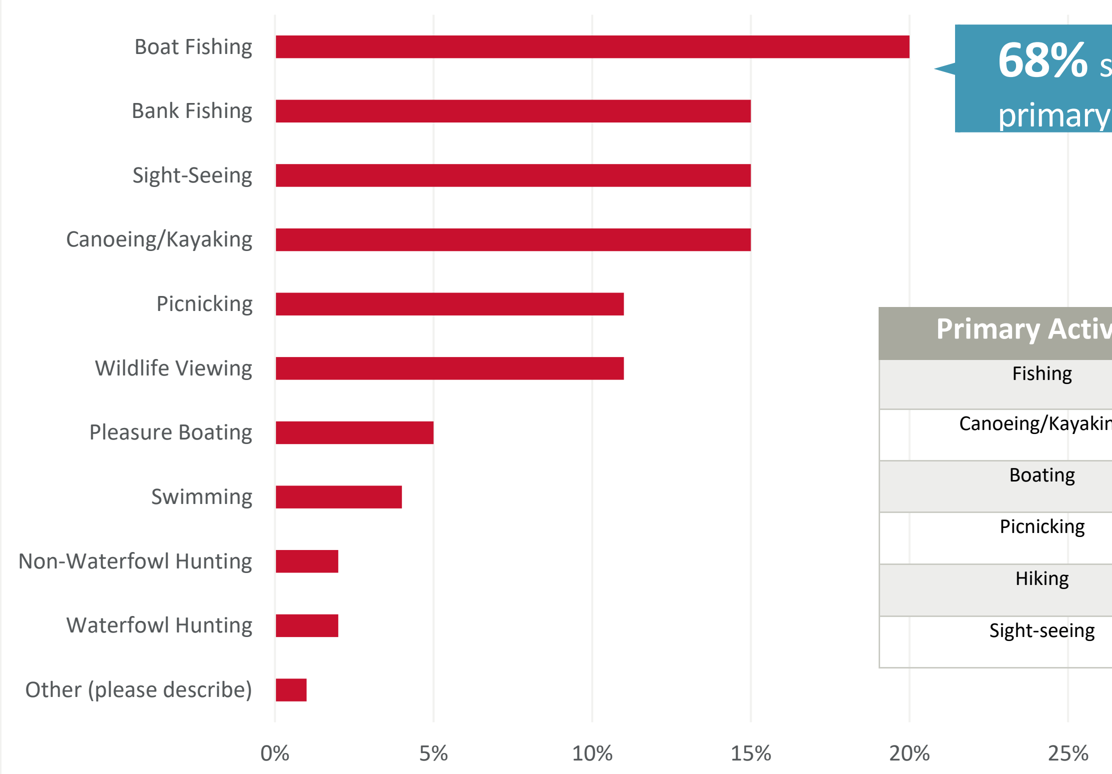


- Zip codes of most frequent visitors: **24330, 24333 & 24381**
- Average # of visits per year are **19**
- Average miles traveled: **23**

88% of respondents were not staying overnight in the Byllesby-Buck Project area. Of the **12%** that were staying, accommodations were made up of: **40%** RV/tent camping and **60%** staying at a vacation/rental home.

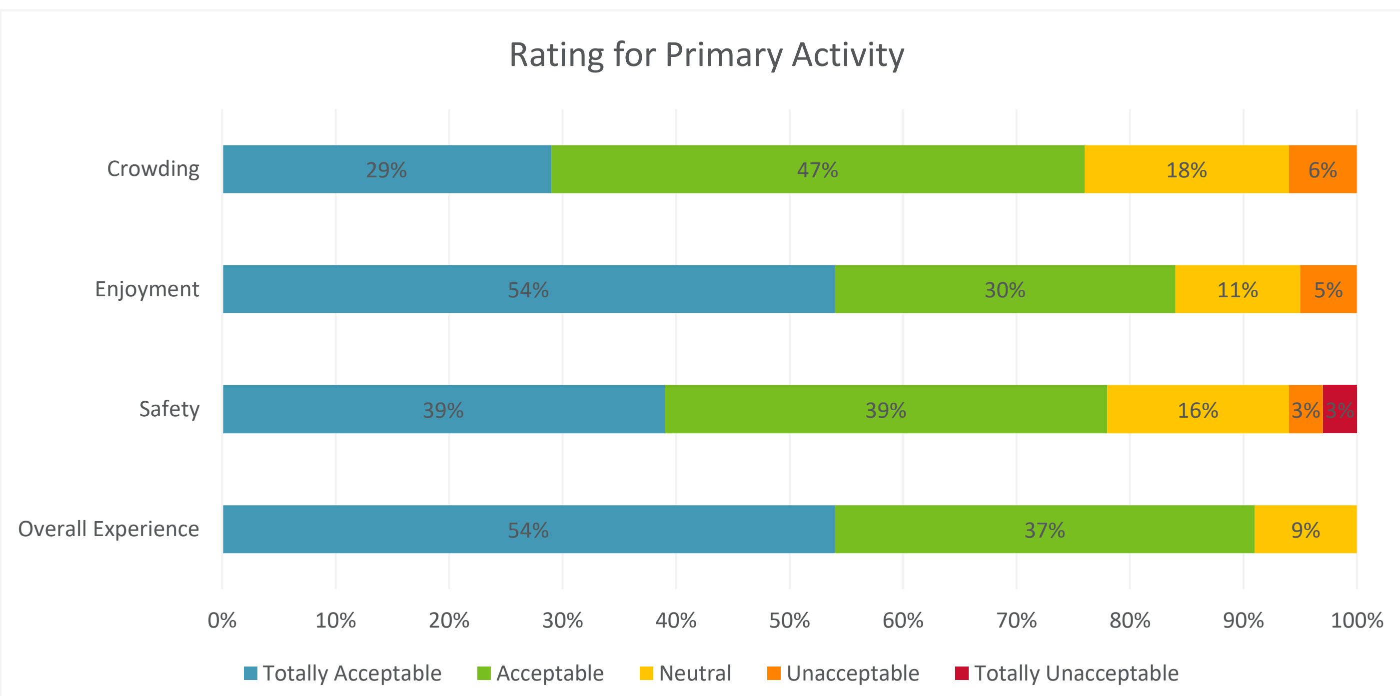
Byllesby-Buck Recreation – *Cumulative Results for Byllesby Boat Launch*

Activities Participated on Trip:

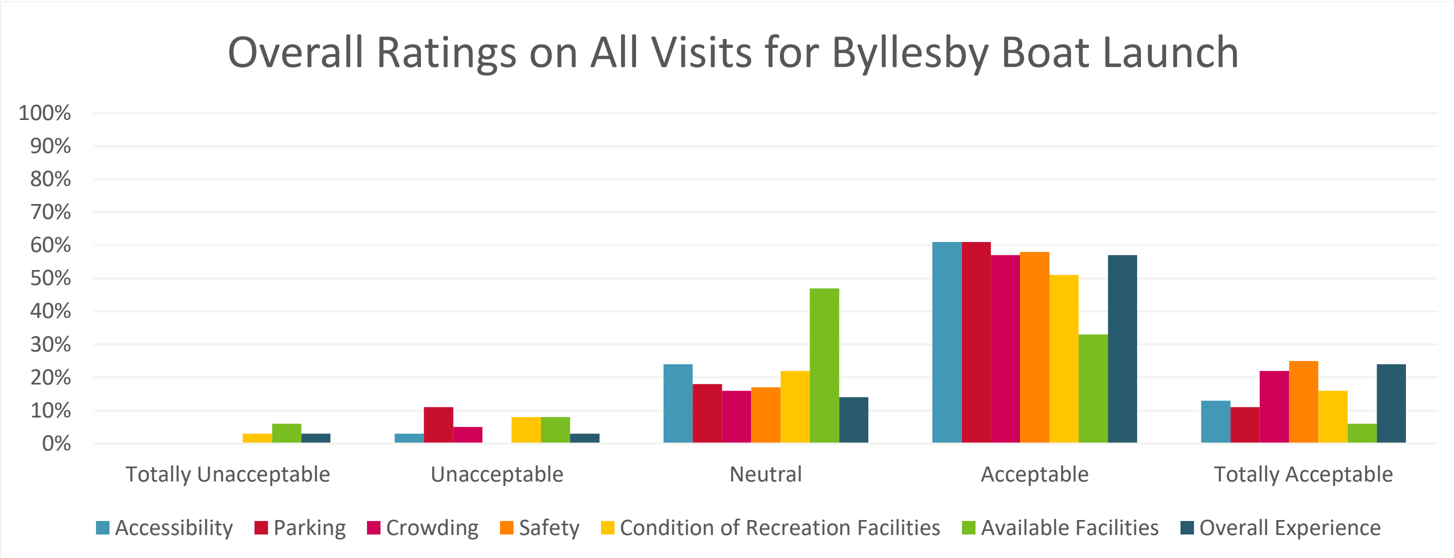


68% selected fishing as the primary activity

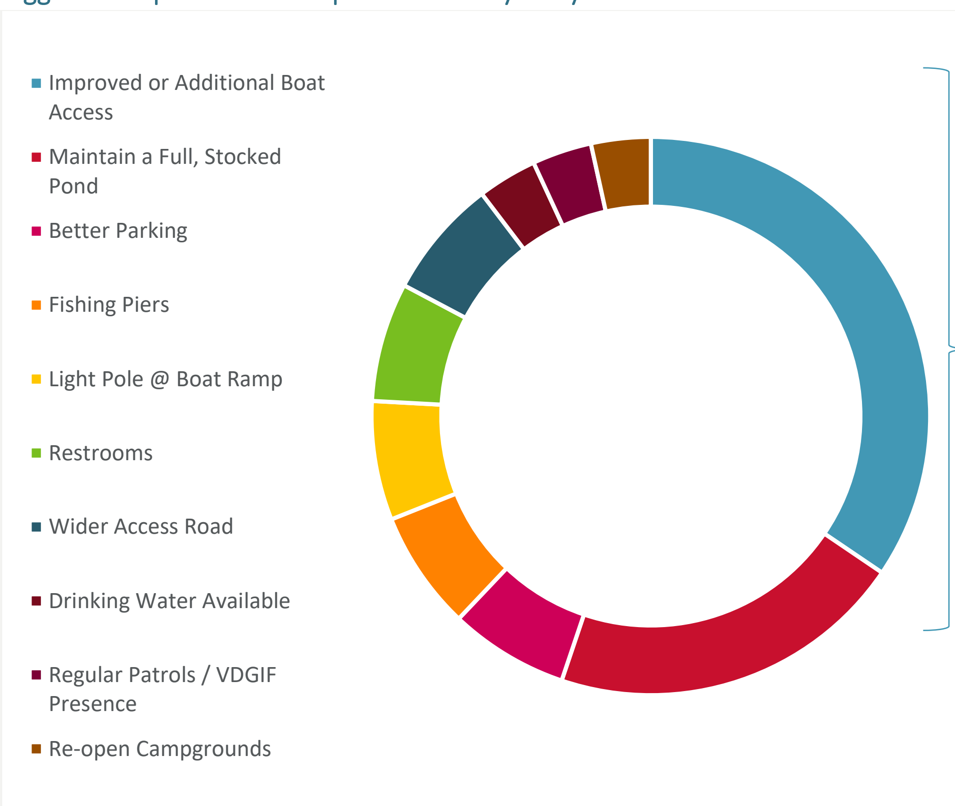
Primary Activity	Percent
Fishing	68%
Canoeing/Kayaking	20%
Boating	3%
Picnicking	3%
Hiking	3%
Sight-seeing	3%



Byllesby-Buck Recreation – *Cumulative Results for Byllesby Boat Launch*



Suggested Improvement Responses from Byllesby Boat Launch:



Improvement Suggestions	**#**
Improved or Additional Boat Access	10
Maintain a Full, Stocked Pond	6
Fishing Piers	2
Light Pole @ Boat Ramp	2
Better Parking	2
Restrooms	2
Drinking Water Available	1
Regular Patrols / VDGIF Presence	1
Re-open Campgrounds	1
Wider Access Road	1

Byllesby-Buck Recreation – *Cumulative Results for Byllesby Boat Launch*

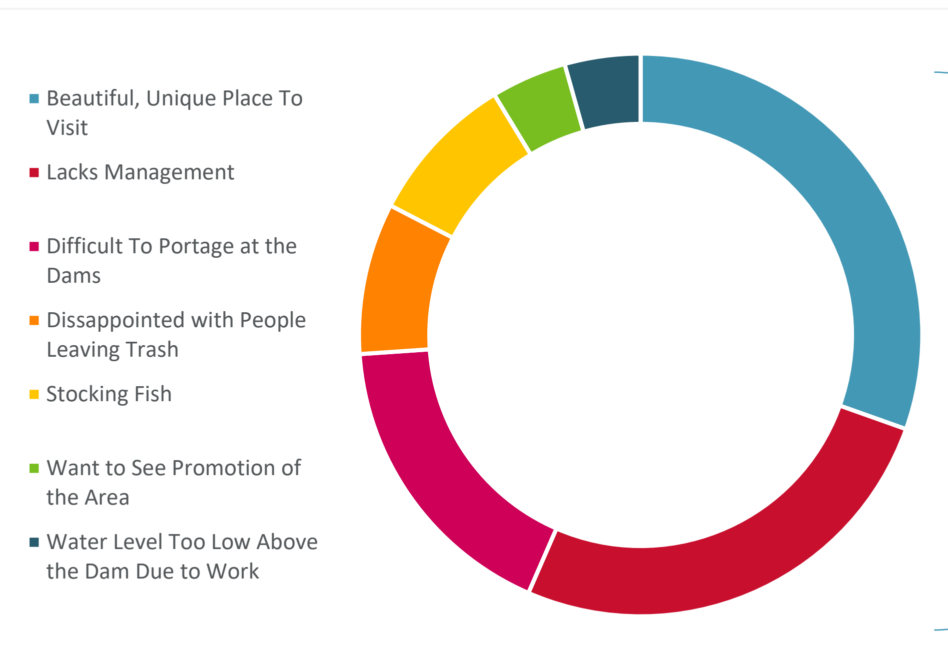
Type(s) of recreation facilities or improvements respondents believe are needed and at what specific location(s) at the Byllesby-Buck Project: *(verbatim responses)*

• Better parking area, more police patrol
• Better parking, more places that are cleared to fish from the bank, more picnic areas for family activities. More trash receptacles so possibly the riverbanks wouldn't be so trashed up. Campgrounds like there used to be would be great. All along the byllesby-buck project area
• Boat Dock/pier
• Boat ramp between dams.
• Boat ramp needs a light pole set up at the launch for us night fisherman
• Boat ramp on the Buck Dam pool.
• Byllesby need more stocking of fish!
• Fishing piers at tail raise
• I wish the campground that was started there would be completed. This would bring people and revenue to the area.
• lighting at byllesby boat launch
• more canoe/kayak launches are always a good idea
• My wife and I love fishing below both dams. Below the dams is the absolute best place we find to catch big carp and all species on a regular basis. We were sad to see signs moved further toward the parking area saying no trespassing at byllesby dam below the dam at the canoe launch. A couple years back we could access that small pool and it was good fishing but now they’ve moved the signs and we couldn’t access that part for fear of trespassing. I pay more for fishing license and get less fishing space year to year. Doesn’t seem fair.
• Need to maintain full pond as much as possible. Recreation has suffered due to the many years of low flows. Feel it has effected the fishing.
• None needed at this time
• Portage at Dam could use some improvement
• Restroom facilities
• wider access road to boat ramp along with regular police patrols due to the location of facility
• Water quality is terrible in terms of the amount of mud coming down river from the dam. Totally unacceptable...
• Stop equipment from working in the river causing muddy water throughout the seasons.
• Excellent area. Frequent for hiking and cycling.

