WATER STRATEGY, HYDRO LICENSING & LAKE SERVICES

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October 2, 2024

Electronically Filed

Debbie-Anne A. Reese, Acting Secretary
Federal Energy Regulatory Commission
888 First Street, NE
Washington, DC 20426

Subject: **Bad Creek Pumped Storage Project (P-2740-053)**
Relicensing Study Progress Report No. 6

Dear Acting Secretary Reese:

Duke Energy Carolinas, LLC (Duke Energy or Licensee) is the Licensee, owner, and operator of the 1,400-megawatt (MW) Bad Creek Pumped Storage Project (FERC Project No. 2740) (Project), located in Oconee County, South Carolina, approximately eight miles north of Salem. The Bad Creek Reservoir (or upper reservoir) was formed from the damming of Bad Creek and West Bad Creek and serves as the Project's upper reservoir. Lake Jocassee serves as the lower reservoir and is licensed separately as part of Duke Energy's Keowee-Toxaway Hydroelectric Project (FERC Project No. 2503).

The existing (original) license for the Project was issued on August 1, 1977, by the Federal Energy Regulatory Commission (FERC or Commission) and expires on July 31, 2027. Accordingly, Duke Energy is pursuing a new license for the Project pursuant to the Commission's Integrated Licensing Process (ILP), as described at 18 Code of Federal Regulations (CFR) Part 5.

Relicensing Studies

Pursuant to 18 Code of Federal Regulations (CFR) § 5.15(c), Duke Energy filed the Initial Study Report (ISR) with the Commission on January 4, 2024, which summarized study activities performed in 2023, as well as ILP activities expected to be completed in 2024. An ISR meeting was held on January 17, 2024. This sixth Quarterly Study Progress Report describes activities performed since the fifth Quarterly Study Progress Report, including activities that occurred in quarter 3 (Q3) of 2024 and activities expected to be conducted in quarter 4 (Q4) of 2024. Unless otherwise described, all relicensing studies are being conducted in conformance with the approved Revised Study Plan (RSP) and the Commission's Study Plan Determination (SPD).

Duke Energy is filing this Quarterly Study Progress Report with the Commission electronically and is distributing this letter to the parties listed on the attached distribution list. For parties listed on the attached distribution list who have provided an email address, Duke Energy is distributing this letter via email; otherwise, it will be distributed via U.S. mail.

Duke Energy looks forward to continuing to work with Commission staff, resource agencies, Indian Tribes, local governments, non-governmental organizations, and interested members of the public

throughout the relicensing process. If there are questions regarding this filing, please contact me at Alan.Stuart@duke-energy.com or via phone at 980-373-2079.

Sincerely,

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Enclosure

cc (w/enclosure): Jeff Lineberger, Duke Energy

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Bad Creek Pumped Storage Project
Relicensing Study Progress Report No. 6
October 2, 2024

1.0 BACKGROUND

Duke Energy Carolinas, LLC (Duke Energy or Licensee) is the Licensee, owner, and operator of the 1,400-megawatt (MW) Bad Creek Pumped Storage Project (FERC Project No. 2740) (Project), located in Oconee County, South Carolina, approximately eight miles north of Salem. The Bad Creek Reservoir (or upper reservoir) was formed from the damming of Bad Creek and West Bad Creek and serves as the Project's upper reservoir. Lake Jocassee serves as the lower reservoir and is licensed separately as part of Duke Energy's Keowee-Toxaway Hydroelectric Project (FERC Project No. 2503).

The existing (original) license for the Project was issued on August 1, 1977, by the Federal Energy Regulatory Commission (FERC or Commission) and expires on July 31, 2027. Accordingly, Duke Energy is pursuing a new license for the Project pursuant to the Commission's Integrated Licensing Process (ILP), as described at 18 Code of Federal Regulations (CFR) Part 5.

2.0 STUDY PLAN DEVELOPMENT

In accordance with 18 CFR §5.11, Duke Energy developed a Proposed Study Plan (PSP) in consultation with agencies and stakeholders and filed it on August 5, 2022. After the filing of the PSP, Duke Energy held a site visit and Project tour on August 16, 2022, and the PSP meeting on September 7, 2022. Duke Energy also continued to consult with agencies and other stakeholders regarding its proposed studies.

Duke Energy evaluated the comments submitted by the Commission and stakeholders in response to the PSP. Based on Duke Energy's review of these comments, FERC criteria for study requests under the ILP, and readily available information (e.g., associated with the previous licensing effort or resulting from ongoing monitoring activities), Duke Energy proposed six resource studies in the

Revised Study Plan (RSP) filed with FERC on December 5, 2022. The RSP includes copies of and summarizes comments received and Duke Energy's responses.

The six studies in the RSP will support evaluation of the potential effects of continued operation of the Project as well as potential effects of construction and operation of the proposed Bad Creek II complex. These studies are:

- Water Resources Study;
- Aquatic Resources Study;
- Visual Resources Study;
- Recreational Resources Study;
- Cultural Resources Study; and
- Environmental Justice Study.

In FERC's Study Plan Determination (SPD) letter on January 4, 2023, FERC approved the proposed studies as submitted in the RSP except the Recreational Resources Study which was approved with modifications. The Recreational Resources Study was modified to include the following:

- An additional traffic counter was added at the Laurel Valley Trail Access.[1]
- Revisions to the Recreation Site Inventory Form to include the number and height of bear cables and number of latrines.

Pursuant to 18 Code of Federal Regulations (CFR) § 5.15(c), Duke Energy filed the Initial Study Report (ISR) with the Commission on January 4, 2024, which summarized study activities performed in 2023, as well as ILP activities expected to be completed in 2024. An ISR meeting was held on January 17, 2024, and the ISR Meeting Summary was filed with FERC on February 1, 2024. The following sections summarize progress implementing the relicensing studies since the June 28, 2024, Study Progress Report.

[1] Although the SPD referenced "Laurel Fork Gap", Duke Energy assumes the Foothills Trail Conservancy and FERC meant to reference the Laurel Valley Trail Access.

3.0 ACCESS ROADS

In its Study Progress Report No. 2, Duke Energy first provided information on a potential temporary access road to the Fisher Knob community (Fisher Knob Access Road). The study areas for the Water Resources, Aquatic Resources, Visual Resources, and Cultural Resources studies were expanded to incorporate the areas potentially affected by the road. Duke Energy initially proposed activities for Fisher Knob Access Road construction to occur prior to license issuance; however, early construction of the Fisher Knob Access Road is no longer part of the licensing proposal and road development, if proposed, will follow license issuance. Studies are unaffected by this change in schedule and still incorporate the areas potentially affected by the proposed Fisher Knob Access Road.

Primary site access for construction is provided by the existing Bad Creek Road. Duke Energy is presently evaluating potential improvements to existing access roads for use during construction of the proposed additional 9.3-mile-long 525-kV transmission line for Bad Creek II. These non-project access roads are located outside the FERC Project Boundary, owned by Duke Energy, subject to Duke Energy-held easements, or are existing U.S. Forest Service roads that would be subject to federal authorization under a non-commercial/road use agreement.

4.0 WATER RESOURCES STUDY

The components of the Water Resources Study and status of each are provided below:

- **Summary of Existing Water Quality Data and Standards**: The final study report was provided in the ISR as Appendix A, Attachment 1.
- **Water Quality Monitoring in the Whitewater River Arm**: A draft interim report with preliminary water quality results from study year 1 was included in the ISR as Appendix A, Attachment 2. Activities for the second study year commenced in June 2024 with redeployment of water quality instrumentation in the Whitewater River arm to collect water quality information. Field work is ongoing, and a draft report will be distributed in Q4, which will include a summary of data for both study years.
- **Computational Fluid Dynamics (CFD) Modeling of Velocity Effects and Vertical Mixing in Lake Jocassee Due to a Second Powerhouse:** A final study report was provided in the ISR as Appendix A, Attachment 3. While the original scope and objectives of this study task have been met, recent optimization studies for Bad Creek II have indicated that variable speed pump-turbine units will be implemented at Bad Creek II

instead of single-speed units, which would result in increased hydraulic capacities compared to what was originally modeled. Therefore, additional CFD modeling has been carried out to incorporate these updated hydraulic capacities. A summary report presenting the effects of updated pumping capacities in Whitewater River cove was developed for Duke Energy and distributed for 30-day stakeholder review on June 12, 2024. The final report is provided with this Study Progress Report as Attachment A and will be included as an addendum to the CFD study report in the Updated Study Report (USR).

- **CHEOPS Modeling of Water Exchange Rates and Lake Jocassee Reservoir Levels:** The final CHEOPS report was distributed to the RCs on April 27, 2024, and was provided as Attachment A of the fifth Quarterly Study Progress Report.
- **Water Quality Management Plan (WQMP) Development:** Development of the WQMP began in second quarter 2024. In early August, Duke Energy met directly with staff from the South Carolina Department of Environmental Services (SCDES, Clean Water Act Section 401 water quality certifying agency) to discuss the proposed Bad Creek II Complex and elements of the WQMP. Duke Energy provided a draft version of the WQMP directly to SCDES for review and comment. Following receipt of comments from SCDES, Duke Energy will revise the draft WQMP as appropriate and distribute it to the Water and Aquatics RCs for input in 2024. Duke Energy presently expects to complete this consultation and finalize the WQMP by the end of Q4.

Variance from Approved Study Plan

The study is proceeding in accordance with the approved study plan except the study area has expanded to incorporate the proposed Fisher Knob Access Road. Additional CFD modeling was carried out to incorporate increased hydraulic pumping capacities associated with recently proposed variable-speed units at Bad Creek II, as described above.

5.0 AQUATIC RESOURCES STUDY

The components of the Aquatic Resources Study and status of each are provided below:

- **Entrainment Study:** The final report was reviewed by stakeholders and provided in the ISR as Appendix B, Attachment 1. As described above, recent optimization studies for Bad Creek II have indicated that variable speed pump-turbine units will be constructed at Bad Creek II instead of single-speed units, which would result in increased hydraulic capacities compared to what was originally modeled for entrainment. Therefore, additional modeling

is being carried out to incorporate these updated hydraulic capacities and Addendum 1 to the final report will be distributed to the Aquatic Resources RC in November 2024 for a 30-day review and included in the USR. Also, per the Commission's request in their ISR comments, a literature review is currently being carried out for the intrinsic population growth rate of threadfin shad, as well as other species of interest, as appropriate. This review will be included as Addendum 2 to the final report and will be distributed to the Aquatic Resources RC for a 30-day review prior to being included in the USR.

- **Effects of Bad Creek II Complex and Expanded Weir on Aquatic Habitat:** The final report was distributed to the RC on June 3, 2024, and was included as Attachment B of the fifth Quarterly Study Progress Report.
- **Impacts to Surface Waters and Associated Aquatic Fauna:** The final report was distributed to the RC on February 14, 2024, and was included as Attachment A of the fourth Quarterly Study Progress Report.

Variance from Approved Study Plan

The Entrainment Study and Effects of Bad Creek II Complex and Expanded Weir on Aquatic Habitat were completed in accordance with the approved study plan. The Impacts to Surface Waters and Associated Aquatic Fauna study area was expanded to include the proposed Fisher Knob Access Road. Stream habitat surveys for five streams within spoil locations were not completed due to safety concerns related to inclement weather. These variances were reported in the ISR.

6.0 VISUAL RESOURCES STUDY

The final study report was distributed to the RC on June 26, 2024, and was included as Attachment B of the fifth Quarterly Study Progress Report.

Variance from Approved Study Plan

The study was completed in accordance with the approved study plan with the addition of the proposed Fisher Knob Access Road into the viewshed model.

7.0 RECREATIONAL RESOURCES STUDY

The status of the Recreational Resources Study is described below.

- **Foothills Trail Recreation Use and Needs (RUN) Study**: The draft RUN Study Report, including the Foothills Trail carrying Capacity analysis report, was distributed to the

Recreational & Visual Resources RC in May and June, 2024. The final RUN Study Report will be provided in the USR.

- **Foothills Trail Condition Assessment**: Duke Energy received comments on the draft report from the FTC, South Carolina Department of Natural Resources (SCDNR), and Friends of Lake Keowee Society. The RC discussed these comments during the February 2024 meeting. Additional information was collected by Long Cane Trails to address some of the RC comments. A memo summarizing the additional information was prepared and distributed to the RC for review on June 26, 2024. The FTC provided comments on the memo, which will be addressed in the USR. The final Foothills Trail Condition Assessment report, including the additional information memo, will be filed with the USR.
- **Whitewater River Cove Existing Recreational Use Evaluation**: This effort has been completed and the final report was included in the ISR as Appendix D, Attachment 3. No further work in association with this task is planned.
- **Whitewater River Cove Recreation Public Safety Evaluation:** This effort will integrate the CFD modeling surface velocity data developed in the Water Resources Study with the Whitewater River cove recreational use data captured during the 2023 boating season. Development of the draft report is underway and distribution to Recreational & Visual Resources RC members is planned for October.

Variance from Approved Study Plan

The study is proceeding in accordance with the study plan as modified by FERC.

8.0 CULTURAL RESOURCES STUDY

The final report was attached as Attachment B of the fourth Quarterly Progress Report[2]. In Q3, Duke Energy identified the need to slightly expand the proposed FERC Project Boundary and the Area of Potential Effect (APE) to align with the proposed widened corridor for the transmission line, based on its current design. Duke Energy notified the SC SHPO of this minor modification to the APE by letter dated September 11, 2024. Additional cultural resources field work has been conducted along the proposed approximately 9.3-mile-long 525-kV transmission corridor for Bad Creek II. Results will be incorporated into an updated final report in the USR.

[2] Consistent with FERC policy, the Cultural Resources report was submitted as Controlled Unclassified Information (CUI)/Privileged information.

Variance from Approved Study Plan

The study was completed in accordance with the approved study plan; the geographic scope of the study area was expanded to encompass the proposed Fisher Knob Access Road and the transmission corridor.

9.0 ENVIRONMENTAL JUSTICE STUDY

The final report was filed as Appendix F of the ISR. No written comments were provided requesting modifications to the final study report. Although disproportionately high or adverse effects to Environmental Justice (EJ) communities surrounding the Project were not identified through desktop analyses, FERC has indicated in verbal comments during the Initial Study Report (ISR) meeting that they would recommend outreach to engage the identified environmental justice communities in the relicensing process. Duke Energy is currently in the process of planning public outreach efforts for late 2024, with a focus on the two geographic areas identified during the desktop analysis. Outreach efforts will be summarized within the USR.

Variance from Approved Study Plan

The study was conducted in accordance with the study plan as modified by FERC.

10.0 WILDLIFE AND BOTANICAL UPDATE

Duke Energy developed a bat study plan in consultation with the SCDNR and U.S. Fish and Wildlife Service (USFWS) to carry out additional surveys for bats at the Project due to potential clearing associated with the proposed Fisher Knob Access Road, spoil areas, transmission line, and other areas of proposed Bad Creek II Power Complex infrastructure. The final bat study plan was distributed to the Wildlife and Botanical RC on May 31, 2024. Copies of the study plan were also distributed to the U.S. Department of Agriculture (J. Magniez) and FERC staff (S. Salazar), per individual requests.

Surveys were carried out between June 1 and June 20 in proposed impact areas including potential spoil sites and the proposed Fisher Knob Access Road, as well as areas potentially impacted by the proposed transmission line construction and maintenance. The potential impact areas contain suitable summer habitat, as outlined by 2024 USFWS guidelines, that require bat surveys according to linear and non-linear project protocols since tree clearing needs to take place during the restricted cutting timeframes. Bat surveys followed the 2024 Range-wide

Indiana Bat and Northern Long-eared Bat Survey Guidelines.[3] The final Bat Study Plan was provided with the fifth Study Progress Report. The Bat Survey Report is currently under development and will be included in the USR.

In response to a written request from the SCDNR in comments submitted to the Commission on the ISR, Duke Energy developed a study plan for the federally threatened small whorled pogonia. This study was designed to determine the presence or absence of this protected species prior to land disturbance activities associated with the access road and overall construction of the Bad Creek II Power Complex and to aid in the quality and comprehensiveness of the statewide dataset for rare, threatened, and endangered species. This survey and other fieldwork components were completed in June 2024. Additionally, field biologists recorded incidental observations of priority plant species identified in the SC Wildlife Action Plan (SWAP) during the survey. The small whorled pogonia draft study plan was distributed to the SCDNR and USFWS for review and comment on May 24, 2024; neither agency had comment on the draft study plan, therefore, the final study plan was distributed to the Wildlife and Botanical RC on June 5, 2024. The final Small Whorled Pogonia Study Plan was provided with the fifth Progress Report as Attachment E. The Small Whorled Pogonia Survey Report was distributed to the Wildlife and Botanical RC on August 28, 2024, and the report was revised to incorporate feedback from the SCDNR and Upstate Forever. This final report was distributed to the Wildlife and Botanical RC on September 19, 2024 and is included as Attachment B.

11.0 PERMITTING ACTIVITIES

In the fifth Quarterly Study Progress Report, Duke Energy provided information about initial work in support of Clean Water Act Section 404 / 401 permitting, including pre-application meetings with the U.S. Army Corps of Engineers (USACE) (as well as SCDES, USFWS, SCDNR, and Catawba Indian Nation) on March 28, 2024, and a follow-up meeting with additional USACE staff on April 11, 2024. In Q3, Duke Energy's consultant, HDR Engineering, Inc. (HDR), carried out surveys of the Project Area for Waters of the U.S. (WOTUS) under Clean Water Act Section 404/401, including delineation of jurisdictional WOUS and stream classifications, in accordance with current regulations and guidance. Duke Energy and HDR filed a combined Preliminary/Approved Jurisdictional Request with the USACE on September 28,

[3] Range-wide Indiana Bat and Northern Long-eared Bat Survey Guidelines | FWS.gov

2024, seeking written verification for the delineated waters within the Project Area and are continuing coordination with USACE on this process.

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Attachment A: Bad Creek CFD Model Updated Pumping Rates Addendum

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BAD CREEK CFD MODEL
UPDATED PUMPING RATES

ADDENDUM

WATER RESOURCES STUDY

Bad Creek Pumped Storage Project
FERC Project No. 2740

Oconee County, South Carolina

September 10, 2024

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BAD CREEK CFD MODEL UPDATED PUMPING RATES ADDENDUM
BAD CREEK PUMPED STORAGE PROJECT
FERC PROJECT NO. 2740
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ACRONYMS AND ABBREVIATIONS

3-D	3-dimensional
Bad Creek or Project	Bad Creek Pumped Storage Project
Bad Creek II Complex or Bad Creek II	Bad Creek II Power Complex
CFD	computational fluid dynamics
cfs	cubic feet per second
Duke Energy or Licensee	Duke Energy Carolinas, LLC
fps	feet per second
ft	feet
ft msl	feet above mean sea level
FERC or Commission	Federal Energy Regulatory Commission
HDR	HDR Engineering, Inc.
ISR	Initial Study Report
I/O	inlet/outlet
WWRC	Whitewater River cove

1 Project Introduction and Background

Duke Energy Carolinas, LLC (Duke Energy or Licensee) is the owner and operator of the 1,400-megawatt Bad Creek Pumped Storage Project (Project) (FERC Project No. 2740) located in Oconee County, South Carolina, approximately eight miles north of Salem. The Project utilizes the Bad Creek Reservoir as the upper reservoir and Lake Jocassee, which is licensed as part of the Keowee-Toxaway Hydroelectric Project (FERC Project No. 2503), as the lower reservoir.

The existing (original) license for the Project was issued by the Federal Energy Regulatory Commission (FERC or Commission) for a 50-year term, with an effective date of August 1, 1977, and expires July 31, 2027. The license has been subsequently and substantively amended, with the most recent amendment on August 6, 2018 for authorization to upgrade and rehabilitate the four pump-turbines in the powerhouse and increase the Authorized Installed and Maximum Hydraulic capacities for the Project.[1]

Given the need for additional significant energy storage and renewable energy generation across Duke Energy's service territories over the Project's new 40 to 50-year license term, Duke Energy is evaluating opportunities to add pumping and generating capacity at the Project. Additional energy storage and generation capacity would be developed by constructing a new power complex (including a new underground powerhouse) adjacent to the existing Bad Creek powerhouse. Therefore, construction of the 1,400-megawatt Bad Creek II Power Complex (Bad Creek II Complex or Bad Creek II) is an alternative relicensing proposal presently being evaluated by Duke Energy.

During the feasibility study phase for Bad Creek II, a three-dimensional (3-D) computational fluid dynamics (CFD) model was developed by HDR Engineering, Inc (HDR) to evaluate impacts under combined operation of the existing and proposed projects on water velocities in the Whitewater River cove (WWRC) of Lake Jocassee downstream of the inlet/outlet (I/O) structures. Results from the CFD feasibility modeling study are presented in the Feasibility Study Report as Volume 5 (*Bad Creek II Power Complex Feasibility Study Lower Reservoir CFD Flow Modeling Report*; HDR 2022). This report was also included in the Revised Study Plan

[1] *Duke Energy Carolinas LLC*, 164 FERC ¶ 62,066 (2018)

submitted to FERC on December 5, 2022. During studies for relicensing in 2023, a second CFD model was developed under Task 3 of the Water Resources Study (*Velocity Effects and Vertical Mixing in Lake Jocassee Due to a Second Powerhouse)* to determine flow patterns and extent of vertical mixing in the WWRC due to the addition of a second powerhouse. Findings from that study were provided in Appendix A of the Initial Study Report (ISR) submitted to the Commission on January 4, 2024 (Duke Energy 2024).

After filing the ISR, Duke Energy provided updated hydraulic capacities, provided by the preferred Original Equipment Manufacturer, for proposed variable speed pump-turbines for Bad Creek II. Based on this information, additional CFD modeling was conducted using the updated proposed hydraulic capacities. This report includes the results of updated CFD modeling and is being provided as an addendum to the Task 3 study report for the Bad Creek relicensing Water Resources Study.

2 Objectives

Increased hydraulic capacities associated with Bad Creek II could affect flow patterns and velocities in the WWRC near the I/O structures. The purpose of this addendum is to provide results of additional CFD model runs carried out to incorporate updated hydraulic capacities associated with Bad Creek II that were not available during original CFD modeling. Updated generating capacity resulted in similar flows as originally estimated (i.e., less than 2 percent difference), so this report's focus is to present the effects of updated pumping capacities on WWRC flows.

3 Study Area

The study area for this assessment includes the area of the WWRC from the immediate vicinity of the Project's existing and proposed I/O structures to the upstream end of the submerged weir (see Figure 3-1; blue rectangle defines study area). Previous CFD modeling results carried out under Task 3 of the Water Resources Study showed the submerged weir limits effects of operations downstream of the weir, therefore, updated modeling focused on the area upstream of the weir only.

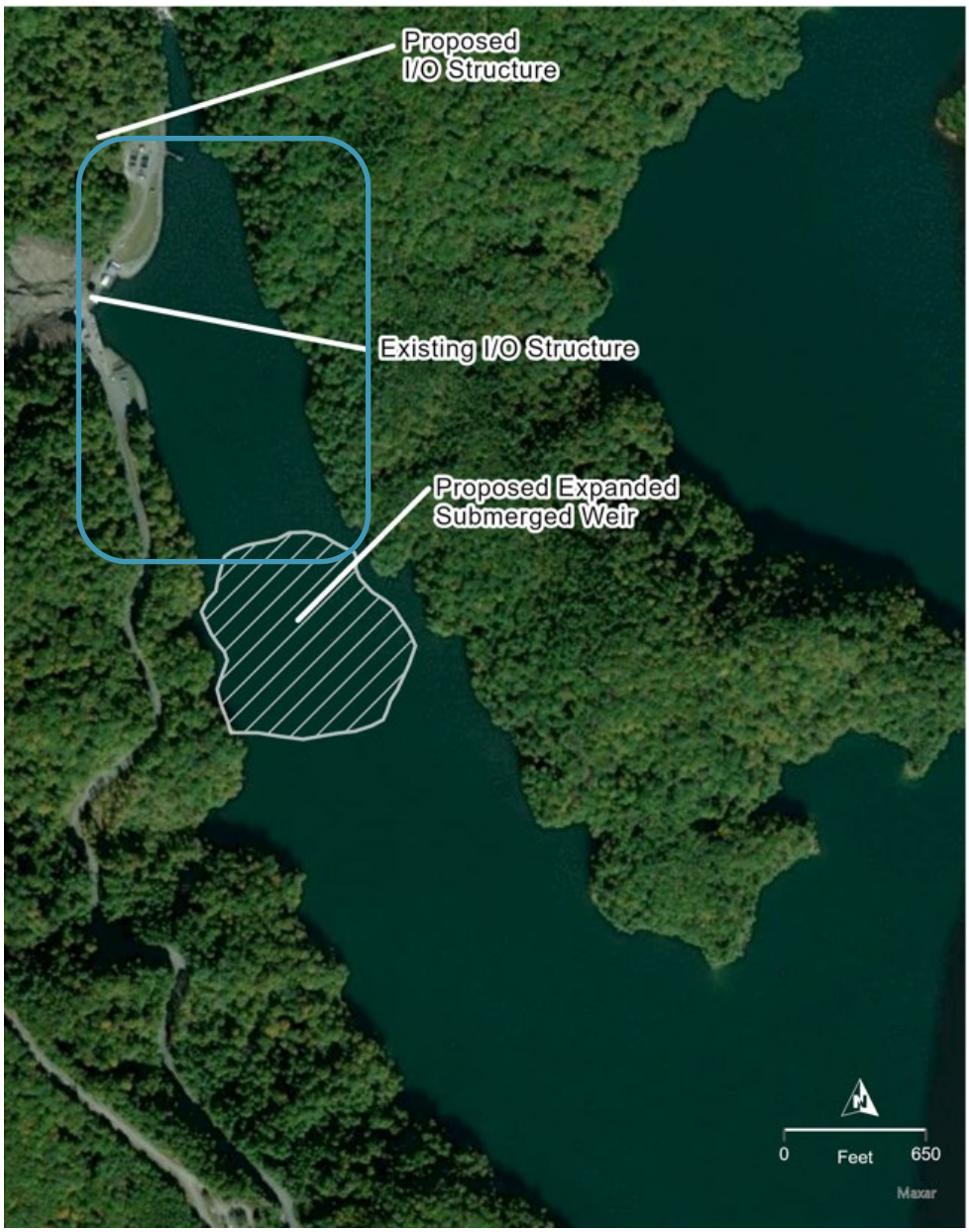


Figure 3-1. CFD Updated Modeling Study Area: Whitewater River Cove

4 Hydraulic Capacities

Existing hydraulic capacities for the Bad Creek Project are included in Table 1. This table shows as-constructed and previously licensed Project capacities and upgraded unit capacities (as amended). On April 23, 2018, Duke Energy filed a Non-Capacity License Amendment Application to upgrade and refurbish the four Francis-type pump-turbines in the powerhouse, replace existing runners with Francis-type pump-turbine runners, and rehabilitate and/or upgrade

the remaining components of the pump-turbine runners at the Bad Creek Project. Authorized installed and maximum hydraulic capacities for the Project were increased to 1,400 megawatts (based upon the definition provided by 18 CFR §11.1[i])[2] and 19,760 cubic feet per second (cfs), respectively. The upgrades were approved by FERC in an amendment order dated August 6, 2018 and modifications for Units 1 – 3 were completed by March 2023 and Unit 4 was completed in February 2024. The upgraded Project is the baseline for the relicensing and upgraded unit capacities were used for (CFD) modeling existing conditions.

