Yayac, Maggie

Subject: FW: Racine Hydroelectric Project (FERC No. 2570) -- Filing of Initial Study Report Meeting Summary
Attachments: 20200611 Racine ISR Meeting Summary.pdf

From: Hanson, Danielle
Sent: Thursday, June 11, 2020 3:00 PM
To: 'Advisory Council on Historic Preservation' <jeddins@achp.gov>; 'City of New Haven' <nhcityhall@frontier.com>; 'City of Pomeroy (Mayor)' <dmanderson242@hotmail.com>; 'Meigs Soil and Water Conservation district' <steve.jenkins@oh.nacdnet.net>; 'ODNR Division of Wildlife' <mike.greenlee@dnr.state.oh.us>; 'OH Rep Dist 94 - Jay Edwards' <JayEdwardsOhio@gmail.com>; 'OHEPA' <Craig.Butler@epa.ohio.gov>; 'Ohio Department of Natural Resources' <sarah.tebbe@dnr.state.oh.us>; 'Ohio Department of Natural Resources' <Steve.Holland@dnr.state.oh.us>; 'Ohio River Valley Water Sanitation Commission' <sdinkins@orsanco.org>; 'Osage Nation' <jmunkres@osagenation-nsn.gov>; 'Osage Nation' <ahunter@osagenation.nsn.gov>; 'SHPO' <khorrocks@ohiohistory.org>; 'Town of New Haven (Mayor)' <bubba070260@gmail.com>; 'US Department of the Interior' <Harold.Peterson@bia.gov>; 'US Environmental Protection Agency' <pelloso.elizabeth@epa.gov>; 'USACE' <andrew.n.johnson@usace.army.mil>; 'USACE' <Belinda.M.Weikle@usace.army.mil>; 'USEPA' <Westlake.kenneth@epa.gov>; 'USEPA' <Rudnick.Barbara@epa.gov>; 'USFWS' <richard_mccorkle@fws.gov>; 'USFWS' <angela_boyer@fws.gov>; 'USFWS' <jennifer_l_norris@fws.gov>; 'USGS' <jswhite@usgs.gov>; 'USGS' <smwickle@usgs.gov>; 'Village of Racine' <racinemayor@suddenlinkmail.com>; 'Villgae of Middleport' <mayormike@village.middleport.oh.us>; 'West Virginia Division of Natural Resources' <jacob.d.harrell@wv.gov>; 'West Virginia Division of Natural Resources' <barbara.d.sargent@wv.gov>; 'West Virginia Division of Natural Resources' <danny.a.bennett@wv.gov>; 'WVDEP' <Brian.L.Bridgewater@wv.gov>
Cc: 'Jonathan M Magalski (jmmagalski@aep.com)' <jmmagalski@aep.com>; Elizabeth B Parcell <ebparcell@aep.com>; Quiggle, Robert <Robert.Quiggle@hdrinc.com>
Subject: Racine Hydroelectric Project (FERC No. 2570) -- Filing of Initial Study Report Meeting Summary

Racine Hydroelectric Project Stakeholders:

AEP Generation Resources Inc. (AEPGR), a unit of American Electric Power (AEP), is the licensee, owner and operator of the Racine Hydroelectric Project (FERC No. 2570) (Project) located on the Ohio River in Meigs County, Ohio. The Project is operated under a license issued by the Federal Energy Regulatory Commission (FERC). The existing FERC license for the Project expires on November 30, 2023. AEPGR is pursuing a new license for the continued operation of the Project in accordance with FERC's Integrated Licensing Process (ILP). Pursuant to the ILP, AEPGR filed the Initial Study Report (ISR) Meeting Summary for the Project on June 11, 2020. The ISR Meeting Summary describes the status and results of the studies that AEPGR conducted in support of Project relicensing as discussed during the ISR Webex Meeting held on May 14, 2020.

On behalf of AEPGR, we are notifying stakeholders of the availability of the ISR Meeting Summary. For your convenience, the ISR Meeting Summary has been attached to this email. The filing can also be viewed online at FERC's eLibrary at https://elibrary.ferc.gov/idmws/common/OpenNat.asp?fileID=15556436. Additionally, AEPGR will be adding the ISR Meeting Summary to the Project's public relicensing website (http://www.aephydro.com/HydroPlant/Racine) in the coming days.

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Should you have any questions regarding this filing, please contact Jon Magalski with AEP at (614) 716-2240 or jmmagalski@aep.com.

Thank you,

Danielle Hanson

Environmental Scientist

HDR
M 315.729.4745
Danielle.Hanson@hdrinc.com

hdrinc.com/follow-us

Yayac, Maggie

Subject: FW: Racine Hydroelectric Project (FERC No. 2570) -- Filing of Initial Study Report Meeting Summary

---

From: Jenkins, Steve - NRCS-CD, Pomeroy, OH [mailto:Steve.Jenkins@oh.nacdnet.net]
Sent: Friday, June 12, 2020 5:39 AM
To: Hanson, Danielle <Danielle.Hanson@hdrinc.com>
Subject: RE: Racine Hydroelectric Project (FERC No. 2570) -- Filing of Initial Study Report Meeting Summary

Good morning Danielle,

Thank you for sending the report to me. I read through the report and was disappointed to read that two of the people I recommended did not respond to the recreational phone survey. I told the guys it was important to follow through with you if we wanted to see any improvements at the fishing access.

I emailed Jon and apologized for not listening to the meeting on May 14 and told him I was not able to listen due to my mother having a stroke the day before. I was at the hospital with her the entire day of the meeting. I'm glad you sent a copy of the report to read through. Very interesting report.

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I do have a question about the report results. If AEP decides to make any improvements to the fishing access, or another agency like FERC requires fishing access improvements, when will that actually happen?

I realize I'm on the distribution list, but I still want to thank you again for sending the report.

Have a great weekend!

Steve

PS: My wife and I had a fantastic first time trip to Arizona the first week of March, just before the COVID-19 virus went viral, no pun intended. I had no idea Arizona was such a beautiful and diverse state, a total misconception on my part. I was expecting to see desert the whole time we were there, but the Grand Canyon and northern mountains were spectacular. We saw some beautiful desert too, but loved the mountains. We'll be coming back again!

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Environmental Scientist

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M 315.729.4745
Danielle.Hanson@hdrinc.com

hdrinc.com/follow-us

Yayac, Maggie

Subject: FW: Racine Hydroelectric Project (FERC No. 2570) -- Filing of Initial Study Report Meeting Summary

From: Hanson, Danielle
Sent: Monday, June 15, 2020 4:26 PM
To: 'Jenkins, Steve - NRCS-CD, Pomeroy, OH' <Steve.Jenkins@oh.nacdnet.net>
Subject: RE: Racine Hydroelectric Project (FERC No. 2570) -- Filing of Initial Study Report Meeting Summary

Good Evening Steve,

I'm sorry to hear about your mom. I hope she is doing alright.

I'm glad the meeting summary was helpful even though you weren't able to listen in to the meeting. Even though two of the individuals you suggested weren't able to participate in the interviews, the information that you and Roger Birch provided is very helpful in considering potential recreational enhancements for the Project.

We're currently in the process of compiling the data and developing the Recreation Study Report. Once the report is finalized it will be filed with FERC and stakeholders will have a chance to review it and provide comments. Regarding your question about any potential improvements to the recreation site, those would be included in AEP's Draft License Application which is due to be filed with FERC by July 3, 2021. Stakeholders will have 90 days to provide comments on AEP's proposal before AEP files the Final License Application with FERC by November 30, 2021.

We appreciate your feedback and continued interest in this relicensing, and look forward to continuing to work together through this process.

PS: I'm so glad you and your wife enjoyed your trip to Arizona. Yuma (where I live) isn't too exciting, but Arizona is such a beautiful state. Before I moved here from the east coast about 7 years ago I never would have imagined how beautiful it was either. There are still so many places and things we want to do and see. If you get a chance on your next trip, some of our favorite places are Flagstaff and Sedona. We drive the 4.5 hours to Flagstaff every year to get a Christmas tree and for a chance to see some snow and the beautiful mountain views. We love Sedona as well, it has some of the most beautiful red rock mountains with incredible views and lots of awesome hiking for all experience levels. There's also some great driving routes with awesome views.

Have a great rest of the week.

Danielle Hanson
M 315.729.4745

hdrinc.com/follow-us

From: Jenkins, Steve - NRCS-CD, Pomeroy, OH [mailto:Steve.Jenkins@oh.nacdnet.net]
Sent: Friday, June 12, 2020 5:39 AM
To: Hanson, Danielle <Danielle.Hanson@hdrinc.com>
Subject: RE: Racine Hydroelectric Project (FERC No. 2570) -- Filing of Initial Study Report Meeting Summary

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Cc: 'Jonathan M Magalski (jmmagalski@aep.com)' <jmmagalski@aep.com>; Elizabeth B Parcell <ebparcell@aep.com>;

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Environmental Scientist

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Danielle.Hanson@hdrinc.com

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Yayac, Maggie

Subject: FW: Virtual Meeting

From: Jonathan M Magalski [mailto:jmmagalski@aep.com]
Sent: Tuesday, June 16, 2020 11:27 AM
To: Jenkins, Steve - NRCS-CD, Pomeroy, OH (Steve.Jenkins@oh.nacdnet.net) <Steve.Jenkins@oh.nacdnet.net>
Subject: RE: Virtual Meeting

Good afternoon Steve,

I apologize for not responding, somehow your email got moved to another folder and forgot all about it until I saw your note to Danielle. I'm sorry to hear about your mother, hopefully she's recovered and back home.

Hopefully I don't reiterate Danielle's response, but I think there's sufficient information to inform any recommended improvements AEP will propose in the Draft License Application (DLA) which is due July 3, 2021. In addition to the survey, a recreational facilities assessment is process and will also help inform any recommendations. We look forward to your comments on the study as well as the DLA and the Final License Application due November 30, 2021. FERC will then ultimately decide what recreational improvements are made and the schedule to complete them.

Sounds like you did very well when you were out last. When EnviroScience completed the spring fisheries survey a few weeks ago, they shocked up a few nice walleye. I'm hoping to get out myself sometime soon. I've been looking for a smaller boat, but it seems they aren't too many for sale given the closures.

Let me know if you have any additional questions or if I didn't adequately answer the ones posed. Have a nice week and stay safe…Jon

AMERICAN ELECTRIC POWER
BOUNDLESS ENERGY
JONATHAN M MAGALSKI | ENVIRONMENTAL SPEC CONSULT
JMMAGALSKI@AEP.COM | D:614.716.2240
1 RIVERSIDE PLAZA, COLUMBUS, OH 43215

From: Jenkins, Steve - NRCS-CD, Pomeroy, OH <Steve.Jenkins@oh.nacdnet.net>
Sent: Wednesday, June 3, 2020 11:30 AM
To: Jonathan M Magalski <jmmagalski@aep.com>
Subject: [EXTERNAL] Virtual Meeting

Good morning Jon,

Hope you and your family are well.

I wanted to let you know I was not able to see any of the meeting you had on Thursday the 14th. My mom had a stroke on Wednesday night and I was at the hospital with her the entire day of your meeting. They allowed one visitor a day, so I was able to spend the whole day with her. She is in rehab now, but not responding very well to therapy. Still hoping to get her home sometime in the near future.

If I remember correctly the recreation study is over now, so do you know when/if a decision might be made by AEP about changing anything for the fishermen at the fishing access? Does AEP make the decision or is it another agency ? Was there enough site activity or survey responses to warrant the enhancements we talked about?

If there was little activity at the site or responses, there is a good reason. The river did not cooperate during most of the study time. The fishing access walkway was under water for quite some time last year and has been all this year. I was fishing on the walkway last evening (June 2nd) standing in a foot of water. I keep records every time I go fishing, and according to my records, that's the first time I've been fishing on the walkway without hip waders since October 21, 2019. That date is the last time the river has been at pool stage and the access walkway was totally clear of standing water.

Eleven people came in and out in the 3 hours I was there fishing last evening. Caught 10 fish and 2 were Fish Ohio catches (crappie and hybrid striper). Makes a huge difference in site activity when the river is down.

Sorry for all the questions, but just curious if any changes are really going to happen.

Stay safe!

Steve Jenkins
District Administrator
Meigs SWCD
(740) 992-4282 Ext.105
steve.jenkins@oh.nacdnet.net

Yayac, Maggie

Subject: FW: Virtual Meeting

From: Jenkins, Steve - NRCS-CD, Pomeroy, OH <Steve.Jenkins@oh.nacdnet.net>
Sent: Tuesday, June 16, 2020 4:03 PM
To: Jonathan M Magalski <jmmagalski@aep.com>
Subject: [EXTERNAL] RE: Virtual Meeting

Thank you for the response and update Jon.

My mother is home and doing well, much better than I anticipated. Amazing what being home will do for an 85 year old body 😊

We caught some really nice walleye over the winter and into spring, just not off the walkway. They were around the bend downstream of the hydro in the rocks and trees where the water was flowing slower. That's the area I mentioned having a handicap accessible fishing pier 8' above river pool stage.

Stay safe!!

From: Jonathan M Magalski <jmmagalski@aep.com>
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To: Jenkins, Steve - NRCS-CD, Pomeroy, OH <Steve.Jenkins@oh.nacdnet.net>
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steve.jenkins@oh.nacdnet.net

law and subject the violator to civil or criminal penalties. If you believe you have received this message in error, please notify the sender and delete the email immediately.

Yayac, Maggie

Subject: FW: Racine Hydroelectric Project - Eastern Spadefoot Habitat Survey Report

From: Nathan.Reardon@dnr.state.oh.us [mailto:Nathan.Reardon@dnr.state.oh.us]
Sent: Friday, June 19, 2020 11:50 AM
To: Hanson, Danielle <Danielle.Hanson@hdrinc.com>; Kate.Parsons@dnr.state.oh.us
Cc: 'Jonathan M Magalski (jmmagalski@aep.com)' <jmmagalski@aep.com>; Michael.Greenlee@dnr.state.oh.us
Subject: RE: Racine Hydroelectric Project - Eastern Spadefoot Habitat Survey Report

Hello Danielle,

Thank you for providing the Eastern Spadefoot Habitat Survey Report. The DOW concurs with Mr. Davis' assessment that a presence/absence survey should be conducted. If there are any questions, please let me know.

Thank you,
Nathan

Nathan Reardon
Compliance Coordinator
ODNR Division of Wildlife
2045 Morse Road
Columbus, OH 43229
Phone: 614-265-6741

From: Hanson, Danielle <Danielle.Hanson@hdrinc.com>
Sent: Wednesday, June 10, 2020 7:53 PM
To: Parsons, Kate <Kate.Parsons@dnr.state.oh.us>; Reardon, Nathan <Nathan.Reardon@dnr.state.oh.us>
Cc: 'Jonathan M Magalski (jmmagalski@aep.com)' <jmmagalski@aep.com>; Greenlee, Michael <Michael.Greenlee@dnr.state.oh.us>
Subject: Racine Hydroelectric Project - Eastern Spadefoot Habitat Survey Report

Good Evening Kate and Nathan,

AEP Generation Resources Inc. (AEPGR), a unit of American Electric Power (AEP), is the Licensee, owner, and operator of the 47.5 megawatt Racine Hydroelectric Project (Project) (FERC Project No. 2570). The Project is located along the Ohio River in Meigs County, Ohio.

AEPGR is pursuing a new license for the Project using the Commission's Integrated Licensing Process (ILP) as defined in 18 Code of Federal Regulations (CFR) Part 5. As part of the FERC relicensing, AEPGR is conducting an Eastern Spadefoot Toad Habitat Suitability Assessment. An initial habitat survey was conducted at the Project in 2019. On behalf of AEPGR, and per request of Mike Greenlee, I am sending the attached Eastern Spadefoot Habitat Survey Report for your review.

Should you have any questions regarding this report, please contact Jon Magalski with AEP at (614) 716-2240 or jmmagalski@aep.com.

Thank you,

Danielle Hanson
Environmental Scientist

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United States Department of the Interior

FISH AND WILDLIFE SERVICE
Pennsylvania Field Office
110 Radnor Road, Suite 101
State College, Pennsylvania 16801-4850

June 29, 2020

Ms. Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
Mail Code: DLC, HL-11.2
888 First St., NE
Washington, DC 20426

RE: Racine Hydroelectric Project (FERC No. 2570); Initial Study Report (ISR) Meeting Summary Disagreements and Requests to Amend Study Plan to Include New or Modified Studies

Dear Secretary Bose:

The U.S. Fish and Wildlife Service (Service) participated in American Electric Power Generation Resources' (AEPGR) May 14, 2020, ISR meeting for the Racine Hydroelectric Project (FERC No. 2570) to discuss progress toward completing approved relicensing studies. Pursuant to 18 CFR § 5.15(c)(4), the Service provides the following comments and requests.

2.2, Water Quality Study:

The Federal Energy Regulatory Commission's (Commission; FERC) August 21, 2018, Scoping Document 1 (SD1) and December 12, 2018, Scoping Document 2 (SD2) identified the following environmental resource issue to be analyzed in the Environmental Assessment (EA) for the Project relicensing:

- Effects of continued project operation on water quality (e.g., dissolved oxygen and water temperature) in the Ohio River downstream of the project.

In the Commission's Study Plan Determination (SPD), they state: "We also recommend that the analysis for this study incorporate data from the operation of the Corps' Racine Locks and Dam facilities at the time of the water quality sampling to determine whether any observed effects on downstream water quality are the result of project operation or the operation of the Corps' facilities." For this analysis to be possible, the Project must be operating during most of the study. The Commission also states in their SPD that "Staff's environmental analysis would need to assess the effects of continued operation on aquatic resources, including water quality, in the Ohio River downstream of the project."

However, from June 17 to October 7, October 10 to October 12, and October 28 to October 31, 2019, overlapping most of the summer low flow season when water temperatures reach their maximum and dissolved oxygen issues are most likely, hydroelectric operations were inactive. Therefore, results of the water quality study cannot be expected to achieve the Commission's stated objectives (above). The Service requests that most of the study be repeated in 2020. Results of the repeated study would not be considered acceptable unless the Project is operating during most of the low-flow summer season. The Service identified this issue during the ISR meeting, and we stated that we would be making this request. Therefore, we expect that AEPGR has anticipated the likely need to repeat most of the study and has already begun the study as of the date of this letter. If that is not the case, then we request that the study be re-initiated immediately in order to evaluate possible effects of Project operations on water quality during the time period beginning July 1 and extending through October 15.

It is also our understanding that weather and precipitation during the summer of 2019 may not have been typical at the Project location, with drought conditions occurring during a portion of the study period, further supporting the need to repeat this study.

There is at least one study task that the Service does not see a need to repeat. We do not consider it necessary to repeat the instantaneous depth profile sampling in the forebay.

It is not entirely clear whether requesting a repeat of this study qualifies as a modification of an approved study. According to 18 CFR 5.15(d), any proposal to modify an ongoing study must be accompanied by a showing of good cause why the proposal should be approved and must include, as appropriate to the facts of the case, a demonstration that:
(1) Approved studies were not conducted as provided for in the approved study plan; or
(2) The study was conducted under anomalous environmental conditions or that environmental conditions have changed in a material way.

The Service believes that both of the above criteria apply because the study was not conducted as provided in the approved study plan in that the Project was not operating during most of the study, thus failing to achieve the primary study objective of identifying effects of Project operations on water quality, and because much of the study was conducted during atypically dry and hot conditions at the Project location.

We would also like to note that the map in the ISR showing the water quality monitoring stations is unreadable.

There were fouling issues with the primary continuous data loggers during this study in 2019. The Service requests that AEPGR consider checking and cleaning data loggers at a greater frequency during the requested 2020 repeat of this study. Instead of checking and cleaning loggers on a monthly basis, we request that the loggers be checked and cleaned on a weekly basis to reduce fouling issues.

2.3, Recreation Study:

The Service supports the positions of West Virginia Division of Natural Resources (WVDNR) and Ohio Department of Natural Resources (ODNR) that an additional year of recreation study should be conducted at the Project.

2.5, Mussel Survey:

The mussel survey was performed according to the agreed-upon modified West Virginia Mussel Survey Protocol. The Service is satisfied with the performance of this study, and appreciates the additional effort expended in adhering to the protocol. As a result of this additional effort, there were several mussel species found during this survey that were not found during the 2010 and 2015 surveys (in support of U.S. Army Corps of Engineers maintenance dredging program), three of which are Ohio State-listed endangered species, and one of which is a threatened species in Ohio. Five of the additional species found during this survey are considered very rare (S2) or extremely rare (S1) in West Virginia. No federally listed endangered or threatened species were found during the survey.

2.6, Fisheries Survey:

Based on the discussion during the May 14 ISR meeting, spring surveys were to be completed in 2020, with some proposed modifications due to the COVID-19 pandemic. As stated during the meeting, the Service supports AEPGR's decision to forgo the spring trawl surveys due to concerns regarding inability of personnel to maintain social distancing in this type of survey. The fall fisheries surveys, which were completed in 2019, documented a total of 25 species and only 2 species in the trawl surveys, whereas more than 60 fish species are known to occur in the Racine Pool (ORSANCO database, 2010-2018).

In their SPD, the Commission stated that "…we recognize that existing data and data collected as part of the approved study plan may be insufficient to satisfactorily estimate American eel entrainment, impingement, and turbine mortality at the project. Therefore, AEP Generation Resources may need to supplement existing desktop entrainment databases with additional studies upstream of the project that focus on American eels. AEP Generation Resources should evaluate the need for additional data or studies on American eel after completing the *Fish Entrainment and Impingement* and *Fisheries Studies*, as modified herein, and should discuss in the ISR the need for any additional data or analysis. The issue can be addressed at the ISR Meeting required under section 5.15(b)(2). Following this meeting, stakeholders can request modifications to the approved study plan for additional data or analysis, or request new site-specific information gathering or studies. Accordingly, we do not recommend targeted eels surveys upstream of the project at this time." Considering the very limited results of the fall 2019 electrofishing surveys (i.e., only 25 species collected and no American eels collected), the Service would like to discuss possible additional, targeted, American eel surveys in the Racine Pool during the fall of 2020.

It is worth noting that sauger (*Sander canadensis*), a migratory species and the only confirmed host for the federally listed endangered sheepnose mussel (*Plethobasus cyphyus*), was among the most abundant species collected in the 2019 electrofishing surveys. However, the Service is unable to determine whether these collections occurred in the Racine Pool or in the RC Byrd Pool, because Figure 2.5-1 in the ISR, which is supposed to show the numbered transects, is unreadable. The sheepnose mussel is known to occur a short distance downstream of the RC Byrd Locks and Dam, and any Project impacts to sauger may have negative reproduction and recruitment effects on this federally listed mussel species. The Service is responsible for recovering this species.

The Commission's August 21, 2018, SD1 and December 12, 2018, SD2 identified effects of continued project operation on upstream and downstream fish passage at Racine Locks and Dam as an environmental resource issue to be analyzed in the EA for the Project relicensing..

In comments filed by the Service in response to AEPGR's Proposed Study Plan[1], as an alternative to the Service's previously requested *Fish Protection and Upstream and Downstream Passage Study* which AEPGR did not agree to, the Service requested information in order to conduct its own analysis. In order to evaluate the magnitude and persistence of false attraction flows, and to develop a holistic model of flow management and operations at the site, the Service requested specific historical data on a daily (or finer) resolution for a period covering at least 10 years. This information was to include headpond elevations, tailwater elevations, gate (i.e., spill) operations (including the sequence and timing of specific gates), unit 1 and unit 2 turbine discharge, lock operations (including any openings for maintenance), and any dam/powerhouse elevation drawings and/or bathymetric data in the immediate upstream or downstream vicinity of the dam that would allow us to estimate mean velocities.

In their Revised Study Plan (RSP), AEPGR agreed to incorporate this information request into the modified Fisheries Study, and renamed the Study accordingly: *Fisheries Survey, Project Characteristics, and Project Operations Related to Potential Fish Passage* study in Section 10 of the RSP (Section 10.6.1 Task 1 – Data Review and Synthesis). While the Commission did not mention or discuss this aspect of the study in their SPD, they stated that "Studies for which no issues were raised in comments on the RSP are not discussed in this determination. Unless otherwise indicated, all components of approved studies not modified in this determination must be completed as described in AEP Generation Resources' RSP." Because the "Fisheries Study" was approved with modifications, it is unclear to the Service whether this component of the study was approved by the Commission. The Service addressed this proposed study revision in RSP comments filed on April 29, 2019, by stating that we appreciated AEPGR's proposal to incorporate the requested information into the study. Will this component of the study be carried out?

2.7, Fish Entrainment and Impingement Study:

RSP Section 11.6.1, Task 1, involves the formation of a study working group including the Service, WVDNR, ODNR and other stakeholders who express interest in participating in this study. Interested parties will also communicate to identify target fish species and if needed, refine protocols specific to this study.

[1] FERC accession number 20190315-5127

Under RSP Section 11.6.6, Task 6 is to determine monthly turbine entrainment rates from existing empirical data and utilize these rates to estimate monthly turbine entrainment for the target species using existing hydrology and Project operations. The Service requests protocols be added to the study related to this task. In recently filed comments[2], the WVDNR has requested an additional analysis to complement the currently proposed entrainment evaluation, in order to ensure as accurate as possible entrainment mortality estimates to inform WV fish loss compensation requirements. WVDNR proposes the use of a sensor fish that can be released into the powerhouse intake to measure acceleration, pressure changes, rotational velocity, and orientation, conveying what real fish may experience during downstream passage through the specific Project turbines.

While the Service supports this proposed study enhancement, we also recommend as an additional verification of results, the use of the Service's Excel-based Turbine Blade Strike Analysis model developed by Service Fish Passage Engineering. As a complement to this model, Service engineers have identified the need to adjust one of the input parameters for evaluation of American eel, to more accurately predict blade-strike potential for this species.

Pursuant to 18 CFR 5.15(e), any proposal for new information gathering or studies must be accompanied by a showing of good cause why the proposal should be approved and must include, as appropriate to the facts of the case, a statement explaining:

(1) Any material changes in the law or regulations applicable to the information request;
(2) Why the goals and objectives of any approved study could not be met with the approved study methodology;
(3) Why the request was not made earlier;
(4) Significant changes in the project proposal or that significant new information material to the study objectives has become available; and
(5) Why the new study request satisfies the study criteria in 18 CFR §5.9(b).

The Service's and WVDNR's previous requests for an in-field verification component (e.g., tailrace netting; hydroacoustic monitoring of fish entering the intake) were denied due to projected costs, despite pointing out that the only historical in-field entrainment studies conducted at projects on the Ohio River were flawed (e.g., < 4% discharge netting efficiency) and not accepted by the resource agencies. Those studies also did not meet the screening criteria for inclusion in the Electric Power Research Institute's (EPRI) entrainment survival database. The Service has commented extensively on this issue in previous comment letters[3], but to date the Commission has not supported any in-field entrainment verification requests at any of the projects on the Ohio River.

A stated objective of the RSP is to conduct a desktop analysis that incorporates the impingement assessment, Project specifications, and hydrology to quantify turbine entrainment and mortality at the Project. The Service continues to be concerned about the ability of this study, as currently proposed, to accurately quantify turbine entrainment mortality at the Project, considering the

[2] FERC accession number 20200605-5046
[3] FERC accession number 20190315-5127

study will largely rely on survival rates at other projects with similar turbines, documented in the EPRI entrainment survival database and other databases (Stone & Webster Environmental Services [1992] and FERC [1995]).

The Service did not previously request use of a sensor fish because Service representatives who are participating in the Racine Project relicensing were unaware of this technology until recently, and until the Commission issued its SPD, we were focused on promoting use of a more substantial in-field study component, such as the use of hydroacoustic monitoring at the Project intake. In previous comments on the Proposed Study Plan[4] the Service requested "some type of in-field verification..." Regarding the Service's Turbine Blade Strike Analysis Model, we have recommended its use in other project relicensing proceedings, including a proceeding for relicensing of another project owned by American Electric Power. It was mostly an oversight on our part that we did not request its use in this relicensing proceeding until now, although as previously stated, we were also focusing on pursuit of some type of in-field verification of desktop results.

It is unclear whether the requested use of a sensor fish and/or the Service's Turbine Blade Strike Analysis model constitutes a modification to an approved study or new information gathering, but the Service believes the above requested approaches to better informing and/or verifying the results of the proposed desktop study satisfy the study criteria in 18 CFR §5.9(b) as follows:

I, Entrainment and Impingement Desktop Study Results Verification

The Licensee proposes to perform a desktop reverification Entrainment/Impingement Study to assess potential Project effects on fish mortality and injury using existing literature and site-specific information. The Licensee is consulting with interested stakeholders to establish appropriate methodology and to identify fish species that are potentially subjected to impingement and entrainment.

At the September 27, 2018, scoping meeting, the Service stated that an in-field entrainment study would likely be requested because it is our opinion that there has never been an acceptable in-field entrainment study conducted at any of the hydropower projects on the Ohio River, as discussed in FERC's 1988 Final Environmental Impact Statement for Hydroelectric development in the Upper Ohio River Basin (FEIS: FERC 1988). In the FEIS, the Commission stated that the results of studies of turbine-induced fish mortality are highly varied, and they concluded that "all entrainment field studies to date are deemed incomplete and inconclusive for answering impact questions on the upper Ohio River system quantitatively, despite extensive effort. The Commission further stated that "no reliable, quantitative estimate of passage rates for sites on the upper Ohio River system is presently available…"

In addition to the Licensee's intention to consult with interested stakeholders to establish appropriate methodology and to identify fish species that are potentially subjected to impingement and entrainment, we request that this consultation also include consideration of some type of verification or "ground-truthing." The resource agencies do not have a high degree

[4] FERC accession number 20190315-5127

of confidence in the studies included in the Electric Power Research Institute (EPRI) database as to their applicability to Ohio River Projects located at locks and dams.

1. *Goals and Objectives*

The goals and objectives of this study enhancement or modification are to provide a ground-truth or secondary verification of desktop study survival rates of all species and life stages of fish that may be entrained in powerhouse turbines, and improve or verify the accuracy of corresponding annual mortality rates. Estimates should also consider indirect, latent mortality of injured fish that are subjected to predation (e.g., due to disorientation or loss of equilibrium), disease (e.g., as a result of cavitation injuries) or physiological stress.

2. *Resource Management Goals*

These goals include: to protect native fish populations and ensure that entrainment impacts are not resulting in population-level effects to species of conservation concern (e.g., American eel, sauger, paddlefish), and to provide an accurate justification for protection, mitigation, and enhancement measures. Conclusions regarding potential population-level effects should consider the cumulative effects of multiple, stacked hydropower project on the Ohio River and its major tributaries (e.g., Allegheny River and Monongahela River).

3. *Public Interest*

The requestor is a resource agency.

4. *Existing Information*

The only Ohio River in-field entrainment studies to date, those at the Racine (WAPORA, Inc. 1987) and Greenup (Olson and Kuehl 1988; Olson et al. 1987) projects, did not satisfy screening criteria for inclusion in the EPRI entrainment survival database. All entrainment field studies to date are deemed incomplete and inconclusive for answering impact questions on the upper Ohio River system quantitatively (FERC 1988).

5. *Nexus to Project Operations and Effects*

Operations of the Project result in injury and mortality of a percentage of fish that are impinged on powerhouse intake trash racks or entrained in Project turbines.

6. *Methodology Consistent with Accepted Practice*

The sensor fish has been utilized at several hydropower projects in the western United States, and the Service’s Turbine Blade Strike Analysis model is currently being used in relicensing studies at other hydropower projects in the Northeast.

7. *Level of Effort, Cost, and Why Alternative Studies Will Not Suffice*

The addition of a sensor fish ground-truth component would be relatively inexpensive compared to other in-field measurements (e.g., discharge netting, hydroacoustic monitoring at the intake). The Service estimates that the cost and level of effort for this study enhancement would be low and attainable. The cost and level of effort associated with the additional use of the Service's Turbine Blade Strike Analysis model would be minimal. The Service previously requested other approaches to verifying the results of the desktop analysis, but the Commission determined that those other approaches were cost-prohibitive.

Thank you for your consideration and for the opportunity to comment on the ISR and ISR meeting summary. If you have any questions regarding this matter, please contact Richard McCorkle of my staff at 302-382-0284 (personal cell number while teleworking during pandemic) or at richard_mccorkle@fws.gov.

Sincerely,

Sonja Jahrsdoerfer

Sonja Jahrsdoerfer
Project Leader

cc: Jonathon Magalski, AEPGR
Jacob Harrell, WVDNR
Michael Greenlee, ODNR

Literature Cited:

Federal Energy Regulatory Commission (FERC). 1995. Preliminary assessment of fish entrainment at hydropower projects, a report on studies and protective measures, volumes 1 and 2 (Paper No. DPR-10). Office of Hydropower Licensing, FERC, Washington, DC.

FERC. 1988. Hydroelectric development in the upper Ohio River basin: Final Environmental Impact Statement. FERC Docket No. EL85-19-114, Ohio, Pennsylvania, West Virginia. Federal Energy Regulatory Commission, Office of Hydropower Licensing. FERC/FEIS-0051.

Olson, F.W., and E.S. Kuehl. 1988. Fisheries Resource Studies, Vanceburg Hydroelectric Generating Station No. 1 (FERC Project No. 2614). Volume 2. Survival of sauger passing through bulb turbines and tainter gates at Greenup Dam, Ohio River. CH2M Hill and Biosonics. Report for the City of Vanceburg, Kentucky.

Olson, F.W., J.F. Palmisano, G.E. Johnson, and W.R. Ross. 1987. Fish population and entrainment studies for the Vanceburg Hydroelectric Generating Station No. 1. CH2M Hill, Inc. and Biosonics, Inc.

Stone & Webster Environmental Services. 1992. Fish entrainment and turbine mortality review and guidelines. EPRI Report TR-101232. September 1992.

WAPORA, Inc. 1987. Fish passage studies at the Racine and New Martinsville hydroelectric projects. 4 vols. Cincinnati, Ohio.

Yayac, Maggie

Subject: FW: [EXTERNAL] RE: Racine eel ramp operation?

From: McCorkle, Richard <richard_mccorkle@fws.gov>
Sent: Tuesday, July 7, 2020 3:58 PM
To: Jonathan M Magalski <jmmagalski@aep.com>
Subject: [EXTERNAL] Racine eel ramp operation?

Jon,

I haven't heard anything more about the temporary eel ramp at Racine. Would it be possible for your consultant to take a few photos and maybe shoot a little video to show the ramp location and setup, and the attraction flow? We would like to know that the ramp is set up in a way that largely conforms with our criteria and that there is sufficient attraction flow. Whatever you can provide would be greatly appreciated. Thanks!

Hope you are well.

Rick

Richard C. McCorkle
Fish and Wildlife Biologist
U.S. Fish & Wildlife Service
Pennsylvania Field Office
110 Radnor Road, Ste 101
State College, PA 16801
Office: 814-206-7470
Personal cell (while teleworking): 302-382-0284

Yayac, Maggie

Subject: FW: [EXTERNAL] RE: Racine eel ramp operation?

From: Jonathan M Magalski <jmmagalski@aep.com>
Sent: Wednesday, July 8, 2020 7:46 AM
To: McCorkle, Richard <richard_mccorkle@fws.gov>
Subject: [EXTERNAL] RE: Racine eel ramp operation?

Good morning Rick,

The eel ramp was deployed the week of June 8. Attached are some photos of the ramp prior to install and in operation. I think a few of the photos provide a good idea of the flows, but I will see if I can get some video for you. Also, note that the photos do not show the wiring covering the ramp or shading of the tank as they were taken prior to everything being completed. Let me know if you have any questions or comments. Take care, talk with you soon....Jon

AMERICAN ELECTRIC POWER
BOUNDLESS ENERGY
JONATHAN M MAGALSKI | **ENVIRONMENTAL SPEC CONSULT**
JMMAGALSKI@AEP.COM | D:614.716.2240
1 RIVERSIDE PLAZA, COLUMBUS, OH 43215

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Yayac, Maggie

Subject: FW: [EXTERNAL] RE: Racine eel ramp operation?

From: McCorkle, Richard <richard_mccorkle@fws.gov>
Sent: Wednesday, July 8, 2020 8:40 AM
To: Jonathan M Magalski <jmmagalski@aep.com>
Subject: Re: [EXTERNAL] RE: Racine eel ramp operation?

Good morning Jon,

Thanks much for the quick response. I'm no expert on the engineering side of things, but the ramp setup looks good to me - spacing between PVC Milieu-type ramp substrate looks good, the ramp appears to be sufficiently watered, collection tank is sufficiently sized, and I can see the attraction flow at the base. I forwarded the photos to our engineer and will let you know if he has any different impressions. Video would be great if possible, but these photos are much appreciated.

Stay well.

Rick

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Office of Real Estate
John Kessler, Chief
2045 Morse Road – Bldg. E-2
Columbus, OH 43229
Phone: (614) 265-6621
Fax: (614) 267-4764

July 21, 2020

Danielle Hanson
HDR Inc.
11 Stanwix Street, Suite 800
Pittsburgh, PA 15222

Re: 20-512; Racine Hydroelectric Project (FERC No. 2570-032)

Project: he proposed project involves continued operation of the existing hydroelectric project under a new license.

Location: The proposed project is located in Racine Township, Meigs County, Ohio.

The Ohio Department of Natural Resources (ODNR) has completed a review of the above referenced project. These comments were generated by an inter-disciplinary review within the Department. These comments have been prepared under the authority of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.), the National Environmental Policy Act, the Coastal Zone Management Act, Ohio Revised Code and other applicable laws and regulations. These comments are also based on ODNR's experience as the state natural resource management agency and do not supersede or replace the regulatory authority of any local, state or federal agency nor relieve the applicant of the obligation to comply with any local, state or federal laws or regulations.

Natural Heritage Database: The Natural Heritage Database has the following records at or within a one-mile radius of the project:

American eel (*Anguilla rostrate*), T
Tippecanoe darter (*Etheostoma Tippecanoe*), T
Goldeye (*Hiodon alosoides*), E
Channel darter (*Percina copelandi*), T
River darter (*Percina shumardi*), T
Paddlefish (*Polyodon spathula*), T
Eastern spadefoot (*Scaphiopus holbrookii*), E

The review was performed on the project area you specified in your request as well as an additional one-mile radius. Records searched date from 1980. This information is provided to inform you of features present within your project area and vicinity.

Please note that Ohio has not been completely surveyed and we rely on receiving information from many sources. Therefore, a lack of records for any particular area is not a statement that rare species or unique features are absent from that area. Although all types of plant communities have been surveyed, we only maintain records on the highest quality areas.

Statuses are defined as: E = state endangered; T = state threatened; P = state potentially threatened; SC = state species of concern; SI = state special interest; A = species recently added to state inventory, status not yet determined; X = presumed extirpated in Ohio; FE = federal endangered, FT = federal threatened, FSC = federal species of concern, FC = federal candidate species.

Fish and Wildlife: The Division of Wildlife (DOW) has the following comments.

Recreational

The Division of Wildlife (DOW) would like to see the number of online surveys and phone interviews increased and AEP expand efforts to gather additional information from anglers regarding recreational facility improvements at the abutment fishing access. Two approaches should be considered for expanding participation in the survey to gather additional feedback from anglers. The first would be to run an article through the local paper, both electronically and on printed copy, asking for input on the current recreational facilities and thoughts on additional improvements. Social media outlets should also be utilized that include information about where they can participate in the online survey. The second approach would include face to face interviews. However, with social distancing guidelines in place and current health and safety precautions, it may not be possible to conduct this type of survey. If that is the case, we would suggest continuing with drop box surveys to gather additional information from anglers on the current recreational facilities and the need for any additional features that would improve the angling opportunities and experience for anglers. Ideally, we would recommend surveys be extended to include the remaining summer months and into Fall of 2020 to increase participation and input from anglers.

Fish and Wildlife

The DOW recommends that impacts to streams, wetlands and other water resources be avoided and minimized to the fullest extent possible, and that Best Management Practices be utilized to minimize erosion and sedimentation.

The entire state of Ohio is within the range of the Indiana bat (*Myotis sodalis*), a state endangered and federally endangered species, the northern long-eared bat (*Myotis septentrionalis*), a state endangered and federally threatened species, the little brown bat (*Myotis lucifugus*), a state endangered species, and the tricolored bat (*Perimyotis subflavus*), a state endangered species. During the spring and summer (April 1 through September 30), these species of bats predominately roost in trees behind loose, exfoliating bark, in crevices and cavities, or in the leaves. However, these species are also dependent on the forest structure surrounding roost trees. If trees are present within the project area, and trees must be cut, the DOW recommends cutting only occur from October 1 through March 31, conserving trees with loose, shaggy bark and/or crevices, holes, or cavities, as well as trees with DBH ≥ 20 if possible. If trees are present within the project area, and trees must be cut during the summer months, the DOW recommends a mist net survey or acoustic survey be conducted from June 1 through August 15, prior to any cutting. Mist net and acoustic surveys should be conducted in accordance with the most recent version of the "*OHIO DIVISION OF WILDLIFE GUIDANCE FOR BAT SURVEYS AND TREE CLEARING*". If state listed bats are documented, DOW recommends cutting only occur from October 1 through March 31, however, limited summer tree cutting may be acceptable after consultation with DOW (contact Sarah Stankavich, sarah.stankavich@dnr.state.oh.us).

The DOW also recommends that a desktop or field-based habitat assessment is conducted to determine if there are potential hibernaculum(a) present within the project area. Habitat assessments should be conducted in accordance with the current USFWS "*Range-wide Indiana Bat Survey Guidelines*" and submitted to Sarah Stankavich, sarah.stankavich@dnr.state.oh.us if potential hibernacula are present within .25 miles of the project area. If a potential hibernaculum is found, the DOW recommends a 0.25-mile tree cutting and subsurface disturbance buffer around the hibernaculum entrance, however, limited summer or winter tree cutting may be acceptable after consultation with DOW. If no tree cutting or subsurface impacts to a hibernaculum are proposed, this project is not likely to impact these species.

The project is within the range of the following listed mussel species.
Federally Endangered
sheepnose (*Plethobasus cyphyus*)
fanshell (*Cyprogenia stegaria*)
pink mucket (*Lampsilis orbiculata*)
snuffbox (*Epioblasma triquetra*)

State Endangered
washboard (*Megalonaias nervosa*)
butterfly (*Ellipsaria lineolata*)
elephant-ear (*Elliptio crassidens*)
long-solid (*Fusconaia maculata maculata*)
Ohio pigtoe (*Pleurobema cordatum*)
pyramid pigtoe (*Pleurobema rubrum*)
monkeyface (*Quadrula metanevra*)
wartyback (*Quadrula nodulata*)

State Threatened
black sandshell (*Ligumia recta*)
threehorn wartyback (*Obliquaria reflexa*)
fawnsfoot (*Truncilla donaciformis*)

The DOW understands that a mussel survey has been conducted and has been coordinated with the resource agencies.

The project is within the range of the following listed fish species.
State Endangered
bigeye shiner (*Notropis boops*)
goldeye (*Hiodon alosoides*
shoal chub (*Macrhybopsis hyostoma*)
speckled chub (*Macrhybopsis aestivalis*
spotted darter (*Etheostoma maculatum*)
western banded killifish (*Fundulus diaphanus menona*)

State Threatened
American eel (*Anguilla rostrata*)
blue sucker (*Cycleptus elongatus*)
channel darter (*Percina copelandi*)
paddlefish (*Polyodon spathula*)
river darter (*Percina shumardi*)
Tippecanoe darter (*Etheostoma tippecanoe*)

The DOW recommends no in-water work in the Ohio River from March 15 through June 30, and in other perennial streams from April 15 through June 30 to reduce impacts to indigenous aquatic species and their habitat. If no in-water work is proposed in the Ohio River or other perennial streams, this project is not likely to impact these or other aquatic species.

The project is within the range of the eastern spadefoot toad (*Scaphiopus holbrookii*), a state endangered species. This species is found in areas of sandy soils that are associated with river valleys. Breeding habitats may include flooded agricultural fields or other water holding depressions. The DOW understands that an approved herpetologist has determined that suitable habitat is present within the project area, and that a presence/absence survey will be conducted.

Due to the potential of impacts to federally listed species, as well as to state listed species, we recommend that this project be coordinated with the U.S. Fish & Wildlife Service.

Water Resources: The Division of Water Resources has the following comment.

The local floodplain administrator should be contacted concerning the possible need for any floodplain permits or approvals for this project. Your local floodplain administrator contact information can be found at the website below.

http://water.ohiodnr.gov/portals/soilwater/pdf/floodplain/Floodplain%20Manager%20Community%20Contact%20List_8_16.pdf

ODNR appreciates the opportunity to provide these comments. Please contact Sarah Tebbe, Environmental Specialist, at (614) 265-6397 or Sarah.Tebbe@dnr.state.oh.us if you have questions about these comments or need additional information.

Mike Pettegrew
Environmental Services Administrator (Acting)

Yayac, Maggie

Subject: FW: 20-512; HDR Inc. - Racine Hydroelectric Project (FERC No. 2570-032) Comments
Attachments: 20-512; HDR Inc. - Racine Hydroelectric Project (FERC No. 2570-032) Comments.pdf

From: sarah.tebbe@dnr.state.oh.us [mailto:sarah.tebbe@dnr.state.oh.us]
Sent: Tuesday, July 21, 2020 2:00 PM
To: Hanson, Danielle <Danielle.Hanson@hdrinc.com>
Subject: 20-512; HDR Inc. - Racine Hydroelectric Project (FERC No. 2570-032) Comments

Hi Danielle,

Attached are the ODNR comments on the subject project.

Thanks,

Sarah Tebbe
Ohio Department of Natural Resources
REALM Office of Environmental Services
2045 Morse Road
Columbus, Ohio 43229
https://ohiodnr.gov/wps/portal/gov/odnr-core/divisions/division-realm/related-resource/environmental-review
(614) 265-6397

Yayac, Maggie

Subject: FW: 20-512; HDR Inc. - Racine Hydroelectric Project (FERC No. 2570-032) Comments
Attachments: 20-512; HDR Inc. - Racine Hydroelectric Project (FERC No. 2570-032) Comments.pdf; 2020 State bat survey guidance_6_3_20.pdf

From: sarah.tebbe@dnr.state.oh.us [mailto:sarah.tebbe@dnr.state.oh.us]
Sent: Wednesday, July 22, 2020 8:36 AM
To: Hanson, Danielle <Danielle.Hanson@hdrinc.com>
Subject: FW: 20-512; HDR Inc. - Racine Hydroelectric Project (FERC No. 2570-032) Comments

Danielle,

I meant to include the attached bat guidance referenced in our comment letter.

Thanks,

Sarah Tebbe
Ohio Department of Natural Resources
REALM Office of Environmental Services
2045 Morse Road
Columbus, Ohio 43229
https://ohiodnr.gov/wps/portal/gov/odnr-core/divisions/division-realm/related-resource/environmental-review
(614) 265-6397

From: Tebbe, Sarah
Sent: Tuesday, July 21, 2020 5:00 PM
To: Hanson, Danielle <Danielle.Hanson@hdrinc.com>
Subject: 20-512; HDR Inc. - Racine Hydroelectric Project (FERC No. 2570-032) Comments

Hi Danielle,

Attached are the ODNR comments on the subject project.

Thanks,

Sarah Tebbe
Ohio Department of Natural Resources
REALM Office of Environmental Services

OHIO DIVISION OF WILDLIFE GUIDANCE FOR BAT SURVEYS AND TREE CLEARING
JUNE 2020

Agency Contacts:

ODNR-DOW Permit Coordinator: Wildlife.Permits@dnr.state.oh.us, (614) 265-6315
ODNR-DOW Bat Survey Coordinator: Sarah Stankavich, sarah.stankavich@dnr.state.oh.us, (614) 265-6764

Due to the evolving situation with COVID-19, we are temporarily suspending bat-handling activities until more is known about the risk to North American bats. This document has been updated with new state guidance for the 2020 field season only, or until bat-handling activities are reinstated. These guidelines replace previous guidelines released in March 2020.

This guidance applies to state recommendations only. Contact the USFWS to determine if federal consultation is also necessary to comply with federal law.

Ohio Mist Net Surveys:
Mist-netting for presence/absence surveys, education events, or research activities will not be authorized for the 2020 season.

Ohio Acoustic Surveys:
Acoustic bat surveys for presence/absence will be accepted by ODNR for the 2020 season. Surveys should follow guidelines laid out in the USFWS Range-wide Indiana Bat Survey Guidelines (March 2020) with the following exceptions:

- Ohio survey dates are June 1 – August 15, 2020
- After conducting automated analyses using one or more of the currently available 'approved' acoustic bat ID programs[1], qualitative analysis (i.e., manual vetting) of any calls recorded from state-endangered species (*Myotis sodalis, M. septentrionalis*[2], *M. lucifugus*[2], and *Perimyotis subflavus*[2]) must be completed.
    - At a minimum, for each detector site/night a program considered presence of state-listed bats likely, review all files (including no IDs) from that site/night. If more than one acoustic bat ID program is used, qualitative analysis must also include a comparison of the results of each program by site and night.

During Field Season:

- **Prior to initiation of field work (a minimum of two weeks in advance)**, permittees must provide proposed survey plans to ODNR-DOW via e-mail. **Plans must be reviewed and approved by ODNR-DOW before ANY surveys take place**. Study plans must specify objectives, location details, dates of proposed work, and all other relevant details.

[1] https://www.fws.gov/midwest/Endangered/mammals/inba/surveys/inbaAcousticSoftware.html
[2] State listing as endangered effective July 1, 2020

After Field Season:

- By March 15, you must submit your final ODNR-DOW report(s) from the previous summer. You are not required to fill out the ODNR-DOW Wildlife Diversity Bat Excel Spreadsheet; instead, please forward your USFWS Midwestern US Spreadsheet (found here: http://www.fws.gov/midwest/endangered/mammals/inba/inbasummersurveyguidance.html) to the ODNR-DOW Bat Survey Coordinator and ODNR-DOW Permit Coordinator and include your state permit number along with an electronic copy of the project report. Electronic summaries emailed during the field season are NOT considered as full compliance of this reporting requirement.

Ohio Environmental Review Recommendations for projects involving disturbance near potential/known bat hibernacula (cliffs, caves, mines) or tree cutting:

Step 1: Coordinate with Ohio Division of Wildlife (DOW) regarding existing records for state-listed endangered bat summer and/or winter occurrence information.

If project site contains a known bat hibernaculum(a) –

- For state-listed endangered species other than the Indiana bat, a recommendation of 0.25-mile tree cutting buffer around all known entrances to protect existing conditions at the hibernaculum(a). If the project involves subsurface disturbance, consultation with DOW is required.
- Limited summer and winter tree cutting may be permitted within the buffer following guidelines detailed below. Coordinate with DOW before cutting.

If a project site does not contain known bat hibernaculum(a)

- Conduct a habitat assessment (desktop or field-based, using methods detailed in current USFWS Range-wide Indiana Bat Guidelines) to determine if a potential hibernaculum(a) is present within the action area.

Step 2: When conducted, a presence/absence survey must follow current DOW guidelines.

Step 3: If a state-listed endangered bat is captured or recorded during the survey:

- Recommendation of no summer tree cutting, or limited cutting following guidelines detailed below, within 5 miles of the capture site if a roost is not located.
- Recommendation of no summer tree cutting, or limited cutting following guidelines detailed below, within 2.5 miles of a roost tree if located.

If no state-listed endangered bat is captured or recorded during the survey:

- Summer tree cutting may proceed for 5 years before a new survey is needed under state guidance.

Limited summer tree cutting guidance for bats that are only state-listed endangered: Limited tree cutting in summer may be permitted after consultation with DOW, but clearing trees with the following characteristics should be avoided unless they pose a hazard: dead or live trees of any size with loose, shaggy bark; crevices, holes, or cavities; live trees of any species with DBH ≥ 20.

FREQUENTLY ASKED QUESTIONS

When does the Bat Survey protocol have to be used?

This protocol should be used anytime Indiana bat, northern long-eared bat, little brown bat, or tricolored bat summer presence/probable absence surveys are conducted in the state of Ohio. For 2020 only, acoustic surveys will meet the ODNR-DOW requirements unless new guidance allowing for the handling of bats during presence/absence surveys is released from USFWS.

How many net surveys are required for presence/probably absence?

As described in the current USFWS Range-wide Indiana Bat Guidelines: Linear projects: a minimum of 2 detector nights per km (0.6 miles) of suitable summer habitat
Non-linear projects: a minimum of 8 detector nights per 123 acres (0.5 km^2) of suitable summer habitat. At least 2 detector locations per 123 acre "site" shall be sampled until at least 8 detector nights has been completed over the course of at least 2 calendar nights (may be consecutive). For example:

- 4 detectors for 2 nights each (can sample the same location or move within the site)
- 2 detectors for 4 nights each (can sample the same location or move within the site)
- 1 detector for 8 nights (must sample at least 2 locations and move within the site)

How long are the results of the surveys valid for an assessment of an area?

Mist-net or acoustic surveys documenting probable absence of state-listed endangered bats are valid for five years.

When can acoustic surveys occur in Ohio?

In Ohio, acoustic surveys may only be conducted from June 1 through August 15 unless indicated otherwise in your state permit. Any surveys outside of the June 1 - August 15 timeframe cannot be used in Ohio to assess the presence/probable absence of state-listed bats.

Can a presence/probable absence survey be conducted within a known Indiana bat and/or northern long-eared bat capture/detection buffer?

Surveys generally cannot be used to document presence/probable absence of state-listed endangered bats bat where presence of the species has already been confirmed by prior surveys.

What if a project is proposing to clear trees between April 1 and September 30 when bats may be present but no bat records exist in the project area?

Any Ohio project that is not within a known bat record buffer, and tree clearing between April 1 and September 31 is being proposed, may have a presence/absence survey conducted between June 1 and August 15 following the range-wide guidance. If a presence/absence survey is not performed, presence of listed bats is assumed.

How does take of northern long-eared bats differ from Indiana bats?

Under Ohio law, there is no exemption for take of any listed bat species.

Yayac, Maggie

Subject: FW: [EXTERNAL] RE: Racine eel ramp operation?
Attachments: IMG_2905.JPG; IMG_2904.MOV

From: Jonathan M Magalski [mailto:jmmagalski@aep.com]
Sent: Tuesday, August 4, 2020 7:28 AM
To: McCorkle, Richard <richard_mccorkle@fws.gov>
Cc: McCloskey, John <john_mccloskey@fws.gov>; Jacob Harrell <jacob.d.harrell@wv.gov>; Hansbarger, Jeff L <Jeff.L.Hansbarger@wv.gov>; Mike Greenlee <michael.greenlee@dnr.state.oh.us>; Andrew N LRH Johnson <andrew.n.johnson@usace.army.mil>; dczayka@envirosciencеinc.com; Quiggle, Robert <Robert.Quiggle@hdrinc.com>; gzimmerman@envirosciencеinc.com; Elizabeth B Parcell <ebparcell@aep.com>; Hanson, Danielle <Danielle.Hanson@hdrinc.com>
Subject: RE: [EXTERNAL] RE: Racine eel ramp operation?

Good morning Rick,

Last week, EnviroScience successfully added attraction flow sourced from the tank and reduced the flow in the ramp. Attached is a photograph at the ramp confluence with the river and a short video showing the flow in the ramp. We'll keep you posted on any collections. In the meantime, please let me know if there are questions or comments. Thank you….Jon

AMERICAN ELECTRIC POWER
BOUNDLESS ENERGY
JONATHAN M MAGALSKI | ENVIRONMENTAL SPEC CONSULT
JMMAGALSKI@AEP.COM | D:614.716.2240
1 RIVERSIDE PLAZA, COLUMBUS, OH 43215

From: McCorkle, Richard <richard_mccorkle@fws.gov>
Sent: Monday, July 27, 2020 8:28 AM
To: Jonathan M Magalski <jmmagalski@aep.com>
Cc: McCloskey, John <john_mccloskey@fws.gov>; Jacob Harrell <jacob.d.harrell@wv.gov>; Hansbarger, Jeff L <Jeff.L.Hansbarger@wv.gov>; Mike Greenlee <michael.greenlee@dnr.state.oh.us>; Andrew N LRH Johnson <andrew.n.johnson@usace.army.mil>; dczayka@envirosciencеinc.com; Quiggle, Robert <Robert.Quiggle@hdrinc.com>; gzimmerman@envirosciencеinc.com; Elizabeth B Parcell <ebparcell@aep.com>; Hanson, Danielle <Danielle.Hanson@hdrinc.com>
Subject: Re: [EXTERNAL] RE: Racine eel ramp operation?

Jon,

Thanks much to you, EnviroScience and HDR for addressing our questions and concerns. Regarding the amount of flow, the previously recommended increase in flow to the ramp was for attraction flow purposes. I understand it can be tricky balancing that with not having too much water flowing down the ramp, itself, hence the suggestion for a separate pipe from the collection tank. Glad to hear that the ramp is mostly covered and that it is treated with a resin to create a smooth surface and prevent abrasions. Thanks also for letting us know if any eels are collected and for any additional photos and video you can provide.

Rick

Richard C. McCorkle
Fish and Wildlife Biologist
U.S. Fish & Wildlife Service
Pennsylvania Field Office
110 Radnor Road, Ste 101
State College, PA 16801
Office: 814-206-7470
Personal cell (while teleworking): 302-382-0284

From: Jonathan M Magalski <jmmagalski@aep.com>
Sent: Monday, July 27, 2020 7:52 AM
To: McCorkle, Richard <richard_mccorkle@fws.gov>
Cc: McCloskey, John <john_mccloskey@fws.gov>; Jacob Harrell <jacob.d.harrell@wv.gov>; Hansbarger, Jeff L <Jeff.L.Hansbarger@wv.gov>; Mike Greenlee <michael.greenlee@dnr.state.oh.us>; Andrew N LRH Johnson <andrew.n.johnson@usace.army.mil>; dczayka@enviroscienceinc.com <dczayka@enviroscienceinc.com>; Quiggle, Robert <Robert.Quiggle@hdrinc.com>; gzimmerman@enviroscienceinc.com <gzimmerman@enviroscienceinc.com>; Elizabeth B Parcell <ebparcell@aep.com>; Hanson, Danielle <Danielle.Hanson@hdrinc.com>
Subject: RE: [EXTERNAL] RE: Racine eel ramp operation?

Hi Rick,

The questions are fairly comprehensive, so I'll do my best to cover them all. The ramp is covered down to the last section of ramp (see attached photo), which is open due to frequent water level fluctuations. I have discussed with EnviroScience and HDR reducing the flows to achieve the desired depth, recognizing that this will reduce the previously recommended flow rate in the ramp. Additionally, we have discussed providing an attraction flow sourced from the tank to the entry point of the ramp. We are working on implementing these measures (reduced flow in the ramp and adding an attraction flow) and will let you know if we encounter any issues.

Below are additional responses (underlined in red) to Brett's questions and comments. Please let me know if you or others have any additional. As requested in a separate email, we will let you know if we collect any eels and will send you additional photos or video once the recommendations are completed. I hope you all have a great week and stay safe.

Jon

AMERICAN ELECTRIC POWER
BOUNDLESS ENERGY

JONATHAN M MAGALSKI | ENVIRONMENTAL SPEC CONSULT
JMMAGALSKI@AEP.COM | D:614.716.2240
1 RIVERSIDE PLAZA, COLUMBUS, OH 43215

From: McCorkle, Richard <richard_mccorkle@fws.gov>
Sent: Thursday, July 9, 2020 3:17 PM
To: Jonathan M Magalski <jmmagalski@aep.com>

Cc: McCloskey, John <john_mccloskey@fws.gov>; Jacob Harrell <jacob.d.harrell@wv.gov>; Hansbarger, Jeff L <Jeff.L.Hansbarger@wv.gov>; Mike Greenlee <michael.greenlee@dnr.state.oh.us>; Andrew N LRH Johnson <andrew.n.johnson@usace.army.mil>; dczayka@envirosceinceinc.com; Quiggle, Robert <Robert.Quiggle@hdrinc.com>; gzimmerman@enviroscienceinc.com; Elizabeth B Parcell <ebparcell@aep.com>; Hanson, Danielle <Danielle.Hanson@hdrinc.com>
Subject: Fw: [EXTERNAL] RE: Racine eel ramp operation?

Jon,

I suspect you may not see this right away as I understand you are on vacation at the moment, but I wanted to send this out now in case it is still possible to do some tweaking to the eel ramp setup.

Please see the comments below from our lead fish passage engineer. In addition, in a follow-up discussion with Brett, he asked if the ramp is covered to prevent predation by birds. Also, if you were to reduce the flow at the top of the ramp, per Brett's recommendation (based on the appearance of too much flow on the ramp itself), then supplemental attraction flow would need to be added below the bottom of the ramp. This would be done using a separate pipe (see attached figure which was previously provided), and would preferably run from the collection tank - the idea is to provide water with conspecific cues from other eels in the tank (if there are any) which increases the attraction for eels approaching the attraction flow.

We would appreciate a response form EnvironScience and/or HDR to the issues Brett has pointed out, and to the above additional issues (is ramp covered, and if flow on ramp is significantly deeper than 1/8 inch then reduce and provide supplemental flow from tank to base of ramp).

Thanks for your consideration.

Rick

Richard C. McCorkle
Fish and Wildlife Biologist
U.S. Fish & Wildlife Service
Pennsylvania Field Office
110 Radnor Road, Ste 101
State College, PA 16801
Office: 814-206-7470
Personal cell (while teleworking): 302-382-0284

From: Towler, Brett <Brett_Towler@fws.gov>
Sent: Thursday, July 9, 2020 2:24 PM
To: McCorkle, Richard <richard_mccorkle@fws.gov>
Cc: McCloskey, John <john_mccloskey@fws.gov>; Jacob Harrell <jacob.d.harrell@wv.gov>; Mike Greenlee <michael.greenlee@dnr.state.oh.us>; Andrew N LRH Johnson <andrew.n.johnson@usace.army.mil>
Subject: Re: [EXTERNAL] RE: Racine eel ramp operation?

Hi Rick,

Well, to be frank, my first reaction wasn't altogether positive. My understanding is that this is a temporary trap, so I'll set aside the resiliency/durability issues associated with a wooden ramp with taped seams. Here are my more pressing concerns about features that may affect the efficacy of the ramp:

1. Peg Spacing: For larger yellow eels of 150 mm or more, we recommend stud or peg-type media with spacing of 30 to 80 mm (USFWS 2019, Section 13.1.1.1). It looks like this design may push that spacing to the limit (~3 inches). Each stud is 0.5 inch in diameter. The studs are spaced 2 inches apart, with spacing of 1.5 inches between the outermost stud and the ramp wall in rows with 4 studs and 2.75 inches between the outermost stud and the ramp wall in rows with 3 studs. This stud spacing is roughly in the middle of the Service's recommended range of 1.2 to 3.1 inches. But the small diameter of the tubes is rather surprising to me. Its important to remember the dual purpose of the stud substrate. It serves to 1) provide purchase for the yellow eels to "snake" their way up, and 2) provide resistance to the flow so that the water doesn't channelize in the gaps and create velocities that may impede eel movement. The first purpose is met (at least for very large yellows) but the second is not. The studs are so small that I don't think they don't generate the tortuous path needed to slow down the water (and the water looks like its moving fast). There may be some misunderstanding based on an earlier recommendation regarding flow rates. Originally, we proposed a flow rate of 50 gpm. Based on the Service's comments, a flow rate to 65 gpm was recommended due to the ramp width. The higher flow rate was accommodated as it was our understanding higher velocities were necessary. Consider the photo (attached) of actual Milieu substrate. See how the quincunx arrangement of the large tubes force the water to also snake through the substrate? That, in concert with shallow depths, keeps the velocities low. In Racine's eelway, the water looks like its shooting those gaps faster than we'd like. We are working to slow the flow rate to reduce the velocities.
2. Water Depth: It appears like there is too much water in the eelway. We recommend 1/8" of water through a conventional aluminum or poly ramp (USFWS 2019, 13.1.1) There's nothing magical about 1/8"... a little more is not a problem. But water correlates to depth, and too much depth results in higher velocities that may inhibit eel movement. It looks like there's about 1-2 inches of water in the pictures you sent; that's a problem. And its exacerbated by the small stud diameter. Perhaps this photo was only taken during a test, but I would ask them to turn the flow down and try to maintain 1/4" or less (the exact depth is a little harder to specify because of the roughness associated with this wooden ramp). As mentioned above, we are working to reduce the flow rate which will reduce the depth and velocities in the ramp. However, in reducing the flow rate, it is recognized that the flow rate will be less than what the Service previously recommended. We will do our best to set the flow rate to provide a depth of 1/4" or less. Regarding the ramp substrate, the ramp is coated with resin creating a smooth surface.
3. Resting Pool: We generally recommend 1" depth in the resting pool, though more is fine. Also, the resting pool should be at least as long as the width of the ramp (USFWS 2019, 13.1.1). I can't quite tell is that is true with this temporary ramp. The resting pools are 12 inches long, 1 inch longer than the width of the ramp. The resting pool depth is at least 1 inch deep.

I realize they are not going to rebuild the peg board... especially for a temporary ramp, but its worth keeping all this in mind if (after testing) we have concerns that eels aren't ascending the ramp efficiently. In the near term, I'd definitely ask them to scale back on the flow to keep the depth at 1/4" or less (and again I making allowance for more depth because of the rough wooden bottom).

Regarding the tank size, it looks appropriately sized, but just to be clear: the minimum size is 15 gallons but may be bigger depending on the number of eels. The following is from Chapter 13 of our manual: The tank is 52 gallons and the live well capacity is set at approximately 24 gallons.

volume	15	20	25	30	35	40	*gallon*
	2	2 2/3	3 1/3	4	4 2/3	5 1/3	ft^3
capacity	5,250	7,000	8,750	10,500	12,250	14,000	*eels*

One other question - I can't see in the photos if they have installed the spray bar and how they've designed the transition at the upper end of the rank (i.e., what does the "cliff" look like at eels fall from the ramp into the bucket). These articulated lock nozzles are really nice and allow you to tweak the end nozzles. Two vendors I have used are Snap-Loc and Loc-Line which you can find in the MSC and McMaster catalogs. See here: The spray bar is installed and is designed to spray onto the ramp back into the tank.

https://www.mcmaster.com/Spray-Nozzles/coolant-dispensers-3/loc-line-coolant-hose/3-4-loc-line-coolant-hose/

Last thing - I took the liberty of running the photos by Alex Haro at USGS (without divulging the project or licensee names). His concerns were in line with mine. He also suggested that the wood surface might abrade the eels and recommended sealing it with polyurethane. In fact, the easiest thing would be to spray it with Flex Seal or an equivalent polyurethane. Just be careful not to use a poly-acrylic; they are water based sealants. As previously mentioned, the wood is coated with resin to create a smooth surface.

Hope that helps.

Holler if you have questions.

Brett

From: McCorkle, Richard <richard_mccorkle@fws.gov>
Sent: Wednesday, July 8, 2020 8:09 AM
To: Towler, Brett <Brett_Towler@fws.gov>
Cc: McCloskey, John <john_mccloskey@fws.gov>; Jacob Harrell <jacob.d.harrell@wv.gov>; Mike Greenlee <michael.greenlee@dnr.state.oh.us>; Andrew N LRH Johnson <andrew.n.johnson@usace.army.mil>
Subject: Fw: [EXTERNAL] RE: Racine eel ramp operation?

Brett,

Below is a response from AEP to my request for photo and possible video documentation of the eel ramp at Racine. It appears the ramp is sufficiently watered and I can see the attraction flow at the base, but wanted to get your impression based on the photos. I think the milieu-type substrate also appears to have the appropriate spacing, but not positive based on the photos. The tank appears to be appropriately-sized. Possible video to follow.

Rick

Richard C. McCorkle
Fish and Wildlife Biologist
U.S. Fish & Wildlife Service
Pennsylvania Field Office
110 Radnor Road, Ste 101
State College, PA 16801
Office: 814-206-7470
Personal cell (while teleworking): 302-382-0284

From: Jonathan M Magalski <jmmagalski@aep.com>
Sent: Wednesday, July 8, 2020 7:46 AM
To: McCorkle, Richard <richard_mccorkle@fws.gov>
Subject: [EXTERNAL] RE: Racine eel ramp operation?

Good morning Rick,

The eel ramp was deployed the week of June 8. Attached are some photos of the ramp prior to install and in operation. I think a few of the photos provide a good idea of the flows, but I will see if I can get some video for you. Also, note that the photos do not show the wiring covering the ramp or shading of the tank as they were taken prior to everything being completed.   Let me know if you have any questions or comments. Take care, talk with you soon….Jon

JONATHAN M MAGALSKI | **ENVIRONMENTAL SPEC CONSULT**
JMMAGALSKI@AEP.COM | D:614.716.2240
1 RIVERSIDE PLAZA, COLUMBUS, OH 43215

From: McCorkle, Richard <richard_mccorkle@fws.gov>
Sent: Tuesday, July 7, 2020 3:58 PM
To: Jonathan M Magalski <jmmagalski@aep.com>
Subject: [EXTERNAL] Racine eel ramp operation?

Jon,

I haven't heard anything more about the temporary eel ramp at Racine. Would it be possible for your consultant to take a few photos and maybe shoot a little video to show the ramp location and setup, and the attraction flow? We would like to know that the ramp is set up in a way that largely conforms with our criteria and that there is sufficient attraction flow. Whatever you can provide would be greatly appreciated. Thanks!

Hope you are well.

Rick

Richard C. McCorkle
Fish and Wildlife Biologist
U.S. Fish & Wildlife Service
Pennsylvania Field Office
110 Radnor Road, Ste 101
State College, PA 16801
Office: 814-206-7470
Personal cell (while teleworking): 302-382-0284

Yayac, Maggie

Subject: FW: [EXTERNAL] RE: Racine eel ramp operation?

From: "McCorkle, Richard" <richard_mccorkle@fws.gov>
Date: August 4, 2020 at 4:18:16 PM EDT
To: Jonathan M Magalski <jmmagalski@aep.com>
Cc: "McCloskey, John" <john_mccloskey@fws.gov>
Subject: Re: [EXTERNAL] RE: Racine eel ramp operation?

Thanks Jon.

The water depth on the ramp looks to be within our criteria, but I forwarded to our engineer for his opinion. Glad to see the additional piping of attraction flow from the collection tank to the base of the ramp. Thanks for keeping us posted. I'll let you know if we have any additional comments or questions.

Rick

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U.S. Fish & Wildlife Service
Pennsylvania Field Office
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State College, PA 16801
Office: 814-206-7470
Personal cell (while teleworking): 302-382-0284

From: Jonathan M Magalski <jmmagalski@aep.com>
Sent: Tuesday, August 4, 2020 10:27 AM
To: McCorkle, Richard <richard_mccorkle@fws.gov>
Cc: McCloskey, John <john_mccloskey@fws.gov>; Jacob Harrell <jacob.d.harrell@wv.gov>; Hansbarger, Jeff L <Jeff.L.Hansbarger@wv.gov>; Mike Greenlee <michael.greenlee@dnr.state.oh.us>; Andrew N LRH Johnson <andrew.n.johnson@usace.army.mil>; dczayka@enviroscienceinc.com <dczayka@enviroscienceinc.com>; Quiggle, Robert <Robert.Quiggle@hdrinc.com>; gzimmerman@enviroscienceinc.com <gzimmerman@enviroscienceinc.com>; Elizabeth B Parcell <ebparcell@aep.com>; Hanson, Danielle <Danielle.Hanson@hdrinc.com>
Subject: RE: [EXTERNAL] RE: Racine eel ramp operation?

Good morning Rick,

Last week, EnviroScience successfully added attraction flow sourced from the tank and reduced the flow in the ramp. Attached is a photograph at the ramp confluence with the river and a short video showing the flow in the ramp. We'll keep you posted on any collections. In the meantime, please let me know if there are questions or comments. Thank you….Jon

<image001.png> **JONATHAN M MAGALSKI** | **ENVIRONMENTAL SPEC CONSULT**
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From: McCorkle, Richard <richard_mccorkle@fws.gov>
Sent: Monday, July 27, 2020 8:28 AM
To: Jonathan M Magalski <jmmagalski@aep.com>
Cc: McCloskey, John <john_mccloskey@fws.gov>; Jacob Harrell <jacob.d.harrell@wv.gov>; Hansbarger, Jeff L <Jeff.L.Hansbarger@wv.gov>; Mike Greenlee <michael.greenlee@dnr.state.oh.us>; Andrew N LRH Johnson <andrew.n.johnson@usace.army.mil>; dczayka@enviroscienceinc.com; Quiggle, Robert <Robert.Quiggle@hdrinc.com>; gzimmerman@enviroscienceinc.com; Elizabeth B Parcell <ebparcell@aep.com>; Hanson, Danielle <Danielle.Hanson@hdrinc.com>
Subject: Re: [EXTERNAL] RE: Racine eel ramp operation?

Jon,

Thanks much to you, EnviroScience and HDR for addressing our questions and concerns. Regarding the amount of flow, the previously recommended increase in flow to the ramp was for attraction flow purposes. I understand it can be tricky balancing that with not having too much water flowing down the ramp, itself, hence the suggestion for a separate pipe from the collection tank. Glad to hear that the ramp is mostly covered and that it is treated with a resin to create a smooth surface and prevent abrasions. Thanks also for letting us know if any eels are collected and for any additional photos and video you can provide.

Rick

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Pennsylvania Field Office
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State College, PA 16801
Office: 814-206-7470
Personal cell (while teleworking): 302-382-0284

From: Jonathan M Magalski <jmmagalski@aep.com>
Sent: Monday, July 27, 2020 7:52 AM
To: McCorkle, Richard <richard_mccorkle@fws.gov>

Cc: McCloskey, John <john_mccloskey@fws.gov>; Jacob Harrell <jacob.d.harrell@wv.gov>; Hansbarger, Jeff L <Jeff.L.Hansbarger@wv.gov>; Mike Greenlee <michael.greenlee@dnr.state.oh.us>; Andrew N LRH Johnson <andrew.n.johnson@usace.army.mil>; dczayka@envirosciencеinc.com <dczayka@enviroscienceinc.com>; Quiggle, Robert <Robert.Quiggle@hdrinc.com>; gzimmerman@enviroscienceinc.com <gzimmerman@enviroscienceinc.com>; Elizabeth B Parcell <ebparcell@aep.com>; Hanson, Danielle <Danielle.Hanson@hdrinc.com>
Subject: RE: [EXTERNAL] RE: Racine eel ramp operation?

Hi Rick,

The questions are fairly comprehensive, so I'll do my best to cover them all. The ramp is covered down to the last section of ramp (see attached photo), which is open due to frequent water level fluctuations. I have discussed with EnviroScience and HDR reducing the flows to achieve the desired depth, recognizing that this will reduce the previously recommended flow rate in the ramp. Additionally, we have discussed providing an attraction flow sourced from the tank to the entry point of the ramp. We are working on implementing these measures (reduced flow in the ramp and adding an attraction flow) and will let you know if we encounter any issues.

Below are additional responses (underlined in red) to Brett's questions and comments. Please let me know if you or others have any additional. As requested in a separate email, we will let you know if we collect any eels and will send you additional photos or video once the recommendations are completed. I hope you all have a great week and stay safe.

Jon

<image001.png> **JONATHAN M MAGALSKI** | **ENVIRONMENTAL SPEC CONSULT**
JMMAGALSKI@AEP.COM | D:614.716.2240
1 RIVERSIDE PLAZA, COLUMBUS, OH 43215

From: McCorkle, Richard <richard_mccorkle@fws.gov>
Sent: Thursday, July 9, 2020 3:17 PM
To: Jonathan M Magalski <jmmagalski@aep.com>
Cc: McCloskey, John <john_mccloskey@fws.gov>; Jacob Harrell <jacob.d.harrell@wv.gov>; Hansbarger, Jeff L <Jeff.L.Hansbarger@wv.gov>; Mike Greenlee <michael.greenlee@dnr.state.oh.us>; Andrew N LRH Johnson <andrew.n.johnson@usace.army.mil>; dczayka@enviroscienceinc.com; Quiggle, Robert <Robert.Quiggle@hdrinc.com>; gzimmerman@enviroscienceinc.com; Elizabeth B Parcell <ebparcell@aep.com>; Hanson, Danielle <Danielle.Hanson@hdrinc.com>
Subject: Fw: [EXTERNAL] RE: Racine eel ramp operation?

Jon,

I suspect you may not see this right away as I understand you are on vacation at the moment, but I wanted to send this out now in case it is still possible to do some tweaking to the eel ramp setup.

Please see the comments below from our lead fish passage engineer. In addition, in a follow-up discussion with Brett, he asked if the ramp is covered to prevent predation by birds. Also, if you were to reduce the flow at the top of the ramp, per Brett's recommendation (based on the appearance of too much flow on the ramp itself), then supplemental attraction flow would need to be added below the bottom of the ramp. This would be done using a separate pipe (see attached figure which was previously provided), and would preferably run from the collection tank - the idea is to provide water with conspecific cues from other eels in the tank (if there are any) which increases the attraction for eels approaching the attraction flow.

We would appreciate a response form EnvironScience and/or HDR to the issues Brett has pointed out, and to the above additional issues (is ramp covered, and if flow on ramp is significantly deeper than 1/8 inch then reduce and provide supplemental flow from tank to base of ramp).

Thanks for your consideration.

Rick

Richard C. McCorkle
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Pennsylvania Field Office
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State College, PA 16801
Office: 814-206-7470
Personal cell (while teleworking): 302-382-0284

From: Towler, Brett <Brett_Towler@fws.gov>
Sent: Thursday, July 9, 2020 2:24 PM
To: McCorkle, Richard <richard_mccorkle@fws.gov>
Cc: McCloskey, John <john_mccloskey@fws.gov>; Jacob Harrell <jacob.d.harrell@wv.gov>; Mike Greenlee <michael.greenlee@dnr.state.oh.us>; Andrew N LRH Johnson <andrew.n.johnson@usace.army.mil>
Subject: Re: [EXTERNAL] RE: Racine eel ramp operation?

Hi Rick,

Well, to be frank, my first reaction wasn't altogether positive. My understanding is that this is a temporary trap, so I'll set aside the resiliency/durability issues associated with a wooden ramp with taped seams. Here are my more pressing concerns about features that may affect the efficacy of the ramp:

1. Peg Spacing: For larger yellow eels of 150 mm or more, we recommend stud or peg-type media with spacing of 30 to 80 mm (USFWS 2019, Section 13.1.1.1). It looks like this design may push that spacing to the limit (~3 inches). Each stud is 0.5 inch in diameter. The studs are spaced 2 inches apart, with spacing of 1.5 inches between the outermost stud and the ramp wall in rows with 4 studs and 2.75 inches between the outermost stud and the ramp wall in rows with 3 studs. This stud spacing is roughly in the middle of the Service's recommended range of 1.2 to 3.1 inches. But the small diameter of the tubes is rather surprising to me. Its important to remember the dual

purpose of the stud substrate. It serves to 1) provide purchase for the yellow eels to "snake" their way up, and 2) provide resistance to the flow so that the water doesn't channelize in the gaps and create velocities that may impede eel movement. The first purpose is met (at least for very large yellows) but the second is not. The studs are so small that I don't think they don't generate the tortuous path needed to slow down the water (and the water looks like its moving fast). <u>There may be some misunderstanding based on an earlier recommendation regarding flow rates. Originally, we proposed a flow rate of 50 gpm. Based on the Service's comments, a flow rate to 65 gpm was recommended due to the ramp width. The higher flow rate was accommodated as it was our understanding higher velocities were necessary.</u> Consider the photo (attached) of actual Milieu substrate. See how the quincunx arrangement of the large tubes force the water to also snake through the substrate? That, in concert with shallow depths, keeps the velocities low. In Racine's eelway, the water looks like its shooting those gaps faster than we'd like. <u>We are working to slow the flow rate to reduce the velocities.</u>

2. <u>Water Depth</u>: It appears like there is too much water in the eelway. We recommend 1/8" of water through a conventional aluminum or poly ramp (USFWS 2019, 13.1.1) There's nothing magical about 1/8"... a little more is not a problem. But water correlates to depth, and too much depth results in higher velocities that may inhibit eel movement. It looks like there's about 1-2 inches of water in the pictures you sent; that's a problem. And its exacerbated by the small stud diameter. Perhaps this photo was only taken during a test, but I would ask them to turn the flow down and try to maintain 1/4" or less (the exact depth is a little harder to specify because of the roughness associated with this wooden ramp). <u>As mentioned above, we are working to reduce the flow rate which will reduce the depth and velocities in the ramp. However, in reducing the flow rate, it is recognized that the flow rate will be less than what the Service previously recommended. We will do our best to set the flow rate to provide a depth of 1/4" or less. Regarding the ramp substrate, the ramp is coated with resin creating a smooth surface.</u>
3. <u>Resting Pool</u>: We generally recommend 1" depth in the resting pool, though more is fine. Also, the resting pool should be at least as long as the width of the ramp (USFWS 2019, 13.1.1). I can't quite tell is that is true with this temporary ramp. <u>The resting pools are 12 inches long, 1 inch longer than the width of the ramp. The resting pool depth is at least 1 inch deep.</u>

I realize they are not going to rebuild the peg board... especially for a temporary ramp, but its worth keeping all this in mind if (after testing) we have concerns that eels aren't ascending the ramp efficiently. In the near term, I'd definitely ask them to scale back on the flow to keep the depth at 1/4" or less (and again I making allowance for more depth because of the rough wooden bottom).

Regarding the tank size, it looks appropriately sized, but just to be clear: the minimum size is 15 gallons but may be bigger depending on the number of eels. The following is from Chapter 13 of our manual: <u>The tank is 52 gallons and the live well capacity is set at approximately 24 gallons.</u>

<image002.png>

One other question - I can't see in the photos if they have installed the spray bar and how they've designed the transition at the upper end of the rank (i.e., what does the "cliff" look like at eels fall from the ramp into the bucket). These articulated lock nozzles are really nice and allow you to tweak the end nozzles. Two vendors I have used are Snap-Loc and Loc-Line which you can find in the MSC and McMaster catalogs. See here: The spray bar is installed and is designed to spray onto the ramp back into the tank.

https://www.mcmaster.com/Spray-Nozzles/coolant-dispensers-3/loc-line-coolant-hose/3-4-loc-line-coolant-hose/

Last thing - I took the liberty of running the photos by Alex Haro at USGS (without divulging the project or licensee names). His concerns were in line with mine. He also suggested that the wood surface might abrade the eels and recommended sealing it with polyurethane. In fact, the easiest thing would be to spray it with Flex Seal or an equivalent polyurethane. Just be careful not to use a poly-acrylic; they are water based sealants. As previously mentioned, the wood is coated with resin to create a smooth surface.

Hope that helps.

Holler if you have questions.

Brett

From: McCorkle, Richard <richard_mccorkle@fws.gov>
Sent: Wednesday, July 8, 2020 8:09 AM
To: Towler, Brett <Brett_Towler@fws.gov>
Cc: McCloskey, John <john_mccloskey@fws.gov>; Jacob Harrell <jacob.d.harrell@wv.gov>; Mike Greenlee <michael.greenlee@dnr.state.oh.us>; Andrew N LRH Johnson <andrew.n.johnson@usace.army.mil>
Subject: Fw: [EXTERNAL] RE: Racine eel ramp operation?

Brett,

Below is a response from AEP to my request for photo and possible video documentation of the eel ramp at Racine. It appears the ramp is sufficiently watered and I can see the attraction flow at the base, but wanted to get your impression based on the photos. I think the milieu-type substrate also appears to have the appropriate spacing, but not positive based on the photos. The tank appears to be appropriately-sized. Possible video to follow.

Rick

Richard C. McCorkle
Fish and Wildlife Biologist
U.S. Fish & Wildlife Service
Pennsylvania Field Office
110 Radnor Road, Ste 101

State College, PA 16801
Office: 814-206-7470
Personal cell (while teleworking): 302-382-0284

From: Jonathan M Magalski <jmmagalski@aep.com>
Sent: Wednesday, July 8, 2020 7:46 AM
To: McCorkle, Richard <richard_mccorkle@fws.gov>
Subject: [EXTERNAL] RE: Racine eel ramp operation?

Good morning Rick,

The eel ramp was deployed the week of June 8. Attached are some photos of the ramp prior to install and in operation. I think a few of the photos provide a good idea of the flows, but I will see if I can get some video for you. Also, note that the photos do not show the wiring covering the ramp or shading of the tank as they were taken prior to everything being completed. Let me know if you have any questions or comments. Take care, talk with you soon....Jon

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1 RIVERSIDE PLAZA, COLUMBUS, OH 43215

From: McCorkle, Richard <richard_mccorkle@fws.gov>
Sent: Tuesday, July 7, 2020 3:58 PM
To: Jonathan M Magalski <jmmagalski@aep.com>
Subject: [EXTERNAL] Racine eel ramp operation?

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Hope you are well.

Rick

Richard C. McCorkle

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State College, PA 16801
Office: 814-206-7470
Personal cell (while teleworking): 302-382-0284

Yayac, Maggie

Subject: FW: Racine Hydroelectric Project (FERC No. 2570) -- Response to Initial Study Report Comments

Attachments: 20200810 Racine Response to ISR Comments.pdf

From: Hanson, Danielle
Sent: Monday, August 10, 2020 3:02 PM
To: 'Advisory Council on Historic Preservation' <jeddins@achp.gov>; 'City of New Haven' <nhcityhall@frontier.com>; 'City of Pomeroy (Mayor)' <dmanderson242@hotmail.com>; 'Meigs Soil and Water Conservation district' <steve.jenkins@oh.nacdnet.net>; 'ODNR Division of Wildlife' <mike.greenlee@dnr.state.oh.us>; 'OH Rep Dist 94 - Jay Edwards' <JayEdwardsOhio@gmail.com>; 'OHEPA' <Craig.Butler@epa.ohio.gov>; 'Ohio Department of Natural Resources' <sarah.tebbe@dnr.state.oh.us>; 'Ohio Department of Natural Resources' <Steve.Holland@dnr.state.oh.us>; 'Ohio River Valley Water Sanitation Commission' <sdinkins@orsanco.org>; 'Osage Nation' <jmunkres@osagenation-nsn.gov>; 'Osage Nation' <ahunter@osagenation.nsn.gov>; 'SHPO' <khorrocks@ohiohistory.org>; 'Town of New Haven (Mayor)' <bubba070260@gmail.com>; 'US Department of the Interior' <Harold.Peterson@bia.gov>; 'US Environmental Protection Agency' <pelloso.elizabeth@epa.gov>; 'USACE' <andrew.n.johnson@usace.army.mil>; 'USACE' <Belinda.M.Weikle@usace.army.mil>; 'USEPA' <Westlake.kenneth@epa.gov>; 'USEPA' <Rudnick.Barbara@epa.gov>; 'USFWS' <richard_mccorkle@fws.gov>; 'USFWS' <angela_boyer@fws.gov>; 'USFWS' <jennifer_l_norris@fws.gov>; 'USGS' <jswhite@usgs.gov>; 'USGS' <smwickle@usgs.gov>; 'Village of Racine' <racinemayor@suddenlinkmail.com>; 'Villgae of Middleport' <mayormike@village.middleport.oh.us>; 'West Virginia Division of Natural Resources' <jacob.d.harrell@wv.gov>; 'West Virginia Division of Natural Resources' <barbara.d.sargent@wv.gov>; 'West Virginia Division of Natural Resources' <danny.a.bennett@wv.gov>; 'WVDEP' <Brian.L.Bridgewater@wv.gov>
Cc: 'Jonathan M Magalski (jmmagalski@aep.com)' <jmmagalski@aep.com>; Elizabeth B Parcell <ebparcell@aep.com>; Quiggle, Robert <Robert.Quiggle@hdrinc.com>
Subject: Racine Hydroelectric Project (FERC No. 2570) -- Response to Initial Study Report Comments

Racine Hydroelectric Project Stakeholders:

AEP Generation Resources Inc. (AEPGR), a unit of American Electric Power (AEP), is the licensee, owner and operator of the Racine Hydroelectric Project (FERC No. 2570) (Project) located on the Ohio River in Meigs County, Ohio. The Project is operated under a license issued by the Federal Energy Regulatory Commission (FERC). The existing FERC license for the Project expires on November 30, 2023. AEPGR is pursuing a new license for the continued operation of the Project in accordance with FERC's Integrated Licensing Process (ILP).

In accordance with the Commission's regulations at 18 C.F.R. § 5.15 and the Commission's May 13, 2019 Study Plan Determination (SPD), AEPGR filed the Initial Study Report (ISR) with FERC on May 5, 2020. Additionally, AEPGR held an Initial Study Report Meeting (ISR Meeting) with participants and FERC staff via Webex on May 14, 2020. An ISR Meeting summary was filed with FERC on June 11, 2020. The deadline to submit any disputes or requests to amend studies was July 11, 2020. Comment letters were received from West Virginia Division of Natural Resources (WVDNR), U.S. Fish and Wildlife Service (USFWS), and U.S. Army Corps of Engineers (USACE) on June 5, June 29, and July 9, 2020, respectively. Additional comments from Ohio Department of Natural Resources (ODNR) were received via email on July 21 and 22, 2020, after the comment response period ended. AEPGR filed responses to comments on the ISR on August 10, 2020.

On behalf of AEPGR, we are notifying stakeholders of the availability of this filing. For your convenience, a copy of the response to ISR comments is attached.

Should you have any questions regarding this filing, please contact Jon Magalski with AEP at (614) 716-2240 or jmmagalski@aep.com.

Thank you,

Danielle Hanson

Environmental Scientist

HDR
M 315.729.4745
Danielle.Hanson@hdrinc.com

hdrinc.com/follow-us

American Electric Power
1 Riverside Plaza
Columbus, OH 43215
aep.com

Via Electronic Filing August 10, 2020

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

Subject: Racine Hydroelectric Project (FERC No. 2570)
Response to Comments on the Initial Study Report

Dear Secretary Bose:

AEP Generation Resources Inc. (AEPGR), a unit of American Electric Power (AEP), is the licensee, owner, and operator of the Racine Hydroelectric Project (Project) (FERC Project No. 2570), located on the Ohio River in Meigs County, Ohio. The Project is operated under a license issued by the Federal Energy Regulatory Commission (FERC or Commission). The existing FERC license for the Project expires on November 30, 2023.

AEPGR has elected to utilize the Integrated Licensing Process (ILP) for the relicensing of the Project as defined in 18 Code of Federal Regulations (C.F.R.) Part 5. In accordance with the Commission's regulations at 18 C.F.R. §5.15 and the Commission's May 13, 2019 Study Plan Determination (SPD), AEPGR filed the Initial Study Report (ISR) with FERC on May 5, 2020. Additionally, AEPGR held an Initial Study Report Meeting (ISR Meeting) with participants and FERC staff via Webex on May 14, 2020. An ISR Meeting summary was filed with FERC on June 11, 2020. The deadline to submit any disputes or requests to amend studies was July 11, 2020. Comment letters were received from West Virginia Division of Natural Resources (WVDNR), U.S. Fish and Wildlife Service (USFWS), and U.S. Army Corps of Engineers (USACE) on June 5, June 29, and July 9, 2020, respectively. Additional comments from Ohio Department of Natural Resources (ODNR) were received via email on July 21 and 22, 2020, after the comment response period ended. AEPGR is hereby providing responses to comments received on the ISR.

Water Quality Study

Stakeholder Comments:

WVDNR and USFWS requested that additional water quality monitoring be collected at the Project from July 1st through October 15th. In addition, USACE provided support for USFWS' request for additional water quality monitoring. Both WVDNR and USFWS agreed that it is not necessary for AEPGR to collect additional reservoir profile data. Due to biofouling that occurred during the 2019 study season, the recommendation was also made to conduct maintenance and performance checks on a bi-weekly or weekly basis rather than monthly.

AEPGR's Response:

AEPGR has taken these additional study requests into consideration and has been working on procuring the necessary equipment and working on logistics to deploy water quality data loggers at the Project in 2020. AEPGR anticipates that continuous water quality data loggers will be deployed at the Project by mid-August and will remain in place through October 15th. Although the data loggers were not installed by July 1st as requested, AEPGR believes that the data collected will capture periods of low flow and high temperatures that are of the greatest concern to the resource agencies. AEPGR is also proposing to conduct bi-weekly maintenance and performance checks as opposed to monthly checks to address the agencies' concerns regarding biofouling.

Recreation Study

Stakeholder Comments:

WVDNR and ODNR requested that an additional year of recreational use data be collected. USFWS and USACE expressed support for WVDNR and ODNR's request for an additional year of study. Suggestions were made regarding using local newspaper advertisements, social media, in-person interviews, and/or continuing the hardcopy drop box surveys to collect additional recreational use information.

AEPGR's Response:

AEPGR installed two weatherproof boxes at the Project's recreation facility, which includes a tailrace fishing platform and picnic area, containing hardcopy survey forms. AEPGR also developed an online survey that was posted to their public relicensing website as well as displayed on signs at the recreation site, which directed recreationists how to access the survey. Additionally, AEPGR reached out to local fishermen with extensive knowledge and experience regarding recreation in the Project area and conducted phone interviews to obtain additional information about their recreational experience at the Project. As part of the phone interviews, AEPGR requested recommendations for any enhancements to the existing Project recreation facilities. A total of 21 online and hardcopy survey questionnaires were completed and phone interviews were conducted with two experienced local fishermen. AEPGR believes that the data that has been collected during this study is sufficient to inform current Project facility usage and inform potential facility enhancements to be considered in the development of the license application.

Mussel Survey

Stakeholder Comments:

WVDNR and USFWS indicated that they were satisfied with the results of the Mussel Survey as performed by AEPGR and stated their appreciation of AEPGR's coordination and additional effort in conducting this study.

AEPGR's Response:

AEPGR appreciates the comments.

Fisheries Survey

Stakeholder Comments:

WVDNR and USFWS expressed support for AEPGR's proposed modification during the ISR Meeting to forgo the spring trawl surveys due to safety concerns related to the COVID-19 pandemic. Additionally, USFWS mentioned that in AEPGR's Revised Study Plan, AEPGR agreed to provide information as requested by USFWS in order to conduct its own analysis related to potential fish passage at the Project. USFWS inquired as to whether this component of the study will be carried out.

AEPGR's Response:

AEPGR appreciates WVDNR and USFWS' support regarding the study modification in light of the current COVID-19 pandemic. As mentioned by USFWS, in the Revised Study Plan AEPGR agreed to provide the following data (as available) to resource agencies for the last five years in order to conduct their own analyses related to potential fish passage at the Project:

- Headpond elevations,
- Tailwater elevations,
- Gate (i.e., spill) operations (including the sequence and timing of specific gates),
- Unit 1 and 2 turbine discharge, and
- Lock operations (including any openings for maintenance).

AEPGR also agreed to provide any available dam/powerhouse elevation drawings and/or bathymetric data upstream or downstream.

This is an ongoing study in which AEPGR has installed a temporary eel ramp that will remain in place through fall 2020. AEPGR will compile available data as indicated above and provide these data to the resource agencies prior to the completion of this study.

Fish Entrainment and Impingement Study

Stakeholder Comments:

WVDNR and USFWS requested that AEPGR use sensor fish technology as developed by the Department of Energy's Pacific Northwest National Laboratory to bolster findings of the desktop entrainment analysis being performed by AEPGR. USFWS also requested that AEPGR use USFWS' Turbine Blade Strike Analysis model while conducting their analyses for this study.

