Appendix 16

Comments on FERC DEA

a) Sappi (July 23, 2021)
b) International Brotherhood Electrical Workers (August 12, 2021)
c) Maine AFL-CIO (August 13, 2021)
d) MDMR (August 13, 2021)
e) Mid-Maine Chamber of Commerce Comments on DEA (August 13, 2021)
f) Kennebec Coalition and Conservation Law Foundation (August 14, 2021)
g) NMFS (August 16, 2021)
h) Brookfield (August 16, 2021)

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
GREATER ATLANTIC REGIONAL FISHERIES OFFICE
55 Great Republic Drive
Gloucester, MA 01930

August 16, 2021

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

RE: Comments on the Draft Environmental Assessment for the Shawmut Hydroelectric Project (FERC No. 2322-069)

Dear Secretary Bose:

We have reviewed the draft environmental assessment (Draft EA) for the Shawmut Project (P-2322), issued July 1, 2021.

The Draft EA identified the FERC staff alternative as the preferred alternative for analysis under NEPA. By definition, the preferred alternative "is the alternative which the agency believes would fulfill its statutory mission and responsibilities, giving consideration to economic, environmental, technical and other factors" 46 Fed. Reg. 18026 (March 23, 1981). The staff alternative does not include several measures that are required by mandatory fishway prescriptions issued by the U.S. Fish and Wildlife Service (USFWS) and NOAA's National Marine Fisheries Service. Therefore, as the staff alternative would not fulfill FERC's statutory responsibilities, we do not see how this can be the preferred alternative. Further, while we recognize FERC's acknowledgment in the draft EA that the prescriptions are mandatory and the terms are reflected in the "Staff Alternative with Mandatory Conditions," the decision to not analyze the effects of that alternative means that the draft EA does not provide a clear description of how the licensee will be required to operate and maintain the project under the terms of a new license and does not present a clear analysis of the effects to our trust resources, including endangered Atlantic salmon because it analyzes an alternative that will not be implemented. As the staff alternative does not include the prescriptive measures, it isn't feasible and its inclusion will only serve to confuse the public and add little value to the decision making process. The staff analysis can put forward an alternative (so long as it is not the preferred alternative) without our prescriptive terms and conditions for comparison; however, it is not clear to us how this approach informs the public and facilitates the decision making process. The preferred alternative must incorporate our prescriptive terms and conditions. For the FERC staff to exclude our mandatory prescription terms and conditions from the preferred alternative is contrary to existing law.

Because the mandatory conditions will be a part of any license issued by FERC, we strongly encourage you to revise the draft EA to analyze the effects of the "Staff Alternative with Mandatory Conditions" as that appears to be the action that FERC is proposing to take and would be consistent with the NEPA definition of "preferred alternative." In the final EA, we recommend FERC appropriately compare alternatives with equal weight and greater consideration for mandatory conditions. We have identified a number of deficiencies and issues with FERC's DEA as detailed in the attachment (Attachment A). These include a failure to adequately consider the combined effects of the continued operation of Shawmut in the context of other dams in the river, dismissal of the recommendation to consider dam removal without adequate analysis of the benefits vs. costs of operation of Shawmut with the mandatory conditions, and insufficient analysis of the effects of the project on Atlantic salmon. If you have questions regarding our comments, please contact Matt Buhyoff (Matt.Buhyoff@noaa.gov).

Sincerely,

Julia E. Crocker

for
Jennifer Anderson,
Assistant Regional Administrator
for Protected Resources

Attachment

cc: Matt Buhyoff, F/GAR 3
Chris Boelke, F/GAR 4
Julianne Rosset, USFWS
Casey Clark, MDMR

National Marine Fisheries Service's Comments on FERC's Draft Environmental Assessment for the Shawmut Hydroelectric Project (FERC No. 2322)

The following provides detailed comments on the draft environmental assessment (Draft EA) for the Shawmut Project (P-2322).

General Comments

NEPA

On August 16, 2017, we recommended that the Commission analyze the impacts of the Shawmut Project by preparing an Environmental Impact Statement (EIS) pursuant to the National Environmental Policy Act (NEPA). Our recommendation was based on sufficient information indicating that the Shawmut Project affects important natural resources, had significant public interest, and that its relicensing constitutes a major federal action significantly affecting the quality of the human environment. It is still our position that this relicensing meets the requirements for preparation of an EIS. Despite the recommendation from us and others, the Commission instead analyzed the environmental effects of this project in an Environmental Assessment (EA). In doing so, the Commission implied that the relicensing of the Shawmut Project is not a major action that significantly affects the quality of the human environment, deprived stakeholders of a required public meeting to discuss its NEPA analysis, and thereby limited the accessibility for the public to provide input on the NEPA document.

On June 1, 2021, Brookfield submitted requests for license amendments at Shawmut, and at each of the three adjacent Brookfield dams on the Kennebec River. The amendment request for Shawmut is described as an "Interim Plan" for the Shawmut Project, which would "continue the protection measures outlined in the expired Interim Plan, plus additional supplemental measures and the terms and conditions contained in the expired Incidental Take Statement and BO, until such time as the Commission issues a decision to relicense the application." The amendment request at the other three projects is to incorporate a Final Plan that "proposes actions the licensees would undertake for the remaining license terms of the Lockwood, Hydro-Kennebec and Weston Projects for the protection of ESA-listed Atlantic salmon, Atlantic sturgeon, and Shortnose sturgeon." The information regarding proposed project operations of all four Brookfield Kennebec River dams contained in the amendment requests are highly interrelated with the Shawmut licensing proposal. Yet, analysis in the DEA largely ignores these proposed actions, other than to establish that "the Commission has no authority to require, through the Shawmut Project license, any passage performance standards or any changes in project operations or facilities that might be needed to meet such standards at the other three projects. Therefore, there is no basis for a license condition for the Shawmut Project that would require Brookfield to meet a cumulative upstream or downstream performance standard for all four lower Kennebec River Projects combined." While we understand and acknowledge that any potential license conditions resulting from this relicensing proceeding will only apply to the Shawmut Project, we note that the DEA's analysis is conspicuously silent on the reasonably foreseeable actions/effects of the adjacent Brookfield dams, as defined in the license amendment requests filed with the Commission on June 1, 2021. As such, we question any conclusions or staff recommendations resulting from isolating the NEPA analysis to only address the effects of the Shawmut relicensing, when Brookfield itself has clearly established in its filings to the Commission that it intends to operate all four of its Kennebec dams, including Shawmut, systematically.

Performance Standards

In several instances you state or imply that our preliminary section 18 prescription specifies performance standards for fishway efficacy. To clarify, our preliminary prescription establishes our expectations for how we will evaluate the degree to which any fishway provides safe, timely, and effective passage of our trust species; the "standards" are intended to be interpreted as likely minimum thresholds for a fishway to be considered as providing safe, timely, and effective passage. As indicated in our preliminary prescription, we anticipate coordinating with the other resource agencies on the development of monitoring plans that will establish more permanent criteria for river herring and American shad. If information suitable to derive those standards are available, we will incorporate them in our modified prescription. We expect to evaluate whether operation of the Project in compliance with the licensee's proposed performance standards and the other proposed measures for Atlantic salmon is likely to jeopardize the continued existence of Atlantic salmon or result in the destruction or adverse modification of their critical habitat in our Biological Opinion. We request that you revise your EA to remove any phrasing or implication that the standards which we reference in our preliminary prescription are final prescriptive measures.

Section 3.3.1., page 39 and page 59

FERC staff indicates that "Brookfield states that it chose its upstream performance standard for salmon because it was directed by NMFS to use performance standards that are comparable to those used for dams on the Penobscot River." We note that "performance standard" is used in this context to mean a standard for upstream or downstream survival and/or delay that the licensee is proposing to achieve through implementation of measures they propose to be included in the project's license.

We also note that this statement from Brookfield is a misinterpretation of the explicit guidance expressed by NMFS staff to Brookfield staff numerous times. Our intention (and Brookfield's) throughout our informal consultation period for this project, as well as coordination on Brookfield's proposed species protection plan (SPP) for its other three Kennebec River dams adjacent to this project, was for Brookfield to develop a plan for improvements to Atlantic salmon passage at these four projects that would minimize the effects of the four dams on Atlantic salmon to the maximum extent practicable and result in a cumulative survival standard (i.e., "end of pipe") (for downstream passage) and passage effectiveness standard (for upstream passage) that was *at least* as high as what was proposed by Black Bear Hydro Partners in their 2012 SPP on the Penobscot River. As there are three mainstem dams on the lower Penobscot versus four on the Kennebec, the per-dam passage efficiency and survival logically needs to be higher on the Kennebec to account for the additional dam. We also emphasized that as spawning habitat is distributed differently on the Kennebec (i.e., almost all spawning habitat is above all four dams on the Kennebec, whereas on the Penobscot, habitat is more evenly distributed between the different dams), that even standards equivalent to those on the Penobscot may be insufficient to ensure that Atlantic salmon are able to survive and recover in the Kennebec River.

Regardless, the difference in cumulative upstream and downstream passage through four dams with a standard of 95% versus 96%, and 96% and 97%, respectively, is approximately 3.5%. These differences can be significant when one is considering effects to a critically endangered species over a 30 to 50 year time horizon. For these reasons, we expect that the difference between Brookfield's proposed standard and Maine Department of Marine Resources' (Maine DMR) recommended standard would be even more significant. In the pending ESA Section 7 consultation we will carry out a thorough analysis of the proposed action, including Brookfield's proposed "performance standards" to determine if the proposed action is likely to jeopardize the continued existence of Atlantic salmon or result in the destruction or adverse modification of designated critical habitat. One outcome of the pending ESA consultation on the effects of continued operation of the Shawmut project on endangered Atlantic salmon may be issuance of an Incidental Take Statement (ITS). That hypothetical ITS would contain an exemption from the ESA section 9 prohibitions on take for a certain amount or extent of take of various life stages of Atlantic salmon incidental to operations of the project. Those "limits" in the ITS have been referred to in some cases as "performance standards." However, we note that this would not be a goal for project operations, but rather the minimal acceptable performance that would be in compliance with any hypothetical ITS. Any incidental take limits set in an ITS should not be confused with NMFS goals or objectives for upstream or downstream fish passage which would always be to get as close to 100% survival and 0% delay as possible.

Section 3.3.1., page 40-41

In several instances in FERC staff's analysis on the importance of the upstream passage standard for salmon, it is implied that the low number of returning salmon to the Kennebec (as compared to the Penobscot) somehow constrains the effect that a higher performance standard would have on survival and recovery of Atlantic salmon. It should be noted that the number of returning salmon to both the Kennebec and the Penobscot is largely influenced by the amount of stocking from the USFWS recovery hatchery program that occurs in each river. Stocking is required, according to the recovery plan, largely because of the effects of dams in freshwater as well as poor marine survival and is essential at this stage of recovery to prevent extinction of the species. We fully expect that stocking in the Kennebec River will increase over the term of any new license. In 2020, Maine DMR stocked 89,000 smolts in the Kennebec River (a five-fold increase in outmigrating smolts when compared to your estimate of 18,420); an effort that is expected to continue for several years. We therefore anticipate that the average annual return of 44 returns could increase significantly during the period of a new license based solely on increased stocking. Arguably, if the Kennebec were being stocked at the same levels as the Penobscot, the difference between a 95%, 96%, and 99% standard on the number of returning adults would be more stark. To illustrate this point, we have adapted your calculation shown in Table 4 to indicate what the difference might be at levels of stocking analogous to the Penobscot (again, returns will be significantly influenced by stocking until the threats to the species (e.g., dams and marine survival) are addressed).

Species	Est Return	Baseline	Brookfield	NMFS minimum	Maine DMR
		79%	95%	96%	99%
Atlantic salmon	846	331	692	721	816

The difference between Maine DMR's standard and the Brookfield standards in Table 4 (pg. 41 of your DEA) is 7 fish, which is more salmon than return to some of our GOM DPS salmon rivers in some years. As demonstrated in the revised table, if the Kennebec saw the same level of returns (again, note that this is largely stocking dependent) as the Penobscot (average return of 846) the *difference* between 95% and 99% (~124 salmon) would be larger than the average annual return to the *entirety* of two of the three recovery units. Therefore, these differences are not minor or insignificant, particularly given the status of this critically endangered species. As indicated, we will fully evaluate the proposed action, including Brookfield's proposed "performance standards" in our Biological Opinion.

On page 41, FERC staff indicate that "...the average return for 2014-2020 represent about two percent of the restoration goal of 2,000 adult salmon. Based on these existing low run sizes compared to the restoration goals, the higher performance standards stipulated by NMFS and recommended by Maine DMR would provide minimal benefits to the Atlantic salmon population at this time." FERC staff's apparent conclusion is that there is no benefit to trying to eliminate or minimize the effects of hydroelectric dams, including Shawmut, given that such dams have already significantly reduced the number of returning adults. Again, this ignores two critical points. First, the number of salmon returning to the Kennebec (and all GOM DPS rivers) will largely be driven by stocking effort until such time as the major threats have been addressed. Second, the primary threat in freshwater (as identified in the 2019 recovery plan) is the effect caused by dams, and hydroelectric dams in particular. Further, the critically small population size and the major impact of dam operations on this population call for ensuring that mortality and delay are minimized to the maximum extent practicable. We urge you to reconsider your approach to this analysis and recommendations in the final EA.

Section 3.3.1., page 39

FERC staff incorrectly states that "This [upstream passage] performance standard was the same standard applied at six hydropower projects on the nearby Penobscot River." We note that only three dams on the Penobscot River currently have upstream passage performance standards for Atlantic salmon (i.e., Milford, West Enfield, Mattaceunk). Further, whether one or more dams on the Penobscot River is operating to meet a particular upstream passage standard is irrelevant to the consideration of upstream survival and delay standards for the Shawmut project, given that each river differs in terms the distribution of suitable spawning and rearing habitat in the watershed and of the number of dams that salmon are forced to encounter to migrate to or from suitable habitat, as described in more detail above in our comments on section 3.3.1, page 39 and page 59.

Section 3.3.1., page 46

FERC staff state that:

"Constructing additional fishways could improve passage effectiveness for any of the target species especially if fish are failing to find the fishway entrances and are being falsely attracted to or are congregating in other areas below the dam (e.g., spillways or powerhouse tailraces). While any of the types of modifications described by NMFS could theoretically improve passage for some of the species, the measures are too general to specifically evaluate their potential benefits at this time. Additionally, under NMFS's prescription and Maine DMR's recommendation, even if Brookfield is meeting performance standards for some species such as the federally listed Atlantic salmon, it might not for others, and therefore, could need to modify the fishways to attempt to improve passage. Any such modifications could affect the effectiveness of the fishways for passing federally listed Atlantic salmon, possibly even reducing passage effectiveness below performance standards in an attempt to improve passage conditions for other non-listed species."

The implication of staff's analysis seems to be that we shouldn't seek to improve passage for other diadromous species, including shad, river herring, and lamprey in the off-chance that doing so would affect the passage of critically endangered salmon. FERC staff do not present any evidence that this hypothetical is a valid concern, nor does it acknowledge that the recovery of co-evolved diadromous species provide important ecological functions and as such, are a physical and biological feature of critical habitat for Atlantic salmon. Atlantic salmon are proficient swimmers that are known to effectively pass numerous types of fishways. We are confident that any fishway designed specifically to pass alewife and shad will also pass Atlantic salmon, and believe that creating additional passage opportunities would only increase the proportion of salmon that pass the project. We anticipate that additional fishways could also reduce migratory delay. Furthermore, any design planning between the resource agencies regarding the construction of a new fishway would necessarily consider the full suite of diadromous fish, including Atlantic salmon. This unfounded assessment should be removed from the final EA.

Section 3.3.1., page 54

We appreciate staff's analysis, as it may provide useful information on the effectiveness (or ineffectiveness) of different rack spacing that we expect we will consider further in our Biological Opinion. We note, however, that although FERC staff acknowledge the behavioral deterrent effect of 1-inch racks, they do not attempt to incorporate it into their analysis and ignore it entirely when recommending 1.5-inch racks. We are aware that 1-inch racks do not physically exclude salmon smolts; studies have been conducted that demonstrate that they may act as a behavioral deterrent. For instance, a recent study in Estonia documented fewer than 25% of acoustically tagged smolts passing through turbines with 1-inch racks, despite 80% of the river flow going through the powerhouse (Kargenberg et al., 2019). In another study, the installation of angled 1-inch racks at a project on the Boguet River in New York fully deterred 100% of radio tagged smolts from entering the project turbines (Nettles and Gloss, 1987). FERC staff did not present any information to indicate that their alternative (1.5-inch racks) would be as effective at deterring juvenile salmon as 1-inch racks. This analysis should be updated to consider behavioral deterrence in the final EA.

Section 3.3.1., page 59

FERC staff state that "...neither NMFS nor Maine DMR demonstrated how the higher survival standards would benefit the downstream migrating Atlantic salmon smolt population."

As we indicated, as part of our section 7 consultation, we will fully analyze the effects of operating the project consistent with Brookfield's proposed passage standards in our Biological Opinion. However, given staff's analysis, it is necessary to emphasize the following points. Atlantic salmon are an ESA-listed species; Section 9 of the Endangered Species Act prohibits the take of ESA listed species. Section 7(a)(2) of the Endangered Species Act requires that federal agencies ensure that any actions they authorize, fund or carry out are not likely to jeopardize the continued existence of any listed species or destroy or adversely modify any designated critical habitat. Furthermore, section 7(a)(1) of the ESA directs federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. The ESA dictates that federal action agencies (such as FERC) should not just minimize project effects, but should proactively seek opportunities to contribute to the recovery of listed species. We see very little evidence in this analysis that FERC staff acknowledges the responsibilities of the Commission under section 7(a)(1). To be clear, while the operation of the project in any configuration is likely to result in the loss of juvenile and adult Atlantic salmon, by ignoring or minimizing our mandatory fishway prescription and Maine DMR's recommendations-- and the associated reduction in impacts to salmon, FERC staff's recommended alternative amounts to the harming, harassing, and killing of significantly more Atlantic salmon on an annual basis for the next 30 to 50 years. Plainly, the most obvious benefit of a higher survival standard is that fewer federally protected salmon would be killed as a result of operations of a federally licensed project. We strongly recommend you reconsider your position on this issue in the final EA.

Ensuring that more Atlantic salmon smolts enter the ocean is the surest method we have for overcoming the significant challenge of high marine mortality. We elaborate on this in the 2019 Recovery Plan and in our recently released 2021-2025 Species in the Spotlight Priority Action Plan (Species in the Spotlight: Priority Actions 2021-2025, Atlantic Salmon)[1]. Marine survival fluctuates considerably, and, given our current understanding, except where it is influenced by the latent effects of dam passage, is very difficult to change. In order to overcome this challenge, we must maximize the quantity and quality of smolts that survive to enter the marine environment. Improving upstream and downstream passage to minimize mortality and delay to the maximum extent practicable should be a high priority for Brookfield and for FERC. As indicated, we look forward to continuing to work with you throughout our anticipated formal consultation under section 7 of the ESA.

Section 3.3.1., Page 59

FERC staff state: "Based on a natural freshwater mortality rate of 0.33% of smolts per kilometer (Stevens et al., 2019), the population potentially surviving below Lockwood Dam using a 96, 97, and 99 percent survival standard would be 13,187 smolts, 13,745 smolts, and 14,914 smolts, respectively. When accounting for estimates of estuarine mortality (1.15% per kilometer) based on Stevens et. al. (2019) and marine survival of smolts (0.4%) based on NMFS (2013), the number of adult salmon returning to Lockwood Dam under a 96, 97, and 99% downstream smolt survival standard would be 24, 25, and 27 adults, respectively. Thus, the incremental gains in survival rates of 1 and 3 percentage points that would accrue through NMFS's prescribed and Maine DMR's recommended performance standards, respectively, would be negligible."

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[1] https://www.fisheries.noaa.gov/resource/document/species-spotlight-priority-actions-2021-2025-atlantic-salmon

Stevens et al. (2019) (cited in staff's analysis) indicates that the latent mortality effects associated with passage at multiple dams significantly affects mortality rates through the estuary. Based on Stich et al. (2015), Stevens et al. (2019) assumed that 87.2% of smolts would survive estuarine migration in an unimpounded system, as compared to 56.2% in a four dam system (like the lower Kennebec), and 34.1% in an eight dam system. Although not explicitly stated, FERC staff have appropriately accounted for latent mortality by calculating the per-kilometer mortality rate for a four dam system from the total 38-km estuary survival estimate presented by Stevens et al. (2019) (i.e., 1.5% per km). However, staff's analysis treats the Brookfield hydro dams as if they are immutable features of the river, rather than temporary features that comprise one of the primary threats to the recovery of a critically endangered species. Using the information from Stevens et al. (2019), we can similarly estimate that estuarine mortality would only be 0.4% per km if the dams weren't present. In other words, the presence of the dams leads to an estuarine mortality rate that is almost four times higher than what we would expect if there weren't any dams in the river. Traditional thinking on salmon recovery would attribute this mortality to poor marine survival that cannot be easily altered; yet the relatively recent work conducted by Stich et al. (2015), Stevens et al. (2019), and others make it apparent that survival in the estuary is actually a latent effect of the species' freshwater experience, and can conceptually be reduced through modifications or removal of the dams whereby there would be a decrease in physiological stress, injury, and migratory delay. This highly significant direct and cumulative effect is glossed over in staff's analysis, and is not addressed in any of the discussions regarding performance standards. The analysis in the final EA should be modified to adequately incorporate the best available information about estuarine survival and the effects of dam passage.

It needs to be emphasized that the downstream performance standards proposed by Brookfield and as discussed by FERC in the DEA, are a measure of direct mortality only; that is, the immediate mortality documented in fish as they pass the project. Other sources of dam-related mortality, particularly in juvenile salmon, are well documented throughout the literature and have been observed at numerous projects in the GOM DPS (Blackwell & Juanes, 1998; Budy et al., 2002; Haeseker et al., 2012; ISAB, 2007; Schaller & Petrosky, 2007; Stich, Kinnison, et al., 2015; Stich, Zydlewski, et al., 2015; Venditti et al., 2000). The total mortality associated with passage through a dammed system can be represented by a conceptual equation: mortality in the impoundment + direct mortality + indirect mortality that occurs in the river + latent mortality in the estuary and marine environment = total dam-related mortality. We will consider these other sources of mortality in detail in our Biological Opinion. Any analysis that only considers direct survival (i.e., the performance or survival standard), although relevant, is an oversimplification, and will significantly underestimate the total mortality associated with the project. For instance, if 10 to 20% of all smolts die due to the combination of dam-related effects in the impoundment, in the river downstream of the dam, and in the estuary, it matters significantly less whether the *direct* survival is 96%, 97%, or 99%. This is not to say that direct passage mortality should be ignored or that a higher standard is not better. However, *only* considering and analyzing direct mortality will lead to erroneous conclusions that underestimate the total effect of the dam.

FERC staff's conclusion that the difference is "negligible" is not supported, ignores additional sources of dam-related mortality, and disregards the species status as critically endangered. FERC has a responsibility under section 7(a)(1) of the ESA to use its authorities to conserve threatened and endangered species; the dismissive treatment of Atlantic salmon in the DEA is wholly contrary to that obligation. The consideration of endangered Atlantic salmon in this analysis unfortunately indicates that little progress has been made to address the inadequacy of regulatory mechanisms related to dams, a primary threat to Atlantic salmon identified in the ESA listing and the 2019 Recovery Plan. It is our view that staff's dismissive analysis and subsequent recommendations as they relate to Atlantic salmon are real impediments to the recovery of the species, as they create and perpetuate uninformed narratives concerning the status and recovery of this iconic Maine fish. We urge you to reconsider these analyses in the final EA.

Section 3.3.1., pg. 60 (similar statement in Section 5.1.3., pg. 122)

FERC staff state:

"Our analysis of downstream passage survival through the various passage routes at the project suggests that the only passage routes that have smolt survival rates that exceed 97% are spill through the forebay Tainter and sluice gates (97.4 % survival), and the spillway log sluice, inflatable bladder spillway sections, and the new fish lift spillway when it is operating (100% survival). Therefore, shutting down some or all units and spilling additional flows through these routes during the April 1 to June 15 smolt passage season could be the only feasible alternative to achieve the higher performance standards prescribed by NMFS or recommended by Maine DMR. There is no information available to predict the survival rates and determine the benefits of the other possible alternative measures identified by NMFS."

We disagree with staff's conclusion. The desktop model that Brookfield developed (pg. 52), which evaluates their proposal to install a 10-foot boom in front of units 7 and 8, concludes that the boom *alone* will increase the average survival to 96.0-96.3% (i.e., only 1% less than the 97% preliminary standard that we included in our prescription as an indication of what may minimally constitute safe, timely, and effective downstream passage). Brookfield's model does not account for the behavioral effect of installing 1-inch (or 1.5-inch) racks in front of all the turbines, prioritizing turbine operation or, if necessary, installing a 20-foot boom in front of unit 7 or 8. In particular, the installation of racks should reduce mortality at the project by at least the 1% needed to meet a 97% standard. Staff acknowledged the potential deterrent effect of the 1-inch racks but did not incorporate it into its analysis. However, as indicated, we expect to evaluate the sufficiency of the performance standards and the proposed measures for Atlantic salmon in our Biological Opinion.

Section 3.3.1., Pg. 72

In its analysis of our recommendation under section 10(j) to stock fish in order get sufficient adults back to the Kennebec River to conduct an upstream passage study, FERC staff state:

"These data suggest that there should be sufficient numbers of returning adult salmon to test the effectiveness of the fishway (using up to 20 adult fish as Brookfield proposes) immediately after it is constructed and put into operation. Therefore, there is no need for Brookfield to stock additional smolts for the purpose of assisting the effectiveness evaluations."

Naturally-reared adult salmon that return to the Kennebec contribute to the survival and recovery of the GOM DPS. These fish are a public resource, having been raised in the USFWS conservation hatchery, and stocked into the Sandy River by Maine DMR. Given the critical importance of naturally reared returning adults to our recovery program, the importance of ensuring these adults safely access spawning habitats, and the dire consequences of passage failure in this system, we would not anticipate naturally reared salmon to be passed at the Lockwood Project until the new fishways have been demonstrated to be adequately effective. For these reasons, FERC's alternative recommendation of utilizing naturally-reared salmon returning to the Kennebec River for purposes of carrying out an upstream passage study is unacceptable. Our 10(j) recommendation supports the USFWS in concluding that it is the responsibility of the licensee to procure all resources necessary to demonstrate effective passage, including, in this case, study fish. This was the intention behind our 10(j) recommendation that Brookfield develop a plan for the stocking of marked smolts upstream of the Shawmut Project. The production of these smolts for study/monitoring purposes should be facilitated and funded by Brookfield, rather than by the taxpayers, and they should not be taken from the limited allocation provided by USFWS' conservation hatchery program.

Section 5.1.2., Pg. 110

FERC staff state:

"To improve attraction to the new fish lift entrance during the upstream anadromous passage season (May 1-October 31), Brookfield proposes to prioritize operation of Units 1 through 6 in the 1912 Powerhouse such that Unit 1 is first on and last off, followed consecutively by Units 2 through 6. NMFS's fishway prescription also requires Brookfield to prioritize operation of the 1912 Powerhouse; however, NMFS characterizes unit prioritization as a "downstream passage measure" and does not specify the time period during the fish passage season when this measure would be required. Therefore, we assume that NMFS's intent is for Brookfield to implement this measure throughout the entire April 1 to December 31 downstream fish passage season."

We concur with your recommendation regarding when this unit prioritization should be implemented. We will clarify this point in our modified prescription.

Section 3.3.3.2, Pg. 118

In regard to the upstream passage standard for Atlantic salmon, FERC staff indicate:

"The incremental gains in passage of 1 to 6 additional Atlantic salmon, on average, per year that could occur under NMFS's prescribed and Maine DMR's recommended performance standards, respectively, would provide minimal benefits to the population as a whole...For these reasons, we do not recommend a license condition requiring a 96% or 99% performance standard for upstream Atlantic salmon passage. We recommend instead that the upstream passage facility be required to achieve a 95% effectiveness for which it was designed."

We reiterate the comments we made on this topic above. We also reemphasize that basing any determination on the number of returning fish, when that number is influenced largely by stocking effort (and will be until the primary threats to the species, including dams, have been addressed), is meaningless. As an example, in 2020, Maine DMR initiated a new multi-year smolt stocking program in the Kennebec River by stocking an additional 89,000 smolts in the Kennebec below Lockwood (USASAC 2021). This constitutes a five-fold increase in the number of smolts leaving the river (as compared to the 18,420 you have estimated in your analysis), which we would expect to lead to a significant increase in the number of returning adults. Therefore, the total returns in your analysis underestimates what we expect to occur at the project in future years. Further, as noted above, the effect of increasing survival of upstream migrating fish increases significantly with an increasingly larger population; the staff analysis using current adult return numbers results significantly undervalues the impact of different survival standards on the population.

As noted above, the term "performance standard" has been used with different meanings in different contexts. We do not consider a licensee's performance standard for Atlantic salmon to be equivalent to intended design performance of the fishway. Fishways are designed to accommodate population targets and pass fish in a safe, timely, and effective manner. In our view, the licensee's proposed performance standard is their established fish passage goal for that species. The standard we have preliminarily identified in our prescription was a preliminary estimate of the minimum criteria we would consider as safe, timely, and effective passage. Despite what a fish lift is *designed* to do, we know that fish lifts *can* pass more than 95% of

Atlantic salmon. On page 41 of your DEA, you indicate that passage at the Milford Dam on the Penobscot River was 95.5% and 100% in 2014 and 2015, respectively, with a pooled passage rate of approximately 99% (71/72=0.986). In that analysis, you imply that Milford and Shawmut are similar projects and that the passage rates should therefore be similar. Therefore, based on your own analysis, it seems reasonable to expect that Brookfield can operate the Shawmut project to pass 96%, or even 99%, of motivated Atlantic salmon.

Section 5.3, Pg. 138

FERC staff did not adopt our recommendation under section 10(j) for a large woody debris management plan that would include provisions for: (1) passing (e.g., sluicing) large woody debris downstream of the project, (2) storing beneficial woody debris and disposing of unused debris, and (3) procedures for transporting stored woody debris to habitat enhancement sites throughout the Kennebec River Basin. Staff instead recommend that Brookfield continue to pass all large woody debris that accumulates at the project downstream of the dam. While we continue to assert that our recommendation would represent a beneficial mitigation of project effects, we acknowledge that, at this time, we do not have any specific information regarding the location of potential restoration sites and their relationship to the project. Therefore, we have no basis to dispute FERC staff's recommendation.

Appendix F, Pg. 188-189

FERC staff include the alternative of decommissioning with dam removal with dam removal in the appendix titled "*Alternatives Considered but Eliminated from Detailed Analysis.*" Staff conclude that because "protection, mitigation, and enhancement measures can be fashioned to support the recovery of diadromous fish in the basin and still provide for the generation of power, decommissioning is not a reasonable alternative to relicensing. As indicated above, we have concerns about staff's analysis that supports its conclusion that protection, mitigation, and enhancement measures can be fashioned to support the recovery of diadromous fish in the lower Kennebec River. We note that staff estimate that licensing the project with staff recommended and mandatory conditions would render the project uneconomical, given that the project's cost to produce power would be over $1.4 million greater annually than the cost of the alternative source of power. In the Final EA, we recommend that staff reexamine its recommendation to relicense the project, particularly with respect to balancing the economic viability of the licensed project with a more robust analysis of the project's direct and cumulative effects on endangered Atlantic salmon and its critical habitat, as well as the effects on other diadromous species-- all ecologically and economically important public resources. We continue to support our recommendation for decommissioning and removal of the Shawmut Project under section 10(a) of the Federal Power Act.

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STATE OF MAINE
DEPARTMENT OF MARINE RESOURCES
21 STATE HOUSE STATION
AUGUSTA, MAINE
04333-0021

JANET T. MILLS
GOVERNOR

PATRICK C. KELIHER
COMMISSIONER

August 13, 2021

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

RE: MDMR Response Draft Environmental Assessment (DEA) for the Shawmut Project

Dear Secretary Bose:

On July 1, 2021, the Federal Energy Regulatory Commission (Commission) filed a *Draft Environmental Assessment* (DEA) for the Shawmut Project (P-2322-069) located on the lower Kennebec River in Maine. Enclosed are the Maine Department of Marine Resources (MDMR) comments on the DEA. MDMR is also requesting a meeting with the Commission to help resolve any issues with the preliminary determination.

The information in the record and provided in our comments demonstrates that the Staff Alternative with Mandatory Conditions will result in significant adverse impacts to endangered Atlantic salmon, alewife, blueback herring, American shad, sea lamprey, and American eel. The Staff Alternative with Mandatory Conditions would preclude the ability to recover ESA listed Atlantic salmon in the entire Distinct Population Segment, even under improved marine survival conditions, and preclude our ability to meet State of Maine resource goals for other species. MDMR does not believe the analysis within the DEA provides "equal consideration" of hydropower development and the protection of, mitigation of damages to, and enhancement of fisheries resources as required by the Federal Power Act. MDMR requests an Environmental Impact Statement and further consideration of our 10(a) and 10(j) recommendations based on these and other relevant comments.

Please contact Gail Wippelhauser at gail.wippelhauser@maine.gov or at 207-904-7962 if you have any questions.

Sincerely,

Meredith Mendelson, Deputy Commissioner

cc: Sean Ledwin, Casey Clark, Paul Christman, DMR
John Perry, Jason Seiders DIFW
Kathy Howatt, DEP
Julianne Rosset, Peter Lamothe, USFWS
Matt Buhyoff, Daniel Tierney, Julie Crocker NOAA

MDMR comments on the DEA

General comments on the Draft Environmental Assessment (DEA)

The lower Kennebec River is an incredibly important watershed for the Maine Department of Marine Resources (MDMR), with significant runs of sea-run fish resources and huge potential for further recovery. For more than 20 years, state and federal agencies, communities, fishing organizations, and environmental groups have been working to restore habitat and passage in the watershed for a wide variety of sea-run fish. The removal of the Edwards Dam in 1999 led to a resurgence of migratory fish numbers and is recognized as a nationally significant fisheries restoration success story (Wippelhauser 2021). In 2018, over 6 million fish returned to the Kennebec and its tributaries to spawn. The State of Maine, federal agencies, NGO partners, FERC, and Licensee currently have an exciting opportunity to build on that success by addressing fish passage issues at several dams, including making significant improvements at the Shawmut Project. Unfortunately, the current Staff Alternative with Mandatory Conditions in this DEA would fall far short of the goals and objectives of MDMR for the Kennebec River. MDMR finds many of the comments and dismissals of agency recommendations disheartening, as we believe the aquatic resources of Maine are of high value to our citizens and should get equal consideration to hydropower development. MDMR hopes our comments in this document help to clarify and add justification to our previous recommendations.

In the Environmental Analysis of several recent relicensing proceedings[1], FERC Staff did not support recommendations made by the resource agencies for effectiveness testing of all new fish passage facilities, in part because of the lack of specific performance standards by which the effectiveness testing could be evaluated. MDMR had recommended river-specific performance standards for Atlantic Salmon and performance standards for American Shad and Sea Lamprey based on data from other river systems. In the interim we have developed river-specific performance standards based on new information for American Shad, Blueback Herring, and Alewife and added justification for standards and operation windows for Sea Lamprey, that are described in our comments and justified in the attached factual background. Further, MDMR provides new information for consideration including results from a second Atlantic Salmon model assessing the rate of population growth under different scenarios; new runs of the MDMR Atlantic Salmon model; specific information on Sea Lamprey passage studies and supporting literature, results from river specific bioenergetics modelling demonstrating significant quantitative impacts of delays on spawner mortality and iteroparity; and a concept for a Nature Like Fishway (NLF) on the west channel that could be developed in concert with the existing proposed lift to potentially meet minimum agency goals for upstream and downstream passage.

In section 6.0 Finding of No Significant Impact (FONSI), FERC Staff stated *"If the Shawmut Project is issued a new license as proposed with the additional staff-recommended measures, the project would continue to operate while providing enhancements to fish and aquatic resources, and protection of recreation, cultural, and historic resources in the project area. Based on our independent analysis, we find that the issuance of a new license for the Shawmut Project, with additional staff-recommended environmental measures, would not constitute a major federal action significantly affecting the quality of the human environment.*" As MDMR demonstrates in its specific comments, FERC staff has used incomplete or outdated information in their analysis

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[1] American Tissue FERC No. 2809-034; Barktheer Mills FERC No. 2808; Ellsworth FERC No. 2727-092.

in some instances, which has led to a minimization of the significant immediate and delayed individual and cumulative impacts on diadromous species by the Shawmut Project. MDMR has used two independent models to demonstrate the significant impact of the Shawmut Project and the three other projects (Weston, Hydro-Kennebec, and Lockwood) that are part of the ESA consultation and cumulative effects for the endangered Atlantic Salmon. MDMR also presents new quantitative information on the severe impacts of passage delays on Atlantic Salmon pre-spawn mortality and iteroparity at the Shawmut Project. We have also demonstrated the impact the Shawmut Project will have on five other species of native diadromous fishes in the Kennebec River.

Because of the FONSI, FERC Staff has determined that a more robust analysis of the project impacts in the form of an Environmental Impact Statement (EIS) is not needed. On the basis of the information and analysis provided in our comments, MDMR strongly urges the Commission to conduct an EIS.

MDMR's comments include the following attachments: 1) a NLF feasibility memo developed by Interfluve; 2) data from a 2020 Lamprey study at Milford; 3) a graph of Atlantic Salmon smolt survival (both test and control fish) between dams in the 2013 Brookfield study; 4) MDMR's factual background that includes new information, primarily model results for developing river specific performance standards for American Shad, Blueback Herring, and Alewife that were not available when MDMR submitted its preliminary terms and conditions; and 5) a summary of results and model inputs from the modified USFWS model. Upon request from FERC Staff, MDMR will provide its original Atlantic Salmon model and a new river-specific model that was modified from the USFWS model developed for Atlantic Salmon in the Penobscot River and included as Appendix D in the NOAA Biological Opinion (Accession 20120831-5201).

Specific comments on the DEA

1. Need For Power (P4)

FERC Staff state the project "*would continue to provide low cost power*" yet in the analysis states that the annual cost to produce power with staff recommendations and mandatory conditions would be $1,424,770 more than that of an alternative source of power. Because this proposal is highly deficient as it relates to protection of ESA listed Atlantic Salmon and other species, we would anticipate these costs will be even higher as further regulatory requirements are added. We would also suggest FERC provide information on the context of this project in respect to overall existing and future energy generation within the NPCC-New England area.

As FERC is aware, electricity is generated from a variety of sources in Maine including coal, petroleum, natural gas, nuclear, hydroelectric, and renewable sources. According to data collected by the U.S. Energy Information Administration, the average electricity generated annually from all these sources from 2001 to 2019 was approximately 4.04 billion megawatt hours (U.S. Energy Information Administration, 2020). Most of the power generated annually during this period was from three sources: coal (41%), natural gas (25%), and nuclear (20%). By comparison, the average annual amount produced by hydroelectric facilities during this period accounted for 6.68% of total generation. The average annual amount produced by renewable sources, defined in the report as non-hydropower sources of renewable power, accounted for 5.04% of total generation. In addition, the annual generation by renewable sources increased by 288% from 2001 to 2019, surpassing annual generation by hydroelectric facilities in 2014. In 2019, 0.27 billion megawatt hours were generated by hydroelectric facilities, whereas 0.45 billion megawatt hours were produced by renewable resources. This same trend has continued in 2020 and 2021 with a record numbers of applications received for development solar sites in the state (SEIA 2021). For example, there has been significant interest in developing distributed generation resources, including 375 MW solar procurement mandated by LD 171149 and about 1,100 MW of executed NEB agreements for Central Maine Power and Versant Power, as of late 2020 (Maine Governors Energy Office, 2021). In Maine there are 132 hydropower dams administered through 97 federal licenses or exemptions authorized by the Federal Energy Regulatory Commission (Maine DEP 2007). The total authorized capacity of all hydropower dams in Maine is 735,331 KW. Of the 132 in Maine, just 12 hydropower dams account for 65% of authorized capacity in the state (FERC 2020). The largest generating dam, Wyman Dam (FERC No. 2329), has an authorized capacity of 83,000 KW or 11.4% of authorized hydroelectric capacity. The sum of authorized capacity of all four dams in the lower Kennebec River is 6.4% of the total hydropower capacity and accounts for 0.43% of annual electricity capacity in Maine. The Shawmut project is 1.19% of the total authorized capacity for hydropower in Maine and less than 0.1% of overall capacity. The number of renewables coming online vastly outpaces any lost generation at the Shawmut project (U.S. Energy Information Administration, 2020) and is projected to further exceed the generation capacity by orders of magnitude of Shawmut in the next 5 years (Maine Governors Energy Office, 2021; SEIA 2021). Sharma and Waldman (2021) demonstrate in a recent paper that replacing the full electricity generation capacity of the lower four Kennebec dams is feasible with solar power using a one-to-one photovoltaic (PV) output comparison, using less area than reservoirs and having a lower environmental impact. If the project is relicensed, the relatively small impacts to generation from environmental measures (e.g. screening, spill) are insignificant to the overall energy picture in Maine or New England.

In addition, FERC Staff should be aware that the Shawmut Project should not be eligible for Low Impact Hydro Institute (LIHI) Certification. When a project achieves LIHI certification, the applicant/dam owner may market the power produced from the facility as coming from a certified Low Impact facility with the expectation they will be able to charge more for electricity generated from the facility. As the Shawmut Project has been recommended for removal by a resource agency it is explicitly ineligible for this certification (LIHI 2020). This project will cost ratepayers more than alternative sources and has a significant environmental impact that is difficult or impossible to mitigate.

2. Alternative considered but eliminated from detailed analysis (P22; Appendix F) Dam removal

FERC staff summarily dismissed the recommendation made by MDMR, NMFS, and the Kennebec Coalition to consider removal of Shawmut Dam to promote the recovery of diadromous fish in the basin. MDMR questions this decision in light of the FERC staff's own economic analysis that determined the project's cost to produce power will be $1,424,770 greater than the cost of an alternative source of power if measures recommended by FERC staff and mandated by federal resource agencies are incorporated into the License. FERC staff provided a number of reasons why the recommendation to consider dam removal was eliminated from detailed analysis. In addition to the considerations of power production, the Commission is required to give equal weight to the protection of, mitigation of damage to, and enhancement of fish and wildlife resources and preservation of other aspects of environmental quality. The imminent extirpation of Atlantic Salmon and preclusion of recovery as defined by the USFWS and NMFS in their recovery plan (2018) and preclusion of the production of millions of fish annually is not given equal weight to power development in this assessment. Based on the recovery criteria for Atlantic Salmon and evidence provided to FERC in comments, the current proposal has a more likely than not probability of precluding recovery of Atlantic Salmon in the entire United States. Given the generation capacity of less than 0.1% of Maine's total capacity and FERC projected costs that exceed alternative sources significantly, it seems prudent to consider the alternative of dam removal further. The loss of production potential of millions of diadromous species and all the associated recreational and commercial opportunities seems to be considered of low importance in this analysis.

FERC staff stated, "*Without a specific decommissioning proposal, any further discussion of the effects of project decommissioning and dam removal would be both premature and speculative*." FERC staff did not define or clarify what would be included in a specific decommissioning proposal. MDMR notes that FERC ordered the decommissioning and removal of Edwards Dam on November 25, 1997 without a specific decommissioning proposal. However, the Licensee considered four decommissioning options in a feasibility study[2]: 1) License surrender and dam removal, 2) Project decommissioning, removal of the powerhouses, and installation of a nature-like fishway (NLF) in forebay canal, 3) Project decommissioning and installation of a NLF at the north end of the dam, and 4) installation of a NLF on the west side of the project forebay. MDMR has contracted with InterFluve to further develop this last option, which is described in a technical memo that is provided as Attachment 1.

In their consideration of dam removal and aquatic resources, FERC staff discussed water velocity and sediment, stating "*Water velocity in the impoundment area would increase and slower water habitats along the edges of the impoundment would disappear as the water recedes into a more defined channe*l." MDMR's response is that that dam removal would return the man-made impoundment to a natural free-flowing river, which would have reduced water velocities along the bank and on the bottom due to frictional forces. Regarding sediment, FERC staff stated *"Removing the dam would release stored sediment to the Kennebec River. There is no information on sediment accumulation or contaminant levels in the project's impoundment. However, the dam has been in place for 109 years, and it is likely that significant quantities of sediment have accumulated within the impoundment. Removing the dam would, at a minimum, cause significant increases in sediment transport, elevated turbidity levels, and sedimentation of aquatic habitat beginning with construction and likely continuing periodically for several years thereafter until the stream channel stabilizes. Once dam removal was complete and most of the accumulated sediment was passed downstream, the decrease in hydraulic residence time through removal of the 12-mile-long impoundment would eventually be expected to improve water quality*

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[2] *Brookfield White Pine Hydro, Llc Energy Enhancements And Lower Kennebec Fish Passage Improvements Study*, filed with FERC on May 20, 2019,

and thermal regimes in the river." First, if there is no information on sediment accumulation, then there is no certainty that removing the dam would release significant quantities of stored sediment. Second, in order to obtain a Maine Waterway Development and Conservation Act (MWDCA) permit to remove a dam, the amount of sediment must be quantified and the presence of contaminants must be assessed, and actions to reduce the impacts of sediment must be taken (e.g. sediment traps, in-water work windows). MDMR has participated in the removal of six hydropower dams in the State of Maine in the past 23 years (Edwards, Smelt Hill, Madison Electric Works, Fort Halifax, Great Works, and Veazie), and in all cases the amount of sediment behind the dam has been minimal (due to the flushing action of the spring freshets). Third, MDMR agrees that the removal would improve water quality and thermal regimes in the river.

FERC staff states that "*Dam removal would also create a free, unobstructed path for fish (including protected Atlantic salmon) to migrate upstream and downstream and utilize riverine habitat within the approximately 12-mile reach of the Kennebec River upstream of Shawmut Dam that is currently impounded. Diadromous fish would no longer be subject to injury or mortality caused by passing the dam, which would improve survival through the affected reach. Access to historical anadromous spawning and rearing habitat in the watershed above Shawmut would still be blocked, however, by Weston, Anson, Abenaki, Williams, and Wyman Dams upstream on the Kennebec River*." MDMR agrees that removal of the Shawmut Dam would create a free, unobstructed migratory path for diadromous species and eliminate the mortality, injury or delay caused by passing the dam, and this is a desirable outcome. We point out that MDMR currently has no plans for restoring Atlantic Salmon and Sea Lamprey above the Williams Project at this time.

In summary, FERC staff notes that MDMR, NMFS, and the Kennebec Coalition support project decommissioning while Sappi and Brookfield are opposed. FERC Staff ends by stating *"Overall, while dam removal would result in better upstream and downstream passage survival for Atlantic salmon, alosines, American eel, and sea lamprey compared to relicensing the project, the upstream and downstream fish passage measures included in the staff alternative with mandatory conditions would nevertheless enhance fish passage over existing conditions. With the recently (2018) constructed upstream fishway at the Hydro-Kennebec Project, and planned new upstream fishways at the Lockwood and Weston Projects, providing upstream fish passage at Shawmut would provide swim-through passage for all species of anadromous fish and allow adult salmon access to an additional 33 miles of mainstem habitat between Lockwood Dam and Abenaki Dam."* MDMR respectfully disagrees that sufficient and appropriate protection, mitigation, and enhancement measures are being applied to this project through the Staff Alternative with Mandatory Conditions. As described in our comments, some aspects of fish restoration and survival will be diminished compared to baseline conditions (e.g. number of salmon spawners entering the Sandy River). FERC Staff seems certain that the proposed upstream and downstream passage measures will provide safe, timely, and effective passage. As MDMRs comments clearly show, this has not been demonstrated for the numbers and species at most other projects in Maine, where poor passage efficiencies and delays have seriously impacted runs of diadromous species. For example, "state of the art" fishways at Milford and Lockwood have provided poor efficiencies and delays for a majority of species, both now likely to be required to build a second fishway (Lockwood) or third fishway (Milford) due to false attraction flows. FERC, as a federal body, under ESA Section 7(a)(1), is required to proactively utilize their authorities to carry out programs for the conservation of endangered species and threatened species listed pursuant to section 4 of this Act. This should include analyzing the proposed action in respect to prospects of recovery (Section 4) of the species as defined in the Atlantic Salmon Recovery Plan (2019), rather than analyzing the actions only as it relates to the existing diminished environmental baseline. Not precluding the ability to reach recovery of the species is the shared obligation of all federal agencies, not just an MDMR goal. Dam removal should be considered in the context of cumulative impacts of the other projects. MDMR believes decommissioning and removal should be further considered in the EIS.

3. Fish Community – migratory fish (p31-34)

The migration periods for the six diadromous species are either incorrect or not included in this section of the DEA. The migration periods in Table 1 have been compiled from biological sampling of river herring collected at the Lockwood and Benton Falls projects, upstream fish passage counts from the Saco, Androscoggin, Kennebec, and Penobscot rivers, commercial harvest data for silver American Eel (downstream migrants), rotary screw trap sampling of smolts in the Sandy River, and migration periods approved by FERC for the American Tissue Project or prescribed for the Mattaceunk Project.

Table 1. Migration periods for diadromous species in the Kennebec River are adopted from the Milford Project in the Penobscot River.

Species	Upstream migration period	Downstream migration period
Atlantic Salmon	May 1- November 10	April 1-June 15 smolts and kelts; October 15-December 31 kelts
Alewife and Blueback Herring	May 1-July 31	June 1-November 30 adults and juveniles
American Shad	May 15-July 31	June 1-July 31 adults; July 15-November 15 juveniles
American Eel	June 1-September 15	August 15-November 15
Sea Lamprey	May 1- June 30	

4. Fish Community – migratory fish – Atlantic Salmon (p31)

The Kennebec River once supported a robust Atlantic Salmon population, and habitat in the Kennebec River is critical to the recovery of the species today. In particular, the Sandy River has the greatest biological value for spawning and rearing habitat in the watershed, but it is currently only accessible to adult Atlantic Salmon through a trap and transport program around the four mainstem dams (NMFS 2009). Dams are also the most significant contributing factor to the loss of Atlantic Salmon habitat connectivity within the range of the DPS (Fay et al. 2006) and have been identified as the greatest impediment to self-sustaining Atlantic Salmon populations in Maine (NRC 2004). In the Kennebec River, there are approximately 251,083 units of historically accessible spawning and rearing habitat for Atlantic Salmon, however hydropower dams reduce or impede access to roughly 222,105 units (88.5%) of that habitat (NMFS 2009). This is a loss of

30% of the historic habitat of Atlantic Salmon within the state of Maine; the only remaining intact population of Atlantic Salmon in the United States.

The DEA states *"According to NMFS's August 28, 2020 filing, designated critical habitat within the Kennebec River contains about 90,000 modeled Atlantic salmon rearing habitat units, of which 63,000 habitat units occur upstream of the Shawmut Dam."* NMFS (2009) states *"The Mainstem Kennebec has the highest biological value to the Merrymeeting Bay SHRU because it provides the central migration conduit for much of the currently occupied habitat found in the Sandy River. The Sandy River has the greatest biological value for spawning and rearing habitat within the occupied range of the Merrymeeting Bay SHRU but is currently only accessible to adult salmon through a trap and truck program around the four lowermost dams."* DMR agrees with NMFS and clarifies that while there is some modeled habitat below the Sandy River, it is inferior to the upper river for spawning, and rearing and is mostly included as a migration corridor.

While it is hard or impossible to measure the true monetary value of a listed species, there are ways to develop costs of impacts for comparison purposes to costs from hydropower development. One way this can be captured is through an existing program, the Atlantic Salmon Restoration and Conservation Program (ASRCP), which was established in 2018. The program is an In-Lieu Fee Program for compensating adverse impacts to Atlantic Salmon within the State of Maine, particularly inadequate passage at road crossings. The ASRCP allows a consistent and defensible mechanism for calculating program credits and debits (fees) based on project impacts to Atlantic Salmon habitat. The scope of impacts includes any adjacent or blocked, spawning or rearing Atlantic Salmon habitat. The fee schedule defines a cost per habitat unit for each of the three bioregions and it was developed by incorporating a series of cost models and quantitative habitat measures (USFWS and TCF 2016). High standards that imply safe and timely volitional passage are required otherwise a separate ESA consultation or payment of a fee is necessary, even if fish passage is still possible at the site. For the Merrymeeting Bay Salmon Habitat Recovery Unit (MMB SHRU), the bioregion that includes the Kennebec River, the cost per habitat unit was $4,850 in 2016 dollars.