Hydraulic capacities at the Project under previously licensed and upgraded (i.e., as amended in 2018) conditions are included in Table 4-1. Results of CFD modeling incorporating upgraded capacities are presented as existing conditions in Volume 5 of the Feasibility Study Report (HDR 2022) upstream of the submerged weir and in the CFD Task 3 report in the ISR (Duke Energy 2024) for downstream of the submerged weir.

Table 4-1. As-Constructed (Original) and Upgraded (Amended) Project Hydraulic Capacities

Bad Creek (Existing Project)				
Unit	Generation		Pumping	
	Original (cfs)	Upgraded/Existing (cfs)	Original (cfs)	Upgraded/Existing (cfs)
Unit 1	4,000	4,940	3,690	4,060
Unit 2	4,000	4,940	3,690	4,060
Unit 3	4,000	4,940	3,690	4,060
Unit 4	4,000	4,940	3,690	4,060
Total	**16,000**	**19,760**	**14,760**	**16,240**

Prior CFD modeling for proposed conditions followed the assumption that Bad Creek II would be constructed with four reversible pump-turbine units similar to the configuration at the existing Project with the same generation and pumping capacities (see Table 4-1). However, during recent (2023) optimization studies for the Bad Creek II Complex, variable speed pump-turbine

[2] *Authorized installed capacity* means the lesser of the ratings of the generator or turbine units. The rating of a generator is the product of the continuous-load capacity rating of the generator in kilovolt-amperes (kVA) and the system power factor in kW/kVA. If the licensee or exemptee does not know its power factor, a factor of 1.0 kW/kVA will be used. The rating of a turbine is the product of the turbine's capacity in horsepower (hp) at best gate (maximum efficiency point) opening under the manufacturer's rated head times a conversion factor of 0.75 kW/hp. If the generator or turbine installed has a rating different from that authorized in the license or exemption, or the installed generator is rewound or otherwise modified to change its rating, or the turbine is modified to change its rating, the licensee or exemptee must apply to the Commission to amend its authorized installed capacity to reflect the change.

units were selected as the chosen configuration (instead of fixed-speed), which resulted in an increase in proposed hydraulic capacities for Bad Creek II as show in Table 4-2.

Table 4-2. Updated Bad Creek II Hydraulic Capacities

Bad Creek II				
Unit	Generation		Pumping	
	Previously Proposed (cfs)	Updated Proposed (2023) (cfs)	Previously Proposed (cfs)	Updated Proposed (2023) (cfs)
Unit 1	4,940	5,000	4,060	4,890
Unit 2	4,940	5,000	4,060	4,890
Unit 3	4,940	5,000	4,060	4,890
Unit 4	4,940	5,000	4,060	4,890
Total	**19,760**	**20,000**	**16,240**	**19,560**

In consideration of the recent 2023 updated capacities, total generation capacity with both projects operating would be 39,760 cfs (19,760 + 20,0000 cfs). Modeled (CFD) versus updated generation capacity is similar (39,200 cfs vs. 39,760 cfs), resulting in a less than 2 percent difference. It is anticipated this difference would not substantially affect existing results (as reported in the ISR); therefore, generation capacity was not assessed further.

Total pumping capacity (with both projects) would be 35,800 cfs (16,240 + 19,560 cfs), resulting in a 9 percent increase (i.e., 32,720 cfs vs. 35,800 cfs); therefore, additional model runs were performed under proposed configurations for pumping operations under full pond and minimum normal pond elevations in Lake Jocassee.

5 Lake Jocassee Lake Levels

The lower reservoir has a licensed operating band between 1,110 ft msl (full pond) and 1,080 (minimum pond or maximum drawdown). Results under full pond and maximum drawdown provide potential upper and lower limits of hydraulic effects of Bad Creek II operations. Figure 5-1 provides an exceedance plot of the Lake Jocassee pond level from 1975 to 2020. This plot shows the percentage of time the reservoir is at or above a given elevation. Lake Jocassee operates within 5 ft of the full pond elevation of 1,110 ft roughly 50 percent of the time, and in the 45-year period of record Lake Jocassee has never reached the maximum drawdown elevation.

For this evaluation, unit operations in pumping mode were simulated with the existing and proposed structures at reservoir levels 1,110 ft msl, 1,096 ft msl, and 1,080 ft msl. The elevation of 1,096 ft msl was selected as an intermediate lake elevation operating scenario because it is roughly halfway between full pond and maximum drawdown, and 1,096 ft msl is the elevation below which fish entrainment becomes elevated at Bad Creek (historically, reservoir elevations were lower than 1,096 ft msl approximately 22 percent of the time).

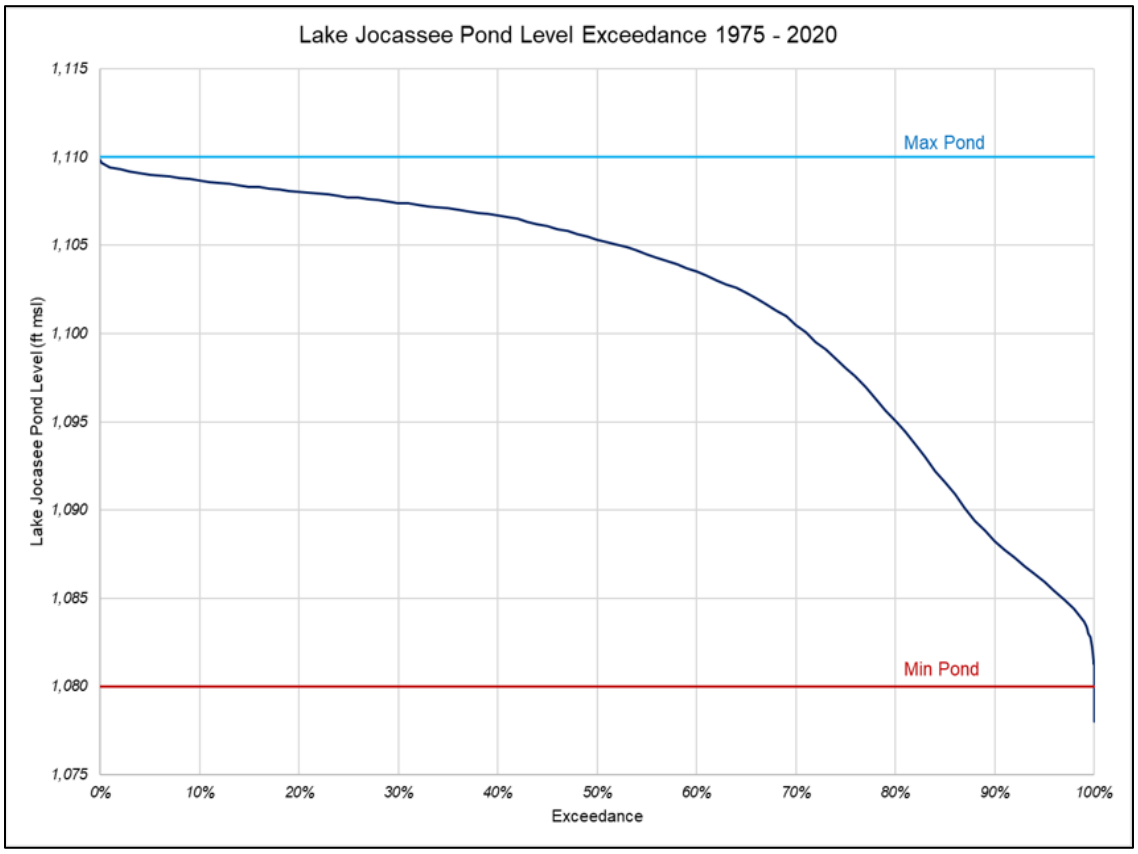


Figure 5-1. Lake Jocassee Pond Level Exceedance

6 Proposed Tunnel Configuration

The Bad Creek II I/O structure will be located in a portal area adjacent to the existing Bad Creek I/O structure (upstream of the existing I/O structure). The proposed location of the new I/O structure portal for Bad Creek II is shown on Figure 6-1.

A schematic of the proposed tunnels extending from the underground powerhouse to the western bank of the WWRC is shown below (Figure 6-2). The proposed I/O structure will be approximately 150 ft wide, 20 ft deep, and 95 ft tall. The location of the structure was selected to

minimize the length of the water conveyance tunnel, permit access, and reduce construction-related environmental impacts to the Whitewater River arm of Lake Jocassee. Two tailrace tunnels extending from the underground powerhouse will penetrate the I/O structure at invert elevation 1,012 ft msl. The two tailrace tunnels are divided into a left and right chamber as the tunnels approach the portal opening. Each tunnel has a diameter of 31 ft and the chambers at the outlet are approximately 38 ft tall by 17.5 ft wide. Flows through the center two chambers (Tunnel 1 Right and Tunnel 2 Left) create higher velocities at the tunnel entrances when compared to the outer two chambers (Tunnel 1 Left and Tunnel 2 Right) which is discussed further in Section 8.

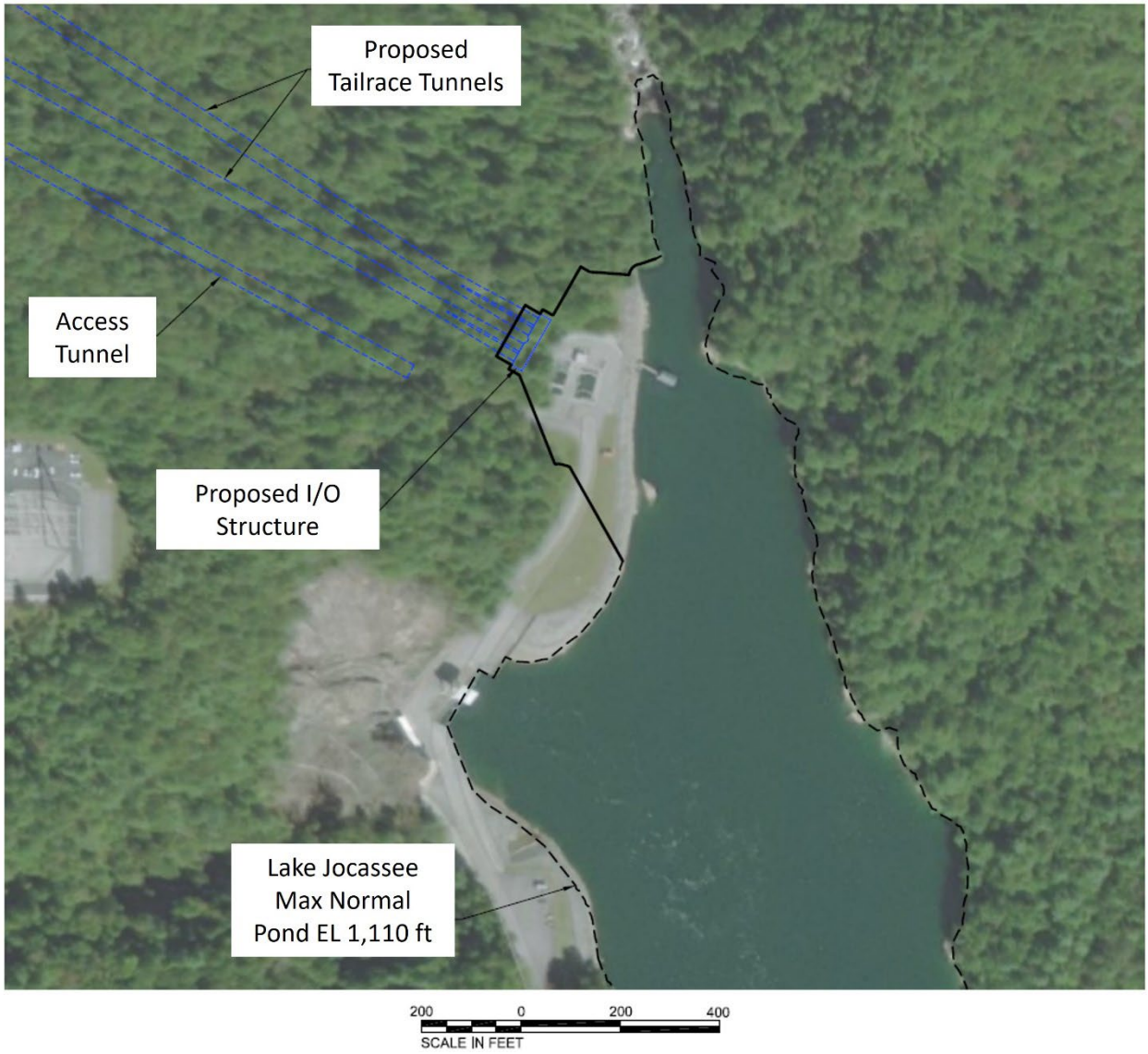
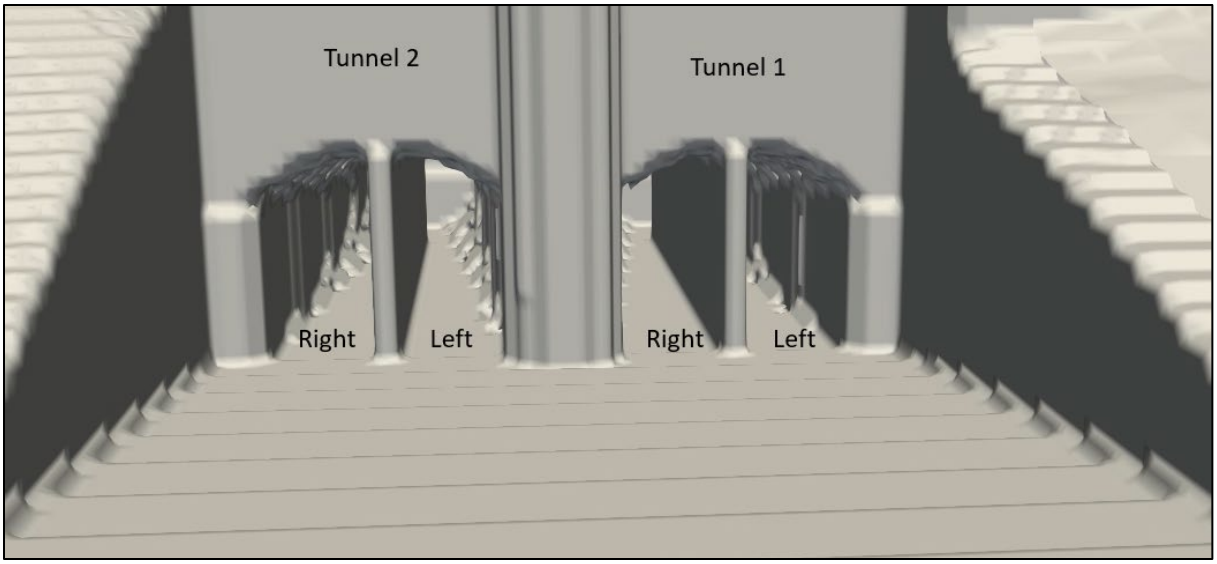


Figure 6-1. Proposed Bad Creek II Lower Reservoir I/O Structure Portal Adjacent to Existing I/O Structure Portal



Note: The left and right tunnel naming convention is based on the direction of flow from the tunnel into Lake Jocassee.

Figure 6-2. Proposed Bad Creek II Powerhouse Tunnel Configuration

7 Methods

7.1 Feasibility CFD Model

As noted in Section 1, two CFD models were previously developed by HDR for the Bad Creek and Bad Creek II projects. The first CFD model was built for the feasibility study (HDR 2022) with the goal of identifying flow velocities and patterns under generation and pumping scenarios with various water level elevations in the WWRC near the I/O structure (upstream of the submerged weir) and to assess the potential for erosion along the opposite (east) shoreline due to increased generation flows from the combined powerhouses. This feasibility model was built with a computational mesh block resolution of 4-ft by 4-ft by 4-ft (length by width by height). Background, methods, and findings of this study are provided in the Bad Creek II Power Complex Feasibility Study Lower Reservoir CFD Flow Modeling Report (HDR 2022) and was also provided in the Revised Study Plan as Appendix I.

7.2 Relicensing CFD Model

The second CFD model was developed for the relicensing study to determine velocity effects and vertical mixing in the WWRC due to operation of a second powerhouse and considering the area downstream of the submerged weir. Inflows to the model were assumed to be constant and

uniform in the horizontal and vertical directions approaching the submerged weir. The long-term average flowrate from the Thompson River arm was also included in the model to incorporate flows downstream of the weir. Because this model incorporated a larger (922 acres) and deeper area of Lake Jocassee (with very slow water circulation), a coarser model mesh was appropriate to meet the objectives and a computational mesh block of 20-ft by 20-ft by 10-ft (length by width by height) was used. Background, methods, and findings of this study were included in the ISR as Appendix A, Attachment 3 (Velocity Effects and Vertical Mixing in Lake Jocassee Due to a Second Powerhouse) (Duke Energy 2024).

7.3 Updated CFD Model

As described above, recent optimization studies have proposed variable-speed turbines for the Bad Creek II Complex, which will result in increased hydraulic capacities compared to those initially proposed and modeled. Because the objective of this report is to assess near-field hydraulics and changes in velocity in the vicinity of the I/O structures due to increased pumping capacity associated with recently proposed variable speed turbines, the Feasibility CFD Model (described in Section 7.1) was considered the most appropriate model (as opposed to the Relicensing CFD Model) to carry out this evaluation. Model description, geometry, evaluation criteria, and mesh development are described in detail in HDR (2022) and are therefore not provided here.

Modeling with variable speed units did not appreciably increase generation flows, however the effects of increased pumping hydraulic capacity did result in a measurable change (i.e., 9 percent), therefore only updated pumping scenarios are discussed in Section 8. Updated generation flows resulted in a flow difference of less than 2 percent, therefore, the results presented in the original Feasibility CFD Model report (HDR 2022) were not revised.

8 Results

8.1 Existing Pumping Velocity Profiles

Existing pumping conditions (16,240 cfs) at cross-section elevations (i.e., model slices) representing full pond (1,100 ft msl), intermediate (1,096 ft msl), and maximum drawdown

(1,080 ft msl) are shown on Figure 8-1, Figure 8-2, and Figure 8-3, respectively. All estimated velocities are included in the attached results table in Attachment 1.

Under existing pumping conditions at the full pond elevation (Figure 8-1), depth-averaged velocities[3] approaching the I/O structure (i.e., approach velocities) are 1.8 fps approximately 100 ft from the I/O structure with a maximum velocity of 2.1 fps. Maximum velocities in the water column near the face of the I/O structure vary based on tunnel position and the hydrostatic pressure acting on tunnel flows and range from 5.5 fps to 6.2 fps.[4]

Under existing pumping conditions at the intermediate pond elevation (Figure 8-2), depth-averaged approach velocities are 2.2 fps approximately 100 ft from the I/O structure with a maximum velocity of 2.5 fps. Maximum velocities near the face of the I/O structure range from 7.2 fps to 7.7 fps.

Under existing pumping conditions at the minimum pond elevation (Figure 8-3), depth-averaged approach velocities are 4.6 fps approximately 100 ft from the I/O structure with a maximum velocity of 5.2 fps. Maximum velocities near the face of the I/O structure range from 7.9 fps to 8.4 fps.

Under existing pumping conditions, the maximum velocity inside the I/O tunnel chambers near the structure face is approximately 13.3 fps and approximately 23 fps in the tailrace tunnel based on the 31-ft-diameter tunnel and given flowrates.

The width of the WWRC (see Figure 3-1) at the existing I/O structure is approximately 1,110 ft and the extent of velocity effects (as shown on Figure 8-3) extend approximately 230 ft from the I/O structure into the WWRC at the minimum pond elevation.

[3] It is noteworthy that bathymetry of the lake bottom impacts flows as they approach the tunnel openings.

[4] Trashracks on the I/O structure are not considered, therefore velocities at the face of the tunnels would be higher than shown here.

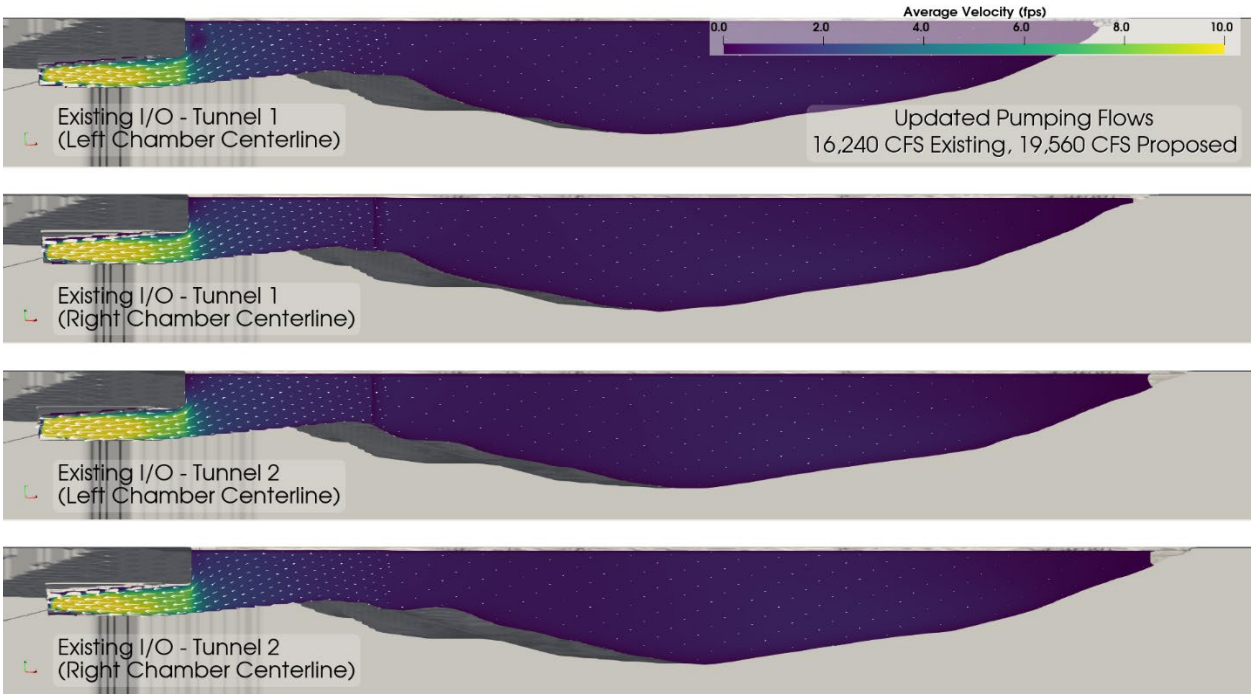


Figure 8-1. Existing Bad Creek I/O Pumping at 1,110 ft msl

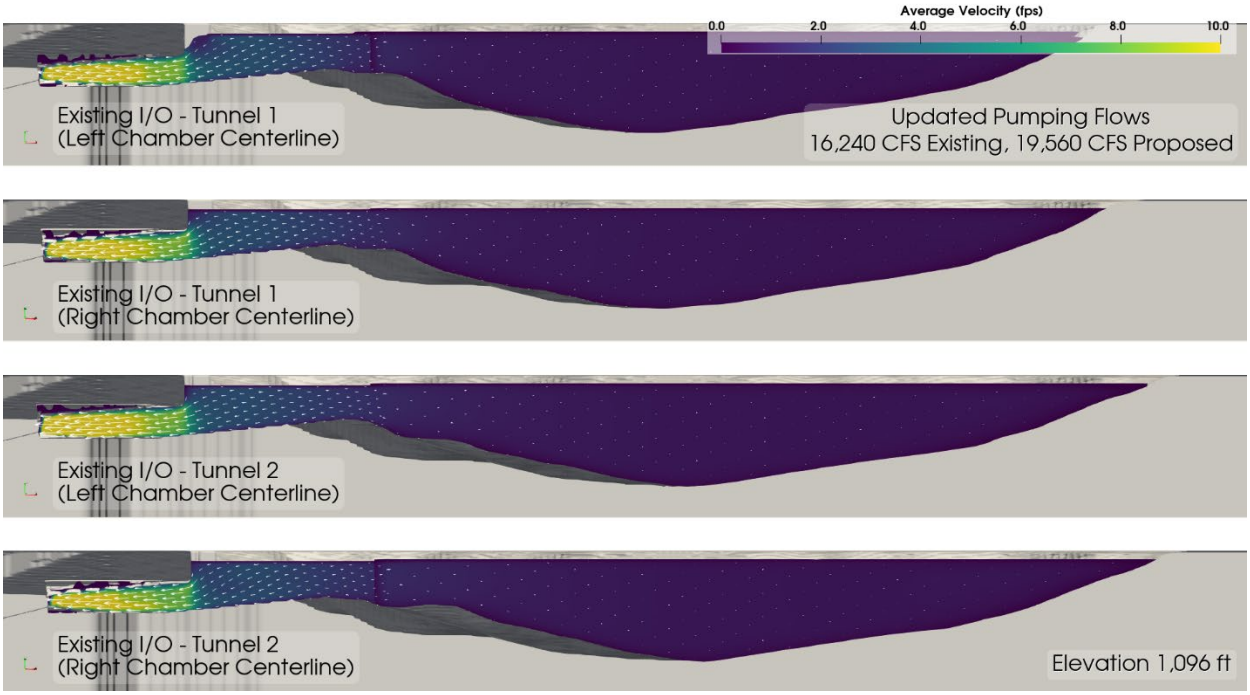


Figure 8-2. Existing Bad Creek I/O Pumping at 1,096 ft msl

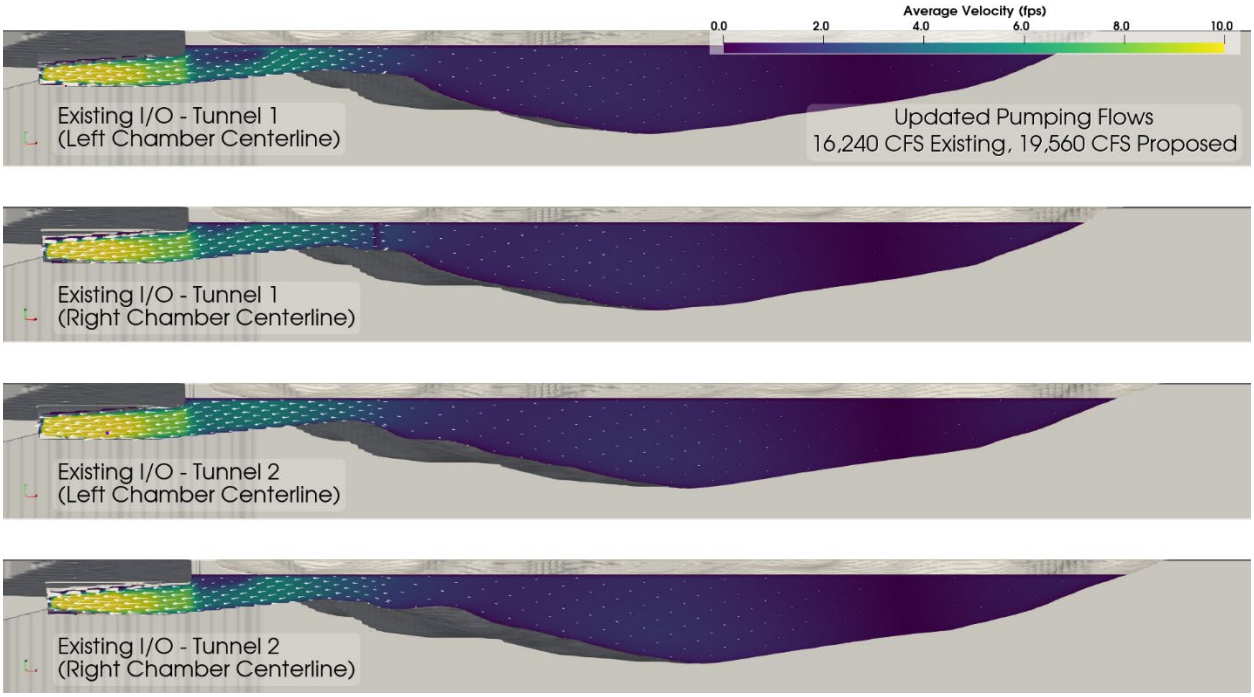


Figure 8-3. Existing Bad Creek I/O Pumping at 1,080 ft msl

8.2 Updated Proposed Pumping Velocity Profiles

As shown on Figure 8-4 through Figure 8-6, the updated increased pumping capacity at Bad Creek II results in higher velocities in the WWRC in the vicinity of the proposed I/O structure when compared to existing velocities at the Bad Creek I/O structure (Figure 8-1 through Figure 8-3). All velocities are included in the attached results table in Attachment 1.