AEPGR's Response:

WVDNR and USFWS previously requested that AEPGR use sonar technology in order to assess the number of fish passing through the powerhouse, to inform the desktop study proposed by AEPGR in the Proposed and Revised Study Plans. FERC indicated in the SPD for the Project that the desktop Fish Entrainment and Impingement Study as proposed by AEPGR was consistent with generally accepted practices for evaluating fish entrainment at hydroelectric projects and is a widely accepted methodology that has been implemented at other FERC projects, in lieu of conducting site-specific entrainment studies. FERC also stated that "AEP Generation Resource's proposed desktop analysis would provide the necessary information for staff to conduct an analysis of fish entrainment and impingement at the project." AEPGR does not believe that adequate justification was provided for modification to the FERC-approved Fish Entrainment and Impingement Study according to the following criteria in 18 CFR 5.15(d):

> (1) Approved studies were not conducted as provided for in the approved study plan; or
> (2) The study was conducted under anomalous environmental conditions or that environmental conditions have changed in a material way.

For the reasons stated above, AEPGR is not proposing to modify the Fish Entrainment and Impingement Study as approved in FERC's SPD and does not believe a modification is warranted.

General Comments

Stakeholder Comments:

In addition to the request for an additional year of recreation data, ODNR provided information from the National Heritage Database for rare, threatened and endangered species, including but not limited to bats, mussels, and Eastern Spadefoot Toad.

AEPGR's Response:

AEPGR appreciates the additional information provided by ODNR and will consider this information during the development of the license application.

If there are any questions regarding this filing, please do not hesitate to contact me at (614) 716-2240 or jmmagalski@aep.com.

Sincerely,

Jonathan M. Magalski
Environmental Specialist Consultant
American Electric Power Services Corporation, Environmental Services

Attachment

Cc: Distribution List
Liz Parcell (AEP)
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Racine Hydroelectric Project (FERC No. 2570)
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Comments on Initial Study Report

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Jim Justice
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Director

Jun 5, 2020

Electronic File

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

RE: Racine Hydroelectric Project (FERC no. P-2570) Initial Study Report Agency Comments

Dear Secretary Bose:

Thank you for allowing the West Virginia Division of Natural Resources, Wildlife Resources Section (WRS) the opportunity to provide comments with regards to the Initial Study Report for the Racine Hydroelectric Project (FERC No. 2570). The WRS has reviewed the referenced report and offers the following comments for consideration:

2.1 Water Quality Study

The WRS would request that an additional year of a water quality assessment be conducted at the Project. The stated purpose of the initial year of water quality assessment was to assess what relationship the Project's operation may have on dissolved oxygen concentrations and temperature both upstream and downstream of the Project. There were long, extended periods during the first year of sampling that coincided with the Project not being in operation, therefore the true extent by which the Project may impact water quality in the tailrace and further downstream is inconclusive. An additional year of sampling may provide clearer evidence of impact or otherwise, provided that the Project maintains operational status throughout the term of the sampling period. The WRS would request that sampling be conducted from, at the very least, July 1st to October 15th to correspond with periods when water quality issues would be expected to occur.

Additionally, the WRS would request that an additional year of analysis be amended to focus specifically on the continuous water quality monitoring stations and exclude the reservoir profile locations. Data collected through the reservoir profile assessment is not expected to offer any new insights from year to year beyond what has already been provided. The purpose of the reservoir profile locations was to assess the likelihood of stratification and the degree by which the reservoir might become stratified. With the previous year being atypically dry and hot, the questions of stratification would have been sufficiently answered.

A review of available data from the water quality assessment indicates several periods when water quality conditions were violated. However, many, if not all, of these violations may be attributable to biofouling of the primary data loggers. With biofouling being a common and regular occurrence, it may be beneficial to increase the number of probe maintenance and performance checks by having weekly or bi-weekly checks as opposed to monthly checks.

2.2 Recreation Study

The WRS would request that an additional year of recreation study be conducted at the Project. With only 21 responses through online submittal and survey box questionnaires, the WRS does not have a high level of confidence that an adequate sample size was assessed. A second year of study should focus on increasing the sample size. The difficulty is in getting people to take the time and effort on their own accord to complete the survey. Steps should be taken to increase the public's awareness of the survey. This can be completed by taking ads out in the local newspapers, publishing social media posts across differing platforms, or providing an incentive for completing the survey. The WRS will also be willing to assist in informing the public through their own channels.

2.4 Mussel Survey

The WRS has reviewed the mussel survey and has no comments at this time. The study was conducted according to the plan as negotiated between the resource agencies and AEP. The WRS appreciates AEP's attention to this matter and in conducting the survey. Results from the survey were positive and indicated a diverse mussel community downstream of the Project.

2.5 Fisheries Survey

The fisheries survey has not been fully completed at this time but is expected to continue for the 2020 sampling season, albeit in a slightly modified condition. In light of safety concerns that have arisen due to the COVID-19 pandemic, the WRS would be in support of abandoning the remaining trawl samples, provided that attention be focused on littoral sampling via electrofishing methodology.

Amendments and Additions to Study Plans in Accordance to 18 CFR § 5.9 (b)

In-Field Support of Fish Entrainment Study

1. *Goals and Objectives:*

   The goal of this study is to provide a complimentary source of information to enhance the desktop entrainment analysis and to better estimate turbine mortality due to Project operation.

2. *Resource Management Goals:*

   As the state resource agency, the WRS is charged with the protection and management of all wildlife, including fish, within West Virginia. As such, the WRS may prescribe conditions that avoid, minimize, or mitigate for any damages likely to incur to West Virginia wildlife and fisheries. It is understood that the Project's operation results in the loss of fish as they pass through turbine and intake structures. As per state rule §47-5A-6, the applicant would be required to compensate the state of West Virginia for any loss of fish. Therefore, the WRS seeks the most accurate estimation of Project impacts as related to fish loss.

3. *Existing Information:*

   To date, the WRS is not aware of any similar analyses conducted at the Racine Project. This would be a novel approach to obtaining a clearer picture of project effects on the ichthyofauna.

4. *Public Interest:*

   The WRS is a state resource agency in service of the public.

5. *Nexus Between Project Operation:*

   During operation of the facility, fish may be able to pass through the trash racks and become entrained through the turbines. As the turbines operate, it is likely that some fish will be struck by turbine blades while others may succumb to changes in barometric pressure and shear stresses as they pass through the intake. The likelihood of experiencing turbine-induced mortality varies from species to species and increases as the size of the fish increases.

6. *Study Methodology:*

   The WRS is requesting the use of sensor fish technology as developed by the Department of Energy's Pacific Northwest National Laboratory to be incorporated and used to bolster findings of the desktop entrainment analysis. The sensor fish can be deployed within the turbine units to assess shear forces, collision potential, pressure changes, and other conditions associated with turbine passage. This information can then be used as a companion source of data for the desktop entrainment study to provide more site-specific information and can be used with existing turbine mortality data to arrive at a more accurate estimate of turbine influence at the Racine Project.

7. *Level of Effort and Cost:*

   This type of study would cost comparatively less and require less effort than other in-field measurement studies (i.e. net survey, sonar survey, etc.) The WRS estimates that the cost and effort of this addition analysis would be low and attainable.

Thank you again for allowing the WRS the opportunity to provide comments and for your consideration in this matter. If you have questions regarding this letter please contact me by telephone at (304)825-6787, or by email at Jacob.D.Harrell@wv.gov.

Sincerely,

Jacob Harrell
Hydropower Coordination Biologist

Cc: Jonathan Magalski, AEP Generation Resources
Rick MacCorkle, USFWS
John McClosky, USFWS
Michael Greenlee, ODNR
Jeff Hansbarger, WVDNR
Danny Bennett, WVDNR

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Pennsylvania Field Office
110 Radnor Road, Suite 101
State College, Pennsylvania 16801-4850

June 29, 2020

Ms. Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
Mail Code: DLC, HL-11.2
888 First St., NE
Washington, DC 20426

RE: Racine Hydroelectric Project (FERC No. 2570); Initial Study Report (ISR) Meeting Summary Disagreements and Requests to Amend Study Plan to Include New or Modified Studies

Dear Secretary Bose:

The U.S. Fish and Wildlife Service (Service) participated in American Electric Power Generation Resources' (AEPGR) May 14, 2020, ISR meeting for the Racine Hydroelectric Project (FERC No. 2570) to discuss progress toward completing approved relicensing studies. Pursuant to 18 CFR § 5.15(c)(4), the Service provides the following comments and requests.

2.2, Water Quality Study:

The Federal Energy Regulatory Commission's (Commission; FERC) August 21, 2018, Scoping Document 1 (SD1) and December 12, 2018, Scoping Document 2 (SD2) identified the following environmental resource issue to be analyzed in the Environmental Assessment (EA) for the Project relicensing:

- Effects of continued project operation on water quality (e.g., dissolved oxygen and water temperature) in the Ohio River downstream of the project.

In the Commission's Study Plan Determination (SPD), they state: "We also recommend that the analysis for this study incorporate data from the operation of the Corps' Racine Locks and Dam facilities at the time of the water quality sampling to determine whether any observed effects on downstream water quality are the result of project operation or the operation of the Corps' facilities." For this analysis to be possible, the Project must be operating during most of the study. The Commission also states in their SPD that "Staff's environmental analysis would need to assess the effects of continued operation on aquatic resources, including water quality, in the Ohio River downstream of the project."

However, from June 17 to October 7, October 10 to October 12, and October 28 to October 31, 2019, overlapping most of the summer low flow season when water temperatures reach their maximum and dissolved oxygen issues are most likely, hydroelectric operations were inactive. Therefore, results of the water quality study cannot be expected to achieve the Commission's stated objectives (above). The Service requests that most of the study be repeated in 2020. Results of the repeated study would not be considered acceptable unless the Project is operating during most of the low-flow summer season. The Service identified this issue during the ISR meeting, and we stated that we would be making this request. Therefore, we expect that AEPGR has anticipated the likely need to repeat most of the study and has already begun the study as of the date of this letter. If that is not the case, then we request that the study be re-initiated immediately in order to evaluate possible effects of Project operations on water quality during the time period beginning July 1 and extending through October 15.

It is also our understanding that weather and precipitation during the summer of 2019 may not have been typical at the Project location, with drought conditions occurring during a portion of the study period, further supporting the need to repeat this study.

There is at least one study task that the Service does not see a need to repeat. We do not consider it necessary to repeat the instantaneous depth profile sampling in the forebay.

It is not entirely clear whether requesting a repeat of this study qualifies as a modification of an approved study. According to 18 CFR 5.15(d), any proposal to modify an ongoing study must be accompanied by a showing of good cause why the proposal should be approved and must include, as appropriate to the facts of the case, a demonstration that:
(1) Approved studies were not conducted as provided for in the approved study plan; or
(2) The study was conducted under anomalous environmental conditions or that environmental conditions have changed in a material way.

The Service believes that both of the above criteria apply because the study was not conducted as provided in the approved study plan in that the Project was not operating during most of the study, thus failing to achieve the primary study objective of identifying effects of Project operations on water quality, and because much of the study was conducted during atypically dry and hot conditions at the Project location.

We would also like to note that the map in the ISR showing the water quality monitoring stations is unreadable.

There were fouling issues with the primary continuous data loggers during this study in 2019. The Service requests that AEPGR consider checking and cleaning data loggers at a greater frequency during the requested 2020 repeat of this study. Instead of checking and cleaning loggers on a monthly basis, we request that the loggers be checked and cleaned on a weekly basis to reduce fouling issues.

2.3, Recreation Study:

The Service supports the positions of West Virginia Division of Natural Resources (WVDNR) and Ohio Department of Natural Resources (ODNR) that an additional year of recreation study should be conducted at the Project.

2.5, Mussel Survey:

The mussel survey was performed according to the agreed-upon modified West Virginia Mussel Survey Protocol. The Service is satisfied with the performance of this study, and appreciates the additional effort expended in adhering to the protocol. As a result of this additional effort, there were several mussel species found during this survey that were not found during the 2010 and 2015 surveys (in support of U.S. Army Corps of Engineers maintenance dredging program), three of which are Ohio State-listed endangered species, and one of which is a threatened species in Ohio. Five of the additional species found during this survey are considered very rare (S2) or extremely rare (S1) in West Virginia. No federally listed endangered or threatened species were found during the survey.

2.6, Fisheries Survey:

Based on the discussion during the May 14 ISR meeting, spring surveys were to be completed in 2020, with some proposed modifications due to the COVID-19 pandemic. As stated during the meeting, the Service supports AEPGR's decision to forgo the spring trawl surveys due to concerns regarding inability of personnel to maintain social distancing in this type of survey. The fall fisheries surveys, which were completed in 2019, documented a total of 25 species and only 2 species in the trawl surveys, whereas more than 60 fish species are known to occur in the Racine Pool (ORSANCO database, 2010-2018).

In their SPD, the Commission stated that "…we recognize that existing data and data collected as part of the approved study plan may be insufficient to satisfactorily estimate American eel entrainment, impingement, and turbine mortality at the project. Therefore, AEP Generation Resources may need to supplement existing desktop entrainment databases with additional studies upstream of the project that focus on American eels. AEP Generation Resources should evaluate the need for additional data or studies on American eel after completing the *Fish Entrainment and Impingement* and *Fisheries Studies*, as modified herein, and should discuss in the ISR the need for any additional data or analysis. The issue can be addressed at the ISR Meeting required under section 5.15(b)(2). Following this meeting, stakeholders can request modifications to the approved study plan for additional data or analysis, or request new site-specific information gathering or studies. Accordingly, we do not recommend targeted eels surveys upstream of the project at this time." Considering the very limited results of the fall 2019 electrofishing surveys (i.e., only 25 species collected and no American eels collected), the Service would like to discuss possible additional, targeted, American eel surveys in the Racine Pool during the fall of 2020.

It is worth noting that sauger (*Sander canadensis*), a migratory species and the only confirmed host for the federally listed endangered sheepnose mussel (*Plethobasus cyphyus*), was among the most abundant species collected in the 2019 electrofishing surveys. However, the Service is unable to determine whether these collections occurred in the Racine Pool or in the RC Byrd Pool, because Figure 2.5-1 in the ISR, which is supposed to show the numbered transects, is unreadable. The sheepnose mussel is known to occur a short distance downstream of the RC Byrd Locks and Dam, and any Project impacts to sauger may have negative reproduction and recruitment effects on this federally listed mussel species. The Service is responsible for recovering this species.

The Commission's August 21, 2018, SD1 and December 12, 2018, SD2 identified effects of continued project operation on upstream and downstream fish passage at Racine Locks and Dam as an environmental resource issue to be analyzed in the EA for the Project relicensing..

In comments filed by the Service in response to AEPGR's Proposed Study Plan[1], as an alternative to the Service's previously requested *Fish Protection and Upstream and Downstream Passage Study* which AEPGR did not agree to, the Service requested information in order to conduct its own analysis. In order to evaluate the magnitude and persistence of false attraction flows, and to develop a holistic model of flow management and operations at the site, the Service requested specific historical data on a daily (or finer) resolution for a period covering at least 10 years. This information was to include headpond elevations, tailwater elevations, gate (i.e., spill) operations (including the sequence and timing of specific gates), unit 1 and unit 2 turbine discharge, lock operations (including any openings for maintenance), and any dam/powerhouse elevation drawings and/or bathymetric data in the immediate upstream or downstream vicinity of the dam that would allow us to estimate mean velocities.

In their Revised Study Plan (RSP), AEPGR agreed to incorporate this information request into the modified Fisheries Study, and renamed the Study accordingly: *Fisheries Survey, Project Characteristics, and Project Operations Related to Potential Fish Passage* study in Section 10 of the RSP (Section 10.6.1 Task 1 – Data Review and Synthesis). While the Commission did not mention or discuss this aspect of the study in their SPD, they stated that "Studies for which no issues were raised in comments on the RSP are not discussed in this determination. Unless otherwise indicated, all components of approved studies not modified in this determination must be completed as described in AEP Generation Resources' RSP." Because the "Fisheries Study" was approved with modifications, it is unclear to the Service whether this component of the study was approved by the Commission. The Service addressed this proposed study revision in RSP comments filed on April 29, 2019, by stating that we appreciated AEPGR's proposal to incorporate the requested information into the study. Will this component of the study be carried out?

2.7, Fish Entrainment and Impingement Study:

RSP Section 11.6.1, Task 1, involves the formation of a study working group including the Service, WVDNR, ODNR and other stakeholders who express interest in participating in this study. Interested parties will also communicate to identify target fish species and if needed, refine protocols specific to this study.

[1] FERC accession number 20190315-5127

Under RSP Section 11.6.6, Task 6 is to determine monthly turbine entrainment rates from existing empirical data and utilize these rates to estimate monthly turbine entrainment for the target species using existing hydrology and Project operations. The Service requests protocols be added to the study related to this task. In recently filed comments[2], the WVDNR has requested an additional analysis to complement the currently proposed entrainment evaluation, in order to ensure as accurate as possible entrainment mortality estimates to inform WV fish loss compensation requirements. WVDNR proposes the use of a sensor fish that can be released into the powerhouse intake to measure acceleration, pressure changes, rotational velocity, and orientation, conveying what real fish may experience during downstream passage through the specific Project turbines.

While the Service supports this proposed study enhancement, we also recommend as an additional verification of results, the use of the Service's Excel-based Turbine Blade Strike Analysis model developed by Service Fish Passage Engineering. As a complement to this model, Service engineers have identified the need to adjust one of the input parameters for evaluation of American eel, to more accurately predict blade-strike potential for this species.

Pursuant to 18 CFR 5.15(e), any proposal for new information gathering or studies must be accompanied by a showing of good cause why the proposal should be approved and must include, as appropriate to the facts of the case, a statement explaining:

(1) Any material changes in the law or regulations applicable to the information request;
(2) Why the goals and objectives of any approved study could not be met with the approved study methodology;
(3) Why the request was not made earlier;
(4) Significant changes in the project proposal or that significant new information material to the study objectives has become available; and
(5) Why the new study request satisfies the study criteria in 18 CFR §5.9(b).

The Service's and WVDNR's previous requests for an in-field verification component (e.g., tailrace netting; hydroacoustic monitoring of fish entering the intake) were denied due to projected costs, despite pointing out that the only historical in-field entrainment studies conducted at projects on the Ohio River were flawed (e.g., < 4% discharge netting efficiency) and not accepted by the resource agencies. Those studies also did not meet the screening criteria for inclusion in the Electric Power Research Institute's (EPRI) entrainment survival database. The Service has commented extensively on this issue in previous comment letters[3], but to date the Commission has not supported any in-field entrainment verification requests at any of the projects on the Ohio River.

A stated objective of the RSP is to conduct a desktop analysis that incorporates the impingement assessment, Project specifications, and hydrology to quantify turbine entrainment and mortality at the Project. The Service continues to be concerned about the ability of this study, as currently proposed, to accurately quantify turbine entrainment mortality at the Project, considering the

[2] FERC accession number 20200605-5046
[3] FERC accession number 20190315-5127

study will largely rely on survival rates at other projects with similar turbines, documented in the EPRI entrainment survival database and other databases (Stone & Webster Environmental Services [1992] and FERC [1995]).

The Service did not previously request use of a sensor fish because Service representatives who are participating in the Racine Project relicensing were unaware of this technology until recently, and until the Commission issued its SPD, we were focused on promoting use of a more substantial in-field study component, such as the use of hydroacoustic monitoring at the Project intake. In previous comments on the Proposed Study Plan[4] the Service requested "some type of in-field verification..." Regarding the Service's Turbine Blade Strike Analysis Model, we have recommended its use in other project relicensing proceedings, including a proceeding for relicensing of another project owned by American Electric Power. It was mostly an oversight on our part that we did not request its use in this relicensing proceeding until now, although as previously stated, we were also focusing on pursuit of some type of in-field verification of desktop results.

It is unclear whether the requested use of a sensor fish and/or the Service's Turbine Blade Strike Analysis model constitutes a modification to an approved study or new information gathering, but the Service believes the above requested approaches to better informing and/or verifying the results of the proposed desktop study satisfy the study criteria in 18 CFR §5.9(b) as follows:

I, Entrainment and Impingement Desktop Study Results Verification

The Licensee proposes to perform a desktop reverification Entrainment/Impingement Study to assess potential Project effects on fish mortality and injury using existing literature and site-specific information. The Licensee is consulting with interested stakeholders to establish appropriate methodology and to identify fish species that are potentially subjected to impingement and entrainment.

At the September 27, 2018, scoping meeting, the Service stated that an in-field entrainment study would likely be requested because it is our opinion that there has never been an acceptable in-field entrainment study conducted at any of the hydropower projects on the Ohio River, as discussed in FERC's 1988 Final Environmental Impact Statement for Hydroelectric development in the Upper Ohio River Basin (FEIS: FERC 1988). In the FEIS, the Commission stated that the results of studies of turbine-induced fish mortality are highly varied, and they concluded that "all entrainment field studies to date are deemed incomplete and inconclusive for answering impact questions on the upper Ohio River system quantitatively, despite extensive effort. The Commission further stated that "no reliable, quantitative estimate of passage rates for sites on the upper Ohio River system is presently available…"

In addition to the Licensee's intention to consult with interested stakeholders to establish appropriate methodology and to identify fish species that are potentially subjected to impingement and entrainment, we request that this consultation also include consideration of some type of verification or "ground-truthing." The resource agencies do not have a high degree

[4] FERC accession number 20190315-5127

of confidence in the studies included in the Electric Power Research Institute (EPRI) database as to their applicability to Ohio River Projects located at locks and dams.

1. *Goals and Objectives*

The goals and objectives of this study enhancement or modification are to provide a ground-truth or secondary verification of desktop study survival rates of all species and life stages of fish that may be entrained in powerhouse turbines, and improve or verify the accuracy of corresponding annual mortality rates. Estimates should also consider indirect, latent mortality of injured fish that are subjected to predation (e.g., due to disorientation or loss of equilibrium), disease (e.g., as a result of cavitation injuries) or physiological stress.

2. *Resource Management Goals*

These goals include: to protect native fish populations and ensure that entrainment impacts are not resulting in population-level effects to species of conservation concern (e.g., American eel, sauger, paddlefish), and to provide an accurate justification for protection, mitigation, and enhancement measures. Conclusions regarding potential population-level effects should consider the cumulative effects of multiple, stacked hydropower project on the Ohio River and its major tributaries (e.g., Allegheny River and Monongahela River).

3. *Public Interest*

The requestor is a resource agency.

4. *Existing Information*

The only Ohio River in-field entrainment studies to date, those at the Racine (WAPORA, Inc. 1987) and Greenup (Olson and Kuehl 1988; Olson et al. 1987) projects, did not satisfy screening criteria for inclusion in the EPRI entrainment survival database. All entrainment field studies to date are deemed incomplete and inconclusive for answering impact questions on the upper Ohio River system quantitatively (FERC 1988).

5. *Nexus to Project Operations and Effects*

Operations of the Project result in injury and mortality of a percentage of fish that are impinged on powerhouse intake trash racks or entrained in Project turbines.

6. *Methodology Consistent with Accepted Practice*

The sensor fish has been utilized at several hydropower projects in the western United States, and the Service's Turbine Blade Strike Analysis model is currently being used in relicensing studies at other hydropower projects in the Northeast.

7. *Level of Effort, Cost, and Why Alternative Studies Will Not Suffice*

The addition of a sensor fish ground-truth component would be relatively inexpensive compared to other in-field measurements (e.g., discharge netting, hydroacoustic monitoring at the intake). The Service estimates that the cost and level of effort for this study enhancement would be low and attainable. The cost and level of effort associated with the additional use of the Service's Turbine Blade Strike Analysis model would be minimal. The Service previously requested other approaches to verifying the results of the desktop analysis, but the Commission determined that those other approaches were cost-prohibitive.

Thank you for your consideration and for the opportunity to comment on the ISR and ISR meeting summary. If you have any questions regarding this matter, please contact Richard McCorkle of my staff at 302-382-0284 (personal cell number while teleworking during pandemic) or at richard_mccorkle@fws.gov.

Sincerely,

Sonja Jahrsdoerfer

Sonja Jahrsdoerfer
Project Leader

cc: Jonathon Magalski, AEPGR
Jacob Harrell, WVDNR
Michael Greenlee, ODNR

Literature Cited:

Federal Energy Regulatory Commission (FERC). 1995. Preliminary assessment of fish entrainment at hydropower projects, a report on studies and protective measures, volumes 1 and 2 (Paper No. DPR-10). Office of Hydropower Licensing, FERC, Washington, DC.

FERC. 1988. Hydroelectric development in the upper Ohio River basin: Final Environmental Impact Statement. FERC Docket No. EL85-19-114, Ohio, Pennsylvania, West Virginia. Federal Energy Regulatory Commission, Office of Hydropower Licensing. FERC/FEIS-0051.

Olson, F.W., and E.S. Kuehl. 1988. Fisheries Resource Studies, Vanceburg Hydroelectric Generating Station No. 1 (FERC Project No. 2614). Volume 2. Survival of sauger passing through bulb turbines and tainter gates at Greenup Dam, Ohio River. CH2M Hill and Biosonics. Report for the City of Vanceburg, Kentucky.

Olson, F.W., J.F. Palmisano, G.E. Johnson, and W.R. Ross. 1987. Fish population and entrainment studies for the Vanceburg Hydroelectric Generating Station No. 1. CH2M Hill, Inc. and Biosonics, Inc.

Stone & Webster Environmental Services. 1992. Fish entrainment and turbine mortality review and guidelines. EPRI Report TR-101232. September 1992.

WAPORA, Inc. 1987. Fish passage studies at the Racine and New Martinsville hydroelectric projects. 4 vols. Cincinnati, Ohio.

DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS
HUNTINGTON DISTRICT
502 8TH STREET
HUNTINGTON, WV 25701

July 09, 2020

Ms. Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
Mail Code: DLC, HL-11.2
888 First St., NE
Washington, DC 20426

RE: Racine Hydropower Project (FERC No. 2570); Initial Study Report (ISR) Meeting Summary USACE Comments

Dear Secretary Bose:

On May 14, 2020, the U.S. Army Corps of Engineers (Corps), Huntington District participated in an American Electric Power (AEP) ISR meeting for the Racine hydropower project. The ISR submittal contained Federal Energy Regulatory Commission (FERC) required studies for relicensing. The Corps provides the following comments.

The Corps has discussed the ISR studies with the appropriate state resource agencies and the US Fish and Wildlife Service (USFWS). In particular, the Huntington District had extensive discussions regarding the Water Quality Study and the Recreation Study.

Water Quality Study: Fish and Wildlife Conservation is a congressionally authorized project purpose and water quality remains a Federal interest for the project at Racine Locks and Dam. The Corps supports the USFWS request to reevaluate the impacts of hydropower and dam operation on water quality in 2020. The hydropower project was not in operation for a significant portion of the 2019 water quality analysis including the critical low flow summer period. As a result, the 2019 study is insufficient to make any determinations on water quality impacts.

Recreation Study: Recreation is a congressionally authorized project purpose at Racine Locks and Dam. The Corps supports the request by the West Virginia Division of Natural Resources and Ohio Department of Natural Resources for an additional year of analysis for the Recreation Study.

RE: Racine Hydropower Project (FERC No. 2570); Initial Study Report (ISR) Meeting Summary USACE Comments

For questions, please contact me by phone (304) 399-5964 or email Lesli.F.StoneSmith@usace.army.mil.

Sincerely,

Lesli Stone Smith
Program Manager
U.S. Army Corps of Engineers

CC: Honggang Cao, FERC
John Zygaj, FERC

Office of Real Estate
John Kessler, Chief
2045 Morse Road – Bldg. E-2
Columbus, OH 43229
Phone: (614) 265-6621
Fax: (614) 267-4764

July 21, 2020

Danielle Hanson
HDR Inc.
11 Stanwix Street, Suite 800
Pittsburgh, PA 15222

Re: 20-512; Racine Hydroelectric Project (FERC No. 2570-032)

Project: he proposed project involves continued operation of the existing hydroelectric project under a new license.

Location: The proposed project is located in Racine Township, Meigs County, Ohio.

The Ohio Department of Natural Resources (ODNR) has completed a review of the above referenced project. These comments were generated by an inter-disciplinary review within the Department. These comments have been prepared under the authority of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.), the National Environmental Policy Act, the Coastal Zone Management Act, Ohio Revised Code and other applicable laws and regulations. These comments are also based on ODNR's experience as the state natural resource management agency and do not supersede or replace the regulatory authority of any local, state or federal agency nor relieve the applicant of the obligation to comply with any local, state or federal laws or regulations.

Natural Heritage Database: The Natural Heritage Database has the following records at or within a one-mile radius of the project:

American eel (*Anguilla rostrate*), T
Tippecanoe darter (*Etheostoma Tippecanoe*), T
Goldeye (*Hiodon alosoides*), E
Channel darter (*Percina copelandi*), T
River darter (*Percina shumardi*), T
Paddlefish (*Polyodon spathula*), T
Eastern spadefoot (*Scaphiopus holbrookii*), E

The review was performed on the project area you specified in your request as well as an additional one-mile radius. Records searched date from 1980. This information is provided to inform you of features present within your project area and vicinity.

Please note that Ohio has not been completely surveyed and we rely on receiving information from many sources. Therefore, a lack of records for any particular area is not a statement that rare species or unique features are absent from that area. Although all types of plant communities have been surveyed, we only maintain records on the highest quality areas.

Statuses are defined as: E = state endangered; T = state threatened; P = state potentially threatened; SC = state species of concern; SI = state special interest; A = species recently added to state inventory, status not yet determined; X = presumed extirpated in Ohio; FE = federal endangered, FT = federal threatened, FSC = federal species of concern, FC = federal candidate species.

Fish and Wildlife: The Division of Wildlife (DOW) has the following comments.

Recreational

The Division of Wildlife (DOW) would like to see the number of online surveys and phone interviews increased and AEP expand efforts to gather additional information from anglers regarding recreational facility improvements at the abutment fishing access. Two approaches should be considered for expanding participation in the survey to gather additional feedback from anglers. The first would be to run an article through the local paper, both electronically and on printed copy, asking for input on the current recreational facilities and thoughts on additional improvements. Social media outlets should also be utilized that include information about where they can participate in the online survey. The second approach would include face to face interviews. However, with social distancing guidelines in place and current health and safety precautions, it may not be possible to conduct this type of survey. If that is the case, we would suggest continuing with drop box surveys to gather additional information from anglers on the current recreational facilities and the need for any additional features that would improve the angling opportunities and experience for anglers. Ideally, we would recommend surveys be extended to include the remaining summer months and into Fall of 2020 to increase participation and input from anglers.

Fish and Wildlife

The DOW recommends that impacts to streams, wetlands and other water resources be avoided and minimized to the fullest extent possible, and that Best Management Practices be utilized to minimize erosion and sedimentation.

The entire state of Ohio is within the range of the Indiana bat (*Myotis sodalis*), a state endangered and federally endangered species, the northern long-eared bat (*Myotis septentrionalis*), a state endangered and federally threatened species, the little brown bat (*Myotis lucifugus*), a state endangered species, and the tricolored bat (*Perimyotis subflavus*), a state endangered species. During the spring and summer (April 1 through September 30), these species of bats predominately roost in trees behind loose, exfoliating bark, in crevices and cavities, or in the leaves. However, these species are also dependent on the forest structure surrounding roost trees. If trees are present within the project area, and trees must be cut, the DOW recommends cutting only occur from October 1 through March 31, conserving trees with loose, shaggy bark and/or crevices, holes, or cavities, as well as trees with DBH ≥ 20 if possible. If trees are present within the project area, and trees must be cut during the summer months, the DOW recommends a mist net survey or acoustic survey be conducted from June 1 through August 15, prior to any cutting. Mist net and acoustic surveys should be conducted in accordance with the most recent version of the "*OHIO DIVISION OF WILDLIFE GUIDANCE FOR BAT SURVEYS AND TREE CLEARING*". If state listed bats are documented, DOW recommends cutting only occur from October 1 through March 31, however, limited summer tree cutting may be acceptable after consultation with DOW (contact Sarah Stankavich, sarah.stankavich@dnr.state.oh.us).

The DOW also recommends that a desktop or field-based habitat assessment is conducted to determine if there are potential hibernaculum(a) present within the project area. Habitat assessments should be conducted in accordance with the current USFWS "*Range-wide Indiana Bat Survey Guidelines*" and submitted to Sarah Stankavich, sarah.stankavich@dnr.state.oh.us if potential hibernacula are present within .25 miles of the project area. If a potential hibernaculum is found, the DOW recommends a 0.25-mile tree cutting and subsurface disturbance buffer around the hibernaculum entrance, however, limited summer or winter tree cutting may be acceptable after consultation with DOW. If no tree cutting or subsurface impacts to a hibernaculum are proposed, this project is not likely to impact these species.

The project is within the range of the following listed mussel species.
<u>Federally Endangered</u>
sheepnose (*Plethobasus cyphyus*)
fanshell (*Cyprogenia stegaria*)
pink mucket (*Lampsilis orbiculata*)
snuffbox (*Epioblasma triquetra*)

<u>State Endangered</u>
washboard (*Megalonaias nervosa*)
butterfly (*Ellipsaria lineolata*)
elephant-ear (*Elliptio crassidens*)
long-solid (*Fusconaia maculata maculata*)
Ohio pigtoe (*Pleurobema cordatum*)
pyramid pigtoe (*Pleurobema rubrum*)
monkeyface (*Quadrula metanevra*)
wartyback (*Quadrula nodulata*)

<u>State Threatened</u>
black sandshell (*Ligumia recta*)
threehorn wartyback (*Obliquaria reflexa*)
fawnsfoot (*Truncilla donaciformis*)

The DOW understands that a mussel survey has been conducted and has been coordinated with the resource agencies.

The project is within the range of the following listed fish species.
<u>State Endangered</u>
bigeye shiner (*Notropis boops*)
goldeye (*Hiodon alosoides*
shoal chub (*Macrhybopsis hyostoma*)
speckled chub (*Macrhybopsis aestivalis*
spotted darter (*Etheostoma maculatum*)
western banded killifish (*Fundulus diaphanus menona*)

<u>State Threatened</u>
American eel (*Anguilla rostrata*)
blue sucker (*Cycleptus elongatus*)
channel darter (*Percina copelandi*)
paddlefish (*Polyodon spathula*)
river darter (*Percina shumardi*)
Tippecanoe darter (*Etheostoma tippecanoe*)

The DOW recommends no in-water work in the Ohio River from March 15 through June 30, and in other perennial streams from April 15 through June 30 to reduce impacts to indigenous aquatic species and their habitat. If no in-water work is proposed in the Ohio River or other perennial streams, this project is not likely to impact these or other aquatic species.

The project is within the range of the eastern spadefoot toad (*Scaphiopus holbrookii*), a state endangered species. This species is found in areas of sandy soils that are associated with river valleys. Breeding habitats may include flooded agricultural fields or other water holding depressions. The DOW understands that an approved herpetologist has determined that suitable habitat is present within the project area, and that a presence/absence survey will be conducted.

Due to the potential of impacts to federally listed species, as well as to state listed species, we recommend that this project be coordinated with the U.S. Fish & Wildlife Service.

Water Resources: The Division of Water Resources has the following comment.

The local floodplain administrator should be contacted concerning the possible need for any floodplain permits or approvals for this project. Your local floodplain administrator contact information can be found at the website below.

http://water.ohiodnr.gov/portals/soilwater/pdf/floodplain/Floodplain%20Manager%20Community%20Contact%20List_8_16.pdf

ODNR appreciates the opportunity to provide these comments. Please contact Sarah Tebbe, Environmental Specialist, at (614) 265-6397 or Sarah.Tebbe@dnr.state.oh.us if you have questions about these comments or need additional information.

Mike Pettegrew
Environmental Services Administrator (Acting)

OHIO DIVISION OF WILDLIFE GUIDANCE FOR BAT SURVEYS AND TREE CLEARING
JUNE 2020

Agency Contacts:

ODNR-DOW Permit Coordinator: Wildlife.Permits@dnr.state.oh.us, (614) 265-6315
ODNR-DOW Bat Survey Coordinator: Sarah Stankavich, sarah.stankavich@dnr.state.oh.us, (614) 265-6764

Due to the evolving situation with COVID-19, we are temporarily suspending bat-handling activities until more is known about the risk to North American bats. This document has been updated with new state guidance for the 2020 field season only, or until bat-handling activities are reinstated. These guidelines replace previous guidelines released in March 2020.

This guidance applies to state recommendations only. Contact the USFWS to determine if federal consultation is also necessary to comply with federal law.

Ohio Mist Net Surveys:
Mist-netting for presence/absence surveys, education events, or research activities will not be authorized for the 2020 season.

Ohio Acoustic Surveys:
Acoustic bat surveys for presence/absence will be accepted by ODNR for the 2020 season. Surveys should follow guidelines laid out in the USFWS Range-wide Indiana Bat Survey Guidelines (March 2020) with the following exceptions:

- Ohio survey dates are June 1 – August 15, 2020
- After conducting automated analyses using one or more of the currently available 'approved' acoustic bat ID programs[1], qualitative analysis (i.e., manual vetting) of any calls recorded from state-endangered species (*Myotis sodalis, M. septentrionalis*[2], *M. lucifugus*[2], and *Perimyotis subflavus*[2]) must be completed.
    - At a minimum, for each detector site/night a program considered presence of state-listed bats likely, review all files (including no IDs) from that site/night. If more than one acoustic bat ID program is used, qualitative analysis must also include a comparison of the results of each program by site and night.

During Field Season:

- **Prior to initiation of field work (a minimum of two weeks in advance)**, permittees must provide proposed survey plans to ODNR-DOW via e-mail. **Plans must be reviewed and approved by ODNR-DOW before ANY surveys take place**. Study plans must specify objectives, location details, dates of proposed work, and all other relevant details.

[1] https://www.fws.gov/midwest/Endangered/mammals/inba/surveys/inbaAcousticSoftware.html
[2] State listing as endangered effective July 1, 2020

After Field Season:

- By March 15, you must submit your final ODNR-DOW report(s) from the previous summer. You are not required to fill out the ODNR-DOW Wildlife Diversity Bat Excel Spreadsheet; instead, please forward your USFWS Midwestern US Spreadsheet (found here: http://www.fws.gov/midwest/endangered/mammals/inba/inbasummersurveyguidance.html) to the ODNR-DOW Bat Survey Coordinator and ODNR-DOW Permit Coordinator and include your state permit number along with an electronic copy of the project report. Electronic summaries emailed during the field season are NOT considered as full compliance of this reporting requirement.

Ohio Environmental Review Recommendations for projects involving disturbance near potential/known bat hibernacula (cliffs, caves, mines) or tree cutting:

Step 1: Coordinate with Ohio Division of Wildlife (DOW) regarding existing records for state-listed endangered bat summer and/or winter occurrence information.

If project site contains a known bat hibernaculum(a) –

- For state-listed endangered species other than the Indiana bat, a recommendation of 0.25-mile tree cutting buffer around all known entrances to protect existing conditions at the hibernaculum(a). If the project involves subsurface disturbance, consultation with DOW is required.
- Limited summer and winter tree cutting may be permitted within the buffer following guidelines detailed below. Coordinate with DOW before cutting.

If a project site does not contain known bat hibernaculum(a)

- Conduct a habitat assessment (desktop or field-based, using methods detailed in current USFWS Range-wide Indiana Bat Guidelines) to determine if a potential hibernaculum(a) is present within the action area.

Step 2: When conducted, a presence/absence survey must follow current DOW guidelines.

Step 3: If a state-listed endangered bat is captured or recorded during the survey:

- Recommendation of no summer tree cutting, or limited cutting following guidelines detailed below, within 5 miles of the capture site if a roost is not located.
- Recommendation of no summer tree cutting, or limited cutting following guidelines detailed below, within 2.5 miles of a roost tree if located.

If no state-listed endangered bat is captured or recorded during the survey:

- Summer tree cutting may proceed for 5 years before a new survey is needed under state guidance.

Limited summer tree cutting guidance for bats that are only state-listed endangered: Limited tree cutting in summer may be permitted after consultation with DOW, but clearing trees with the following characteristics should be avoided unless they pose a hazard: dead or live trees of any size with loose, shaggy bark; crevices, holes, or cavities; live trees of any species with DBH ≥ 20.

FREQUENTLY ASKED QUESTIONS

When does the Bat Survey protocol have to be used?

This protocol should be used anytime Indiana bat, northern long-eared bat, little brown bat, or tricolored bat summer presence/probable absence surveys are conducted in the state of Ohio. For 2020 only, acoustic surveys will meet the ODNR-DOW requirements unless new guidance allowing for the handling of bats during presence/absence surveys is released from USFWS.

How many net surveys are required for presence/probably absence?

As described in the current USFWS Range-wide Indiana Bat Guidelines: Linear projects: a minimum of 2 detector nights per km (0.6 miles) of suitable summer habitat
Non-linear projects: a minimum of 8 detector nights per 123 acres (0.5 km^2) of suitable summer habitat. At least 2 detector locations per 123 acre "site" shall be sampled until at least 8 detector nights has been completed over the course of at least 2 calendar nights (may be consecutive). For example:

- 4 detectors for 2 nights each (can sample the same location or move within the site)
- 2 detectors for 4 nights each (can sample the same location or move within the site)
- 1 detector for 8 nights (must sample at least 2 locations and move within the site)

How long are the results of the surveys valid for an assessment of an area?

Mist-net or acoustic surveys documenting probable absence of state-listed endangered bats are valid for five years.

When can acoustic surveys occur in Ohio?

In Ohio, acoustic surveys may only be conducted from June 1 through August 15 unless indicated otherwise in your state permit. Any surveys outside of the June 1 - August 15 timeframe cannot be used in Ohio to assess the presence/probable absence of state-listed bats.

Can a presence/probable absence survey be conducted within a known Indiana bat and/or northern long-eared bat capture/detection buffer?

Surveys generally cannot be used to document presence/probable absence of state-listed endangered bats bat where presence of the species has already been confirmed by prior surveys.

What if a project is proposing to clear trees between April 1 and September 30 when bats may be present but no bat records exist in the project area?

Any Ohio project that is not within a known bat record buffer, and tree clearing between April 1 and September 31 is being proposed, may have a presence/absence survey conducted between June 1 and August 15 following the range-wide guidance. If a presence/absence survey is not performed, presence of listed bats is assumed.

How does take of northern long-eared bats differ from Indiana bats?

Under Ohio law, there is no exemption for take of any listed bat species.

Yayac, Maggie

Subject: FW: [EXTERNAL] RE: Racine eel ramp operation?
Attachments: Updated Racine ISR Meeting May 2020.pdf

From: Jonathan M Magalski [mailto:jmmagalski@aep.com]
Sent: Wednesday, August 12, 2020 6:56 AM
To: Michael.Greenlee@dnr.state.oh.us
Cc: Hanson, Danielle <Danielle.Hanson@hdrinc.com>
Subject: RE: [EXTERNAL] RE: Racine eel ramp operation?

Good morning Mike,

Sorry for not connecting before your meeting, I have been on vacation. Attached is the slide deck that was presented in May that contains summaries of the studies to date. What's not included are the results of the spring fisheries surveys or eel ramp deployment which have since been completed. Also, the analyses of the trail cameras at the fishing area is not included and currently being performed. The only other thing to add is that we are working to deploy water quality monitors, hopefully next week. Finally, in the slide deck you'll also find the relicensing schedule. Otherwise, there's not much to add.

I hope the meeting went well. Please let me know if you have questions or need anything else. Thanks…Jon

AMERICAN ELECTRIC POWER
BOUNDLESS ENERGY

JONATHAN M MAGALSKI | **ENVIRONMENTAL SPEC CONSULT**
JMMAGALSKI@AEP.COM | D:614.716.2240
1 RIVERSIDE PLAZA, COLUMBUS, OH 43215

From: Michael.Greenlee@dnr.state.oh.us <Michael.Greenlee@dnr.state.oh.us>
Sent: Wednesday, August 5, 2020 9:46 AM
To: Jonathan M Magalski <jmmagalski@aep.com>
Subject: Re: [EXTERNAL] RE: Racine eel ramp operation?

Hi John:

Thank for passing this along. We are having a joint virtual meeting with WVA DNR fisheries staff and wanted to give a brief update on the Racine Hydro relicensing and was wondering if you would have some time for a phone conversation later this afternoon or on Monday of next week. Our joint virtual meeting is next Tuesday. I just want to share an update and highlight some of the more pertinent studies such as the recreation study. I only have 3-5 minutes since our agenda is pretty full, but thought it would be a good opportunity to share updates on the project and where you are in the process. Thanks John.

Mike Greenlee

ODNR-Division of Wildlife

From: Jonathan M Magalski <jmmagalski@aep.com>
Sent: Tuesday, August 4, 2020 10:27 AM
To: McCorkle, Richard <richard_mccorkle@fws.gov>
Cc: McCloskey, John <john_mccloskey@fws.gov>; Jacob Harrell <jacob.d.harrell@wv.gov>; Hansbarger, Jeff L <Jeff.L.Hansbarger@wv.gov>; Greenlee, Michael <Michael.Greenlee@dnr.state.oh.us>; Andrew N LRH Johnson <andrew.n.johnson@usace.army.mil>; dczayka@enviroscienceinc.com <dczayka@enviroscienceinc.com>; Quiggle, Robert <Robert.Quiggle@hdrinc.com>; gzimmerman@enviroscienceinc.com <gzimmerman@enviroscienceinc.com>; Elizabeth B Parcell <ebparcell@aep.com>; Hanson, Danielle <Danielle.Hanson@hdrinc.com>
Subject: RE: [EXTERNAL] RE: Racine eel ramp operation?

Good morning Rick,

Last week, EnviroScience successfully added attraction flow sourced from the tank and reduced the flow in the ramp. Attached is a photograph at the ramp confluence with the river and a short video showing the flow in the ramp. We'll keep you posted on any collections. In the meantime, please let me know if there are questions or comments. Thank you....Jon

AMERICAN ELECTRIC POWER
BOUNDLESS ENERGY

JONATHAN M MAGALSKI | **ENVIRONMENTAL SPEC CONSULT**
JMMAGALSKI@AEP.COM | D:614.716.2240
1 RIVERSIDE PLAZA, COLUMBUS, OH 43215

From: McCorkle, Richard <richard_mccorkle@fws.gov>
Sent: Monday, July 27, 2020 8:28 AM
To: Jonathan M Magalski <jmmagalski@aep.com>
Cc: McCloskey, John <john_mccloskey@fws.gov>; Jacob Harrell <jacob.d.harrell@wv.gov>; Hansbarger, Jeff L <Jeff.L.Hansbarger@wv.gov>; Mike Greenlee <michael.greenlee@dnr.state.oh.us>; Andrew N LRH Johnson <andrew.n.johnson@usace.army.mil>; dczayka@enviroscienceinc.com; Quiggle, Robert <Robert.Quiggle@hdrinc.com>; gzimmerman@enviroscienceinc.com; Elizabeth B Parcell <ebparcell@aep.com>; Hanson, Danielle <Danielle.Hanson@hdrinc.com>
Subject: Re: [EXTERNAL] RE: Racine eel ramp operation?

Jon,

Thanks much to you, EnviroScience and HDR for addressing our questions and concerns. Regarding the amount of flow, the previously recommended increase in flow to the ramp was for attraction flow purposes. I understand it can be tricky balancing that with not having too much water flowing down the ramp, itself, hence the suggestion for a separate pipe from the collection tank. Glad to hear that the ramp is mostly covered and that it is treated with a resin to create a smooth surface and prevent abrasions. Thanks also for letting us know if any eels are collected and for any additional photos and video you can provide.

Rick

Richard C. McCorkle
Fish and Wildlife Biologist
U.S. Fish & Wildlife Service

Pennsylvania Field Office
110 Radnor Road, Ste 101
State College, PA 16801
Office: 814-206-7470
Personal cell (while teleworking): 302-382-0284

From: Jonathan M Magalski <jmmagalski@aep.com>
Sent: Monday, July 27, 2020 7:52 AM
To: McCorkle, Richard <richard_mccorkle@fws.gov>
Cc: McCloskey, John <john_mccloskey@fws.gov>; Jacob Harrell <jacob.d.harrell@wv.gov>; Hansbarger, Jeff L <Jeff.L.Hansbarger@wv.gov>; Mike Greenlee <michael.greenlee@dnr.state.oh.us>; Andrew N LRH Johnson <andrew.n.johnson@usace.army.mil>; dczayka@enviroscienceinc.com <dczayka@enviroscienceinc.com>; Quiggle, Robert <Robert.Quiggle@hdrinc.com>; gzimmerman@enviroscienceinc.com <gzimmerman@enviroscienceinc.com>; Elizabeth B Parcell <ebparcell@aep.com>; Hanson, Danielle <Danielle.Hanson@hdrinc.com>
Subject: RE: [EXTERNAL] RE: Racine eel ramp operation?

Hi Rick,

The questions are fairly comprehensive, so I'll do my best to cover them all. The ramp is covered down to the last section of ramp (see attached photo), which is open due to frequent water level fluctuations. I have discussed with EnviroScience and HDR reducing the flows to achieve the desired depth, recognizing that this will reduce the previously recommended flow rate in the ramp. Additionally, we have discussed providing an attraction flow sourced from the tank to the entry point of the ramp. We are working on implementing these measures (reduced flow in the ramp and adding an attraction flow) and will let you know if we encounter any issues.

Below are additional responses (underlined in red) to Brett's questions and comments. Please let me know if you or others have any additional. As requested in a separate email, we will let you know if we collect any eels and will send you additional photos or video once the recommendations are completed. I hope you all have a great week and stay safe.

Jon

AMERICAN ELECTRIC POWER
BOUNDLESS ENERGY
JONATHAN M MAGALSKI | **ENVIRONMENTAL SPEC CONSULT**
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From: McCorkle, Richard <richard_mccorkle@fws.gov>
Sent: Thursday, July 9, 2020 3:17 PM
To: Jonathan M Magalski <jmmagalski@aep.com>
Cc: McCloskey, John <john_mccloskey@fws.gov>; Jacob Harrell <jacob.d.harrell@wv.gov>; Hansbarger, Jeff L <Jeff.L.Hansbarger@wv.gov>; Mike Greenlee <michael.greenlee@dnr.state.oh.us>; Andrew N LRH Johnson <andrew.n.johnson@usace.army.mil>; dczayka@enviroscienceinc.com; Quiggle, Robert <Robert.Quiggle@hdrinc.com>; gzimmerman@enviroscienceinc.com; Elizabeth B Parcell <ebparcell@aep.com>; Hanson, Danielle <Danielle.Hanson@hdrinc.com>
Subject: Fw: [EXTERNAL] RE: Racine eel ramp operation?

Jon,

I suspect you may not see this right away as I understand you are on vacation at the moment, but I wanted to send this out now in case it is still possible to do some tweaking to the eel ramp setup.

Please see the comments below from our lead fish passage engineer. In addition, in a follow-up discussion with Brett, he asked if the ramp is covered to prevent predation by birds. Also, if you were to reduce the flow at the top of the ramp, per Brett's recommendation (based on the appearance of too much flow on the ramp itself), then supplemental attraction flow would need to be added below the bottom of the ramp. This would be done using a separate pipe (see attached figure which was previously provided), and would preferably run from the collection tank - the idea is to provide water with conspecific cues from other eels in the tank (if there are any) which increases the attraction for eels approaching the attraction flow.

We would appreciate a response form EnvironScience and/or HDR to the issues Brett has pointed out, and to the above additional issues (is ramp covered, and if flow on ramp is significantly deeper than 1/8 inch then reduce and provide supplemental flow from tank to base of ramp).

Thanks for your consideration.

Rick

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From: Towler, Brett <Brett_Towler@fws.gov>
Sent: Thursday, July 9, 2020 2:24 PM
To: McCorkle, Richard <richard_mccorkle@fws.gov>
Cc: McCloskey, John <john_mccloskey@fws.gov>; Jacob Harrell <jacob.d.harrell@wv.gov>; Mike Greenlee <michael.greenlee@dnr.state.oh.us>; Andrew N LRH Johnson <andrew.n.johnson@usace.army.mil>
Subject: Re: [EXTERNAL] RE: Racine eel ramp operation?

Hi Rick,

Well, to be frank, my first reaction wasn't altogether positive. My understanding is that this is a temporary trap, so I'll set aside the resiliency/durability issues associated with a wooden ramp with taped seams. Here are my more pressing concerns about features that may affect the efficacy of the ramp:

1. Peg Spacing: For larger yellow eels of 150 mm or more, we recommend stud or peg-type media with spacing of 30 to 80 mm (USFWS 2019, Section 13.1.1.1). It looks like this design may push that spacing to the limit (~3 inches). Each stud is 0.5 inch in diameter. The studs are spaced 2 inches apart, with spacing of 1.5 inches between the outermost stud and the ramp wall in rows with 4 studs and 2.75 inches between the outermost stud and the ramp wall in rows with 3 studs. This stud spacing is roughly in the middle of the Service's recommended range of 1.2 to 3.1 inches. But the small diameter of the tubes is rather surprising to me. Its important to remember the dual purpose of the stud substrate. It serves to 1) provide purchase for the yellow eels to "snake" their way up, and 2) provide resistance to the flow so that the water doesn't channelize in the gaps and create velocities that may impede eel movement. The first purpose is met (at least for very large yellows) but the second is not. The studs are so small that I don't think they don't generate the tortuous path needed to slow down the water (and the water looks like its moving fast). There may be some misunderstanding based on an earlier recommendation regarding flow rates. Originally, we proposed a flow rate of 50 gpm. Based on the Service's comments, a flow rate to 65 gpm was recommended due to the ramp width. The higher flow rate was accommodated as it was our understanding higher velocities were necessary. Consider the photo (attached) of actual Milieu substrate. See how the quincunx arrangement of the large tubes force the water to also snake through the substrate? That, in concert with shallow depths, keeps the velocities low. In Racine's eelway, the water looks like its shooting those gaps faster than we'd like. We are working to slow the flow rate to reduce the velocities.
2. Water Depth: It appears like there is too much water in the eelway. We recommend 1/8" of water through a conventional aluminum or poly ramp (USFWS 2019, 13.1.1) There's nothing magical about 1/8"... a little more is not a problem. But water correlates to depth, and too much depth results in higher velocities that may inhibit eel movement. It looks like there's about 1-2 inches of water in the pictures you sent; that's a problem. And its exacerbated by the small stud diameter. Perhaps this photo was only taken during a test, but I would ask them to turn the flow down and try to maintain 1/4" or less (the exact depth is a little harder to specify because of the roughness associated with this wooden ramp). As mentioned above, we are working to reduce the flow rate which will reduce the depth and velocities in the ramp. However, in reducing the flow rate, it is recognized that the flow rate will be less than what the Service previously recommended. We will do our best to set the flow rate to provide a depth of 1/4" or less. Regarding the ramp substrate, the ramp is coated with resin creating a smooth surface.
3. Resting Pool: We generally recommend 1" depth in the resting pool, though more is fine. Also, the resting pool should be at least as long as the width of the ramp (USFWS 2019, 13.1.1). I can't quite tell is that is true with this temporary ramp. The resting pools are 12 inches long, 1 inch longer than the width of the ramp. The resting pool depth is at least 1 inch deep.

I realize they are not going to rebuild the peg board... especially for a temporary ramp, but its worth keeping all this in mind if (after testing) we have concerns that eels aren't ascending the ramp efficiently. In the near term, I'd definitely ask them to scale back on the flow to keep the depth at 1/4" or less (and again I making allowance for more depth because of the rough wooden bottom).

Regarding the tank size, it looks appropriately sized, but just to be clear: the minimum size is 15 gallons but may be bigger depending on the number of eels. The following is from Chapter 13 of our manual: The tank is 52 gallons and the live well capacity is set at approximately 24 gallons.

volume	15	20	25	30	35	40	*gallon*
	2	2 $^2/_3$	3 $^1/_3$	4	4 $^2/_3$	5 $^1/_3$	*ft^3*
capacity	5,250	7,000	8,750	10,500	12,250	14,000	*eels*

One other question - I can't see in the photos if they have installed the spray bar and how they've designed the transition at the upper end of the rank (i.e., what does the "cliff" look like at eels fall from the ramp into the bucket). These articulated lock nozzles are really nice and allow you to tweak the end nozzles. Two vendors I have used are Snap-Loc and Loc-Line which you can find in the MSC and McMaster catalogs. See here: The spray bar is installed and is designed to spray onto the ramp back into the tank.

https://www.mcmaster.com/Spray-Nozzles/coolant-dispensers-3/loc-line-coolant-hose/3-4-loc-line-coolant-hose/

Last thing - I took the liberty of running the photos by Alex Haro at USGS (without divulging the project or licensee names). His concerns were in line with mine. He also suggested that the wood surface might abrade the eels and recommended sealing it with polyurethane. In fact, the easiest thing would be to spray it with Flex Seal or an equivalent polyurethane. Just be careful not to use a poly-acrylic; they are water based sealants. As previously mentioned, the wood is coated with resin to create a smooth surface.

Hope that helps.

Holler if you have questions.

Brett

From: McCorkle, Richard <richard_mccorkle@fws.gov>
Sent: Wednesday, July 8, 2020 8:09 AM
To: Towler, Brett <Brett_Towler@fws.gov>
Cc: McCloskey, John <john_mccloskey@fws.gov>; Jacob Harrell <jacob.d.harrell@wv.gov>; Mike Greenlee <michael.greenlee@dnr.state.oh.us>; Andrew N LRH Johnson <andrew.n.johnson@usace.army.mil>
Subject: Fw: [EXTERNAL] RE: Racine eel ramp operation?

Brett,

Below is a response from AEP to my request for photo and possible video documentation of the eel ramp at Racine. It appears the ramp is sufficiently watered and I can see the attraction flow at the base, but wanted to get your impression based on the photos. I think the milieu-type substrate also appears to have the appropriate spacing, but not positive based on the photos. The tank appears to be appropriately-sized. Possible video to follow.

Rick

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From: Jonathan M Magalski <jmmagalski@aep.com>
Sent: Wednesday, July 8, 2020 7:46 AM
To: McCorkle, Richard <richard_mccorkle@fws.gov>
Subject: [EXTERNAL] RE: Racine eel ramp operation?

This email has been received from outside of DOI - Use caution before clicking on links, opening attachments, or responding.

Good morning Rick,

The eel ramp was deployed the week of June 8. Attached are some photos of the ramp prior to install and in operation. I think a few of the photos provide a good idea of the flows, but I will see if I can get some video for you. Also, note that the photos do not show the wiring covering the ramp or shading of the tank as they were taken prior to everything being completed. Let me know if you have any questions or comments. Take care, talk with you soon….Jon

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From: McCorkle, Richard <richard_mccorkle@fws.gov>
Sent: Tuesday, July 7, 2020 3:58 PM
To: Jonathan M Magalski <jmmagalski@aep.com>
Subject: [EXTERNAL] Racine eel ramp operation?

This is an **EXTERNAL** email. **STOP**. **THINK** before you CLICK links or OPEN attachments. If suspicious please click the '**Report to Incidents**' button in Outlook or forward to incidents@aep.com from a mobile device.

Jon,

I haven't heard anything more about the temporary eel ramp at Racine. Would it be possible for your consultant to take a few photos and maybe shoot a little video to show the ramp location and setup, and the attraction flow? We would like to know that the ramp is set up in a way that largely conforms with our criteria and that there is sufficient attraction flow. Whatever you can provide would be greatly appreciated. Thanks!

Hope you are well.

Rick

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Yayac, Maggie

Subject: FW: Racine Hydroelectric Project (FERC No. 2570) -- Filing of Fifth Quarterly Study Progress Report
Attachments: 20200813 Racine 5th Quarterly Study Progress Report.pdf

From: Hanson, Danielle
Sent: Thursday, August 13, 2020 11:19 AM
To: 'Advisory Council on Historic Preservation' <jeddins@achp.gov>; 'City of New Haven' <nhcityhall@frontier.com>; 'City of Pomeroy (Mayor)' <dmanderson242@hotmail.com>; 'Meigs Soil and Water Conservation district' <steve.jenkins@oh.nacdnet.net>; 'ODNR Division of Wildlife' <mike.greenlee@dnr.state.oh.us>; 'OH Rep Dist 94 - Jay Edwards' <JayEdwardsOhio@gmail.com>; 'OHEPA' <Craig.Butler@epa.ohio.gov>; 'Ohio Department of Natural Resources' <sarah.tebbe@dnr.state.oh.us>; 'Ohio Department of Natural Resources' <Steve.Holland@dnr.state.oh.us>; 'Ohio River Valley Water Sanitation Commission' <sdinkins@orsanco.org>; 'Osage Nation' <jmunkres@osagenation-nsn.gov>; 'Osage Nation' <ahunter@osagenation.nsn.gov>; 'Shawnee Tribe' <tonya@shawnee-tribe.com>; 'SHPO' <khorrocks@ohiohistory.org>; 'Town of New Haven (Mayor)' <bubba070260@gmail.com>; 'US Department of the Interior' <Harold.Peterson@bia.gov>; 'US Environmental Protection Agency' <pelloso.elizabeth@epa.gov>; 'USACE' <andrew.n.johnson@usace.army.mil>; 'USACE' <Belinda.M.Weikle@usace.army.mil>; 'USEPA' <Westlake.kenneth@epa.gov>; 'USEPA' <Rudnick.Barbara@epa.gov>; 'USFWS' <richard_mccorkle@fws.gov>; 'USFWS' <angela_boyer@fws.gov>; 'USFWS' <jennifer_l_norris@fws.gov>; 'USGS' <jswhite@usgs.gov>; 'USGS' <smwickle@usgs.gov>; 'Village of Racine' <racinemayor@suddenlinkmail.com>; 'Villgae of Middleport' <mayormike@village.middleport.oh.us>; 'West Virginia Division of Natural Resources' <jacob.d.harrell@wv.gov>; 'West Virginia Division of Natural Resources' <barbara.d.sargent@wv.gov>; 'West Virginia Division of Natural Resources' <danny.a.bennett@wv.gov>; 'WVDEP' <Brian.L.Bridgewater@wv.gov>
Cc: 'Jonathan M Magalski (jmmagalski@aep.com)' <jmmagalski@aep.com>; Elizabeth B Parcell <ebparcell@aep.com>; Quiggle, Robert <Robert.Quiggle@hdrinc.com>
Subject: Racine Hydroelectric Project (FERC No. 2570) -- Filing of Fifth Quarterly Study Progress Report

Racine Hydroelectric Project Stakeholders:

AEP Generation Resources Inc. (AEPGR), a unit of American Electric Power (AEP), is the licensee, owner and operator of the Racine Hydroelectric Project (FERC No. 2570) (Project) located on the Ohio River in Meigs County, Ohio. The Project is operated under a license issued by the Federal Energy Regulatory Commission (FERC). The existing FERC license for the Project expires on November 30, 2023. AEPGR is pursuing a new license for the continued operation of the Project in accordance with FERC's Integrated Licensing Process (ILP). As proposed in AEPGR's April 12, 2019 Revised Study Plan and approved in FERC's May 13, 2019 Study Plan Determination (SPD), AEPGR filed the Fifth Quarterly Study Progress Report for the Project on August 13, 2020. The progress report describes the study efforts that have been completed since FERC's SPD and study activities that are generally expected to be performed during quarter 3 of 2020.

On behalf of AEPGR, we are notifying stakeholders of the availability of the progress report. For your convenience, a copy of the progress report is attached.

Should you have any questions regarding this filing, please contact Jon Magalski with AEP at (614) 716-2240 or jmmagalski@aep.com.

Thank you,

Danielle Hanson
Environmental Scientist

HDR
M 315.729.4745
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American Electric Power
1 Riverside Plaza
Columbus, OH 43215
aep.com

Via Electronic Filing August 13, 2020

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

Subject: Racine Hydroelectric Project (FERC No. 2570-032)
Fifth Quarterly Study Progress Report

Dear Secretary Bose:

AEP Generation Resources Inc. (AEPGR), a unit of American Electric Power (AEP), hereby submits the Fifth Quarterly Study Progress Report for the Racine Hydroelectric Project (Project) (FERC No. 2570) relicensing.

AEPGR has elected to utilize the Integrated Licensing Process (ILP) for the relicensing of the Project as defined in 18 Code of Federal Regulations (C.F.R.) Part 5. As proposed in AEPGR's April 12, 2019 Revised Study Plan (RSP) and approved in the Federal Energy Regulatory Commission's (FERC or Commission) May 13, 2019 Study Plan Determination (SPD), AEPGR is hereby filing the Fifth Quarterly Study Progress Report for the Project. This progress report describes the activities performed since the SPD, as well as ILP activities generally expected to be conducted in quarter 3 (Q3) of 2020. Unless otherwise described, all relicensing studies are being conducted in conformance with the approved RSP and the Commission's SPD.

1. Water Quality Study

- In their comments on the Initial Study Report (ISR), the U.S. Fish and Wildlife Service (USFWS) and the West Virginia Division of Natural Resources (WVDNR) requested that AEPGR collect additional water quality data at the Project from July 1st through October 15th, with the exception of the reservoir profile data. The U.S. Army Corps of Engineers (USACE) also provided support for this study request.
- AEPGR has been working on procuring the necessary equipment and working on logistics to deploy water quality data loggers at the Project in 2020. AEPGR anticipates that continuous water quality data loggers will be deployed at the Project in August and will remain in place through October 15th. Although the data loggers were not installed by July 1st as requested, AEPGR believes that the data collected will capture periods of low flow and high temperatures that are of the greatest concern to the resource agencies. AEPGR is also proposing to conduct bi-weekly maintenance and performance checks as opposed to monthly checks to address the agencies' concerns regarding biofouling.

2. Recreation Study

- Weatherproof boxes containing hardcopies of recreation survey questionnaires and five trail cameras were deployed at the tailrace fishing access site from May 2019 through May 2020. An online Visitor Use Survey was also launched in May 2019 and remained open through May 2020. A total of 21 hardcopy and online surveys were completed during the study season. Interviews were conducted with local fishermen with extensive knowledge and experience regarding recreation in the Project area. The purpose of the interviews was to obtain additional information about their recreational experience at the Project and recommendations for any potential enhancements to the existing recreation facilities. Additionally, a Recreation Facilities Inventory and Condition Assessment was performed.

- AEPGR is currently compiling and processing all of the data collected and will develop a final study report that will be filed with FERC.

3. Cultural Resources Study

- The Cultural Resources Study has been completed in accordance with the RSP and the Commission's SPD. No additional activities are anticipated related to this study.

4. Mussel Survey

- The Mussel Survey has been completed in accordance with the RSP and the Commission's SPD. No additional activities are anticipated related to this study.

5. Fisheries Survey, Project Characteristics, and Project Operations Related to Potential Fish Passage

- AEPGR conducted the fall fisheries surveys upstream and downstream of the Project in November 2019. AEPGR completed the spring fisheries in May 2020, with the exception of the trawl surveys. During the May 14, 2020 Initial Study Report Meeting (ISR Meeting), AEPGR proposed to modify the spring fisheries surveys to forgo the trawl surveys due to safety concerns related to the COVID-19 pandemic. WVDNR and USFWS expressed their support for this modification during the ISR Meeting as well as in their written comments on the ISR by letters dated June 5 and June 29, 2020, respectively.
- Based on consultation with USFWS and WVDNR, a temporary eel ramp was installed at the Project in mid-June 2020. AEPGR has continued to consult with USFWS and WVDNR on the design of the eel ramp and the status of monitoring. USFWS provided comments on the design of the eel ramp in July and AEPGR has made adjustments based on the comments received. AEPGR will continue to coordinate with resource agencies regarding the eel monitoring through fall 2020.
- Task 1 of the RSP states that AEPGR will provide the following data (as available) to resource agencies for the last five years in order to conduct their own analyses related to potential fish passage at the Project:
    - Headpond elevations,
    - Tailwater elevations,
    - Gate (i.e., spill) operations (including the sequence and timing of specific gates),
    - Unit 1 and 2 turbine discharge, and

- Lock operations (including any openings for maintenance).

AEPGR also agreed to provide any available dam/powerhouse elevation drawings and/or bathymetric data upstream or downstream.

AEPGR will compile available data as indicated above and provide these data to the resource agencies prior to the completion of this study.

6. Fish Entrainment and Impingement Study

- AEPGR continues to compile data from other relicensing studies (i.e., Fisheries Survey) and other Project-specific information that will be used in the analyses for this study. AEPGR anticipates collecting intake velocity data when the river flows are appropriate for deploying the necessary equipment. AEPGR will continue to consult with resource agencies regarding the list of target species and to refine the study protocols. Once all of the data has been compiled, AEPGR will perform the analyses as described in the RSP and develop a final study report to be filed with FERC.

7. Eastern Spadefoot Toad Habitat Suitability Assessment

- A literature review and search of museum specimens was conducted in 2019. Additionally, an initial site visit was conducted in September 2019 to review the primary habitat indicators present at the Project. The Habitat Suitability Assessment Report was included in Appendix D of the ISR. Field surveys were expected to occur through June of 2020, during the peak period with the highest probability of finding Eastern Spadefoot Toads. However, due to COVID-19, field surveys were not able to be conducted during the peak season. AEPGR will continue to consult with resource agencies and stakeholders to determine the next best steps regarding this study.

If there are any questions regarding this progress report, please do not hesitate to contact me at (614) 716-2240 or jmmagalski@aep.com.

Sincerely,

Jonathan M. Magalski
Environmental Specialist Consultant
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Cc: Distribution List
Liz Parcell (AEP)
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601 57th Street SE
Charleston, WV 25304

Racine Hydroelectric Project (FERC No. 2570)
Distribution List

Mr. Randall Reid-Smith
The Culture Center
West Virginia Division of Culture and History
1900 Kanawha Boulevard E.
Charleston, WV 25305

Mr. Danny Bennett
West Virginia Division of Natural Resources
738 Ward Road
Elkins, WV 26241

Mr. Jacob Harrell
West Virginia Division of Natural Resources
1110 Railroad Street
Farmington, WV 26571

Ms. Barbara Sargent
Environmental Resources Specialist
West Virginia Division of Natural Resources
PO Box 67
Elkins, WV 26241-3235

Local Governments

Mr. Don Anderson
Mayor
City of Pomeroy
660 E. Main Street, #A
Pomeroy, OH 45769

Meigs County Commissioners
Meigs County
100 E. Second Street
Pomeroy, OH 45769

Mr. Steve Jenkins
Administrator
Meigs Soil and Water Conservation District
113 East Memorial Drive, Suite D
Pomeroy, OH 45769

Mr. Sam Anderson
Mayor
Town of Hartford
PO Box 96
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Ms. Roberta Hysell
Town of New Haven
218 5th Street
New Haven, WV 25265

Mr. Greg Kaylor
Mayor
Town of New Haven
218 5th Street
New Haven, WV 25265

Mr. Michael Gerlach
Mayor
Village of Middleport
659 Pearl Street
Middleport, OH 45760

Mr. J. Scott Hill
Mayor
Village of Racine
405 Main Street
PO Box 399
Racine, OH 45771

Tribes

Absentee Shawnee Tribe of Oklahoma
2025 South Gordon Cooper
Shawnee, OK 74801

Mr. Kim Penrod
Director, Cultural Resources/106 Archives, Library and Museum
Delaware Nation
31064 State Highway 281
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Anadarko, OK 73005

Racine Hydroelectric Project (FERC No. 2570)
Distribution List

Delaware Tribe of Indians
5100 Tuxedo Blvd.
Bartlesville, OK 74006

Eastern Band of Cherokee Indians
PO Box 455
Cherokee, NC 28719

Eastern Shawnee Tribe of Oklahoma
PO Box 350
Seneca, MO 64865

Miami Tribe of Oklahoma
PO Box 1326
Miami, OK 74355

Dr. Andrea Hunter
Director, THPO
Osage Nation Historic Preservation Office
627 Grandview Avenue
Pawhuska, OK 74056

Mr. James Munkres
Archaeologist
Osage Nation Historic Preservation Office
627 Grandview Avenue
Pawhuska, OK 74056

Seneca-Cayuga Nation
23701 S. 655 Road
Grove, OK 74344

Ms. Tonya Tipton
Tribal Historic Preservation Officer
Shawnee Tribe
29 S. Highway 69A
Miami, OK 74354

<u>Non-governmental Organizations</u>

Mr. John Seebach
American Rivers
1104 14th St NW, Suite 1400
Washington, DC 20005

Mr. Kevin Richard Colburn
National Stewardship Director
American Whitewater
PO Box 1540
Cullowhee, NC 28779

Nature Conservancy
6375 Riverside Drive, Suite 100
Dublin, OH 43017

Mr. Richard Cogen
Executive Director
Ohio River Foundation
PO Box 42460
Cincinnati, OH 45242

Telephone Memo

To: Public Files
From: Jay Summers, Wildlife Biologist, Division of Hydropower Licensing
Date: August 17, 2020
Docket: P-2570-032
Project: Racine Hydroelectric Project

Subject: Conversation with Ms. Erin Hazelton, Ohio Department of Natural Resources

On August 17, 2020, I contacted Ms. Erin Hazelton of Ohio Department of Natural Resources (ODNR), seeking clarification on ODNR comments filed for the Racine Hydroelectric Project (project) regarding the initial study report. Specifically, I requested clarification on: 1) whether ODNR was requesting surveys for federally and state-listed bat species, and 2) whether ODNR was recommending a presence/absence field survey for the state-listed eastern spadefoot on project lands, per the methodology for surveying the eastern spadefoot contained within the revised study plan.[1] Ms. Hazelton stated the following:

- ODNR was not requesting surveys for listed bats at this time; rather, providing a recommendation for the applicant to conduct surveys prior to any tree clearing at the project in the future
- ODNR recommends a presence/absence survey for the eastern spadefoot, based on the eastern spadefoot habitat evaluation conducted in 2019

[1] The revised study plan states AEP Generation Resources will perform presence/absence field studies if: (1) suitable habitat is found within the project boundary, and (2) based on the opinion of the biologist conducting the study and in consultation with ODNR.

FEDERAL ENERGY REGULATORY COMMISSION
WASHINGTON, DC 20426
September 9, 2020

OFFICE OF ENERGY PROJECTS

Project No. 2570-032
Racine Hydroelectric Project
AEP Generation Resources, Inc.

VIA FERC Services

Mr. Jonathan Magalski
Environmental Specialist Consultant
American Electric Power Services Corporation
1 Riverside Plaza
Columbus, OH 43215

Reference: Determination on Requests for Study Modifications for the Racine Hydroelectric Project

Dear Mr. Magalski:

Pursuant to 18 C.F.R. § 5.15 of the Commission's regulations, this letter contains the determination on requests for modifications to the approved study plan for AEP Generation Resource, Inc.'s (AEP Generation Resources) Racine Hydroelectric Project No. 2570 (project). The determination is based on the study criteria set forth in sections 5.9(b) and 5.15(d) and (e) of the Commission's regulations, applicable law, Commission policy and practice, and Commission staff's review of the record of information.

Background

The study plan determination (SPD) for the project was issued on May 13, 2019. AEP Generation Resources filed an initial study report (ISR) on May 5, 2020, held an ISR meeting on May 14, 2020, and filed an ISR meeting summary on June 11, 2020. Comments on the ISR and meeting summary were filed by the West Virginia Department of Natural Resources (West Virginia DNR) on June 5, 2020, the U.S. Fish and Wildlife Service (FWS) on June 30, 2020, the U.S. Army Corps of Engineers (Corps) on July 10, 2020, and the Ohio Department of Natural Resources (Ohio DNR) on August 10, 2020.[1] AEP Generation Resources filed reply comments on August 10, 2020.

Comments

Some of the comments received do not specifically request modifications to the approved studies or new studies. This determination does not address these types of comments, which include: comments on the presentation of data and results; requests for additional information; or recommendations for protection, mitigation, or enhancement measures. This determination only addresses specific recommendations to modify the approved study plan.

Study Plan Determination

Pursuant to section 5.15(d) of the Commission's regulations, any proposal to modify a required study must be accompanied by a showing of good cause, and must include a demonstration that: (1) the approved study was not conducted as provided for in the approved study plan; or (2) the study was conducted under anomalous environmental conditions or that environmental conditions have changed in a material way. As specified in section 5.15(e), requests for new information gathering or studies must include a statement explaining: (1) any material change in law or regulations applicable to the information request; (2) why the goals and objectives of the approved study could not be met with the approved study methodology; (3) why the request was not made earlier; (4) significant changes in the project proposal or that significant new information material to the study objectives has become available; and (5) why the new study request satisfies the study criteria in section 5.9(b).

As indicated in Appendix A, the requested modifications to the Water Quality Study are approved. The requested modifications to the Fish Entrainment and Impingement and Recreation studies are approved in part. The requested modifications to the Eastern Spadefoot Study are not approved. The specific modifications to the studies and schedule, and the bases for modifying the study plan are discussed in Appendix B.

[1] Ohio DNR's letter was sent to AEP Generation Resources, but was not filed with the Commission. AEP Generation Resources appended Ohio DNR's letter to its August 10, 2020 reply comments. On August 17, 2020, staff conducted a teleconference to clarify the recommendations in Ohio DNR's letter.

Fisheries Survey, Project Characteristics, and Project Operations Related to Potential Fish Passage Study (Fisheries Study)

During the ISR meeting, AEP Generation Resources proposed to modify the Fisheries Study to eliminate the required spring trawl surveys because: (1) the trawl surveys conducted in the fall of 2019 did not yield any new information on fish populations in the project area; (2) existing trawl data is available from Ohio DNR; and (3) maintaining social distancing while conducting trawl surveys is infeasible. In its comments on the ISR and meeting summary, West Virginia DNR and FWS concur with AEP Generation Resource's proposal to forgo spring trawl surveys. Because no entity objected to these changes during the ISR meeting or in comments on the ISR, these proposed revisions to the Fisheries Study are approved under section 5.15(c)(7) of the Commission's regulations.

Please note that nothing in this determination is intended, in any way, to limit any agency's proper exercise of its independent statutory authority to require additional studies.

If you have any questions, please contact Jay Summers at (202) 502-8764 or via email at jay.summers@ferc.gov.

Sincerely,

Terry L. Turpin
Director
Office of Energy Projects

Enclosures: Appendix A – Summary of Determinations on Requested Modifications to Approved Studies
Appendix B – Staff's Recommendations on Requested Modifications to Approved Studies

APPENDIX A

SUMMARY OF DETERMINATIONS ON REQUESTED MODIFICATIONS TO APPROVED STUDIES (*see* Appendix B for discussion)

Study	Recommending Entity	Adopted	Adopted with Modifications	Not Adopted
Water Quality Study	West Virginia DNR, FWS, Corps	X		
Fisheries Study	West Virginia DNR, FWS	X		
Fish Entrainment and Impingement Study	West Virginia DNR, FWS		X	
Eastern Spadefoot Study	AEP Generation Resources			X
Recreation Study	West Virginia DNR, FWS, Corps, FERC		X	

APPENDIX B

STAFF RECOMMENDATIONS ON REQUESTED MODIFICATIONS TO APPROVED STUDIES

Water Quality Study

Background

The purpose of the Water Quality Study is to characterize baseline water quality conditions and evaluate potential project effects on water quality in the project area.

AEP Generation Resources, Inc. (AEP Generation Resources) collected continuous water temperature and dissolved oxygen (DO) data from May 1 through October 31, 2019 at the following locations using data loggers: (1) the project intake area; (2) the tailrace; and (3) 4,200 feet downstream of the project.[2] As required by the May 13, 2019 study plan determination (SPD), an additional data logger was installed adjacent to the downstream entrance to the U.S. Army Corps of Engineers' (Corps) Racine Lock at a location approximately 2,000 feet downstream from the Racine Dam. This data logger collected continuous water temperature and DO data from June 14 through October 31, 2019. AEP Generation Resources also collected monthly (from May through October) in-situ water quality data for temperature, DO, pH, and specific conductance at each of the four continuous water quality monitoring locations. Lastly, AEP Generation Resources collected water temperature and DO profile data on a monthly basis from May 1 through October 31, 2019 at three locations upstream of the project.

Requested Study Modification

In their comments on the Initial Study Report (ISR) meeting summary, the Corps, U.S. Fish and Wildlife Service (FWS), and West Virginia Department of Natural Resources (West Virginia DNR) state that in 2019 there were extended periods when the project was not operating, and because these extended periods of non-generation coincided with the collection of water quality data, the objectives of the study were not met. FWS also states that because 2019 was atypically dry and hot, the study was conducted under anomalous environmental conditions. For these reasons, the Corps, FWS, and West Virginia DNR recommend that AEP Generation Resources conduct an

---

[2] Two data loggers were deployed at each of the water quality monitoring stations to establish a primary and secondary logger to provide backup data in the event the primary logger was lost or malfunctioned.

additional year of continuous water quality monitoring at the four established water quality monitoring locations from July 1 through October 15, at a minimum.[3]

FWS and West Virginia DNR also recommend that AEP Generation Resources consider checking and cleaning the water quality data loggers at a greater frequency. Instead of checking and cleaning the data loggers on a monthly basis, FWS and West Virginia DNR request that the loggers be checked and cleaned on a weekly or bi-weekly basis to reduce biofouling issues.

Comments on the Requested Study Modification

In its reply comments, AEP Generation Resources states that it proposes to redeploy continuous water quality data loggers at the project from mid-August through October 15, 2020. AEP Generation Resources further states that although the data loggers would not be installed by July 1, as requested by the agencies, it believes this additional data will sufficiently capture periods of low flow and high water temperatures. Lastly, AEP Generation Resources states that it proposes to conduct bi-weekly maintenance and performance checks on the data loggers to address the concerns with biofouling.

Discussion and Staff Recommendation

Regarding whether the Water Quality Study was conducted under anomalous environmental conditions, the hot and dry conditions experienced in the project area in 2019 were appropriate for determining project effects on water quality because reservoir stratification and the potential release of water with low DO concentrations through the powerhouse are most likely to occur under these conditions. Therefore, the environmental conditions experienced in the project area in 2019 do not compromise the validity of this data or, by itself, necessitate the collection of additional water quality data.

However, the ISR indicates that the project was not operating from June 17 through October 7, October 10 through October 12, and October 28 through October 31, 2019, such that the project was off-line approximately 65 percent of the time during the collection of water quality data in 2019. Moreover, the project was offline during the months of July, August, and September, which are typically the hottest months of the

[3] FWS and West Virginia DNR concur that the reservoir profile data collected in 2019 was collected in accordance with the approved study plan and is valid. Therefore, FWS and West Virginia DNR state that this portion of the Water Quality Study does not need to be repeated.

year, and therefore, the time of year when project operation is most likely to have an adverse effect on water quality. Therefore, the lack of available water quality data during operations over the full study period, especially from July through September, has resulted in inadequate information being produced to evaluate the effects of continued project operation on water quality.

Regarding AEP Generation Resources' proposal to collect continuous water temperature and DO data from mid-August through October 31, 2020, site-specific water quality data would still not be available during periods of project generation from mid-May through mid-August. This data gap would hinder an assessment of project effects on water quality during the summer months when effects on water quality are likely to be most pronounced. To ensure that sufficient data is available to characterize water quality conditions in the project area when the project is operating and support an analysis of project operational effects on this resource during the critical summer months, we recommend that AEP Generation Resources also conduct continuous water quality monitoring from June through August 2021. Additionally, although not addressed in AEP Generation Resources' reply comments, we recommend in-situ water quality measurements also be conducted at each of the four established continuous water quality monitoring locations to achieve consistency with the intent of the approved study plan. Therefore, we recommend that in-situ monitoring occur on a monthly basis and coincide with the timing of all remaining continuous water quality monitoring sampling (September through October 2020, and June through August 2021).

Downloading the water quality data loggers on a bi-weekly basis, as proposed by AEP Generation Resources, would limit the potential for extended periods of lost or inaccurate data resulting from biofouling or lost or malfunctioning loggers by increasing the frequency of data retrieval. We also recommend that AEP Generation Resources conduct bi-weekly maintenance and performance checks on all primary and secondary data loggers associated with the collection of additional water quality data related to this study.

Fish Entrainment and Impingement Study

<u>Background</u>

The purpose of the Fish Entrainment and Impingement Study is to assess potential project effects on fish mortality and injury using a combination of existing literature and site-specific information. The approved study plan requires a methodology that includes the following seven separate tasks: (1) formation of a working group;[4] (2) characterizing the physical, operational, and water quality characteristics of the project that may affect fish entrainment, impingement, and survival; (3) collect intake velocity data; (4) developing a target fish species list that includes species of management concern as well as other non-game species (e.g., rare, threatened, and endangered species); (5) using data from tasks 2 through 4 to assess the potential for trash rack exclusion and vulnerability to impingement and entrainment; (6) determining monthly turbine entrainment rates from existing empirical data and utilize these rates to estimate monthly turbine entrainment for the target fish species using existing hydrology and project operations data; and (7) calculating turbine mortality for the range of target species' sizes expected to become entrained and apply this to the monthly entrainment estimates.

In the ISR, AEP Generation Resources states this study has not yet been completed, primarily because a majority of the study's tasks rely on the results of other on-going studies. Therefore, no results for this study have been provided within the timeframe required by the approved study plan. Further, in its reply comments, AEP Generation Resources does not indicate why there has been a delay in reaching an agreement on the specific methodology to be used for the blade strike analysis.

Requested Study Modification

West Virginia DNR requests that the Fish Entrainment and Impingement Study be modified to include a provision to use sensor fish technology, as developed by the Department of Energy's Pacific Northwest National Laboratory, to provide site-specific information to improve the accuracy of fish entrainment estimates at the project. West Virginia DNR further states that deploying sensor fish through the project's turbines would provide valuable site-specific data on shear forces, collision potential, pressure changes, and other conditions associated with fish passage through the turbines.

FWS states that it supports West Virginia DNR's request to incorporate the use of sensor fish technology in the Fish Entrainment and Impingement Study. FWS further recommends that task 7 be modified to include a provision to use FWS' Excel-based Turbine Blade Strike Analysis model (Towler and Pica, 2018).[5] FWS states that this requested study modification is necessary to provide a secondary verification of desktop

[4] Task 1 specifies that the working group include representatives from FWS, West Virginia DNR, and Ohio DNR, and that the purpose of the group is to refine the methods associated with conducting the study within the first year.

[5] Towler, B. and J. Pica. 2018. Turbine Blade Strike Analysis: A Desktop Tool for Estimating Mortality of Fish Entrained in Hydroelectric Turbines. Available at: https://www.fws.gov/northeast/fisheries/fishpassageengineering.html.

study survival rates of all species and life stages of fish that may be entrained in the project's turbines and improve the overall accuracy of corresponding annual mortality rates. West Virginia DNR has not specifically commented on FWS' recommendation to modify task 7.

Comments on the Requested Study Modification

In its reply comments, AEP Generation Resources cites to section 5.15(d) of the Commission's regulations and states that the resource agencies have not adequately demonstrated that the approved study was: (1) not conducted as provided for in the approved study plan; or (2) conducted under anomalous environmental conditions or that environmental conditions have changed in a material way. Therefore, AEP Generation Resources states that adequate justification to modify the Fish Entrainment and Impingement Study was not provided by the agencies. Accordingly, AEP Generation Resources does not propose to modify this study.

Discussion and Staff Recommendation

Sensor Fish

We previously explained our rationale for not recommending FWS' and West Virginia DNR's prior requests to modify the study to include an in-field verification component in the SPD. In the SPD, we concluded that there was no justification for the added level of cost and effort associated with the agencies' recommendations at that time to incorporate sonar technology into the study methodology to inform the study and validate its results. We also concluded that the approved study would be adequate to provide the necessary information for staff to conduct an analysis of fish entrainment and impingement at the project. Our previous conclusions for not including an in-field verification component with this study remain valid and are equally applicable to FWS' and West Virginia DNR's requests for the use of sensor fish.

Blade Strike Analysis

As noted above, AEP Generation Resources and FWS have been unable to reach clear agreement in the first study year on the specific methodology to be used for the required blade strike analysis. AEP Generation Resources to date has only stated generally that it will continue to work with the resource agencies to refine the methodologies associated with this study. AEP Generation Resources has neither clearly identified a blade strike methodology for us to consider and weigh against FWS's recommendation nor explained why it does not accept FWS' recommended methodology.

FWS' recommended Excel-based Turbine Blade Strike Analysis model is consistent with generally accepted practice in the scientific community and is a methodology that has been commonly used in other recent relicensing proceedings (e.g., Pejepscot Hydroelectric Project No. 4784, Kelley's Falls Hydroelectric Project No. 3025, and Niagara Hydroelectric Project No. 2466). For these reasons, and to resolve the ongoing disagreement between AEP Generation Resources and FWS on the specific methodology to use for the analysis, we recommend that AEP Generation Resources modify the Fish Entrainment and Impingement Study to remove the provision for AEP Generation Resources to refine the mortality methodology in consultation with resource agencies and replace it with a provision to use FWS' Excel-based Turbine Blade Strike Analysis model to estimate fish mortality through the project's turbines. Because AEP Generation Resources is already proposing, generally, to conduct a blade strike analysis as part of this study, we anticipate no additional cost associated with our recommendation.

Eastern Spadefoot Toad Habitat Suitability Assessment

Background

The purpose of the Eastern Spadefoot Habitat Suitability Assessment is to determine if eastern spadefoot toad habitat occurs within the project area, and if so, determine if those areas are being used by the eastern spadefoot toad (eastern spadefoot) through a presence/absence field survey. The SPD requires AEP Generation Resources to use soils data, topographic maps, aerial photographs, and other relevant information to determine if suitable eastern spadefoot habitat indicators are present (e.g., sandy soils and flood-prone areas). If suitable eastern spadefoot habitat is found within the project boundary, the SPD requires that a presence/absence field survey be conducted to determine if the eastern spadefoot is making use of project land. The presence/absence component of the study would be conducted based on: (1) the professional opinion of the qualified biologist conducting the habitat assessment; and (2) consultation with Ohio DNR, predicated on data acquired from the habitat assessment.

The results of the habitat survey indicate the presence of moderate-quality eastern spadefoot habitat within the project boundary. Consequently, the biologist that conducted the habitat study concluded that a presence/absence survey is necessary to verify whether the eastern spadefoot is making use of project land.

Requested Study Modification

AEP Generation Resources requests to modify the study by suspending all remaining field activities, including the presence/absence field survey, due to the

COVID-19 pandemic. AEP Generation Resources further states it will consult with the resource agencies to determine the appropriate steps to take with the study.

Comments on the Requested Study Modification

Ohio DNR recommends that AEP Generation Resources conduct the presence/absence survey for the eastern spadefoot.[6]

Discussion and Staff Recommendation

Eastern spadefoot habitat has been identified within the project boundary and Ohio DNR has been consulted. The field component of the study can be conducted independently, by a solitary biologist, and in compliance with social distancing protocols. For these reasons, we recommend AEP Generation Resources conduct the presence/absence component of the Eastern Spadefoot Toad Habitat Suitability Assessment, as provided for in the SPD.

Recreation Study

Background

The purpose of the Recreation Study is to collect information on current recreation use levels and the condition of the project's recreation facilities. To meet the goals and objectives of the study, the study methodology includes the following tasks: (1) a recreation facility inventory and condition assessment; (2) stakeholder/agency interviews; (3) a visitor use survey consisting of an online survey and on-site survey using a drop-box; and (4) recreation use documentation using trail cameras.

Requested Study Modification

West Virginia DNR requests that the Recreation Study be modified to conduct an additional year of visitor use surveys in order to obtain a larger sample size. West Virginia DNR also recommends that AEP Generation Resources consider additional methods for increasing participation in the survey, including newspaper advertisements, social media posts, and incentives for completing the survey.

Ohio DNR requests that the Recreation Study be modified to conduct the visitor use survey for the remaining summer months into Fall of 2020 to increase the sample size of the online surveys and phone interviews, particularly from anglers. Specifically, Ohio DNR recommends expanding participation in the survey through electronic and printed

[6] *See* Telephone Memo issued on August 17, 2020.

newspaper advertisements and through social media. Ohio DNR notes that though in-person interviews would be useful, they may not be possible due to the COVID-19 pandemic, and therefore recommends the continued use of a drop box to distribute on-site surveys.

FWS and the Corps support the requests made by West Virginia DNR and Ohio DNR to continue the visitor use survey.

Comments on the Requested Study Modification

In its reply comments, AEP Generation Resources states that it completed the study as required by the approved study plan. AEP Generation Resources also states that the data collected and interviews conducted with experienced anglers provide sufficient information to meet the objectives of the study.

Discussion and Staff Recommendation

West Virginia DNR, Ohio DNR, FWS and the Corps have not provided the required justification for their requested study plan modifications. Specifically, the agencies did not demonstrate that: (1) the approved study was not conducted as provided for in the approved study plan; or (2) the study was conducted under anomalous environmental conditions or that environmental conditions have changed in a material way. AEP Generation Resources conducted the study using the survey collection methods required by the approved study plan, which did not require a minimum number of survey responses.

However, the survey was conducted under anomalous environmental conditions, (section 5.15(d)). The project was not operating from June 17 through October 7, October 10 through October 12, and October 28 through October 31, 2019, which includes a significant portion of the study season. During these periods, flows were redirected through the Corps' Tainter gates, which are located on the opposite side of the dam from the project's tailrace fishing pier. Because fish were likely attracted to the redirected flows, and therefore were drawn away from the tailrace fishing pier, the quality of fishing at the pier would have likely been reduced during these periods, which may have affected use by anglers. Because the only recreation amenities at the project are the tailrace fishing pier and picnic tables, and fishing is the primary recreation activity, a decrease in site visitation may have occurred due to these anomalous environmental conditions.

For these reasons, we recommend the Recreation Study be modified to continue the visitor use survey, consisting of an online survey and on-site survey using a drop-box, and the recreation use documentation using trail cameras from September through October 2020 and June through August 2021.

Yayac, Maggie

From:	McCorkle, Richard <richard_mccorkle@fws.gov>
Sent:	Thursday, September 24, 2020 10:00 AM
To:	Jonathan M Magalski
Subject:	[EXTERNAL] follow up to phone/voice mail exchanges regarding Racine data request

Jon,

Thanks for the return phone call - sorry I missed it. I understand about powerhouse drawings being CEII. If we need to go that route, it wouldn't be the first time sending a CEII request to FERC, although I will hold off for now until we see what information we can obtain without going that route. You mentioned you may be able to at least provide elevation and dimensions for the power house and other project features. We would be interested in whatever you can provide along those lines.

We are also interested in the headpond and tailwater elevations for the past 5 years, and operational data for the past 5 years, that you mentioned in your message you could provide. I assume an additional formal request is not necessary, but please let me know if you need something more from me or would like to discuss.

Thanks again, and I hope you're staying safe healthy.

Rick

Richard C. McCorkle
Fish and Wildlife Biologist
U.S. Fish & Wildlife Service
Pennsylvania Field Office
110 Radnor Road, Ste 101
State College, PA 16801
Office: 814-206-7470
Personal cell (while teleworking): 302-382-0284

Yayac, Maggie

Subject: FW: [EXTERNAL] Re: USFWS Turbine Blade Strike Analysis Model, including different blade strike coefficient for American eel

Attachments: Turbine Blade Strike Analysis 200316.xlsm; TBSA - Background, Data Requirements, and Simulations.pdf; TBSA Lambda Calibration for Eels 200307.xlsm; RE: [EXTERNAL] Re: USFWS Turbine Blade Strike Analysis Model, including different blade strike coefficient for American eel

From: McCorkle, Richard <richard_mccorkle@fws.gov>
Sent: Wednesday, September 30, 2020 9:57 AM
To: Jonathan M Magalski <jmmagalski@aep.com>
Subject: Fw: [EXTERNAL] Re: USFWS Turbine Blade Strike Analysis Model, including different blade strike coefficient for American eel

Jon,

I failed to change the subject line in my previous forwarding of this information. I've changed the subject line here, so you may want to forward this version to the modeling folks, instead.