The four mainstem dams on the Lower Kennebec constitute the single largest impact on historical habitat in the Kennebec River. Lockwood, Hydro-Kennebec, Shawmut, and Weston and their associated impoundments impact both principle constituent elements defined in the Endangered Species Act listing of the species: migratory corridors and spawning and rearing habitat.

For simplicity, the calculations of habitat value are based on impacted habitat upstream and do not include immediately adjacent habitat impacts. The sum of rearing habitat impacted by the six dams is roughly 93,369 units. The quantity of rearing habitat used for this calculation is based on a modeling approach developed by Wright et al. (2008). The sum of measured spawning habitat impacted by the four dams is roughly 2,145 units. Spawning habitat has been identified by habitat surveys, but the majority of habitat in the watershed has not been surveyed and thus the quantity of spawning habitat used in this calculation represents only a portion of actual spawning habitat in the Kennebec watershed. If the fee schedule developed for the Kennebec River is applied to the total habitat impacted by the six dams, the cost to restore, enhance, create, or preserve in order to mitigate for the lost habitat would be approximately $463.8 million (Table 2) for projects below Williams and over $1 billion for all historic Atlantic Salmon habitat. While this approach is appropriate for estimating the monetary value of the impact to habitat in the Kennebec River, the quantity of habitat that is impacted is so great that it is impossible to replace in-kind. In addition, the estimation of habitat here does not include loss of habitat for other diadromous species or loss of ecological services or function from the absence of diadromous species from historic habitats. Given the severe impacts of the staff recommendation with mandatory conditions alternative, to mitigate for the impacts, if using this program (hypothetical for context), would exceed the value of the Shawmut project by orders of magnitude.

Table 2. Estimates of cost to mitigate for lost value of Atlantic Salmon habitat blocked by dams in the Kennebec River. *Spawning habitat has been identified by habitat surveys, but the majority of habitat in the watershed has not been surveyed and thus the quantity of spawning habitat in this table represents only a portion of actual spawning habitat in the Kennebec watershed.

	Y (Occupied) N (Unoccupied) I (Inaccessible)*	Critical Habitat	Blocked Rearing Habitat Units	Blocked Spawning Habitat Units*
Lockwood	Y	Y	93,369	Not surveyed
Hydro-Kennebec	Y	Y	91,284	Not surveyed
Shawmut	Y	Y	87,800	Not surveyed
Weston	Y	Y	74,617	2,145
Anson	N	N	38,954	Not surveyed
Abenaki	N	N	38,954	Not surveyed
Cost to Mitigate Lost Habitat				$ 463,816,081

5. Fish Community - river herring, American Shad, American Eel, (p32-34)

American Shad collected at the Lockwood fish lift are transported and released into the Hydro-Kennebec and Shawmut impoundments, not into the Sandy River as stated in the DEA.

Diadromous species in the Kennebec River support important commercial and recreational fisheries. Statewide, the Striped Bass fishery supported 3,110 jobs and generated $202-million dollars in revenue in 2016 (Southwick Associates 2019). In 2019, Maine's recreational fishermen landed 92,081 American Shad. The lucrative American Eel (elver) fishery was worth over $20 million dollars in 2018 and 2019. Statewide, the commercial harvest of river herring is a source of income for the municipalities with fishing rights and was valued at $814,240 in 2019 and $586,182 in 2020. Maine's lobster industry, valued at $485.4 million in 2019, became increasingly dependent of river herring as bait since the Atlantic herring stocks plummeted. Sea-run fish are an important part of the riparian and coastal environment, providing forage for eagles, seals, puffins, whales, cod, pollack, and other freshwater and marine species. While we lack river specific estimates, the Kennebec River is focal area for all of these important recreational, commercial, and ecosystem benefits as one of the largest watersheds in Maine with accessibility by large population centers.

6. Fish Community – migratory fish – Sea Lamprey (p33)

The DEA states "According to the 2019 fish passage report for the Kennebec River Projects, 8 Sea Lamprey were collected in the Lockwood fish lift in 2019 (Brookfield, 2020a)." While this statement is true, the data collected from the Lockwood fish lift is biased as data can only be collected during the hours of operation of the fish lift, which is not operated 24 hours a day during the migratory season. Based on this data alone, it is unknown how many lamprey are present or attempt and fail to pass the Lockwood Project each year.

7. Upstream anadromous fish passage – FERC analysis (p 36-38)

The Licensee has proposed to construct permanent upstream fish passage (a single fish lift) at the Shawmut project. Successful fishways must create hydraulic signals strong enough to attract fish to one or multiple entrances in the presence of competing flows (i.e., false attraction). The Shawmut dam is extremely long and has multiple discharge locations that will produce significant false attraction flows during the passage season. MDMR has serious concerns about the design, operation, and location of the fishway and believes the current proposal will result in significant delays and likely poor upstream passage efficiency for multiple species. MDMR also has serious concerns about the cumulative adverse impacts of the Lockwood, Hydro-Kennebec, and Weston projects, which have similar issues.

The DEA states *"Brookfield designed its proposed upstream fishways through an extensive design review process. The final fishway design and location was selected based on: (1) the results of a radio telemetry study using adult alewives to identify areas below the dam where upstream migrating anadromous alewives congregated, (2) a 3-dimensional hydraulic model of the selected area to visually depict future hydraulic conditions and ensure that there were no obvious hydraulic limitations to successful passage, and (3) extensive agency consultation and a design review process to obtain agency input on the fishway design alternatives."*

The DEA also states that *"The results of these efforts led to the development of fishways that were designed consistent with current standards for upstream passage of anadromous fish and are reasonably certain to facilitate fish passage on an annual basis for the numbers of each species specified by NMFS and recommended by Maine DMR".*

Despite claims to the contrary by Brookfield, MDMR has always maintained serious concerns about the fish lift and downstream designs at this complicated site. While efforts were made to provide comments reactively to proposals by Brookfield, many of the best options for passage have been dismissed by Brookfield that would be supported and may be required by the agencies.

As proof that the agencies were not satisfied with the direction of the currently proposed fish plans, the resource agencies all supported a delay in passage to complete the licensee commissioned study, *Energy Enhancements and Lower Kennebec Fish Passage Improvements Study* (Feasibility Study), filed for stakeholder review and comment on May 20, 2019 (FERC Accession #s 20190701-5155 and 20190701-5154). The Feasibility Study considered several fish passage options, including a Nature-Like Fishway (NLF) and dam decommissioning and removal at the Shawmut project. A NLF alternative was included in the Feasibility Study at the request of resource agencies, yet Brookfield failed to move the NLF alternative forward in the consultation process. MDMR worked with Interfluve and determined a NLF is feasible, practical and a reasonable addition, in concert with the proposed fishway, to improve the chances to meet agency goals and ESA requirements for passage efficiency and timing. A memo with conceptual details for the NLF is attached. An NLF has many benefits that would be additive the proposed fishway and would improve both upstream and downstream passage and delays at the site. In addition, the Feasibility Study demonstrated that removal of the Shawmut dam was feasible and reasonably practical. MDMR does not agree that the current fishway design is "*reasonably certain to facilitate fish passage on an annual basis for the numbers of each species specified by NMFS and recommended by MDMR*" as we explain in our comments below.

To inform the location of the proposed fishway, the Licensee conducted a siting study from May 19-June 14, 2016 with radio-tagged alewife to quantify the preferential use of discrete tailwater regions to inform the placement of the proposed fishway and siting of the fishway entrance. MDMR noted in our comments on April 28,2020 that the study occurred during a low flow period, which was not representative of flows during the passage season, and that Alewife are not a good proxy for predicting the attraction of other species to a fishway entrance, as the Lockwood and Brunswick projects demonstrate.

MDMR is very concerned about the effectiveness of the proposed fishway in May, June, and July when the majority of anadromous species are migrating upstream (Table 3). To help inform the fish passage design, CFD modeling was conducted by the licensee at a limited number of flows that were not developed in consultation with the agencies and were not representative of flows during the passage season. The initial modeling was conducted at 2,540 cfs; 4,790 cfs; 10,750 cfs; and 20,270 cfs which represent the 95%, 50% 15%, and 5% exceedance flows. One additional model run that included the location of the proposed fish lift and its attraction water was conducted at 4,790 cfs. The maximum station hydraulic capacity of the Shawmut Project is 6,690 cfs, which is exceeded approximately 65% of the time in May, 35% of the time in June, and 20% of the time in July, the months when 91% of Atlantic Salmon and 100% of American Shad, Blueback herring, Alewife, and Sea lamprey migrate upstream. Water in excess of station capacity is spilled at the sluice gate in the middle of the dam, the hinged flashboards on the west side of the dam, or the rubber crest(s) on the eastern half of the dam. As a result, there will be false attraction to multiple locations at the project during the majority of the upstream migration season. These conditions, with false attraction to multiple locations at the project, were not including in the CFD modeling conducted by the licensee.

Table 3. Percent of migration occurring by month for four species at the Lockwood Project.

Month	Atlantic Salmon	River herring	American Shad	Sea Lamprey
May	8.1%	73.9%	1.5%	56.0%
June	52.4%	26.1%	82.4%	44.0%
July	28.6%		16.0%	
August	3.3%			
Sept	3.3%			
October	4.2%			

While it is hard to predict the exact passage efficiency and passage delays for the proposed fish passage facilities at the Shawmut Project, the results of studies conducted on Atlantic Salmon and American Shad migrating upstream at the Lockwood Project are illustrative. The Lockwood and Shawmut projects are similar in that they are complex, wide sites, that have multiple sources of spill that create false attraction for migrating fish. Two years of telemetry studies using adult Atlantic Salmon were conducted by Brookfield at the Lockwood Project. In 2016, 16 of the 18 test fish (88.9%) which returned to the Project area were recaptured in the fish lift, and the time from return to the project area to recapture was 0.7-111.2 days (mean=17 days). In 2017, 14 of the 20 test fish (70%) were recaptured in the fish lift, and the time from return to the project area to recapture was 3.3-123 days (mean=43.5). As part of a study of energy consumption (Rubenstein 2021 Thesis Defense), adult Atlantic Salmon were captured at the Lockwood fish lift, tagged with thermal radio tags and released downstream of the Project. In 2018, 66.7% of the tagged adults (4 of 6) were recaptured at the fish lift, and the time to recapture was 16-33 days (mean=21.8). The following year, 45.0% of tagged adults (9 of 20) were recaptured, and the time to recapture was 9-30 days (mean=18.7). A 2015 study found that 0% of American Shad captured in the fishway, radio tagged, and returned downstream were recaptured at the fishway.

The Lockwood fishway (fish lift) was designed consistent with standards for upstream passage of anadromous fish in 2004, but the complicated arrangement of the project has undermined the ability of the fishway to effectively attract and pass fish. MDMR would not be surprised to see similar results at the Shawmut Project, where false attraction is likely to occur during the migration season. MDMR believes that having only one non-volitional fishway at the Shawmut Project will result in a large percentage of fish not finding the fishway and/or experiencing substantial delays. Dam removal would address those issue or the completion of an NLF at the site in concert with the existing proposed fishway may address those issues.

Operational period

Brookfield proposed to operate the upstream fishway (fish lift) from May 1 to October 31 during daylight hours, but FERC Staff recommended and NMFS prescribed an operational period of May 1 to November 10 to include the entire upstream migration period for Atlantic Salmon in Maine. MDMR agrees that the fish lift should be operated from May 1 to November 10, but strongly recommends that it be operated 24 hours a day from May 1 through June 30 to accommodate nocturnal migrants such Sea Lamprey (Castro-Santos et al. 2016; MDMR unpublished) and Alewife (Grote et al. 2014) as well as other diurnal migrants.

In addition, the proposed fish lift is not a volitional facility (fish cannot pass upstream at will, but must be in the hopper when the gates close before the hopper is lifted) , and its operation is vulnerable to regular mechanical failures and power outages. The Licensee considered at a conceptual level both a NLF (which is volitional) and a fish lift during the Feasibility Study, but only pursued the fish lift design. MDMR has further explored concepts developed in the Licensees feasibility study and has conceptual designs for a NLF at this site, which are provided as an Appendix. There is potential that adequate fish passage efficiency and timeliness could be achieved at the Shawmut Project if both a nature-like fishway and the proposed fish lift are constructed at the site.

8. Upstream fishway performance standards (p38-44)

FERC Staff analysis states "*Brookfield also states that …it already demonstrated throughout the design review process that the proposed fishway designs would meet a performance standard of 95% for Atlantic salmon.*" MDMR is uncertain how Brookfield made this demonstration. While the fishway designs may meet design standards, any fishway must be tested to ensure that species interact with the fishway as intended, which is heavily dependent on site specific variables (e.g. false attraction, siting of the fishway, etc.) and project operations. Based on the site specific characteristics, it very unlikely this project will meet this low standard.

FREC Staff analysis states "*Brookfield conducted studies to inform the location of the fish lift and designed the facility in accordance with the FWS's Design Criteria Manual and in close consultation with NMFS, Interior, and Maine DMR based on the agencies' direction at the time that Brookfield should plan to achieve a 95% upstream passage effectiveness standard for Atlantic salmon. This performance standard was the same standard applied at six hydropower projects on the nearby Penobscot River*." MDMR never stated at any time that Brookfield should plan to achieve a 95% upstream passage effectiveness standard for Atlantic Salmon nor do we recall that statement being made by USFWS of NMFS. Recent modeling information suggests the 95% standard is insufficient for meeting recovery goals in the Penobscot river.

Atlantic Salmon

While Brookfield provided opportunities to comment on their proposal, the fishway designs and siting were completed by Brookfield and not based on "agencies direction" speaking for MDMR. The resource agencies all recognized that the status quo fishway path was not going to result in successful fish passage and therefore supported a 2 year delay so the *Energy Enhancements and Lower Kennebec Fish Passage Improvements Study* (Feasibility Study) could identify better options, which it did. Unfortunately, Brookfield has not advanced any of the alternatives of the study and finalized the study without further agency input, resulting in an incomplete and misleading analysis. Given the high uncertainty of meeting even proposed standards for Atlantic Salmon and recent development of modeling indicating the need for high survival, MDMR believes the current proposals for upstream fish passage are inadequate. The balance of risks is currently borne by Atlantic Salmon as the proposal does not take into account the high risk of failure of one or more fishways cumulatively in meeting even Brookfield's proposed standards. The proposal and design process was completed with a strong emphasis on reducing costs to Brookfield and was not informed by the quantitative population modeling now available. As this action is related to an endangered species with federal agencies responsible for promoting the species, it is important to note that the ESA is not intended to favor economic interests over potential harm to endangered species (Tennessee Valley Auth. v. Hill, 437 U.S. 153, 184, 1978) ("The plain intent of Congress in enacting this statute was to halt and reverse the trend toward extinction whatever the cost."). Congress has established that endangered species must be prioritized and "courts may not use equity's scales to strike a different balance" (Nat'l Wildlife Fed'n v. Nat'l Marine Fisheries Serv., 422 F.3d 782, 793 (9th Cir. 2005); Cottonwood, 789 F.3d at 1091) ("[T]he equities and public interest factors always tip in favor of the protected species."). The current upstream fish passage plan is reasonably certain to perform in a similar way to Milford or Lockwood or worst, thereby not meeting either the efficiency and/or the timing standards proposed by Brookfield. A proactive approach, such as supporting dam removal or at minimum building a second fishway, is more in the spirit of the ESA balancing of risks than a "wait and test" adaptive framework that has a very low chance of success as defined by the applicants proposed standards or especially as defined by MDMR goals that actually take into account population dynamics and recovery goals. This proactive approach also comports with Federal Power Act (FPA) equal consideration provisions, FPA Section 18 prescriptions authorities, where agencies use best judgement to maintain all life stages of fish impacted by the project and adapt to new information, and authorities under the Fish and Wildlife Coordination Act.

The DEA statement "*Although most of the adult salmon returning to the Penobscot River are of hatchery origin, current returns to the Penobscot River are the highest of all rivers in the State of Maine, averaging 846 adults per year from 2014-2020,35 with a 2020 count of 1,602 salmon (Maine DMR, 2020b*)". This statement could be interpreted as saying the standards on the Penobscot are effective, contribute to the large numbers of returns, and therefore should be adequate for the Kennebec. First, as FERC correctly points out, the vast majority of the returning adults are from smolt stocked hatchery fish. These fish do not count towards recovery goals as they are not "naturally reared". The downstream migrants, which represent the vast majority of those returns, are stocked below the Milford dam to avoid the impacts of downstream passage (ASCOM 2020). In addition, upon capture at Milford as adults, a high percentage of fish are removed from the river for broodstock collection, and therefore only need to navigate the fishway at one dam in order to contribute to future generations (through hatchery propagation and stocking). Natural reared fish, the demographic benchmark for the abundance criteria of the Atlantic Salmon Recovery Plan (2019), return in numbers much lower than required to meet even the downlisting criteria of 500. Resource agencies routinely hesitate to stock fish above Milford as modeling demonstrates large losses due to dam impacts. Therefore this example is not appropriate to demonstrate success of the fish passage standards on the Penobscot. Further, the standards proposed by Brookfield and FERC staff are inconsistent with standards established for Atlantic Salmon in the Penobscot River, which are project-specific and include both an efficiency and a timing component. In addition, the discussion of upstream and downstream performance standards in the DEA includes incorrect, incomplete, or outdated information.

Five hydropower projects on the Penobscot River have project-specific performance standards for Atlantic Salmon that include both an efficiency and a timing component[3]. For a sixth facility, the Medway Project, the Licensee is only required to consult with NMFS once every five years regarding the status of Atlantic Salmon to ensure that operation of the Project is consistent with the listing determinations and the recovery objectives for the species at the time. The site-specific standards for the five projects are:

> The performance standard for upstream fish passage at the **Milford Project** and West Enfield Project requires that **95% of upstream migrating Atlantic Salmon pass the dam within 48 hours** of approaching within 200 meters of the Project when the river temperature is at or below 23°C. The upstream migrants must not exhibit any trauma, loss of equilibrium, or descaling greater than 20% of the body surface. Fish displaying these injuries or signs of trauma will be categorized as not having passed safely and will be considered failures.
>
> The upstream performance standard for the **Mattaceunk Project** is achieved if, based upon an average of three-years, **95%** of pre-spawned adult Atlantic Salmon approaching the project survive upstream passage. When analyzing telemetry test data, **at least 75% of adult test fish pass the project area within 48 hours of approaching the dam; and, 2) the remaining 20% of test fish pass the project within 96 hours.** The project area is defined as 200 meters downstream of the project dam/powerhouse to the upstream fishway exit.

The Licensee did not propose performance standards for Atlantic Salmon in the FLA or in the recent ISPP for the Shawmut Project, but did propose standards in the SPP that was submitted in 2019 (and later rejected by FERC) and in the SPP for the Lockwood, Hydro-Kennebec, and Weston projects submitted in 2021 (Table 4). The 2021 SPP includes project-specific standards for the Shawmut Project based on NMFS preliminary Section 18 prescription and a cumulative standard for the Lockwood, Hydro-Kennebec, and Weston projects,

Table 4. Summary of performance standards proposed by Brookfield for Atlantic Salmon in the Kennebec River.

Source	Downstream efficiency	Downstream timing	Upstream efficiency	Upstream timing
FLA	No standard	No standard	No standard	No standard
SPP (12/31/2019)	Cumulative 84.9%	Cumulative 96 hrs	Cumulative ≥81.4%	No standard
ISPP Shawmut (5-31-2021)	No standard	No standard	No standard	No standard
SPP Lockwood, Hydro-Kennebec, Weston (5-31-2021)	Cumulative ≥88.5%; but Shawmut=97%	Cumulative; but Shawmut goal=24 hour	Cumulative ≥84.9%; but Shawmut=96%	Cumulative; but Shawmut goal=48 hours

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[3] The 96% standard for Milford, West Enfield, Stillwater, and Orono is based on a 75% confidence interval, while the standard for Mattaceunk is based on a point estimate. (Accession 2120831-5201 and Accession 20200804-5132).

MDMR did not support the use of a cumulative standard when they were proposed during consultation with the Licensee in 2018. MDMR did not support the use of a cumulative standard when the Licensee submitted its previous version of the SPP on December 31, 2019. MDMR opposes the use of a cumulative standard now for several reasons. First, the Licensee has provided no justification in the form of supporting documents or calculations for the proposed standards. Second, the Licensee stated in the 2019 SPP and the 2021 SPP that the proposed standards are consistent with the standards established for hydroelectric project dams in the Downeast and Penobscot Bay SHRUs. This statement is false. A cumulative performance standard is not consistent with the precedent set by the National Marine Fisheries Service (NMFS) and the Federal Energy Regulatory Commission (FERC) for the Milford, West Enfield, Mattaceunk, Orono, and Stillwater projects on the Penobscot River. These five projects are owned by the same parent corporation (Brookfield), but each has site-specific performance standards that were required by NMFS in the Biological Opinion and Take Permit and were approved by FERC and incorporated into the licenses. Finally, cumulative performance standards conflict with the current framework for licensing the projects on the Kennebec River. Each project holds a separate FERC license and each project should have a project specific performance standard. Project specific performance standards will ensure that State and federal resource agencies can improve performance at one poorly performing project.

Performance standards should be river-specific, when data is available, and consider the distribution of spawning/rearing habitat relative to barriers. MDMR has argued that the performance standards for Atlantic Salmon in the Kennebec River must be stricter than those in the Penobscot River because of the distribution of spawning/rearing habitat relative to hydropower dams. Nearly 86% of the Atlantic Salmon spawning/rearing habitat in the Penobscot River was above 4-6 dams (Table 5) prior to the execution of the Penobscot River Restoration Project (PRRP), which resulted in the removal of the two lowermost mainstem dams (Veazie and Great Works); decommissioning of the lowermost dam on the Piscataquis River (Howland) and construction of a bypass around the Howland dam. The site-specific performance standards in the Penobscot River were applied after the PRRP was implemented.

Table 5. Habitat distribution in the Penobscot River (PR) before (from Nieland et al, 2013) and after execution of the Penobscot River Restoration Project and current high quality habitat distribution in the Kennebec River (KR).

	PR before	PR after	KR current
0 dams	5.60%	7.5%	
1 dam	3.39%	21.0%	
2 dams	0.30%	19.6%	
3 dams	5.64%	25.3%	
4 dams	32.52%	26.6%	52.5%
5 dams	14.62%		
6 dams	37.92%		47.5%

FERC Staff conducted an analysis of the estimated number of adult Atlantic Salmon that would effectively pass upstream under existing (79% at Lockwood with trap and transport) and proposed passage effectiveness (95% Brookfield, 96% NMFS, and 99% MDMR). FERC Staff began with the average number of adults captured at the Lockwood fish lift from 2014-2020 (average =35, range =11-51) and the average two-year passage efficiency at Lockwood (79%), and determined the average annual return to be 44 adults. Under the 79%, 95%, 96% and 99% performance standards, the number of adults that would pass Weston were calculated to be 35, 36, 37, and 42 fish, respectively.

MDMR disagrees with the use of 79% passage efficiency for the analysis. Based on the following information, the passage efficiency for Atlantic Salmon at Lockwood appears to be no more than 70% and delays in passage are substantial. In 2016, 16 of 20 (88.9%) radio tagged wild adult Atlantic Salmon were recaptured, and the time from return to the project area to recapture was 0.7-111.2 days (mean = 17 days). Results of the 2016 study were confounded by Brookfield's ability to detect when a tagged fish had entered the fish lift[4], which increased the likelihood that Brookfield would successfully capture a tagged fish compared to an untagged fish. MDMR expressed concerns to Brookfield about this practice in writing on January 30, 2017, and the practice was discontinued. In 2017, 14 of 20 (70%) tagged adult Atlantic Salmon were recaptured, and the time to recapture was 3.3-123 days (mean = 43.5). Due to the poor results and the impact on fish in the study, the study was discontinued. As part of a study of energy consumption (Rubenstein 2021 Thesis Defense), adult Atlantic Salmon were captured at the Lockwood fish lift, tagged with thermal radio tags and released downstream of the Project. In 2018, 66.7% of the tagged adults (4 of 6) were recaptured, and the time to recapture was 16-33 days (mean = 21.8). The following year, 45.0% of tagged adults (9 of 20) were recaptured, and the time to recapture was 9-30 days (mean = 18.7).

MDMR reran the FERC Staff analysis using 70% efficiency, which resulted in a significantly different picture (Table 6). MDMR also considered how the results would change when the 88,753 smolts stocked in 2020 or the 100,082 stocked in 2021 return as adults. Using an average smolt to adult ratio of hatchery smolts of 0.0015 (calculated from stocking and returns in the Penobscot River for 2014-2020) we expect 133 adults from the 2020 stocking and 150 adults from the 2021 stocking in addition to the average of 50 adult returns produced from egg planting assuming the 70% efficiency.

Table 6. Estimated number of adult Atlantic Salmon passing upstream of the Weston Project under existing condition and proposed effectiveness scenarios and percent change from existing conditions (compare to DEA Table 4).

Existing conditions (trap and transport)	Baseline 70% at Lockwood	95% at each of four dams	96% at four dams	99% at four dams
183 (133+50)	128	149	155	176
200 (150+50)	140	163	170	192
		11.5% increase	14.9% increase	26.1% increase

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[4] The receiver can be set to emit an audible sound or click when a transmitter is detected.

MDMR conducted an alternative analysis comparing current (baseline) conditions to proposed performance standards that does not require an estimate of passage efficiency at Lockwood (Table 7). MDMR currently transports all Atlantic Salmon caught at the Lockwood Project to the Sandy River. Between 2006 and 2019, MDMR transported 346 adults to the Sandy River with no mortalities or injuries, and transport time for a fish was a maximum of 3 hours. This is the baseline condition. Trap and haul fish passage is not a long term solution, has numerous issues (NMFS 2011), and should not be considered a viable option for the duration of a license. However, it is illustrative to compare the proposed action to the baseline.

Table 7. Estimated cumulative number of adult Atlantic Salmon passing upstream of the Weston project under existing conditions and proposed effectiveness scenarios and percent change from existing conditions for the period 2014-2020.

	Baseline	95% at each of four dams	96% at each of four dams	99% at each dam
Number passed	346	281	293	332
Percent change	0%	18.5%	15.1%	3.9%

Studies conducted in the Penobscot River at the Milford Project, show significant upstream passage delay of Atlantic Salmon similar to those seen at Lockwood. Upstream adult Atlantic Salmon studies were conducted by Black Bear Hydro Partners (BBHP; a subsidiary of Brookfield Renewable Energy Group) in 2014 and 2015 and concurrent studies were conducted by University of Maine (UM) in the same years at the Milford Project. In the 2014 BBHP study, delay times at Milford ranged from 1.9 hours to 36.9 days, but results were confounded by the fish lift being shut down for multiple periods during the study (ATS Species Protection Plan 2014 annual report filed with FERC March 24, 2015). In the 2015 BBHP study, 49 fish were tagged and 47 were included in the delay estimate. In 2015, delay times ranged from 2.5 hours to 35 days, with 17% of tagged fish passing within 48 hours and 46% within 1 week (ATS Species Protection Plan 2015 annual report filed with FERC May 31, 2016). In the 2014 UM study, 22 fish were tagged but only 10 were included in the delay estimate. In 2014, delay times at Milford ranged from 1.2 hours to 76 days, with 50% of tagged fish (n=10) passing within 48 hours and 70% of tagged fish passing within 1 week (Izzo 2016). In 2015, the UM study tagged 49 fish and found delay times ranged from 7.4 hours to 26 days, with 34.7% of tagged fish passing within 48 hours and 63.2% passing within 1 week (Izzo 2016). In 2018, Rubenstein (2021 Thesis Defense) found that the average approach time to Milford Dam was 4.0 days and 23 days spent below the dam before passing. In 2019, the approach time to Milford Dam was 4.0 days while delay time was 11 days. This fish lift is considered “state of the art” yet the false attraction and small entrance areas inherent at these large, complex sites, similar to Shawmut, will result in significant delays.

Recent research by the University of Maine at Orono, in collaboration with MDMR, indicates that Atlantic Salmon delayed below both Lockwood Dam and Milford Dam experience substantially greater temperatures than they would if their migration to cold-water holding areas in the vicinity of spawning habitat was unimpeded. Exposure to these high temperatures, which often exceeded thermal stress levels for the species, is associated with increased metabolic costs, depletion of energy stores, and reductions in spawning success, survival, and rates of repeat spawning (Rubenstein 2021 Thesis Defense). The bioenergetic model developed for this project based on Lennox et al. (2018), field validation of the model, and actual Kennebec and Penobscot Atlantic Salmon lipid readings, temperature, run timing, and passage efficiency data suggests that the expected delays at these fishways are significantly reducing the probability of spawning success and iteroparity. This impact of delay is well established for sea-run species in the literature (Glebe and Leggett 1981; Jonsson et. al. 1997; Bowerman et. al. 2007; Martin et al. 2015; Fenkes et al. 2016).

This new information shows that reasonable estimates of delay at four dams based on similar fish lifts at Lockwood and Milford, which MDMR would expect would be similar to the Shawmut project, results in an increase in the number of fish that would run out of energy before spawning, presumably to die unless they abandoned their migration (Rubenstein 2021 Thesis Defense). The model estimated the resulting pre-spawn mortality based on Kennebec specific temperatures was 6.8% for zero dams, 10.7% for one dam, 18.1% for two dams, 26.9% for three dams, and 45.5% for four dams. That translates to a 38.7% increase in pre-spawn mortality for fish traveling up to the Sandy River compared to a no dam scenario, a previously unquantified estimate. This effectively means more than one out of three returning adults would die prior to spawning because of delays caused by the dams. In addition, this research shows that reasonable estimates of delay at four dams result in a 65% decrease in the number of fish that would have the energy to recondition after spawning, which allows fish to return to spawn again in subsequent years, between the zero dam scenario and the four dam scenario. The ability to spawn multiple times is foundational to Atlantic Salmon populations across their range (Fleming 1996; Lawrence et al. 2016; Bordeleau et al. 2020). This estimate does not take into account downstream passage efficiency at hydro projects, which is an additive source of mortality. That added mortality of downstream passage was predicted by NOAA to be 49%-58% in their August 28, 2020 preliminary prescription for the Shawmut project. Combined impacts of upstream delays and poor downstream survival essential eliminate this important life history characteristic, further diminishing the chances of recovery with four dams between spawning grounds in the Sandy River (Lawrence et al. 2016).

MDMR reran its Atlantic Salmon model using only smolt production in the Sandy River (0-4 dams; 97% downstream passage efficiency; marine survival of 0.0108; and either 96% upstream passage efficiency survival) at each dam or the estimated pre-spawn survivals resulting from passage delays (Rubenstein 2021 Thesis Defense). With all dams in place, the estimated mortality due to delays reduces the number of adult returns by 36% compared to Brookfield’s proposal of 96% at each dam (Table 8). This new information should compel further consideration of dam removal and most certainly the incorporation of a second upstream fishway into the planning process.

Table 8. Comparison of modeled adult Atlantic Salmon returns under Brookfield proposed passage efficiencies (i.e. survival) and with the pre-spawn survival as estimated by Rubenstein (2021). Smolt production is either: Low (1 smolt/100m2) or High (3/100m2).

Scenario	4 dams Low	4 dams High	3 dam Low	3 dam High	2 dams Low	2 dams High	0 dams Low	0 dams High
BREG 96/97 passage	87	262	105	316	125	376	189	918
Pre-Spawn Survival & 96/97	56	168	87	261	11	334	183	891
Decrease (%)	36	36	17	17	11	11	3	3

Dams are thus associated with and causal to increased mortality of post-spawn Atlantic Salmon, as reflected in the rates of repeat spawning in dammed rivers: repeat spawning rates in the Penobscot River (Maine, c.1%) and the St. Johns River (New Brunswick, 1.2%) are much less than in undammed systems (Maynard et al. 2018, Bordeleau et al. 2020). Because most repeat spawning Atlantic Salmon are female (Fleming 1996, Bordeleau et al. 2020), the loss of repeat spawning related to impacts of delays at dams translates into a direct reduction of potential egg production for the river system. Repeat spawners are larger and produce more eggs than maiden spawners; for example, in the Trinité River (Quebec) and Mirimichi River (New Brunswick), repeat spawners were estimated to produce nearly 2000 more eggs then maiden two sea-winter females. Further, repeat spawners can buffer populations against years with high mortality of post-smolts at sea, as repeat spawners represented a greater proportion of the total Atlantic Salmon run in years when returns of maiden spawners were low (Bordeleau et al. 2020). Consequently, these older, larger, repeat spawning females are critical for population resilience (Hixon et al. 2014; Bordeleau et al. 2020) and reducing the persistent, fixed source of mortality for post-spawn Atlantic Salmon associated with delays at dams is imperative for population recovery. Given that delays at Milford and Lockwood dams both significantly exceed the proposed averaged 48-hour passage standard for upstream migrating adults, MDMR considers it highly likely that passage delays at Shawmut will also be long enough to produce biologically significant decreases in survival and the probability of repeat spawning. This new information demonstrates that the cumulative effects of these delays would certainly preclude the ability to recovery Atlantic Salmon in the United States. Based on passage effectiveness at similar projects, this should be compelling information to further consider dam removal and at minimum proactively develop a second fishway to the headpond at the site where major false attraction will occur on the west side of the project. Lawrence et al (2016) found kelt survival is key to population persistence. This impact is greater under the Staff Alternative with Mandatory Conditions than the current environmental baseline.

Alosines-river herring

FERC Staff conducted an analysis to understand the effects of existing and proposed fish passage alternatives on the upstream migrating alosine population by estimating the number of river herring that could potentially reach habitat above the Shawmut Project under existing trap and transport operations, and under the performance standards recommended by MDMR and prescribed by NMFS for volitional passage. FERC Staff began with the number of adult river herring captured at the Lockwood fish lift from 2014-2020 (average =201,349) and the average passage efficiency at Pejepscot Project (19.8%), and estimated the average annual return to be 1,016,914 fish. Under a 70% performance standard, more fish would pass upstream of the Shawmut Project at a 70% passage efficiency at the Lockwood, H-K, and Shawmut Dams than existing trap and transport (348,802 versus 201,349).

FERC Staff provided no rationale for using the passage efficiency measured at the Pejepscot Project. MDMR conducted an alternative analysis (Table 9) using the results of a study conducted in the same year at the Milford Project because the Milford and Lockwood are newer (constructed in 2013 and 2005, respectively) than the Pejepscot fishlift (constructed in 1987), and were designed using the best available information at the time. Milford and Lockwood are also the first dams on the river. Using the passage efficiency of 65% for Alewife at Milford, the estimated number of river herring below Lockwood changes from 1,016,914 to 309,349 fish, and the number passing Shawmut at 70% efficiency declines from 348,802 to 106,250. MDMR stocked a total of 182,381 river herring into the Shawmut headpond in 2018. The 70% scenario does not improve on existing conditions for the Shawmut project. Trap and haul fish passage is not a long term solution, has numerous issues (NMFS 2011), and should not be considered a viable option for the duration of a license. However, it is illustrative to compare the proposed action to the baseline.

Table 9. Estimated number of river herring effectively passing upstream of the Weston Project under two estimates of passage effectiveness at Lockwood and upstream performance standards proposed by NMFS and MDMR (compare to DEA Table 5).

Estimated upstream passage effectiveness at Lockwood	Returns to Lockwood	Existing conditions (MDMR trap and transport)	NMFS 70% performance standards	MDMR 90% performance standard
FERC using Pejepscot=19.8%	1,016,914	201,349	348,802	741,330
MDMR using Milford = 65%	303,349	201,349	106,250	225,821

FERC Staff opines that American Shad are a difficult species to pass, points to the low number of fish passed at the Lockwood, Brunswick, and Pejepscot projects, and suggest that achievement of performance standards might not be realistically achievable due lack of motivation to continue to migrate upstream due to stress related to the study, energetic demand from migrating long distances upstream and passing multiple dams during the migration, or other poorly understood factors. While MDMR appreciates FERC highlighting that poor upstream passage is impacting American Shad in Maine, the implication that upstream fishways will never effectively pass the species is not supported by the literature. Haro and Castro-Santos (2012) described the failure of fishways designed to pass American Shad. They found that few designs had incorporated knowledge of the swimming, schooling, and migratory behaviors of American Shad; technical fishways designed for adult salmonids on the Columbia River have never been rigorously evaluated for American Shad; similar but smaller fishway designs on the East Coast frequently had poor performance; and effective downstream passage for juvenile and postspawning adult American Shad has been given little consideration in most passage projects.

9. Upstream fishway effectiveness testing (P45-46)

FERC staff analysis states "*Testing the upstream passage effectiveness for American shad, alewife, blueback herring, and sea lamprey for three consecutive years would document the levels at which the fishways are passing all four of these species. However, Maine DMR does not recommend any performance standards for two of its target species (alewife, blueback herring); therefore, without specific performance standards to evaluate, there is no information to analyze and no information to determine whether effectiveness testing would or would not provide benefits to alewife and blueback herring*."

MDMR filed its response to the Ready for Environmental Analysis and terms and conditions for the Shawmut Project with FERC on August 28, 2020. In the interval, MDMR has obtained new information that has resulted in the development of performance standards for Alewife and Blueback Herring and a modification of our performance standards for American Shad. Specifically, an Alewife Populations model that can be used to assess the general impact of dams passage efficiency on population abundance became available online, and Kennebec River specific models for American Shad and Blueback Herring have been developed by Dr. Daniel Stich. These models are described in detail in the attached Factual Background. On the basis of these models. MDMR has determined that at least 90% of adult Alewife and Blueback Herring need to pass upstream at each of the dams within 72 hours and at least 70% of American Shad need to pass upstream within 72 hours if at least 95% of all adult and juvenile alosines pass downstream at each dam with 24 hours. .

The aquatic habitat in the Kennebec River from the Lockwood Project to and including the Weston Project has been designated as Critical Habitat for Atlantic Salmon under the Endangered Species Act (ESA). Atlantic Salmon primarily use this habitat as migration corridor. The final rule designating critical habitat for the GOM DPS identified the primary constituent elements (PCEs) essential for the conservation of Atlantic Salmon (74 FR 29300; June 19, 2009). The PCEs for migration habitat include "*Freshwater and estuary migration sites with abundant, diverse native fish communities to serve as a protective buffer against predation*.

The prey buffering concept has been demonstrated quantitatively on the Penobscot River, where increasing river herring returns were strongly related to declining seal-induced injury rates (Leach 2020). The current proposal significantly reduces native fish community potential throughout the freshwater and estuary migration sites of Atlantic Salmon. Abundant, diverse diadromous species are required for avoiding adverse modification to critical habitat and may provide one of the only mechanisms to reduce predation exacerbated by the Shawmut impoundment. Habitat degradation and ecological impacts caused by these dams, such as increased predators in impoundments and reduced diverse native fish communities due to habitat degradation, should be fully considered under 10(j) and can be represented as MDMR's performance standards for those species. The Atlantic Salmon Recovery Plan (2019) states "*The dramatic decline in diadromous species has negative impacts on Atlantic Salmon populations,* *including through depletion of an alternative food source for predators of Salmon, reductions in food available for juvenile and adult Atlantic Salmon, nutrient cycling, and habitat conditioning*". The consideration of minimization measures for those species, such as providing passage at night for Sea Lamprey and meeting abundance targets to river herring, is of critical importance.

10. Upstream anadromous fishway operating schedule (p46-48)

MDMR concurs with the upstream passage operating schedule of May 1 to November 10. However, based on data from the Milford project on the Penobscot River, the fish lift should be operated at night from May 1- June 30 in order to pass Sea Lamprey. FERC's assessment that there is "no evidence" to support operating the fishway at night is not correct. The Lockwood fish lift is not operated at night and thus no lamprey passage information is collected at the only fishway on the Kennebec currently during the predominate migration window. As no data has been collected on the Kennebec River nor at the Shawmut Project, the best available science is from other river systems where it is well understood that lamprey predominately move at night. These studies also demonstrate that lamprey are motivated to move upstream rather than spawn downstream. This was recently demonstrated on the Penobscot River as well as other rivers in the northeast. The dismissal of information that is not specific to the Kennebec is wholly inconsistent FERC policy and precedent.

On the Connecticut River, Castro-Santos et al. (2016) reported that 64% of entries into fish passage structures occurred at night (i.e., between sunset and sunrise); in fact, entry rates were as much as 24.4 times greater at night. In a study on the River Mondego, (Portugal), Pereira et al. (2016) found that most detections of Sea Lamprey in a vertical-slot fish pass occurred at night, i.e., between dusk and dawn (88% in 2014 and 75% in 2015). Data from fish passage facilities in Connecticut indicate that in the early part of the upstream migration period, lamprey enter fish passes exclusively at night. As the run progresses, however, lamprey may enter at any time (Steve Gephard, CTDEEP Fisheries, pers. Comm. Old Lyme, CT). At the Westfield River fish passage facility in Massachusetts, nearly all lamprey pass at night (Caleb Slater, Massachusetts Division of Fisheries and Wildlife. Pers. Comm. Westborough, MA). In 2020, lamprey passage occurred primary in the evening and early morning hours at the Milford fish lift (31/45 fish or 68.8%), with many of those occurring in the early morning (e.g. 1am EST) (Figure 1; MDMR, unpublished data). In 2021, DMR, USGS, and University of Maine found a similar pattern when tracking movement of 100 tagged fish in the Penobscot River, with data currently going through QA/QC. Given the strong propensity for lamprey to exhibit nocturnal movement patterns and demonstrated motivation to utilize upstream habitat, fishways should be operated at night to allow for lamprey passage. As FERC notes, lampreys do not necessarily hone to their natal streams and therefore we would expect lamprey to behave in a similar way in the Kennebec as we would in the Penobscot or Connecticut where nocturnal fish passage information is documented.

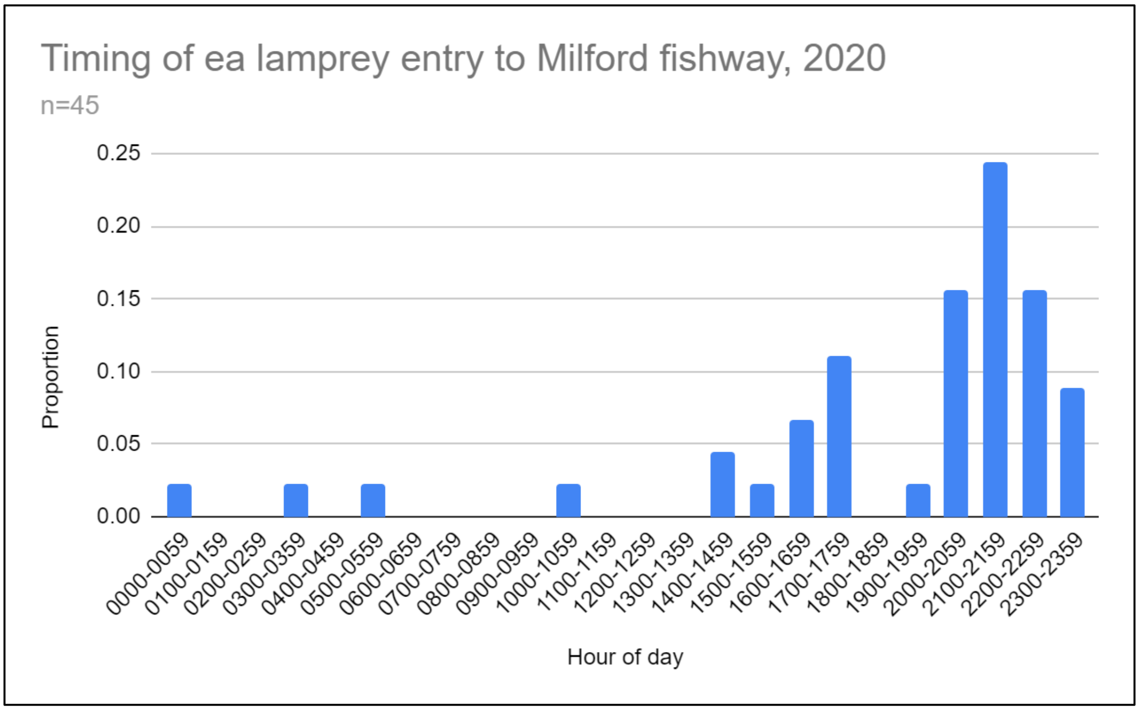

Figure 1. Sea Lamprey timing data from a 2020 Penobscot River tagging study, time of entry to the Milford fish lift.

Studies in the Penobscot (Attachment 2) demonstrate that lamprey are very well suited for upstream migration studies, where 100% of the tagged fish returned to the dam and 82% passed Milford. This year (2021) 100 lamprey were tagged with a preliminary estimate of 72% upstream efficiency and noted predominate nocturnal movement (QA/QC in progress). The 80% performance standard has been achieved at Milford so this request is reasonable. MDMR would anticipate a more than 80 times increase in lamprey reaching above the Weston project with nighttime operations (Table 10).

Table 10. Theoretical difference in Sea Lamprey returns using assumptions of 1) Milford returns with expansion for efficiency of 7,000 starting population, the 80% standard for upstream passage per project (Nighttime), and a 26.4% efficiency of passage (80% efficiency times 33% entry during daylight hours) with No Nighttime passage based on Penobscot and Connecticut entry timing. Results show a more than 80 times reduction in the number of lampreys above the Weston project using these assumptions.

	Motivated LP	Lockwood	Hydro-Kennebec	Shawmut	Weston
Nighttime	7000	5600	4480	3584	2867
No Nighttime	7000	1848	488	129	34

11. Downstream anadromous fish passage (p48-56)

The description of downstream passage measures proposed by the Licensee should include the extension of the Taintor gate spillway into the tailrace of the 1982 powerhouse.

The Licensee proposes to utilize three gates in the forebay area (Sluice Gate, Tainter Gate, and Deep Gate) to pass fish downstream. The licensee also proposes to install a guidance boom (discussed below) to guide fish away from Units 7 and 8 and towards the forebay gates that serve as downstream bypasses. Brookfield does not propose specific low flow thresholds for the Shawmut Project (as it does in the draft SPP for the Lockwood, Hydro-Kennebec, and Weston projects) that would require generation curtailment to provide for additional spill for protection of downstream migrating Atlantic Salmon smolts. The proposal also fails to provide adequate protection for other species during their period of downstream passage. The proposed downstream operational facilities are inadequate to safely and effectively pass Atlantic Salmon and all species downstream.

Surface Guidance Boom

The Licensee proposed to construct a fish guidance boom system that is intended to preclude downstream migrating fish from entrainment in Units 7 and 8. MDMR does not support the Licensee's proposal to use surface guidance booms at the Shawmut Project and finds them to be inadequate to protect the GOM DPS population of Atlantic Salmon and the other diadromous species in the Kennebec River. Data provided by the Licensee (SPP, Table 5-1) demonstrates that the guidance booms used at the Lockwood, Hydro-Kennebec, and Weston Projects do not guide 14.3-30.6% of the migrating smolts away from the turbines. Data provided by the Licensee (FLA, Table 4-22) shows that 32.7% of the downstream migrating smolts were entrained into the turbines at the Shawmut Project. The instantaneous survival was 7% lower when fish went through the turbines compared to spill routes at Shawmut and that grossly underestimates the sublethal effects, including injury and disorientation, that would result in higher mortality in the estuary. Studies at the Ellsworth dam on the Union river assessing injury to Atlantic Salmon showed that 22-30% of fish that went through the turbines had injuries compared to 3.8% that went through spill routes, demonstrating that impact quantitatively (Accession # 20171229-5079). The 2015 *Evaluation of Downstream Passage for Adult and Juvenile River Herring* [5]demonstrated that 53 percent of the study fish went through the Lockwood turbines, rather than being guided by the boom to the downstream bypass, and survival was lowest for those fish passing Lockwood via the units (i.e., 77-4-81.7% survival). This would indicate that performance standards would not likely be met for these species with the proposed plan.

In addition, MDMR has consulted with the USFWS regarding floating guidance booms and concurs with their comments that are provided below.
"The Service does not know of any studies that have assessed how effective floating guidance booms are at protecting eels as they attempt to migrate downstream past a hydroelectric project. However, we do know that eels are a bottom-oriented species (Brown et al. 2009) and therefore a floating guidance boom with partial depth panels would not be fully protective. As stated in

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[5] Accession No. 20160331-5144

our 2019 Fish Passage Engineering Design Criteria manual, "A floating guidance system for downstream fish passage is constructed as a series of partial depth panels or screens anchored across a river channel, reservoir, or power canal. These structures are designed for pelagic fish which commonly approach the guidance system near the upper levels of the water column. While full-depth guidance systems are strongly preferred, partial-depth guidance systems may be acceptable at some sites (e.g., for protection of salmonids, but not eels)." Booms have not been implemented as a protective measure for eels or alosines anywhere else in our region, which spans fourteen states, unless they are installed with other protective measures that are suitable to ensure the safe, timely, and effective downstream passage of our trust species (e.g., inclined bar screens, angled bar racks, etc.). Therefore, the Service recommends that any protective measure implemented at the mainstem Kennebec River hydroelectric projects, as part of the current SPP process, are protective of all migratory species and that the proposed mitigation measures comport with the Service's fish passage guidelines."

Atlantic Salmon smolt survival

Radio telemetry studies conducted at the Weston, Shawmut, Hydro-Kennebec, and Lockwood projects resulted in baseline survival of downstream migrating Atlantic Salmon smolts ranging from 89.5–100%, but only 66-94.5% of smolts successfully passed the projects within 24 hours (Table 11). The Shawmut project averaged 93% survival (86.2% within 24 hours). This analysis only measured survival from just above to just below the projects and fails to take into account the impact of the latent mortality and other mortality associated with the cumulative effects of passing multiple projects (Attachment 3). For example, smolts that were released at Weston and detected at Lockwood had much lower survival, with a four-year average of 56%, and that does not include the impacts of the Weston impoundment as fish were released just upstream of the dam.

Table 11. Results of downstream passage effectiveness testing for Atlantic Salmon smolts in the Kennebec River for the years 2013-2015. Baseline survival was estimated for all fish that passed the project. Adjusted survival was estimated only for fish that successfully passed downstream within 24 hours.

		Baseline survival			Adjusted survival		
Project	Year	S1	S2	S1/S2	S1	S2	S1/S2
Weston	2013	0.910	0.950	0.957			
Weston	2014	0.880	0.983	0.895	0.850	0.983	0.864
Weston	2015	0.898	0.900	0.997	0.561	0.850	0.660
Shawmut	2013	0.930	0.970	0.963			
Shawmut	2014	0.920	0.983	0.936	0.870	0.983	0.885
Shawmut	2015	0.860	0.949	0.906	0.796	0.949	0.838
Hydro-Kennebec	2013	0.940	1.000	0.941			
Hydro-Kennebec	2014	0.970	0.990	0.980	0.891	0.990	0.900
Lockwood	2013	0.950	0.950	1.000			
Lockwood	2014	0.960	0.983	0.977	0.931	0.983	0.946
Lockwood	2015	0.931	0.950	0.980	0.834	0.950	0.888

To assess the true impacts of the projects, it is important to account for survival with dam dependency. The NOAA Science Center modeled smolt survival with dam dependency (Stevens et al. 2019) using 40 years of data on the Penobscot River, with estimates of estuarine mortality for fish that passed 4 dams at 1.15% per kilometer versus 0.34% with no downstream dams (natural mortality baseline). MDMR developed a deterministic Atlantic Salmon model utilizing this data and other data in the watershed and modeled smolt survival with four dams under a number of scenarios. Using the passage scenario of 96% upstream and downstream passage per project, these projects would result in a 45% reduction in smolt survival to sea compared to smolt survival without the projects. Using the updated 97% survival per project proposed in the SPP (12% direct mortality across four projects) and NOAAs estimate from a dam impact model (Nieland and Sheehan 2020) of 6% mortality per dam baseline (24% indirect mortality across four projects), would result in 36% mortality of smolts from project effects alone. In NOAAs August 28, 2020 preliminary Section 18 prescription, their analysis estimated about 40% loss of smolts due to project impacts. The loss of between 36-45% of smolts from dam impacts in addition to baseline mortality on an Atlantic Salmon run that is currently below replacement is not supportive of recovery, even under the most favorable marine survival and freshwater production scenarios. It is unlikely that the Licensee could even achieve the 97% downstream standard based on their proposal as many fish would still be entrained in turbines without shutdowns or full screening. Thus, representations of "Whole Station Survival" vastly understate the current take of these projects as they measure only a small window of impacts that do not account for large impacts of impoundments and latent impacts to fish that pass dams (e.g. delayed mortality in estuary rather than directly after passing project). In addition, in their Augusta 28, 2020 preliminary prescription for the Shawmut project, NOAA predicted that the overall survival of kelts through the four projects cumulatively would be 42% to 51%, an incredibly low number of fish that would preclude the important life history trait of repeat spawning. Lawrence et al. (2016) found that *"As the number of dams increases from one to four, the probability of negative population growth increases four-fold. Kelt survival rate, number of dams, and smolt dam passage survival were all found to be significant factors in predicting population persistence. The present study suggests two primary conclusions: (i) dams are likely to have a negative influence on Atlantic salmon; and (ii) kelts have considerable and positive influence on population viability."* The losses of smolts and kelts along with other impacts from Staff Recommendations with Mandatory Conditions make recovery of ESA salmon nearly impossible.