Under updated pumping conditions at the full pond elevation (Figure 8-4), depth-averaged approach velocities for the proposed I/O structure are 1.7 fps approximately 100 ft from the I/O structure with a maximum velocity of 2.0 fps. Maximum velocities in the water column near the face of the I/O structure vary based on tunnel position and hydrostatic pressure and range from 9.6 fps to 10.1 fps.

Under updated pumping conditions at the intermediate pond elevation (Figure 8-5), depth-averaged approach velocities are 2.5 fps approximately 100 ft from the I/O structure with a maximum velocity of 3.1 fps. Maximum velocities near the face of the I/O structure range from 9.2 fps to 9.7 fps.

Under updated pumping conditions at the minimum pond elevation (Figure 8-6), depth-averaged approach velocities are 4.5 fps approximately 100 ft from the I/O structure with a maximum velocity of 8.3 fps. Maximum velocities near the face of the I/O structure range from 7.4 fps to 10.9 fps.

Under updated pumping conditions, the maximum velocity inside the I/O tunnel chambers near the structure face is approximately 16 fps and approximately 28 fps in the tailrace tunnel based on the 31-ft diameter-tunnel and given flowrate.

The width of the WWRC (see Figure 3-1) at the proposed I/O structure is approximately 675 ft and the extent of velocity effects (as shown on Figure 8-6) extend approximately 400 ft from the I/O structure into the WWRC at the minimum pond elevation.

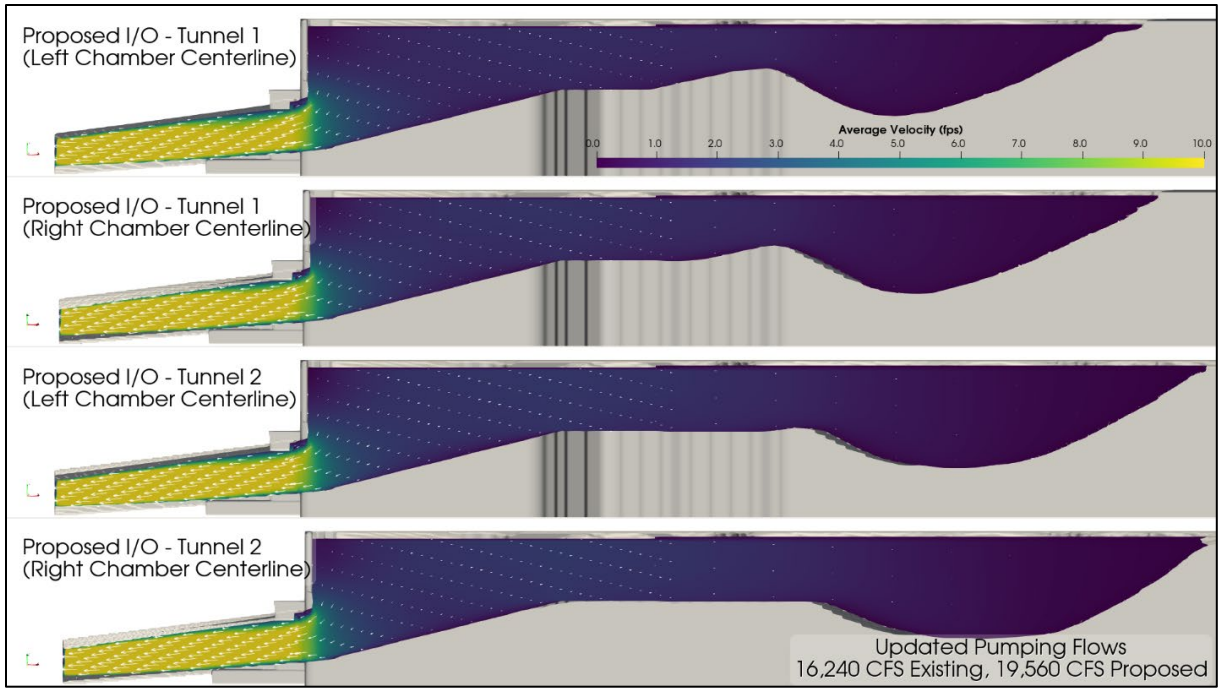


Figure 8-4. Proposed Bad Creek II I/O Updated Pumping at 1,110 ft msl

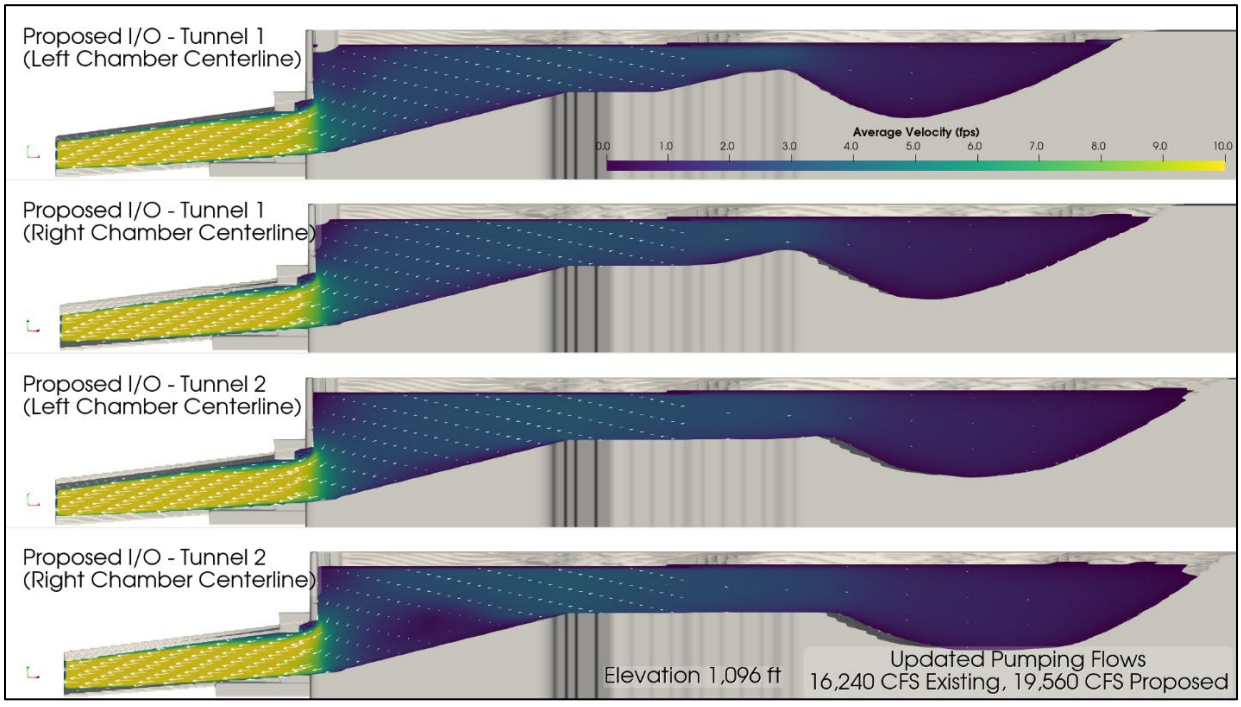


Figure 8-5. Proposed Bad Creek II I/O Updated Pumping at 1,096 ft msl

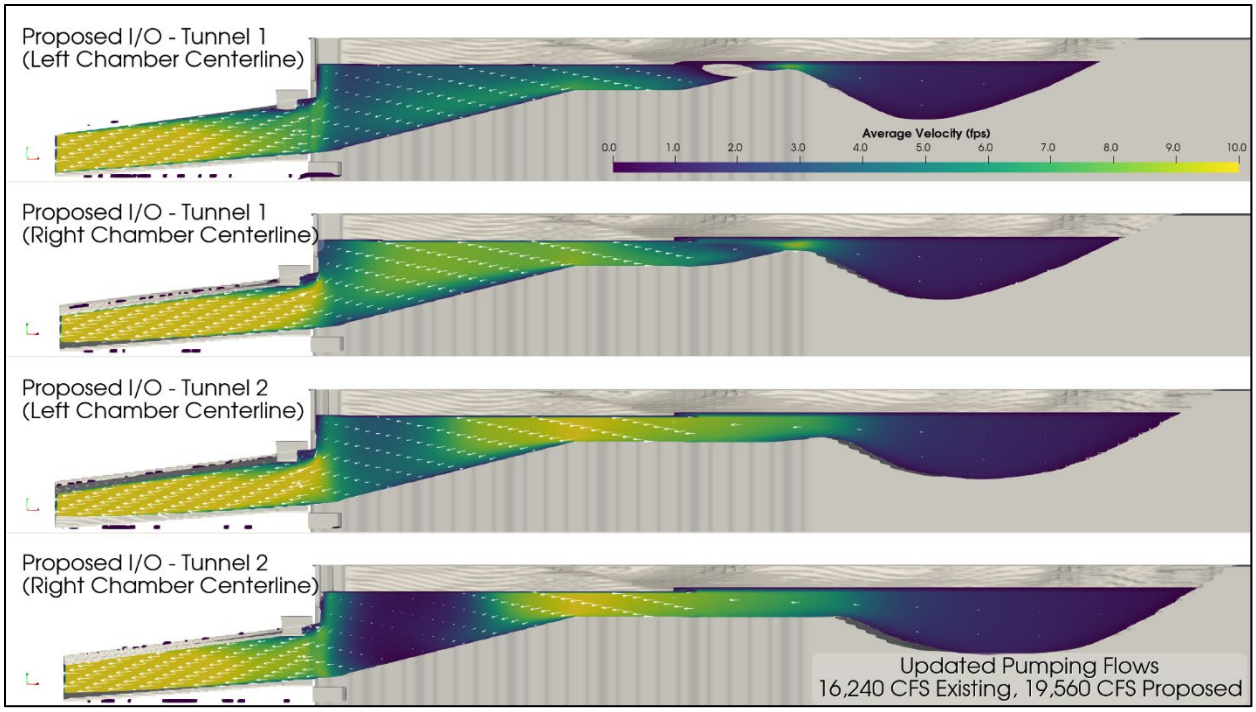


Figure 8-6. Proposed Bad Creek II I/O Updated Pumping at 1,080 ft msl

8.3 Surface Velocities

Plan view flow patterns and velocity vectors at the three reservoir levels (i.e., full, intermediate, and minimum pond) are presented on Figure 8-7, Figure 8-9, and Figure 8-9, respectively. Areas of recirculation occur near the west and east banks under both full pond and minimum pond scenarios, and, similar to the profile figures, velocities increase as reservoir levels decrease and with increased proximity to the proposed I/O structure, as indicated by velocity vectors. Recirculation patterns in the vicinity of the proposed I/O structure under the minimum pond scenario are also indicated on Figure 8-9. These patterns are caused by flow splitting at the tunnel abutments and the restricted flow area near the I/O structure, resulting in increased velocities.

As the pond level decreases, the volume of water decreases and increases the strength of recirculation in the recirculation area. This effect results in concentrated flow through the center of the proposed I/O structure approach channel and center tunnels (Tunnel 1 Right, Tunnel 2 Left) and is more pronounced as the pond level decreases.

Accelerated flows across the weir in the direction of the I/O structure are more pronounced at minimum pond (Figure 8-9). As water is pulled upstream through the WWRC during pumping,

flows are spread evenly across the submerged weir before converging into a main center channel in the cove, with localized eddies of slower moving water (i.e., recirculation) on both sides of the main flow path.

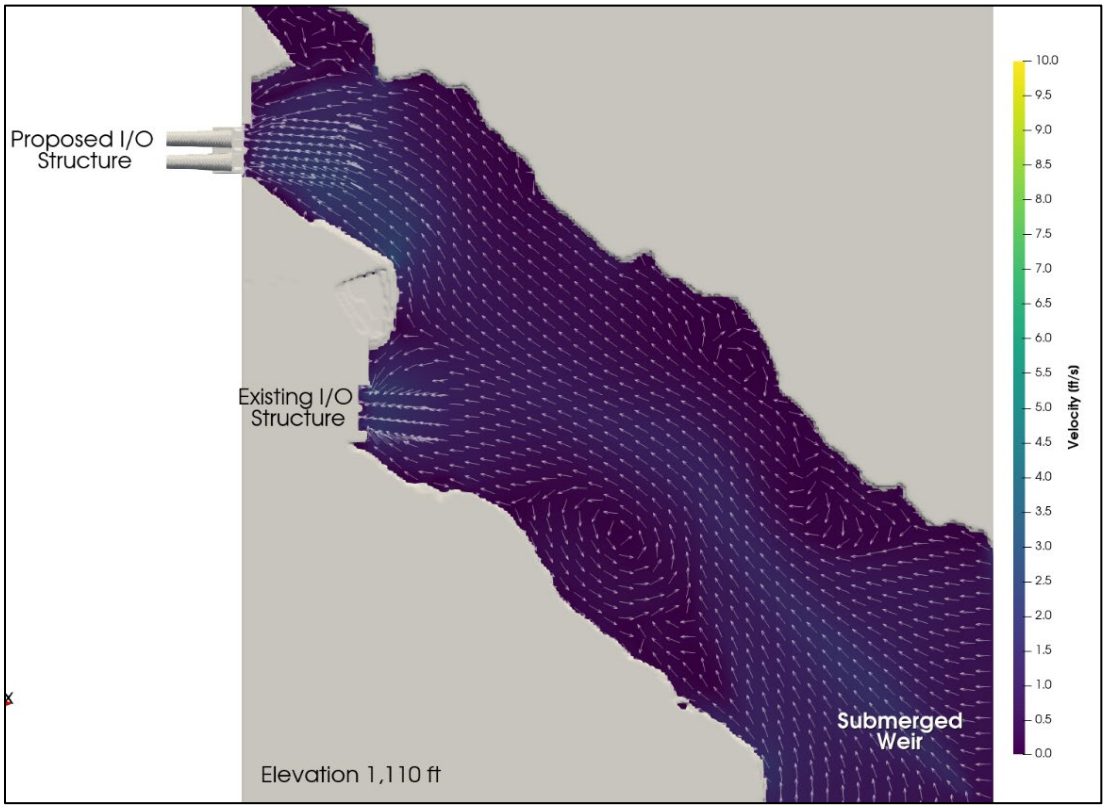


Figure 8-7. Proposed Bad Creek II I/O Updated Pumping Plan View at Elevation 1,110 ft msl

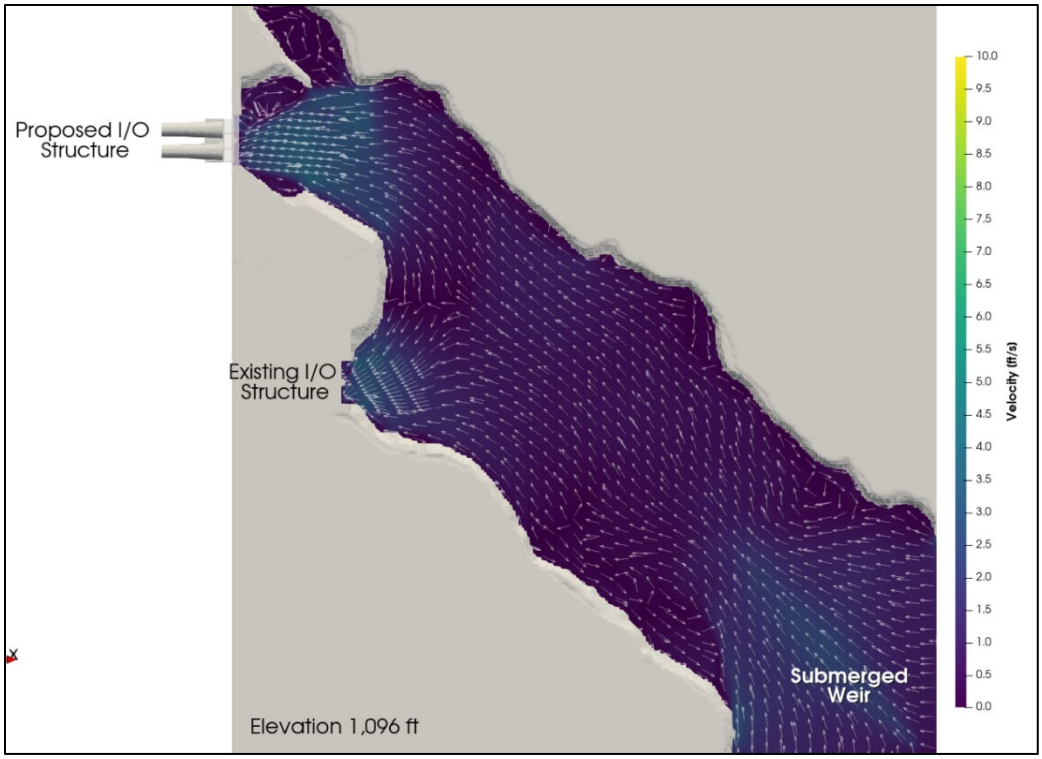


Figure 8-8. Proposed Bad Creek II I/O Updated Pumping Plan View at Elevation 1,096 ft msl

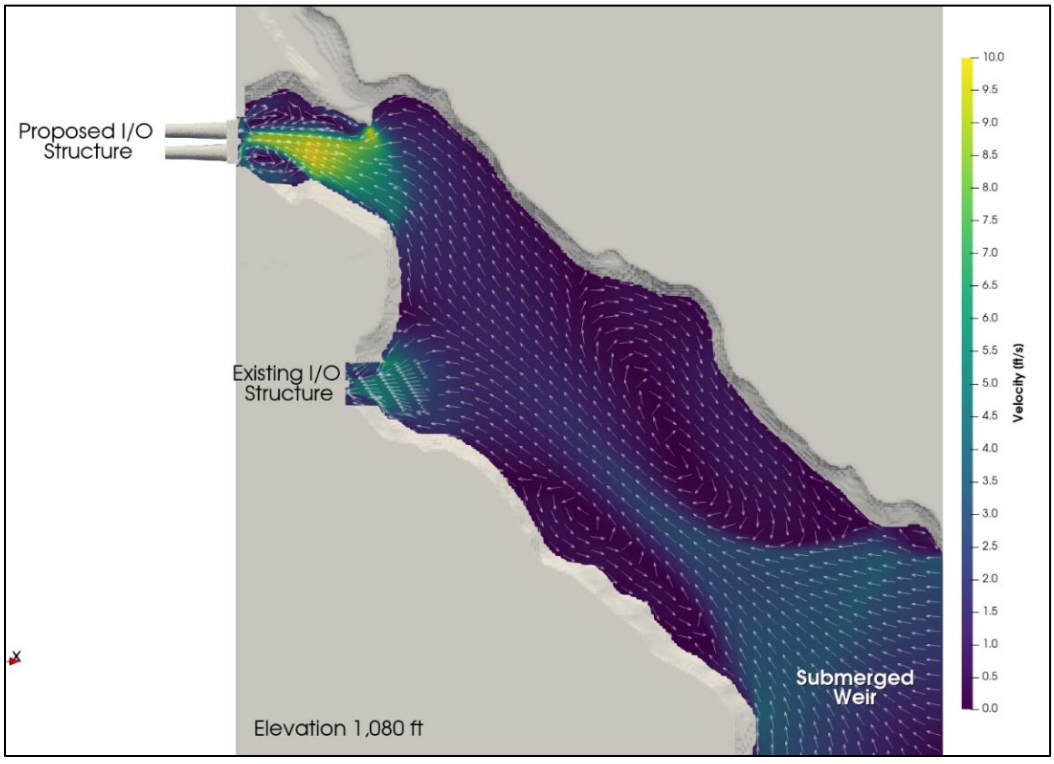


Figure 8-9. Proposed Bad Creek II I/O Updated Pumping Plan View at Elevation 1,080 ft msl

Surface velocity contours are shown on Figure 8-10 and Figure 8-11 for existing conditions[5] and Figure 8-12 and Figure 8-14 for proposed updated pumping conditions under full, intermediate, and minimum pond levels.

Under existing pumping conditions and full pond levels, surface velocities do not exceed 2.0 fps in the WWRC and are on average below 1.0 fps. At minimum pond, existing maximum surface velocities across the weir could reach 3.0 fps and up to 5.0 fps directly in front of the existing I/O structure.

Under full pond conditions for proposed updated pumping operations, velocities are very similar to existing conditions with maximum velocities of 1.5 fps near the existing and proposed I/O structures. Under proposed updated pumping at the minimum pond level, surface velocities could reach 10.0 fps near the proposed I/O structure (see Figure 8-14 and Figure 8-9); however, these higher velocities are localized and constrained within the small area adjacent to the I/O structure in a recessed alcove. As part of Bad Creek II construction, expansion of the submerged weir (in the downstream direction) is being considered; maximum velocities over the proposed expanded weir are 3.5 fps, which are consistent with maximum velocities over the existing submerged weir.

As indicated above, surface velocities under minimum pond could reach 10.0 fps, which could have implications for non-motorized boats moving northward through WWRC, however, the high flows are constrained to the area immediately adjacent to the I/O structure within the recessed area of the shoreline where the proposed I/O will be constructed. Additionally, as shown on Figure 8-9, at minimum pond the area upstream of the proposed I/O is largely dewatered and therefore would not support boating activities regardless of Bad Creek II operations. It should be noted that Lake Jocassee has never been at the licensed maximum drawdown since its creation; maximum drawdown scenarios in this evaluation provide the most conservative hypothetical condition.

[5] A surface velocity map was not generated for the existing intermediate pond level as this scenario was not evaluated as part of the feasibility study; however, it is expected that the results would be similar to Figure 8-13.