Rick

Richard C. McCorkle
Fish and Wildlife Biologist
U.S. Fish & Wildlife Service
Pennsylvania Field Office
110 Radnor Road, Ste 101
State College, PA 16801
Office: 814-206-7470
Personal cell (while teleworking): 302-382-0284

From: McCorkle, Richard <richard_mccorkle@fws.gov>
Sent: Wednesday, September 30, 2020 9:52 AM
To: Jonathan M Magalski <jmmagalski@aep.com>
Subject: Fw:

Jon,

I know I previously sent the Service's Turbine Blade Strike Analysis Model, but am forwarding this because it includes some good explanation of why we recommend entering a higher blade strike correlation coefficient for American eel. Also, the attached model may be an update compared to what I previously provided. Please forward to the folks who are doing the desktop entrainment and blade strike analyses for Racine and

Niagara. Of course the different coefficient for American eel only applies to Racine, as eels still are not reaching Niagara.

Thanks!

Rick

Richard C. McCorkle
Fish and Wildlife Biologist
U.S. Fish & Wildlife Service
Pennsylvania Field Office
110 Radnor Road, Ste 101
State College, PA 16801
Office: 814-206-7470
Personal cell (while teleworking): 302-382-0284

From: Pica, Jessica E <jessica_pica@fws.gov>
Sent: Wednesday, September 30, 2020 9:37 AM
To: McCorkle, Richard <richard_mccorkle@fws.gov>; Smith, Scott <scott.smith@dwr.virginia.gov>; McCloskey, John <john_mccloskey@fws.gov>
Cc: Alan Weaver <alan.weaver@dwr.virginia.gov>

Morning all,

We've been asked a lot recently about the appropriate strike correlation coefficient (lambda) for eels in the Franke equations and the TBSA model. Franke (1999) recommends the use of 0.2 for most fish (e.g., salmonids, clupeids), but the equations were never calibrated for eels. Literature suggests eel mortality in Kaplans/propellers may be higher. We were provided the Gomes and Larinier (2008) data set on eel mortality in Kaplans. Fortunately, the data set included enough info for Brett Towler to run it through the TBSA model. Calculations on 74 different sites resulted in an average Lambda value of 0.42; there was also a fair amount of scatter around the mean, but he ran multiple linear regression analyses that showed no clear dependency of Lambda on other variables (e.g., turbine opening).

For those running TBSA on Kaplans or propellers for eels, in the absence of biological evaluations we recommend using Lambda=0.42.

As a general consideration, the Gomes and Larinier (2008) suggest turbine mortality for eels through Kaplan, propellers is higher than other fish; Brett's calculations suggest it's twice that of other fish.

I've attached the data and and calculations supporting the use of lambda = 0.42.

Attached is an updated and QC'ed release of our Turbine Blade Strike Model (TBSA). This version includes the following significant changes:

- On the Route Data tab, there is now a button Turbine Characteristics. Clicking this button will export the blade strike probabilities for all the units in your model to a separate worksheet.
- An enhanced Import Example button on Route Data tab now allows user to select one of 5 different examples.

Additionally, there were minor fixes to the following:

- Formatting errors on the Route Data tab were resolved so that you can now add up to 20 units.
- You can now Export Archives with different numbers of units.

Please note that the underlying equations and blade strike calculations, which were QC'ed in previous versions, have not changed.

Thanks,
Jessica

American Electric Power
1 Riverside Plaza
Columbus, OH 43215
aep.com

October 2, 2020 *Via Electronic Filing*

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

Subject: Racine Hydroelectric Project (FERC No. 2570)
Response to Determination on Requests for Study Modifications

Dear Secretary Bose:

On September 9, 2020, the Federal Energy Regulatory Commission (FERC or Commission) issued a determination on requests for modifications to the approved study plan (Study Determination) for AEP Generation Resources Inc.'s (AEPGR) Racine Hydroelectric Project (P-2570) (Project). In the Study Determination, the Commission directed AEPGR to conduct additional water quality and recreation study tasks in 2020 and 2021. While AEPGR intends to conduct additional data collection per the Commission's Study Determination, AEPGR respectfully requests a variance to the proposed schedule to accommodate staff and equipment mobilization and generation unit outages. AEPGR believes that the proposed schedules described herein are consistent with agency and stakeholder requests and will provide consistent data from a single study season.

Background

The Commission issued a Study Plan Determination (SPD) for the Project on May 13, 2019. AEPGR filed an initial study report (ISR) on May 5, 2020, held an ISR meeting on May 14, 2020, and filed an ISR meeting summary on June11, 2020. Comments on the ISR and meeting summary were filed by the West Virginia Division of Natural Resources (WVDNR) on June 5, 2020, the U.S. Fish and Wildlife Service (USFWS) on June 30, 2020, the U.S. Army Corps of Engineers (Corps) on July 10, 2020, and the Ohio Department of Natural Resources (ODNR) on August 10, 2020. AEPGR filed reply comments on August 10, 2020.

Water Quality Study

As described in the Water Quality Study Report presented as Appendix B of the ISR, AEPGR conducted water quality monitoring at four locations at the Project in 2019. While water quality data was collected from May 1 through October 31, 2019, the Project's generating units were offline approximately 65 percent of the time during the study period.

In their comments on the ISR, the USFWS, WVDNR, and Corps recommended that AEPGR conduct an additional year of continuous water quality monitoring at the four established water quality monitoring locations from July 1 through October 15, 2020. The USFWS, WVDNR, and Corps indicated that the additional data collection was appropriate because the Project was generally not operating during the 2019 water quality study and additional data was needed to assess the Project's effects (if any) on temperature and dissolved oxygen (DO) in the Ohio River. The USFWS and WVDNR further recommended that AEPGR consider checking and cleaning the water quality data loggers on a weekly or bi-weekly basis. In response to comments on the ISR, AEPGR indicated that water quality data would be collected from mid-August through October 2020 and that the data loggers would be checked bi-weekly.

The Commission's Study Determination adopted and expanded the recommendations of the USFWS, WVDNR, ODNR, and Corps. Specifically, the Study Determination directed AEPGR to collect temperature and DO at the four existing water quality monitoring locations from September through October of 2020 and May through August 2021. Additionally, the Commission directed AEPGR to collect *in-situ* water quality data at the established monitoring locations on a monthly basis and to check the data loggers on a bi-weekly basis.

AEPGR intended to redeploy water quality data loggers in August 2020 as indicated in the response to comments on the ISR. However, the Project's generating units were offline for maintenance for an extended period of time during August and early September 2020. Because the additional data collection required pursuant to the Commission's Study Determination was intended to collect water quality data during routine Project operations, AEPGR postponed data collection until the units were operating regularly.

While the Project's generating units have returned to service, redeployment of the water quality data loggers would not be completed until October, and data would be unavailable for September 2020. As such, AEPGR is requesting a variance from the study schedule outlined in the Commission's Study Determination. AEPGR proposes to redeploy the water quality data loggers at the four established monitoring locations from May 1 through October 31, 2021 to collect continuous temperature and DO data. AEPGR will conduct bi-weekly data downloads and equipment checks during the 2021 study period and will also collect *in-situ* water quality data on a monthly basis. AEPGR believes that this schedule will provide consistent data documenting water quality parameters over the course of a single study season from late spring through fall. Further, AEPGR believes that this proposed schedule is consistent with agency comments and requests for a second season of water quality data collection.

Recreation Study

As described in the ISR, AEPGR collected visitor use data at the Project's formal recreation area in 2019 and 2020. Study methods included collecting visitor use surveys at a weatherproof drop-box at the Project's recreation area and via an online visitor survey. AEPGR also deployed trail cameras at the Project's recreation area to document visitor use trends. The study was conducted in accordance with the Commission's SPD.

The WVDNR, ODNR, USFWS, and Corps requested modifications to the Recreation Study. These requested modifications included extending the survey period to collect additional survey responses. In the Study Determination, FERC staff concluded that the Recreation Study was conducted under anomalous environmental conditions because the Project only operated 17 days from June 17 through October 31, 2019. When the Project is not operating, flows are directed through the Corps' Tainter gates instead of the Project's generating units. The quality of fishing at the Project's tailrace fishing pier could be adversely affected when the Project is not discharging flows into the tailrace. For these reasons, FERC staff recommend the Recreation Study be modified to continue the visitor use survey, consisting of an online survey and on-site survey using a drop-box, and the recreation use documentation using trail cameras from September through October 2020 and June through August 2021.

As discussed above, the Project's generating units were offline for portions of September 2020. Because flows are not discharged into the tailrace when the Project is not operating, AEPGR did not collect additional recreation data in September 2020. While the Project's generating units have returned to service, the onsite survey forms and trail cameras would not be deployed until October 2020. Accordingly, AEPGR respectfully requests a variance from the schedule in the Commission's Study Determination. AEPGR proposes to redeploy the trail cameras, onsite survey forms, and reopen the online survey by June 1, 2021 and to continue to collect recreation data at the Project through October 31, 2021. AEPGR believes that this schedule will provide a continuous and consistent data set encompassing a full recreation season and is consistent with stakeholder requests.

Should you have additional questions regarding this request, please do not hesitate to contact me at (614) 716-2240 or via email at jmmagalski@aep.com.

Sincerely,

Jonathan M. Magalski
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Cc: Liz Parcell (AEPGR)
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FEDERAL ENERGY REGULATORY COMMISSION
WASHINGTON, DC 20426
October 15, 2020

OFFICE OF ENERGY PROJECTS

Project No. 2570-032 – Ohio
Racine Hydroelectric Project
AEP Generation Resources, Inc.

VIA FERC Service

Mr. Jonathan Magalski
Environmental Specialist Consultant
American Electric Power Services Corporation
1 Riverside Plaza
Columbus, OH 43215

Reference: Modification of Approved Study Plan

Dear Mr. Magalski:

On September 9, 2020, a Determination on Requests for Study Modifications (determination) for the Racine Hydroelectric Project (project) was issued that modified the required Water Quality and Recreation studies. The determination modified the Water Quality Study to require: (1) continuous monitoring from mid-August through October 31, 2020, and from June through August of 2021 at four established water quality monitoring locations; and (2) monthly monitoring to occur during the months of September through October of 2020, and June through August of 2021. The determination also modified the Recreation Study to require a second study season for the required visitor use surveys and documentation of recreation use.

On October 2, 2020, AEP Generation Resources, Inc. (AEP Generation Resources) filed a request to further modify the Water Quality and Recreation studies. AEP Generation Resources bases its request on the issue that the project was off-line for maintenance for an extended period of time during August and early September of 2020. Because the purpose of collecting additional water quality data is to assess the effects of project operation on water quality, AEP Generation Resources states that the water quality data required by the determination was not collected in August or September of 2020. Additionally, AEP Generation Resources states that although normal project operation has resumed, it is not possible to redeploy the water quality data loggers until mid- to late-October of 2020. For these reasons, AEP Generation Resources requests a modification of the approved schedule of the Water Quality Study to conduct the required continuous and monthly water quality monitoring from May 1 through October 31, 2021, instead of mid-August through October 31, 2020, and from June through August of 2021. AEP Generation Resources states that this amended timeframe would ensure consistent data is collected over the course of a single study season.

In its October 2, 2020 request, AEP Generation Resources also states that because the project was not operating for portions of 2020, and flows were not discharged in the vicinity of the tailrace fishing pier, the required visitor use survey was not conducted and trail cameras for monitoring use were not deployed.[1] For these reasons, AEP Generation Resources requests a modification of the approved schedule to conduct the visitor use survey and deploy the trail cameras by June 1, 2021, and continue through October 31, 2021, instead of September through October of 2020 and June through August of 2021. AEP Generation Resources states that this amended timeframe would likewise ensure consistent data is collected over the course of a single study season.

The requested modification of the Water Quality Study would ensure that sufficient data is in the record to characterize water quality conditions in the project area when the project is operating and support an analysis of project effects on this resource during the critical summer months. The requested modification for the Recreation Study would ensure that information is obtained to characterize recreation use at project recreation sites during the recreation season when the project is operating. Therefore, the requested study plan modifications are reasonable and consistent with the goals and objectives of the Water Quality and Recreation studies, and are approved.

If you have any questions, please contact Jay Summers at (202) 502-8764.

Sincerely,

Terry L. Turpin
Director
Office of Energy Projects

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[1] The primary recreation activity at the project is tailrace fishing. The project was off-line approximately 65 percent of the time during 2019, resulting in tailrace flows being directed to the opposite side of the dam from the project's tailrace fishing pier. Staff concluded in the determination that because the project was offline, the quality of fishing at the tailrace fishing pier may have reduced, resulting in reduced visitation by anglers.

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Via Electronic Filing

November 13, 2020

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

Subject: Racine Hydroelectric Project (FERC No. 2570-032)
Sixth Quarterly Study Progress Report

Dear Secretary Bose:

AEP Generation Resources Inc. (AEPGR), a unit of American Electric Power (AEP), hereby submits the Sixth Quarterly Study Progress Report for the Racine Hydroelectric Project (Project) (FERC No. 2570) relicensing.

AEPGR has elected to utilize the Integrated Licensing Process (ILP) for the relicensing of the Project as defined in 18 Code of Federal Regulations (C.F.R.) Part 5. As proposed in AEPGR's April 12, 2019 Revised Study Plan (RSP) and approved in the Federal Energy Regulatory Commission's (FERC or Commission) May 13, 2019 Study Plan Determination (SPD), AEPGR is hereby filing the Sixth Quarterly Study Progress Report for the Project. This progress report describes the activities performed since the previous progress report, as well as study activities generally expected to be conducted in quarter 4 (Q4) of 2020. Unless otherwise described, all relicensing studies are being conducted in conformance with the approved RSP and the Commission's SPD.

1. Water Quality Study

- A Water Quality Study Report was filed with the Commission as Appendix B to the May 5, 2020 Initial Study Report (ISR). On September 9, 2020, the Commission issued a Determination on Requests for Study Modifications (Study Determination) for the Project. In the Study Determination, the Commission directed AEPGR to collect temperature and dissolved oxygen (DO) data at the four existing water quality monitoring locations from September through October of 2020 and May through August 2021. Additionally, the Commission directed AEPGR to collect *in-situ* water quality data at the established monitoring locations on a monthly basis and to check the data loggers on a bi-weekly basis.
- On October 2, 2020, AEPGR filed a request to modify the schedule for DO and temperature data collection described in the Commission's Study Determination. Specifically, AEPGR requested a modification of the approved schedule for the Water Quality Study to conduct continuous and monthly water quality monitoring from May 1 through October 31, 2021. The Commission approved the study modification in a letter order dated October 15, 2020.

- AEPGR intends to deploy water quality monitoring equipment in 2021 consistent with the study schedule approved by the Commission.

2. Recreation Study

- The Commission's September 9, 2020 Study Determination directed AEPGR to conduct visitor use surveys and deploy trail cameras to monitor visitor use trends at the Project's recreation facility from September through October of 2020 and June through August of 2021.
- On October 2, 2020, AEPGR filed a request to modify the schedule for visitor use surveys and trail camera deployment described in the Commission's Study Determination. Specifically, AEPGR requested a modification to the approved schedule for the Recreation Study to conduct visitor use surveys and deploy trail cameras at the Project's recreation facility from June 1, 2021 through October 31, 2021. The Commission approved the study modification in a letter order dated October 15, 2020.
- AEPGR is currently compiling and processing the data collected in 2020, and AEPGR intends to conduct visitor use surveys and deploy trail cameras consistent with the schedule approved by the Commission.

3. Cultural Resources Study

- The Cultural Resources Study has been completed in accordance with the RSP and the Commission's SPD. No additional activities are anticipated related to this study.

4. Mussel Survey

- The Mussel Survey has been completed in accordance with the RSP and the Commission's SPD. No additional activities are anticipated related to this study.

5. Fisheries Survey, Project Characteristics, and Project Operations Related to Potential Fish Passage

- Based on consultation with the U.S. Fish and Wildlife Service (USFWS) and the West Virginia Department of Natural Resources (WVDNR), a temporary eel ramp was installed at the Project in mid-June 2020. AEPGR continued to consult with USFWS and WVDNR on the design of the eel ramp and the status of monitoring. USFWS provided comments on the design of the eel ramp in July and AEPGR made adjustments based on the comments received. The temporary eel ramp was removed in early October 2020.
- Task 1 of the RSP states that AEPGR will provide the following data (as available) to resource agencies for the last five years in order to conduct their own analyses related to potential fish passage at the Project:
    - Headpond elevations,
    - Tailwater elevations,
    - Gate (i.e., spill) operations (including the sequence and timing of specific gates),
    - Unit 1 and 2 turbine discharge, and
    - Lock operations (including any openings for maintenance).

AEPGR also agreed to provide any available dam/powerhouse elevation drawings or descriptions, and/or bathymetric data upstream or downstream from the Project. AEPGR is compiling available data as indicated above and will provide these data to the resource agencies prior to the completion of this study.

6. Fish Entrainment and Impingement Study

- AEPGR continues to compile data from other relicensing studies (i.e., Fisheries Survey) and other Project-specific information that will be used in the analyses for this study. AEPGR is also reviewing previous intake velocity measurements (including acoustic Doppler data collected at the intake structures) to determine if sufficient information is available to inform the Fish Entrainment and Impingement Study. AEPGR will continue to consult with resource agencies regarding the list of target species and to refine the study protocols. Once all of the data has been compiled, AEPGR will perform the analyses as described in the RSP and develop a final study report.

7. Eastern Spadefoot Toad Habitat Suitability Assessment

- A literature review and search of museum specimens was conducted in 2019. Additionally, an initial site visit was conducted in September 2019 to review the primary habitat indicators present at the Project. The Habitat Suitability Assessment Report was included in Appendix D of the ISR. Field surveys were expected to occur through June of 2020, during the peak period with the highest probability of finding Eastern Spadefoot Toads. However, due to the COVID-19 pandemic, field surveys were not able to be conducted during the peak season. AEPGR anticipates that fieldwork to determine the presence/absence of eastern spadefoot toad at the Project will occur in the late spring/early summer of 2021.

If there are any questions regarding this progress report, please do not hesitate to contact me at (614) 716-2240 or jmmagalski@aep.com.

Sincerely,

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Yayac, Maggie

Subject: FW: [EXTERNAL] Racine Generation and Forebay/Tailwater Elevations

From: McCorkle, Richard <richard_mccorkle@fws.gov>
Sent: Friday, November 13, 2020 3:01 PM
To: Jonathan M Magalski <jmmagalski@aep.com>
Subject: Re: [EXTERNAL] Racine Generation and Forebay/Tailwater Elevations

This is an **EXTERNAL** email. **STOP**. **THINK** before you CLICK links or OPEN attachments. If suspicious please click the '**Report to Incidents**' button in Outlook or forward to incidents@aep.com from a mobile device.

Thanks Jon. Happy Friday to you, too, and hope you have a great weekend!

Rick

Richard C. McCorkle
Fish and Wildlife Biologist
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Pennsylvania Field Office
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Personal cell (while teleworking): 302-382-0284

From: Jonathan M Magalski <jmmagalski@aep.com>
Sent: Friday, November 13, 2020 2:49 PM
To: McCorkle, Richard <richard_mccorkle@fws.gov>
Subject: [EXTERNAL] Racine Generation and Forebay/Tailwater Elevations

Happy Friday Rick,

I hope you are doing well. I just realized I never sent this information to you. Attached are the forebay and tailrace elevations going back to 2015 and the generation record going back to 2014. Regarding the generation record, I will note that generation is reported in megawatts and is the sum of both units. Unfortunately, we cannot easily query which unit is running. However, I think for your analyses, total generation should be sufficient. Please let me know if you have questions or need anything else. Have a great weekend....Jon

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December 4, 2020 *Via Electronic Distribution*

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**Subject: Racine Hydroelectric Project (FERC No. 2570)
Consultation Regarding the Fish Entrainment and Impingement Study
Target Species Selection**

Dear Mr. McCorkle, Mr. Harrell, and Mr. Greenlee:

On May 13, 2019, the Federal Energy Regulatory Commission (FERC or Commission) issued a Study Plan Determination (SPD) for AEP Generation Resources Inc.'s (AEPGR) Racine Hydroelectric Project (FERC No. 2570) (Project) located along the Ohio River in Meigs County, Ohio. The SPD describes the studies that AEPGR has been directed to conduct in support of a new FERC license for the Project. AEPGR's Fish Entrainment and Impingement Study was approved without modifications in FERC's SPD.

Pursuant to the SPD, AEPGR consulted with a working group consisting of representatives from the U.S. Fish & Wildlife Service (USFWS), West Virginia Division of Natural Resources (WVDNR), and the Ohio Department of Natural Resources (ODNR) to identify target fish species to be analyzed during the Fish Entrainment and Impingement Study. By letter dated January 9, 2020, AEPGR proposed to include 12 species of fish and corresponding life stages in the analysis, with size classes bracketed accordingly.

On January 30, 2020, the USFWS provided comments on the proposed list of targeted species. In addition to the diadromous American eel (*Anguilla rostrata*), the USFWS requested that AEPGR include non-diadromous fish species that undertake long-distance, in-river migrations in the analysis. The USFWS also recommended that the analysis include documented hosts for federally or state listed mussels that have the potential to occur in the vicinity of the Project. With respect to size class evaluation, the USFWS recommended that AEPGR evaluate percent survival in fish length increments of no more than two inches per increment. Finally, the USFWS recommended that final selection of fish species to be evaluated in the entrainment and impingement study be postponed until the spring 2020 fisheries survey data was collected pursuant to the Commission's approved Fisheries Survey, Project Characteristics, and Project Operations Related to Potential Fish Passage Study (Fisheries Study).

By letter dated February 7, 2020, the WVDNR also provided comments on AEPGR's proposed list of target fish species. The WVDNR recommended that AEPGR include 82 species of fish in the entrainment and impingement evaluation.

AEPGR appreciates the comments and recommendations provided by the USFWS and WVDNR regarding the target species list developed for the Fish Entrainment and Impingement Study. Pursuant to the USFWS's comments, and to facilitate further consultation regarding the target species, AEPGR is providing a summary of the fish species collected during the fall 2019 and spring 2020 fisheries surveys at the Project in the enclosed Microsoft Excel database[1]. AEPGR notes that the fall fisheries survey was completed in November 2019, and the spring fisheries survey was completed in May 2020. The fall 2019 survey data was presented in the May 5, 2020 Initial Study Report (ISR); AEPGR is currently developing a report on the results of the Fisheries Study and intends to file a report concurrent with the May 12, 2021 Updated Study Report as described in the approved study plan. While the Fisheries Study Report will provide additional information and details regarding the specific study methods, the Excel database provides the results of fisheries sampling by season to inform the selection of target species and data analysis.

Based on the comments provided by the USFWS and WVDNR and the results of the fisheries surveys, AEPGR has revised the proposed target species for the Fish Entrainment and Impingement Study. AEPGR's proposed target species include species captured during the 2019 and 2020 fisheries surveys, the diadromous American eel (a species known to occur in the Ohio River)[2], non-diadromous species that undertake long-distance, in-river migration, and potential host species for federally and state-listed mussel species identified in the USFWS's January 30, 2020 correspondence. The proposed target species are presented in Table 1. In total, AEPGR is proposing to include 35 species in the entrainment and impingement analysis.

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[1] During the May 14, 2020 ISR Meeting, AEPGR proposed to modify the spring 2020 fisheries survey to forgo trawl surveys due to safety concerns associated with the COVID-19 pandemic. The WVDNR and USFWS expressed support for this modification during the ISR Meeting and in subsequent written comments dated June 5 and June 29, 2020, respectively. The Commission approved the modification in the September 9, 2020 Determination on Requests for Study Modifications for the Racine Hydroelectric Project. Consequently, the summary database includes the results of trawl surveys conducted in fall 2019 but there is no corresponding trawl survey data from spring 2020.

[2] At the request of the USFWS and WVDNR, AEPGR installed a temporary eel ramp at the Project in mid-June 2020. The eel ramp was operated through early October 2020. While the American eel is known to occur in the Ohio River, AEPGR notes that no eels were collected at the Project during the sampling period.

Table 1. Proposed Entrainment and Impingement Study Target Species

Species	Scientific Name	Justification for Including as Target Species
American Eel	*Anguilla rostrata*	Diadromous species known to occur in the Ohio River
Bluegill	*Lepomis macrochirus*	Species captured during AEPGR fisheries surveys
Bluntnose Minnow	*Pimephales notatus*	Potential mussel host
Channel Catfish	*lctalurus punctatus*	Species captured during AEPGR fisheries surveys
Channel Shiner	*Notropis wickliffi*	Species captured during AEPGR fisheries surveys
Common Carp	*Cyprinus carpio*	Species captured during AEPGR fisheries surveys
Emerald Shiner	*Notropis atherinoides*	Species captured during AEPGR fisheries surveys
Freshwater Drum	*Aplodinotus grunniens*	Species captured during AEPGR fisheries surveys
Gizzard Shad	*Dorosoma cepedianum*	Species captured during AEPGR fisheries surveys
Golden Redhorse	*Moxostoma erythrurum*	Species captured during AEPGR fisheries surveys
Green Sunfish	*Lepomis cyanellus*	Species captured during AEPGR fisheries surveys
Highfin Carpsucker	*Carpiodes velifer*	Species captured during AEPGR fisheries surveys
Hybrid Striped Bass	*Marone chrysops x M. saxatilis*	Species captured during AEPGR fisheries surveys
Largemouth Bass	*Micropterus salmoides*	Species captured during AEPGR fisheries surveys; potential mussel host
Logperch	*Percina caprodes*	Species captured during AEPGR fisheries surveys; potential mussel host
Longnose Gar	*Lepisosteus osseus*	Species captured during AEPGR fisheries surveys
Northern Hogsucker	*Hypentelium nigricans*	Species captured during AEPGR fisheries surveys
Quillback	*Carpiodes cyprinus*	Species captured during AEPGR fisheries surveys
River Carpsucker	*Carpiodes carpio*	Species captured during AEPGR fisheries surveys
River Redhorse	*Moxostoma carinatum*	Species captured during AEPGR fisheries surveys
River Shiner	*Notropis blennius*	Species captured during AEPGR fisheries surveys
Sauger	*Sander canadensis*	Species captured during AEPGR fisheries surveys; potential mussel host
Silver Chub	*Macrhybopsis storeriana*	Species captured during AEPGR fisheries surveys
Silver Redhorse	*Moxostoma anisurum*	Species captured during AEPGR fisheries surveys
Skipjack Herring	*Alosa chrysochloris*	Species captured during AEPGR fisheries surveys; potential mussel host; non-diadromous species that undertakes long distance, in-river migrations
Smallmouth Bass	*Micropterus dolomieu*	Species captured during AEPGR fisheries surveys
Smallmouth Buffalo	*lctiobus bubalus*	Species captured during AEPGR fisheries surveys
Smallmouth Redhorse	*Moxostoma breviceps*	Species captured during AEPGR fisheries surveys
Spotfin Shiner	*Cyprinella spiloptera*	Species captured during AEPGR fisheries surveys; potential mussel host
Spotted Bass	*Micropterus punctulatus*	Species captured during AEPGR fisheries surveys
Spotted Sucker	*Minytrema melanops*	Species captured during AEPGR fisheries surveys

Species	Scientific Name	Justification for Including as Target Species
Walleye	*Sander vitreus*	Species captured during AEPGR fisheries surveys; potential mussel host; non-diadromous species that undertakes long distance, in-river migrations
White Bass	*Morone chrysops*	Species captured during AEPGR fisheries surveys
White Crappie	*Pomoxis annularis*	Potential mussel host
Yellow Perch	*Perea flavescens*	Species captured during AEPGR fisheries surveys

Based on comments from the USFWS, AEPGR is also proposing to evaluate percent survival in fish length increments of no more than two inches per increment.

In order to finalize the list of target species, AEPGR would like to schedule a conference call with USFWS, WVDNR, and ODNR to discuss the proposed target list as described in this letter. AEPGR is proposing a conference call the week of December 14, 2020 and will be reaching out to your offices via email to confirm a time and date. In the meantime, should you have additional questions, please do not hesitate to contact me at (614) 716-2240 or via email at jmmagalski@aep.com.

Sincerely,

Jonathan M. Magalski
Environmental Specialist Consultant
American Electric Power Services Corporation, Environmental Services

Encls.

Cc: L. Parcell (AEPGR)
FERC

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Via Electronic Filing February 12, 2021

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

Subject: Racine Hydroelectric Project (FERC No. 2570-032)
Seventh Quarterly Study Progress Report

Dear Secretary Bose:

AEP Generation Resources Inc. (AEPGR), a unit of American Electric Power (AEP), hereby submits the Seventh Quarterly Study Progress Report for the Racine Hydroelectric Project (Project) (FERC No. 2570) relicensing.

AEPGR has elected to utilize the Integrated Licensing Process (ILP) for the relicensing of the Project as defined in 18 Code of Federal Regulations (C.F.R.) Part 5. As proposed in AEPGR's April 12, 2019 Revised Study Plan (RSP) and approved in the Federal Energy Regulatory Commission's (FERC or Commission) May 13, 2019 Study Plan Determination (SPD), AEPGR is hereby filing the Seventh Quarterly Study Progress Report for the Project. This progress report describes the activities performed since the previous progress report, as well as study activities generally expected to be conducted in quarter 1 (Q1) of 2021. Unless otherwise described, all relicensing studies are being conducted in conformance with the approved RSP and the Commission's SPD.

1. Water Quality Study

- Consistent with the study schedule approved by the Commission on October 15, 2020, AEPGR intends to deploy water quality monitoring equipment on or around May 1, 2021. AEPGR will collect continuous water temperature and dissolved oxygen, and *in-situ* water quality data on a monthly basis from approximately May 1 through October 31, 2021.

2. Recreation Study

- AEPGR is currently compiling and processing the data collected in 2020.
- Consistent with the study schedule approved by the Commission on October 15, 2020, AEPGR intends to conduct visitor use surveys and deploy trail cameras from on or around June 1 through October 31, 2021.

3. Cultural Resources Study

- The Cultural Resources Study has been completed in accordance with the RSP and the Commission's SPD. No additional activities are anticipated related to this study.

4. Mussel Survey

- The Mussel Survey has been completed in accordance with the RSP and the Commission's SPD. No additional activities are anticipated related to this study.

5. Fisheries Survey, Project Characteristics, and Project Operations Related to Potential Fish Passage

- Task 1 of the RSP states that AEPGR will provide the following data (as available) to resource agencies for the last five years in order to conduct their own analyses related to potential fish passage at the Project:
  - Headpond elevations,
  - Tailwater elevations,
  - Gate (i.e., spill) operations (including the sequence and timing of specific gates),
  - Unit 1 and 2 turbine discharge, and
  - Lock operations (including any openings for maintenance).

  AEPGR also agreed to provide any available dam/powerhouse elevation drawings or descriptions, and/or bathymetric data upstream or downstream from the Project. AEPGR has provided to the U.S. Fish and Wildlife Service (USFWS) the headpond and tailwater elevations, and Unit 1 and 2 turbine discharge information on November 13, 2020. It is AEPGR's understanding that the USFWS is working with the U.S. Army Corps of Engineers to obtain the gate and lock operational information.

6. Fish Entrainment and Impingement Study

- On January 9, 2020, AEPGR sent a letter to the USFWS, West Virginia Division of Natural Resources (WVDNR) and Ohio Department of Natural Resources (ODNR) with a proposed list of 12 target species for review and comment. USFWS and WVDNR provided comments on the proposed list by letters dated January 30 and February 7, 2020, respectively. Based on agency comments and the results of the spring and fall fisheries surveys conducted at the Project, AEPGR revised the list of target species to include 35 fish species. By letter dated December 4, 2020, AEPGR consulted with the USFWS, WVDNR and ODNR regarding the revised list of target fish species. On December 14, 2020, AEPGR held a conference call with USFWS, WVDNR and ODNR to discuss the revised target species list. No changes to the revised target species list were proposed during the call or in any subsequent follow-up. Therefore, AEPGR is proceeding with completing the study using the 35 target fish species as detailed in their December 4, 2020 letter. AEPGR is currently performing the analyses as described in the RSP and plans to include the final study report in the Updated Study Report to be filed with FERC by May 12, 2021.

7. Eastern Spadefoot Toad Habitat Suitability Assessment

- A literature review and search of museum specimens was conducted in 2019. Additionally, an initial site visit was conducted in September 2019 to review the primary habitat indicators present at the Project. The Habitat Suitability Assessment Report was included in Appendix D of the ISR. Field surveys were expected to occur through June of 2020, during the peak period with the highest probability of finding Eastern Spadefoot Toads. However, due to the COVID-19 pandemic, field surveys were not able to be conducted during the peak season. AEPGR anticipates that fieldwork to determine the presence/absence of eastern spadefoot toad at the Project will occur in the late spring/early summer of 2021.

If there are any questions regarding this progress report, please do not hesitate to contact me at (614) 716-2240 or jmmagalski@aep.com.

Sincerely,

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Mr. Richard Cogen
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Via Electronic Filing May 12, 2021

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

Subject: Racine Hydroelectric Project (FERC No. 2570)
Updated Study Report
Virtual WebEx Meeting Scheduled for May 25, 2021

Dear Secretary Bose:

AEP Generation Resources Inc. (AEPGR), a unit of American Electric Power, is the Licensee, owner, and operator of the 47.5-megawatt Racine Hydroelectric Project (Project) (FERC Project No. 2570). The Project is located along the Ohio River in Meigs County, Ohio.

AEPGR operates and maintains the Project under a license from the Federal Energy Regulatory Commission (FERC or Commission). The Project's existing license expires on November 30, 2023. AEPGR is pursuing a new license for the Project using the Commission's Integrated Licensing Process as defined in 18 Code of Federal Regulations (CFR) Part 5.

AEPGR has conducted studies as provided in the April 12, 2019 Revised Study Plan (RSP) and approved in the Commission's May 13, 2019 Study Plan Determination for the Project. In accordance with 18 CFR §5.15(c), AEPGR filed an Initial Study Report (ISR) with the Commission on May 5, 2020 and held an ISR Meeting on May 14, 2020. The Commission issued a Determination on Requests for Study Modifications on September 9, 2020.

Since that time, AEPGR has continued to diligently pursue studies as approved by the Commission. In accordance with 18 CFR §5.15(f), AEPGR is hereby filing the Updated Study Report (USR) with the Commission. The USR describes AEPGR's overall progress in implementing the study plan and schedule, summarizes available data, and describes any variances from the study plan and schedule approved by the Commission. This USR also serves as AEPGR's Eighth Quarterly Study Progress Report for the Project.

Concurrent with this filing, the USR is being made available to stakeholders on the Project's public relicensing website at www.aephydro.com/HydroPlant/Racine. The USR can also be found on FERC's online eLibrary (https://elibrary.ferc.gov/eLibrary/search) by searching docket No. P-2570.

The Commission's regulations at 18 C.F.R. § 5.15(f) require AEPGR to hold a USR Meeting with participants and FERC staff within 15 days of filing the USR. Accordingly, AEPGR will hold a virtual USR Meeting via WebEx from 1:00 p.m. until 4:00 p.m. on May 25, 2021.

To allow for adequate planning, AEPGR respectfully requests that those planning on joining the USR WebEx Meeting RSVP by emailing Jon Magalski at jmmagalski@aep.com on or before May 21, 2021.

If there are any questions regarding this filing, please do not hesitate to contact me at (614) 716-2240 or jmmagalski@aep.com.

Sincerely,

Jonathan M. Magalski
Environmental Specialist Consultant
American Electric Power Services Corporation, Environmental Services

Cc: Distribution List
Liz Parcell (AEP)
Rob Quiggle (HDR)

Racine Hydroelectric Project (FERC No. 2570)
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Nature Conservancy
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Dublin, OH 43017

Updated Study Report

Racine Hydroelectric Project (FERC No. 2570)

May 12, 2021

Prepared by:

HDR

Prepared for:

AEP Generation Resources Inc.

AEP AMERICAN® ELECTRIC POWER

Yayac, Maggie

Subject: FW: Racine Hydroelectric Project (FERC No. 2570) -- Filing of Updated Study Report
Attachments: 20210512 Racine Project USR Cover Letter.pdf

From: Hanson, Danielle
Sent: Wednesday, May 19, 2021 2:12 PM
To: 'Advisory Council on Historic Preservation' <jeddins@achp.gov>; 'City of New Haven' <nhcityhall@frontier.com>; 'City of Pomeroy (Mayor)' <dmanderson242@hotmail.com>; 'ODNR Division of Wildlife' <mike.greenlee@dnr.state.oh.us>; 'OH Rep Dist 94 - Jay Edwards' <JayEdwardsOhio@gmail.com>; 'OHEPA' <Craig.Butler@epa.ohio.gov>; 'Ohio Department of Natural Resources' <sarah.tebbe@dnr.state.oh.us>; 'Ohio Department of Natural Resources' <Steve.Holland@dnr.state.oh.us>; 'Ohio River Valley Water Sanitation Commission' <sdinkins@orsanco.org>; 'Osage Nation' <jmunkres@osagenation-nsn.gov>; 'Osage Nation' <ahunter@osagenation.nsn.gov>; 'Shawnee Tribe' <tonya@shawnee-tribe.com>; 'SHPO' <khorrocks@ohiohistory.org>; 'Steve Jenkins' <steve.jenkins2957@gmail.com>; 'Town of New Haven (Mayor)' <bubba070260@gmail.com>; 'US Department of the Interior' <Harold.Peterson@bia.gov>; 'US Environmental Protection Agency' <pelloso.elizabeth@epa.gov>; 'USACE' <andrew.n.johnson@usace.army.mil>; 'USACE' <Belinda.M.Weikle@usace.army.mil>; 'USEPA' <Westlake.kenneth@epa.gov>; 'USEPA' <Rudnick.Barbara@epa.gov>; 'USFWS' <richard_mccorkle@fws.gov>; 'USFWS' <angela_boyer@fws.gov>; 'USFWS' <jennifer_l_norris@fws.gov>; 'USGS' <jswhite@usgs.gov>; 'USGS' <smwickle@usgs.gov>; 'Village of Racine' <racinemayor@suddenlinkmail.com>; 'Villgae of Middleport' <mayormike@village.middleport.oh.us>; 'West Virginia Division of Natural Resources' <jacob.d.harrell@wv.gov>; 'West Virginia Division of Natural Resources' <barbara.d.sargent@wv.gov>; 'West Virginia Division of Natural Resources' <danny.a.bennett@wv.gov>; 'WVDEP' <Brian.L.Bridgewater@wv.gov>
Cc: 'Jonathan M Magalski (jmmagalski@aep.com)' <jmmagalski@aep.com>; Elizabeth B Parcell <ebparcell@aep.com>; Quiggle, Robert <robert.quiggle@hdrinc.com>
Subject: Racine Hydroelectric Project (FERC No. 2570) -- Filing of Updated Study Report

Racine Hydroelectric Project Stakeholders:

AEP Generation Resources Inc. (AEPGR), a unit of American Electric Power (AEP), is the licensee, owner and operator of the Racine Hydroelectric Project (FERC No. 2570) (Project) located on the Ohio River in Meigs County, Ohio. The Project is operated under a license issued by the Federal Energy Regulatory Commission (FERC). The existing FERC license for the Project expires on November 30, 2023. AEPGR is pursuing a new license for the continued operation of the Project in accordance with FERC's Integrated Licensing Process (ILP). Pursuant to the ILP, AEPGR filed the Updated Study Report (USR) for the Project on May 12, 2021. The USR describes the status and results of the studies that AEPGR conducted in support of Project relicensing.

On behalf of AEPGR, we are notifying stakeholders of the availability of the USR. For your convenience, a copy of the cover letter filed with the USR is attached. Please note that, due to file size restrictions, the USR has not been included in this email. AEPGR encourages stakeholders to view the filing online at FERC's eLibrary at https://elibrary.ferc.gov/eLibrary/filedownload?fileid=15790130. AEPGR has also added the USR to the Project's public relicensing website (http://www.aephydro.com/HydroPlant/Racine).

The Commission's regulations at 18 C.F.R. § 5.15(f) require AEPGR to hold an USR Meeting with participants and FERC staff within 15 days of filing the USR. Accordingly, AEPGR will hold an USR Meeting (via Webex) from 1 PM to 4 PM on May 25, 2021. To allow for adequate planning, AEPGR respectfully requests that those planning on joining the USR Webex Meeting RSVP by emailing Jon Magalski at jmmagalski@aep.com on or before close of business May 21, 2021.

Should you have any questions regarding this filing or the USR Meeting, please contact Jon Magalski with AEP at (614) 716-2240 or jmmagalski@aep.com.

Thank you,

Danielle Hanson
Environmental Scientist

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American Electric Power
1 Riverside Plaza
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Via Electronic Filing June 11, 2021

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

Subject: Racine Hydroelectric Project (FERC No. 2570)
Summary of Updated Study Report Meeting

Dear Secretary Bose:

AEP Generation Resources Inc. (AEPGR), a unit of American Electric Power (AEP), is the Licensee, owner, and operator of the 47.5 megawatt Racine Hydroelectric Project (Project) (FERC Project No. 2570). The Project is located along the Ohio River in Meigs County, Ohio.

AEPGR operates and maintains the Project under a license from the Federal Energy Regulatory Commission (FERC or Commission). The Project's existing license expires on November 30, 2023. AEPGR is pursuing a new license for the Project using the Commission's Integrated Licensing Process (ILP) as defined in 18 Code of Federal Regulations (CFR) Part 5.

Pursuant to 18 CFR § 5.15(f), AEPGR filed the Updated Study Report (USR) with the Commission on May 12, 2021. The timely filing of the USR was consistent with the requirements of the ILP and with the pre-filing process plan and schedule presented in AEPGR's July 2, 2018 Pre-Application Document and in the Commission's Scoping Document 1 and Scoping Document 2, dated August 21, 2018 and December 12, 2018, respectively.

The Commission's regulations direct license applicants to convene an Updated Study Report Meeting (USR Meeting) within 15 days of filing the USR. Therefore, concurrent with the May 12, 2021 filing of the USR, AEPGR filed notification that the USR Meeting would be held on May 25, 2021.

The USR Meeting was held from 1:00 p.m. to approximately 2:00 p.m. on May 25, 2021. The Commission's regulations at 18 CFR § 5.15(f) require AEPGR to file this summary of the USR Meeting, including any proposed modifications to ongoing studies or new studies proposed by the Licensee, within 15 days of the USR Meeting deadline as presented in FERC's Scoping Documents.

1.0 Purpose and List of Participants

1.1 Purpose

In accordance with 18 CFR § 5.15(f), AEPGR held an USR Meeting with the relicensing participants and the Commission staff via Webex to discuss the study results and the Licensee's or other participant's proposals, if any, to modify the study plan in light of the progress of the study plan and data collected.

The study plan approved by the Commission directed AEPGR to conduct seven studies in support of relicensing the Project:

1. Water Quality Study
2. Recreation Study
3. Cultural Resources Study
4. Mussel Survey
5. Fisheries Survey
6. Fish Entrainment and Impingement Study
7. Eastern Spadefoot Toad Habitat Suitability Assessment

During the Initial Study Report Meeting (ISR Meeting) on May 14, 2020, summaries of all seven studies were presented. Two out of the seven studies presented in the ISR Meeting were completed at that time, including the Cultural Resources Study and the Mussel Survey. During the USR Meeting on May 25, 2021, only the Fisheries Survey and the Fish Entrainment and Impingement Study were presented because those studies had been completed since the ISR Meeting. Overall, four of the seven studies have been completed to date. As mentioned during the USR Meeting, three of the studies are ongoing (i.e., Water Quality Study, Recreation Study, and the Eastern Spadefoot Toad Habitat Suitability Assessment).

The purpose of the USR Meeting was to discuss available study results and any proposals to modify the study plans in light of the progress of studies and data collected.

In furtherance of these objectives, AEPGR presented information regarding the relicensing process for the Project, and specific information regarding each approved study that has been completed since the ISR Meeting, including:

- Study status;
- Summary of study methods and results; and
- Variances from the approved study plan.

A copy of the presentation is attached to this USR Meeting Summary.

1.2 Participants

Concurrent with the May 12, 2021 filing of the USR, resource agencies, Tribes, non-governmental organizations, and other interested parties were invited to participate in the USR Meeting. Table 1 presents the meeting participants and their respective organization/affiliation.

TABLE 1
CONSTANTINE PROJECT ISR MEETING PARTICIPANTS

Participant	Organization / Affiliation
Aaron Liberty	Federal Energy Regulatory Commission (FERC)
Jay Summers	Federal Energy Regulatory Commission (FERC)
Colleen Corballis	Federal Energy Regulatory Commission (FERC)
Rick McCorkle	U.S. Fish and Wildlife Service (USFWS)
John McCloskey	U.S. Fish and Wildlife Service (USFWS)
Major Patrick Kelly	United States Army Corps of Engineers (USACE)
Matt Coakley	United States Army Corps of Engineers (USACE)
Belinda Weikle	United States Army Corps of Engineers (USACE)
Andrew Johnson	United States Army Corps of Engineers (USACE)
Carol Siegley	Ohio Environmental Protection Agency (Ohio EPA)
Mike Greenlee	Ohio Department of Natural Resources (ODNR)
Matt Hangsleben	Ohio Department of Natural Resources (ODNR)
Jacob Harrell	West Virginia Division of Natural Resources (WVDNR)
Jon Magalski	American Electric Power (AEP)
Liz Parcell	American Electric Power (AEP)
Gene Sirca	American Electric Power (AEP)
Rob Quiggle	HDR Engineering, Inc. (HDR)
Danielle Hanson	HDR Engineering, Inc. (HDR)
Kate Estler	HDR Engineering, Inc. (HDR)
Courtney Pitman	HDR Engineering, Inc. (HDR)
Dave Czayka	EnviroScience, Inc. (EnviroScience)
Jody Smet	Eagle Creek Renewable Energy (Eagle Creek)
Joyce Foster	Eagle Creek Renewable Energy (Eagle Creek)
Katelyn Jackson	EA Engineering, Science, & Technology, Inc. (EA)
Stephen Panozzo	Stantec

2.0 Summary of USR Meeting

As noted above, AEPGR presented information regarding the relicensing process, approved pre-filing schedule, and study activities to date. This information is summarized in the presentation attached to this USR Meeting Summary. The following sections summarize the information presented and the discussion/questions in regard to the approved studies.

2.1 Introduction

Jon Magalski (AEP) provided a brief explanation of the USR Meeting purpose and everyone introduced themselves to the group. Jon mentioned that the Project was in the process of being sold to Eagle Creek Renewable Energy (Eagle Creek) and stated that AEPGR would continue to work with stakeholders and Eagle Creek throughout the relicensing process. Jon introduced Eagle Creek and turned the discussion over to them to provide background information on the company.

Joyce Foster (Eagle Creek) reviewed the Eagle Creek PowerPoint slides. Joyce discussed the mission of Eagle Creek, to create value for stakeholders, and highlighted top priority values such as, safety and compliance. Jody Smet (Eagle Creek) further stated that their regulatory team has extensive licensing experience, but Ohio was a newer state for them. Jody commented that Eagle Creek has worked with some of the call participants on other projects, but they will be new to others. Lastly, Jody noted that Eagle Creek has been working with AEPGR to get up to speed on the Project. Jody then turned the discussion back over to Jon.

Jon discussed the filing of the USR and the overall Process Plan and Schedule for the Project. The status of approved studies and upcoming ILP milestones were also presented to the group. Additionally, Jon mentioned that the eastern spadefoot toad biologist has been in the field for the Eastern Spadefoot Toad Habitat Suitability Assessment.

An opportunity was given for general questions regarding process, etc. and Liz Parcell (AEP) clarified that the Draft License Application (DLA) would be filed on July 3, 2021. Aaron Liberty (FERC) asked if AEPGR was going to file a Preliminary Licensing Proposal (PLP) or a DLA and stated that it was not clear in the USR. Jon confirmed that AEPGR would be filing a DLA. No further questions were asked, and the discussion was turned over to Dave Czayka (EnviroScience) to discuss the Fisheries Survey.

2.2 Fisheries Survey

Dave Czayka presented the objectives of, methods for, and results of the Fisheries Survey. The study was completed in conformance with the Commission's Study Plan Determination (SPD). The Fisheries Survey was conducted upstream and downstream of the Project and American Eel (*Anguilla rostrata*) sampling was conducted downstream of the Racine dam.

<u>Summary of Study Methods and Results</u>

- A scientific collector's permit was obtained prior to conducting field surveys.
- The fall fisheries sampling was completed from November 11-13, 2019 and the spring fish surveys were conducted from May 27-28, 2020.
- Electrofishing was performed at five sites, two in Racine Pool and three in RC Byrd Pool.
- Trawl surveys were performed in the fall of 2019 at six location, two location within Racine Pool and four within RC Byrd Pool. Trawl surveys downstream were conducted in two different habitat types: 30-m off the bank and mid-channel. Dave mentioned that EnviroScience coordinated with resource agencies on timing for the surveys.
- Jon Magalski reminded everyone that no trawl sampling was conducted in the spring of 2020 due to COVID-19 and other safety concerns and those were forgone in consultation with resource agencies.
- A map showing the general location of the electrofishing and trawl locations was presented to the group.

- EnviroScience coordinated with West Virginia Division of Natural Resources (WVDNR) regarding water temperatures in the Ohio River and an approved timeframe for sampling.
- Sampling was conducted at night and completed in a downstream direction for 500-m. Fish were processed upon completion of each 500-m transect and released after data collection.
- Habitat assessments were performed at each site.
- Prior to sampling each day, water quality sampling was monitored using a YSI ProDSS multiparameter sonde to determine conductivity for electrofishing. Water quality data for temperature, pH, dissolved oxygen (DO), and specific conductivity were also collected at each sampling location.
- In addition to the fisheries surveys, American Eel sampling was conducted downstream from the Project's powerhouse. EnviroScience and HDR designed and constructed a temporary eel ramp per the specifications recommended by U.S. Fish and Wildlife Service (USFWS) and WVDNR. The ramp was installed on the downstream side of the Project.
- With respect to fish passage, AEPGR transmitted forebay and tailrace elevation data from January 2015 to early November 2020 and generation records from January 2014 to early November 2020 to the USFWS for review.
- The fall fisheries survey resulted in the collection of 227 individuals, composed of 24 species. All 24 species were represented in the electrofishing survey and only two species were collected by trawl.
- The spring fisheries survey resulted in the collection of 975 individuals, representing 26 species. All 26 species were represented in the electrofishing survey as no trawl surveys were conducted due to COVID-19 pandemic safety concerns.
- The relative weight for ten gamefish species was calculated using methods developed by Blackwell et al. (2000). A table of Average Relative Weights was presented during the meeting.
- Habitat was assessed at every site, including a Qualitative Habitat Evaluation Index (QHEI), ORSANCO Habitat Survey Data Sheets, and depth range of trawl survey. A table detailing the QHEI for each sampling transect was presented during the meeting (see attached PowerPoint slides).
- An overview of the American Eel sampling was provided. The temporary eel ramp was installed in June 2020 and monitored daily through a cellular camera mounted on the collection tank. Maintenance occurred once or twice weekly and involved a variety of tasks such as, removing debris from the intake screen, restarting the pump, removing algae from the livewell, etc.
- During the collection period the pump was inactive on three occasions for an extended time due to a malfunctioning pump, vandalism, and an instance where the pump turned off and EnviroScience was not able to complete maintenance due to facility operations and the inability to safely access the collection area.
- The pump ran for 77 days throughout the monitoring period and no American Eels were observed during that time.

<u>Variances from FERC-approved Study Plan</u>

- The spring fisheries survey was completed in 2020; however, spring sampling was delayed until the end of May due to COVID-19 safety and travel restrictions during April 2020.

During the spring survey effort, the water temperature was above the target range for the study, as defined by USFWS and WVDNR.

- The approved study plan included trawl sampling at six transects in the spring and fall. However, due to safety concerns with the COVID-19 pandemic and close working conditions, no trawl sampling was conducted during the spring sampling event in 2020. The decision to forgo trawl sampling in the spring of 2020 was made in agreement with the WVDNR and USFWS and approved by FERC.
- Operation of the eel ramp was suspended three times during the study season for reasons beyond AEPGR's control. These included a faulty pump, vandalism of the eel ramp, and restriction to the eel ramp area due to safety concerns of facility operation.

Questions/General Comments

- In reference to the Project-specific information related to potential fish passage that AEPGR sent to USFWS, Jon Magalski asked Rick McCorkle if he received all of the information that he needed. Rick responded that he was just reviewing that information again and needed to have a meeting with other individuals to discuss and would get back to him if any additional information was needed. Jon mentioned that Rick has been working with Andrew Johnson (U.S. Army Corps of Engineers [USACE]) to gather additional information; Rick acknowledged this and thanked Andrew and AEPGR for the information they have provided.
- Rick stated he had reviewed the American Eel plan they received in March 2020, and that all of the flow was to be introduced at the top of the ramp; Rick said that he should have caught that earlier. Rick discussed how there was too much flow at the top of the ramp, but it was addressed and had been resolved later during consultation. Rick asked for clarification on the number of days that the pump was in operation because he noted that the dates of operation seemed to add up to 90 days, but the USR stated that the pump was running for 77 days. Rick expressed his disappointment with the study due to the vandalism that occurred and the lack of an ideal location to site the ramp. Jon responded that AEPGR would go back and confirm the number of days the ramp was operating. Jon also mentioned that they did not experience any high flow events during the eel sampling period that might have washed the ramp out. Rick acknowledged that was a good point.

2.3 Fish Entrainment and Impingement Study

Kate Estler (HDR) presented the objectives of, methods for, and results of the Fish Entrainment and Impingement Study. AEPGR completed the Fish Entrainment and Impingement Study in conformance with the Commission's SPD.

Summary of Study Methods and Results

- As an initial task, AEPGR consulted with the USFWS, WVDNR, and Ohio Department of Natural Resources (ODNR) regarding a proposed list of target fish species to be included in the desktop entrainment analysis.

- USFWS provided comments on AEPGR's proposed target fish species list. USFWS stated that the final selection of fish species to be evaluated should be postponed until the Fisheries Survey was completed to better understand the fish species that are present in the Project vicinity. USFWS recommended that the analysis include documented hosts for the federally listed endangered mussels that have potential to occur in the vicinity of the Project. Additionally, USFWS recommended that AEPGR evaluate percent survival in fish length increments of no more than two inches per increment.
- WVDNR also commented that the entrainment analysis should be conducted upon the completion of the Fisheries Survey. WVDNR provided a list of suggested fish species to be included in the desktop analysis.
- AEPGR's proposed target species included species captured during the 2019 and 2020 fisheries surveys, the diadromous American Eel (a species known to occur in the Ohio River), non-diadromous migratory species, and potential host species for federal and state-listed mussel species identified in the USFWS's correspondence.
- In total, AEPGR proposed to include 35 species in the entrainment and impingement analysis. AEPGR held a conference call with the working group to discuss the proposed target list of species to include in this study. AEPGR did not receive any additional comments on or requests to modify the list of target species. A table of the target fish species list was presented during the meeting.
- Monthly water quality profile data were collected in three locations. All DO and temperature readings at the plant profile location and all others collected during the study remained in compliance with the State water quality criteria.
- Pursuant to the SPD, the key physical characteristics, operational information, and intake velocities associated with the Project intake structure were compiled from Project drawings, field data, and hydraulic calculations (see PowerPoint slides for additional information).
- Emerald Shiner (*Notropis atherinoides*) were the most abundant species collected in the 2019 and 2020 surveys, comprising 69 percent of the catch combined (additional species are described in the attached PowerPoint slides).
- Burst swim speeds for target or representative species were compared to the estimated intake velocity to evaluate fish susceptibility to intake flows at the Project. River flow of up to about 32,000 cubic feet per second (cfs) corresponds to a maximum approach velocity of 4.3 feet per second (fps) in front of the intake. The burst speeds shown in Table 5-4 of the Fish Entrainment and Impingement Study Report indicate that 29 percent of the target species would be able to avoid entrainment at the Project
- However, based on the velocity modeling performed in 2017, only the areas immediately in front of the bar racks had modeled velocities above 4.0 fps, but were very localized. Areas that were about 20 feet from the trashracks exhibited lower velocities, ranging from 2.0 to 4.0 fps, and were comparable to normal river velocities at the 100,000 cfs river flow model. At the lower end of the range, approximately 83 percent of the target species and life stages were predicted to escape entrainment.

- A desktop evaluation using Ohio River morphometrics and flow data from the nearest upstream gauge indicated that the velocity of the river in the vicinity of the Project can sometimes be as high as 6 fps.
- All target and representative species would pass through the trashracks and none would be impinged.
- Early life stages of fish cannot move independently and are more susceptible to entrainment at the Project.
- Monthly entrainment estimates include 329,450 fish in a normal water year. A graph of the estimates was presented during the meeting (see attached PowerPoint slides).
- The majority (95 percent) of the estimated entrainment is from fish in the smallest size classes, 0-6 inches.
- Blade strike analysis indicated that most entrained fish (98.3 percent) are expected to survive passage through the turbines. Fish in larger size classes have higher blade strike probabilities but comprise the lowest percentage of the estimated entrainment. The relatively low blade strike probabilities are attributed to the large runner diameter, slow turbine speed, and having only four turbine blades.
- The potential for eel entrainment is during their downstream migration during the fall, however the overall number of eels passing downstream is likely low given their scarcity in fisheries sampling data.

<u>Variances from FERC-approved Study Plan</u>

- There were no variances from the FERC-approved Study Plan.

<u>Questions</u>

- There were no questions from the group related to the Fish Entrainment and Impingement Study.

<u>General Comments</u>

- Rick McCorkle (USFWS) mentioned that the USR noted that there can be velocities at the intake up to 6 fps. Kate Estler responded and said that the 6 fps was not necessarily at the intake, but in the general Project area. Rick stated that 6 fps is very high for escapement for a lot of species and life stages, even if common in the river. He further stated he would suspect that even the strongest swimmers would be hunkered down below for the roughness factor.
- Jacob Harrell (WVDNR) noted that the mortality estimates were focused on turbine blade analysis and inquired about mortality related to head and changes in barometric pressure and effects on fish. Rob Quiggle (HDR) stated that he did not recall that analysis being included in the approved study plan, and that data from other projects on the Ohio River with similar units were reviewed and there was not a lot of change in barometric pressure.
- Rick McCorkle mentioned that FERC had asked a question earlier regarding the type of document AEPGR was going to file and if there was an opportunity for stakeholders to

comment on the document. Jon Magalski mentioned that there was a two-step process and that AEPGR will file a DLA by July 3 and stakeholders will be able to provide comments before the Final License Application (FLA) is filed. Rick thanked Jon. Aaron Liberty (FERC) added that there is a 90-day comment period, which gives stakeholders until October to file their comments on the DLA. Aaron clarified for the group that he asked AEPGR if they were going to file a PLP or a DLA. Aaron stated that a PLP is basically just an Exhibit E and a DLA contains all of the exhibits. Aaron also stated that a PLP is easier to review but noted again that AEPGR would be filing a DLA. Rick thanked Aaron for the additional information.

- Rick asked if USFWS had additional data needs regarding flow modeling as related to potential fish passage when that information should be filed to be able to have it included in the FLA. Jon responded that it would make sense to file any data requests with comments on the DLA. Aaron concurred that any outstanding data needs should be filed with stakeholders' comments on the DLA.
- Belinda Weikle (USACE) asked if the PowerPoint presentation would be available on the Project's relicensing website. Jon indicated that he would send PowerPoint via email to the USR meeting participants, that it would be posted to the Project's relicensing website, and also filed with the USR Meeting Summary (Jon sent the PowerPoint via email after the meeting).
- Lastly, Aaron inquired about the intake modeling performed in 2017, and asked if AEPGR would be able to file that report with FERC. Jon asked Gene Sirca (AEP) if it was possible to file the report. Gene replied saying they could work together on it. Jon stated that AEPGR would take a look at the report and provide a response to FERC.

3.0 Conclusion

AEPGR is filing this USR Meeting Summary in accordance with 18 CFR § 5.15(f) of the Commission's regulations. After review of the USR Meeting Summary, stakeholders may file disagreements with the meeting summary, request modifications to ongoing studies, or request new studies. Disagreements with the USR Meeting Summary and any requests to amend the study plan to include new or modified studies must be filed with the Commission no later than 30 days after the filing of the USR Meeting Summary (on or before July 11, 2021). In requesting modifications to ongoing studies or new studies, stakeholders must take into account the following criteria:

- *Criteria for Modification of Approved Study (18 C.F.R. 5.15(d)).* Any proposal to modify an ongoing study must be accompanied by a showing of good cause why the proposal should be approved, and must include, as appropriate to the facts of the case, a demonstration that:
  (1) Approved studies were not conducted as provided for in the approved study plan; or
  (2) The study was conducted under anomalous environmental conditions or that environmental conditions have changed in a material way.

- *Criteria for New Study (18 C.F.R. 5.15(e)).* Any proposal for new information gathering or studies must be accompanied by a showing of good cause why the proposal should be approved, and must include, as appropriate to the facts of the case, a statement explaining:
  (1) Any material changes in the law or regulations applicable to the information request;
  (2) Why the goals and objectives of any approved study could not be met with the approved study methodology;
  (3) Why the request was not made earlier;
  (4) Significant changes in the project proposal or that significant new information material to the study objectives has become available; and
  (5) Why the new study request satisfies the study criteria in 18 C.F.R. § 5.9(b).

AEPGR will have 30 days to respond to any disagreements or requests to amend the study plan (August 10, 2021). The Commission's Director of the Office of Energy Projects will resolve any disagreements and amend the approved study plan, as appropriate, within 30 days of the due date for AEPGR's response (no later than September 9, 2021).

If there are any questions regarding this filing, please do not hesitate to contact me at (614) 716-2240 or jmmagalski@aep.com.

Sincerely,

Jonathan M. Magalski
Environmental Specialist Consultant
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Attachment

Cc: Distribution List
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Yayac, Maggie

Subject: FW: Racine Hydroelectric Project (FERC No. 2570) -- Filing of Updated Study Report Meeting Summary
Attachments: 20210611 Racine USR Meeting Summary.pdf

From: Hanson, Danielle
Sent: Friday, June 11, 2021 12:45 PM
To: Advisory Council on Historic Preservation <jeddins@achp.gov>; City of New Haven <nhcityhall@frontier.com>; City of Pomeroy (Mayor) <dmanderson242@hotmail.com>; ODNR Division of Wildlife <mike.greenlee@dnr.state.oh.us>; OH Rep Dist 94 - Jay Edwards <JayEdwardsOhio@gmail.com>; OHEPA <Craig.Butler@epa.ohio.gov>; Ohio Department of Natural Resources <sarah.tebbe@dnr.state.oh.us>; Ohio Department of Natural Resources <Steve.Holland@dnr.state.oh.us>; Ohio River Valley Water Sanitation Commission <sdinkins@orsanco.org>; Osage Nation <jmunkres@osagenation-nsn.gov>; Osage Nation <ahunter@osagenation.nsn.gov>; Shawnee Tribe <tonya@shawnee-tribe.com>; SHPO <khorrocks@ohiohistory.org>; Steve Jenkins <steve.jenkins2957@gmail.com>; Town of New Haven (Mayor) <bubba070260@gmail.com>; US Department of the Interior <Harold.Peterson@bia.gov>; US Environmental Protection Agency <pelloso.elizabeth@epa.gov>; USACE <andrew.n.johnson@usace.army.mil>; USACE <Belinda.M.Weikle@usace.army.mil>; USEPA <Westlake.kenneth@epa.gov>; USEPA <Rudnick.Barbara@epa.gov>; USFWS <richard_mccorkle@fws.gov>; USFWS <angela_boyer@fws.gov>; USFWS <jennifer_l_norris@fws.gov>; USGS <jswhite@usgs.gov>; USGS <smwickle@usgs.gov>; Village of Racine <racinemayor@suddenlinkmail.com>; Villgae of Middleport <mayormike@village.middleport.oh.us>; West Virginia Division of Natural Resources <jacob.d.harrell@wv.gov>; West Virginia Division of Natural Resources <barbara.d.sargent@wv.gov>; West Virginia Division of Natural Resources <danny.a.bennett@wv.gov>; WVDEP <Brian.L.Bridgewater@wv.gov>
Cc: 'Jonathan M Magalski (jmmagalski@aep.com)' <jmmagalski@aep.com>; Elizabeth B Parcell <ebparcell@aep.com>; Quiggle, Robert <robert.quiggle@hdrinc.com>
Subject: Racine Hydroelectric Project (FERC No. 2570) -- Filing of Updated Study Report Meeting Summary

Racine Hydroelectric Project Stakeholders:

AEP Generation Resources Inc. (AEPGR), a unit of American Electric Power (AEP), is the licensee, owner and operator of the Racine Hydroelectric Project (FERC No. 2570) (Project) located on the Ohio River in Meigs County, Ohio. The Project is operated under a license issued by the Federal Energy Regulatory Commission (FERC). The existing FERC license for the Project expires on November 30, 2023. AEPGR is pursuing a new license for the continued operation of the Project in accordance with FERC's Integrated Licensing Process (ILP). Pursuant to the ILP, AEPGR filed the Updated Study Report (USR) Meeting Summary for the Project on June 11, 2021. The USR Meeting Summary describes the status and results of the studies that AEPGR conducted in support of Project relicensing as discussed during the USR Webex Meeting held on May 25, 2021.

On behalf of AEPGR, we are notifying stakeholders of the availability of the USR Meeting Summary. For your convenience, the USR Meeting Summary has been attached to this email. The filing can also be viewed online at FERC's eLibrary at https://elibrary.ferc.gov/eLibrary/filedownload?fileid=15811927. Additionally, AEPGR will be adding the USR Meeting Summary to the Project's public relicensing website (http://www.aephydro.com/HydroPlant/Racine) in the coming days.

Disagreements with the USR Meeting Summary and any requests to amend the study plan to include new or modified studies must be filed with the Commission no later than 30 days after the filing of the USR Meeting Summary (on or before July 11, 2021).

Should you have any questions regarding this filing, please contact Jon Magalski with AEP at (614) 716-2240 or jmmagalski@aep.com.

Thank you,

Danielle Hanson
Environmental Scientist

HDR
M 315.729.4745
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hdrinc.com/follow-us

American Electric Power
1 Riverside Plaza
Columbus, OH 43215
aep.com

Via Electronic Filing July 2, 2021

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

Subject: Racine Hydroelectric Project (FERC No. 2570)
Draft License Application

Dear Secretary Bose:

AEP Generation Resources Inc. (AEPGR), a unit of American Electric Power (AEP), is the Licensee, owner, and operator of the 47.5 megawatt Racine Hydroelectric Project (Project) (FERC No. 2570). The Project is located along the Ohio River in Meigs County, Ohio.

AEPGR operates and maintains the Project under a license from the Federal Energy Regulatory Commission (FERC or Commission). The Project's existing license expires on November 30, 2023. AEPGR is pursuing a new license for the Project using the Commission's Integrated Licensing Process (ILP) as defined in 18 Code of Federal Regulations (CFR) Part 5. In accordance with 18 CFR §5.16(a), AEPGR is filing herewith the Draft License Application (DLA) for the Project.

As described in the DLA, AEPGR is proposing to continue the operation of the Project and does not propose the development of any new hydroelectric facilities or increased generation capacity, but provides for protection, mitigation, and enhancement (PM&E) measures related to recreation resources associated with the Project. The proposed PM&E measures described in the DLA reflect careful consideration of available information, the results of studies conducted, and issues specific to the Project. AEPGR believes that the proposed PM&E measures as described in the DLA adequately take into consideration the important power and non-power values of the Project and the interests of stakeholders.

The DLA is composed of two volumes, as described below:

Volume I of II
- Table of Contents
- Initial Statement and Additional Information Required by 18 CFR §5.18(a)
- Exhibit A – Project Description
- Exhibit B – Project Operation and Resource Utilization
- Exhibit C – Construction History
- Exhibit D – Costs and Financing
- Exhibit E – Environmental Report
- Exhibit F – General Design Drawings

- Exhibit G – Project Boundary Maps
- Exhibit H – Ability to Operate
- Appendices

Volume II of II (CRITICAL ENERGY INFRASTRUCTURE INFORMATION [CEII])

- Single-Line Diagram
- Exhibit F – General Design Drawings

Concurrent with this filing, AEPGR is making public portions of the DLA available to resource agencies, Indian Tribes, local governments, non-governmental organizations, and members of the public on the Project's distribution list. An electronic copy of the DLA can be downloaded from FERC's eLibrary system (https://www.ferc.gov/docs-filing/elibrary.asp) by searching under docket number P-2570 (sub docket 032). The DLA will also be available at the Project's public relicensing website at www.aephydro.com/HydroPlant/Racine.

In accordance with 18 CFR §5.16(e), interested parties may file comments regarding the DLA within 90 days of the date of this letter (i.e., by October 1, 2021). All comments must be eFiled with FERC or sent to FERC at the following address:

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

If there are any questions regarding this filing, please do not hesitate to contact me at (614) 716-2240 or jmmagalski@aep.com.

Sincerely,

Jonathan M. Magalski
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Mr. Cameron Sholly
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Racine Hydroelectric Project (FERC No. 2570)
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Mr. Bob Peterson
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Racine Hydroelectric Project (FERC No. 2570)
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Ms. Tonya Tipton
Tribal Historic Preservation Officer
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Mr. Kevin Richard Colburn
National Stewardship Director
American Whitewater
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Cullowhee, NC 28779

Nature Conservancy
6375 Riverside Drive, Suite 100
Dublin, OH 43017

Mr. Richard Cogen
Executive Director
Ohio River Foundation
PO Box 42460
Cincinnati, OH 45242

Yayac, Maggie

Subject: Racine Hydroelectric Project (FERC No. 2570) -- Filing of Draft License Application
Attachments: Racine Project DLA Cover Letter 20210702.pdf

From: Hanson, Danielle
Sent: Friday, July 2, 2021 2:02 PM
To: Advisory Council on Historic Preservation <jeddins@achp.gov>; City of New Haven <nhcityhall@frontier.com>; City of Pomeroy (Mayor) <dmanderson242@hotmail.com>; ODNR Division of Wildlife <mike.greenlee@dnr.state.oh.us>; OH Rep Dist 94 - Jay Edwards <JayEdwardsOhio@gmail.com>; OHEPA <Craig.Butler@epa.ohio.gov>; Ohio Department of Natural Resources <sarah.tebbe@dnr.state.oh.us>; Ohio Department of Natural Resources <Steve.Holland@dnr.state.oh.us>; Ohio River Valley Water Sanitation Commission <sdinkins@orsanco.org>; Osage Nation <jmunkres@osagenation-nsn.gov>; Osage Nation <ahunter@osagenation.nsn.gov>; Shawnee Tribe <tonya@shawnee-tribe.com>; SHPO <khorrocks@ohiohistory.org>; Steve Jenkins <steve.jenkins2957@gmail.com>; Town of New Haven (Mayor) <bubba070260@gmail.com>; US Department of the Interior <Harold.Peterson@bia.gov>; US Environmental Protection Agency <pelloso.elizabeth@epa.gov>; USACE <andrew.n.johnson@usace.army.mil>; USACE <Belinda.M.Weikle@usace.army.mil>; USEPA <Westlake.kenneth@epa.gov>; USEPA <Rudnick.Barbara@epa.gov>; USFWS <richard_mccorkle@fws.gov>; USFWS <angela_boyer@fws.gov>; USFWS <jennifer_l_norris@fws.gov>; USGS <jswhite@usgs.gov>; USGS <smwickle@usgs.gov>; Village of Racine <racinemayor@suddenlinkmail.com>; Villgae of Middleport <mayormike@village.middleport.oh.us>; West Virginia Division of Natural Resources <jacob.d.harrell@wv.gov>; West Virginia Division of Natural Resources <barbara.d.sargent@wv.gov>; West Virginia Division of Natural Resources <danny.a.bennett@wv.gov>; WVDEP <Brian.L.Bridgewater@wv.gov>
Cc: 'Jonathan M Magalski (jmmagalski@aep.com)' <jmmagalski@aep.com>; Elizabeth B Parcell <ebparcell@aep.com>; Quiggle, Robert <robert.quiggle@hdrinc.com>; Jody.Smet@eaglecreekre.com; joyce.foster@eaglecreekre.com
Subject: Racine Hydroelectric Project (FERC No. 2570) -- Filing of Draft License Application

Racine Hydroelectric Project Stakeholders:

AEP Generation Resources Inc. (AEPGR), a unit of American Electric Power (AEP), is the licensee, owner and operator of the Racine Hydroelectric Project (FERC No. 2570) (Project) located on the Ohio River in Meigs County, Ohio. The Project is operated under a license issued by the Federal Energy Regulatory Commission (FERC). The existing FERC license for the Project expires on November 30, 2023. AEPGR is pursuing a new license for the continued operation of the Project in accordance with FERC's Integrated Licensing Process (ILP). Pursuant to the ILP, AEPGR filed the Draft License Application (DLA) for the Project on July 2, 2021.

A described in the DLA, AEPGR is proposing to continue the operation of the Project and does not propose the development of any new hydroelectric facilities or increased generation capacity, but provides for protection, mitigation, and enhancement (PM&E) measures related to recreation resources associated with the Project. The proposed PM&E measures described in the DLA reflect careful consideration of available information, the results of studies conducted, and issues specific to the Project.

On behalf of AEPGR, we are notifying stakeholders of the availability of the DLA. For your convenience, a copy of the cover letter filed with the DLA is attached. Please note that, due to file size restrictions, the DLA has not been included in this email. AEPGR encourages stakeholders to view the filing online at FERC's eLibrary at https://elibrary.ferc.gov/eLibrary/filedownload?fileid=15824437 and https://elibrary.ferc.gov/eLibrary/filedownload?fileid=15824438. AEPGR has also added the DLA to the Project's public relicensing website (http://www.aephydro.com/HydroPlant/Racine).

In accordance with 18 CFR § 5.16(e), interested parties may file comments regarding the DLA within 90 days of the date of this filing (i.e., by October 1, 2021).

Should you have any questions regarding this filing, please contact Jon Magalski with AEP at (614) 716 - 2240 or jmmagalski@aep.com.

Thank you,

Danielle Hanson
Environmental Scientist

HDR
M 315.729.4745
Danielle.Hanson@hdrinc.com

hdrinc.com/follow-us

Yayac, Maggie

Subject: FW: Racine Hydroelectric Project (FERC No. 2570) -- Filing of Draft License Application

-----Original Message-----
From: Jonathan M Magalski <jmmagalski@aep.com>
Sent: Monday, July 5, 2021 7:54 AM
To: Weikle, Belinda M CIV USARMY CELRH (USA) <Belinda.M.Weikle@usace.army.mil>; gfsirca@aep.com
Cc: Kelley, Patrick J MAJ USARMY CELRH (USA) <Patrick.J.Kelley@usace.army.mil>; Elizabeth B Parcell <ebparcell@aep.com>
Subject: RE: Racine Hydroelectric Project (FERC No. 2570) -- Filing of Draft License Application

Hi Belinda,

Please find attached Volume II of the DLA for Racine. The document contains CEI information, is not made publically available and should be maintained as confidential. If you have any questions, please let me know. Thank you....Jon

JONATHAN M MAGALSKI | ENVIRONMENTAL SPEC CONSULT JMMAGALSKI@AEP.COM | D:614.716.2240
1 RIVERSIDE PLAZA, COLUMBUS, OH 43215

-----Original Message-----
From: Weikle, Belinda M CIV USARMY CELRH (USA) <Belinda.M.Weikle@usace.army.mil>
Sent: Friday, July 2, 2021 6:26 PM
To: Gene F Sirca Jr. <gfsirca@aep.com>; Jonathan M Magalski <jmmagalski@aep.com>
Cc: Kelley, Patrick J MAJ USARMY CELRH (USA) <Patrick.J.Kelley@usace.army.mil>
Subject: [EXTERNAL] FW: Racine Hydroelectric Project (FERC No. 2570) -- Filing of Draft License Application

Good evening Gene and Jon!

We have downloaded the Racine hydropower relicensing DLA Volume I.

Would you please post the Racine Project DLA Volume II to your AEP BOX account so that MAJ Kelley and I can download it?

Please let me know if you have questions.

Thanks,

Belinda M. Weikle, M.S.C.E., P.E.
U.S. Army Corps of Engineers
Huntington District
Water Resources
502 Eighth Street
Huntington, WV 25701
304-399-5808 Office Phone
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Belinda.M.Weikle@usace.army.mil

-----Original Message-----
From: Hanson, Danielle <Danielle.Hanson@hdrinc.com>
Sent: Friday, July 02, 2021 5:02 PM
To: Advisory Council on Historic Preservation <jeddins@achp.gov>; City of New Haven <nhcityhall@frontier.com>; City of Pomeroy (Mayor) <dmanderson242@hotmail.com>; ODNR Division of Wildlife <mike.greenlee@dnr.state.oh.us>; OH Rep Dist 94 - Jay Edwards <JayEdwardsOhio@gmail.com>; OHEPA <Craig.Butler@epa.ohio.gov>; Tebbe, Sarah

<sarah.tebbe@dnr.state.oh.us>; Ohio Department of Natural Resources <Steve.Holland@dnr.state.oh.us>; Dinkins, Sam <sdinkins@orsanco.org>; Osage Nation <jmunkres@osagenation-nsn.gov>; Osage Nation <ahunter@osagenation.nsn.gov>; Shawnee Tribe <tonya@shawnee-tribe.com>; SHPO <khorrocks@ohiohistory.org>; Steve Jenkins <steve.jenkins2957@gmail.com>; Town of New Haven (Mayor) <bubba070260@gmail.com>; US Department of the Interior <Harold.Peterson@bia.gov>; US Environmental Protection Agency <pelloso.elizabeth@epa.gov>; Johnson, Andrew N CIV USARMY CELRH (USA) <Andrew.N.Johnson@usace.army.mil>; Weikle, Belinda M CIV USARMY CELRH (USA) <Belinda.M.Weikle@usace.army.mil>; Westlake, Kenneth <westlake.kenneth@epa.gov>; USEPA <Rudnick.Barbara@epa.gov>; USFWS <richard_mccorkle@fws.gov>; USFWS <angela_boyer@fws.gov>; USFWS <jennifer_l_norris@fws.gov>; USGS <jswhite@usgs.gov>; smtp-Wickle, SM <SMWickle@usgs.gov>; Village of Racine <racinemayor@suddenlinkmail.com>; Villgae of Middleport <mayormike@village.middleport.oh.us>; West Virginia Division of Natural Resources <jacob.d.harrell@wv.gov>; West Virginia Division of Natural Resources <barbara.d.sargent@wv.gov>; West Virginia Division of Natural Resources <danny.a.bennett@wv.gov>; Bridgewater, Brian L <brian.l.bridgewater@wv.gov>
Cc: Jonathan M Magalski <jmmagalski@aep.com>; Elizabeth B Parcell <ebparcell@aep.com>; Quiggle, Robert <Robert.Quiggle@hdrinc.com>; Jody.Smet@eaglecreekre.com; joyce.foster@eaglecreekre.com
Subject: [Non-DoD Source] Racine Hydroelectric Project (FERC No. 2570) -- Filing of Draft License Application

Racine Hydroelectric Project Stakeholders:

AEP Generation Resources Inc. (AEPGR), a unit of American Electric Power (AEP), is the licensee, owner and operator of the Racine Hydroelectric Project (FERC No. 2570) (Project) located on the Ohio River in Meigs County, Ohio. The Project is operated under a license issued by the Federal Energy Regulatory Commission (FERC). The existing FERC license for the Project expires on November 30, 2023. AEPGR is pursuing a new license for the continued operation of the Project in accordance with FERC's Integrated Licensing Process (ILP). Pursuant to the ILP, AEPGR filed the Draft License Application (DLA) for the Project on July 2, 2021.

A described in the DLA, AEPGR is proposing to continue the operation of the Project and does not propose the development of any new hydroelectric facilities or increased generation capacity, but provides for protection, mitigation, and enhancement (PM&E) measures related to recreation resources associated with the Project. The proposed PM&E measures described in the DLA reflect careful consideration of available information, the results of studies conducted, and issues specific to the Project.

On behalf of AEPGR, we are notifying stakeholders of the availability of the DLA. For your convenience, a copy of the cover letter filed with the DLA is attached. Please note that, due to file size restrictions, the DLA has not been included in this email. AEPGR encourages stakeholders to view the filing online at FERC's eLibrary at https://nam12.safelinks.protection.outlook.com/?url=https%3A%2F%2Furldefense.com%2Fv3%2F__https%3A%2F%2Felibrary.ferc.gov%2FeLibrary%2Ffiledownload%3Ffileid%3D15824437__%3B!!H3PqUTRkow!q9MeV4oVDcPvxY12NdGokM7cpb9G5bPuYrghT5xdqLEi7GhS2in9UvV4tP9hxHQ%24&data=04%7C01%7CMaggie.Yayac%40hdrinc.com%7Cb29ee0029e7043952a0108d9408dd3d2%7C3667e201cbdc48b39b425d2d3f16e2a9%7C0%7C0%7C637611800146621070%7CUnknown%7CTWFpbGZsb3d8eyJWIjoiMC4wLjAwMDAiLCJQIjoiV2luMzIiLCJBTiI6Ik1haWwiLCJXVCI6Mn0%3D%7C1000&sdata=y6KUIZRsK%2FbxeZiS5yFm2QEc3fqtTGerRosTxjD%2F8Pk%3D&reserved=0 <Blockedhttps://nam12.safelinks.protection.outlook.com/?url=https%3A%2F%2Felibrary.ferc.gov%2FeLibrary%2Ffiledownload%3Ffileid%3D15824437&data=04%7C01%7CMaggie.Yayac%40hdrinc.com%7Cb29ee0029e7043952a0108d9408dd3d2%7C3667e201cbdc48b39b425d2d3f16e2a9%7C0%7C0%7C637611800146621070%7CUnknown%7CTWFpbGZsb3d8eyJWIjoiMC4wLjAwMDAiLCJQIjoiV2luMzIiLCJBTiI6Ik1haWwiLCJXVCI6Mn0%3D%7C1000&sdata=26hN5aSzZ%2BkS9LluBp%2F85MBvlT25oscq%2Bx6IFF89rGQ%3D&reserved=0> and https://nam12.safelinks.protection.outlook.com/?url=https%3A%2F%2Furldefense.com%2Fv3%2F__https%3A%2F%2Felibrary.ferc.gov%2FeLibrary%2Ffiledownload%3Ffileid%3D15824438__%3B!!H3PqUTRkow!q9MeV4oVDcPvxY12NdGokM7cpb9G5bPuYrghT5xdqLEi7GhS2in9UvV4URzqVBs%24&data=04%7C01%7CMaggie.Yayac%40hdrinc.com%7Cb29ee0029e7043952a0108d9408dd3d2%7C3667e201cbdc48b39b425d2d3f16e2a9%7C0%7C0%7C637611800146621070%7CUnknown%7CTWFpbGZsb3d8eyJWIjoiMC4wLjAwMDAiLCJQIjoiV2luMzIiLCJBTiI6Ik1haWwiLCJXVCI6Mn0%3D%7C1000&sdata=BAxQpiHeBzR5v%2FYLIiSfXwZN88lyY9nj%2FsbOT7fvQ5I%3D&reserved=0 <Blockedhttps://nam12.safelinks.protection.outlook.com/?url=https%3A%2F%2Felibrary.ferc.gov%2FeLibrary%2Ffiledownload%3Ffileid%3D15824438&data=04%7C01%7CMaggie.Yayac%40hdrinc.com%7Cb29ee0029e7043952a0108d9408dd3d2%7C3667e201cbdc48b39b425d2d3f16e2a9%7C0%7C0%7C637611800146621070%7CUnknown%7CTWFpb

GZsb3d8eyJWIjoiMC4wLjAwMDAiLCJQIjoiV2luMzIiLCJBTiI6Ik1haWwiLCJXVCI6Mn0%3D%7C1000&sdata=nDzmATu1vo4aRyILcmQ%2FZUzfGlPRQE34puUUpHbz48A%3D&reserved=0> . AEPGR has also added the DLA to the Project's public relicensing website (https://nam12.safelinks.protection.outlook.com/?url=https%3A%2F%2Furldefense.com%2Fv3%2F__http%3A%2F%2Fwww.aephydro.com%2FHydroPlant%2FRacine__%3B!!H3PqUTRkow!q9MeV4oVDcPvxY12NdGokM7cpb9G5bPuYrghT5xdqLEi7GhS2in9UvV4dFAI2FY%24&data=04%7C01%7CMaggie.Yayac%40hdrinc.com%7Cb29ee0029e7043952a0108d9408dd3d2%7C3667e201cbdc48b39b425d2d3f16e2a9%7C0%7C0%7C637611800146621070%7CUnknown%7CTWFpbGZsb3d8eyJWIjoiMC4wLjAwMDAiLCJQIjoiV2luMzIiLCJBTiI6Ik1haWwiLCJXVCI6Mn0%3D%7C1000&sdata=qImb%2B%2BNJWXibKQz9%2FjgWeXjPKvRedJT8rvQ%2FDV2v71M%3D&reserved=0).

In accordance with 18 CFR § 5.16(e), interested parties may file comments regarding the DLA within 90 days of the date of this filing (i.e., by October 1, 2021).

Should you have any questions regarding this filing, please contact Jon Magalski with AEP at (614) 716 - 2240 or jmmagalski@aep.com <mailto:jmmagalski@aep.com> .

Thank you,

Danielle Hanson

Environmental Scientist

HDR

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United States Department of the Interior

FISH AND WILDLIFE SERVICE
Pennsylvania Field Office
110 Radnor Road, Suite 101
State College, Pennsylvania 16801-4850

July 12, 2021

Ms. Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
Mail Code: DLC, HL-11.2
888 First St., NE
Washington, DC 20426

RE: Racine Hydroelectric Project (FERC No. 2570); Updated Study Report (USR) Comments and USR Meeting Summary Comments

Dear Secretary Bose:

The U.S. Fish and Wildlife Service (Service) has reviewed the May 12, 2021, Updated Study Report (USR) for the Racine Hydroelectric Project (Federal Energy Regulatory Commission [FERC; Commission] No. 2570; Project), and the USR Meeting Summary filed by American Electric Power Generation Resources Inc. (AEPGR; Licensee) on June 11, 2021. Pursuant to 18 CFR §5.15, the Service provides the following comments.

General Note

Mean sea level (msl) is often used as an elevation reference for the Racine Project and in the USR. This is a periodically updated tidal datum that should not be confused with a vertical geodetic datum. Continued use of msl may contribute to significant measurement, reporting, and construction errors over time. The Service recommends conversion to, and adoption of, the North American Vertical Datum of 1988 (NAVD 88), which has been adopted by the National Oceanic and Atmospheric Administration (NOAA) and the Federal Emergency Management Agency (FEMA), and is the basis for the U.S. Geological Survey's (USGS) primary elevation data product, the National Elevation Dataset (NED).

Recreation

USR Status and Summaries of Studies, Recreation Study, 2.2.2, Summary of Study Methods and Results: AEPGR states that an online Visitor Use Survey will be made available in June 2021 and remain in place through the end of October 2021. As of July 8, the online Visitor Use Survey does not yet appear to be available at the provided URL: www.aephydro.com/HydroPlant/Racine

Fisheries Surveys

USR Status and Summaries of Studies, 2.5.2, Fisheries Surveys, Summary of Study Methods and Results, bottom of page 10: It is understandable that COVID-19 restrictions prevented surveying prior to the end of May 2020; however, the Service questions the statement that high flows also contributed to the late start. Based on dam Tainter gate opening and tailwater elevation data for the months of April and May (Figure 1), it appears there were other windows prior to the end of May when river flow was low and the surveys could have been completed. According to the U.S. Army Corps of Engineers (USACE; Corps), the total gate opening (i.e., across all Tainter gates) is the variable that they track for correlation with river flow (i.e., greater total gate opening = more spill associated with higher river flow). For example, on May 22, 2020, the total gate opening was 112 feet, corresponding with a high flow event, and tailwater was also elevated, whereas, at the time of the fisheries surveys on May 27 and May 28, total gate opening ranged between 15 and 27 feet, and the tailwater elevation was lower, reflecting lower flow conditions more conducive to conducting the surveys. During the period May 14-19, when it appears there was an earlier opportunity to conduct the surveys due to low flow conditions, the total gate opening ranged between 14 and 28 feet. As illustrated in Figure 1, there were additional opportunities, prior to the end of May, when the fisheries surveys could have been completed, so high flow should not have been cited as a contributing factor.

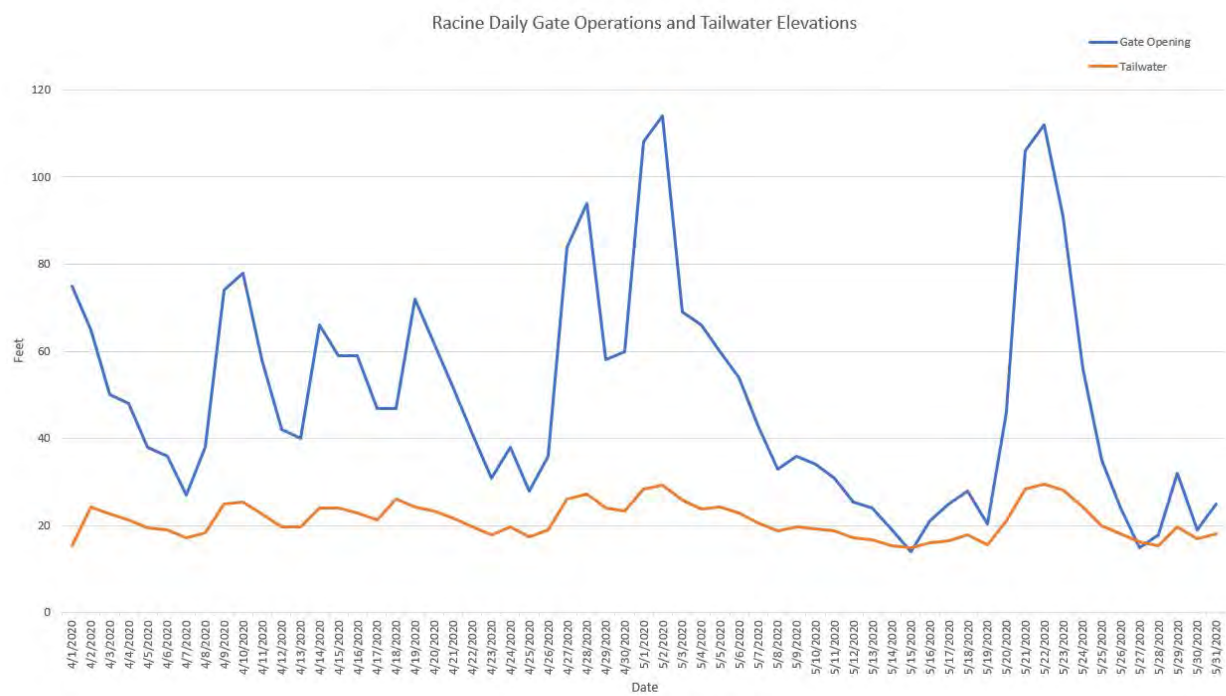

Figure 1. Total Racine Dam Tainter Gate Opening, and Tailwater Elevation, April 1-May 31, 2020. EnviroScience's 2020 spring fisheries surveys in support of the Racine Project relicensing were conducted on May 27 and 28, when total gate opening and tailwater were low, reflecting a low amount of spill corresponding with relatively low river flow. Tailwater elevation is represented by the lower gage reading (e.g., a gage reading of 20 feet = a Tailwater elevation of 546 ft msl).

USR Status and Summaries of Studies, 2.5.2, Fisheries Survey, Summary of Study Methods and Results, page 13: Is additional information available regarding how much of the 65 gallons-per-minute (gpm) was diverted to the base of the eel ramp via the attached gutter when this adjustment was made on August 3, 2020? If so, please provide this information.

USR Status and Summaries of Studies, 2.5.2.1.1, Fisheries Survey, Table 2-1, Water Quality Summary: Please correct the water temperature values for 5/27/20 and 5/28/20. The column heading for these values indicates units are in degrees Celsius, but the values for these dates are much too high to be degrees Celsius readings. The Celsius (C) values for these dates should be 19.4 and 20.2, respectively. As AEPGR has previously stated, the spring surveys started late due to safety concerns and travel restrictions related to COVID-19. The water temperatures were above the maximum threshold (10 degrees C [50 degrees Fahrenheit; F]) specified by the resource agencies for successfully documenting or estimating relative abundance of certain species (e.g., yellow perch).

USR Status and Summaries of Studies, 2.5.2.1.2, Fisheries Survey: The Service appreciates EnviroScience's adherence to the trawl survey methodology to reduce freshwater mussel bycatch. It is unclear whether this methodology may have affected survey results, but the fall trawl survey collected substantially fewer species compared to previous trawl surveys conducted by the Ohio Department of Natural Resources (ODNR), each of which collected more than a dozen species, including rare species not collected in Ohio River Valley Water Sanitation Commission (ORSANCO) electrofishing surveys (see below).

USR Status and Summaries of Studies, 2.5.3, Fisheries Survey, Variances from FERC-Approved Study Plan: As discussed in this section, the Commission's Study Plan Determination (SPD) was not issued until May 13, 2019, and, because water temperature had already risen well above the optimal range defined by the Service and the West Virginia Division of Natural Resources (WVDNR) for conducting the spring fisheries surveys, the decision was made to postpone the spring surveys until 2020. The Service's believes that Integrated Licensing Process schedules should anticipate the typical timing of study seasons, and be adjusted to avoid this kind of problem. Many milestones in the schedule for this Project were not timed appropriately, putting the resource agencies at a disadvantage and negatively impacting the conduct of studies.

Appendix B, Fisheries Survey Report, Executive Summary, page iv, last paragraph: The statement that fish assemblage data (from the relicensing surveys), including species richness and relative abundance, was comparable to species richness and relative abundance data ORSANCO collected from 2010-2018 is accurate if comparing to a single, typical ORSANCO electrofishing survey; however, the ORSANCO surveys and ODNR's mini-trawl surveys (included in ORSANCO data) documented more than 60 species total across all surveys during that time period. The EnviroScience electrofishing survey results were typical when compared to a single ORSANCO electrofishing survey, but documented fewer than half of the species known to occur in the Project vicinity.

The results of the licensee's fall trawl sampling indicated very few species, although results may be, in part, a function of habitat quality due to dam proximity. Only two common species, channel catfish and freshwater drum, were collected, and only upstream (no species collected downstream), whereas two mini trawl surveys of the Racine Pool (River Miles 204 and 208), conducted by ODNR in the fall of 2012, collected 18 species and 13 species, respectively, including several rare species: warmouth (*Lepomis gulosus;* S1/Critically Imperiled in WV), bluebreast darter (*Etheostoma camurum;* S2/Imperiled in OH; host for the federally listed endangered northern riffleshell, *Epioblasma torulosa rangiana*), channel darter (*Percina copelandi;* WV and OH Imperiled; listed as Threatened in OH), slenderhead darter (*Percina phoxocephala;* S1/Critically Imperiled in WV), and river darter (*Percina shumardi;* S1/Critically Imperiled in WV; Threatened in OH). In addition, while downstream trawling in the RC Byrd Pool did not collect any fish, a 2012 fall mini trawl survey conducted by ODNR immediately downstream (RM 238) yielded 15 species, including three of the above rare species, as well as the Tippecanoe darter (*Etheostoma tippecanoe;* Threatened in OH; S2/Imperiled in WV).