Byllesby-Buck Recreation – *cumulative results by Byllesby Boat Launch*

• In meeting I attended. there was some thought of lowering pond during n winter.. we need to be able to access boat ramp.. kayaking/fishing boats ..
• Better availability about the dam on power house side
• Canoe and kayak access at the beginning of byllesby lake (end of rapids) so you don't have to paddle 2 miles to get to
• Bathrooms at bylledby pool boat ramp.
• Boat launch at buck dam.
• I fish from byllesby boat landing on average twice a week. Enjoy the fact that its ussually not over crowded.
• water clarity has been really murky this year with a lot of debris in the water

Additional Comment Responses from Byllesby Boat Launch:



Comments	#
Beautiful, Unique Place To Visit	7
Lacks Management	6
Difficult To Portage at the Dams	4
Dissappointed with People Leaving Trash	2
Stocking Fish	2
Want to See Promotion of the Area	1
Water Level Too Low Above the Dam Due to Work	1

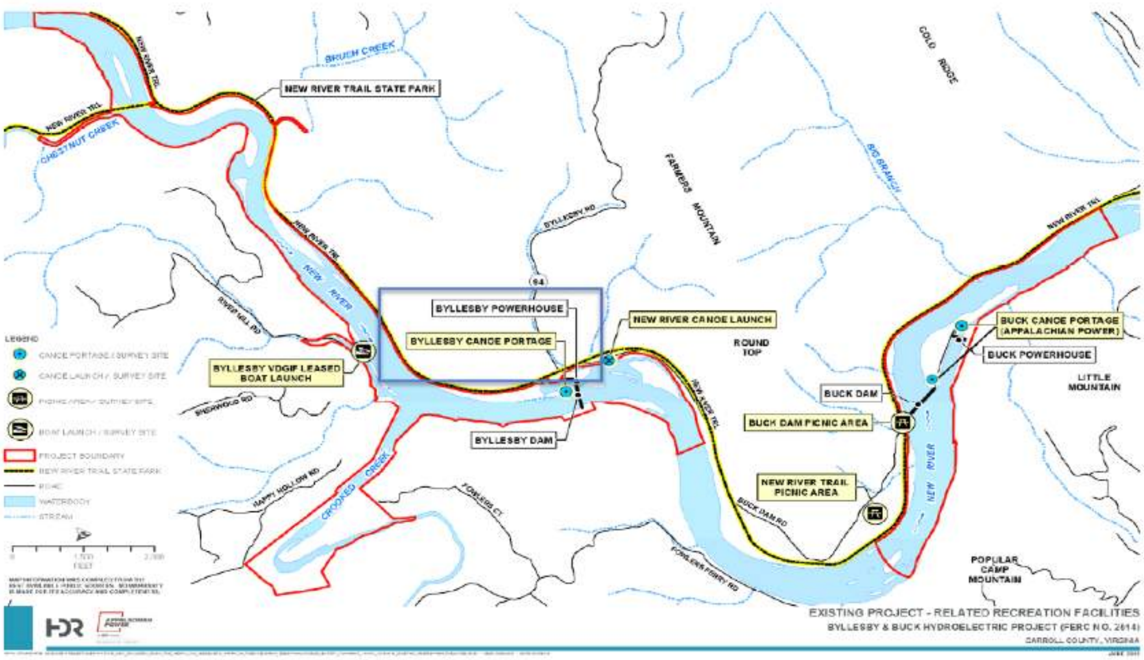
Byllesby-Buck Recreation – *cumulative results by Byllesby Boat Launch*

Additional comments: *(verbatim responses)*

• Beautiful place to visit and show off to visitors
• Due to dam work the water level above the dam is too low to be used for boating/kayaking and fishing.
• Fishing has dropped off over the past few years between the dams. What can AEP do to improve this.
• I just love it there and go every chance I can.
• If this area was helped and marketed correctly I believe it would flourish. I own New River Outdoor Adventures and I would help promote the area for families, fishermen, and nature lovers. Timmy Dixon 2762378823
• Ive lived in this area my whole life and enjoyed everything it has to offer please let the younger generation enjoy it also give them something to do in a place with not much else to do
• More visibility of park officials to help patrol the area so maybe people wouldn't leave so much trash and things
• My biggest complaint is the way some people leave their trash all over the ground. There's not much you can do about that. There could be twice as many trash cans and some people would be too lazy to walk five extra steps
• Portage above buck dam so we dont have to go below buck dam
• This is a unique part of the river in our area. I often bring my out of state guests here.
• This is by far, the best recreation area of its kind!
• Please do some thing about the muddy condition of the river. It is killing the fishing,
• Muddy water conditions that are made by AEP is unacceptable.
• Preserve what you can.
• Parking
• A beautiful area
• Solar lights for night safety.
• Only comments i have are positive. Enjoy fishing the area. Would be nice to have a small dock at the landing to make more accessible getting in and out of the boat. Nothing big as i feel it would attract the wrong groups of people and become a hangout instead of a boat launch. Just a suggestion, but i am happy i have a place close to home to enjoy time at.

Byllesby-Buck Recreation – *Cumulative Results for Byllesby Canoe Portage*

Survey Locations:



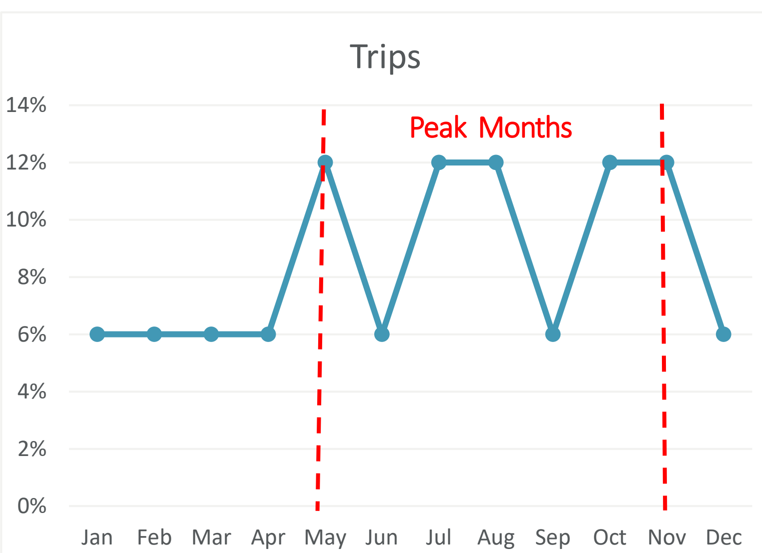
From **April 2020 to December 2020** there have been **4** respondents from the **Byllesby Canoe Portage**. Overall, **3%** of the responses came from this location.

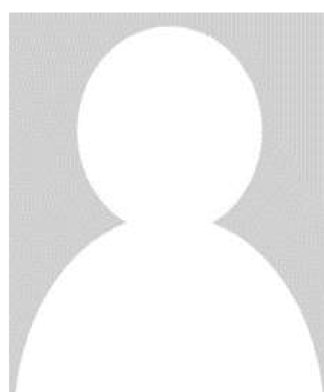
These respondents answered questions about their use of the recreation facilities. This data is collected to support the Federal Energy Regulatory Commission (FERC) relicensing process.

Predominately **50%** of the survey respondents come from one zip code location, which is **40** miles away from the Project. **67%** of respondents consider themselves to be regular visitors to the area with at least 3 or more times a year with an average length of stay being **2** hours.

Males made up **75%** of the respondents, **50%** in their thirties.

The months most visited are May, July, August, October & November.



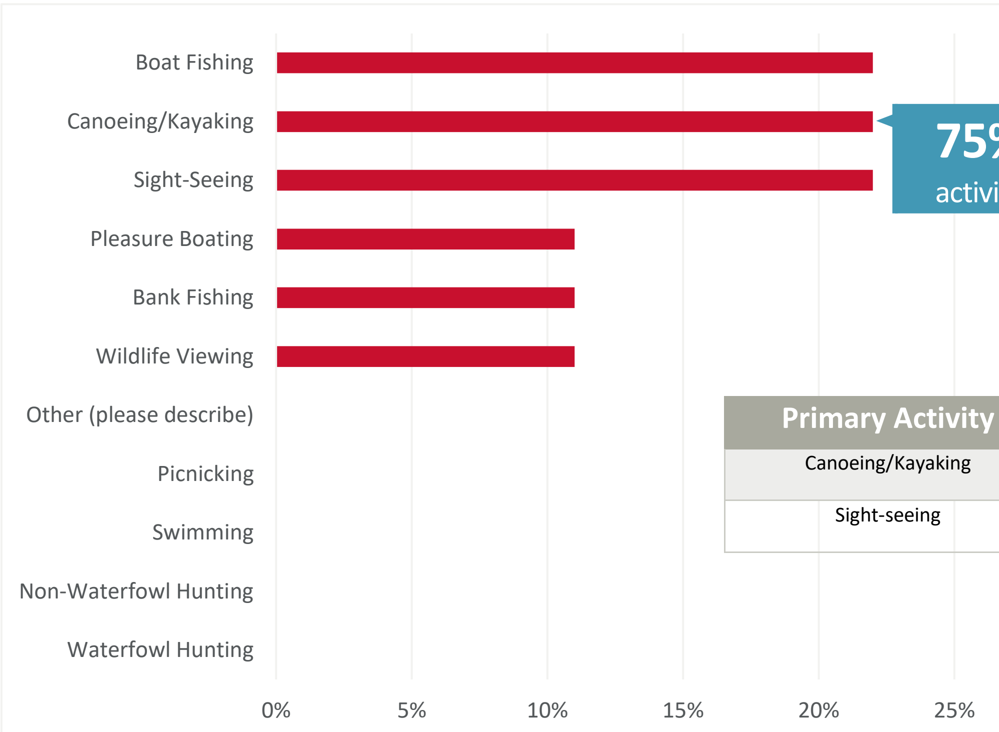


- Zip code of most frequent visitors: **24312**
- Average # of visits per year are **36**
- Average miles traveled: **83**

100% of respondents were not staying overnight in the Byllesby-Buck Project area.

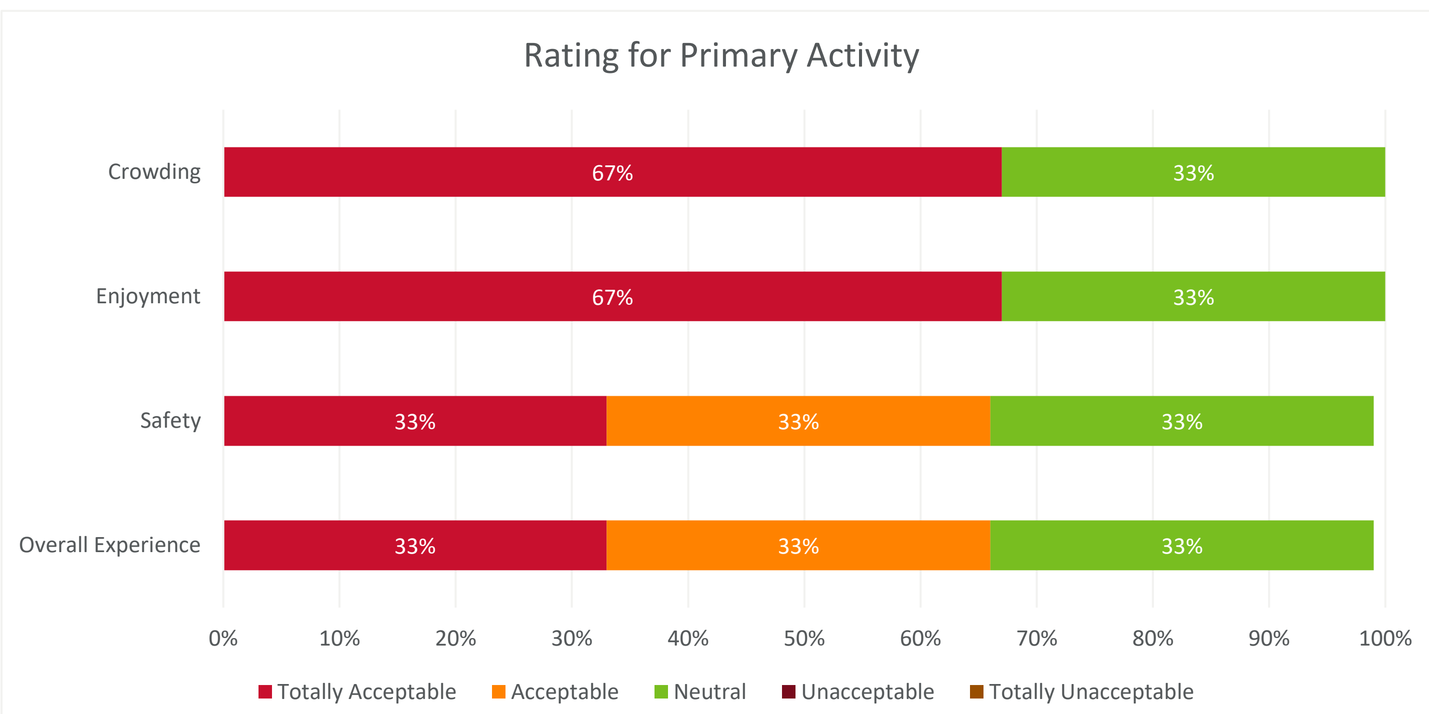
Byllesby-Buck Recreation –*Cumulative Results for Byllesby Canoe Portage*

Activities Participated on Trip:

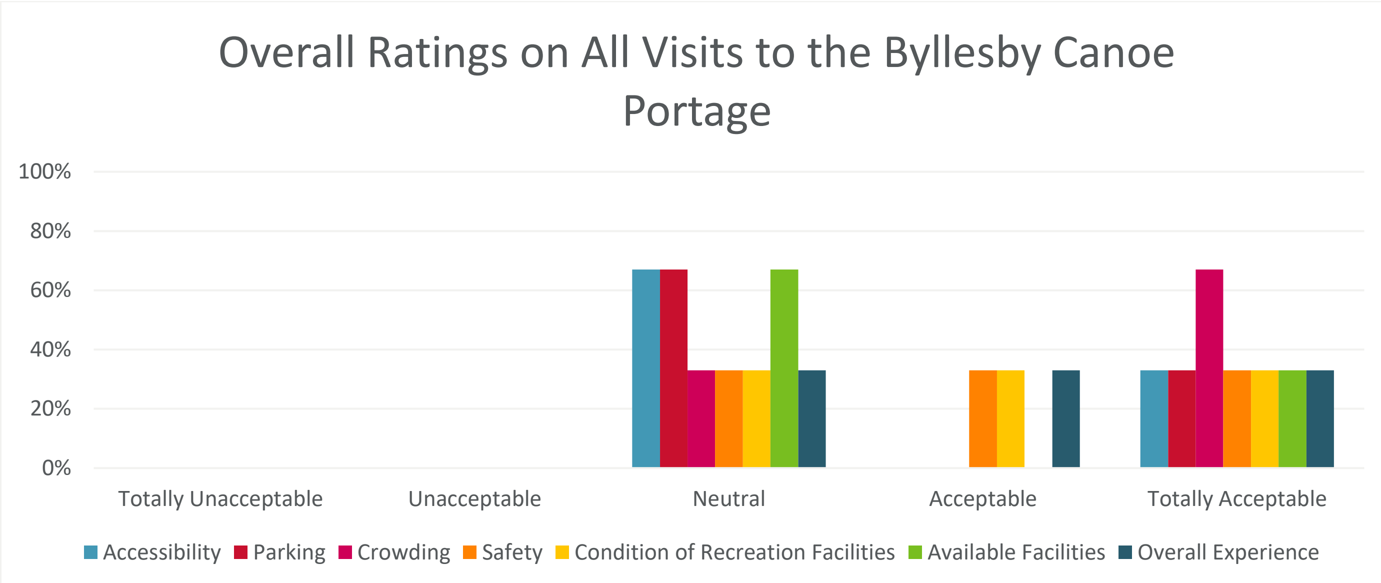


75% selected canoeing as the primary activity

Primary Activity	Percent
Canoeing/Kayaking	75%
Sight-seeing	25%



Byllesby-Buck Recreation – *Cumulative Results for Byllesby Canoe Portage*



Type(s) of recreation facilities or improvements respondents believe are needed and at what specific location(s) at the Byllesby-Buck Project: *(verbatim responses)*

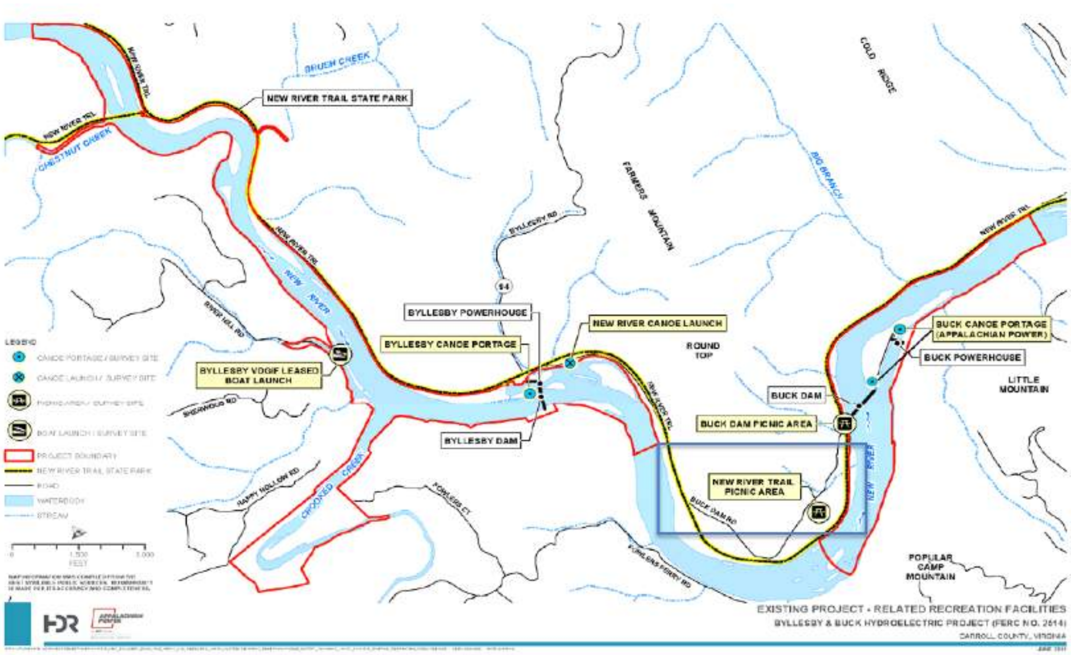
- Easier public access and Portage options for kayak/canoe around both dams.
- A good boat launch on the power plant side of the river would be awesome.