Trash racks

Brookfield did not propose any changes to the existing 3.5-inch rack trash racks at the 1942 powerhouse and 1.5-inch racks at the 1912 powerhouse. FERC Staff recommended replacing the 3.5-inch racks with 1.5-inch racks. NMFS' preliminary prescription requires the installation of 1-inch racks at both powerhouses if the approach velocities are sufficiently low to prevent entrainment.

FERC Staff analysis (Table 8) shows that 1-inch racks would not physically exclude juvenile alosines or juvenile Sea Lamprey in addition to Atlantic Salmon smolts,. Assuming that the distribution of juvenile alosines through the various passage routes follows a 1:1 ratio proportional to the distribution of flow through the various passage routes, we conclude that from July 1- September 15 most of the juvenile alosines will be passing through the turbines, because the only spill provided during this period is 35 cfs released through the surface sluice gate. FERC Staff has estimated mean turbine passage survival for juvenile alosines through unit 7-8 to be 95.4% and through units 1-6 to be 93.9% (DEA, Table 7). Thus, passage via units 7-8 would just meet MDMR's performance standard of 95% survival and passage via units 1-6 would not meet performance standards. MDMR recommends that a minimum of 5% of station flows be passed through the surface sluice from July 1-September 15 to improve survival for juvenile alosines. This recommendation is supported by the USFWS fishway criteria. MDMR is concerned about latent mortality of any these species entering any turbine and more work is needed to ascertain this impact.

FERC Staff analysis (Table 8) also shows that 1-inch racks would not physically exclude adult Alewife < 11.6 inches and adult Blueback Herring < 11.4 inches. A similar analysis conducted in the Lower Barker Project EA (FERC No. 2808) found that 1-inch racks would not physically exclude adult American Eel < 26.7 inches. FERC Staff did not conduct a blade strike analysis for adults of these three species as it did for juvenile alosines. In addition, NMFS' preliminary prescription for 1-inch racks is contingent on the final (calculated) approach velocity, resulting in uncertainty about what size racks will ultimately be installed. Therefore, we request that FERC Staff complete a blade strike analysis in the EA for adult Alewife, Blueback Herring, American Shad, Atlantic Salmon, and American Eel at 3.5, 1.5, and 1.0-inch spacing in order to gain a complete understanding of the current and future impacts of the Shawmut Project. The analysis is especially important because passage effectiveness studies have not been conducted for these species/life stage with the exception of American Eel.

The dedicated spill flows that Brookfield has proposed to continue to provide for downstream passage (Table 12) are not adequate to provide safe, timely, and effective passage for adult and juvenile alosines. Alewife, Blueback Herring, and American Shad collectively spawn between May 1 and July 31 in the Kennebec River, and the adults migrate downstream soon after spawning. Juvenile Alewife, Blueback Herring, and American Shad emigrate from the Kennebec River over an extended period (June 28-October 25; MDMR beach seine data); however, migrations likely extend beyond these sampling dates. From June 15 through November 1, the only dedicated surface spill for downstream passage is a maximum of 35 cfs through the sluice gate, which is 0.52% of station capacity and is 0.43-0.81% of average flow at the Shawmut dam between June and September. The USFWS recommends a minimum of 5% of station flow for downstream passage attraction.

Table 12. Dates, amount of spill, and location of spill proposed by Brookfield (with one date change proposed by FERC Staff) at the Shawmut Project.

Dates	Spill cfs	Location
April 1 - December 31	≤ 35	Surface sluice gate
April 1 - June 15	600	Taintor gate
November 1 - December 31	385/35)	Taintor gate/surface sluice combined (420 maximum)
September 15 - November 15 August 15 – October 31 (FERC)	~425	Taintor deep gate (and unit 7-8 nighttime shutdowns)

Brookfield also indicates that it will prioritize units for protection of Atlantic Salmon. Based on the average daily inflow reported in Table 2 of the EA, station capacity will be exceeding in all months except July, August, and September. Therefore, station capacity will be exceeded at the project for the majority of the downstream migration of Atlantic Salmon smolts and adult alosines in the spring and the majority of the juvenile alosines and adult eels in the summer and fall. While unit prioritization is proposed for these times as a protective measure, the prioritization will not be in effect as all units will be "on". The Licensee does not propose any additional spill or flows during the migration period, as they do for the Penobscot projects.

12. Downstream anadromous fish passage performance standards

As MDMR discussed previously (paragraph 6), the standards proposed by Brookfield and FERC staff are not consistent with standards established for Atlantic Salmon in the Penobscot River. Five of the hydropower projects have project-specific performance standards for Atlantic Salmon that include both an efficiency and a timing component[6], and at a sixth project (Medway), the Licensee is only required to consult with NMFS every five years to ensure Project operation is consistent with current requirements. The site-specific standards for the five projects are:

> The performance standard for downstream migrating smolts and kelts at the **Milford, West Enfield, Stillwater, Orono, and Mattaceunk** projects is **a minimum of 96% survival.** That is, no fewer than 96% of downstream migrating smolts and kelts approaching the dam structure must survive passing the dam structure, which would include from 200 meters upstream of the trashracks and continuing downstream to a point where delayed effects of passage can be quantified. Fish that stop moving prior to reaching the most downstream telemetry array or take longer than **24 hours** to pass the Project will be considered to have failed in their passage attempt.

The FLA and DEA did not consider the timing component of performance standards and the DEA did not consider the cumulative impacts, both immediate and delayed, of the Weston, Shawmut, Hydro-Kennebec, and Lockwood projects on downstream migrating Atlantic Salmon smolts. When the timing component is included in the analysis, passage survival estimates decline by 3-33% (Table 11). In addition, a comparison of the reach by reach survival of test smolts and control smolts from Brookfield's three years of effectiveness testing found significantly higher survival in control fish (mean=0.962, SD=0.044) than in test fish (mean=0.949, SD=0.038), t(49)=2.414, p=0.009821). The difference in survival in the 2013 study can be seen in Attachment 3.

FERC Staff analysis of new trash racks prescribed by the NMFS indicates that 1-inch track racks or overlays on the 1912 powerhouse (Units 1-6, currently 1.5-inch racks) and on the 1982 powerhouse (Units 7-8, currently 3.5-inch racks) would exclude about 50% of the size range of adult Alewife, the largest Blueback Herring, all adult Atlantic Salmon, and all adult American Shad. Analysis conducted by FERC Staff for the Lower Barker Project FEA indicates that American Eel 26 inches or longer would also be excluded by 1-inch racks. Brookfield has

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[6] The 96% standard for Milford, West Enfield, Stillwater, and Orono is based on a 75% confidence interval, while the standard for Mattaceunk is based on a point estimate. (Accession 2120831-5201 and Accession 20200804-5132).

estimated that approach velocities would be 1.6 fps in front of units 1-6 and 3.5 fps in front of units 7-8. Based on FERC Staff analysis, all adult fish excluded would also be able to avoid impingement. Although 1-inch racks would not exclude juvenile alosines, FERC staff analysis using the TBSA Model estimated that juvenile alosines passing through turbines 7-8 would have an average survival of 97.5% and those passing via turbines 1-6 would have an average survival of 91.9%.

Brookfield developed a model to assess how route utilization and survival rates would change with the installation of a forebay guidance boom. The model assumed the boom would be 53% effective at guiding fish to the bypass gates based on data from studies conducted at the Lockwood project. This is simply the percent of fish that used the bypass in 2014 . More appropriate is the data from 2013, where 62 of the 75 fish that passed via the turbines were detected near the bypass before passing via the turbines.

13. Downstream passage performance standards

Based on new information that became available after MDMR submitted its preliminary terms and conditions, MDMR has developed Kennebec River specific performance standards for American Shad, Blueback herring, and alewife. Standards for Atlantic Salmon and Sea Lamprey remain unchanged from those submitted in our preliminary terms and conditions.

<u>Downstream fish passage</u>
Based on the minimum goals, a project's facilities would be considered to be performing in a safe, timely, and effective manner if:

1. At least 99% of the Atlantic Salmon smolts and kelts that pass downstream at the next upstream hydropower dam (or approach within 200 m of the project spillway) pass the project within 24 hours.
2. At least 95% of the adult and juvenile American Shad that pass downstream at the next upstream hydropower dam (or within 200 m of the project spillway) pass the project within 24 hours.
3. At least 95% of the adult and juvenile Blueback Herring that pass downstream at the next upstream hydropower dam (or within 200 m of the project spillway) pass the project within 24 hours.
4. At least 95% of the adult and juvenile Alewife that pass downstream at the next upstream hydropower dam (or within 200 m of the project spillway) pass the project within 24 hours.

The NMFS clearly foresaw the need for high performance standards. The Biological Opinion states: "*Data to inform downstream passage survival standards for Atlantic salmon smolts and kelts in the Kennebec and Androscoggin Rivers are very limited. However, given the best available information, it is anticipated that downstream survival standards that will be incorporated in the final SPP will likely need to be between 96% and 100% at each Project. These standards will be refined using information from passage studies that will be undertaken as part of the ISPP. It is possible that the proposed studies will indicate that the interim downstream passage facilities currently in place are not enough to meet the standard and that significant structural and/or operational changes may be necessary to achieve such a high level* *of survival. The interim period will be used to determine how best to operate or modify the Projects to achieve sufficiently high survival rates. In addition, over the term of the interim period we and/or the licensee will develop a model for the Androscoggin and Kennebec Rivers to provide data that will be used to inform the development of upstream and downstream performance standards*."

FERC staff conducted an analysis to compare downstream passage survival standards of 96%, 97%, and 99% on the migrating smolt population. FERC staff used the same natural freshwater mortality rate/km, the same estuarine mortality rate/km, and the same marine survival that MDMR has used in its modeling exercises. Starting with 18,420 smolts at the mouth of the Sandy River, the number potentially surviving below the Lockwood Dam was 13,187 smolts at 95%; 13,745 smolts at 96%; and 14,914 smolts at 99%, and the number of adults returning to Lockwood was 24, 25, and 27 fish respectively. FERC's conclusion is that the incremental gains in survival would be negligible. However, FERC's analysis underscores the significant cumulative impacts caused by passage through the four dams. At 96%, 97%, and 99% survival an estimated 11,418, 11,168, or 10,644 smolts do not survive the trip from just upstream of the Weston Dam to the outlet of Merrymeeting Bay (a loss of 61-66% of the smolts). FERC using Steven's et. al (2019) could also use a modified estuarine survival to examine the removal of Shawmut, which will show the most marked improvement in survival. In 2020 and 2021, the USFWS released hatchery reared Atlantic Salmon smolts below Lockwood (88,753 and 100,08 in the two years, respectively). Had they been released at the mouth of the Sandy River an estimated 55,014 to 51.285 (at 96 and 99% efficiency) would have been lost in 2021 and 62,036 to 57,832 would have been lost in 2021. While marine survival is a continuing challenge, we can improve river survival by reducing the impacts measurably at this projects.

We concur with FERC Staff that one of the only ways of improving downstream passage survival for smolts above 97% would be to shut down some or all of the units to increase spill. However, spill at the spillway log sluice or the inflatable bladders would likely interfere with attraction to the new upstream fish passage facility. MDMR believes full exclusionary screening and shutdowns might be required to meet this complicated system of management tradeoffs.

14. Downstream anadromous fish passage effectiveness testing

As discussed in section 11, MDMR has developed downstream passage performance standards for Atlantic Salmon smolts and kelts, juvenile and adult American Shad, juvenile and Adult Alewife, and juvenile and adult Blueback Herring. Therefore we, recommend that three years of studies be conducted for each of these species and life stages. We note that the existing licenses of the Weston, Shawmut, and Lockwood projects contain provisions for testing permanent downstream passage facilities per the 1998 settlement agreement. At this time we do not have standards for Sea Lamprey macrophthalmia or adult American Eel. However, we recommend testing of American Eel

15. Upstream eel passage measures

MDMR does not have records of American Eel movements from the Licensee for the Lockwood, Hydro-Kennebec, Shawmut and Weston project. We reviewed upstream passage data from the

Sebasticook River, Messalonskee Stream, and Seven Mile Stream (data primarily collected by MDMR staff), and determined American Eel used upstream passage facilities from May 26 through September 26. Of the nearly 1,6 million individuals counted, 4.7% migrated in May (specifically May 26-May 30, 2001), 59.6% in June, 26.0% in July, 9.2% in August, and 0.5% in September.

16. Upstream eel passage effectiveness testing and monitoring

Nearly 20 years ago, MDMR developed a process for siting and testing upstream American Eel passage. First, nighttime observations are made in the project area to determine where American Eel are naturally congregating; data collected includes the number of the individuals at each location and their approximate size distribution. Depending on the abundance of individuals and the geography of the project, the concentration areas may be determined within a few visits or may require more than one year. The second step is to design and install an upstream passage at each concentration area. The third step is to test the internal efficiency of the upstream passage. A known number of American Eel of appropriate size are released into a secure containment at the bottom of the ladder. The internal efficiency is the number of individuals that successfully reach the capture tank at the top of the ladder in a given time period.

17. Downstream eel passage (P66-69)

Although MDMR does not have performance standards for downstream American Eel passage, we recommend that FERC Staff consider at least one year of effectiveness testing at the Shawmut Project to determine if the new trash racks and the Tainter and deep gate spillway extensions have improved the effectiveness of downstream American Eel passage. MDMR prefers full exclusionary screening that comports with the USFWS 2019 manual for American eels. If that is not recommended, the continued interim shutdowns must be made permanent and consideration of better options should continue.

18. Cumulative effects

The Kennebec River from the Weston Project area to the Lockwood Project have been converted from a free-flowing river to a series of impoundments. These impoundments meet water quality standards for Class B and Class C waters in terms of dissolved oxygen, number of *Escherichia coli* bacteria of human and domestic animal origin. The water quality standards also state that "Discharges to Class B waters may not cause adverse impact to aquatic life in that the receiving waters must be of sufficient quality to support all aquatic species indigenous to the receiving water without detrimental changes in the resident biological community" and "Discharges to Class C waters may cause some changes to aquatic life, except that the receiving waters must be of sufficient quality to support all species of fish indigenous to the receiving waters and maintain the structure and function of the resident biological community." The presence of the six lower hydropower projects in the Kennebec River currently impact and will continue to impact the fish indigenous to the receiving waters. The coordinated operation of the upper basin storage projects, the regulations of flows at the Williams Project and the non-instantaneous run-of-river of the lower projects have cumulative impacts.

Atlantic Salmon

Analysis of the cumulative and long term impacts of the four lower hydropower projects and proposed performance standards should be considered relative to the goals and objectives in the recovery plan for the endangered Atlantic Salmon (USFWS NMFS 2019). This could be considered part of the Commissions responsibility under 7(a)(1) of the ESA and certainly the responsibility under 7(a)(2) as this document is referenced as part of the initiation materials. A robust NEPA analysis should compare the action to the baseline but should also consider the impacts in the context of potential preclusion of recovery of Atlantic Salmon in the United States. The Commission is required to provide equal consideration to fisheries and wildlife but seems to diminish the value of these resources in favor of power production in its draft analysis.

RECOVERY GOAL: The overall goal of this recovery plan is to remove the GOM DPS of Atlantic Salmon from the Federal List of Endangered and Threatened Wildlife. The interim goal is to reclassify the DPS from endangered to threatened status.

Reclassification Objectives – Maintain sustainable, naturally reared populations with access to sufficient suitable habitat in at least two of the three SHRUs, and ensure that management options for marine survival are better understood. In addition, reduce or eliminate those threats that, either individually or in combination, pose a risk of imminent extinction to the DPS.
Biological Criteria for Reclassification – Reclassification of the GOM DPS from endangered to threatened will be considered when all of the following biological criteria are met:
1. Abundance: The DPS has total annual returns of at least 1,500 adults originating from wild origin, or hatchery stocked eggs, fry or parr spawning in the wild, with at least 2 of the 3 SHRUs having a minimum annual escapement of 500 naturally reared adults.
2. Productivity: Among the SHRUs that have met or exceeded the abundance criterion, the population has a positive mean growth rate greater than 1.0 in the 10-year (two-generation) period preceding reclassification.
3.. Habitat: In each of the SHRUs where the abundance and productivity criterion have been met, there is a minimum of 7,500 units of accessible and suitable spawning and rearing habitats capable of supporting the offspring of 1,500 naturally reared adults.

Delisting Objectives – Maintain self-sustaining, wild populations with access to sufficient suitable habitat in each SHRU, and ensure that necessary management options for marine survival are in place. In addition, reduce or eliminate all threats that, either individually or in combination, pose a risk of endangerment to the DPS.
Biological Criteria for Delisting - Delisting of the GOM DPS will be considered when all of the following criteria are met:
***1. Abundance*:** The DPS has a self-sustaining annual escapement of at least 2,000 wild origin adults in each SHRU, for a DPS-wide total of at least 6,000 wild adults.
2. Productivity: Each SHRU has a positive mean population growth rate of greater than 1.0 in the 10-year (two-generation) period preceding delisting. *In addition,* at the time of delisting, the DPS demonstrates self-sustaining persistence, whereby the total wild population in each SHRU has less than a 50-percent probability of falling below 500 adult wild spawners in the next 15 years based on population viability analysis (PVA) projections.
3. Habitat: Sufficient suitable spawning and rearing habitat for the offspring of the 6,000 wild

adults is accessible and distributed throughout the designated Atlantic salmon critical habitat, with at least 30,000 accessible and suitable Habitat Units in each SHRU, located according to the known migratory patterns of returning wild adult salmon. This will require both habitat protection and restoration at significant levels.

Furthermore the cumulative and long-term impacts of the four lower projects need to be assessed relative to the primary constituent elements (PCE) of designated critical habitat (FR 74)

(B) Physical and Biological Features of the Migration PCE

1. Freshwater and estuary migratory sites free from physical and biological barriers that delay or prevent access of adult salmon seeking spawning grounds needed to support recovered populations.

2. Freshwater and estuary migration sites with pool, lake, and instream habitat that provide cool, oxygenated water and cover items (e.g., boulders, woody debris, and vegetation) to serve as temporary holding and resting areas during upstream migration of adult salmon.

3. Freshwater and estuary migration sites with abundant, diverse native fish communities to serve as a protective buffer against predation.

4. Freshwater and estuary migration sites free from physical and biological barriers that delay or prevent emigration of smolts to the marine environment.

5. Freshwater and estuary migration sites with sufficiently cool water temperatures and water flows that coincide with diurnal cues to stimulate smolt migration.

6. Freshwater migration sites with water chemistry needed to support sea water adaptation of smolts.

<u>MDMR model</u>

MDMR developed a deterministic model to assess the impact of the six lower mainstem dams on the number of returning adults to determine if achieving a population of 500 returning adults, the number needed for reclassification, was possible. The model is described in detail in Attachment 4 (factual background section 3.1.6). The number of returning adults exceeds 500 individuals under conditions of moderate marine survival (MM), high freshwater production (HF), and 99% passage efficiency (Figure 2). The model was also run with the proposed 97/96% downstream/upstream effectiveness, but with a variable number of dams (Figure 3). With all dams in place, 500 returning adults is not possible with the proposed 97/96% downstream/upstream effectiveness. As dams are removed, a return of 500 adults becomes possible under lower marine survival and lower freshwater production. Figure 4, taken from our August 28, 2020 comments, shows that using slightly different assumptions from Legault (2005) and Baum (1983), recovery of 2,000 adults becomes possible under conditions of high marine survival and freshwater production with a 99% upstream and downstream efficiency at each project. These estimates do not take into account new information presented in comments from

Rubenstein (2021 Thesis Defense), which would lower returns if expected delays were similar to existing conditions at Milford and Lockwood.

Figure 2. Estimated returns of adult Atlantic Salmon to the Kennebec River with six mainstem dams operating (Lockwood, Hydro-Kennebec, Shawmut, Weston, Abenaki, and Anson). The model was run with low marine (LM=0.00321), medium marine (MM=0.01080), and high marine (HM=0.02720) survival and low freshwater (LF=1 smolt/100m^2) and high freshwater (HF=3 smolts/100m^2) smolt production at downstream/upstream passage efficiencies of 97%/96% or 99%/99% at each dam.

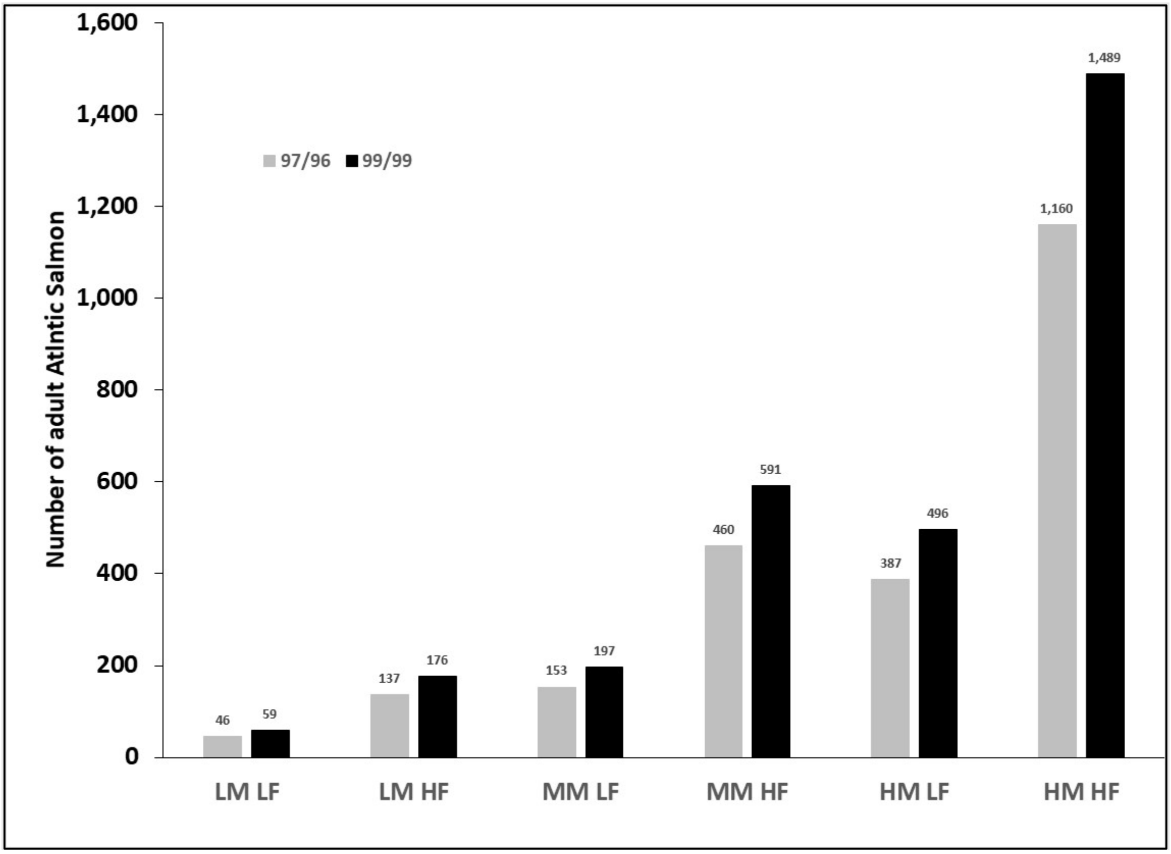


Figure 3. Estimated returns of adult Atlantic Salmon to the Kennebec River with six, five, four, two, or none of the lower mainstem dams operating. The model was run with low marine (M=0.00321) and high marine (HM=0.02720) survival and low freshwater (LF=1 smolt/100m^2) and high freshwater (HF=3 smolts/100m^2) smolt production at downstream/upstream passage efficiencies of 97%/96% or 99%/99% at each dam.

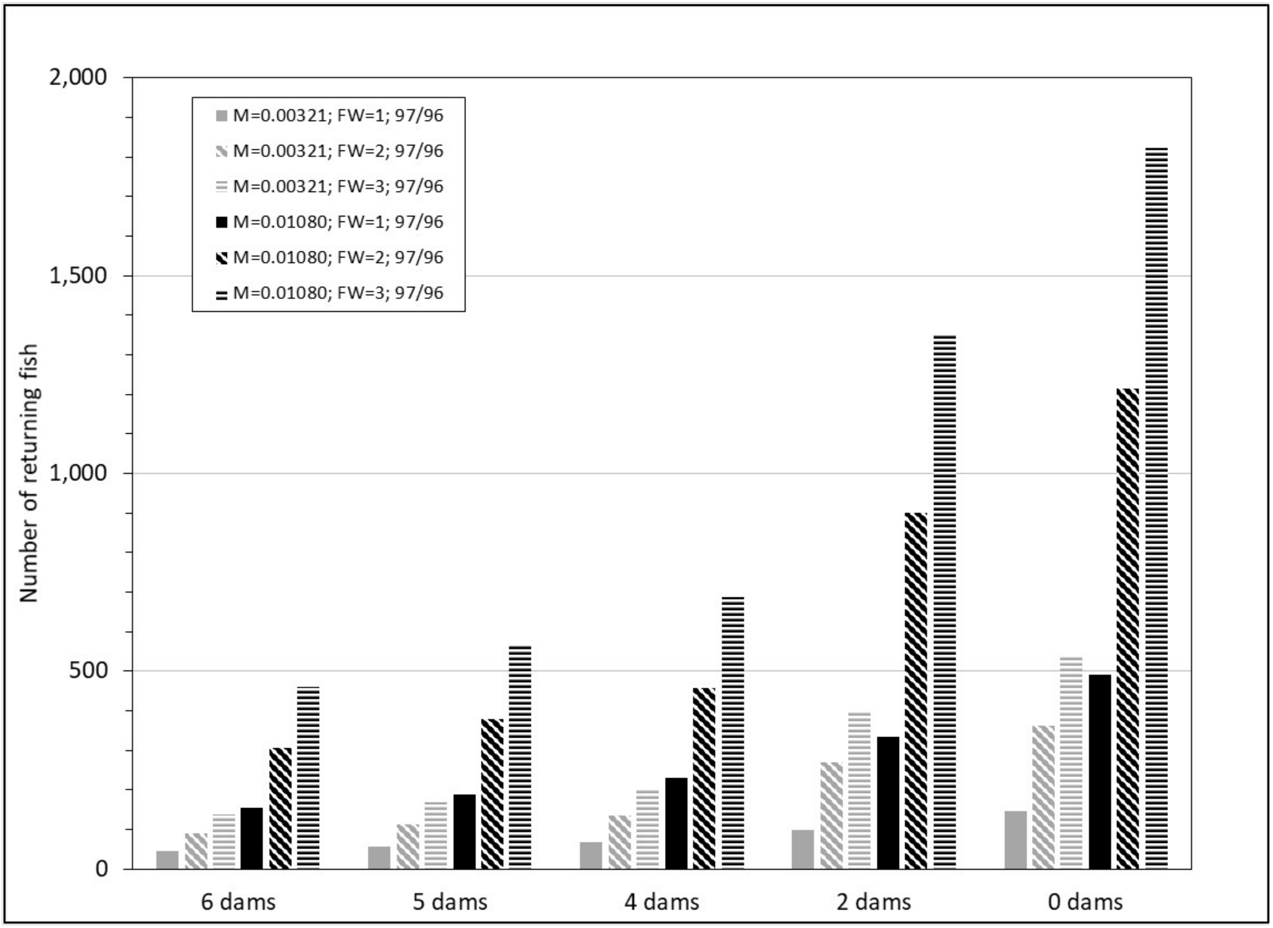
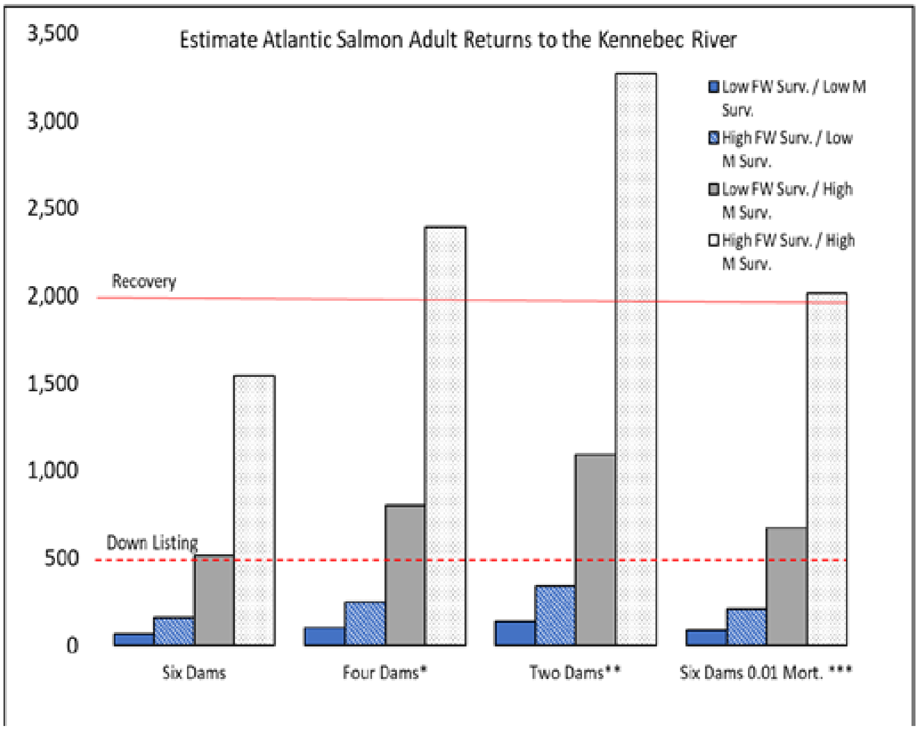


Figure 4. Estimated returns of adult Atlantic Salmon to the Kennebec River with six, four, two, or none of the lower mainstem dams operating. The model was run with low marine (M=0.005) and high marine (HM=0.04) survival and low freshwater (LF=1 smolt/100m^2) and high freshwater (HF=3 smolts/100m^2) smolt production at downstream/upstream passage efficiencies of 96%/96% (two, four and six dam scenarios) or 99%/99% at each dam (six dam 0.01 mort scenario).



USFWS modified model

The Biological Opinion for the Penobscot River was supported by two river specific models. The Dam Impacts Assessment (DIA) Model was developed by the NMFS (Nieland et al. 2013, Nieland and Sheehan 2020), and the matrix population model was developed by the USFWS. The latter, which was an appendix in the NOAA Biological Opinion, supported and confirmed the results of the DIA model. Mr. Fred Seavey, retired from the USFWS, volunteered to adapt the USFWS model for the Kennebec River, and ran several scenarios at the request of MDMR. The USFWS modified model incorporates the following Kennebec River data: the distances from the mouth of the Sandy River to each of the four lowermost dams and to the outlet of Merrymeeting Bay; smolt survival data from Brookfield's downstream passage studies; and adult upstream passage efficiency at the Lockwood Project. In addition, it uses the same natural in-river mortality of 0.0033%/km for a downstream migrating smolts (Stevens et al. 2019) as MDMR used in its model, For matrix models, the alternatives are referred to as Life Table Response Experiments (LTRE) since the alternatives modify the survival for specific life stages (in this case the cumulative smolt and in-river adult survival since those two stages interact with the hydroelectric projects) that are effected by each alternative while all the other stages that are unaffected remain the same. Therefore, the experiments can be compared to determine how each is predicted to influence the population. Matrix models can estimate the numbers of individuals in each stage or population parameters, like lambda (the rate of population growth). In the Penobscot River model, lambda was modeled because it is easily interpreted (< 1 declining population, 1 stable population, > 1 increasing population) and it is used in the recovery plan as one of the biological criteria for reclassification and for delisting (a mean population growth rate of greater than 1.0 in the 10-year period preceding reclassification or delisting).

The model is constructed in two steps. First, the cumulative smolt and in-river adult survival (the affected life stages) are estimated using published or unpublished survival estimates. A Monte Carlo and/or bootstrap analysis (randomly drawing from the empirical estimates) is used to estimate a mean cumulative survival and its error (variance and standard deviation). Second, the cumulative survival estimates for each alternative are then used in the model for each LTRE and statistics for lambda are developed through a Monte Carlo simulation of 10,000 iterations. The statistics include the mean, variance, upper and lower 95 percent confidence, and the percentiles. The percentiles are especially important because they provide an easily understood indication of the probability that a lambda of 1 (stable population growth) is predicted to be met. For example, under the FERC proposed performance standard the model predicts that a lambda of 1 cannot be met under low marine survival and is met in only 1 of 20 years (P95) under high marine survival.

All models are a simple representation of the life history even though they are often complex. However, they can be interpreted in a comparative manner among the LTREs or against a baseline condition, such as the unimpounded alternative. Matrix population models are widely accepted and with a robust literature (see Caswell 2000). This model was originally constructed by Robertson (2005) for his thesis and used by Sweka and Mackay (2009) during the Atlantic Salmon framework discussions. The model parameters for the life stages are based on published survival estimates for wild fish since the recovery criteria is based on wild origin fish. The model is also a female only model so it estimates only lambda for females (the fecundity is also reduced in the model to represent the proportion of eggs that will become females).

The Kennebec River model was used to evaluate seven alternatives that were identified by MDMR under low (current) and high (pre-regime shift) marine survival. The model extent is the lower Kennebec River since it includes river reaches only to and from the Sandy River. The seven alternatives include:

1. Existing Conditions (trap-and-haul from the Lockwood Project to the Sandy River);
2. Unimpounded (all hydroelectric projects removed);
3. FERC Performance Standard US95% DS96% at all hydroelectric projects;
4. NOAA Performance Standard US96% DS97% at all hydroelectric projects;

5. Maine DMR Performance Standard US99% DS99% at all hydroelectric projects;
6. Shawmut Project Removed with FERC Performance Standard US95% DS96% at all hydroelectric projects; and
7. Lockwood and Shawmut Projects Removed with FERC Performance Standard US95% DS96% at all hydroelectric projects.

The results of the modeling indicate that recovery (lambda ≥ 1.0) is possible under high marine survival if the four lowermost dams are removed. Recovery is not possible (lambda ≤ 1.0) with the four dams in place under the FERC, NMFS, or MDMR performance standards. Under high marine survival and with Lockwood and Shawmut removed, lambda approaches 1.0. Attachment 4 includes a table (Table 1) with the results for lambda for each alternative under low and high marine survival and a table (Table 2) with the vital rates that were used in the model were taken from Robertson.

Alosines (P76-77)

MDMR's goal is to restore American Shad, Blueback Herring, and Alewife to their historic spawning/rearing habitat in the Kennebec River and to their estimated historic abundance (Table 13).

The goal for **American Shad** is to provide safe, timely, and effective upstream and downstream passage in order to achieve a minimum annual return of 1,018,000[7] wild adults to the mouth of the Kennebec River; a minimum annual return of 509,000 adults above Augusta; a minimum of 303,500 adults annually passing upstream at the Lockwood and Hydro Kennebec Project dams; a minimum of 260,500 adults annually passing upstream at the Shawmut Project dam; and a minimum of 156,600 adults annually passing upstream at the Weston Project dam.

The goal for **Blueback Herring** is to provide safe, timely, and effective upstream and downstream passage in order to achieve a minimum annual return of 6,000,000[8] wild adults to the mouth of the Kennebec River; a minimum annual return of 3,000,000 adults above Augusta; a minimum of 1,788,000 adults annually passing upstream at the Lockwood and Hydro Kennebec Project dams; a minimum of 1,535,000 adults annually passing upstream at the Shawmut Project dam; and a minimum of 922,400 adults passing upstream at the Weston Project dam.

The goal for **Alewife** is to provide safe, timely, and effective upstream and downstream passage in order to achieve a minimum annual return of 5,785,000[9] adults above Augusta; a minimum of 608,200 adults annually passing at the Lockwood, Hydro Kennebec, and Shawmut project dams; and a minimum of 473,500 adults annually passing upstream at the Weston Project dam.

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[7] Based on 5,015 hectares of spawning/rearing habitat and a minimum return of 203 adults per hectare.
[8] Based on 5,015 hectares of spawning/rearing habitat and a minimum return of 1,196 adults/hectare.
[9] Based on 9,946 hectares of spawning/rearing habitat and a minimum of 581.5 adults/hectare; the Maine State average is 988.4/hectare.

Table 13. Alosine habitat and estimated production in the Kennebec River above the location of the former Edwards Dam (ED). Operating projects are Lockwood (LO), Hydro Kennebec (HK), Shawmut (SH), Weston (WE), and Abenaki (AB).

Habitat description	Surface area (ha)	% of total area	American Shad production	Blueback herring production	Alewife production
Kennebec-ED to LO	524	20.9	106,332	626,461	
Kennebec-LO/HK to SH	212	8.4	42,966	253,135	
Kennebec SH to WE	512	20.4	103,965	612,514	
Kennebec WE to AB	415	16.5	84,215	496,156	
Sandy to Rt 4 bridge	356	14.2	72,345	426,223	
Sebasticook	489	19.5	99,212	584,515	
Sebasticook lakes/ponds	9,946	78.6			7,730,400
Seven Mile lakes/ponds					
Webber Pond					1,065,200
Wesserunsett Lake	568				561,700
Sandy (4 lakes)	479				473,500
Totals			509,035	2,999,004	1,034,819

Freshwater and estuary migration sites with abundant, diverse native fish communities to serve as a protective buffer against predation are one of the Physical and Biological Features of the Migration PCE (74 FR 29300; June 19, 2009). As a major component of the native fish community (both biomass and abundance), alosines are a biological feature of the Migration PCE.

FERC Staff stated "*Currently, alosines returning to the Kennebec River have significant amounts of habitat available for spawning in the 63 miles of mainstem river downstream of the Lockwood Project, as well as in lower river tributaries such as the Sebasticook River*." This statement is not entirely correct. Alosines do not spawn in the lower 19 miles of the mainstem Kennebec River, which is mesohaline or polyhaline. Alewife spawn in lakes and ponds. Currently, 54% of their historic spawning habitat in the Sebasticook River is accessible, but spawning habitat in Wesserunsett Lake and the Sandy River is not. American Shad and Blueback Herring spawn in flowing water. They are known to spawn in three tributaries of the 9-mile long Merrymeeting Bay (Eastern River, Cathance River, and Abagadasset River). Blueback Herring have been observed spawning in Cobbosseecontee Stream and Messalonskee Stream and they are clearly spawning in the Sebasticook River, but currently do not have voluntary access to about 60% of their spawning habitat above Lockwood. American Shad are known to spawn in at two locations in Augusta and in the area between Lockwood dam and the confluence of the Kennebec and Sebasticook Rivers. However, nearly 60% of their historic spawning habitat is not freely accessible.

FERC Staff wrote "*Fish that migrate to Lockwood and enter the fish lift are trapped and trucked to a variety of upstream spawning habitats. These habitats include the mainstem river (including impoundments of the lower Kennebec Projects) and tributaries upstream of Lockwood. Because American shad, blueback herring, and alewife are already stocked into habitats upstream of Lockwood, relicensing the Shawmut Project under the staff alternative with mandatory conditions would provide minor benefits to these species' upstream migrations. There would be additional benefits to downstream passage survival of juvenile and adult post-spawn alosines through the implementation of the downstream passage measures (e.g., forebay guidance boom, new trash racks on the turbine intakes, new fish lift spillway). Overall, relicensing the project would benefit American shad, blueback herring, and alewife populations in the Kennebec River and would reduce cumulative adverse effects on these species*."

Restoration of alosines in the Kennebec River above Lockwood has been limited by the upstream passage facility at the Lockwood Project, which became operational in 2006. It is an interim fish lift that terminates in a trap-and-transport facility. Fish and water are collected in the hopper, lifted, and discharged into a 12-foot diameter sorting tank. River herring (Alewife and Blueback Herring) and American Shad are dip-netted into two ten-foot diameter tanks, Atlantic Salmon are moved into a 250-gallon isolation tank, and other species are sluiced downstream. On a given day, MDMR is limited by the number of trucks available (1-2), the number of fish that can be put in a tank (1500-1700, temperature dependent), the number of sorting tanks that sluice fish into a stocking tank (2), and the number of fish captured per lift. MDMR estimates it takes 15-20 minutes to load fish into the stocking truck and 1 hour to drive to Shawmut, release the fish, and return to Lockwood. The maximum number of river herring that MDMR has been able to stock into the Shawmut headpond in one day has been about 23,800 fish (1700 fish/tank x 2 trucks x 8 trips).

Safe, timely, and effective upstream and downstream fish passage that meets performance standards for American Shad, Blueback Herring, and Alewife will be needed at the Lockwood, Hydro Kennebec, Shawmut, and Weston projects to meet MDMR goals for restoration of these species and to maintain an abundant, diverse native fish communities that are one of the elements of migration habitat. to serve as a protective buffer against predation of Atlantic Salmon smolts.

American Eel

Despite the presence of upstream American Eel passage at the Lockwood, Hydro-Kennebec, Shawmut, and Weston dams, the electrofishing fish community study conducted for the Shawmut relicensing indicates an ongoing negative cumulative impact of the three lower dams on the distribution and abundance of American eel. American eel accounted for 9.8% of the total catch in the tailrace and 5% in the impoundment. In a study looking at restoration of species after the removal of the Edwards Dam (conducted in 2002), American eel represented 37% of all fish caught by electrofishing just downstream of the Lockwood Dam.

19. Alosine and Sea Lamprey Upstream Fish Passage Performance Standards and Effectiveness Testing (P119-121)

FERC Staff dismissal of the need for fish passage performance standards for American Shad and Sea Lamprey does not comport with Commission responsibilities under the FPA which requires the Commission to give equal consideration to the protection of, mitigation of damage to, and enhancement of fish and wildlife resources. Brookfield should be required to build a second fishway proactively to ensure these species persistence and then test it to ensure its meeting these standards if dam removal is not ordered. Anadromous fish are motivated to move upstream and use available habitat and can make much larger migrations that 70 river miles. For example, Sea Lamprey historically migrated 850 km in the Rhine River (Hardisty 1986) and 320 miles in the Delaware and Susquehanna River (Bigelow and Schroeder 1948). American Shad effectiveness testing occurs regularly at other projects and as previously mentioned, MDMR studies of Sea Lamprey at Milford demonstrated that 100% of the fish returned to the project and over 80% passed the project (Attachment 2). Studies are feasible, fish are motivated, density dependence happens downstream at some threshold and fish production requires upstream available habitat. To realize the benefits to Atlantic salmon of Sea Lamprey, lampreys much reach the Sandy River in sufficient numbers.

20. Upstream Anadromous Fishway Operation Schedule for Sea Lamprey (P121)

The threshold of having Kennebec specific information for run timing on a panmictic species that does not home to natal rivers is arbitrary. American Shad standards and testing all have a basis in fact as described elsewhere in this document. Sea Lamprey data indicate a predominance of nighttime movement at fishways in the Penobscot (Attachment 2) and Connecticut Rivers (Castro-Santos et al. 2016) where approximately 2/3 of fish enter the fishway at night. There are numerous other studies that indicate this behavior and a large number of examples where the Commission uses out of basin information to inform fish passage and species impacts. The Kennebec River below Lockwood has many thousands of Sea Lamprey, as MDMR crews and fishermen observe redd building annually just below Lockwood dam and thousands of redds at Six Mile Falls just upstream of the Sidney, Maine boat launch.

As previously reported, the efficiency of the Milford fishway was used as the benchmark for the performance standard and it is reasonable that fish passage efficiency would increase significantly if the fishways are operated at night, approximately 80 times using the example from Table 10. The obvious difference in counts of Sea Lamprey in the Kennebec (18 counted in 2021) vs Milford (5,776 in 2021) in recent years and predominance of nighttime movement in our 2020 and 2021 studies indicate that 24 hr operations are a major factor in providing for runs of Sea Lamprey into historic habitat. We also hypothesize that the lack of pheromones of lamprey ammocetes above the Lockwood Project reduces motivation (Bjerselius 2000) but that would immediately change if fish are passed upstream and can successfully spawn (e.g. a single spawning event can result in tens of thousands of juveniles).

MDMR's goal is to restore Sea Lamprey to historic spawning and nursery habitat in the Kennebec river drainage upstream of Lockwood Dam, particularly within the Sandy River. For the species to reach spawning habitat in the Sandy River, effective passage at all four dams is essential. Restoring Sea Lamprey to their historic range within the state is beneficial in and of itself and for the restoration and recovery of other sea run fish, particularly endangered salmon (Kircheis 2004). In watershed unrestricted by dams, Sea Lamprey are capable of reaching small, high-gradient, headwater streams (Nislow and Kynard 2009). They spawn in gravel-cobble substrate, and the spawning process results in streambed modification and sediment transport (Nislow and Kynard 2009; Sousa et al. 2012; Hogg et al. 2016). Sea Lamprey spawning activities condition the habitat for other species, including Atlantic Salmon, by removing fines and reducing substrate embeddedness (Kircheis 2004). Given the high degree of embeddedness in Maine streams due to past land use practices, the role of lamprey as "ecosystem engineers" is particularly important (Kircheis 2004; Sousa et al. 2012).

Anadromous Sea Lamprey also serve as a conduit of nutrients between marine and freshwater systems. Semelparous adults contribute marine derived nutrients (MDN) to rivers and are important sources of phosphorus in phosphorus-limited systems of New England, like Maine's Sedgeunkedunk Stream (Weaver et al. 2018, Nislow and Kynard et al 2009). Filter-feeding ammocetes, (the juvenile life stage that spends up to eight years in stream sediments), break down terrestrially derived nutrients in streams, and eventually export nutrients into the marine environment (Beamish 1980, Kircheis 2004; Nislow and Kynard 2009; Weaver et al. 2018). Sea Lamprey spawning occurs in late spring and early summer, thus pulses of MDN from post-spawn carcasses occur after canopy formation reduces light penetration to the stream and concurrent with the emergence of macroinvertebrates and Atlantic Salmon fry (Beamish 1980; Nislow and Kynard 2009; Weaver et al. 2015, 2016). Consequently, the influx of nutrients may help support stream food webs during a time when nutrients and energy flow are otherwise being limiting (Weaver et al. 2016). Further, Sea Lamprey are the sole semelparous species among the complex of sea run species that spawn in Maine's rivers. Gametes and metabolic waste from iteroparous species, such as Atlantic Salmon, river herring, and American Shad do serve as a source of MDN, but carcasses of semelparous species are generally a more important source of nutrients, highlighting the importance of providing lamprey passage into critical habitat Atlantic Salmon (Moore et al. 2011; Nislow and Kynard 2009).

21. Consistency with Comprehensive Plans (p140-142)

In one sentence, FERC indicated it has reviewed 21 comprehensive plans and found no inconsistencies. This is not a robust review and as described above, this action is wholly inconsistent with the Recovery Plan for Atlantic Salmon (2019), a comprehensive plan, as this action as currently proposed eliminates the potential for meeting the recovery goals of that plan for a highly endangered species. This plan is also inconsistent with goals for river herring and eels, also found in comprehensive plans.

22. Project Retirement (p187-191)

<u>Decommissioning with Dam Removal</u>

Dam removal is the most effective fish passage strategy and reduces the cumulative impacts of multiple projects significantly, allowing for reduced performance standards per project. Our analysis indicates that the restoration of multiple anadromous species to the Kennebec River with the mainstem dams in place is only possible with extremely high upstream and downstream passage effectiveness. The Recovery Plan (USFWS 2019) states that dam removal might be necessary for the reclassification or delisting of the endangered Atlantic Salmon. FERC staff analysis focuses mostly on the negative implications of dam removal and spends little time on the positive aspects. For a more comprehensive review, MDMR suggests adding more language about the positive aspects of removal. See Wippelhauser (2021) for a great result from downstream dam removal on the Kennebec for aquatic resources and Lewis et. al (2008) and Robbins and Lewis (2008) that showed property values increased at a higher rate than adjacent areas around dam removal sites in Augusta and Waterville and anglers willingness to pay increased respectively.

The Klamath Facilities Removal Final Environmental Impact Statement/Environmental Impact Report (2012) shows there are significant benefits of dam removal, particularly for fisheries resources, recreation, water quality, and temperatures, and some of the issues. The 2011 removal of the Elwha dam in Washington State showed rapid recolonization of species (Moser and Paradis 2017; Duda et al. 2020) and other benefits.

23. Summary (p191-192)

Based on the comments of MDMR, we respectfully disagree that sufficient and appropriate protection, mitigation, and enhancement measures are being applied to this project through the Staff Alternative with Mandatory Conditions. As described in our comments, some aspects of fish restoration and survival will be diminished compared to baseline conditions (e.g. number of Atlantic Salmon spawners entering the Sandy River). MDMR believes decommissioning and removal should be further considered in an EIS. MDMR also believes that alternative measures, such as an NLF in concert with the current proposal, may allow for energy generation and meet minimum fisheries goals without potentially impacting upstream developments such as the Sappi Mill intake and outfall systems.

The potential impact of a Shawmut dam removal to the Sappi Mill intake and outflow, other critical infrastructure, recreation, riparian properties, and municipal tax revenue are concerns the State of Maine takes seriously. To further understand some of the issues, MDMR has recently conducted a bathymetric survey of the Shawmut headpond and compiled existing information to help better understand the potential changes in water elevation of a dam removal and allow for hydraulic modeling. Potential impacts to the Sappi Mill or other community impacts can and should be addressed collaboratively. MDMR believes that addressing potential impacts is important and restoration of sea-run species and maintaining highly effective operations and profitability at the mill and other critical infrastructure, maintained or enhanced recreation, and maintaining riparian landowner value are not mutually exclusive. Many dam removals in Maine (e.g. Edwards, Great Works) and across the country have addressed these types of issues successfully, often with improvements to existing infrastructure at no or low cost to the impacted party. The TRC Environmental memo (March 11, 2021) prepared for Sappi that outlined concerns and provided recommendations properly caveated that TRC had “very little time to review site information and prepare these recommendations” and therefore recommendations should be “considered conceptual in nature”. While the memo is a great start to help spotlight potential concerns and options, we hope to assist in further refining the potential needs, costs, and opportunities to address any issues with more information moving forward. Initial survey data indicates the Maine Water Company intake near Big Eddy and the proposed Run of River Whitewater Recreation Area in Skowhegan would not be impacted by a dam removal but further analysis is warranted out of an abundance of caution. Continued conversations and information sharing with affected communities are important and forthcoming.

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Attachment 1

TECHNICAL MEMORANDUM

To: Sean Ledwin, Maine Department of Marine Resources

From: Michael Burke, P.E.

Date: July 20, 2021

Re: Nature-like Fishway Conceptual Analysis
Shawmut Dam, Kennebec River, Maine

1. Introduction

This memorandum summarizes a preliminary analysis of options to develop a large-scale nature-like fishway (NLF) at the Shawmut Dam site on the Kennebec River, Fairfield, Maine. The analysis was completed at the request of and under contract to the Maine Department of Marine Resources, Division of Sea Run Fisheries and Habitat (MDMR). The goal for the analysis was to evaluate options to install an NLF that would be compatible with continued operation of the Shawmut hydroelectric station. The analysis was completed utilizing existing publicly-available information resources, and specifically focused on the west side of the river.

2. Site Characteristics[1]

The Shawmut hydroelectric station is located in the village of Shawmut, Town of Fairfield, Maine, at approximate river mile 70 on the Kennebec River. The station is owned and operated by Brookfield White Pine Hydro LLC (BWP), and is licensed by the Federal Energy Regulatory Commission (FERC No. 2232).

STATION DESCRIPTION

The station (Figure 1) comprises two powerhouses (8 generating units) located near the west bank of the river, and an approximate 1,135-foot-long spillway with hydraulic height of approximately 24 feet under normal operating conditions. The spillway consists of a hinged flashboard spillway section and a bladder dam spillway section, separated by a log sluice. These facilities raise the normal pool (elevation 112)[2] behind the dam four feet above the permanent spillway elevation (elevation 108). A concrete cutoff wall and earthen dike extend across the upland area to the west of the dam.

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[1] Description of site characteristics based on final license application (FLA) filed with FERC by BWP on January 30, 2020 (BWP 2020).

[2] Elevations in the FLA are referenced to a 'USGS' vertical datum. Although not a standard vertical datum, the USGS datum is expected to refer to the vertical datum that USGS gaging station datums along the Kennebec River are commonly in reference to, which is the National Geodetic Vertical Datum of 1929 (NGVD1929).

Figure 1. Site Characteristics.

LAND SETTING

The lands immediately surrounding the west end of the station are owned by BWP (Figure 2). Prior to 2018, the Keyes Fibre Company mill was located on the adjacent property, but the mill has since been demolished with the underlying parcels transferred to the State of Maine, Department of Inland Fisheries and Wildlife (MDIFW). A canoe portage skirts the west end of the station, with take-out and put-in sites located on the BWP parcel upstream and downstream of the dam. The hand-carry launch was enhanced at the time the Keyes Fibre factory site was reclaimed.