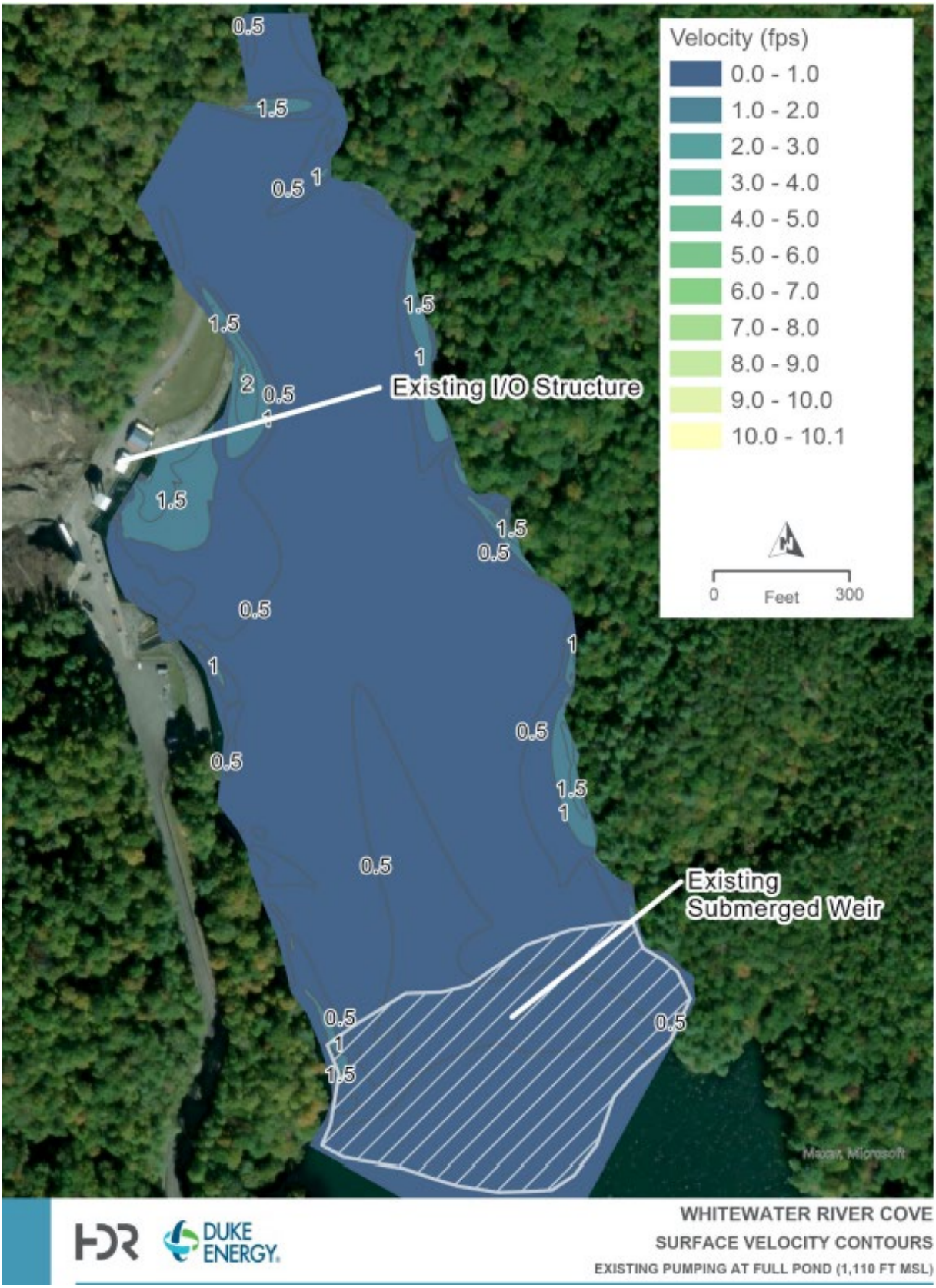


Figure 8-10. Existing Pumping at Full Pond

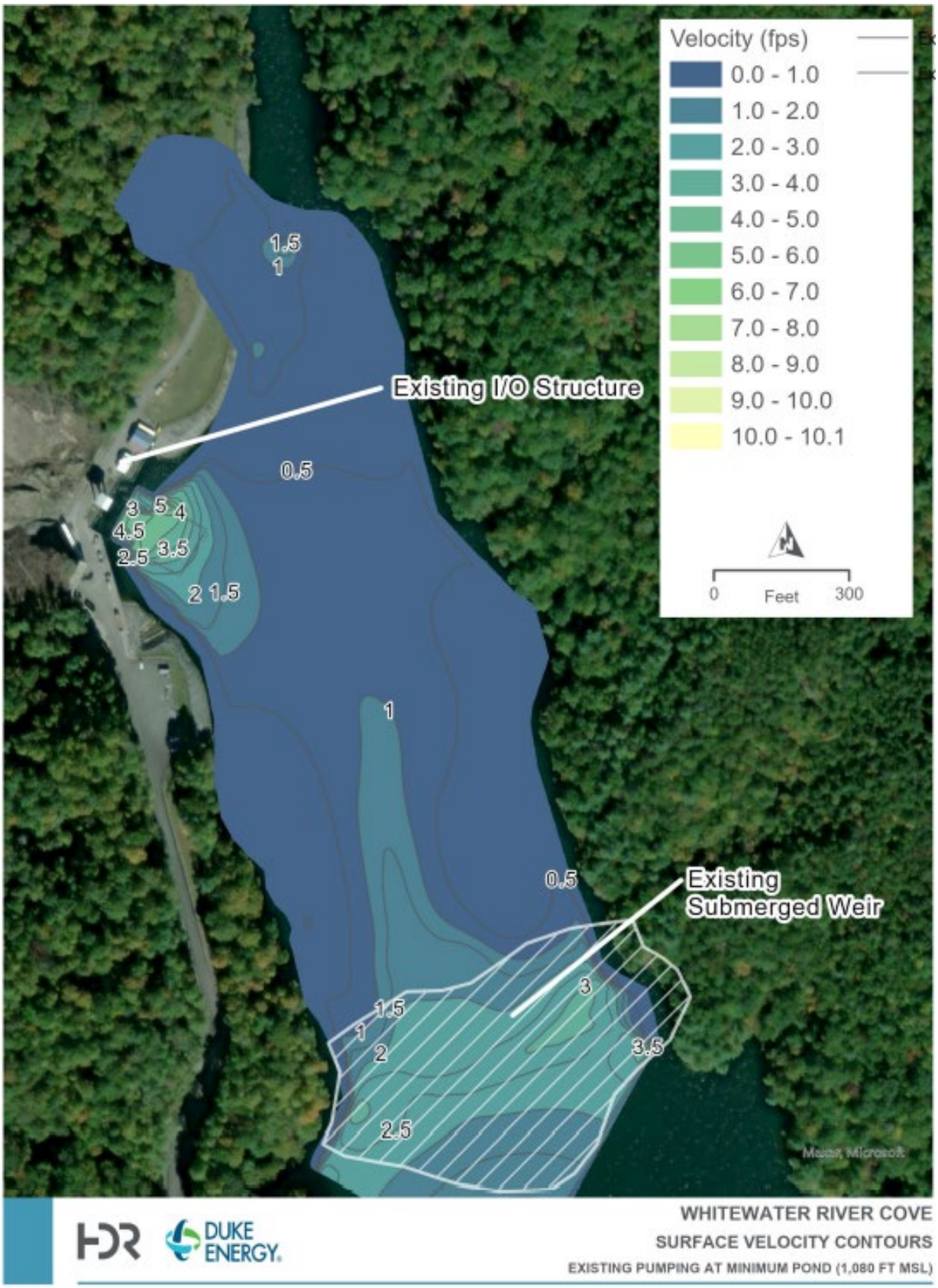


Figure 8-11. Existing Pumping at Minimum Pond

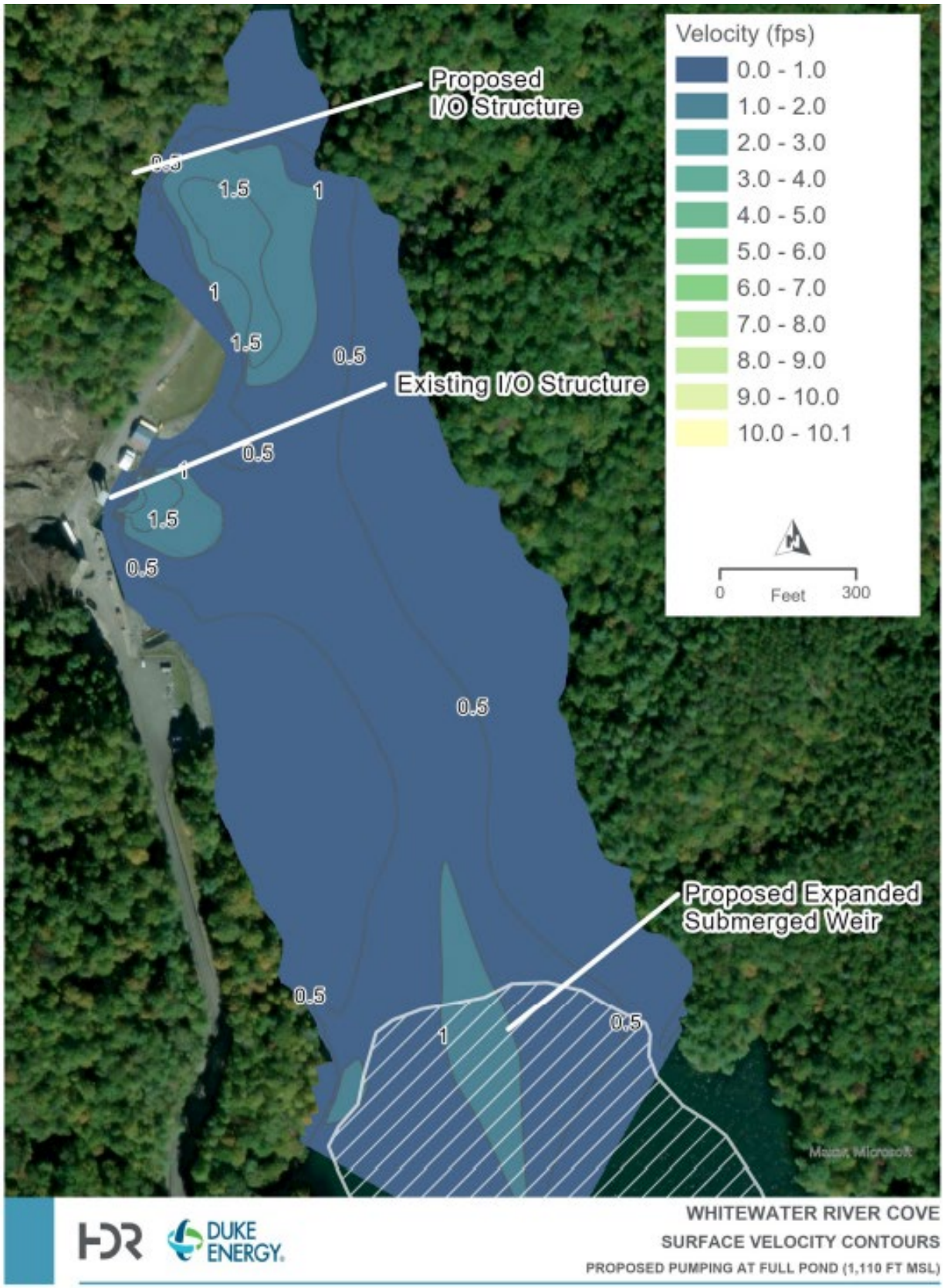


Figure 8-12. Proposed Updated Pumping at Full Pond

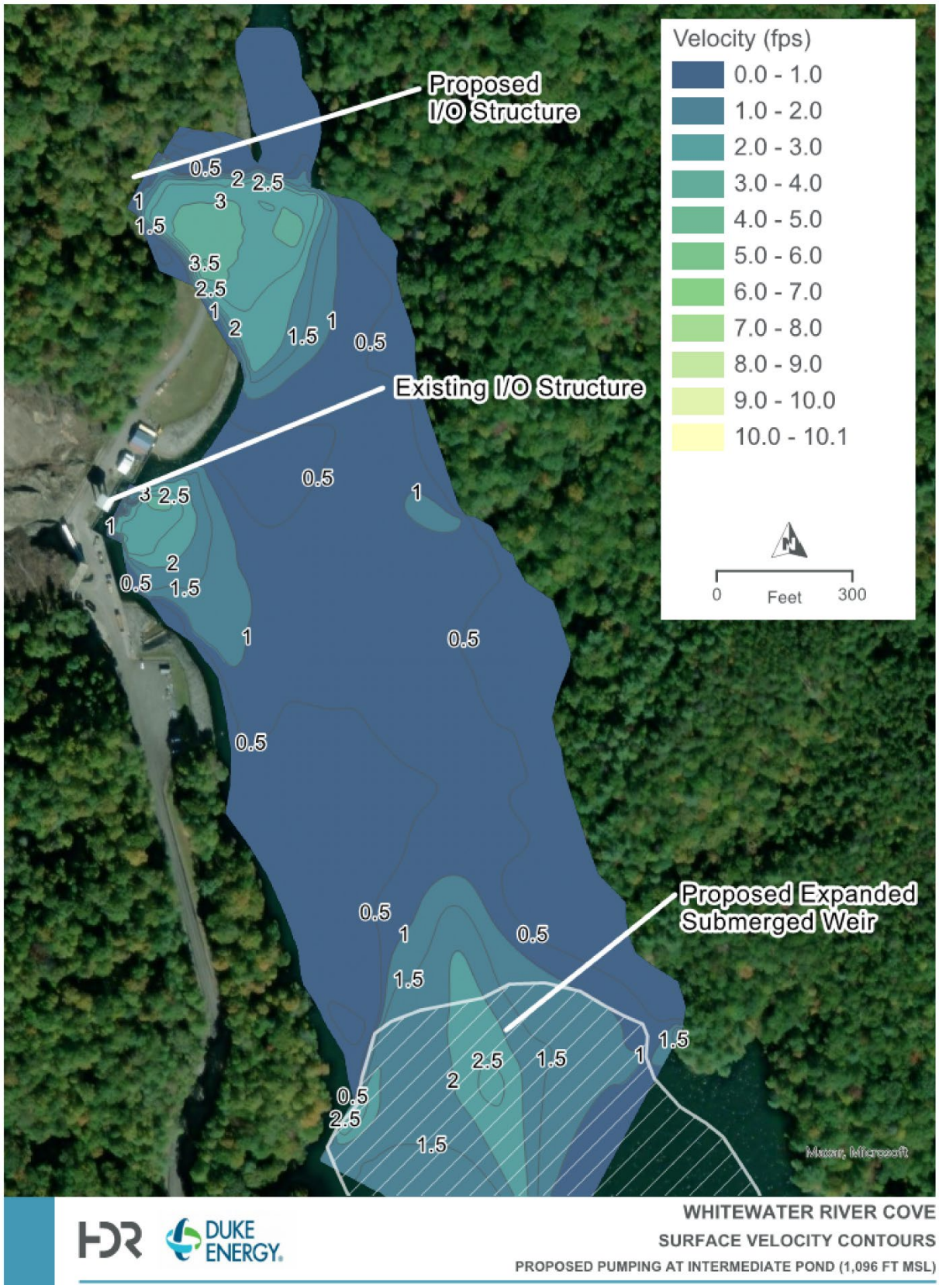


Figure 8-13. Proposed Updated Pumping at Intermediate Pond

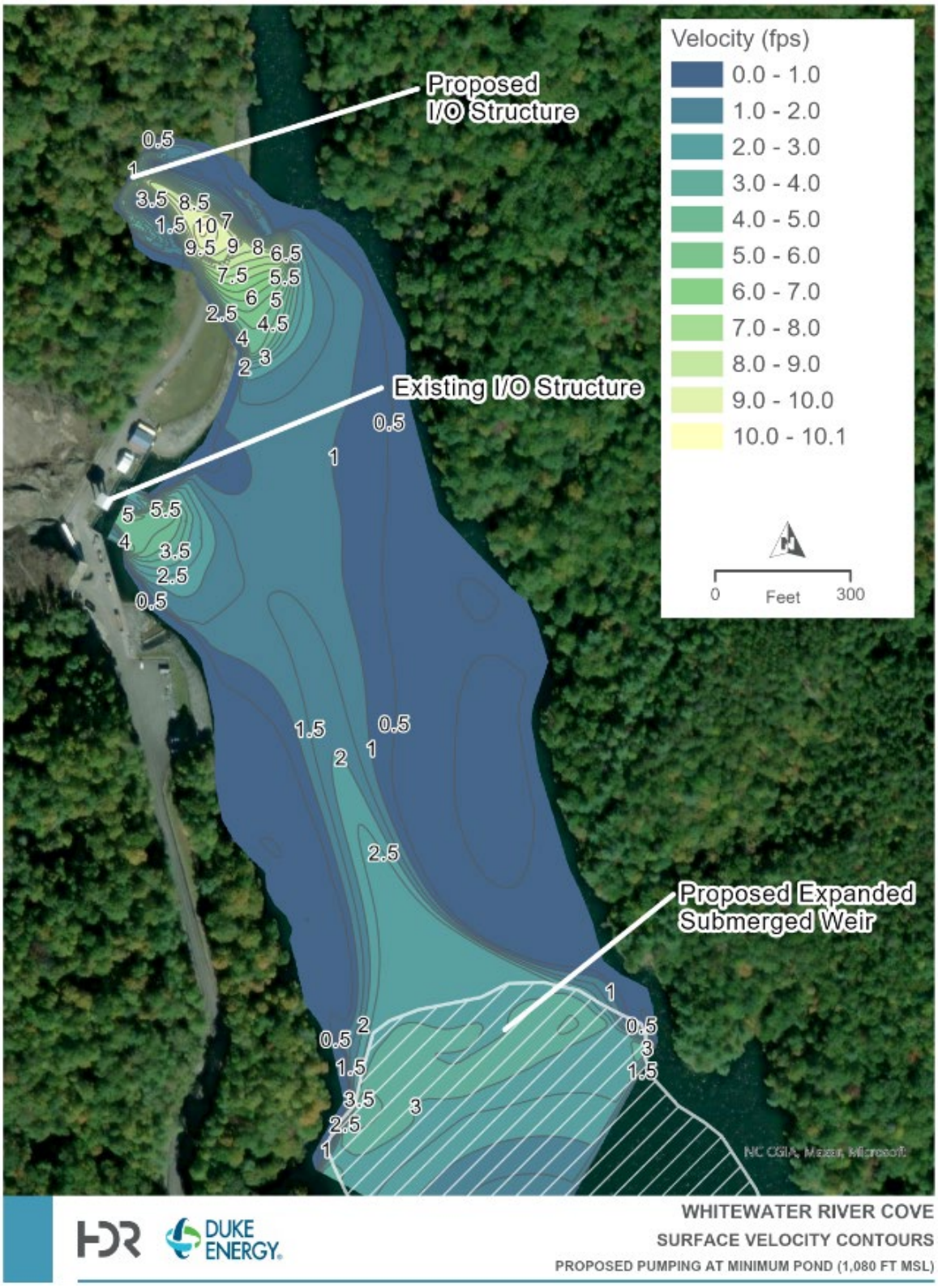


Figure 8-14. Proposed Updated Pumping at Minimum Pond

9 Conclusions

As expected, velocities in the WWRC under all operational scenarios increase with decreased reservoir elevations. As stated in Section 5, Lake Jocassee has never been at the licensed maximum drawdown since its creation and it is worth noting Bad Creek II would likely not operate at maximum hydraulic capacities in the unlikely event of a drawdown (licensed minimum pond level). Therefore, maximum drawdown scenarios with maximum pumping evaluated in this study provide the most conservative results.

As indicated in Section 8.3, surface velocities in the WWRC under minimum pond elevations could reach 10.0 fps, which may have implications for non-motorized boats moving through the WWRC near the Project. To support the relicensing effort, Duke Energy carried out a Whitewater River Cove Existing Recreational Use Evaluation with the goal of characterizing the existing recreational use of Whitewater River cove to inform Duke Energy on the level of boating use disruption that could occur in the cove during the Bad Creek II Complex construction.[6] The final Existing Recreational Use Evaluation, which was developed in consultation with relicensing stakeholders, was filed with Initial Study Report in January 2024. Results of this study, which was carried out from Memorial Day through Labor Day in 2023, showed the majority of boats in Whitewater River cove were motorboats (83 percent), followed by personal watercraft (e.g., jet ski) (10 percent), kayaks (7 percent), and canoes (less than 1 percent); therefore, a minor percentage (<10%) of boaters using the WWRC do so in a non-motorized boat. It is likely from a recreational boater safety perspective, boats would be able to navigate this area of the WWRC by keeping to the east side of the WWRC along the shore opposite the proposed I/O structure since the new I/O structure would be situated approximately 200 ft back from the existing shoreline in a recessed alcove (shown on Figure 6-1). It is important to note that at low reservoir elevations, the northern portion of the WWRC would be dewatered and therefore be inaccessible (depicted on Figure 8-9) as the reservoir bottom elevation in this area is higher than 1,080 ft msl. As a result, boating in this area of WWRC would largely be precluded by low lake levels, regardless of Bad Creek II operations. Duke Energy plans to carry out additional analyses and develop proposed guidelines for boater safety

[6] Whitewater River cove will be closed to recreation during Bad Creek II construction (approximately 7 years) for public safety.

and recreational use under future operations in consultation with relicensing stakeholders; findings from that study will be included in the Updated Study Report.

10 References

HDR Engineering, Inc. (HDR). 2022. Bad Creek II Power Complex Feasibility Study Lower Reservoir CFD Flow Modeling Report. Prepared for Duke Energy. September 1, 2022.

Duke Energy Carolinas, LLC. 2024. Initial Study Report. Bad Creek Pumped Storage Station. Prepared by HDR. January 4, 2024. Available at FERC eLibrary: https://elibrary.ferc.gov/eLibrary/filelist?accession_num=20240104-5044

Attachment 1

Attachment 1 - Updated Pumping Estimated Velocities

Operations	Water Surface Elevation (ft)	IO Structure	Flowrate (cfs)	Tunnel	Velocities (fps)											
					Max velocity in 31-ft Tunnel*	Max at Tunnel Face**	Max - Tunnel Face				Max – 100 ft downstream				Depth Averaged 100 ft Downstream	Depth Averaged 200 ft Downstream
							X	*Y*	*Z*	Magnitude	*X*	*Y*	*Z*	Magnitude		
Pumping	1,110	1	16,240	1L	23.0	13.3	*6.0*	*0.6*	*1.3*	**6.2**	*1.8*	*0.7*	*0.7*	**2.1**	**2.0**	No Difference/Lower Velocity
				1R			*5.5*	*0.6*	*1.3*	**5.7**	*1.9*	*0.2*	*0.4*	**2.0**	**1.9**	
				2L		13.3	*5.4*	*0.0*	*1.1*	**5.5**	*1.7*	*0.2*	*0.2*	**1.7**	**1.7**	
				2R			*5.8*	*0.9*	*1.0*	**6.0**	*1.7*	*0.4*	*0.3*	**1.8**	**1.7**	
		2	19,560	1L	27.7	16.0	*9.4*	*0.4*	*2.4*	**9.7**	*1.3*	*0.4*	*0.5*	**1.4**	**1.5**	
				1R			*9.6*	*0.0*	*1.7*	**9.7**	*1.7*	*0.2*	*0.8*	**1.9**	**1.7**	
				2L		16.0	*10.0*	*0.2*	*1.5*	**10.1**	*1.9*	*0.1*	*0.5*	**2.0**	**1.8**	
				2R			*9.4*	*0.4*	*1.9*	**9.6**	*1.7*	*0.3*	*0.4*	**1.8**	**1.7**	
Pumping	1,096	1	16,240	1L	23.0	13.3	*7.3*	*0.1*	*1.1*	**7.4**	*2.4*	*0.0*	*0.8*	**2.5**	**2.4**	No Difference/Lower Velocity
				1R			*7.0*	*0.1*	*2.5*	**7.4**	*2.4*	*0.1*	*0.3*	**2.4**	**2.2**	
				2L		13.3	*7.4*	*0.2*	*2.1*	**7.7**	*2.3*	*0.4*	*0.3*	**2.3**	**2.2**	
				2R			*6.3*	*0.5*	*3.6*	**7.2**	*2.3*	*0.3*	*0.6*	**2.4**	**2.1**	
		2	19,560	1L	27.7	16.0	*8.8*	*0.2*	*2.5*	**9.2**	*2.8*	*0.2*	*0.4*	**2.8**	**2.6**	**3.0**
				1R			*8.8*	*0.3*	*3.1*	**9.3**	*3.0*	*0.3*	*0.1*	**3.0**	**2.7**	**3.1**
				2L		16.0	*9.1*	*0.1*	*3.3*	**9.7**	*3.0*	*0.4*	*0.1*	**3.0**	**2.7**	**3.3**
				2R			*9.0*	*0.8*	*3.5*	**9.7**	*3.0*	*0.5*	*0.1*	**3.1**	**1.9**	**3.4**
Pumping	1,080	1	16,240	1L	23.0	13.3	*8.4*	*0.6*	*0.3*	**8.4**	*4.6*	*1.4*	*1.9*	**5.2**	**4.9**	No Difference/Lower Velocity
				1R			*8.1*	*0.0*	*1.1*	**8.2**	*4.7*	*0.8*	*0.3*	**4.8**	**4.5**	
				2L		13.3	*8.0*	*0.0*	*1.0*	**8.1**	*4.5*	*0.4*	*0.3*	**4.5**	**4.3**	
				2R			*7.9*	*0.0*	*0.8*	**7.9**	*4.6*	*0.8*	*0.7*	**4.7**	**4.6**	
		2	19,560	1L	27.7	16.0	*7.3*	*0.5*	*0.7*	**7.4**	*5.2*	*0.2*	*1.2*	**5.3**	**4.4**	**5.8**
				1R			*10.8*	*0.0*	*1.6*	**10.9**	*8.2*	*0.8*	*1.2*	**8.3**	**7.3**	**8.0**
				2L		16.0	*10.1*	*0.2*	*1.8*	**10.3**	*4.7*	*0.6*	*0.6*	**4.8**	**4.3**	**9.8**
				2R			*8.9*	*0.2*	*0.6*	**8.9**	*1.5*	*0.9*	*0.3*	**1.8**	**1.8**	**9.7**

*Velocities will transition from calculated value based on horseshoe shaped chamber opening to calculated velocity in tunnels (circle shaped) as the geometry transitions, these values should be rough bookends for velocities in the intake structure/tunnel.

**Assumes equal flow distribution between each side of screen face, which is unlikely.

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Attachment B: Small Whorled Pogonia Survey Report

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Small Whorled Pogonia Survey Report

Bad Creek Pumped Storage Project

FERC Project No. 2740

Oconee County, South Carolina

September 19, 2024

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Contents

Figures

Appendices

Acronyms and Abbreviations

Bad Creek II	Bad Creek II Power Complex
Bad Creek or Project	Bad Creek Pumped Storage Project
Duke Energy	Duke Energy Carolinas, LLC
ILP	Integrated Licensing Process
SCDNR	South Carolina Department of Natural Resources
SWAP	South Carolina Wildlife Action Plan
USFWS	U.S. Fish and Wildlife Survey
USACE	U.S. Army Corps of Engineers

1 Introduction

Duke Energy Carolinas, LLC (Duke Energy) is the owner and operator of the 1,400-megawatt Bad Creek Pumped Storage Project (Project; Federal Energy Regulatory Commission [FERC] Project No. 2740) located in Oconee County, South Carolina. The existing (original) license for the Project was issued by the Commission for a 50-year term, with an effective date of August 1, 1977, and expires July 31, 2027, therefore, Duke Energy is pursuing a new license for the Project pursuant to the Commission's Integrated Licensing Process (ILP) (18 Code of Federal Regulations Part 5). An alternative relicensing proposal presently being evaluated by Duke Energy is the construction of a second 1,400-megawatt power complex (Bad Creek II Power Complex; Bad Creek II) adjacent to the existing Project to increase renewable pumping and generating capacity at the Project.

In response to a written request from the South Carolina Department of Natural Resources (SCDNR) in comments submitted to the Commission on the Initial Study Report (Duke Energy 2024) and to support Endangered Species Act Compliance for Clean Water Act Section 404, U.S. Army Corps of Engineers (USACE) permitting, Duke Energy contracted HDR to survey for the federally threatened small whorled pogonia (*Isotria medeoloides*) during the appropriate survey window (mid-May through early July)[1] as detailed in the Small Whorled Pogonia Study Plan, which was developed in collaboration with the SCDNR and filed with the fifth ILP Study Progress Report on June 28, 2024.

The SCDNR Natural Heritage Trust Program, which documents and tracks element of occurrence data for rare, threatened, and endangered species (both federal and state) indicates no record of the small whorled pogonia within a 2-mile of radius of the Project (SCNHP 2023), however, this species is listed by the U.S. Fish and Wildlife Survey (USFWS) (Information for Planning and Consultation [IPaC] species list; **Appendix A**) as having the potential to occur in the project vicinity, therefore surveys were conducted to determine the presence or absence of this protected species prior to land disturbance activities associated with the construction of Bad Creek II. This survey was also carried out to aid in the quality and comprehensiveness of the statewide dataset for rare, threatened, and endangered species and record incidental observations of priority plant species identified in the South Carolina Wildlife Action Plan (SWAP) during the survey.