Additional Comments: *(verbatim responses)*

No responses given

Byllesby-Buck Recreation – *Cumulative Results for New River Canoe Launch*

Survey Locations:



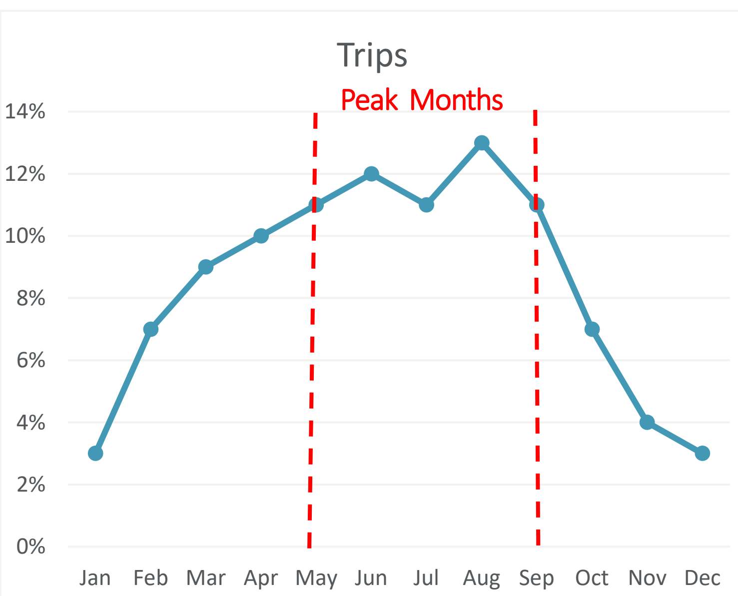
From **April 2020 to December 2020** there have been **19** respondents from the **New River Canoe Launch**. Overall, **17%** of the responses came from this location.

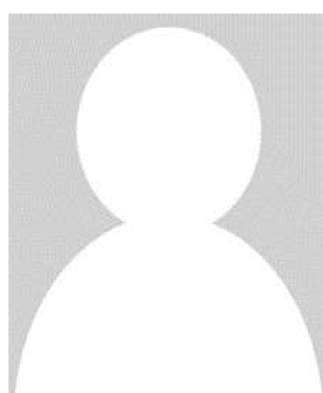
These respondents answered questions about their use of the recreation facilities. This data is collected to support the Federal Energy Regulatory Commission (FERC) relicensing process.

Predominately **48%** of the survey respondents come from two zip code locations, which average about **21** miles away from the Project. While **100%** consider themselves to be regular visitors to the area with at least 3 or more times a year with an average length of stay being **3.6** hours.

Males made up **67%** of the respondents, with **47%** in their forties.

The most frequent months visited are May through September with a slight dip in July.



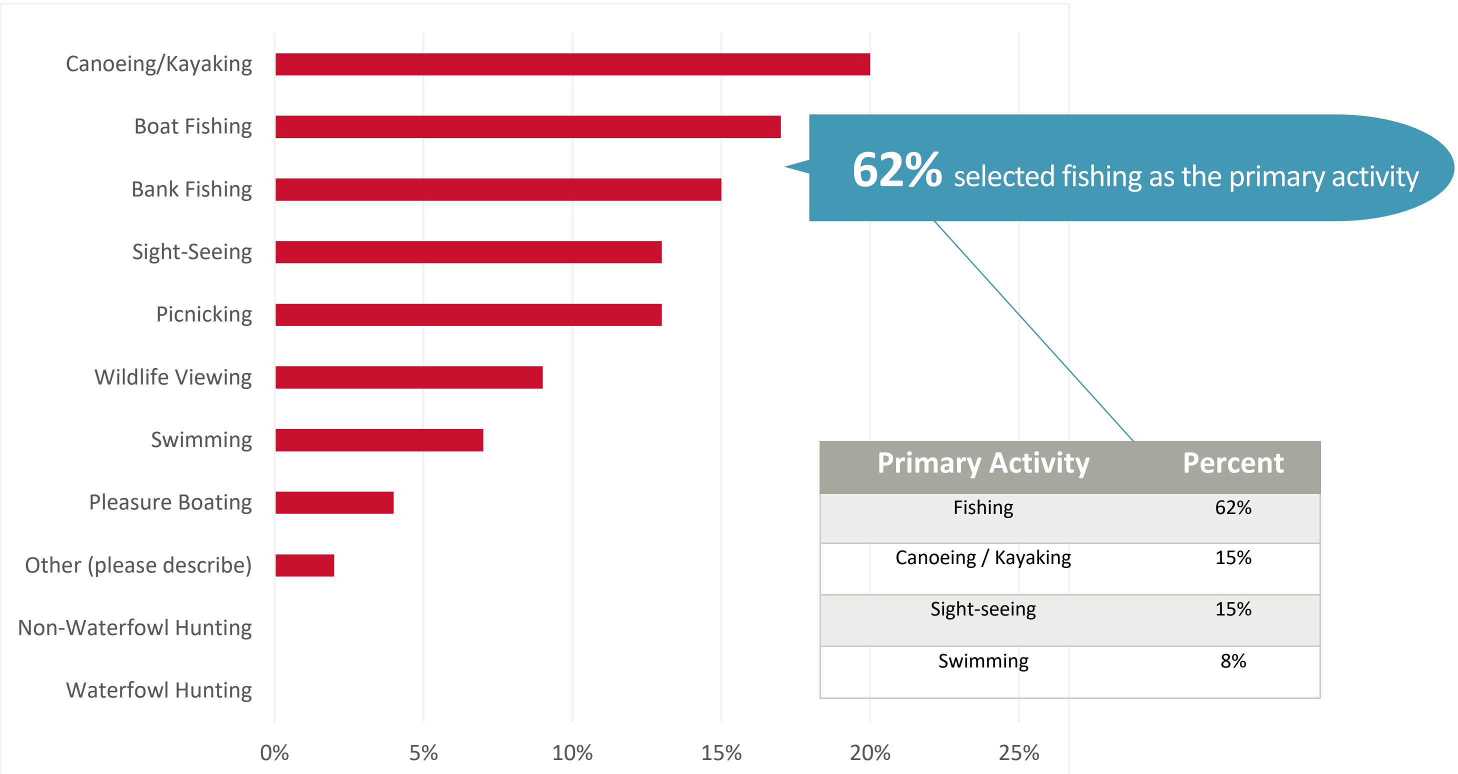


- Zip codes of most frequent visitors: **24330 & 24382**
- Average # of visits per year are **29**
- Average miles traveled: **39**

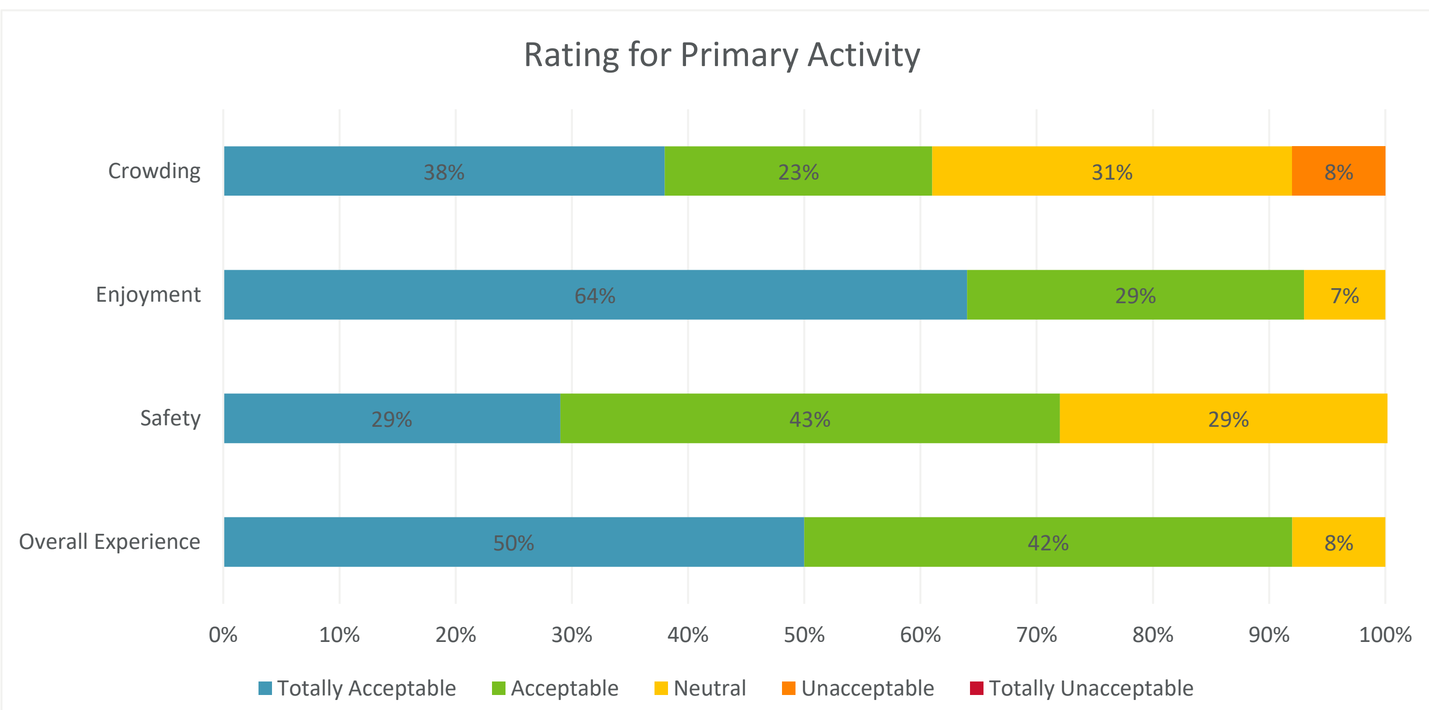
88% of respondents were not staying overnight in the Byllesby-Buck Project area. Of the **12%** that were staying overnight **100%** were staying in either an RV/Auto/Tent campground.

Byllesby-Buck Recreation – *Cumulative Results for New River Canoe Launch*

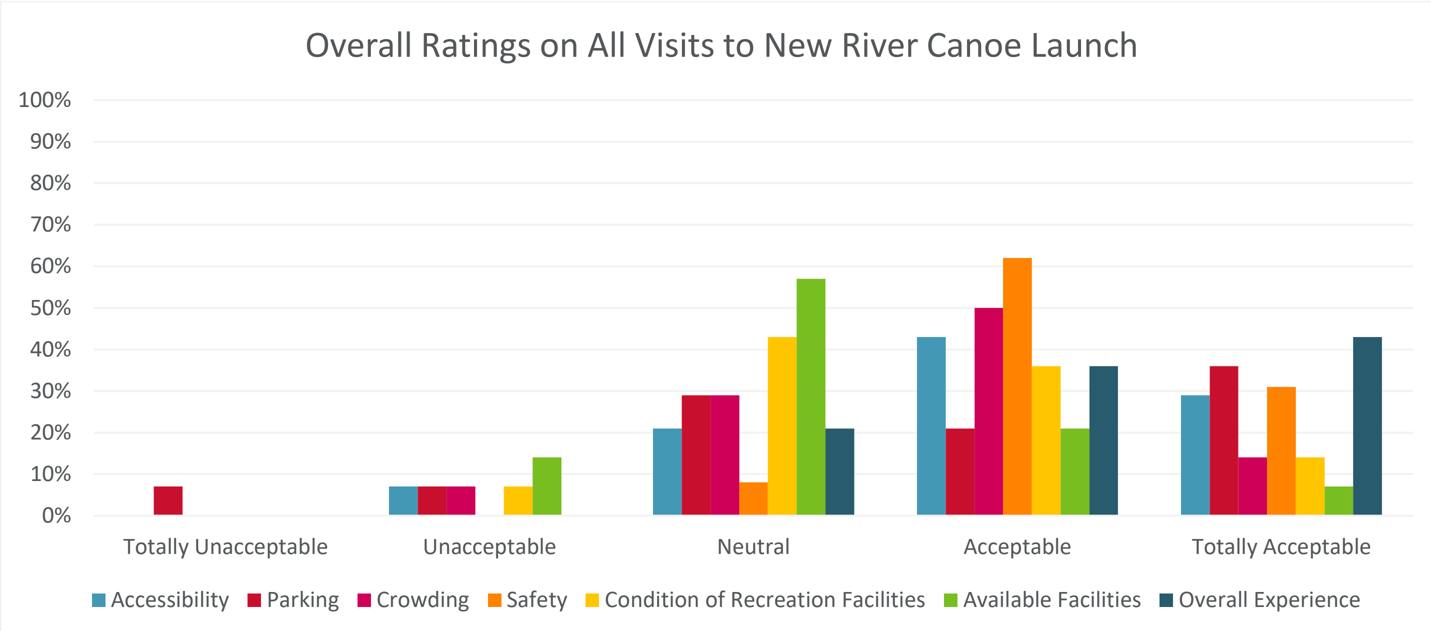
Activities Participated on Trip:



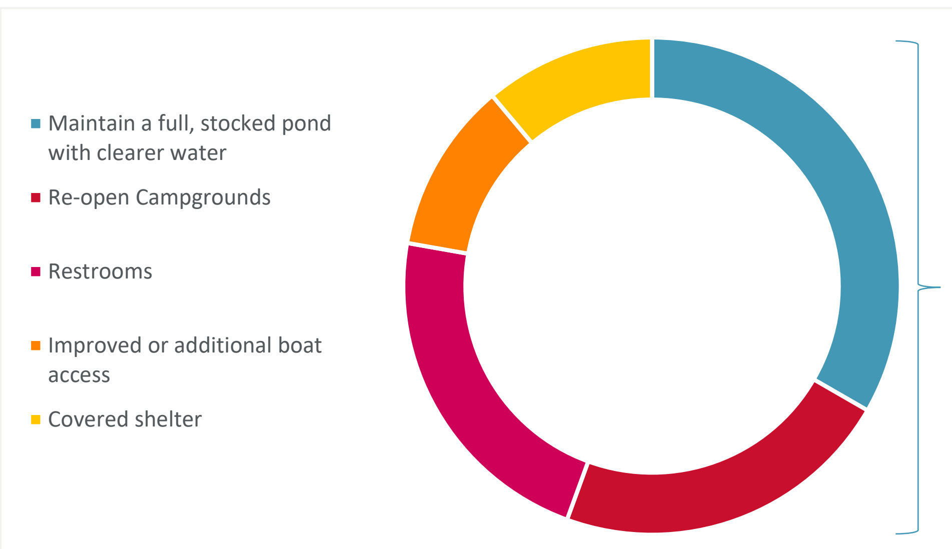
Primary Activity	Percent
Fishing	62%
Canoeing / Kayaking	15%
Sight-seeing	15%
Swimming	8%



Byllesby-Buck Recreation – *Cumulative Results for New River Canoe Launch*



Suggested Improvement Responses from New River Canoe Launch:



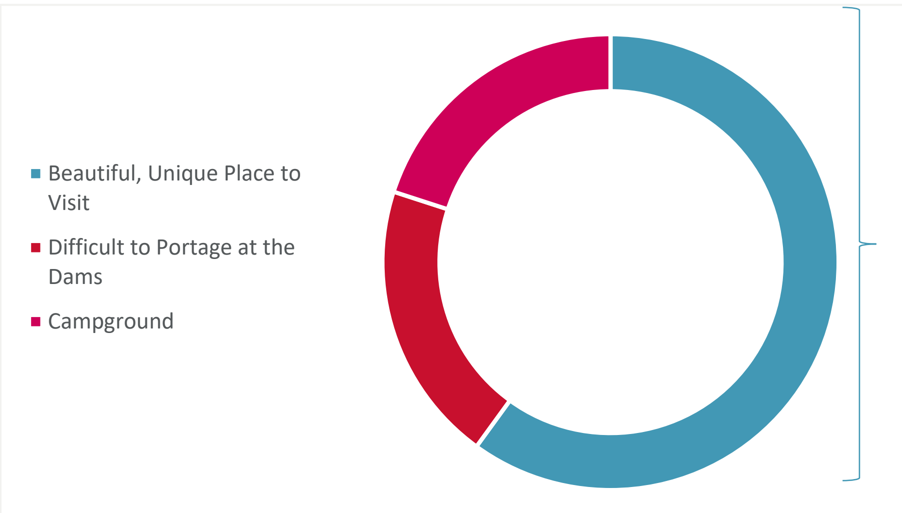
Improvement Suggestions	#
Maintain a full, stocked pond w/ clearer water	3
Re-open Campgrounds	2
Restrooms	2
Improved or additional boat access	1
Covered shelter	1

Byllesby-Buck Recreation – *Cumulative Results for New River Canoe Launch*

Type(s) of recreation facilities or improvements respondents believe are needed and at what specific location(s) at the Byllesby-Buck Project: *(verbatim responses)*

- Open the campground back up
- Bathroom facilities at the Byllesby canoe put in and at the picnic area at the bend in the river. More marked hiking trails. More history information. Tours of the dam. An established camping area with water and bathrooms AND the old ticket booth and century old modular home restored as a history of the new river museum. (I would be happy to help manage these, living less than a mile from the dam!) Regular litter clean up. The fisherman frequently leaves bait trash everywhere.
- Prohibit overnight camping along the riverbank. Campers block access to the river.
- Restrooms, picnic shelter

Additional Comment Responses from New River Canoe Launch:



Comments	#
Beautiful, Unique Place to Visit	3
Difficult to Portage at the Dams	1
Campground	1