Adjacent to the station on the parcel owned by BWP is an electrical substation owned by Central Maine Power Company (CMP). To the west, these parcels are bordered by rail and town road rights-of-way, a small, private residential parcel, and a CMP parcel that routes transmission lines along the rail corridor to the south. A series of power poles are located in the open corridor between the CMP substation and the private residential/CMP parcels. The width of this open corridor varies from approximately 180 feet at the narrowest points to over 200 feet.

The elevation of the established Federal Emergency Management Agency (FEMA) base flood (1-percent chance annual exceedance probability, i.e., 100-year return period) for the river upstream of Shawmut dam (FEMA 2011) appears to be higher than most of this open corridor, and appears close to the top elevation of the earthen berm. More detailed analysis and precise ground survey data would be required to directly compare the relative elevations of the earthen berm and the base flood elevation.

Figure 2. Property Ownership.

FLOW CHARACTERISTICS[3]

The combined facilities offer flexibility in adapting station operations to fluctuating river discharge, maintaining headpond elevation within a narrow range of the normal pool elevation (112) up to total river discharge of 40,000 cfs, which equates to an approximate 1% to 2% exceedance flow on the annual flow duration curve. The combined station generation flow ranges from approximately 2,100 cfs to 6,700 cfs, with approximately 60 percent of the capacity represented by the 6 generating units in the older north powerhouse, and 40 percent of the capacity represented by the 2 units in the newer west powerhouse.

The station generation flow capacity is supplemented by the spillways in conveying river flow past the dam. The spillways extend east from the powerhouses. With three sections over the eastern half of the dam having rated discharge of 7,000 cfs each, the bladder dam spillway offers the greatest discharge capacity at the normal pool elevation. However, each section of the bladder dam spillway must be operated in a fully inflated or fully deflated condition, and at no in-between state. The hinged flashboard spillway has combined capacity of 10,080 cfs distributed across 3 sections of 24 boards each. In addition, the log sluice has capacity of 1,500 cfs. Lastly, a tainter gate and downstream passage located between the powerhouses offer incremental additional discharge capacity.

Based on the description in the 2021 Response to AIR filed with FERC (BWP 2021), typical flow configurations to maintain the approximate normal pool elevation (elevation 112 + 0.5 feet of freeboard) include the following:

- Flow less than 6,700 cfs – All flow typically through power houses[4].
- Flow between 6.700 and 8,250 cfs – All flow through powerhouses and log sluice.
- Flow between 8,250 and 23,835 cfs – All flow through the powerhouses and a variable combination of hinged flashboards and bladder dam #1 (the western bladder section), depending on river flow. Log sluice is closed.
- Flow between 23,835 and 30,835 cfs - All flow through the powerhouses and a variable combination of hinged flashboards and bladder dams #1 and #2. Log sluice is closed.
- Flow between 30,835 cfs and 40,000 cfs - Flow through the powerhouses, log sluice gate, and a variable combination of hinged flashboards and bladder dams #1, #2 and #3.
- Flow greater than 40,000 cfs – Headpond pool elevation would rise above normal pool elevation.

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[3] Description of flow characteristics based on FLA and on written response to Additional Information Request (AIR), submitted to FERC February 24, 2021 (BWP 2021).

[4] Also assumed to include downstream passage and/or tainter gate at some or all periods of the year.

3. Fish Passage Objectives

Presently, there are no upstream fish passage facilities at the site. A new combined fish lift and vertical slot fishway system are proposed by BWP to support licensing of the project (BWP 2020). The options analysis reported in this memorandum evaluated the potential for a large-scale NLF as a supplement to or as an alternative to the proposed fish passage facilities. The intent was to evaluate a NLF system that would be compatible with continued generation at the site.

FISH PASSAGE FLOW

The estimated upstream fish passage flow range for the Shawmut site is 2,540 cfs to 20,270 cfs in the Kennebec River (Alden 2019). Over this flow range, based on the typical operations summarized above, flow may pass through the powerhouses only (up to 6,700 cfs), through the powerhouses and log sluice only (up to 8,250 cfs), or through a combination of powerhouse flow, bladder dam #1, and hinged flashboard spillways (up to 23,835 cfs).

For comparison to the overall upstream fish passage flow range, 6,700 cfs is a flow level that is exceeded approximately 65% and 45% of the time in the key upstream fish passage months of May and June, respectively, based on the flow duration curves presented in the FLA (BWP 2020). Thus, with the generating units at full gate, there will be excess river flow approximately 50% to 60% of the time, on average, during the upstream fish passage season. This pattern will influence both attraction to fish passage facilities, and the ability to allocate flow to fish passage facilities during the passage season without reducing generation during selected periods.

The U.S Fish and Wildlife Service fish passage engineering design criteria (USFWS 2019) require minimum fishway attraction flow[5] of at least 5% of station capacity, although increased flow proportions are typically greatly preferred to facilitate the ability of upstream migrating fish to find the fishway entrance. NOAA Fisheries has not published specific criteria, but typically encourages as much attraction flow as is technically possible (NOAA Fisheries 2015, 2008).

Thus, based on a flow of 6,700cfs, the minimum amount of flow required by the USFWS criteria for attraction for upstream fish passage is approximately 340 cfs. However, at sites such as this, with a long spillway that creates a competing attraction signal spread across the river as much as 50% to 60% of the time during the upstream passage season, a higher proportion for attraction is typically strongly encouraged, especially with NLF designs. The conceptual NLF options discussed below have the capacity to substantially increase the proportion of attraction flow. The flow dedicated to the NLF for purposes of attraction would be determined based on discussions between the dam operator, stakeholders, and fish passage designers.

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[5] Fishway discharge plus auxiliary water supply attraction flow

ANALOG LARGE-SCALE NLF FISHWAY

There are relatively few large-scale NLF fishways in service at operating hydroelectric stations in the region. One ‘prototype’ for the NLF concept is the fish bypass channel at the Howland Dam on the Piscataquis River in Howland, Maine. Placed into service in 2015, the Howland fish bypass has an average hydraulic gradient of 1.51% and average wetted width of 105 feet at the high fish passage flow (5% exceedance flow) at that site. The target native fish community at the Shawmut and Howland sites is similar, with focus on Atlantic salmon, river herring, and American shad, among others.

The Howland Dam is a decommissioned former hydroelectric site that operates passively. Hence the volume of flow entering the bypass channel fluctuates with changing river flow and headpond level. The amount of flow entering the channel is governed by the relative elevations and geometries of the 400-foot-long permanent spillway, the bypass channel hydraulic control section, and a 6-foot-wide downstream passage chute.

The proportion of flow entering the bypass channel ranges from 80% of the total river flow at the low fish passage flow, to approximately 18% at the high fish passage flow. This equates to bypass fish passage flows of 190 cfs to 1,800 cfs based on total river fish passage flows of 250 cfs to 10,600 cfs. The Howland bypass channel gains additional flow at higher flow magnitudes, up to 13,150 cfs at the 100-year peak flow discharge (87,900 cfs).

Early indications of the effectiveness of the Howland bypass channel have been positive, consequently the general design philosophy was used as an analog for the Shawmut site. The proposed concept NLF design includes a broad channel cross section with a deeper portion to concentrate lower flow conditions, and a sloping bed profile to accommodate increasing flow volumes while maintaining a zone of passage, even though velocities in the deeper portion may become increasingly swift with increasing discharge.

4. Constraints

Due to the property ownership pattern and existing features, several constraints were considered when evaluating a conceptual NLF layout at the site. The constraints include the CMP substation, the rail line, the private residential parcel and the CMP parcel. In addition, the primary access to the station is along the Town road right-of-way, across the open corridor. Lastly, the MDIFW property facilitates access to the hand-carry boat launch.

With respect to site access, a NLF alignment through the open corridor would require provision of alternate access means across the open channel in the form of a bridge that would support operations and maintenance functions. Replacement of the hand-carry launch would also be required if the existing access and launch were impacted by NLF construction. In addition, there are at least seven transmission poles in the open corridor between the substation and the CMP parcel. As many as three additional power poles and an existing water hydrant could be impacted within the CMP parcel, depending on the final NLF alignment and channel size. Repositioning of the power poles as well as adjustment to the hydrant location was not considered a hard constraint in the current analysis, but will require further evaluation in future phases.

5. Conceptual NLF Options

Based on the above factors, multiple NLF layout options were evaluated. The analysis focused on establishing the maximum size of NLF that could be built at the site, given the site constraints, while also maximizing fishway entrance attraction effectiveness by maximizing the available discharge capacity. A narrower NLF channel, which avoids the CMP parcel, was also developed. The analysis to date has not included detailed hydraulic modeling or engineering calculations, relying instead on existing data[6], observations and lessons learned from implementation and monitoring of the Howland NLF analog and other projects, and basic calculations. More detailed evaluations will be required to advance these options to detailed designs.

PROPERTY SETBACKS

While evaluating layout options, a minimum setback of 16 feet from the CMP substation to the edge of grading was included. Adjacent to the rail corridor, an approximate setback of 75 feet from the right-of-way to the edge of grading was included.

For the maximum channel width option, a minimal setback was included between the private residential parcel and the edge of grading. As noted above, this option also includes grading over the northeast corner of the CMP property. Design refinement associated with the reduced width channel option would avoid grading on the CMP parcel and enable a wider setback from the private residential parcel.

HYDRAULIC CRITERIA

Conceptual NLF layouts were evaluated based on normal pool elevation of 112 feet, and typical tailwater elevations of 88 feet and 89 feet for the downstream and upstream powerhouses, respectively (Alden 2019). The hydraulic height was spread along the maximum channel length available within constraints to result in an average hydraulic gradient within the recommended NLF range for the target fish species. For large NLF that emulate natural channel patterns, the goal was to

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[6] Preliminary grading analysis of conceptual NLF options was performed based on the most recent LiDAR terrain data available from the Maine GeoLibrary. The LiDAR data is published in reference to the North American Vertical Datum of 1988 (NAVD1988). As noted in footnote #2 on page 1 of this memo, it is believed that elevations referenced in the FLA, such as pool and tailwater elevations, are in reference to NGVD1929. The conversion between these two datums in the vicinity of the Shawmut Dam is defined as follows: Elevation relative to NAVD1988 – 0.67 feet = Elevation relative to NGVD1929. However, elevations determined from LiDAR data are often higher than actual ground elevations, the degree to which varies from site to site based on land cover type, season of data acquisition, and other factors. LiDAR data also does not reflect below water elevations accurately. For these reasons, it is estimated that the effective offset between the LiDAR data and the elevations cited in the FLA is 0.5 feet of less, which is acceptable for the preliminary grading analysis. However, for future detailed design evaluations, precise clarifications and alignment of site elevation datums and acquisition of survey-grade terrain data will be required to refine NLF designs.

obtain average hydraulic gradient less than 2.5% to 3%, which is the approximate maximum slope range for riffles in natural river channel settings. The NLF options were evaluated with a cross section shape having variable bed elevations to provide flow, depth and velocity diversity along a gradient that adapts to varying flow discharge.

CONCEPTUAL NLF LAYOUTS AND HYDRAULIC CAPACITY

Conceptual layouts for a (1) maximized width and (2) reduced width NLF option are shown in Drawing Sheets 1-2 and 3-4, respectively. These two options place the NLF entrance in the topographic low adjacent to the tailrace outflow from the western powerhouse. The resulting effective hydraulic gradient is approximately 2%. The channel cross section includes a deeper low flow channel area along the outside of the sweeping channel alignment, and a sloping higher elevation area along the inside of the channel bend (left side when looking downstream), similar in character to a river channel bar. Overall, the character of the NLF would be that of a boulder-based naturalized river channel with a diversity of currents and flow patterns. Because upstream coarse sediment supply to the NLF is anticipated to be negligible, the proposed NLF channel would be designed with a high degree of stability and resistance to erosion, and resilient against flood flows.

The upstream invert of the channel alignment options has been placed 5 feet below the normal pool elevation. Based on this vertical position and the proposed 2% hydraulic gradient, estimated channel capacities at normal pool are approximately 1,600 to 2,400 cfs for the maximized width option (wetted width of approximately 100 feet), and 1,500 to 2,000 cfs for the reduced width option (wetted width of approximately 80 feet), pending refinement of hydraulic inlet designs and other design details. Increased channel discharge would result from increased pool elevations.

NLF HYDRAULIC INLET

Based on the estimated NLF capacities reported above, during the periods of the upstream fish passage season where river flow exceeds station generation capacity, it may be possible to allow the NLF to flow passively (i.e., without inlet control). Based on the flow duration curves in the FLA, this may be the case approximately 50% to 60% of the time in the months of May and June. When viable, passive operation of fish passage facilities is preferred

Passive operation may be less viable during those periods when river flow is below station capacity. If this is determined to be the case, a hydraulic inlet control structure would be required. Under this circumstance, to maintain normal pool elevation within range, this control structure would be operated to limit the amount of flow entering the NLF to a mandated proportion relative to generation and downstream passage flows. The control structure may also allow the channel to be shut off when needed for maintenance activities. The scale of the control structure will be determined by the range of operations required. Design of the control structure will require detailed engineering analysis and modeling. Among other factors, it would be essential to avoid local hydraulic conditions around the control structure that may deter fish passage effectiveness.

FLOODING PATTERNS

Noted earlier in the memo, much of the open corridor to the west of the dam appears to be below the FEMA base flood (100-year) elevation established upstream of the dam. Management of flood levels and response of the NLF and adjacent areas to major floods would require consideration in subsequent design phases. The first step would be to establish the predicted inundation of the area during major floods in the current configuration. The design would then be refined to provide similar flood management patterns and site stability characteristics. This may include strategic grading of landforms around the NLF, and may influence the design of a control structure if included in the project.

UPSTREAM FISH PASSAGE EFFECTIVENESS

The conceptual NLF options identified are well within the channel slope range to provide safe, timely and effective volitional fish passage for upstream migrating native fish. The position of the NLF entrance close to the west powerhouse tailrace outflow on the same side of the river as the north powerhouse, and the notable potential volume of water that is able to conveyed through the NLF, should result in good fish attraction to the NLF.

Because the NLF could be operated to partially offset spill that would typically occur in the middle or opposite site of the river, the proportion of the fish passage flow range when flow would be concentrated along the west side of the river would be extended and the attraction flow volume on the west side of the river would be increased. This would benefit both attraction to the NLF as well as to any other potential passage facilities.

As an example of the benefit of spill offset that could be provided by the NLF during the fish passage flow range, one scenario is that the NLF flow could be prioritized before spill through the log sluice, which is located in the center of the river. If the generating station where at full gate, and the 1,500 cfs that is typically spilled through the log sluice were instead conveyed by the NLF, the non-spill periods would increase to greater than 50% of the time in May and 70% of the time in June, based on the flow duration curves in the FLA. All of the flow would be on the west side of the river.

Attraction to the NLF entrance is an essential component of project success, and refinement of the conceptual NLF options to optimize attraction effectiveness should receive detailed consideration during subsequent detailed design phases. This should include detailed modeling of the NLF outflow and entrance conditions, in the context of other flow patterns in the river downstream of the dam.

In addition to the base NLF options shown on drawing sheets 1 to 4, two NLF entrance location variations were evaluated (Drawing Sheet 5). The first variation would shift the entrance downstream of the prominent riffle located near the outlet of the west power house tailrace. The intent with this approach was to place the entrance downstream of the channel features which may disperse flow laterally, and could lead to enhanced attraction. This variation adds channel length to the NLF, and results in a flatter NLF channel slope.

The second variation includes a realignment of the downstream half of the NLF through the present location of the west powerhouse (Drawing Sheet 5). This variation places the entrance close to a deep pool near the tailrace of the north powerhouse. This variation may also enhance attraction under certain flow conditions and could be evaluated further in future design phases, but would result in a major change to the current configuration and operation at the facility.

FACILITY AND RECREATIONAL ACCESS CONSIDERATIONS

The conceptual NLF layouts through the open corridor west of the dam would interrupt the current vehicular access to the generating station. With construction of the NLF, a new bridge would be required to secure access to the station for operation and maintenance activity. Required bridge rating would need to take into account the full suite of potential access requirements, including for future heavy equipment or truck access to facilitate future facility repairs, if needed. Drawing sheets 1 and 3 show the required access bridge schematically, but this feature requires future analysis and design.

The conceptual NLF layouts would also impact the hand-carry launch and portage facilities. These would need to be replaced in-kind. It is assumed that replacement location for these facilities may be able to be located on the State property, following a collaborative design discussion with an appropriate planning committee.

OTHER CONSIDERATIONS

Prior to 2018, the Keyes Fibre Company mill was located on the property now owned by MDIFW. The downstream half of the NLF conceptual alignments cross this property. The site was reclaimed in 2018; however, the potential exists for underground, unknown features to be uncovered through mass excavation of the site. In addition, the potential presence of soils or substances requiring special management has not been investigated. These factors should be investigated in subsequent planning and design phases.

Subsurface investigations such as borings, test pits, or rock probes have not been completed within the conceptual NLF areas. In addition to soil quality and material characteristics, the presence of bedrock ledge has not been determined. Subsurface investigations should be considered early in subsequent design phases.

6. References

Alden 2019. Upstream Fish Passage Plans – Shawmut Hydroelectric Station. December.

Brookfield White Pine Hydro LLC (BWP) 2020. Application for New License - Shawmut Hydroelectric Project FERC No. 2322-060. January 30.

Brookfield White Pine Hydro LLC (BWP) 2021. Response to Commissions' Additional Information Request - Shawmut Hydroelectric Project FERC No. 2322-060. February 24.

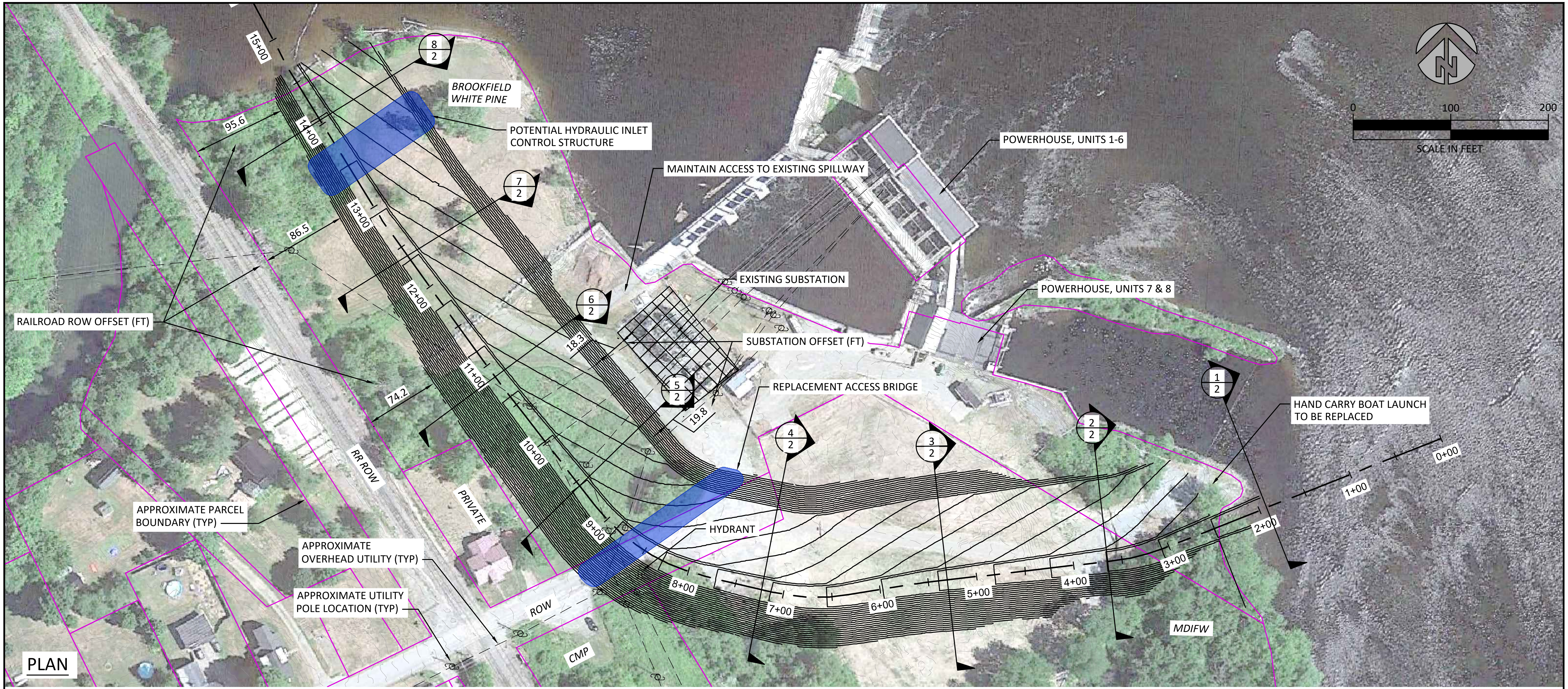
Federal Emergency Management Agency (FEMA) 2011. Flood Insurance Study, Kennebec County, Maine. Effective Date June 16, 2011.

NOAA Fisheries. 2008. Anadromous Salmonid Passage Facility Design. NMFS, Northwest Region, Portland, Oregon.

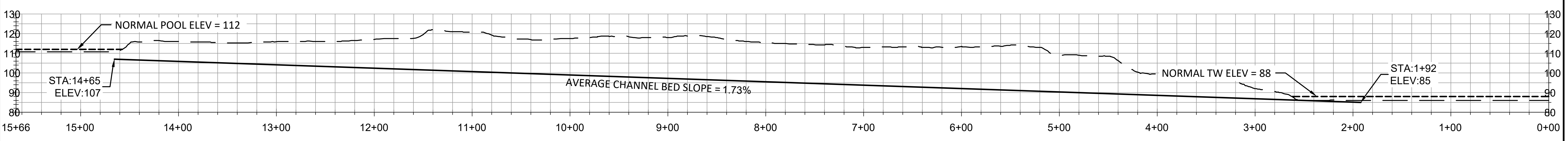
NOAA Fisheries 2015. Diadromous Fish Passage: A Primer on Technology, Planning and Design for the Atlantic and Gulf Coasts.

US Fish and Wildlife Service Northeast Region (USFWS) 2019. Fish Passage Engineering Design Criteria. USFWS Region 5. June.

7. Conceptual Drawings



PLAN



PROFILE

NO.	BY	DATE	REVISION DESCRIPTION

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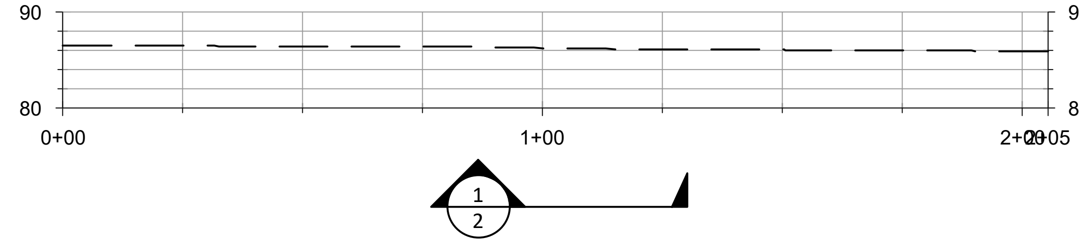
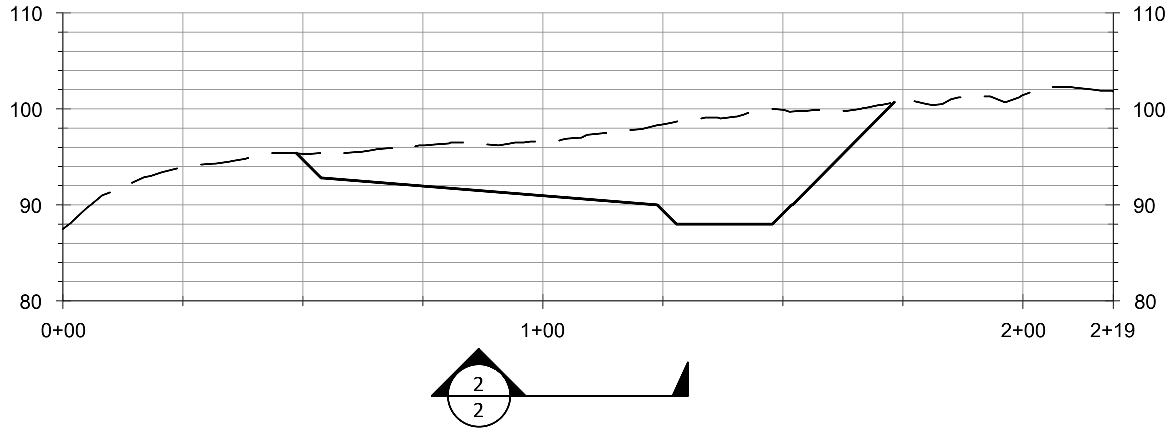
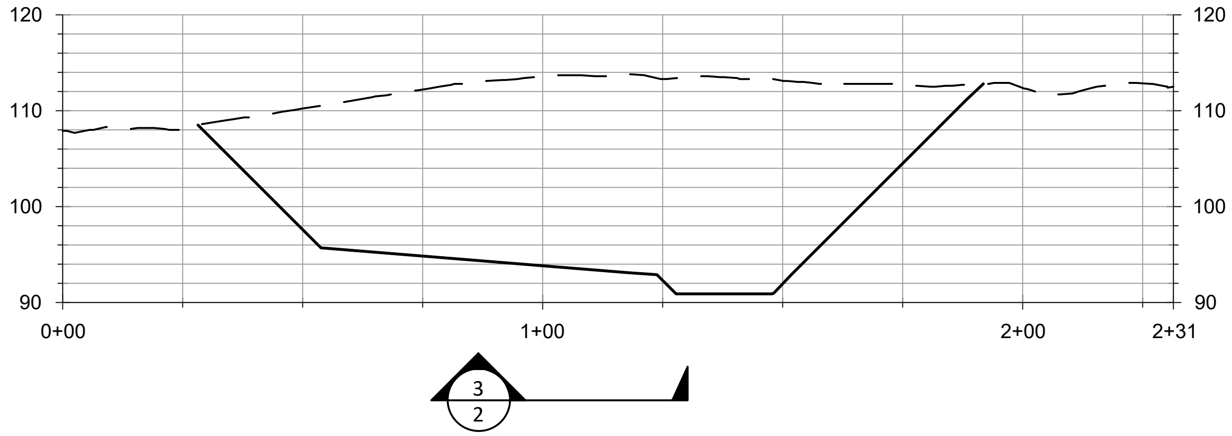
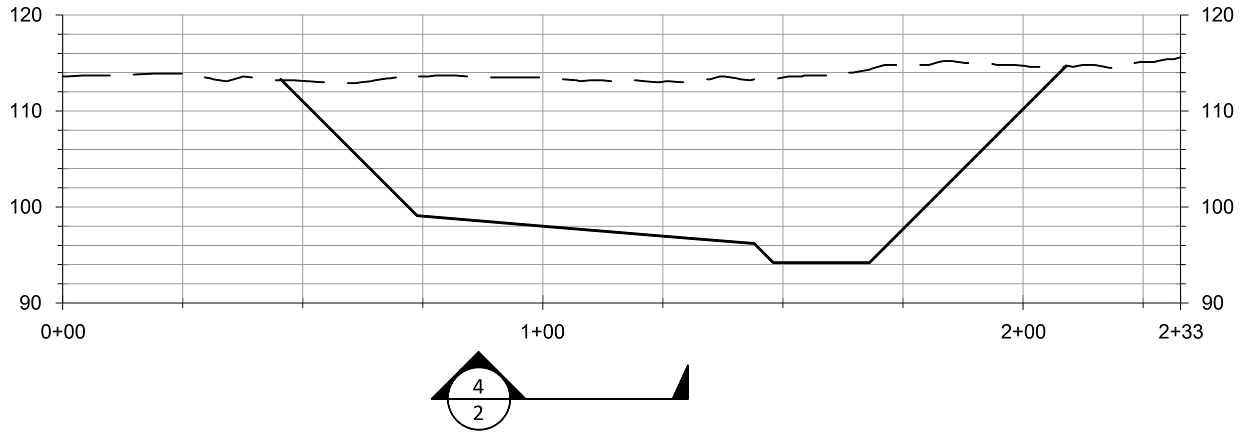
PLAN AND PROFILE -
MAXIMIZED WIDTH NLF
OPTION

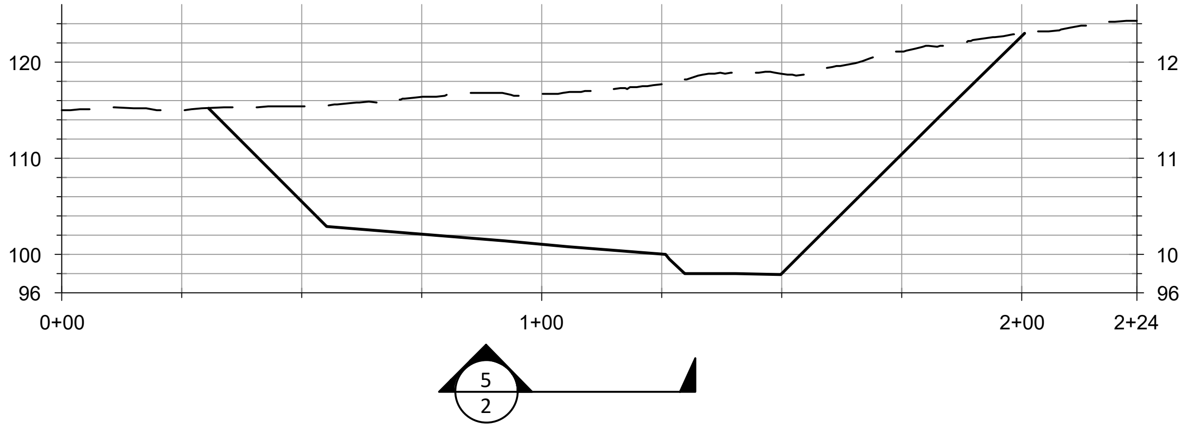
SHEET
1 OF 5

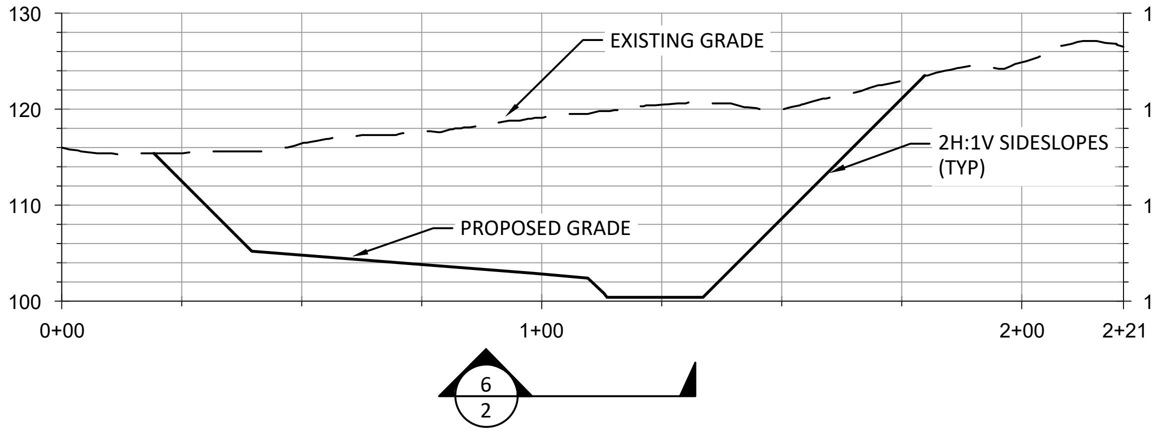


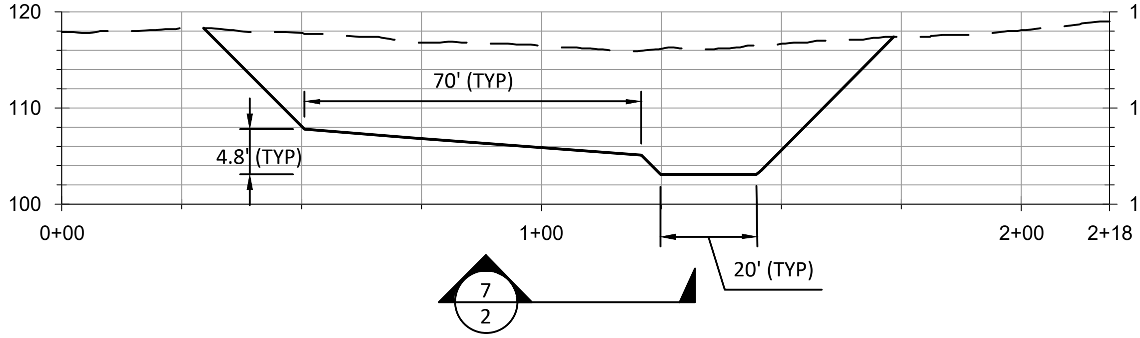


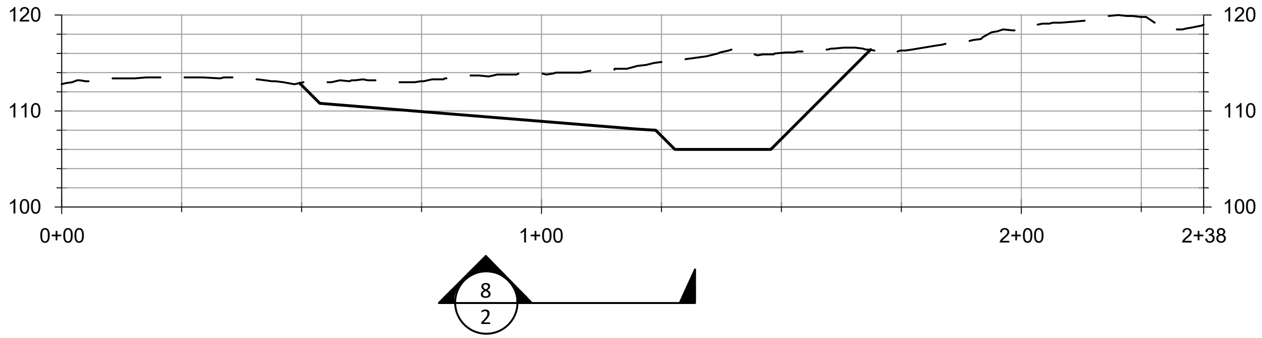












C:\Users\marcel\Documents\Working Files\Shamut\IFI_ ShawmutPrelim - Standard\IFI_ ShawmutPrelim.dwg - marcel - 7/19/21

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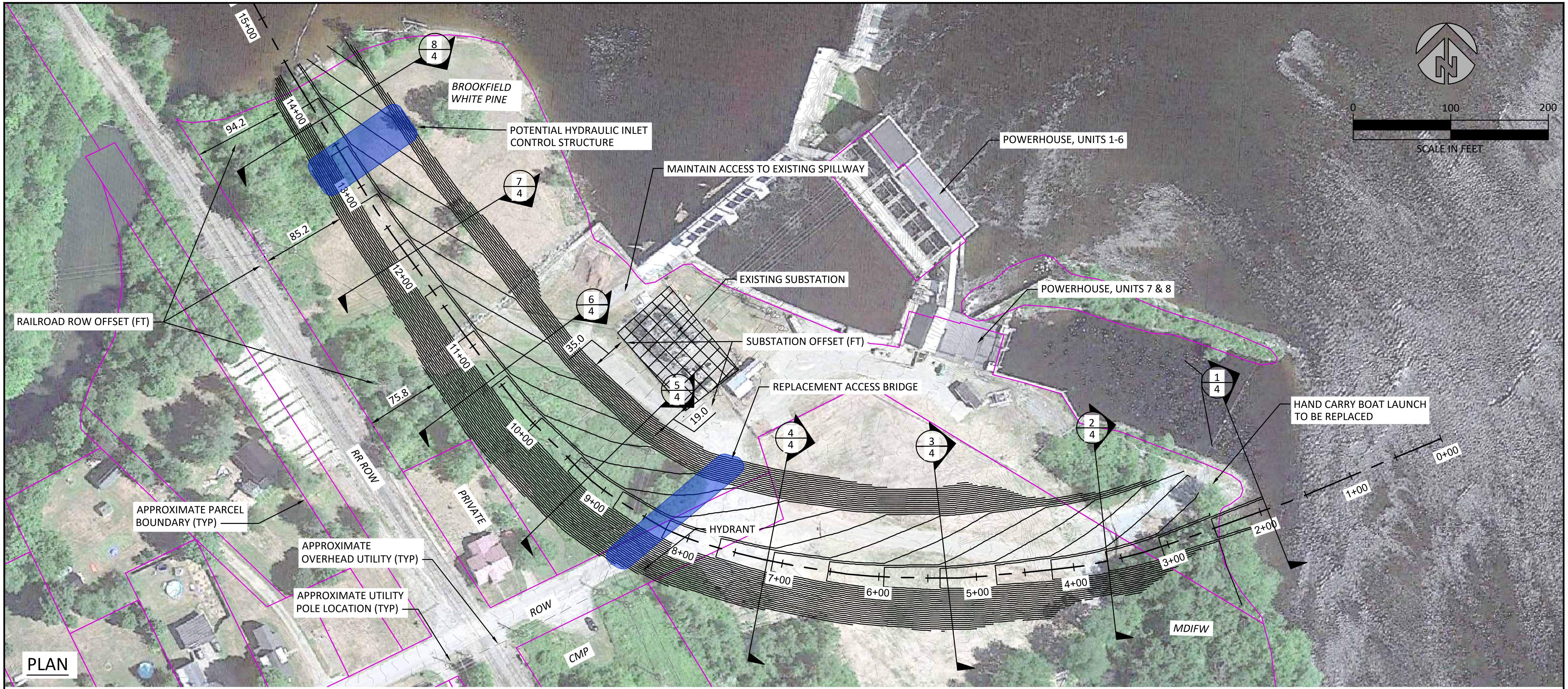
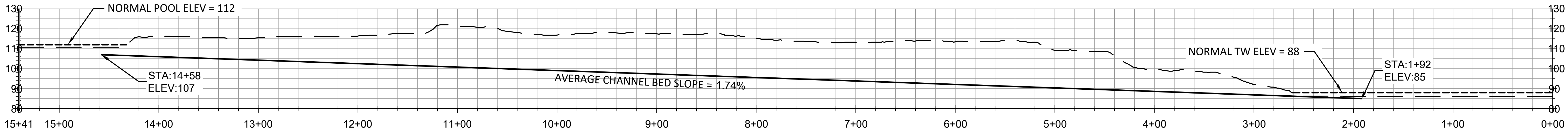
CROSS SECTIONS - MAXIMIZED WIDTH NLF OPTION

SHEET
2 OF 5





PROFILE

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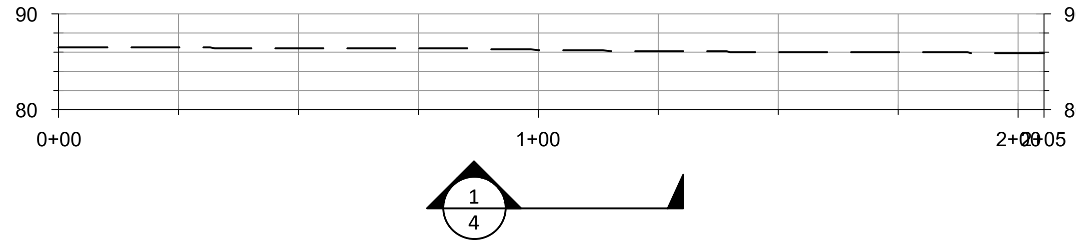
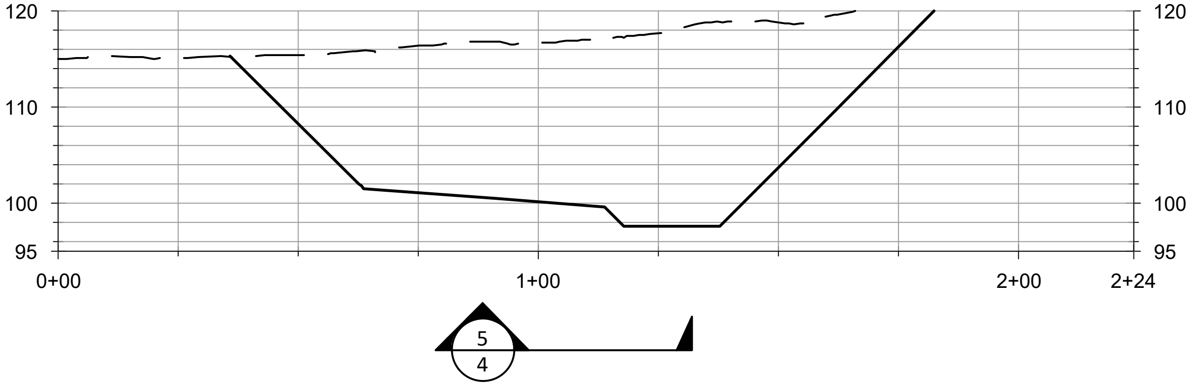
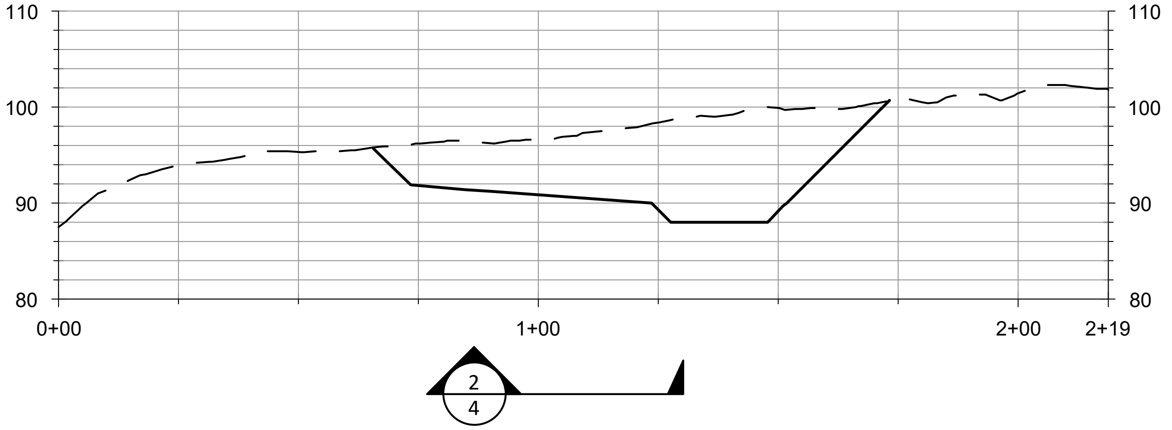
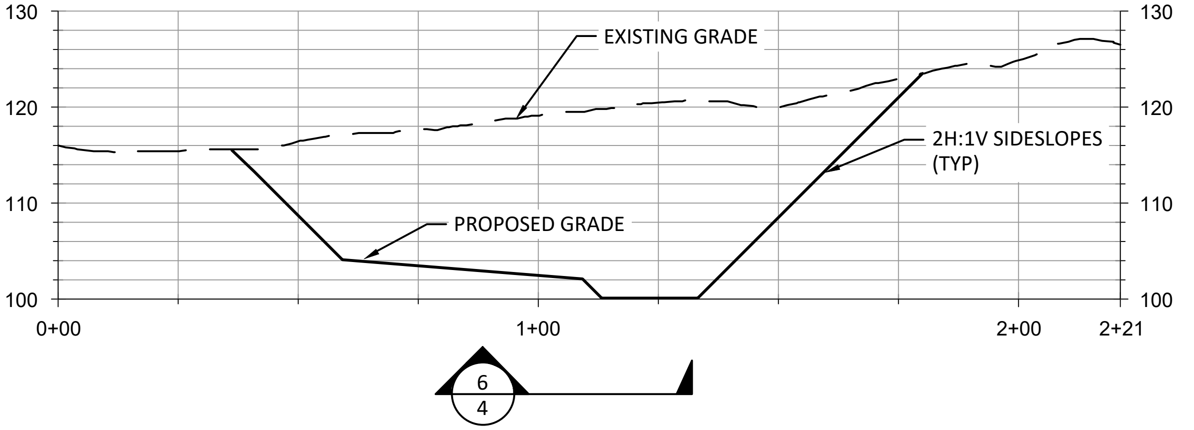
PLAN AND PROFILE - REDUCED WIDTH NLF OPTION

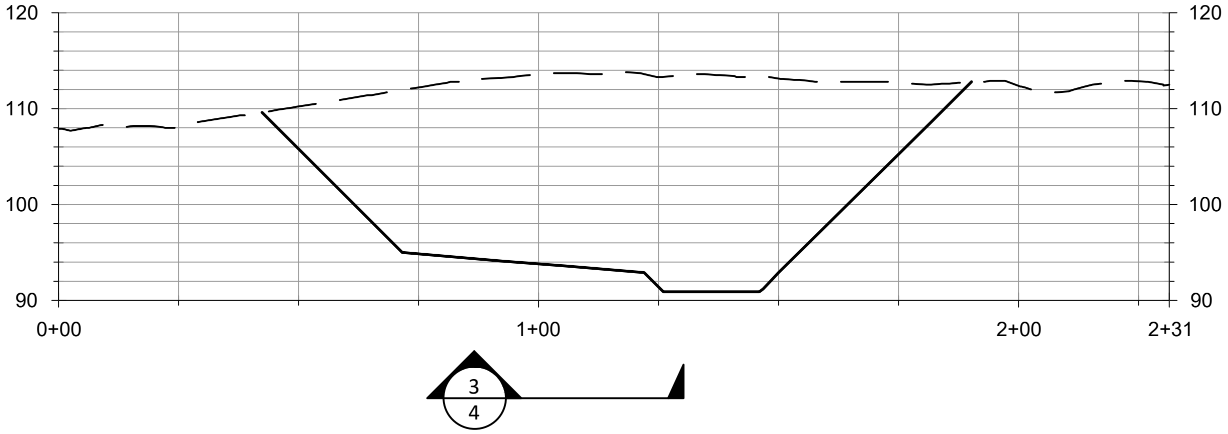
SHEET
3 OF 5

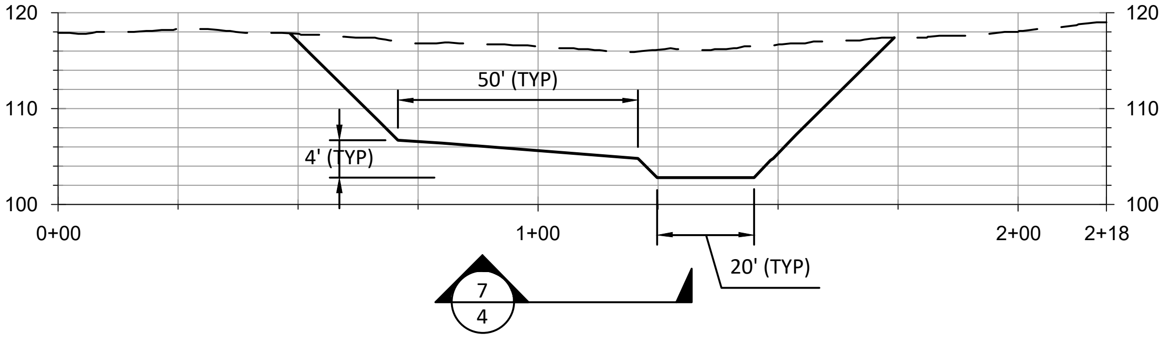


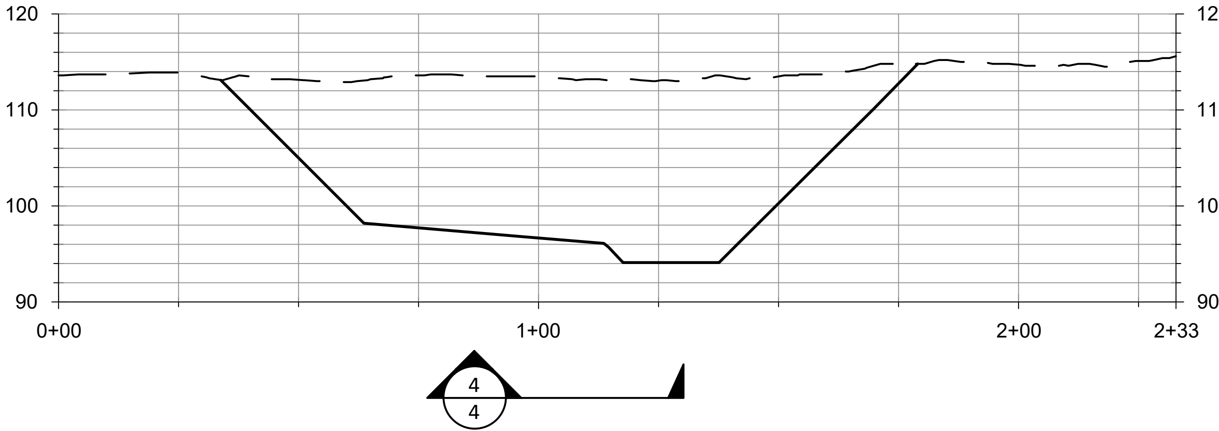


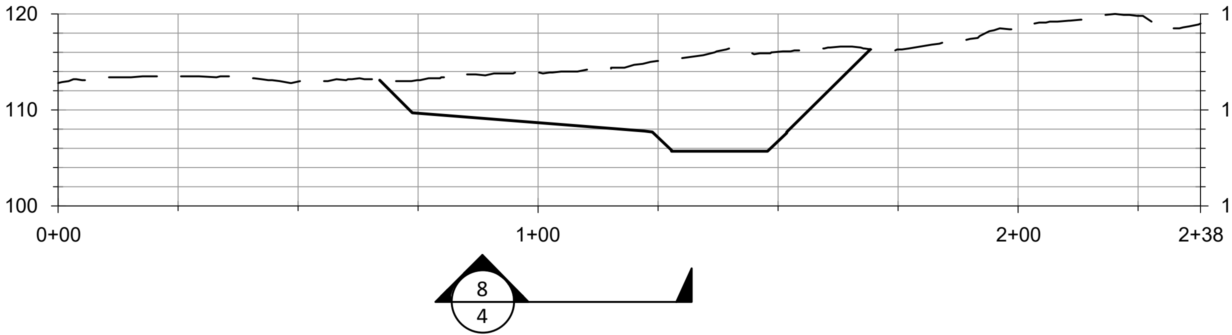












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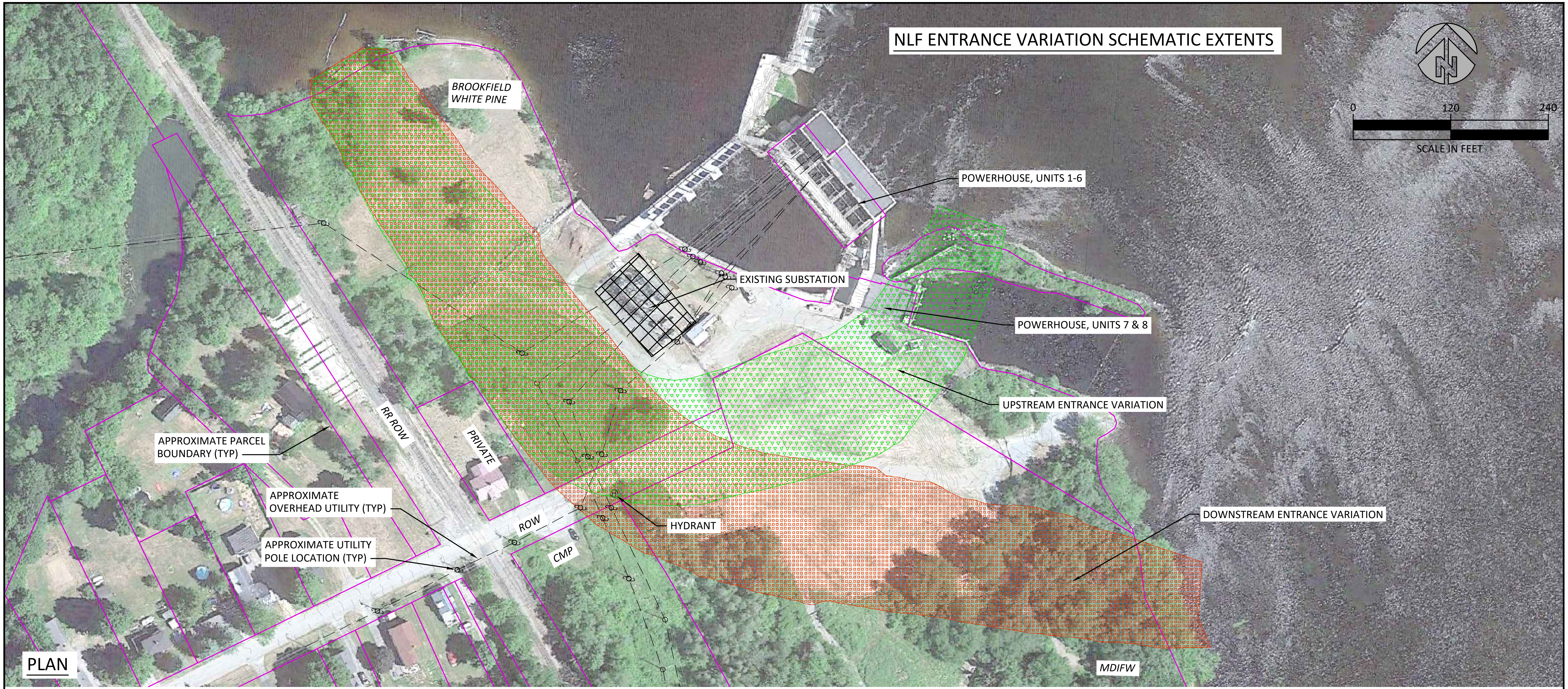
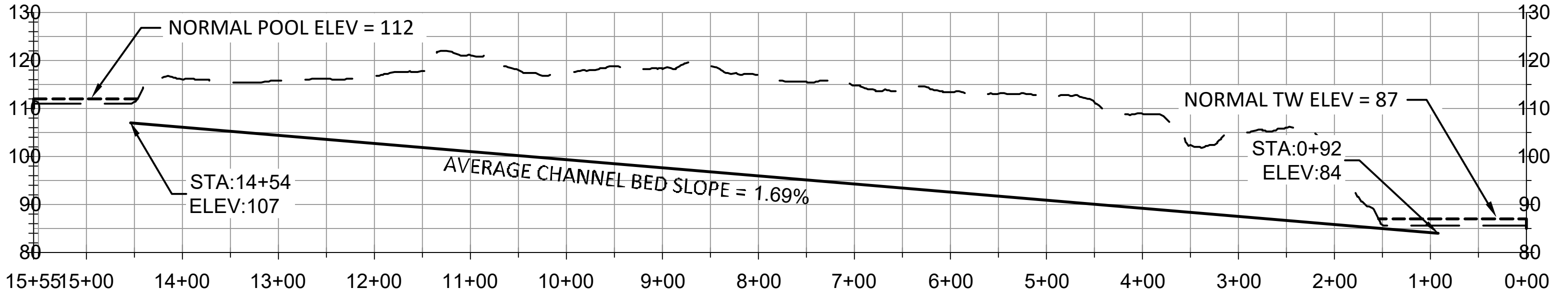
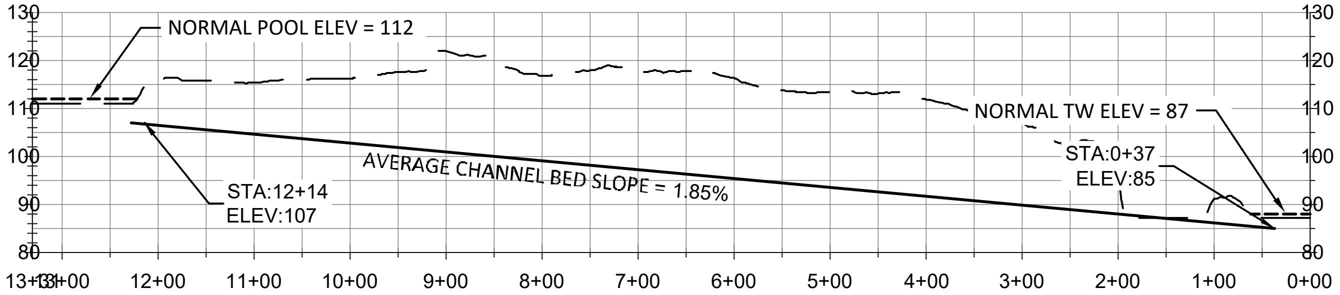
CROSS SECTIONS - REDUCED WIDTH NLF OPTION

SHEET
4 OF 5





PROFILE - DOWNSTREAM ENTRANCE VARIATION



PROFILE - UPSTREAM ENTRANCE VARIATION

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NLF ENTRANCE VARIATION OPTIONS

SHEET
5 OF 5

Attachment 2

2020 Lamprey Tagging

Preliminary Results

November 3, 2020

We radio-tagged and released a total of 50 adult sea lamprey over two days. All lamprey were surgically tagged and double-tagged with a PIT tag as well. Fish 1-16 were tagged and released at Sandy Point on June 1. Fish 17-50 were tagged at Milford Dam on June 3 and trucked downstream to Sandy Point to be released. All fish were released on river left, which is the same side of the river as the entrance to the Milford Dam fishway.