In addition, the WV imperiled (S2) banded killifish (*Fundulus diaphanous*) was documented in ORSANCO surveys (both upstream and downstream of the Racine Project), as were the orangespotted sunfish (*Lepomis humilis;* S1 in WV), silver lamprey (*Ichthyomyzon unicuspis;* WV S2S3; upstream only), and bullhead minnow (*Pimephales vigilax;* S2 in WV; upstream only).

The relicensing surveys did find one species that was not found in any of the 2010-2018 ORSANCO or ODNR Racine Pool surveys, river shiner (*Notropis blennius*), although this species has been commonly collected by ORSANCO in other Ohio River pools.

Compared to the other studies referenced above, the licensee's fall trawl sampling yielded a greatly reduced diversity of fish species, and none of the rare species previously documented in the area.

Appendix B, Fisheries Study, Section 2.2, Schedule: The optimal temperature range for conducting surveys is erroneously stated as "40 – 50ºC." This optimal temperature range of 40 – 50 degrees should be expressed in degrees Fahrenheit. Otherwise, the optimal range in Celsius is 4.4 – 10 degrees. Due to a delay related to COVID-19 safety concerns and travel restrictions, the spring surveys were not conducted within the temperature range defined by the Service and WVDNR. Instead, the surveys were conducted when water temperature was between 19.4 and 20.2 degrees C (66.9-68.4 degrees F), well above the range requested by the agencies.

Appendix B, Fisheries Study, 2.9.1, Fisheries Survey Deviations: This section should also discuss the fact that the surveys (electrofishing and trawling) were not conducted within the optimal temperature range of 4.4-10 degrees C (40-50 degrees F) defined by the Service and WVDNR and required by the FERC Study Plan Determination (SPD).

Appendix B, Fisheries Study, 3.1, Fall Fish Survey: Why are gage heights from the RC Byrd Lock and Dam, more than 40 miles downstream of the Racine Project, provided here? There are upstream and downstream gages at the Racine Locks and Dam, and readings from these gages would be much more informative regarding flows at the Project during these surveys. Based on data from the Racine gages for November 11-13, 2019, the Racine Pool elevation ranged between 560.54 feet and 561.17 feet, while the lower pool (tailwater) elevation ranged between 540.49 feet and 541.20 feet during the fall surveys. The total gate opening on the dam ranged from 1 foot to 6.25 feet, indicating relatively low flow conditions during the surveys.

Appendix B, Fisheries Study, 3.2, Spring 2020 Sampling Results: Gage heights from the RC Byrd Lock and Dam are also provided for the spring fisheries surveys. Gage data from immediately upstream and downstream of the Racine Locks and Dam are available and much more informative for evaluating the spring survey results. On May 27 and 28, 2020, the Racine Pool elevation ranged between 560.60 feet and 561.33 feet, and the tailwater elevation ranged between 540.99 feet and 544.19 feet. The total gate opening ranged between 15 feet and 27 feet, indicating that flows were relatively low, but somewhat higher during the spring surveys than they were during the fall 2019 surveys, as would be expected. As previously stated and as shown in Figure 1, there were favorable flow conditions earlier in the spring when water temperatures would have been within or closer to the optimal range for conducting the surveys. However, the Service understands that safety concerns and travel restrictions related to COVID-19 were the primary drivers of the late start of these surveys.

Appendix B, Fisheries Study, 4.0, Discussion: There is a statement in this section that silver chub (*Macrhybopsis storeriana*) was one of two species found during the relicensing surveys but not in 2010-2018 ORSANCO surveys. However, the ORSANCO database for this time period does include records of this species' collection during an ORSANCO electrofishing survey of the Racine Pool on August 2, 2010. This error should also be corrected in Table 4.1. This species was also documented in the RC Byrd Pool during a July 30, 2013, ORSANCO electrofishing survey, although it was collected at river mile 261, well downstream of the Racine Locks and Dam. As previously discussed, the ORSANCO surveys and trawl surveys conducted by ODNR resulted in more than 60 species being documented in the Racine Pool for the 2010-2018 time period.

Regarding the minimal collection of darter species during the relicensing surveys, the Service agrees this may have been related to limited suitable habitat for darters in the Project vicinity. However, it may also have been related to survey methodology, as Racine Pool and RC Byrd Pool records for several darter species are included in the ORSANCO database for the 2010-2018 time period. Those records were primarily from ODNR trawl surveys.

American Eel

Appendix B, Fisheries Study, Section 2.8, American Eel Survey: This section states that EnviroScience and HDR designed and constructed a temporary eel ramp per the specifications recommended by WVDNR and the Service. However, the flow to the ramp was not initially split between the top of the ramp and the base of the ramp to meet the water depth criterion on the sloped portion of the ramp, while also providing sufficient attraction flow to the base of the ramp. The recommendations provided to EnviroScience, HDR and AEPGR on July 1, 2019, included a detailed illustration from the Service's criteria manual, clearly showing this division of flow. Photos of the ramp provided by AEPGR also did not show a sprayer (e.g., sprayer manifold) for evenly distributing flow at the top of the ramp. This specification is also identified in the criteria manual illustration.

EnviroScience states that the ramp was installed on the downstream side of the dam to be in place during the American eel migration. However, the ramp was not installed and operational until more than 30 days after the water temperature trigger was reached for starting the survey. The Service understands that this was at least partly related to COVID-19 safety concerns and travel restrictions, but the late start should be noted. Per the SPD, the study was to commence when water temperature reached 15 degrees C (59 degrees F). ORSANCO water temperature data are missing for the beginning of May, but water temperature had already reached 20 degrees C (68 degrees F) as of May 13, 2020. The eel ramp operation was to continue until water temperatures dropped to 10 degrees C (50 degrees F), but the ramp was disassembled on October 7, at which time water temperature was 20.7 degrees C (69.2 degrees F). Lastly, because the Project was not discharging during a significant portion of August and early September, the study's effectiveness was likely reduced during that portion of the migration season, due to lack of sufficient attraction flow (i.e., far-field attraction) to the side of the river where the eel ramp was located.

USR Meeting Summary, Variances from FERC-approved Study Plan; USR Status and Summaries of Studies, 2.5.3, Fisheries Survey, Variances from FERC-Approved Study Plan; and Appendix B, Fisheries Study, 2.9.2, American Eel Survey Deviations: Specific variances from the SPD or deviations from Service recommendations that were not sufficiently addressed in the USR or the USR Meeting Summary include (1) the eel ramp operation began more than 30 days after water temperature had reached the trigger for beginning the survey; (2) the eel ramp study was ended before the water temperature trigger was reached for ending the study; (3) the water depth on the sloped portions of the ramp was well above the Service's criterion of 1/16 inch to 1/8 inch for approximately 40 days of the 77 total days of operation[1]; (4) the Project was not generating for a significant portion of the latter half of the study, and therefore was not providing a far-field attraction flow to the powerhouse side of the river where the ramp was located; and (5) the fall electrofishing surveys were not preceded by a period of elevated river flow.

According to the SPD, at a minimum, downstream electrofishing targeting American eel was to be conducted during evening/night-time hours, after periods of elevated river discharge, to coincide with periods of peak upstream eel migration. The spring electrofishing surveys were conducted May 27-28, 2020. The surveys were conducted at night, beginning just after dusk, in conformance with the SPD. In addition, these surveys were conducted following a period of elevated river discharge (Figure 1), also in conformance with the SPD. The fall electrofishing surveys downstream of the Project were conducted November 11-13, 2019. These surveys were also conducted at night. However, there was no period of elevated river discharge prior to the

[1] The American Eel Study Plan (Appendix A of Fisheries Study Report) acknowledges this criterion, stating that "the ramp surface will remain wetted at all times and approximately 0.0625-inches to 0.125-inches of water will be maintained by pumping water down the length of the ramp…"

conduct of the fall electrofishing surveys. Over a 5-day span preceding the fall surveys, the tailwater elevation remained below 542 feet (lower gage reading < 16 ft), and the total gate opening did not exceed 8 feet (Figure 2), indicating there was no period of elevated discharge immediately preceding the fall surveys. The SPD also specified that the study should include a spring, summer, and fall American eel-targeted electrofishing survey (as site safety conditions allow). The downstream electrofishing surveys covered only two short time periods and were not American eel-targeted surveys, although the surveys were conducted along both shorelines.

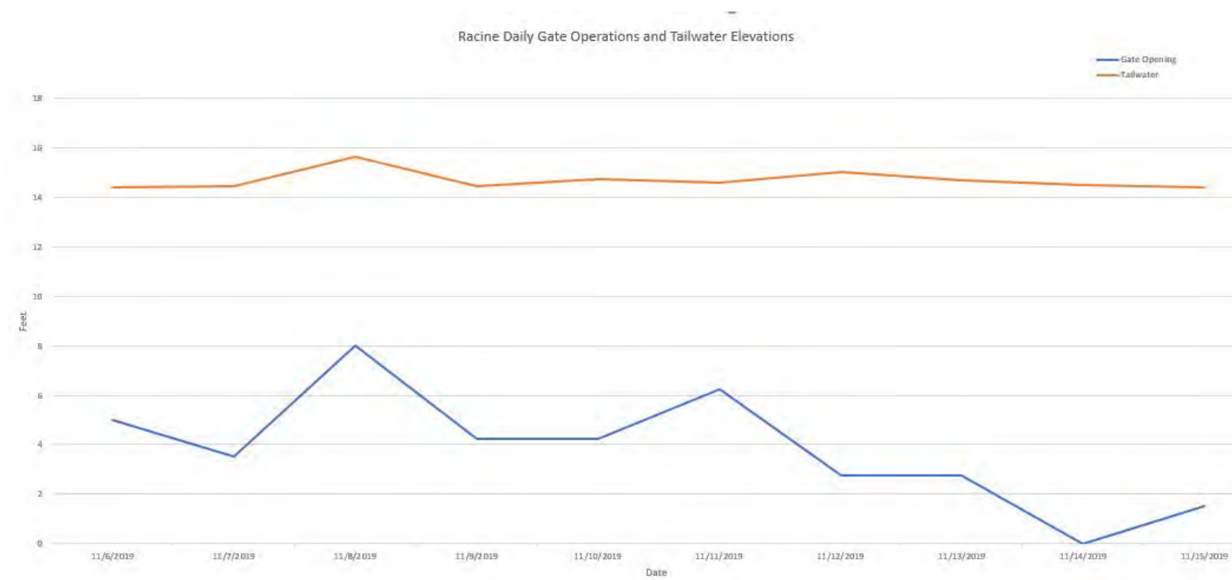

Figure 2. Total Racine Dam Tainter Gate Opening, and Tailwater Elevation, November 6-15, 2019. EnviroScience's 2019 fall fisheries surveys in support of the Racine Project relicensing were conducted November 11-13, 2019. Total gate opening and tailwater were low during the 5 days preceding the surveys, reflecting a low amount of spill corresponding with relatively low river flow. Tailwater elevation is represented by the lower gage reading (e.g., a gage reading of 15 feet = a Tailwater elevation of 541 ft msl).

The Service previously commented on the licensee's March 2020 "Temporary Upstream American Eel Ramp Design and Methodology" (methodology). In that methodology (Section 4.1, Ramp Construction), the licensee stated that "the ramp surface will remain wetted by pumping water down the full length of the ramp with a flow of approximately 50 gallons per minute (gpm)." The Service did not comment that this amount of flow (or the 65 gpm recommended by the Service) should not be introduced at the top of the ramp and that, instead, only enough flow to maintain a wetted surface with a water depth of 1/16 in to 1/8 in should be provided at the top of the ramp, with the balance of the flow going to the base of the ramp for attraction flow. However, the Service previously provided detailed recommendations (July 1, 2019, email to Dave Czayka, EnviroScience; AEPGR representatives copied), including an excerpt from the Service's Fish Passage Engineering Design Criteria manual (USFWS 2019; criteria manual) with the criterion for water depth (above).

The Service's July 1, 2019, recommendations included a detailed illustration from the criteria manual, showing a split in the flow, with a portion of the flow delivered to the top of the ramp and the rest of the flow delivered to the base of the ramp for attraction. Based on ramp photos provided by AEPGR, it also appears that a sprayer manifold may not have been used to evenly distribute water at the top of the ramp. The Service's recommendations also provided the full citation for the criteria manual which, when entered into a search engine, brings up the downloadable pdf of the criteria manual. The excessive amount of flow to the top of the ramp could have been avoided. The Service did not catch this mistake when we reviewed the March 2020 proposed methodology, and we were not consulted during ramp construction. It was not until the Service inquired about the ramp on July 7, 2020, that photos and a short video were provided (on July 8) by AEPGR.

In an October 2, 2020, filed "Response to Determination on Requests for Study Modifications," AEPGR stated that the Project's generating units were offline for maintenance for an extended period of time during August and early September, 2020. The Service considers this another variance from the requirements of the SPD. The Commission stated in the SPD that flow releases from the Project also have the potential to affect upstream migrating eels by creating a source of false attraction flows, guiding them away from the Corps' locks on the west side of the dam, or other available means of upstream migration, thereby potentially impeding or delaying their upstream migration. The Project was not generating during a significant portion of the latter half of the eel ramp study, which reduced the potential for eels to be attracted to the powerhouse side of the river where the eel ramp was located.

The Service appreciates the effort on the part of the licensee and their consultants, especially under the circumstances of the pandemic, but the conduct of this study (late start, early finish, incorrect flow to the ramp at the start of the study, no Project discharge during a significant portion of the study), and the vandalism to the ramp all contributed to limited potential for success. Regarding the vandalism, the USR states that on June 22, 2020, EnviroScience discovered that the anchors on the last section of the ramp had been cut and a section of the ramp was separated from the rest of the ramp. The Service would appreciate more details regarding how this section of the ramp was anchored. The ramp sections appeared to be attached to one another using flashing tape. Was this the only method used for joining the ramp sections together? The siting of the ramp was also constrained by site-specific issues, resulting in the ramp being installed in a less-than-optimal location for attracting eels. Due to these siting constraints and the potential for vandalism, the Service is not requesting a repeat of this study. However, considering the shortcomings of this study, the Service considers the study insufficient for arriving at informed conclusions as to whether eels are congregating below the Project and searching for a reliable upstream route of passage when the Project is discharging a false attraction flow.

The USR understandably does not include any discussion of targeted surveys for adult (silver phase) eels during their downstream spawning migrations because such surveys were not required by the FERC SPD. The Service and the licensee also could not identify or agree on methods that would have a high likelihood of success. As previously stated, the Service has determined that electrofishing surveys and trawl surveys are not very effective for collecting eels on large river systems where eels are not abundant. Based on conversations with ORSANCO, it is our understanding that eels are generally under-represented, compared to their relative abundance, in Ohio River electrofishing surveys. Both the Service and WVDNR requested the use of hydroacoustic (e.g., DIDSON) monitoring of the Racine Pool upstream of the Project intake. Eels would be easily identifiable using this approach, which also would have provided valuable data for the entrainment study. However, this method was determined to be too expensive, despite its use in other FERC relicensing studies, and the request was denied.

In their SPD, the Commission did recognize the possible need for additional American eel studies in the Racine Pool if sufficient data were not collected to satisfactorily estimate American eel entrainment, impingement, and turbine mortality at the project. The Commission stated that AEPGR may need to supplement existing desktop entrainment databases with additional studies upstream of the project that focus on American eels. The Commission further stated that the licensee should evaluate the need for additional data or studies on American eel after completing the SPD-approved studies. This issue was to be addressed in the Initial Study Report (ISR); however, due to study delays, the fisheries studies were not completed until after the ISR was filed.

Appendix B, Fisheries Study, 4.0, Discussion: Regarding the conclusion that the American eel appears to be rare in the vicinity of the Project, (based on only one record in the 2010-2018 Racine and RC Byrd pools ORSANCO data and no records from the eel ramp monitoring portion of the relicensing study), as the Service has previously noted, this species is generally under-represented in fisheries surveys, compared to its actual relative abundance. Furthermore, the eel ramp was not installed in an ideal location for collecting eels that may approach the Project dam, and there was no far-field attraction flow due to a powerhouse maintenance shutdown during part of the study. Siting the ramp approximately 250 meters (820 feet) downstream of the Project, along the shoreline, may have produced better results, but this location was determined to be impractical in terms of providing attraction flow and flow to the ramp. This location may also have been more difficult to monitor and protect from vandalism. Although records from electrofishing surveys are limited, anglers continue to report catches of this species from the Ohio River and its tributaries, including as far upstream as Morgantown, West Virginia, from the Monongahela River, a major Ohio River tributary.

The ODNR received an American eel angler report in May of 2021, from immediately downstream of the Pike Island Locks and Dam (Pike Island). The Service contacted the angler who provided photo documentation of the eel which, based on the photo, appeared to be an upstream migrating (yellow/immature) eel approximately 20 inches (508 mm) long. Pike Island is 153 miles upstream of the Racine Project, with three hydroelectric projects (at Corps locks and dams) in between. The many hydroelectric projects on the Ohio River likely injure or kill some of the sexually mature silver eels during their downstream migration, contributing to the species' continuing scarcity. Cumulative turbine mortality, which refers to the estimated combined turbine mortality within a watershed, is thought to cause significant reductions in a watershed's reproductive contribution to the eel population, and this is true even when survival rates of eel passage are relatively high through each successive turbine on a river system (Gomez and Sullivan 2012). For example, if survival of downstream migrating American eels passing through project turbines is determined to be 90 percent at each of the 10 currently operating hydropower projects on the Ohio River, this would theoretically result in a cumulative survival rate of only 35 percent (0.9^{10}).

Entrainment and Impingement

USR Status and Summaries of Studies, Fish Entrainment and Impingement Study, 2.6.2.5.1, Trashrack Exclusion and Intake Avoidance; and Appendix C, Fish Entrainment and Impingement Study Report, 5.3.2, Trashrack Exclusion and Intake Avoidance: Please explain the following statement: "Burst swim speed data were compiled from the literature, however if data for a specific species or group was not directly available, it was calculated as 2x critical swim speed based on Bell (1991)." Specifically, to what does "critical swim speed" refer? Bell (1991) does not use this terminology, but instead defines three different swim speed categories: (1) cruising speed, (2) sustained speed, and (3) darting speed.

The maximum powerhouse intake approach velocity of 4.3 feet per second (fps) is well above the Service's recommendation that intake approach velocity should not exceed 2 fps, 1 foot upstream of the trashrack (USFWS 2019), to prevent unacceptable levels of fish entrainment.

USR Status and Summaries of Studies, 2.6.2.5.2, Impingement Assessment; and Appendix C, Fish Entrainment and Impingement Study Report, 5.3.3, Impingement Assessment: The Service does not agree that there would be no impingement at the Project. Given the high velocities at the intake, especially during maximum generation, fish may become laterally impinged while trying to escape entrainment. Fish will not always be longitudinally oriented (i.e., parallel to flow), especially if they feel the increasing velocity at the intake and attempt to escape entrainment. In such situations, fish may attempt to turn away from the trash rack and become impinged while oriented perpendicular to the flow.

There is also no discussion regarding velocity calculations for the impingement part of the study. Was open/through-screen velocity calculated? While approach velocity (e.g., 1 foot upstream of the trash racks) may be the primary driver for impingement, through-screen velocity may relate to how difficult it is for a fish to remove itself from a screen once impinged (EPRI 2000).

USR Status and Summaries of Studies, 2.6.2.5.5, Turbine Mortality and Estimated Survival of Target Species: The Service disagrees with the statement that the Project's turbine speed (160 revolutions per minute [rpm]) is slow. This turbine speed is moderate for a Kaplan turbine, compared to Kaplan turbines at other projects (e.g., turbine speeds as low as 54.5 rpm), and provides an extremely limited time window for fish to safely pass the rotating turbine without being struck by a blade. This turbine speed may also be sufficient to cause barometric pressure changes as fish pass the rotating blades, potentially resulting in barotrauma to some species (e.g., species with swim bladders), as further discussed later in these comments.

Regarding the statement that the potential for American eel entrainment is during their downstream migration in the fall, it should be noted that sexually mature eels do not undertake their downstream migrations only in the fall, although the fall may be the season when peak downstream migration occurs in most river systems. The timing of this peak may vary from year to year or by watershed, and is also water temperature-dependent. In a Shenandoah River study, American eels moved downstream past dams in every month of the year except July, and peak migration time differed for each of the 3 study years (Eyler et al. 2016). Because downstream migration of this species in the Ohio River has not been studied, the assumption that all downstream eel migration is in the fall may have resulted in an underestimate of eel entrainment impacts at Racine.

Appendix C, Fish Entrainment and Impingement Study Report, 4.3.1, Assessment of Impingement Potential at the Intake: As stated in this section, the Project's intake has trash racks with a clear bar spacing of 6.125 inches. The Service's fish passage engineering criteria call for a 0.75-inch clear spacing where American eel is present (USFWS 2019), to prevent entrainment of this species, which shows a higher susceptibility to turbine-induced injury or mortality than most other species. However, as stated elsewhere in the USR, the velocity measured 1 foot upstream of the intake (at maximum Project generation) exceeds 4 fps. According to the Service's criteria, normal velocities, measured 1 foot upstream of the intake, should not exceed 2 fps. While the clear spacing of the bars on the trash racks greatly exceeds the Service's criterion for preventing entrainment, the Service's criterion for velocity in front of the intake is also greatly exceeded at this project; therefore, the wide bar spacing likely prevents substantial impingement of fish against the Project's trash racks.

Appendix C, Fish Entrainment and Impingement Study Report, 4.3.3, Monthly Turbine Entrainment Rate Calculation: The Service questions AEPGR's adjustment to the data to account for cold stress of clupeids. AEPGR reduced estimated entrainment rates for gizzard shad (*Dorosoma cepedianum*) and skipjack herring (*Alosa chrysochloris*) by 94.4 percent in the winter, 6.1 percent in the fall, and 20.6 percent in the spring, based on the percentage of time that water temperature is expected to be below 8 degrees C (critical water temperature), because they consider any mortality related to entrainment of cold-shocked clupeids to not be the result of project operations. In a laboratory experiment using gizzard and threadfin shad (*Dorosoma petenense*) collected from the Clinch River in Tennessee, loss of equilibrium (LOE) for threadfin shad occurred at 7.2 degrees C and for gizzard shad at less than 3.5 degrees C (Fost 2006). Both species exhibited reduced swimming performance at temperatures slightly above the LOE temperature threshold. A conclusion of the study was that threadfin shad and gizzard shad are susceptible to impingement [or entrainment] before moribundity occurs (Fost 2006).

Based on these findings, it is an erroneous assumption that when water temperature drops below 8 degrees C, clupeids become moribund. On the contrary, this study and other recent research indicates that clupeids experience loss of equilibrium and reduced swimming performance at temperatures below 8 degrees C, but are not necessarily moribund. Fish in this non-moribund state of reduced equilibrium and swimming performance would be unable to escape entrainment, and would be susceptible to turbine-induced injury or mortality at the Project. In such cases, Project operation would be the cause of the injury or mortality.

USR Meeting response regarding whether barotrauma was considered; Appendix C, Fish Entrainment and Impingement Study Report, 4.3.4, Turbine Blade Strike Evaluation: Causes of injury and mortality other than from turbine blade strikes (e.g., extreme pressure changes) were briefly discussed, but there is no indication that factors other than blade strike were included in this study. Computational Fluid Dynamics (CFD) modeling (Keller et al. 2006) and field studies (Carlson et al. 2008) have shown that fish passing through turbines are subject to mild compression at the turbine intake, followed by sudden decompression in the short period of travel from the stay vanes and wicket gates past the suction side of the runner blades (*In* Richmond et al. 2015). Brown et al. (2012) found that injuries during decompression are caused by swim bladder expansion and rupture, or by gas bubble formation in blood (*emboli*) (*In* Richmond et al. 2015). Bluegills (*Lepomis macrochirus*), and presumably most physoclistous fish species, those with no connection between swim bladder and digestive tract (e.g., percines), are extremely susceptible to swim bladder rupture when exposed to sudden pressure change during turbine passage (Abernethy et al. 2000).

In a study of pressure changes simulating passage through a Kaplan turbine under a "fish-friendly" mode of operation, both rapid pressure change in test fish (turbine passage pressure spike) and gradual change in control fish (depth-acclimated fish returned to surface pressures) resulted in significant injury rates for bluegills (Abernethy et al. 2002) . Injury and mortality rates for bluegills were higher if they had first been acclimated to water pressures equivalent to 30 feet of depth (Abernethy et al. 2002). The maximum depth in front of the Racine intake is approximately 65 feet.

Appendix C, Fish Entrainment and Impingement Study Report, 5.2.2, Intake Specifications: Section 4.3.1 indicates a 6.125-inch "clear bar spacing," whereas this section states that the bar spacing is 6.125 inches "center-to-center." These are conflicting statements. A center-to-center spacing of 6.125 inches would equate to a clear bar spacing that is less than 6.125 inches. Please clarify.

Appendix C, Fish Entrainment and Impingement Study Report, 5.2.3, Intake Flows: Why were gage data from the Greenup Dam evaluated in order to determine the number of days per year that river flows exceeded the maximum threshold for Project operation? The Greenup Dam is more than 103 miles downstream of the Racine Project, and there are numerous tributaries and a substantial amount of additional watershed between the Racine and Greenup dams. Were these flow data prorated, based on differences in drainage area? If not, the calculated average number of days (26) per year that river flows exceeded the maximum threshold for Project operation is likely an overestimate (i.e., the Project may be able to operate on more days than this evaluation suggests). The drainage area above the Racine Project has been estimated to be 40,104 to 40,130 square miles, while the drainage area above the Greenup Project, according to USGS gage at the Greenup Dam (Gage #03216600), is 62,000 square miles, approximately 55% larger than the Racine drainage area. If the Greenup data were not prorated to account for this difference, entrainment impacts are likely underestimated.

USR Meeting Summary, 2.3, Fish Entrainment and Impingement Study, and USR Appendix C, Fish Entrainment and Impingement Study Report, 5.2.4: Based on the information provided, the calculated approach velocity was based on intake dimensions of 21 feet (W) x 88 feet (H). However, only approximately 65 feet of the 88-foot-high intake is submerged at a normal Racine Pool elevation of 560 feet above msl. How would this affect the velocity calculation? It appears this may not have been taken into account, and could result in an underestimate of intake velocity at maximum Project generation. If this is the case, the maximum intake velocity may be higher than 4.3 fps, and this entrainment evaluation may have underestimated overall entrainment rates.

To calculate intake velocities, calibrated CFD models work best, followed by field measurements. At a minimum, a 1-dimensional (1-D) analysis should be used to calculate normal flow (i.e., approach flow perpendicular to the intake). We recognize that 2-D modeling was completed by GEI Consultants, Inc. in 2017, as referenced in the USR regarding velocities a short distance away from the influence of the intake, but the USR does not indicate that the 2-D modeling was used to calculate intake velocity or that it was of a fine enough resolution for that purpose. Based on the limited amount of information provided in the USR, it appears that the intake velocity was calculated using intake dimensions. Open velocity (aka impingement velocity or through-screen velocity) should also be calculated; this is also a 1-D exercise but must be based on accurate drawings so that it accounts for structural steel. The Service requests more details regarding how intake velocities were determined, and the associated calculations.

The licensee points out that velocity of the river in the vicinity of the Project, while often lower than that estimated in front of the intake, can sometimes be as high as approximately 6 fps, and it is further stated that fish species and life stages with swim speeds capable of overcoming such velocities would be able to avoid the approach velocity of the intake. However, when river flow reaches these high velocities, most species and life stages with sustained swim speeds below 6.0 fps will likely avoid these high velocity flows by seeking out eddies or benthic structure where bed roughness provides reduced velocities. In addition, the licensee noted that velocities in areas that were 20 feet away from the intake were lower, ranging from 2.0 to 4.0 fps, based on velocity modeling performed in 2017 for AEPGR by GEI. This difference may result in fish being attracted to the powerhouse intake or becoming entrained in this higher flow when they are in the vicinity of the intake, and weaker swimming species and life stages that are unable to escape this flow will become entrained in the powerhouse. It should be noted that the GEI modeling report describes the intake dimensions as "21.75 ft-wide by 60-ft-high."

There does not appear to be any discussion in the entrainment analysis regarding downstream migrating fish that may be attracted to the Project intake and voluntarily enter the intake. Based on life history information and time of year, did this study consider this behavior? It appears that the study included an assumption that all fish that are capable of escaping the Project intake will actively avoid entrainment. This may not be the case for all species or life stages.

The Service has many concerns regarding this entrainment and impingement study. Despite requests by both the Service and WVDNR, there was no infield verification (e.g., hydroacoustic monitoring; use of a sensor fish; balloon-tag study). Fish population and relative abundance data specific to the Racine Project area were not representative of the fish community across all seasons (e.g., "spring" survey conducted at summer water temperatures). The study assumed moribund condition of clupeids at water temperature < 8 degrees C, which has been refuted by recent research. The Greenup Project (> 103 miles downstream) data were used for determining when river flows prevented the Project from operating, possibly resulting in an underestimate of entrainment (unless the drainage area was prorated to account for the significant difference in drainage area). It appears that the full height of the intake (instead of the submerged height) may have been used to calculate intake velocity. If this was the case, intake velocity may have been underestimated, which would result in underestimates of entrainment rates. The study assumed no impingement impacts, based solely on the spacing between the trashrack bars. The potential for injury or mortality from barotrauma was not considered. American eel were assumed to undertake their downstream spawning migrations only in the fall months. Based on the many assumptions and unanswered questions related to this study, the Service has little confidence in the study's results and conclusions.

Despite these concerns, the estimated annual entrainment numbers for important freshwater mussel hosts (e.g., sauger, *Sander canadensis;* skipjack herring) are high, and may be higher, depending on the validity of these concerns. The high entrainment rates estimated for sauger are particularly troubling, considering this species is the only known natural host for the federally listed endangered sheepnose mussel (*Plethobasus cyphyus*), a species that has been documented a short distance downstream from the RC Byrd Dam, the next downstream Project below Racine.

Due to the lack of studies specifically targeting downstream migrating American eels, the actual relative abundance of adult eels remains undetermined. However, as previously discussed, cumulative turbine mortality is thought to cause significant reductions in a watershed's reproductive contribution to the eel population. The Racine Project is one of ten hydroelectric projects currently operating on the Ohio River, with additional projects operating on the Allegheny River and other tributaries. There are also many (> 10) additional licensed but unbuilt projects, some of which will soon be starting construction. Failure to address cumulative entrainment impacts to this species will ensure its continued scarcity in the Ohio River. Due to the inherently hazardous nature of hydroelectric turbines, the Service does not recognize passage through turbine intakes as an acceptable downstream route for fish (USFWS 2019).

Thank you for your consideration in this matter. If you have any questions, please contact Richard McCorkle at richard_mccorkle@fws.gov.

Sincerely,

Sonja Jahrsdoerfer

Sonja Jahrsdoerfer
Project Leader

cc: WVDNR, Jacob Harrell
ODNR, Michael Greenlee
USACE, Andrew Johnson
USFWS, Ohio Field Office, Patrice Ashfield
USFWS, West Virginia Field Office, Jennifer Norris

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Stephen S. McDaniel
Director

July 16, 2021

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

RE: Racine Hydroelectric Project (FERC no. P-2570); Updated Study Report Comments

Dear Secretary Bose:

Thank you for allowing the West Virginia Division of Natural Resources, Wildlife Resources Section (WRS) the opportunity to provide comments with regards to the Updated Study Report (USR) as submitted for the Racine Hydroelectric Project (FERC No. 2570). The WRS has reviewed the referenced report and offers the following comments for your consideration:

2.5 Fisheries Survey

The results of the trawl component of the fisheries survey are less than desirable. The capture of only two species of fish (channel catfish and freshwater drum) is not consistent with previous trawl surveys of the Ohio River and may indicate that errors had been made in the sampling procedure. It can be expected that a portion of the trawls would be empty, considering the nature of trawl surveys, but it is hard to believe that within a large riverine ecosystem, such as the Ohio River, two-thirds of the trawls would have no catches and of the one-third of trawls that did have a catch, only two of the most common species would be netted. There are a number of reasons that may have attributed to these results to include: trawl not making secure benthic contact, speed of the boat being too slow, etc. Additionally, due to the difficulty of trawl surveys, it may be preferred to sample more than six transects. As such, the WRS would request that the trawl component of the fisheries survey be reassessed. The WRS would be amenable to continued coordination with the surveying group and would additionally be able to offer training on the trawl methodology employed by the WRS.

2.6 Fish Entrainment and Impingement Study

The methodology incorporated within the desktop entrainment review is not consistent with typical desktop entrainment procedures. In particular, it is not an acceptable practice to use every project within the EPRI database as establishing likely fish entrainment rates. Most of the projects within the EPRI database would be considered to be incompatible with the operations at the Racine Project. Differences in turbine type, project size, trash rack spacing, and project fisheries contribute to this incompatibility. The practice of establishing likely fish entrainment rates using every project as a surrogate can potentially lead to inaccurate or misleading results of entrainment at the Racine Project. A preferred method would be to identify one or more projects that have similar trash rack spacing, incorporate similar turbine designs, and similar fish assemblages within the associated pools.

Cold shock/stress of Gizzard Shad leading to large die-offs in the winter has not been observed to occur at the Racine Project. Even still, the WRS acknowledges that Gizzard Shad may experience a level of torpor and reduced biological function when water temperatures decrease below 8° C; however, the primary cause of mortality in a Gizzard Shad passing through the turbine structures would be blade-strike and/or barotrauma. If there were no hydropower project at Racine, then Gizzard Shad would not be succumbing to entrainment, regardless of cold shock/stress. The WRS does not concur with the exclusion of Gizzard Shad from the entrainment estimations due to cold shock/stress.

The calculated approach velocity in front of the intake racks of 4.3 ft/sec exceeds the critical swim speed of most fish species present at the Project. Critical swim speed differs from burst swim speed in that the critical swim speed is the maximum likely swim speed that a fish can sustain for a period of time (approximately five minutes before failure) whereas burst swim speed refers to the maximum likely swim speed can be maintained for a few seconds. An approach velocity exceeding the critical swim speed can potentially generate more fatigue in fish and potentially lead to higher entrainment rates than what would be expected with lower approach velocities. It may be conceivable, then, that the number of fish entrained by the Project has been under-estimated through this desktop entrainment analysis.

The WRS has calculated blade-strike probabilities and mortality probabilities that differ significantly from what is reported within the USR. With 4 blades and a runner speed of 160 rotations per minute, the time needed to safely pass through the turbine structures can be calculated to be 0.09375 seconds. Fish greater than 10 inches in length would need more than .111882 seconds to safely pass through the turbine structures without being struck by a blade. It can be further calculated, then, that a fish exceeding 10 inches in total length is more than guaranteed to be struck by a blade. The provided desktop entrainment analysis had calculated relatively low blade strike probabilities with respect to body size than what would be expected or what the WRS had calculated. Additionally, this underestimation of the blade strike probability contributes to a likely underestimation of blade-strike mortality.

The WRS is currently evaluating other options regarding the fish entrainment and impingement study and would request continued consultation with the Racine Project and its partners in arriving at an acceptable entrainment analysis.

The WRS appreciates the opportunity to provide comments regarding the Updated Study Report for the Racine Project. If you have any questions or comments concerning this letter please contact me at (304)989-0208 or by email at jacob.d.harrell@wv.gov.

Sincerely Yours,

Jacob Harrell
Hydropower Coordination Biologist

Telephone Memo

To: Public Files
From: Jay Summers, Wildlife Biologist, Division of Hydropower Licensing
Date: July 20, 2021
Docket: Project No. 2570-032
Project: Racine Hydroelectric Project

Subject: Conversation with Mr. Jacob Harrell, West Virginia Division of Natural Resources

On July 20, 2021, I contacted Mr. Jacob Harrell of West Virginia Division of Natural Resources (WVDNR), seeking clarification on WVDNR comments on the updated study report (USR); specifically, if WVDNR was requesting a modification to the fisheries survey.[1] Mr. Harrell stated the following: 1) WVDNR did not agree with the conclusions presented within the USR regarding the studies; 2) WVDNR was seeking a modification to the fisheries survey, and the fish entrainment and impingement study; and 3) both the fisheries survey, and the fish entrainment and impingement study, should be reassessed.

[1] Filed with the Commission on July 16, 2021.

American Electric Power
1 Riverside Plaza
Columbus, OH 43215
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Via Electronic Filing   August 10, 2021

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

Subject: **Racine Hydroelectric Project (FERC No. 2570)**
Response to Comments on the Updated Study Report

Dear Secretary Bose:

AEP Generation Resources Inc. (AEPGR), a unit of American Electric Power (AEP), is the licensee, owner, and operator of the Racine Hydroelectric Project (Project) (FERC Project No. 2570), located on the Ohio River in Meigs County, Ohio. The Project is operated under a license issued by the Federal Energy Regulatory Commission (FERC or Commission). The existing FERC license for the Project expires on November 30, 2023.

AEPGR has elected to utilize the Integrated Licensing Process (ILP) for the relicensing of the Project as defined in 18 Code of Federal Regulations (C.F.R.) Part 5. In accordance with the Commission's regulations at 18 C.F.R. §5.15 and the Commission's May 13, 2019 Study Plan Determination (SPD), AEPGR filed the Updated Study Report (USR) with FERC on May 12, 2021. Additionally, AEPGR held an Updated Study Report Meeting (USR Meeting) with participants and FERC staff via Webex on May 25, 2021. An USR Meeting summary was filed with FERC on June 11, 2021. The deadline to submit any disputes or requests to amend studies was July 12, 2021[1]. Comment letters were received from U.S. Fish and Wildlife Service (USFWS or Service) and West Virginia Division of Natural Resources (WVDNR) on July 12 and July 16, 2021, respectively. AEPGR is hereby providing responses to comments received on the USR.

General Comment

Stakeholder Comments:

Comment from USFWS: Mean sea level (msl) is often used as an elevation reference for the Racine Project and in the USR. This is a periodically updated tidal datum that should not be confused with a vertical geodetic datum. Continued use of msl may contribute to significant measurement, reporting, and construction errors over time. The Service recommends conversion to, and adoption of, the North American Vertical Datum of 1988 (NAVD 88), which has been

[1] Comment deadline was July 11, which fell on a Sunday, so the actual deadline was July 12, 2021.

adopted by the National Oceanic and Atmospheric Administration (NOAA) and the Federal Emergency Management Agency (FEMA), and is the basis for the U.S. Geological Survey's (USGS) primary elevation data product, the National Elevation Dataset (NED).

AEPGR's Response:

Comment acknowledged. AEPGR will make any necessary adjustments in the Final License Application (FLA).

Recreation Study

Stakeholder Comments:

USFWS stated that as of July 8 the online Visitor Use Survey did not appear to be available on the Project's relicensing website (www.aephydro.com/HydroPlant/Racine).

AEPGR's Response:

On the relicensing website for Racine, approximately halfway down the list of documents there is a link to "Recreation Site Survey Questionnaire" that takes the user to the recreation survey. The original link was never removed from the website after its initial launch in 2019 and was reactivated at the end of May 2021 for an additional recreation season. The following is a direct link to the survey: https://hdrinc.co1.qualtrics.com/jfe/form/SV_eP2frFDVehootUx.

Fisheries Survey

Stakeholder Comments:

USFWS questioned the statement that high flows contributed to a late start to the spring fisheries survey.

AEPGR's Response:

The Initial Study Report Meeting (ISR Meeting) was held on Thursday, May 14, 2020 where sampling was discussed, and the fisheries scope altered. The highwater event occurred only three working days later as the field team were in the process of mobilizing for the work. There was another highwater event that that started on May 20, 2020 and the river did not return to normal for seven days. These highwater events limited sampling to the last part of the month.

Stakeholder Comments:

USFWS asked if there was additional information available regarding how much of the 65 gallons-per-minute (gpm) was diverted to the base of the eel ramp via the attached gutter when this adjustment was made on August 3, 2020.

AEPGR's Response:

The flow meter was upstream of the split between the water that went to the ramp and water that flowed down the attraction gutter. However, the adjustment was to keep a 1/16 inch to 1/8 inch of water on the ramp (approximately 40 percent or 26 gpm) and the rest (approximately 60 percent or 39 gpm) went to the diversion which drove the attractant flow.

Stakeholder Comments:

USFWS commented that the column heading for water temperature values for 5/27/20 and 5/28/20 indicated units were in degrees Celsius (°C), but the values were much too high to be in °C and suggested that the values should be converted to 19.4°C and 20.2°C, respectively.

AEPGR's Response:

The water quality summary Table 3.4 in the fisheries report designates the temperature in degrees Fahrenheit (°F) in the header row. AEPGR agrees with the conversion to °C.

Stakeholder Comments:

USFWS commented that it was unclear if adherence to the trawl survey methodology to reduce freshwater mussel bycatch may have affected survey results because the fall trawl survey collected substantially fewer species compared to previous trawl surveys conducted by the Ohio Department of Natural Resources (ODNR). WVDNR also expressed their concern with the trawl surveys and the low number of fish captured.

AEPGR's Response:

The fisheries team conducting the trawl surveys was comprised of experienced fisheries biologists with seven to ten years of fisheries sampling using multiple methods of fish collection including trawling through the eastern United States. Without reviewing site-specific ODNR trawling area lengths/time of tow, habitat or locations, comparisons of catch per unit effort (CPUE) are not possible. The fisheries survey team followed specific protocols and site locations as specified in the FERC-approved Revised Study Plan.

Stakeholder Comments:

USFWS noted that the Commission's SPD was not issued until May 13, 2019, which resulted in the spring fisheries surveys being pushed to 2020 and commented that the Integrated Licensing Process schedules should anticipate the typical timing of study seasons and be adjusted to avoid this kind of problem.

AEPGR's Response:

AEPGR acknowledges the comment.

Stakeholder Comments:

USFWS made a comment related to the statement that fish assemblage data (from the relicensing surveys), including species richness and relative abundance, was comparable to species richness and relative abundance data Ohio River Valley Water Sanitation Commission (ORSANCO) collected from 2010-2018 is accurate if comparing to a single, typical ORSANCO electrofishing survey; however, the ORSANCO surveys and ODNR's mini-trawl surveys (included in ORSANCO data) documented more than 60 species total across all surveys during that time period. The EnviroScience electrofishing survey results were typical when compared to a single ORSANCO electrofishing survey but documented fewer than half of the species known to occur in the Project vicinity.

AEPGR's Response:

AEPGR agrees that that the fisheries data collected by EnviroScience is more comparable to a one-time sampling event and is not representative of the entire pool surveys completed by ORSANCO and ODNR over multiple years. The intent in the executive summary of the report was to note that the fisheries community percent composition observed was somewhat similar to species composition relative to the ORSANCO data. It is important to note that the purpose of the fisheries sampling conducted for the relicensing effort was to document fish assemblages outside the standard sampling season, as recommended by USFWS and WVDNR, and to find lower diversity during those timeframes was not unexpected.

Stakeholder Comments:

USFWS noted that the optimal temperature range for conducting surveys was erroneously stated as "40 – 50°C." and that it should be expressed in °F (or 4.4 – 10°C). USFWS further noted that due to a delay related to COVID-19 safety concerns and travel restrictions, the spring surveys were not conducted within the temperature range defined by USFWS and WVDNR and were instead, conducted when water temperature was between 19.4 and 20.2°C (66.9-68.4°F), well above the range requested by the agencies.

AEPGR's Response:

AEPGR agrees that the surveys were not conducted within the recommended temperature range and delayed due to COVID-19 restrictions. USFWS' suggestion that the readings should be "40 – 50°F" was a typographical error.

Stakeholder Comments:

USFWS commented that Section 2.9.1 Fisheries Survey Deviations of the study report should discuss the fact that the surveys (electrofishing and trawling) were not conducted within the optimal temperature range of 4.4-10°C (40-50°F) defined by USFWS and WVDNR and required by the FERC SPD.

AEPGR's Response:

AEPGR appreciates and acknowledges the comment.

Stakeholder Comments:

USFWS questioned why gage heights from the RC Byrd Lock and Dam were referenced in Section 3.1 Fall 2019 Sampling Results and Section 3.2 Spring 2020 Sampling Results of the study report when there are gages upstream and downstream of the Racine Locks and Dam. In their comment letter USFWS provided elevation data from gages located upstream and downstream of the Racine Project during the timeframe for both the fall and spring fisheries surveys.

AEPGR's Response:

AEPGR appreciates the comments and agrees that data from closer gages should have been referenced in the study report. Thank you for providing the additional information.

Stakeholder Comments:

USFWS noted a statement in Section 4.0 Discussion of the study report that Silver Chub (*Macrhybopsis storeriana*) was one of two species found during the relicensing surveys but not in the 2010-2018 ORSANCO surveys and stated that the ORSANCO data actually includes record of this species being collected on August 2, 2010.

AEPGR's Response:

AEPGR appreciates the comment and acknowledges the misstatement in the report.

Stakeholder Comments:

USFWS expressed several concerns regarding the American Eel (*Anguilla rostrata*) ramp design, construction and operation.

AEPGR's Response:

AEPGR acknowledges that no spreader manifold was installed in the eel ramp after the initial startup and field staff observing the operation of the water flow in relation to the ramp. The opening on the discharge was wide and angled to evenly distribute flow on the ramp and facilitated water falling into the live well. Water covered the entire bottom of the trough from top to bottom, including after the flow adjustment and any eels navigating the ramp upstream would have had appropriate flow coverage and water agitation cues all the way to the live well. The water flow over the ramp out of the PVC discharge was evenly distributed across the channel with laminar flow and a sprayer manifold was not needed as it would only have created additional backpressure on the pump and further restricted total flow. The opinion of the fisheries biologists that constructed the eel ramp is that a spreader manifold would also have presented a likely opportunity for clogging and malfunction. Additionally, AEPGR acknowledges that the eel ramp was not installed and operational according to the water temperature trigger due to COVID-19 safety concerns and travel restrictions.

Stakeholder Comments:

USFWS commented that specific variances from the SPD or deviations from the USFWS' recommendations were not sufficiently addressed in the USR or USR Meeting Summary including (1) the eel ramp operation began more than 30 days after water temperature had reached the trigger for beginning the survey; (2) the eel ramp study was ended before the water temperature trigger was reached for ending the study; (3) the water depth on the sloped portions of the ramp was well above the Service's criterion of 1/16 inch to 1/8 inch for approximately 40 days of the 77 total days of operation; (4) the Project was not generating for a significant portion of the latter half of the study, and therefore was not providing a far-field attraction flow to the powerhouse side of the river where the ramp was located; and (5) the fall electrofishing surveys were not preceded by a period of elevated river flow. Additionally, USFWS requested additional details regarding how the ramp was anchored.

AEPGR's Response:

AEPGR appreciates and acknowledges these comments. Many of these circumstances were outside of AEPGR's control due to various factors. Several of these comments have been addressed in the preceding responses. Regarding the base ramp construction, the lower sections of the ramp were connected with wood braces and metal hinges that were screwed onto the sides and bottom connecting the two sections of ramp to allow for some flexing under various conditions while maintaining structural integrity. Flashing tape was installed to smooth these junctions and to bridge any small gaps between the connections, as well as to prevent water loss. The ramp was then anchored and tied back into the shore with come-along straps that where either cemented into the ground cover (riprap) or had sufficient on-site rock anchors to attach to. After the vandalism event and cutting of a base ramp supporting strap, signs were posted, and the straps were replaced with cable. Following those improvements on the ramp, it remained in place for the duration of the survey.

Stakeholder Comments:

USFWS commented on the conclusion that the American Eel appears to be rare in the vicinity of the Project and stated that this species is generally under-represented in fisheries surveys compared to its actual relative abundance. USFWS also noted several issues with the difficulty of siting the ramp below the Project that may have affected the results of the monitoring effort. Additionally, USFWS provided information regarding reports of American Eels being collected along the Ohio River.

AEPGR's Response:

AEPGR appreciates the comments and additional information provided by USFWS. AEPGR acknowledges the challenges of finding an ideal location to site the ramp below the Project to provide appropriate attraction flow and flow to the ramp as well as allowing for ease of monitoring and protection from vandalism. AEPGR worked with its consultants and resource agencies to select the most feasible option given the site-specific challenges and conditions at this Project.

<u>Fish Entrainment and Impingement Study</u>

Stakeholder Comments:

USFWS asked AEPGR to explain the following statement: *"Burst swim speed data were compiled from the literature, however if data for a specific species or group was not directly available, it was calculated as 2x critical swim speed based on Bell (1991)."*

AEPGR's Response:

Critical swim speed is a special category of prolonged swimming speed and represents the maximum speed a fish could maintain for a maximum of 60 minutes until fatigue (Brett 1964). Sustained speed is a speed that can be maintained by fish for more than 200 minutes without fatigue, while prolonged speed can be maintained between 20 seconds and 200 minutes and ends in fatigue. Burst speed, analogous to darting speed, is the maximum speed that a fish can maintain for no more than 20 seconds and is performed anaerobically (Wolter and Arlinghaus 2004, Webb 1975, Beamish 1978). AEPGR will revise text in the study report to clarity as follows; "Burst swim speed data were compiled from the literature (Bell 1991), however if species-specific data were unavailable, burst swim speed or darting speed was calculated as 2x the cruising or sustained speed identified in the literature."

Stakeholder Comments:

USFWS stated that they do not agree that there would be no impingement at the Project. USFWS also asked if open/through screen velocity was calculated.

AEPGR's Response:

Approach velocity was the metric that was proposed and included in the FERC-approved study plan. Through screen velocity is usually an important metric for cooling water intake structures that have fine mesh traveling screens with low screen porosity (EPRI 2000). This metric is not commonly used in hydropower plant evaluations that do not have fine mesh traveling screens. The trashracks at the Racine Project have very high screen porosity, and most fish near the intake would be entrained through the facility. Although impingement cannot be completely ruled out or avoided at the Racine intake structure, as described in Section 5.3.3 of the entrainment study report, based on the trashrack bar spacing and swimming ability (both burst and critical swim speeds) of fish occurring in the Ohio River near the intake structure, the overall risk of fish impingement is considered low at the Racine Project. For those fish that are of sufficient size to be impinged laterally on the trashrack bars, most will have a burst swim speed capable of overcoming the through screen velocity and critical swim speed that could allow them to seek a velocity shelter or move just upstream to a lower velocity area (less than 2 feet per second [fps]).

Stakeholder Comments:

USFWS stated that they disagreed with the statement that the Project's turbine speed (160 revolutions per minute [rpm]) is slow. USFWS also commented that the potential for entrainment of American Eels is not only in the fall, and noted that sexually mature eels do not only undertake their downstream migration in the fall and the timing of this peak may vary from year to year or by watershed and is also water temperature dependent.

AEPGR's Response:

In general, the speed of Kaplan turbines is low in comparison to other turbine types. For reference, Kaplan turbines were proposed to be installed at the RC Byrd Project. FERC concluded in its 2015 Environmental Assessment for the RC Byrd Project that "…Fish entrained into the turbine units would have a low probability of blade strike. The survival rate for most small and medium size fish likely to be entrained would be high. The majority of the fish impacted by the turbines would likely consist of young fish of highly prolific species that have the ability to compensate for losses.

Therefore, the estimated entrainment and mortality would only minimally effect fish populations in the Project vicinity (FERC 2015).

The entrainment study report text will be revised to improve clarity.

AEPGR acknowledges the comment regarding the potential timing for entrainment of American Eels. The statement in the conclusion of the report regarding potential fall American Eel entrainment only pointed out the time of year that eels were most likely to be moving through the Project area, based on their well-documented natural history, and was not meant to indicate that they could not be entrained in other months. American Eel collections in the Project area are extremely rare and no American Eels were collected in the AEPGR fish surveys.

The American Eel entrainment estimates presented in the draft report are based on actual entrainment data from the Electric Power Research Institute (EPRI) database, including all records of American Eel entrainment across all facilities and months, and were not revised or trimmed based on any assumption as to the timing of occurrence near an intake. The estimates (as presented in Table 5-8, Table 5-9, Table 5-10, and in Appendix C of the study report) suggest that entrainment risk at the Racine Project for American Eel occurs primarily during fall months. AEPGR maintains that these methods are consistent with accepted professional practices and are not an underestimate of American Eel entrainment.

The study report text will be updated to clarify that all fish that encounter the Racine intake have the potential to be entrained. However, susceptibility of a specific taxon depends on multiple factors including life stage and life history characteristics (spawning season, movement and migration patterns, habitat requirements, etc.).

Stakeholder Comments:

USFWS noted that the Racine Project has trashracks with 6.125 inch spacing and that the USFWS' fish passage engineering criteria call for a 0.75 inch clear spacing where American Eels are present. USFWS also notes that the velocity measured one foot upstream of the intake (at maximum Project generation) exceeds 4 fps, which should not exceed 2 fps. USFWS further states that while the clear spacing of the bars on the trashracks greatly exceeds USFWS' criterion for preventing entrainment, the USFWS' criterion for velocity in front of the intake is also greatly exceeded, and therefore, the wide bar spacing likely prevents substantial impingement of fish against the trashracks.

AEPGR's Response:

AEPGR appreciates and acknowledges these comments.

Stakeholder Comments:

USFWS questions AEPGR's adjustment to the data to account for cold stress of clupeids. USFWS believes that it is an erroneous assumption that when water temperature drops below 8°C clupeids become moribund. WVDNR also stated that it does not concur with the exclusion of Gizzard Shad from the entrainment estimates due to cold stress.

AEPGR's Response:

The method presented in the draft study report is consistent with generally accepted desktop entrainment studies and accepted by FERC on other Projects, including the Free Flow Power Projects on the Ohio River. The purpose of the cold stress adjustment was to correct for the high rates of entrainment due to temperature-related entrainment/mortality at four plants reported in the EPRI database (Youghiogheny, Townsend Dam, Minetto, and Richard B. Russell). The data from those facilities represented over 99.9 percent of the data used to derive the monthly entrainment rates for Gizzard Shad and Skipjack Herring, which were then used to estimate monthly and annual entrainment at the Racine Project for those species. Additionally, the U.S. Geological Survey (USGS) temperature gage used to identify the period of time when temperatures were less than 8°C is closer in proximity to the Racine Project than the other Projects in the database, which are farther north and likely experienced colder water temperatures for much longer periods. Thus, the adjustment applied to the database was likely conservative compared to what it would have been if temperatures from near the Townsend and Minetto facilities were used to determine the adjustment.

Fost (2006) evaluated fish for up to 6-hours post exposure to acute cold-shock conditions. The study also found that the laboratory test conditions were unable to replicate the stress impact on condition factor in test fish, as evidenced by the significantly lower body condition documented in the wild caught shad compared to test fish. As such, the results of the study do not effectively predict Gizzard Shad and Threadfin Shad response to acute or long-term exposure to low winter water temperatures. Had the test conditions been able to replicate winter body condition in wild shad populations, the observed responses to the acute cold-shock conditions may have been more pronounced or occurred at different threshold temperatures.

Fost (2006) also emphasized that shad that are susceptible to impingement could be classified as moribund or impaired, with moribund fish expected to succumb to their stressed condition and die regardless of impingement. In theory, impaired shad could recover if environmental conditions improved and thus mortality would be a result of impingement. However, the likelihood of improving environmental conditions (e.g., water temperatures increase stress-inducing levels) is lower in waterbodies of the northeastern U.S. (i.e., Townsend Dam and Minetto facilities from the database). Further, studies have documented increased predation rates in cold-shock impaired fish (Coutant et al. 1974; Coutant et al. 1976; Wolters and Coutant 1976).

Around 8 to 10°C or lower, shad begin to experience loss of equilibrium and reduced swimming performance reducing their ability to escape the intake approach velocities (Loar et al. 1977). A study by King et al. (2010) regarding impingement susceptibility on the Ohio River found loss of equilibrium and reduced swimming performance at or below 7°C. Clupeids are readily understood to be sensitive fish prone to winter die-off. A literature review by EPRI (2008) on mass mortalities of clupeid species (i.e., Gizzard and Threadfin Shad) indicated the die-off events were common in larger freshwater lakes, rivers, and reservoirs. Seasonally combined data from a 2-year impingement study (King et al. 2010) resulted in 16 of 112 combined events with impingement events of more than 10,000 fish. The study found that only 25 percent of impinged fish were alive at the time of sample collection (immediately after impingement on continuously rotating screens[2]) The dominant taxa impinged were Gizzard Shad, Threadfin Shad, Freshwater Drum, and Skipjack Herring. Nearly all of the fresh dead fish collected during the study were captured during winter and fall samples.

Gizzard Shad are especially susceptible to winter die-off in the northern part of their range, since they are not well-adapted physiologically to extended cold periods. Feeding begins to cease at temperatures around 11°C, while activity remains consistent (White et al. 1986). When temperatures reach 8°C, Gizzard Shad are no longer able to mobilize high lipid energy reserves and enter starvation mode, resulting in quick utilization of muscle and liver glycogens, forcing the fish to use other tissues for energy. Around this time, Gizzard Shad begin to lose cell function and the ability to diffuse wastes across cell membranes. During extended periods with water temperatures well below 8°C, Gizzard Shad begin to exhibit loss of equilibrium and brain function, become disoriented or comatose, and succumb to the combined effects of stress, starvation, and loss of body functions (White et al. 1986).

Winter die-offs are often more severe for younger age classes as well, as they deplete their energy reserves more quickly (Shuter and Post 1990). Further, White et al. (1986) found that young-of-year impingement rates of fish in the 40-125 millimeter (mm) size range (1.5-4.9 inch) were comparable to natural winter die-off rates documented for the same size of fish. Similar research for Threadfin Shad indicates that they begin to experience mortality at prolonged exposure to temperatures around 9°C (Strawn 1965). McLean et al. (1985), found that all age and size classes were impacted by cold temperatures in winter months and the majority of the Threadfin Shad population was eliminated.

[2] During the study, screens were rotated at a minimum of 1-2-hour intervals or continuously when possible (King et al. 2010).

These data on Gizzard and Threadfin Shad support the conclusion that these two clupeids are sensitive to extreme temperature lows or prolonged exposure to low winter temperatures (e.g., below 10°C), which puts the fish into a state of stress of which they are frequently unable to overcome. The clupeid entrainment data from the EPRI database studies were collected at facilities primarily located in New York and Pennsylvania where fish would be exposed to prolonged low water temperatures in the ranges that could result in fish mortality events. Since these data were used to estimate entrainment at the Racine Project, where prolonged low temperatures occur less frequently, it is appropriate to adjust the entrainment database values to avoid over estimating clupeid entrainment attributed to the Racine Project, where cold-induced mortality events are likely to occur less frequently.

It is also important to note, regardless of the adjustment approach discussed here, shad species are susceptible to entrainment at the Racine intake and that susceptibility is reflected in the estimated entrainment values presented in the study report. With or without the adjustment, shad are likely to be in the top five species expected to be entrained at the facility. Shad are highly fecund fish that are able to overcome losses to entrainment or impingement, cold-induced mortality, natural predation, and other environmental stressors, as evidenced by their relative abundance in recent fish community surveys.

Stakeholder Comments:

USFWS commented that causes of injury and mortality other than from turbine blade strikes (e.g., extreme pressure changes) were briefly discussed in the study report, but there was no indication that factors other than blade strike was included in this study.

AEPGR's Response:

Survival rates from the EPRI database from Projects with similar turbine characteristics were generally high. For example, the Crowley, Townsend and Twin Branch Projects had Kaplan turbines with speeds ≤150 rpm and rated head ≤16 feet. Immediate survival rates at these Projects were 0.982 on average, with a minimum rate of 0.860. Latent survival (48-hour) rates were 0.960 on average, with a minimum rate of 0.343[3]. White Sucker and Walleye had the lowest survival rates and Bluegill and Largemouth Bass, other Percinids included in the study did not exhibit lower survival rates (0.860 minimum and 0.958 average). Additionally, Bluegill were low in relative abundance in the Racine fish community study, and based on their life history characteristics (e.g., preference for slow-moving water, nest building and guarding, and tendency to seek shelter from

[3] It should be noted that the low survival rates for White Sucker and Walleye (0.343 and 0.623) included in the EPRI survival database were accompanied by very low control survival (0.556 and 0425), indicating that these studies had apparent experimental stresses, thus these data should be interpreted with caution.

vegetation or other cover), are less likely to aggregate near the intake structure (Smith 1985). These data suggest that entrainment survival at the Racine Project is expected to be relatively high.

Stakeholder Comments:

USFWS asked for clarification regarding the trashrack spacing at the Project.

AEPGR's Response:

The correct bar spacing measurement is 6.125 inches center-to-center, Section 4.3.1 of the study report will be corrected.

Stakeholder Comments:

USFWS inquired as to why gage data from the Greenup Dam were used to determine the number of days per year that river flows exceeded the maximum threshold for Project operation and asked if these flows were prorated based on differences in drainage area.

AEPGR's Response:

Daily average outflows from the USGS Gage 03216600 Ohio River at Greenup Dam were linearly prorated to the Racine Project based on the drainage area. This was the closest downstream gage with available discharge data with a long period of record to provide historical and current flow data. A sentence to clarify this step in the analysis will be inserted into the revised report.

Stakeholder Comments:

USFWS commented that the calculated approach velocity was based on intake dimensions of 21 feet (W) by 88 feet (H) and noted that only approximately 65 feet of the 88-foot-high intake is submerged at a normal pool elevation of 560 feet above mean sea level. USFWS asked for clarification on how this may affect the intake velocity calculation. USFWS also commented on the statement that river velocities may sometimes be as high as 6 fps, as noted during velocity modeling performed in 2017 for AEPGR by GEI. USFWS stated that there does not appear to be any discussion in the entrainment analysis regarding downstream migrating fish that may be attracted to the Project intake and voluntarily enter the intake and asked if this study considered this type of behavior in the analysis. Additionally, USFWS expressed concern regarding the high entrainment rates estimated for Sauger, as this species is the only known natural host for the federally listed endangered sheepnose mussel (*Plethobasus cyphyus*).

AEPGR's Response:

AEPGR has taken this comment into account and recalculated the approach velocity using the wetted dimensions of the intake (21 feet x 65 feet (normal water depth at screens) resulting in a revised approach velocity of 5.86 fps. This will be revised in the study report as will the associated discussion of potential fish avoidance. It is important to note, that this revision will have no effect on the entrainment rates or estimates, as those rates were calculated from the EPRI database. There was no adjustment to those entrainment data based on the number or percentage of target species that have the potential to escape entrainment or impingement based on approach velocity and swim speeds.

The discussion of the GEI report will be removed from the study report. Modeling river/intake velocities was not the purpose of this study and was not part of the FERC-approved study plan, therefore, its results will not be included.

Section 5.3.4 of the study report discusses susceptibility of early life stages of all fish in the Racine Project area to entrainment due to their general lack of mobility. Table 5-6 in the study report shows the periods when early life stages for each species on the target list with the potential to be in the Racine Project area and therefore susceptible to entrainment, due to the timing of spawning. Additionally, the EPRI database used to estimate entrainment rates and annual entrainment included smaller size classes of fish that would account for juvenile life stages. American Eel make downstream migrations but have been accounted for in the entrainment analysis and discussed in a previous comment response.

Specific taxa reported in the EPRI database (1997) and that have been shown to dominate impingement at Ohio steam-electric facilities (King et al. 2010), included the Gizzard and Threadfin Shad, Skipjack Herring, and Freshwater Drum. The susceptibility of Gizzard and Threadfin Shad at the Racine Project is addressed in other comment responses and will be clarified in the revised study report. Freshwater Drum and Skipjack Herring are considered non-migratory species, yet they may undertake long distance, in-river migrations which can increase their susceptibility to impingement and entrainment at the Racine intake structure. The increased risk to entrainment at the Racine Project has been captured in the entrainment estimates provided in the study report. For example, in a normal water year (Table 5-8), Skipjack Herring was estimated to have the third highest total annual entrainment, with Freshwater Drum exhibiting the sixth highest total entrainment estimate. For a wet water year (Table 5-10), Skipjack Herring had the fourth highest annual entrainment estimate, with Freshwater Drum estimated to have the seventh highest total entrainment. The rates captured in the EPRI database are reflective of actual entrainment of those taxa, which is a product of their high mobility, regardless of the source waterbody.

Sauger were not included in the EPRI Survival database but survival data for Walleye (*Sander vitreus*), a species with a very similar body type and life history, are included. After eliminating the data with low control survival attributed to environmental stress by the study authors (<0.7000 as suggested by EPRI 1997 supporting documentation), Walleye survival was high (0.928 after

24-hours and 0.917 after 48-hours). These survival estimates are encouraging and demonstrate the likelihood of survival of most entrained Sauger and Walleye.

Stakeholder Comments:

WVDNR commented that the methodology used in the desktop entrianment review is not consistent with typical desktop entrainment procedures. WVDNR stated that in particular, it is not an acceptable practice to use every Project within the EPRI database as establishing likely fish entrainment rates. WVDNR further stated that most of the Projects within the EPRI database would be considered to be incompatible with the operations at the Racine Project.

AEPGR's Response:

The use of all Projects in the EPRI database has been done for several other Projects and the approach has been approved by FERC, including three Projects on the Ohio River (Emsworth Locks & Dam, Emsworth Back Channel and Montgomery Locks & Dam). The use of all of the Projects in the EPRI entrainment database increases the robustness of the data used to estimate entrainment for each of the target species. The calculation of an average entrainment rate for each target species based on data from all database Projects combined is used to represent the average susceptibility of each species to entrainment. This method likely overestimates the monthly and annual entrainment at the Racine Project, and thus is a conservative approach.

For each facility (and associated entrainment results) that is eliminated from the desktop evaluation, there is a reduction in the number of data points and target species represented in the dataset used to estimate entrainment. The selection of a single facility to represent the Racine Project would have an even more pronounced impact on the robustness of the data and coverage of the target species. For example, the Luray Project in Virginia, is the closest Project to the Racine Project and is similar in operation, as it is a run-of-river facility with 1,477 cubic feet per second (cfs) capacity and 3 units. The only species collected at Luray in their entrainment study was American Eel, thus the use of this Project would only support the estimation of entrainment for American Eel. Townsend Dam in Bever Pennsylvania, has the most comparable trashrack dimensions to the Racine Project at 5.5 inch clear spacing, a 4,400 cfs capacity, a Kaplan turbine and a similar fish community composition. However, only 58 percent of the target species selected for evaluation at the Racine Project were entrained during the Townsend Dam entrainment study provided in the EPRI database. Therefore, it was decided that the best way to estimate entrainment at the Racine facility was to include all Projects in the database and use the average entrainment rate, per size class, per month to generate the entrainment estimates.

Stakeholder Comments:

WVDNR commented that the calculated approach velocity in front of the intake racks of 4.3 fps exceeds the critical swim speed of most fish species present at the Project. WVDNR stated that an approach velocity exceeding the critical swim speed can potentially generate more fatigue in fish and potentially lead to higher entrainment rates than what would be expected with lower approach velocities. WVDNR further stated that it may be conceivable, then, that the number of fish entrained by the Project was underestimated through the desktop entrainment analysis.

AEPGR's Response:

The method used to estimate entrainment does not make any assumptions about the species or number of individuals that can escape entrainment based on swim speeds. Section 5.3.2 (Trashrack Exclusion and Intake Avoidance) in the study report presents a qualitative summary of those species that are more likely to escape entrainment based on their swim speeds and those that will likely be entrained. This analysis is not incorporated into the entrainment estimate; none of the species that have higher swim speeds than approach velocities have been removed from the entrainment estimates. Those rates and estimates have been derived solely from the EPRI database.

Stakeholder Comments:

WVDNR stated that they calculated blade-strike probabilities and mortality probabilities that differed significantly from what was reported within the USR. WVDNR calculated the time needed to safely pass through the turbine structures to be 0.09375 seconds and indicated that fish greater than 10 inches in length would need more than .111882 seconds to safely pass through the turbine structures without being struck by a blade. Furthermore, WVDNR suggested that a fish exceeding 10 inches in total length is more than guaranteed to be struck by a blade and that the study has appeared to have underestimated the blade strike probability contributing to a likely underestimation of blade-strike mortality.

AEPGR's Response:

The turbine blade strike and survival estimates presented in the study report were made using the USFWS probabilistic tool, as described in the FERC-approved study plan. The tool is based on the Franke method and is consistent with standard industry practice. The tool models blade strike and non-turbine route fish mortality using runner diameter, number of blades, turbine discharge, net head, turbine speed, turbine efficiency, and other data. The tool is designed to minimize the potential for calculation errors and maintains the calculations behind a macro that cannot be manipulated by users. Users enter the parameters required for the model, and the model performs the calculations and returns the results. Appendix D of the study report shows the input into the tool and the results. The USFWS has reviewed the results of the model and did not express any concerns with the results presented in the study report.

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Sincerely,

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Attachments:
Attachment A – Comments on Updated Study Report
Attachment B - Revised Fish Entrainment and Impingement Study Report

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Racine Hydroelectric Project (FERC No. 2570)
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Attachment A
Comments on Updated Study Report

United States Department of the Interior

FISH AND WILDLIFE SERVICE

Pennsylvania Field Office
110 Radnor Road, Suite 101
State College, Pennsylvania 16801-4850

July 12, 2021

Ms. Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
Mail Code: DLC, HL-11.2
888 First St., NE
Washington, DC 20426

RE: Racine Hydroelectric Project (FERC No. 2570); Updated Study Report (USR) Comments and USR Meeting Summary Comments

Dear Secretary Bose:

The U.S. Fish and Wildlife Service (Service) has reviewed the May 12, 2021, Updated Study Report (USR) for the Racine Hydroelectric Project (Federal Energy Regulatory Commission [FERC; Commission] No. 2570; Project), and the USR Meeting Summary filed by American Electric Power Generation Resources Inc. (AEPGR; Licensee) on June 11, 2021. Pursuant to 18 CFR §5.15, the Service provides the following comments.

<u>General Note</u>

Mean sea level (msl) is often used as an elevation reference for the Racine Project and in the USR. This is a periodically updated tidal datum that should not be confused with a vertical geodetic datum. Continued use of msl may contribute to significant measurement, reporting, and construction errors over time. The Service recommends conversion to, and adoption of, the North American Vertical Datum of 1988 (NAVD 88), which has been adopted by the National Oceanic and Atmospheric Administration (NOAA) and the Federal Emergency Management Agency (FEMA), and is the basis for the U.S. Geological Survey's (USGS) primary elevation data product, the National Elevation Dataset (NED).

<u>Recreation</u>

USR Status and Summaries of Studies, Recreation Study, 2.2.2, Summary of Study Methods and Results: AEPGR states that an online Visitor Use Survey will be made available in June 2021 and remain in place through the end of October 2021. As of July 8, the online Visitor Use Survey does not yet appear to be available at the provided URL: www.aephydro.com/HydroPlant/Racine

Fisheries Surveys

USR Status and Summaries of Studies, 2.5.2, Fisheries Surveys, Summary of Study Methods and Results, bottom of page 10: It is understandable that COVID-19 restrictions prevented surveying prior to the end of May 2020; however, the Service questions the statement that high flows also contributed to the late start. Based on dam Tainter gate opening and tailwater elevation data for the months of April and May (Figure 1), it appears there were other windows prior to the end of May when river flow was low and the surveys could have been completed. According to the U.S. Army Corps of Engineers (USACE; Corps), the total gate opening (i.e., across all Tainter gates) is the variable that they track for correlation with river flow (i.e., greater total gate opening = more spill associated with higher river flow). For example, on May 22, 2020, the total gate opening was 112 feet, corresponding with a high flow event, and tailwater was also elevated, whereas, at the time of the fisheries surveys on May 27 and May 28, total gate opening ranged between 15 and 27 feet, and the tailwater elevation was lower, reflecting lower flow conditions more conducive to conducting the surveys. During the period May 14-19, when it appears there was an earlier opportunity to conduct the surveys due to low flow conditions, the total gate opening ranged between 14 and 28 feet. As illustrated in Figure 1, there were additional opportunities, prior to the end of May, when the fisheries surveys could have been completed, so high flow should not have been cited as a contributing factor.

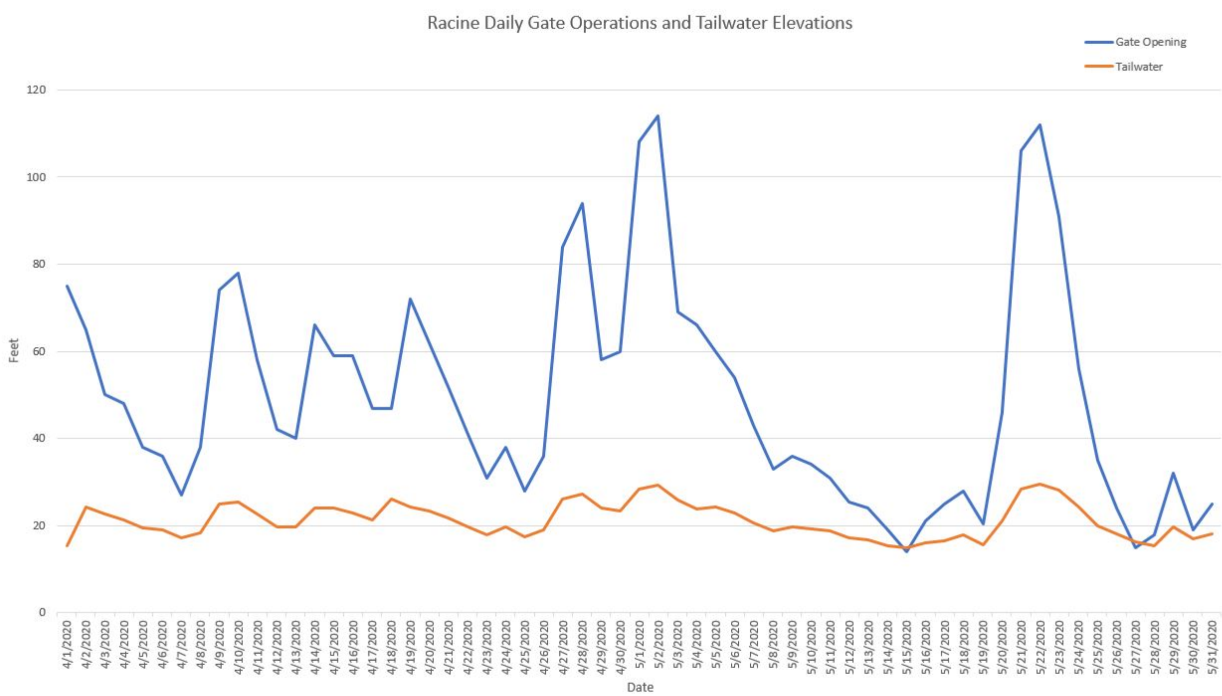

Figure 1. Total Racine Dam Tainter Gate Opening, and Tailwater Elevation, April 1-May 31, 2020. EnviroScience's 2020 spring fisheries surveys in support of the Racine Project relicensing were conducted on May 27 and 28, when total gate opening and tailwater were low, reflecting a low amount of spill corresponding with relatively low river flow. Tailwater elevation is represented by the lower gage reading (e.g., a gage reading of 20 feet = a Tailwater elevation of 546 ft msl).

USR Status and Summaries of Studies, 2.5.2, Fisheries Survey, Summary of Study Methods and Results, page 13: Is additional information available regarding how much of the 65 gallons-per-minute (gpm) was diverted to the base of the eel ramp via the attached gutter when this adjustment was made on August 3, 2020? If so, please provide this information.

USR Status and Summaries of Studies, 2.5.2.1.1, Fisheries Survey, Table 2-1, Water Quality Summary: Please correct the water temperature values for 5/27/20 and 5/28/20. The column heading for these values indicates units are in degrees Celsius, but the values for these dates are much too high to be degrees Celsius readings. The Celsius (C) values for these dates should be 19.4 and 20.2, respectively. As AEPGR has previously stated, the spring surveys started late due to safety concerns and travel restrictions related to COVID-19. The water temperatures were above the maximum threshold (10 degrees C [50 degrees Fahrenheit; F]) specified by the resource agencies for successfully documenting or estimating relative abundance of certain species (e.g., yellow perch).

USR Status and Summaries of Studies, 2.5.2.1.2, Fisheries Survey: The Service appreciates EnviroScience's adherence to the trawl survey methodology to reduce freshwater mussel bycatch. It is unclear whether this methodology may have affected survey results, but the fall trawl survey collected substantially fewer species compared to previous trawl surveys conducted by the Ohio Department of Natural Resources (ODNR), each of which collected more than a dozen species, including rare species not collected in Ohio River Valley Water Sanitation Commission (ORSANCO) electrofishing surveys (see below).

USR Status and Summaries of Studies, 2.5.3, Fisheries Survey, Variances from FERC-Approved Study Plan: As discussed in this section, the Commission's Study Plan Determination (SPD) was not issued until May 13, 2019, and, because water temperature had already risen well above the optimal range defined by the Service and the West Virginia Division of Natural Resources (WVDNR) for conducting the spring fisheries surveys, the decision was made to postpone the spring surveys until 2020. The Service's believes that Integrated Licensing Process schedules should anticipate the typical timing of study seasons, and be adjusted to avoid this kind of problem. Many milestones in the schedule for this Project were not timed appropriately, putting the resource agencies at a disadvantage and negatively impacting the conduct of studies.

Appendix B, Fisheries Survey Report, Executive Summary, page iv, last paragraph: The statement that fish assemblage data (from the relicensing surveys), including species richness and relative abundance, was comparable to species richness and relative abundance data ORSANCO collected from 2010-2018 is accurate if comparing to a single, typical ORSANCO electrofishing survey; however, the ORSANCO surveys and ODNR's mini-trawl surveys (included in ORSANCO data) documented more than 60 species total across all surveys during that time period. The EnviroScience electrofishing survey results were typical when compared to a single ORSANCO electrofishing survey, but documented fewer than half of the species known to occur in the Project vicinity.

The results of the licensee's fall trawl sampling indicated very few species, although results may be, in part, a function of habitat quality due to dam proximity. Only two common species, channel catfish and freshwater drum, were collected, and only upstream (no species collected downstream), whereas two mini trawl surveys of the Racine Pool (River Miles 204 and 208), conducted by ODNR in the fall of 2012, collected 18 species and 13 species, respectively, including several rare species: warmouth (*Lepomis gulosus;* S1/Critically Imperiled in WV), bluebreast darter (*Etheostoma camurum;* S2/Imperiled in OH; host for the federally listed endangered northern riffleshell, *Epioblasma torulosa rangiana*), channel darter (*Percina copelandi;* WV and OH Imperiled; listed as Threatened in OH), slenderhead darter (*Percina phoxocephala;* S1/Critically Imperiled in WV), and river darter (*Percina shumardi;* S1/Critically Imperiled in WV; Threatened in OH). In addition, while downstream trawling in the RC Byrd Pool did not collect any fish, a 2012 fall mini trawl survey conducted by ODNR immediately downstream (RM 238) yielded 15 species, including three of the above rare species, as well as the Tippecanoe darter (*Etheostoma tippecanoe;* Threatened in OH; S2/Imperiled in WV).

In addition, the WV imperiled (S2) banded killifish (*Fundulus diaphanous*) was documented in ORSANCO surveys (both upstream and downstream of the Racine Project), as were the orangespotted sunfish (*Lepomis humilis;* S1 in WV), silver lamprey (*Ichthyomyzon unicuspis;* WV S2S3; upstream only), and bullhead minnow (*Pimephales vigilax;* S2 in WV; upstream only).

The relicensing surveys did find one species that was not found in any of the 2010-2018 ORSANCO or ODNR Racine Pool surveys, river shiner (*Notropis blennius*), although this species has been commonly collected by ORSANCO in other Ohio River pools.

Compared to the other studies referenced above, the licensee's fall trawl sampling yielded a greatly reduced diversity of fish species, and none of the rare species previously documented in the area.

Appendix B, Fisheries Study, Section 2.2, Schedule: The optimal temperature range for conducting surveys is erroneously stated as "40 – 50ºC." This optimal temperature range of 40 – 50 degrees should be expressed in degrees Fahrenheit. Otherwise, the optimal range in Celsius is 4.4 – 10 degrees. Due to a delay related to COVID-19 safety concerns and travel restrictions, the spring surveys were not conducted within the temperature range defined by the Service and WVDNR. Instead, the surveys were conducted when water temperature was between 19.4 and 20.2 degrees C (66.9-68.4 degrees F), well above the range requested by the agencies.

Appendix B, Fisheries Study, 2.9.1, Fisheries Survey Deviations: This section should also discuss the fact that the surveys (electrofishing and trawling) were not conducted within the optimal temperature range of 4.4-10 degrees C (40-50 degrees F) defined by the Service and WVDNR and required by the FERC Study Plan Determination (SPD).

Appendix B, Fisheries Study, 3.1, Fall Fish Survey: Why are gage heights from the RC Byrd Lock and Dam, more than 40 miles downstream of the Racine Project, provided here? There are upstream and downstream gages at the Racine Locks and Dam, and readings from these gages would be much more informative regarding flows at the Project during these surveys. Based on data from the Racine gages for November 11-13, 2019, the Racine Pool elevation ranged between 560.54 feet and 561.17 feet, while the lower pool (tailwater) elevation ranged between 540.49 feet and 541.20 feet during the fall surveys. The total gate opening on the dam ranged from 1 foot to 6.25 feet, indicating relatively low flow conditions during the surveys.

Appendix B, Fisheries Study, 3.2, Spring 2020 Sampling Results: Gage heights from the RC Byrd Lock and Dam are also provided for the spring fisheries surveys. Gage data from immediately upstream and downstream of the Racine Locks and Dam are available and much more informative for evaluating the spring survey results. On May 27 and 28, 2020, the Racine Pool elevation ranged between 560.60 feet and 561.33 feet, and the tailwater elevation ranged between 540.99 feet and 544.19 feet. The total gate opening ranged between 15 feet and 27 feet, indicating that flows were relatively low, but somewhat higher during the spring surveys than they were during the fall 2019 surveys, as would be expected. As previously stated and as shown in Figure 1, there were favorable flow conditions earlier in the spring when water temperatures would have been within or closer to the optimal range for conducting the surveys. However, the Service understands that safety concerns and travel restrictions related to COVID-19 were the primary drivers of the late start of these surveys.

Appendix B, Fisheries Study, 4.0, Discussion: There is a statement in this section that silver chub (*Macrhybopsis storeriana*) was one of two species found during the relicensing surveys but not in 2010-2018 ORSANCO surveys. However, the ORSANCO database for this time period does include records of this species' collection during an ORSANCO electrofishing survey of the Racine Pool on August 2, 2010. This error should also be corrected in Table 4.1. This species was also documented in the RC Byrd Pool during a July 30, 2013, ORSANCO electrofishing survey, although it was collected at river mile 261, well downstream of the Racine Locks and Dam. As previously discussed, the ORSANCO surveys and trawl surveys conducted by ODNR resulted in more than 60 species being documented in the Racine Pool for the 2010-2018 time period.

Regarding the minimal collection of darter species during the relicensing surveys, the Service agrees this may have been related to limited suitable habitat for darters in the Project vicinity. However, it may also have been related to survey methodology, as Racine Pool and RC Byrd Pool records for several darter species are included in the ORSANCO database for the 2010-2018 time period. Those records were primarily from ODNR trawl surveys.

<u>American Eel</u>

Appendix B, Fisheries Study, Section 2.8, American Eel Survey: This section states that EnviroScience and HDR designed and constructed a temporary eel ramp per the specifications recommended by WVDNR and the Service. However, the flow to the ramp was not initially split between the top of the ramp and the base of the ramp to meet the water depth criterion on the sloped portion of the ramp, while also providing sufficient attraction flow to the base of the ramp. The recommendations provided to EnviroScience, HDR and AEPGR on July 1, 2019, included a detailed illustration from the Service's criteria manual, clearly showing this division of flow. Photos of the ramp provided by AEPGR also did not show a sprayer (e.g., sprayer manifold) for evenly distributing flow at the top of the ramp. This specification is also identified in the criteria manual illustration.

EnviroScience states that the ramp was installed on the downstream side of the dam to be in place during the American eel migration. However, the ramp was not installed and operational until more than 30 days after the water temperature trigger was reached for starting the survey. The Service understands that this was at least partly related to COVID-19 safety concerns and travel restrictions, but the late start should be noted. Per the SPD, the study was to commence when water temperature reached 15 degrees C (59 degrees F). ORSANCO water temperature data are missing for the beginning of May, but water temperature had already reached 20 degrees C (68 degrees F) as of May 13, 2020. The eel ramp operation was to continue until water temperatures dropped to 10 degrees C (50 degrees F), but the ramp was disassembled on October 7, at which time water temperature was 20.7 degrees C (69.2 degrees F). Lastly, because the Project was not discharging during a significant portion of August and early September, the study's effectiveness was likely reduced during that portion of the migration season, due to lack of sufficient attraction flow (i.e., far-field attraction) to the side of the river where the eel ramp was located.

USR Meeting Summary, Variances from FERC-approved Study Plan; USR Status and Summaries of Studies, 2.5.3, Fisheries Survey, Variances from FERC-Approved Study Plan; and Appendix B, Fisheries Study, 2.9.2, American Eel Survey Deviations: Specific variances from the SPD or deviations from Service recommendations that were not sufficiently addressed in the USR or the USR Meeting Summary include (1) the eel ramp operation began more than 30 days after water temperature had reached the trigger for beginning the survey; (2) the eel ramp study was ended before the water temperature trigger was reached for ending the study; (3) the water depth on the sloped portions of the ramp was well above the Service's criterion of 1/16 inch to 1/8 inch for approximately 40 days of the 77 total days of operation[1]; (4) the Project was not generating for a significant portion of the latter half of the study, and therefore was not providing a far-field attraction flow to the powerhouse side of the river where the ramp was located; and (5) the fall electrofishing surveys were not preceded by a period of elevated river flow.

According to the SPD, at a minimum, downstream electrofishing targeting American eel was to be conducted during evening/night-time hours, after periods of elevated river discharge, to coincide with periods of peak upstream eel migration. The spring electrofishing surveys were conducted May 27-28, 2020. The surveys were conducted at night, beginning just after dusk, in conformance with the SPD. In addition, these surveys were conducted following a period of elevated river discharge (Figure 1), also in conformance with the SPD. The fall electrofishing surveys downstream of the Project were conducted November 11-13, 2019. These surveys were also conducted at night. However, there was no period of elevated river discharge prior to the

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[1] The American Eel Study Plan (Appendix A of Fisheries Study Report) acknowledges this criterion, stating that "the ramp surface will remain wetted at all times and approximately 0.0625-inches to 0.125-inches of water will be maintained by pumping water down the length of the ramp…"

conduct of the fall electrofishing surveys. Over a 5-day span preceding the fall surveys, the tailwater elevation remained below 542 feet (lower gage reading < 16 ft), and the total gate opening did not exceed 8 feet (Figure 2), indicating there was no period of elevated discharge immediately preceding the fall surveys. The SPD also specified that the study should include a spring, summer, and fall American eel-targeted electrofishing survey (as site safety conditions allow). The downstream electrofishing surveys covered only two short time periods and were not American eel-targeted surveys, although the surveys were conducted along both shorelines.

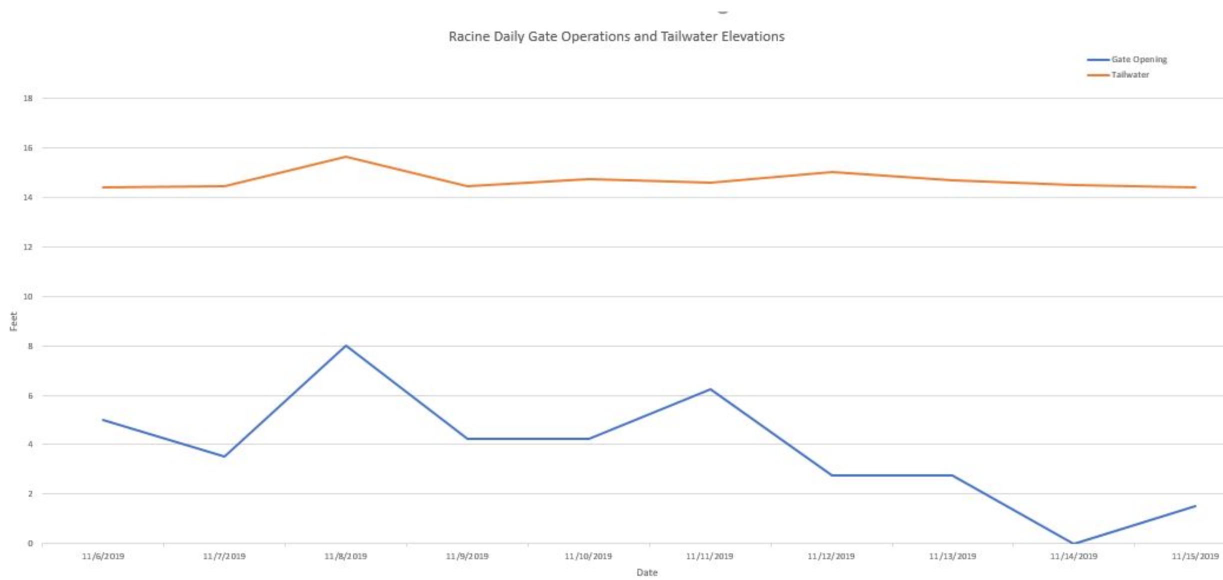

Figure 2. Total Racine Dam Tainter Gate Opening, and Tailwater Elevation, November 6-15, 2019. EnviroScience's 2019 fall fisheries surveys in support of the Racine Project relicensing were conducted November 11-13, 2019. Total gate opening and tailwater were low during the 5 days preceding the surveys, reflecting a low amount of spill corresponding with relatively low river flow. Tailwater elevation is represented by the lower gage reading (e.g., a gage reading of 15 feet = a Tailwater elevation of 541 ft msl).

The Service previously commented on the licensee's March 2020 "Temporary Upstream American Eel Ramp Design and Methodology" (methodology). In that methodology (Section 4.1, Ramp Construction), the licensee stated that "the ramp surface will remain wetted by pumping water down the full length of the ramp with a flow of approximately 50 gallons per minute (gpm)." The Service did not comment that this amount of flow (or the 65 gpm recommended by the Service) should not be introduced at the top of the ramp and that, instead, only enough flow to maintain a wetted surface with a water depth of 1/16 in to 1/8 in should be provided at the top of the ramp, with the balance of the flow going to the base of the ramp for attraction flow. However, the Service previously provided detailed recommendations (July 1, 2019, email to Dave Czayka, EnviroScience; AEPGR representatives copied), including an excerpt from the Service's Fish Passage Engineering Design Criteria manual (USFWS 2019; criteria manual) with the criterion for water depth (above).

The Service's July 1, 2019, recommendations included a detailed illustration from the criteria manual, showing a split in the flow, with a portion of the flow delivered to the top of the ramp and the rest of the flow delivered to the base of the ramp for attraction. Based on ramp photos provided by AEPGR, it also appears that a sprayer manifold may not have been used to evenly distribute water at the top of the ramp. The Service's recommendations also provided the full citation for the criteria manual which, when entered into a search engine, brings up the downloadable pdf of the criteria manual. The excessive amount of flow to the top of the ramp could have been avoided. The Service did not catch this mistake when we reviewed the March 2020 proposed methodology, and we were not consulted during ramp construction. It was not until the Service inquired about the ramp on July 7, 2020, that photos and a short video were provided (on July 8) by AEPGR.

In an October 2, 2020, filed "Response to Determination on Requests for Study Modifications," AEPGR stated that the Project's generating units were offline for maintenance for an extended period of time during August and early September, 2020. The Service considers this another variance from the requirements of the SPD. The Commission stated in the SPD that flow releases from the Project also have the potential to affect upstream migrating eels by creating a source of false attraction flows, guiding them away from the Corps' locks on the west side of the dam, or other available means of upstream migration, thereby potentially impeding or delaying their upstream migration. The Project was not generating during a significant portion of the latter half of the eel ramp study, which reduced the potential for eels to be attracted to the powerhouse side of the river where the eel ramp was located.

The Service appreciates the effort on the part of the licensee and their consultants, especially under the circumstances of the pandemic, but the conduct of this study (late start, early finish, incorrect flow to the ramp at the start of the study, no Project discharge during a significant portion of the study), and the vandalism to the ramp all contributed to limited potential for success. Regarding the vandalism, the USR states that on June 22, 2020, EnviroScience discovered that the anchors on the last section of the ramp had been cut and a section of the ramp was separated from the rest of the ramp. The Service would appreciate more details regarding how this section of the ramp was anchored. The ramp sections appeared to be attached to one another using flashing tape. Was this the only method used for joining the ramp sections together? The siting of the ramp was also constrained by site-specific issues, resulting in the ramp being installed in a less-than-optimal location for attracting eels. Due to these siting constraints and the potential for vandalism, the Service is not requesting a repeat of this study. However, considering the shortcomings of this study, the Service considers the study insufficient for arriving at informed conclusions as to whether eels are congregating below the Project and searching for a reliable upstream route of passage when the Project is discharging a false attraction flow.

The USR understandably does not include any discussion of targeted surveys for adult (silver phase) eels during their downstream spawning migrations because such surveys were not required by the FERC SPD. The Service and the licensee also could not identify or agree on methods that would have a high likelihood of success. As previously stated, the Service has determined that electrofishing surveys and trawl surveys are not very effective for collecting eels on large river systems where eels are not abundant. Based on conversations with ORSANCO, it is our understanding that eels are generally under-represented, compared to their relative abundance, in Ohio River electrofishing surveys. Both the Service and WVDNR requested the use of hydroacoustic (e.g., DIDSON) monitoring of the Racine Pool upstream of the Project intake. Eels would be easily identifiable using this approach, which also would have provided valuable data for the entrainment study. However, this method was determined to be too expensive, despite its use in other FERC relicensing studies, and the request was denied.

In their SPD, the Commission did recognize the possible need for additional American eel studies in the Racine Pool if sufficient data were not collected to satisfactorily estimate American eel entrainment, impingement, and turbine mortality at the project. The Commission stated that AEPGR may need to supplement existing desktop entrainment databases with additional studies upstream of the project that focus on American eels. The Commission further stated that the licensee should evaluate the need for additional data or studies on American eel after completing the SPD-approved studies. This issue was to be addressed in the Initial Study Report (ISR); however, due to study delays, the fisheries studies were not completed until after the ISR was filed.

Appendix B, Fisheries Study, 4.0, Discussion: Regarding the conclusion that the American eel appears to be rare in the vicinity of the Project, (based on only one record in the 2010-2018 Racine and RC Byrd pools ORSANCO data and no records from the eel ramp monitoring portion of the relicensing study), as the Service has previously noted, this species is generally under-represented in fisheries surveys, compared to its actual relative abundance. Furthermore, the eel ramp was not installed in an ideal location for collecting eels that may approach the Project dam, and there was no far-field attraction flow due to a powerhouse maintenance shutdown during part of the study. Siting the ramp approximately 250 meters (820 feet) downstream of the Project, along the shoreline, may have produced better results, but this location was determined to be impractical in terms of providing attraction flow and flow to the ramp. This location may also have been more difficult to monitor and protect from vandalism. Although records from electrofishing surveys are limited, anglers continue to report catches of this species from the Ohio River and its tributaries, including as far upstream as Morgantown, West Virginia, from the Monongahela River, a major Ohio River tributary.