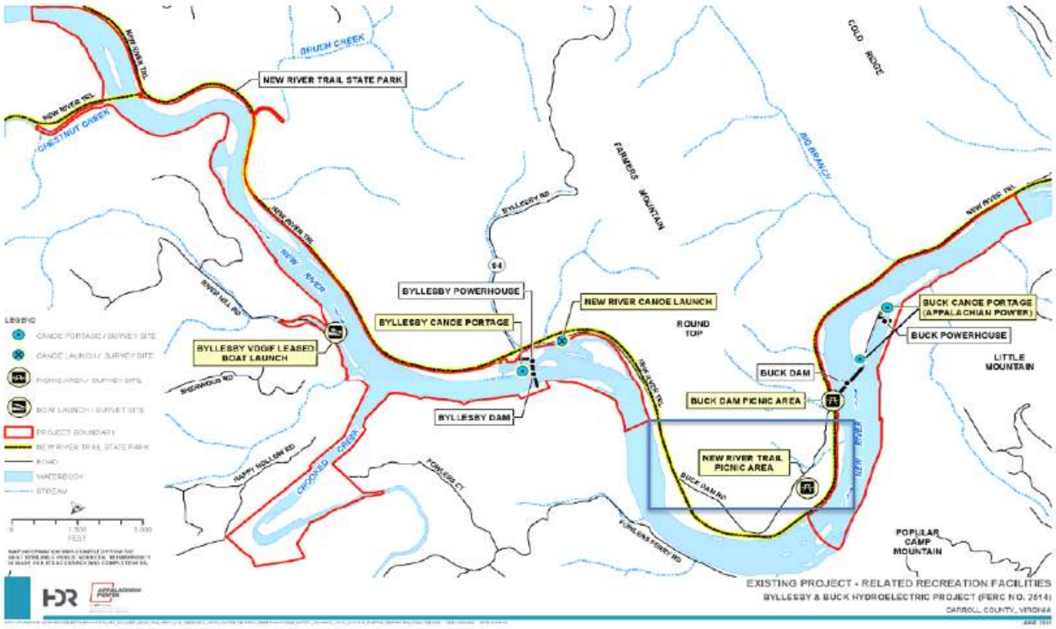
Byllesby-Buck Recreation – *Cumulative Results for New River Canoe Launch*

Additional comments: *(verbatim responses)*

• Beautiful place to visit.
• Fishing has dropped off over the past few years between the dams. What can AEP do to improve this.
• My family lives on Byllesby Rd. We walk down to the river and the trails every single day. Some days we hike around in the forest. Some days we walk the trail. Some days we bike the road or trail. In warmer months we sit on the bank and play in the sand and swim and tube and kayak. We picnic. We bird watch. We track animal prints. My husband and I go there for date night. We camp. We just exist with nature. I can think of few things we do not do there (except fishing, which we do not enjoy.) My 3 children's entire lives has transpired between our house and Byllesby/Buck Dam. It is our favorite place on Earth and is heaven on earth. We know just about every square inch. If you would like more information on our experience along this stretch of river... please email or call. I would love to discuss further our experience.

Byllesby-Buck Recreation – *Cumulative Results for the New River Trail Picnic Area*

Survey Locations:



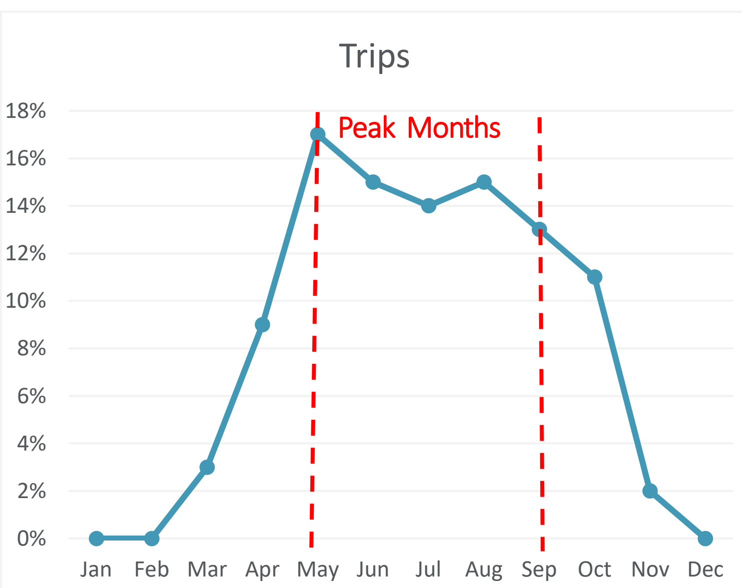
From **April 2020 to December 2020** there have been **24** respondents from the **New River Trail Picnic Area**. Overall, **14%** of the responses came from this location.

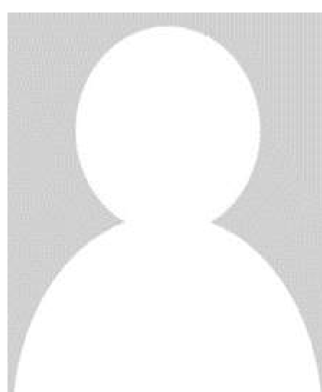
These respondents answered questions about their use of the recreation facilities. This data is collected to support the Federal Energy Regulatory Commission (FERC) relicensing process.

Predominately **46%** of the survey respondents come from two zip code locations, which average about **20** miles away from the Project. **79%** consider themselves to be regular visitors to the area with at least 3 or more times a year with an average length of stay being **5** hours.

Males made up **67%** of the respondents, with **75%** in their forties, fifties, and sixties.

The most frequent months visited are May through September. May was the most popular month for this location.



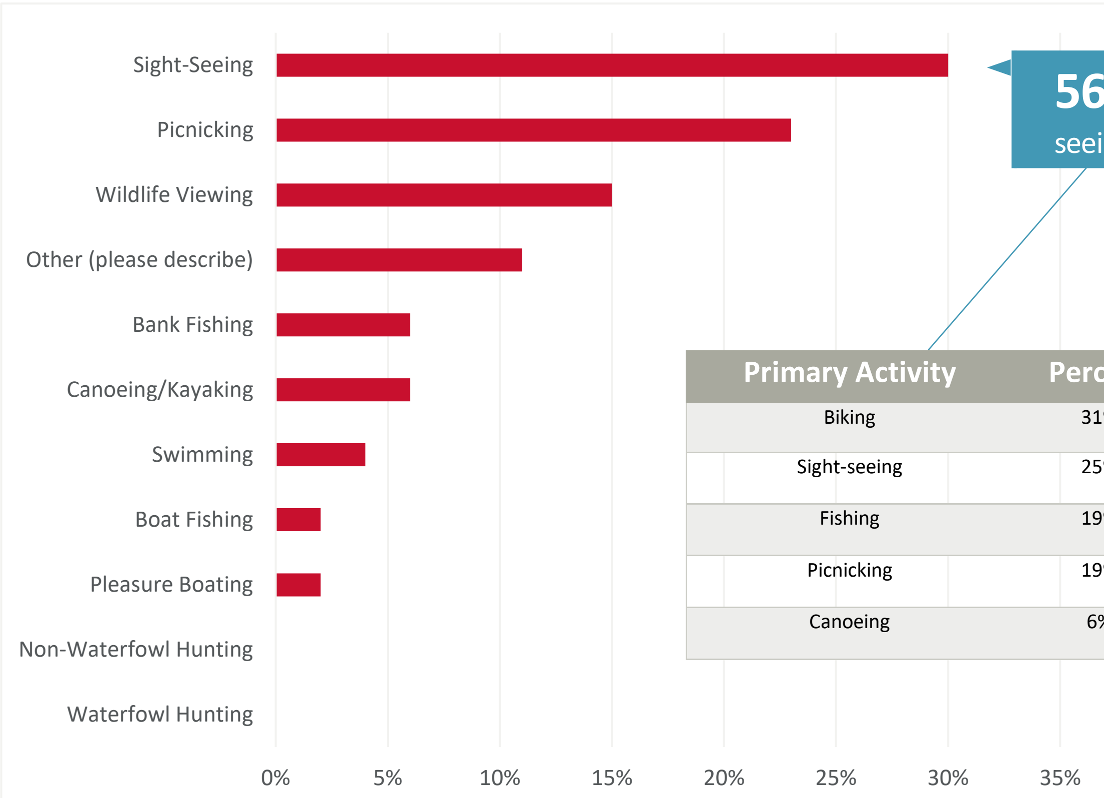


- Zip code of most frequent visitors: **24330 & 24382**
- Average # of visits per year are **10**
- Average miles traveled: **48**

74% of respondents were not staying overnight in the Byllesby-Buck Project area. Of the **26%** that were staying overnight, they stayed in either a motel/hotel, at a vacation/rental home or at another place.

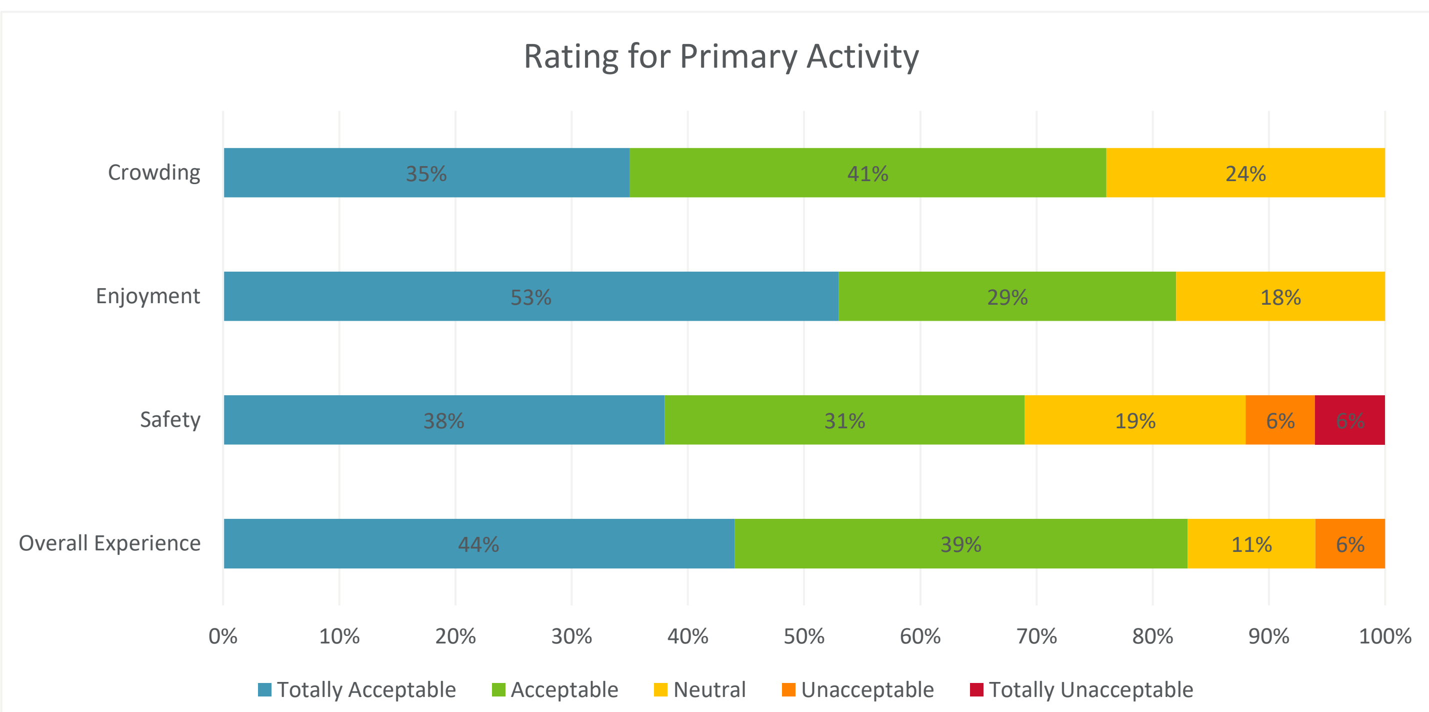
Byllesby-Buck Recreation – *Cumulative Results for the New River Trail Picnic Area*

Activities Participated on Trip:

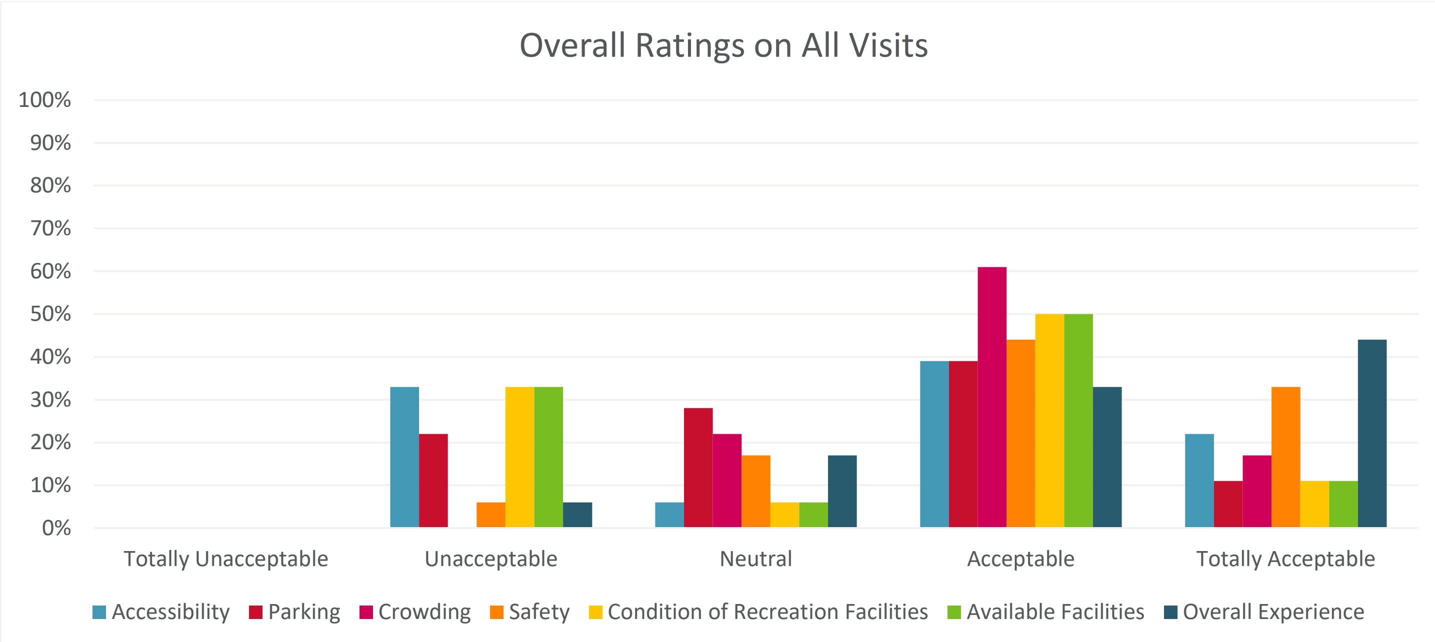


56% selected biking and sight-seeing as the primary activity

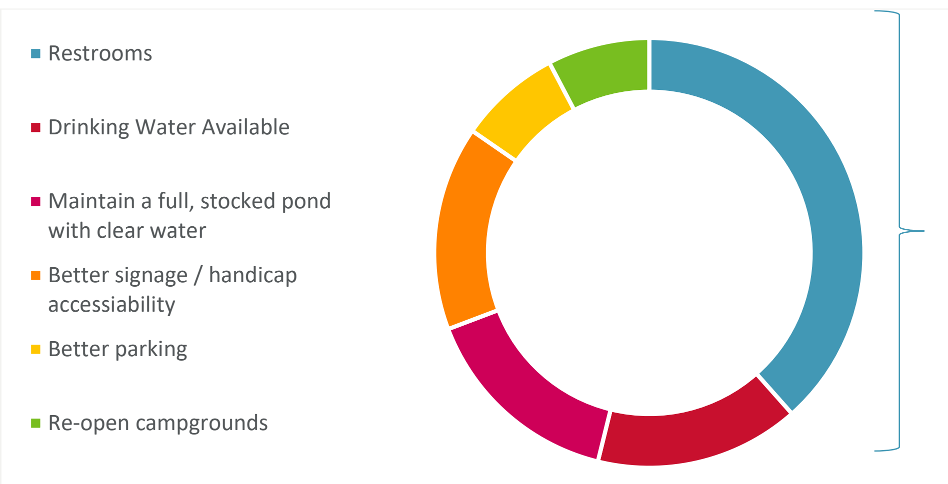
Primary Activity	Percent
Biking	31%
Sight-seeing	25%
Fishing	19%
Picnicking	19%
Canoeing	6%



Byllesby-Buck Recreation – *Cumulative Results for the New River Trail Picnic Area*



Suggested Improvement Responses from New River Trail Picnic Area:



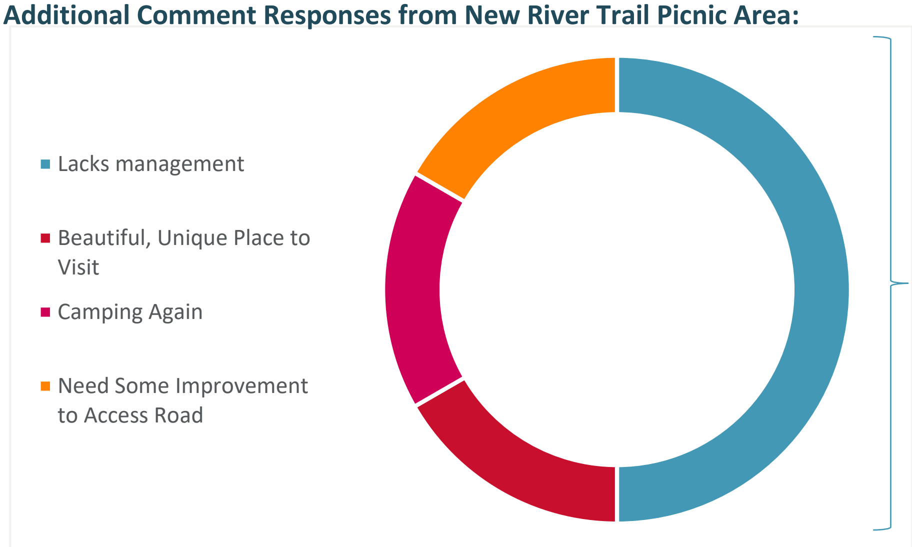
Improvement Suggestions	#
Restrooms	5
Drinking Water Available	2
Maintain a full, stocked pond with clear water	2
Better signage / handicap accessibility	2
Better parking	1
Re-open campgrounds	1

Byllesby-Buck Recreation – *cumulative results by New River Trail Picnic Area*

Type(s) of recreation facilities or improvements respondents believe are needed and at what specific location(s) at the Byllesby-Buck Project: *(verbatim responses):*

• Repairs to bike trail
• restroom at boatlanding
• Parking area, drinking water availability, water usage for kayaking.
• Better signage
• River needs cleaned and water level is too low
• Better bathrooms and cleaner areas
• boat access to the river needs to be improved greatly and the water quality no longer supports a good fishing population
• faster access to byllesby dam from main roads, drinking water at more locations
• Camping between the dams would be amazing. I have great memories of camping when I was younger.
• More areas for picnics, off road parking, handicap access, more areas for river enjoyment
• Restroom facilities
• Better handicap friendly access
• Loved to picnic table by the river. Amazing.
• Bathroom at Byllesby.