This document provides an overview of the approach and results of the small whorled pogonia survey.

2 Study Area Overview

The Study Area included lands that will be potentially impacted by the construction of Bad Creek II and associated infrastructure including the proposed spoil area locations, Fisher Knob access road, and the Bad Creek 100kV Transmission Line access roads (Figure 1).

[1] A Natural Resources Survey was carried out by Duke Energy in 2021 and indicated that suitable habitat for the small whorled pogonia was present at the site, however, the study was performed outside of the survey window. The Natural Resources Survey was filed with the Pre-Application Document in February, 2023.

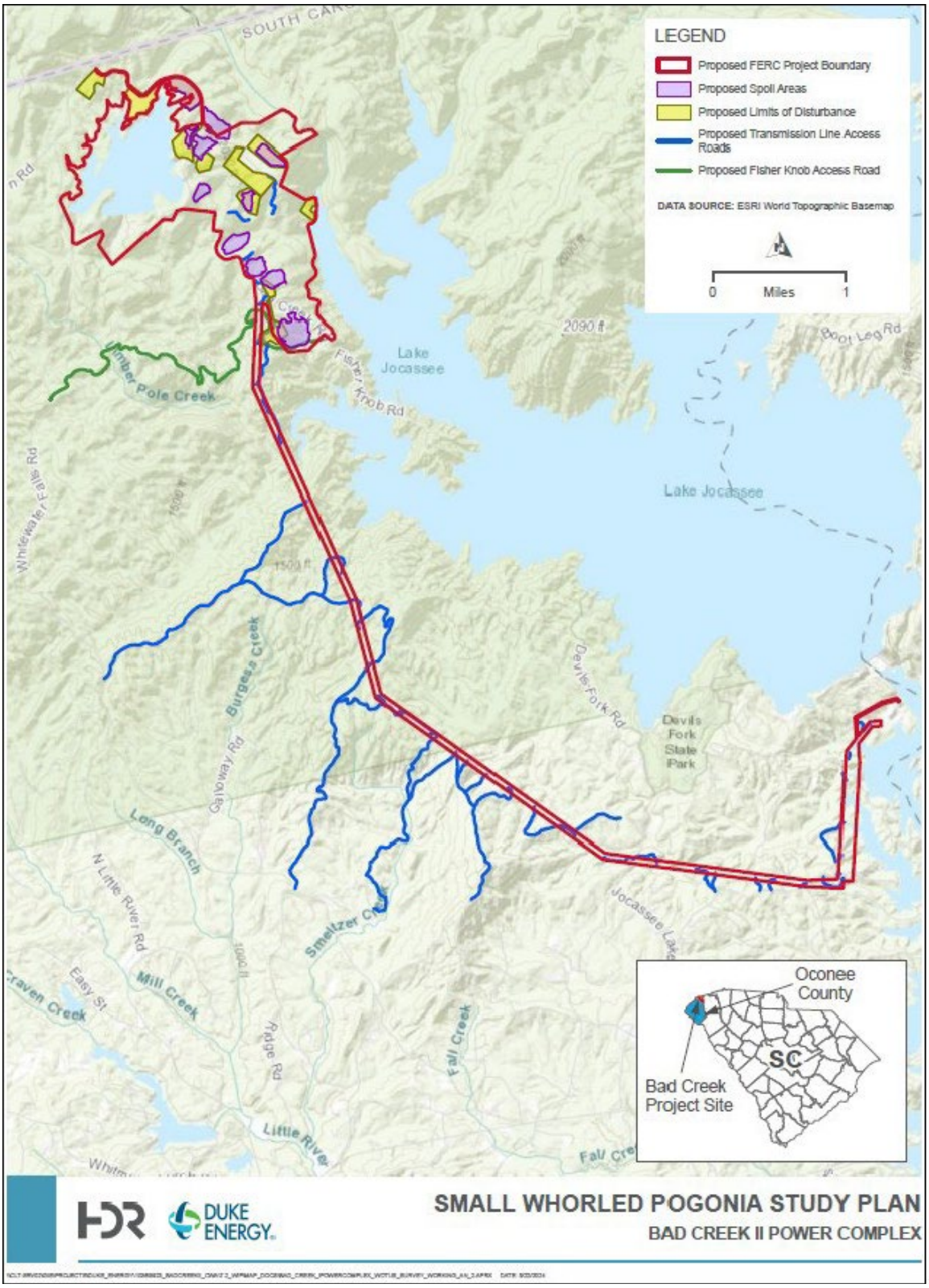

Figure 1. Bad Creek Site Vicinity with Proposed Locations of Spoil Areas and Transmission Line Access Roads

The Study Area is situated in the Southern Crystalline Ridges and Mountains ecoregion, which is the larger Level III Blude Ridge ecoregion of South Carolina. The Blue Ridge ecoregion is a narrow strip of mountainous ridges to hilly plateaus which transition to more massive mountainous areas with high peaks. The Southern Crystalline Ridges and Mountains region is a rough, dissected region with elevations between 1,200 – 4,500 feet above sea level (Griffith et al. 2002).

3 Small Whorled Pogonia Overview

3.1 Species Description

The small whorled pogonia is a perennial orchid that produces a smooth, hollow stem ranging from 2 to 14 inches tall and topped by five to six leaves in circular arrangement (false whorl). One or two flowers stand in the center of the whorl of leaves. The leaves are milky-green or grayish-green, and the flower is yellowish-green with a greenish-white lip (USFWS 2024). Flowers appear soon after the plants emerge in mid-May or June. This species is non-clonal, and plants may emerge each spring or they may remain vegetatively dormant and below the ground for one to several years. Each plant typically produces only one, rarely more than one, overwintering bud per year (USFWS 2022).

3.2 Habitat

The small whorled pogonia occurs in both young and mature mixed-deciduous or mixed-deciduous/coniferous forests. Sometimes it grows in stands of softwoods with a thick layer of dead leaves, often on slopes near small streams. The species may also be found on dry, rocky, wooded slopes; moist slopes; ravines lacking stream channels; or slope bases near braided channels of vernal streams. The orchid, often limited by shade, requires small light gaps or canopy breaks, and typically grows under canopies that are relatively open or near features like logging roads or streams that create long-persisting breaks in the forest canopy. It prefers acidic soils with a thick layer of dead leaved and sparse to moderate ground cover (USFWS 2024).

3.3 Natural Vegetative Community Types

The Study Area supports a wide diversity of flora and fauna due to highly varied topography and climatic conditions. Resources used to identify and categorize vegetative community types within the Study Area included the Ecological Zones in the Southern Blue Ridge Escarpment 4th Approximation (Simon 2015) and the Natural Communities of South Carolina Initial Classification and Description (Nelson 1986). The NatureServe community classification system (NatureServe 2013) was used to identify and categorize vegetative community types within the Study Area. Terminology in the Ecological Zones in the Southern Blue Ridge Escarpment was also used to describe the terrestrial habitats within the Study Area. Ecological groups and community types that were identified within the Study Area included Shortleaf Pine-Oak Forest and Woodland, Montane Oak-Hickory Forest, Cove Forest, and Floodplain Forest.

Shortleaf Pine-Oak Forest and Woodland

This habitat type is characterized by shortleaf pine (*Pinus echinate*) and oak dominated forested areas on exposed ridges and sideslopes (Simon 2015). Dominant tree canopy cover observed included white oak (*Quercus alba*), southern red oak (*Quercus falcata*), northern red oak (*Quercus rubra*), chestnut oak (*Quercus montana*), mockernut hickory (*Carya tomentosa*), tulip poplar

(*Liriodendron tulipifera*), white pine (*Pinus strobus*), sugar maple (*Acer saccharum*), eastern hemlock (*Tsuga canadensis*), loblolly pine (*Pinus taeda*), and sourwood (*Oxydendrum arboreum*). Sapling and shrubs consist of similar canopy species as well as American holly (*Ilex opaca*), buffalo-nut (*Pyrularia pubera*), lowbush blueberry *(Vaccinium angustifolium*), mountain laurel (*Kalmia latifolia*), rhododendron (*Rhododendron maximum*), Fraser magnolia (*Magnolia fraseri*), American witch-hazel (*Hamamelis virginiana*), black oak (*Quercus velutina*), and sassafras (*Sassafras albium)*. Herbaceous and vine species consisted of running cedar (*Lycopodium digitatum*), striped wintergreen (*Chimaphila maculata*), Christmas fern (*Polystichum acrostichoides*) and muscadine grape *(Vitis rotundifolia).*

Mixed Oak/Rhododendron Forest

This habitat type is characterized by rhododendron-dominated thickets found on mountains and upper piedmont with sparse herbaceous cover. Dominant species observed for this habitat type included northern red oak, shortleaf pine, mountain laurel, rhododendron, eastern hemlock, white pine, sourwood, red maple (*Acer rubrum*), and black gum (*Nyssa sylvatica*).

Montane Oak-Hickory Forest (Cove and Slope)

This habitat type is characterized by a mix of hardwood tree species on lower elevations within mountains and upland slopes between rivers and headwater tributaries. Dominant tree species observed for this habitat type included northern red oak, chestnut oak, pignut hickory (*Carya glabra*), white pine, red maple, tulip poplar, mountain laurel, sourwood, black gum, magnolia, and low bush blueberry.

Acidic Cove Forest

This habitat type is characterized by hemlock and mixed hardwood-conifer forests, typically dominated by an evergreen understory occurring in narrow coves (ravines) and extending to adjacent protected, north-facing slopes (Simon 2015). Dominant tree species observed for this habitat type consisted of red maple, sweetgum (*Liquidambar styraciflua*), black gum, eastern hemlock, rhododendron, tulip poplar, sourwood, chestnut oak, sweet birch (*Betula lenta*), and green ash (*Fraxinus pennsylvanica*). Shrubs consist of mountain doghobble (*Leucothoe fontanesiana*), buffalo-nut, witch hazel, elderberry (*Sambucus nigra*), Fraser magnolia, American snowbell (*Styrax americanus*), and pawpaw (*Asimina triloba*). The herbaceous and vine layer is dominated by Galax (*Galax urceolata*), wild hydrangea (*Hydrangea arborescens*), Jack-in-the-pulpit (*Arisaema triphyllum*), jewelweed (*Impatiens capensis*), Indian cucumber (*Medeola virginiana*), violets (*Viola* spp.), Christmas fern, sedges (*Carex* spp.), and Virginia creeper (*Parthenocissus quinquefolia*).

Floodplain Forest

This habitat type is found in regularly or seasonally flooded areas adjacent to river systems with a diverse herbaceous cover. Dominant trees consisted of white oak, sweetgum, red maple, eastern hemlock, sourwood, red oak, and American sycamore (*Platanus occidentalis*). The shrub and vine layer consists of pawpaw, alders (*Alnus* spp.), and muscadine. The herbaceous layer consists of New York fern (*Parathelypteris noveboracencis*), Indian cucumber, Hartweg's wild ginger (*Asarum* hartwegii), running cedar) partridge berry (*Mitchella repens*), sedge, Christmas fern, jewelweed (*Impatiens capensis*), and nettled chain fern (*Woodwardia areolata*).

Plants identified in the study area during the field investigation were classified into their appropriate category as tree, shrub, herb or vine and are provided in **Appendix B**.

4 Survey Methods

Before fieldwork began, a desktop review of existing site information was conducted to aid in identifying potential small whorled pogonia habitat in the Study Area. Information evaluated during the desktop review included existing vegetation patterns, topography, drainage, and potential or known SWAP priority plants (SCDNR 2015) in the vicinity of the study area.

Surveys were conducted during the USFWS recommended optimal survey window of mid-May – early July. Areas were surveyed along the 50-foot-wide buffer of the proposed temporary Fisher Knob access road and within the proposed limits of disturbance and spoil area alternatives, as well as along proposed transmission line access roads related to the Bad Creek II Power Complex proposed infrastructure (Figure 1).

Survey areas were visually delineated by local topography (ravines, slopes, benches) or by landmarks (boulders, downed or otherwise conspicuous trees, or old roads) (USFWS 2016). The survey methodology consisted of slowly traversing back and forth across transects; surveyors were spaced approximately 25-feet apart focusing the immediate area within a 10-to-15-foot radius depending on habitat type and visibility. Handheld Global Positioning System (GPS) units were used to navigate throughout the site to avoid survey gaps.

Vegetation cover type and specific habitats/substrates were noted by surveyors and photographed. A detailed photo log is included in **Appendix C**. Applicable reference materials were used during the field assessments including regional field guides and plant identification mobile apps to identify plants to genus and species level. Surveyors were aware that no small whorled pogonia voucher specimens were to be collected, and any plant locations were considered to be “Privileged Non-Public Information”. Additionally, field biologists recorded incidental observations of priority plant species identified on the South Carolina SWAP list that may occur in the Blue Ridge Ecoregion; this list is provided in **Appendix D**.

5 Survey Results and Conclusions

No small whorled pogonia was identified during the 2024 surveys[2], and no species on the SWAP list were observed. Several individuals of the *Trillium* genus were identified, including potential for the southern nodding trillium (*Trillium rugelii*, a SWAP species), but could not be classified to the species level since the survey was conducted outside of the survey window. Potential habitat for the small whorled pogonia was observed in all study areas.

The species inventory is based on the best professional judgment of HDR’s team of biologists with experience in plant identification in the Blue Ridge ecoregion. Surveyor qualifications are provided in **Appendix E**. Further evaluation of rare, threatened, and endangered plants, and potential jurisdiction may be necessary if additional guidance, status changes, or further rulemaking are provided from the USACE, USFWS, and SCDNR. Documentation of consultation with resource agencies and other relicensing stakeholders is included in **Appendix F**. In association with the Draft License Application (scheduled for completion in February 2025), Duke Energy will consult with USFWS,

[2] Small whorled pogonia surveys were carried out in 2024 as follows: June 3-5 for the proposed Fisher Knob Access Road and transmission line access roads, and intermittently between late May and July 2024 for potential spoil areas and the general proposed limits of disturbance for Bad Creek II construction.

SCDNR, and the Wildlife and Botanical Resources Committee on the need to prepare a Species Protection Plan specific to small whorled pogonia or other special status plant species and communities. If required and as applicable, the Species Protection Plan may include, among other identified protection measures, provisions for future surveys.

6 References

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Appendix A

Appendix A – Threatened and Endangered Species List

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United States Department of the Interior

FISH AND WILDLIFE SERVICE
South Carolina Ecological Services
176 Croghan Spur Road, Suite 200
Charleston, SC 29407-7558
Phone: (843) 727-4707 Fax: (843) 727-4218

In Reply Refer To: 08/14/2024 14:47:17 UTC
Project Code: 2024-0130237
Project Name: Bad Creek Relicensing

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

To Whom It May Concern:

The enclosed species list identifies threatened, endangered, proposed and candidate species, as well as proposed and final designated critical habitat, that may occur within the boundary of your proposed project and/or may be affected by your proposed project. The species list fulfills the requirements of the U.S. Fish and Wildlife Service (Service) under section 7(c) of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 *et seq.*).

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

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

A Biological Assessment is required for construction projects (or other undertakings having similar physical impacts) that are major Federal actions significantly affecting the quality of the human environment as defined in the National Environmental Policy Act (42 U.S.C. 4332(2)(c)). For projects other than major construction activities, the Service suggests that a biological

evaluation similar to a Biological Assessment be prepared to determine whether the project may affect listed or proposed species and/or designated or proposed critical habitat. Recommended contents of a Biological Assessment are described at 50 CFR 402.12.

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

https://www.fws.gov/sites/default/files/documents/endangered-species-consultation-handbook.pdf

Migratory Birds: In addition to responsibilities to protect threatened and endangered species under the Endangered Species Act (ESA), there are additional responsibilities under the Migratory Bird Treaty Act (MBTA) and the Bald and Golden Eagle Protection Act (BGEPA) to protect native birds from project-related impacts. Any activity, intentional or unintentional, resulting in take of migratory birds, including eagles, is prohibited unless otherwise permitted by the U.S. Fish and Wildlife Service (50 C.F.R. Sec. 10.12 and 16 U.S.C. Sec. 668(a)). For more information regarding these Acts, see https://www.fws.gov/program/migratory-bird-permit/what-we-do.

The MBTA has no provision for allowing take of migratory birds that may be unintentionally killed or injured by otherwise lawful activities. It is the responsibility of the project proponent to comply with these Acts by identifying potential impacts to migratory birds and eagles within applicable NEPA documents (when there is a federal nexus) or a Bird/Eagle Conservation Plan (when there is no federal nexus). Proponents should implement conservation measures to avoid or minimize the production of project-related stressors or minimize the exposure of birds and their resources to the project-related stressors. For more information on avian stressors and recommended conservation measures, see https://www.fws.gov/library/collections/threats-birds.

In addition to MBTA and BGEPA, Executive Order 13186: *Responsibilities of Federal Agencies to Protect Migratory Birds*, obligates all Federal agencies that engage in or authorize activities that might affect migratory birds, to minimize those effects and encourage conservation measures that will improve bird populations. Executive Order 13186 provides for the protection of both migratory birds and migratory bird habitat. For information regarding the implementation of Executive Order 13186, please visit https://www.fws.gov/partner/council-conservation-migratory-birds.

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

Attachment(s):

- Official Species List
- USFWS National Wildlife Refuges and Fish Hatcheries
- Bald & Golden Eagles
- Migratory Birds
- Wetlands

OFFICIAL SPECIES LIST

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

This species list is provided by:

South Carolina Ecological Services
176 Croghan Spur Road, Suite 200
Charleston, SC 29407-7558
(843) 727-4707

PROJECT SUMMARY

Project Code: 2024-0130237
Project Name: Bad Creek Relicensing
Project Type: Power Gen - Hydropower - FERC
Project Description: hydro relicensing
Project Location:

The approximate location of the project can be viewed in Google Maps: https://www.google.com/maps/@34.979103800000004,-82.99510223504396,14z

Counties: Oconee County, South Carolina

ENDANGERED SPECIES ACT SPECIES

There is a total of 5 threatened, endangered, or candidate species on this species list.

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

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

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

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

MAMMALS

NAME	STATUS
Northern Long-eared Bat *Myotis septentrionalis* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/9045	Endangered
Tricolored Bat *Perimyotis subflavus* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/10515	Proposed Endangered

INSECTS

NAME	STATUS
Monarch Butterfly *Danaus plexippus* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/9743	Candidate

FLOWERING PLANTS

NAME	STATUS
Small Whorled Pogonia *Isotria medeoloides* Population: No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/1890	Threatened
Smooth Coneflower *Echinacea laevigata* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/3473	Threatened

CRITICAL HABITATS

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

YOU ARE STILL REQUIRED TO DETERMINE IF YOUR PROJECT(S) MAY HAVE EFFECTS ON ALL ABOVE LISTED SPECIES.

USFWS NATIONAL WILDLIFE REFUGE LANDS AND FISH HATCHERIES

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

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

BALD & GOLDEN EAGLES

Bald and golden eagles are protected under the Bald and Golden Eagle Protection Act[1] and the Migratory Bird Treaty Act[2].

Any person or organization who plans or conducts activities that may result in impacts to bald or golden eagles, or their habitats[3], should follow appropriate regulations and consider implementing appropriate conservation measures, as described in the links below. Specifically, please review the "Supplemental Information on Migratory Birds and Eagles".

---

1. The Bald and Golden Eagle Protection Act of 1940.
2. The Migratory Birds Treaty Act of 1918.
3. 50 C.F.R. Sec. 10.12 and 16 U.S.C. Sec. 668(a)

There are likely bald eagles present in your project area. For additional information on bald eagles, refer to Bald Eagle Nesting and Sensitivity to Human Activity

For guidance on when to schedule activities or implement avoidance and minimization measures to reduce impacts to migratory birds on your list, see the PROBABILITY OF PRESENCE SUMMARY below to see when these birds are most likely to be present and breeding in your project area.

NAME	BREEDING SEASON
Bald Eagle *Haliaeetus leucocephalus* This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities. https://ecos.fws.gov/ecp/species/1626	Breeds Sep 1 to Aug 31

PROBABILITY OF PRESENCE SUMMARY

The graphs below provide our best understanding of when birds of concern are most likely to be present in your project area. This information can be used to tailor and schedule your project activities to avoid or minimize impacts to birds. Please make sure you read "Supplemental Information on Migratory Birds and Eagles", specifically the FAQ section titled "Proper Interpretation and Use of Your Migratory Bird Report" before using or attempting to interpret this report.

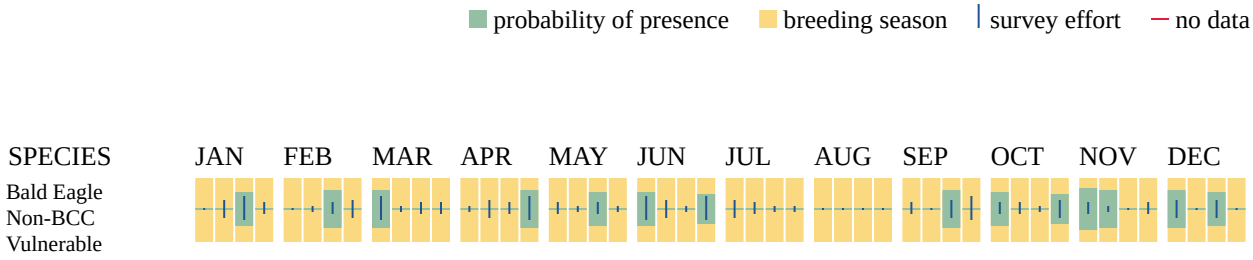
Probability of Presence (■)

Green bars; the bird's relative probability of presence in the 10km grid cell(s) your project overlaps during that week of the year.

Breeding Season (■)
Yellow bars; liberal estimate of the timeframe inside which the bird breeds across its entire range.

Survey Effort (|)
Vertical black lines; the number of surveys performed for that species in the 10km grid cell(s) your project area overlaps.

No Data (–)
A week is marked as having no data if there were no survey events for that week.



Additional information can be found using the following links:

- Eagle Management https://www.fws.gov/program/eagle-management
- Measures for avoiding and minimizing impacts to birds https://www.fws.gov/library/collections/avoiding-and-minimizing-incidental-take-migratory-birds
- Nationwide conservation measures for birds https://www.fws.gov/sites/default/files/documents/nationwide-standard-conservation-measures.pdf
- Supplemental Information for Migratory Birds and Eagles in IPaC https://www.fws.gov/media/supplemental-information-migratory-birds-and-bald-and-golden-eagles-may-occur-project-action

MIGRATORY BIRDS

Certain birds are protected under the Migratory Bird Treaty Act[1] and the Bald and Golden Eagle Protection Act[2].

Any person or organization who plans or conducts activities that may result in impacts to migratory birds, eagles, and their habitats[3] should follow appropriate regulations and consider implementing appropriate conservation measures, as described in the links below. Specifically, please review the "Supplemental Information on Migratory Birds and Eagles".

1. The Migratory Birds Treaty Act of 1918.
2. The Bald and Golden Eagle Protection Act of 1940.
3. 50 C.F.R. Sec. 10.12 and 16 U.S.C. Sec. 668(a)

For guidance on when to schedule activities or implement avoidance and minimization measures to reduce impacts to migratory birds on your list, see the PROBABILITY OF PRESENCE SUMMARY below to see when these birds are most likely to be present and breeding in your project area.

NAME	BREEDING SEASON
Bald Eagle *Haliaeetus leucocephalus* This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities. https://ecos.fws.gov/ecp/species/1626	Breeds Sep 1 to Aug 31
Bobolink *Dolichonyx oryzivorus* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9454	Breeds May 20 to Jul 31
Canada Warbler *Cardellina canadensis* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9643	Breeds May 20 to Aug 10
Cerulean Warbler *Setophaga cerulea* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/2974	Breeds Apr 27 to Jul 20
Chimney Swift *Chaetura pelagica* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9406	Breeds Mar 15 to Aug 25
Chuck-will's-widow *Antrostomus carolinensis* This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA https://ecos.fws.gov/ecp/species/9604	Breeds May 10 to Jul 10
Eastern Whip-poor-will *Antrostomus vociferus* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/10678	Breeds May 1 to Aug 20
Golden-winged Warbler *Vermivora chrysoptera* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/8745	Breeds May 1 to Jul 20
Kentucky Warbler *Geothlypis formosa* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9443	Breeds Apr 20 to Aug 20

NAME	BREEDING SEASON
Prairie Warbler *Setophaga discolor* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9513	Breeds May 1 to Jul 31
Prothonotary Warbler *Protonotaria citrea* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9439	Breeds Apr 1 to Jul 31
Red-headed Woodpecker *Melanerpes erythrocephalus* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9398	Breeds May 10 to Sep 10
Wood Thrush *Hylocichla mustelina* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9431	Breeds May 10 to Aug 31

PROBABILITY OF PRESENCE SUMMARY

The graphs below provide our best understanding of when birds of concern are most likely to be present in your project area. This information can be used to tailor and schedule your project activities to avoid or minimize impacts to birds. Please make sure you read "Supplemental Information on Migratory Birds and Eagles", specifically the FAQ section titled "Proper Interpretation and Use of Your Migratory Bird Report" before using or attempting to interpret this report.

Probability of Presence (■)

Green bars; the bird's relative probability of presence in the 10km grid cell(s) your project overlaps during that week of the year.

Breeding Season (■)
Yellow bars; liberal estimate of the timeframe inside which the bird breeds across its entire range.

Survey Effort (|)
Vertical black lines; the number of surveys performed for that species in the 10km grid cell(s) your project area overlaps.

No Data (–)
A week is marked as having no data if there were no survey events for that week.

■ probability of presence ■ breeding season | survey effort – no data

Additional information can be found using the following links:

- Eagle Management https://www.fws.gov/program/eagle-management

- Measures for avoiding and minimizing impacts to birds https://www.fws.gov/library/collections/avoiding-and-minimizing-incidental-take-migratory-birds
- Nationwide conservation measures for birds https://www.fws.gov/sites/default/files/documents/nationwide-standard-conservation-measures.pdf
- Supplemental Information for Migratory Birds and Eagles in IPaC https://www.fws.gov/media/supplemental-information-migratory-birds-and-bald-and-golden-eagles-may-occur-project-action

WETLANDS

Impacts to NWI wetlands and other aquatic habitats may be subject to regulation under Section 404 of the Clean Water Act, or other State/Federal statutes.