The ODNR received an American eel angler report in May of 2021, from immediately downstream of the Pike Island Locks and Dam (Pike Island). The Service contacted the angler who provided photo documentation of the eel which, based on the photo, appeared to be an upstream migrating (yellow/immature) eel approximately 20 inches (508 mm) long. Pike Island is 153 miles upstream of the Racine Project, with three hydroelectric projects (at Corps locks and dams) in between. The many hydroelectric projects on the Ohio River likely injure or kill some of the sexually mature silver eels during their downstream migration, contributing to the species' continuing scarcity. Cumulative turbine mortality, which refers to the estimated combined turbine mortality within a watershed, is thought to cause significant reductions in a watershed's reproductive contribution to the eel population, and this is true even when survival rates of eel passage are relatively high through each successive turbine on a river system (Gomez and Sullivan 2012). For example, if survival of downstream migrating American eels passing through project turbines is determined to be 90 percent at each of the 10 currently operating hydropower projects on the Ohio River, this would theoretically result in a cumulative survival rate of only 35 percent (0.9^{10}).

Entrainment and Impingement

USR Status and Summaries of Studies, Fish Entrainment and Impingement Study, 2.6.2.5.1, Trashrack Exclusion and Intake Avoidance; and Appendix C, Fish Entrainment and Impingement Study Report, 5.3.2, Trashrack Exclusion and Intake Avoidance: Please explain the following statement: "Burst swim speed data were compiled from the literature, however if data for a specific species or group was not directly available, it was calculated as 2x critical swim speed based on Bell (1991)." Specifically, to what does "critical swim speed" refer? Bell (1991) does not use this terminology, but instead defines three different swim speed categories: (1) cruising speed, (2) sustained speed, and (3) darting speed.

The maximum powerhouse intake approach velocity of 4.3 feet per second (fps) is well above the Service's recommendation that intake approach velocity should not exceed 2 fps, 1 foot upstream of the trashrack (USFWS 2019), to prevent unacceptable levels of fish entrainment.

USR Status and Summaries of Studies, 2.6.2.5.2, Impingement Assessment; and Appendix C, Fish Entrainment and Impingement Study Report, 5.3.3, Impingement Assessment: The Service does not agree that there would be no impingement at the Project. Given the high velocities at the intake, especially during maximum generation, fish may become laterally impinged while trying to escape entrainment. Fish will not always be longitudinally oriented (i.e., parallel to flow), especially if they feel the increasing velocity at the intake and attempt to escape entrainment. In such situations, fish may attempt to turn away from the trash rack and become impinged while oriented perpendicular to the flow.

There is also no discussion regarding velocity calculations for the impingement part of the study. Was open/through-screen velocity calculated? While approach velocity (e.g., 1 foot upstream of the trash racks) may be the primary driver for impingement, through-screen velocity may relate to how difficult it is for a fish to remove itself from a screen once impinged (EPRI 2000).

USR Status and Summaries of Studies, 2.6.2.5.5, Turbine Mortality and Estimated Survival of Target Species: The Service disagrees with the statement that the Project's turbine speed (160 revolutions per minute [rpm]) is slow. This turbine speed is moderate for a Kaplan turbine, compared to Kaplan turbines at other projects (e.g., turbine speeds as low as 54.5 rpm), and provides an extremely limited time window for fish to safely pass the rotating turbine without being struck by a blade. This turbine speed may also be sufficient to cause barometric pressure changes as fish pass the rotating blades, potentially resulting in barotrauma to some species (e.g., species with swim bladders), as further discussed later in these comments.

Regarding the statement that the potential for American eel entrainment is during their downstream migration in the fall, it should be noted that sexually mature eels do not undertake their downstream migrations only in the fall, although the fall may be the season when peak downstream migration occurs in most river systems. The timing of this peak may vary from year to year or by watershed, and is also water temperature-dependent. In a Shenandoah River study, American eels moved downstream past dams in every month of the year except July, and peak migration time differed for each of the 3 study years (Eyler et al. 2016). Because downstream migration of this species in the Ohio River has not been studied, the assumption that all downstream eel migration is in the fall may have resulted in an underestimate of eel entrainment impacts at Racine.

Appendix C, Fish Entrainment and Impingement Study Report, 4.3.1, Assessment of Impingement Potential at the Intake: As stated in this section, the Project's intake has trash racks with a clear bar spacing of 6.125 inches. The Service's fish passage engineering criteria call for a 0.75-inch clear spacing where American eel is present (USFWS 2019), to prevent entrainment of this species, which shows a higher susceptibility to turbine-induced injury or mortality than most other species. However, as stated elsewhere in the USR, the velocity measured 1 foot upstream of the intake (at maximum Project generation) exceeds 4 fps. According to the Service's criteria, normal velocities, measured 1 foot upstream of the intake, should not exceed 2 fps. While the clear spacing of the bars on the trash racks greatly exceeds the Service's criterion for preventing entrainment, the Service's criterion for velocity in front of the intake is also greatly exceeded at this project; therefore, the wide bar spacing likely prevents substantial impingement of fish against the Project's trash racks.

Appendix C, Fish Entrainment and Impingement Study Report, 4.3.3, Monthly Turbine Entrainment Rate Calculation: The Service questions AEPGR's adjustment to the data to account for cold stress of clupeids. AEPGR reduced estimated entrainment rates for gizzard shad (*Dorosoma cepedianum*) and skipjack herring (*Alosa chrysochloris*) by 94.4 percent in the winter, 6.1 percent in the fall, and 20.6 percent in the spring, based on the percentage of time that water temperature is expected to be below 8 degrees C (critical water temperature), because they consider any mortality related to entrainment of cold-shocked clupeids to not be the result of project operations. In a laboratory experiment using gizzard and threadfin shad (*Dorosoma petenense*) collected from the Clinch River in Tennessee, loss of equilibrium (LOE) for threadfin shad occurred at 7.2 degrees C and for gizzard shad at less than 3.5 degrees C (Fost 2006). Both species exhibited reduced swimming performance at temperatures slightly above the LOE temperature threshold. A conclusion of the study was that threadfin shad and gizzard shad are susceptible to impingement [or entrainment] before moribundity occurs (Fost 2006).

Based on these findings, it is an erroneous assumption that when water temperature drops below 8 degrees C, clupeids become moribund. On the contrary, this study and other recent research indicates that clupeids experience loss of equilibrium and reduced swimming performance at temperatures below 8 degrees C, but are not necessarily moribund. Fish in this non-moribund state of reduced equilibrium and swimming performance would be unable to escape entrainment, and would be susceptible to turbine-induced injury or mortality at the Project. In such cases, Project operation would be the cause of the injury or mortality.

USR Meeting response regarding whether barotrauma was considered; Appendix C, Fish Entrainment and Impingement Study Report, 4.3.4, Turbine Blade Strike Evaluation: Causes of injury and mortality other than from turbine blade strikes (e.g., extreme pressure changes) were briefly discussed, but there is no indication that factors other than blade strike were included in this study. Computational Fluid Dynamics (CFD) modeling (Keller et al. 2006) and field studies (Carlson et al. 2008) have shown that fish passing through turbines are subject to mild compression at the turbine intake, followed by sudden decompression in the short period of travel from the stay vanes and wicket gates past the suction side of the runner blades (*In* Richmond et al. 2015). Brown et al. (2012) found that injuries during decompression are caused by swim bladder expansion and rupture, or by gas bubble formation in blood (*emboli*) (*In* Richmond et al. 2015). Bluegills (*Lepomis macrochirus*), and presumably most physoclistous fish species, those with no connection between swim bladder and digestive tract (e.g., percines), are extremely susceptible to swim bladder rupture when exposed to sudden pressure change during turbine passage (Abernethy et al. 2000).

In a study of pressure changes simulating passage through a Kaplan turbine under a "fish-friendly" mode of operation, both rapid pressure change in test fish (turbine passage pressure spike) and gradual change in control fish (depth-acclimated fish returned to surface pressures) resulted in significant injury rates for bluegills (Abernethy et al. 2002) . Injury and mortality rates for bluegills were higher if they had first been acclimated to water pressures equivalent to 30 feet of depth (Abernethy et al. 2002). The maximum depth in front of the Racine intake is approximately 65 feet.

Appendix C, Fish Entrainment and Impingement Study Report, 5.2.2, Intake Specifications: Section 4.3.1 indicates a 6.125-inch "clear bar spacing," whereas this section states that the bar spacing is 6.125 inches "center-to-center." These are conflicting statements. A center-to-center spacing of 6.125 inches would equate to a clear bar spacing that is less than 6.125 inches. Please clarify.

Appendix C, Fish Entrainment and Impingement Study Report, 5.2.3, Intake Flows: Why were gage data from the Greenup Dam evaluated in order to determine the number of days per year that river flows exceeded the maximum threshold for Project operation? The Greenup Dam is more than 103 miles downstream of the Racine Project, and there are numerous tributaries and a substantial amount of additional watershed between the Racine and Greenup dams. Were these flow data prorated, based on differences in drainage area? If not, the calculated average number of days (26) per year that river flows exceeded the maximum threshold for Project operation is likely an overestimate (i.e., the Project may be able to operate on more days than this evaluation suggests). The drainage area above the Racine Project has been estimated to be 40,104 to 40,130 square miles, while the drainage area above the Greenup Project, according to USGS gage at the Greenup Dam (Gage #03216600), is 62,000 square miles, approximately 55% larger than the Racine drainage area. If the Greenup data were not prorated to account for this difference, entrainment impacts are likely underestimated.

USR Meeting Summary, 2.3, Fish Entrainment and Impingement Study, and USR Appendix C, Fish Entrainment and Impingement Study Report, 5.2.4: Based on the information provided, the calculated approach velocity was based on intake dimensions of 21 feet (W) x 88 feet (H). However, only approximately 65 feet of the 88-foot-high intake is submerged at a normal Racine Pool elevation of 560 feet above msl. How would this affect the velocity calculation? It appears this may not have been taken into account, and could result in an underestimate of intake velocity at maximum Project generation. If this is the case, the maximum intake velocity may be higher than 4.3 fps, and this entrainment evaluation may have underestimated overall entrainment rates.

To calculate intake velocities, calibrated CFD models work best, followed by field measurements. At a minimum, a 1-dimensional (1-D) analysis should be used to calculate normal flow (i.e., approach flow perpendicular to the intake). We recognize that 2-D modeling was completed by GEI Consultants, Inc. in 2017, as referenced in the USR regarding velocities a short distance away from the influence of the intake, but the USR does not indicate that the 2-D modeling was used to calculate intake velocity or that it was of a fine enough resolution for that purpose. Based on the limited amount of information provided in the USR, it appears that the intake velocity was calculated using intake dimensions. Open velocity (aka impingement velocity or through-screen velocity) should also be calculated; this is also a 1-D exercise but must be based on accurate drawings so that it accounts for structural steel. The Service requests more details regarding how intake velocities were determined, and the associated calculations.

The licensee points out that velocity of the river in the vicinity of the Project, while often lower than that estimated in front of the intake, can sometimes be as high as approximately 6 fps, and it is further stated that fish species and life stages with swim speeds capable of overcoming such velocities would be able to avoid the approach velocity of the intake. However, when river flow reaches these high velocities, most species and life stages with sustained swim speeds below 6.0 fps will likely avoid these high velocity flows by seeking out eddies or benthic structure where bed roughness provides reduced velocities. In addition, the licensee noted that velocities in areas that were 20 feet away from the intake were lower, ranging from 2.0 to 4.0 fps, based on velocity modeling performed in 2017 for AEPGR by GEI. This difference may result in fish being attracted to the powerhouse intake or becoming entrained in this higher flow when they are in the vicinity of the intake, and weaker swimming species and life stages that are unable to escape this flow will become entrained in the powerhouse. It should be noted that the GEI modeling report describes the intake dimensions as “21.75 ft-wide by 60-ft-high.”

There does not appear to be any discussion in the entrainment analysis regarding downstream migrating fish that may be attracted to the Project intake and voluntarily enter the intake. Based on life history information and time of year, did this study consider this behavior? It appears that the study included an assumption that all fish that are capable of escaping the Project intake will actively avoid entrainment. This may not be the case for all species or life stages.

The Service has many concerns regarding this entrainment and impingement study. Despite requests by both the Service and WVDNR, there was no infield verification (e.g., hydroacoustic monitoring; use of a sensor fish; balloon-tag study). Fish population and relative abundance data specific to the Racine Project area were not representative of the fish community across all seasons (e.g., “spring” survey conducted at summer water temperatures). The study assumed moribund condition of clupeids at water temperature < 8 degrees C, which has been refuted by recent research. The Greenup Project (> 103 miles downstream) data were used for determining when river flows prevented the Project from operating, possibly resulting in an underestimate of entrainment (unless the drainage area was prorated to account for the significant difference in drainage area). It appears that the full height of the intake (instead of the submerged height) may have been used to calculate intake velocity. If this was the case, intake velocity may have been underestimated, which would result in underestimates of entrainment rates. The study assumed no impingement impacts, based solely on the spacing between the trashrack bars. The potential for injury or mortality from barotrauma was not considered. American eel were assumed to undertake their downstream spawning migrations only in the fall months. Based on the many assumptions and unanswered questions related to this study, the Service has little confidence in the study's results and conclusions.

Despite these concerns, the estimated annual entrainment numbers for important freshwater mussel hosts (e.g., sauger, *Sander canadensis;* skipjack herring) are high, and may be higher, depending on the validity of these concerns. The high entrainment rates estimated for sauger are particularly troubling, considering this species is the only known natural host for the federally listed endangered sheepnose mussel (*Plethobasus cyphyus*), a species that has been documented a short distance downstream from the RC Byrd Dam, the next downstream Project below Racine.

Due to the lack of studies specifically targeting downstream migrating American eels, the actual relative abundance of adult eels remains undetermined. However, as previously discussed, cumulative turbine mortality is thought to cause significant reductions in a watershed's reproductive contribution to the eel population. The Racine Project is one of ten hydroelectric projects currently operating on the Ohio River, with additional projects operating on the Allegheny River and other tributaries. There are also many (> 10) additional licensed but unbuilt projects, some of which will soon be starting construction. Failure to address cumulative entrainment impacts to this species will ensure its continued scarcity in the Ohio River. Due to the inherently hazardous nature of hydroelectric turbines, the Service does not recognize passage through turbine intakes as an acceptable downstream route for fish (USFWS 2019).

Thank you for your consideration in this matter. If you have any questions, please contact Richard McCorkle at richard_mccorkle@fws.gov.

Sincerely,

Sonja Jahrsdoerfer

Sonja Jahrsdoerfer
Project Leader

cc: WVDNR, Jacob Harrell
ODNR, Michael Greenlee
USACE, Andrew Johnson
USFWS, Ohio Field Office, Patrice Ashfield
USFWS, West Virginia Field Office, Jennifer Norris

References:

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Stephen S. McDaniel
Director

July 16, 2021

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

RE: Racine Hydroelectric Project (FERC no. P-2570); Updated Study Report Comments

Dear Secretary Bose:

Thank you for allowing the West Virginia Division of Natural Resources, Wildlife Resources Section (WRS) the opportunity to provide comments with regards to the Updated Study Report (USR) as submitted for the Racine Hydroelectric Project (FERC No. 2570). The WRS has reviewed the referenced report and offers the following comments for your consideration:

2.5 Fisheries Survey

The results of the trawl component of the fisheries survey are less than desirable. The capture of only two species of fish (channel catfish and freshwater drum) is not consistent with previous trawl surveys of the Ohio River and may indicate that errors had been made in the sampling procedure. It can be expected that a portion of the trawls would be empty, considering the nature of trawl surveys, but it is hard to believe that within a large riverine ecosystem, such as the Ohio River, two-thirds of the trawls would have no catches and of the one-third of trawls that did have a catch, only two of the most common species would be netted. There are a number of reasons that may have attributed to these results to include: trawl not making secure benthic contact, speed of the boat being too slow, etc. Additionally, due to the difficulty of trawl surveys, it may be preferred to sample more than six transects. As such, the WRS would request that the trawl component of the fisheries survey be reassessed. The WRS would be amenable to continued coordination with the surveying group and would additionally be able to offer training on the trawl methodology employed by the WRS.

2.6 Fish Entrainment and Impingement Study

The methodology incorporated within the desktop entrainment review is not consistent with typical desktop entrainment procedures. In particular, it is not an acceptable practice to use every project within the EPRI database as establishing likely fish entrainment rates. Most of the projects within the EPRI database would be considered to be incompatible with the operations at the Racine Project. Differences in turbine type, project size, trash rack spacing, and project fisheries contribute to this incompatibility. The practice of establishing likely fish entrainment rates using every project as a surrogate can potentially lead to inaccurate or misleading results of entrainment at the Racine Project. A preferred method would be to identify one or more projects that have similar trash rack spacing, incorporate similar turbine designs, and similar fish assemblages within the associated pools.

Cold shock/stress of Gizzard Shad leading to large die-offs in the winter has not been observed to occur at the Racine Project. Even still, the WRS acknowledges that Gizzard Shad may experience a level of torpor and reduced biological function when water temperatures decrease below 8° C; however, the primary cause of mortality in a Gizzard Shad passing through the turbine structures would be blade-strike and/or barotrauma. If there were no hydropower project at Racine, then Gizzard Shad would not be succumbing to entrainment, regardless of cold shock/stress. The WRS does not concur with the exclusion of Gizzard Shad from the entrainment estimations due to cold shock/stress.

The calculated approach velocity in front of the intake racks of 4.3 ft/sec exceeds the critical swim speed of most fish species present at the Project. Critical swim speed differs from burst swim speed in that the critical swim speed is the maximum likely swim speed that a fish can sustain for a period of time (approximately five minutes before failure) whereas burst swim speed refers to the maximum likely swim speed can be maintained for a few seconds. An approach velocity exceeding the critical swim speed can potentially generate more fatigue in fish and potentially lead to higher entrainment rates than what would be expected with lower approach velocities. It may be conceivable, then, that the number of fish entrained by the Project has been under-estimated through this desktop entrainment analysis.

The WRS has calculated blade-strike probabilities and mortality probabilities that differ significantly from what is reported within the USR. With 4 blades and a runner speed of 160 rotations per minute, the time needed to safely pass through the turbine structures can be calculated to be 0.09375 seconds. Fish greater than 10 inches in length would need more than .111882 seconds to safely pass through the turbine structures without being struck by a blade. It can be further calculated, then, that a fish exceeding 10 inches in total length is more than guaranteed to be struck by a blade. The provided desktop entrainment analysis had calculated relatively low blade strike probabilities with respect to body size than what would be expected or what the WRS had calculated. Additionally, this underestimation of the blade strike probability contributes to a likely underestimation of blade-strike mortality.

The WRS is currently evaluating other options regarding the fish entrainment and impingement study and would request continued consultation with the Racine Project and its partners in arriving at an acceptable entrainment analysis.

The WRS appreciates the opportunity to provide comments regarding the Updated Study Report for the Racine Project. If you have any questions or comments concerning this letter please contact me at (304)989-0208 or by email at jacob.d.harrell@wv.gov.

Sincerely Yours,

Jacob Harrell
Hydropower Coordination Biologist

Attachment B
Revised Fish Entrainment and Impingement Study Report

Hanson, Danielle

From: Quiggle, Robert
Sent: Tuesday, August 10, 2021 2:10 PM
To: Advisory Council on Historic Preservation; City of New Haven; City of Pomeroy (Mayor); ODNR Division of Wildlife; OH Rep Dist 94 - Jay Edwards; OHEPA; Ohio Department of Natural Resources; Ohio Department of Natural Resources; Ohio River Valley Water Sanitation Commission; Osage Nation; Osage Nation; Shawnee Tribe; SHPO; Steve Jenkins; Town of New Haven (Mayor); US Department of the Interior; US Environmental Protection Agency; USACE; USACE; Westlake, Kenneth; USEPA; USFWS; USFWS; USFWS; USGS; USGS; Village of Racine; Villgae of Middleport; West Virginia Division of Natural Resources; West Virginia Division of Natural Resources; West Virginia Division of Natural Resources; Bridgewater, Brian L
Cc: Jonathan M Magalski; Elizabeth B Parcell; Hanson, Danielle
Subject: Racine Hydroelectric Project (FERC No. 2570) -- Response to Comments on Updated Study Report

Racine Hydroelectric Project Stakeholders:

AEP Generation Resources Inc. (AEPGR), a unit of American Electric Power (AEP), is the licensee, owner and operator of the Racine Hydroelectric Project (FERC No. 2570) (Project) located on the Ohio River in Meigs County, Ohio. The Project is operated under a license issued by the Federal Energy Regulatory Commission (FERC). The existing FERC license for the Project expires on November 30, 2023. AEPGR is pursuing a new license for the continued operation of the Project in accordance with FERC's Integrated Licensing Process (ILP).

In accordance with the Commission's regulations at 18 C.F.R. § 5.15 and the Commission's May 13, 2019 Study Plan Determination (SPD), AEPGR filed the Updated Study Report (USR) with FERC on May 12, 2021. Additionally, AEPGR held an Updated Study Report Meeting (USR Meeting) with participants and FERC staff via Webex on May 25, 2021. The USR Meeting summary was filed with FERC on June 11, 2021. The deadline to submit any disputes or requests to amend studies was July 12, 2021. Comments were received from U.S. Fish and Wildlife Service (USFWS) and West Virginia Division of Natural Resources (WVDNR), dated June 12 and June 16, 2021, respectively. AEPGR filed responses to USFWS and WVDNR's comments on the USR on August 10, 2021.

On behalf of AEPGR, we are notifying stakeholders of the availability of the USR comment responses. The response to comments on the USR can be accessed from FERC's eLibrary at:
https://elibrary.ferc.gov/eLibrary/filelist?accession_num=20210810-5156.

Should you have any questions regarding this filing, please contact Jon Magalski with AEP at (614) 716-2240 or jmmagalski@aep.com.

Thank you,

Robert Quiggle, RPA
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Via Electronic Filing August 13, 2021

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

Subject: Racine Hydroelectric Project (FERC No. 2570-032)
Ninth Quarterly Study Progress Report

Dear Secretary Bose:

AEP Generation Resources Inc. (AEPGR), a unit of American Electric Power (AEP), hereby submits the Ninth Quarterly Study Progress Report for the Racine Hydroelectric Project (Project) (FERC No. 2570) relicensing.

AEPGR has elected to utilize the Integrated Licensing Process (ILP) for the relicensing of the Project as defined in 18 Code of Federal Regulations (C.F.R.) Part 5. As proposed in AEPGR's April 12, 2019 Revised Study Plan (RSP) and approved in the Federal Energy Regulatory Commission's (FERC or Commission) May 13, 2019 Study Plan Determination (SPD), AEPGR is hereby filing the Ninth Quarterly Study Progress Report for the Project. This progress report describes the activities performed since the previous progress report, as well as study activities generally expected to be conducted in quarter 3 (Q3) of 2021. Unless otherwise described, all relicensing studies are being conducted in conformance with the approved RSP and the Commission's SPD.

1. Water Quality Study

- Consistent with the study schedule approved by the Commission on October 15, 2020, AEPGR deployed water quality monitoring equipment on or around May 1, 2021. AEPGR continues to collect continuous water temperature and dissolved oxygen, and *in-situ* water quality data on a monthly basis and will do so through October 31, 2021.

2. Recreation Study

- Consistent with the study schedule approved by the Commission on October 15, 2020, AEPGR relaunched the online visitor use survey and redeployed the hardcopy survey form boxes at the tailrace fishing access site prior to June 1, 2021. Additionally, AEPGR redeployed trail cameras at the five locations listed in the RSP. Recreation data will be collected through October 31, 2021.

3. Cultural Resources Study

- The Cultural Resources Study has been completed in accordance with the RSP and the Commission's SPD. No additional activities are anticipated related to this study.

4. **Mussel Survey**

   - The Mussel Survey has been completed in accordance with the RSP and the Commission's SPD. No additional activities are anticipated related to this study.

5. **Fisheries Survey, Project Characteristics, and Project Operations Related to Potential Fish Passage**

   - The draft Fisheries Survey report was filed with the Updated Study Report (USR) on May 12, 2021. The results of the report were discussed at the USR Meeting on May 25, 2021.

6. **Fish Entrainment and Impingement Study**

   - The draft Fish Entrainment and Impingement Study report was filed with the USR on May 12, 2021. The results of the report were discussed at the USR Meeting on May 25, 2021. The draft Fish Entrainment and Impingement Study report was subsequently revised based on stakeholder comments and was filed on August 10, 2021 as Attachment B to AEPGR's Response to Comments on the USR.

7. **Eastern Spadefoot Toad Habitat Suitability Assessment**

   - A Presence/Absence field survey was conducted at the Project during July 1-2. Due to dry conditions in the Project area, no additional surveys have been completed since that time. Additional surveys will be conducted as suitable weather conditions allow.

8. **Updated Study Report and Meeting**

   - AEPGR's USR was filed with FERC on May 12, 2021. Subsequently, AEPGR held an USR Meeting via Webex on May 25, 2021. Following the USR Meeting, AEPGR filed an USR Meeting summary on June 11, 2021 with a deadline to file comments on July 12, 2021[1]. U.S. Fish and Wildlife Service (USFWS) and West Virginia Division of Natural Resources (WVDNR) filed comments on the USR on July 12 and July 16, 2021, respectively. AEPGR filed responses to USFWS and WVDNR's comments on August 10, 2021. FERC will provide a resolution of disagreements by September 9, 2021.

[1] Comment deadline was July 11, which fell on a Sunday, so the actual deadline was July 12, 2021.

If there are any questions regarding this progress report, please do not hesitate to contact me at (614) 716-2240 or jmmagalski@aep.com.

Sincerely,

Jonathan M. Magalski
Environmental Supervisor, Renewables
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Cc: Distribution List
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FEDERAL ENERGY REGULATORY COMMISSION
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August 26, 2021

OFFICE OF ENERGY PROJECTS

Project No. 2570-032
Racine Hydroelectric Project
AEP Generation Resources, Inc.

VIA FERC Service

Mr. Jonathan Magalski
Environmental Specialist Consultant
American Electric Power Services Corporation
1 Riverside Plaza
Columbus, OH 43215

Reference: Determination on Requests for Study Modifications for the Racine Hydroelectric Project

Dear Mr. Magalski:

Pursuant to 18 C.F.R. § 5.15 of the Commission's regulations, this letter contains the determination on requests for modifications to the approved study plan for AEP Generation Resources Inc. (AEP Generation Resources) Racine Hydroelectric Project No. 2570 (project). The determination is based on the study criteria set forth in sections 5.9(b) and 5.15(d) and (e) of the Commission's regulations, applicable law, Commission policy and practice, and Commission staff's review of the record of information.

Background

AEP Generation Resources filed an updated study report on May 12, 2021, held an updated study report meeting on May 25, 2021, and filed an updated study report meeting summary on June 11, 2021. Comments on the updated study report and meeting summary were filed by the U.S. Fish and Wildlife Service (FWS) on July 12, 2021 and the West Virginia Division of Natural Resources, Wildlife Resources Section (West Virginia DNR) on July 16, 2021. AEP Generation Resources filed reply comments on August 10, 2021.

Comments

There were a number of comments received that did not specifically request additional studies or modifications to the approved studies, including: comments on the presentation of data and results; comments disputing the interpretation of study results; statements constituting ongoing consultation and requests for future consultation; and requests for additional information. This determination does not address these comments. This determination only addresses specific recommendations to modify the approved study plan.

Study Plan Determination

Pursuant to section 5.15(d) of the Commission's regulations, any proposal to modify a required study must be accompanied by a showing of good cause, and must include a demonstration that: (1) the approved study was not conducted as provided for in the approved study plan; or (2) the study was conducted under anomalous environmental conditions or that environmental conditions have changed in a material way. As specified in section 5.15(e), requests for new information gathering or studies must include a statement explaining: (1) any material change in law or regulations applicable to the information request; (2) why the goals and objectives of the approved study could not be met with the approved study methodology; (3) why the request was not made earlier; (4) significant changes in the project proposal or that significant new information material to the study objectives has become available; and (5) why the new study request satisfies the study criteria in section 5.9(b). As specified in section 5.15(f), requests for new information gathering or studies must demonstrate extraordinary circumstances warranting approval.

As indicated in Appendix A, the requested modifications to the *Fisheries Study* are not approved; and the requested modifications to *Fish Entrainment and Impingement* studies are approved in part. The bases for these findings are explained in Appendix B. Commission staff considered all study plan criteria in section 5.9 of the Commission's regulations; however, only the specific study criteria particularly relevant to the study in question are referenced in Appendix B.

Please note that nothing in this determination is intended, in any way, to limit any agency's proper exercise of its independent statutory authority to require additional studies.

If you have questions, please contact Jay Summers at (202) 502-8764 or via email at jay.summers@ferc.gov.

Sincerely,

for
Terry L. Turpin
Director
Office of Energy Projects

Enclosures: Appendix A – Summary of Determinations on Requested Modifications to Approved Studies

Appendix B – Staff's Recommendations on Requested Modifications to Approved Studies

APPENDIX A

SUMMARY OF DETERMINATIONS ON REQUESTED MODIFICATIONS TO APPROVED STUDIES (*see* Appendix B for discussion)

Study	Recommending Entity	Adopted	Adopted in Part	Not Adopted
Fisheries Study	West Virginia DNR			X
Fish Entrainment and Impingement Study	West Virginia DNR		X	

APPENDIX B

STAFF RECOMMENDATIONS ON REQUESTED MODIFICATIONS TO APPROVED STUDIES

Fisheries Study

Background

As required by the approved study plan, AEP Generation Resources Inc. (AEP Generation Resources) supplemented existing fisheries data collected from the Racine and RC Byrd[1] Reservoirs by conducting electrofishing and trawl surveys of the fish community in the project area.[2] Regarding trawl surveys, the approved study plan required AEP Generation Resources to conduct two sampling events, one each in the spring and fall months. AEP Generation Resources conducted daytime trawl surveys in the fall of 2019 at six locations, including two locations within the Racine Reservoir and four locations downstream of Racine Dam within the RC Byrd Reservoir. AEP Generation Resources used a trawl methodology recommended by the U.S. Fish and Wildlife Service (FWS) and West Virginia Division of Natural Resources, Wildlife Resources Section (West Virginia DNR) to minimize the effects of the trawl surveys on freshwater mussels. Specifically, AEP Generation Resources used an 8-foot mini-Missouri trawl net and conducted three, one-minute trawls at each of the six sampling locations.

A total of 57 fish, representing two species (channel catfish and freshwater drum), were collected during the trawl surveys conducted in the fall of 2019.

During the initial study report meeting, AEP Generation Resources proposed to modify the *Fisheries Study* to eliminate the required spring trawl surveys because: (1) the trawl surveys conducted in the fall of 2019 did not yield any new information on fish populations in the project area; (2) existing trawl data is available from the Ohio Department of Natural Resources (Ohio DNR); and (3) maintaining Covid-19 social distancing while conducting trawl surveys was infeasible. In its comments on the initial

[1] The U.S. Army Corps of Engineers' RC Byrd Locks and Dam is located 41.7 river miles downstream of Racine Locks and Dam. The RC Byrd Reservoir backs up to Racine Locks and Dam.

[2] As part of the *Fisheries Study*, AEP Generation Resources also installed and operated a temporary eel ramp downstream of Racine Dam to characterize the relative abundance of American eels downstream of the project and determine the timing and magnitude of upstream eel migration at the project.

study report and meeting summary, West Virginia DNR and FWS concurred with AEP Generation Resource's proposal to forgo the spring trawl surveys. Because no entity objected to these changes to the *Fisheries Study* during the initial study report meeting or in comments on the initial study report, AEP Generation Resource's proposed revisions to forgo spring trawl surveys were approved under section 5.15(c)(7) of the Commission's regulations.

Requested Study Modification

Although West Virginia DNR previously concurred with AEP Generation Resource's proposal to forgo the spring trawl surveys, West Virginia DNR now states that the results of the trawl survey component of the *Fisheries Study* are inadequate and not consistent with previous trawl surveys conducted on the Ohio River. West Virginia DNR states that the low number of fish and low species diversity collected during the trawl surveys may be attributable to a number of factors, including, but not limited to, the trawl not making secure benthic contact and the boat speed being too low. West Virginia DNR also states that sampling more transects may be preferable. West Virginia DNR recommends modifying the study to require AEP Generation Resources to repeat the trawl component of the *Fisheries Study*. West Virginia DNR further states that it is amenable to continued coordination with the surveying group and would be able to offer training on the trawl methodologies used by West Virginia DNR.

Comments on the Requested Study Modification

In its reply comments, AEP Generation Resources states that the trawl surveys were conducted in accordance with the specific protocols required by the approved study plan. AEP Generation Resources states that comparisons of catch per unit effort between trawl data collected for this study and other trawl data collected on the Ohio River are not possible without reviewing site-specific data from the other studies (e.g., lengths/time of tow, habitat or locations, etc.) referenced by West Virginia DNR in their comments. AEP Generation Resources also states that the trawl surveys were conducted by experienced fisheries biologists with expertise in trawl sampling.

Discussion and Staff Recommendation

As discussed above, the need for conducting additional trawl surveys at the project was addressed in the September 9, 2020, determination on requests for study modifications. At that time, West Virginia DNR supported AEP Generation Resource's proposal to forgo additional trawl surveys. It is unclear why West Virginia DNR's requested modifications to the trawl component of the *Fisheries Study* were not made at that time. Moreover, beyond the largely speculative reasons provided by West Virginia DNR to explain the fall trawl survey results and offering to provide training on trawl methods used by West Virginia DNR, the specific modifications to the *Fisheries Study* being requested by West Virginia DNR are unclear. West Virginia DNR has not provided any new information that would alter the conclusions discussed in the September 9, 2020 determination as they pertain to the need for additional trawl surveys at the project, nor has it demonstrated that the study was not conducted according to the approved study plan or was conducted under anomalous conditions (section 5.15(d)). For the above reasons, we do not recommend West Virginia DNR's requested modification to the *Fisheries Study*.

Fish Entrainment and Impingement Study

Background

As required by the approved study plan, AEP Generation Resources conducted a *Fish Entrainment and Impingement Study* to assess the potential project effects on fish mortality and injury using a combination of existing literature and site-specific information. The approved study plan requires a methodology that includes the following seven separate tasks: (1) form a study working group;[3] (2) characterize the physical, operational, and water quality characteristics of the project that may affect fish entrainment, impingement, and survival; (3) collect intake velocity data; (4) develop a target fish species list that includes species of management concern as well as other non-game species (e.g., rare, threatened, and endangered species); (5) use data from tasks 2 through 4 to assess the potential for trash rack exclusion and vulnerability to impingement and entrainment; (6) determine monthly turbine entrainment rates from existing empirical data and use these rates to estimate monthly turbine entrainment for the target fish species using existing hydrology and project operations data; and (7) estimate turbine mortality for the range of target species' sizes expected to become entrained using the FWS' Excel-based Turbine Blade Strike Analysis model.

Electric Power Research Institute (EPRI) Database

Requested Study Modification

West Virginia DNR states that the methodology used by AEP Generation Resources for the *Fish Entrainment and Impingement Study* is not consistent with typical desktop entrainment studies. West Virginia DNR states that the study should not have

[3] Task 1 specifies that the purpose of the working group is to refine the methods associated with conducting the *Fish Entrainment and Impingement Study*. Task 1 also specifies that the working group include representatives from FWS, West Virginia DNR, and Ohio DNR.

used every project available in the EPRI (1997)[4] database to establish fish entrainment rates at the project because this can potentially lead to inaccurate or misleading entrainment estimates. Rather, West Virginia DNR states that a preferred method is to identify and use one or more projects from the EPRI database that have similar configurations, size, and fish assemblages to the Racine Project. Therefore, to estimate rates of fish entrainment at the project, West Virginia DNR recommends modifying the methodology for the *Fish Entrainment and Impingement Study* to require AEP Generation Resources to only use projects from the EPRI database that have similar characteristics to the Racine Project.

Comments on the Requested Study Modification

In its reply comments, AEP Generation Resources states that the use of all projects in the EPRI database increases the robustness of the data used to estimate entrainment for each target fish species. AEP Generation Resources also states that the calculation of an average entrainment rate for each target fish species based on data from all EPRI database projects combined is used to represent the average susceptibility of each species to entrainment. AEP Generation Resources states that this method likely overestimates the monthly and annual entrainment estimates at the Racine Project and thus is a conservative approach. AEP Generation Resources also states that using all projects in the EPRI database to estimate entrainment rates at the project is a common approach that has been used in other relicensing proceedings, including three projects located on the Ohio River (e.g., Emsworth Locks & Dam Project No. 13757, Emsworth Back Channel Project No. 13761, and Montgomery Locks & Dam Project No. 13768).

Discussion and Staff Recommendation

The approved study plan required that a literature review of turbine entrainment field studies conducted at other hydroelectric projects be performed to compile entrainment rates for target fish species. The approved study plan further specified that, "the primary sources of turbine entrainment information may include, but does not have to be limited to, the comprehensive Turbine Entrainment and Survival Database Field Tests prepared by the EPRI." However, the approved study plan did not require only those projects with characteristics comparable to those of the Racine Project (e.g., similar mode of operation, geographic location, turbine type, hydraulic capacity, etc.) to be selected from the EPRI database and used to estimate monthly turbine entrainment rates at the project.

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[4] EPRI. 1997. Turbine Entrainment and Survival Database – Field Tests. EPRI Report No. TR-108630. Prepared by Alden Research Laboratory, Inc. Holden, MA.

A review of recent desktop entrainment studies conducted at other projects indicates that the EPRI (1997) database is often filtered to select entrainment data from only those projects with characteristics that match or are within a comparable range to those found at the project undergoing relicensing.[5] However, using as many projects as possible from the EPRI database is also a methodology that is commonly used to estimate fish entrainment when conducting desktop entrainment studies.[6]

West Virginia DNR has not demonstrated that the study was not conducted according to the approved study plan or was conducted under anomalous conditions (section 5.15(d)). The use of select entrainment studies from the EPRI database was not specifically required in the approved study plan and the methods used by AEP Generation Resources to estimate fish entrainment at the project are consistent with scientifically accepted methods (section 5.9(b)(6)). Therefore, we do not recommend West Virginia DNR's requested modification to the *Fish Entrainment and Impingement Study*.

Entrainment Data Adjustments

<u>Requested Study Modification</u>

As part of the *Fish Entrainment and Impingement Study*, AEP Generation Resources adjusted the monthly entrainment estimates for clupeids (i.e., gizzard shad and skipjack herring) at the project to account for the high rates of clupeid cold stress-related entrainment at four projects contained in the EPRI (1997) database during the fall, winter, and spring months (i.e., Youghiogheny (Pennsylvania), Townsend Dam (Pennsylvania), Minetto (New York), and Richard B. Russell (Georgia/South Carolina)).[7] The study report states that because episodic entrainment rates for clupeids are indicative of temperature-related entrainment/mortality, it is necessary to correct for water temperature-induced entrainment/mortality that is not the result of project operation.

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[5] *See* R.L. Harris Hydroelectric Project No. 2628, Bedford Hydroelectric Project No. 5596, and Tallassee Shoals Hydroelectric Project No. 6951.

[6] *See* Niagara Hydroelectric Project No. 2466, Grand Rapids Hydroelectric Project No. 2362, Bear Swamp Hydroelectric Project No. 2669, and Byllesby-Buck Hydroelectric Project No. 2514.

[7] Winter months included December, January, and February; fall months included September, October, and November; and spring months included March, April, and May.

Using water temperature data from U.S. Geological Survey (USGS) gage no. 03216070 (Ironton, Ohio),[8] the number of days that the mean daily water temperature was less than 8° Celsius (C) was used to represent the period of time that clupeid entrainment could be a result of cold stress and not project operation. Based on this water temperature analysis, the estimated entrainment rates for clupeids at the project were reduced by 94.4 percent in the winter, 20.6 percent in the spring, and 6.1 percent in the fall.

West Virginia DNR states that although cold shock/stress of clupeids has not been observed at the project, clupeids could experience a level of torpor and reduced biological function when water temperatures fall below 8° C. West Virginia DNR states that clupeids experiencing reduced swimming performance associated with cold shock/stress would be susceptible to turbine-related injury or mortality (i.e., blade-strike and/or barotrauma) at the project. Therefore, West Virginia DNR recommends modifying the methodology for the *Fish Entrainment and Impingement Study* to require AEP Generation Resources to estimate the monthly entrainment rate for clupeids at the project without making any adjustments to the EPRI data to account for cold shock/stress.

Comments on the Requested Study Modification

In its reply comments, AEP Generation Resources states that the data from the four EPRI projects referenced above represented over 99.9 percent of the data used to derive the monthly entrainment rates for clupeids, which was then used to estimate monthly and annual entrainment at the Racine Project for gizzard shad and skipjack herring. AEP Generation Resources states that the clupeid entrainment data from the EPRI database studies was collected at facilities primarily located in New York and Pennsylvania where fish are exposed to prolonged low water temperatures in ranges that may result in fish mortality events. AEP Generation Resources states that it is therefore appropriate to adjust the entrainment database values to avoid over estimating entrainment attributed to the Racine Project, which is located in an area that typically experiences fewer cold-induced mortality events than are experienced in New York and Pennsylvania. AEP Generation Resources further states that USGS gage no. 03216070 is closer in proximity to the Racine Project than the four projects in the EPRI database, most of which are farther north and likely experienced colder water temperatures for much longer periods. Thus, AEP Generation Resources states that the adjustment applied to the database was likely conservative compared to what it would have been if water

[8] This gage is located on the Ohio River, approximately 90 miles downstream of the project.

temperatures from near the Townsend and Minetto projects were used to determine the adjustment.

AEP Generation Resources also states that the cold-stress adjustments made to the estimated rates of entrainment for clupeids at the project are consistent with generally accepted desktop entrainment studies, including those conducted for three projects located on the Ohio River (e.g., Emsworth Locks & Dam Project No. 13757, Emsworth Back Channel Project No. 13761, and Montgomery Locks & Dam Project No. 13768). AEP Generation Resources states that regardless of the approach used to adjust the rates of entrainment, shad are susceptible to entrainment at the project and even with the adjustments, are still likely to be among the top five species entrained at the facility.

Discussion and Staff Recommendation

The approved study plan does not specify whether entrainment estimates at the project would be adjusted to account for high rates of clupeid entrainment at certain projects in the EPRI database during the spring, fall, and winter months. AEP Generation Resource's adjustments to the entrainment data to account for potential cold stress of clupeids appears to be a reasonable approach. AEP Generation Resource's entrainment data adjustments also do not conflict with the approved study methodology and are consistent with methods used for other desktop entrainment studies conducted at hydroelectric projects in the Ohio River Basin (section 5.9(b)(6)).

However, AEP Generation Resource's entrainment data adjustments may underestimate actual entrainment and do not allow for Commission staff to independently investigate whether alternative adjustments may be more appropriate. Providing entrainment and turbine mortality estimates for gizzard shad and skipjack herring with and without AEP Generation Resource's cold stress adjustments would ensure sufficient information is available to inform staff's environmental analysis of project effects on existing fishery resources and potential license conditions (section 5.9(b)(5)). Therefore, we recommend that the final license application include: (1) AEP Generation Resource's existing entrainment and turbine mortality estimates contained in the study report, which are calculated based on "adjusted data;" and (2) a separate analysis of the effects of project operation on fish entrainment and turbine mortality that includes entrainment and turbine mortality estimates for gizzard shad and skipjack herring without the adjustments made in the study report to account for cold shock/stress at the project.

American Electric Power
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aep.com

Via Electronic Filing

September 8, 2021

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

Subject: Racine Hydroelectric Project (FERC No. 2570)
Resubmittal of the Revised Entrainment and Impingement Study Report

Dear Secretary Bose:

AEP Generation Resources Inc. (AEPGR), a unit of American Electric Power (AEP), is the licensee, owner, and operator of the Racine Hydroelectric Project (Project) (FERC Project No. 2570), located on the Ohio River in Meigs County, Ohio. The Project is operated under a license issued by the Federal Energy Regulatory Commission (FERC or Commission). The existing FERC license for the Project expires on November 30, 2023.

AEPGR has elected to utilize the Integrated Licensing Process (ILP) for the relicensing of the Project as defined in 18 Code of Federal Regulations (C.F.R.) Part 5. In accordance with the Commission's regulations at 18 C.F.R. §5.15 and the Commission's May 13, 2019 Study Plan Determination (SPD), AEPGR filed the Updated Study Report (USR) with FERC on May 12, 2021. Additionally, AEPGR held an Updated Study Report Meeting (USR Meeting) with participants and FERC staff via Webex on May 25, 2021. An USR Meeting summary was filed with FERC on June 11, 2021. The deadline to submit any disputes or requests to amend studies was July 12, 2021[1]. Comment letters were received from U.S. Fish and Wildlife Service (USFWS or Service) and West Virginia Division of Natural Resources (WVDNR) on July 12 and July 16, 2021, respectively. AEPGR filed responses to comments received on the USR on August 10, 2021. In addition to responses to comments, AEPGR filed a revised Entrainment and Impingement Study report. However, some of the turbine strike analysis tables were inadvertently left out of Appendix D of the revised report. Therefore, AEPGR is hereby providing the complete revised Entrainment and Impingement Study report that includes the full Appendix D.

If there are any questions regarding this filing, please do not hesitate to contact me at (614) 716-2240 or jmmagalski@aep.com.

[1] Comment deadline was July 11, which fell on a Sunday, so the actual deadline was July 12, 2021.

Sincerely,

Jonathan M. Magalski
Environmental Supervisor, Renewables
American Electric Power Services Corporation, Environmental Services

Attachment:
Attachment A – Revised Fish Entrainment and Impingement Study Report

Cc: Distribution List
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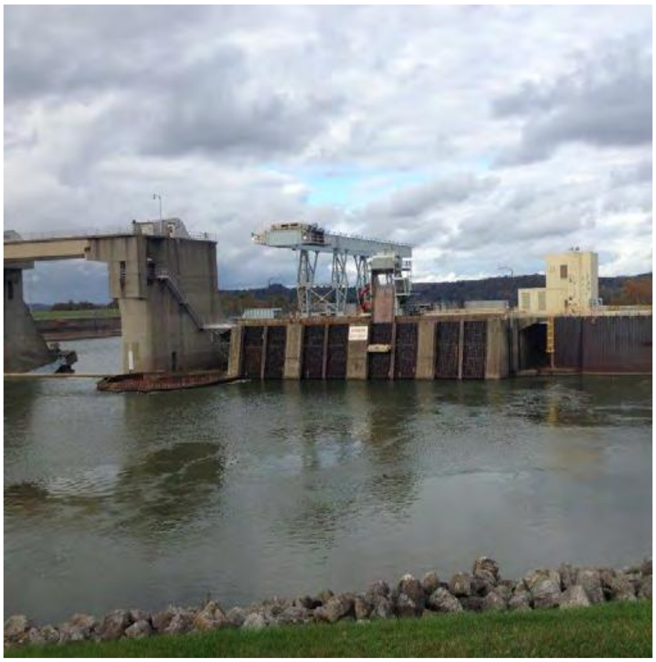
Attachment A
Revised Fish Entrainment and Impingement Study Report



Fish Entrainment and Impingement Study Report

Racine Hydroelectric Project (FERC No. 2570)

August 10, 2021

Prepared by:

HDR

Prepared for:

AEP Generation Resources Inc.

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Acronyms and Abbreviations

ADCP	Acoustic Doppler Current Profiler
AEP	American Electric Power
CFR	Code of Federal Regulations
cfs	cubic feet per second
EPRI	Electric Power Research Institute
FERC or Commission	Federal Energy Regulatory Commission
fps	feet per second
ft	feet/foot
hr	Hour
ILP	Integrated Licensing Process
m	meter
PM&E	protection, mitigation, and enhancement
RSP	Revised Study Plan
SPD	Study Plan Determination
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey

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1 Project Introduction and Background

1.1 Introduction

AEP Generation Resources Inc. (AEPGR or Licensee), a unit of American Electric Power (AEP), is the Licensee, owner, and operator of the 47.5 megawatt (MW) Racine Hydroelectric Project (Project No. 2570) (Project or Racine Project), located on the Ohio River at River Mile (RM) 237.5, near the Village of Racine in Meigs County, Ohio. The Project is located at the U.S. Army Corps of Engineers' (USACE) Racine Locks and Dam and is operated in a run-of-river mode.

The Project is currently licensed by the Federal Energy Regulatory Commission (FERC or Commission) under the authority granted to FERC by Congress through the Federal Power Act, 16 United States Code (USC) §791(a), *et seq*., to license and oversee the operation of non-federal hydroelectric projects on jurisdictional waters and/or federal land. The features associated with the FERC-licensed Project include the water-retaining integral powerhouse/intake structure and a cellular cofferdam non-overflow section connecting the powerhouse to the right abutment (looking downstream). There are 23 acres of federal land within the FERC Project boundary.

The remainder of the development is owned, operated, and maintained by the USACE and is not part of the FERC- licensed Project. The USACE portions of the development include a short gravity section between the powerhouse and spillway, a 1,717-foot-long spillway, two lock structures at the left end of the spillway (looking downstream), and the left abutment.

The Project was issued an original, 50-year license by the Commission on December 27, 1973. The current license expires on November 30, 2023. In accordance with FERC's regulations at 18 Code of Federal Regulations (CFR) §16.9(b), AEPGR must file its application for a new license with FERC no later than November 30, 2021.

A Pre-Application Document (PAD) and Notice of Intent (NOI) to relicense the Project were filed on July 2, 2018. The PAD and NOI were distributed to federal and state resource agencies, local governments, Indian Tribes, and interested members of the public simultaneously with their filing with FERC. On August 21, 2018 the Commission issued Scoping Document 1 to advise resource agencies, Indian Tribes, non-governmental organizations, and other stakeholders as to the proposed scope of FERC's Environmental Assessment (EA) for the Project and to seek additional information pertinent to the Commission's analysis. On October 30, 2018, the U.S. Fish and Wildlife Service (USFWS) and West Virginia Division of Natural Resources (WVDNR) formally requested a study of the potential effects of the Project on entrainment and impingement mortality on resident fish populations. FERC issued Scoping Document 2 on December 12, 2018 to provide information on the proposed action and alternatives, the environmental analysis process FERC staff will follow to prepare the EA, and a revised list of issues to be addressed in the EA. A Proposed Study Plan (PSP) was submitted by AEPGR on December 14, 2018 that included the proposed methods for conducting a desktop Fish Entrainment and Impingement Study. A Revised Study Plan (RSP) was submitted on April 12, 2019 that included revisions in response to agency and stakeholder comments. On May 13, 2019, FERC issued a Study Plan Determination (SPD) that approved the Fish Entrainment and Impingement Study without modification. This Fish Impingement and Entrainment Study utilizes the existing fish community information, fisheries data collected upstream and downstream in the vicinity of the Project, hydrological data, water quality data, and structural/operational characteristics of the Project to quantify turbine entrainment and mortality for a select list of fish species.

2 Study Goals and Objectives

As described in the approved study plan, the goals and objectives of this study are to:

- Describe the physical characteristics of the powerhouse and intake structures, including location, dimensions, turbine specifications, trashrack spacing, and desktop calculated, and field collection of intake velocities that could influence entrainment.
- Describe the fish community and compile a target species list for entrainment analysis.
- Utilize intake velocities, trashrack spacing, target fish swim speeds, and other Project specifications to conduct a desktop impingement assessment.
- Conduct a desktop analysis that incorporates the impingement assessment, Project specifications, hydrology and target species list confirmed in the December 4, 2020 letter from AEPGR to USFWS, WVDNR, and Ohio Department of Natural Resources (ODNR) quantify turbine entrainment and turbine mortality at the Project.

3 Study Area

The Racine Hydroelectric Project is located at RM 237.5 on the Ohio River, approximately four miles south of the Village of Racine in Meigs County, Ohio. Figure 3-1 provides an overview of the Project location and setting. Figure 3-2 provides an overview of the Project facilities described further in Section 5.2. The study area includes the FERC-licensed portion of the Racine Project consisting of the water-retaining integral powerhouse/intake structure and a cellular cofferdam non-overflow section connecting the powerhouse to the right abutment. The remaining portion of the development is owned, operated, and regulated by the USACE and is not part of the FERC-licensed Project.

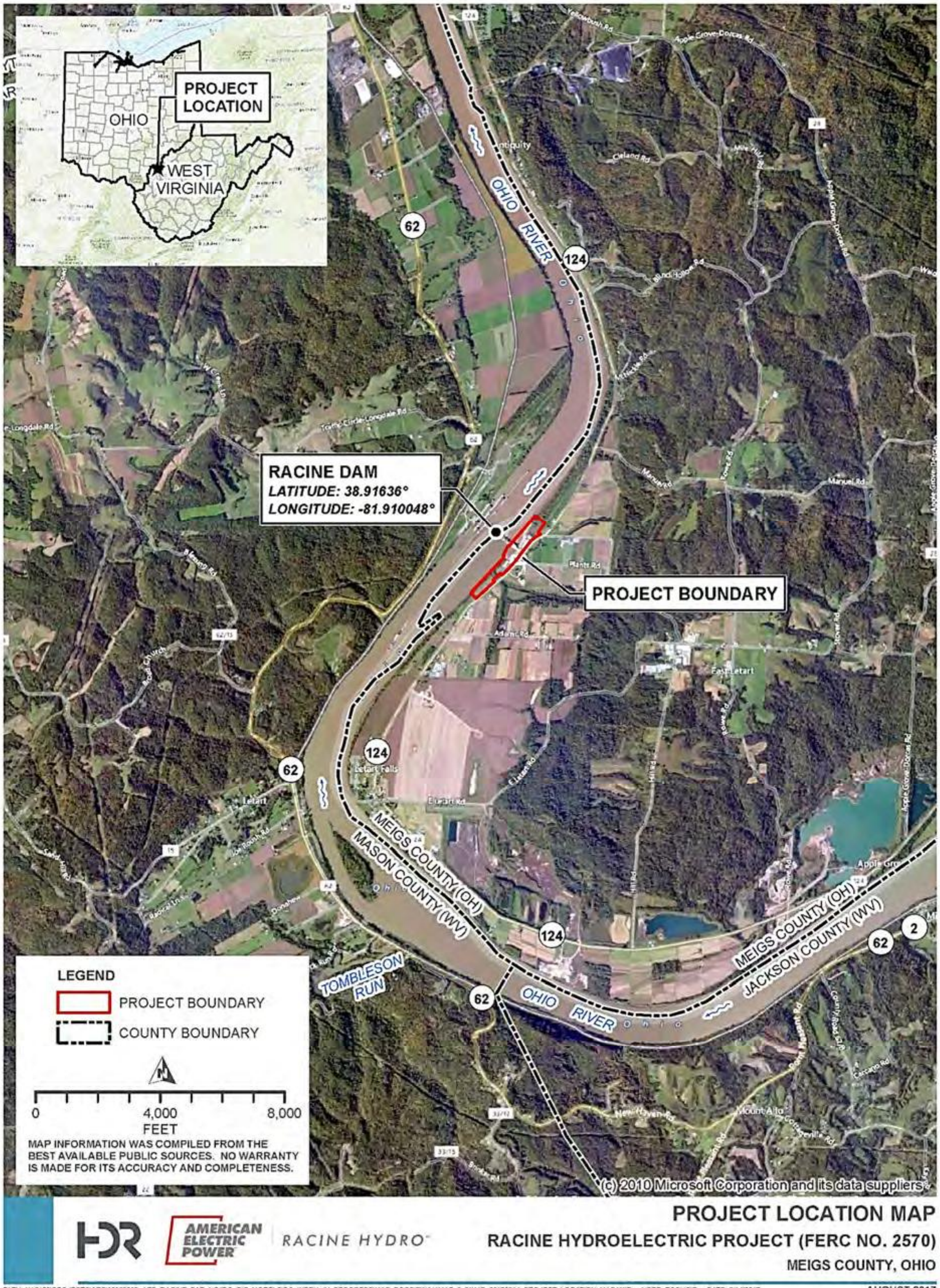


Figure 3-1. Project Location Map

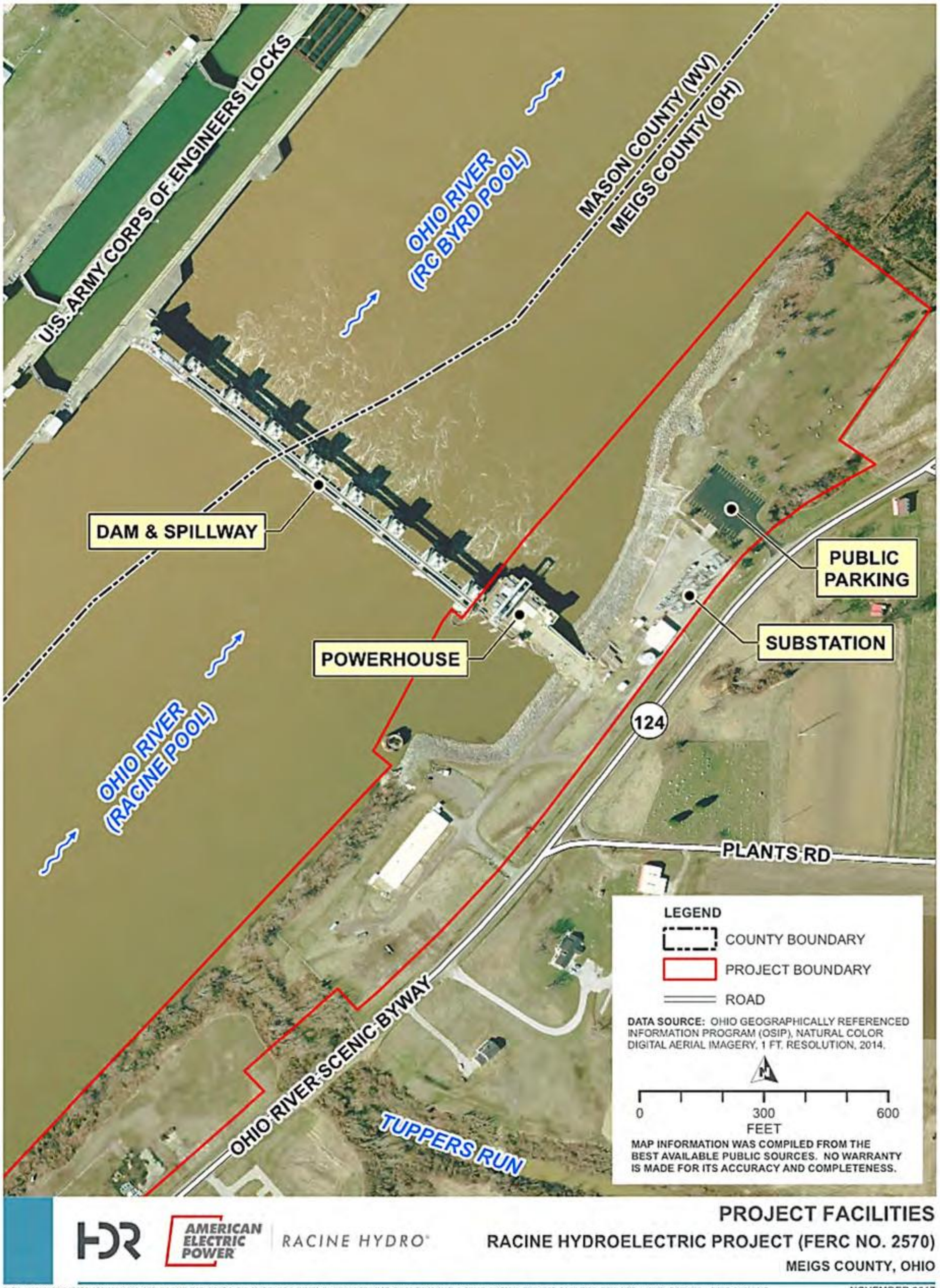


Figure 3-2. Fish Entrainment and Impingement Evaluation Study Area

4 Methodology

4.1 Water Chemistry Characteristics

Monthly water quality profile data were collected in three locations in the Study Area from May 1 through October 31, 2019, to identify the presence and extent of stratification that occurs in the forebay and to evaluate its potential influence (if any) on fish entrainment (AEPGR 2020). One profile location was immediately adjacent to the intake structure and two locations were approximately 0.4 miles upstream of the Project dam. Water quality profiles were collected using a YSI EXO2 (or similar equipment). A vertical profile of temperature and dissolved oxygen (DO; milligrams per liter [mg/L]) was collected beginning at the water's surface and moving in 1-meter (m) increments until the bottom was reached. Measurements were taken in 0.5-m increments upon discovery of a thermocline and within 1 m of the surface and bottom.

4.2 Intake Characteristics and Velocities

The intake structure at the Project is located on the right (looking downstream) side of the main dam and is equipped with two steel trash racks. The approach velocity was calculated using the intake structure and trash rack dimensions along with the design maximum flow capacity of the two generating units.

4.3 Desktop Review of Entrainment and Impingement Potential

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

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

Pursuant to the approved study plan, AEPGR consulted with a working group consisting of representatives from the USFWS, WVDNR, and ODNR to identify target fish species to be analyzed during the Fish Entrainment and Impingement Study. By letter dated January 9, 2020, AEPGR proposed to include 12 species of fish and corresponding life stages in the analysis, with size classes bracketed accordingly.

On January 30, 2020, the USFWS provided comments on the proposed list of targeted species. In addition to the diadromous American eel (*Anguilla rostrata*), the USFWS requested that AEPGR include non-diadromous fish species that undertake long-distance, in-river migrations in the analysis. The USFWS also recommended that the analysis include documented hosts for federal or state-listed mussels that have the potential to occur in the vicinity of the Project. With respect to size class evaluation, the USFWS recommended that AEPGR evaluate percent survival in fish length increments of no more than two inches per increment. Finally, the USFWS recommended that final selection of fish species to be evaluated in the entrainment and impingement study be postponed until the spring 2020 fisheries survey data was collected pursuant to the Commission’s approved Fisheries Survey, Project Characteristics, and Project Operations Related to Potential Fish Passage Study (Fisheries Study).

By letter dated February 7, 2020, the WVDNR also provided comments on AEPGR's proposed list of target fish species. The WVDNR recommended that AEPGR include 82 species of fish in the entrainment and impingement evaluation.

Based on comments provided by the USFWS and WVDNR, AEPGR developed a revised list of target species. By letter dated December 4, 2020, AEPGR distributed the revised target list and summary data from the fall 2019 and spring 2020 fisheries surveys at the Project. AEPGR's proposed target species included species captured during the 2019 and 2020 fisheries surveys, the diadromous American eel (a species known to occur in the Ohio River), non-diadromous species that undertake long-distance, in-river migration, and potential host species for federal and state-listed mussel species identified in the USFWS's January 30, 2020 correspondence. The proposed target species are presented in Table 4-1. In total, AEPGR proposed to include 35 species in the entrainment and impingement analysis. AEPGR held a conference call with the working group on December 14, 2020 to discuss the proposed target list of species to include in this study. AEPGR did not receive any additional comments on or requests to modify the list of target species.

Table 4-1. Target Fish Species and Justification for Inclusion in the Entrainment and Impingement Study for Racine Hydroelectric Project

Common Name	Scientific Name	Justification for Inclusion
American Eel	*Anguilla rostrata*	Diadromous species known to occur in the Ohio River
Bluegill	*Lepomis macrochirus*	Species captured during AEPGR fisheries surveys
Bluntnose Minnow	*Pimephales notatus*	Potential mussel host
Channel Catfish	*Ictalurus punctatus*	Species captured during AEPGR fisheries surveys
Channel Shiner	*Notropis wickliffi*	Species captured during AEPGR fisheries surveys
Common Carp	*Cyprinus carpio*	Species captured during AEPGR fisheries surveys
Emerald Shiner	*Notropis atherinoides*	Species captured during AEPGR fisheries surveys
Freshwater Drum	*Aplodinotus grunniens*	Species captured during AEPGR fisheries surveys
Gizzard Shad	*Dorosoma cepedianum*	Species captured during AEPGR fisheries surveys
Golden Redhorse	*Moxostoma erythrurum*	Species captured during AEPGR fisheries surveys
Green Sunfish	*Lepomis cyanellus*	Species captured during AEPGR fisheries surveys
Highfin Carpsucker	*Carpiodes velifer*	Species captured during AEPGR fisheries surveys
Hybrid Striped Bass	*Morone chrysops x M. saxatilis*	Species captured during AEPGR fisheries surveys

Common Name	Scientific Name	Justification for Inclusion
Largemouth Bass	*Micropterus salmoides*	Species captured during AEPGR fisheries surveys; potential mussel host
Logperch	*Percina caprodes*	Species captured during AEPGR fisheries surveys; potential mussel host
Longnose Gar	*Lepisosteus osseus*	Species captured during AEPGR fisheries surveys
Northern Hogsucker	*Hypentelium nigricans*	Species captured during AEPGR fisheries surveys
Quillback	*Carpiodes cyprinus*	Species captured during AEPGR fisheries surveys
River Carpsucker	*Carpiodes carpio*	Species captured during AEPGR fisheries surveys
River Redhorse	*Moxostoma carinatum*	Species captured during AEPGR fisheries surveys
River Shiner	*Notropis blennius*	Species captured during AEPGR fisheries surveys
Sauger	*Sander canadensis*	Species captured during AEPGR fisheries surveys; potential mussel host
Silver Chub	*Macrhybopsis storeriana*	Species captured during AEPGR fisheries surveys
Silver Redhorse	*Moxostoma anisurum*	Species captured during AEPGR fisheries surveys
Skipjack Herring	*Alosa chrysochloris*	Species captured during AEPGR fisheries surveys; potential mussel host; non-diadromous species that undertakes long distance, in-river migrations
Smallmouth Bass	*Micropterus dolomieu*	Species captured during AEPGR fisheries surveys
Smallmouth Buffalo	*Ictiobus bubalus*	Species captured during AEPGR fisheries surveys
Smallmouth Redhorse	*Moxostoma breviceps*	Species captured during AEPGR fisheries surveys
Spotfin Shiner	*Cyprinella spiloptera*	Species captured during AEPGR fisheries surveys; potential mussel host
Spotted Bass	*Micropterus punctulatus*	Species captured during AEPGR fisheries surveys
Spotted Sucker	*Minytrema melanops*	Species captured during AEPGR fisheries surveys

Common Name	Scientific Name	Justification for Inclusion
Walleye	*Sander vitreus*	Species captured during AEPGR fisheries surveys potential; mussel host; non-diadromous species that undertakes long distance, in-river migrations
White Bass	*Morone chrysops*	Species captured during AEPGR fisheries surveys
White Crappie	*Pomoxis annularis*	Potential mussel host
Yellow Perch	*Perca flavescens*	Species captured during AEPGR fisheries surveys

4.3.1 Assessment of Impingement Potential at the Intake

Impingement and intake avoidance were evaluated based on the 6.125-inch center-to-center bar spacing of the trash racks at the Project's intake structure. This process involved comparing available target fish swim speeds with calculated intake velocities, as well as estimating minimum body lengths (total length) for the target fish species that would be excluded by or impinged on the 6.125-inch center-to-center bar spacing of the trash racks. A scaling factor relating fish length to body width was used for the assessment to determine minimum sizes of the target fish species that would physically be excluded by the trash racks (Smith 1985).

4.3.2 Fish Entrainment Rates

4.3.2.1 EPRI Database and Data Selection

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

Although some projects used to compile the database may not match the exact specifications of the Racine Project, using as many projects as possible from the EPRI database accounts for the variability of aquatic ecosystems and fish populations, while providing a robust database for calculating average monthly entrainment rates for a wide range of species. This is a commonly applied approach in desktop entrainment evaluations. Therefore, all 43 hydroelectric projects were used in this analysis (Appendix A).

4.3.2.2 Entrainment Rate Calculation

The EPRI (1997) entrainment database provides results from field trials conducted at hydroelectric facilities using full-flow tailrace netting. This involves the placement of a conical net in the immediate tailrace to collect the entire discharge on a seasonal or monthly basis. This results in the calculation of entrainment rates (fish/volume of water if recorded, or fish/hour (hr)/cubic feet per second [cfs] of sampled unit capacity), including the number, species, and size of entrained fish. Since only approximately half of the studies in the EPRI database recorded volume of water sampled, the number of fish per hour per 1,000 cfs of unit capacity was used in this assessment. This allowed for the standardization of the data and a larger sample size in the EPRI database from which to draw. All of the projects/studies in the database recorded hours sampled, as well as provided the hydraulic capacity of the sampled units. These rates were determined for 10 size groups for each species as provided in EPRI (1997).

Entrainment rates were compiled by month and annually. Several of the target species were not represented in the EPRI (1997) database; as such, a surrogate(s) or group rate was used (e.g., genus or family) for those target species.

4.3.3 Monthly Turbine Entrainment Rate Calculation

Project-specific entrainment estimates were calculated, based on the flow and generation at the Project and Racine Pool fish community composition, in combination with the entrainment rates in the EPRI database using the methods described below. First, average monthly entrainment rates (fish per hour per 1,000 cfs unit capacity) were calculated for each target species from the EPRI database. Using available flow data for the period of record (POR) from 1987-2016, monthly entrainment rates were determined for a dry (90% flow exceedance), average (50% flow exceedance), and wet (10% flow exceedance) year. Flow data and project operations were reviewed to provide conservative estimated monthly generation amounts in 1,000 cfs-hours. Monthly entrainment rates for the target species were then multiplied by the monthly generation amounts to obtain a monthly entrainment estimate for ten size groups per species. Monthly entrainment estimates were then adjusted based on each species relative abundance as determined in electrofishing and trawl surveys conducted in the Project area, discussed in Section 5.3.1. If a species on the target list was not collected in the Project area during the 2019 or 2020 surveys, one individual was assumed to be collected, contributing to 0.08 percent of the Racine fish community.

Another adjustment was made to the data to account for cold stress of Clupeids (Clupeidae). The purpose of the cold stress adjustment was to correct for the high rates of entrainment due to temperature-related entrainment/mortality at four plants reported in the EPRI database (Youghiogheny, Townsend Dam, Minetto, and Richard B. Russell). For computation of total fish numbers entrained at the Projects, Gizzard Shad (*Dorosoma cepedianum*) and Skipjack Herring (*Alosa chrysochloris*) (Clupeids used as surrogate) entrainment estimates were adjusted to account for high rates of Clupeid entrainment realized at certain projects in the EPRI (1997) database during fall, winter, and spring months. Gizzard Shad and other Clupeids can become lethargic and moribund when water temperatures are 8°C or less for prolonged periods (GeoSyntec 2005; Jenkins and Burkhead 1993; Duke Energy 2008). Such episodic entrainment rates are indicative of temperature-related entrainment/mortality, and not operational-related entrainment/mortality. Winter, fall, and spring episodic entrainment of Clupeids was observed in several studies in the EPRI (1997) database; specifically, the Youghiogheny, Townsend Dam, Minetto, and Richard B. Russell projects. Because each of these projects were incorporated into the entrainment rate estimation for Clupeids, it was necessary to correct for temperature-induced entrainment that is not a result of project operations. The data from those facilities represented over 99.9 percent of the data used to derive the monthly entrainment rates for Gizzard Shad and Skipjack Herring, which were then used to estimate monthly and annual entrainment at Racine for those species. Additionally, the USGS temperature gage used to identify the period of time when temperatures were less than 8°C is closer in proximity to the Racine Project than the other projects in the database, which are farther north and likely experienced colder water temperatures for much longer periods. Thus, the adjustment applied to the database was likely conservative compared to what it would have been if temperatures from near the Townsend and Minetto facilities were used to determine the adjustment.

To account for the temperature-induced entrainment, an assessment of hourly and 15-minute water temperature recorded at a USGS stream gage (gage no. 03216070 Ironton, OH) for a five-year period (2016-2020) was made to determine the period of time that temperatures are 8°C or below at the project. It was assumed that temperatures at this location would be representative for the region. The result was the compilation of hundreds of data points, of which the percentage of those <8°C was determined for each season. Averaging the five years of data together resulted in the percentage of time water temperatures were <8°C for each season. The number of days that mean daily water temperature was less than 8°C (critical water temperature) was used to represent the period of time that Clupeid entrainment may be a result of "cold stress" and not due to project operations; therefore, Gizzard Shad and Skipjack Herring entrainment estimates were reduced by 94.4% in the winter, 6.1% in the fall, and 20.6% in the spring (winter = December, January, and February; fall = September, October, and November; spring = March, April and May).

As an example, the following steps were taken to estimate monthly/annual entrainment rates:

1. Monthly entrainment rates (fish/hr/1,000 cfs of unit capacity) were determined from the EPRI database for 10 size groups of each target/surrogate species.
2. Monthly entrainment rates for each species/size group were multiplied by the monthly flow volumes determined for an average, dry, and wet water year that would have been passed through the Project. For example, using the month of June in an average water year (10,288 cfs) and June Bluegill (*Lepomis macrochirus*) (2.1-4 in) entrainment rate (0.2860), the following entrainment estimate resulted:

   0.2860 fish/hr/1,000 cfs of unit capacity x 10,288 cfs-hours = 2,942 fish.
3. Entrainment estimates were then multiplied by the species' relative abundance in the Racine Pool as determined from electrofishing and trawl surveys. For example, the Bluegill relative abundance in the Racine Pool was 0.50 percent, for a total of 15 fish **(2,942 x 0.005 = 14.7 fish)**. This methodology was conducted for each species, month, and size group with the resulting number of fish summed to obtain combined monthly and annual entrainment estimates. For Clupeids, the correction factors mentioned above were multiplied by the estimate after factoring in the relative abundance.

4.3.4 Turbine Blade Strike Evaluation

This evaluation uses the most recent version of the Turbine Blade Strike Analysis Model (USFWS 2020) created by the USFWS, which is a probabilistic Excel-based Visual Basic for Applications implementation of the methods outlined by Franke et al. (1997) for evaluating fish mortalities due to turbine entrainment, as well as through non-turbine routes. This tool allows for the estimation of turbine passage and mortality (blade strikes) based on site-specific information (i.e., turbine type, number of units, bar rack spacing, etc.) and length distribution for target species used in this impingement and entrainment assessment. Using the model, fish can be subjected to up to 20 hazards, or routes, including 3 turbine types and bypasses, incorporating the Franke et al. (1997) equations into a Monte Carlo simulation that produces a probabilistic model result for turbine and non-turbine mortality.

While the greatest opportunity for fish mortality through a facility lies in potential contact with the turbine runner blades, injuries and mortalities can result from other mechanisms including extreme pressure changes, shear stress, water turbulence, cavitation, and grinding (Deng et al. 2005) all of which can be the result of project and non-project features (i.e. turbines, spillways, sluices, gates, locks, etc.).

The analysis was conducted for the upper limit of each of the size classes used in the entrainment analysis (i.e. 2” used for 0-2” class) as well as some additional larger sized groups. The assumed flow scenario used in this analysis evaluates the passage mortality under the assumption that all fish that pass downstream of the project pass through either of the turbines and that the turbines are operating at full capacity. For each size class of fish, 5,000 fish were used as an input population when simulating the blade strike analysis. The output of each model run resulted in a probability of blade strike for fish in that size class. A strike mortality coefficient value (λ) of 0.2 as recommended by the USFWS was used, which is considered to be the most conservative value in the absence of more specific information. The specific inputs and model run results are provided for reference in Appendix D. The results of this analysis were applied to the entrainment estimates, as calculated in section 4.3.3 to provide an estimate of potential blade strike mortality to entrained fish. An additional analysis was conducted to assess the blade strike probability for silver phase eels that would pass downstream of the Project during the fall. Silver phase eels are adult eels, therefore the analysis was conducted for eels from 20-38”. Per communications from USFWS, a strike mortality coefficient value (λ) of 0.42 was used for the eel specific analysis. This elevated strike mortality coefficient was calculated by USFWS and is based on data from Gomes and Lariner (2008) that suggests eels have higher mortality than other species of fish when passing through Kaplan turbines

5 Study Results

5.1 Water Chemistry Characteristics

Temperature and oxygen profile data collected closest to the intake structures (Plant) were generally consistent with the profile data collected at the two other locations in the Study Area, upstream of the plant (Mid and Lock). The most appreciable fluctuation in DO in the Study Area was measured on September 11, 2019 at the Plant location, where DO readings increased by 1.56 mg/L between the surface reading to the 0.5-m reading and decreased 1.04 mg/L from the 0.5-m reading to the 1-m reading (Figure 5-1). However, profile collection at this location was difficult due to its proximity to the intake structure and dam spillway. All DO and temperature readings at the Plant profile location and all others collected as part of this study remained in compliance with the State water quality criteria. No thermal or DO stratification was observed and the Study Area appeared well-mixed during the study period.

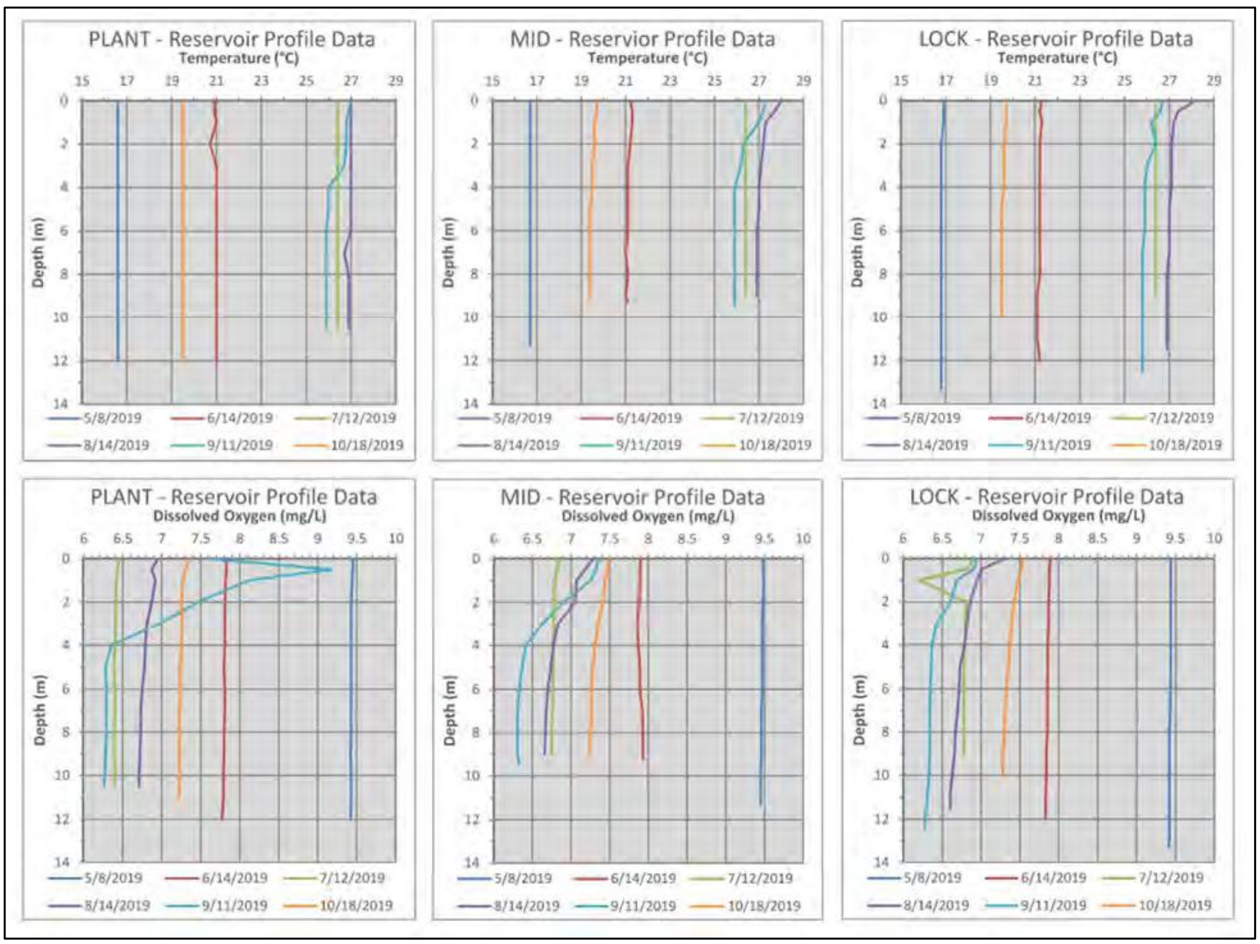


Figure 5-1. Dissolved Oxygen and Temperature Profile Data Collected in the Racine Reservoir in 2019

5.2 Intake Structure Characteristics

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

5.2.1 Reservoir

The reservoir formed by the Racine Locks and Dam has a surface area of 5,300 acres at maximum normal pool elevation of 560.0 feet at mean sea level (ft msl), with 22 feet of gross head. The reservoir surface elevation is regulated by the eight Tainter gates of the spillway. Each gate is approximately 110 feet long and 34 feet high (top elevation 562 feet when closed), spanning between the 15-foot-wide concrete piers. The depth of water at the trashracks is approximately 65 feet.

5.2.2 Intake Specifications

The intake structure is 126 feet-long with four sections of intake screens. Each intake screen is 21 feet-wide and 88 feet high and has a set of steel trashracks with bar spacing of 6.125 inches center-to-center. The intakes can be sealed using stoplogs. The trash racks are equipped with an automated trash rake, which allow operating time setting changes to accommodate changes in debris loading with river flow conditions. There are two sets of stoplogs, so both units can be dewatered at the same time.

Table 5-1. Racine Pool and Intake Specifications

Parameter	Specification
Pool Surface Area (acres)	5,300
Pool Elevation (feet at msl)	560.0 (22 feet gross head)
Water Depth at Screens (feet)	65
Intake Length (feet)	126
Number of Screens	4
Intake Dimensions (W x H feet)	21 x 88
Screen Slope (percent)	20
Trashrack Spacing (in)	6.125 inches center-to-center

5.2.3 Intake Flows

River flow from 4,000 cfs up to about 32,000 cfs (maximum hydraulic capacity of the Project depending on head across the structure) is generally released through the Project. The Project does not have any low-level outlet gates or trash gates (of any significant size) in which to release flows. Flows greater than approximately 32,000 cfs are released by the USACE through the Tainter gates. For river flows between approximately 31,300 cfs and 150,000 cfs, discharges are made through both the dam and the Project. For river flows between approximately 150,000 cfs (maximum threshold of river flow when the Project can operate) to approximately 225,000 cfs (open river conditions when all Tainter gates are raised clear of the water), discharges are made through the dam only (Table 5-2).

The maximum threshold of river flow when the Project can operate is 150,000 cfs. U.S. Geological Survey (USGS) gage data (USGS 03216600 Ohio River at Greenup Dam) that was linearly prorated to the Project based on the drainage area, was evaluated from October 1986 to October 2016 and showed that river flows exceeded the maximum threshold of river flow when the Project can operate an average of 26 days per year (Figure 5-2), indicating that the Project could theoretically operate at maximum turbine discharge approximately 57 percent of the time (particularly during the higher flow months of January, February, March, and April), Figure 5-3.

Table 5-2. Racine Hydroelectric Project Specifications

Parameter	Specification
Installed Capacity (MW)	48 (24 x 2 units)
Operating Mode	Run of River
Unit Type	Esher-Wyss
Unit Orientation	Horizontal
Number of Units	2
Max. Hydraulic Capacities of Each Unit (cfs)	16,000
Min. Hydraulic Capacities of Each Unit (cfs)	4,000
Turbine Efficiency Maximum (% of max discharge)	66-67%
Runner Diameter (ft)	25
Runner Speed (rpm)	160
Number of Blades	4
Turbine Rated Head (ft)	22
Maximum Threshold of River Flow when Project can Operate (cfs)	150,000
Minimum Operating Flow (cfs)	4,000
Minimum Intake Velocity (ft/s)	2.2
Maximum Intake Velocity (ft/s)	5.86

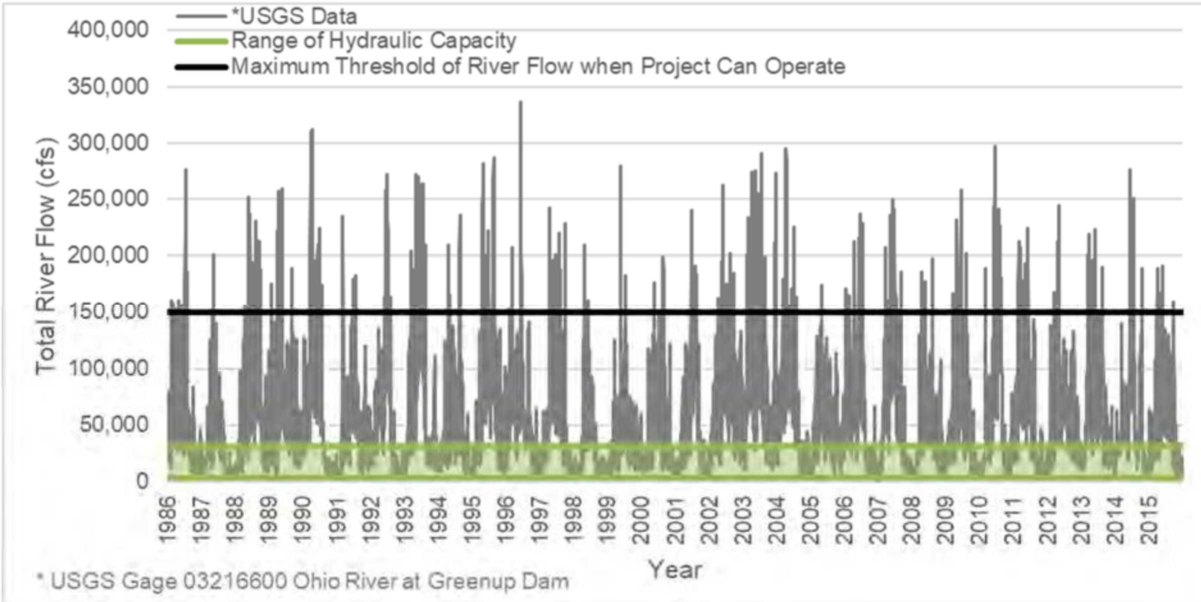


Figure 5-2. U.S. Geological Survey (USGS) Gage Data versus Range of Hydraulic Capacity (4,000 – 32,000 cfs) and Maximum Threshold of River Flow (150,000 cfs) at Racine Hydroelectric Project

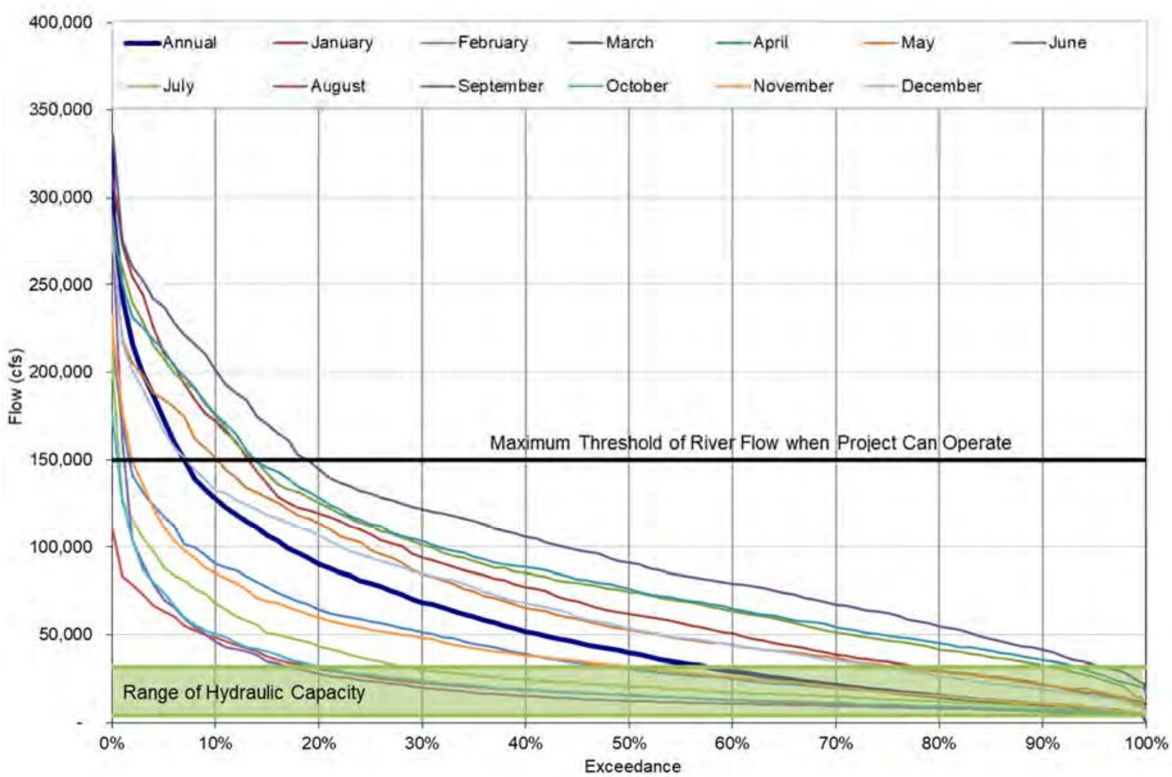


Figure 5-3. Flow Exceedance for the Period of Record (1986 – 2016) at Racine Hydroelectric Project Operating Range

5.2.4 Intake Velocities

The calculated approach velocity at the Project 1-foot in front of the intake racks is 5.86 feet per second (fps) based on the intake structure opening dimensions, normal water depth at the screens (65-ft) and the maximum flow (32,000 cfs) through the four 21-ft x 88-ft screens (Table 5-2).

5.3 Desktop Review of Entrainment and Impingement Potential

5.3.1 Fish Community and Target Species

Boat electrofishing was performed at three sampling locations downstream of the Racine Locks and Dam in the Fall of 2019 and Spring of 2020. Daytime trawl net sampling was also conducted at three locations downstream of Racine Locks and Dam in Fall 2019. Details of the methods and preliminary results of the study are included in the Fisheries Study Report. The relative abundance (RA) of each species collected in all the surveys combined are presented in Table 5-3. These results have been used in the desktop entrainment estimates provided in Section 5.3.5. Emerald Shiner (*Notropis atherinoides*) were the most abundant species collected in the 2019 and 2020 fish surveys, comprising 69 percent of the catch combined. Channel Catfish (*Ictalurus punctatus*) was the next most abundant species collected, making up 6 percent of the catch, followed by Gizzard Shard, Freshwater Drum (*Aplodinotus grunniens*), Sauger (*Sander canadensis*), Channel Shiner (*Notropis wickliffi*), Hybrid Striped Bass (*Morone chrysops* x *M. saxatilis*), River Shiner (*Notropis blennius*), Smallmouth Buffalo (*Ictiobus bubalus*) and River Carpsucker (*Carpiodes carpio*), each comprising less than five percent of the catch. Twenty-two other species were collected in smaller numbers during the 2019 and 2020 fish surveys.

Table 5-3. Fish Species Collected from Electrofishing and Daytime Trawl Sampling Sites Downstream of the Racine Locks and Dam in 2019 and 2020

Common Name	Scientific Name	Number Collected	RA%
Emerald Shiner	*Notropis atherinoides*	833	69.1
Channel Catfish	*Ictalurus punctatus*	72	6.0
Gizzard Shad	*Dorosoma cepedianum*	43	3.6
Freshwater Drum	*Aplodinotus grunniens*	42	3.5
Sauger	*Sander canadensis*	35	2.9
Channel Shiner	*Notropis wickliffi*	30	2.5
Hybrid Striped Bass	*Morone chrysops* x *M. saxatilis*	17	1.4
River Shiner	*Notropis blennius*	16	1.3
Smallmouth Buffalo	*Ictiobus bubalus*	15	1.2
River Carpsucker	*Carpiodes carpio*	14	1.2
Golden Redhorse	*Moxostoma erythrurum*	10	0.8
Smallmouth Redhorse	*Moxostoma breviceps*	10	0.8
Longnose Gar	*Lepisosteus osseus*	10	0.8

Common Name	Scientific Name	Number Collected	RA%
Silver Chub	*Macrhybopsis storeriana*	9	0.7
Quillback	*Carpiodes cyprinus*	8	0.7
Bluegill	*Lepomis macrochirus*	6	0.5
Silver Redhorse	*Moxostoma anisurum*	5	0.4
Walleye	*Sander vitreus*	4	0.3
Largemouth Bass	*Micropterus salmoides*	3	0.2
White Bass	*Morone chrysops*	3	0.2
Spotted Bass	*Micropterus punctulatus*	2	0.2
Common Carp	*Cyprinus carpio*	2	0.2
Northern Hogsucker	*Hypentelium nigricans*	2	0.2
Smallmouth Bass	*Micropterus dolomieu*	2	0.2
Highfin Carpsucker	*Carpiodes velifer*	2	0.2
Logperch	*Percina caprodes*	1	0.1
Spotted Sucker	*Minytrema melanops*	1	0.1
Yellow Perch	*Perca flavescens*	1	0.1
Spotfin Shiner	*Cyprinella spiloptera*	1	0.1
Green Sunfish	*Lepomis cyanellus*	1	0.1
Skipjack Herring	*Alosa chrysochloris*	1	0.1
Silver Redhorse	*Moxostoma anisurum*	1	0.1
American Eel[1]	*Anguilla rostrata*	1	0.1
Bluntnose Minnow[1]	*Pimephales notatus*	1	0.1
White Crappie[1]	*Pomoxis annularis*	1	0.1
Grand Total		**1,205**	**100.0**

[1] Species were not collected in the 2019 and 2020 surveys but assumed 1 individual was collected for the purposes of this analysis, because they were included in the target species list.

5.3.2 Trashrack Exclusion and Intake Avoidance

Burst swim speeds for target or representative species were compared to the estimated intake velocity to evaluate fish susceptibility to intake flows at the Project. Burst swim speed is the swim speed used to escape predation, maneuver through high flows, or in this case, escape intake velocities and avoid entrainment. Burst swim speed data were compiled from the literature (Bell 1991), however if species-specific data were unavailable, burst swim speed or darting speed was calculated as 2x critical swim speed identified in the literature.

As described in Section 5.2.4 of this study report, river flow of up to approximately 32,000 cfs can be used for Project operations, corresponding to a maximum approach velocity of 5.86 fps in front of the intake. The burst speeds shown in Table 5-4 indicate that 15 percent of the target species would be able to avoid entrainment at the Project. Larval and juvenile life stages, in most cases, would be unable to avoid entrainment at the Project given that estimated burst speeds are less than approach velocities at the intake.

A desktop evaluation using Ohio River morphometrics and flow data from the nearest upstream gage (USGS 03216600 Ohio River at Greenup Dam) indicates that the velocity of the river in the vicinity of the Project, while often lower than that estimated in front of the intake, can sometimes be as high as approximately 6 fps. Fish species and life stages with swim speeds capable of overcoming velocities of approximately 6 fps, in normal river conditions, would be able to avoid the approach velocity at the intake structure.