Additional Comment Responses from New River Trail Picnic Area:



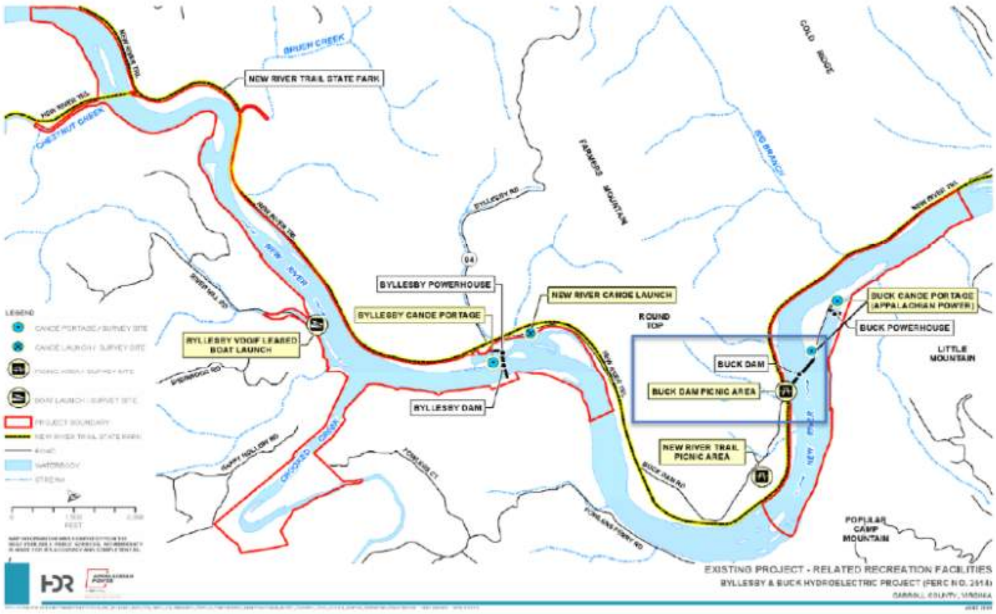
Comments	#
Lacks management	3
Beautiful, Unique Place to Visit	1
Camping Again	1
Need Some Improvement to Access Road	1

Additional comments: *(verbatim responses)*

• Some improvements to the access road going to the boat landing would be nice.
• Its absolutely beautiful there!
• Need to make improvements to enhance the river area and fishing experience
• There are many low income residents in the area that rely on fishing the New River as an important food source. Habitat quality needs to be improved. I am an infrequent visitor due to the current conditions of the river in this area. I would use the river much more frequently if it were to improve. It is also an economic development issue for this area. We are trying to build the number of visitors who stay overnight in our hotels and campgrounds.
• Needs camping facilities again.
• Give old Forest Service campground to New River Trail and reopen.

Byllesby-Buck Recreation – *Cumulative Results for Buck Dam Picnic Area*

Survey Locations:



From **April 2020 to December 2020** there have been **10** respondents from **Buck Dam Picnic Area**. Overall, **7%** of the responses came from this location.

These respondents answered questions about their use of the recreation facilities.

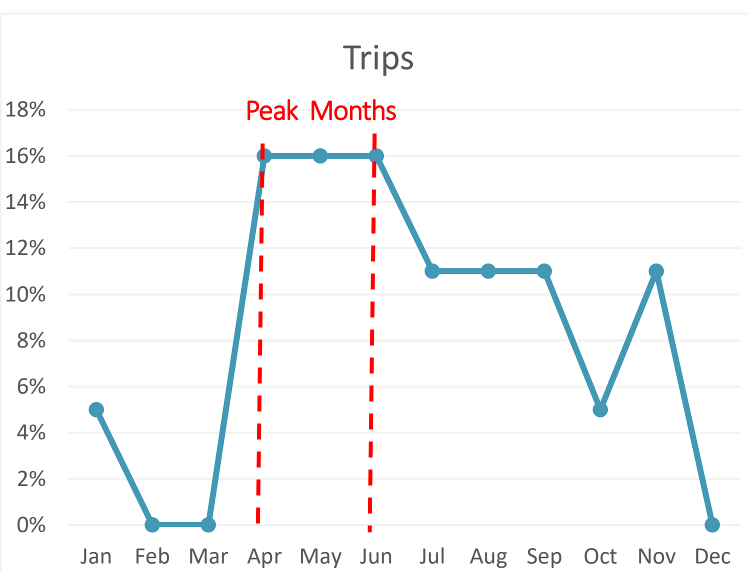
This data is collected to support the Federal Energy Regulatory Commission (FERC) relicensing process.

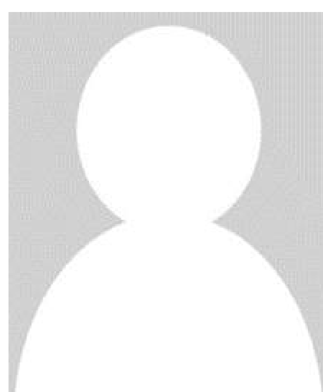
Predominately **25%** of the survey respondents come from one zip code location, which is about **12.5** miles away from The Project.

100% consider themselves to be regular visitors to the area with at least 3 or more times a year with an average length of stay being **6** hours.

Males made up **56%** of the respondents, with **22%** split between being in their thirties, forties, fifties, and sixties.

The most frequent months visited are April through June.



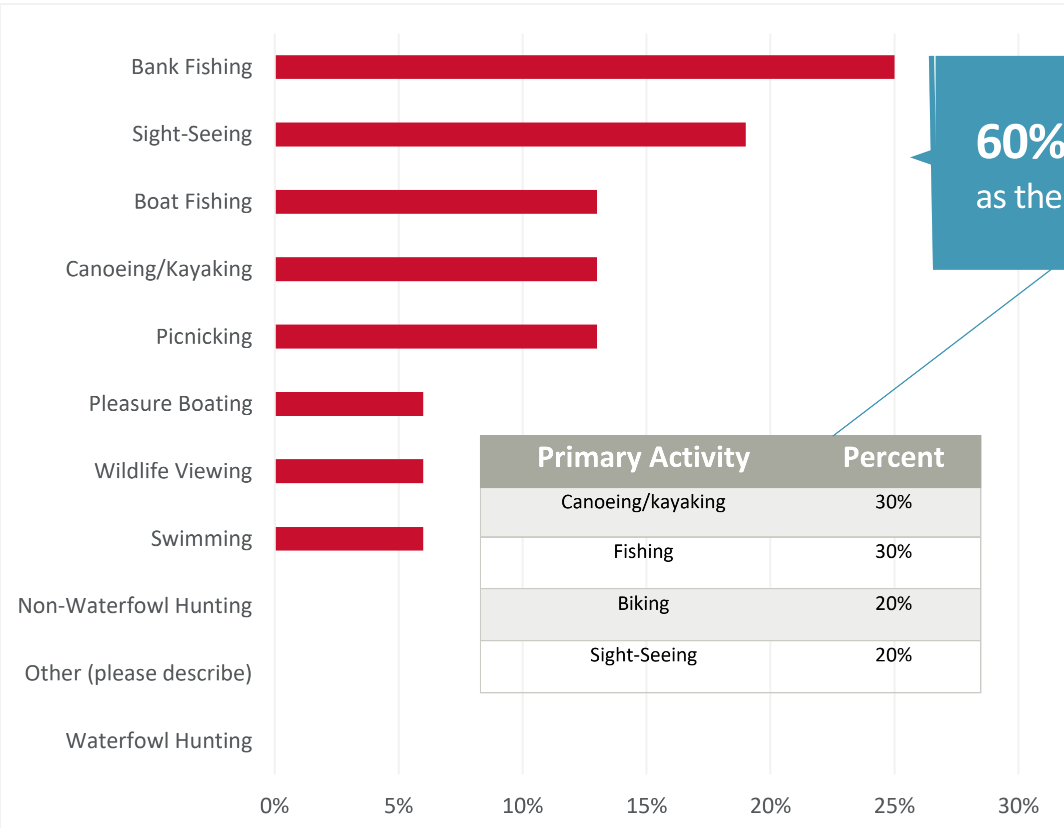


- Zip code of most frequent visitors: **24330**
- Average # of visits per year are **10**
- Average miles traveled: **23**

80% of respondents were not staying overnight in the Byllesby-Buck Project area. 100% of those that stayed overnight stayed in a RV/Auto/Tent Campground.

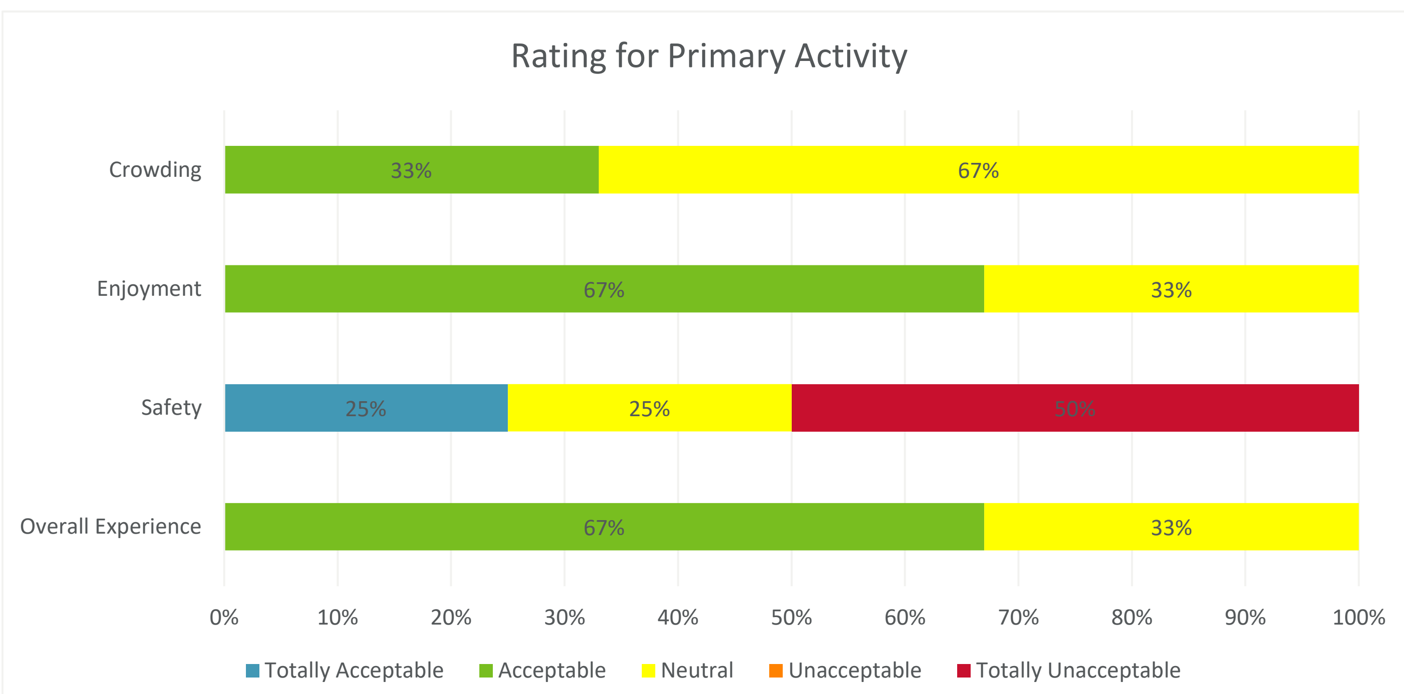
Byllesby-Buck Recreation – *Cumulative Results for Buck Dam Picnic Area*

Activities Participated on Trip:

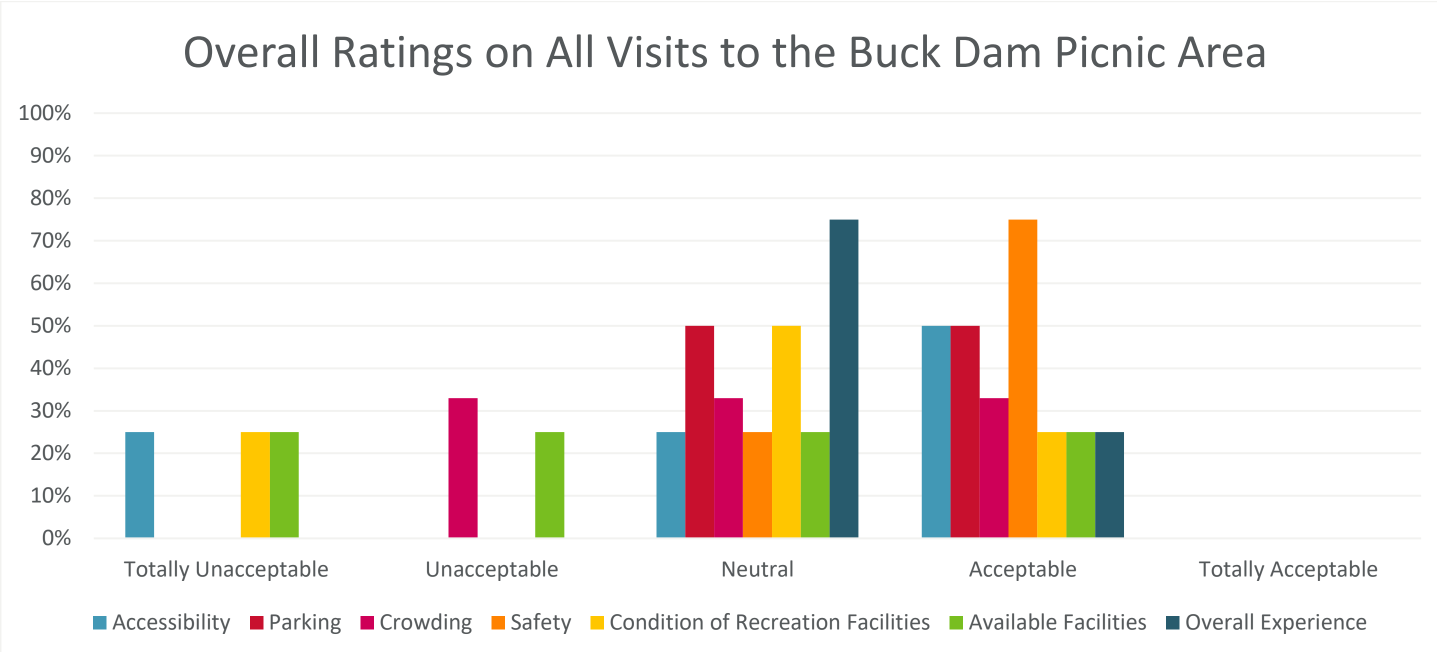


60% selected fishing and canoeing as the primary activity

Primary Activity	Percent
Canoeing/kayaking	30%
Fishing	30%
Biking	20%
Sight-Seeing	20%



Byllesby-Buck Recreation – *Cumulative Results for Buck Dam Picnic Area*



Type(s) of recreation facilities or improvements respondents believe are needed and at what specific location(s) at the Byllesby-Buck Project: *(verbatim responses)*

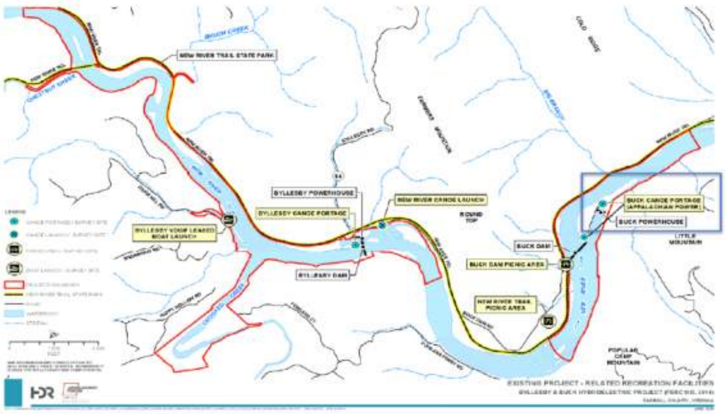
- more public parking at the Byllesby dam canoe portage
- We need to be able to float from below Byllesby dam to above buck without having to go below buck dam Need to be a Portage above buck so you dont have go below
- Campgrounds need mowed and maintained. we used to camp there weeks at a time
- More bathrooms always plus no matter location in state of Virginia.