For more information please contact the Regulatory Program of the local U.S. Army Corps of Engineers District.

Please note that the NWI data being shown may be out of date. We are currently working to update our NWI data set. We recommend you verify these results with a site visit to determine the actual extent of wetlands on site.

WETLAND INFORMATION WAS NOT AVAILABLE WHEN THIS SPECIES LIST WAS GENERATED. PLEASE VISIT HTTPS://WWW.FWS.GOV/WETLANDS/DATA/MAPPER.HTML OR CONTACT THE FIELD OFFICE FOR FURTHER INFORMATION.

IPAC USER CONTACT INFORMATION

Agency: HDR
Name: Erin Bradshaw Settevendemio
Address: 440 S Church St, Suite 900
City: Charlotte
State: NC
Zip: 28202
Email erin.settevendemio@hdrinc.com
Phone: 7049736869

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Appendix B

Appendix B – Identified Plants List

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Identified Plants List

	Genus Species	Common Name
Trees	*Acer rubrum*	Red Maple
	Albizia julibrissin	Silktree
	Asimina triloba	Common Paw Paw
	Betula lenta	Sweet Birch
	Carya glabra	Pignut Hickory
	Carya tomentosa	Mockernut Hickory
	Diospyros virginiana	Persimmon
	Fraxinus pennsylvanica	Green Ash
	Hamamelis virginiana	American Witchhazel
	Ilex opaca	American Holly
	Juniperus virginiana	Eastern Red-Cedar
	Kalmia latifolia	Mountain Laurel
	Liquidambar styraciflua	Sweetgum
	Liriodendron tulipifera	Tulip Poplar
	Magnolia frasier	Fraser Magnolia
	Nyssa sylvatica	Black Tupelo
	Oxydendron arboreum	Sourwood
	Pinus echinata	Shortleaf Pine
	Pinus strobus	White Pine
	Pinus taeda	Loblolly Pine
	Platanus occidentalis	American Sycamore
	Prunus serotina	Black Cherry
	Quercus alba	White Oak
	Quercus falcata	Southern Red Oak
	Quercus montana	Chestnut Oak
	Quercus rubra	Northern Red Oak
	Quercus velutina	Black Oak
	Rhododendron maximum	Great Laurel
	Robinia pseudoacacia	Black Locust
	Salix nigra	Black Willow
	Sassafras albidum	Sassafras
	Tsuga canadensis	Eastern Hemlock
Shrubs	*Alnus serrulata*	Brookside Alder
	Amelanchier arborea	Common Serviceberry
	Aralia spinosa	Devil's Walking Stick
	Elaeagnus umbellata	Autumn olive
	Epigaea repens	Trailing Arbutus
	Halesia tetraptera	Mountain Silverbell
	Leucothoe fontanesiana	Dog Hobble
	Pyrularia pubera	Buffalo-nut
	Rhododendron maximum	Great Laurel
	Rosa multiflora	Rambler Rose
	Rubus spp.	Blackberry
	Styrax americanus	American Snowbell
	Vaccinium spp.	Blueberry
	Viburnum acerifolium	Mapleleaf Viburnum
	Xanthorhiza simplicissima	Shrub Yellowroot

	Genus Species	Common Name
Herbs	*Actaea racemosa*	Black Snakeroot
	Andropogon virginicus	Broom-Sedge
	Arisaema triphyllum	Jack-in-the-Pulpit
	Arundinaria appalachiana	Hill Cane
	Bidens aristosa	Bearded Beggarticks
	Boehmeria cylindrica	Small-Spike False Nettle
	Bromus arvensis	Field Brome
	Cardamine diphylla	Two-leaved Toothwort
	Carex frankii	Frank's Sedge
	Carex lurida	Shallow Sedge
	Carex spp.	Sedge
	Carex stipata	Stalk-Grain Sedge
	Chimaphila maculata	Striped Wintergreen
	Circaea spp.	Nightshade
	Cladonia rangiferina	Reindeer lichen
	Clematis virginiana	Devil's-Darning-Needles
	Cyperus strigosus	Straw-Color Flat Sedge
	Dichanthelium scoparium	Broom Rosette Grass
	Diodia teres	Poorjoe
	Elephantopus tomentosus	Common Elephant's Foot
	Eupatorium cappilifolium	Dog Fennel
	Eupatorium perfoliatum	Common Boneset
	Euphorbia spp.	Spurge
	Eurybia divaricata	White Wood-aster
	Galax urceolata	Galax
	Goodyera pubescens	Downy Rattlesnake Plantain
	Hexastylis spp.	Wild Ginger
	Houstonia purpurea	Summer Bluet
	Hydrangea arborescens	Wild Hydrangea
	Hylodesmum nudiflorum	Naked-flowered Tick-Trefoil
	Impatiens capensis	Spotted Touch-Me-Not
	Iris cristata	Dwarf Crested Iris
	Juncus effusus	Lamp Rush
	Juncus tenuis	Lesser Poverty Rush
	Junus spp.	Rushes
	Laportea canadensis	Wood Nettle
	Lespedeza cuneata	Chinese Bush-Clover
	Lycopodium digitatum	Running Cedar
	Lycopus uniflorus	Northern Bugleweed
	Lysimachia quadrifolia	Whorled Loosestrife
	Maianthemum racemosum	Solomon's Plume
	Medeola virginiana	Cucumber Root
	Microstegium vinimum	Japanese Stiltgrass
	Monarda clinopodia	White Bergamot
	Murdannia keisak	Marsh Dewflower
	Nabalus altissimus	Tall Rattlesnake Root
	Nabalus trifoliolatus	Three-Leaved Rattlesnake Root
	Onoclea sensibilis	Sensitive Fern
	Osmunda regalis	Royal Fern
	Osmundastrum cinnamomeum	Cinnamon Fern
	Oxalis corniculata	Creeping Yellow Wood-Sorrel
	Packera anonyma	Small's Ragwort

	Genus Species	Common Name
	Parathelypteris noveboracencis	New York Fern
	Passiflora lutea	Yellow Passionflower
	Perilla frutescens	Beefsteakplant
	Persicaria sagittata	Arrow-Leaf Tearthumb
	Phyrma leptostachya	American Lopseed
	Polygala polygama	Racemed Milkwort
	Polystichum arostichoides	Christmas Fern
	Potentilla canadensis	Dwarf Cinquefoil
	Pteridium aquilinium	Common Bracken Fern
	Rubus allegheniensis	Allegheny Blackberry
	Sceptridium biternatum	Sparse-lobed Grapefern
	Scirpus cyperinus	Cottongrass Bulrush
	Schizachyrium scoparium	Little Bluestem
	Smilax spp.	Greenbriar
	Solidago altissima	Tall Goldenrod
	Stellar pubera	Star Chickweed
	Trifolium repens	White Clover
	Trillium cuneatum	Little Sweet Betsy
	Trillium catesbaei	Bashful Wakerobin
	Trillium spp.	Trillium species
	Verbesina spp.	Crownbeard
	Vernonia noveboracensis	New York Ironweed
	Viola primulifolia	Primrose-leaved Violet
	Viola spp.	Violet
	Vulpia spp.	Grass spp.
	Woodwardia areolata	Netted Chain Fern
Vines	*Bignonia capreolata*	Crossvine
	Dioscorea villosa	Wild Yam
	Mitchella repens	Partridge Berry
	Parthenocissus quiquefolia	Virginia Creeper
	Toxicodendron radicans	Poison Ivy
	Vitis rotundifolia	Muscadine

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Appendix C

Appendix C – Representative Site Photographs

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Photo 1. Potential SWP habitat; rocky slope with dappled sunlight (Fisher Knob Access Road)

Photo 2. Running cedar *Lycopodium digitatum* (Fisher Knob Access Road)

Photo 3. Potential SWP habitat; hardwood forest with dappled sunlight (Fisher Knob Access Road)

Photo 4. Potential SWP habitat; dry upland hardwood forest with dappled sunlight

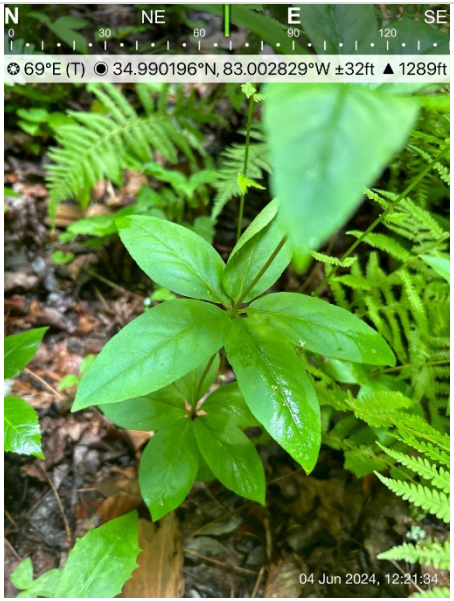

Photo 5. Whorled loosestrife *Lysimachia quadrifolia* (Fisher Knob Access Road)

Photo 6. Dense rhododendron sp.; not habitat for SWP (Fisher Knob Access Road)

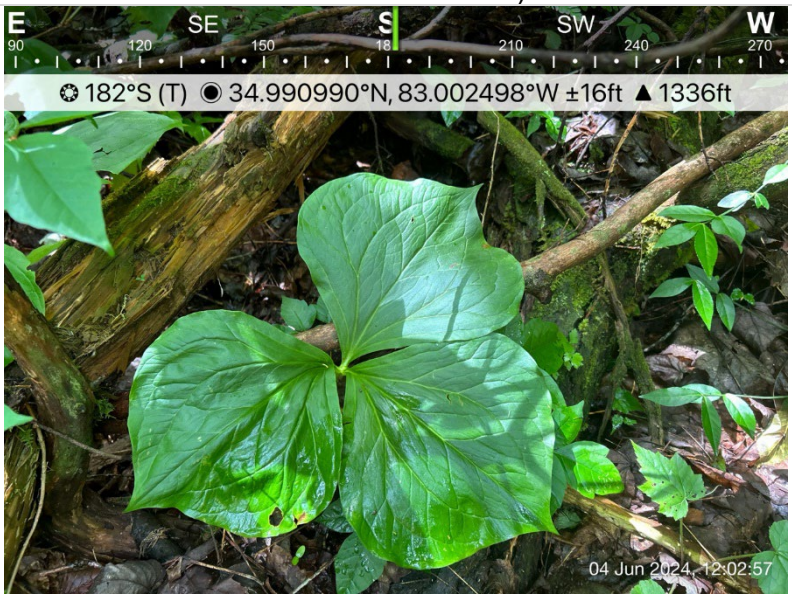

Photo 7. *Trillium* sp. (Fisher Knob Access Road)

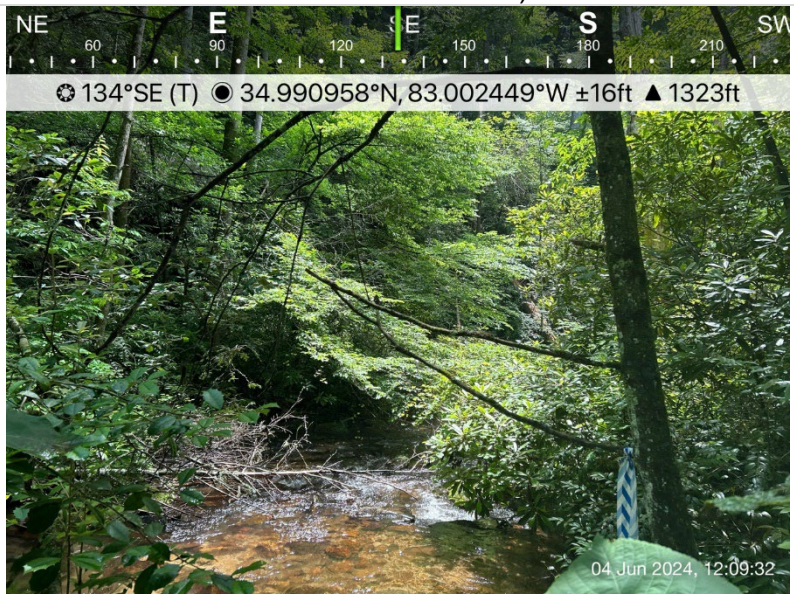

Photo 8. Cove forest adjacent to Howard Creek with dense vegetation; not habitat for SWP (Fisher Knob Access Road)

Photo 9. Hemlock, white pine with dense fern/herbaceous layer; not habitat for SWP (Fisher Knob Access Road)

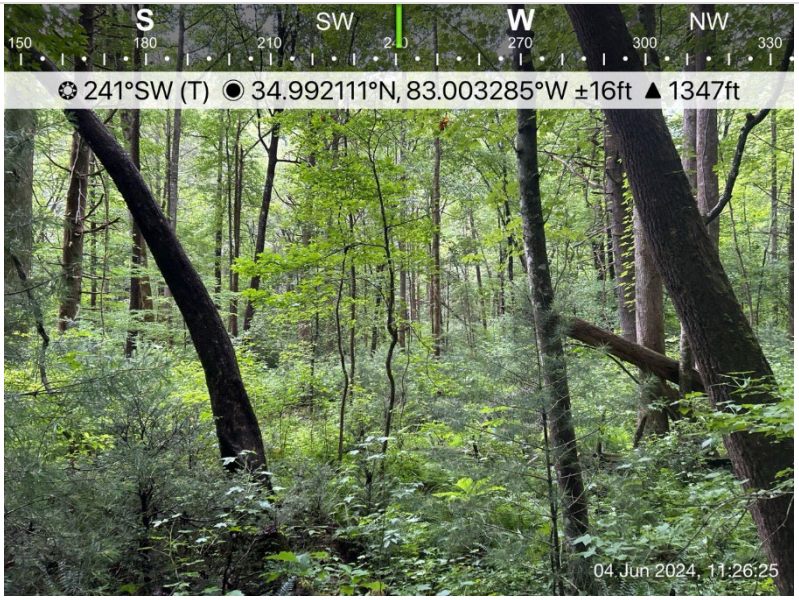

Photo 10. Bottomland forest with dense herb and shrub layers; not habitat for SWP (Fisher Knob Access Road)

Photo 11. Bashful wakerobin *Trillium catesbaei* (Fisher Knob Access Road)

Photo 12. Mixed hardwood forest with herbaceous layer; not habitat for SWP (Fisher Knob Access Road)

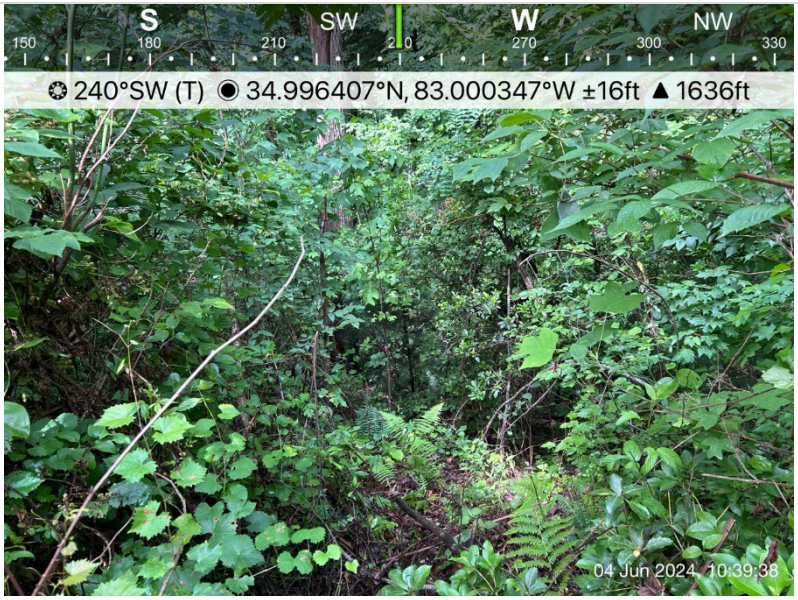

Photo 13. Forested area with dense understory and herbaceous layers; not habitat for SWP (Fisher Knob Access Road)

Photo 14. Potential SWP habitat; upland hardwood forest with dappled sunlight (Fisher Knob Access Road)

Photo 15. Potential SWP habitat; hardwood slope (transmission line access roads)

Photo 16. Open space along access road; potential habitat for SWP on margins (transmission line access roads)

Photo 17. Slope with dense rhododendron sp.; not habitat for SWP (transmission line Access Roads)

Photo 18. Potential SWP habitat; mixed hardwood with dappled sunlight (transmission line access roads)

Photo 19. Mixed hardwood with dense understory; not habitat for SWP (transmission line access roads)

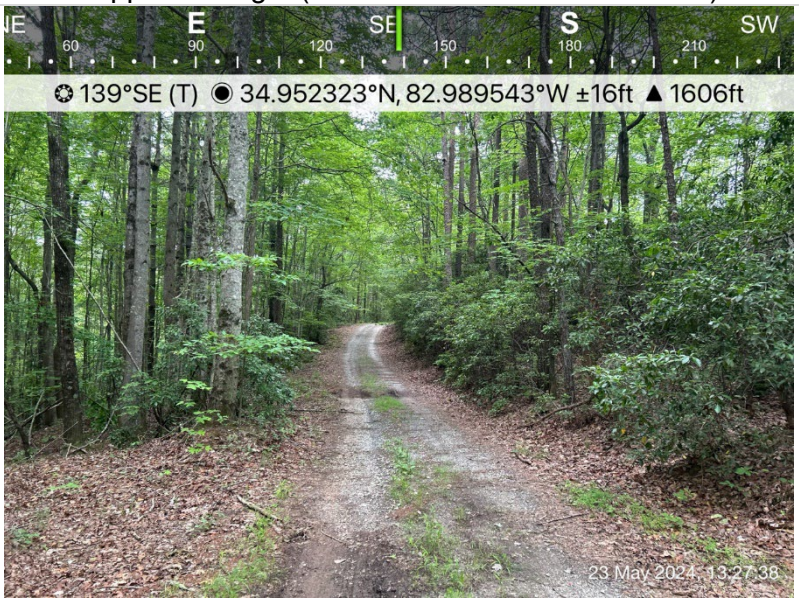

Photo 20. Access Road; potential habitat for SWP on margins (transmission line access roads)

Photo 21. Potential SWP habitat; dense mixed hardwood with dappled sunlight (transmission line access roads)

Photo 22. Potential SWP habitat; acidic cove forest (spoil location B)

Photo 23. Maintained open area; not habitat for SWP (spoil locations B, E, and F)

Photo 24. Potential SWP habitat; shortleaf pine and oak woodland (spoil locations B and C)

Photo 25. Dense vegetation in ROW; not SWP habitat (spoil locations C and M)

Photo 26. Potential SWP habitat; montane oak hickory cove forest (spoil location D)

Photo 27. Potential SWP habitat; dry mesic oak hickory forest (spoil locations C, D, G, I, and M)

Photo 28. Mixed hardwood with dense shrub layer; not habitat for SWP (spoil location J)

Photo 29. Potential SWP habitat; upland mixed wood with dappled sunlight (spoil location K)

Photo 30. Potential SWP habitat; open herb layer with dappled sunlight (spoil location D)

Photo 31. Disturbed open habitat; not habitat for SWP (spoil location F)

Photo 32. Potential SWP habitat; upland mixed wood with dappled sunlight (spoil location K)

Appendix D

Appendix D – South Carolina SWAP Priority Plants for the Blue Ridge Ecoregion

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SWAP Priority Plants for the Blue Ridge Ecoregion

Scientific Name	Common Name	Legal Status	Priority	Habitat
Agrimonia pubescens	Soft Groovebur		Moderate	Low Elevation Basic and Acidic Mesic Forests
Arnoglossum muehlenbergii	Great Indian Plantain		Moderate	Low Elevation Basic and Acidic Mesic Forests; Bottomlands and Riparian Zones
Asplenium monanthes	Single-sorus Spleenwort		Moderate	Wet/Moist Unique Landforms
Asplenium pinnatifidum	Lobed Spleenwort		Moderate	Rock Outcrops
Asplenium resiliens	Black-stem Spleenwort		Moderate	Wet/Moist Unique Landforms
Betula alleghaniensis	Yellow Birch		Moderate	Bottomlands and Riparian Zones
Bryocrumia vivicolor	Bryocrumia Moss		High	Bottomlands and Riparian Zones
Cardamine flagellifera	Blue-Ridge Bittercress		High	Bottomlands and Riparian Zones
Carex appalachica	Appalachian Sedge		Moderate	Appalachian Oak Forest; High Elevation Forest; Rock Outcrops; Wet/Moist Unique Landforms
Carex biltmoreana	Biltmore Sedge		High	Rock Outcrops; Wet/Moist Unique Landforms
Carex communis var. amplisquama	Fort Mountain Sedge		High	Low Elevation Basic Mesic Forest
Carex decomposita	Cypress-knee Sedge		High	Depressions; Wet/Moist Unique Landforms
Carex folliculata	Long Sedge		Moderate	High Elevation Forest; Wet/Moist Unique Landforms
Carex manhartii	Manhart Sedge		Moderate	Bottomlands and Riparian Zones
Carex pedunculata	Longstalk Sedge		Moderate	Low Elevation Basic Mesic Forest
Carex radfordii	Radford's Sedge		High	Appalachian Oak Forest; Low Elevation Basic Mesic Forest
Carex woodii	Pretty Sedge		Moderate	Bottomlands and Riparian Zones
Cheilolejeunea evansii	Evan's Cheilolejeunea		High	Bottomlands and Riparian Zones; Wet/Moist Unique Landforms
Chrysosplenium americanum	American Golden-saxifrage		Moderate	Low Elevation Acidic Mesic Forest; Wet/Moist Unique Landforms
Cladrastis kentukea	Yellowwood		Moderate	Low Elevation Basic Mesic Forest
Collinsonia verticillata	Whorled Horse-balm		Moderate	Low Elevation Basic Mesic Forest; Low Elevation Acidic Mesic Forest
Comptonia peregrina	Sweet Fern		Moderate	Grasslands/Early-Successional
Convallaria majuscula	American Lily-of-the-valley		Moderate	High Elevation Forest
Coreopsis latifolia	Broad-leaved Tickseed		High	Low Elevation Basic Mesic Forest
Cornus racemosa	Stiff Dogwood		Moderate	Bottomlands and Riparian Zones
Cystopteris bulbifera	Bulblet Fern		Moderate	Rock Outcrops

Scientific Name	Common Name	Legal Status	Priority	Habitat
Danthonia epilis	Bog Oat-grass		Moderate	Rock Outcrops; Wet/Moist Unique Landforms
Deschampsia flexuosa	Crinkled Hairgrass		Moderate	Rock Outcrops
Dicentra eximia	Wild Bleeding-heart		Moderate	Low Elevation Basic Mesic Forest
Diplazium pycnocarpon	Glade Fern		Moderate	Low Elevation Basic Mesic Forest
Dryopteris goldiana	Goldie's Woodfern		Moderate	Low Elevation Basic Mesic Forest; Rock Outcrops
Echinacea laevigata	Smooth Coneflower	LE: Endangered	Highest	Grasslands/Early-Successional
Eurybia avita	Alexander's Rock Aster		High	Rock Outcrops
Fothergilla major	Mountain Witch-alder		High	Low Elevation Basic Mesic Forest
Gaylussacia baccata	Black Huckleberry		Moderate	Appalachian Oak Forest; Low Elevation Acidic Mesic Forest
Gymnoderma lineare	Rocky Gnome Lichen	LE: Endangered	Highest	Rock Outcrops
Helenium brevifolium	Shortleaf Sneezeweed		Moderate	Bottomlands and Riparian Zones
Helianthus glaucophyllus	White-leaved Sunflower		Moderate	Low Elevation Basic Mesic Forest
Helonias bullata	Swamp-pink	LT: Threatened	Highest	Wet/Moist Unique Landforms
Hydrangea cinerea	Ashy-hydrangea		Moderate	Low Elevation Basic Mesic Forest
Hydrocotyle americana	American Water-pennywort		Moderate	Bottomlands and Riparian Zones; Depressions
Hymenophyllum tayloriae	Taylor's Fern		High	Wet/Moist Unique Landforms
Hymenophyllum tunbrigense	Tunbridge Fern		Moderate	Wet/Moist Unique Landforms
Hypericum buckleii	Blue Ridge St. John's-wort		High	Rock Outcrops
Impatiens pallida	Pale Jewel-weed		Moderate	Bottomlands and Riparian Zones; Depressions
Isoetes caroliniana	Engelmann's Quillwort		Moderate	Depressions
Isotria medeoloides	Small Whorled Pogonia	LT: Threatened	Highest	Wet/Moist Unique Landforms
Juncus subcaudatus	Woods-rush		Moderate	Depressions
Juniperus communis var. depressa	Dwarf Juniper		Moderate	High Elevation Forest
Krigia montana	False Dandelion		High	Rock Outcrops
Lejeunea blomquistii	"A Liverwort"		High	Rock Outcrops
Leptohymenium sharpii	Sharp's Leptohymenium Moss		High	Wet/Moist Unique Landforms

Scientific Name	Common Name	Legal Status	Priority	Habitat
Liatris microcephala	Small-head Gayfeather		Moderate	Rock Outcrops
Liparis liliifolia	Large Twayblade		Moderate	Low Elevation Basic Mesic and Acidic Forests
Listera smallii	Kidney-leaf Twayblade		Moderate	Low Elevation Acidic Mesic Forest
Lophocolea appalachiana	Appalachian Lophocolea		High	Wet/Moist Unique Landforms
Lycopodium clavatum	Running Pine		Moderate	Appalachian Oak Forest; High Elevation Forest
Lycopodium porophilum	Rock Clubmoss		Moderate	Rock Outcrops
Lycopodium tristachyum	Deep-root Clubmoss		Moderate	High Elevation Forest
Lysimachia fraseri	Fraser Loosestrife		High	Bottomlands and Riparian Zones
Lysimachia hybrida	Lance-leaf Loosestrife		Moderate	Depressions
Magnolia cordata	Piedmont Cucumber Tree		Moderate	Low Elevation Basic Mesic Forest
Mitella diphylla	Two-leaf Bishop's-cap		Moderate	Low Elevation Basic Mesic Forest
Monotropsis odorata	Sweet Pinesap		High	Appalachian Oak Forest; High Elevation Forest
Oenothera perennis	Small Sundrops		Moderate	Depressions
Panax quinquefolius	American Ginseng		High	Low Elevation Basic Mesic Forest
Parnassia grandifolia	Large-leaved Grass-of-parnassus		High	Wet/Moist Unique Landforms
Pellaea atropurpurea	Purple-stem Cliff-brake		Moderate	Rock Outcrops
Pellaea wrightiana	Cliff-brake Fern		Moderate	Rock Outcrops
Pellia appalachiana	Appalachian Pellia		Moderate	Bottomlands and Riparian Zones; Wet/Moist Unique Landforms
Phacelia bipinnatifida	Fernleaf Phacelia		Moderate	Low Elevation Basic Mesic Forest; Bottomlands and Riparian Zones
Plagiochila caduciloba	Gorge Leafy Liverwort		High	Wet/Moist Unique Landforms
Plagiochila sharpii	"A Liverwort"		High	Wet/Moist Unique Landforms
Plagiochila sullivantii	"A Liverwort"		High	Wet/Moist Unique Landforms
Plagiomnium carolinianum	Mountain Wavy-leaf Moss		High	Wet/Moist Unique Landforms
Platanthera integrilabia	White Fringeless Orchid	C: Candidate	Highest	Bottomlands and Riparian Zones; Depressions
Platyhypnidium pringlei	Pringle's Platyhypnidium Moss		High	Wet/Moist Unique Landforms
Poa alsodes	Blue-grass		Moderate	Low Elevation Basic Mesic Forest
Porella japonica ssp. appalachiana	"A Liverwort"		Moderate	Bottomlands and Riparian Zones