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

Common Name	Scientific Name	Age	Length[1]	Burst Swim Speed (fps)[2]	Reference
Blacknose Dace[3]	*Rhinichthys atratulus*	Juvenile	1.69	2.54	Katopodis and Gervais 2016
Blacknose Dace[3]	*Rhinichthys atratulus*	Adult	1.60-1.74 (SL)	2.02-3.02	Nelson et al. 2003
Blacktail Shiner[3]	*Cyprinella venusta*	Adult	1.85	4.01	Katopodis and Gervais 2016
Bluegill[4]	*Lepomis macrochirus*	Juvenile	1.97	2.66	Katopodis and Gervais 2016
Bluegill[4]	*Lepomis macrochirus*	Adult	3.94-5.91	2.44	Gardner et al. 2006
Bullhead Minnow[3]	*Pimephales vigilax*	Adult	1.97	2.6	Katopodis and Gervais 2016
Central Stoneroller[3]	*Campostoma anomalum*	Juvenile / Adult	1.42-4.33	1.84-3.52	Layher 1993
Central Stoneroller[3]	*Campostoma anomalum*	Juvenile	1.81	4.13	Katopodis and Gervais 2016
Channel Catfish x Blue Catfish[5]	*Ictalurus punctatus x I. furcatus*	Juvenile	6.30-9.06	7.88	Beecham et al. 2009
Darters[6]	*Etheostoma* spp.	Adult	1.42	2.62	Katopodis and Gervais 2016
Eastern Shiners[3]	*Notropis* spp.	Adult	1.65	3.38	Katopodis and Gervais 2016
Emerald Shiner[3]	*Notropis atherinoides*	Adult	2.5	4	Bell 1991
Fathead Minnow[3]	*Pimephales promelas*	Adult	1.85	2.16	Katopodis and Gervais 2016
Golden Shiner[3]	*Notemigonus crysoleucas*	Adult	1.54-4.33	2.02-4.68	Layher 1993
Greenside Darter[7]	*Etheostoma blennioides*	Adult	1.57-2.68	1.02-2.64	Layher 1993
Herring[10]	Clupeidae	Fry	0.4-0.8	0.0-1.0	Bell 1991
Herring[10]	Clupeidae	Juvenile / Adult	6.0-11.0	5.0-7.0	Bell 1991

Common Name	Scientific Name	Age	Length[1]	Burst Swim Speed (fps)[2]	Reference
Largemouth Bass[11]	*Micropterus salmoides*	Juvenile	3.5-4.72 (FL)	2.32-3.28	Farlinger and Beamish 1977
Largemouth Bass[11]	*Micropterus salmoides*	Juvenile	5.04	2.46	Katopodis and Gervais 2016
Longear Sunfish[4]	*Lepomis megalotis*	Juvenile / Adult	2.20-5.35	1.24-2.56	Layher 1993
Longnose Sucker[7]	*Catostomus catostomus*	Juvenile / Adult	3.9-16.0	4.0-8.0	Bell 1991
Mimic Shiner[3]	*Notropis volucellus*	Juvenile	1.38	2.86	Katopodis and Gervais 2016
Proserpine Shiner[3]	*Cyprinella proserpina*	Adult	1.57	3.99	Katopodis and Gervais 2016
Pumpkinseed[4]	*Lepomis gibbosus*	Adult	5	2.44	Brett and Sutherland 1965
Red Shiner[3]	*Cyprinella lutrensis*	Adult	1.69	4.67	Katopodis and Gervais 2016
Redbreast Sunfish[4]	*Lepomis auritus*	Juvenile	1.89	2.32	Katopodis and Gervais 2016
Redfin Shiner[3]	*Lythrurus umbratilis*	Adult	1.77	3.61	Katopodis and Gervais 2016
Ribbon Shiner[3]	*Lythrurus fumeus*	Juvenile	1.3	2.5	Katopodis and Gervais 2016
Robust Redhorse[7]	*Moxostoma robustum*	Larvae	0.51-0.8	0.46-0.76	Reutz and Jennings 2000
Satinfin Shiners[3]	*Cyprinella* spp.	Adult	2.09	4.44	Katopodis and Gervais 2016
Smallmouth Bass	*Micropterus dolomieu*	Larvae	0.55-0.98	1.2-1.74	Larimore and Deuver 1968
Smallmouth Bass	*Micropterus dolomieu*	Juvenile	3.58-3.66	2.6-3.6	Webb 1998
Smallmouth Bass	*Micropterus dolomieu*	Adult	10.3-14.9	3.2-7.8	Bunt et al. 1999
Smallmouth Bass	*Micropterus dolomieu*	Adult	11.81	5.77	Katopodis and Gervais 2016
Spottail Shiner[3]	*Notropis hudsonius*	Juvenile	2.01	1.44	Katopodis and Gervais 2016
Striped Bass[12]	*Morone saxatilis*	Fry	0.5-1.0	0.4-1.0	Bell 1991
Suckers[7]	*Catostomus* spp.	Adult	7.05	8.33	Katopodis and Gervais 2016
Sunfish Species[4]	*Lepomis* spp.	Adult	3.19	4.35	Katopodis and Gervais 2016
Walleye[8]	*Sander vitreus*	Juvenile	3.15 (FL)	2.48	Peake et al. 2000
Walleye[8]	*Sander vitreus*	Juvenile	6.30 (FL)	6.02	Peake et al. 2000

Common Name	Scientific Name	Age	Length[1]	Burst Swim Speed (fps)[2]	Reference
Walleye[8]	*Sander vitreus*	Adult	13.78-22.44 (FL)	5.48-8.57	Peake et al. 2000
White Crappie[9]	*Pomoxis annularis*	Juvenile	3.03	0.36-1.04	Smiley and Parsons 1997
White Sucker[7]	*Catostomus commersonii*	Adult	6.69-14.57 (FL)	4.96	Hunter and Mayor 1986
Yellow Perch	*Perca flavescens*	Juvenile	3.5	2	Katopodis and Gervais 2016
Yellow Perch	*Perca flavescens*	Adult	9.6	5.6	Katopodis and Gervais 2016

[1] Lengths are Total Length (TL) unless otherwise noted (SL: standard length; FL: fork length), [2] Burst swim speeds were calculated as 2x critical speed (Bell 1991), unless burst speed was provided in the literature. [3] Used to represent the Shiners, Chubs, and Minnows group. [4] Used to represent the *Lepomis* Sunfishes group. [5] Used to represent the Catfishes group.[6] Used to represent the Darters group. [7] Used to represent the Suckers, Buffalo and Redhorse group. [8] Used to represent Sauger.[9] Used to represent Black Crappie. [10] Used to represent Gizzard Shad and Skipjack Herring. [11] Used to represent Spotted Bass. [12] Used to represent Hybrid Striped Bass and White Bass.

5.3.3 Impingement Assessment

Proportional estimates of body width to length (scaling factor) were compiled by Smith (1985) for all the target and representative species in this study. The scaling factor multiplied by the maximum recorded length for the species (Jenkins and Burkhead 1993), or maximum recorded length from field data collected during the Fisheries Study, resulted in a corresponding width which was then compared to the trash rack spacing at the Project (6.125 inch) (Table 5-5).

Although impingement cannot be completely ruled out or avoided at the Racine intake structure, based on the trash rack bar spacing and swimming ability (both burst and critical swim speeds) of fish occurring in the Ohio River near the intake structure, the overall risk of fish impingement is relatively low at Racine. In nearly all instances, the minimum size of the species listed below is larger than the maximum size to which the species can grow.

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

Common Name	Body Scaling Factor	Maximum Length (in)	Fish Width (in)	Minimum Size (in) Excluded by Trash Racks (6.125 in)
American Eel	0.04	60.0	2.4	153.1
Bluegill	0.132	7.5	1.0	46.4
Bluntnose Minnow	0.119	3.8	0.5	51.5
Channel Catfish	0.156	19.7	3.1	39.3
Channel Shiner	0.108	3.3	0.4	56.7
Emerald Shiner	0.108	3.8	0.4	56.7
Freshwater Drum	0.109	13.4	1.5	56.2
Gizzard Shad	0.105	14.1	1.5	58.3
Golden Redhorse	0.127	22.2	2.8	48.2

Common Name	Body Scaling Factor	Maximum Length (in)	Fish Width (in)	Minimum Size (in) Excluded by Trash Racks (6.125 in)
Green Sunfish	0.154	7.1	1.1	39.8
Highfin Carpsucker	0.146	13.6	2.0	42.0
Hybrid Striped Bass	0.102	21.3	2.2	60.0
Largemouth Bass	0.134	12.5	1.7	45.7
Logperch	0.104	4.1	0.4	58.9
Longnose Gar	0.049	34.3	1.7	125.0
Northern Hogsucker	0.146	6.3	0.9	42.0
Quillback	0.14	16.9	2.4	43.8
River Carpsucker	0.14	17.9	2.5	43.8
River Redhorse	0.127	24.2	3.1	48.2
River Shiner	0.108	2.4	0.3	56.7
Sauger	0.14	16.7	2.3	43.8
Silver Chub	0.102	5.4	0.6	60.0
Silver Redhorse	0.127	22.4	2.9	48.2
Skipjack Herring	0.099	15.2	1.5	61.9
Smallmouth Bass	0.128	12.6	1.6	47.9
Smallmouth Buffalo	0.14	23.4	3.3	43.8
Smallmouth Redhorse	0.127	20.9	2.6	48.2
Spotfin Shiner	0.11	2.6	0.3	55.7
Spotted Bass	0.128	12.8	1.6	47.9
Spotted Sucker	0.146	12.2	1.8	42.0
Walleye	0.125	24.9	3.1	49.0
White Bass	0.102	13.6	1.4	60.0
White Crappie	0.085	12.6	1.1	72.1
Yellow Perch	0.114	5.9	0.7	53.7

[1] Scaling factor (Smith 1985) expresses body width as a proportion of length based on proportional measurements. [2] Channel Shiner not represented in Smith (1985); used scaling factor of Emerald Shiner. [3] Highfin Carpsucker not represented in Smith (1985); used scaling factor of White Sucker. [4] River Carpsucker not represented in Smith (1985); used scaling factor of Quillback. [5] River Redhorse not represented in Smith (1985); used scaling factor of Smallmouth Redhorse. [6] Silver Redhorse not represented in Smith (1985); used scaling factor of Smallmouth Redhorse. [7] Smallmouth Buffalo not represented in Smith (1985); used scaling factor of Quillback. [8] Spotted Sucker not represented in Smith (1985); used scaling factor of White Sucker. [9] Bluntnose Minnow not collected, used maximum length of collected Emerald Shiner. [10] White Crappie not collected, used Smallmouth Bass maximum collected length, *Species and maximum length collected in the 2019 and 2020 Fish Community Study. in=inch

5.3.4 Early Life Stage Entrainment Susceptibility

The early life stages of fish (eggs and larvae) cannot move independently (eggs) or have limited swimming ability (larvae), and therefore are unable to overcome currents, thus leaving them susceptible to entrainment at the Project. An assessment of target and representative species shows that the majority of species present in the Ohio River in the Project area have spawning periods around April, May and June, with eggs developing into larvae from May to August (Table 5-6).

Some species or groups, such as *Lepomis* sunfish (*Lepomis* spp.), have prolonged spawning periods followed by prolonged egg and larval development periods, thus increasing risk of entrainment. However, members of the genus *Lepomis*, like others in the Centrarchidae family, create nests along shorelines with preference for cover such as vegetation and woody debris; therefore, entrainment risk for these early life stages is low. Additionally, most freshwater fish species have demersal and/or adhesive eggs and larvae that remain close to areas with protective cover, which also lowers risk of entrainment (Cada 1991).

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

Common Name	Water Temp	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Bluegill	26.5												
Bluntnose Minnow	24												
Channel Catfish	20												
Emerald Shiner	21.5												
Freshwater Drum	22												
Gizzard Shad	15.5												
Golden Redhorse	17-22												
Green Sunfish	16-28												
Highfin Carpsucker	19-28												
Largemouth Bass	17												
Logperch	12.5												
Longnose Gar	19-21												
Northern Hogsucker	unknown												
Quillback	19-28												
River Carpsucker	21												
River Shiner	unknown												
Sauger	9												
Silver Chub	20												
Silver Redhorse	14												
Skipjack Herring	unknown												
Smallmouth Bass	19												
Smallmouth Buffalo	15.6-18.3												
Smallmouth Redhorse	unknown												
Spotfin Shiner	21-24												
Spotted Bass	19.5												
Spotted Sucker	16.5												
Walleye	5.6-10												
White Bass	16												
White Crappie	14-23												
Yellow Perch	7.2-11.1												

Spawning Period (Stauffer et al. 1995; Jenkins and Burkhead 1993; Holland-Bartels et al. 1990)
Eggs and larvae (estimated to begin two-thirds of the way through the spawning period and lasting 60 days post spawn)

5.3.5 Monthly Entrainment Estimates

The total annual generation (in terms of flow) estimated at the Project for an average water year (POR) was 180,687 (1,000 cfs-hours), with a range of 165,696 to 217,805 based on the dry and wet years, respectively (Table 5-7).

Table 5-7. Estimated Generation (1,000 cfs-hours) at Racine Hydroelectric Plant

1,000 CFS Hours	Dry Year	Wet Year	Normal Year
Month	**1988**	**2004**	**2012**
1	16,784	16,739	16,896
2	16,545	16,241	21,504
3	22,174	16,896	19,200
4	21,789	14,592	19,847
5	21,561	18,432	16,117
6	6,264	21,063	10,288
7	6,289	20,677	11,300
8	5,428	19,918	9,132
9	7,318	11,957	9,646
10	7,751	20,599	9,984
11	19,047	23,025	17,870
12	14,745	17,664	18,904
Annual	**165,696**	**217,805**	**180,687**

Entrainment estimates peak from October to December, with a smaller peak in March (Figure 5-4). Peaking months may correspond to spawning movements (April), recruitment to sufficient size to be collected in entrainment study sampling nets (October - December), or large storm/flow events. Emerald Shiner and Gizzard Shad comprised the majority of the estimated entrainment at the Project, with Emerald Shiner dominating the entrainment from January to June and Gizzard Shad dominating the entrainment from July through December. The high relative abundance of these two species in the Project area likely contributes to their dominance in the entrainment estimates. Additionally, it is likely that some portion of the Gizzard Shad entrainment in the colder months is due to cold stress/shock.

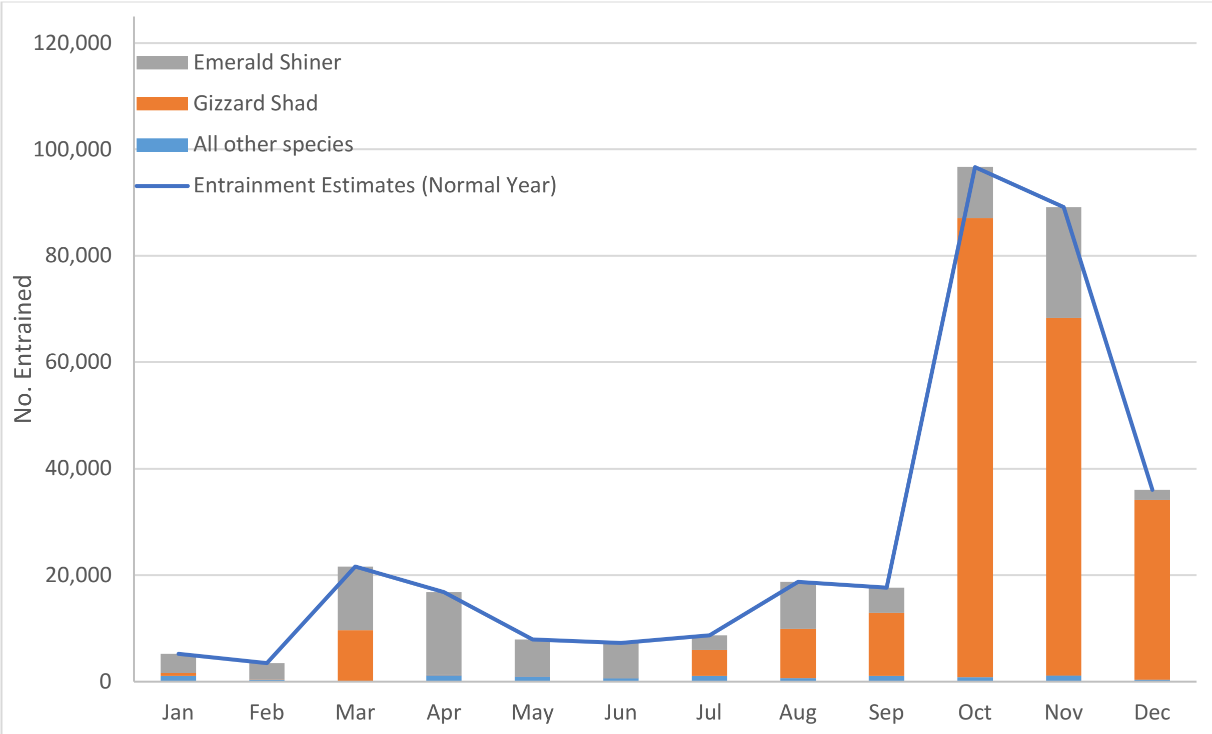


Figure 5-4. Average Monthly Entrainment Estimates and Species Composition based on the EPRI (1997) Entrainment Database and Monthly Generation at Racine Hydroelectric Plant in a Normal Water Year, Adjusted for Cold Stress and Relative Abundance of Target Species

The annual number of fish entrained at Racine Hydroelectric Plant ranged from 312,136 to 490,042, with 329,450 fish estimated as entrained annually in a normal water year. Table 5-8, Table 5-9 and Table 5-10 show the entrainment estimates at the Project by species and month for a normal, dry and wet water year, respectively. Although these estimates have been adjusted for cold stress for all Clupeidae, Gizzard Shad comprised a majority of the fish entrained (68% annually), with peak entrainment for this species occurring in October and November (86,264 and 67,215 fish, respectively) (Figure 5-4). Emerald Shiner was estimated as the second-most entrained species, comprising 29 percent of the annual entrainment estimate. Estimated entrainment of Emerald Shiner peaked in April and November (15,566 and 20,786 fish, respectively). All other species combined represented three percent of the total estimated fish entrained. Appendix B includes monthly entrainment rates for each target species from the EPRI database used to calculate entrainment estimates adjusted for cold stress and for the relative abundance in the Project area. Appendix C includes monthly estimates of entrainment for each target species and length class for dry, normal and wet water years.

Table 5-8. Entrainment Estimates Based on a Normal Water Year (2012) at Racine Hydroelectric Plant

Target Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
American Eel[1]	0	0	0	0	4	7	10	3	5	7	35	30	102
Bluegill	5	4	13	661	176	58	198	131	466	263	120	12	2,107
Bluntnose Minnow[1]	4	1	0	2	1	0	1	0	0	0	0	0	10
Channel Catfish	34	4	15	27	5	6	484	153	31	10	32	0	800
Channel Shiner	0	0	0	0	37	0	0	11	7	4	48	0	107
Common Carp	2	0	0	1	1	1	1	1	0	0	1	0	8
Emerald Shiner	3,596	3,086	11,947	15,566	6,904	6,614	2,744	8,835	4,765	9,631	20,786	1,964	96,440
Freshwater Drum	0	0	0	0	30	9	92	93	379	182	90	0	875
Gizzard Shad	537	38	9,556	80	27	9	4,888	9,266	11,851	86,264	67,215	33,748	223,479
Golden Redhorse	0	0	0	1	5	1	0	1	1	0	0	0	10
Green Sunfish	0	0	1	1	1	0	0	0	0	0	0	0	3
Highfin Carpsucker	0	0	0	0	2	0	2	1	0	0	0	0	5
Hybrid Striped Bass	0	0	2	7	34	3	10	51	5	4	3	0	121
Largemouth Bass	10	4	4	12	1	45	49	6	8	11	23	4	176
Logperch	0	1	0	6	4	5	14	1	2	1	1	0	35
Longnose Gar	0	2	0	0	0	0	0	2	3	5	0	0	12
Northern Hogsucker	23	12	1	27	2	1	1	1	0	5	9	3	86
Quillback	0	0	0	0	0	0	0	0	0	0	0	0	0
River Carpsucker	0	0	0	0	17	0	11	9	0	0	0	0	36
River Redhorse	0	0	0	0	0	2	0	0	0	0	0	0	2
River Shiner	0	0	0	0	20	0	0	6	3	2	26	0	57
Sauger	29	11	14	177	590	390	21	48	74	109	31	0	1,492
Silver Chub	0	237	14	58	3	4	1	0	1	8	57	0	382
Silver Redhorse	0	0	0	2	1	0	0	0	0	1	0	0	6

Target Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Skipjack Herring	954	64	48	2	5	13	21	104	36	55	662	285	2,248
Smallmouth Bass	2	1	1	1	2	9	21	6	13	5	3	1	63
Smallmouth Buffalo	0	0	0	0	1	0	0	0	0	0	0	0	1
Smallmouth Redhorse	0	0	0	1	5	1	0	1	1	0	0	0	10
Spotfin Shiner	0	0	0	1	0	0	1	0	0	0	0	0	3
Spotted Bass	0	0	0	0	0	0	0	0	0	0	0	0	0
Spotted Sucker	0	0	0	0	0	0	0	0	0	0	0	0	0
Walleye	12	3	1	8	17	42	63	11	9	10	4	4	182
White Bass	0	0	0	1	6	1	2	9	1	1	1	0	21
White Crappie[1]	1	0	1	3	1	3	4	2	1	1	2	2	20
Yellow Perch	14	20	11	198	17	61	54	5	25	133	5	8	551
Total	**5,223**	**3,487**	**21,628**	**16,842**	**7,917**	**7,287**	**8,693**	**18,757**	**17,687**	**96,713**	**89,153**	**36,063**	**329,450**

[1] Species was not collected in the Racine Pool during Fall 2019-Spring 2020. Assumed one individual collected for entrainment estimates

Table 5-9. Entrainment Estimates Based on a Dry Water Year (1988) at Racine Hydroelectric Plant

Target Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
American Eel[1]	0	0	0	0	2	2	3	1	2	3	19	12	44
Bluegill	5	3	15	726	235	35	110	78	353	204	128	10	1,902
Bluntnose Minnow[1]	4	1	0	2	1	0	0	0	0	0	0	0	10
Channel Catfish	1,200	122	604	1,071	259	134	9,704	3,266	838	274	1,214	6	18,691
Channel Shiner	0	0	0	0	50	0	0	7	5	3	52	0	116
Common Carp	2	0	1	1	1	1	1	1	0	0	1	0	7
Emerald Shiner	3,572	2,374	13,798	17,089	9,237	4,028	1,527	5,251	3,615	7,477	22,155	1,532	91,656
Freshwater Drum	0	0	0	0	40	5	51	55	287	142	96	0	677

Target Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Gizzard Shad	533	29	11,037	87	37	5	2,720	5,507	8,991	66,969	71,642	26,324	193,881
Golden Redhorse	0	0	0	1	6	1	0	1	1	0	0	0	10
Green Sunfish	0	0	1	1	1	0	0	0	0	0	0	0	3
Highfin Carpsucker	0	0	0	0	3	0	1	1	0	0	0	0	5
Hybrid Striped Bass	0	0	2	8	46	2	6	30	4	3	3	0	105
Largemouth Bass	10	3	4	13	1	27	27	3	6	9	24	3	132
Logperch	0	1	0	7	6	3	8	0	1	1	1	0	28
Longnose Gar	0	1	0	0	0	0	0	1	2	4	0	0	9
Northern Hogsucker	23	9	1	29	2	1	1	0	0	4	9	2	84
Quillback	0	0	0	0	1	0	0	0	0	0	0	0	1
River Carpsucker	0	0	0	0	22	0	6	5	0	0	0	0	34
River Redhorse	0	0	0	0	0	1	0	0	0	0	0	0	1
River Shiner	0	0	0	0	26	0	0	4	3	1	28	0	62
Sauger	29	8	16	194	789	237	12	29	56	85	33	0	1,486
Silver Chub	0	182	16	64	4	2	0	0	1	6	61	0	336
Silver Redhorse	0	0	0	2	2	0	0	0	0	1	0	0	6
Skipjack Herring	948	49	55	2	6	8	11	62	27	42	705	223	2,139
Smallmouth Bass	2	0	1	1	3	6	11	3	10	4	3	1	45
Smallmouth Buffalo	0	0	0	0	2	0	0	0	0	0	0	0	2
Smallmouth Redhorse	0	0	0	1	6	1	0	1	1	0	0	0	10
Spotfin Shiner	0	0	0	1	0	0	0	0	0	0	0	0	2
Spotted Bass	0	0	0	0	0	0	0	0	0	0	0	0	0
Spotted Sucker	0	0	0	0	0	0	0	0	0	0	0	0	0
Walleye	12	2	1	8	23	25	35	6	7	7	5	3	135
White Bass	0	0	0	1	8	0	1	5	1	1	1	0	18

Target Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
White Crappie[1]	1	0	1	3	1	2	2	1	1	0	2	1	16
Yellow Perch	14	15	13	217	22	37	30	3	19	104	6	6	486
Total	**6,355**	**2,802**	**25,566**	**19,532**	**10,842**	**4,565**	**14,269**	**14,322**	**14,231**	**75,343**	**96,186**	**28,123**	**312,136**

[1] Species was not collected in the Racine Pool during Fall 2019-Spring 2020. Assumed one individual collected for entrainment estimates

Table 5-10. Entrainment Estimates Based on a Wet Water Year (2004) at Racine Hydroelectric Plant

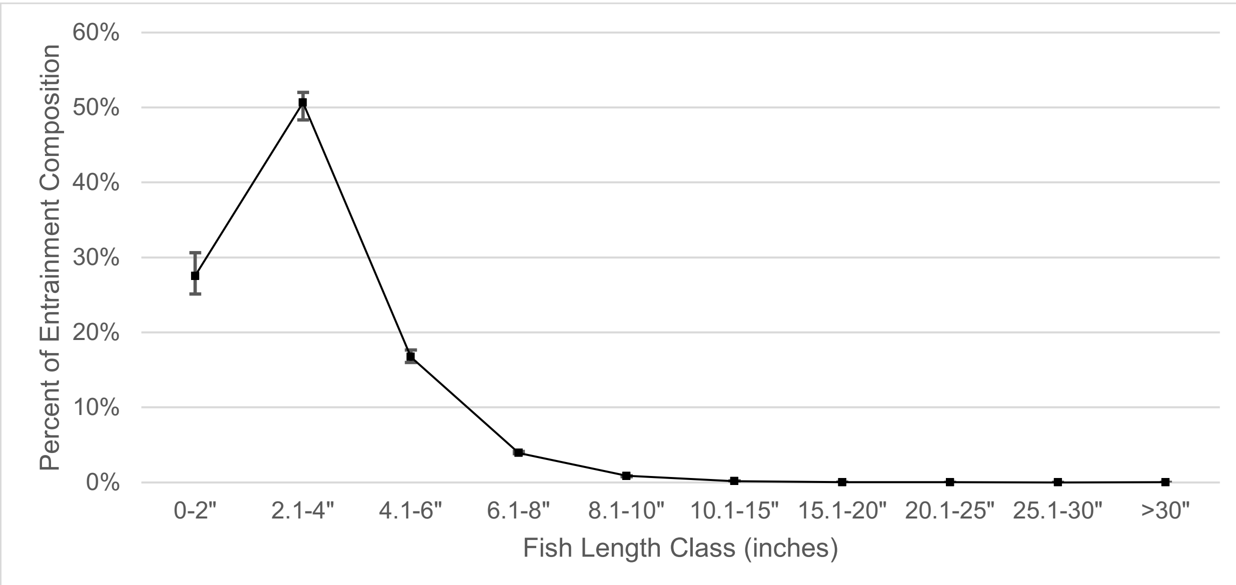
Target Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
American Eel[1]	0	0	0	0	4	14	19	7	7	14	46	28	139
Bluegill	5	3	11	486	201	119	363	286	577	542	155	12	2,759
Bluntnose Minnow[1]	4	1	0	1	1	1	1	0	0	0	0	0	11
Channel Catfish	33	3	13	20	6	13	886	333	38	20	41	0	1,406
Channel Shiner	0	0	0	0	42	0	0	25	8	7	62	0	145
Common Carp	2	0	0	0	1	2	2	2	0	1	1	0	12
Emerald Shiner	3,563	2,330	10,514	11,445	7,896	13,542	5,021	19,270	5,907	19,871	26,782	1,835	127,977
Freshwater Drum	0	0	0	0	34	18	168	202	470	377	116	0	1,385
Gizzard Shad	532	29	8,409	59	31	18	8,945	20,211	14,690	177,977	86,605	31,534	349,039
Golden Redhorse	0	0	0	1	5	3	1	2	1	0	0	0	13
Green Sunfish	0	0	1	1	1	0	0	0	0	0	0	0	3
Highfin Carpsucker	0	0	0	0	3	0	3	3	0	0	0	0	8
Hybrid Striped Bass	0	0	2	5	39	7	18	111	7	8	4	0	202
Largemouth Bass	10	3	3	9	1	92	90	12	10	23	29	4	287
Logperch	0	1	0	4	5	10	25	2	2	3	1	0	53
Longnose Gar	0	1	0	0	0	0	0	3	4	10	0	0	19
Northern Hogsucker	23	9	1	20	2	2	3	1	0	11	11	3	87

Target Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Quillback	0	0	0	0	1	0	0	0	0	0	0	0	1
River Carpsucker	0	0	0	0	19	0	20	19	0	0	0	0	58
River Redhorse	0	0	0	0	0	4	0	0	0	0	0	0	4
River Shiner	0	0	0	0	23	0	0	13	4	4	33	0	77
Sauger	29	8	12	130	674	798	38	105	91	225	40	0	2,150
Silver Chub	0	179	12	43	3	8	2	0	1	17	73	0	338
Silver Redhorse	0	0	0	1	2	1	1	0	0	2	0	0	8
Skipjack Herring	945	48	42	2	5	26	38	227	44	113	853	267	2,610
Smallmouth Bass	2	0	1	1	2	19	38	12	16	10	3	1	105
Smallmouth Buffalo	0	0	0	0	2	0	0	0	0	0	0	0	2
Smallmouth Redhorse	0	0	0	1	5	3	1	2	1	0	0	0	13
Spotfin Shiner	0	0	0	1	0	1	1	0	0	0	0	0	4
Spotted Bass	0	0	0	0	0	0	0	0	0	0	0	0	0
Spotted Sucker	0	0	0	0	0	0	0	0	0	0	0	0	0
Walleye	12	2	1	6	19	85	114	24	11	20	6	4	303
White Bass	0	0	0	1	7	1	3	20	1	1	1	0	36
White Crappie[1]	1	0	1	2	1	6	8	5	2	1	2	2	30
Yellow Perch	14	15	10	146	19	124	99	11	31	275	7	7	758
Total	**5,175**	**2,633**	**19,033**	**12,383**	**9,055**	**14,919**	**15,907**	**40,911**	**21,925**	**199,533**	**114,871**	**33,697**	**490,042**

[1] Species was not collected in the Racine Pool during Fall 2019-Spring 2020. Assumed one individual collected for entrainment estimates

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

According to the analysis performed for this study, fish measuring less than six inches in length were the majority (95 percent) of entrained fish (Figure 5-5), and fish less than eight inches exhibit the highest entrainment rates throughout the year (Table 5-11). Of the fish less than eight inches in length, entrainment rates in fall were greatest, suggesting these are the species likely spawned the prior spring and recently recruited to sizes large enough to be captured in the sampling nets.



Note: Error bars represent percent composition based on a Dry Water (1988) and Wet Water Year (2004) at Racine Hydroelectric Plant.

Figure 5-5. Entrainment Composition by Fish Size Class Estimates Based on a Normal Water Year (2012) at Racine Hydroelectric Plant.

Table 5-11. Entrainment Estimates by Size Class and Month Based on a Normal Water Year (2012) at Racine Hydroelectric Plant

Month	0-2"	2.1-4"	4.1-6"	6.1-8"	8.1-10"	10.1-15"	15.1-20"	20.1-25"	25.1-30"	>30"	Total/Month
Jan	1,901	2,718	517	28	35	20	2	1	0	0	**5,223**
Feb	2,190	1,053	200	16	17	11	0	0	0	0	**3,487**
Mar	4,967	6,653	9,580	101	201	126	0	0	0	0	**21,628**
Apr	2,806	13,165	636	48	159	26	1	0	0	0	**16,842**
May	1,498	5,528	175	534	60	111	10	1	0	0	**7,917**
Jun	271	6,249	204	406	9	17	67	62	0	0	**7,287**
Jul	761	2,837	4,955	22	41	66	10	1	0	0	**8,693**
Aug	1,280	9,290	6,260	1,668	119	133	7	0	0	0	**18,757**
Sep	1,906	13,785	1,095	524	335	35	2	0	0	5	**17,687**
Oct	21,928	56,370	15,189	2,804	398	15	2	0	1	6	**96,713**
Nov	31,830	33,257	16,225	6,627	1,144	36	2	0	1	30	**89,153**
Dec	19,402	15,987	67	192	363	22	0	0	2	28	**36,063**
Total	**90,738**	**166,893**	**55,103**	**12,970**	**2,882**	**620**	**104**	**66**	**5**	**70**	**329,450**

Table 5-12. Entrainment Estimates by Size Class and Month Based on a Dry Water Year (1988) at Racine Hydroelectric Plant

Month	0-2"	2.1-4"	4.1-6"	6.1-8"	8.1-10"	10.1-15"	15.1-20"	20.1-25"	25.1-30"	>30"	Total/Month
Jan	1,888	3,747	560	28	35	94	2	1	0	0	**6,355**
Feb	1,685	920	159	12	13	12	0	0	0	0	**2,802**
Mar	5,737	8,168	11,156	120	234	151	0	0	0	0	**25,566**
Apr	3,081	15,243	931	55	177	44	1	0	0	0	**19,532**
May	2,004	7,493	333	738	86	169	18	0	0	0	**10,842**
Jun	261	3,815	138	249	9	12	41	39	0	0	**4,565**
Jul	9,731	1,676	2,761	22	27	46	4	1	1	1	**14,269**
Aug	3,078	6,207	3,766	1,032	119	116	5	0	0	0	**14,322**

Month	0-2"	2.1-4"	4.1-6"	6.1-8"	8.1-10"	10.1-15"	15.1-20"	20.1-25"	25.1-30"	>30"	Total/Month
Sep	1,852	10,753	873	422	270	57	1	0	0	2	**14,231**
Oct	17,115	43,904	11,817	2,179	311	13	2	0	0	2	**75,343**
Nov	34,008	36,451	17,376	7,071	1,221	40	2	0	1	16	**96,186**
Dec	15,133	12,476	52	150	283	17	0	0	1	11	**28,123**
Total	**95,574**	**150,852**	**49,921**	**12,077**	**2,785**	**771**	**78**	**42**	**3**	**33**	**312,136**

Table 5-13. Entrainment Estimates by Size Class and Month Based on a Wet Water Year (2004) at Racine Hydroelectric Plant

Month	0-2"	2.1-4"	4.1-6"	6.1-8"	8.1-10"	10.1-15"	15.1-20"	20.1-25"	25.1-30"	>30"	Total/Month
Jan	1,883	2,693	512	28	35	20	2	1	0	0	**5,175**
Feb	1,654	795	151	12	13	8	0	0	0	0	**2,633**
Mar	4,371	5,854	8,431	89	177	111	0	0	0	0	**19,033**
Apr	2,063	9,680	468	36	117	19	1	0	0	0	**12,383**
May	1,713	6,323	200	611	69	126	12	1	0	0	**9,055**
Jun	556	12,795	417	832	18	36	138	127	0	0	**14,919**
Jul	1,392	5,191	9,067	40	76	122	18	2	0	0	**15,907**
Aug	2,791	20,262	13,653	3,638	260	291	15	0	0	0	**40,911**
Sep	2,362	17,088	1,358	649	415	44	2	0	1	6	**21,925**
Oct	45,240	116,299	31,338	5,785	821	32	4	0	1	13	**199,533**
Nov	41,011	42,851	20,905	8,539	1,475	47	3	0	2	39	**114,871**
Dec	18,129	14,939	63	179	339	21	0	0	2	27	**33,697**
Total	**123,165**	**254,770**	**86,562**	**20,438**	**3,814**	**876**	**196**	**132**	**6**	**85**	**490,042**

5.3.6 Turbine Mortality and Estimated Survival of Target Species

Blade strike probabilities and associated survival rates of an individual of a given size were calculated for each of the ten size classes used in the entrainment analysis (Table 5-14). The calculated blade strike survival rates were then applied to the project specific entrainment estimates to determine potential fish mortalities on a monthly and annual basis during normal, dry, and wet water years (Table 5-15, Table 5-16 and Table 5-17). The inputs and results from the Turbine Blade Strike Analysis Model (USFWS 2020) are provided in Appendix D, a summary of the results is provided below.

Based on the model results, calculated blade strike probabilities were relatively low, ranging from 1.1 to 22.2 percent for the size classes evaluated and with the chance of blade strike increasing with fish size (Table 5-14). Approximately 95 percent of the fish that would be expected to be entrained at Racine were less than six inches in length (Figure 5-5), fish in these size classes have a low probability of blade strike, ranging from 1.1 to 3.3 percent. Fish larger than six inches in length exhibited a higher probability of blade strike mortality but are estimated to be entrained less frequently. Fish greater than 30 inches had the lowest survival probability due to blade strike yet represented only 0.2 percent of entrainment estimated for Racine. Annual blade strike mortalities are expected to be relatively low across all size classes, with only 1.6 percent mortality based on dry water year flows and 1.7 percent mortality based on both normal water year and wet water year flows. According to this assessment, the annual average number of fish from the target species list expected to experience immediate turbine-related mortality at the Project is approximately 5,483 fish in a normal water year (Table 5-11). Based on a dry and wet year, this number could range from approximately 5,141 to 8,276 fish (Table 5-12 and Table 5-13). The highest blade strike mortalities are predicted for October and November and the lowest are predicted for January and February.

The blade strike probability was also calculated for adult silver phase American eel ranging from 20-38 inches in length. A separate mortality coefficient value (λ) of 0.42 was used for this analysis. The blade strike probability for these size classes ranged from 23.4% for 20” eels up to 44.5% for 38” eels (Table 5-14). The probability of blade strike increased with eel size and was greater than the estimated strike probability for non-eel fish of an equivalent size. However, while known to be present in the Ohio River system in locations above and below the Project, eels were not captured during the 2019 and 2020 fisheries sampling surveys. Available historic Ohio River fisheries sampling data indicate that eel represent a very small portion of the catch, composing 0.02% and 0.01% of the fish collected. During the fall, silver eels make rapid downstream migrations; this downstream migration would result in a short term influx of eels from upstream portions of the watershed. The number of silver eels out-migrating and the timing of migration is likely to vary year to year making it difficult to assess their relative abundance relative to the resident fish community and therefore not possible to estimate the number of eels potentially struck as was done for the resident community in Tables 5-11 to 5-13. While the number of migratory eels present varies seasonally, the documented low abundance of eels in and around the Project area indicate that eels of all sizes are relatively rare. This result is not unexpected given the number of downstream dams and inland distance.

River discharge is generally lower during the fall when eels would potentially be migrating downstream (Figure 5-3), which increases the likelihood that down migrating eels would enter the turbines instead of passing over the spillway. The point at which spillage would approximately equal turbine passage discharge represents a seven percent exceedance flow for September and October and an 18 percent exceedance flow November. While downstream eel migration is known to be triggered by fall high flow events, it is possible that eels would be more likely to encounter the Project during conditions with a greater amount of spill. Overall, turbine passage is likely to be the primary downstream migration route outside of higher flow conditions. While eels may experience a higher probability of blade strike than other fish species, the large turbine diameter, Kaplan type turbine, and small number of blades minimizes the potential for blade strike relative to other turbine designs.

Table 5-14. Estimated Blade Strike and Survival Probabilities by Size Class

General Fish Community	0-2"	2.1-4"	4.1-6"	6.1-8"	8.1-10"	10.1-15"	15.1-20"	20.1-25"	25.1-30"	>30"
Blade Strike Probability	1.1%	1.1%	3.3%	4.5%	5.5%	8.3%	11.1%	13.9%	16.7%	22.2%
Survival Probability	98.9%	98.9%	96.7%	95.5%	94.5%	91.7%	88.9%	86.1%	83.3%	77.8%
American Eel	**20”**	**22”**	**24”**	**26”**	**28”**	**30”**	**32”**	**34”**	**36”**	**38”**
Blade Strike Probability	23.4%	26.3%	26.3%	30.8%	33.8%	33.8%	38.3%	39.8%	42.6%	44.5%
Survival Probability	76.6%	73.7%	73.7%	69.2%	66.2%	66.2%	61.7%	60.2%	57.4%	55.5%

Table 5-15. Blade Strike Mortalities by Size Class and Month Based on a Normal Water Year (2012) at Racine Hydroelectric Plant

Month	0-2"	2.1-4"	4.1-6"	6.1-8"	8.1-10"	10.1-15"	15.1-20"	20.1-25"	25.1-30"	>30"	Total No.
Jan	21	30	17	1	2	2	0	0	0	0	**73**
Feb	24	12	7	1	1	1	0	0	0	0	**45**
Mar	55	73	316	5	11	10	0	0	0	0	**470**
Apr	31	145	21	2	9	2	0	0	0	0	**210**
May	16	61	6	24	3	9	1	0	0	0	**121**
Jun	3	69	7	18	0	1	7	9	0	0	**115**
Jul	8	31	164	1	2	6	1	0	0	0	**213**
Aug	14	102	207	75	7	11	1	0	0	0	**416**
Sep	21	152	36	24	18	3	0	0	0	1	**255**
Oct	241	620	501	126	22	1	0	0	0	1	**1,514**
Nov	350	366	535	298	63	3	0	0	0	7	**1,623**
Dec	213	176	2	9	20	2	0	0	0	6	**429**
Total	**998**	**1,836**	**1,818**	**584**	**159**	**51**	**12**	**9**	**1**	**16**	**5,483**

Table 5-16. Blade Strike Mortalities by Size Class and Month Based on a Dry Water Year (1988) at Racine Hydroelectric Plant

Month	0-2"	2.1-4"	4.1-6"	6.1-8"	8.1-10"	10.1-15"	15.1-20"	20.1-25"	25.1-30"	>30"	Total No.
Jan	21	41	18	1	2	8	0	0	0	0	**92**
Feb	19	10	5	1	1	1	0	0	0	0	**36**
Mar	63	90	368	5	13	13	0	0	0	0	**552**
Apr	34	168	31	2	10	4	0	0	0	0	**248**
May	22	82	11	33	5	14	2	0	0	0	**170**
Jun	3	42	5	11	1	1	5	5	0	0	**72**
Jul	107	18	91	1	1	4	0	0	0	0	**224**
Aug	34	68	124	46	7	10	1	0	0	0	**290**
Sep	20	118	29	19	15	5	0	0	0	0	**207**
Oct	188	483	390	98	17	1	0	0	0	1	**1,178**
Nov	374	401	573	318	67	3	0	0	0	4	**1,741**
Dec	166	137	2	7	16	1	0	0	0	2	**332**
Total	**1,051**	**1,659**	**1,647**	**543**	**153**	**64**	**9**	**6**	**1**	**7**	**5,141**

Table 5-17. Blade Strike Mortalities by Size Class and Month Based on a Wet Water Year (2004) at Racine Hydroelectric Plant

Month	0-2"	2.1-4"	4.1-6"	6.1-8"	8.1-10"	10.1-15"	15.1-20"	20.1-25"	25.1-30"	>30"	Total No.
Jan	21	30	17	1	2	2	0	0	0	0	**72**
Feb	18	9	5	1	1	1	0	0	0	0	**34**
Mar	48	64	278	4	10	9	0	0	0	0	**414**
Apr	23	106	15	2	6	2	0	0	0	0	**154**
May	19	70	7	27	4	10	1	0	0	0	**138**
Jun	6	141	14	37	1	3	15	18	0	0	**235**
Jul	15	57	299	2	4	10	2	0	0	0	**390**
Aug	31	223	451	164	14	24	2	0	0	0	**908**
Sep	26	188	45	29	23	4	0	0	0	1	**316**

Oct	498	1,279	1,034	260	45	3	0	0	0	3	**3,123**
Nov	451	471	690	384	81	4	0	0	0	9	**2,091**
Dec	199	164	2	8	19	2	0	0	0	6	**400**
Total	**1,355**	**2,802**	**2,857**	**920**	**210**	**73**	**22**	**18**	**1**	**19**	**8,276**

6 Conclusion

Entrainment potential at Racine Hydroelectric Project will vary with river flow, species, swim speed, fish size, life stage and hydropower operations. Based on the center-to-center bar rack spacing of 6.125 inches, the potential for impingement is very low. The impingement assessment, based on site-specific fish length data and body scaling factors (Smith 1985), indicate that target species approaching the Racine intake structure would pass through the trash racks and avoid impingement on the racks. Approximately 29 percent of the target and representative species, mostly in juvenile and adult life stages, have burst swim speeds that allow them to avoid entrainment by overcoming the approach velocities at the intake. Species such as Smallmouth Bass (*Micropterus dolomieu*), Yellow Perch (*Perca flavescens*), Walleye (*Sander vitreus*), and several herring (Clupeidae), catfish (*Ictalurus* spp.) and sucker (Catostomidae) species, have burst swim speeds greater than the Project's calculated approach velocity of 5.86 fps. However, based on the intake dimensions, river dimensions near the intake, and river flows, the area of influence of the intake structure is limited to the area just upstream of the intake structure, and outside of the intake's area of influence flow velocities were generally less than the calculated approach velocity at the intake. Thus, it is likely that more than 15 percent of the target species are able to avoid entrainment into the intake. Based on the approach velocities at the intake and bar rack spacing, most species and life-stages are susceptible to entrainment at the Racine intake structure, with the exception of those juvenile and adult species with burst speeds sufficient to overcome the 5.86 fps approach velocity. American Eel, although have been documented in the Ohio River mainstem as far upstream as Pittsburg, are unlikely to occur in large numbers in the Project are due to the presence of several dams between the Project and the sheer distance from the marine waters. American Eel were not collected in the 2019 and 2020 fish surveys conducted by AEPGR and were extremely rare in historic fisheries sampling efforts in the Project area. The potential for eel entrainment is during their downstream migration during the fall, however the overall number of eels passing downstream is likely low given their scarcity in fisheries sampling data. If American Eel were present, it is unlikely that they would be entrained, as fish in the larger size classes are not predicted to be entrained in high numbers.

Based on site-specific target species and the EPRI (1997) entrainment data the estimated annual number of fish entrained at Racine is 329,450 fish in a normal water year, and ranges from 312,136 (dry year) to 490,042 (wet year) fish entrained annually. Emerald Shiner and Gizzard Shad comprise the majority of the estimated entrainment at the Project, with Emerald Shiner dominating the entrainment from January to June and Gizzard Shad dominating the entrainment from July through December. The high relative abundance of these two species in the Project area likely contributes to their dominance in the entrainment estimates. Some portion of the winter Gizzard Shad entrainment is likely also due to cold stress/shock. The majority (95%) of the estimated entrainment is from fish in the smallest size classes, 0-6 inches, with the 2.1-4-inch size classes estimated as most frequently entrained.

Although fish that approach the intake structure at Racine are generally susceptible to being entrained, the blade strike analysis indicated that most entrained fish (98.3%) are expected to survive passage through the turbines. The probability of being struck by a turbine blade ranged from 1.1 and 22.2 percent, for the size classes evaluated; however, for the fish sizes that dominated entrainment at Racine (0-6 in), the probability of blade strike is between 1.1 and 3.3 percent. Fish in larger size classes have higher blade strike probabilities but comprise the lowest percentage of the estimated entrainment. Relative to non-eel fish of a comparable size, eels experience a greater probability of blade strike. The probability of blade strike for 20-38” eels ranged from 23.4-44.5 percent. The relatively low blade strike probabilities for both groups of fish are attributed to the large 25-ft runner diameter, Kaplan type turbine, , and having only 4 turbine blades. Turbine designs with smaller diameters, greater speeds, and more blades have an increased risk of blade strike. Based on this assessment, approximately 5,500 fish per year from the target species list are expected to experience turbine related mortality. Entrainment mortalities will likely be the highest in the summer and fall months when fish are most active, and in winter and fall months for Gizzard Shad. Gizzard Shad are likely to dominate entrainment and turbine mortalities at Racine due to their high relative abundance in the Project pool, tendency to experience cold stress/shock in low temperatures (10˚C or less), and high rates of entrainment in fall and winter months.

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Appendix A

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

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

No.	Site Name	State	River	Reservoir Area (ac)	Reservoir Volume (ac-ft)	Usable Storage (ac-ft)	Fluctuation Limits (ft)	Length (mi)	Width (ft)	Total Plant Capacity (cfs)	No. Units	Operating Mode[2]	Average Velocity at Trash Rack (ft/sec)	Trash Rack Spacing (inch)
1	Belding	MI	Flat	-	-	-	-	-	-	416	2	-	-	2
2	Bond Falls	MI	W.B. Ontonagon	-	-	-	-	-	-	900	2	PK	-	3
3	Brule	WI	Brule	545	8880	530	1	5.2	340	1377	3	PK-partial	1	1.62
4	Buzzard's Roost	SC	Saluda	11404	270000	174000	-	-	-	3930	3	-	-	3.625
5	Caldron Falls	WI	Peshtigo	1180	-	-	-	-	-	1300	2	PK	-	2
6	Centralia	WI	Wisconsin	250	-	-	0	2	1400	3640	6	ROR	2.3	3.5
7	Colton	NY	Raquette	195	620	103	0.5	-	-	1503	3	PK	-	2
8	Crowley	WI	N.F. Flambeau	422	3539	-	1	-	-	2400	2	ROR	1.4	2.375
9	E. J. West	NY	Sacandaga	25940	792000	68100	23	-	-	5400	2	-	-	4.5
10	Feeder Dam	NY	Hudson	-	-	-	-	-	-	5000	5	PK	-	2.75
11	Four Mile Dam	MI	Thunder Bay	1112	2500	-	0.5	-	-	1500	3	ROR	-	2
12	Gaston Shoals	SC	Broad	300	2500	-	-	-	-	2211	3	-	-	1.5
13	Grand Rapids	MI/WI	Menominee	250	-	-	0.5	-	-	3870	5	ROR	-	1.75
14	Herrings	NY	Black	140	-	-	-	-	-	3610	3	ROR	-	4.125
15	High Falls - Beaver River	NY	Beaver	145	1058	290	-	-	-	900	3	-	0.7	1.81
16	Higley	NY	Raquette	742	4446	-	1.5	-	-	2045	3	PK	-	3.63
17	Hillman Dam	MI	Thunder Bay	988	1600	-	-	-	-	270	1	ROR	-	3.25
18	Hollidays Bridge	SC	Saluda	466	6000	466	-	5	150	4396	4	-	-	-

No.	Site Name	State	River	Reservoir Area (ac)	Reservoir Volume (ac-ft)	Usable Storage (ac-ft)	Fluctuation Limits (ft)	Length (mi)	Width (ft)	Total Plant Capacity (cfs)	No. Units	Operating Mode[2]	Average Velocity at Trash Rack (ft/sec)	Trash Rack Spacing (inch)
19	Johnsonville	NY	Hoosic	450	6430	540	6.5	-	-	1288	2	PK	-	2
20	Kleber	MI	Black	270	3000	-	0	0.9	-	400	2	ROR	1.41	3
21	Lake Algonquin	NY	Sacandaga	-	-	-	-	-	-	750	1	-	-	1
22	Luray	VA	S.F. Shenandoah	-	-	-	-	-	-	1477	3	ROR	-	2.75
23	Minetto	NY	Oswego	350	4730	290	1.8	-	-	7500	5	PULSE	2.4	2.5
24	Moshier	NY	Beaver	365	7339	680	3	-	-	660	2	PK	-	1.5
25	Ninety-Nine Islands	SC	Broad	433	2300	-	-	-	-	4800	6	-	-	1.5
26	Ninth Street Dam	MI	Thunder Bay	9884	2600	-	0.5	-	-	1650	3	ROR	-	1
27	Norway Point Dam	MI	Thunder Bay	10502	3800	-	0.5	-	-	1775	2	ROR	-	1.69
28	Potato Rapids	WI	Peshtigo	288	-	-	-	-	-	1380	3	ROR	-	1.75
29	Raymondville	NY	Raquette	50	264	-	1	-	-	1640	1	PK	-	2.25
30	Richard B. Russell	GA/SC	Savannah	31770	1297513	126864	5	-	-	60000	8	PK	-	8
31	Saluda	SC	Saluda	556	7228	-	-	-	-	812	4	-	-	-
32	Sandstone Rapids	WI	Peshtigo	150	-	-	-	-	-	1300	2	PK	-	1.75
33	Schaghticoke	NY	Hoosic	164	1150	120	6.5	-	-	1640	4	ROR	-	2.125
34	Shawano	WI	Wolf	155	1090	-	0	-	-	850	1	ROR	-	5
35	Sherman Island	NY	Hudson	305	6960	1060	3.7	-	-	6600	4	PK	-	3.125
36	Thornapple	WI	Flambeau	295	1000	295	1.5	4	600	1400	2	ROR-mod	1.22	1.69
37	Tower	MI	Black	102	620	-	0	0.9	-	404	2	ROR	0.82	1

No.	Site Name	State	River	Reservoir Area (ac)	Reservoir Volume (ac-ft)	Usable Storage (ac-ft)	Fluctuation Limits (ft)	Length (mi)	Width (ft)	Total Plant Capacity (cfs)	No. Units	Operating Mode[2]	Average Velocity at Trash Rack (ft/sec)	Trash Rack Spacing (inch)
38	Townsend Dam	PA	Beaver	-	-	-	0	0.9	600	4400	2	ROR	-	5.5
39	Twin Branch	IA	St. Joseph	1065	-	-	-	8.75	-	3200	-	ROR	-	3
40	Warrensburg	NY	Schroon	-	-	-	-	-	-	1350	1	-	-	-
41	White Rapids	MI/WI	Menominee	435	5155	415	1	2.3	580	3994	3	PK-partial	1.9	2.5
42	Wisconsin River Division	WI	Wisconsin	240	1120	-	0	2.5	1000	5150	10	ROR	1.4	2.19
43	Youghiogheny	PA	Youghiogheny	2840	149300	-	20	-	-	1600	2	ROR	0.7	10

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

Appendix B

Appendix B – Entrainment Rates (Number of Fish/1,000 CFS-Hours) for all Size Class Reported in the EPRI Database, Adjusted for Cold Stress and the Relative Abundance in the Project Area

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Appendix B. Annual Entrainment Rate (fish/hr/1,000 cfs unit capacity) For All Size Groups Reported in the EPRI Database, Adjusted for Cold Stress and the Relative Abundance in the Project Area

Target Species	0-2"	2.1-4"	4.1-6"	6.1-8"	8.1-10"	10.1-15"	15.1-20"	20.1-25"	25.1-30"	>30"
American Eel	-	-	-	0.0000	0.0000	0.0003	0.0007	0.0001	0.0001	0.0022
Bluegill	0.0250	0.0335	0.1031	0.0028	0.0000	0.0003	0.0001	-	-	-
Bluntnose Minnow	0.0001	0.0006	0.0000	-	-	-	-	-	-	-
Channel Catfish	2.0513	0.3977	0.0483	0.0150	0.0133	0.0202	0.0011	0.0002	0.0002	0.0002
Channel Shiner	0.0011	0.0062	-	-	-	-	-	-	-	-
Common Carp	0.0001	0.0002	0.0001	0.0000	0.0000	0.0000	0.0001	0.0001	0.0000	-
Emerald Shiner	1.8721	4.7738	0.1128	-	-	-	0.0058	0.0058	-	-
Freshwater Drum	0.0001	0.0595	0.0016	0.0050	0.0011	0.0151	0.0010	0.0001	-	-
Gizzard Shad	4.0679	8.2609	4.0185	0.8897	0.1600	0.0151	0.0000	-	-	-
Golden Redhorse	0.0000	0.0001	0.0001	0.0001	-	0.0003	0.0002	-	-	-
Green Sunfish	0.0000	0.0001	0.0001	0.0000	-	-	-	-	-	-
Highfin Carpsucker	-	-	0.0000	0.0001	0.0002	0.0000	0.0000	-	-	-
Hybrid Striped Bass	-	0.0008	0.0009	0.0013	0.0072	0.0003	-	-	-	-
Largemouth Bass	0.0073	0.0050	0.0012	0.0003	0.0001	0.0004	0.0001	-	-	-
Logperch	0.0011	0.0013	0.0003	0.0000	-	0.0000	-	-	-	-
Longnose Gar	-	-	0.0001	-	0.0004	0.0006	0.0001	-	-	-
Northern Hogsucker	0.0001	0.0019	0.0003	0.0016	0.0005	0.0005	0.0000	-	-	-
Quillback	-	0.0000	-	-	-	-	-	-	-	-
River Carpsucker	-	-	0.0001	0.0008	0.0017	0.0002	0.0001	-	-	-
River Redhorse	-	0.0002	-	-	-	-	-	-	-	-
River Shiner	0.0006	0.0033	-	-	-	-	-	-	-	-
Sauger	-	0.0004	0.0014	0.0763	0.0252	0.0104	-	-	-	-
Silver Chub	-	0.0127	0.0064	0.0002	0.0001	-	-	-	-	-
Silver Redhorse	0.0000	0.0002	0.0001	0.0001	0.0000	0.0000	0.0000	-	-	-
Skipjack Herring	0.0898	0.0300	0.0154	0.0023	0.0006	0.0000	0.0000	-	-	-
Smallmouth Bass	0.0025	0.0016	0.0008	0.0004	0.0002	0.0003	0.0000	0.0000	-	-
Smallmouth Buffalo	-	-	-	-	-	0.0001	-	-	-	-
Smallmouth Redhorse	0.0000	0.0001	0.0001	0.0001	-	0.0003	0.0002	-	-	-
Spotfin Shiner	0.0000	0.0002	0.0000	-	-	-	-	-	-	-
Spotted Bass	-	0.0000	-	-	-	0.0000	-	-	-	-
Spotted Sucker	0.0000	0.0000	-	-	-	-	-	-	-	-
Walleye	0.0030	0.0057	0.0019	0.0015	0.0013	0.0017	0.0002	0.0000	0.0000	-
White Bass	-	0.0001	0.0002	0.0002	0.0013	0.0001	-	-	-	-
White Crappie	0.0006	0.0007	0.0001	0.0001	0.0001	0.0001	-	-	-	-
Yellow Perch	0.0171	0.0177	0.0054	0.0008	0.0001	0.0000	-	0.0000	-	-

Appendix C

Appendix C – Monthly Entrainment Estimates (Number of Fish/1,000 CFS-Hours) by Size Class for Target Species Based on Normal, Dry and Wet Water Years

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Monthly Entrainment Estimates by Length Class for Target Species Based on a Dry Water Year (1988) at Racine Hydroelectric Plant

Target Species	Month	0-2"	2.1-4"	4.1-6"	6.1-8"	8.1-10"	10.1-15"	15.1-20"	20.1-25"	25.1-30"	>30"
American Eel[1]	Jan	-	-	-	-	-	-	-	-	-	-
	Feb	-	-	-	-	-	-	-	-	-	-
	Mar	-	-	-	-	-	-	-	-	-	-
	Apr	-	-	-	-	-	-	-	-	<1	<1
	May	-	-	-	<1	-	<1	1	<1	<1	<1
	Jun	-	-	-	-	-	<1	2	<1	<1	<1
	Jul	-	-	-	-	<1	1	2	<1	<1	<1
	Aug	-	-	-	-	-	<1	1	<1	<1	<1
	Sep	-	-	-	-	-	<1	<1	<1	<1	2
	Oct	-	-	-	-	-	-	-	<1	<1	2
	Nov	-	-	-	-	-	1	1	<1	1	16
	Dec	-	-	-	-	-	-	-	-	1	11
Bluegill	Jan	1	1	2	2	-	-	-	-	-	-
	Feb	1	2	<1	<1	-	-	-	-	-	-
	Mar	4	4	5	2	-	-	-	-	-	-
	Apr	14	329	378	5	<1	-	-	-	-	-
	May	4	196	30	5	<1	-	-	-	-	-
	Jun	1	9	22	4	<1	<1	-	-	-	-
	Jul	85	2	21	2	<1	-	-	-	-	-
	Aug	11	5	59	3	<1	<1	-	-	-	-
	Sep	18	7	323	5	<1	-	-	-	-	-
	Oct	17	20	163	<1	<1	2	1	-	-	-
	Nov	65	47	15	1	<1	-	-	-	-	-
	Dec	1	7	1	1	-	-	-	-	-	-
Bluntnose Minnow[1]	Jan	-	4	-	-	-	-	-	-	-	-
	Feb	-	1	-	-	-	-	-	-	-	-
	Mar	-	<1	<1	-	-	-	-	-	-	-
	Apr	-	2	-	-	-	-	-	-	-	-
	May	<1	1	-	-	-	-	-	-	-	-
	Jun	<1	<1	-	-	-	-	-	-	-	-
	Jul	<1	<1	<1	-	-	-	-	-	-	-
	Aug	<1	<1	-	-	-	-	-	-	-	-
	Sep	<1	<1	-	-	-	-	-	-	-	-
	Oct	<1	<1	-	-	-	-	-	-	-	-
	Nov	-	<1	-	-	-	-	-	-	-	-
	Dec	-	-	-	-	-	-	-	-	-	-
Channel Catfish	Jan	-	1,076	48	-	-	76	-	-	-	-
	Feb	-	113	6	-	-	4	-	-	-	-
	Mar	-	498	95	4	1	6	-	-	-	-
	Apr	-	812	239	2	3	15	-	-	-	-
	May	1	100	101	24	6	23	6	-	-	-
	Jun	99	10	14	2	4	2	2	1	-	-
	Jul	9,574	100	3	10	4	11	1	<1	1	1
	Aug	2,384	705	47	42	50	38	1	-	-	-
	Sep	418	303	44	25	16	31	<1	-	-	-
	Oct	95	147	26	2	2	1	1	-	-	-
	Nov	84	1,032	85	8	2	3	<1	-	-	-
	Dec	-	6	-	-	-	-	-	-	-	-
Channel Shiner	Jan	-	-	-	-	-	-	-	-	-	-
	Feb	-	-	-	-	-	-	-	-	-	-
	Mar	-	-	-	-	-	-	-	-	-	-
	Apr	-	-	-	-	-	-	-	-	-	-
	May	-	50	-	-	-	-	-	-	-	-
	Jun	-	-	-	-	-	-	-	-	-	-
	Jul	-	-	-	-	-	-	-	-	-	-
	Aug	3	4	-	-	-	-	-	-	-	-
	Sep	2	3	-	-	-	-	-	-	-	-
	Oct	1	1	-	-	-	-	-	-	-	-
	Nov	4	47	-	-	-	-	-	-	-	-
	Dec	-	-	-	-	-	-	-	-	-	-
Common Carp	Jan	-	-	-	-	-	-	1	1	-	-
	Feb	-	-	-	-	-	-	-	-	-	-
	Mar	-	<1	<1	-	-	<1	<1	-	-	-
	Apr	-	<1	<1	-	-	-	-	<1	-	-
	May	-	1	-	-	-	<1	<1	<1	<1	-
	Jun	<1	-	-	-	<1	<1	-	<1	-	-
	Jul	<1	<1	-	-	-	<1	<1	<1	-	-
	Aug	<1	<1	<1	-	-	<1	<1	<1	<1	-
	Sep	-	<1	<1	<1	<1	-	-	-	-	-
	Oct	<1	<1	<1	<1	-	<1	<1	-	-	-
	Nov	-	<1	<1	<1	<1	-	-	-	-	-
	Dec	-	-	-	-	-	-	-	-	-	-

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Target Species	Month	0-2"	2.1-4"	4.1-6"	6.1-8"	8.1-10"	10.1-15"	15.1-20"	20.1-25"	25.1-30"	>30"
Emerald Shiner	Jan	1,080	2,493	-	-	-	-	-	-	-	-
	Feb	1,657	638	79	-	-	-	-	-	-	-
	Mar	5,706	7,607	484	-	-	-	-	-	-	-
	Apr	2,883	13,961	246	-	-	-	-	-	-	-
	May	1,999	7,092	146	-	-	-	-	-	-	-
	Jun	85	3,774	96	-	-	-	36	36	-	-
	Jul	4	1,493	30	-	-	-	-	-	-	-
	Aug	676	4,575	-	-	-	-	-	-	-	-
	Sep	1,307	2,068	240	-	-	-	-	-	-	-
	Oct	3,130	4,331	17	-	-	-	-	-	-	-
	Nov	9,548	12,358	250	-	-	-	-	-	-	-
	Dec	42	1,490	-	-	-	-	-	-	-	-
Freshwater Drum	Jan	-	-	-	-	-	-	-	-	-	-
	Feb	-	-	-	-	-	-	-	-	-	-
	Mar	-	-	-	-	-	-	-	-	-	-
	Apr	-	-	-	-	-	-	-	-	-	-
	May	-	-	3	-	3	28	5	-	-	-
	Jun	-	-	-	<1	-	4	<1	1	-	-
	Jul	1	27	1	1	4	17	1	-	-	-
	Aug	-	-	-	-	2	51	2	-	-	-
	Sep	-	275	6	-	-	6	1	-	-	-
	Oct	-	137	3	-	-	2	-	-	-	-
	Nov	-	-	4	92	-	-	-	-	-	-
	Dec	-	-	-	-	-	-	-	-	-	-
Gizzard Shad	Jan	-	20	490	13	8	2	<1	-	-	-
	Feb	-	<1	14	5	8	2	-	-	-	-
	Mar	-	18	10,551	111	225	134	-	-	-	-
	Apr	-	9	44	24	6	5	-	-	-	-
	May	-	2	27	2	3	2	-	-	-	-
	Jun	-	-	-	1	1	4	-	-	-	-
	Jul	1	1	2,700	6	4	10	-	-	-	-
	Aug	-	855	3,647	980	18	8	-	-	-	-
	Sep	86	8,063	241	360	226	14	-	-	-	-
	Oct	13,845	39,159	11,573	2,149	242	2	-	-	-	-
	Nov	23,899	22,785	16,788	6,931	1,206	33	-	-	-	-
	Dec	14,919	10,957	5	144	282	16	-	-	-	-
Golden Redhorse	Jan	-	-	-	-	-	-	-	-	-	-
	Feb	-	-	-	-	-	-	-	-	-	-
	Mar	-	-	-	-	-	-	-	-	-	-
	Apr	-	1	-	-	-	-	-	-	-	-
	May	-	<1	-	-	-	4	2	-	-	-
	Jun	-	<1	<1	-	-	<1	1	-	-	-
	Jul	<1	-	-	-	-	-	<1	-	-	-
	Aug	-	-	-	-	-	1	-	-	-	-
	Sep	-	-	<1	<1	-	-	-	-	-	-
	Oct	-	-	-	-	-	-	-	-	-	-
	Nov	-	-	-	-	-	-	-	-	-	-
	Dec	-	-	-	-	-	-	-	-	-	-
Green Sunfish	Jan	-	-	-	-	-	-	-	-	-	-
	Feb	-	-	-	-	-	-	-	-	-	-
	Mar	<1	<1	1	-	-	-	-	-	-	-
	Apr	<1	<1	<1	-	-	-	-	-	-	-
	May	<1	<1	<1	-	-	-	-	-	-	-
	Jun	<1	<1	<1	<1	-	-	-	-	-	-
	Jul	-	<1	<1	-	-	-	-	-	-	-
	Aug	-	<1	-	-	-	-	-	-	-	-
	Sep	-	<1	<1	-	-	-	-	-	-	-
	Oct	-	<1	<1	-	-	-	-	-	-	-
	Nov	-	-	<1	-	-	-	-	-	-	-
	Dec	-	-	-	-	-	-	-	-	-	-
Highfin Carpsucker	Jan	-	-	-	-	-	-	-	-	-	-
	Feb	-	-	-	-	-	-	-	-	-	-
	Mar	-	-	-	-	-	-	-	-	-	-
	Apr	-	-	-	-	-	-	-	-	-	-
	May	-	-	<1	2	<1	-	-	-	-	-
	Jun	-	-	-	-	-	-	-	-	-	-
	Jul	-	-	-	-	1	<1	-	-	-	-
	Aug	-	-	-	-	1	-	<1	-	-	-
	Sep	-	-	-	-	-	-	-	-	-	-
	Oct	-	-	-	-	-	-	-	-	-	-
	Nov	-	-	-	-	-	-	-	-	-	-
	Dec	-	-	-	-	-	-	-	-	-	-

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Hybrid Striped Bass	Jan	-	-	-	-	-	-	-	-	-	-
	Feb	-	-	-	-	-	-	-	-	-	-
	Mar	-	1	1	-	-	-	-	-	-	-
	Apr	-	-	-	6	2	-	-	-	-	-
	May	-	-	6	-	40	-	-	-	-	-
	Jun	-	-	-	-	2	-	-	-	-	-
	Jul	-	1	1	1	2	-	-	-	-	-
	Aug	-	2	-	3	25	2	-	-	-	-
	Sep	-	-	2	2	-	-	-	-	-	-
	Oct	-	1	2	<1	-	<1	-	-	-	-
	Nov	-	3	-	-	-	-	-	-	-	-
	Dec	-	-	-	-	-	-	-	-	-	-
Largemouth Bass	Jan	-	5	4	-	-	-	2	-	-	-
	Feb	-	2	1	<1	-	-	-	-	-	-
	Mar	1	3	<1	<1	<1	<1	-	-	-	-
	Apr	-	8	<1	-	-	5	<1	-	-	-
	May	-	<1	<1	<1	<1	1	-	-	-	-
	Jun	27	<1	<1	<1	<1	<1	<1	-	-	-
	Jul	18	9	-	<1	<1	<1	-	-	-	-
	Aug	<1	2	<1	<1	<1	<1	<1	-	-	-
	Sep	<1	4	1	<1	<1	<1	-	-	-	-
	Oct	<1	7	2	<1	<1	-	<1	-	-	-
	Nov	-	13	7	2	<1	2	<1	-	-	-
	Dec	<1	3	<1	-	<1	<1	-	-	-	-
Logperch	Jan	-	<1	-	-	-	-	-	-	-	-
	Feb	-	1	-	-	-	-	-	-	-	-
	Mar	-	<1	-	-	-	-	-	-	-	-
	Apr	<1	4	2	-	-	1	-	-	-	-
	May	<1	5	1	<1	-	-	-	-	-	-
	Jun	1	2	<1	-	-	<1	-	-	-	-
	Jul	6	2	<1	-	-	-	-	-	-	-
	Aug	<1	<1	<1	-	-	-	-	-	-	-
	Sep	<1	1	1	-	-	-	-	-	-	-
	Oct	<1	1	<1	-	-	<1	-	-	-	-
	Nov	-	<1	<1	<1	-	<1	-	-	-	-
	Dec	-	-	-	-	-	-	-	-	-	-
Longnose Gar	Jan	-	-	-	-	-	-	-	-	-	-
	Feb	-	-	-	-	-	1	-	-	-	-
	Mar	-	-	-	-	-	-	-	-	-	-
	Apr	-	-	-	-	-	-	-	-	-	-
	May	-	-	-	-	-	-	-	-	-	-
	Jun	-	-	-	-	-	-	-	-	-	-
	Jul	-	-	-	-	-	-	-	-	-	-
	Aug	-	-	<1	-	<1	<1	<1	-	-	-
	Sep	-	-	-	-	1	2	-	-	-	-
	Oct	-	-	-	-	2	2	1	-	-	-
	Nov	-	-	-	-	-	-	-	-	-	-
	Dec	-	-	-	-	-	-	-	-	-	-
Northern Hogsucker	Jan	-	1	1	11	5	5	-	-	-	-
	Feb	-	5	1	4	-	<1	<1	-	-	-
	Mar	-	-	<1	-	1	<1	-	-	-	-
	Apr	-	27	<1	-	1	1	-	-	-	-
	May	-	1	<1	<1	1	1	-	-	-	-
	Jun	<1	<1	<1	<1	<1	<1	-	-	-	-
	Jul	1	<1	<1	<1	-	<1	-	-	-	-
	Aug	<1	<1	<1	<1	-	-	-	-	-	-
	Sep	-	<1	-	-	-	<1	-	-	-	-
	Oct	-	1	1	2	<1	<1	-	-	-	-
	Nov	-	2	1	5	1	1	-	-	-	-
	Dec	-	<1	<1	1	-	1	-	-	-	-
Quillback	Jan	-	-	-	-	-	-	-	-	-	-
	Feb	-	-	-	-	-	-	-	-	-	-
	Mar	-	-	-	-	-	-	-	-	-	-
	Apr	-	-	-	-	-	-	-	-	-	-
	May	-	1	-	-	-	-	-	-	-	-
	Jun	-	-	-	-	-	-	-	-	-	-
	Jul	-	-	-	-	-	-	-	-	-	-
	Aug	-	-	-	-	-	-	-	-	-	-
	Sep	-	-	-	-	-	-	-	-	-	-
	Oct	-	-	-	-	-	-	-	-	-	-
	Nov	-	-	-	-	-	-	-	-	-	-
	Dec	-	-	-	-	-	-	-	-	-	-

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River Carpsucker	Jan	-	-	-	-	-	-	-	-	-	-
	Feb	-	-	-	-	-	-	-	-	-	-
	Mar	-	-	-	-	-	-	-	-	-	-
	Apr	-	-	-	-	-	-	-	-	-	-
	May	-	-	2	17	3	-	-	-	-	-
	Jun	-	-	-	-	-	-	-	-	-	-
	Jul	-	-	-	-	5	2	-	-	-	-
	Aug	-	-	-	-	4	-	1	-	-	-
	Sep	-	-	-	-	-	-	-	-	-	-
	Oct	-	-	-	-	-	-	-	-	-	-
	Nov	-	-	-	-	-	-	-	-	-	-
	Dec	-	-	-	-	-	-	-	-	-	-
River Redhorse	Jan	-	-	-	-	-	-	-	-	-	-
	Feb	-	-	-	-	-	-	-	-	-	-
	Mar	-	-	-	-	-	-	-	-	-	-
	Apr	-	-	-	-	-	-	-	-	-	-
	May	-	-	-	-	-	-	-	-	-	-
	Jun	-	1	-	-	-	-	-	-	-	-
	Jul	-	-	-	-	-	-	-	-	-	-
	Aug	-	-	-	-	-	-	-	-	-	-
	Sep	-	-	-	-	-	-	-	-	-	-
	Oct	-	-	-	-	-	-	-	-	-	-
	Nov	-	-	-	-	-	-	-	-	-	-
	Dec	-	-	-	-	-	-	-	-	-	-
River Shiner	Jan	-	-	-	-	-	-	-	-	-	-
	Feb	-	-	-	-	-	-	-	-	-	-
	Mar	-	-	-	-	-	-	-	-	-	-
	Apr	-	-	-	-	-	-	-	-	-	-
	May	-	26	-	-	-	-	-	-	-	-
	Jun	-	-	-	-	-	-	-	-	-	-
	Jul	-	-	-	-	-	-	-	-	-	-
	Aug	1	2	-	-	-	-	-	-	-	-
	Sep	1	2	-	-	-	-	-	-	-	-
	Oct	1	1	-	-	-	-	-	-	-	-
	Nov	2	25	-	-	-	-	-	-	-	-
	Dec	-	-	-	-	-	-	-	-	-	-
Sauger	Jan	-	-	7	-	14	7	-	-	-	-
	Feb	-	-	-	-	4	4	-	-	-	-
	Mar	-	-	-	-	5	10	-	-	-	-
	Apr	-	8	4	8	160	13	-	-	-	-
	May	-	-	-	677	17	95	-	-	-	-
	Jun	-	-	-	237	-	-	-	-	-	-
	Jul	-	-	-	-	6	5	-	-	-	-
	Aug	-	-	-	-	14	14	-	-	-	-
	Sep	-	-	4	24	25	3	-	-	-	-
	Oct	-	-	2	17	63	3	-	-	-	-
	Nov	-	-	-	22	11	-	-	-	-	-
	Dec	-	-	-	-	-	-	-	-	-	-
Silver Chub	Jan	-	-	-	-	-	-	-	-	-	-
	Feb	-	132	50	-	-	-	-	-	-	-
	Mar	-	3	13	-	-	-	-	-	-	-
	Apr	-	61	2	-	2	-	-	-	-	-
	May	-	2	2	<1	-	-	-	-	-	-
	Jun	-	1	1	1	-	-	-	-	-	-
	Jul	-	-	<1	-	-	-	-	-	-	-
	Aug	-	-	-	-	-	-	-	-	-	-
	Sep	-	1	-	-	-	-	-	-	-	-
	Oct	-	2	4	-	-	-	-	-	-	-
	Nov	-	23	35	2	-	-	-	-	-	-
	Dec	-	-	-	-	-	-	-	-	-	-
Silver Redhorse	Jan	-	-	-	-	-	-	-	-	-	-
	Feb	-	-	-	-	-	-	-	-	-	-
	Mar	-	-	<1	-	-	-	-	-	-	-
	Apr	-	1	<1	1	-	-	-	-	-	-
	May	-	1	-	-	-	<1	1	-	-	-
	Jun	<1	<1	<1	<1	<1	<1	<1	-	-	-
	Jul	<1	<1	<1	-	-	<1	<1	-	-	-
	Aug	<1	<1	<1	-	-	-	<1	-	-	-
	Sep	-	-	<1	<1	-	<1	<1	-	-	-
	Oct	-	-	<1	1	<1	-	-	-	-	-
	Nov	-	-	-	-	-	-	-	-	-	-
	Dec	-	-	-	-	-	-	-	-	-	-

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Skipjack Herring	Jan	806	138	2	1	1	-	-	-	-	-
	Feb	27	17	1	3	2	-	-	-	-	-
	Mar	25	24	2	3	1	-	-	-	-	-
	Apr	<1	<1	2	<1	<1	-	-	-	-	-
	May	-	2	4	1	<1	-	-	-	-	-
	Jun	<1	2	3	3	1	-	<1	-	-	-
	Jul	<1	9	2	1	<1	-	-	-	-	-
	Aug	<1	52	7	2	1	-	-	-	-	-
	Sep	20	7	-	<1	<1	-	-	-	-	-
	Oct	27	10	3	3	1	<1	-	-	-	-
	Nov	405	106	187	6	1	<1	-	-	-	-
	Dec	172	8	40	2	<1	-	-	-	-	-
Smallmouth Bass	Jan	1	<1	<1	<1	-	-	-	-	-	-
	Feb	-	<1	-	-	-	-	-	-	-	-
	Mar	-	1	<1	<1	-	-	-	-	-	-
	Apr	<1	1	-	<1	-	1	<1	-	-	-
	May	<1	<1	<1	<1	1	1	<1	-	-	-
	Jun	4	<1	<1	<1	<1	<1	<1	-	-	-
	Jul	10	1	<1	<1	<1	<1	-	<1	-	-
	Aug	1	1	1	<1	<1	<1	<1	-	-	-
	Sep	<1	5	3	1	<1	<1	<1	-	-	-
	Oct	<1	2	1	<1	<1	<1	<1	-	-	-
	Nov	-	1	1	<1	<1	<1	-	-	-	-
	Dec	<1	<1	<1	-	<1	-	-	-	-	-
Smallmouth Buffalo	Jan	-	-	-	-	-	-	-	-	-	-
	Feb	-	-	-	-	-	-	-	-	-	-
	Mar	-	-	-	-	-	-	-	-	-	-
	Apr	-	-	-	-	-	-	-	-	-	-
	May	-	-	-	-	-	2	-	-	-	-
	Jun	-	-	-	-	-	-	-	-	-	-
	Jul	-	-	-	-	-	-	-	-	-	-
	Aug	-	-	-	-	-	-	-	-	-	-
	Sep	-	-	-	-	-	-	-	-	-	-
	Oct	-	-	-	-	-	-	-	-	-	-
	Nov	-	-	-	-	-	-	-	-	-	-
	Dec	-	-	-	-	-	-	-	-	-	-
Smallmouth Redhorse	Jan	-	-	-	-	-	-	-	-	-	-
	Feb	-	-	-	-	-	-	-	-	-	-
	Mar	-	-	-	-	-	-	-	-	-	-
	Apr	-	1	-	-	-	-	-	-	-	-
	May	-	<1	-	-	-	4	2	-	-	-
	Jun	-	<1	<1	-	-	<1	1	-	-	-
	Jul	<1	-	-	-	-	-	<1	-	-	-
	Aug	-	-	-	-	-	1	-	-	-	-
	Sep	-	-	<1	<1	-	-	-	-	-	-
	Oct	-	-	-	-	-	-	-	-	-	-
	Nov	-	-	-	-	-	-	-	-	-	-
	Dec	-	-	-	-	-	-	-	-	-	-
Spotfin Shiner	Jan	-	-	-	-	-	-	-	-	-	-
	Feb	-	-	<1	-	-	-	-	-	-	-
	Mar	-	<1	-	-	-	-	-	-	-	-
	Apr	-	1	-	-	-	-	-	-	-	-
	May	-	-	-	-	-	-	-	-	-	-
	Jun	-	<1	-	-	-	-	-	-	-	-
	Jul	-	<1	-	-	-	-	-	-	-	-
	Aug	-	<1	-	-	-	-	-	-	-	-
	Sep	-	-	<1	-	-	-	-	-	-	-
	Oct	<1	<1	-	-	-	-	-	-	-	-
	Nov	-	<1	-	-	-	-	-	-	-	-
	Dec	-	-	-	-	-	-	-	-	-	-
Spotted Bass	Jan	-	-	-	-	-	-	-	-	-	-
	Feb	-	-	-	-	-	-	-	-	-	-
	Mar	-	-	-	-	-	-	-	-	-	-
	Apr	-	-	-	-	-	-	-	-	-	-
	May	-	-	-	-	-	-	-	-	-	-
	Jun	-	<1	-	-	-	<1	-	-	-	-
	Jul	-	-	-	-	-	-	-	-	-	-
	Aug	-	-	-	-	-	-	-	-	-	-
	Sep	-	-	-	-	-	-	-	-	-	-
	Oct	-	-	-	-	-	-	-	-	-	-
	Nov	-	-	-	-	-	<1	-	-	-	-
	Dec	-	-	-	-	-	-	-	-	-	-

Monthly Entrainment Estimates by Length Class for Target Species Based on a Dry Water Year (1988) at Racine Hydroelectric Plant

Target Species	Month	0-2"	2.1-4"	4.1-6"	6.1-8"	8.1-10"	10.1-15"	15.1-20"	20.1-25"	25.1-30"	>30"
Spotted Sucker	Jan	-	-	-	-	-	-	-	-	-	-
	Feb	-	-	-	-	-	-	-	-	-	-
	Mar	-	-	-	-	-	-	-	-	-	-
	Apr	-	-	-	-	-	-	-	-	-	-
	May	-	-	-	-	-	-	-	-	-	-
	Jun	-	-	-	-	-	-	-	-	-	-
	Jul	-	-	-	-	-	-	-	-	-	-
	Aug	-	-	-	-	-	-	-	-	-	-
	Sep	<1	<1	-	-	-	-	-	-	-	-
	Oct	-	<1	-	-	-	-	-	-	-	-
	Nov	-	-	-	-	-	-	-	-	-	-
	Dec	-	-	-	-	-	-	-	-	-	-
Walleye	Jan	1	<1	<1	1	7	3	-	-	-	-
	Feb	-	<1	1	<1	-	<1	<1	-	-	-
	Mar	-	-	<1	-	<1	<1	-	-	-	-
	Apr	-	<1	1	1	2	4	<1	-	-	-
	May	<1	<1	2	8	4	8	<1	-	-	-
	Jun	16	5	<1	1	1	2	<1	<1	-	-
	Jul	3	27	2	<1	1	1	1	<1	<1	-
	Aug	<1	2	3	<1	<1	1	<1	<1	-	-
	Sep	<1	1	3	1	1	1	<1	<1	-	-
	Oct	-	<1	2	3	1	1	<1	-	-	-
	Nov	-	1	1	1	<1	1	<1	-	-	-
	Dec	-	<1	1	1	1	<1	-	-	-	-
White Bass	Jan	-	-	-	-	-	-	-	-	-	-
	Feb	-	-	-	-	-	-	-	-	-	-
	Mar	-	<1	<1	-	-	-	-	-	-	-
	Apr	-	-	-	1	<1	-	-	-	-	-
	May	-	-	1	-	7	-	-	-	-	-
	Jun	-	-	-	-	<1	-	-	-	-	-
	Jul	-	<1	<1	<1	<1	-	-	-	-	-
	Aug	-	<1	-	<1	4	<1	-	-	-	-
	Sep	-	-	<1	<1	-	-	-	-	-	-
	Oct	-	<1	<1	<1	-	<1	-	-	-	-
	Nov	-	1	-	-	-	-	-	-	-	-
	Dec	-	-	-	-	-	-	-	-	-	-
White Crappie[1]	Jan	<1	1	-	-	<1	-	-	-	-	-
	Feb	-	-	-	-	-	-	-	-	-	-
	Mar	-	<1	-	<1	1	-	-	-	-	-
	Apr	-	2	<1	<1	<1	-	-	-	-	-
	May	-	<1	<1	<1	<1	<1	-	-	-	-
	Jun	2	<1	<1	<1	-	<1	-	-	-	-
	Jul	2	<1	<1	<1	<1	<1	-	-	-	-
	Aug	<1	1	<1	<1	<1	<1	-	-	-	-
	Sep	-	<1	<1	<1	<1	<1	-	-	-	-
	Oct	<1	<1	-	<1	-	<1	-	-	-	-
	Nov	<1	2	<1	<1	-	-	-	-	-	-
	Dec	-	1	-	-	-	-	-	-	-	-
Yellow Perch	Jan	-	8	5	1	<1	<1	-	-	-	-
	Feb	<1	9	6	<1	<1	<1	-	-	-	-
	Mar	<1	7	5	1	<1	<1	-	<1	-	-
	Apr	184	14	12	5	1	<1	-	-	-	-
	May	1	14	6	1	<1	<1	-	-	-	-
	Jun	27	8	1	<1	<1	<1	-	-	-	-
	Jul	25	4	1	<1	<1	<1	-	-	-	-
	Aug	1	1	1	<1	<1	<1	-	-	-	-
	Sep	<1	13	4	1	<1	<1	-	-	-	-
	Oct	<1	84	19	1	<1	<1	-	-	-	-
	Nov	<1	3	2	1	<1	-	-	-	-	-
	Dec	<1	2	4	<1	<1	<1	-	-	-	-

[1] Species was not collected in the Racine Pool during Fall 2019-Spring 2020. Assumed one individual collected for entrainment estimates

Monthly Entrainment Estimates by Length Class for Target Species Based on a Normal Water Year (2012) at Racine Hydroelectric Plant

Target Species	Month	0-2"	2.1-4"	4.1-6"	6.1-8"	8.1-10"	10.1-15"	15.1-20"	20.1-25"	25.1-30"	>30"
American Eel[1]	Jan	-	-	-	-	-	-	-	-	-	-
	Feb	-	-	-	-	-	-	-	-	-	-
	Mar	-	-	-	-	-	-	-	-	-	-
	Apr	-	-	-	-	-	-	-	-	<1	<1
	May	-	-	-	<1	-	1	2	1	<1	<1
	Jun	-	-	-	-	-	1	5	1	<1	<1
	Jul	-	-	-	-	<1	4	6	1	<1	<1
	Aug	-	-	-	-	-	1	2	<1	<1	<1
	Sep	-	-	-	-	-	<1	<1	<1	<1	5
	Oct	-	-	-	-	-	-	-	<1	1	6
	Nov	-	-	-	-	-	2	2	<1	1	30
	Dec	-	-	-	-	-	-	-	-	2	28
Bluegill	Jan	1	1	2	2	-	-	-	-	-	-
	Feb	1	2	<1	<1	-	-	-	-	-	-
	Mar	4	3	4	2	-	-	-	-	-	-
	Apr	12	300	344	5	<1	-	-	-	-	-
	May	3	147	23	4	<1	-	-	-	-	-
	Jun	1	15	36	6	<1	<1	-	-	-	-
	Jul	154	3	39	3	<1	-	-	-	-	-
	Aug	19	8	100	5	<1	<1	-	-	-	-
	Sep	24	9	426	7	<1	-	-	-	-	-
	Oct	22	26	211	<1	<1	3	1	-	-	-
	Nov	61	44	14	1	<1	-	-	-	-	-
	Dec	1	9	1	1	-	-	-	-	-	-
Bluntnose Minnow[1]	Jan	-	4	-	-	-	-	-	-	-	-
	Feb	-	1	-	-	-	-	-	-	-	-
	Mar	-	<1	<1	-	-	-	-	-	-	-
	Apr	-	2	-	-	-	-	-	-	-	-
	May	<1	1	-	-	-	-	-	-	-	-
	Jun	<1	<1	-	-	-	-	-	-	-	-
	Jul	<1	<1	<1	-	-	-	-	-	-	-
	Aug	<1	<1	-	-	-	-	-	-	-	-
	Sep	<1	<1	-	-	-	-	-	-	-	-
	Oct	<1	<1	-	-	-	-	-	-	-	-
	Nov	-	<1	-	-	-	-	-	-	-	-
	Dec	-	-	-	-	-	-	-	-	-	-
Channel Catfish	Jan	-	30	1	-	-	2	-	-	-	-
	Feb	-	4	<1	-	-	<1	-	-	-	-
	Mar	-	12	2	<1	<1	<1	-	-	-	-
	Apr	-	21	6	<1	<1	<1	-	-	-	-
	May	<1	2	2	<1	<1	<1	<1	-	-	-
	Jun	5	<1	1	<1	<1	<1	<1	<1	-	-
	Jul	478	5	<1	<1	<1	1	<1	<1	<1	<1
	Aug	111	33	2	2	2	2	<1	-	-	-
	Sep	15	11	2	1	1	1	<1	-	-	-
	Oct	3	5	1	<1	<1	<1	<1	-	-	-
	Nov	2	27	2	<1	<1	<1	<1	-	-	-
	Dec	-	<1	-	-	-	-	-	-	-	-
Channel Shiner	Jan	-	-	-	-	-	-	-	-	-	-
	Feb	-	-	-	-	-	-	-	-	-	-
	Mar	-	-	-	-	-	-	-	-	-	-
	Apr	-	-	-	-	-	-	-	-	-	-
	May	-	37	-	-	-	-	-	-	-	-
	Jun	-	-	-	-	-	-	-	-	-	-
	Jul	-	-	-	-	-	-	-	-	-	-
	Aug	4	7	-	-	-	-	-	-	-	-
	Sep	2	4	-	-	-	-	-	-	-	-
	Oct	2	2	-	-	-	-	-	-	-	-
	Nov	4	44	-	-	-	-	-	-	-	-
	Dec	-	-	-	-	-	-	-	-	-	-
Common Carp	Jan	-	-	-	-	-	-	1	1	-	-
	Feb	-	-	-	-	-	-	-	-	-	-
	Mar	-	<1	<1	-	-	<1	<1	-	-	-
	Apr	-	<1	<1	-	-	-	-	<1	-	-
	May	-	<1	-	-	-	<1	<1	<1	<1	-
	Jun	1	-	-	-	<1	<1	-	<1	-	-
	Jul	<1	<1	-	-	-	<1	<1	<1	-	-
	Aug	<1	1	<1	-	-	<1	<1	<1	<1	-
	Sep	-	<1	<1	<1	<1	-	-	-	-	-
	Oct	<1	<1	<1	<1	-	<1	<1	-	-	-
	Nov	-	<1	<1	<1	<1	-	-	-	-	-
	Dec	-	-	-	-	-	-	-	-	-	-

Monthly Entrainment Estimates by Length Class for Target Species Based on a Normal Water Year (2012) at Racine Hydroelectric Plant

Target Species	Month	0-2"	2.1-4"	4.1-6"	6.1-8"	8.1-10"	10.1-15"	15.1-20"	20.1-25"	25.1-30"	>30"
Emerald Shiner	Jan	1,087	2,509	-	-	-	-	-	-	-	-
	Feb	2,154	829	103	-	-	-	-	-	-	-
	Mar	4,941	6,587	420	-	-	-	-	-	-	-
	Apr	2,626	12,716	224	-	-	-	-	-	-	-
	May	1,494	5,301	109	-	-	-	-	-	-	-
	Jun	139	6,198	158	-	-	-	60	60	-	-
	Jul	8	2,683	53	-	-	-	-	-	-	-
	Aug	1,138	7,698	-	-	-	-	-	-	-	-
	Sep	1,723	2,726	316	-	-	-	-	-	-	-
	Oct	4,031	5,578	22	-	-	-	-	-	-	-
	Nov	8,958	11,594	234	-	-	-	-	-	-	-
	Dec	54	1,911	-	-	-	-	-	-	-	-
Freshwater Drum	Jan	-	-	-	-	-	-	-	-	-	-
	Feb	-	-	-	-	-	-	-	-	-	-
	Mar	-	-	-	-	-	-	-	-	-	-
	Apr	-	-	-	-	-	-	-	-	-	-
	May	-	-	2	-	3	21	4	-	-	-
	Jun	-	-	-	1	-	6	1	1	-	-
	Jul	1	48	1	1	7	30	3	-	-	-
	Aug	-	-	-	-	3	86	3	-	-	-
	Sep	-	362	8	-	-	8	1	-	-	-
	Oct	-	177	4	-	-	2	-	-	-	-
	Nov	-	-	4	86	-	-	-	-	-	-
	Dec	-	-	-	-	-	-	-	-	-	-
Gizzard Shad	Jan	-	20	494	13	8	2	<1	-	-	-
	Feb	-	<1	18	7	10	3	-	-	-	-
	Mar	-	15	9,135	96	194	116	-	-	-	-
	Apr	-	8	41	22	5	4	-	-	-	-
	May	-	2	20	2	2	2	-	-	-	-
	Jun	-	-	-	2	1	6	-	-	-	-
	Jul	2	1	4,851	10	7	17	-	-	-	-
	Aug	-	1,438	6,137	1,649	30	13	-	-	-	-
	Sep	114	10,627	318	474	299	19	-	-	-	-
	Oct	17,834	50,441	14,908	2,768	311	2	-	-	-	-
	Nov	22,422	21,377	15,751	6,503	1,131	31	-	-	-	-
	Dec	19,127	14,047	7	185	361	21	-	-	-	-
Golden Redhorse	Jan	-	-	-	-	-	-	-	-	-	-
	Feb	-	-	-	-	-	-	-	-	-	-
	Mar	-	-	-	-	-	-	-	-	-	-
	Apr	-	1	-	-	-	-	-	-	-	-
	May	-	<1	-	-	-	3	2	-	-	-
	Jun	-	<1	<1	-	-	<1	1	-	-	-
	Jul	<1	-	-	-	-	-	<1	-	-	-
	Aug	-	-	-	-	-	1	-	-	-	-
	Sep	-	-	1	1	-	-	-	-	-	-
	Oct	-	-	-	-	-	-	-	-	-	-
	Nov	-	-	-	-	-	-	-	-	-	-
	Dec	-	-	-	-	-	-	-	-	-	-
Green Sunfish	Jan	-	-	-	-	-	-	-	-	-	-
	Feb	-	-	-	-	-	-	-	-	-	-
	Mar	<1	<1	1	-	-	-	-	-	-	-
	Apr	<1	<1	<1	-	-	-	-	-	-	-
	May	<1	<1	<1	-	-	-	-	-	-	-
	Jun	<1	<1	<1	<1	-	-	-	-	-	-
	Jul	-	<1	<1	-	-	-	-	-	-	-
	Aug	-	<1	-	-	-	-	-	-	-	-
	Sep	-	<1	<1	-	-	-	-	-	-	-
	Oct	-	<1	<1	-	-	-	-	-	-	-
	Nov	-	-	<1	-	-	-	-	-	-	-
	Dec	-	-	-	-	-	-	-	-	-	-
Highfin Carpsucker	Jan	-	-	-	-	-	-	-	-	-	-
	Feb	-	-	-	-	-	-	-	-	-	-
	Mar	-	-	-	-	-	-	-	-	-	-
	Apr	-	-	-	-	-	-	-	-	-	-
	May	-	-	<1	2	<1	-	-	-	-	-
	Jun	-	-	-	-	-	-	-	-	-	-
	Jul	-	-	-	-	1	<1	-	-	-	-
	Aug	-	-	-	-	1	-	<1	-	-	-
	Sep	-	-	-	-	-	-	-	-	-	-
	Oct	-	-	-	-	-	-	-	-	-	-
	Nov	-	-	-	-	-	-	-	-	-	-
	Dec	-	-	-	-	-	-	-	-	-	-