Additional comments: *(verbatim responses)*

- Beautiful area, love the remoteness, quality of fishing could improve by stockings of different species of all the current fish there.
- Please take down all the no trespassing and no fishing signs below the dams. My father and I fished below buck dam for years and never got hurt or drowned. It's ridiculous that you can put up a concrete dam and then keep people from gaining from its fish collections by placing signs further and further from the dams that say no trespassing. I want to be able to access any part of the area dangerous or not that should be my choice.
- Some improvements to the access road going to the boat landing would be nice.
- Spend many days camping and hiking

Byllesby-Buck Recreation – *Cumulative Results Buck Dam Canoe Portage*

Survey Locations:



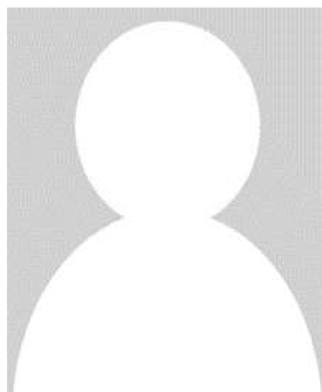
From **April 2020 to December 2020** there have been **24** respondents from **Buck Dam Canoe Portage**. Overall, **17%** of the responses came from this location.

These respondents answered questions about their use of the recreation facilities. This data is collected to support the Federal Energy Regulatory Commission (FERC) relicensing process.

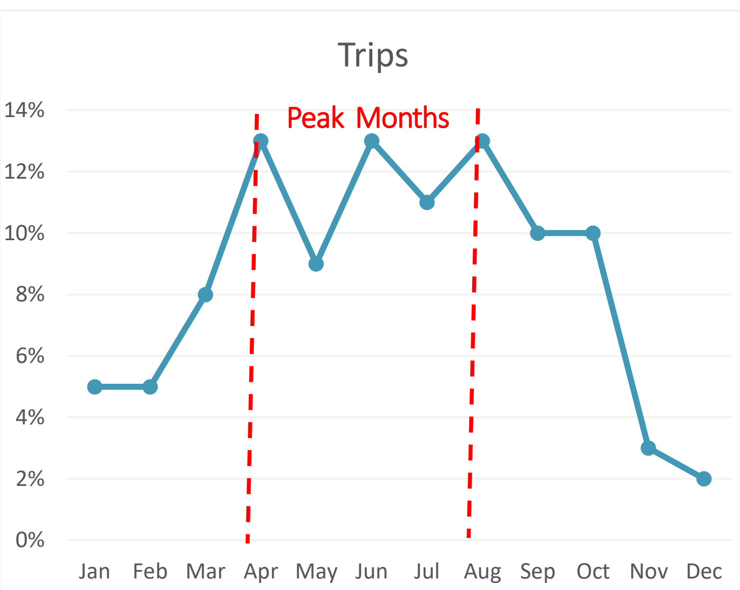
Predominately **52%** of the survey respondents come from four zipcode locations, which are **20** miles away from the Project. **100%** consider themselves to be regular visitors to the area with at least 3 or more times a year with an average length of stay being **7** hours.

Males made up **63%** of the respondents, **62%** in their thirties and forties.

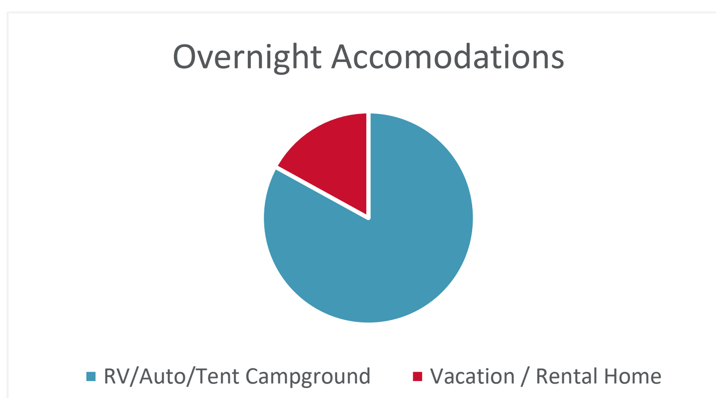
The most frequent months visited are from April to September, with April, June, and August being the peak months.



- Zip codes of most frequent visitors: **24333, 24348, 24350, and 24382**
- Average # of visits per year are **16**
- Average miles traveled: **33**

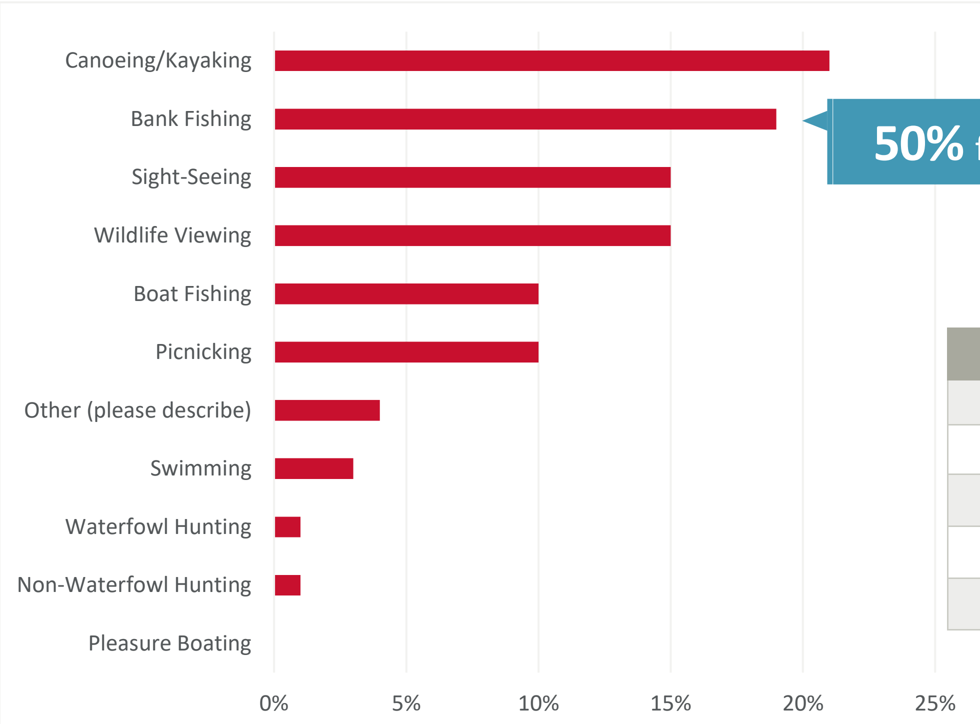


68% were not staying overnight in the Byllesby-Buck Project area. Of the **42%** that were staying overnight a breakdown of the accommodations used is shown:



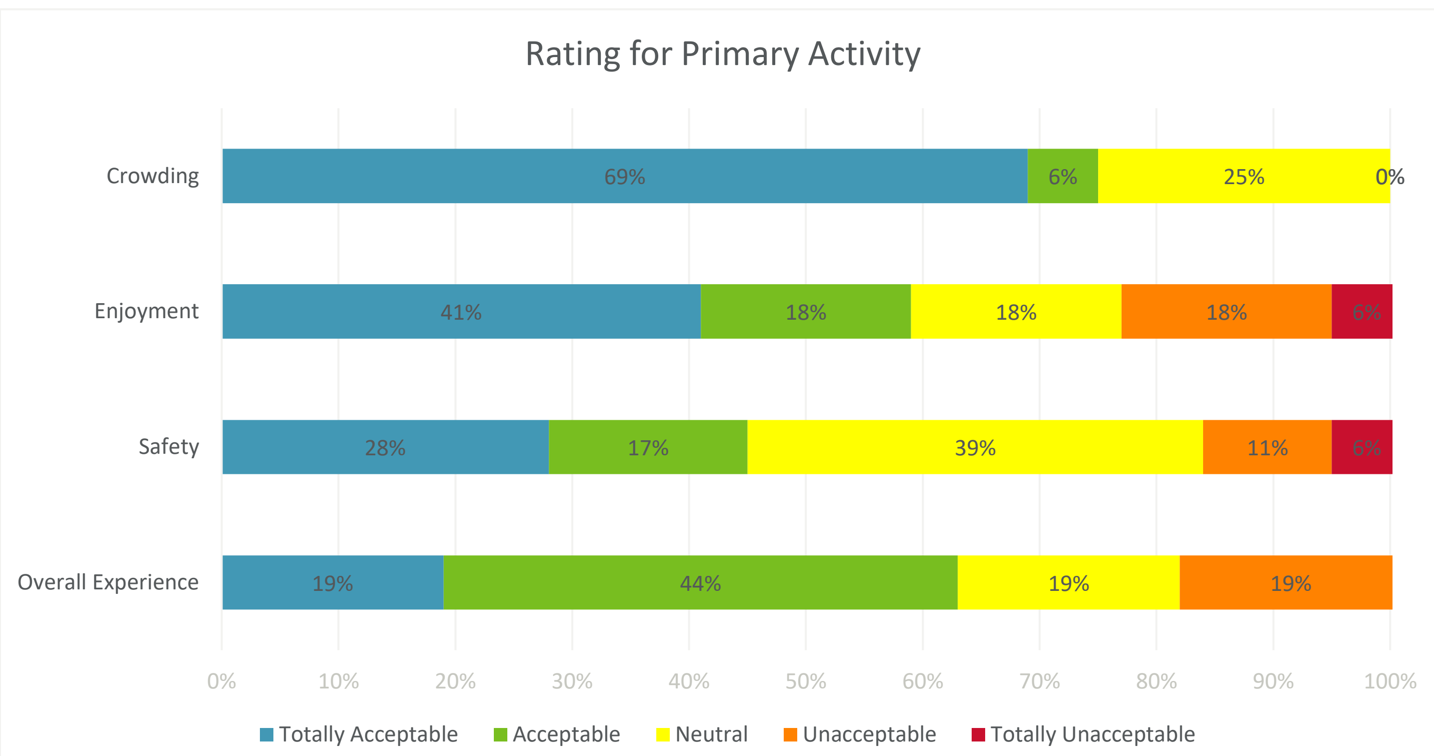
Byllesby-Buck Recreation – *Cumulative Results Buck Dam Canoe Portage*

Activities Participated on Trip:

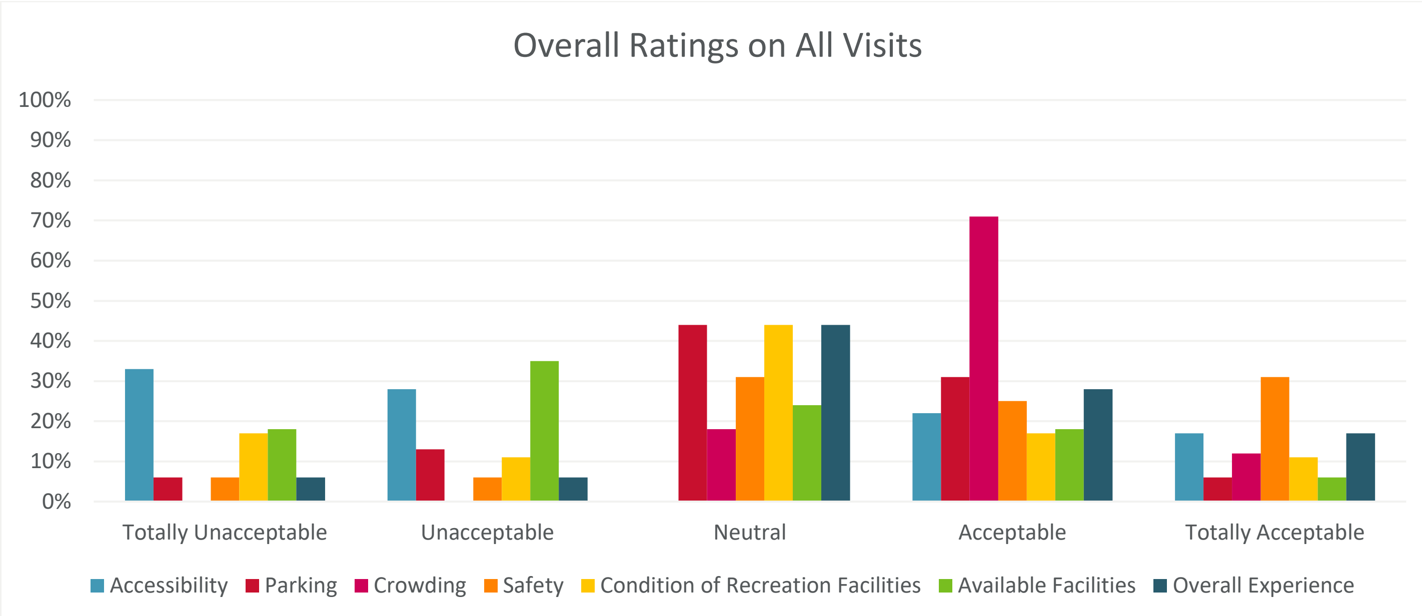


50% fishing is the primary activity

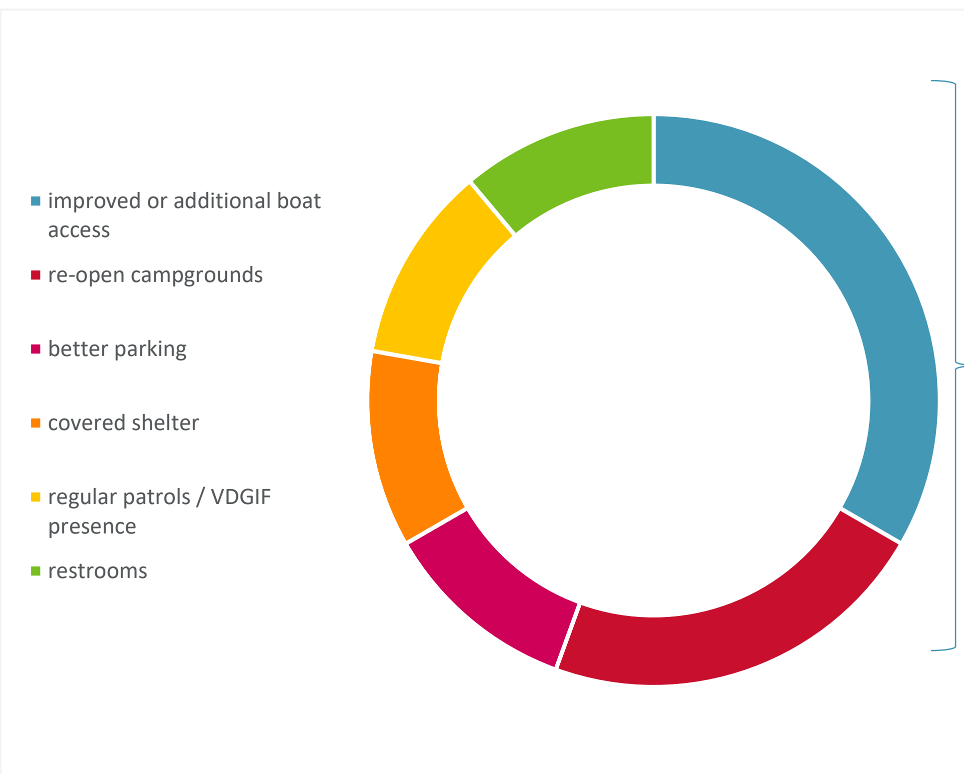
Primary Activity	Percent
Fishing	50%
Canoeing/kayaking	30%
Biking	6%
Hiking	6%
Waterfowl Hunting	6%



Byllesby-Buck Recreation – *Cumulative Results Buck Dam Canoe Portage*



Suggested Improvement Responses from Buck Dam Canoe Portage:



Improvement Suggestions	#
improved or additional boat access	3
re-open campgrounds drinking water available	2
better parking	1
covered shelter	1
regular patrols / VDGIF presence	1
restrooms	1

Byllesby-Buck Recreation – *Cumulative Results Buck Dam Canoe Portage*

Type(s) of recreation facilities or improvements respondents believe are needed and at what specific location(s) at the Byllesby-Buck Project: *(verbatim responses)*

• access below buck dam on opposite side from Ivanhoe. As I am getting older, it is much more difficult to drag canoe/ kayak from parking lot to put in area. Put in area is also terrible. You should be able ate drive down to the put in area, unload, and then park back in parking lot. The wildlife biologist from Va dept of game use my boat ramp further down stream for access when shocking fish. Also, trying to get around dams is very difficult and dangerous. There is no easy portage!!!
• Better access to the Buck Dam tail race.
• Better canoe and kayak launches, better areas to park and have better access to the water. Need to have more VDGIF presence between the dams.
• Better parking and facilities. I would like to see better access to the river. The long carry from the parking area to the water through the sand is a bit much. A better portage system.
• Boat launches and vehicle access to them
• Easier portage, steep muddy banks are dangerous. Porta Johns would be great, covered shelter
• I would like to see a more secure boat ramp in order to get to the buck dam pool. Right now the only way I know to get to that water is to run the large Rapids above it. Then to Portage the dam and float to the ivanhoe public boat landing.
• Make access for fishing at buck dam
• Maybe a port-a-john at Byllesby
• More access
• More Camping areas and bathrooms and boat launches
• My family and friends have used public access for Buck Dam area located off of Loafers Rest Rd. for over 10 years. We have enjoyed Floating/fishing and kayaking down the river up until 3-4 years ago when the water has been so murky and low. Which unfortunately we have used less and less.We really depended on this recreation for fun, relaxation , stress release , comradery and even sometimes supper, even more important now in this Covid 19 environment! The input has always been challenging, The waxing and waining entrance trail to get to the river put in is not people friendly. Carrying boats of all kinds, single file, thru the tick infested area down a significant slope "thus the waxing and waining" trail to arrive at a dangerous put in at the river.One boat put in at a time and if there is anybody fishing from the bank they have to move, and we all know that the fisherman does not want to move and at times won't move. I challenge some of your 50, 60 and 70 year old employees to take a couple boats down the trail.
• Needs boat launch on loafers rest side.
• Parking area, drinking water availability, water usage for kayaking.
• Would like to see clear water in the river.