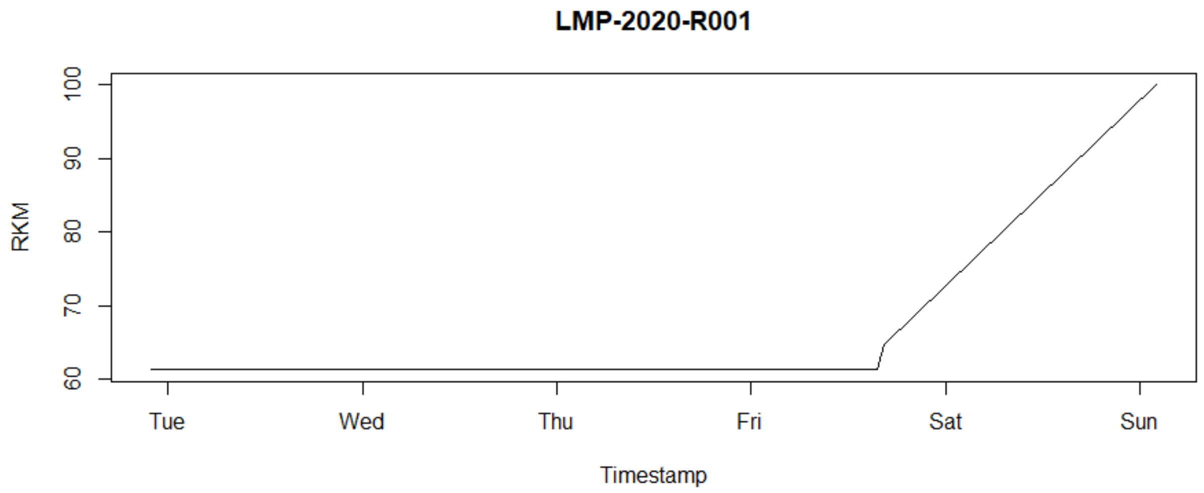
Forty-one lamprey (82%) are confirmed to have passed Milford. Thirty-nine of these (78% of all lamprey, 95.1% of passers) were detected somewhere upstream of Milford, and the remaining two fish were detected at the Milford PIT antennas but nowhere else upstream of the dam.

EVERY SINGLE LAMPREY returned to the Milford fishway sometime after release. Although some were not successful in passing the dam again, we saw 48/50 lamprey (96% of all tagged fish) on a dropper antenna in the Milford fishway, on the Milford PIT array, or just upstream of Milford within 24 hours of release. Of the remaining two fish, one was seen entering the fishway within 36-48 hours of release, and the other was not detected at Milford but was detected in or near the Howland Dam bypass approximately 48 hours after release.

Fish were considered to have approached Milford if they were detected on either of the dropper antennas, or if they were detected on a Yagi antenna at a time of day when the tag had likely already been released into the river. The first detection on a dropper antenna was considered the entrance to the fishway for 45 fish. Three fish were not detected on any radio antennas but were detected by the Milford PIT array; the time of approach and fishway entrance could not be determined for these fish. Likewise, the time of approach could not be determined for the fish that was only detected at Howland and a second fish that was first detected upstream of Orson Island on the mainstem.

Of the 45 fish that were seen entering the fishway on a dropper antenna, the timing of fishway entry was skewed towards the hours between sunset and sunrise, with 31/45 (68.8%) fish first detected in the fishway during dark. Twenty-two of the 33 (66.7%) fish for which the time of passage was known passed the dam during dark. Twenty-seven of 40 (67.5%) fish for which passage times could be determined or inferred passed the dam within 48 hours of arrival in the fishway (Only 22 fish had known passage times, and 5 more could be inferred using the timestamps of other detections).

Following are the tracks and brief histories for each fish.



Captured, tagged, and released Monday, June 1, 2020

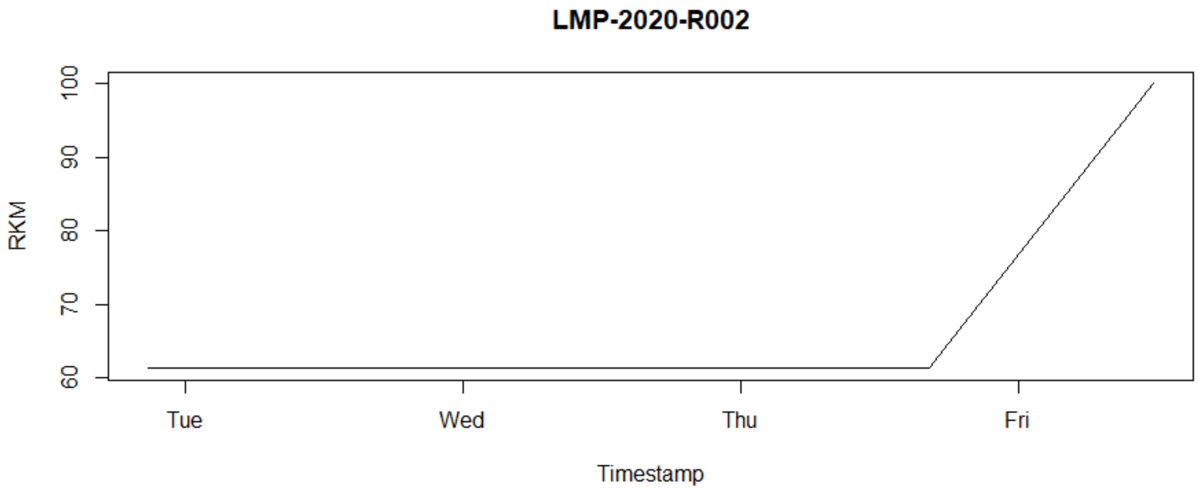
First detected on Milford West rxr at 2200 on June 1

Entered the fishway at 2207 on June 1

This fish was detected on the Milford PIT antenna at 0230 on 6/3. Subsequently it was detected on the droppers; may have passed, fallen back, and reentered fishway

Passed Milford at 1539 on June 5, after 89.5 hours in the fishway

Detected on the West Enfield PIT array at 0202 on June 7



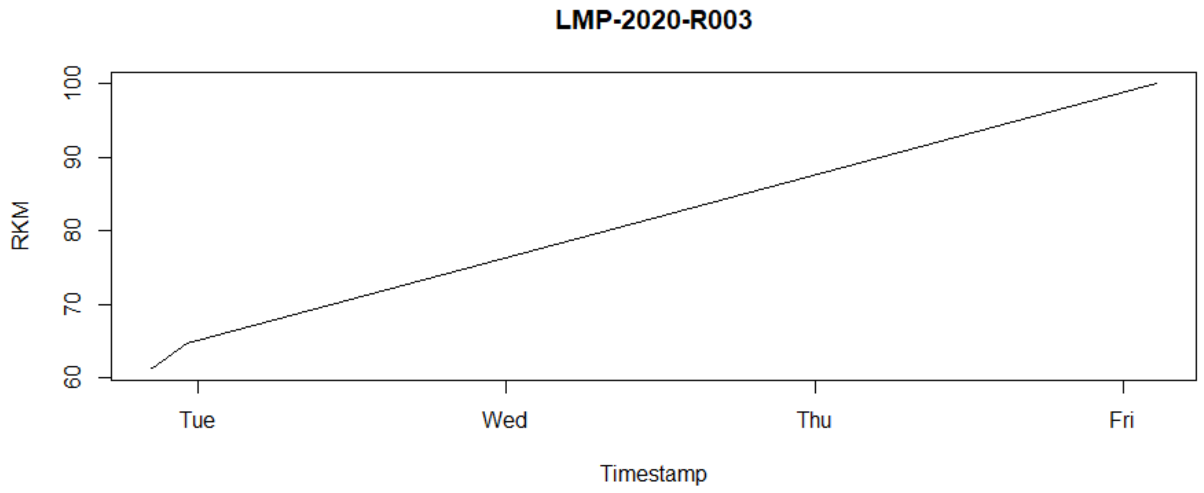
Captured, tagged, and released on Monday, June 1, 2020

First detected on the Milford West rxr at 2054 on June 1

Entered the fishway at 2059 on June 1

Milford passage occurred sometime between 1620-1800 on 6/4

Detected on the West Enfield PIT array at 1137 on 6/5



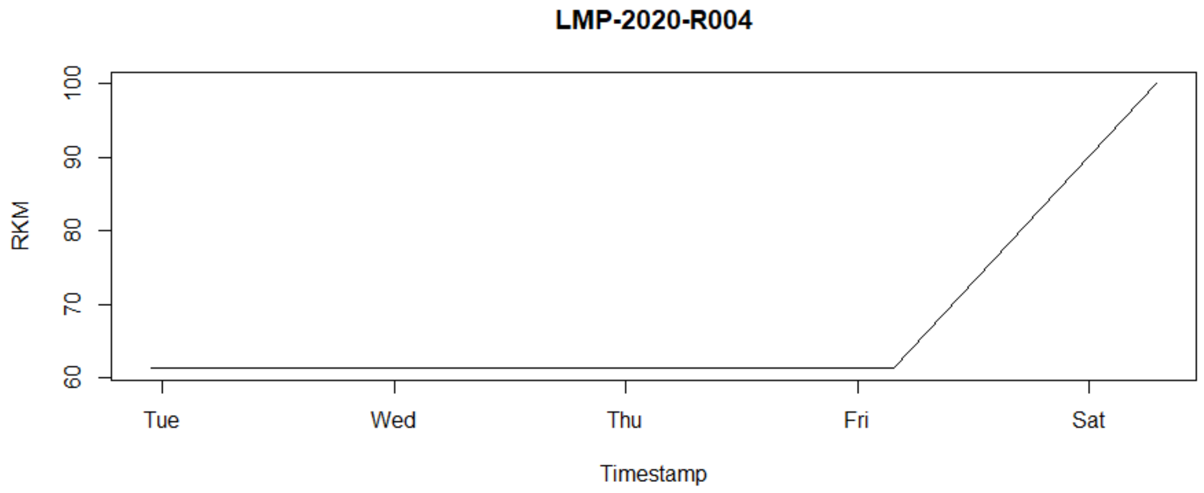
Captured, tagged, and released on Monday, June 1, 2020

First detected on Milford West rxr at 2027 on 6/1

Entered the fishway at 2029 on 6/1

Milford passage occurred sometime between 2057-2308 on 6/1

Detected on the West Enfield PIT array at 0233 on 6/5



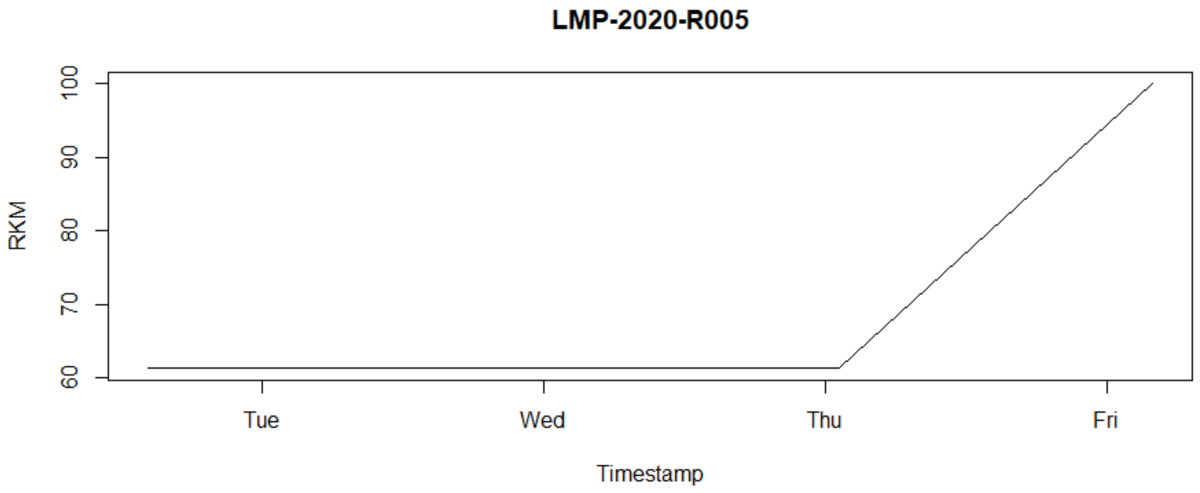
Captured, tagged, and released on Monday, June 1, 2020

First detected on Milford West rxr at 2255 on 6/1

Entered the fishway at 2309 on 6/1

Milford passage occurred sometime between 0350 on 6/5 and 0658 on 6/6

Detected on West Enfield PIT at 0658 on 6/6



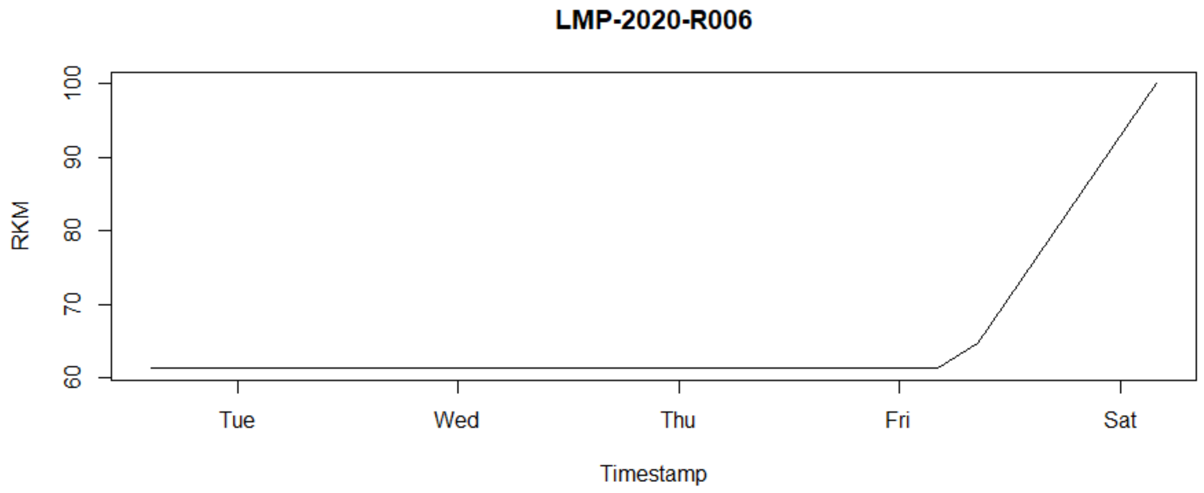
Captured, tagged, and released on Monday, June 1, 2020

First detected on Milford West rxr at 1418 on 6/1

Entered fishway at 1425 on 6/1

Passed Milford at 0152 on 6/4, after 59.5 hours in the fishway

Detected on West Enfield PIT at 0354 on 6/5



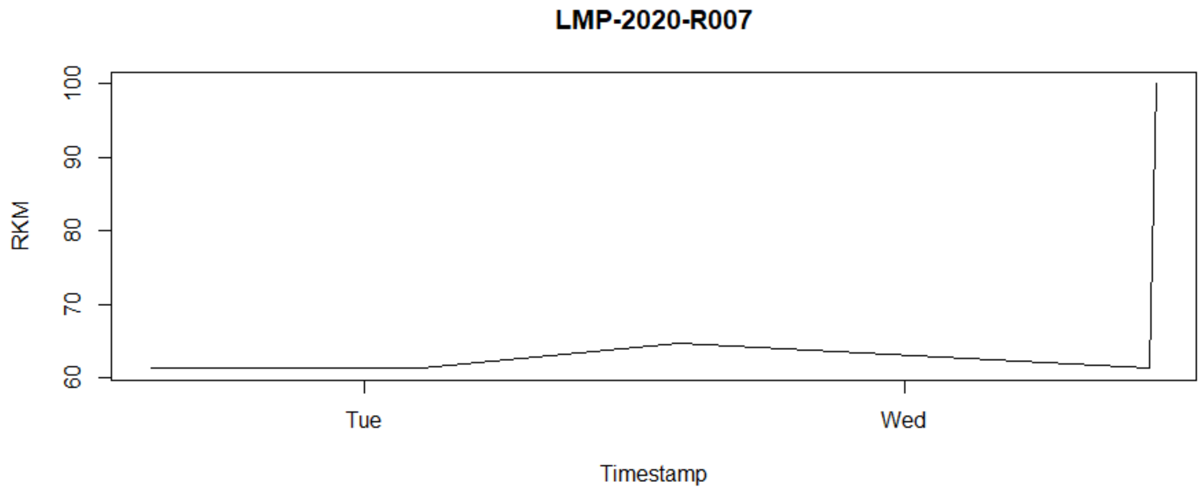
Captured, tagged, and released on Monday, June 1, 2020

First detected on Milford West rxr at 1442 on 6/1

Entered fishway at 1449 on 6/1

Detected on Milford PIT at 0107 on 6/5, but then was detected on droppers before being detected upstream of Milford at 0823 on 6/5. Dropper detections could be false, but regardless passage would have happened the morning of 6/5

Detected on West Enfield PIT at 0352 on 6/6



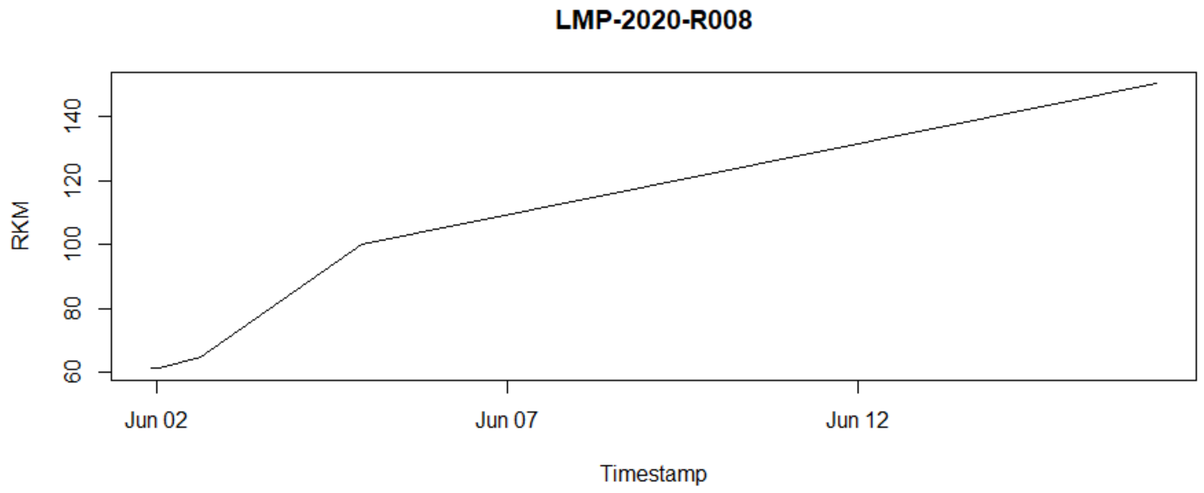
Captured, tagged, and released on Monday, June 1, 2020

First detected on Milford West rxr at 1434 on 6/1

Entered fishway at 1515 on 6/1

Passed Milford at 0230 on 6/2 after 11.25 hours in the fishway

Detected on West Enfield PIT at 1109 on 6/3



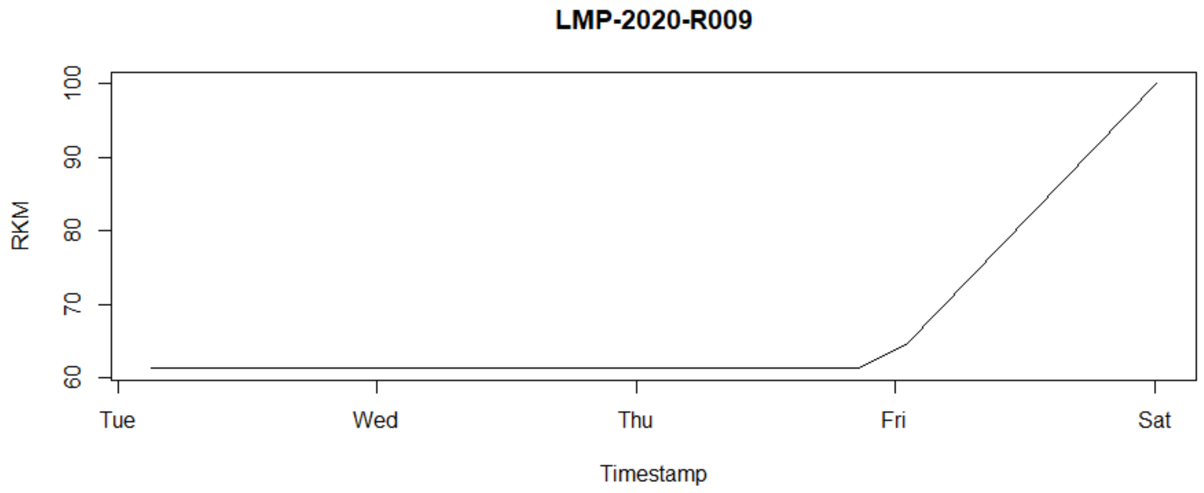
Captured, tagged, and released on Monday, June 1, 2020

First detected on downstream dropper at 2217 on 6/1

Entered fishway at 2217 on 6/1

Passed Milford at 0106 on 6/2 after 2.8 hours in the fishway

Detected passing West Enfield (2202 on 6/4), approached Weldon at 0629 on 6/16



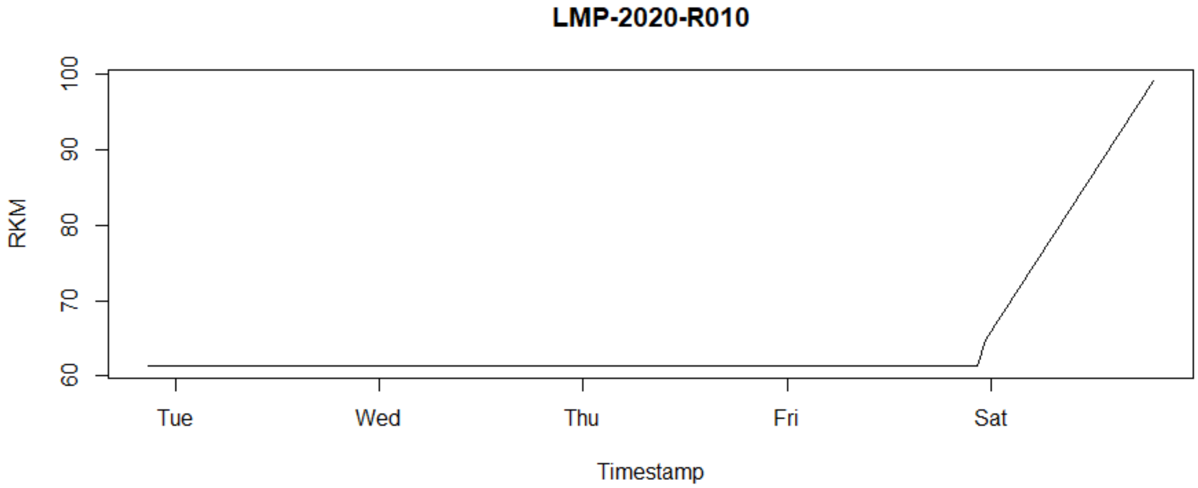
Captured, tagged, and released on Monday, June 1, 2020

First detected on downstream dropper at 0307 on 6/2

Entered the fishway at 0307 on 6/2

Passed Milford at 2037 on 6/4, after 65.5 hours in the fishway

Detected on West Enfield PIT at 0008 on 6/6



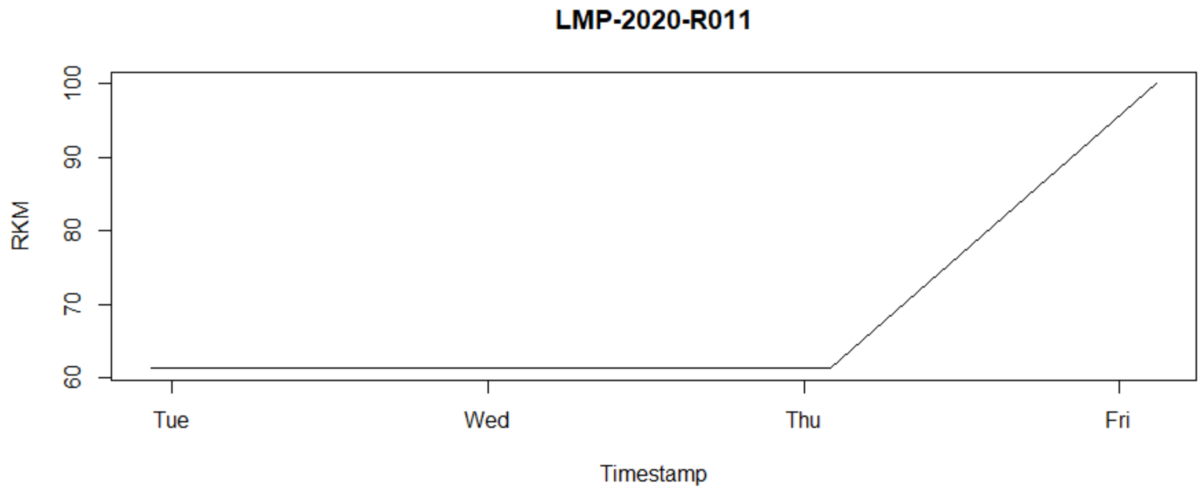
Captured, tagged, and released on Monday, June 1, 2020

First detected on downstream dropper at 2053 on 6/1

Entered fishway at 2053 on 6/1

Passed Milford at 2218 on 6/5, after 97.4 hours in the fishway

Detected in or near Howland bypass at 1902 on 6/6

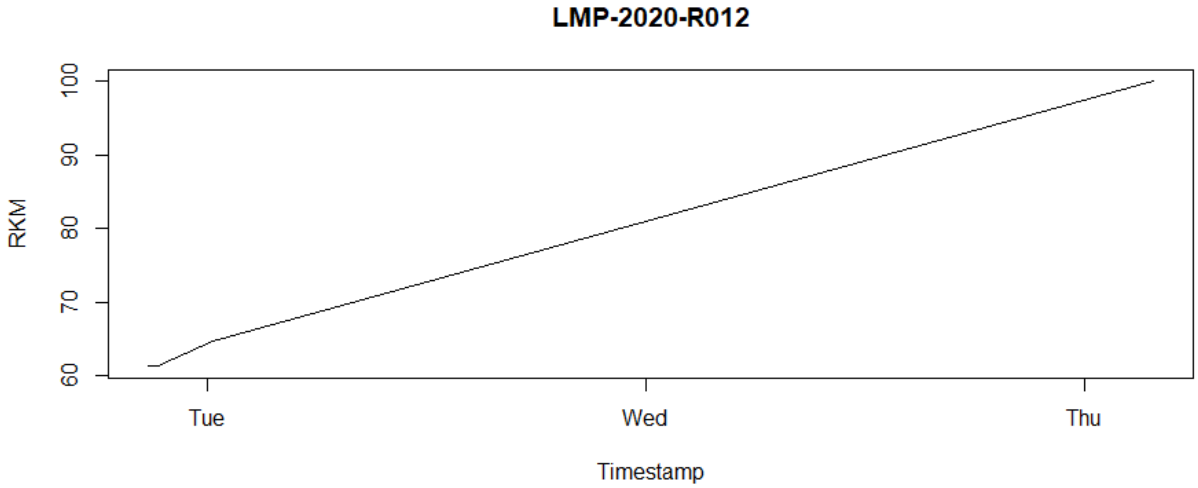


Captured, tagged, and released on Monday, June 1, 2020

First detected on Milford West rxr at 2228 on 6/1

Entered the fishway at 2247 on 6/1

Passed Milford Dam at 0202 on 6/4, after 51.25 hours in the fishway



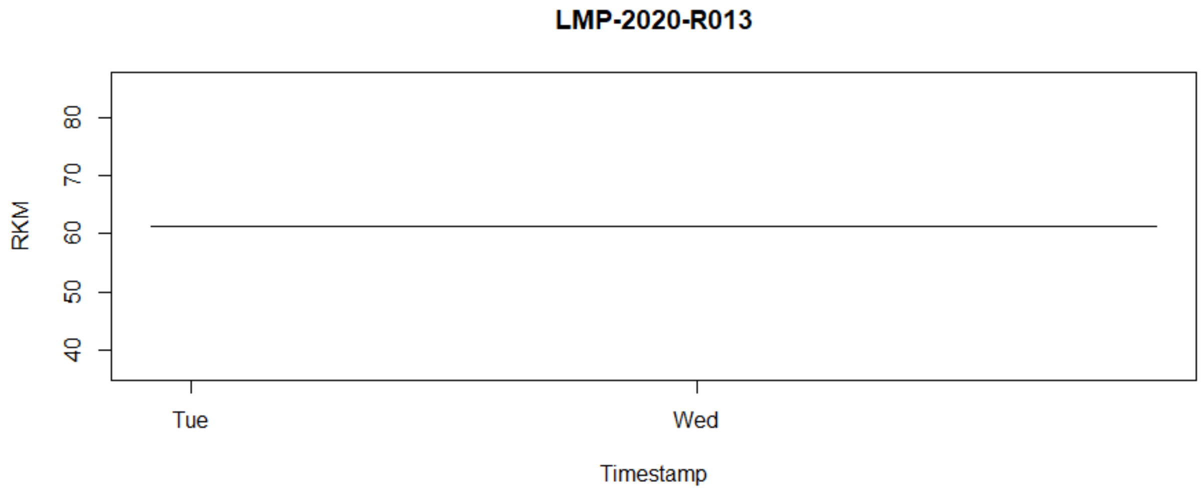
Captured, tagged, and released on Monday, June 1, 2020

First detected on Milford West rxr at 2047 on 6/1

Entered the fishway at 2115 on 6/1

Milford passage occurred sometime between 2135 on 6/1 and 0018 on 6/2

Detected on West Enfield PIT at 0344 on 6/4

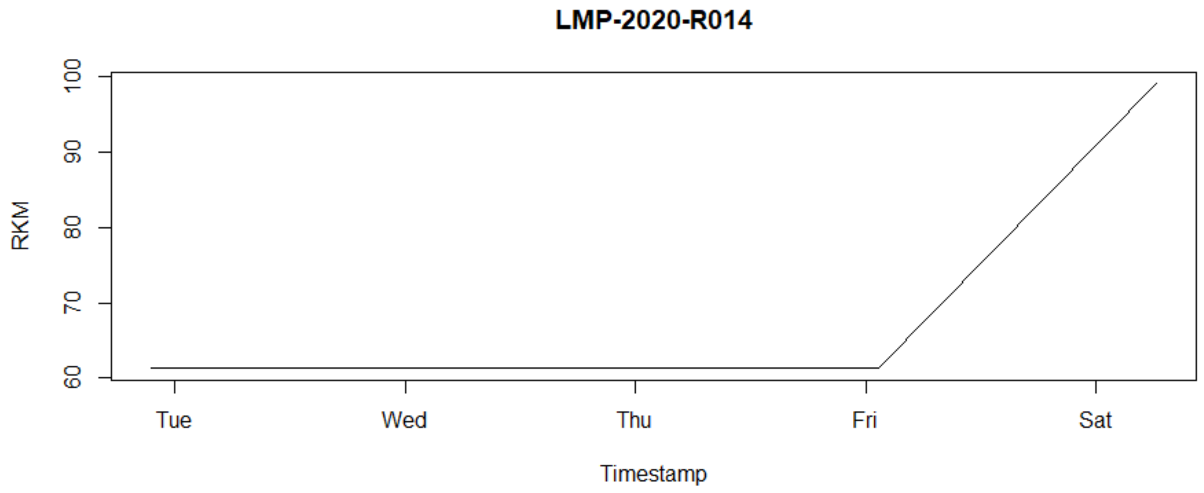


Captured, tagged, and released on Monday, June 1, 2020

First detected on Milford West rxr at 2208 on 6/1

Entered the fishway at 2227 on 6/1

Did not pass Milford; detected in the fishway until the night of 6/3



Captured, tagged, and released on Monday, June 1, 2020

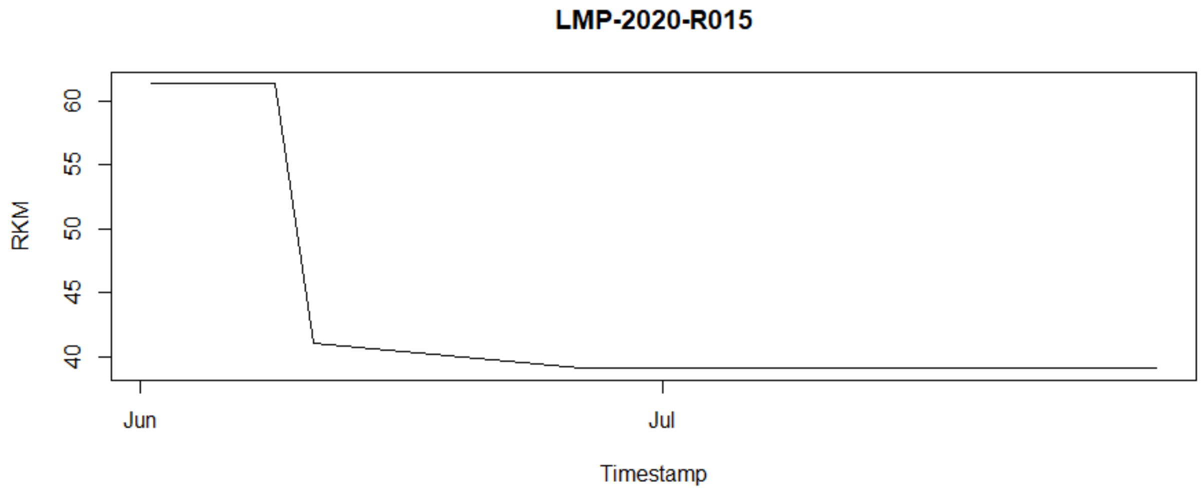
First detected on Milford East Yagi at 2137 on 6/1

Entered the fishway at 0055 on 6/2

Seems to have spent night between 6/4 and 6/5 in upper section of Milford fishway

Passed Milford at 0118 on 6/5 after 72.4 hours in the fishway

Detected in or near Howland bypass at 0617 on 6/6

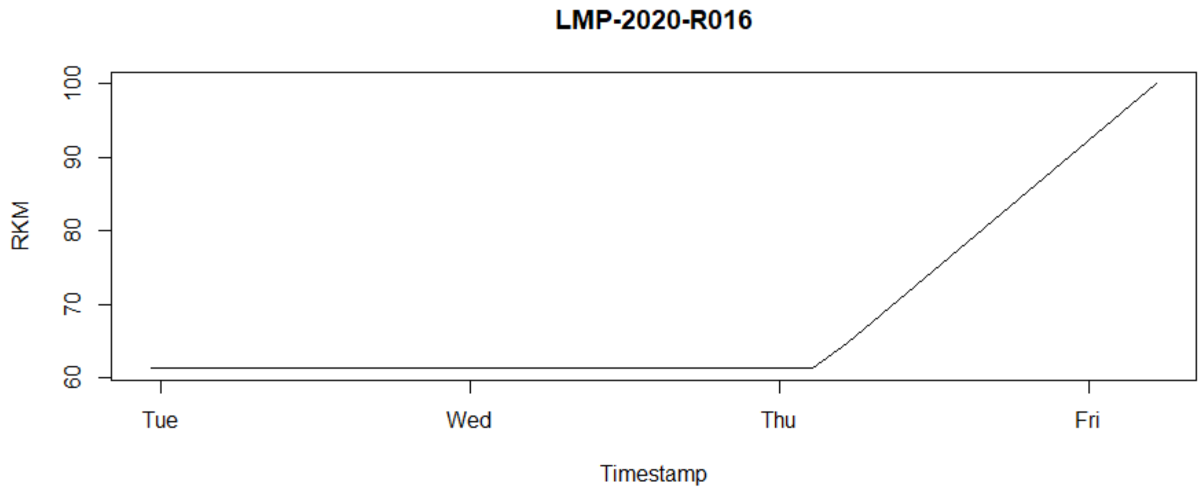


Captured, tagged, and released on Monday, June 1, 2020

Detected on Milford East Yagi at 1625; I assume but am not sure that this was its approach after release

Entered the fishway at 2327 on 6/1

Never detected on upstream dropper--no evidence that it went into trap



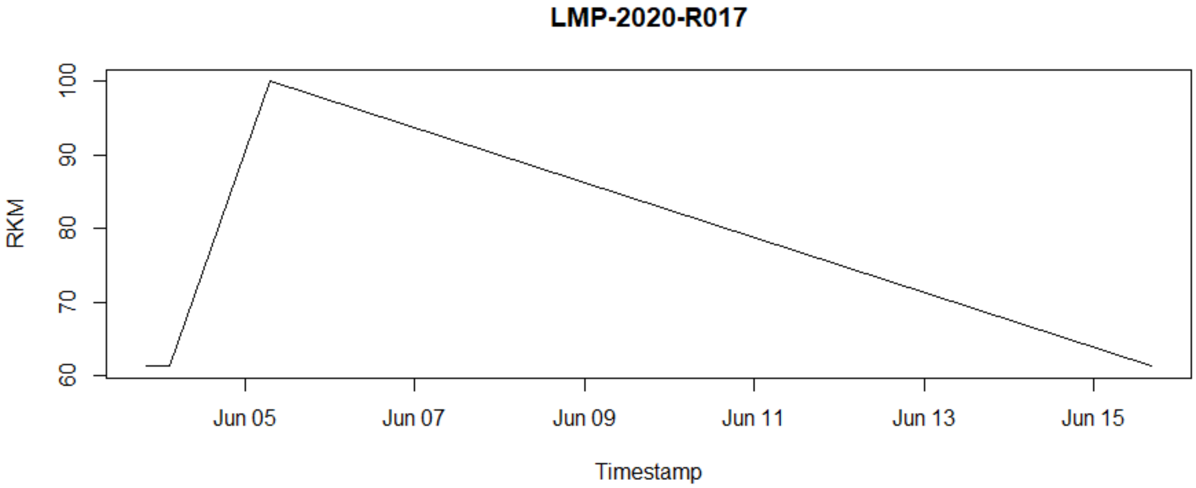
Captured, tagged, and released on Monday, June 1, 2020

First detected on Milford West rxr at 2319 on 6/1

Entered the fishway at 2319 on 6/1

Passed Milford at 0232 on 6/4 after 51.2 hours in the fishway

Detected on West Enfield PIT



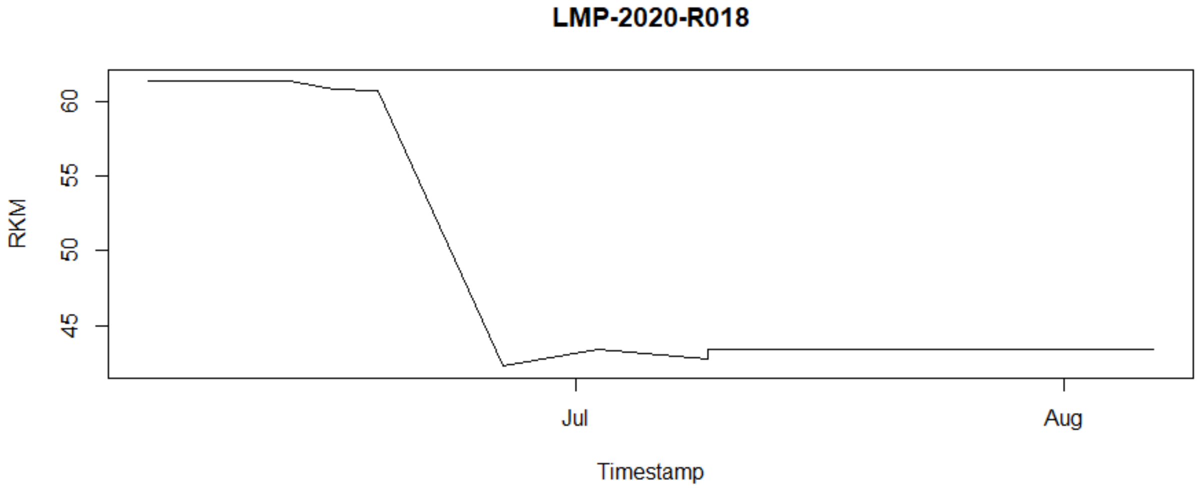
Captured, tagged, and released on Wednesday, June 3, 2020

First detected on downstream dropper at 2019 on 6/3

Entered the fishway at 2019 on 6/3

Passed Milford at 0230 on 6/4, after 6.2 hours in the fishway

Detected on West Enfield PIT at 0712 on 6/5



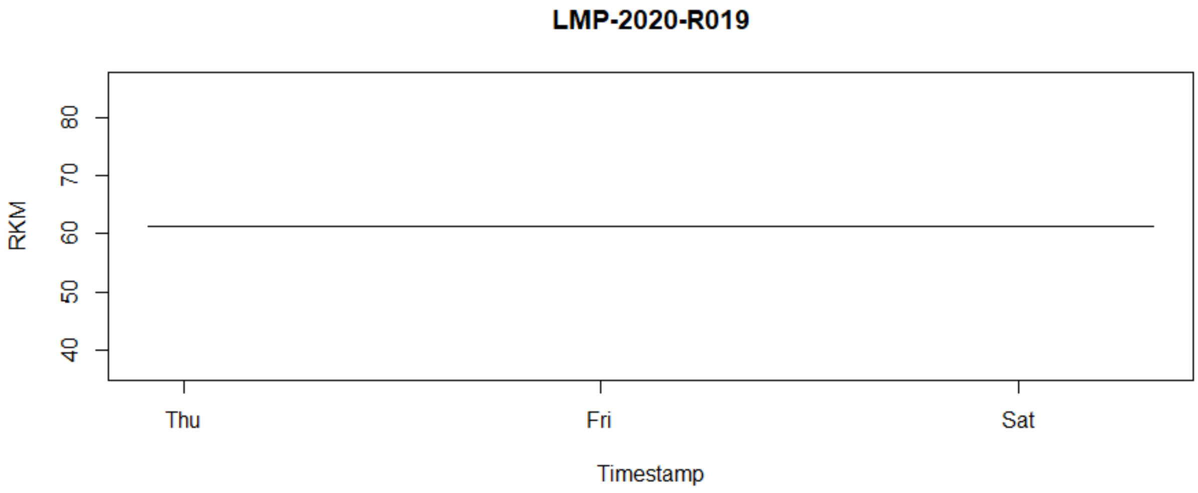
Captured, tagged, and released on Wednesday, June 3, 2020

First detected on Milford East Yagi at 2127 on 6/3

Entered the fishway at 2129 on 6/3

Detected in fishway until 2042 on 6/12

Did not pass Milford; went downstream and was detected via mobile tracking throughout July



Captured, tagged, and released on Wednesday, June 3, 2020

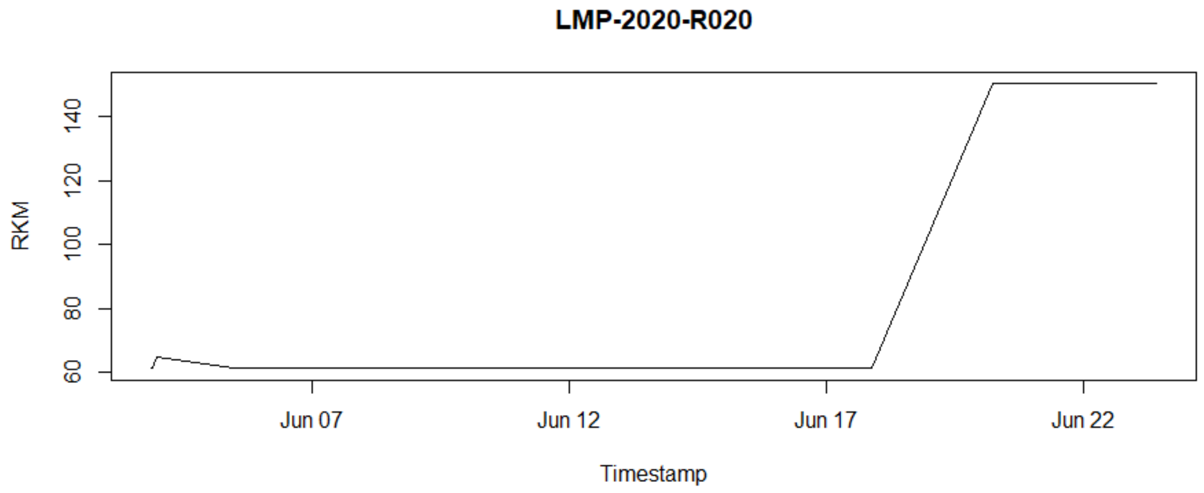
First detected on downstream dropper at 2159 on 6/3

Entered the fishway at 2159 on 6/3

Passed Milford at 0746 on 6/6, after 57.4 hours in the fishway

Detected on Milford PIT at 0443 and 0746 on 6/6, but detected at droppers in between. Dropper detections may be false

Detected on Milford PIT, but nowhere upstream of Milford; assumed to have passed



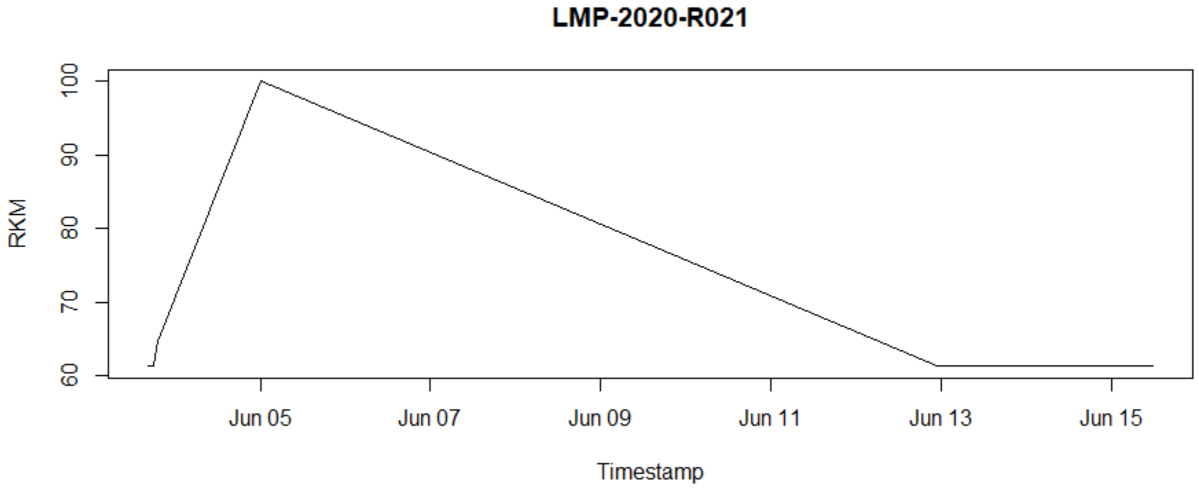
Captured, tagged, and released on Wednesday, June 3, 2020

First detected on downstream dropper at 2113 on 6/3

Entered fishway at 2113 on 6/3

Milford passage occurred sometime between 2130 on 6/17 and 0542 on 6/20

Detected at Weldon the morning of 6/20



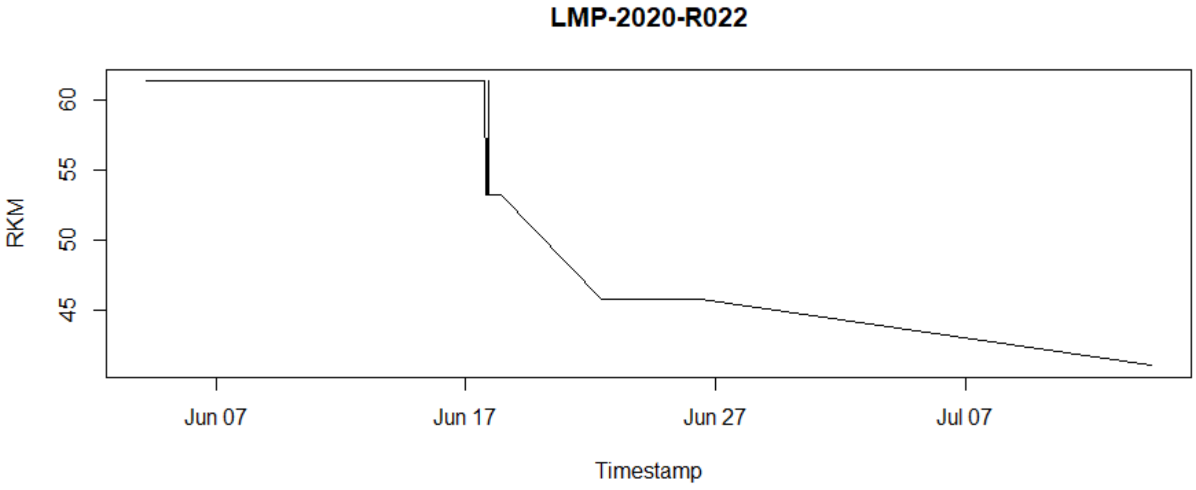
Captured, tagged, and released on Wednesday, June 3, 2020

First detected on downstream dropper at 1631 on 6/3

Entered fishway at 1631 on 6/3

Passed Milford at 1754 on 6/3, after 1.4 hours in the fishway

Detected on West Enfield PIT at 0016 on 6/5



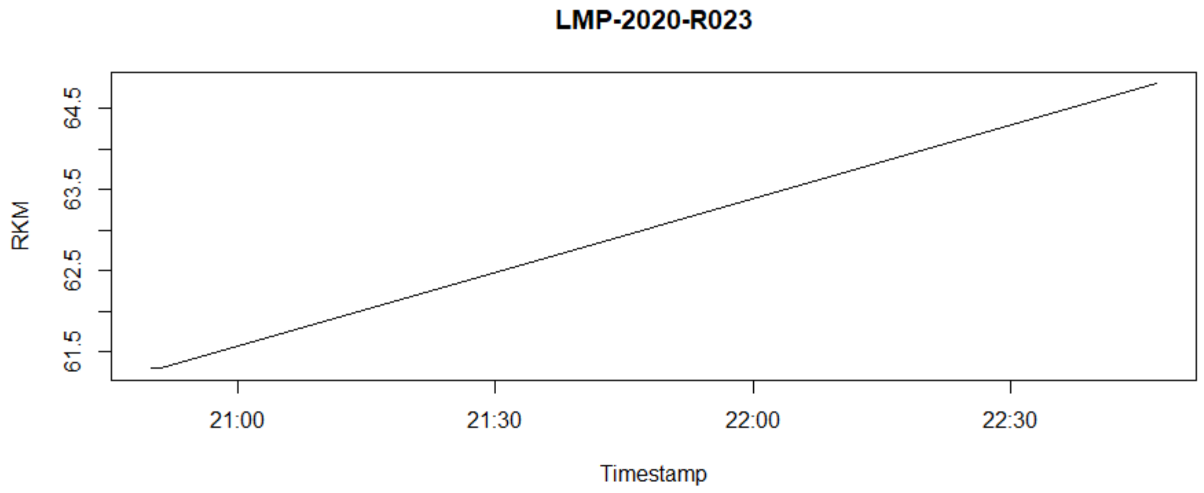
Captured, tagged, and released on Wednesday, June 3, 2020

First detected on downstream dropper at 0523 on 6/4

Entered the fishway at 0523 on 6/4

Was detected on the Milford PIT at 1715 on 6/4, but then seems to have fallen back downstream within a few hours. This fish is counted as NOT passing the dam because I felt that single detection at the PIT antenna was questionable.