Monthly Entrainment Estimates by Length Class for Target Species Based on a Normal Water Year (2012) at Racine Hydroelectric Plant

Target Species	Month	0-2"	2.1-4"	4.1-6"	6.1-8"	8.1-10"	10.1-15"	15.1-20"	20.1-25"	25.1-30"	>30"
Hybrid Striped Bass	Jan	-	-	-	-	-	-	-	-	-	-
	Feb	-	-	-	-	-	-	-	-	-	-
	Mar	-	1	1	-	-	-	-	-	-	-
	Apr	-	-	-	6	2	-	-	-	-	-
	May	-	-	5	-	30	-	-	-	-	-
	Jun	-	-	-	-	3	-	-	-	-	-
	Jul	-	2	1	2	4	-	-	-	-	-
	Aug	-	3	-	5	41	3	-	-	-	-
	Sep	-	-	3	3	-	-	-	-	-	-
	Oct	-	1	2	<1	-	<1	-	-	-	-
	Nov	-	3	-	-	-	-	-	-	-	-
	Dec	-	-	-	-	-	-	-	-	-	-
Largemouth Bass	Jan	-	5	4	-	-	-	2	-	-	-
	Feb	-	2	1	<1	-	-	-	-	-	-
	Mar	1	2	<1	<1	<1	<1	-	-	-	-
	Apr	-	7	<1	-	-	4	<1	-	-	-
	May	-	<1	<1	<1	<1	<1	-	-	-	-
	Jun	44	<1	<1	<1	<1	<1	<1	-	-	-
	Jul	33	16	-	1	<1	<1	-	-	-	-
	Aug	<1	4	1	1	<1	<1	<1	-	-	-
	Sep	<1	5	1	1	<1	<1	-	-	-	-
	Oct	<1	8	3	<1	<1	-	<1	-	-	-
	Nov	-	13	7	1	<1	2	<1	-	-	-
	Dec	<1	4	1	-	<1	<1	-	-	-	-
Logperch	Jan	-	<1	-	-	-	-	-	-	-	-
	Feb	-	1	-	-	-	-	-	-	-	-
	Mar	-	<1	-	-	-	-	-	-	-	-
	Apr	<1	4	1	-	-	<1	-	-	-	-
	May	<1	4	1	<1	-	-	-	-	-	-
	Jun	1	4	<1	-	-	<1	-	-	-	-
	Jul	11	3	<1	-	-	-	-	-	-	-
	Aug	<1	1	<1	-	-	-	-	-	-	-
	Sep	<1	1	1	-	-	-	-	-	-	-
	Oct	<1	1	1	-	-	<1	-	-	-	-
	Nov	-	<1	<1	<1	-	<1	-	-	-	-
	Dec	-	-	-	-	-	-	-	-	-	-
Longnose Gar	Jan	-	-	-	-	-	-	-	-	-	-
	Feb	-	-	-	-	-	2	-	-	-	-
	Mar	-	-	-	-	-	-	-	-	-	-
	Apr	-	-	-	-	-	-	-	-	-	-
	May	-	-	-	-	-	-	-	-	-	-
	Jun	-	-	-	-	-	-	-	-	-	-
	Jul	-	-	-	-	-	-	-	-	-	-
	Aug	-	-	<1	-	1	<1	<1	-	-	-
	Sep	-	-	-	-	1	2	-	-	-	-
	Oct	-	-	-	-	2	2	1	-	-	-
	Nov	-	-	-	-	-	-	-	-	-	-
	Dec	-	-	-	-	-	-	-	-	-	-
Northern Hogsucker	Jan	-	1	1	11	5	5	-	-	-	-
	Feb	-	6	1	5	-	<1	<1	-	-	-
	Mar	-	-	<1	-	1	<1	-	-	-	-
	Apr	-	25	<1	-	1	1	-	-	-	-
	May	-	<1	<1	<1	<1	1	-	-	-	-
	Jun	<1	1	<1	<1	<1	<1	-	-	-	-
	Jul	1	<1	<1	<1	-	<1	-	-	-	-
	Aug	<1	<1	<1	<1	-	-	-	-	-	-
	Sep	-	<1	-	-	-	<1	-	-	-	-
	Oct	-	1	1	3	1	<1	-	-	-	-
	Nov	-	2	1	5	1	<1	-	-	-	-
	Dec	-	<1	<1	1	-	1	-	-	-	-
Quillback	Jan	-	-	-	-	-	-	-	-	-	-
	Feb	-	-	-	-	-	-	-	-	-	-
	Mar	-	-	-	-	-	-	-	-	-	-
	Apr	-	-	-	-	-	-	-	-	-	-
	May	-	<1	-	-	-	-	-	-	-	-
	Jun	-	-	-	-	-	-	-	-	-	-
	Jul	-	-	-	-	-	-	-	-	-	-
	Aug	-	-	-	-	-	-	-	-	-	-
	Sep	-	-	-	-	-	-	-	-	-	-
	Oct	-	-	-	-	-	-	-	-	-	-
	Nov	-	-	-	-	-	-	-	-	-	-
	Dec	-	-	-	-	-	-	-	-	-	-

Monthly Entrainment Estimates by Length Class for Target Species Based on a Normal Water Year (2012) at Racine Hydroelectric Plant

Target Species	Month	0-2"	2.1-4"	4.1-6"	6.1-8"	8.1-10"	10.1-15"	15.1-20"	20.1-25"	25.1-30"	>30"
River Carpsucker	Jan	-	-	-	-	-	-	-	-	-	-
	Feb	-	-	-	-	-	-	-	-	-	-
	Mar	-	-	-	-	-	-	-	-	-	-
	Apr	-	-	-	-	-	-	-	-	-	-
	May	-	-	1	13	3	-	-	-	-	-
	Jun	-	-	-	-	-	-	-	-	-	-
	Jul	-	-	-	-	8	3	-	-	-	-
	Aug	-	-	-	-	7	-	1	-	-	-
	Sep	-	-	-	-	-	-	-	-	-	-
	Oct	-	-	-	-	-	-	-	-	-	-
	Nov	-	-	-	-	-	-	-	-	-	-
	Dec	-	-	-	-	-	-	-	-	-	-
River Redhorse	Jan	-	-	-	-	-	-	-	-	-	-
	Feb	-	-	-	-	-	-	-	-	-	-
	Mar	-	-	-	-	-	-	-	-	-	-
	Apr	-	-	-	-	-	-	-	-	-	-
	May	-	-	-	-	-	-	-	-	-	-
	Jun	-	2	-	-	-	-	-	-	-	-
	Jul	-	-	-	-	-	-	-	-	-	-
	Aug	-	-	-	-	-	-	-	-	-	-
	Sep	-	-	-	-	-	-	-	-	-	-
	Oct	-	-	-	-	-	-	-	-	-	-
	Nov	-	-	-	-	-	-	-	-	-	-
	Dec	-	-	-	-	-	-	-	-	-	-
River Shiner	Jan	-	-	-	-	-	-	-	-	-	-
	Feb	-	-	-	-	-	-	-	-	-	-
	Mar	-	-	-	-	-	-	-	-	-	-
	Apr	-	-	-	-	-	-	-	-	-	-
	May	-	20	-	-	-	-	-	-	-	-
	Jun	-	-	-	-	-	-	-	-	-	-
	Jul	-	-	-	-	-	-	-	-	-	-
	Aug	2	4	-	-	-	-	-	-	-	-
	Sep	1	2	-	-	-	-	-	-	-	-
	Oct	1	1	-	-	-	-	-	-	-	-
	Nov	2	24	-	-	-	-	-	-	-	-
	Dec	-	-	-	-	-	-	-	-	-	-
Sauger	Jan	-	-	7	-	15	7	-	-	-	-
	Feb	-	-	-	-	5	5	-	-	-	-
	Mar	-	-	-	-	5	9	-	-	-	-
	Apr	-	8	4	8	146	12	-	-	-	-
	May	-	-	-	506	13	71	-	-	-	-
	Jun	-	-	-	390	-	-	-	-	-	-
	Jul	-	-	-	-	12	9	-	-	-	-
	Aug	-	-	-	-	24	24	-	-	-	-
	Sep	-	-	6	31	33	4	-	-	-	-
	Oct	-	-	2	22	81	4	-	-	-	-
	Nov	-	-	-	20	10	-	-	-	-	-
	Dec	-	-	-	-	-	-	-	-	-	-
Silver Chub	Jan	-	-	-	-	-	-	-	-	-	-
	Feb	-	172	65	-	-	-	-	-	-	-
	Mar	-	3	11	-	-	-	-	-	-	-
	Apr	-	55	1	-	1	-	-	-	-	-
	May	-	1	1	<1	-	-	-	-	-	-
	Jun	-	1	2	1	-	-	-	-	-	-
	Jul	-	-	1	-	-	-	-	-	-	-
	Aug	-	-	-	-	-	-	-	-	-	-
	Sep	-	1	-	-	-	-	-	-	-	-
	Oct	-	3	6	-	-	-	-	-	-	-
	Nov	-	22	33	2	-	-	-	-	-	-
	Dec	-	-	-	-	-	-	-	-	-	-
Silver Redhorse	Jan	-	-	-	-	-	-	-	-	-	-
	Feb	-	-	-	-	-	-	-	-	-	-
	Mar	-	-	<1	-	-	-	-	-	-	-
	Apr	-	1	<1	<1	-	-	-	-	-	-
	May	-	1	-	-	-	<1	<1	-	-	-
	Jun	<1	<1	<1	<1	<1	<1	<1	-	-	-
	Jul	<1	<1	<1	-	-	<1	<1	-	-	-
	Aug	<1	<1	<1	-	-	-	<1	-	-	-
	Sep	-	-	<1	<1	-	<1	<1	-	-	-
	Oct	-	-	<1	1	<1	-	-	-	-	-
	Nov	-	-	-	-	-	-	-	-	-	-
	Dec	-	-	-	-	-	-	-	-	-	-

Monthly Entrainment Estimates by Length Class for Target Species Based on a Normal Water Year (2012) at Racine Hydroelectric Plant

Target Species	Month	0-2"	2.1-4"	4.1-6"	6.1-8"	8.1-10"	10.1-15"	15.1-20"	20.1-25"	25.1-30"	>30"
Skipjack Herring	Jan	811	139	2	1	1	-	-	-	-	-
	Feb	35	22	2	3	2	-	-	-	-	-
	Mar	22	21	1	3	1	-	-	-	-	-
	Apr	<1	<1	2	<1	<1	-	-	-	-	-
	May	-	1	3	<1	<1	-	-	-	-	-
	Jun	<1	3	4	4	1	-	<1	-	-	-
	Jul	<1	16	3	2	<1	-	-	-	-	-
	Aug	<1	88	11	4	1	-	-	-	-	-
	Sep	26	9	-	1	<1	-	-	-	-	-
	Oct	34	13	3	4	1	<1	-	-	-	-
	Nov	380	100	175	5	1	<1	-	-	-	-
	Dec	220	11	51	3	1	-	-	-	-	-
Smallmouth Bass	Jan	1	<1	<1	<1	-	-	-	-	-	-
	Feb	-	1	-	-	-	-	-	-	-	-
	Mar	-	1	<1	<1	-	-	-	-	-	-
	Apr	<1	1	-	<1	-	1	<1	-	-	-
	May	<1	<1	<1	<1	<1	1	<1	-	-	-
	Jun	7	1	<1	<1	<1	<1	<1	-	-	-
	Jul	18	2	<1	<1	<1	<1	-	<1	-	-
	Aug	1	2	1	1	<1	<1	<1	-	-	-
	Sep	<1	6	4	2	<1	<1	<1	-	-	-
	Oct	<1	3	1	<1	<1	<1	<1	-	-	-
	Nov	-	1	1	<1	<1	<1	-	-	-	-
	Dec	<1	1	<1	-	<1	-	-	-	-	-
Smallmouth Buffalo	Jan	-	-	-	-	-	-	-	-	-	-
	Feb	-	-	-	-	-	-	-	-	-	-
	Mar	-	-	-	-	-	-	-	-	-	-
	Apr	-	-	-	-	-	-	-	-	-	-
	May	-	-	-	-	-	1	-	-	-	-
	Jun	-	-	-	-	-	-	-	-	-	-
	Jul	-	-	-	-	-	-	-	-	-	-
	Aug	-	-	-	-	-	-	-	-	-	-
	Sep	-	-	-	-	-	-	-	-	-	-
	Oct	-	-	-	-	-	-	-	-	-	-
	Nov	-	-	-	-	-	-	-	-	-	-
	Dec	-	-	-	-	-	-	-	-	-	-
Smallmouth Redhorse	Jan	-	-	-	-	-	-	-	-	-	-
	Feb	-	-	-	-	-	-	-	-	-	-
	Mar	-	-	-	-	-	-	-	-	-	-
	Apr	-	1	-	-	-	-	-	-	-	-
	May	-	<1	-	-	-	3	2	-	-	-
	Jun	-	<1	<1	-	-	<1	1	-	-	-
	Jul	<1	-	-	-	-	-	<1	-	-	-
	Aug	-	-	-	-	-	1	-	-	-	-
	Sep	-	-	1	1	-	-	-	-	-	-
	Oct	-	-	-	-	-	-	-	-	-	-
	Nov	-	-	-	-	-	-	-	-	-	-
	Dec	-	-	-	-	-	-	-	-	-	-
Spotfin Shiner	Jan	-	-	-	-	-	-	-	-	-	-
	Feb	-	-	<1	-	-	-	-	-	-	-
	Mar	-	<1	-	-	-	-	-	-	-	-
	Apr	-	1	-	-	-	-	-	-	-	-
	May	-	-	-	-	-	-	-	-	-	-
	Jun	-	<1	-	-	-	-	-	-	-	-
	Jul	-	1	-	-	-	-	-	-	-	-
	Aug	-	<1	-	-	-	-	-	-	-	-
	Sep	-	-	<1	-	-	-	-	-	-	-
	Oct	<1	<1	-	-	-	-	-	-	-	-
	Nov	-	<1	-	-	-	-	-	-	-	-
	Dec	-	-	-	-	-	-	-	-	-	-
Spotted Bass	Jan	-	-	-	-	-	-	-	-	-	-
	Feb	-	-	-	-	-	-	-	-	-	-
	Mar	-	-	-	-	-	-	-	-	-	-
	Apr	-	-	-	-	-	-	-	-	-	-
	May	-	-	-	-	-	-	-	-	-	-
	Jun	-	<1	-	-	-	<1	-	-	-	-
	Jul	-	-	-	-	-	-	-	-	-	-
	Aug	-	-	-	-	-	-	-	-	-	-
	Sep	-	-	-	-	-	-	-	-	-	-
	Oct	-	-	-	-	-	-	-	-	-	-
	Nov	-	-	-	-	-	<1	-	-	-	-
	Dec	-	-	-	-	-	-	-	-	-	-

Monthly Entrainment Estimates by Length Class for Target Species Based on a Normal Water Year (2012) at Racine Hydroelectric Plant

Target Species	Month	0-2"	2.1-4"	4.1-6"	6.1-8"	8.1-10"	10.1-15"	15.1-20"	20.1-25"	25.1-30"	>30"
Spotted Sucker	Jan	-	-	-	-	-	-	-	-	-	-
	Feb	-	-	-	-	-	-	-	-	-	-
	Mar	-	-	-	-	-	-	-	-	-	-
	Apr	-	-	-	-	-	-	-	-	-	-
	May	-	-	-	-	-	-	-	-	-	-
	Jun	-	-	-	-	-	-	-	-	-	-
	Jul	-	-	-	-	-	-	-	-	-	-
	Aug	-	-	-	-	-	-	-	-	-	-
	Sep	<1	<1	-	-	-	-	-	-	-	-
	Oct	-	<1	-	-	-	-	-	-	-	-
	Nov	-	-	-	-	-	-	-	-	-	-
	Dec	-	-	-	-	-	-	-	-	-	-
Walleye	Jan	1	<1	<1	1	7	3	-	-	-	-
	Feb	-	1	2	<1	-	<1	<1	-	-	-
	Mar	-	-	<1	-	<1	<1	-	-	-	-
	Apr	-	<1	1	1	2	3	<1	-	-	-
	May	<1	<1	2	6	3	6	<1	-	-	-
	Jun	26	9	<1	2	2	3	<1	<1	-	-
	Jul	5	49	4	1	1	2	1	<1	<1	-
	Aug	<1	3	5	1	1	1	<1	<1	-	-
	Sep	<1	1	4	2	1	1	<1	<1	-	-
	Oct	-	<1	2	4	2	2	<1	-	-	-
	Nov	-	1	1	1	<1	1	<1	-	-	-
	Dec	-	<1	1	2	1	1	-	-	-	-
White Bass	Jan	-	-	-	-	-	-	-	-	-	-
	Feb	-	-	-	-	-	-	-	-	-	-
	Mar	-	<1	<1	-	-	-	-	-	-	-
	Apr	-	-	-	1	<1	-	-	-	-	-
	May	-	-	1	-	5	-	-	-	-	-
	Jun	-	-	-	-	1	-	-	-	-	-
	Jul	-	<1	<1	<1	1	-	-	-	-	-
	Aug	-	<1	-	1	7	<1	-	-	-	-
	Sep	-	-	<1	<1	-	-	-	-	-	-
	Oct	-	<1	<1	<1	-	<1	-	-	-	-
	Nov	-	1	-	-	-	-	-	-	-	-
	Dec	-	-	-	-	-	-	-	-	-	-
White Crappie[1]	Jan	<1	1	-	-	<1	-	-	-	-	-
	Feb	-	-	-	-	-	-	-	-	-	-
	Mar	-	<1	-	<1	1	-	-	-	-	-
	Apr	-	2	<1	<1	<1	-	-	-	-	-
	May	-	<1	<1	<1	<1	<1	-	-	-	-
	Jun	3	<1	<1	<1	-	<1	-	-	-	-
	Jul	3	1	<1	<1	<1	<1	-	-	-	-
	Aug	1	1	<1	<1	<1	<1	-	-	-	-
	Sep	-	1	<1	<1	<1	<1	-	-	-	-
	Oct	<1	<1	-	<1	-	<1	-	-	-	-
	Nov	<1	1	<1	<1	-	-	-	-	-	-
	Dec	-	2	-	-	-	-	-	-	-	-
Yellow Perch	Jan	-	8	5	1	<1	<1	-	-	-	-
	Feb	<1	11	8	<1	<1	<1	-	-	-	-
	Mar	<1	6	4	1	<1	<1	-	<1	-	-
	Apr	168	13	11	5	1	<1	-	-	-	-
	May	1	10	4	1	<1	<1	-	-	-	-
	Jun	45	14	1	<1	<1	<1	-	-	-	-
	Jul	46	7	1	<1	<1	<1	-	-	-	-
	Aug	2	2	1	1	<1	<1	-	-	-	-
	Sep	<1	17	5	2	<1	<1	-	-	-	-
	Oct	<1	108	24	1	<1	<1	-	-	-	-
	Nov	<1	3	2	1	<1	-	-	-	-	-
	Dec	<1	2	5	<1	<1	<1	-	-	-	-

[1] Species was not collected in the Racine Pool during Fall 2019-Spring 2020. Assumed one individual collected for entrainment estimates

Monthly Entrainment Estimates by Length Class for Target Species Based on a Wet Water Year (2014) at Racine Hydroelectric Plant

Target Species	Month	0-2"	2.1-4"	4.1-6"	6.1-8"	8.1-10"	10.1-15"	15.1-20"	20.1-25"	25.1-30"	>30"
American Eel[1]	Jan	-	-	-	-	-	-	-	-	-	-
	Feb	-	-	-	-	-	-	-	-	-	-
	Mar	-	-	-	-	-	-	-	-	-	-
	Apr	-	-	-	-	-	-	-	-	<1	<1
	May	-	-	-	<1	-	1	2	1	<1	<1
	Jun	-	-	-	-	-	2	10	1	<1	<1
	Jul	-	-	-	-	<1	7	10	2	<1	<1
	Aug	-	-	-	-	-	2	5	<1	<1	<1
	Sep	-	-	-	-	-	<1	<1	<1	1	6
	Oct	-	-	-	-	-	-	-	<1	1	13
	Nov	-	-	-	-	-	2	2	<1	2	39
	Dec	-	-	-	-	-	-	-	-	2	27
Bluegill	Jan	1	1	2	2	-	-	-	-	-	-
	Feb	1	2	<1	<1	-	-	-	-	-	-
	Mar	3	3	4	2	-	-	-	-	-	-
	Apr	9	220	253	4	<1	-	-	-	-	-
	May	3	168	26	4	<1	-	-	-	-	-
	Jun	2	30	75	13	<1	<1	-	-	-	-
	Jul	281	6	71	5	<1	-	-	-	-	-
	Aug	41	17	218	10	<1	<1	-	-	-	-
	Sep	30	11	528	8	<1	-	-	-	-	-
	Oct	45	54	434	<1	<1	6	2	-	-	-
	Nov	79	57	18	1	<1	-	-	-	-	-
	Dec	1	9	1	1	-	-	-	-	-	-
Bluntnose Minnow[1]	Jan	-	4	-	-	-	-	-	-	-	-
	Feb	-	1	-	-	-	-	-	-	-	-
	Mar	-	<1	<1	-	-	-	-	-	-	-
	Apr	-	1	-	-	-	-	-	-	-	-
	May	<1	1	-	-	-	-	-	-	-	-
	Jun	<1	1	-	-	-	-	-	-	-	-
	Jul	1	1	<1	-	-	-	-	-	-	-
	Aug	<1	<1	-	-	-	-	-	-	-	-
	Sep	<1	<1	-	-	-	-	-	-	-	-
	Oct	<1	<1	-	-	-	-	-	-	-	-
	Nov	-	<1	-	-	-	-	-	-	-	-
	Dec	-	-	-	-	-	-	-	-	-	-
Channel Catfish	Jan	-	30	1	-	-	2	-	-	-	-
	Feb	-	3	<1	-	-	<1	-	-	-	-
	Mar	-	11	2	<1	<1	<1	-	-	-	-
	Apr	-	15	4	<1	<1	<1	-	-	-	-
	May	<1	2	2	1	<1	1	<1	-	-	-
	Jun	9	1	1	<1	<1	<1	<1	<1	-	-
	Jul	874	9	<1	1	<1	1	<1	<1	<1	<1
	Aug	243	72	5	4	5	4	<1	-	-	-
	Sep	19	14	2	1	1	1	<1	-	-	-
	Oct	7	11	2	<1	<1	<1	<1	-	-	-
	Nov	3	35	3	<1	<1	<1	<1	-	-	-
	Dec	-	<1	-	-	-	-	-	-	-	-
Channel Shiner	Jan	-	-	-	-	-	-	-	-	-	-
	Feb	-	-	-	-	-	-	-	-	-	-
	Mar	-	-	-	-	-	-	-	-	-	-
	Apr	-	-	-	-	-	-	-	-	-	-
	May	-	42	-	-	-	-	-	-	-	-
	Jun	-	-	-	-	-	-	-	-	-	-
	Jul	-	-	-	-	-	-	-	-	-	-
	Aug	10	15	-	-	-	-	-	-	-	-
	Sep	3	5	-	-	-	-	-	-	-	-
	Oct	4	4	-	-	-	-	-	-	-	-
	Nov	5	57	-	-	-	-	-	-	-	-
	Dec	-	-	-	-	-	-	-	-	-	-
Common Carp	Jan	-	-	-	-	-	-	1	1	-	-
	Feb	-	-	-	-	-	-	-	-	-	-
	Mar	-	<1	<1	-	-	<1	<1	-	-	-
	Apr	-	<1	<1	-	-	-	-	<1	-	-
	May	-	<1	-	-	-	<1	<1	<1	<1	-
	Jun	2	-	-	-	<1	<1	-	<1	-	-
	Jul	<1	1	-	-	-	<1	1	<1	-	-
	Aug	<1	2	<1	-	-	<1	<1	<1	<1	-
	Sep	-	<1	<1	<1	<1	-	-	-	-	-
	Oct	<1	<1	<1	<1	-	<1	<1	-	-	-
	Nov	-	<1	<1	<1	<1	-	-	-	-	-
	Dec	-	-	-	-	-	-	-	-	-	-

Monthly Entrainment Estimates by Length Class for Target Species Based on a Wet Water Year (2014) at Racine Hydroelectric Plant

Target Species	Month	0-2"	2.1-4"	4.1-6"	6.1-8"	8.1-10"	10.1-15"	15.1-20"	20.1-25"	25.1-30"	>30"
Emerald Shiner	Jan	1,077	2,486	-	-	-	-	-	-	-	-
	Feb	1,627	626	77	-	-	-	-	-	-	-
	Mar	4,348	5,797	369	-	-	-	-	-	-	-
	Apr	1,930	9,349	165	-	-	-	-	-	-	-
	May	1,709	6,062	125	-	-	-	-	-	-	-
	Jun	284	12,690	323	-	-	-	123	123	-	-
	Jul	14	4,909	98	-	-	-	-	-	-	-
	Aug	2,481	16,789	-	-	-	-	-	-	-	-
	Sep	2,136	3,379	392	-	-	-	-	-	-	-
	Oct	8,317	11,509	45	-	-	-	-	-	-	-
	Nov	11,542	14,939	302	-	-	-	-	-	-	-
	Dec	50	1,785	-	-	-	-	-	-	-	-
Freshwater Drum	Jan	-	-	-	-	-	-	-	-	-	-
	Feb	-	-	-	-	-	-	-	-	-	-
	Mar	-	-	-	-	-	-	-	-	-	-
	Apr	-	-	-	-	-	-	-	-	-	-
	May	-	-	2	-	3	24	4	-	-	-
	Jun	-	-	-	1	-	13	1	3	-	-
	Jul	3	88	3	3	13	55	5	-	-	-
	Aug	-	-	-	-	7	188	7	-	-	-
	Sep	-	449	10	-	-	10	1	-	-	-
	Oct	-	365	8	-	-	4	-	-	-	-
	Nov	-	-	5	111	-	-	-	-	-	-
	Dec	-	-	-	-	-	-	-	-	-	-
Gizzard Shad	Jan	-	20	489	13	8	2	<1	-	-	-
	Feb	-	<1	14	5	7	2	-	-	-	-
	Mar	-	13	8,039	84	171	102	-	-	-	-
	Apr	-	6	30	16	4	3	-	-	-	-
	May	-	2	23	2	3	2	-	-	-	-
	Jun	-	-	-	3	3	12	-	-	-	-
	Jul	4	2	8,877	19	12	31	-	-	-	-
	Aug	-	3,136	13,385	3,597	64	29	-	-	-	-
	Sep	141	13,174	394	588	370	23	-	-	-	-
	Oct	36,794	104,068	30,756	5,712	643	4	-	-	-	-
	Nov	28,890	27,544	20,295	8,379	1,457	40	-	-	-	-
	Dec	17,872	13,126	6	173	337	20	-	-	-	-
Golden Redhorse	Jan	-	-	-	-	-	-	-	-	-	-
	Feb	-	-	-	-	-	-	-	-	-	-
	Mar	-	-	-	-	-	-	-	-	-	-
	Apr	-	1	-	-	-	-	-	-	-	-
	May	-	<1	-	-	-	3	2	-	-	-
	Jun	-	1	<1	-	-	<1	2	-	-	-
	Jul	<1	-	-	-	-	-	<1	-	-	-
	Aug	-	-	-	-	-	2	-	-	-	-
	Sep	-	-	1	1	-	-	-	-	-	-
	Oct	-	-	-	-	-	-	-	-	-	-
	Nov	-	-	-	-	-	-	-	-	-	-
	Dec	-	-	-	-	-	-	-	-	-	-
Green Sunfish	Jan	-	-	-	-	-	-	-	-	-	-
	Feb	-	-	-	-	-	-	-	-	-	-
	Mar	<1	<1	<1	-	-	-	-	-	-	-
	Apr	<1	<1	<1	-	-	-	-	-	-	-
	May	<1	<1	<1	-	-	-	-	-	-	-
	Jun	<1	<1	<1	<1	-	-	-	-	-	-
	Jul	-	<1	<1	-	-	-	-	-	-	-
	Aug	-	<1	-	-	-	-	-	-	-	-
	Sep	-	<1	<1	-	-	-	-	-	-	-
	Oct	-	<1	<1	-	-	-	-	-	-	-
	Nov	-	-	<1	-	-	-	-	-	-	-
	Dec	-	-	-	-	-	-	-	-	-	-
Highfin Carpsucker	Jan	-	-	-	-	-	-	-	-	-	-
	Feb	-	-	-	-	-	-	-	-	-	-
	Mar	-	-	-	-	-	-	-	-	-	-
	Apr	-	-	-	-	-	-	-	-	-	-
	May	-	-	<1	2	<1	-	-	-	-	-
	Jun	-	-	-	-	-	-	-	-	-	-
	Jul	-	-	-	-	2	1	-	-	-	-
	Aug	-	-	-	-	2	-	<1	-	-	-
	Sep	-	-	-	-	-	-	-	-	-	-
	Oct	-	-	-	-	-	-	-	-	-	-
	Nov	-	-	-	-	-	-	-	-	-	-
	Dec	-	-	-	-	-	-	-	-	-	-

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Target Species	Month	0-2"	2.1-4"	4.1-6"	6.1-8"	8.1-10"	10.1-15"	15.1-20"	20.1-25"	25.1-30"	>30"
Hybrid Striped Bass	Jan	-	-	-	-	-	-	-	-	-	-
	Feb	-	-	-	-	-	-	-	-	-	-
	Mar	-	1	1	-	-	-	-	-	-	-
	Apr	-	-	-	4	1	-	-	-	-	-
	May	-	-	5	-	34	-	-	-	-	-
	Jun	-	-	-	-	7	-	-	-	-	-
	Jul	-	4	2	4	8	-	-	-	-	-
	Aug	-	6	-	10	90	6	-	-	-	-
	Sep	-	-	3	3	-	-	-	-	-	-
	Oct	-	2	4	1	-	<1	-	-	-	-
	Nov	-	4	-	-	-	-	-	-	-	-
	Dec	-	-	-	-	-	-	-	-	-	-
Largemouth Bass	Jan	-	5	4	-	-	-	2	-	-	-
	Feb	-	2	1	<1	-	-	-	-	-	-
	Mar	<1	2	<1	<1	<1	<1	-	-	-	-
	Apr	-	5	<1	-	-	3	<1	-	-	-
	May	-	<1	<1	<1	<1	<1	-	-	-	-
	Jun	91	1	<1	<1	<1	<1	<1	-	-	-
	Jul	60	29	-	1	<1	<1	-	-	-	-
	Aug	1	8	2	2	<1	<1	<1	-	-	-
	Sep	<1	7	2	1	<1	<1	-	-	-	-
	Oct	<1	17	5	<1	<1	-	<1	-	-	-
	Nov	-	16	9	2	<1	2	<1	-	-	-
	Dec	<1	3	1	-	<1	<1	-	-	-	-
Logperch	Jan	-	<1	-	-	-	-	-	-	-	-
	Feb	-	1	-	-	-	-	-	-	-	-
	Mar	-	<1	-	-	-	-	-	-	-	-
	Apr	<1	3	1	-	-	<1	-	-	-	-
	May	<1	4	1	<1	-	-	-	-	-	-
	Jun	2	8	<1	-	-	<1	-	-	-	-
	Jul	20	5	<1	-	-	-	-	-	-	-
	Aug	<1	1	<1	-	-	-	-	-	-	-
	Sep	<1	1	1	-	-	-	-	-	-	-
	Oct	<1	1	1	-	-	<1	-	-	-	-
	Nov	-	<1	<1	<1	-	<1	-	-	-	-
	Dec	-	-	-	-	-	-	-	-	-	-
Longnose Gar	Jan	-	-	-	-	-	-	-	-	-	-
	Feb	-	-	-	-	-	1	-	-	-	-
	Mar	-	-	-	-	-	-	-	-	-	-
	Apr	-	-	-	-	-	-	-	-	-	-
	May	-	-	-	-	-	-	-	-	-	-
	Jun	-	-	-	-	-	-	-	-	-	-
	Jul	-	-	-	-	-	-	-	-	-	-
	Aug	-	-	1	-	1	1	<1	-	-	-
	Sep	-	-	-	-	1	3	-	-	-	-
	Oct	-	-	-	-	5	4	1	-	-	-
	Nov	-	-	-	-	-	-	-	-	-	-
	Dec	-	-	-	-	-	-	-	-	-	-
Northern Hogsucker	Jan	-	1	1	11	5	5	-	-	-	-
	Feb	-	5	1	4	-	<1	<1	-	-	-
	Mar	-	-	<1	-	1	<1	-	-	-	-
	Apr	-	18	<1	-	<1	1	-	-	-	-
	May	-	<1	<1	<1	1	1	-	-	-	-
	Jun	<1	1	1	<1	<1	<1	-	-	-	-
	Jul	2	<1	<1	<1	-	<1	-	-	-	-
	Aug	<1	<1	1	<1	-	-	-	-	-	-
	Sep	-	<1	-	-	-	<1	-	-	-	-
	Oct	-	2	1	7	1	<1	-	-	-	-
	Nov	-	2	1	7	1	1	-	-	-	-
	Dec	-	<1	<1	1	-	1	-	-	-	-
Quillback	Jan	-	-	-	-	-	-	-	-	-	-
	Feb	-	-	-	-	-	-	-	-	-	-
	Mar	-	-	-	-	-	-	-	-	-	-
	Apr	-	-	-	-	-	-	-	-	-	-
	May	-	1	-	-	-	-	-	-	-	-
	Jun	-	-	-	-	-	-	-	-	-	-
	Jul	-	-	-	-	-	-	-	-	-	-
	Aug	-	-	-	-	-	-	-	-	-	-
	Sep	-	-	-	-	-	-	-	-	-	-
	Oct	-	-	-	-	-	-	-	-	-	-
	Nov	-	-	-	-	-	-	-	-	-	-
	Dec	-	-	-	-	-	-	-	-	-	-

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Target Species	Month	0-2"	2.1-4"	4.1-6"	6.1-8"	8.1-10"	10.1-15"	15.1-20"	20.1-25"	25.1-30"	>30"
River Carpsucker	Jan	-	-	-	-	-	-	-	-	-	-
	Feb	-	-	-	-	-	-	-	-	-	-
	Mar	-	-	-	-	-	-	-	-	-	-
	Apr	-	-	-	-	-	-	-	-	-	-
	May	-	-	1	15	3	-	-	-	-	-
	Jun	-	-	-	-	-	-	-	-	-	-
	Jul	-	-	-	-	15	5	-	-	-	-
	Aug	-	-	-	-	16	-	2	-	-	-
	Sep	-	-	-	-	-	-	-	-	-	-
	Oct	-	-	-	-	-	-	-	-	-	-
	Nov	-	-	-	-	-	-	-	-	-	-
	Dec	-	-	-	-	-	-	-	-	-	-
River Redhorse	Jan	-	-	-	-	-	-	-	-	-	-
	Feb	-	-	-	-	-	-	-	-	-	-
	Mar	-	-	-	-	-	-	-	-	-	-
	Apr	-	-	-	-	-	-	-	-	-	-
	May	-	-	-	-	-	-	-	-	-	-
	Jun	-	4	-	-	-	-	-	-	-	-
	Jul	-	-	-	-	-	-	-	-	-	-
	Aug	-	-	-	-	-	-	-	-	-	-
	Sep	-	-	-	-	-	-	-	-	-	-
	Oct	-	-	-	-	-	-	-	-	-	-
	Nov	-	-	-	-	-	-	-	-	-	-
	Dec	-	-	-	-	-	-	-	-	-	-
River Shiner	Jan	-	-	-	-	-	-	-	-	-	-
	Feb	-	-	-	-	-	-	-	-	-	-
	Mar	-	-	-	-	-	-	-	-	-	-
	Apr	-	-	-	-	-	-	-	-	-	-
	May	-	23	-	-	-	-	-	-	-	-
	Jun	-	-	-	-	-	-	-	-	-	-
	Jul	-	-	-	-	-	-	-	-	-	-
	Aug	5	8	-	-	-	-	-	-	-	-
	Sep	1	3	-	-	-	-	-	-	-	-
	Oct	2	2	-	-	-	-	-	-	-	-
	Nov	3	30	-	-	-	-	-	-	-	-
	Dec	-	-	-	-	-	-	-	-	-	-
Sauger	Jan	-	-	7	-	14	7	-	-	-	-
	Feb	-	-	-	-	4	4	-	-	-	-
	Mar	-	-	-	-	4	8	-	-	-	-
	Apr	-	6	3	6	107	8	-	-	-	-
	May	-	-	-	579	15	81	-	-	-	-
	Jun	-	-	-	798	-	-	-	-	-	-
	Jul	-	-	-	-	21	17	-	-	-	-
	Aug	-	-	-	-	52	52	-	-	-	-
	Sep	-	-	7	39	41	5	-	-	-	-
	Oct	-	-	4	46	167	8	-	-	-	-
	Nov	-	-	-	26	13	-	-	-	-	-
	Dec	-	-	-	-	-	-	-	-	-	-
Silver Chub	Jan	-	-	-	-	-	-	-	-	-	-
	Feb	-	130	49	-	-	-	-	-	-	-
	Mar	-	2	10	-	-	-	-	-	-	-
	Apr	-	41	1	-	1	-	-	-	-	-
	May	-	1	1	<1	-	-	-	-	-	-
	Jun	-	2	4	2	-	-	-	-	-	-
	Jul	-	-	2	-	-	-	-	-	-	-
	Aug	-	-	-	-	-	-	-	-	-	-
	Sep	-	1	-	-	-	-	-	-	-	-
	Oct	-	6	12	-	-	-	-	-	-	-
	Nov	-	28	42	3	-	-	-	-	-	-
	Dec	-	-	-	-	-	-	-	-	-	-
Silver Redhorse	Jan	-	-	-	-	-	-	-	-	-	-
	Feb	-	-	-	-	-	-	-	-	-	-
	Mar	-	-	<1	-	-	-	-	-	-	-
	Apr	-	1	<1	<1	-	-	-	-	-	-
	May	-	1	-	-	-	<1	1	-	-	-
	Jun	<1	<1	<1	<1	<1	<1	<1	-	-	-
	Jul	<1	1	<1	-	-	<1	<1	-	-	-
	Aug	<1	<1	<1	-	-	-	<1	-	-	-
	Sep	-	-	<1	<1	-	<1	<1	-	-	-
	Oct	-	-	<1	2	<1	-	-	-	-	-
	Nov	-	-	-	-	-	-	-	-	-	-
	Dec	-	-	-	-	-	-	-	-	-	-

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Target Species	Month	0-2"	2.1-4"	4.1-6"	6.1-8"	8.1-10"	10.1-15"	15.1-20"	20.1-25"	25.1-30"	>30"
Skipjack Herring	Jan	803	138	2	1	1	-	-	-	-	-
	Feb	26	17	1	3	2	-	-	-	-	-
	Mar	19	19	1	2	1	-	-	-	-	-
	Apr	<1	<1	1	<1	<1	-	-	-	-	-
	May	-	1	4	<1	<1	-	-	-	-	-
	Jun	<1	6	9	9	2	-	<1	-	-	-
	Jul	<1	29	5	3	<1	-	-	-	-	-
	Aug	1	191	25	9	2	-	-	-	-	-
	Sep	32	11	-	1	<1	-	-	-	-	-
	Oct	71	26	7	8	1	<1	-	-	-	-
	Nov	489	129	226	7	2	<1	-	-	-	-
	Dec	205	10	48	2	1	-	-	-	-	-
Smallmouth Bass	Jan	1	<1	<1	<1	-	-	-	-	-	-
	Feb	-	<1	-	-	-	-	-	-	-	-
	Mar	-	1	<1	<1	-	-	-	-	-	-
	Apr	<1	<1	-	<1	-	1	<1	-	-	-
	May	<1	<1	<1	<1	<1	1	<1	-	-	-
	Jun	15	1	<1	1	1	1	<1	-	-	-
	Jul	33	3	1	1	<1	<1	-	<1	-	-
	Aug	3	5	2	1	1	1	<1	-	-	-
	Sep	<1	8	5	2	<1	<1	<1	-	-	-
	Oct	<1	6	2	<1	<1	<1	<1	-	-	-
	Nov	-	1	1	1	<1	<1	-	-	-	-
	Dec	<1	1	<1	-	<1	-	-	-	-	-
Smallmouth Buffalo	Jan	-	-	-	-	-	-	-	-	-	-
	Feb	-	-	-	-	-	-	-	-	-	-
	Mar	-	-	-	-	-	-	-	-	-	-
	Apr	-	-	-	-	-	-	-	-	-	-
	May	-	-	-	-	-	2	-	-	-	-
	Jun	-	-	-	-	-	-	-	-	-	-
	Jul	-	-	-	-	-	-	-	-	-	-
	Aug	-	-	-	-	-	-	-	-	-	-
	Sep	-	-	-	-	-	-	-	-	-	-
	Oct	-	-	-	-	-	-	-	-	-	-
	Nov	-	-	-	-	-	-	-	-	-	-
	Dec	-	-	-	-	-	-	-	-	-	-
Smallmouth Redhorse	Jan	-	-	-	-	-	-	-	-	-	-
	Feb	-	-	-	-	-	-	-	-	-	-
	Mar	-	-	-	-	-	-	-	-	-	-
	Apr	-	1	-	-	-	-	-	-	-	-
	May	-	<1	-	-	-	3	2	-	-	-
	Jun	-	1	<1	-	-	<1	2	-	-	-
	Jul	<1	-	-	-	-	-	<1	-	-	-
	Aug	-	-	-	-	-	2	-	-	-	-
	Sep	-	-	1	1	-	-	-	-	-	-
	Oct	-	-	-	-	-	-	-	-	-	-
	Nov	-	-	-	-	-	-	-	-	-	-
	Dec	-	-	-	-	-	-	-	-	-	-
Spotfin Shiner	Jan	-	-	-	-	-	-	-	-	-	-
	Feb	-	-	<1	-	-	-	-	-	-	-
	Mar	-	<1	-	-	-	-	-	-	-	-
	Apr	-	1	-	-	-	-	-	-	-	-
	May	-	-	-	-	-	-	-	-	-	-
	Jun	-	1	-	-	-	-	-	-	-	-
	Jul	-	1	-	-	-	-	-	-	-	-
	Aug	-	<1	-	-	-	-	-	-	-	-
	Sep	-	-	<1	-	-	-	-	-	-	-
	Oct	<1	<1	-	-	-	-	-	-	-	-
	Nov	-	<1	-	-	-	-	-	-	-	-
	Dec	-	-	-	-	-	-	-	-	-	-
Spotted Bass	Jan	-	-	-	-	-	-	-	-	-	-
	Feb	-	-	-	-	-	-	-	-	-	-
	Mar	-	-	-	-	-	-	-	-	-	-
	Apr	-	-	-	-	-	-	-	-	-	-
	May	-	-	-	-	-	-	-	-	-	-
	Jun	-	<1	-	-	-	<1	-	-	-	-
	Jul	-	-	-	-	-	-	-	-	-	-
	Aug	-	-	-	-	-	-	-	-	-	-
	Sep	-	-	-	-	-	-	-	-	-	-
	Oct	-	-	-	-	-	-	-	-	-	-
	Nov	-	-	-	-	-	<1	-	-	-	-
	Dec	-	-	-	-	-	-	-	-	-	-

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Target Species	Month	0-2"	2.1-4"	4.1-6"	6.1-8"	8.1-10"	10.1-15"	15.1-20"	20.1-25"	25.1-30"	>30"
Spotted Sucker	Jan	-	-	-	-	-	-	-	-	-	-
	Feb	-	-	-	-	-	-	-	-	-	-
	Mar	-	-	-	-	-	-	-	-	-	-
	Apr	-	-	-	-	-	-	-	-	-	-
	May	-	-	-	-	-	-	-	-	-	-
	Jun	-	-	-	-	-	-	-	-	-	-
	Jul	-	-	-	-	-	-	-	-	-	-
	Aug	-	-	-	-	-	-	-	-	-	-
	Sep	<1	<1	-	-	-	-	-	-	-	-
	Oct	-	<1	-	-	-	-	-	-	-	-
	Nov	-	-	-	-	-	-	-	-	-	-
	Dec	-	-	-	-	-	-	-	-	-	-
Walleye	Jan	1	<1	<1	1	7	3	-	-	-	-
	Feb	-	<1	1	<1	-	<1	<1	-	-	-
	Mar	-	-	<1	-	<1	<1	-	-	-	-
	Apr	-	<1	1	1	1	2	<1	-	-	-
	May	<1	<1	2	7	4	7	<1	-	-	-
	Jun	53	18	1	5	3	5	<1	<1	-	-
	Jul	9	89	7	2	2	4	2	<1	<1	-
	Aug	<1	6	11	2	2	3	<1	<1	-	-
	Sep	<1	2	5	2	1	1	<1	<1	-	-
	Oct	-	<1	4	7	3	4	<1	-	-	-
	Nov	-	1	1	1	1	1	1	-	-	-
	Dec	-	<1	1	2	1	1	-	-	-	-
White Bass	Jan	-	-	-	-	-	-	-	-	-	-
	Feb	-	-	-	-	-	-	-	-	-	-
	Mar	-	<1	<1	-	-	-	-	-	-	-
	Apr	-	-	-	1	<1	-	-	-	-	-
	May	-	-	1	-	6	-	-	-	-	-
	Jun	-	-	-	-	1	-	-	-	-	-
	Jul	-	1	<1	1	1	-	-	-	-	-
	Aug	-	1	-	2	16	1	-	-	-	-
	Sep	-	-	1	1	-	-	-	-	-	-
	Oct	-	<1	1	<1	-	<1	-	-	-	-
	Nov	-	1	-	-	-	-	-	-	-	-
	Dec	-	-	-	-	-	-	-	-	-	-
White Crappie[1]	Jan	<1	1	-	-	<1	-	-	-	-	-
	Feb	-	-	-	-	-	-	-	-	-	-
	Mar	-	<1	-	<1	<1	-	-	-	-	-
	Apr	-	2	<1	<1	<1	-	-	-	-	-
	May	-	<1	<1	<1	<1	<1	-	-	-	-
	Jun	6	<1	<1	<1	-	<1	-	-	-	-
	Jul	6	2	<1	<1	<1	<1	-	-	-	-
	Aug	2	3	<1	1	<1	<1	-	-	-	-
	Sep	-	1	<1	<1	<1	1	-	-	-	-
	Oct	<1	1	-	<1	-	<1	-	-	-	-
	Nov	<1	2	<1	<1	-	-	-	-	-	-
	Dec	-	2	-	-	-	-	-	-	-	-
Yellow Perch	Jan	-	8	5	1	<1	<1	-	-	-	-
	Feb	<1	9	6	<1	<1	<1	-	-	-	-
	Mar	<1	6	4	<1	<1	<1	-	<1	-	-
	Apr	124	10	8	4	1	<1	-	-	-	-
	May	1	12	5	1	<1	<1	-	-	-	-
	Jun	92	28	3	<1	<1	<1	-	-	-	-
	Jul	84	12	2	<1	<1	<1	-	-	-	-
	Aug	3	4	2	1	<1	<1	-	-	-	-
	Sep	<1	22	6	2	<1	<1	-	-	-	-
	Oct	<1	223	50	2	<1	<1	-	-	-	-
	Nov	<1	4	2	1	<1	-	-	-	-	-
	Dec	<1	2	4	<1	<1	<1	-	-	-	-

[1] Species was not collected in the Racine Pool during Fall 2019-Spring 2020. Assumed one individual collected for entrainment estimates

Monthly Entrainment Estimates by Length Class for Target Species Based on a Normal Water Year (2012) at Racine Hydroelectric Plant

Target Species	Month	0-2"	2.1-4"	4.1-6"	6.1-8"	8.1-10"	10.1-15"	15.1-20"	20.1-25"	25.1-30"	>30"
American Eel[1]	Jan	-	-	-	-	-	-	-	-	-	-
	Feb	-	-	-	-	-	-	-	-	-	-
	Mar	-	-	-	-	-	-	-	-	-	-
	Apr	-	-	-	-	-	-	-	-	<1	<1
	May	-	-	-	<1	-	1	2	1	<1	<1
	Jun	-	-	-	-	-	1	5	1	<1	<1
	Jul	-	-	-	-	<1	4	6	1	<1	<1
	Aug	-	-	-	-	-	1	2	<1	<1	<1
	Sep	-	-	-	-	-	<1	<1	<1	<1	5
	Oct	-	-	-	-	-	-	-	<1	1	6
	Nov	-	-	-	-	-	2	2	<1	1	30
	Dec	-	-	-	-	-	-	-	-	2	28
Bluegill	Jan	1	1	2	2	-	-	-	-	-	-
	Feb	1	2	<1	<1	-	-	-	-	-	-
	Mar	4	3	4	2	-	-	-	-	-	-
	Apr	12	300	344	5	<1	-	-	-	-	-
	May	3	147	23	4	<1	-	-	-	-	-
	Jun	1	15	36	6	<1	<1	-	-	-	-
	Jul	154	3	39	3	<1	-	-	-	-	-
	Aug	19	8	100	5	<1	<1	-	-	-	-
	Sep	24	9	426	7	<1	-	-	-	-	-
	Oct	22	26	211	<1	<1	3	1	-	-	-
	Nov	61	44	14	1	<1	-	-	-	-	-
	Dec	1	9	1	1	-	-	-	-	-	-
Bluntnose Minnow[1]	Jan	-	4	-	-	-	-	-	-	-	-
	Feb	-	1	-	-	-	-	-	-	-	-
	Mar	-	<1	<1	-	-	-	-	-	-	-
	Apr	-	2	-	-	-	-	-	-	-	-
	May	<1	1	-	-	-	-	-	-	-	-
	Jun	<1	<1	-	-	-	-	-	-	-	-
	Jul	<1	<1	<1	-	-	-	-	-	-	-
	Aug	<1	<1	-	-	-	-	-	-	-	-
	Sep	<1	<1	-	-	-	-	-	-	-	-
	Oct	<1	<1	-	-	-	-	-	-	-	-
	Nov	-	<1	-	-	-	-	-	-	-	-
	Dec	-	-	-	-	-	-	-	-	-	-
Channel Catfish	Jan	-	30	1	-	-	2	-	-	-	-
	Feb	-	4	<1	-	-	<1	-	-	-	-
	Mar	-	12	2	<1	<1	<1	-	-	-	-
	Apr	-	21	6	<1	<1	<1	-	-	-	-
	May	<1	2	2	<1	<1	<1	<1	-	-	-
	Jun	5	<1	1	<1	<1	<1	<1	<1	-	-
	Jul	478	5	<1	<1	<1	1	<1	<1	<1	<1
	Aug	111	33	2	2	2	2	<1	-	-	-
	Sep	15	11	2	1	1	1	<1	-	-	-
	Oct	3	5	1	<1	<1	<1	<1	-	-	-
	Nov	2	27	2	<1	<1	<1	<1	-	-	-
	Dec	-	<1	-	-	-	-	-	-	-	-
Channel Shiner	Jan	-	-	-	-	-	-	-	-	-	-
	Feb	-	-	-	-	-	-	-	-	-	-
	Mar	-	-	-	-	-	-	-	-	-	-
	Apr	-	-	-	-	-	-	-	-	-	-
	May	-	37	-	-	-	-	-	-	-	-
	Jun	-	-	-	-	-	-	-	-	-	-
	Jul	-	-	-	-	-	-	-	-	-	-
	Aug	4	7	-	-	-	-	-	-	-	-
	Sep	2	4	-	-	-	-	-	-	-	-
	Oct	2	2	-	-	-	-	-	-	-	-
	Nov	4	44	-	-	-	-	-	-	-	-
	Dec	-	-	-	-	-	-	-	-	-	-
Common Carp	Jan	-	-	-	-	-	-	1	1	-	-
	Feb	-	-	-	-	-	-	-	-	-	-
	Mar	-	<1	<1	-	-	<1	<1	-	-	-
	Apr	-	<1	<1	-	-	-	-	<1	-	-
	May	-	<1	-	-	-	<1	<1	<1	<1	-
	Jun	1	-	-	-	<1	<1	-	<1	-	-
	Jul	<1	<1	-	-	-	<1	<1	<1	-	-
	Aug	<1	1	<1	-	-	<1	<1	<1	<1	-
	Sep	-	<1	<1	<1	<1	-	-	-	-	-
	Oct	<1	<1	<1	<1	-	<1	<1	-	-	-
	Nov	-	<1	<1	<1	<1	-	-	-	-	-
	Dec	-	-	-	-	-	-	-	-	-	-

Monthly Entrainment Estimates by Length Class for Target Species Based on a Normal Water Year (2012) at Racine Hydroelectric Plant

Target Species	Month	0-2"	2.1-4"	4.1-6"	6.1-8"	8.1-10"	10.1-15"	15.1-20"	20.1-25"	25.1-30"	>30"
Emerald Shiner	Jan	1,087	2,509	-	-	-	-	-	-	-	-
	Feb	2,154	829	103	-	-	-	-	-	-	-
	Mar	4,941	6,587	420	-	-	-	-	-	-	-
	Apr	2,626	12,716	224	-	-	-	-	-	-	-
	May	1,494	5,301	109	-	-	-	-	-	-	-
	Jun	139	6,198	158	-	-	-	60	60	-	-
	Jul	8	2,683	53	-	-	-	-	-	-	-
	Aug	1,138	7,698	-	-	-	-	-	-	-	-
	Sep	1,723	2,726	316	-	-	-	-	-	-	-
	Oct	4,031	5,578	22	-	-	-	-	-	-	-
	Nov	8,958	11,594	234	-	-	-	-	-	-	-
	Dec	54	1,911	-	-	-	-	-	-	-	-
Freshwater Drum	Jan	-	-	-	-	-	-	-	-	-	-
	Feb	-	-	-	-	-	-	-	-	-	-
	Mar	-	-	-	-	-	-	-	-	-	-
	Apr	-	-	-	-	-	-	-	-	-	-
	May	-	-	2	-	3	21	4	-	-	-
	Jun	-	-	-	1	-	6	1	1	-	-
	Jul	1	48	1	1	7	30	3	-	-	-
	Aug	-	-	-	-	3	86	3	-	-	-
	Sep	-	362	8	-	-	8	1	-	-	-
	Oct	-	177	4	-	-	2	-	-	-	-
	Nov	-	-	4	86	-	-	-	-	-	-
	Dec	-	-	-	-	-	-	-	-	-	-
Gizzard Shad	Jan	-	20	494	13	8	2	<1	-	-	-
	Feb	-	<1	18	7	10	3	-	-	-	-
	Mar	-	15	9,135	96	194	116	-	-	-	-
	Apr	-	8	41	22	5	4	-	-	-	-
	May	-	2	20	2	2	2	-	-	-	-
	Jun	-	-	-	2	1	6	-	-	-	-
	Jul	2	1	4,851	10	7	17	-	-	-	-
	Aug	-	1,438	6,137	1,649	30	13	-	-	-	-
	Sep	114	10,627	318	474	299	19	-	-	-	-
	Oct	17,834	50,441	14,908	2,768	311	2	-	-	-	-
	Nov	22,422	21,377	15,751	6,503	1,131	31	-	-	-	-
	Dec	19,127	14,047	7	185	361	21	-	-	-	-
Golden Redhorse	Jan	-	-	-	-	-	-	-	-	-	-
	Feb	-	-	-	-	-	-	-	-	-	-
	Mar	-	-	-	-	-	-	-	-	-	-
	Apr	-	1	-	-	-	-	-	-	-	-
	May	-	<1	-	-	-	3	2	-	-	-
	Jun	-	<1	<1	-	-	<1	1	-	-	-
	Jul	<1	-	-	-	-	-	<1	-	-	-
	Aug	-	-	-	-	-	1	-	-	-	-
	Sep	-	-	1	1	-	-	-	-	-	-
	Oct	-	-	-	-	-	-	-	-	-	-
	Nov	-	-	-	-	-	-	-	-	-	-
	Dec	-	-	-	-	-	-	-	-	-	-
Green Sunfish	Jan	-	-	-	-	-	-	-	-	-	-
	Feb	-	-	-	-	-	-	-	-	-	-
	Mar	<1	<1	1	-	-	-	-	-	-	-
	Apr	<1	<1	<1	-	-	-	-	-	-	-
	May	<1	<1	<1	-	-	-	-	-	-	-
	Jun	<1	<1	<1	<1	-	-	-	-	-	-
	Jul	-	<1	<1	-	-	-	-	-	-	-
	Aug	-	<1	-	-	-	-	-	-	-	-
	Sep	-	<1	<1	-	-	-	-	-	-	-
	Oct	-	<1	<1	-	-	-	-	-	-	-
	Nov	-	-	<1	-	-	-	-	-	-	-
	Dec	-	-	-	-	-	-	-	-	-	-
Highfin Carpsucker	Jan	-	-	-	-	-	-	-	-	-	-
	Feb	-	-	-	-	-	-	-	-	-	-
	Mar	-	-	-	-	-	-	-	-	-	-
	Apr	-	-	-	-	-	-	-	-	-	-
	May	-	-	<1	2	<1	-	-	-	-	-
	Jun	-	-	-	-	-	-	-	-	-	-
	Jul	-	-	-	-	1	<1	-	-	-	-
	Aug	-	-	-	-	1	-	<1	-	-	-
	Sep	-	-	-	-	-	-	-	-	-	-
	Oct	-	-	-	-	-	-	-	-	-	-
	Nov	-	-	-	-	-	-	-	-	-	-
	Dec	-	-	-	-	-	-	-	-	-	-

Monthly Entrainment Estimates by Length Class for Target Species Based on a Normal Water Year (2012) at Racine Hydroelectric Plant

Target Species	Month	0-2"	2.1-4"	4.1-6"	6.1-8"	8.1-10"	10.1-15"	15.1-20"	20.1-25"	25.1-30"	>30"
Hybrid Striped Bass	Jan	-	-	-	-	-	-	-	-	-	-
	Feb	-	-	-	-	-	-	-	-	-	-
	Mar	-	1	1	-	-	-	-	-	-	-
	Apr	-	-	-	6	2	-	-	-	-	-
	May	-	-	5	-	30	-	-	-	-	-
	Jun	-	-	-	-	3	-	-	-	-	-
	Jul	-	2	1	2	4	-	-	-	-	-
	Aug	-	3	-	5	41	3	-	-	-	-
	Sep	-	-	3	3	-	-	-	-	-	-
	Oct	-	1	2	<1	-	<1	-	-	-	-
	Nov	-	3	-	-	-	-	-	-	-	-
	Dec	-	-	-	-	-	-	-	-	-	-
Largemouth Bass	Jan	-	5	4	-	-	-	2	-	-	-
	Feb	-	2	1	<1	-	-	-	-	-	-
	Mar	1	2	<1	<1	<1	<1	-	-	-	-
	Apr	-	7	<1	-	-	4	<1	-	-	-
	May	-	<1	<1	<1	<1	<1	-	-	-	-
	Jun	44	<1	<1	<1	<1	<1	<1	-	-	-
	Jul	33	16	-	1	<1	<1	-	-	-	-
	Aug	<1	4	1	1	<1	<1	<1	-	-	-
	Sep	<1	5	1	1	<1	<1	-	-	-	-
	Oct	<1	8	3	<1	<1	-	<1	-	-	-
	Nov	-	13	7	1	<1	2	<1	-	-	-
	Dec	<1	4	1	-	<1	<1	-	-	-	-
Logperch	Jan	-	<1	-	-	-	-	-	-	-	-
	Feb	-	1	-	-	-	-	-	-	-	-
	Mar	-	<1	-	-	-	-	-	-	-	-
	Apr	<1	4	1	-	-	<1	-	-	-	-
	May	<1	4	1	<1	-	-	-	-	-	-
	Jun	1	4	<1	-	-	<1	-	-	-	-
	Jul	11	3	<1	-	-	-	-	-	-	-
	Aug	<1	1	<1	-	-	-	-	-	-	-
	Sep	<1	1	1	-	-	-	-	-	-	-
	Oct	<1	1	1	-	-	<1	-	-	-	-
	Nov	-	<1	<1	<1	-	<1	-	-	-	-
	Dec	-	-	-	-	-	-	-	-	-	-
Longnose Gar	Jan	-	-	-	-	-	-	-	-	-	-
	Feb	-	-	-	-	-	2	-	-	-	-
	Mar	-	-	-	-	-	-	-	-	-	-
	Apr	-	-	-	-	-	-	-	-	-	-
	May	-	-	-	-	-	-	-	-	-	-
	Jun	-	-	-	-	-	-	-	-	-	-
	Jul	-	-	-	-	-	-	-	-	-	-
	Aug	-	-	<1	-	1	<1	<1	-	-	-
	Sep	-	-	-	-	1	2	-	-	-	-
	Oct	-	-	-	-	2	2	1	-	-	-
	Nov	-	-	-	-	-	-	-	-	-	-
	Dec	-	-	-	-	-	-	-	-	-	-
Northern Hogsucker	Jan	-	1	1	11	5	5	-	-	-	-
	Feb	-	6	1	5	-	<1	<1	-	-	-
	Mar	-	-	<1	-	1	<1	-	-	-	-
	Apr	-	25	<1	-	1	1	-	-	-	-
	May	-	<1	<1	<1	<1	1	-	-	-	-
	Jun	<1	1	<1	<1	<1	<1	-	-	-	-
	Jul	1	<1	<1	<1	-	<1	-	-	-	-
	Aug	<1	<1	<1	<1	-	-	-	-	-	-
	Sep	-	<1	-	-	-	<1	-	-	-	-
	Oct	-	1	1	3	1	<1	-	-	-	-
	Nov	-	2	1	5	1	<1	-	-	-	-
	Dec	-	<1	<1	1	-	1	-	-	-	-
Quillback	Jan	-	-	-	-	-	-	-	-	-	-
	Feb	-	-	-	-	-	-	-	-	-	-
	Mar	-	-	-	-	-	-	-	-	-	-
	Apr	-	-	-	-	-	-	-	-	-	-
	May	-	<1	-	-	-	-	-	-	-	-
	Jun	-	-	-	-	-	-	-	-	-	-
	Jul	-	-	-	-	-	-	-	-	-	-
	Aug	-	-	-	-	-	-	-	-	-	-
	Sep	-	-	-	-	-	-	-	-	-	-
	Oct	-	-	-	-	-	-	-	-	-	-
	Nov	-	-	-	-	-	-	-	-	-	-
	Dec	-	-	-	-	-	-	-	-	-	-

Monthly Entrainment Estimates by Length Class for Target Species Based on a Normal Water Year (2012) at Racine Hydroelectric Plant

Target Species	Month	0-2"	2.1-4"	4.1-6"	6.1-8"	8.1-10"	10.1-15"	15.1-20"	20.1-25"	25.1-30"	>30"
River Carpsucker	Jan	-	-	-	-	-	-	-	-	-	-
	Feb	-	-	-	-	-	-	-	-	-	-
	Mar	-	-	-	-	-	-	-	-	-	-
	Apr	-	-	-	-	-	-	-	-	-	-
	May	-	-	1	13	3	-	-	-	-	-
	Jun	-	-	-	-	-	-	-	-	-	-
	Jul	-	-	-	-	8	3	-	-	-	-
	Aug	-	-	-	-	7	-	1	-	-	-
	Sep	-	-	-	-	-	-	-	-	-	-
	Oct	-	-	-	-	-	-	-	-	-	-
	Nov	-	-	-	-	-	-	-	-	-	-
	Dec	-	-	-	-	-	-	-	-	-	-
River Redhorse	Jan	-	-	-	-	-	-	-	-	-	-
	Feb	-	-	-	-	-	-	-	-	-	-
	Mar	-	-	-	-	-	-	-	-	-	-
	Apr	-	-	-	-	-	-	-	-	-	-
	May	-	-	-	-	-	-	-	-	-	-
	Jun	-	2	-	-	-	-	-	-	-	-
	Jul	-	-	-	-	-	-	-	-	-	-
	Aug	-	-	-	-	-	-	-	-	-	-
	Sep	-	-	-	-	-	-	-	-	-	-
	Oct	-	-	-	-	-	-	-	-	-	-
	Nov	-	-	-	-	-	-	-	-	-	-
	Dec	-	-	-	-	-	-	-	-	-	-
River Shiner	Jan	-	-	-	-	-	-	-	-	-	-
	Feb	-	-	-	-	-	-	-	-	-	-
	Mar	-	-	-	-	-	-	-	-	-	-
	Apr	-	-	-	-	-	-	-	-	-	-
	May	-	20	-	-	-	-	-	-	-	-
	Jun	-	-	-	-	-	-	-	-	-	-
	Jul	-	-	-	-	-	-	-	-	-	-
	Aug	2	4	-	-	-	-	-	-	-	-
	Sep	1	2	-	-	-	-	-	-	-	-
	Oct	1	1	-	-	-	-	-	-	-	-
	Nov	2	24	-	-	-	-	-	-	-	-
	Dec	-	-	-	-	-	-	-	-	-	-
Sauger	Jan	-	-	7	-	15	7	-	-	-	-
	Feb	-	-	-	-	5	5	-	-	-	-
	Mar	-	-	-	-	5	9	-	-	-	-
	Apr	-	8	4	8	146	12	-	-	-	-
	May	-	-	-	506	13	71	-	-	-	-
	Jun	-	-	-	390	-	-	-	-	-	-
	Jul	-	-	-	-	12	9	-	-	-	-
	Aug	-	-	-	-	24	24	-	-	-	-
	Sep	-	-	6	31	33	4	-	-	-	-
	Oct	-	-	2	22	81	4	-	-	-	-
	Nov	-	-	-	20	10	-	-	-	-	-
	Dec	-	-	-	-	-	-	-	-	-	-
Silver Chub	Jan	-	-	-	-	-	-	-	-	-	-
	Feb	-	172	65	-	-	-	-	-	-	-
	Mar	-	3	11	-	-	-	-	-	-	-
	Apr	-	55	1	-	1	-	-	-	-	-
	May	-	1	1	<1	-	-	-	-	-	-
	Jun	-	1	2	1	-	-	-	-	-	-
	Jul	-	-	1	-	-	-	-	-	-	-
	Aug	-	-	-	-	-	-	-	-	-	-
	Sep	-	1	-	-	-	-	-	-	-	-
	Oct	-	3	6	-	-	-	-	-	-	-
	Nov	-	22	33	2	-	-	-	-	-	-
	Dec	-	-	-	-	-	-	-	-	-	-
Silver Redhorse	Jan	-	-	-	-	-	-	-	-	-	-
	Feb	-	-	-	-	-	-	-	-	-	-
	Mar	-	-	<1	-	-	-	-	-	-	-
	Apr	-	1	<1	<1	-	-	-	-	-	-
	May	-	1	-	-	-	<1	<1	-	-	-
	Jun	<1	<1	<1	<1	<1	<1	<1	-	-	-
	Jul	<1	<1	<1	-	-	<1	<1	-	-	-
	Aug	<1	<1	<1	-	-	-	<1	-	-	-
	Sep	-	-	<1	<1	-	<1	<1	-	-	-
	Oct	-	-	<1	1	<1	-	-	-	-	-
	Nov	-	-	-	-	-	-	-	-	-	-
	Dec	-	-	-	-	-	-	-	-	-	-

Monthly Entrainment Estimates by Length Class for Target Species Based on a Normal Water Year (2012) at Racine Hydroelectric Plant

Target Species	Month	0-2"	2.1-4"	4.1-6"	6.1-8"	8.1-10"	10.1-15"	15.1-20"	20.1-25"	25.1-30"	>30"
Skipjack Herring	Jan	811	139	2	1	1	-	-	-	-	-
	Feb	35	22	2	3	2	-	-	-	-	-
	Mar	22	21	1	3	1	-	-	-	-	-
	Apr	<1	<1	2	<1	<1	-	-	-	-	-
	May	-	1	3	<1	<1	-	-	-	-	-
	Jun	<1	3	4	4	1	-	<1	-	-	-
	Jul	<1	16	3	2	<1	-	-	-	-	-
	Aug	<1	88	11	4	1	-	-	-	-	-
	Sep	26	9	-	1	<1	-	-	-	-	-
	Oct	34	13	3	4	1	<1	-	-	-	-
	Nov	380	100	175	5	1	<1	-	-	-	-
	Dec	220	11	51	3	1	-	-	-	-	-
Smallmouth Bass	Jan	1	<1	<1	<1	-	-	-	-	-	-
	Feb	-	1	-	-	-	-	-	-	-	-
	Mar	-	1	<1	<1	-	-	-	-	-	-
	Apr	<1	1	-	<1	-	1	<1	-	-	-
	May	<1	<1	<1	<1	<1	1	<1	-	-	-
	Jun	7	1	<1	<1	<1	<1	<1	-	-	-
	Jul	18	2	<1	<1	<1	<1	-	<1	-	-
	Aug	1	2	1	1	<1	<1	<1	-	-	-
	Sep	<1	6	4	2	<1	<1	<1	-	-	-
	Oct	<1	3	1	<1	<1	<1	<1	-	-	-
	Nov	-	1	1	<1	<1	<1	-	-	-	-
	Dec	<1	1	<1	-	<1	-	-	-	-	-
Smallmouth Buffalo	Jan	-	-	-	-	-	-	-	-	-	-
	Feb	-	-	-	-	-	-	-	-	-	-
	Mar	-	-	-	-	-	-	-	-	-	-
	Apr	-	-	-	-	-	-	-	-	-	-
	May	-	-	-	-	-	1	-	-	-	-
	Jun	-	-	-	-	-	-	-	-	-	-
	Jul	-	-	-	-	-	-	-	-	-	-
	Aug	-	-	-	-	-	-	-	-	-	-
	Sep	-	-	-	-	-	-	-	-	-	-
	Oct	-	-	-	-	-	-	-	-	-	-
	Nov	-	-	-	-	-	-	-	-	-	-
	Dec	-	-	-	-	-	-	-	-	-	-
Smallmouth Redhorse	Jan	-	-	-	-	-	-	-	-	-	-
	Feb	-	-	-	-	-	-	-	-	-	-
	Mar	-	-	-	-	-	-	-	-	-	-
	Apr	-	1	-	-	-	-	-	-	-	-
	May	-	<1	-	-	-	3	2	-	-	-
	Jun	-	<1	<1	-	-	<1	1	-	-	-
	Jul	<1	-	-	-	-	-	<1	-	-	-
	Aug	-	-	-	-	-	1	-	-	-	-
	Sep	-	-	1	1	-	-	-	-	-	-
	Oct	-	-	-	-	-	-	-	-	-	-
	Nov	-	-	-	-	-	-	-	-	-	-
	Dec	-	-	-	-	-	-	-	-	-	-
Spotfin Shiner	Jan	-	-	-	-	-	-	-	-	-	-
	Feb	-	-	<1	-	-	-	-	-	-	-
	Mar	-	<1	-	-	-	-	-	-	-	-
	Apr	-	1	-	-	-	-	-	-	-	-
	May	-	-	-	-	-	-	-	-	-	-
	Jun	-	<1	-	-	-	-	-	-	-	-
	Jul	-	1	-	-	-	-	-	-	-	-
	Aug	-	<1	-	-	-	-	-	-	-	-
	Sep	-	-	<1	-	-	-	-	-	-	-
	Oct	<1	<1	-	-	-	-	-	-	-	-
	Nov	-	<1	-	-	-	-	-	-	-	-
	Dec	-	-	-	-	-	-	-	-	-	-
Spotted Bass	Jan	-	-	-	-	-	-	-	-	-	-
	Feb	-	-	-	-	-	-	-	-	-	-
	Mar	-	-	-	-	-	-	-	-	-	-
	Apr	-	-	-	-	-	-	-	-	-	-
	May	-	-	-	-	-	-	-	-	-	-
	Jun	-	<1	-	-	-	<1	-	-	-	-
	Jul	-	-	-	-	-	-	-	-	-	-
	Aug	-	-	-	-	-	-	-	-	-	-
	Sep	-	-	-	-	-	-	-	-	-	-
	Oct	-	-	-	-	-	-	-	-	-	-
	Nov	-	-	-	-	-	<1	-	-	-	-
	Dec	-	-	-	-	-	-	-	-	-	-

Appendix D

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

Racine Hydroelectric Project (FERC No. 2570) ARCHIVED RUN .N5000-L6-S97 4/14/2021
Description of analysis JCASSONE
Release 190214

	ROUTE SELECTION			TURBINE DATA													BYPASS
					D	N	B	Q	Q_{OPT}/Q	H	ω	ζ	λ	D_1	D_2	η	P_B
Route Name	Route Selection Prob.	Prob. Lower Bound	Calc. Type	Route Type	Runner Dia. (ft)	Blades (#)	Runner Height (ft)	Turbine Discharge (cfs)	Discharge at Opt. Eff. (%)	Net. Head (ft)	Speed (rpm)	Swirl Coeff. (-)	Correlation Coeff. (-)	Runner Dia. at Inlet (ft)	Runner Dia. at Disch. (ft)	Turbine Eff. (-)	Estimated Mortality (-)
Turbine	0.500	0.000	2	Kaplan	25.00	4		16,000	66.1%	22	160.0		0.20			0.90	0.000
Turbine	0.500	0.500	2	Kaplan	25.00	4		16,000	66.1%	22	160.0		0.20			0.90	0.000

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

BLADE STRIKE SIMULATION RESULTS		
Turbine Strikes:	157 of 5000 fish	3.1%
Bypass Failures:	0 of 5000 fish	0.0%
Passed:	4843 of 5000 fish	96.9%

Racine Hydroelectric Project (FERC No. 2570) ARCHIVED RUN .N5000-L8-S96 4/14/2021
Description of analysis JCASSONE
Release 190214

	ROUTE SELECTION			TURBINE DATA													BYPASS
					D	N	B	Q	Q_{OPT}/Q	H	ω	ζ	λ	D_1	D_2	η	P_B
Route Name	Route Selection Prob.	Prob. Lower Bound	Calc. Type	Route Type	Runner Dia. (ft)	Blades (#)	Runner Height (ft)	Turbine Discharge (cfs)	Discharge at Opt. Eff. (%)	Net. Head (ft)	Speed (rpm)	Swirl Coeff. (-)	Correlation Coeff. (-)	Runner Dia. at Inlet (ft)	Runner Dia. at Disch. (ft)	Turbine Eff. (-)	Estimated Mortality (-)
Turbine	0.500	0.000	2	Kaplan	25.00	4		16,000	66.1%	22	160.0		0.20			0.90	0.000
Turbine	0.500	0.500	2	Kaplan	25.00	4		16,000	66.1%	22	160.0		0.20			0.90	0.000

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

BLADE STRIKE SIMULATION RESULTS		
Turbine Strikes:	217 of 5000 fish	4.3%
Bypass Failures:	0 of 5000 fish	0.0%
Passed:	4783 of 5000 fish	95.7%

Racine Hydroelectric Project (FERC No. 2570) ARCHIVED RUN .N5000-L10-S94 4/14/2021

Description of analysis JCASSONE

Release 190214

	ROUTE SELECTION			TURBINE DATA													BYPASS
					D	N	B	Q	Q_{OPT}/Q	H	ω	ζ	λ	D_1	D_2	η	P_B
Route Name	Route Selection Prob.	Prob. Lower Bound	Calc. Type	Route Type	Runner Dia. (ft)	Blades (#)	Runner Height (ft)	Turbine Discharge (cfs)	Discharge at Opt. Eff. (%)	Net. Head (ft)	Speed (rpm)	Swirl Coeff. (-)	Correlation Coeff. (-)	Runner Dia. at Inlet (ft)	Runner Dia. at Disch. (ft)	Turbine Eff. (-)	Estimated Mortality (-)
Turbine	0.500	0.000	2	Kaplan	25.00	4		16,000	66.1%	22	160.0		0.20			0.90	0.000
Turbine	0.500	0.500	2	Kaplan	25.00	4		16,000	66.1%	22	160.0		0.20			0.90	0.000

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

BLADE STRIKE SIMULATION RESULTS		
Turbine Strikes:	292 of 5000 fish	5.8%
Bypass Failures:	0 of 5000 fish	0.0%
Passed:	4708 of 5000 fish	94.2%

Racine Hydroelectric Project (FERC No. 2570) ARCHIVED RUN .N5000-L15-S92 4/14/2021

Description of analysis JCASSONE

Release 190214

	ROUTE SELECTION			TURBINE DATA													BYPASS
					D	N	B	Q	Q_{OPT}/Q	H	ω	ζ	λ	D_1	D_2	η	P_B
Route Name	Route Selection Prob.	Prob. Lower Bound	Calc. Type	Route Type	Runner Dia. (ft)	Blades (#)	Runner Height (ft)	Turbine Discharge (cfs)	Discharge at Opt. Eff. (%)	Net. Head (ft)	Speed (rpm)	Swirl Coeff. (-)	Correlation Coeff. (-)	Runner Dia. at Inlet (ft)	Runner Dia. at Disch. (ft)	Turbine Eff. (-)	Estimated Mortality (-)
Turbine	0.500	0.000	2	Kaplan	25.00	4		16,000	66.1%	22	160.0		0.20			0.90	0.000
Turbine	0.500	0.500	2	Kaplan	25.00	4		16,000	66.1%	22	160.0		0.20			0.90	0.000

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

BLADE STRIKE SIMULATION RESULTS		
Turbine Strikes:	407 of 5000 fish	8.1%
Bypass Failures:	0 of 5000 fish	0.0%
Passed:	4593 of 5000 fish	91.9%

Racine Hydroelectric Project (FERC No. 2570) ARCHIVED RUN .N5000-L20-S89 4/14/2021

Description of analysis JCASSONE

Release 190214

	ROUTE SELECTION			TURBINE DATA													BYPASS
					D	N	B	Q	Q_{OPT}/Q	H	ω	ζ	λ	D_1	D_2	η	P_B
Route Name	Route Selection Prob.	Prob. Lower Bound	Calc. Type	Route Type	Runner Dia. (ft)	Blades (#)	Runner Height (ft)	Turbine Discharge (cfs)	Discharge at Opt. Eff. (%)	Net. Head (ft)	Speed (rpm)	Swirl Coeff. (-)	Correlation Coeff. (-)	Runner Dia. at Inlet (ft)	Runner Dia. at Disch. (ft)	Turbine Eff. (-)	Estimated Mortality (-)
Turbine	0.500	0.000	2	Kaplan	25.00	4		16,000	66.1%	22	160.0		0.20			0.90	0.000
Turbine	0.500	0.500	2	Kaplan	25.00	4		16,000	66.1%	22	160.0		0.20			0.90	0.000

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

BLADE STRIKE SIMULATION RESULTS		
Turbine Strikes:	572 of 5000 fish	11.4%
Bypass Failures:	0 of 5000 fish	0.0%
Passed:	4428 of 5000 fish	88.6%

Racine Hydroelectric Project (FERC No. 2570) ARCHIVED RUN .N5000-L25-S85 4/14/2021

Description of analysis JCASSONE

Release 190214

	ROUTE SELECTION			TURBINE DATA													BYPASS
					D	N	B	Q	Q_{OPT}/Q	H	ω	ζ	λ	D_1	D_2	η	P_B
Route Name	Route Selection Prob.	Prob. Lower Bound	Calc. Type	Route Type	Runner Dia. (ft)	Blades (#)	Runner Height (ft)	Turbine Discharge (cfs)	Discharge at Opt. Eff. (%)	Net. Head (ft)	Speed (rpm)	Swirl Coeff. (-)	Correlation Coeff. (-)	Runner Dia. at Inlet (ft)	Runner Dia. at Disch. (ft)	Turbine Eff. (-)	Estimated Mortality (-)
Turbine	0.500	0.000	2	Kaplan	25.00	4		16,000	66.1%	22	160.0		0.20			0.90	0.000
Turbine	0.500	0.500	2	Kaplan	25.00	4		16,000	66.1%	22	160.0		0.20			0.90	0.000

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

BLADE STRIKE SIMULATION RESULTS		
Turbine Strikes:	743 of 5000 fish	14.9%
Bypass Failures:	0 of 5000 fish	0.0%
Passed:	4257 of 5000 fish	85.1%

Racine Hydroelectric Project (FERC No. 2570) ARCHIVED RUN .N5000-L30-S83 4/14/2021

Description of analysis JCASSONE

Release 190214

ROUTE SELECTION				TURBINE DATA													BYPASS
					D	N	B	Q	Q_{OPT}/Q	H	ω	ζ	λ	D_1	D_2	η	P_B
Route Name	Route Selection Prob.	Prob. Lower Bound	Calc. Type	Route Type	Runner Dia. (ft)	Blades (#)	Runner Height (ft)	Turbine Discharge (cfs)	Discharge at Opt. Eff. (%)	Net. Head (ft)	Speed (rpm)	Swirl Coeff. (-)	Correlation Coeff. (-)	Runner Dia. at Inlet (ft)	Runner Dia. at Disch. (ft)	Turbine Eff. (-)	Estimated Mortality (-)
Turbine	0.500	0.000	2	Kaplan	25.00	4		16,000	66.1%	22	160.0		0.20			0.90	0.000
Turbine	0.500	0.500	2	Kaplan	25.00	4		16,000	66.1%	22	160.0		0.20			0.90	0.000

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

BLADE STRIKE SIMULATION RESULTS		
Turbine Strikes:	843 of 5000 fish	16.9%
Bypass Failures:	0 of 5000 fish	0.0%
Passed:	4157 of 5000 fish	83.1%

Racine Hydroelectric Project (FERC No. 2570) ARCHIVED RUN .N5000-L40-S78 4/14/2021

Description of analysis JCASSONE

Release 190214

ROUTE SELECTION				TURBINE DATA													BYPASS
					D	N	B	Q	Q_{OPT}/Q	H	ω	ζ	λ	D_1	D_2	η	P_B
Route Name	Route Selection Prob.	Prob. Lower Bound	Calc. Type	Route Type	Runner Dia. (ft)	Blades (#)	Runner Height (ft)	Turbine Discharge (cfs)	Discharge at Opt. Eff. (%)	Net. Head (ft)	Speed (rpm)	Swirl Coeff. (-)	Correlation Coeff. (-)	Runner Dia. at Inlet (ft)	Runner Dia. at Disch. (ft)	Turbine Eff. (-)	Estimated Mortality (-)
Turbine	0.500	0.000	2	Kaplan	25.00	4		16,000	66.1%	22	160.0		0.20			0.90	0.000
Turbine	0.500	0.500	2	Kaplan	25.00	4		16,000	66.1%	22	160.0		0.20			0.90	0.000

MODEL SIMULATION INPUT PARAMETERS		
n_f	5,000	Number of fish
μ	40.0	Mean length (inches)
σ	0.0	SD in length (inches)

BLADE STRIKE SIMULATION RESULTS		
Turbine Strikes:	1122 of 5000 fish	22.4%
Bypass Failures:	0 of 5000 fish	0.0%
Passed:	3878 of 5000 fish	77.6%

Racine Hydroelectric Project, FERC Project No. 2570 ARCHIVED RUN .N5000-L20-S77 5/11/2021

Eel Analysis JCASSONE

Release 190214

	ROUTE SELECTION			TURBINE DATA													BYPASS
					D	N	B	Q	Q_{OPT}/Q	H	ω	ζ	λ	D_1	D_2	η	P_B
Route Name	Route Selection Prob.	Prob. Lower Bound	Calc. Type	Route Type	Runner Dia. (ft)	Blades (#)	Runner Height (ft)	Turbine Discharge (cfs)	Discharge at Opt. Eff. (%)	Net. Head (ft)	Speed (rpm)	Swirl Coeff. (-)	Correlation Coeff. (-)	Runner Dia. at Inlet (ft)	Runner Dia. at Disch. (ft)	Turbine Eff. (-)	Estimated Mortality (-)
Turbine 1	0.500	0.000	2	Kaplan	25.00	4		16,000	66.1%	22	160.0		0.42			0.90	0.000
Turbine 2	0.500	0.500	2	Kaplan	25.00	4		16,000	66.1%	22	160.0		0.42			0.90	0.000

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

BLADE STRIKE SIMULATION RESULTS		
Turbine Strikes:	1171 of 5000 fish	23.4%
Bypass Failures:	0 of 5000 fish	0.0%
Passed:	3829 of 5000 fish	76.6%

Racine Hydroelectric Project, FERC Project No. 2570 ARCHIVED RUN .N5000-L22-S74 5/11/2021

Eel Analysis JCASSONE

Release 190214

	ROUTE SELECTION			TURBINE DATA													BYPASS
					D	N	B	Q	Q_{OPT}/Q	H	ω	ζ	λ	D_1	D_2	η	P_B
Route Name	Route Selection Prob.	Prob. Lower Bound	Calc. Type	Route Type	Runner Dia. (ft)	Blades (#)	Runner Height (ft)	Turbine Discharge (cfs)	Discharge at Opt. Eff. (%)	Net. Head (ft)	Speed (rpm)	Swirl Coeff. (-)	Correlation Coeff. (-)	Runner Dia. at Inlet (ft)	Runner Dia. at Disch. (ft)	Turbine Eff. (-)	Estimated Mortality (-)
Turbine 1	0.500	0.000	2	Kaplan	25.00	4		16,000	66.1%	22	160.0		0.42			0.90	0.000
Turbine 2	0.500	0.500	2	Kaplan	25.00	4		16,000	66.1%	22	160.0		0.42			0.90	0.000

MODEL SIMULATION INPUT PARAMETERS		
n_f	5,000	Number of fish
μ	22.0	Mean length (inches)
σ	0.0	SD in length (inches)

BLADE STRIKE SIMULATION RESULTS		
Turbine Strikes:	1315 of 5000 fish	26.3%
Bypass Failures:	0 of 5000 fish	0.0%
Passed:	3685 of 5000 fish	73.7%

Racine Hydroelectric Project, FERC Project No. 2570 ARCHIVED RUN .N5000-L24-S74 5/11/2021

Eel Analysis JCASSONE

Release 190214

ROUTE SELECTION				TURBINE DATA														BYPASS
					D	N	B	Q	Q_{OPT}/Q	H	ω	ζ	λ	D_1	D_2	η		P_B
Route Name	Route Selection Prob.	Prob. Lower Bound	Calc. Type	Route Type	Runner Dia. (ft)	Blades (#)	Runner Height (ft)	Turbine Discharge (cfs)	Discharge at Opt. Eff. (%)	Net. Head (ft)	Speed (rpm)	Swirl Coeff. (-)	Correlation Coeff. (-)	Runner Dia. at Inlet (ft)	Runner Dia. at Disch. (ft)	Turbine Eff. (-)		Estimated Mortality (-)
Turbine 1	0.500	0.000	2	Kaplan	25.00	4		16,000	66.1%	22	160.0		0.42			0.90		0.000
Turbine 2	0.500	0.500	2	Kaplan	25.00	4		16,000	66.1%	22	160.0		0.42			0.90		0.000

MODEL SIMULATION INPUT PARAMETERS		
n_f	5,000	Number of fish
μ	24.0	Mean length (inches)
σ	0.0	SD in length (inches)

BLADE STRIKE SIMULATION RESULTS		
Turbine Strikes:	1315 of 5000 fish	26.3%
Bypass Failures:	0 of 5000 fish	0.0%
Passed:	3685 of 5000 fish	73.7%

Racine Hydroelectric Project, FERC Project No. 2570 ARCHIVED RUN .N5000-L26-S69 5/11/2021

Eel Analysis JCASSONE

Release 190214

ROUTE SELECTION				TURBINE DATA														BYPASS
					D	N	B	Q	Q_{OPT}/Q	H	ω	ζ	λ	D_1	D_2	η		P_B
Route Name	Route Selection Prob.	Prob. Lower Bound	Calc. Type	Route Type	Runner Dia. (ft)	Blades (#)	Runner Height (ft)	Turbine Discharge (cfs)	Discharge at Opt. Eff. (%)	Net. Head (ft)	Speed (rpm)	Swirl Coeff. (-)	Correlation Coeff. (-)	Runner Dia. at Inlet (ft)	Runner Dia. at Disch. (ft)	Turbine Eff. (-)		Estimated Mortality (-)
Turbine 1	0.500	0.000	2	Kaplan	25.00	4		16,000	66.1%	22	160.0		0.42			0.90		0.000
Turbine 2	0.500	0.500	2	Kaplan	25.00	4		16,000	66.1%	22	160.0		0.42			0.90		0.000

MODEL SIMULATION INPUT PARAMETERS		
n_f	5,000	Number of fish
μ	26.0	Mean length (inches)
σ	0.0	SD in length (inches)

BLADE STRIKE SIMULATION RESULTS		
Turbine Strikes:	1540 of 5000 fish	30.8%
Bypass Failures:	0 of 5000 fish	0.0%
Passed:	3460 of 5000 fish	69.2%

Racine Hydroelectric Project, FERC Project No. 2570 ARCHIVED RUN .N5000-L28-S66 5/11/2021

Eel Analysis JCASSONE

Release 190214

	ROUTE SELECTION			TURBINE DATA													BYPASS
					D	N	B	Q	Q_{OPT}/Q	H	ω	ζ	λ	D_1	D_2	η	P_B
Route Name	Route Selection Prob.	Prob. Lower Bound	Calc. Type	Route Type	Runner Dia. (ft)	Blades (#)	Runner Height (ft)	Turbine Discharge (cfs)	Discharge at Opt. Eff. (%)	Net. Head (ft)	Speed (rpm)	Swirl Coeff. (-)	Correlation Coeff. (-)	Runner Dia. at Inlet (ft)	Runner Dia. at Disch. (ft)	Turbine Eff. (-)	Estimated Mortality (-)
Turbine 1	0.500	0.000	2	Kaplan	25.00	4		16,000	66.1%	22	160.0		0.42			0.90	0.000
Turbine 2	0.500	0.500	2	Kaplan	25.00	4		16,000	66.1%	22	160.0		0.42			0.90	0.000

MODEL SIMULATION INPUT PARAMETERS		
n_f	5,000	Number of fish
μ	28.0	Mean length (inches)
σ	0.0	SD in length (inches)

BLADE STRIKE SIMULATION RESULTS		
Turbine Strikes:	1690 of 5000 fish	33.8%
Bypass Failures:	0 of 5000 fish	0.0%
Passed:	3310 of 5000 fish	66.2%

Racine Hydroelectric Project, FERC Project No. 2570 ARCHIVED RUN .N5000-L30-S66 5/11/2021

Eel Analysis JCASSONE

Release 190214

	ROUTE SELECTION			TURBINE DATA													BYPASS
					D	N	B	Q	Q_{OPT}/Q	H	ω	ζ	λ	D_1	D_2	η	P_B
Route Name	Route Selection Prob.	Prob. Lower Bound	Calc. Type	Route Type	Runner Dia. (ft)	Blades (#)	Runner Height (ft)	Turbine Discharge (cfs)	Discharge at Opt. Eff. (%)	Net. Head (ft)	Speed (rpm)	Swirl Coeff. (-)	Correlation Coeff. (-)	Runner Dia. at Inlet (ft)	Runner Dia. at Disch. (ft)	Turbine Eff. (-)	Estimated Mortality (-)
Turbine 1	0.500	0.000	2	Kaplan	25.00	4		16,000	66.1%	22	160.0		0.42			0.90	0.000
Turbine 2	0.500	0.500	2	Kaplan	25.00	4		16,000	66.1%	22	160.0		0.42			0.90	0.000

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

BLADE STRIKE SIMULATION RESULTS		
Turbine Strikes:	1691 of 5000 fish	33.8%
Bypass Failures:	0 of 5000 fish	0.0%
Passed:	3309 of 5000 fish	66.2%

Racine Hydroelectric Project, FERC Project No. 2570 ARCHIVED RUN .N5000-L32-S62 5/11/2021

Eel Analysis JCASSONE

Release 190214

	ROUTE SELECTION			TURBINE DATA													BYPASS
					D	N	B	Q	Q_{OPT}/Q	H	ω	ζ	λ	D_1	D_2	η	P_B
Route Name	Route Selection Prob.	Prob. Lower Bound	Calc. Type	Route Type	Runner Dia. (ft)	Blades (#)	Runner Height (ft)	Turbine Discharge (cfs)	Discharge at Opt. Eff. (%)	Net. Head (ft)	Speed (rpm)	Swirl Coeff. (-)	Correlation Coeff. (-)	Runner Dia. at Inlet (ft)	Runner Dia. at Disch. (ft)	Turbine Eff. (-)	Estimated Mortality (-)
Turbine 1	0.500	0.000	2	Kaplan	25.00	4		16,000	66.1%	22	160.0		0.42			0.90	0.000
Turbine 2	0.500	0.500	2	Kaplan	25.00	4		16,000	66.1%	22	160.0		0.42			0.90	0.000

MODEL SIMULATION INPUT PARAMETERS		
n_f	5,000	Number of fish
μ	32.0	Mean length (inches)
σ	0.0	SD in length (inches)

BLADE STRIKE SIMULATION RESULTS		
Turbine Strikes:	1917 of 5000 fish	38.3%
Bypass Failures:	0 of 5000 fish	0.0%
Passed:	3083 of 5000 fish	61.7%

Racine Hydroelectric Project, FERC Project No. 2570 ARCHIVED RUN .N5000-L34-S60 5/11/2021

Eel Analysis JCASSONE

Release 190214

	ROUTE SELECTION			TURBINE DATA													BYPASS
					D	N	B	Q	Q_{OPT}/Q	H	ω	ζ	λ	D_1	D_2	η	P_B
Route Name	Route Selection Prob.	Prob. Lower Bound	Calc. Type	Route Type	Runner Dia. (ft)	Blades (#)	Runner Height (ft)	Turbine Discharge (cfs)	Discharge at Opt. Eff. (%)	Net. Head (ft)	Speed (rpm)	Swirl Coeff. (-)	Correlation Coeff. (-)	Runner Dia. at Inlet (ft)	Runner Dia. at Disch. (ft)	Turbine Eff. (-)	Estimated Mortality (-)
Turbine 1	0.500	0.000	2	Kaplan	25.00	4		16,000	66.1%	22	160.0		0.42			0.90	0.000
Turbine 2	0.500	0.500	2	Kaplan	25.00	4		16,000	66.1%	22	160.0		0.42			0.90	0.000

MODEL SIMULATION INPUT PARAMETERS		
n_f	5,000	Number of fish
μ	34.0	Mean length (inches)
σ	0.0	SD in length (inches)

BLADE STRIKE SIMULATION RESULTS		
Turbine Strikes:	1992 of 5000 fish	39.8%
Bypass Failures:	0 of 5000 fish	0.0%
Passed:	3008 of 5000 fish	60.2%

Racine Hydroelectric Project, FERC Project No. 2570 ARCHIVED RUN .N5000-L36-S57 5/11/2021

Eel Analysis JCASSONE

Release 190214

	ROUTE SELECTION			TURBINE DATA														BYPASS
					D	N	B	Q	Q_{OPT}/Q	H	ω	ζ	λ	D_1	D_2	η		P_B
Route Name	Route Selection Prob.	Prob. Lower Bound	Calc. Type	Route Type	Runner Dia. (ft)	Blades (#)	Runner Height (ft)	Turbine Discharge (cfs)	Discharge at Opt. Eff. (%)	Net. Head (ft)	Speed (rpm)	Swirl Coeff. (-)	Correlation Coeff. (-)	Runner Dia. at Inlet (ft)	Runner Dia. at Disch. (ft)	Turbine Eff. (-)		Estimated Mortality (-)
Turbine 1	0.500	0.000	2	Kaplan	25.00	4		16,000	66.1%	22	160.0		0.42			0.90		0.000
Turbine 2	0.500	0.500	2	Kaplan	25.00	4		16,000	66.1%	22	160.0		0.42			0.90		0.000

MODEL SIMULATION INPUT PARAMETERS		
n_f	5,000	Number of fish
μ	36.0	Mean length (inches)
σ	0.0	SD in length (inches)

BLADE STRIKE SIMULATION RESULTS		
Turbine Strikes:	2130 of 5000 fish	42.6%
Bypass Failures:	0 of 5000 fish	0.0%
Passed:	2870 of 5000 fish	57.4%

Racine Hydroelectric Project, FERC Project No. 2570 ARCHIVED RUN .N5000-L38-S55 5/11/2021

Eel Analysis JCASSONE

Release 190214

	ROUTE SELECTION			TURBINE DATA														BYPASS
					D	N	B	Q	Q_{OPT}/Q	H	ω	ζ	λ	D_1	D_2	η		P_B
Route Name	Route Selection Prob.	Prob. Lower Bound	Calc. Type	Route Type	Runner Dia. (ft)	Blades (#)	Runner Height (ft)	Turbine Discharge (cfs)	Discharge at Opt. Eff. (%)	Net. Head (ft)	Speed (rpm)	Swirl Coeff. (-)	Correlation Coeff. (-)	Runner Dia. at Inlet (ft)	Runner Dia. at Disch. (ft)	Turbine Eff. (-)		Estimated Mortality (-)
Turbine 1	0.500	0.000	2	Kaplan	25.00	4		16,000	66.1%	22	160.0		0.42			0.90		0.000
Turbine 2	0.500	0.500	2	Kaplan	25.00	4		16,000	66.1%	22	160.0		0.42			0.90		0.000

MODEL SIMULATION INPUT PARAMETERS		
n_f	5,000	Number of fish
μ	38.0	Mean length (inches)
σ	0.0	SD in length (inches)

BLADE STRIKE SIMULATION RESULTS		
Turbine Strikes:	2226 of 5000 fish	44.5%
Bypass Failures:	0 of 5000 fish	0.0%
Passed:	2774 of 5000 fish	55.5%

Racine Hydroelectric Project, FERC Project No. 2570 ARCHIVED RUN .N5000-L40-S52 5/11/2021

Eel Analysis JCASSONE

Release 190214

	ROUTE SELECTION			TURBINE DATA													BYPASS
					D	N	B	Q	Q_{OPT}/Q	H	ω	ζ	λ	D_1	D_2	η	P_B
Route Name	Route Selection Prob.	Prob. Lower Bound	Calc. Type	Route Type	Runner Dia. (ft)	Blades (#)	Runner Height (ft)	Turbine Discharge (cfs)	Discharge at Opt. Eff. (%)	Net. Head (ft)	Speed (rpm)	Swirl Coeff. (-)	Correlation Coeff. (-)	Runner Dia. at Inlet (ft)	Runner Dia. at Disch. (ft)	Turbine Eff. (-)	Estimated Mortality (-)
Turbine 1	0.500	0.000	2	Kaplan	25.00	4		16,000	66.1%	22	160.0		0.42			0.90	0.000
Turbine 2	0.500	0.500	2	Kaplan	25.00	4		16,000	66.1%	22	160.0		0.42			0.90	0.000

MODEL SIMULATION INPUT PARAMETERS		
n_f	5,000	Number of fish
μ	40.0	Mean length (inches)
σ	0.0	SD in length (inches)

BLADE STRIKE SIMULATION RESULTS		
Turbine Strikes:	2397 of 5000 fish	47.9%
Bypass Failures:	0 of 5000 fish	0.0%
Passed:	2603 of 5000 fish	52.1%

From: Jonathan M Magalski <jmmagalski@aep.com>
Sent: Wednesday, September 8, 2021 1:33 PM
To: McCorkle, Richard
Subject: RE: Racine Entrainment and Impingement Study Report tables cut off
Attachments: 20210908 Racine Revised Entrainment Report.pdf

Hi Rick,

I hope you enjoyed the long weekend, sorry for the slow reply. For some reason, when we filed the revised Fish E&I Report with the USR response to comments a few of the tables in Appendix D were omitted. Attached is the report that contains all of the tables. We are in the process of filing this updated report with FERC.