Scientific Name	Common Name	Legal Status	Priority	Habitat
Pycnanthemum montanum	Single-haired Mountain-mint		Moderate	Appalachian Oak Forest; High Elevation Forest; Low Elevation Basic Mesic Forest
Rhododendron catawbiense	Catawba Rhododendron		Moderate	High Elevation Forest
Rudbeckia heliopsidis	Sun-facing Coneflower		High	Low Elevation Acidic Mesic Forest
Sarracenia rubra ssp. jonesii	Mountain Sweet Pitcher-plant	LE: Endangered	Highest	Rock Outcrops; Wet/Moist Unique Landforms
Saxifraga careyana	Carey Saxifrage		High	High Elevation Forest; Low Elevation Basic Mesic Forest; Rock Outcrops
Senecio millefolium	Piedmont Ragwort		High	Rock Outcrops
Shortia galacifolia	Oconee bells		High	High Elevation Forest; Low Elevation Basic Mesic Forest; Rock Outcrops; Wet/Moist Unique Landforms
Silene ovata	Ovate Catchfly		High	Appalachian Oak Forest; High Elevation Forest; Low Elevation Basic Mesic Forest
Solidago simulans	Granite Dome Goldenrod		High	High Elevation Forest; Low Elevation Basic Mesic Forest; Rock Outcrops
Stachys clingmanii	Clingman's Hedge-nettle		High	Appalachian Oak Forest; High Elevation Forest
Thermopsis mollis	Soft-haired Thermopsis		Moderate	Low Elevation Acidic Mesic Forest
Tradescantia virginiana	Virginia Spiderwort		Moderate	High Elevation Forest; Low Elevation Basic Mesic Forest
Trichomanes boschianum	Bristle-fern		Moderate	Low Elevation Basic Mesic Forest; Rock Outcrops; Depressions
Trichophorum cespitosum	Deer-haired Bulrush		Moderate	High Elevation Forest
Trillium grandiflorum	Large-flower Trillium		Moderate	High Elevation Forest; Depressions
Trillium rugelii	Southern Nodding Trillium		High	Low Elevation Basic Mesic Forest; Depressions
Trillium simile	Sweet White Trillium		High	Low Elevation Basic Mesic Forest; Depressions
Triphora trianthophora	Nodding Pogonia		Moderate	Depressions
Viola conspersa	American Bog Violet		Moderate	Low Elevation Basic Mesic Forest
Xyris torta	Twisted Yellow-eyed-grass		Moderate	Wet/Moist Unique Landforms

Appendix E

Appendix E – Surveyor Qualifications

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Surveyor Qualifications

Name	Eric Mularski, PWS, PMP
Education	B.S, Biology – Eastern Washington University – 2001
Experience:	Environmental Sciences and Planning Manager – HDR Engineering, Inc. (HDR) – October 2015 to present Environmental Scientist – HDR – November 2006 to October 2015 Environmental Scientist – Buck Engineering – October 2004 to November 2006 Fisheries Technician – Kalispel Tribe of Indians – June 2001 to September 2004
Qualifications:	18 years experience conducting botanical and presence and absence surveys for federally protected plant species in the Southern Blue Ridge Ecoregion of North Carolina, South Carolina, and Virgina.

Name	Paul Bright
Education	B.S. Geography: B.A. Earth Science – University of North Carolina at Charlotte - 2006
Experience:	Environmental Scientist II – HDR – January 2022 to present Environmental Scientist – SWCA Consultants – September 2021 to January 2022 Natural Resources Assistant – Mecklenburg County Park & Recreation Natural Resources – October 2020 to September 2021 Chief Operating Officer – EDIA Maps – November 2021 to September 2021 Environmental Scientist – Carolina Wetland Services – June 2006 to November 2009
Qualifications:	5 years experience conducting botanical and presence and absence surveys for federally protected plant species in the Southern Blue Ridge Ecoregion of North Carolina and South Carolina.

Name	Jake Irvin, PWS, CE
Education	M.S. Environmental Sciences – University of North Carolina at Wilmington – 2019 B.A. Environmental Sciences – Ferrum College - 2017
Experience:	Environmental Scientist II – HDR – July 2019 to present
Qualifications:	5 years experience conducting botanical and presence and absence surveys for federally protected plant species in the Southern Blue Ridge Ecoregion of North Carolina, South Carolina, and Virgina.

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Appendix F

Appendix F – Consultation

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From:	Crutchfield Jr., John U
To:	Olds, Melanie J; Elizabeth Miller
Cc:	Stuart, Alan Witten; Fletcher, Scott T; Kulpa, Sarah; Mularski, Eric; McCarney-Castle, Kerry
Subject:	Bad Creek Relicensing - Small Whorled Pogonia Draft Study Plan (REVIEW REQUESTED)
Date:	Friday, May 24, 2024 12:20:08 PM
Attachments:	image001.png
Importance:	High

Dear Melanie and Elizabeth:

Duke Energy is pleased to distribute the draft Small Whorled Pogonia Study Plan for your review and comment. Bad Creek_Small Whorled Pogonia Study Plan_May 2024

We kindly request comments back by June 7th; however, Duke Energy will have field crews at the project site the week of June 3rd, therefore, expedited comments received by the end of next week (May 31) would be greatly appreciated to facilitate the field effort.

Please let Alan or me know if you have any questions.

Regards,

John Crutchfield
Project Manager II
Water Strategy, Hydro Licensing & Lake Services
Regulated & Renewable Energy
Duke Energy
525 South Tryon Street, DEP-35B | Charlotte, NC 28202
Office 980-373-2288| Cell 919-757-1095

From:	Olds, Melanie J
To:	Crutchfield Jr., John U; Elizabeth Miller
Cc:	Stuart, Alan Witten; Fletcher, Scott T; Kulpa, Sarah; Mularski, Eric; McCarney-Castle, Kerry
Subject:	Re: [EXTERNAL] Bad Creek Relicensing - Small Whorled Pogonia Draft Study Plan (REVIEW REQUESTED)
Date:	Wednesday, May 29, 2024 7:37:51 AM
Attachments:	image001.png Outlook-aguwz1wf.png Outlook-4amisz42.png

John,

The Service has reviewed the Small Whorled Pogonia Study Plan and does not have any comments. We look forward to seeing the results of the survey.

Melanie

Melanie Olds
Fish & Wildlife Biologist
Regulatory Team Lead/FERC Coordinator

U.S. Fish and Wildlife Service
South Carolina Ecological Services Field Office
176 Croghan Spur Road, Suite 200
Charleston, SC 29407
Phone: (843) 534-0403

From: Crutchfield Jr., John U <John.Crutchfield@duke-energy.com>
Sent: Friday, May 24, 2024 12:19 PM
To: Olds, Melanie J <melanie_olds@fws.gov>; Elizabeth Miller <MillerE@dnr.sc.gov>
Cc: Stuart, Alan Witten <Alan.Stuart@duke-energy.com>; scott.fletcher <scott.fletcher@duke-energy.com>; Kulpa, Sarah -hdrinc <Sarah.Kulpa@hdrinc.com>; Mularski, Eric -HDRInc <Eric.Mularski@HDRInc.com>; Kerry McCarney-Castle <Kerry.McCarney-Castle@hdrinc.com>
Subject: [EXTERNAL] Bad Creek Relicensing - Small Whorled Pogonia Draft Study Plan (REVIEW REQUESTED)

links, opening attachments, or responding.

Dear Melanie and Elizabeth:

Duke Energy is pleased to distribute the draft Small Whorled Pogonia Study Plan for your review and comment. Bad Creek_Small Whorled Pogonia Study Plan_May 2024

We kindly request comments back by June 7th; however, Duke Energy will have field crews at the project site the week of June 3rd, therefore, expedited comments received by the end of next week (May 31) would be greatly appreciated to facilitate the field effort.

Please let Alan or me know if you have any questions.

Regards,

John Crutchfield
Project Manager II
Water Strategy, Hydro Licensing & Lake Services
Regulated & Renewable Energy
Duke Energy
525 South Tryon Street, DEP-35B | Charlotte, NC 28202
Office 980-373-2288| Cell 919-757-1095

From:	Crutchfield Jr., John U
To:	Elizabeth Miller
Cc:	Stuart, Alan Witten; Fletcher, Scott T; Kulpa, Sarah; Mularski, Eric; McCarney-Castle, Kerry
Subject:	RE: Bad Creek Relicensing - Small Whorled Pogonia Draft Study Plan (REVIEW REQUESTED)
Date:	Friday, May 31, 2024 2:13:55 PM
Attachments:	image001.png
Importance:	High

Elizabeth: Good afternoon!

I wanted to check in to see if SC DNR has any comments on the Small Whorled Pogonia Draft Study Plan. The survey crews are scheduled to be in the field next week and if Sc DNR has any comments on the study plan that might affect field surveys, please let us know.

Regards,
John

From: Crutchfield Jr., John U
Sent: Friday, May 24, 2024 12:20 PM
To: Melanie Olds <melanie_olds@fws.gov>; Elizabeth Miller <MillerE@dnr.sc.gov>
Cc: Stuart, Alan Witten <Alan.Stuart@duke-energy.com>; Fletcher, Scott T <Scott.Fletcher@duke-energy.com>; Kulpa, Sarah -hdrinc <Sarah.Kulpa@hdrinc.com>; Mularski, Eric -HDRInc <Eric.Mularski@HDRInc.com>; Kerry McCarney-Castle <Kerry.McCarney-Castle@hdrinc.com>
Subject: Bad Creek Relicensing - Small Whorled Pogonia Draft Study Plan (REVIEW REQUESTED)
Importance: High

Dear Melanie and Elizabeth:

Duke Energy is pleased to distribute the draft Small Whorled Pogonia Study Plan for your review and comment. Bad Creek_Small Whorled Pogonia Study Plan_May 2024

We kindly request comments back by June 7th; however, Duke Energy will have field crews at the project site the week of June 3rd, therefore, expedited comments received by the end of next week (May 31) would be greatly appreciated to facilitate the field effort.

Please let Alan or me know if you have any questions.

Regards,

John Crutchfield
Project Manager II
Water Strategy, Hydro Licensing & Lake Services

Regulated & Renewable Energy
Duke Energy
525 South Tryon Street, DEP-35B | Charlotte, NC 28202
Office 980-373-2288| Cell 919-757-1095

From:	Elizabeth Miller
To:	Crutchfield Jr., John U
Cc:	Stuart, Alan Witten; Fletcher, Scott T; Kulpa, Sarah; Mularski, Eric; McCarney-Castle, Kerry
Subject:	RE: [EXTERNAL] RE: Bad Creek Relicensing - Small Whorled Pogonia Draft Study Plan (REVIEW REQUESTED)
Date:	Monday, June 3, 2024 10:20:57 AM
Attachments:	image001.png

Hi John,

The SCDNR has reviewed the Small Whorled Pogonia draft Study Plan and has no comments to offer.

Thank you,

Elizabeth

Elizabeth C. Miller
SCDNR
Office: 843-953-3881
Cell: 843-729-4636

From: Crutchfield Jr., John U <John.Crutchfield@duke-energy.com>
Sent: Monday, June 3, 2024 9:09 AM
To: Elizabeth Miller <MillerE@dnr.sc.gov>
Cc: Stuart, Alan Witten <Alan.Stuart@duke-energy.com>; Fletcher, Scott T <Scott.Fletcher@duke-energy.com>; Kulpa, Sarah -hdrinc <Sarah.Kulpa@hdrinc.com>; Mularski, Eric -HDRInc <Eric.Mularski@HDRInc.com>; Kerry McCarney-Castle <Kerry.McCarney-Castle@hdrinc.com>
Subject: RE: [EXTERNAL] RE: Bad Creek Relicensing - Small Whorled Pogonia Draft Study Plan (REVIEW REQUESTED)

Thank you, Elizabeth.

From: Elizabeth Miller <MillerE@dnr.sc.gov>
Sent: Monday, June 3, 2024 9:07 AM
To: Crutchfield Jr., John U <John.Crutchfield@duke-energy.com>
Cc: Stuart, Alan Witten <Alan.Stuart@duke-energy.com>; Fletcher, Scott T <Scott.Fletcher@duke-energy.com>; Kulpa, Sarah -hdrinc <Sarah.Kulpa@hdrinc.com>; Mularski, Eric -HDRInc <Eric.Mularski@HDRInc.com>; Kerry McCarney-Castle <Kerry.McCarney-Castle@hdrinc.com>
Subject: [EXTERNAL] RE: Bad Creek Relicensing - Small Whorled Pogonia Draft Study Plan (REVIEW REQUESTED)

Hi John,

Our upstate botanist was unable to review the draft plan last week but is planning to do so today. I'll get you our comments as soon as I can.

Thanks,

EM

Elizabeth C. Miller
SCDNR
Office: 843-953-3881
Cell: 843-729-4636

From: Crutchfield Jr., John U <John.Crutchfield@duke-energy.com>
Sent: Friday, May 31, 2024 2:14 PM
To: Elizabeth Miller <MillerE@dnr.sc.gov>
Cc: Stuart, Alan Witten <Alan.Stuart@duke-energy.com>; Fletcher, Scott T <Scott.Fletcher@duke-energy.com>; Kulpa, Sarah -hdrinc <Sarah.Kulpa@hdrinc.com>; Mularski, Eric -HDRInc <Eric.Mularski@HDRInc.com>; Kerry McCarney-Castle <Kerry.McCarney-Castle@hdrinc.com>
Subject: RE: Bad Creek Relicensing - Small Whorled Pogonia Draft Study Plan (REVIEW REQUESTED)
Importance: High

Elizabeth: Good afternoon!

I wanted to check in to see if SC DNR has any comments on the Small Whorled Pogonia Draft Study Plan. The survey crews are scheduled to be in the field next week and if Sc DNR has any comments on the study plan that might affect field surveys, please let us know.

Regards,
John

From: Crutchfield Jr., John U
Sent: Friday, May 24, 2024 12:20 PM
To: Melanie Olds <melanie_olds@fws.gov>; Elizabeth Miller <MillerE@dnr.sc.gov>
Cc: Stuart, Alan Witten <Alan.Stuart@duke-energy.com>; Fletcher, Scott T <Scott.Fletcher@duke-energy.com>; Kulpa, Sarah -hdrinc <Sarah.Kulpa@hdrinc.com>; Mularski, Eric -HDRInc <Eric.Mularski@HDRInc.com>; Kerry McCarney-Castle <Kerry.McCarney-Castle@hdrinc.com>
Subject: Bad Creek Relicensing - Small Whorled Pogonia Draft Study Plan (REVIEW REQUESTED)
Importance: High

Dear Melanie and Elizabeth:

Duke Energy is pleased to distribute the draft Small Whorled Pogonia Study Plan for your review and comment. Bad Creek_Small Whorled Pogonia Study Plan_May 2024

We kindly request comments back by June 7th; however, Duke Energy will have field crews at the project site the week of June 3rd, therefore, expedited comments received by the end of next week (May 31) would be greatly appreciated to facilitate the field effort.

Please let Alan or me know if you have any questions.

Regards,

John Crutchfield
Project Manager II
Water Strategy, Hydro Licensing & Lake Services
Regulated & Renewable Energy
Duke Energy
525 South Tryon Street, DEP-35B | Charlotte, NC 28202
Office 980-373-2288| Cell 919-757-1095

EXTERNAL EMAIL: Do not click any links or open any attachments unless you trust the sender and know the content is safe.

From:	Crutchfield Jr., John U
To:	Abney, Michael A; Andrew Grosse; Andy Douglas; Austen Attaway; Bill Ranson-Retired; Chris Starker; Dale Wilde; Elizabeth Miller; Mularski, Eric; Fletcher, Scott T; Huff, Jen; Jennifer Kindel; Keith A. Bradley; Ken Forrester; Olds, Melanie J; Amedee, Morgan D.; Pat Cloninger; Samantha Tessel; Stuart, Alan Witten; suewilliams130@gmail.com; Wes Cooler; Willie Simmons
Cc:	Sarah Salazar; McCarney-Castle, Kerry; Salazar, Maggie
Subject:	Bad Creek Relicensing - Small Whorled Pogonia Final Study Plan
Date:	Wednesday, June 5, 2024 10:40:59 AM
Attachments:	image001.png
Importance:	High

Dear Wildlife & Botanical Resources Committee:

Please find attached the final Small Whorled Pogonia Study Plan which was developed in consultation and review by the US Fish & Wildlife Service and the South Carolina Department of Natural Resources. The study plan is being provide to the Resource Committee for information and reference.

The study plan can be accessed at the following link: 20240605_Bad Creek_Small Whorled Pogonia_Study Plan.pdf

The study plan was developed In response to a written request from the South Carolina Department of Natural Resources (SCDNR) in comments submitted to the Federal Energy Regulatory Commission on the Initial Study Report and to support Clean Water Act Section 404 U.S. Army Corps of Engineers permitting activities associated with the Bad Creek II Power Complex.

Duke Energy will survey the area around the proposed Fisher Knob Access Road for the federally threatened small whorled pogonia (*Isotria medeoloides*) during the appropriate survey window (mid-May through early July).

Please let Alan or me know if you have any questions.
Regards,

John Crutchfield
Project Manager II
Water Strategy, Hydro Licensing & Lake Services
Regulated & Renewable Energy
Duke Energy
525 South Tryon Street, DEP-35B | Charlotte, NC 28202
Office 980-373-2288| Cell 919-757-1095

Memo

Date:	Wednesday, June 05, 2024
Project:	Bad Creek II Power Complex
To:	Alan Stuart, Duke Energy
From:	Eric Mularski, HDR
Subject:	Small Whorled Pogonia Study Plan

Project Understanding

Duke Energy Carolinas, LLC (Duke Energy) is the owner and operator of the 1,400-megawatt Bad Creek Pumped Storage Project (Project; Federal Energy Regulatory Commission [FERC] Project No. 2740) located in Oconee County, South Carolina. The existing (original) license for the Project was issued by the Commission for a 50-year term, with an effective date of August 1, 1977, and expires July 31, 2027, therefore, Duke Energy is pursuing a new license for the Project pursuant to the Commission's Integrated Licensing Process (ILP) (18 Code of Federal Regulations Part 5). An alternative relicensing proposal presently being evaluated by Duke Energy is the construction of a second 1,400-megawatt power complex (Bad Creek II Power Complex) adjacent to the existing Project to increase renewable pumping and generating capacity at the Project.

In response to a written request from the South Carolina Department of Natural Resources (SCDNR) in comments submitted to the Commission on the Initial Study Report (Duke Energy 2024) and to support Clean Water Act Section 404 U.S. Army Corps of Engineers permitting, Duke Energy proposed to survey the area around the proposed Fisher Knob Access Road for the federally threatened small whorled pogonia (*Isotria medeoloides*) during the appropriate survey window (mid-May through early July).[1]

The SCDNR Natural Heritage Trust Program, which documents and tracks element of occurrence data for rare, threatened, and endangered species (both federal and state) indicates no record of the small whorled pogonia within a 2-mile of radius of the Project (SCNHP 2023), however, this species is listed on the U.S. Fish and Wildlife Survey (USFWS) Information for Planning and Consultation (IPaC) database as having the potential to occur in the project vicinity, therefore surveys are proposed to determine the presence or absence of this protected species prior to land disturbance activities associated with the access road and overall construction of the Bad Creek II Power Complex. This will aid in the quality and comprehensiveness of the statewide dataset for rare, threatened, and endangered species. Additionally, field biologists will record incidental observations of priority plant species identified in the SC Wildlife Action Plan (SWAP) during the survey.

[1] A Natural Resources Survey was carried out by Duke Energy in 2021 and indicated that suitable habitat for the small whorled pogonia was present at the site, however, the study was performed outside of the survey window. The Natural Resources Survey was filed with the Pre-Application Document in February, 2023.

This document provides an overview of the approach to the proposed small whorled pogonia surveys.

Small Whorled Pogonia

Species Description

The small whorled pogonia is a perennial orchid that produces a smooth, hollow stem from 2 to 14 inches tall and topped by five to six leaves in circular arrangement (false whorl). One or two flowers stand in the center of the whorl of leaves. The leaves are milky-green or grayish-green, and the flower is yellowish-green with a greenish-white lip (USFWS 2024). Flowers appear soon after the plants emerge in mid-May or June. This species is non-clonal, and plants may emerge each spring or they may remain vegetatively dormant and below the ground for one to several years. Each plant produces only one, rarely more than one, overwintering bud per year (USFWS 2022).

Habitat

The small whorled pogonia occurs in young as well as maturing (second to third successional growth) mixed-deciduous or mixed-deciduous/coniferous forests. Sometimes it grows in stands of softwoods with a thick layer of dead leaves, often on slopes near small streams. The species may also be found on dry, rocky, wooded slopes; moist slopes; ravines lacking stream channels; or slope bases near braided channels of vernal streams. The orchid, often limited by shade, requires small light gaps or canopy breaks, and typically grows under canopies that are relatively open or near features like logging roads or streams that create long-persisting breaks in the forest canopy. It prefers acidic soils with a thick layer of dead leaved and sparse to moderate ground cover (USFWS 2024).

Proposed Survey Methods

Surveys will be conducted during the USFWS recommended optimal survey window of mid-May – early July. Potential habitat will be surveyed along a 50-foot-wide buffer of the proposed Fisher Knob Access Road and within the proposed limits of disturbance and spoil area alternatives, as well as along proposed transmission line access roads related to the Bad Creek II Power Complex proposed infrastructure (Figure 1).

Survey areas can be visually delineated by local topography (ravines, slopes, benches) or by landmarks (boulders, downed or otherwise conspicuous trees, or old roads) (USFWS 2016). The survey methodology will consist of slowly traversing back and forth across transects; surveyors will be spaced approximately 25-feet apart focusing the immediate area within a 10-to-15-foot radius depending on habitat type and visibility. Handheld Global Positioning System (GPS) units will be used to navigate throughout the site to avoid survey gaps.

Small whorled pogonia plants favor certain micro-habitats such as:

- Vernal or ephemeral runoff courses (leaf piles)
- Terraces or benches and base-of-slope areas
- Small canopy openings, fern patches

If one or more small whorled pogonia plants are identified during the survey, the surveyor will do the following:

- Delineate a polygon of the location and demarcate the boundaries using brightly colored flagging. A GPS unit will be used to collect boundary coordinates.
- Photo-document the plants sufficiently to confirm the identification of the species.
- Describe the size of each population (e.g., in square feet).
- Record a detailed written description and photo-document of specific and surrounding habitat.
- Contact USFWS and SCDNR representatives within 48 hours of species sightings.

Vegetation cover type and specific habitats /substrates will be noted by surveyor. No voucher specimens will be collected, and any plant locations will be considered to be “Privileged Non-Public Information”. Additionally, field biologists will record incidental observations of priority plant species identified in the South Carolina SWAP; a list of priority plants included in the SWAP that may occur in Blue Ridge Ecoregion is provided in Table 1.

Results and Conclusions

Results and conclusions of the field surveys will be provided in a summary report during the third quarter of 2024.