Ended up near Orono dam in mainstem, then Bangor headpond



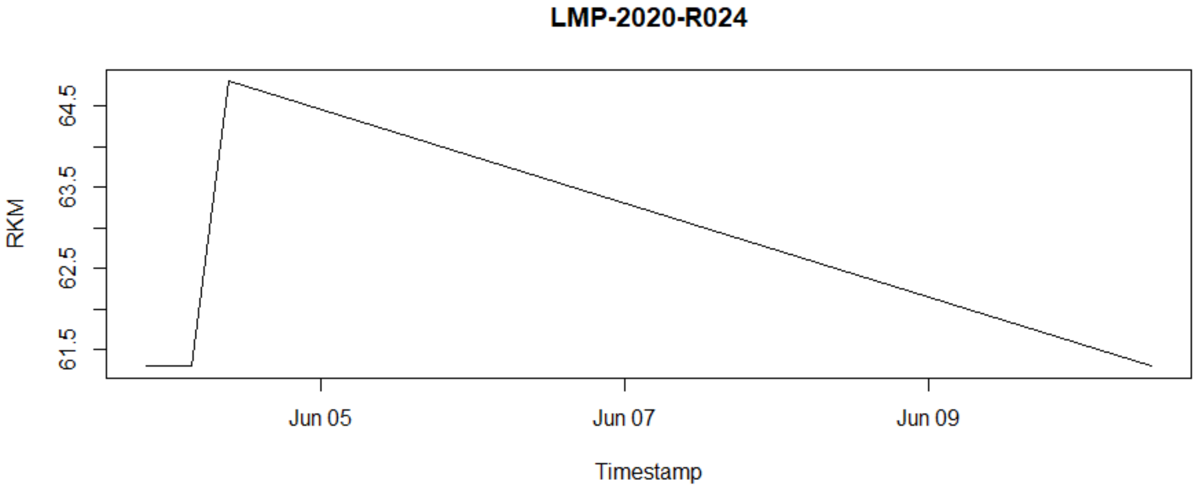
Captured, tagged, and released on Wednesday, June 3, 2020

First detected on upstream dropper at 2050 on 6/3

Entered the fishway at 2050 on 6/3

Milford passage occurred sometime between 2115 on 6/3 and 2247 on 6/3

Detected upstream of Orson Island on mainstem



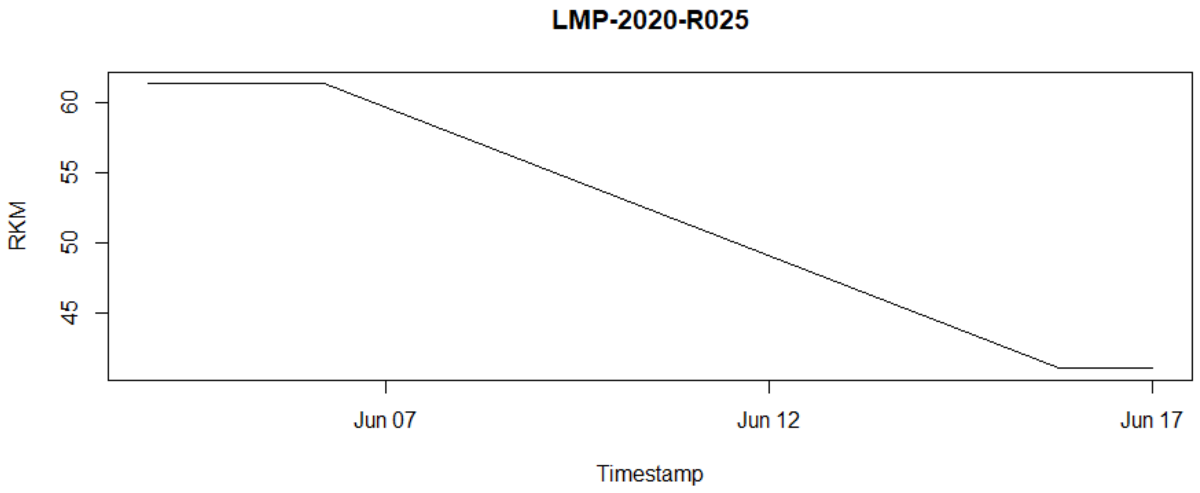
Captured, tagged, and released on Wednesday, June 3, 2020

First detected on downstream dropper at 2027 on 6/3

Entered fishway at 2027 on 6/3

Passed Milford at 0329 on 6/4, after 7 hours in the fishway

Detected upstream of Orson Island on mainstem



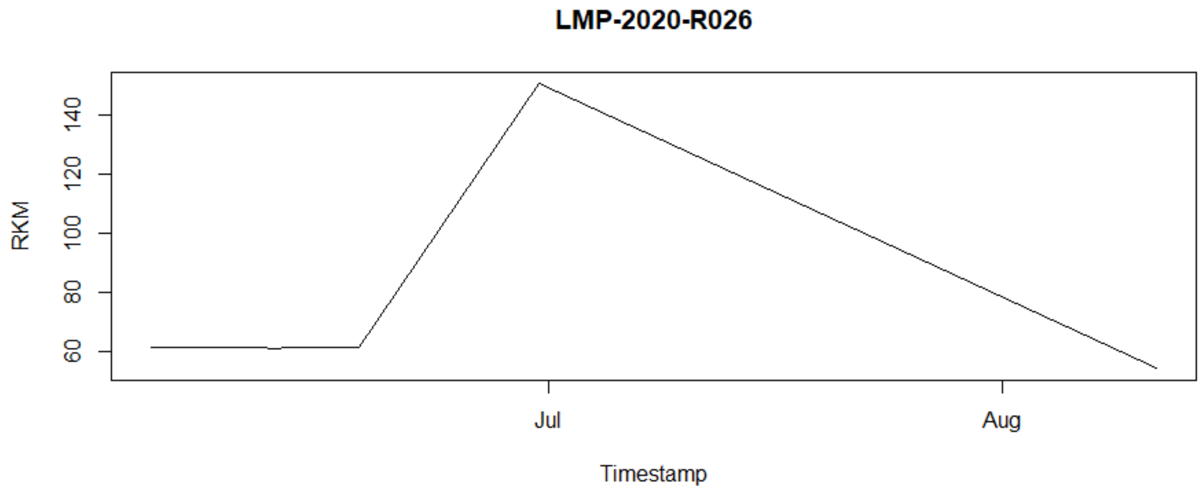
Captured, tagged, and released on Wednesday, June 3, 2020

First detected on downstream dropper at 2157 on 6/3

Entered fishway at 2157 on 6/3

Detected in fishway until at 0459 on 6/6

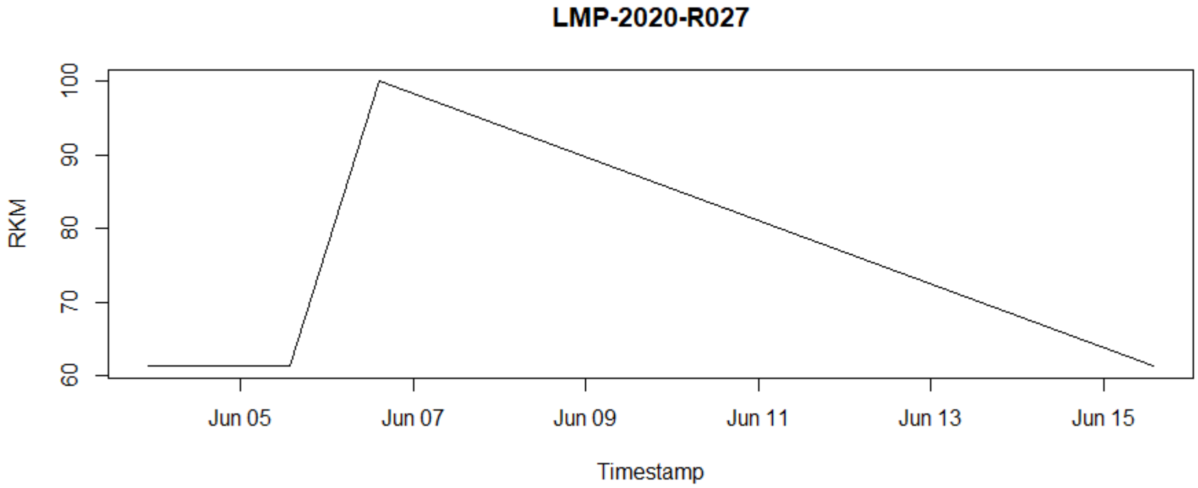
Did not pass Milford. Detected in Bangor headpond mid-June



Captured, tagged, and released on Wednesday, June 3, 2020

First detection was simultaneous on Milford East Yagi (above entrance to fishway), and downstream dropper at 2111 on 6/3

Detected in fishway until mid-June but no solid evidence that it passed the dam



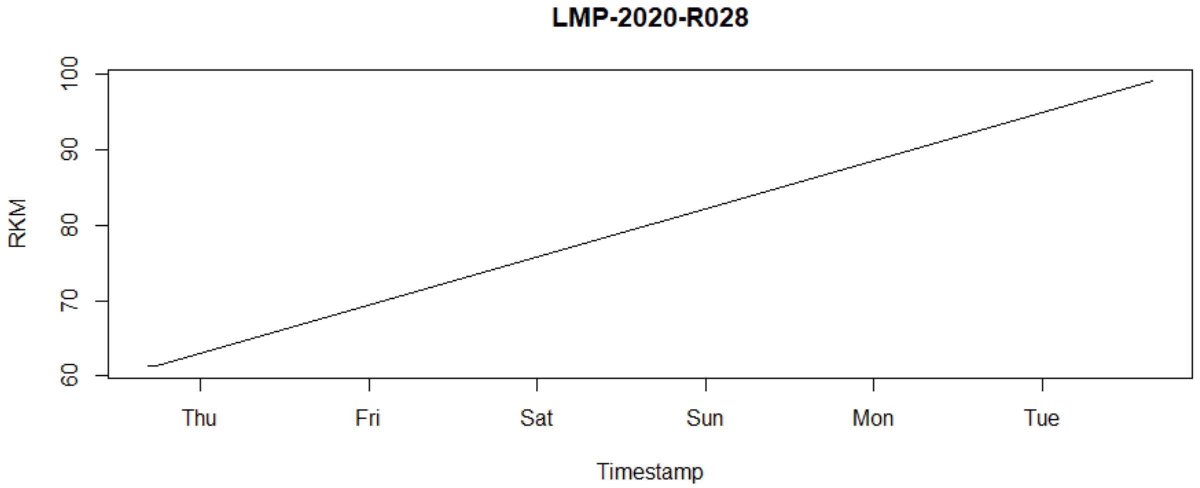
Captured, tagged, and released on Wednesday, June 3, 2020

First detected on downstream dropper at 2223 on 6/3

Detected on Milford PIT at 1744 on 6/4, and was subsequently detected on droppers. May have dropped back before permanently passing on 6/5

Passed Milford at 1334 on 6/5 after spending 39.2 hours in the fishway

Detected on West Enfield PIT at 1437 on 6/6

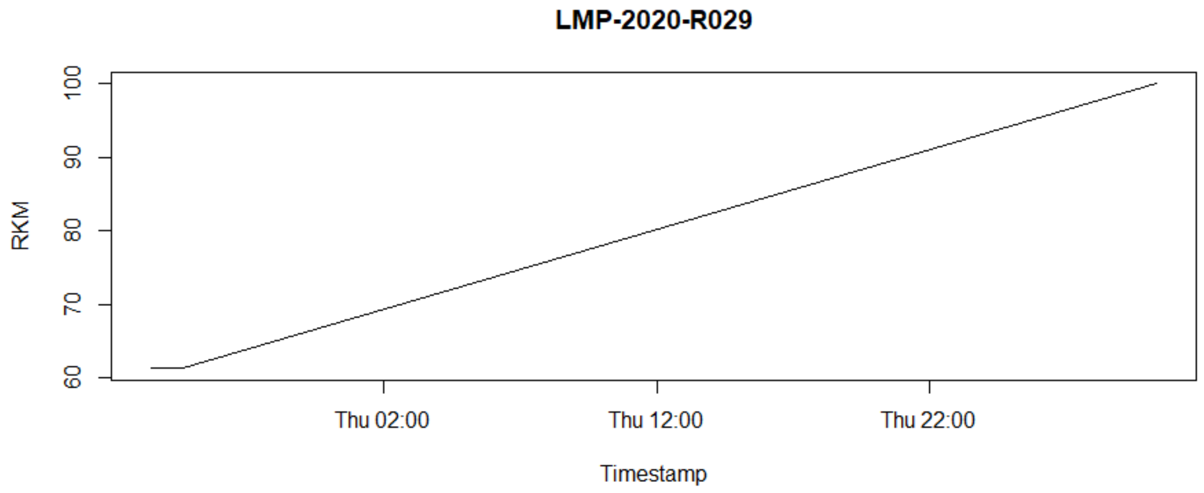


Captured, tagged, and released on Wednesday, June 3, 2020

First detected on downstream dropper at 1635 on 6/3

Passed Milford at 1744 on 6/3, after 1.15 hours in the fishway

Detected in or near Howland bypass on the afternoon of 6/9

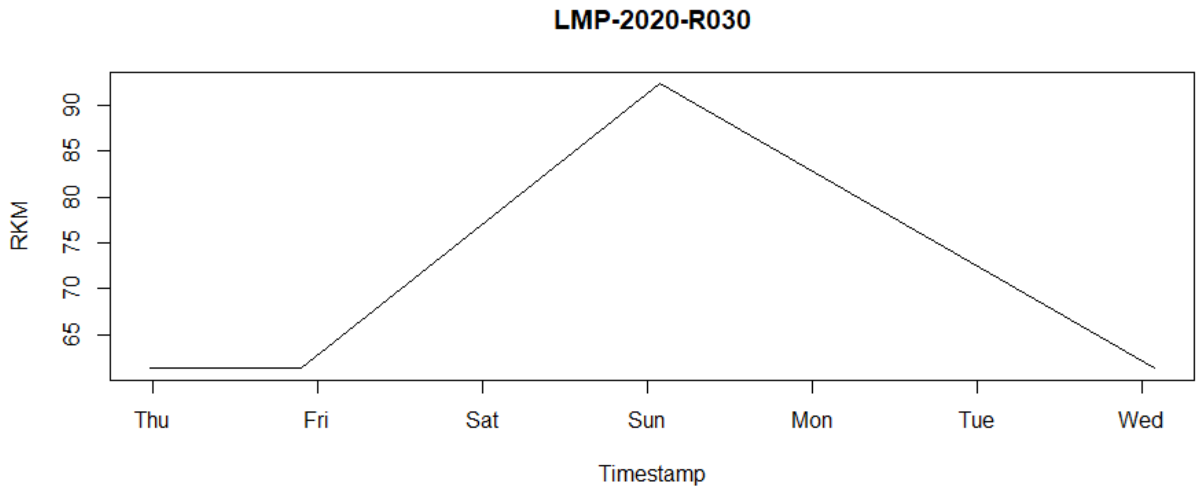


Captured, tagged, and released on Wednesday, June 3, 2020

First detected on downstream dropper at 1731 on 6/3

Passed Milford at 1840 on 6/3 after 0.98 hours in the fishway

Detected on West Enfield PIT at 0617 on 6/5

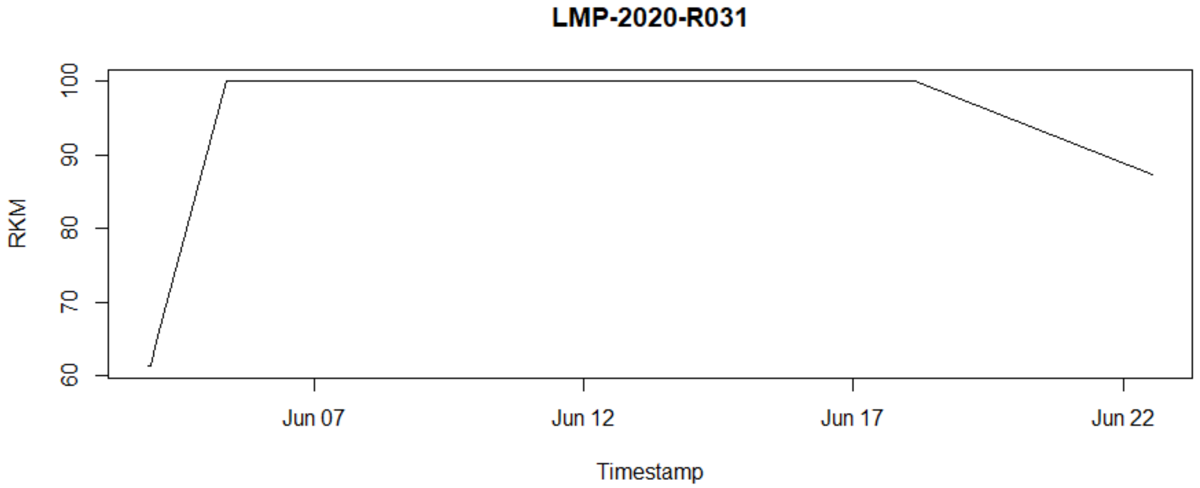


Captured, tagged, and released on Wednesday, June 3, 2020

First detected on downstream dropper at 2347 on 6/3

Milford passage occurred sometime between 2137 on 6/4 and 0147 on 6/7

Detected in mainstem at confluence with Passadumkeag on 6/7

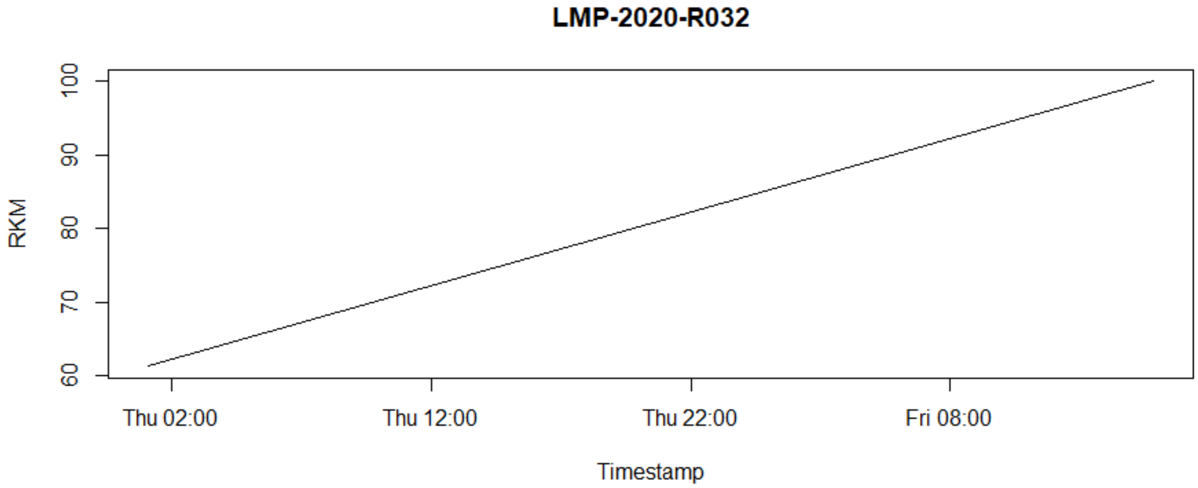


Captured, tagged, and released on Wednesday, June 3, 2020

First detected on upstream dropper at 2225 on 6/3

Milford passage occurred sometime between 6/3 at 2355 and 6/4 at 0144

Detected on West Enfield PIT and in both the headpond and tailrace the night of 6/17-6/18

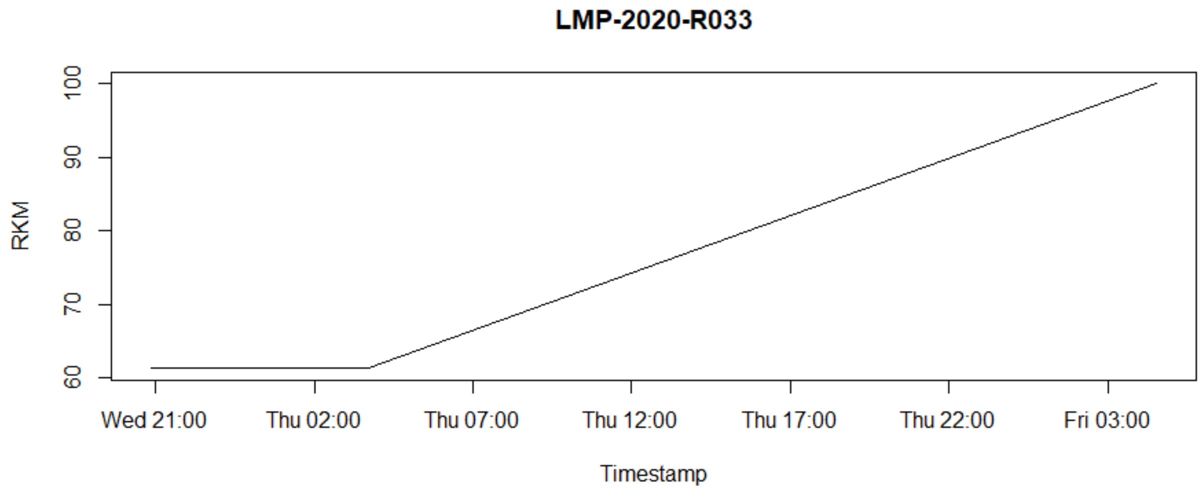


Captured, tagged, and released on Wednesday, June 3, 2020

First detected on Milford PIT at 0107 on 6/4; assumed to pass at this time

Detected on West Enfield PIT at 1549 on 6/5

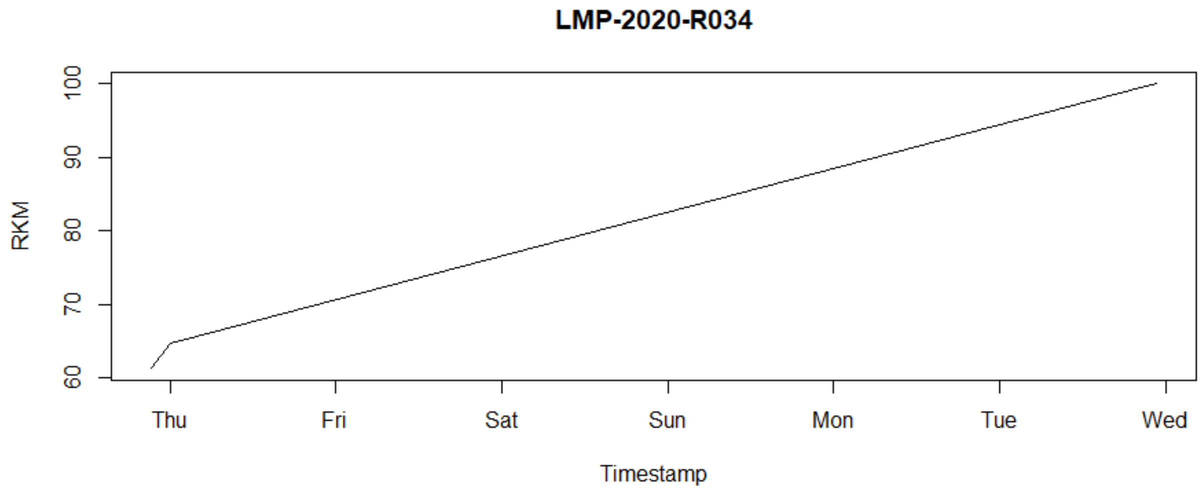
Detected at Great Works in late September, but this detection is unlikely to be real



Captured, tagged, and released on Wednesday, June 3, 2020

First detected on Milford PIT at 2053 on 6/3; assumed to have passed at this time

Detected on West Enfield PIT at 0432 on 6/5

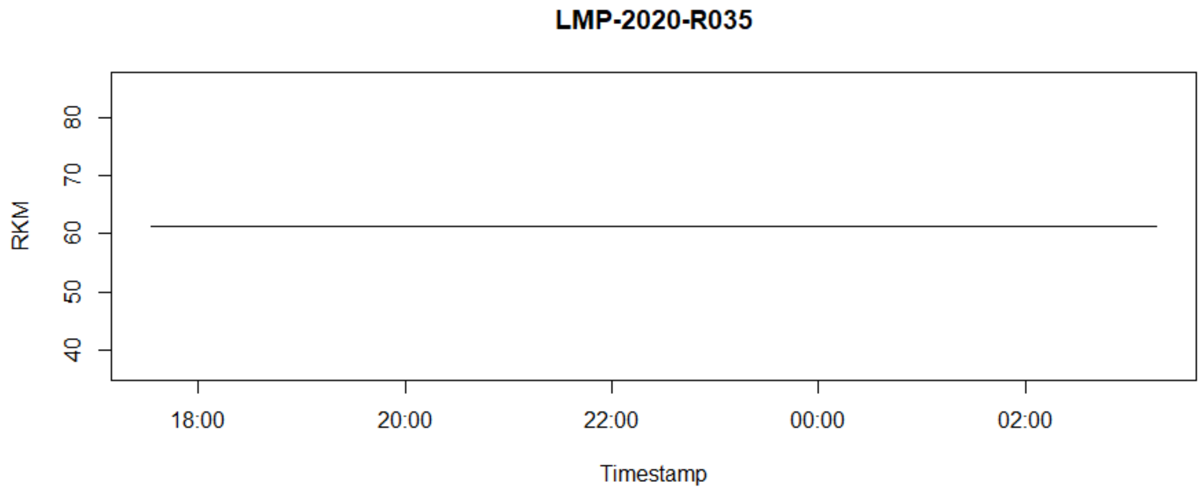


Captured, tagged, and released on Wednesday, June 3, 2020

First detected on upstream dropper at 2123 on 6/3

Milford passage occurred sometime between 2123 on 6/3 and 0003 on 6/4

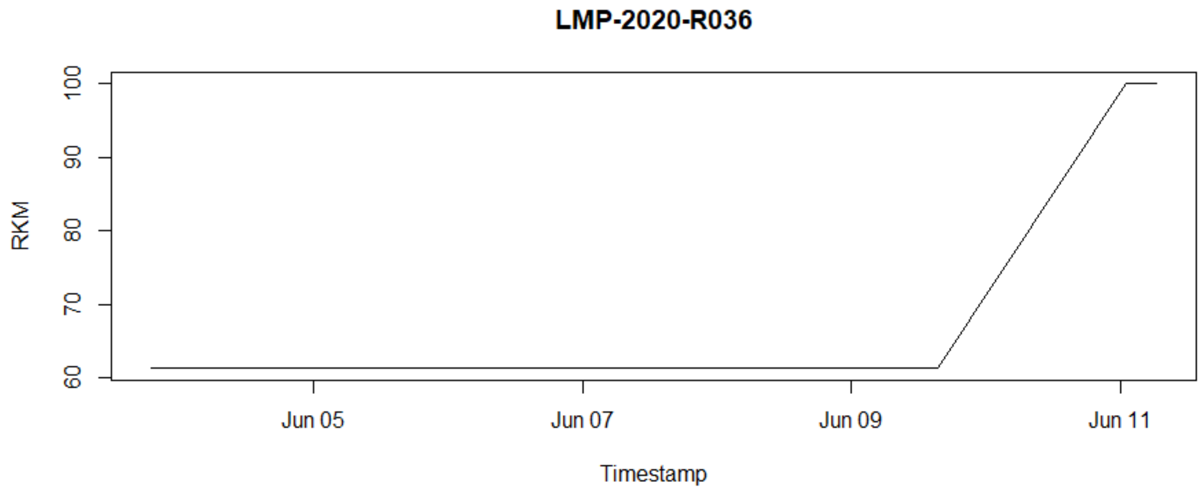
Detected in the West Enfield headpond at 2241 on 6/9



Captured, tagged, and released on Wednesday, June 3, 2020

First detected on downstream dropper at 1733 on 6/3

Passed Milford at 0316 on 6/4

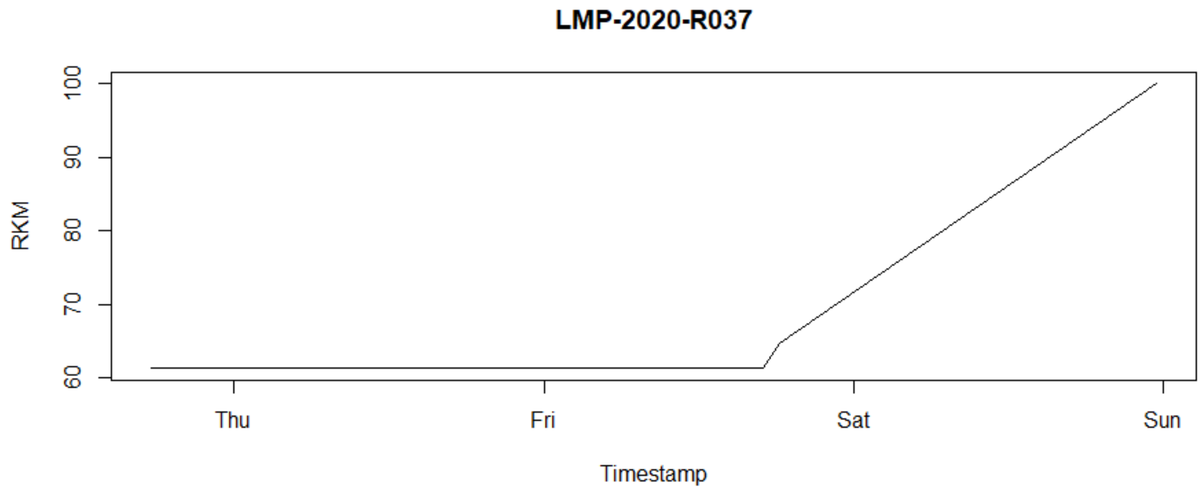


Captured, tagged, and released on Wednesday, June 3, 2020

First detected on downstream dropper at 1906 on 6/3

Milford passage occurred sometime between 1553 on 6/9 and 0103 on 6/11

Detected in West Enfield headpond the morning of 6/11

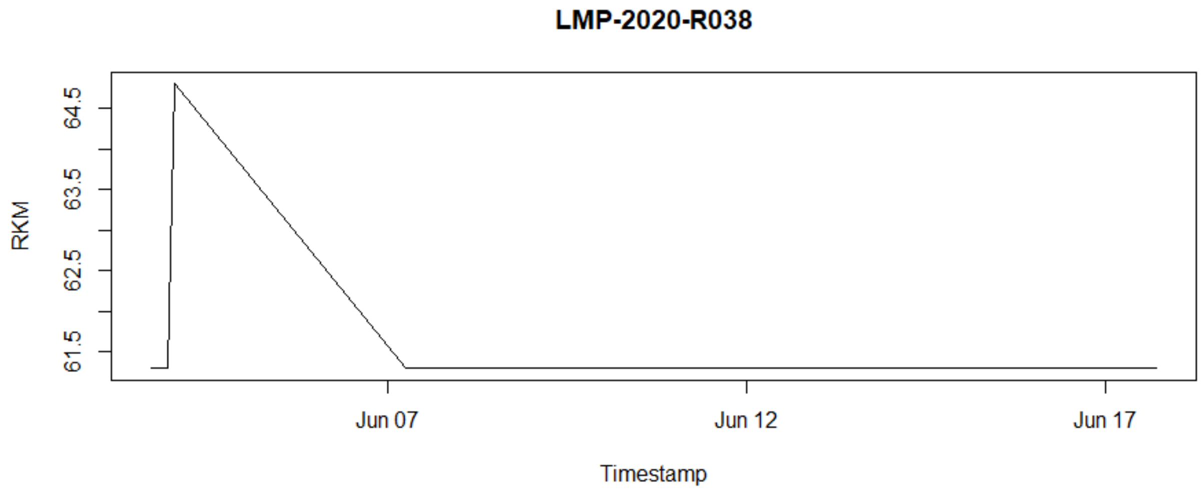


Captured, tagged, and released on Wednesday, June 3, 2020

First detected on downstream dropper at 1736 on 6/3

Passed Milford at 1702 on 6/5, after 47.4 hours in the fishway

Detected on West Enfield PIT at 2328 on 6/6



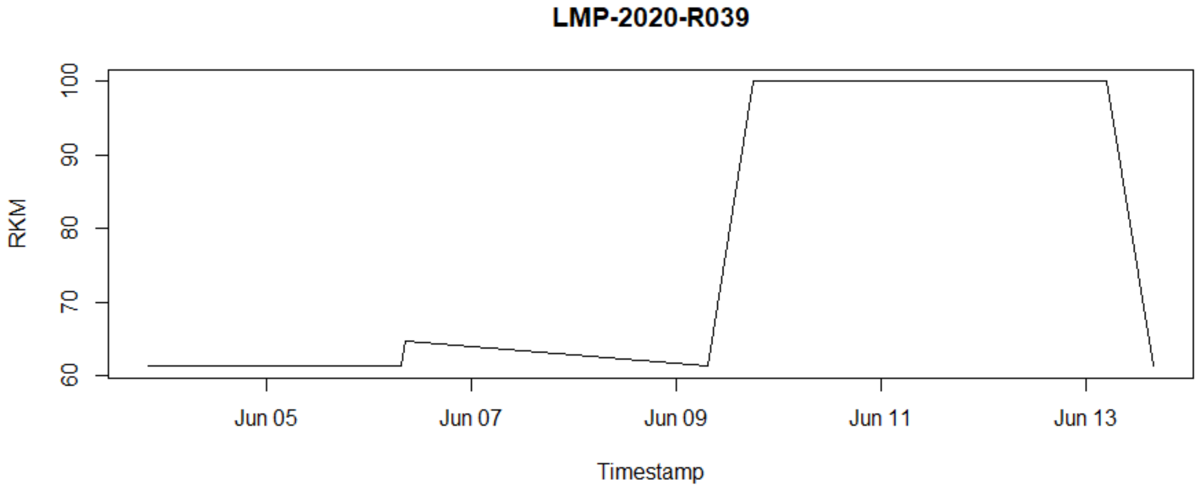
Captured, tagged, and released on Wednesday, June 3, 2020

First detected on Milford East Yagi and both droppers simultaneously at 1718 on 6/3

Milford passage occurred sometime between 2236 on 6/3 and 0048 on 6/4

Detected upstream of Orson Island on mainstem at 0048 on 6/4

Appears to have fallen back below Milford and entered the fishway again, but there is no evidence that it passed a second time

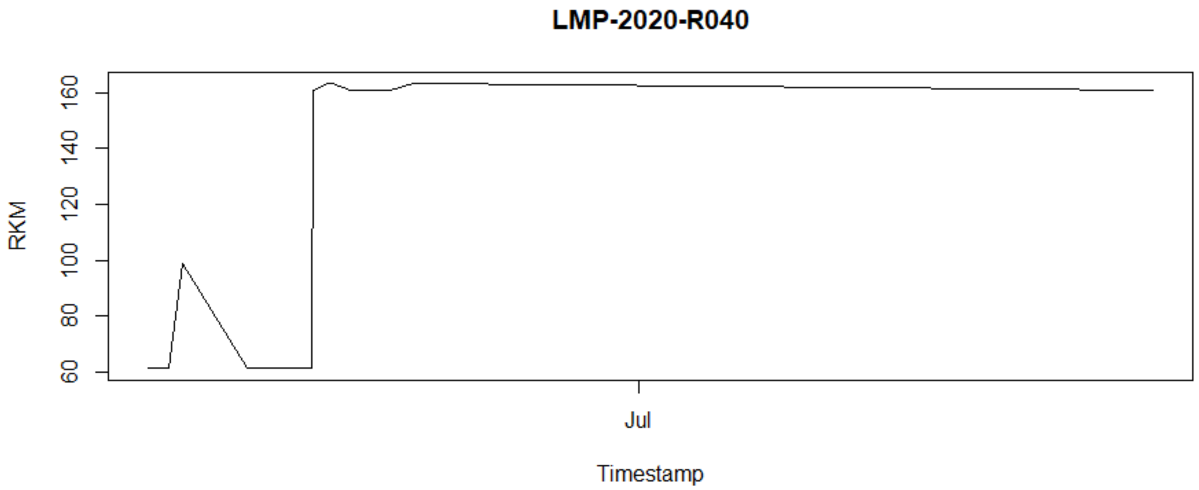


Captured, tagged, and released on Wednesday, June 3, 2020

First detected on downstream dropper at 2028 at 6/3

Passed Milford at 0737 on 6/6, after 59.15 hours in the fishway

Detected in the West Enfield headpond the evening of 6/9

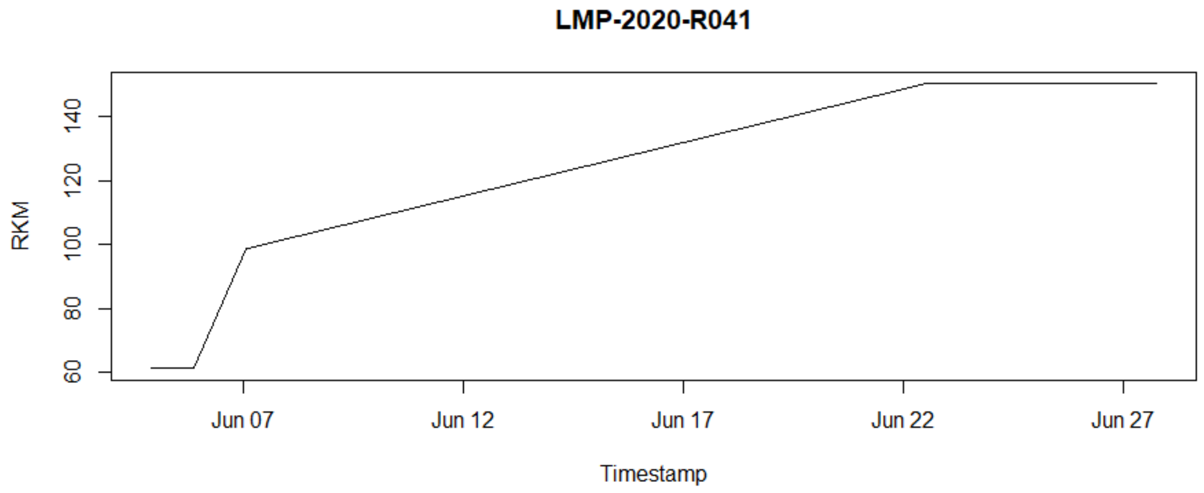


Captured, tagged, and released on Wednesday, June 3, 2020

First detected on downstream dropper at 1740 on 6/3

Passed Milford at 1935 on 6/4, after 25.9 hours in the fishway

Detected approaching Brownsmill on 6/13



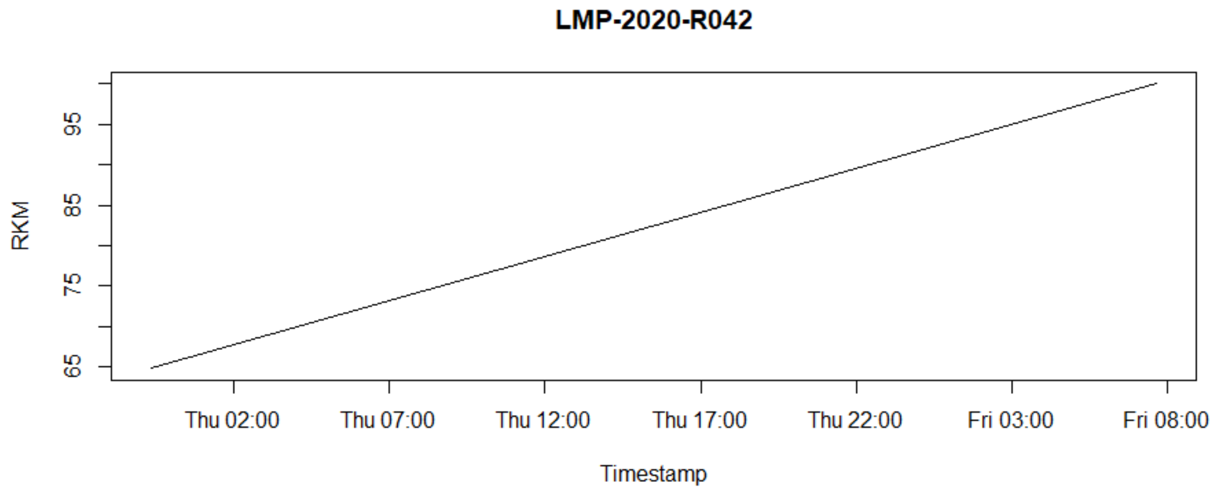
Captured, tagged, and released on Wednesday, June 3, 2020

First detected on downstream dropper at 2158 on 6/4

Passed Milford at 2104 on 6/5 after 23.1 hours in the fishway

Detected in or near Howland bypass in the early morning of 6/7

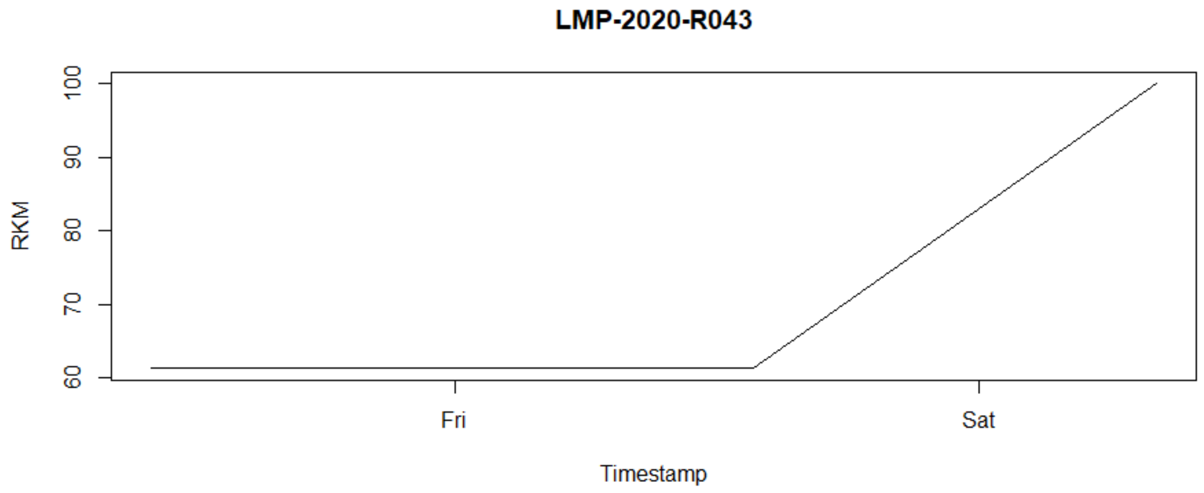
Detected around Weldon 6/22-6/27; according to radio data it may have passed but this is not confirmed by PIT data



Captured, tagged, and released on Wednesday, June 3, 2020

First detected upstream of Orson Island on mainstem (6/3/2020 at 2322)

Detected on West Enfield PIT at 0738 on 6/5

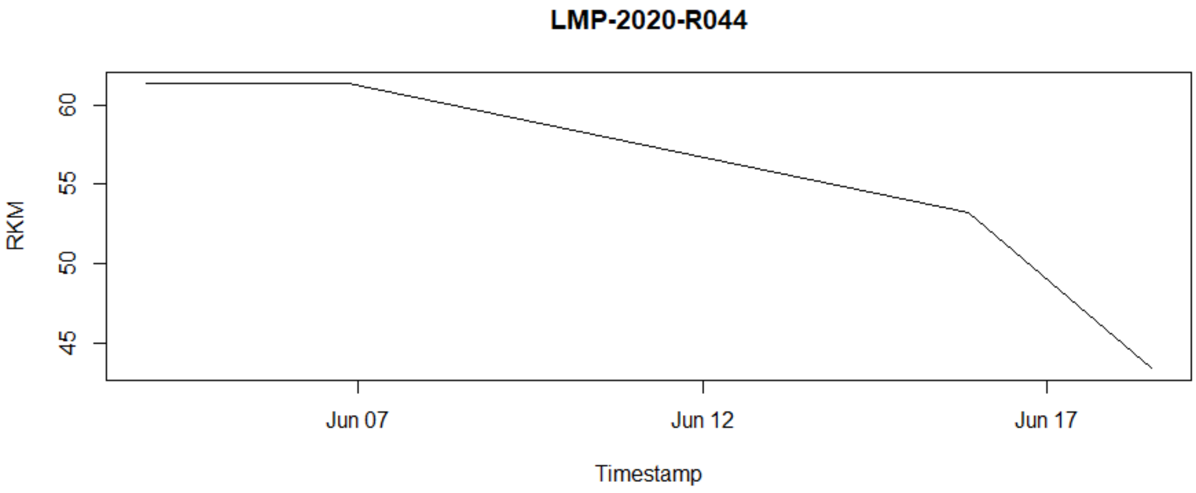


Captured, tagged, and released on Wednesday, June 3, 2020

First detected on downstream dropper at 1010 on 6/4

Passed Milford at 1539 on 6/5 after 29.5 hours in the fishway

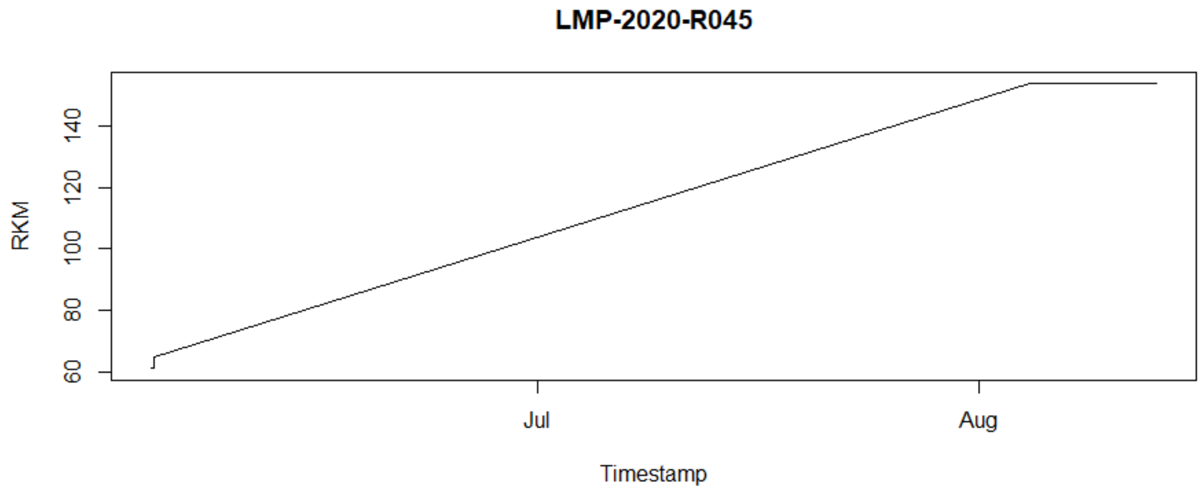
Detected on West Enfield PIT at 0805 on 6/6



Captured, tagged, and released on Wednesday, June 3, 2020

First detected on downstream dropper at 2220 on 6/3

Did not pass Milford. Detected around Orono Dam on mainstem in mid-June

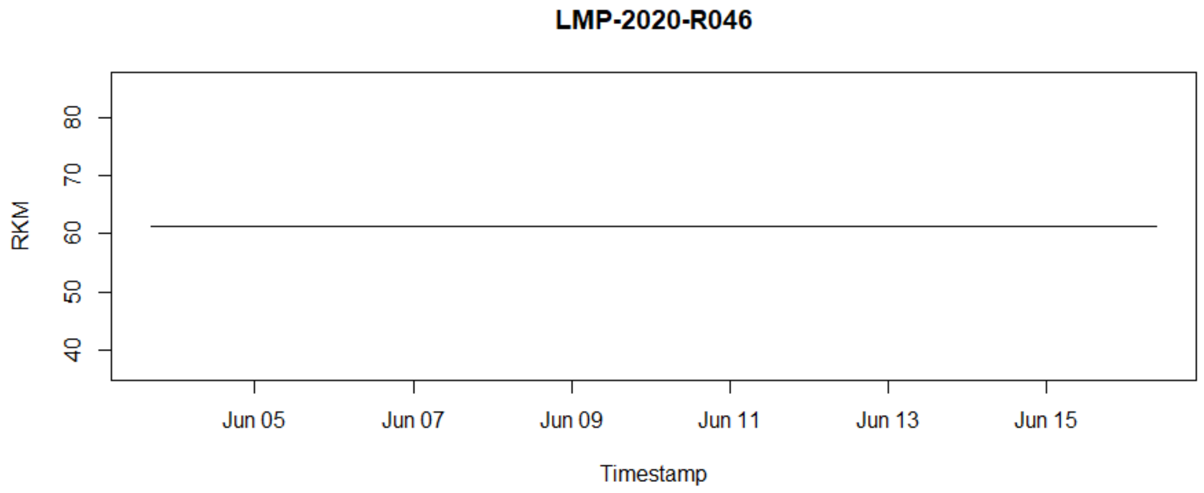


Captured, tagged, and released on Wednesday, June 3, 2020

First detected on downstream dropper at 2138 on 6/3

Milford passage occurred sometime between 0008 and 0211 on 6/4

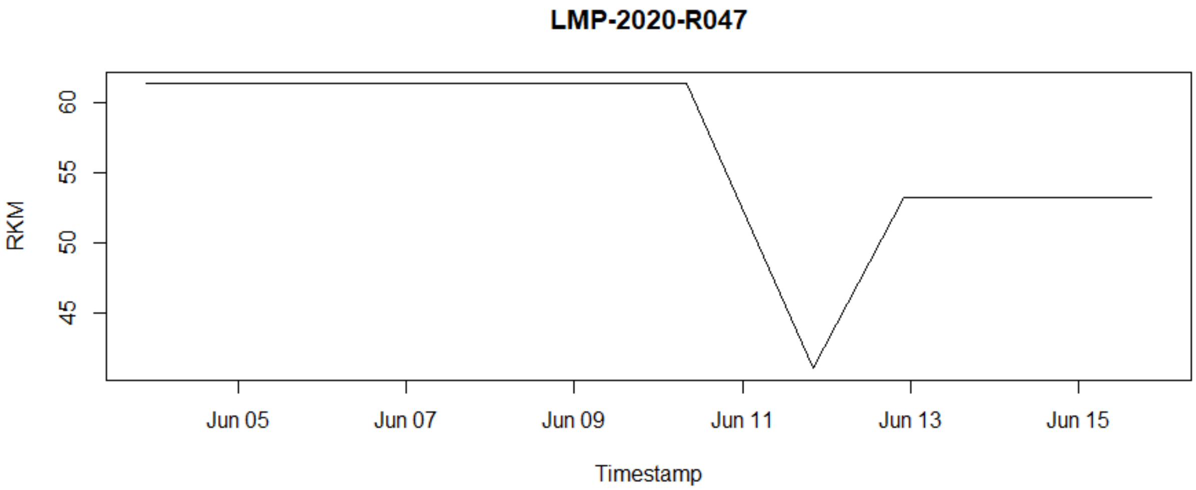
Detected in Pleasant River via mobile tracking