I'm glad you asked the question since it identified some inadvertently missing information the report. Please let me know if you have any questions or need anything additional. Thanks....Jon

---

From: McCorkle, Richard <richard_mccorkle@fws.gov>
Sent: Friday, September 3, 2021 11:24 AM
To: Jonathan M Magalski <jmmagalski@aep.com>
Subject: [EXTERNAL] Re: Racine Entrainment and Impingement Study Report tables cut off

Jon,

I see tables are not cut off in AEPGR's response to USR comments. If you can confirm that all tables from the USR that were cut off are shown in full in the response document, then go ahead and ignore my previous request, below. Thanks.

Rick

Richard C. McCorkle
Fish and Wildlife Biologist
U.S. Fish & Wildlife Service
Pennsylvania Field Office
110 Radnor Road, Ste 101
State College, PA 16801
Office: ~~814-206-7470~~
Personal cell (while teleworking): 302-382-0284

From: McCorkle, Richard <richard_mccorkle@fws.gov>
Sent: Friday, September 3, 2021 10:11 AM

To: Jonathan M Magalski <jmmagalski@aep.com>
Subject: Racine Entrainment and Impingement Study Report tables cut off

Hi Jon,

I meant to ask you about this a couple of months ago when I was reviewing the Racine USR, but I must have forgotten. I had limited time to review the USR, so never did justice to reviewing results in the appendices, but at the time one of our engineers pointed out to me that she could not sufficiently evaluate the blade strike results because most or all of the tables are cut off on the left.

Would it be possible to get a better copy of that report that doesn't have the tables cut off at the left?

Thanks for your consideration.

Rick

Richard C. McCorkle
Fish and Wildlife Biologist
U.S. Fish & Wildlife Service
Pennsylvania Field Office
110 Radnor Road, Ste 101
State College, PA 16801
Office: ~~814-206-7470~~
Personal cell (while teleworking): 302-382-0284

Hanson, Danielle

From: Jonathan M Magalski <jmmagalski@aep.com>
Sent: Tuesday, September 21, 2021 1:27 PM
To: Weikle, Belinda M CIV USARMY CELRH (USA)
Cc: Kelley, Patrick J MAJ USARMY CELRH (USA); Elizabeth B Parcell
Subject: RE: Racine Hydropower - RELICENSING - Copy Request - Revised Entrainment and Impingement Study Report
Attachments: UPDATED Racine Revised Entrainment Report_09.08.21.pdf

Hi Belinda,

Doing well, hope the same for you. Definitely a wet day here and a few more to follow.

Please find attached the revised Entrainment and Impingement with all the tables in Appendix D. Please let me know if you have any questions or need anything else. Take care….Jon

JONATHAN M MAGALSKI | ENVIRONMENTAL SUPV
JMMAGALSKI@AEP.COM | D:614.716.2240
1 RIVERSIDE PLAZA, COLUMBUS, OH 43215

From: Weikle, Belinda M CIV USARMY CELRH (USA) <Belinda.M.Weikle@usace.army.mil>
Sent: Tuesday, September 21, 2021 2:53 PM
To: Jonathan M Magalski <jmmagalski@aep.com>
Cc: Kelley, Patrick J MAJ USARMY CELRH (USA) <Patrick.J.Kelley@usace.army.mil>; Elizabeth B Parcell <ebparcell@aep.com>
Subject: [EXTERNAL] Racine Hydropower - RELICENSING - Copy Request - Revised Entrainment and Impingement Study Report

Good afternoon Jon!

I hope that you are doing well this afternoon! It's been a wet, soggy day here in WV.

Would you please provide MAJ Kelley and I an electronic copy of the Racine hydropower revised Entrainment and Impingement Study report (including the full Appendix D) referenced in the September 8, 2021 AEP letter to FERC?

AEPs letter to the FERC is attached for reference.

Have a great day!

Respectfully,

Belinda M. Weikle, M.S.C.E., P.E.
U.S. Army Corps of Engineers
Great Lakes and Ohio River Division - Huntington District
Water Resources Engineering Section

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Huntington, WV 25701
304-399-5808 Office Phone
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Belinda.M.Weikle@usace.army.mil

DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS
HUNTINGTON DISTRICT
502 8TH STREET
HUNTINGTON, WV 25701

September 30, 2021

Project Management

Kimberly D. Bose
Secretary
Federal Energy Regulatory Commission
888 First Street, NE
Washington, DC 20246

Dear Secretary Bose:

On July 2, 2021, American Electric Power Generation Resources Inc. (AEPGR) submitted a Draft License Application (DLA), Volumes I and II, for the Racine Hydroelectric Project Federal Energy Regulatory Commission relicensing activity, Project No. P-2570, Submittal 20210702-5101. The district's Non-Federal Hydropower Project Delivery Team (PDT) conducted a thorough review of the licensee's DLA and provided comments through the United States Army Corps of Engineers' (USACE) Design Review and Checking System (DrChecks). AEPGR is requested to evaluate the District's comments within DrChecks to obtain comment resolution. AEPGR's revised DLA should address all of USACE's DrChecks comments. The DrChecks Comment Summary Report is attached for your information.

If you have any questions or concerns, please contact the undersigned at Patrick.j.kelley@usace.army.mil or 606-585-4022.

Patrick J. Kelley
Major, Corps of Engineers
Hydropower Program Manager
Huntington District

Enclosure:
(1) DrChecks Comment Summary Report

Use the form below to select criteria for the report

a. Comment Type (req.) ◉ Any ○ Critical
b. Evaluation Status (opt.) Please select from below
c. BackCheck Status (opt.) Please select from below
d. Discipline (opt.) Please select from below
e. Keyword(s) (opt.)
f. Start Date (opt.)
g. End Date (opt.)
h. Comment ID(s) (opt.)

Generate Report

Racine Hydro Relicensing DLA Volume I of II dated 7-2-21

Displaying 2 comments for the criteria specified in this report.

Id	Discipline	Section/Figure	Page Number	Line Number
9347169	Geotechnical	E.3.5	E-15	4

Comment Classification: **Controlled Unclassified Information (CUI)**

Propose changing "There are no signs of erosion present along the shoreline of the Project." to "Seepage-related outflanking has resulted in limited displacement of both up and downchannel stone treatments along the right descending bank of the Project together with launching of stone into the fisherman access." Photograph describing this condition, as of 09 JUL 21, is attached.

(Attachment: Racine_Fisherman_Access_Stone_Launching.jpg)

Submitted By: Gregory O'Bryan (606-356-5617). Submitted On: Jul 29 2021

Evaluation not conducted

Id	Discipline	Section/Figure	Page Number	Line Number
9389524	Environmental	n/a	E21	n/a

Comment Classification: **Controlled Unclassified Information (CUI)**

E.4.2.3 cites from an AEP study that observed that hydro production at the facility resulted in the addition of oxygen at levels equal to or greater than the addition that takes place solely from the dam.

That statement is counter to ORSANCO's conclusion that "During low flow periods, aeration at dams is the major source of oxygen to the Ohio River."

I have not read the AEP study that was cited, so I will not discredit it. However, it should be noted in this section that there was an EIS that determined that stacked hydropower on the Ohio River would result in continued diminishment of dissolved oxygen downstream and that ORSANCO recognizes the aeration potential from USACE dams in comparison to hydropower projects.

Submitted By: Andrew Johnson ((304) 399-5189). Submitted On: Aug 26 2021

Evaluation not conducted

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Pennsylvania Field Office
110 Radnor Road, Suite 101
State College, Pennsylvania 16801-4850

October 1, 2021

Ms. Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
888 First St., NE
Washington, DC 20426

RE: Racine Hydroelectric Project (FERC No. 2570); Comments on Draft License Application

Dear Secretary Bose:

The U.S. Fish and Wildlife Service (Service) has reviewed the Draft License Application (DLA) for the Racine Hydroelectric Project (Federal Energy Regulatory Commission [FERC; Commission] No. 2570; [Project]) filed by AEPGR Generation Resources Inc. (AEPGR; Applicant) on July 2, 2021. Pursuant to 18 CFR §5.16(e), the Service provides the following comments.

Additional Information Required by 18 CFR §4.32(a)(2), page AI-1, (1): The Applicant states that AEPGR presently holds and will continue to hold the proprietary rights necessary to operate and maintain the Project. However, on March 5, 2021, AEPGR and Eagle Creek Racine Hydro, LLC (ECRH) filed with the Commission an application for the transfer of the Project license from AEPGR to ECRH as part of AEPGR's sale of the Project to ECRH (FERC Accession number 20210305-5279).

EXHIBIT A, Project Description

Section A.2, Physical Composition, Dimensions, and General Configuration, A.2.1, Reservoir: Table A.2-1 indicates that the maximum depth of the reservoir is 9 feet (ft). As stated in Section A.2.3, the Project does not include a penstock, canal or other form of water conveyance, and the upper pool (reservoir) flows directly into the units from the forebay through the intake. The water column in front of the Project intake is a part of the Project reservoir. Here, water depth is approximately 65 ft. In addition, the Service obtained bathymetry data from the U.S. Army Corps of Engineers (USACE) that depict depths of greater than 50 ft, more than 1,500 ft upstream of the dam. The 9-foot depth is the minimum channel depth that must be maintained for navigation, but the reservoir is much deeper in many areas.

It is also stated in this section and elsewhere that river flow up to about 32,000 cubic ft per second (cfs) (maximum hydraulic capacity of the turbines depending on head across the structure) is generally released through the Project, but elsewhere in the DLA (e.g., Section B.1.2) the maximum hydraulic capacity is given as 31,300 cfs.

Table A.2-1, and Section A.2.5, Powerhouse and Intake: Mean sea level (msl) is used here and elsewhere as an elevation reference. This is a periodically updated tidal datum that should not be confused with a vertical geodetic datum. Continued use of msl may contribute to significant measurement, reporting, and construction errors over time. The Service recommends conversion to, and adoption of, the North American Vertical Datum of 1988 (NAVD 88), which has been adopted by the National Oceanic and Atmospheric Administration (NOAA) and the Federal Emergency Management Agency (FEMA), and is the basis for the U.S. Geological Survey's (USGS) primary elevation data product, the National Elevation Dataset (NED).

This section also states that there are two 21.75-foot-wide by 60-foot high intake openings. However, AEPGR's revised *Fish Entrainment and Impingement Study Report* (FERC Accession number 20210908-5134) describes the intake openings as being 21 ft wide by 88 ft high, with a water depth in front of the trash racks of approximately 65 ft.

The name of the generator manufacturer is misspelled in the last paragraph of this section. It should be "Elin."

EXHIBIT B, Project Operation and Resource Utilization

Section B.1.2, Description of Operations, Operations During Normal, Low, and High Flows: This section states that river flows from approximately 4,000 cfs to 31,300 cfs (hydroelectric plant discharge capacity) normally will be passed through the turbines. Based on the average daily flows provided in Table B.2-3, all flow would normally be routed through the turbines during the drier months in late summer to early fall from July through October. At such times, the only consistently available route for downstream fish migration is through the turbines. Due to the inherently hazardous nature of hydroelectric turbines, the Service does not recognize passage through turbine intakes as an acceptable downstream passage route for fish (Service 2019).

During Project shutdowns, it is our understanding that a 1-foot gate opening is provided via Tainter gate #8 (nearest the powerhouse) to attract fish to the angler access area below the powerhouse. To provide a safer downstream passage option for fish, the Service recommends that this gate be left open 1 foot at all times, to provide an alternative downstream passage route during these lower flow periods. The lock structures are not open for sufficient periods to provide reliable and timely downstream passage, and the Service does not consider the lock chambers to be a safe route of passage.

The Service would like to discuss this proposed Protection, Mitigation and Enhancement (PM&E) measure with AEPGR and/or ECRH, and the USACE. Providing a minimum flow through a Tainter gate may also help to maintain water quality (primarily dissolved oxygen) downstream of the Project from increased aeration, and will also benefit darters and other riffle-associated species that are found in dam tailwater habitats in the Ohio River.

Section B.2.2, Flows: This section states that the current primary compliance requirements associated with the operation of the Project are to provide a minimum flow of 6,300 cfs immediately below the Racine dam and operate in a run-of-river (ROR) mode in cooperation with the USACE. This requirement under current License Article 13 can be met via (1) release through the USACE Tainter gates, (2) discharge from the Project powerhouse, or (3) a combination of Project discharge and Tainter gate spillage. Required minimum flows at hydroelectric projects do not typically pass through the powerhouse, but are instead released through dam gates or over the dam crest. Describing this requirement as a minimum flow requirement is misleading, as there are times when all flow at the Racine Project is directed through the Project turbines. The Service does not consider this license requirement to be a true hydroelectric project minimum flow requirement. When all flow is directed through the powerhouse, there is the potential for a reduction in aeration and associated dissolved oxygen levels below the Project, and an increased potential for turbine entrainment-related injury and mortality impacts to the fish community. In addition, habitat conditions downstream of the Tainter gates that are beneficial to riffle habitat-associated species (e.g., darters) are not consistently available due to the lack of a true minimum flow requirement at the Project.

EXHIBIT E, Environmental Report

Section E.2.2, Dams and Diversions in the Basin, Table E.2-1: For purposes of considering cumulative effects, it is important to take into account all of the currently operating and planned hydroelectric projects on the Ohio River. There are some errors and omissions in Table E.2-1. The Emsworth Locks and Dam project (P-13757) has not been constructed yet, although it appears this project will be moving to construction. Missing from this table is the Emsworth Back Channel project (P-13761), although this project also has not yet been built. Construction of the Montgomery Locks and Dam project (P-13768) is expected to begin in 2022. The Newburgh Lock and Dam project (P-12962) received a license, but the associated FERC docket no longer exists and it appears this project did not move forward. Currently operating projects that are missing from the table include the Ohio Falls Hydroelectric Project (P-289) and the New Martinsville (Hannibal) Hydroelectric Project (P-3206). There are also new preliminary permits for projects at the RC Byrd (P-15094), New Cumberland (P-15045) and Pike Island (P-15230) locks and dams, with the latter two projects having proceeded with filings of Notices of Intent and Pre-Application Documents. It is also important to consider the projects that are operating on major Ohio River tributaries, when considering cumulative effects. Table 1 (Appendix 1) lists proposed and operating projects on the Ohio, Allegheny and Monongahela rivers.

Thirteen of the 20 USACE locks and dams on the Ohio River have FERC-licensed hydroelectric projects, and 10 of those projects are currently operating. The remaining three are expected to move to construction within the next couple of years. In addition to five projects or developments currently operating on the Allegheny River, the licensed project at the Allegheny Lock and Dam 2 is expected to move to construction within the next couple of years. Lastly, there are seven licensed projects on the Monongahela River, all of which are expected to be built, and there are many other currently operating projects on other Ohio River tributaries (e.g., Beaver River, Kanawha River, New River).

Section E.4.4, PM&E Measures Proposed by the Applicant, Resource Agencies, and/or Other Consulting Parties: Because the water quality study is not yet completed, it is premature to state that no new PM&E measures related to water resources are proposed at this time. As stated in section E.4.2.4, the Commission's September 9, 2020 Determination on Requests for Study Modifications directed AEPGR to conduct an additional season of water quality monitoring at the Project. This was primarily because the Project's generating units were off-line approximately 65 percent of the time during the study period. This study is being conducted from May 1 through October 31, 2021. Section E.4.3 states that AEPGR will further evaluate potential Project impacts on water quality when the final Water Quality Study Report is completed. If the water quality study shows that downstream water quality is affected, PM&E measures may be needed to protect water quality and reduce impacts to aquatic life downstream of the Project.

Section E.5, Fish and Aquatic Resources, E.5.1, Aquatic Habitat: The Applicant states that tailwaters are a small portion of the Ohio River Navigation Dam System and are not considered significant for spawning; however, they provide some habitat for guarding and non-guarding nesting species. Dam tailwaters may be more important than indicated here. Water velocities are visibly higher at the tailwaters of navigation dams (for about 1.5 miles downstream), where the rivers are more stream-like (Pennsylvania Fish and Boat Commission [PFBC] 2012). Here, water circulation patterns, including turbulent hydraulics directly below dams, and eddies adjacent to shorelines or behind obstructions, provide an important environmental condition of fish habitat for many species, especially walleye (*Sander vitreus*) and sauger (*Sander canadensis*) (PFBC 2012). Deep scour plunge pools, excavated by backwash at the spillway of gates or aprons of fixed-crest dams, followed downstream by shallow gravel/cobble bars where scour material is deposited by outwash, enhance the complexity of tailwater habitat (PFBC 2012).

Within the navigation pool-dominated Ohio River, diverse [fish] communities exist only in the tailrace waters below lock and dam structures and may represent disjunct populations totally isolated from those of other pools (Argent and Kimmel 2008). Lotic fish species listed as threatened by the State of Pennsylvania were found at higher abundances in dam tailwaters on the Ohio River (Freedman et al. 2009a), and a similar trend was noted for dams in the Allegheny River (Argent and Kimmel 2011). Suckers (Catostomidae) that appeared to have been spawning were captured just below dams and riffles, and several female darters that were ripe with eggs were also captured (Stauffer et al. 2010). Darters spawn primarily in the shallow swift-moving water found directly below the dams (Stauffer et al. 2010). A 2012 Ohio Department of Natural Resources (ODNR) survey conducted at river mile (RM) 238, just a half mile downstream from the Racine Locks and Dam, resulted in the collection of a sauger and four darter species (Tippecanoe darter, *Etheostoma tippecanoe;* channel darter, *Percina copelandi;* slenderhead darter, *Percina phoxocephala;* and river darter, *Percina shumardi*). The darter records are included in the 2010-2018 Ohio River Valley Water Sanitation Commission (ORSANCO) fish population data, and are the only records for these darter species during this time-period, from the RC Byrd Pool, downstream of the Racine Locks and Dam.

Section E.5, Fish and Aquatic Resources, and Section E.5.2.2, 2019-2020 Fish Surveys, Discussion, page E-41: The Applicant states that only one American eel (*Anguilla rostrata*) collection has been made over the prior 8 years, suggesting this species is rare in the vicinity of the Project. While the American eel is present in low abundance, it is the Service's understanding that the species is underrepresented in surveys and is more abundant than records indicate, based on discussions with ORSANCO biologists who conduct the electrofishing surveys on the Ohio River and its tributaries. Furthermore, its low abundance is in part related to the many locks and dams in the Ohio River drainage that act as partial barriers to upstream migration (Pearson and Krumholz 1984) or at least cause migration delays. It is also likely that during their downstream migration only a small percentage of adult eels successfully pass through the many hydroelectric powerhouses on the Ohio River, and reach the Sargasso Sea to spawn and contribute to the larger eel population.

The American eel is rare enough that the State of Ohio has listed it as a threatened species. This is all the more reason for a concerted effort to undertake restoration efforts in the Ohio River watershed for this once-abundant, economically and ecologically beneficial, species. Early accounts regarding eel abundance in the Ohio River Basin are not widely available, but Bean (1892) described American eel as abundant in the three rivers. During the period 1920-1950, the American eel was "rather numerous" in the Ohio River at least as far upstream as Marietta, in the lower Scioto River, and especially in the Muskingum River upstream as far as Zanesville (Trautman 1981).

In 2015, there were "numerous angler catches, accompanied by pictures," reported from the Allegheny and Monongahela rivers (Stauffer et al. 2016), the upstream tributaries that come together to form the Ohio River. The Service obtained copies of some of these records along with accompanying photos. Every year there are additional angler reports from throughout the Ohio River drainage. The ODNR received an angler report from immediately below the Pike Island Lock and Dam in May 2021. The Service followed up with this angler who, upon request, provided a photograph of the yellow-phase (immature) eel that was presumably searching for upstream passage at that lock and dam. Some of the Monongahela River angler reports have come from as far upstream as Morgantown, West Virginia, and a PFBC fisheries biologist stated that he has received "dozens of other reports over the last decade and some additional photos" for angler-caught eels in the Monongahela River (Eric Davis, PFBC, personal communication, 8/15/2017). There are also many records from other Ohio River tributaries, including from the Kanawha River, Guyandotte River (recent angler report with photos), Eighteenmile Creek, Big Sandy Creek, Meadow River and Coal River.

Although the American eel is not abundant in the Ohio River, there have been many recent records from upstream of the Racine Project, indicating that outmigration of mature (silver phase) eels can be expected. However, to the extent hydropower projects operating on the Ohio River do not present an alternative to downstream passage through the powerhouse, cumulative entrainment mortality may prevent a large percentage of these eels from reaching their spawning grounds in the Sargasso Sea. In previous comments, the Service pointed out that the fall electrofishing surveys conducted in support of this relicensing were not preceded by a period of elevated river flow (i.e., which would likely trigger downstream migration).

Regarding the survey for upstream migrating yellow eels, this section states that the temporary eel ramp was constructed per the specifications recommended by the West Virginia Division of Natural Resources (WVDNR) and the Service, and that the ramp remained wetted at all times and the associated components were inspected and maintained weekly to ensure proper function. While this section appropriately points out that the pump was inactive on three separate occasions due to equipment malfunctioning and vandalism, there is no mention of the other problems with this study that were identified by the Service in its July 12, 2021, Updated Study Report (USR) comments (e.g., ramp operation began more than 30 days after the water temperature trigger was reached for commencing the study; the study was ended before the water temperature trigger was reached for ending the study; the water depth on the sloped section of the ramp was well above the Service's criteria for approximately 40 of the 77 days of operation; the Project was not generating for a significant portion of the latter half of the study and, therefore, was not providing the necessary far-field attraction).

There is no discussion in this section regarding fish species that serve as hosts for freshwater mussels. Although the mussel survey conducted in support of this relicensing did not document any federally listed endangered mussel species, and there are no records from the immediate vicinity of the Project, federally listed species have been documented in the navigation pools both upstream (Racine Pool) and downstream (RC Byrd Pool) of the Project. There are recent records for the endangered pink mucket pearly mussel (*Lampsilis abrupta*) from both pools; and recent records for the endangered fanshell (*Cyprogenia stegaria*), sheepnose (*Plethobasus cyphyus*) and snuffbox (*Epioblasma triquetra*) from the Racine Pool (USFWS 2017).

Among the documented hosts for these mussel species are the banded sculpin, *Cottus carolinae* (in Ohio River but not documented near Project); greenside darter, *Etheostoma blennioides* (documented both upstream and downstream of Project); banded darter, *E. zonale* (documented in Racine Pool and elsewhere in Ohio River); rainbow darter, *E. caeruleum* (Racine Pool and elsewhere in Ohio River); logperch, *Percina caprodes* (both upstream and downstream); blackside darter, *P. maculata* (in Ohio River but not documented near Project); largemouth bass, *Micropterus salmoides* (both upstream and downstream); smallmouth bass, *M. dolomieu* (both upstream and downstream); spotted bass, *M. punctulatus* (both upstream and downstream); sauger (both upstream and downstream); walleye (both upstream and downstream); and white crappie, *Pomoxis annularis* (both upstream and downstream) (ORSANCO; AEPGR 2021). The Project may be a limiting factor for dispersal of mussel glochidia (larvae) due to the lack of safe, timely and effective upstream or downstream fish passage. Fish are known to use the Racine locks, but the Project creates a false attraction flow that likely attracts fish away from the locks. In addition, as explained elsewhere in these comments, the Service does not consider the locks to be a safe, timely or effective route of passage. Mussel hosts attempting to move downstream past the Project may be injured or killed by the Project's turbines, and fish that use the locks may experience migration delays and may also be injured or killed by boat propellers.

E.5, Fish and Aquatic Resources, E.5.2.3, 2021 Entrainment and Impingement Study:

American Eel Entrainment and Turbine Blade Strike Mortality

This section states that the potential for American eel entrainment is during their downstream migration in the fall; however the overall number of eels passing downstream is likely low given their scarcity in fisheries sampling data and other means for passing downstream. The Service does not completely agree with this statement for a number of reasons. The timing of downstream migration of adult American eels has not been established in the Ohio River, and out-migration tends to vary by watershed and by year, often in response to triggers (e.g., high flow events, drop in water temperature). American eel seaward migrations occur in the fall and early winter ([Scott and Crossman 1973] *In* Stauffer et al. 2016), with spawning taking place in the Sargasso Sea in late winter (Stauffer et al. 1995).

In a study on the Shenandoah River, American eels moved downstream past dams in every month of the year except July (Eyler et al. 2016). Peak migration time differed for each of the 3 study years (February and March; October and December; November). For all years combined, peak migration occurred in November and December, and migrations typically coincided with high-discharge events (Eyler et al. 2016). Both the Service and WVDNR requested in-field verification of desktop entrainment study results, including consideration of hydroacoustic monitoring of the intake, which could have provided data on timing and numbers of out-migrating eels. The Applicant and the Commission did not support this request.

On the Susquehanna River, turbine blade strike eel mortalities were reported from below a hydroelectric facility in mid-October 2019, and between September 18 and November 29, 2020. The 2019 mortality event followed some pulses in river flow, above station hydraulic capacity, which led to corresponding decreases in river temperature (6-10 degree C drop). Eels likely moved downriver, triggered by freshets and decrease in water temperature. In 2020, river flows were less than station capacity for nearly the entire time period from mid-September to the end of November, with only one event in mid-November where flows were above hydraulic capacity. However, mortality events in November appeared to follow peak flow events on November 3 and November 16. Water temperatures during all mortality events ranged between 67 and 44 degrees F, suggesting these mortality events occurred after water temperatures had begun to decline from summer highs (typically > 72 degrees F).

ORSANCO fisheries surveys and the surveys conducted in support of this relicensing were not designed to capture out-migrating adult American eels and have likely underestimated the density of eels in the Ohio River and Project vicinity. As previously discussed, ORSANCO fisheries biologists who conduct the Ohio River surveys have indicated that the American eel is generally underrepresented in fisheries surveys, compared to its actual relative abundance. Regarding the statement that other means of downstream passage are available, the lock structures and Tainter gates are not open consistently and do not provide reliable year-round downstream passage. Fish passage through locks during normal operations may occur, but is not likely a major passageway given unsuitable flow patterns through and around the lock chambers to attract fish into or lead them out of the chambers; and for those that make their way into the confinement of a lock chamber, tow prop entrainment and mortality are more likely than in the open river (USACE 2016). Evaluating potential lock passage for the first eight locks and dams downriver from Pittsburgh, Knights et al. (2003) reached the general conclusion that fish passage through the lock chamber is probably not a viable means of population-level fish passage.

Although the American eel is panmictic, population-level cumulative entrainment effects are likely. The Service has been petitioned twice within the past 15 years to provide protections for this species under the Endangered Species Act because the species' population remains depressed. One of the cited reasons for this is entrainment impacts at hydropower projects (Shepard 2015). For example, the Service and other resource agencies have been working with hydropower companies on the Susquehanna River to restore that river's American eel population, requiring the collection and transport of elvers to free-flowing reaches of the river, above the four hydroelectric dams on the lower main stem of the river. Within the past few years, some of the earliest transported eels have begun to reach sexual maturity. As described above, many of these eels have failed to successfully pass the first of four hydroelectric powerhouses on the lower main stem (York Haven Hydroelectric Project), with significant turbine-induced mortality events having been documented in both 2019 and 2020. Using the Service's Turbine Blade Strike Analysis model (TBSA model; Towler and Pica 2019), the Service recently determined that turbine mortality rates at that one hydropower project may be greater than 50 percent.

The average tail length of silver-phase female eels in the 2020 Susquehanna River mortality event was 31.6 inches (n=263), and out-migrating radio-tagged eels in the previously cited study on the Shenandoah River (Eyler et al. 2016) had an average tail length of 33.6 inches (n=145). In the TBSA conducted in support of this relicensing, the estimated survival probability for American eels with an average tail length of 32 inches was 61.7 percent. Applying this estimated survival rate to each of the ten currently operating hydropower projects on the Ohio River results in a cumulative survival rate of 0.8 percent (0.617^{10}) for eels passing through all ten powerhouses. The cumulative survival probability for eels of the same size attempting to out-migrate from above the additional four hydropower projects located at locks and dams on the Allegheny River would be 0.12 percent (0.617^{14}).

Turbine mortality disproportionately affects large fecund female eels, since these eels are often found in headwater habitats that may be located upstream of multiple hydroelectric dams (Shepard 2015). An egg per recruit model used to evaluate eel passage at hydroelectric dams on the Susquehanna River showed that cumulative downstream turbine passage survival at multiple dams must be at least 33 percent to realize any benefit to providing upstream passage over these dams (Sweka *et al.* 2014). Verreault and Dumont (2003) estimated cumulative mortality rates of 40 percent for Lake Ontario's out-migrating female eels that pass through the Moses-Saunders and Beauharnois hydroelectric facilities on the St. Lawrence River. The cumulative impact of multiple hydroelectric projects within a watershed, as simulated by McCleave (2001), indicates substantial decrease in overall eel reproductive contribution from a watershed, even when survival rates of eel passage were high through each successive turbine or dam project.

Based on the results of the 2021 Fish Entrainment and Impingement Study, the Service is concerned about entrainment of large adult silver phase American eels that migrate downstream seasonally to spawn in the ocean. Because of their large size, adult American eels are particularly susceptible to entrainment mortality. According to Section E.5.2.3, the probability of blade strike for 20-38 inch American eels ranged from 23.4 to 44.5 percent. It is important to protect large adult silver-phase American eels by providing safe downstream passage as they migrate downstream as part of their reproductive life cycle.

Entrainment of Sauger

The Service is also concerned about the high entrainment rates estimated for sauger as this species is the only known natural host for the federally listed endangered sheepnose mussel, a species that has been documented a short distance downstream from the RC Byrd Locks and Dam, the next downstream dam below Racine, and also in the Racine Pool, downstream of the Belleville Project (FERC No. 6939). Sauger were collected during the fisheries surveys in support of relicensing. Because of their relatively large body size, adult sauger are susceptible to entrainment injury and mortality. It is important to protect this host fish from Project operations, given its importance to the reproductive life cycle and dispersal of the sheepnose mussel.

Estimated peaks in sauger entrainment rates occurred during the months of April through June (mostly May and June) in the relicensing desktop entrainment study, which obtained sauger entrainment rates from all studies in the Electric Power Research Institute (EPRI) database. Lesser peaks appeared during August through October (mostly October), with a higher August peak in the wet year analysis. During turbine discharge netting studies at the Townsend Water Power Project (FERC No. 3451) on the Beaver River, an upper Ohio River tributary, the months of April through June (1992-1994) accounted for 82.2 percent of entrained sauger. Estimates for numbers of entrained sauger were highest in April (3,558), May (6,980) and June (2,085), with additional peaks in September (847) and October (904), and smaller peaks in November (443) and August (226) (RMC 1994b). Migration barriers, operation of impoundments, low water flows, and channelization have also been implicated as causes of sauger population declines (Regier et al. 1969, Hesse 1994, Pegg et al. 1997, McMahon and Gardner 2001, Jaeger et al. 2005). Sauger can have extensive movements, especially during their spawning season (Jeffrey and Edds 1999). They have been known to move up to 380 kilometers (Collette et al. 1977).

Entrainment Study Conclusions and Barotrauma

The conclusions from this section of the DLA state that, based on the 2021 Fish Entrainment and Impingement Study, approximately 5,500 fish per year from the target species list (n = 35) are expected to experience turbine-related mortality. This estimate only takes into account mortality related to blade strikes. The Service previously commented that there is no indication that AEPGR considered causes of injury and mortality other than from turbine blade strikes (e.g., extreme pressure changes). Computational Fluid Dynamics modeling and field studies have shown that fish passing through turbines are subject to mild compression at the turbine intake, followed by sudden decompression in the short period of travel from the stay vanes and wicket gates past the suction side of the runner blades (*In* Richmond et al. 2015). Brown et al. (2012) found that injuries during decompression are caused by swim bladder expansion and rupture, or by gas bubble formation in blood (*emboli*) (*In* Richmond et al. 2015). Bluegills (*Lepomis* *macrochirus*), and presumably most physoclistous fish species, those with no connection between swim bladder and digestive tract (e.g., percines), are extremely susceptible to swim bladder rupture when exposed to sudden pressure change during turbine passage (Abernethy et al. 2000). In a Tennessee River study, sauger experienced barotrauma (injury caused by changes in barometric water pressure) over a wide range of capture depths (6-19 meters [20-62 ft]) (Kitterman and Bettoli 2009).

In a study of pressure changes simulating passage through a Kaplan turbine under a "fish-friendly" mode of operation, both rapid pressure change in test fish (turbine passage pressure spike) and gradual change in control fish (depth-acclimated fish returned to surface pressures) resulted in significant injury rates for bluegills (Abernethy et al. 2002). Injury and mortality rates for bluegills were higher if they had first been acclimated to water pressures equivalent to 30 ft of depth (Abernethy et al. 2002). The maximum depth in front of the Racine intake is approximately 65 ft.

Entrainment Conclusions – General Comments

As stated previously, large-bodied fish such as American eel and sauger would be particularly susceptible to blade strike injury and mortality. In addition, sauger are known to be susceptible to barotrauma related to rapid pressure changes. Large adult American eel and sauger are more important to their populations than smaller immature individuals as they are primarily reproductive females. For this reason, the Service recommends consideration of PM&E measures to protect these large-bodied fish from entrainment. The Service would like to work with AEPGR and/or ECRH to develop a Fish Protection Plan for the Project that would include measures to protect migratory species including American eel and skipjack herring (*Alosa chrysochloris*), and species that are important hosts for federally listed mussels (e.g., sauger), by providing a safe, timely and effective alternative downstream route of passage.

Application of "Cold Stress" Entrainment Filter to Clupeid Entrainment Estimates

In our comments on the USR, the Service questioned AEPGR's adjustment to the data to account for cold stress of clupeids. In these comments, we focused on a study involving identification of loss of equilibrium in gizzard shad (*Dorosoma cepedianum*) and threadfin shad (*D. petenense*). However, we did not specifically comment on skipjack herring. AEPGR responded to our comments by stating that this adjustment is consistent with generally accepted desktop entrainment studies and accepted by FERC on other Projects. However, the Service believes it is inappropriate to apply this adjustment to entrainment data for skipjack herring. We could find no support in the literature for cold stress effects to skipjack herring, nor did any of the references cited by AEPGR for application of this adjustment (Geosyntec 2005; Jenkins and Burkhead 1993; Duke Energy 2008) involve studies where such an adjustment was applied to data for skipjack herring entrainment. The GeoSyntec (2005) study was focused solely on threadfin shad. Jenkins' and Burkhead's (1993) Fishes of Virginia discusses cold stress effects on gizzard shad, but this reference does not include a skipjack herring account. The Duke Energy (2008) study separated skipjack herring from gizzard shad before applying the cold stress "entrainment filter" to gizzard shad only.

The entrainment study for the Free Flow Power projects (HDR 2013) cited the same three references, above, and therefore also inappropriately applied the cold stress adjustment to the entrainment results for skipjack herring. The two Pennsylvania studies (Youghiogheny and Townsend) from the EPRI database that were cited in the Free Flow Power study and in AEPGR's desktop study focused on gizzard shad and alewife entrainment, and the Minetto project in New York, also cited as an EPRI study where cold stress was an issue, is outside of the skipjack herring's range. Likewise, the citing of the Richard B. Russel project data in the EPRI database is inappropriate as the skipjack herring does not occur in the Savannah River. It was inappropriate for Free Flow Power to apply a cold stress filter to the skipjack herring data, and it was equally inappropriate for AEPGR to do so.

We also note that the study by Fost (2006) found significant differences between the temperature thresholds for gizzard shad and threadfin shad for loss of equilibrium (LOE). The LOE threshold for threadfin shad was 45 degrees F (7.2 degrees C), whereas the LOE threshold for gizzard shad was 38.3 degrees F (3.5 degrees C). Given this difference (nearly 7 degrees F), any application of a cold stress filter to skipjack herring data would need to be supported by empirical data. The Service has been unable to find any such data.

<u>Assumptions Regarding Winter Entrainment of Skipjack Herring</u>

We also question whether skipjack herring is even present at the Project during the winter months. This relicensing's desktop entrainment study showed peak entrainment of skipjack herring in January and another peak in November, with a lesser peak in December. Unless there are data to support the presence of large numbers of skipjack herring in the vicinity of the Project during the winter months, we believe this is an erroneous assumption of the study. The Service reviewed the EPRI database and confirmed that none of the studies included data for skipjack herring. We assume that AEPGR used a surrogate species (e.g., gizzard shad) to obtain entrainment estimates for skipjack herring.

The skipjack herring spawning migration in the upper Mississippi River occurs from early May to early July (NatureServe 2021). Mature skipjack herring immediately leave the spawning site once the spawn is complete ([Ross 2001] *In* Chandler 2014) and begin the journey back to their original habitat location. The skipjack herring winter entrainment numbers in the relicensing study were comprised primarily of small, young-of-year (YOY) individuals. If skipjack herring's life history, which has not been well-studied, is similar to that of other highly migratory Alosines, then one would expect the YOY to also migrate downstream during the fall, and not remain in the vicinity of the Project during the winter months. In the Susquehanna River, YOY American shad (*Alosa sapidissima*) generally out-migrate in October and November.

In AEPGR's response to our USR comments, they stated that "Freshwater Drum and Skipjack Herring are considered non-migratory species, yet they may undertake long distance, in-river migrations…" Although generally not considered anadromous, skipjack herring do move considerable distances within freshwater (Ross 2001), and the species may be anadromous in the Mississippi River. Limburg and Waldman (2009) included skipjack herring in a list of diadromous fishes found in the North Atlantic (Texas to Florida). Scharpf (2003) stated that, with the possible exception of some Mississippi River populations, it completes its entire life cycle in fresh water.

Native to the Gulf of Mexico (Hubbs et al. 1991), skipjack herring are primarily southern in their distribution, with Gulf Coast and lower Mississippi River populations being anadromous (Rice and Zimmerman 2019). The species was extirpated from the upper Mississippi system following construction of navigational facilities there, primarily the lock and dam at Keokuk, Indiana (Burgess 1980). Keokuk is approximately 375 miles upstream of the Ohio River confluence. The historic skipjack herring spawning run extended up to St. Anthony Falls, Minnesota (MNDNR 2021), an additional 480+ miles upstream of Keokuk, Indiana, and more than 850 miles upstream of the mouth of the Ohio River. The Ohio River is 981 miles long. Whether there were historic spawning runs that began in the Gulf of Mexico and extended all the way upriver to St. Anthony Falls is apparently unknown. There is anecdotal information suggesting that there may have been separate spawning runs/populations in the Mississippi River, with each run only covering a subsection of the river, and the run extending to St. Anthony Falls possibly returning downstream only as far as the mouth of the Ohio River to overwinter.

The Service also searched on-line angler forums and found comments from anglers stating that the species is not found in the upper Ohio River during the winter and, as far downstream as the Greenup Locks and Dam, anglers stated that the species is not found until the water temperature warms up in mid-to-late spring or late April to early May.

The Service believes that the skipjack herring is highly migratory in the Ohio River, and until more information becomes available, we also believe that this species is unlikely to be present in the upper Ohio River during the winter months. The estimated entrainment numbers in AEPGR's relicensing study are very low during the spawning season and late summer/early fall months, possibly not reflecting reality, as adults would presumably begin their downstream migration after spawning, and YOY would begin downstream migration in the fall.

The skipjack herring is also the only known host for the elephant-ear mussel (*Elliptio crassidens*), a species that is listed as endangered in Ohio and imperiled (S2) in West Virginia, and was documented downstream of the Project during the mussel survey conducted in support of Project relicensing (AEPGR 2020).

<u>Correction of Lambda (turbine blade strike coefficient) Value Used for American Eel</u>

Regarding the TBSA, the Service apparently requested that a lambda value (blade strike correlation coefficient) of 0.42 be used for American eel. The correct value should have been 0.40. Service fish passage engineers previously recommended a value of 0.402, which was rounded to 0.40. The Service was mistaken in requesting use of a lambda value of 0.42. However, we ran our own TBSA model simulations for American eel, using a lambda value of 0.40, and our results are comparable to those obtained in the relicensing study. For example, for eels measuring 30 inches, the blade strike probability (mortality) from our analysis ranged from 33.9 percent to 34.2 percent. AEPGR's analysis resulted in a blade strike probability of 33.8 percent for eels of the same length. For eels measuring 38 inches, the blade strike probability in our analysis ranged from 43.0 percent to 43.3 percent, whereas AEPGR's analysis for eels of the same length resulted in a strike probability of 44.5 percent.

Issues Pertaining to the Trashrack Impingement Evaluation

The Service previously requested clarification regarding the bar spacing on the trash racks. This issue was not resolved, as the revised Fish Entrainment and Impingement Study Report and AEPGR's response to USR comments both state that the center-to-center bar spacing measurement is 6.125 inches, whereas Section E.5.2.3 of the DLA (top of page E-43) provides this same measurement as representing the clear spacing (i.e., measurement between the bars, not center-to-center). The measurement of the clear spacing between the bars is more meaningful than center-to-center spacing as it pertains to impingement and/or entrainment potential. The clear spacing measurement between the bars is narrower than the center-to-center spacing, and is more appropriate for determining the sizes of fish that may become impinged or entrained. In Section 5.2.2 of the revised Fish Entrainment and Impingement Study Report, AEPGR states that the trashracks have a bar spacing of 6.125 inches center-to-center, and in the Impingement Assessment section (5.3.3) of that report, AEPGR states that fish proportional body widths were compared to the trash rack spacing at the Project (6.125 inch). If, as stated in that revised report, this is a center-to-center measurement, then this comparison is not valid, as it ignores the fact that the clear spacing will be narrower than 6.125 inches.

In our comments on the USR, the Service pointed out that the intake velocity was calculated based on the full height of the intake structure (88 ft) versus the height of the submerged portion of the intake (65 ft). Based on this comment, the Applicant recalculated and revised the intake velocity to 5.86 ft per second (fps), which is significantly higher than the previously calculated maximum intake velocity of 4.3 fps. Because this revision to the USR was made after the DLA was filed, the DLA does not include this higher intake velocity. In their USR, AEPGR states that this revision will have no effect on the entrainment rates or estimates, as those rates were calculated from the EPRI database and there was no adjustment to those data based on the number or percentage of target species that have the potential to escape entrainment or impingement based on approach velocity and swim speeds.

On page E-44 of the DLA, under *Trashrack Exclusion and Intake Avoidance,* AEPGR states that fish body widths were compared to the trashrack spacing (6.125 inches), and that burst swim speeds for target or representative species were compared to the estimated intake velocity (4.3 fps) to evaluate fish susceptibility to intake flows at the Project. Considering the higher calculated intake velocity (5.86 fps) and the likelihood that the trashrack clear spacing is narrower than 6.125 inches, the Service does not accept the Applicant's conclusions regarding potential impingement impacts. As stated in previous comments, the Service does not agree that, based on body width-to-length scaling, all target and representative species would pass through the trashracks and not be impinged. This conclusion ignores the potential for fish to become laterally pinned against the trashrack, especially considering the higher calculated intake velocity of 5.86 fps. The discussion in this section regarding burst swim speeds versus intake velocity is no longer valid, given the revised intake velocity calculation.

On September 26, 2019, AEPGR provided a digital photo of the Project debris sluice (chute) to FERC, WVDNR and the Service via email. The Service closely examined the photo which depicts debris on the flat surface at the base of the chute, including woody debris, what appear(s) to be one or two relatively large-bodied fish carcasses, and a gull presumably there to scavenge. Regarding debris, FERC (1995) notes a positive correlation between debris accumulation and fish impingement on modular inclined screens (page 4-6). One of, if not the primary effect of debris accumulation, is a localized velocity increase due to a decrease in effective open area. It is reasonable then to assume that increased impingement position occurs on any (hazardous) intake screen that reduces the gross flow area (whether that reduction and increased local velocity is due to steel structure, bars, or accumulated debris). Accumulated debris reduces porosity, essentially the clear spacing, which also likely contributes to increased impingement potential. The Service's fish passage engineers generally recommend a 1-inch clear spacing on intake trashracks, or a 0.75-inch spacing when American eel is present (USFWS 2019); however, given the high approach velocity at the Project intake, tighter spacing on the trashracks would likely lead to a significant increase in rates of impingent.

EPRI (2000) elucidates the relationship between approach, normal, and through screen velocities in the context of impingement. The authors recognize that impingement's primary driver may be approach velocity. They also acknowledge that "through screen velocity may relate to how difficult it is for a fish to remove itself from a screen once impinged." Fish may become constrained in their movements once impinged, unable to overcome inertia. The Service's fish passage engineering criterion for intake approach velocity to avoid impingement or entrainment is $\leq$ 2 fps (USFWS 2019). The calculated intake approach velocity at the Project is 5.86 fps, and there are likely localized increases above this velocity when debris accumulates on the trashracks. The Service requests that AEPGR and/or ECRH consider, as a precursor to possible PM&E measures, working with the Service to develop a plan to monitor sluiced trash rack debris for fish. Such monitoring may also provide useful information regarding the timing of out migration or downstream movements of species of interest (i.e., silver phase American eel, skipjack herring adults and juveniles, sauger).

Turbine Cooling Water Intake Impingement

There is another possible impingement issue that the Service did not previously raise. Hydropower turbines generally have a Cooling Water System (CWS) fed by pumps that draw water from the underground tailrace or draft tube, sometimes with a backup system in the penstock where this feature is present. At the request of resource agencies, the strainer screens on the cooling water intakes at two Susquehanna River hydropower plants are monitored from September through mid-December, annually, for juvenile American shad and adult American eels that may become impinged on the CWS intake strainer screens. At each of these projects, the CWS intake strainer screens are located in the top of the draft tube. As of 2021, American eel restoration efforts have been underway on the Susquehanna River for the past 13 years, and sexually mature eels began to show up on CWS strainer screens starting in 2015. Annual impingement of American eel has been low thus far (26 total between the two plants) because many of the stocked eels have yet to reach sexual maturity and begin out-migrating. A total of 69 American shad were collected from strainer screens between 2002 and 2019, but that species has been nearly extirpated from the Susquehanna, and restoration efforts have been slow to yield results.

Many other species have been collected from the screens, including shiners and darters. Although the relatively wide clear spacing on the trashracks at the Racine Project intake generally prevents impingement of these small species, they may be more susceptible to impingement on the CWS strainer screens. Smaller-bodied fish species that serve as hosts for federally listed endangered mussels (e.g., greenside darter, banded darter, rainbow darter, logperch, blackside darter) may be subject to impingement on CWS strainer screens at Racine, assuming such a system is a component of the Project. Similar to one of the objectives for monitoring sluiced trashrack debris from the powerhouse intake, monitoring of any CWS intake strainer screens may also provide useful information regarding the timing of out migration or downstream movements of species of interest (i.e., mussel hosts, silver phase American eel, skipjack herring adults and juveniles, sauger). In order to ensure that the Commission and the resource agencies have the necessary information to evaluate all possible modes of impingement mortality at the Project, the Service requests that the Final License Application include a description of the CWS at the Project, including location of any cooling water intake, strainer screen porosity, and any other pertinent information that would help to inform impingement potential.

Section E.5.4.2, 2019 Mussel Survey: This section states that as part of the relicensing process, AEPGR conducted a mussel survey that was completed in September 2019. This section further states that AEPGR is not proposing any changes to the Project or operations that would alter the existing hydraulics and therefore, the mussels observed during the survey are not expected to be affected by the continued operation of the Project. The Service is concerned about possible entrainment impacts to host fish for federally listed mussels. While no federally listed mussels were found downstream as part of the mussel surveys, federally listed mussels do occur in the Racine and RC Byrd pools, and allowing safer downstream passage of these host fish would enhance their recovery within the Ohio River system. To protect these fish and enhance mussel recovery, the Service would like to work with AEPGR to develop a Fish Protection Plan for the Project, which would include developing PM&E measures to protect hosts for federally listed mussels from entrainment by providing safer downstream fish passage.

Exhibit E, Environmental Report, E.5, Fish and Aquatic Resources, E.5.5.2, State Listed Threatened, Endangered, and Candidate Aquatic Species: Although they were not found during relicensing studies, missing from the list in Table E.5-12 are the American eel and the Tippecanoe darter, both of which are listed as threatened in Ohio. The paddlefish (*Polyodon spathula*), channel darter and river darter, also listed as a threatened in Ohio, have also been documented in the vicinity of the Project (ORSANCO). The three darter species were all documented in a single 2012 Missouri mini-trawl survey at RM 238, immediately downstream from the Project (ORSANCO). There is a Racine Pool record from 1989 for American eel, and many older records from the RC Byrd Pool (ORSANCO). There are 1997 and 1989 Racine Pool records for paddlefish, both from RM 237.5, immediately upstream of the Project. In addition, there are a few records from the Racine Pool for the Ohio State-listed endangered goldeye (*Hiodon alosoides*), the most recent being from 1987, at RM 237.5, immediately upstream of the Project (ORSANCO). There are also records for this species from the RC Byrd Pool (ORSANCO).

Exhibit E, Environmental Report, E.6, Terrestrial Resources, E.6.3, Wetland, Riparian,

and Littoral Habitats: On page E-58, AEPGR states that there are approximately 2.2 acres of potential wetlands within the Project boundary upstream of the powerhouse and in Tuppers Run. The National Wetlands Inventory (NWI) mapping also maps the downstream Project tailrace, to which the Project discharges, as a Riverine Lower Perennial Unconsolidated Bottom (R2UBH) wetland. This is not reflected in Figure E.6-1, but Section E.6.3.1, Riverine Wetlands, states that the section of the Ohio River within the Project boundary downstream of the Racine powerhouse is classified as R2UBH. There is lack of agreement between this statement and the initial statement implying all mapped wetlands within the Project boundary are upstream of the Project, and Figure E.6-1 does not show mapped wetlands both upstream and downstream of the Project.

Exhibit E, Environmental Report, E.7, Wildlife Resources, E.7.3, Reptiles and Amphibians, Table E.7-3: This table includes the eastern massasauga (*Sistrurus catenatus*) which, in addition to being listed by the State of Ohio as endangered, is also federally listed as threatened (date listed: 9/30/2016).

Section E.7.5 Federally Listed Threatened, Endangered, and Candidate Wildlife Species: This section states that based on a search of the Service's Information for Planning and Consultation (IPaC) planning tool for federally listed or candidate wildlife species, only two wildlife species were identified, Indiana bat (*Myotis sodalis*) (endangered), and northern long-eared bat (*Myotis septentrionalis*) (threatened), as potentially occurring within the Project area. According to Section E.7.6 (Project Impacts on Wildlife Resources), resource agencies and other stakeholders have not identified any potential Project-related impacts to wildlife resources within the Project area. However, any tree removal associated with maintenance or improvements to facilities (including expansion of the recreational fishing facilities) has the potential to adversely affect both of these bat species, as they roost and form maternity colonies in trees during the summer. If any tree removal is performed during the license term, consultation with the Service is recommended in order to evaluate any impacts to these species. To avoid adverse effects to breeding and roosting bats, the Service generally recommends a time of year restriction (no tree removal from April 1 to November 15).

EXHIBIT H, Ability to Operate (18 CFR §5.18(c))

H.7, Modifications to Project Facilities and Consistency with Comprehensive Plans (18 CFR §5.18(c)(1)(i)(G) and (H)): Regarding the list of comprehensive plans, the Service requests inclusion of the 2000 Atlantic States Marine Fisheries Commission's American Eel Fishery Management Plan. A stated goal of this plan is to protect and enhance the abundance of American eel in inland and territorial waters of the Atlantic States and jurisdictions and contribute to the viability of the American eel spawning population. Among the stated objectives are to protect and enhance American eel abundance in all watersheds where eel now occur, and, where practical, to restore American eel to those waters where they had historical abundance but may now be absent, by providing access to inland waters for glass eel, elvers, and yellow eel, and adequate escapement to the ocean for pre-spawning adult eel (ASMFC 2000). This plan is included in the Commission's list of comprehensive plans for projects in West Virginia. The Commission has already accepted this plan as a comprehensive plan, and the Service believes it should be included in the list of Comprehensive plans considered by the Commission for its consistency determination in this relicensing process.

Addendum II to the above plan includes a request for special consideration for American eel in the FERC relicensing process. This consideration should include, but not be limited to, improving upstream and downstream passage, and collecting data on both means of passage (ASMFC 2008). This addendum discusses the 33,663 dams that potentially hinder American eel movement on the Atlantic and Gulf coasts. This addendum has also been accepted by the Commission as a comprehensive plan for projects in West Virginia (referred to as "Amendment 2" in the list), and should also be added to the list of plans considered for this Project relicensing.

Project Characteristics and Operations Related to Potential Fish Passage

The following discussion is provided in partial fulfillment of the Service's commitment to conduct its own analysis of flow distribution at the Project in order to identify possible opportunities for fish PM&E measures.

In response to AEPGR's filing of the Pre-Application Document, the Service requested a *Fish Protection and Upstream and Downstream Passage* study. AEPGR chose not to conduct the requested study. The Service responded by requesting additional information in order to conduct its own analysis.

It is our understanding that river flow can be passed through two 24-MW bulb turbines, under the eight (8) 110-foot wide Tainter gates, through the 1,200-foot long commercial lock, and/or the 600-foot long auxiliary lock. The resulting flows are complex and spatially (laterally) separated. The flow fields created by these 12 project elements create directional cues that may attract (or dissuade) eels and other species during their migrations up- and downstream. The efficacy of any eelways, fish protection devices, or other mitigation measures will be influenced, primarily, by the location and timing of these artificial flows over the course of a year.

To evaluate the magnitude and persistence of these sources of (false) attraction, the Service intended to develop a holistic model of flow management and operations at the site. To that end, we requested that AEPGR provide the following historical data on daily (or finer) resolution for a period covering the last 10 years:

- Headpond elevations
- Tailwater elevations
- Gate (i.e., spill) operations (including the sequence and timing of specific gates)
- Unit 1 and unit 2 turbine discharge
- Lock operations (including any openings for maintenance)

Additionally, the Service requested any dam/powerhouse elevation drawings and/or bathymetric data in the immediate upstream or downstream vicinity of the dam that would allow us to estimate mean velocities. The information provided to the Service is described under "Tainter Gate Openings and Project Generation" below.

The Service's stated goal for this information request was to enable the Service to evaluate the magnitude and persistence of the various sources of flows that serve as attraction flows to fish that are approaching the Project during upstream and downstream migrations.

Our resource management goals for this analysis include protecting and restoring migratory fish populations (e.g., American eel and species that serve as hosts for endangered freshwater mussels), and improving dispersal of endangered freshwater mussels in the Ohio River.

The Service described the nexus to Project operations and effects of the proposed analysis as follows: The Project discharge creates a false attraction for upstream migrating fish, thus reducing the potential for successful upstream passage through the USACE's locks. In addition, when most or all of the flow is through the powerhouse, the predominant flow to the powerhouse attracts downstream migrating fish, resulting in impingement or entrainment of a percentage of downstream migrants, causing injury and/or mortality to some of these fish. Attraction to the Project intake when most or all flow is through the powerhouse also reduces rates of downstream passage through dam Tainter gates and USACE locks.

False Attraction Flow

As previously stated, when the Project is operating, and especially when flows are within the Project's hydraulic capacity and all flow is through the powerhouse, the Project creates a far-field false attraction flow that attracts fish to the powerhouse side of the river, where there is no upstream passage option. This false attraction flow also attracts fish away from the only upstream passage option when all flow is through the powerhouse, the USACE navigation locks. During the time period over which the Project has been in existence, this false attraction flow has likely resulted in a reduction in upstream fish migration and, at a minimum, migration delays (e.g., for yellow phase American eel). This condition, when all flow is through the powerhouse and there is no spillage through the Tainter gates, occurs approximately 40 percent of the time (Figure 1), when inflow to the Project is between 4,000 and 32,000 cfs.

Evaluation of Locks for Fish Passage

While we were unable to obtain detailed information regarding lock openings as alternative downstream passage routes, some information was available on-line. Lockage (when boats "lock through") is provided on a priority basis in the following order: (1) government emergency vessels (e.g., U.S. Coast Guard vessels); (2) commercial passenger vessels; (3) commercial cargo vessels; and (4) recreational vessels. Commercial traffic is heavy on the river, with annual commercial traffic on the Ohio River averaging more than 150 million tons. However, traffic may be quite variable depending on time of year or section of river/navigation pool.

The Louisville District of the USACE operates eight navigation structures on the Ohio, from Markland downriver to the mouth. Lockage is available 24 hours a day, 365 days a year, serving both the towing industry and recreational boaters.[1] However, lockages are not provided according to any particular schedule. Instead, they are provided on an as-needed basis. A vessel

1 https://www.lrl.usace.army.mil/Missions/Civil-Works/Navigation/History/

wishing to lock through must contact the lockmaster to arrange for a lockage. According to the USACE's Pittsburgh District, sometimes in the summer there are lines of pleasure boats waiting for lockages on busy weekends, and almost 30,000 recreational boats locked through this district's locks in 2003.[2]

Tainter Gate Safety Evaluation as a Potential Route of Passage

Possibly the safest alternative downstream route of passage is via one of the USACE's Tainter gates. However, the bottoms of these radial gates are only clear of the water during very high flows when the turbines are not operating and there is no entrainment mortality potential. Otherwise, when flows are within the operational range of the hydropower, the bottom of the gate is submerged and may be a collision hazard for fish. Gate openings are in 0.5-foot increments, and when all gates are not completely closed, the minimum opening is 0.5 ft, which may be particularly hazardous to any large-bodied fish that attempt to move downstream via this route. In addition to the amount of gate opening, flow conditions may also influence the degree to which this route presents a collision hazard. The Service has not studied the flow regime (e.g., laminar, plunging/turbulent) through a gate to determine collision potential.

Based on our review of a USACE drawing of a Tainter gate at the Racine Project, it appears that, at normal lower pool levels (surface elevation $\geq$ 538 ft), the sill (elevation = 528 ft) is submerged under at least 10 ft of water, and at a normal upper pool level (surface elevation $\geq$ 560 ft), the sill is submerged under at least 32 ft of water. The USACE must maintain the upper and lower pool elevations for navigation. Therefore, the sill, both upstream and downstream, should always be sufficiently submerged, and abrasion/descaling of fish from making contact with the sill may not be an issue. However, abrasion/descaling from making contact with the sill and/or the bottom of a gate may be more likely if fish pass through a gate with a very small opening (e.g., 0.5 ft). Any debris that has accumulated in a gate opening may also increase the potential for fish injury.

Similar to a Tainter gate at the Racine Project, Figure 2 depicts a Tainter gate with a well-submerged sill.

Tainter Gate Openings and Project Generation

In response to the Service's request, on November 13, 2020, AEPGR transmitted forebay and tailrace elevations from January 2015 to early November 2020 and generation records from January 2014 to early November 2020. In addition, on September 24, 2020, the USACE's Huntington District provided the Service with a spreadsheet of Racine Lock and Dam operations, and a document depicting the Racine Dam gate schedule, along with responses to other questions and information requests. The USACE also provided a link to obtaining bathymetry data for the Project area, and assistance with interpreting the provided information.

We note that we requested data covering the last 10 years, but most of the provided data covers only a short (~ 5-year) time period during which there were multiple extended Project shutdowns (Table 2) related to the Functional Replacement Dam project (FDR). As a result, most of the data

[2] https://www.nrc.gov/docs/ML0809/ML080980172.pdf

cover a time period when Project operations were not typical, confounding the Service's ability to conduct a meaningful analysis. In addition, although a gate schedule was obtained from the USACE, it is our understanding that this schedule is not precisely followed, and we observed significant differences between this schedule and actual gate openings in the operations data we received. The operations data also do not include gate-specific openings; instead, the data show total gate opening (all gates combined, expressed in ft).

The key months of interest to the Service are April through June (sauger and skipjack herring spawning and highest expected sauger entrainment rates), July through August (post-spawn downstream migration of adult skipjack herring, and smaller sauger entrainment peak), and September through December (YOY skipjack herring downstream migration, additional smaller entrainment peaks for sauger, and likely downstream migration period for adult silver-phase American eel). During the 5 years from September 2015 through September 2020, the Project was operating most of the time during these key months only in 2016 (Table 2).

During the period 1991-2021, river flows were below Project hydraulic capacity (no generation) 0.3 percent of the time; within hydraulic capacity, when all flow may be through the powerhouse, 39.8 percent of the time; above hydraulic capacity but within the Project's operating range (Project is able to operate but excess flow above hydraulic capacity is released through Tainter gates) 52.7 percent of the time; and above the Project's operation range (not enough head differential to operate due to high river flow, with all flow released through the Tainter gates) 3.0 percent of the time (Figure 1 and Table 3). River flows during this 30-year period were within the Project's operating range 92.5 percent of the time. However, the Project did not operate 92.5 percent of the time. According to Section B.1.3 of the DLA, the Project's Plant [Capacity] Factor was 0.359 during the 2016-2020 period when there were extended shutdowns related to the FRD project. The Plant Capacity Factor (PCF) is the ratio of its actual output over a period of time, to its potential output. We assume that the PCF for the 2016-2020 period is not representative of the PCF over the life of the Project, due to the extended shutdowns related to the FRD.

During 2016, river flows were below Project hydraulic capacity 0.5 percent of the time, within hydraulic capacity 42.6 percent of the time, above hydraulic capacity but within the Project's operating range 53 percent of the time, and above the Project's operating range 3.0 percent of the time (Table 4). Therefore, river flows were within the Project's operating range more than 95 percent of the time, but more than half of that time was above hydraulic capacity, resulting in the need to release excess flow through one or more of the Tainter gates (Figure 3).

During the key period of April through June of 2016 (sauger and skipjack herring spawning and highest expected sauger entrainment rates), there were no days when the Project did not generate (Table 5 and Figure 4). During April, there were no periods of generation with no Tainter gate opening (i.e., there was presumably an alternative to the powerhouse available for downstream fish passage; Table 6). This was mostly the case during May 2016, when no gate opening was available only 8 percent of the time. However, in the key month of June, all Tainter gates were closed 65 percent of the time, during which there was no alternative to the powerhouse, aside from the locks, for downstream passage. It is important to note that when all gates are closed, fish moving downstream will likely be attracted to the powerhouse side of the river (i.e., away from the locks), as that is where the predominant flow is.

During July through August, 2016 (post-spawn downstream migration of adult skipjack herring, and smaller sauger entrainment peak), the Project was generating on most days (Table 5), but all gates were closed 61 percent of the time in July and 83 percent of the time in August (Table 6 and Figure 5), indicating high potential for entrainment during those months. From the beginning of September through December (YOY skipjack herring downstream migration, additional smaller entrainment peaks for sauger, and likely downstream migration period for adult silver-phase American eel), the Project was again generating on most days (Table 5), but, except for during December, gates were closed much of the time, especially in November when all gates were closed 96 percent of the time (Table 6 and Figure 6). This is a significant concern to the Service, as this period likely coincides with silver phase American eel out-migration.

Tainter Gate #8 as a Possible Alternative Downstream Passage Route

Based on communications from the USACE Huntington District, it is the Service's understanding that whenever the turbines are not operating, Tainter gate #8, the gate nearest the powerhouse, is left open 1 foot in order to provide a tailwater flow that attracts fish to the downstream fishing area below the powerhouse. As previously stated, the Service would like to work with the USACE and the Applicant to evaluate as a PM&E measure, the possibility of leaving gate #8 open 1 foot at all times, including when the turbines are operating, to provide an alternative to the powerhouse for downstream passage. Such a measure would also provide a minimum flow to enhance aeration and habitat for riffle-associated species (e.g., darters).

Thank you for your consideration in this matter. If you have any questions, please contact Richard McCorkle at richard_mccorkle@fws.gov.

Sincerely,

Sonja Jahrsdoerfer

Sonja Jahrsdoerfer
Project Leader

cc: WVDNR, Jacob Harrell
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Appendix 1 - Tables

Table 1. Proposed, Licensed, and Currently Operating Hydropower Projects on the Ohio, Allegheny and Monongahela Rivers.

	FERC #	Project Name	Waterway	Status
1	289	Ohio Falls	Ohio River	Operating
2	2211	Markland L/D	Ohio River	Operating
3	2570	Racine L/D	Ohio River	Operating
4	2614	Greenup L/D	Ohio River	Operating
5	3206	New Martinsville	Ohio River	Operating
6	6641	Smithland L/D	Ohio River	Operating
7	6902	Willow Island L/D	Ohio River	Operating
8	6939	Belleville L/D	Ohio River	Operating
9	10228	Cannelton L/D	Ohio River	Operating
10	12667	Meldahl L/D	Ohio River	Operating
11	13757	Emsworth L/D	Ohio River	License issued
12	13761	Emsworth Back Channel	Ohio River	License issued
13	13768	Montgomery L/D	Ohio River	License issued
14	15045	New Cumberland L/D	Ohio River	NOI/PAD filed
15	15094	RC Byrd L/D	Ohio River	Preliminary Permit
16	15230	Pike Island L/D	Ohio River	NOI/PAD filed
17	2280	Kinzua Pumped Storage	Allegheny River	Operating
18	3021	Allegheny L/D 8	Allegheny River	Operating
19	3021	Allegheny L/D 9	Allegheny River	Operating
20	3494	Allegheny L/D 6	Allegheny River	Operating
21	3671	Allegheny L/D 5	Allegheny River	Operating
22	13755	Allegheny L/D 2	Allegheny River	License issued
23	13739	Braddock L/D	Monongahela River	License issued
24	13753	Opekiska L/D	Monongahela River	License issued
25	13762	Morgantown L/D	Monongahela River	License issued
26	13763	Grays Landing L/D	Monongahela River	License issued
27	13766	Maxwell L/D	Monongahela River	License issued
28	13767	Charleroi (L/D 4)	Monongahela River	License issued
29	13771	Point Marion L/D	Monongahela River	License issued

Table 2. Percent of Time When Project Was Not Generating (# units = 0).

Month	Year					
	2015	2016	2017	2018	2019	2020
1		42%	100%	100%	14%	9%
2		100%	100%	100%	72%	46%
3		92%	100%	100%	1%	67%
4		0%	100%	100%	70%	100%
5		0%	100%	100%	0%	82%
6		0%	100%	100%	45%	1%
7		1%	100%	100%	100%	4%
8		13%	100%	100%	100%	4%
9	4%	8%	100%	100%	100%	2%
10	5%	0%	100%	100%	40%	
11	0%	0%	100%	30%	19%	
12	22%	15%	100%	26%	19%	

Table 3. 1991-2021 Statistics

11,171	total days	
37	days < 4,000 cfs	only through gates, no generation, locks when needed
0.3%	% days < 4,000 cfs	
4,448	days >= 4,000 & <=31,300 cfs	only through units, locks when needed
39.8%	% days >= 4,000 & <=31,300 cfs	
5,882	days > 31,300 & <=150,000 cfs	combination through units and gates, locks when needed
52.7%	% days > 31,300 & <=150,000 cfs	
804	days > 150,000 cfs	only through gates, no generation, locks when needed
7.2%	% days > 150,000 cfs	

Table 4. 2016 Statistics

366	total days	
2	days < 4,000 cfs	only through gates, no generation, locks when needed
0.5%	% days < 4,000 cfs	
156	days >= 4,000 & <=31,300 cfs	only through units, locks when needed
42.6%	% days >= 4,000 & <=31,300 cfs	
197	days > 31,300 & <=150,000 cfs	combination through units and gates, locks when needed
53.8%	% days > 31,300 & <=150,000 cfs	
11	days > 150,000 cfs	only through gates, no generation, locks when needed
3.0%	% days > 150,000 cfs	

Table 5. 2016 Monthly Statistics

Month	# Units = 0	Gate Opening = 0	Avg Gate Opening (ft)	Avg Hydro Flow (cfs)	Avg Gage Flow (cfs)
1	42.2%	0.4%	14.9	15,918	50,235
2	100.0%	0.0%	48.4	0	114,207
3	91.6%	0.0%	33.6	2,551	78,860
4	0.0%	0.0%	13.8	27,434	57,845
5	0.0%	7.8%	14.3	27,311	81,592
6	0.0%	65.5%	3.1	18,853	42,015
7	0.9%	60.6%	1.6	10,356	25,176
8	13.4%	83.3%	0.4	12,998	17,704
9	8.2%	70.2%	0.8	8,196	10,047
10	0.0%	63.2%	3.4	17,838	24,934
11	0.0%	96.5%	0.1	19,984	21,030
12	14.9%	2.7%	26.2	15,466	67,399

Table 6. Percent of time gates are closed (gate opening = 0)

Month	Year					
	2015	2016	2017	2018	2019	2020
1		0%	3%	8%	6%	0%
2		0%	0%	44%	23%	15%
3		0%	5%	3%	3%	5%
4		0%	0%	22%	0%	0%
5		8%	0%	0%	5%	0%
6		65%	0%	0%	0%	8%
7		61%	0%	0%	0%	67%
8		83%	0%	0%	0%	60%
9	87%	70%	0%	9%	0%	44%
10	77%	63%	0%	0%	57%	
11	68%	96%	0%	0%	45%	
12	23%	3%	0%	8%	10%	

Appendix 2 - Figures

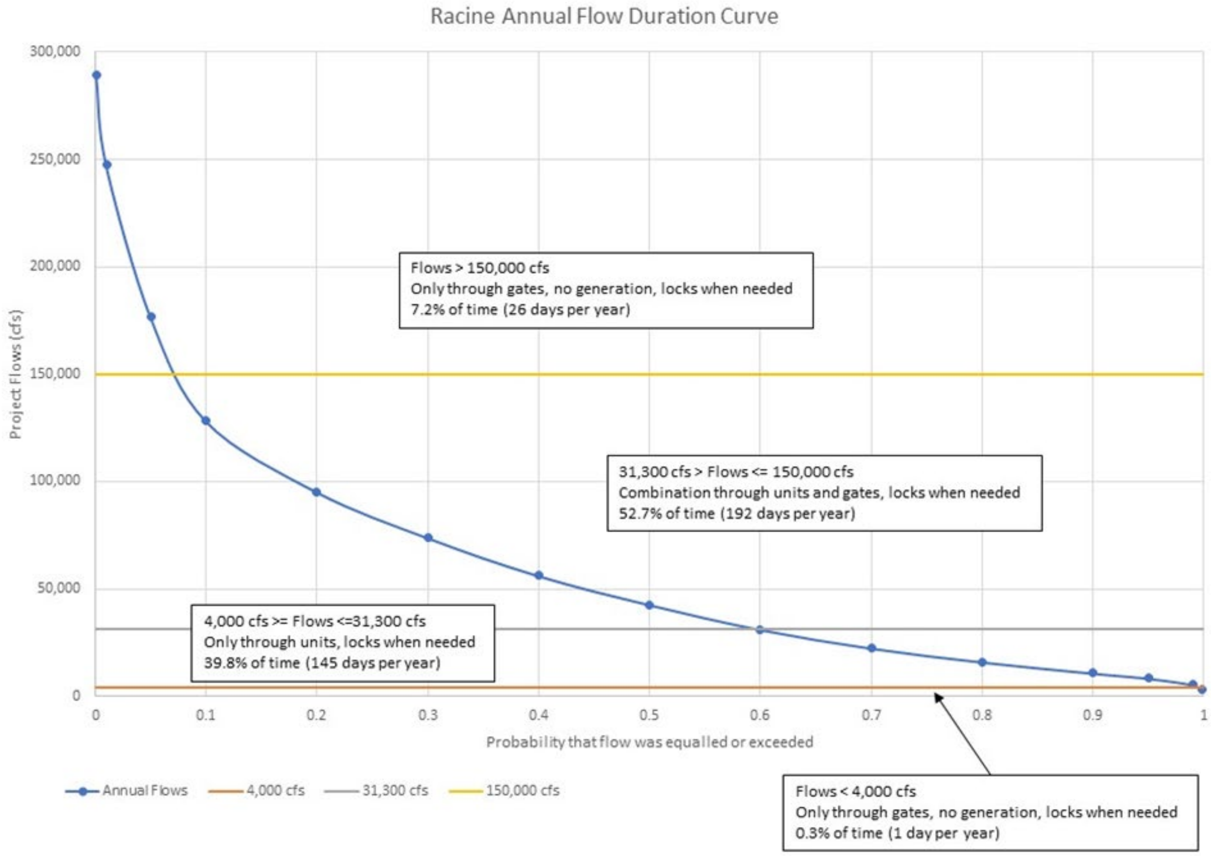

Figure 1. Racine Project flow duration curve illustrating the percentage of time/number of days per year when (1) flows are above the Project's hydraulic capacity (no generation); (2) flows are between 31,300 cfs and 150,000 cfs, Project is generating, and there is also spill released through Tainter gates; (3) flows are between 4,000 cfs and 31,300 cfs and all flow is typically through the powerhouse (i.e., no spill released through gates); and (4) flows are below hydraulic capacity and Project is not generating (based on data from USGS Gage 03216600 for years 1991-2021; prorated: gage drainage area = 62,000 square miles; project drainage area = 40,104 square miles).

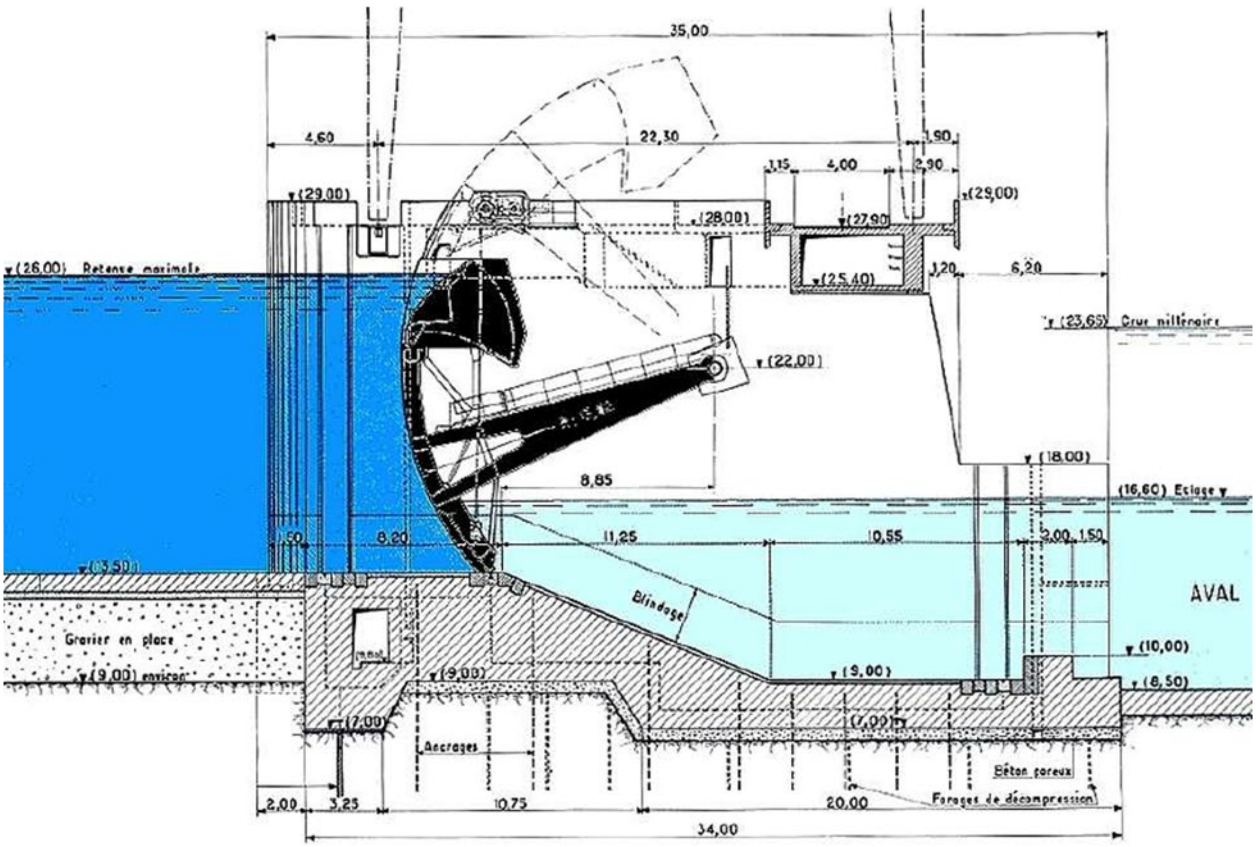

Figure 2. Illustration of a Tainter gate at the Sauveterre Dam, Rhone, France, similar to those at Racine, with submerged sill (credit: Christophe Peteuil).

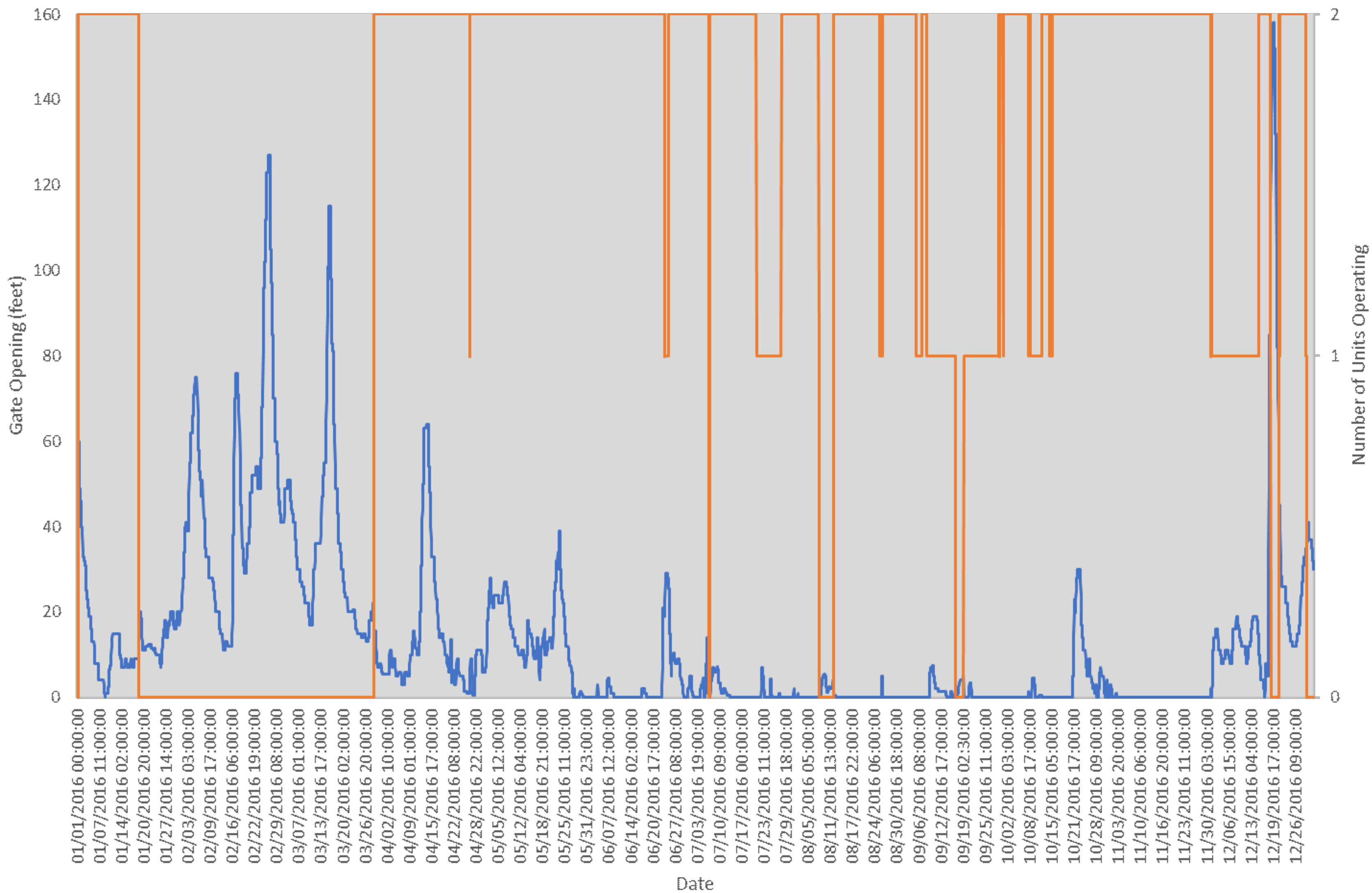

Figure 3. 2016 Total Tainter Gate Opening (blue) and Number of Units Operating (orange)

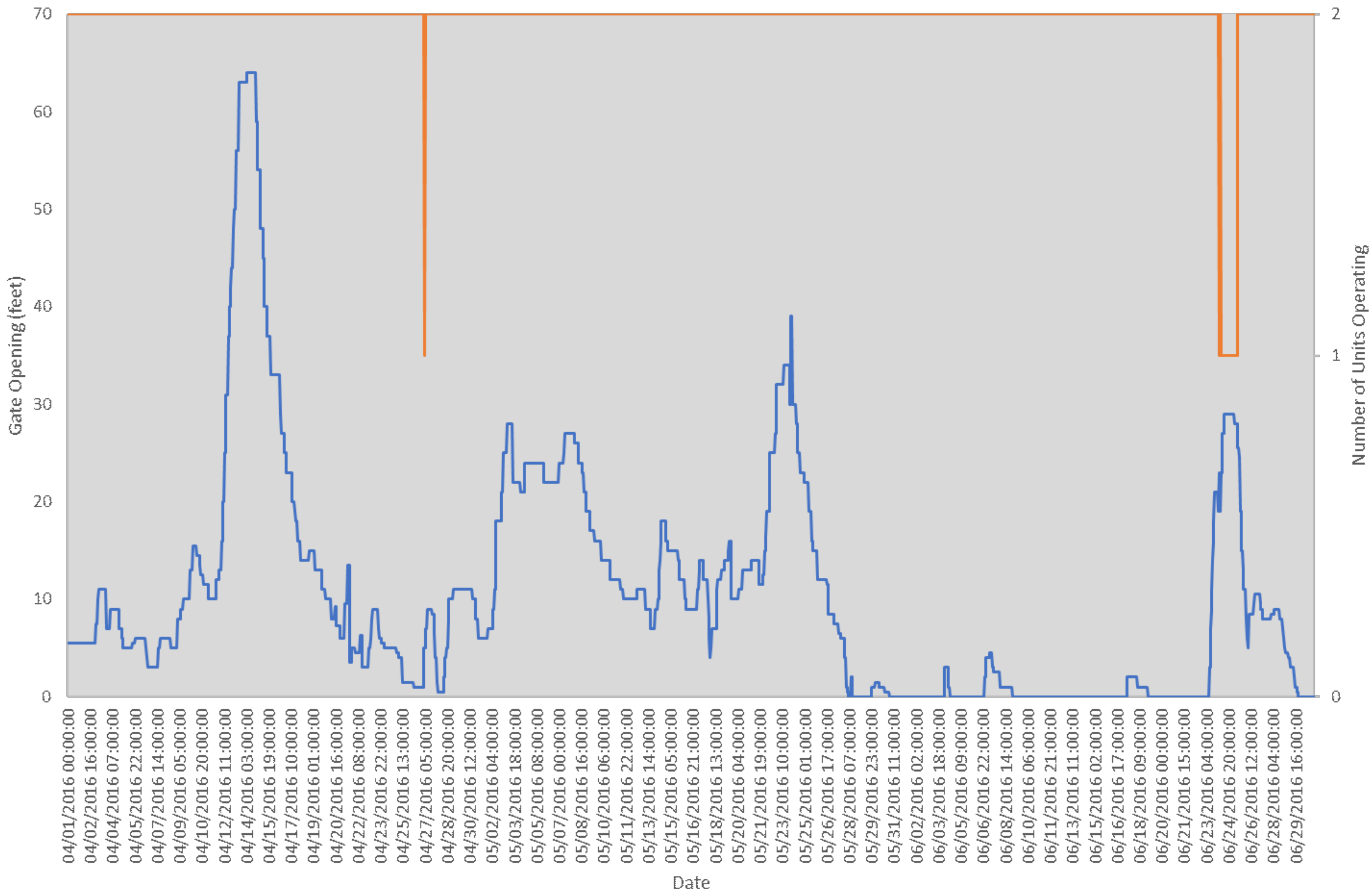

Figure 4. April – June 2016 Total Tainter Gate Opening (blue) and Number of Units Operating (orange)

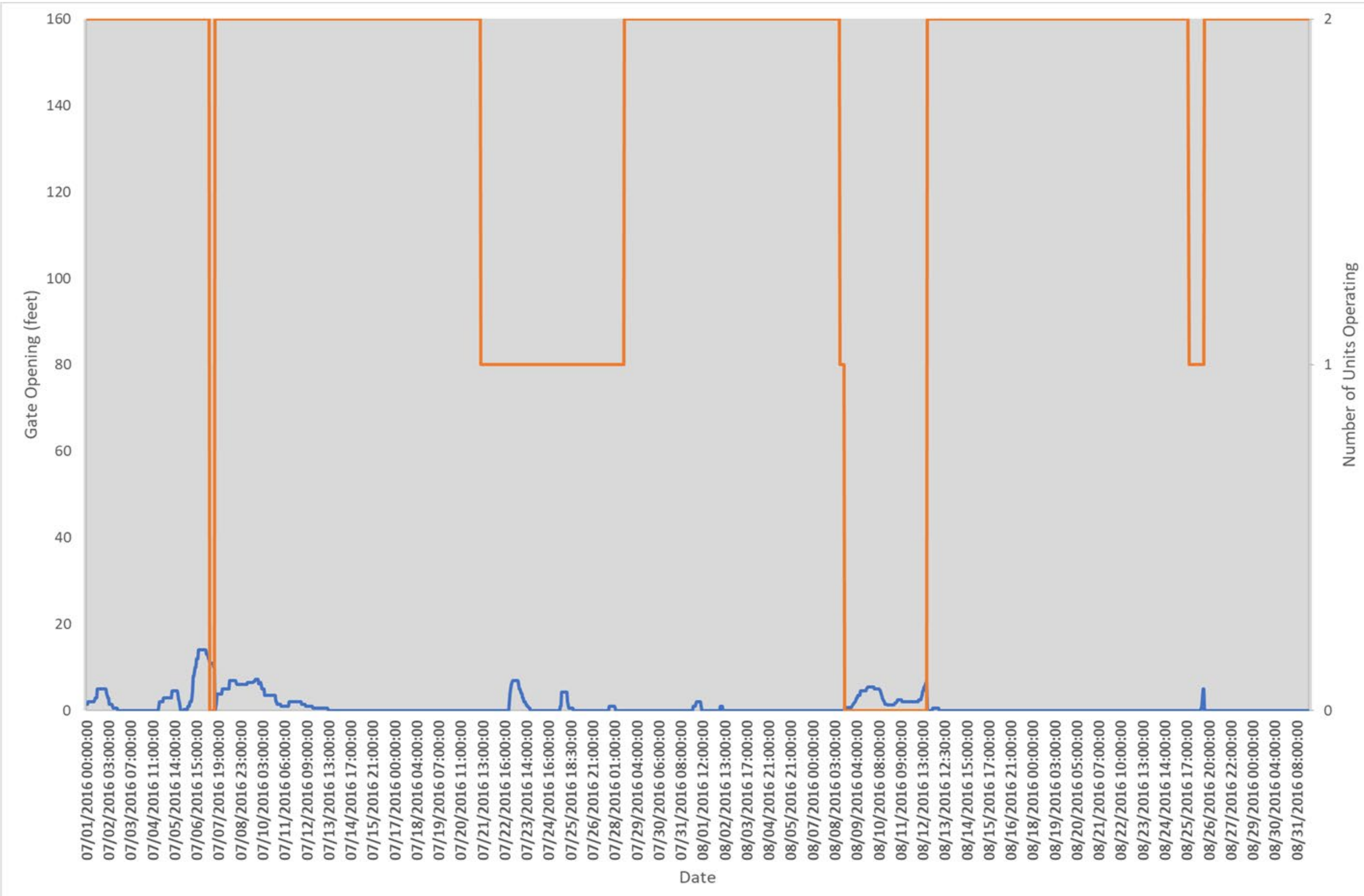

Figure 5. July – August 2016 Total Tainter Gate Opening (blue) and Number of Units Operating (orange)

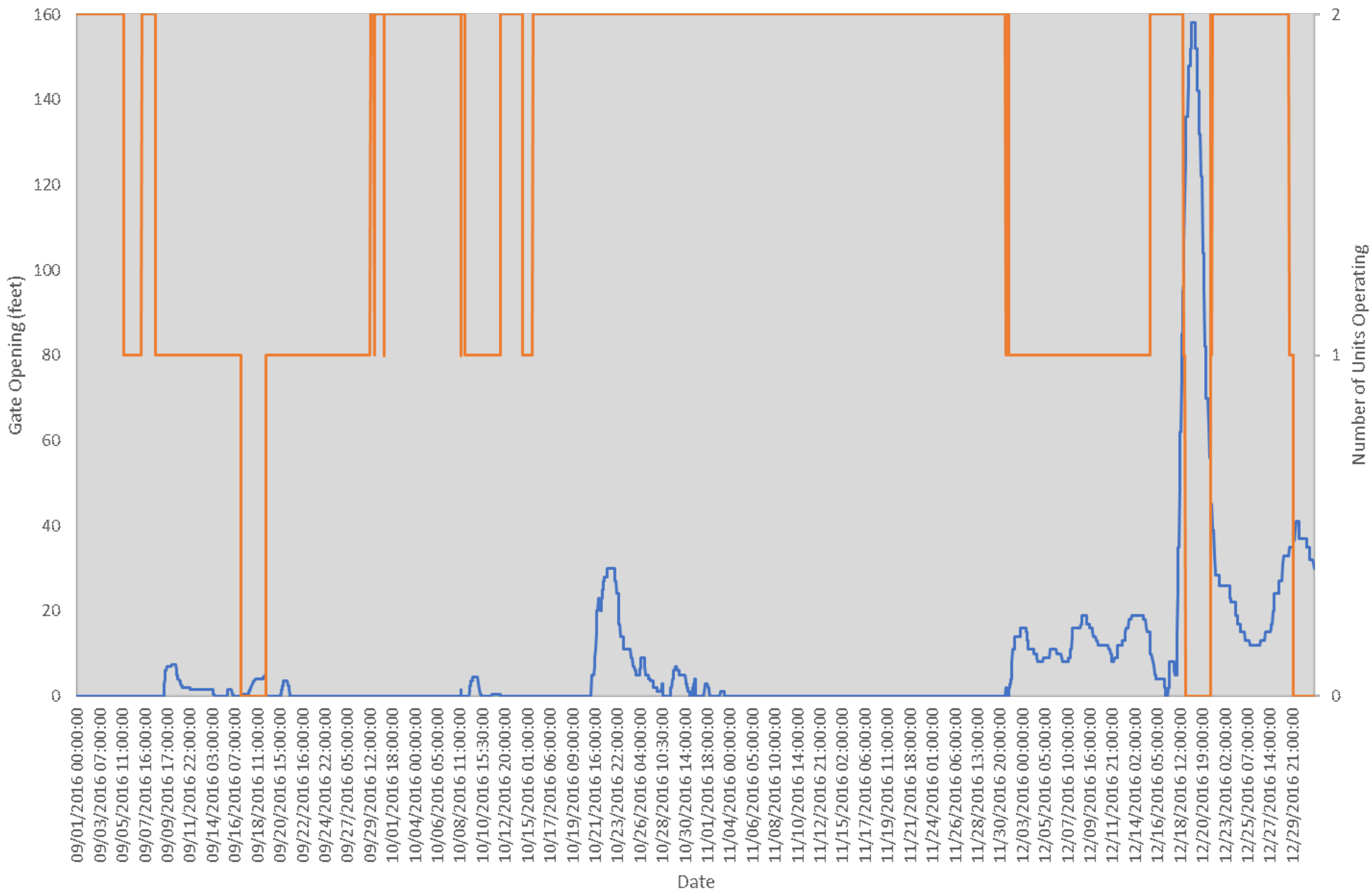

Figure 6. September – December 2016 Total Tainter Gate Opening (blue) and Number of Units Operating (orange)

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