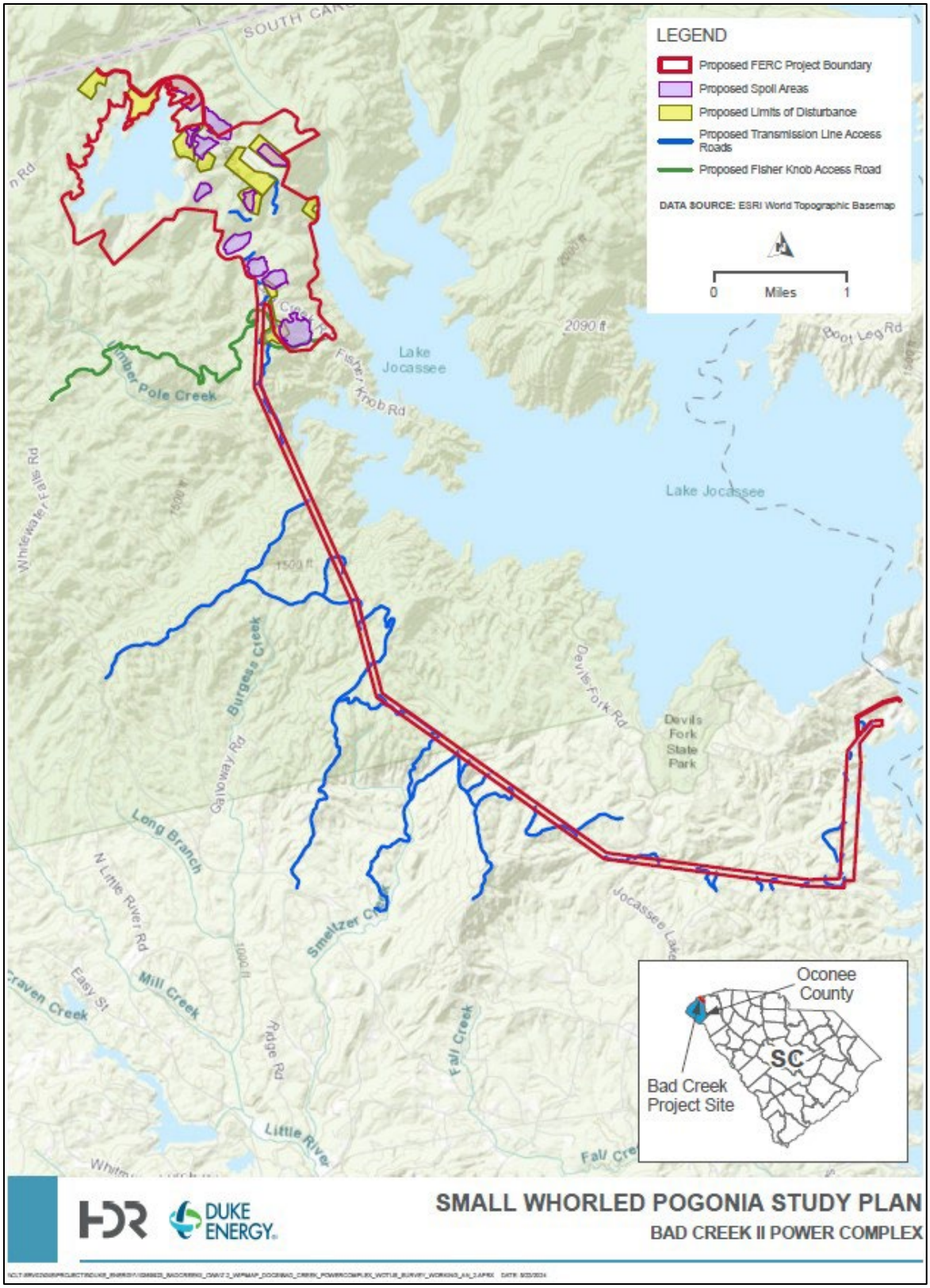

Figure 1. Bad Creek Site Vicinity and Proposed Area of Small Whorled Pogonia Surveys

Table 1. List of South Carolina State Wildlife Action Plan Priority Plant that May Occur in Blue Ridge Ecoregion

Scientific Name	Common Name	Legal Status	Priority	Habitat
Agrimonia pubescens	Soft Groovebur		Moderate	Low Elevation Basic and Acidic Mesic Forests
Arnoglossum muehlenbergii	Great Indian Plantain		Moderate	Low Elevation Basic and Acidic Mesic Forests; Bottomlands and Riparian Zones
Asplenium monanthes	Single-sorus Spleenwort		Moderate	Wet/Moist Unique Landforms
Asplenium pinnatifidum	Lobed Spleenwort		Moderate	Rock Outcrops
Asplenium resiliens	Black-stem Spleenwort		Moderate	Wet/Moist Unique Landforms
Betula alleghaniensis	Yellow Birch		Moderate	Bottomlands and Riparian Zones
Bryocrumia vivicolor	Bryocrumia Moss		High	Bottomlands and Riparian Zones
Cardamine flagellifera	Blue-Ridge Bittercress		High	Bottomlands and Riparian Zones
Carex appalachica	Appalachian Sedge		Moderate	Appalachian Oak Forest; High Elevation Forest; Rock Outcrops; Wet/Moist Unique Landforms
Carex biltmoreana	Biltmore Sedge		High	Rock Outcrops; Wet/Moist Unique Landforms
Carex communis var. amplisquama	Fort Mountain Sedge		High	Low Elevation Basic Mesic Forest
Carex decomposita	Cypress-knee Sedge		High	Depressions; Wet/Moist Unique Landforms
Carex folliculata	Long Sedge		Moderate	High Elevation Forest; Wet/Moist Unique Landforms
Carex manhartii	Manhart Sedge		Moderate	Bottomlands and Riparian Zones
Carex pedunculata	Longstalk Sedge		Moderate	Low Elevation Basic Mesic Forest
Carex radfordii	Radford's Sedge		High	Appalachian Oak Forest; Low Elevation Basic Mesic Forest
Carex woodii	Pretty Sedge		Moderate	Bottomlands and Riparian Zones
Cheilolejeunea evansii	Evan's Cheilolejeunea		High	Bottomlands and Riparian Zones; Wet/Moist Unique Landforms
Chrysosplenium americanum	American Golden-saxifrage		Moderate	Low Elevation Acidic Mesic Forest; Wet/Moist Unique Landforms
Cladrastis kentukea	Yellowwood		Moderate	Low Elevation Basic Mesic Forest
Collinsonia verticillata	Whorled Horse-balm		Moderate	Low Elevation Basic Mesic Forest; Low Elevation Acidic Mesic Forest
Comptonia peregrina	Sweet Fern		Moderate	Grasslands/Early-Successional

Scientific Name	Common Name	Legal Status	Priority	Habitat
Convallaria majuscula	American Lily-of-the-valley		Moderate	High Elevation Forest
Coreopsis latifolia	Broad-leaved Tickseed		High	Low Elevation Basic Mesic Forest
Cornus racemosa	Stiff Dogwood		Moderate	Bottomlands and Riparian Zones
Cystopteris bulbifera	Bulblet Fern		Moderate	Rock Outcrops
Danthonia epilis	Bog Oat-grass		Moderate	Rock Outcrops; Wet/Moist Unique Landforms
Deschampsia flexuosa	Crinkled Hairgrass		Moderate	Rock Outcrops
Dicentra eximia	Wild Bleeding-heart		Moderate	Low Elevation Basic Mesic Forest
Diplazium pycnocarpon	Glade Fern		Moderate	Low Elevation Basic Mesic Forest
Dryopteris goldiana	Goldie's Woodfern		Moderate	Low Elevation Basic Mesic Forest; Rock Outcrops
Echinacea laevigata	Smooth Coneflower	LE: Endangered	Highest	Grasslands/Early-Successional
Eurybia avita	Alexander's Rock Aster		High	Rock Outcrops
Fothergilla major	Mountain Witch-alder		High	Low Elevation Basic Mesic Forest
Gaylussacia baccata	Black Huckleberry		Moderate	Appalachian Oak Forest; Low Elevation Acidic Mesic Forest
Gymnoderma lineare	Rocky Gnome Lichen	LE: Endangered	Highest	Rock Outcrops
Helenium brevifolium	Shortleaf Sneezeweed		Moderate	Bottomlands and Riparian Zones
Helianthus glaucophyllus	White-leaved Sunflower		Moderate	Low Elevation Basic Mesic Forest
Helonias bullata	Swamp-pink	LT: Threatened	Highest	Wet/Moist Unique Landforms
Hydrangea cinerea	Ashy-hydrangea		Moderate	Low Elevation Basic Mesic Forest
Hydrocotyle americana	American Water-pennywort		Moderate	Bottomlands and Riparian Zones; Depressions
Hymenophyllum tayloriae	Taylor's Fern		High	Wet/Moist Unique Landforms
Hymenophyllum tunbrigense	Tunbridge Fern		Moderate	Wet/Moist Unique Landforms
Hypericum buckleii	Blue Ridge St. John's-wort		High	Rock Outcrops
Impatiens pallida	Pale Jewel-weed		Moderate	Bottomlands and Riparian Zones; Depressions
Isoetes caroliniana	Engelmann's Quillwort		Moderate	Depressions
Isotria medeoloides	Small Whorled Pogonia	LT: Threatened	Highest	Wet/Moist Unique Landforms
Juncus subcaudatus	Woods-rush		Moderate	Depressions

Scientific Name	Common Name	Legal Status	Priority	Habitat
Juniperus communis var. depressa	Dwarf Juniper		Moderate	High Elevation Forest
Krigia montana	False Dandelion		High	Rock Outcrops
Lejeunea blomquistii	"A Liverwort"		High	Rock Outcrops
Leptohymenium sharpii	Sharp's Leptohymenium Moss		High	Wet/Moist Unique Landforms
Liatris microcephala	Small-head Gayfeather		Moderate	Rock Outcrops
Liparis liliifolia	Large Twayblade		Moderate	Low Elevation Basic Mesic and Acidic Forests
Listera smallii	Kidney-leaf Twayblade		Moderate	Low Elevation Acidic Mesic Forest
Lophocolea appalachiana	Appalachian Lophocolea		High	Wet/Moist Unique Landforms
Lycopodium clavatum	Running Pine		Moderate	Appalachian Oak Forest; High Elevation Forest
Lycopodium porophilum	Rock Clubmoss		Moderate	Rock Outcrops
Lycopodium tristachyum	Deep-root Clubmoss		Moderate	High Elevation Forest
Lysimachia fraseri	Fraser Loosestrife		High	Bottomlands and Riparian Zones
Lysimachia hybrida	Lance-leaf Loosestrife		Moderate	Depressions
Magnolia cordata	Piedmont Cucumber Tree		Moderate	Low Elevation Basic Mesic Forest
Mitella diphylla	Two-leaf Bishop's-cap		Moderate	Low Elevation Basic Mesic Forest
Monotropsis odorata	Sweet Pinesap		High	Appalachian Oak Forest; High Elevation Forest
Oenothera perennis	Small Sundrops		Moderate	Depressions
Panax quinquefolius	American Ginseng		High	Low Elevation Basic Mesic Forest
Parnassia grandifolia	Large-leaved Grass-of-parnassus		High	Wet/Moist Unique Landforms
Pellaea atropurpurea	Purple-stem Cliff-brake		Moderate	Rock Outcrops
Pellaea wrightiana	Cliff-brake Fern		Moderate	Rock Outcrops
Pellia appalachiana	Appalachian Pellia		Moderate	Bottomlands and Riparian Zones; Wet/Moist Unique Landforms
Phacelia bipinnatifida	Fernleaf Phacelia		Moderate	Low Elevation Basic Mesic Forest; Bottomlands and Riparian Zones
Plagiochila caduciloba	Gorge Leafy Liverwort		High	Wet/Moist Unique Landforms
Plagiochila sharpii	"A Liverwort"		High	Wet/Moist Unique Landforms
Plagiochila sullivantii	"A Liverwort"		High	Wet/Moist Unique Landforms

Scientific Name	Common Name	Legal Status	Priority	Habitat
Plagiomnium carolinianum	Mountain Wavy-leaf Moss		High	Wet/Moist Unique Landforms
Platanthera integrilabia	White Fringeless Orchid	C: Candidate	Highest	Bottomlands and Riparian Zones; Depressions
Platyhypnidium pringlei	Pringle's Platyhypnidium Moss		High	Wet/Moist Unique Landforms
Poa alsodes	Blue-grass		Moderate	Low Elevation Basic Mesic Forest
Porella japonica ssp. appalachiana	"A Liverwort"		Moderate	Bottomlands and Riparian Zones
Pycnanthemum montanum	Single-haired Mountain-mint		Moderate	Appalachian Oak Forest; High Elevation Forest; Low Elevation Basic Mesic Forest
Rhododendron catawbiense	Catawba Rhododendron		Moderate	High Elevation Forest
Rudbeckia heliopsidis	Sun-facing Coneflower		High	Low Elevation Acidic Mesic Forest
Sarracenia rubra ssp. jonesii	Mountain Sweet Pitcher-plant	LE: Endangered	Highest	Rock Outcrops; Wet/Moist Unique Landforms
Saxifraga careyana	Carey Saxifrage		High	High Elevation Forest; Low Elevation Basic Mesic Forest; Rock Outcrops
Senecio millefolium	Piedmont Ragwort		High	Rock Outcrops
Shortia galacifolia	Oconee bells		High	High Elevation Forest; Low Elevation Basic Mesic Forest; Rock Outcrops; Wet/Moist Unique Landforms
Silene ovata	Ovate Catchfly		High	Appalachian Oak Forest; High Elevation Forest; Low Elevation Basic Mesic Forest
Solidago simulans	Granite Dome Goldenrod		High	High Elevation Forest; Low Elevation Basic Mesic Forest; Rock Outcrops
Stachys clingmanii	Clingman's Hedge-nettle		High	Appalachian Oak Forest; High Elevation Forest
Thermopsis mollis	Soft-haired Thermopsis		Moderate	Low Elevation Acidic Mesic Forest
Tradescantia virginiana	Virginia Spiderwort		Moderate	High Elevation Forest; Low Elevation Basic Mesic Forest
Trichomanes boschianum	Bristle-fern		Moderate	Low Elevation Basic Mesic Forest; Rock Outcrops; Depressions
Trichophorum cespitosum	Deer-haired Bulrush		Moderate	High Elevation Forest
Trillium grandiflorum	Large-flower Trillium		Moderate	High Elevation Forest; Depressions

Scientific Name	Common Name	Legal Status	Priority	Habitat
Trillium rugelii	Southern Nodding Trillium		High	Low Elevation Basic Mesic Forest; Depressions
Trillium simile	Sweet White Trillium		High	Low Elevation Basic Mesic Forest; Depressions
Triphora trianthophora	Nodding Pogonia		Moderate	Depressions
Viola conspersa	American Bog Violet		Moderate	Low Elevation Basic Mesic Forest
Xyris torta	Twisted Yellow-eyed-grass		Moderate	Wet/Moist Unique Landforms

References

Duke Energy Carolinas, LLC (Duke Energy). 2024. Bad Creek Pump Storage Project (FERC Project No. 2740) Initial Study Report. Prepared by HDR Engineering, Inc. January, 2024. Accessed May 21, 2024. eLibrary; https://elibrary.ferc.gov/eLibrary/filelist?accession_num=20240104-5044

South Carolina Department of Natural Resources (SCDNR). 2015. SC State Wildlife Action Plan. https://www.dnr.sc.gov/swap/index.html. Accessed May 16, 2024.

South Carolina Natural Heritage Program (SCNHP). 2023, Species of Concern Data Explorer Geographic Information System (GIS). SCDNR Columbia, SC. [URL]: SC Natural Heritage Program. Accessed October 2023.

U.S. Fish and Wildlife Service (USFWS). 2016. Small Whorled Pogonia (*Isotria medeoloides*) Survey Protocol for Maine. Small Whorled Pogonia Survey Protocol for Maine | FWS.gov. Accessed May 16, 2024.

_____. 2022. Small Whorled Pogonia (*Isotria medeoloides*) 5-Year Review: Summary and Evaluation. August, 2022. Small whorled pogonia 5 year review (ecosphere-documents-production-public.s3.amazonaws.com). Accessed May 15, 2024.

_____. 2024. Small Whorled Pogonia Fact Sheet. Small Whorled Pogonia Fact Sheet (fws.gov). Accessed May 15, 2024.

From:	Crutchfield Jr., John U
To:	Abney, Michael A; Andrew Grosse; Andy Douglas; Austen Attaway; Bill Ranson-Retired; Chris Starker; Dale Wilde; Elizabeth Miller; Mularski, Eric; Fletcher, Scott T; Huff, Jen; Jennifer Kindel; Keith A. Bradley; Ken Forrester; Olds, Melanie J; Amedee, Morgan D.; Pat Cloninger; Samantha Tessel; Stuart, Alan Witten; suewilliams130@gmail.com; Wes Cooler; Willie Simmons
Cc:	Kulpa, Sarah; McCarney-Castle, Kerry; Salazar, Maggie
Subject:	Bad Creek Relicensing - Small Whorled Pogonia Survey Report
Date:	Wednesday, August 28, 2024 6:37:10 AM
Attachments:	image001.png
Importance:	High

Dear Wildlife & Botanical Resources Committee:

Duke Energy is pleased to provide the final Small Whorled Pogonia Survey report, which was developed in response to a written request from the South Carolina Department of Natural Resources (SCDNR) in comments submitted to the Federal Energy Regulatory Commission on the Bad Creek relicensing Initial Study Report and to support Clean Water Act Section 404 U.S. Army Corps of Engineers permitting activities associated with the Bad Creek II Power Complex. The report was developed in consultation with the U.S. Fish & Wildlife Service and SCDNR and is being provided to the Resource Committee for information and reference.

The final report can be accessed at the following link: Small Whorled Pogonia Survey Report.

Please let Alan Stuart or me know if you have any questions.

Regards,

John Crutchfield
Project Manager II
Water Strategy, Hydro Licensing & Lake Services
Regulated & Renewable Energy
Duke Energy
525 South Tryon Street, DEP-35B | Charlotte, NC 28202
Office 980-373-2288| Cell 919-757-1095

From:	Chris Starker
To:	Crutchfield Jr., John U; Abney, Michael A; Andrew Grosse; Andy Douglas; Austen Attaway; Bill Ranson-Retired; Dale Wilde; Elizabeth Miller; Mularski, Eric; Fletcher, Scott T; Huff, Jen; Jennifer Kindel; Keith A. Bradley; Ken Forrester; Olds, Melanie J; Amedee, Morgan D.; Pat Cloninger; Samantha Tessel; Stuart, Alan Witten; suewilliams130@gmail.com; Wes Cooler; Willie Simmons
Cc:	Kulpa, Sarah; McCarney-Castle, Kerry; Salazar, Maggie
Subject:	Re: Bad Creek Relicensing - Small Whorled Pogonia Survey Report
Date:	Wednesday, August 28, 2024 3:18:56 PM
Attachments:	image001.png

Thank you for sharing the report. Will there be additional surveys conducted? As the study plan and report state, "This species … may remain vegetatively dormant and below the ground for one to several years." Neither the study plan nor the report includes a schedule/calendar for conducting surveys, but only provides an "optimal survey window of mid-May to early July." Seems like multiple calendar years would be ideal for determining its presence/absence considering orchids don't flower every year and may not even put out vegetative growth. Additionally, the survey results on page 5 state, "No small whorled pogonia was identified during the 2024 survey," which sounds as if there are plans to conduct additional surveys in following years, but this is not clear.

Similarly, the report should clearly state the year when the current observations/surveys were conducted. One assumes the survey results are from 2024 due to the statement in the study results section stated above, but based on the footnote on page 1, there could have been a survey in 2023, although hastily done given the lack of time for preparation. Regardless, redundancy in clarity never hurts and the reader shouldn't have to piece clues together to figure it out.

We also recommend including the qualifications of the biologists associated with the study and report, which is normal for a report of this type.

Lastly, northern starflower (see Photo 5 on page 2 of Appendix C) is not a rare species, although its presence in SC is perhaps unusual. It is in fact globally secure and not ranked in SC. Given the location of the surveys, though, its observation is perhaps on the edge of its typical range. That said, based on the image in the photo, it looks more like Indian cucumber (Medeola virginiana) to me.

Regardless of the presence/absence of SWP, I do want to point out that some of the plant community types that may be disturbed are ecologically significant, such as shortleaf pine forest and cove forest specifically.

Sincerely,
Chris

Chris Starker
Land Conservation Manager
864-203-1948

From: Crutchfield Jr., John U <John.Crutchfield@duke-energy.com>
Sent: Wednesday, August 28, 2024 6:36 AM
To: Abney, Michael A <Michael.Abney@duke-energy.com>; Andrew Grosse <grossea@dnr.sc.gov>; Andy Douglas <adoug41@att.net>; Austin Attaway <attawaya@dnr.sc.gov>; Bill Ranson <bill.ranson@retiree.furman.edu>; Chris Starker <cstarker@upstateforever.org>; dwilde@keoweefolks.org <dwilde@keoweefolks.org>; Elizabeth Miller <MillerE@dnr.sc.gov>; Mularski, Eric -HDRInc <Eric.Mularski@HDRInc.com>; Fletcher, Scott T <Scott.Fletcher@duke-energy.com>; Jen Huff <jen.huff@hdrinc.com>; Jennifer Kindel <kindelj@dnr.sc.gov>; Keith Bradley <bradleyk@dnr.sc.gov>; Ken Forrester <forresterk@dnr.sc.gov>; Melanie Olds <melanie_olds@fws.gov>; Morgan Amedee <amedeemd@dhec.sc.gov>; Pat Cloninger <cloningerp@dnr.sc.gov>; Samantha Tessel <Tessels@dnr.sc.gov>; alan.stuart@duke-energy.com <alan.stuart@duke-energy.com>; Sue Williams <suewilliams130@gmail.com>; wes.cooler@mac.com <wes.cooler@mac.com>; Willie Simmons <simmonsw@dnr.sc.gov>
Cc: Kulpa, Sarah -hdrinc <Sarah.Kulpa@hdrinc.com>; Kerry McCarney-Castle <Kerry.McCarney-Castle@hdrinc.com>; Maggie Salazar <maggie.salazar@hdrinc.com>
Subject: Bad Creek Relicensing - Small Whorled Pogonia Survey Report

Dear Wildlife & Botanical Resources Committee:

Duke Energy is pleased to provide the final Small Whorled Pogonia Survey report, which was developed in response to a written request from the South Carolina Department of Natural Resources (SCDNR) in comments submitted to the Federal Energy Regulatory Commission on the Bad Creek relicensing Initial Study Report and to support Clean Water Act Section 404 U.S. Army Corps of Engineers permitting activities associated with the Bad Creek II Power Complex. The report was developed in consultation with the U.S. Fish & Wildlife Service and SCDNR and is being provided to the Resource Committee for information and reference.

The final report can be accessed at the following link: Small Whorled Pogonia Survey Report.

Please let Alan Stuart or me know if you have any questions.

Regards,

John Crutchfield
Project Manager II
Water Strategy, Hydro Licensing & Lake Services
Regulated & Renewable Energy
Duke Energy
525 South Tryon Street, DEP-35B | Charlotte, NC 28202
Office 980-373-2288| Cell 919-757-1095

From:	Keith A. Bradley
To:	Chris Starker; Crutchfield Jr., John U; Abney, Michael A; Andrew Grosse; Andy Douglas; Austen Attaway; Bill Ranson-Retired; Dale Wilde; Elizabeth Miller; Mularski, Eric; Fletcher, Scott T; Huff, Jen; Jennifer Kindel; Ken Forrester; Olds, Melanie J; Amedee, Morgan D.; Pat Cloninger; Samantha Tessel; Stuart, Alan Witten; suewilliams130@gmail.com; Wes Cooler; Willie Simmons
Cc:	Kulpa, Sarah; McCarney-Castle, Kerry; Salazar, Maggie
Subject:	RE: Bad Creek Relicensing - Small Whorled Pogonia Survey Report
Date:	Thursday, August 29, 2024 10:24:37 AM
Attachments:	image001.png

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Cc:	Kulpa, Sarah; McCarney-Castle, Kerry; Salazar, Maggie
Subject:	RE: [EXTERNAL] RE: Bad Creek Relicensing - Small Whorled Pogonia Survey Report
Date:	Wednesday, September 4, 2024 7:57:38 AM
Attachments:	image001.png

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Cc:	Kulpa, Sarah; McCarney-Castle, Kerry; Salazar, Maggie
Subject:	Re: [EXTERNAL] RE: Bad Creek Relicensing - Small Whorled Pogonia Survey Report
Date:	Thursday, September 5, 2024 4:05:58 PM
Attachments:	image001.png Outlook-xphlhut5.png Outlook-xlnh23b0.png

John,

The Service reviewed the report and does not have any comments.

Melanie

Melanie Olds
Fish & Wildlife Biologist
Regulatory Team Lead/FERC Coordinator

U.S. Fish and Wildlife Service
South Carolina Ecological Services Field Office
176 Croghan Spur Road, Suite 200
Charleston, SC 29407
Phone: (843) 534-0403

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Comment Response Table: Small Whorled Pogonia Survey Report

Organization	Comment/Question	Response
Upstate Forever	Are additional / future surveys planned for small whorled pogonia?	In association with the Draft License Application (scheduled for completion in February 2025), Duke Energy will consult with USFWS, SCDNR, and the Wildlife and Botanical Resources Committee on the need to prepare a Species Protection Plan specific to Small Whorled Pogonia or other special status plant species and communities. If required and as applicable, the Species Protection Plan may include, among other identified protection measures, provisions for future surveys.
	It is unclear when the surveys were conducted; please clarify.	Small whorled pogonia surveys were carried out in 2024 as follows: June 3-5 for the proposed Fisher Knob Access Road and transmission line access roads, and intermittently between late May and July 2024 for potential spoil areas and the general proposed limits of disturbance for Bad Creek II construction. As stated in the Small Whorled Pogonia Survey Report, a (more general) Natural Resources Survey was carried out by HDR in 2021 and indicated that suitable habitat for the small whorled pogonia was present at the site, however, that study was performed outside of the survey window for this species. The current study (2024) was performed during the recommended survey window.
	We recommend including the qualifications of the biologists associated with the study and report.	A summary of the surveyors' qualifications has been added to the revised study report (Appendix E). As previously noted in the study report, HDR's biologists who conducted the survey have previous experience in plant identification in the Blue Ridge ecoregion.
	Northern starflower (see Photo 5 on page 2 of Appendix C) is not a rare species, although its presence in SC is perhaps unusual.	Based on additional comments from SCDNR (below), the referenced photo caption has been revised from *Lysimachia borealis* to *Lysimachia quadrifolia* in the revised study report.
	Some of the plant community types that may be disturbed are ecologically significant, such as shortleaf pine forest and cove forest specifically.	Duke Energy acknowledges that, as documented in the Small Whorled Pogonia Survey Report (2024) and the previous Natural Resources Assessment (2021), there are other ecologically significant natural plant communities throughout the Project and will continue to consult with the Resource Committee regarding future construction impacts, as applicable.
SCDNR	The northern starflower photo (*Trientalis borealis*, = *Lysimachia borealis*), is actually a picture of the fairly common *Lysimachia quadrifolia*. Some other species that are certainly misidentifications	As noted above, the caption for the photo "northern starflower" has been revised from *Lysimachia borealis* to *Lysimachia quadrifolia* in the revised study report. Duke Energy appreciates SCDNR's review of the small whorled pogonia survey report. Duke Energy has further consulted with HDR, and HDR has in turn further reviewed available field survey documentation including

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	include: • *Asarum hartwegii* • *Carex pallescens* • *Juncus articulatus* • *Moehringia macrophylla* • *Scoparium* spp. (perhaps *Schizachyrium scoparium* was intended) • *Urtica dioica* (likely *Laportea canadensis*) • *Vaccinium angustifolium* • *Verbesina helianthoides*	field notes and site photographs. We have incorporated these comments into the revised study report as follows: • Four species names in Appendix B have been corrected (*Asarum hartwegii, Carex pallescens, Juncus articulates, and Moehringia macrophylla)*. ○ *Asarum hartwegii* was misidentified and is likely a wild ginger (*Hexastylis* sp.). ○ *Carex pallas*cen – changed to *Carex* sp. ○ *Juncus articulas* – changed to *Juncus* sp. ○ *Moehringia macrophylla* – was likely star chickweed (*Stellar pubera*), which is a common species in South Carolina. • For *Scoparium spp., Schizachyrium scoparium* was in fact intended (Little Bluestem), which is a common species in South Carolina. • Based on available documentation, HDR is unable to confirm the last two species in SCDNR's list (left column), so the taxonomic classifications in Appendix B have been revised from species to genus level. HDR notes that these genera (wood nettle, blueberry, and crownbeards) are fairly common and were widely observed in the field.
	Circaea alpina would represent *Circaea canadensis.* This is a state-tracked rare species and any data on the occurrence is appreciated.	Duke Energy agrees with this species correction provided by SCDNR based on location. HDR's field team reviewed field notes and photographic inventory for this species. A photograph of a nightshade (*Circaea* spp.) plant species was retrieved, and the photograph metadata was used to acquire the location coordinates. The photograph and location map are illustrated on the following page.

Nightshade (*Circaea* spp.) near 34.990708°, -82.990566°