Captured, tagged, and released on Wednesday, June 3, 2020

First detected on downstream dropper at 1642 on 6/3

No evidence that it ever passed Milford

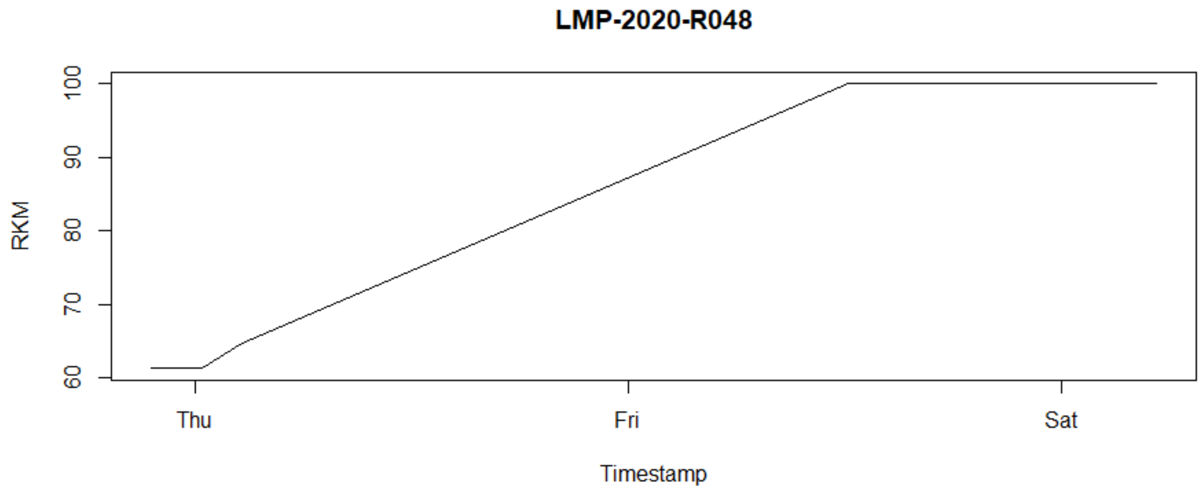


Captured, tagged, and released on Wednesday, June 3, 2020

First detected on upstream dropper at 2148 on 6/3

Detection from Brownsmill is likely false; there is no other evidence that it passed Milford

Ended up near Orono dam on mainstem

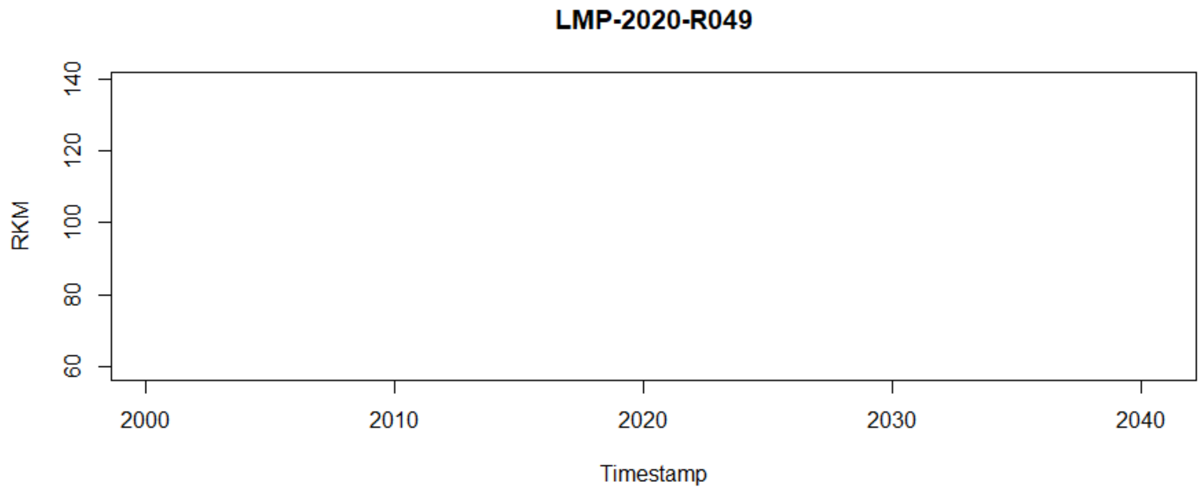


Captured, tagged, and released on Wednesday, June 3, 2020

First detected on upstream dropper at 2134 on 6/3

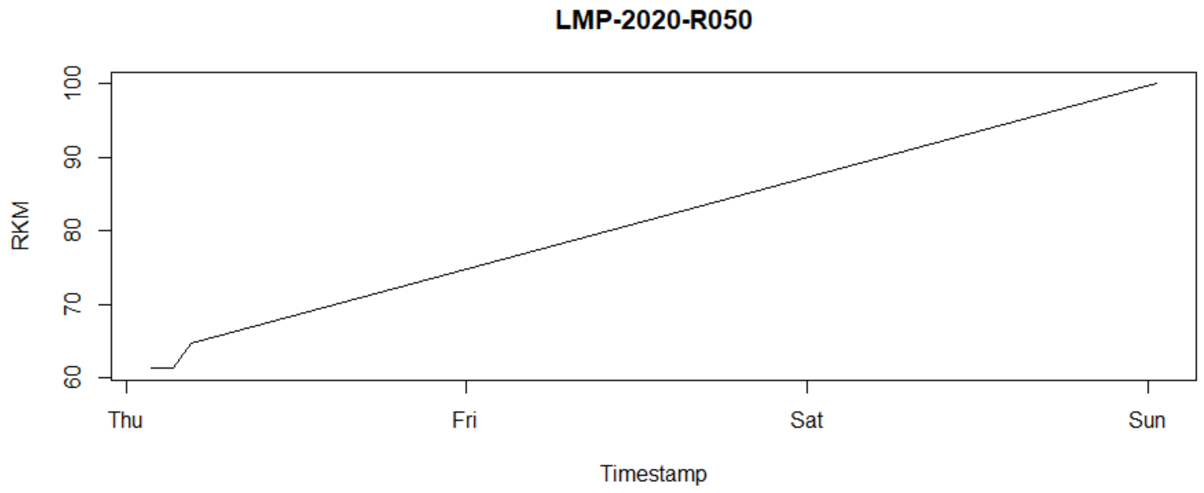
Milford passage occurred sometime between 0022 and 0234 on 6/4

Detected on West Enfield PIT at 1209 on 6/5



Captured, tagged, and released on Wednesday, June 3, 2020

Only detections of this fish are from in or near the Howland bypass on afternoon of 6/5. Detections appear to be real.



Captured, tagged, and released on Wednesday, June 3, 2020

First detected on Milford PIT at 0150 on 6/4; assumed to have passed at this time

Detected on West Enfield PIT at 0035 on 6/7

Attachment 3

Lockwood, MS-K28 and MS-K29 and for Weston control smolts at the Weston Project, MS-K6, MS-K7, Shawmut, MS-K14, Hydro Kennebec, MS-K21, Lockwood, MS-K28 and MS-K29. Passage was summed for Shawmut test smolts at the Shawmut release site, Shawmut, MS-K14, Hydro Kennebec, MS-K21, Lockwood, MS-K28 and MS-K29 and for Shawmut control smolts at Shawmut, MS-K14, Hydro Kennebec, MS-K21, Lockwood, MS-K28 and MS-K29. Passage was summed for Hydro Kennebec test smolts at the Hydro Kennebec release site, Hydro Kennebec, MS-K21, Lockwood, MS-K28 and MS-K29 and for Hydro Kennebec control smolts at Hydro Kennebec, MS-K21, Lockwood, MS-K28 and MS-K29. Passage was summed for Lockwood control smolts at MS-K28 and MS-K29. Where reach-specific survivorship probabilities were available (Tables 45, 46, and 47 in the draft BWPH smolt report and Table 15 in the draft HKLLC smolt report), those values were overlaid on the figure to provide a graphical presentation of smolt survival over the entire Kennebec River study reach.

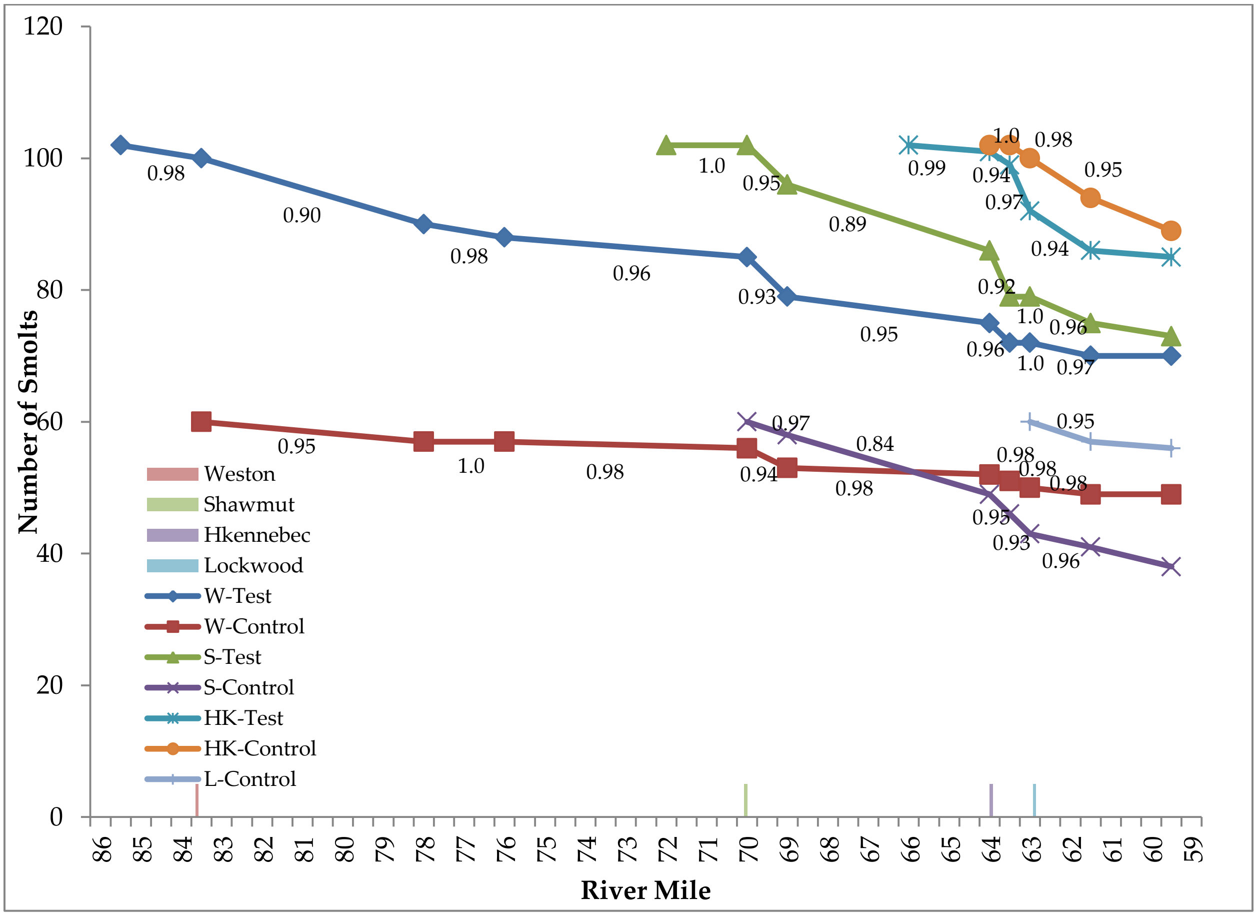


Figure 1 – Response 16: Overall survival (based on transmitter detections) for radio-tagged Atlantic salmon smolts moving through ten reaches of the Kennebec River. Project locations marked with vertical bars. Program MARK reach estimates overlaid on reaches for reference.

Attachment 4

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1.0 MDMR authority

The Maine Department of Marine Resources (MDMR) is a cabinet level agency of the State of Maine. MDMR was established to regulate, conserve, and develop marine, estuarine, and diadromous fish resources; to conduct and sponsor scientific research; to promote and develop marine coastal industries; to advise and cooperate with state, local, and federal officials concerning activities in coastal waters; and to implement, administer, and enforce the laws and regulations necessary for these purposes. MDMR is the lead state agency in the restoration and management of diadromous (anadromous and catadromous) species of fishes. MDMR's policy is to restore Maine's native diadromous fish to their historical habitat.

2.0 Description of the drainage

The Kennebec River, Maine's second largest river, has a total drainage area of 5,930 square miles (ENSR 2007). Major tributaries, listed from upstream to downstream, include the Moose River, Dead River, Carrabassett River, Sandy River, Sebasticook River, Messalonskee Stream, and Cobbosseecontee Stream. The Kennebec River originates at Moosehead Lake and flows south approximately 233 km (145 mi) where it is joined by the Androscoggin River, Maine's third largest river, to form Merrymeeting Bay. The Kennebec River then travels approximately 30 km (19 mi) before exiting to the ocean at Fort Popham. Major communities located along the mainstem of the Kennebec River include Bingham, Anson, Madison, Norridgewock, Skowhegan, Waterville, Winslow, Augusta, Hallowell, and Gardiner. The upper two-thirds of the basin, generally above Waterville, is hilly and mountainous, being part of the Appalachian Mountain Range. The lower third of the basin, including the Sebasticook River and Cobbosseecontee Stream tributary areas, has a gentler topography representative of the coastal area. The Carrabassett River and Sandy River are major contributors to flooding in the watershed; both tributaries are considered hydrologically flashy and contribute approximately 40% of the peak discharge of the Kennebec River during flood events (ENSR 2007).

2.1 Focus area

This document focuses on the regions of the Kennebec River basin that were historically inhabited by diadromous fishes, specifically the Kennebec River from the Williams Project to the Gulf of Maine and seven tributaries (the Carrabassett River, Sandy River, Sebasticook River, Messalonskee Stream; Seven Mile Stream; and Cobbosseecontee Stream). The focus area is comprised of four major hydrologic zones (Figure 1). The upper Kennebec River from the Williams Project to the Lockwood Project (rkm 181-101) is comprised of impounded river separated by short sections of flowing river. The restored Kennebec River from the Lockwood Dam to the head-of-tide and former location of the Edwards Dam (rkm 101-74) is free-flowing riverine habitat with a defined channel. The upper Kennebec River estuary (rkm 74-45), Merrymeeting Bay (rkm 45-30) and the Androscoggin River estuary (Brunswick Project downstream to former Bay Bridge) are tidal freshwater habitat. The lower Kennebec Estuary (rkm 0-30) is tidal with salinity ranging from 0–32‰ depending on location and freshwater discharge. The temporal scope of the document includes the past, present, and reasonably foreseeable future actions for the next 40-50 years and their effects on migratory fish and the fisheries they support. This document focuses on upstream and downstream diadromous fish movement and access to spawning/rearing habitat in the Kennebec River and its tributaries, including an evaluation of the dams that act as barriers to fish movement in the river. MDMR's restoration efforts in the focus area have been ongoing since 1987 (Table 1).

2.2 Water classifications

Kennebec River, main stem.
From the Route 201A bridge in Anson-Madison to the Fairfield-Skowhegan boundary, including all impoundments - Class B.
From the Fairfield-Skowhegan boundary to the Shawmut Dam - Class C.
From the Shawmut Dam to its confluence with Messalonskee Stream, excluding all impoundments - Class B.
Waters impounded by the Hydro-Kennebec Dam and the Lockwood Dam in Waterville-Winslow - Class C.
From its confluence with Messalonskee Stream to the Sidney-Augusta boundary, including all impoundments - Class B.

Sandy River, main stem.
From the outlet of Sandy River Ponds to the Route 142 bridge in Phillips - Class AA.
From the Route 142 bridge in Phillips to its confluence with the Kennebec River - Class B.
Sandy River, tributaries - Class B unless otherwise specified.
All tributaries entering above the Route 142 bridge in Phillips - Class A.
Wilson Stream, main stem, below the outlet of Wilson Pond - Class C.

Carrabassett River, main stem.
Above a point located 1.0 mile above the dam in Kingfield - Class AA.
From a point located 1.0 mile above the dam in Kingfield to a point located 1.0 mile above the railroad bridge in North Anson - Class A.
From a point located 1.0 mile above the railroad bridge in North Anson to its confluence with the Kennebec River - Class B.
Carrabassett River, tributaries - Class A unless otherwise specified.
South Branch Carrabassett River - Class AA. The Legislature finds, however, that permitted water withdrawal from this river segment provides significant social and economic benefits and that this existing use may be maintained.
All tributaries entering the Carrabassett River below the Wire Bridge in New Portland - Class B.
West Branch Carrabassett River above its confluence with Alder Stream - Class AA

In addition, the mainstem Kennebec between MillStream in Norridgewock andWeston Dam is in Category 4-C for flow regime alternations (MDEP 2016).

2.3 Hydropower in the Kennebec Watershed

Hydropower projects approved by the Federal Energy Regulatory Commission (FERC) operate under the terms of a license or an exemption (MDEP 2007). Licenses are issued under the Federal Power Act for the development or continued operation of non-federal waterpower projects. Licenses are valid for a maximum of 50 years. Under FERC's regulations, a licensee must file to relicense a project no later than 2 years prior to the license expiration date. When a license expires, FERC may deny license renewal, issue a new license to the original licensee or a new licensee, or recommend to Congress that the United States acquire the project. If action has not been taken by the license expiration date, the project will operate on an annual license until relicensing action is taken. Exemptions from the licensing provisions of the Federal Power Act are issued in perpetuity for the development of non-federal waterpower projects having a capacity of 5,000 KW or less and utilizing an existing dam or natural water feature. Exemptions are subject to conditions imposed by fish and wildlife agencies

Currently there are 16 federally licensed hydropower projects (18 dams) within this geographical range (Table 2; Figure 1). Three hydropower projects have been decommissioned and removed on the Lower Kennebec and major tributaries. Edwards Dam, removed in 1999, was the lowermost dam on the Kennebec River. Madison Electric Works, which was the lowermost dam on the Sandy River, was removed in 2006. Fort Halifax, removed in 2008, was the lowermost dam on the Sebasticook River.

2.4 Status of fish passage at hydropower projects

Lockwood Project –The upstream fish passage facility at the Lockwood Project became operational in 2006 pursuant to the 1998 Settlement. It is an interim fish lift that terminates in a trap-and-truck facility. Fish and water are collected in the hopper, lifted, and discharged into a 12-foot diameter sorting tank. River herring (Alewife and Blueback Herring) and American Shad are dip-netted into two ten-foot diameter tanks, Atlantic Salmon are moved into a 250-gallon isolation tank, and other species are sluiced downstream. The river herring, American Shad, and Atlantic Salmon are trucked upstream to spawning habitat by MDMR. An upstream passage facility designed specifically for American Eel (ramp) is installed in the bypass in the spring and removed in the fall. Downstream passage is provided via spill, a downstream bypass in the power canal that releases 350 cfs, or through the turbines. An angled boom in the power canal serves to guide fish to the bypass.

Pursuant to the 1998 Settlement, permanent (swim-through) upstream passage at the Lockwood Project and the Hydro Kennebec Project was to be operational two years after 8,000 American Shad were captured in any single season at the interim facility at Lockwood or a biological assessment trigger was initiated for Atlantic Salmon, Alewife or Blueback Herring. The interim upstream passage facility at Lockwood Project was never converted to a permanent facility, because the trigger number was never met – the greatest number of American Shad passed at Lockwood in a single year has been 830 fish. Ultimately, the listing of Atlantic Salmon and the resulting Interim Species Protection Plan (ISPP) became the trigger for providing permanent upstream passage at the four mainstem dams. The current license requires the Licensee to provide an upstream fish passage to be operational by May 1, 2022. The Licensee has plans, currently at the 90% design phase, to construct a new vertical slot fishway in the Lockwood bypass reach that is intended to provide swim-through passage for all diadromous fish species. The Licensee expects to construct the facility in 2021. The existing fish lift will continue to be operated as a trap-and-transport facility.

Hydro Kennebec–Pursuant to the ISPP and the current license, the permanent upstream fish passage facility at the Hydro Kennebec Project, a fish lift, became operational in the fall of 2017. Fish and water are collected in the hopper, lifted, and discharged into an exit flume that extends 470 feet into the headpond. An upstream passage facility designed specifically for American Eel (ramp) is located on the west side of the spillway; the entrance and exit are installed in the spring and removed in the fall. Downstream passage is provided via spill (although spill is rare), through a gate located in the powerhouse forebay that discharges into a large plunge pool, or through the turbines. An angled boom in the forebay serves to guide fish to the bypass.

Shawmut– Pursuant to the ISPP and the current license, the Licensee is required to provide an upstream fish passage to be operational by May 1, 2022. The Licensee has plans, currently in the 90% design phase, to construct a new fish lift at the upper powerhouse and a fishway channel that extends through a peninsula that separates the upper and lower powerhouses. Permanent upstream eel passage (ramp) was operational on the east side of the spillway until the installation of a rubber dam on the spillway in 2009 that eliminated attraction to the area. Since 2010, a portable eel passage (6-foot long, 1-foot wide ramp with climbing substrate, a collection bucket and attraction water) has been installed annually between the first section of the hinged flashboards and the unit 1 tailrace. Water released at this location to provide additional downstream passage for Atlantic Salmon smolts may interfere with upstream eel passage as evidenced by declines in upstream migrants from 2016 to 2018. In 2019, a second upstream eel passage, similar in design to the other ramp, was installed adjacent to the forebay plunge pool

Downstream passage is provided via the spillway, hinged flashboards, the turbines or a surface weir (sluice) and Tainter gate in the forebay. The 4-feet wide by 22-inch deep sluice is located on the right side of the intake structure by Unit 6. When all stoplogs are removed, the sluice passes 30-35 cfs over the face of the dam and into a 3-feet deep plunge pool. The 7-foot high by 10-foot wide Tainter gate is located to the right of the sluice and can pass up to 600 cfs; it is unclear from the Final License Application if water released from the Tainter gate also passes into the 3-foot deep plunge pool. The sluice and Tainter gate are operated from April 1-June 15 to pass Atlantic Salmon smolts and kelts and from November 1 to December 31 (depending on ice and flow conditions). Four sections of hinged flashboards immediately adjacent to the canal headworks are opened for the smolt migration season and provide approximately 560 cfs of spill.

Downstream passage for American Eel is provided by passing approximately 425 cfs through the Tainter gate and turning off units 7 and 8 for 8 hours for a six-week period between September 15 and November 15. A study conducted by the Licensee in 2008 (Next Era Energy 2009) on the downstream passage of American Eel found that passage via the deep gate increased with higher flow through the gate when Units 7-8 were turned off (58.3% at 207 cfs and 83.5% at 425 cfs), immediate survival increased with the higher flow, and immediate survival of eels passing through Units 1-6 was 90% (9 of 10). Survival of eels not entering the forebay was not described. In 2009, the Licensee in consultation with resource agencies designed and constructed a plunge pool below the outlet of the deep gate. MDMR questions whether passing downstream migrating American Eel via a flow of 425 cfs into a 3-foot deep plunge pool is safe.

Weston– Pursuant to the ISPP and the current license, the Licensee is required to provide an upstream fish passage to be operational by May 1, 2022. The Licensee has plans, currently the

90% design phase, to construct a new fish lift at the powerhouse. An upstream passage facility designed specifically for American Eel (ramp) is located on the west side of the south channel dam. Downstream passage is provided via a surface sluice gate and associated unregulated spill, or through the turbines.

Abenaki and Anson–These two projects, separated by 0.76 river miles, have the same owner and were licensed together. Both projects currently have upstream and downstream passage facilities for American Eel, and both have the same license requirements for upstream and downstream passage for Atlantic Salmon. Briefly,[1] interim downstream passage is to be operational at each project two years after the Licensee receives written notice from MDMR and the U.S. Fish and Wildlife Service (USFWS) that sustained annual stocking of Atlantic Salmon above the projects has begun or will begin within two years. Permanent upstream passage is to be operational at each project within two years after the Licensee receives written certification from the MDMR and USFWS that 226 adult Atlantic Salmon originating from the Kennebec River and obtained from the Lockwood fish lift or another Kennebec River trap and truck facility have been released into the Kennebec River watershed above the Weston dam in any single season. In no event, however, will permanent upstream and permanent downstream passage for Atlantic Salmon be required to be operational prior to May 1, 2020.

2.5 Impoundments

The Weston Project impoundment is 12.4 miles long and is 930 acres. The Shawmut Project impoundment is 12 miles long and is 1310 acres. The Hydro Kennebec Project impoundment is 3 miles long and is 250 acres. The Lockwood Project impoundment is 1.2 miles long and is 81.5 acres.

Impoundments alter flow dynamics of river systems, effectively converting once lentic river reaches into lotic systems, which in turn alters temperatures and sediment transport characteristics relative to the freely flowing condition (Kondolf et al. 2014, Davies et al. 1999). Impoundments contribute to increasing embeddedness of downstream substrate (i.e., channel armoring), alter the distribution and availability of stream substrate size classes, and reduce habitat suitability for native invertebrates and fishes that rely on more lentic systems (Tiffen et al. 2016). Impacts to biological communities can translate to reduced water quality.

The altered hydrological and temperature regimes in impoundments can create habitat that is more favorable for lacustrine species instead of the native stream-dwelling species (Watson et al. 2018). The "artificial" habitat in impoundments has been associated with establishment of populations of non-native species, (introduced either to provide recreational opportunities or accidentally via boat traffic), allowing them to become invasive (Graf 2003). In Maine, some of the piscivorous invasive species that have become established in impoundments include smallmouth bass *Micropterus dolomieu* and largemouth bass *Micropterus salmoides* (Watson et al. 2018).

Impoundments have been associated with migratory delays for downstream migrating diadromous species, including America Eel and salmonids (Raymond 2011, Jepson et al. 2000,

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[1] The licenses contain additional details regarding fish passage for Atlantic Salmon.

Mensinger 2020). Migratory delays may be the result of the absence of migratory cues in headponds that are normally associated with lentic systems, as evidenced by documented search behavior within headponds (Brown et al. 2009; Trancart et al. 2020). When coupled with the presence of invasive piscivorous species, migratory delay in impoundments can associated with increased mortality for migrants via predation (Jepson et al. 2000, Raymond 2011).

2.6 Fish passage testing and performance standards

Diadromous fish species require safe, timely, and effective access to high quality habitats at different life stages in order to successfully survive and reproduce. Hydroelectric projects often prevent or delay migrations or cause injury or mortality that contribute to population declines. These adverse impacts can be mitigated by properly designed fishways, however many fishways fail to perform as intended, including fishways developed and operated utilizing USFWS Fish Passage Design Criteria (USFWS 2019). When there are a series of fishways within a migration corridor for diadromous species, such as in the upper Kennebec River, the risks increase that one or more underperforming fishways will result in significant cumulative negative impacts to these fish populations. This potential for cumulative impacts creates the need for highly effective fish passage at each of the dams that meet agency design and performance standards.

To ensure that minimum restoration goals for the Kennebec River are met, the new fish passage facility at the Hydro Kennebec Project and the facilities that have been proposed for the Lockwood, Shawmut, and Weston projects (to be operational by May 1, 2022) will need to be tested for their effectiveness in passing adult and juveniles stages of Atlantic Salmon, American Shad, Blueback Herring, Alewife, Sea Lamprey, and American Eel during their upstream and downstream migrations. In a report that analyzed mitigation (fish passage) at hydropower projects, FERC (2004) acknowledged the impacts of the projects on fish populations and the importance of testing the effectiveness of fish passage facilities and also recognized the use of modeling tools for assessing management actions and fish passage improvements at multiple projects.

Migratory delay comes at energetic costs to further upstream migration and subsequent reproduction, consequently, it is recommended that fish pass performance include not only target numbers or percentage of fish passing, but also metrics for movement rates and time to pass (Castro-Santos et al. 2009; Castro-Santos and Letcher 2010; Castro-Santos and Perry 2012; Castro-Santos et al. 2016; Stich et al. 2019). The overall energetic costs to migration and reproduction imposed by migratory delay will increase with the number of dams encountered and should be factored in when setting passage time performance standards.

In the Environmental Analysis of three recent relicensing proceedings[2], the FERC did not support recommendations made by the resource agencies for effectiveness testing of all new fish passage facilities. One reason FERC did not support effectiveness testing was the lack of specific performance standards by which the effectiveness testing could be evaluated. Therefore, MDMR has developed performance standards for five species, Atlantic Salmon, American Shad, Blueback Herring, Alewife, and Sea Lamprey, which are described and justified in sections 3.5-

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[2] American Tissue FERC No. 2809-034; Barker Mills FERC No. 2808; Ellsworth FERC No. 2727-092.

3.9. Effective fish passage is also important for American Eel, which spawns just once and dies (semelparous), but performance standards have not been developed at this time.

3.0 Diadromous fish in the Kennebec River watershed

The Kennebec River, Maine's second largest drainage, historically was inhabited by 11 native diadromous species: Shortnose Sturgeon (*Acipenser brevirostrum*), Atlantic Sturgeon (*Acipenser oxyrinchus*), Rainbow Smelt (*Osmerus mordax*), Atlantic tomcod (*Microgadus tomcod*), Striped Bass (*Morone saxatilis*), Alewife (*Alosa pseudoharengus*). American Shad (*Alosa sapidissima*), Blueback Herring (*Alosa aestivalis*), Atlantic Salmon (*Salmo salar*), Sea Lamprey (*Petromyzon marinus*), and American Eel (*Anguilla rostrata*). These species were once very abundant and supported important commercial fisheries. In 1867, the Governor appointed two Commissioners of Fisheries under a legislative resolve to restore anadromous fish to the rivers and inland waters of the state. The Commissioners surveyed the fisheries in Maine's major river systems and concluded that the decline of anadromous species was caused by impassable dams, overfishing, and pollution of the water (Foster and Atkins 1867).

Foster and Atkins (1868) and Atkins (1887) reported that four species of anadromous fish (Shortnose Sturgeon, Atlantic Sturgeon, Striped Bass, and Rainbow Smelt) historically did not migrate past Taconic Falls where the Lockwood Project is located, while six species historically migrated farther upstream (Table 3). Foster and Atkins (1868) and Atkins (1887) reported that Atlantic Salmon ascended many miles in the Carrabassett River and the Sandy River, and these two rivers probably were the principal spawning grounds; however, the upstream limit of Atlantic Salmon may have been about 12 miles above the Forks (confluence of the Kennebec River and Dead River) and at Grand Falls on the Dead River. Foster and Atkins (1868) and Akins (1887) also reported that Alewife and American Shad ascended as far upstream as Norridgewock Falls, current location of the Abenaki and Anson projects, and into the lower part of the Sandy River. It is likely their close relative, the Blueback Herring, had the same range. The historic upstream limit of American Eel and Sea Lamprey is not known, but American Eel currently are found in the Williams Project impoundment and Sea Lamprey generally occupy large river and tributary habitats with extents similar to Atlantic Salmon.

The restoration of diadromous fish species in the Kennebec River began with a Settlement Agreement that was signed in 1986 by the Kennebec Hydro Developers Group (KHDG) and the State of Maine. Eleven years later, FERC for the first time in its history refused to renew a hydropower license for environmental reasons and ordered the decommissioning and removal of the Edwards Dam on November 25, 1997. The following year a multi-party settlement agreement (1998 Agreement) was signed that included new schedules or triggers for upstream and downstream fish passage at the seven KHDG projects and provided additional funds for restoration efforts. Removal of the Edwards Dam allowed Shortnose Sturgeon, Atlantic Sturgeon and Striped Bass free access to all their historic habitat on the mainstem of the Kennebec River. In addition, the restored Kennebec River supports the greatest abundance and biomass of American Eel between Merrymeeting Bay and the Williams Dam (Yoder et al. 2006). The installation of fish passage facilities at barriers in the Sebasticook River and removal of the Fort Halifax Dam has resulted in the largest run of river herring on the east coast (Wippelhauser 2021).

Restoration of Atlantic Salmon, American Shad, Blueback Herring, Alewife, and Sea Lamprey has lagged on the mainstem Kennebec River, primarily because of the lack of upstream fish passage. This situation is particular critical for the endangered Gulf of Maine (GOM) Distinct Population Segment (DPS) of Atlantic Salmon, one of the most iconic and imperiled species in the United States. All high-quality spawning habitat for Atlantic Salmon lies above four dams (Sandy River) or six dams (Carrabassett River and mainstem Kennebec River) and restoring runs into the Kennebec River in sufficient numbers is essential to meet recovery goals for the entire species statewide (USFWS and NMFS 2019). About 60% of American Shad and Blueback Herring historic spawning habitat is above the Lockwood and Hydro Kennebec projects, and 10% of Alewife historical spawning habitat is above the Shawmut Project. Sea Lamprey habitat above these projects exceeds 90% of presumed historic habitats. Significant underutilized habitat exists for American Eel.

3.1 Atlantic Salmon (*Salmo salar*)

3.1.1 Goals and objectives

Pursuant to the *Recovery Plan for the Gulf of Maine Distinct Population Segment of Atlantic Salmon (Salmo salar)* (USFWS and NMFS 2019), the following abundance criteria must be met for downlisting of the Gulf of Maine Distinct Population Segment (GOM DPS) from endangered to threatened and for delisting the species[3]:

> ***Downlisting:*** The DPS has total annual returns of at least 1,500 adults originating from wild origin, or hatchery stocked eggs, fry or parr spawning in the wild, with at least 2 of the 3 SHRUs having a minimum annual escapement of 500 naturally reared adults.
>
> ***Delisting:*** The DPS has a self-sustaining annual escapement of at least 2,000 wild origin adults in each SHRU, for a DPS-wide total of at least 6,000 wild adults.

3.1.2 Biology and ecology

The Atlantic Salmon is a medium-sized, highly migratory, anadromous, iteroparous fish that historically ranged from northeastern Labrador to the Housatonic River in Connecticut (Collette and Klein-MacPhee 2002). In Maine, adult Atlantic Salmon ascend their natal rivers from spring through fall with the peak occurring in June (Meister 1958, Baum 1997). Adults that return to spawn after one year at sea are termed “grilse”, and those that return after two years at sea are termed “two sea winter” or 2SW” fish; occasionally a “3SW” fish will return. Spawning occurs in late October through November, therefore, early returning fish seek out cold water refugia until the fall. Preferred spawning habitat is a gravel substrate with adequate water circulation to keep the buried eggs well oxygenated (Peterson 1978), and spawning sites are often located at the downstream end of riffles where water percolates through the gravel or where upwellings of groundwater occur (Danie et al. 1984). The optimal water temperature during the spawning period ranges from 7.2°C to 10.0°C (Jordan and Beland 1981, Peterson et al. 1977). The female digs a series of nests (redds) in the gravel where the eggs are deposited and are fertilized by one or more males (Jordan and Beland 1981). Female 2SW adults produce an average of 7,500 eggs

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[3] The complete list of criteria to accomplish recovery or delisting is in Appendix A.

(Baum and Meister 1971). Currently, few post-spawn salmon (kelts) survive to return as repeat spawners. The eggs hatch in late March or April, and the alevins (sac fry) remain in the redd until mid-May (Gustafson-Greenwood and Moring 1991) when they emerge and begin active feeding. Within days, the fry enter the parr stage, identified by the vertical bars on their sides, and begin to actively defend territories (Allen 1940, Kalleberg 1958, Mills 1964, Danie et al. 1984). Some male parr become sexually mature (precocious parr) and can successfully participate in spawning. In a parr's second or third spring, when it has grown to 12.5 to 15 cm in length, a series of physiological, morphological, and behavioral changes occur (Schaffer and Elson 1975). This smoltification process prepares the fish for migration to the ocean and life in salt water. In Maine, the vast majority of wild/naturally reared parr remain in freshwater for two years (90% or more). Naturally reared smolts in Maine range in size from 13 to 17 cm and most smolts enter the sea during May to begin their ocean migration to feeding areas in the North Atlantic.(USASAC 2004).

Atlantic Salmon are part of a co-evolved diadromous fish community that together shaped Maine's riverine and lacustrine habitats through connectivity with the ocean (Fay et al. 2006, Saunders et al. 2006). As the returns of Atlantic Salmon to Maine's rivers declined, it is likely that some of these ecosystem functions also declined or were lost, including reductions to the primary productivity due to the loss of marine derived nutrients from metabolic waste products, eggs, and carcasses that are incorporated into the local food web in the areas where spawning occurs (Moore et al. 2011, Guyette et al. 2014).

3.1.3 Historical and current distribution

Foster and Atkins (1868) and Atkins (1887) reported that within the Kennebec River Atlantic Salmon ascended many miles in the Carrabassett River and the Sandy River, and these two rivers probably were the principal spawning grounds; however, the upstream limit of Atlantic Salmon may have been about 12 miles above the Forks (confluence of the Kennebec River and Dead River) and at Grand Falls on the Dead River. Currently, MDMR transports all returning Atlantic Salmon that utilize the Lockwood Project fish lift to the Sandy River where they are released.

3.1.4 Relevant fishery and stock status

Historically, hundreds of thousands of adult Atlantic Salmon returned annually to spawn in the rivers of New York and New England and represented a culturally significant species for Maine's tribes and later became an important economic resource both recreationally and commercially. Habitat loss and degradation due to dams and industry, overharvest, and other human impacts brought the Atlantic Salmon to the brink of extinction within its U.S. range (Fay et al. 2006, NAS 2004). Today, the only remaining populations of Atlantic Salmon in the United States, the GOM DPS, exist in several watersheds in Maine.

The GOM DPS of Atlantic Salmon, originally listed as endangered in December 2000 by the National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (USFWS), encompassed salmon populations in small river systems along the Maine coast. In 2009, the GOM DPS was expanded (74 FR 29344), and critical habitat was delineated (74 FR 23900) for three Salmon Habitat Recovery Units (SHRUs) within the expanded DPS: the Merrymeeting Bay SHRU, Penobscot Bay SHRU, and Downeast SHRU. The Merrymeeting Bay SHRU includes the Kennebec, Androscoggin, Sheepscot, Pemaquid, Medomak, and St. George watersheds. The total functional, critical habitat units for each SHRU within the GOM DPS are (74 FR 23900, Table 2): Merrymeeting Bay SHRU (40,001), Penobscot Bay SHRU (63,058) and Downeast Coastal (29,111). However, nearly all the high-quality habitat in the Merrymeeting Bay SHRU is in the Kennebec River, specifically in the Sandy River, Carrabassett River, and upper Kennebec River.

As described in section 3.5.1, the minimum spawning escapement required is 500 naturally reared adults in two of the three SHRUs for downlisting and 2,000 in each of the three SHRUs for delisting. However, the current numbers of wild origin Atlantic Salmon that return to Maine rivers are orders of magnitude less than those required to meet ESA recovery standards. A total of just 389 naturally reared adults returned to the GOM DPS in 2020.[4] Data provided by MDMR and restoration partners, represented in the U.S. Atlantic Salmon Assessment Committee (USASAC 2019) reports, indicate severe limitations in freshwater production of "naturally reared" fish that would contribute to meeting recovery goals. Based on the amount of available critical habitat, downlisting and delisting (recovery) of the GOM DPS of Atlantic Salmon will rely on expanding the population being restored in the Kennebec River. Providing safe, timely, and highly effective passage on the Kennebec River is essential to meeting recovery goals.

Because the expanded listing included the Kennebec River, Brookfield Renewable (the indirect parent company of the Licensees of the Lockwood, Hydro Kennebec, Shawmut, and Weston projects) developed Interim Species Protection Plans (ISPPs) that created schedules for constructing upstream fish passage and testing the effectiveness of existing downstream fish passage at the four projects; the ISPPs were incorporated into the project licenses by FERC. Prior to the December 31, 2019 expiration of the ISPPs, Brookfield Renewable consulted with state and federal fishery agencies to develop a Species Protection Plan (SPP) to replace the ISPPs. The SPP was submitted to FERC on December 31, 2020, and was rejected by FERC on July 1, 2020 in response to letters from the resource agencies expressing their lack of support for the SPP. At this time, there is no take permit, no Biological Opinion, and no reasonable and prudent measures to avoid, minimize, and mitigate project impacts on Atlantic Salmon.

3.1.5 Past and current management actions in the Kennebec River

Restoration of the species began in 2003 when MDMR initiated a stocking program in the Sandy River using three life stages of GOM DPS Atlantic Salmon. In addition to adult Atlantic Salmon returns, which are transported from the Lockwood Project fishlift to the Sandy River in trucks and allowed to spawn naturally, MDMR has utilized Penobscot-origin, F2 generation fry and eyed-eggs for supplementation. For five years, eyed-eggs were raised in streamside incubators and released as fry. Since 2004, eyed-eggs have been deposited in man-made redds in the winter, and allowed to develop and emerge naturally (Table 4). Despite these efforts, much of the spawning habitat in the Kennebec River remains underutilized due to poor adults returns and a limited supply of eggs. The USFWS has also transported Penobscot-origin F1 generation parr to the Nashua National Fish Hatchery to stock as smolts into the Kennebec river. The first stocking of 100,000 smolts occurred in the spring of 2020, with planned stocking to continue into the foreseeable future if funding is available.

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[4] https://atlanticsalmonrestoration.org/cms/cms-annual-reports-meeting-notes/2021-cms-annual-meeting-reports-notes

3.1.6 Findings of current research

DIA model

Nieland et al. (2013) developed a population viability analysis, the Dam Impacts Assessment (DIA) model, to examine the demographic effects of 15 hydropower dams and actions resulting from the Penobscot River Restoration Project (PRRP)[5] on Atlantic Salmon survival and recovery in the Penobscot Bay SHRU (NMFS 2012). The model incorporated life stage-specific information for Atlantic Salmon to simulate the life cycle of the species in the Penobscot River. Most model inputs were considered to be random variables, and Monte Carlo sampling from probability density functions was used to create multiple estimates of population trajectories over time (50 years, roughly ten generations). Two scenarios were modeled – the base case (existing conditions) and recovery case (freshwater survival was doubled and marine survival was quadrupled). Within each scenario, the impacts of the following actions were analyzed: 1) all dams on; 2) all dams off; 3) mainstem dams off, tributary dams on; 4) tributary dams off, mainstem dams on; and 5) implementation of the PRRP (Veazie, Great Works, and Howland off.) Dams "on" were operating normally, and dams "off" were removed. In addition, hatchery supplementation could be turned off and passage efficiency at dams could be increased.

DIA modelling results indicated:

1. Salmon abundance (median number of 2SW females), salmon distribution to upper reaches of the Penobscot watershed, and the proportion of wild-origin fish in the upper reaches of the watershed increased as mainstem dams were removed. Under the base case, with stocking, and with all dams removed, the number of 2SW females approached recovery (~450).
2. Salmon abundance increased when marine survival and freshwater survival were increased, but increased marine survival resulted in the greatest increase in salmon abundance. Under the recovery scenario, with no stocking, and implementation of the PRRP, the number of female 2SW fish was approximately 2,000.
3. Implementation of the PRRP (2 dams removals and the Howland bypass) coupled with performance standards (downstream passage within 24 hours and 96% passage survival at the Milford, West Enfield, Orono, and Stillwater dams and upstream passage within 48 hours and 95% passage efficiency at the Milford and West Enfield dams) and stocking supplementation would not result in jeopardy.

MDMR model

Because NMFS never created a DIA model for the Kennebec River, MDMR developed a simple deterministic model utilizing the best available data, current research, and knowledge of the watershed to assess the cumulative impacts of multiple dams on Atlantic Salmon recovery. The model was used to develop survival goals for upstream and downstream passage at each hydropower facility. Major assumptions of the model were generally consistent with NOAA Fisheries Dam Impact Models (Nieland et al. 2013; Nieland and Sheehan 2020), utilized in the Penobscot River, and included:

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[5] The PRRP included the purchase of the Veazie, Great Works, and Howland hydropower projects; removal of the two lowermost mainstem dams on the mainstem (Veazie and Great Works); decommissioning of the lowermost dam on the Piscataquis River (Howland) and construction of a bypass around the dam; construction of a new upstream passage facility at the Milford Project; construction of a second powerhouse at the Orono and Stillwater projects to replace the lost power generation; and increased flow through the Stillwater River after the fish passage season.

1. The number of salmon smolts produced by the Sandy River, Carrabassett River, and mainstem Kennebec downstream of the Williams Project was estimated from the following equations (habitat units were modeled in 74 FR 23900):
    a. Low = (habitat units) x (1.0 smolts/unit) (P. Christman, Sheepscot River Monitoring, MDMR).
    b. Intermediate = (habitat units) x (2.0 smolts/unit); and
    c. High number =(habitat unit) x (3 smolts/unit) (Legault 2005, Orciari et al. 1994).
2. Downstream migrating smolts experienced natural in-river mortality of 0.0033%/km (Stevens et al. 2019) from the release point in each spawning area to the first dam, between dams, and downstream to the Augusta.
3. Estuarine mortality was 0.00368/km for smolts that had passed no dams; 0.0087/km for fish that passed 2 dams; .0115/km for fish that passed 4 dams; 0.013 for fish that passed five dams, and 0.0145/km for fish that passed 6 dams (Stevens et al. 2019). The estuary extended from the head-of- tide at Augusta to the outlet of Merrymeeting Bay (The Chops).
4. The estimates for marine survival were:
    a. Low = 0.321% (Penobscot River average 2008-2018, estuarine mortality removed, J. Kocik).
    b. Intermediate=1.08% (Penobscot River maximum 2008-2018, estuarine mortality removed, J. Kocik).
    c. High = 2.72% (Penobscot River maximum 1969-2018, estuarine mortality removed, J. Kocik).

    These values were consistent with those used in the DIA model (Figure 3.9.4; for the base case, 90% of marine survival values for 1969-2008 ranged from 0.00124-0.01782, mean~0.00627, median = 0.00436; std dev~0.00598; marine survival was increased by a factor of 4 for the recovery case).
5. Downstream passage survival at each of the six mainstem dams was set at 97% and upstream passage efficiency at each dam was set at 96% consistent with performance standards proposed by the Licensee and at 99% for upstream and downstream effectiveness as proposed by MDMR. The SPPs for the Penobscot River also include time to pass standards (no more than 24 hours for downstream passage and no more than 48 hours for upstream passage). Neither the DIA nor the MDMR model included an analysis of passage delays; however, studies have demonstrated that the downstream passage timing standard is achievable.

At low marine survival (0.00321), low or high freshwater production (1 or 3 smolts/100m^2), and passage through 6 dams, the estimated number of adult Atlantic Salmon returning to the Kennebec River ranged from 46-176 (Figure 2). At medium marine survival (0.01080), the downlisting target was surpassed only with high freshwater production and 99%/99% passage efficiency (Figure 2). At the highest marine survival (0.02720), high freshwater production, and 99%/99% passage efficiency the reclassification goal of 2,000 adult was not attained. Regardless of the marine survival and freshwater production, the 99%/99% effectiveness scenario resulted in 28-29% more adult returns than the 97/96% scenario.

While this analysis indicates that it may be possible to achieve recovery goals, it is important to acknowledge the issue of passage delays. Smolts that are emigrating downstream need to reach the estuary in a timely manner due to temperature and physiological processes (McCormick et al. 1998). In addition, it is recognized that adult upstream passage delays can have substantial long-term effects. Adult salmon that spend excessive amounts of time in warm mainstem river waters will deplete fat reserves needed for both the upstream spawning migration and for returning to the ocean the following year (Rand and Hinch 1998; Naughton et al. 2005). Passage delays will need to be minimized in order to achieve recovery goals.

Adults salmon return to Maine's rivers during summer and can be exposed to high temperature events. High temperature both slows and increases the energetic cost of migration at the expense of energy stores necessary for continued upstream movement and reproduction; if thermal stress is severe, it can result in death (Pörtner and Farrell 2008; Jonsson and Jonsson 2009; Elliott and Elliott 2010; Martin et al. 2012). Migratory delays caused by dams can compound the problem, preventing salmon from reaching suitable thermal refuge habitat necessary to withstand high summer temperatures (Hasler et al. 2012; Frechette et al. 2018). In the Kennebec River, suitable cool water habitat for adults exists only upstream of existing dams in headwater tributaries like the Sandy River. Minimizing delays caused by dams is imperative to ensure that salmon reach thermal refuge habitat in order to maximize the survival of fish and available energy stores for reproduction.

Effectiveness studies demonstrate the difficulty of meeting high performance standards for fish passage, although increased flow may improve survival of downstream migrants. Radio telemetry studies conducted at the Weston, Shawmut, Hydro-Kennebec, and Lockwood projects resulted in baseline survival[6] of downstream migrating Atlantic Salmons molts ranging from 89.5–100%, but only 66-94.5% of smolts successfully passed the projects within 24 hours (Table 5). Because the 93.5% baseline survival at the Shawmut Project was less than the 96% proposed in the ISPP, downstream passage flow was increased from 420 to 650 cfs although no additional testing occurred. Radio telemetry studies conducted at four projects in the Penobscot River resulted in adjusted survivals of 84.0-98.0% (Table 5) after spill had been increased between 20% and 50% of river flow at each station from 8 pm to 4 am during the peak two weeks of the outmigration period.

In the Kennebec River, upstream passage effectiveness has only been tested at the Lockwood Project. In 2016, 20 wild adult Atlantic Salmon that were captured in the fish lift were radio tagged and moved downstream. Sixteen of the 18 that returned to the project area were recaptured (89%), and the time from return to the project area to recapture was 0.7-111.2 days (mean = 17 days). When the study was repeated in 2017, 13 of 19 (68%) tagged adult Atlantic Salmon that returned to the project area were recaptured, and time to recapture was 3.3-123 days (mean = 43.5). Due to the poor results, the study was discontinued. As part of a study of energy consumption, adult Atlantic Salmon were captured at the Lockwood fish lift, tagged with thermal radio tags and released downstream of the Project. In 2018, 66.7% of the tagged adults (4 of 6) were recaptured, and the time to recapture was 16-33 days (mean = 21.8). The following year,

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[6] The baseline rate does not consider amount of time to pass the project. The adjusted survival is calculated from fish that passed a project within 24 hours.

45.0% of tagged adults (9 of 20) were recaptured, and the time to recapture was 9-30 days (mean = 18.7).

The NMFS (2013) clearly foresaw the need for high performance standards. The Biological Opinion issued for the ISPPs states on page 17: "Data to inform downstream passage survival standards for Atlantic Salmon smolts and kelts in the Kennebec and Androscoggin Rivers are very limited. However, given the best available information, it is anticipated that downstream survival standards that will be incorporated in the final SPP will likely need to be between 96% and 100% at each Project. These standards will be refined using information from passage studies that will be undertaken as part of the ISPP. It is possible that the proposed studies will indicate that the interim downstream passage facilities currently in place are not enough to meet the standard and that significant structural and/or operational changes may be necessary to achieve such a high level of survival. The interim period will be used to determine how best to operate or modify the Projects to achieve sufficiently high survival rates. In addition, over the term of the interim period we and/or the licensee will develop a model for the Androscoggin and Kennebec Rivers to provide data that will be used to inform the development of upstream and downstream performance standards."

3.2 American Shad (Alosa sapidissima)

3.2.1 Goals and objectives

The goal for American Shad is to achieve and sustain a minimum population of 1,018,000 adults entering the mouth of the Kennebec River annually based on 5,015 hectares of spawning and nursery habitat in the mainstem and identified tributaries.