Additional Comment Responses from Buck Dam Canoe Portage:

Comments	#
beautiful, unique place to visit	1
need some improvement to access road	1
remove 'no fishing' signs	1

Additional comments: *(verbatim responses)*

- Allow fishing against the wall of the Buck Dam tail race.
- I have always enjoyed putting in on Fowler's ferry road and fishing in between the dams. I have always had good luck and the view of stoots mountain with its rock outcroppings is amazing. Especially when there is a little river mist in the air.
- I have not spent much time on the river for the past 5 years. the river is always muddy, flood waters not controlled by the dams. Everywhere has become a sandy bottom for all the clean up of the dams. It seems like buck dam is always out of control.

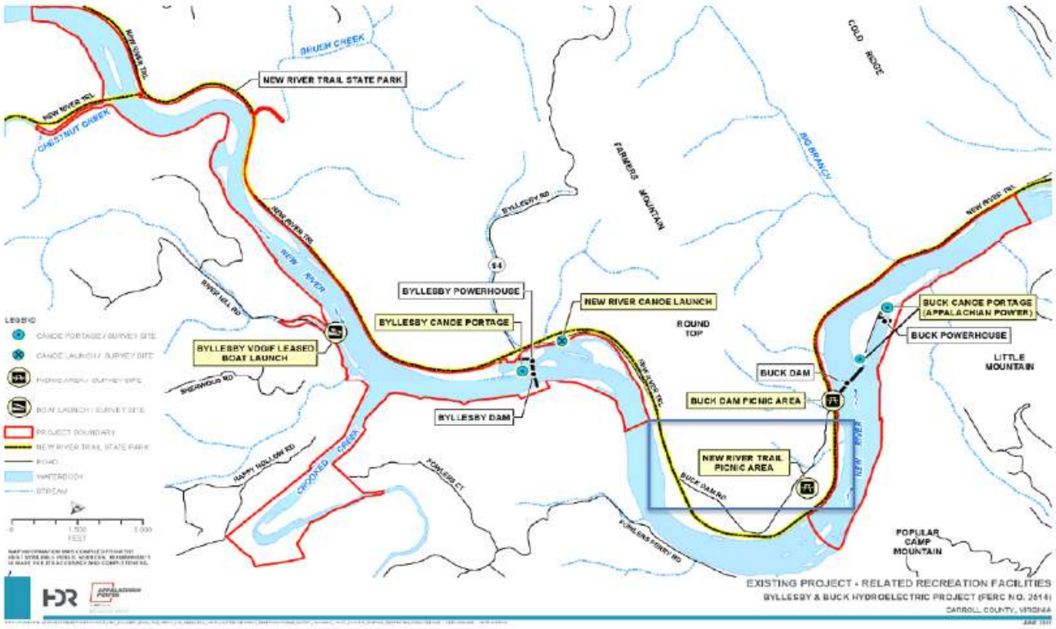
  Fishing this section of the river is terrible. Fish count is way down. Spawns are terrible. This use to be a great section to fish. It has been 5 years since there were any good fishing. According to VGIF, the fish count is lowest in 5 years.
- I just love it there and go every chance I can.
- I think better access to the river, parking, and information in the parking area are key. It would be nice to see some type of workaround for the portage as well. The portage around the dam is a nightmare, especially if you are overnighting and have loaded canoes. It is dangerous.

  Ideally, for recreation, the dams would not be there. I think the gradient of the area and double shoals between Fries and the dam are a good indicator that there is some excellent whitewater under the reservoir. I know a lot of paddlers who love to paddle double shoals but don't because they hate the 2-mile flatwater paddle to the next access point to get out.
- If this area was helped and marketed correctly I believe it would flourish. I own New River Outdoor Adventures and I would help promote the area for families, fishermen, and nature lovers.

• Ive lived in this area my whole life and enjoyed everything it has to offer please let the younger generation enjoy it also give them something to do in a place with not much els to do
• Man made muddy water throughout the year is just unacceptable.
• Re open the camp ground
• The boat put in that is maintained by AEP is in my opinion unacceptable and dangerous. There has been no improvements ,only maintenance over the years. The parking is good and room to expand if needed. There is an access with a gate used only by AEP, this site could be a much better access to drop off boats. It would take us up to 45 minutes to drive around to Ivanhoe to put in at that wonderful access, even handicap people can use that put in! After all we are South West Virginia with a lot of poverty and a lot of families rely on the river for recreation and dinner(fishing the last couple of years has been horrible !!) I suspect do to the murky and low waters since the work on the dams, This has not changed much at all for the better even though work on the dams have been complete. So in the Covid 19 pandemic when we are all encouraged to get out side, get some vitamin D, yes we can but cannot enjoy the river or fish for supper, I am a dreamer and I really would like to see this area in South West Virginia develop some seasonal "river rapids" that would be a huge economic impact for Carole County, Wythe County, Galax, Fries and Wytheville. This area needs a project to really boost our economy, open up more jobs, more recreation , help with poverty and substance abuse. I am asking that AEP take a leap of faith, trust and believe in our communities ,for the well being in all these localities and make these improvements and highly consider the "seasonal water Rapids" that can put several Counties and Towns on the map. Thank you for reaching out.
• This is by far, the best recreation area of its kind!
• We kayak fish this area every chance we get. We will sleep in our vehicles or tent camp depending on how many go fishing with our group. We see so many people and the biggest complaints I hear are how hard it is to portage the dams.

Byllesby-Buck Recreation – *Cumulative Results for "Other" Areas*

Survey Locations:



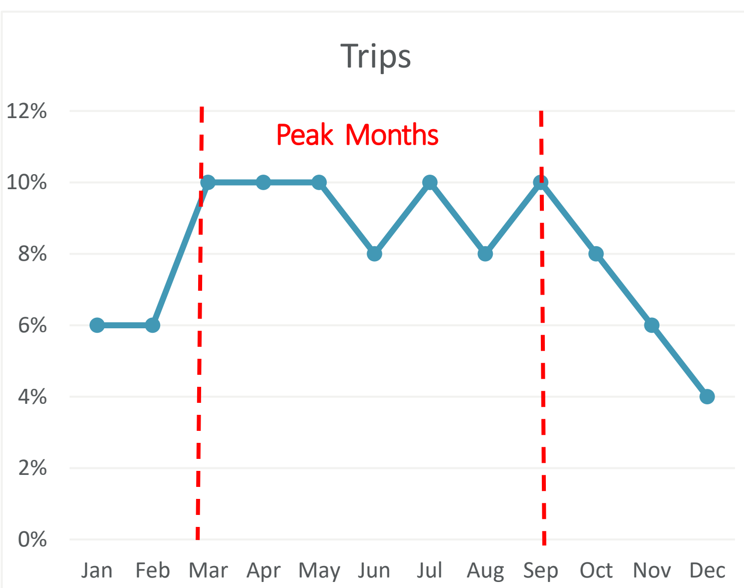
From **April 2020 to December 2020** there have been **9** respondents from "**Other" Areas**. Overall, **6%** of the responses came from this location.

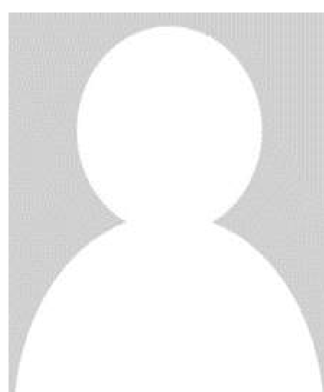
These respondents answered questions about their use of the recreation facilities. This data is collected to support the Federal Energy Regulatory Commission (FERC) relicensing process.

Predominately **33%** of the survey respondents come from one zip code location, which is about **20** miles away from the Project. **86%** consider themselves to be regular visitors to the area with at least 3 or more times a year with an average length of stay being **6** hours.

Males made up **63%** of the respondents, with **72%** in their forties.

The most frequent months visited are March through September with a decline in the fall months.



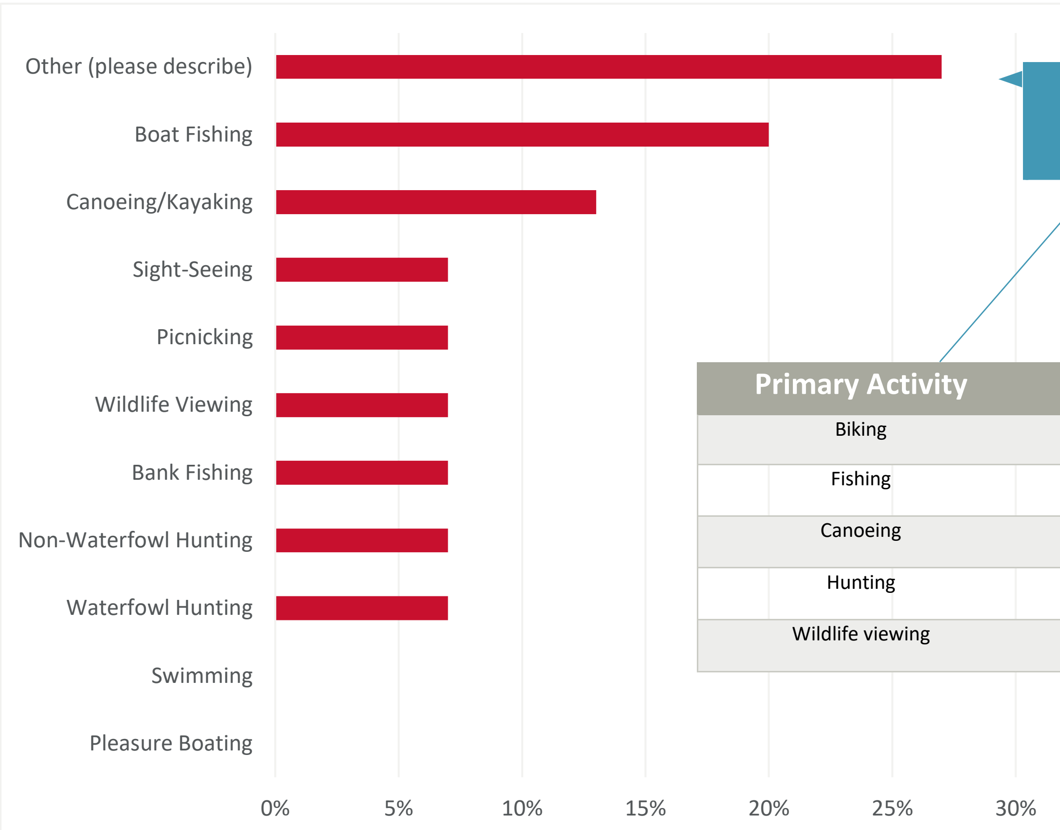


- Zip code of most frequent visitors: **24382**
- Average # of visits per year are **19**
- Average miles traveled: **40**

100% of respondents were not staying overnight in the Byllesby-Buck Project area.

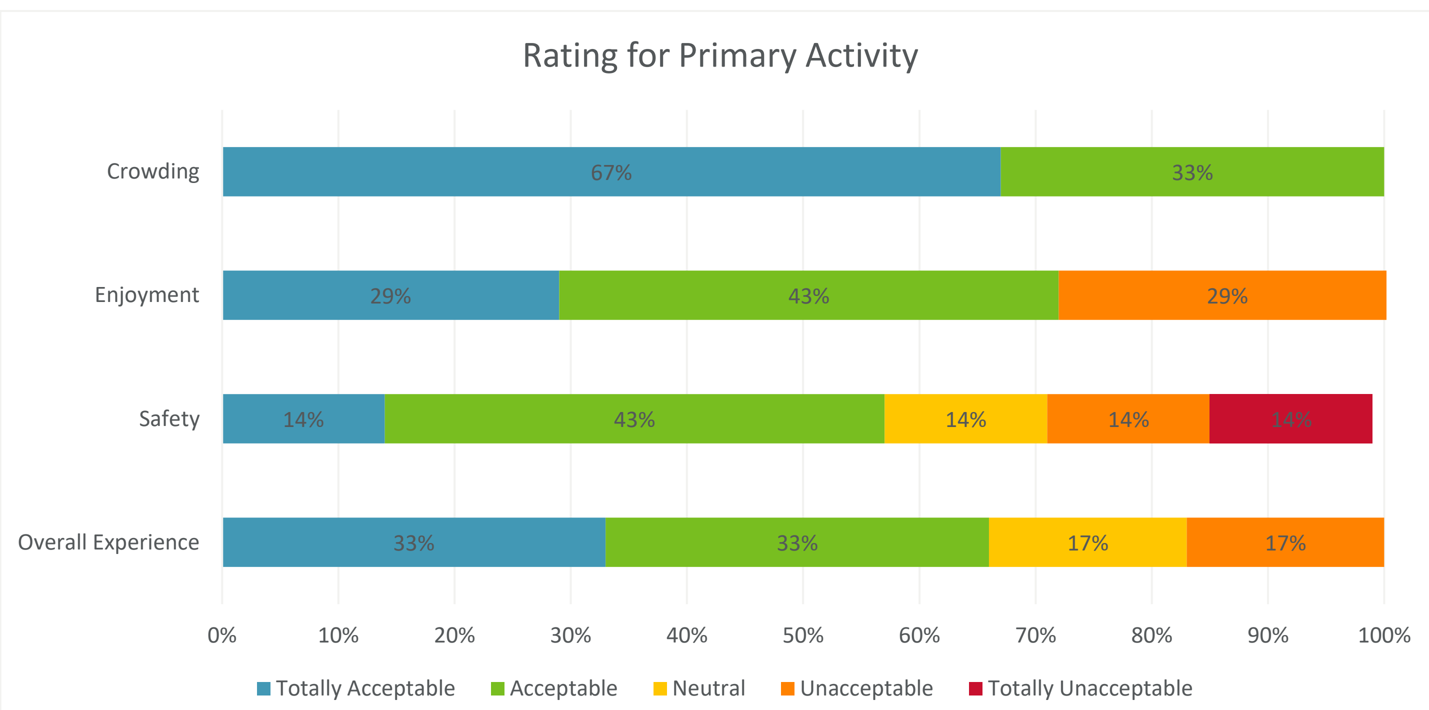
Byllesby-Buck Recreation – *Cumulative Results for "Other" Areas*

Activities Participated on Trip:

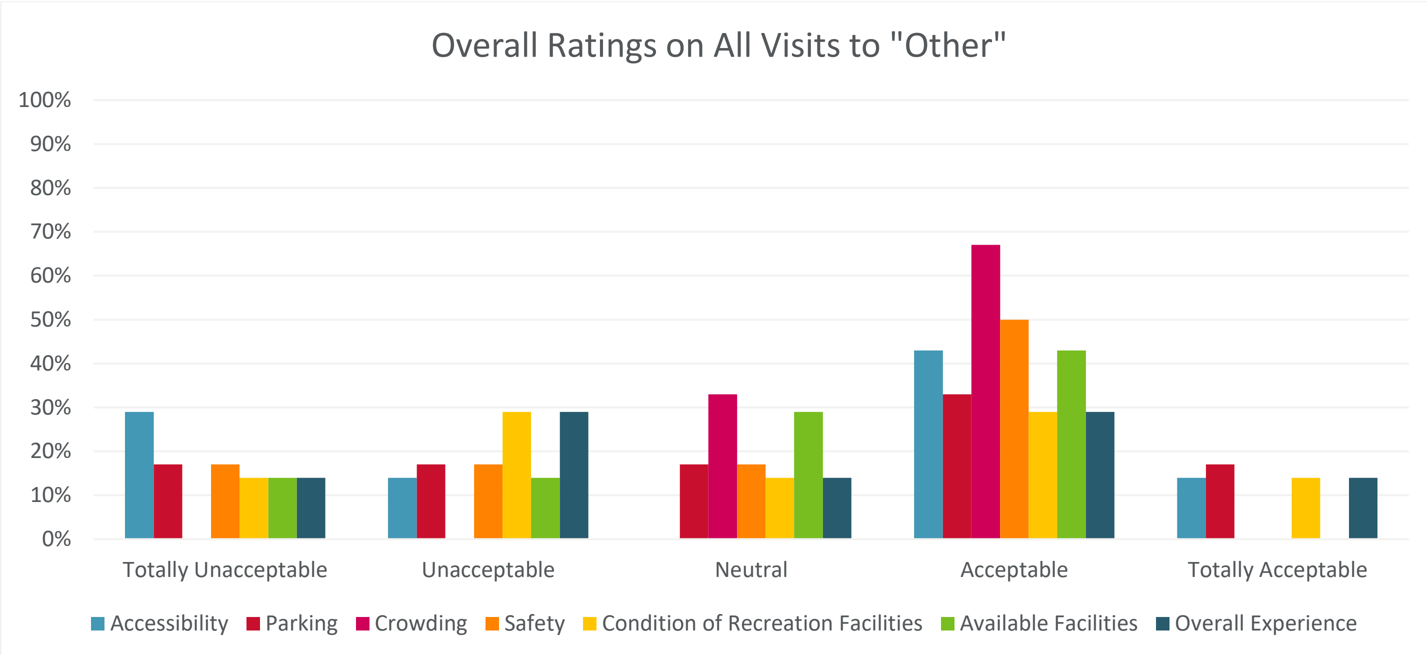


58% selected biking and fishing as the primary activity

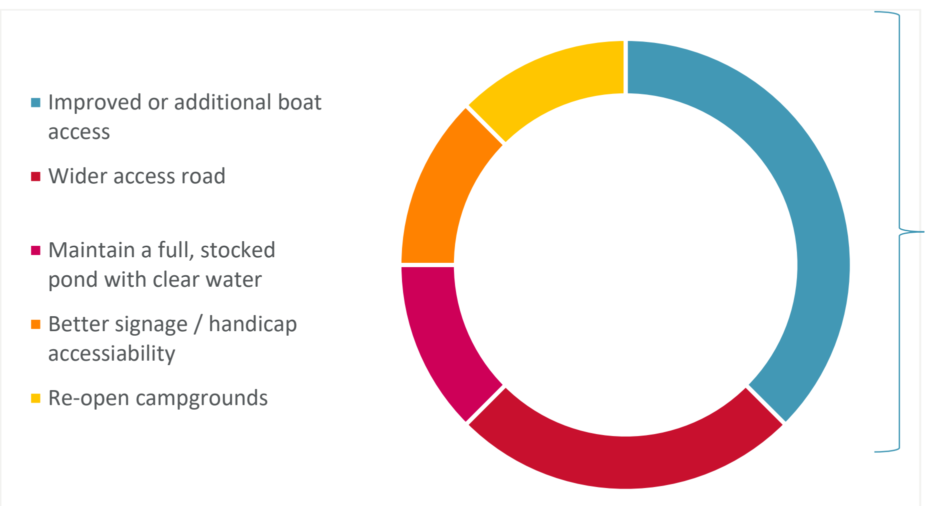
Primary Activity	Percent
Biking	29%
Fishing	29%
Canoeing	14%
Hunting	14%
Wildlife viewing	14%



Byllesby-Buck Recreation – *Cumulative Results for "Other" Areas*



Suggested Improvement Responses from New River Trail Picnic Area:



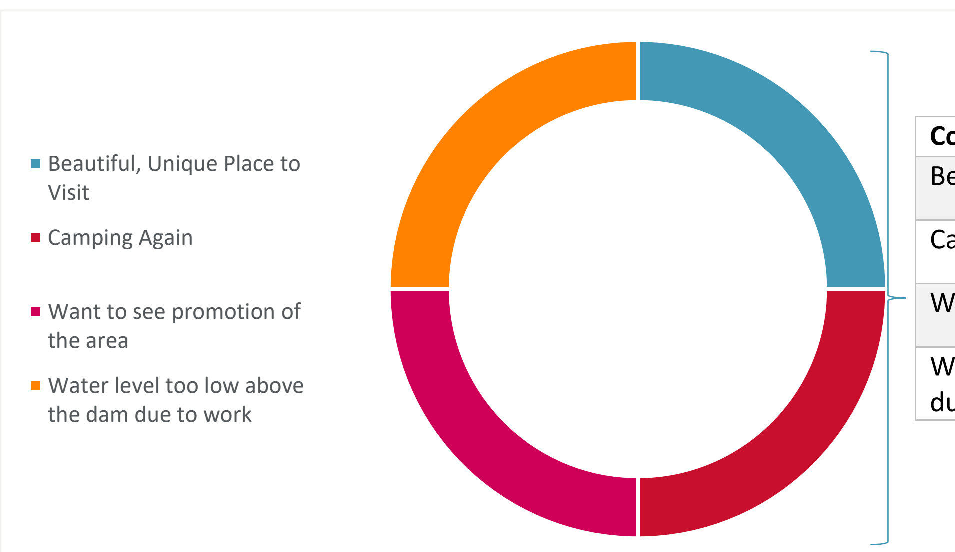
Improvement Suggestions	#
Improved or additional boat access	3
Wider access road	2
Maintain a full, stocked pond with clear water	1
Better signage / handicap accessibility	1
Re-open campgrounds	1

Byllesby-Buck Recreation – *Cumulative Results for "Other" Areas*

Type(s) of recreation facilities or improvements respondents believe are needed and at what specific location(s) at the Byllesby-Buck Project: *(verbatim responses)*

• Boat launch below buck dam
• For Wythe County residents on Loafer's Rest Rd and Van Lue Rd the VDGIF fishing access and canoe launch is in need of significant repair, for older individuals and others their needs to be accessible access for both bank fishing and canoe/kayak drop off. The Access at the Horse Park in Ivanhoe is too far by road for those of us on river right near the Buck Dam to readily access.
• I would like to see better access to the river, scheduled release dates and improved water quality for fishing
• Road down to Kayak Launch at Loafers Rest.
• The access point off of Loafers Rest needs a tremendous amount of improvement. The parking is very acceptable, The the access is defiantly not accessible for most people, a long hale down narrow winding path that empties into a field with a very narrow path. It is difficult to no navigate these paths without getting into the tall grass that is ladened with tics. Once you arrive at the put in it is about 6-8 feet wide. Heaven forbid there be someone attempting to fish from the non-existing bank, and you have to interrupt that person to get boat in the water, and if you have 2,4, or 6 boats makes for a miserable experience for all parties. It would be a much better experience if a"boat put in" could be at the area that AEP has gated. This would be a game changer and you can add ADA access that now-a-days is a must. Thank you for your consideration
• water quality and fish habitat
• We used to camp many many years ago. It would be nice for the facilities to be reopened

Additional Comment Responses from New River Trail Picnic Area:



Comments	#
Beautiful, Unique Place to Visit	1
Camping Again	1
Want to see promotion of the area	1
Water level too low above the dam due to work	1

Byllesby-Buck Recreation – *Cumulative Results for "Other" Areas*

Additional comments: *(verbatim responses)*

• As a property owner on the New River in Wythe County which is is very close to Bucks Dam, and a citizen and elected official of the Town of Wytheville I ask you all to please take all suggestions serious. The citizens that live in the Towns, County"s and Cities near or on the new area in South West Virginia are affected in many ways by the New River. To include recreation, boating, fishing, both recreational and for sustainability. Sustainability includes environmental, social and economic impacts. The people and families in South West Virginia are usually forgotten, and pushed aside!!! I would ask you to consider making it possible to use Buck Dam to our advantage. It would be a HUGE ECONOMIC BOOST to many Towns, Cities and County"s in the region to have the ability to release the waters on a schedule to provide rapids and thus a huge Tourism destination, that would be a HUGE economic impact for all the Families and Citizens in this section of South West Virginia. This would increase self-esteem, increase employment and help us fight drug abuse. For once, it would be welcome to be treated as if we were Northern Virginia and not treated a certain way because we are SWV. This is a once in a lifetime opportunity not just for the citizens but also for all that are making this decision, and I say this because this relicensing for AEP is what 40 -50 years, and this opportunity won't come again anytime soon. These request, the change in the put-in and providing rapids, is not that costly for AEP and you can be proud that these changes will have a huge impact and will change this area for the better for decades to come and we would have AEP to thank for believing in us and given us not just a chance but a new life stile for people in this part of SWV. The year 2020 mostly with have bad memories for all, especially in areas such as SWV, But I hope you will give us something to hold on to and remember for our lifetime, that we were all part of a huge improvement in so many lives right here in SWV. Think about all that will be gained for comparatively low monetary outlay. Thank you for your time and patience. Be Safe.
• Campground
• Great place for waterfowl and goose hunting. Good access and plenty of game. I hope it stays around
• The turbidity during the work on the dams has been unacceptable. All year the New River has been so turbid as to make it impossible to safely paddle. The number of paddlers and floating fisherman has been significantly reduced this year. Publicly available water quality monitoring should be readily available to residents using the River. Most visitors accessing the Byllesby- Buck Project area do so by travelling through Wythe County even though the project is located in Carroll County.

Attachment 4

Attachment 4 – Trail Camera Representative Photographs

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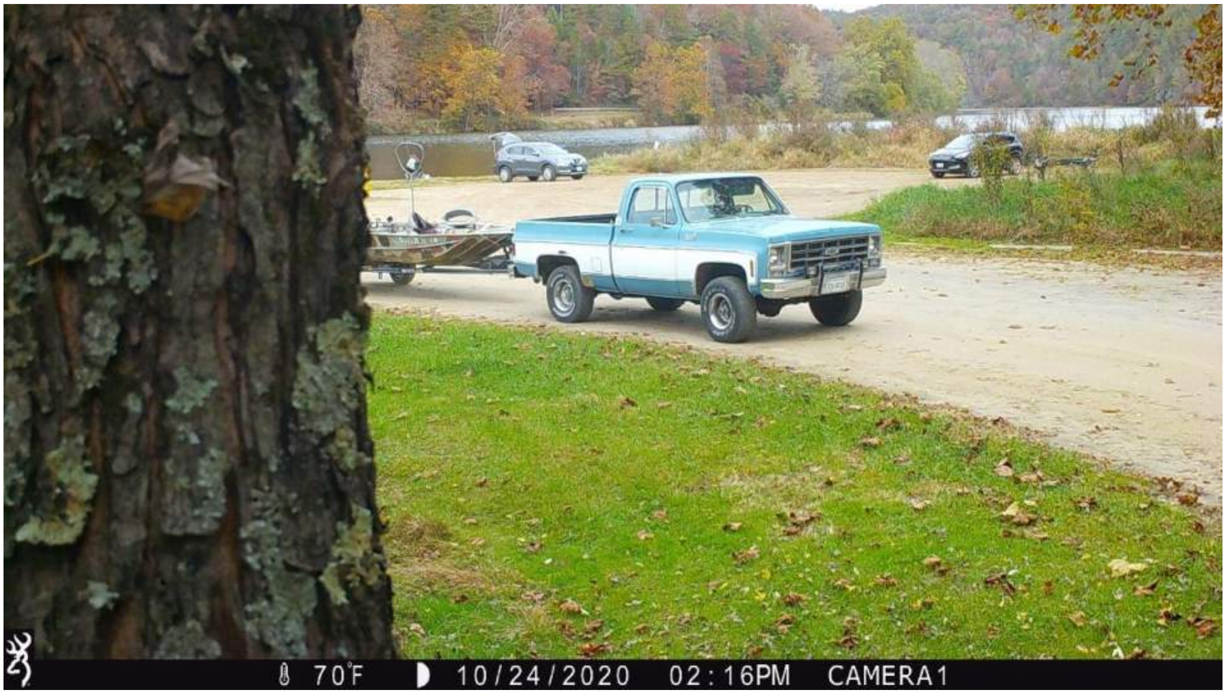
Trail Camera Documentation

Byllesby VWDR Boat Launch

Sunday, May 10, 2020

Friday, July 24, 2020



Saturday, October 24, 2020

Byllesby Canoe Portage – Parking Lot

Sunday, May 10, 2020

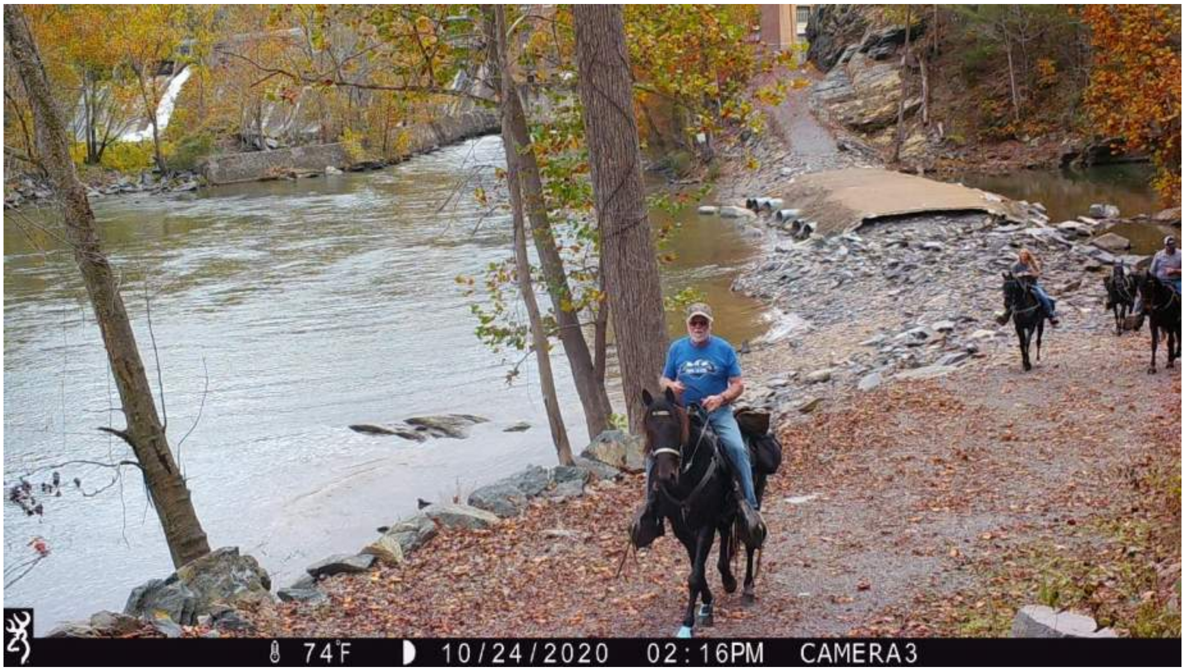
Friday, July 24, 2020

Saturday, October 24, 2020

New River Canoe Launch

Sunday, May 10, 2020

Friday, July 24, 2020



Saturday, October 24, 2020

New River Picnic Area - Upper

Sunday, May 10, 2020

Friday, July 24, 2020

Saturday, October 24, 2020

New River Picnic Area - Lower

Sunday, May 10, 2020

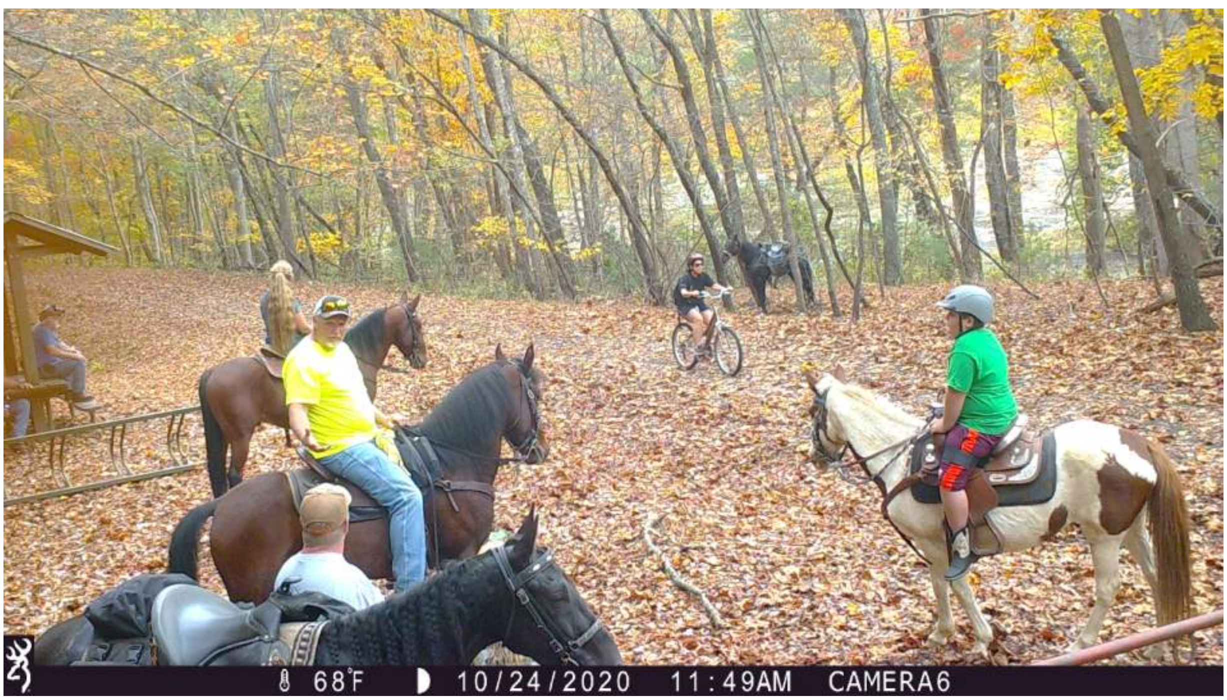
Friday, July 31, 2020

Saturday, October 24, 2020

Buck Dam Picnic Area

Sunday, May 10, 2020

Friday, July 31, 2020



Saturday, October 24, 2020

Buck Dam – Fishing Access Trail Camera View:

Buck Dam Canoe Portage (Put-In) Trail Camera View:

Document Content(s)