Objectives are to:

- Achieve and maintain an adult return of a minimum of 203 adults/hectare.
- Achieve and sustain a minimum population of 509,000 adult American Shad above Augusta.
- Pass at least 303,500 adult American Shad at the Lockwood and Hydro Kennebec Project dams.
- Pass at least 260,500 adult American Shad at the Shawmut Project dam.
- Pass at least 156,600 adult American Shad at the Weston Project dam; and
- Pass at least 99,200 adult American Shad at the Benton Falls Project dam.

3.2.2 Biology and ecology

The American Shad is a highly migratory, pelagic, schooling species that ranges along the east coast of North American from Newfoundland to Florida (Colette and Klein-MacPhee 2002; Scott and Crossman 1973). American Shad spend most of their lives in the ocean. As adults they return to their natal rivers to spawn, exhibiting low stray rates (3%,), and are capable of migrating long distances upstream (CRASC 1992; MDMR and MDIFW 2008; SRAFRC 2010). Generally, in river systems with limited barriers, American Shad prefer to spawn in upstream and mid-river segments until energy reserves or water temperatures no longer facilitate spawning (Massmann 1952, Bilkovic et al. 2002). Spawning sites in Virginia were associated with hydrographic parameters (high current velocity, high dissolved oxygen, and shallow depth), physical habitat features (increasing sediment size and woody debris), and the presence of a forested shoreline

(Bilkovec et al. 2002). American Shad are broadcast spawners with semi-buoyant eggs, and females will spawn multiple times throughout their annual migration (Hyle et al. 2014, McBride et al. 2016). Populations of American Shad that spawn north of Cape Hatteras are iteroparous with the repeat spawners ranging from 63-74% in the Connecticut, Saint John, and Mirimichi rivers (Colette and Klein-MacPhee 2002). Repeat spawners are especially important due to higher lifetime fecundity rates and reduced annual variability of spawning stock size (Harris and Hightower 2012). Larvae transform into juveniles 3 to 5 weeks after hatching. Juveniles disperse downstream of the spawning areas, generally staying in a lower portion of the same river for the summer (McCormick et al. 1996). Most juveniles in river systems in the northern Atlantic states will begin their seaward migration when water temperatures are between 18 and 26°C (Marcy 1976, Watson 1970). In the Connecticut, which supports the largest American Shad run on the east coast of the United States, year-class strength is determined during the larval emergence stage and is significantly correlated with mean river discharge, water temperature, and total monthly precipitation (Crecco et al 1983; Crecco and Savoy 1984; Crecco and Savoy 1985).

3.6.3 Historical and current distribution

American Shad historically were able to access 2,508 hectares of riverine spawning/rearing habitat above the head-of-tide in Augusta (Table 6). Adults ascended the mainstem Kennebec River as far upstream as Norridgewock Falls, current location of the Abenaki and Anson projects, migrated into lower part of the Sandy River, and ascended to the confluence of the East Branch and West Branch of the Sebasticook River (Foster and Atkins 1868; Akins 1887). Most of the habitat (59.6%) lies above the Lockwood Dam, while 20.9% is between the head-of-tide (site of former Edwards Dam) and the Lockwood Dam, and 19.5% is in the Sebasticook River.

Removal of Edwards Dam was an important step in enhancing the American Shad population, but access to habitat above the Lockwood dam is clearly necessary to reach production and distribution goals. Currently, swim-through fish passage on the Sebasticook River allows adult American Shad to access 489 hectares of habitat. In contrast, 1,495 hectares of spawning/rearing habitat in the Kennebec River above the Lockwood Dam is not freely accessible. MDMR annually transports American Shad that use the fish passage facility at the Lockwood Project, which is not connected to the headpond, to upstream spawning /rearing habitat.

This plan provides reach by reach (dam to dam) minimum production targets for adult American Shad. Minimum production targets are based on accessible and potentially accessible spawning/nursery habitat area and the adult production/unit of habitat area, a method commonly used in other American Shad plans in the Connecticut River (CRASC 2017), Susquehanna River (SRAFRC 2010), and Penobscot River (MDMR and MDIFW 2008). Because of insufficient data for Maine’s rivers, we used the most recent determination of minimum adult production/unit habitat developed for the Connecticut River (203 adults/hectare; CRASC 2017). This value likely underestimates the true production/unit habitat due to upstream and downstream passage inefficiencies that were known to exist when it was calculated (CRASC 2017). MDMR may increase the minimum adult production target values as improvements to habitat quantity and quality and fish passage occur in the future.

3.2.4 Relevant fishery and stock status

American Shad are managed in state waters by the Atlantic States Marine Fisheries Commission (ASMFC). The ASMFC Fishery Management Plan (FMP) for Shad and River Herring was adopted in 1985. Amendment 1, adopted in 1998, required specific American Shad monitoring programs, and established a five-year phase-out of the ocean-intercept fishery for American Shad by January 1, 2005. Amendment 3, approved in 2010, revised American Shad regulatory and monitoring programs, required states and jurisdictions to develop sustainable fishery management plans (SFMPs) in order to maintain commercial and recreational harvest fisheries beyond January 2013, and to submit a habitat plan regardless of whether their fisheries would remain open to harvest. Effective May 19, 1998, the State of Maine closed all state waters to commercial fishing for American Shad, and established a two fish per day recreational limit for American Shad. Gear restrictions limit anglers to a single hook and line while fishing American Shad.

The *Atlantic States Marine Fisheries Commission 2020 American Shad Benchmark Stock Assessment and Peer Review Report* ("benchmark stock assessment") (ASMFC 2020) included fisheries-dependent and fisheries-independent data obtained from member resource agencies. Commercial landings data combined from all rivers and estuaries along the east coast (for the United States and Canada) have declined since the 1950s by more than an order of magnitude, from as high as 11 million pounds in 1957 to less than a quarter of million pounds in 2016. Adult mortality for the coastwide metapopulation is unknown. However, adult mortality was determined to be unsustainable for 3 stocks (Connecticut, Delaware, and Potomac) and sustainable for 5 stocks (Hudson, Rappahannock, York, Albemarle Sound, and Neuse). It is important to note that juvenile and adult mortality must be sustainable for population abundance to be favorable (i.e. not depleted). Abundance status is unknown for most systems, but was determined to be depleted for one system (Hudson) and not depleted for one system (Albemarle Sound). Because abundance status is unknown for most systems due to data limitations, trends in YOY and adult abundance since the 2005 closure of the ocean-intercept fishery were analyzed. MDMR's young-of-year beach seine survey showed no trend for the period 2005-2017.

The benchmark stock assessment utilized a newly developed simulation model based on habitat and life history traits that was applied to most of the systems known to have American Shad to model theoretical effects of fish passage and dams on spawner potential (Stich 2019). This approach allowed the comparison of three broad scale scenarios: 1) historical or "intact" rivers, 2) worst case scenario with current dams and "no passage", and 3) dams with imposed realistic upstream and downstream passage to best reflect the "status quo." Based on this modeling exercise, coastwide production potential was more than 72.8 million spawners per year compared with the no passage scenario of just under 42.8 million spawners, a reduction of 41%. Even with extensive fish passage efforts, dams represented a fixed constraint of about 37% on the fishery potential of American Shad.

3.2.5 Past and current management actions in the Kennebec River

Restoration of American Shad in the Kennebec River began in 1987 with the signing of the first KHDG settlement agreement, which provided funds for restoration in exchange for delays in upstream fish passage. Between 1987 and 1997, MDMR stocked millions of American Shad fry and thousands of fingerlings and adults above the Edwards Dam (Table 7). The removal of

Edwards Dam in 1999 allowed American Shad free access to about 21% of their historic spawning habitat. Pursuant to the 1998 Settlement Agreement, the installation of permanent upstream fish passage (a swim-through fish lift) at the Benton Falls Project and at the Burnham Project in 2006 and the removal of the Fort Halifax Dam in 2008 made all historic American Shad spawning/rearing habitat in the Sebasticook River accessible. Pursuant to the 1998 Settlement Agreement, interim upstream passage became operational at the Lockwood Project in 2006. Since the interim fish lift became operational in 2006, only 1,413 adult American Shad have used it (Table 8). Attempts to determine why so few American Shad use the Lockwood fish lift have failed. In 2015, the Licensee in consultation with the agencies, conducted a sound study, a 2D hydraulic modeling study, and a radio telemetry study. Interestingly, adult American Shad used in the telemetry study were angled by recreational fishermen in the tailrace, but none of the tagged American Shad were detected near the fishway entrance.

3.2.6 Findings of current research

Major conclusion from the benchmark stock assessment were:

- At low levels, stocks are sensitive to both biotic and abiotic perturbations that truncate age structure thereby reducing population resilience.
- Recovery of American Shad stocks will need to address multiple factors (e.g., fish passage, predation, water quality, climate change, etc.) in addition to harvest.
- Habitat quantity is greatly reduced from historic levels, and even with fish passage will continue to be a limiting factor on a coastwide basis.

In the past decade, computer models have been used to explore the potential impacts of dams to American Shad populations with similar results. Harris and Hightower (2017) developed a "density-dependent, deterministic, stage-based matrix model to predict the population-level results of transporting American Shad to suitable spawning habitat upstream of dams on the Roanoke River, North Carolina and Virginia". They reported that predicted population increases were highest when young-of-year survival was improved, and transport benefited the population only if high rates of effective fecundity and juvenile survival could be achieved. Castro-Santos and Letcher (2010) developed a simulation model that synthesized bioenergetics, reproductive biology, and behavior to estimate the effects of migratory distance and delays at dams on spawning success and survival of individual adult migrants that ascended the Connecticut River, spawned, and survived to return to the marine environment. They found that delays to both upstream and downstream movements had dramatic effects on spawning success and the spatial extent of spawning. Most recently, Stich et al. (2019) developed a stochastic, life-history based, simulation model for the Penobscot River and found that the probability of achieving management goals (total spawner abundance, distribution to upstream habitat, and percentage of repeat spawners) was greatest with high downstream passage efficiency, minimal migration delays at dams, and high upstream passage efficiency.

A version of the model developed by Stich (2019) was used in the benchmark stock assessment. Each coastal river system was modeled using the potential spawning habitat available prior to the construction of dams and latitudinal-appropriate life history parameters developed for regional metapopulations (e.g., clines in size-at-age, maturity rates, and iteroparity) and used in the stock assessment. Dr. Stich has made the life history models for the Connecticut, Kennebec (Stich et al. 2020), Merrimack, Mohawk-Hudson, Penobscot, Saco, and Susquehanna river available, and provided MDMR with the results of standard base runs for the Kennebec River. The base runs predicted population abundance over time under varied fish passage efficiencies and distribution of spawning fish in the watershed. MDMR has used these results to develop performance standards for fish passage facilities at hydropower projects on the mainstem Kennebec River.

Haro and Castro-Santos (2012) described the failure of fishways designed to pass American Shad. They found that few designs had incorporated knowledge of the swimming, schooling, and migratory behaviors of American Shad; technical fishways designed for adult salmonids on the Columbia River have never been rigorously evaluated for American Shad; similar but smaller fishway designs on the East Coast frequently had poor performance; and effective downstream passage for juvenile and postspawning adult American Shad has been given little consideration in most passage projects.

There are multiple examples of upstream fish passage facilities at hydropower projects that are not effective for passing American Shad. In the Kennebec River, few adults annually enter the fish lift at the Lockwood Project (0-830) and similarly low numbers utilize the vertical slot fishway on the nearby Androscoggin River (0-1,096) despite the fact that spawning occurs less than a mile downstream. On the Merrimack River, an average of 17% of the American Shad that passed the first barrier successfully also passed the second barrier (Sprankle 2005). On the Susquehanna River, Connecticut River, and Merrimack River, the mean passage efficiencies for American Shad migrating upstream through fishways from the first dam to the spawning grounds were less than 3% (Brown et al 2013). Migration delays caused by fishways or trapping facilities need to be considered because they can limit spawning success and the number of repeat spawning adults (Castro-Santos and Letcher, 2010).

Survival of adult American Shad migrating downstream at hydropower dams is highly variable. In the Penobscot River, survival of adults ranged from 76.6-95.8% and was 51.4% at one project in the Androscoggin River with median time to pass ranging from 8.0 hours to 5.3 days (Table 9).

3.3 Blueback Herring (Alosa aestivalis)

3.3.1 Goals and objectives

The goal for Blueback Herring, is to

- Achieve and sustain a minimum population of 6,000,000 adults entering the mouth of the Kennebec River annually based on 5,015 hectares of spawning and nursery habitat in the mainstem and identified tributaries.
- Achieve and maintain an adult return of a minimum of 1,196 adults/hectare (484/acre).
- Achieve and sustain a minimum population of 3,000,000 adults above Augusta.
- Pass at least 1,788,000 adults at the Lockwood and Hydro Kennebec Project dams.
- Pass at least 1,535,000 adults at the Shawmut Project dam.
- Pass at least 922,400 adults at the Weston Project dam; and
- Pass at least 585,000 adults at the Benton Falls Project dam.

3.3.2 Biology and ecology

The Blueback Herring is an anadromous, highly migratory, pelagic, schooling fish found along the east coast of North America from Cape Breton, Nova Scotia and the Bay of Fundy watershed, New Brunswick, to Florida in the United States (Scott and Crossman 1973; Colette and Klein-MacPhee 2002). Blueback herring and Alewife are collectively referred to as river herring because of their similarity in size and appearance. Blueback herring spend most of their lives in the ocean and as adults they return to their coastal rivers to spawn. In the portions of their range where Blueback Herring and Alewife co-occur, Blueback Herring prefer to spawn over hard substrates in swift current (Loesch and Lund 1977; Johnston and Cheverie 1988). Blueback herring will ascend freshwater far upstream (Massmann 1953; Davis and Cheek 1966; Perlmutter *et al*. 1967; Crecco 1982); their distribution is a function of habitat suitability and hydrological conditions, such as swift flowing water (Loesch and Lund 1977). In tributaries of the Rappahannock River, Virginia, upstream areas were found to be more important for Blueback Herring spawning than downstream areas (O’Connell and Angermeier 1997). Spawning occurs at temperatures ranging from a minimum of 13°C (Hawkins 1979; Rulifson et al. 1982) to a maximum of 27°C (Loesch 1968). Blueback herring are repeat spawners and there appears to be an increase in repeat spawning from south to north (Rulifson et al. 1982). In Nova Scotia, 75% of adults in Nova Scotia had previously spawned (O’Neill 1980). Spawning typically occurs over an extended period, with groups or “waves” of migrants staying 4 to 5 days before rapidly returning to sea (Hildebrand and Schroeder 1928; Bigelow and Schroeder 1953; Klauda et al. 1991). The majority of spent adult Blueback Herring emigrating from the Connecticut River moved through fish passage facilities between 1700 and 2100 hours (Taylor and Kynard 1984). Initially, Blueback Herring eggs are demersal, but during the water-hardening stage, they are less adhesive and become pelagic (Johnston and Cheverie 1988). In general, Blueback Herring eggs are buoyant in flowing water, but settle along the bottom in still water (Ross and Biagi 1990). Juvenile Blueback Herring spend three to nine months in their natal rivers before migrating to the ocean (Kosa and Mather 2001). In the Kennebec River, female and male Blueback Herring reach a maximum age of 7 years and total length of 289 mm and 277 mm, respectively. Females may produce 30,000-400,000 eggs. Blueback herring return to the Kennebec River to spawn for the first time at age 2 (males) and age 3 (females). Spawning fish are primarily between three and four years old.

3.3.3 Historical and current distribution

Foster and Atkins (1867) and Atkins (1887) did not describe the range of Blueback Herring in the Kennebec River. However, the species likely accessed the same areas as Alewife and American Shad considering their comparable swimming abilities and spawning habitat requirements. Therefore, this plan assumes that adult Blueback Herring ascended the mainstem Kennebec River to Norridgewock Falls, current location of the Abenaki and Anson projects, migrated into lower part of the Sandy River, and ascended to the confluence of the East Branch and West Branch of the Sebasticook River and were able to access 2,508 hectares of spawning and rearing habitat above Augusta (Table 6).

The removal of Edwards Dam in 1999 allowed Blueback Herring free access to about 21% of their historic spawning habitat. Pursuant to the 1998 Settlement Agreement, the installation of permanent upstream fish passage (a swim-through fish lift) at the Benton Falls Project and at the Burnham Project in 2006 and the removal of the Fort Halifax Dam in 2008 made all historic

Blueback Herring spawning/rearing habitat in the Sebasticook River accessible (489 hectares, 19.5% of historic habitat). Returns of adult Blueback Herring to the Benton Falls fish lift ranged from 1.2-1.3 million from 2017-2019 (Table 8).

Pursuant to the 1998 Settlement Agreement, interim upstream passage became operational at the Lockwood Project in 2006. Between 2014 and 2019, an average of 84,925 adult Blueback Herring (range 34,063-164,886) have been lifted at the Lockwood Project fish lift, and transported upstream by the MDMR (Table 8). Because the fish lift is not connected to the headpond, the majority (59.6%) of historic Blueback Herring habitat remains inaccessible.

3.3.4 Relevant fishery and stock status

States manage their river herring fisheries (Blueback Herring and Alewife) collaboratively through the Atlantic States Marine Fisheries Commission (ASMFC), which periodically conducts stock assessments or stock updates on all managed species. According to the most recent stock update for river herring (ASMFC 2017), severe declines in commercial landings of river herring began coastwide in the early 1970s and domestic landings are now a fraction of what they were at their peak (>30 million pounds annually from 1950-1972) and have remained at persistently low levels since the mid-1990s. Beginning in 2002, several states enacted moratoria on their commercial and /or recreational fisheries (Massachusetts, Rhode Island, Connecticut, Virginia for waters flowing into North Carolina, and North Carolina). As of January 1, 2012 states or jurisdictions without an approved sustainable fisheries management plan (SFMP), as required under ASMFC Amendment 2 to the Shad and River Herring FMP, were closed. As a result, prohibitions on harvest (commercial or recreational) were extended to the following states: New Jersey, Delaware, Pennsylvania, Maryland, D.C., Virginia (for all waters), Georgia and Florida.

ASMFC approved Maine's first SFMP to harvest river herring in 2010 and an updated SFMP in 2017. Maine has 38 municipalities with the exclusive right to commercially harvest river herring, and currently 22 municipalities actively harvest river herring. Directed commercial harvest of Alewife or Blueback Herring does not occur in the main stem of nine rivers (Penobscot, Kennebec, Androscoggin, Saco, St. Croix, Presumpscot, Machias, Salmon Falls, and East Machias), but does exist on the tributaries of larger rivers. The primary sustainability threshold is a minimum escapement of 35 fish per surface acre of spawning habitat. Escape numbers are measured through passage counts above commercial fisheries and managed by closed fishing days, season length, gear restrictions or continuous escapement. If the escapement threshold is not met than the commercial fishery will close for conservation. River herring populations in five of Maine's river systems with a commercial harvest (Androscoggin, Kennebec, Sebasticook, Damariscotta, and Union) either showed an increase or no trend in multiple assessment criteria (ASMFC 2017).

Recreational fishermen are allowed to harvest four-days per week throughout the year. The limit is 25 fish per day and gear is restricted to dip net and hook-and-line. Recreational fishermen may not fish in waters, or in waters upstream, of a municipality that owns fishing rights. Recreational fishing for river herring in Maine is limited and landings are low.

3.3.5 Past and current management actions in the Kennebec River

Restoration of Blueback herring has been a combination of active (stocking) and passive (natural expansion into accessible spawning/rearing habitat) actions in the Kennebec River watershed. The removal of Edwards Dam in 1999 allowed Blueback Herring free access to about 21% of their historic spawning habitat. Blueback herring naturally expanded into this habitat as evidenced by the presence of juveniles in the restored Kennebec River. Pursuant to the 1998 Settlement Agreement, interim upstream fish passage (a fish pump) became operational at the Fort Halifax Project in 2000, and MDMR stocked captured adult river herring into upstream habitat. Biological sampling indicates that few of the fish were Blueback Herring (Table 8). Pursuant to the 1998 Settlement Agreement, permanent upstream fish passage (a swim-through fish lift) became operational at the Benton Falls Project and at the Burnham Project in 2006. Following removal of the Fort Halifax Dam in 2008, the number of Blueback Herring migrating into spawning/rearing habitat in the Sebasticook River has increased by 1400% (Table 8). Also pursuant to the 1998 Settlement Agreement, interim upstream passage became operational at the Lockwood Project in 2006. The number of Blueback Herring returning to the mainstem has increased (Table 8), but the population is maintained by MDMR stocking efforts.

3.3.6 Findings of current research

This plan provides reach by reach (dam to dam) production targets for adult Blueback Herring. Production targets are based on accessible and potentially accessible spawning/nursery habitat area and the most recent determination of adult production per unit of habitat area, a method commonly used for American Shad and Alewife. The unit production was estimated from the number of Blueback Herring passed at Benton Falls and the amount of available upstream habitat. The targets were calculated as target number of adult Blueback Herring = (habitat surface hectares) × (1,196 adults/hectare).

The Kennebec River watershed contains approximately 2,508 hectares of Blueback Herring riverine spawning/nursery habitat that was historically accessible (Table 6). The majority of the habitat (59.6%) is above the Lockwood Dam, while 20.9% lies between the head-of-tide (site of former Edwards Dam) and the Lockwood Dam, and 19.5% is in the Sebasticook River (Table 6). Removal of Edwards Dam was an important step in enhancing the Blueback Herring population, which naturally recolonized the reach between Augusta, the Lockwood Dam, and the Fort Halifax Dam. The population rapidly expanded in the Sebasticook River after the removal of Fort Halifax with over one million adults being passed annually at Benton Falls in the past 4 years (Table 8). Blueback herring began using the fish lift at the Lockwood Project soon after it became operational in 2006 (Table 8). However, free access to habitat above the Lockwood dam is clearly necessary to reach production and distribution goals. MDMR estimates that the habitat above the Lockwood Project could produce a minimum of 2 million Blueback Herring.

Dr. Daniel Stich has recently developed a stochastic, life-history based, simulation model for Blueback Herring for the Mohawk River and the Kennebec River; these models are conceptually similar to the American Shad model. Dr. Stich ran 48 scenarios to explore the effects of downstream passage survival (1.00, 0.95, and 0.90) in combination with varying upstream passage efficiency (0.70-1.00) and time-to-pass (1, 3, 7, and 20 days per dams) on Blueback Herring distribution and abundance. The upstream and downstream passage facilities should be operated daily (24 hours/day) to accommodate the migratory movements of river herring (Grote et al. 2014).

MDMR is not aware of any effectiveness testing that has been conducted on Blueback Herring. However, studies of the related Alewife have resulted in downstream passage efficiencies that raged from 90.9-100.0% with median time to pass form 0.9 hours to 3.3 days and upstream passage efficiency from 19.8-65.1% (Table 9).

3.4 Alewife (Alosa pseudoharengus)

3.4.1 Goals and objectives

The goal for **Alewife** is to

1. Achieve and maintain an adult return that exceeds a minimum of 581.5 adults/hectare (235/acre) and is consistent with the Maine State average of 988.4/ha (400/acre).
2. Achieve and sustain a minimum population of 5,785,000 adults above Augusta.
3. Pass at least 608,200, adults at the Lockwood, Hydro Kennebec, and Shawmut project dams.
4. Pass at least 473,500 adults at the Weston Project dam; and
5. Pass at least 4,540,200 adults at the Benton Falls Project dam.

3.4.2 Biology and ecology

The Alewife is an anadromous, highly migratory, euryhaline, pelagic, schooling species that historically ranged from South Carolina to Labrador, Nova Scotia, and northeastern Newfoundland (Berry 1964; Winters et al. 1973; Burgess 1978). Alewife and Blueback Herring are collectively referred to as river herring because of their similarity in size and appearance Although Alewife and Blueback Herring co-occur throughout much of their respective ranges, Alewife are typically more abundant than Blueback Herring in the northern portion of their range (Schmidt et al. 2003). The Alewife spends the majority of its life at sea, returning to freshwater river systems along the Atlantic coast of the United States to spawn. Alewife spawn in lakes and ponds in coastal watersheds (Loesch 1987), in the slow-moving sections of rivers or streams (Jones et al. 1978), in shore-bank eddies or deep pools below the dams (Loesch and Lund 1977). Alewife home to their natal waters to spawn (Ross and Biagi 1990), but can be introduced to new habitat or may stray to new habitat which they will recolonize. Alewife may ascend long distances in freshwater to reach spawning habitat. In the Rappahannock River, upstream areas were found to be more important than downstream areas for spawning Alewife (O'Connell and Angermeier 1997). Spawning typically is initiated at water temperatures ranging from 5-10°C (Loesch 1987), and may last two to three days for each group or "wave" of fish that arrives (Cooper 1961; Kissil 1969; Kissil 1974). Many Alewife are repeat spawners, with some individuals completing seven or eight spawning events in a lifetime (Jessop et al. 1983). In the Kennebec River, female and male Alewife reach a maximum age of 8 and 7 years and total length of 331 mm and 316 mm, respectively. Females may produce 60,000-467,000 eggs. Alewife return to the Kennebec River to spawn for the first time at age 2 (males) and age 3 (females). Spawning fish are primarily between the ages of 4 and 5, with 17-19% being repeat spawners. The spawning habitat of Alewife can range from sand, gravel, or coarse stone substrates, to submerged vegetation or organic detritus (Edsall 1964; Mansueti and Hardy 1967; Jones et al. 1978). Adults migrate downstream soon after spawning. The fertilized eggs remain demersal and adhesive for several hours (Mansueti 1956; Jones et al. 1978), after which they become pelagic. Eggs most often hatch within 80 to 95 hours (Edsall 1970), the yolk-sac is absorbed within 2-5 days of hatching, and the larvae begin feeding exogenously (Cianci 1965; Jones et al. 1978). Outmigration of the juveniles is related to declining water temperature (Pardue 1983; Loesch 1987) and changes in water flow, water levels, precipitation, and light intensity (Cooper 1961; Kissil 1974; Richkus 1975; 1975b; Pardue 1983).

3.4.3 Historical and current distribution

Alewife historically were able to access 9,946 hectares of spawning and rearing habitat above the head-of-tide in Augusta (Table 6). Adults ascended the mainstem Kennebec River as far upstream as Norridgewock Falls, current location of the Abenaki and Anson projects, migrated into lower part of the Sandy River, and ascended to the confluence of the East Branch and West Branch of the Sebasticook River (Foster and Atkins 1868; Akins 1887). Currently, swim-through fish passage allows adult Alewife to access 3,557 hectares of habitat in the Sebasticook River and 999 hectares in Seven Mile Stream. However, 1,047 hectares of spawning/rearing habitat in the Kennebec River is not freely accessible. MDMR annually transports Alewife that use the fish passage facility at the Lockwood Project, which is not connected to the headpond, to upstream spawning/rearing habitat.

This plan provides reach (dam to dam) minimum production targets for adult Alewife. Minimum production targets are based on accessible and potentially accessible spawning/nursery habitat area and the adult production/unit of habitat area, a method commonly used in other American Shad plans and studies in the Connecticut River (CRASC 2017), Susquehanna River (SRAFRC 2010), and Penobscot River (MDMR 2008).

In the past, MDMR has used 235 adults/acre as the unit area production, which was the average minimum production of six harvested populations for the period 1971-1983 when the fishery was closed one day per week. Recent analysis of data for seven harvested runs for the period 2005-2017 (with three closed days per week) and reanalysis of the 1971-1983 data resulted in updating the average unit production to 400 adults/acre. This updated estimate of unit production is an average for harvested populations. The average production in this plan were calculated by the equation: number of adult Alewife = (habitat surface acres) × (400 adults/acre) or in metric units number of adult Alewife = (habitat surface hectares) × *(988.4 adults/hectare). The unit production of non-harvested populations, which would be a more accurate assessment of habitat carrying capacity, has been estimated for Maine and New Brunswick Alewife populations and is used for management of Alewife populations in Canada (Gibson and Myers 2003; Gibson et al. 2017).

3.4.4 Relevant fishery and stock status

States manage their river herring fisheries (Blueback Herring and Alewife) collaboratively through the Atlantic States Marine Fisheries Commission (ASMFC), which periodically conducts stock assessments or stock updates on all managed species. According to the most recent stock update for river herring (ASMFC 2017), severe declines in commercial landings of river herring began coastwide in the early 1970s and domestic landings are now a fraction of what they were at their peak (>30 million pounds annually from 1950-1972) and have remained at persistently low levels since the mid-1990s. Beginning in 2002, several states enacted moratoria on their commercial and /or recreational fisheries (Massachusetts, Rhode Island, Connecticut, Virginia for waters flowing into North Carolina, and North Carolina). As of January 1, 2012 states or jurisdictions without an approved sustainable fisheries management plan (SFMP), as required under ASMFC Amendment 2 to the Shad and River Herring Fisheries Management Plan, were closed. As a result, prohibitions on harvest (commercial or recreational) were extended to the following states: New Jersey, Delaware, Pennsylvania, Maryland, D.C., Virginia (for all waters), Georgia and Florida.

ASMFC approved Maine's first SFMP to harvest river herring in 2010 and an updated SFMP in 2017. Maine has 38 municipalities with the exclusive right to commercially harvest river herring. Currently, 22 municipalities actively harvest river herring. Directed commercial harvest of Alewife or Blueback Herring does not occur in nine of Maine's largest rivers (Penobscot, Kennebec, Androscoggin, Saco, St. Croix, Presumpscot, Machias, Salmon Falls, and East Machias), but commercial fisheries do exist on the tributaries of larger rivers. The primary sustainability threshold is a minimum escapement of 35 fish per surface acre of spawning habitat. Escape numbers are measured through passage counts above commercial fisheries and managed by closed fishing days, season length, gear restrictions or continuous escapement. If the escapement threshold is not met than the commercial fishery will close for conservation. River herring populations in five of Maine's river systems with a commercial harvest (Androscoggin, Kennebec, Sebasticook, Damariscotta, and Union) either showed an increase or no trend in multiple assessment criteria (ASMFC 2017).

Recreational fishermen are allowed to harvest four-days per week throughout the year. The limit is 25 fish per day and gear is restricted to dip net and hook-and-line. Recreational fishermen may not fish in waters, or in waters upstream, of a municipality that owns fishing rights. Recreational fishing for river herring in Maine is limited and landings are low.

3.4.5 Past and current management actions in the Kennebec River

Restoration of Alewife to the Kennebec River began in 1987 with the signing of the first KHDG settlement agreement. With funds from the settlement, MDMR stocked approximately 1.3 million adult Alewife into 9 inaccessible lakes and ponds from 1987 through 2006 (Table 10).

By 2003, the Maine Department of Marine Resources (MDMR) and its partners had provided upstream fish passage at four non-hydropower dams in the Sebasticook River (Guilford Dam, Sebasticook Lake, Stetson Pond, Plymouth Pond), which in turn triggered construction of upstream passage at the Benton Falls Project and the Burnham Project. A fish lift at each of the projects became operational in 2006. After the Fort Halifax Dam was removed, the Alewife population migrating up the Sebasticook River expanded significantly (Table 8; Wippelhauser 2021). Upstream passage into Webber Pond on Seven-Mile Stream also has resulted in a large Alewife population. Alewives returning to the mainstem of the Kennebec River have increased in number, but the population is maintained by stocking.

3.4.6 Findings of current research

Barber et al. (2018) developed a developed a deterministic model to explore the theoretical nutrient dynamics of Alewife migrations at differing spawner abundances. Adult Alewife on their spawning migration importing nitrogen and phosphorus into freshwater habitats, and outmigrating juveniles subsequently transport freshwater-derived nutrients into the ocean.

Productivity level was the major determinant of export, while fisheries mortality had the strongest effect on adult import.

The "Alewife population model", a web-based application[7] for understanding likely fish passage outcomes for Alewife, was developed by Betsy Barber, Alejandro Molina-Moctezuma, Jamie Gibson, Andrew O'Malley, and Joseph Zydlewski. The basic structure and inputs of the original model have been described in Barber et al. (2018), and the same information and the R code is annotated at the web site.

The Alewife population model was developed to compare theoretical spawner abundance between scenarios with different dam passage rates. Spawner abundance is calculated using a deterministic population model, which defines inputs using averages applied to groups. The model is used to explore general trends and compare the results of scenarios when different average values are used as inputs. The model does not make forecasts or predictions about the exact number of spawners that will be present in the river after a certain number of years**.** In addition, no annual environmental variability was built into the model; inputs were averages; all spawning habitat was considered to be of the same quality; all density-dependent mortality was included in the recruitment curve; and in the absence of dams, fish were distributed throughout the system according to habitat availability. The types of questions that can be answered using the Alewife population model are those that make comparisons between scenarios, such as:

1. How would improving passage at a specific dam increase total Alewife abundance in the river?
2. Where would passage improvements result in the largest increase in spawner abundance?

MDMR used the Alewife population model to compare total theoretical Alewife abundance in the Kennebec River between scenarios with different upstream and downstream fish passage efficiencies given the distribution of spawning habitat relative to the four mainstem dams. In order to achieve a minimum number of spawners (608,200 adult Alewife) to historic habitat in the Kennebec River, upstream passage of adults would need to be at least 90% effective at each of the four dams and downstream passage of adults and juveniles at each of the four dams would need to be at least 95% effective (Figure 3). If dams were removed, required upstream and downstream passage effectiveness of adults and juveniles at remaining projects would decrease. Because adult Alewife have limited energy stores, time to pass at each dam should be minimized. The upstream and downstream passage facilities should be operated daily (24 hours/day) to accommodate the migratory movements of river herring (Grote et al. 2013). These results form the basis of our performance standards.

Several fish passage studies of adult Alewife have been conducted in recent years using small radio telemetry tags. These Studies have resulted in estimated downstream passage efficiencies that ranged from 90.9-100.0% with median time to pass form 0.9 hours to 3.3 days and upstream passage efficiency from 19.8-65.1% (Table 9).

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[7] https://umainezlab.shinyapps.io/Alewifepopmodel/

3.5 Sea Lamprey (*Petromyzon marinus*)

3.5.1 Goals and objectives

The goal for Sea Lamprey is to restore access for the species to historic spawning and nursery habitat.

3.5.2 Biology and ecology

The Sea Lamprey is an anadromous, semelparous, species that ranges in the wester Atlantic Ocean from the St. Lawrence River in Canada to the State of Florida in the United States (Scott and Crossman; Colette and Klein-MacPhee 2002). Unlike the other diadromous species native to Maine, there is no evidence that Sea Lamprey home to their natal river system (Hansen et al. 2016). They spawn in gravel-cobble substrate, and the spawning process results in streambed modification and sediment transport (Nislow and Kynard 2009; Sousa et al. 2012; Hogg et al. 2016). Lamprey spawning activities condition the habitat for other species, including Atlantic Salmon, by removing fines and reducing substrate embeddedness (Kircheis 2004). Given the high degree of embeddedness in Maine streams due to past land use practices, the role of lamprey as "ecosystem engineers" is particularly important (Kircheis 2004; Sousa et al. 2012). Sea Lamprey spawning in Maine begins in late May and extends into early summer and peaks at water temperatures of 17-19°C (Kircheis 2004). Sea Lamprey metamorphize as juveniles and swim downstream to feed in the ocean in the late fall and spring (Kircheis 2004). General movement is thought to occur at nighttime and during high flow events (Kircheis 2004). Given their small size at 100 mm to 200 mm (Kircheis 2004), turbine entrainment is possible without appropriately sized exclusion screening or other measures to bypass outmigrating Sea Lamprey.

Anadromous Sea Lampreys also serve as a conduit of nutrients between marine and freshwater systems. Semelparous adults contribute marine derived nutrients (MDN) to rivers, whereas filter-feeding ammocetes, (the juvenile life stage that spends up to eight years in stream sediments), break down terrestrially derived nutrients in streams, and eventually export nutrients into the marine environment (Beamish 1980, Kircheis 2004; Nislow and Kynard 2009; Weaver et al. 2018). Atlantic coastal streams are generally considered to be phosphorus-limited, although Sedgeunkedunk Stream in Maine was found to be both nitrogen and phosphorus limited (Weaver et al. 2016). Nislow and Kynard (2009) demonstrated that Sea Lamprey contributed phosphorus to a Connecticut River tributary at levels as great as 0.26 gm^{-2}. Sea Lamprey spawning occurs in late spring and early summer, thus pulses of MDN from post-spawn lamprey carcasses occur after canopy formation reduces light penetration to the stream and concurrent with the emergence of macroinvertebrates and Atlantic Salmon fry (Beamish 1980; Nislow and Kynard 2009; Weaver et al. 2015, 2016). Consequently, the influx of nutrients may help support stream food webs during a time when nutrients and energy flow might otherwise be limiting (Weaver et al. 2016). Further, Sea Lamprey are the sole semelparous species among the complex of sea run species that spawn in Maine's rivers. Gametes and metabolic waste from iteroparous species, such as Atlantic Salmon, river herring, and shad do serve as a source of MDN, but carcasses of semelparous species are generally a more important source of nutrients, highlighting the importance of providing lamprey passage into critical habitat areas (Moore et al. 2011; Nislow and Kynard 2009). The species is an important component of the riverine ecosystem in Maine that, like other sea run fish species, has been prevented from reaching much of its historic range by barriers to upstream passage.

3.5.3 Historical and current distribution

The historical distribution of Sea Lamprey in the Kennebec River is not known. However, in watersheds unrestricted by dams, Sea Lamprey are capable of reaching small, high-gradient, headwater streams (Nislow and Kynard 2009).

The removal of Edwards Dam in 1999 allowed Sea Lamprey free access to the mainstem Kennebec River as far upstream as the Lockwood Dam and the Fort Halifax Dam. Between 2006 and 2020, a total of 194 Sea Lamprey have been used the Lockwood Project fish lift (average 13, range 0-15).

3.5.4 Relevant fishery and stock status

Currently there is no commercial harvest of Sea Lamprey in Maine, although Carolina Biological Supply Company harvested as many as 8,000 sea lamprey from the Sheepscot River at Head Tide in the 1970's and 1980's (Kircheis 2004).

In Europe, the Sea Lamprey has declined over the last 25 years from a combination of (1) habitat loss associated with dam construction, (2) degradation of water quality from mining, industrial, and urban development, (3) direct loss of habitat by sand extraction and dredging, (4) overfishing, and (5) changes in water quality (temperature) and quantity (Hansen et al.2016). Dams without fishway that are appropriate for Sea Lamprey or fishways that are not operated at night may have resulted in a similar decline in abundance of Sea Lamprey along the Atlantic coast. Assessment of the status of Sea Lamprey is complicated by the fact that adult sea lampreys do not appear to home to natal streams (Waldman et al. 2008), but rather, select spawning streams through innate attraction using other sensory cues (Vrieze et al. 2010, 2011

3.5.5 Past and current management actions

Sea Lamprey have not been actively managed in the past. Recent research has led to an appreciation of the ecological goods and services provided by the species, and as a result, MDMR has begun efforts to improve upstream and downstream passage adult and juveniles.

3.5.6 Findings of current research

On the Connecticut River, Castro-Santos et al. (2016) reported that 64% of entries into fish passage structures occurred at night (i.e., between sunset and sunrise); in fact, entry rates were as much as 24.4 times greater at night. In a study on the River Mondego, (Portugal), Pereira et al. (2016) found that most detections of Sea Lamprey in a vertical-slot fish pass occurred at night, i.e., between dusk and dawn (88% in 2014 and 75% in 2015). Data from fish passage facilities in Connecticut indicate that in the early part of the upstream migration period, lamprey enter fish passes exclusively at night. As the run progresses, however, lamprey may enter at any time (Steve Gephard, CTDEEP Fisheries, pers. comm. Old Lyme, CT). At the Westfield River fish passage facility in Massachusetts, nearly all lamprey pass at night (Caleb Slater, Massachusetts Division of Fisheries and Wildlife. Pers. Comm. Westborough, MA). In 2020, lamprey passage occurred primary in the evening hours at the Milford fish lift, with some passage occurring in the early morning (e.g. 1am EST) (MDMR, unpublished data). Given the strong propensity for lamprey to exhibit nocturnal movement patterns, fishways, including fish lifts, should be operated at night to allow for lamprey passage.

On the Connecticut River, the combined passage percentage for Sea Lamprey at Turner's Falls was 46.7%, whereas fish pass entry was 64.1% of tagged individuals (Castro-Santos et al. 2016). This is comparable to entry rates for Pacific lamprey at Bonneville (67%) and McNary Dams (61%) on the Columbia River (Johnson et al. 2012; Keefer et al. 2013a; 2013b). At Turner's Falls, failure to pass was predominantly associated with the fish pass entrance, so concerted improving ability for lamprey to enter fish ladders is likely to be a key aspect of ensuring overall passage success (Castro-Santos et al. 2016). Passage efficiency for a vertical-slot fish pass on the River Mondego, (Portugal), was determined to be 33% via PIT telemetry and 31% via radio-telemetry (Pereira et al. 2016). In 2020, 50 radio tagged sea-lamprey passed the Milford fish lift on the Penobscot River at 81% (MDMR, unpublished data).

Detection of a radio-tag from a Sea Lamprey at Brownsville on the Pleasant River (a tributary of the Penobscot River) in August 2020 indicates that two dam removals, installation of a fish lift that is operated day and night, and installation of a nature-like fishway at a decommissioned hydropower project has positive impacts on lamprey migratory range (MDMR, unpublished data).

During the years 2014-2020, the earliest recorded Sea Lamprey was counted at the Milford Dam fish lift (Penobscot River) on May 7; lamprey have been recorded at Milford as late as July 6 (MDMR unpublished data). Lamprey on the Westfield River have been observed as early as April 14 during the years 2005 to 2019 (Caleb Slater, Massachusetts Division of Fisheries and Wildlife. Pers. Comm. Westborough, MA). For the years 1978-2018, lamprey were recorded at the Rainbow Dam fishway on the Farmington River, (a tributary of the Connecticut River) as early as 16 April (mean start date of 29 April) and as late as July 11 (mean end date of 24 June; CT DEEP Fisheries Division, unpublished data, Old Lyme, CT). Given the long distances that Sea Lamprey must travel to reach spawning grounds while temperatures are favorable for spawning, we recommend that a Sea Lamprey passage season should begin no later than May 1 and extend to July 30. As more information becomes available, this season can be adjusted. \

3.6 American Eel (*Anguilla rostrata*)

3.6.1 Goals and objectives

The goal is to provide safe, timely, and effective upstream and downstream passage for American Eel throughout its historically accessible habitat.

3.6.2 Biology and ecology

The American Eel is a highly migratory, semelparous, facultative catadromous species that spends most of its life in freshwater or estuarine environments and spawns in the ocean (Collette and Klein-MacPhee 2000; Shepard 2015). The species ranges over more than 50 degrees of latitude, being found from the southern tip of Greenland, along the entire eastern coast of North America, around the Gulf of Mexico, and through most of the West Indies (Smith 1989). Within that range, it may use the broadest types of habitat of any fish species (Helfman et al. 1987). Spawning occurs in winter and early spring only in a large region of the Sargasso Sea (Kleckner and McCleave 1985; Wippelhauser et al. 1985; McCleave et al. 1987) probably in association with, or delimited by, density fronts meandering east-west in the Sargasso Sea (Kleckner and McCleave 1988). The eggs hatch and release a long-lived larval stage (leptocephalus) which drift and swim in the upper 300 m of the water column for several months, growing slowly to a length of 5-6 cm (Kleckner and McCleave 1985). The oceanic current move the leptocephali to the south and west and into the Gulf Stream, which transports them northward along the east coast of the U.S. Somewhere over the continental shelf, the larvae metamorphose into a miniature transparent eels (glass eels). Glass eels actively migrate toward land and freshwater and ascend rivers during the winter and spring. The migration occurs earlier in the southern portion of the range and later in the northern portion (Helfman et al. 1987; McCleave and Kleckner 1982). Glass eels ascend estuaries by drifting on flooding tides and holding position near bottom on ebb tides (McCleave and Kleckner 1982; Wippelhauser and McCleave 1987) and also by actively swimming along shore in the estuaries and above tidal influence (Sheldon and McCleave 1985 Barbin and Krueger 1994). When the migrating glass eels become pigmented they are termed elvers or yellow eels. Depending on where they cease their upstream migration, some yellow eels reach the extreme upper portions of the rivers while others stay behind in the brackish areas (Hardy 1978, Fahay 1978). The timing and duration of elver/yellow eel upstream migration can occur over a broad period of time from March through October, peaking in May through July. Yellow eel can continue migrating until they reach sexual maturity (Richkus and Whalen 1999). The growth rates of elvers/yellow eels are highly variable, although growth appears to vary with latitude and habitat (slower growth in the north than in the south; slower growth occurs in freshwater than in estuaries). The variable growth rates make length a poor predictor of age (Facey and Van Den Avyle 1987). Eventually yellow eels undergo a final metamorphosis into a silver eel, the adult stage that will migrate to the Sargasso sea to spawn and die. Silver eels may begin their seaward spawning migration in late summer through fall from New England tributaries (Facey and Van Den Avyle 1987). The yellow eel undergoes several physiological changes in becoming a silver eel, including: (1) a color change from yellow/green to metallic, bronze-black sheen; (2) body fattening; (3) skin thickening; (4) enlargement of the eye and change in visual pigment; (5) increased length of capillaries in the rete of the swim bladder; and (6) digestive tract degeneration (Facey and Van Den Avyle 1987).

The timing of the American Eel migrations in Maine’s waters is well-known from commercial harvests and MDMR monitoring. Upstream migrations generally begin earlier in the western part of the state and downstream migrations generally begin earlier in the upper reaches of a watershed. The upstream migration of glass eels is considered to occur from March 15- June 15. The upstream migration season for elvers and yellow eels is June 1-September 30. The downstream migration of silver eels occurs from August 15- October 31. Migration mostly occurs at night although glass eels may occasionally move during the day.

3.6.3 Historical and current distribution

Foster and Atkins (1868) and Atkins (1887) did not describe the historical range of American Eel in the Kennebec River watershed. However, the current range on the mainstem of the river extends as far upstream as Williams Project impoundment.

3.6.4 Relevant fishery and stock status

Like anadromous species, the abundance of American Eel has declined, and the decline has been attributed in part to dams, overfishing, and poor water quality. The species has been considered for listing under the ESA twice, but the USFWS determined in both cases that listing was not warranted at the time.

States manage their American Eel fisheries collaboratively through the Atlantic States Marine Fisheries Commission (ASMFC), which periodically conducts stock assessments or stock updates on all managed species. Currently two states, Maine and South Carolina, commercially harvest glass/elver eels (legally defined as eel <6 inches total length); all 15 states and jurisdictions commercially harvest yellow eels; and New York commercially harvests silver eels. Prior to the glass eel harvest in Maine, which began in the late 1970s, silver eels accounted for the majority of the Maine's commercial eel landings.

In the 2012 benchmark stock assessment, both trend analyses and DB-SRA results indicated the American Eel stock has declined in recent decades and the prevalence of significant downward trends in multiple surveys across the coast was cause for concern. Therefore, the stock status was depleted, and no overfishing determination could be made at that time based solely on the trend analyses performed. In the 2017 stock assessment update, the trend analysis results were similar to the 2012 results with few exceptions. Despite downward trends in the indices, commercial yellow American Eel landings have been stable in the recent decades along the Atlantic coast (U.S. and Canada) although landings still remain much lower than historical landings. Therefore, the stock status is unchanged, it is depleted, and no overfishing determination can be made based on the trend analyses performed.

Since the ASMFC Interstate Fisheries Management Plan for American Eel (FMP) was approved in 1999, it has been modified four times. Addendum I (2006) established a mandatory catch and effort monitoring program for American Eel. Addendum II (2008) made recommendations for improving upstream and downstream passage for American Eels. Addendum III (2013) made changes to the commercial fishery, specifically implementing restrictions on pigmented eels, increasing the yellow eel size limit from 6 to 9 inches, and reducing the recreational creel limit from 50 fish to 25 fish per day. Addendum IV (2014) established a coastwide landings cap of 907,671 pounds of yellow eel, reduced Maine's glass eel quota to 9,688 pounds, and allowed for the continuation of New York's silver eel weir fishery in the Delaware River. Two management triggers for the yellow eel fishery were established: (1) if the coastwide cap is exceeded by more than 10% in a given year, or (2) the coastwide cap is exceeded for two consecutive years regardless of the percent overage. If either one of the triggers were met then states would implement state-specific allocations based on average landings from 1998-2010 with allocation percentages derived from 2011-2013. Addendum V (2018) revised the yellow eel coastwide cap and management triggers based on recent fishery performance and updated landings data, and removing state-by-state quotas for the yellow eel fishery.

3.6.5 Past and current management actions in the Kennebec River

Since 1995, the MDMR has been requesting the installation of upstream and downstream eel at each hydropower facility as part of a settlement agreement or the relicensing process. Pursuant to the 1998 Settlement Agreement, upstream and downstream passage (either permanent or interim) for American Eel has been provided at all of the mainstem dams in the Kennebec River and the Sebasticook River. However, our understanding of the best means of providing downstream passage and the timing of the outmigration of silver eels have evolved in the last 25 years and testing of the existing interim facilities has not been rigorous. Analysis of Maine's silver eel harvest data indicates that the downstream migration of silver eels in the Kennebec River primarily occurs from August 15 to October 31.

3.6.6 Findings of current research

Anguillicoloides crassus, a highly infectious exotic nematode that infects the swimbladder of Anguillid eels, was originally found in 1995 at two separate locations in the U.S., an American eel aquaculture operation in Texas and from a single wild eel captured in Winyah Bay, South Carolina. Collections in 1998 and 1999 found a mean parasite prevalence rate (percent infected) of 52% in the Carolinas, but only 10-29% in Chesapeake Bay and less than 12% in the Hudson River; a study in 2010 found the same decline in parasite prevalence with latitude, but prevalence had increased to 58% in South Carolina, 41% in Chesapeake Bay, and 39% in New York (Shepard 2015). MDMR sampling has documented *A. crassus* in Maine. A major concern is that this parasite, which can damage the swim bladder of the American eel hosts, could potentially reduce the ability of infected adult eels to migrate and spawn successfully in the Sargasso Sea.

4.0 Economic value of the diadromous fishery resource

The Kennebec River supports important recreational fisheries for Striped Bass and American Shad and commercial fisheries for river herring and American Eel and annually exports millions of juvenile and adult sea-run fish to Maine's coastal waters.

Statewide, the Striped Bass fishery supported 3,110 jobs and generated $202-million dollars in revenue in 2016 (Southwick Associates 2019). In 2019, Maine's recreational fishermen landed 92,081 American Shad. The lucrative American Eel (elver) fishery was worth over $20 million dollars in 2018 and 2019. Statewide, the commercial harvest of river herring is a source of income for the municipalities with fishing rights and was valued at $814,240 in 2019 and $586,182 in 2020. Maine's lobster industry, valued at $485.4 million in 2019, became increasingly dependent of river herring as bait since the Atlantic herring stocks plummeted. Sea-run fish are an important part of the riparian and coastal environment, providing forage for eagles, seals, puffins, whales, cod, pollack, and other freshwater and marine species.

4.1 Value of salmon habitat

The Kennebec River once supported a robust Atlantic Salmon population, and habitat in the Kennebec River is critical to the recovery of the species today. In particular, the Sandy River has the greatest biological value for spawning and rearing habitat in the watershed, but it is currently only accessible to adult salmon through a trap and truck program around the four mainstem dams (NMFS 2009). Dams are also the most significant contributing factor to the loss of salmon habitat connectivity within the range of the DPS (Fay et al. 2006) and have been identified as the greatest impediment to self-sustaining Atlantic Salmon populations in Maine (NRC 2004). In the Kennebec River, there are approximately 251,083 units of historically accessible spawning and rearing habitat for Atlantic Salmon, however hydropower dams reduce or impede access to roughly 222,105 units (88.5%) of that habitat (NMFS 2009). Put into perspective, this is a loss of 30% of the historic habitat of Atlantic Salmon within the state of Maine; the only remaining intact population of Atlantic Salmon in the United States.

The Atlantic Salmon Restoration and Conservation Program (ASRCP) was established in 2018. The program is an In-Lieu Fee Program for compensating adverse impacts to Atlantic Salmon within the State of Maine. The ASRCP allows a consistent and defensible mechanism for calculating program credits and debits (fees) based on project impacts to Atlantic Salmon habitat. The scope of impacts includes any adjacent or blocked, spawning or rearing Atlantic Salmon critical habitat. The fee schedule defines a cost per habitat unit for each of the three bioregions and it was developed by incorporating a series of cost models and quantitative habitat measures. For the Merrymeeting Bay Salmon Habitat Recovery Unit (MMB SHRU), the bioregion that includes the Kennebec River, the cost per habitat unit is $4,850.

The four mainstem dams on the Lower Kennebec constitute the single largest impact on historical habitat in the Kennebec River. Lockwood, Hydro-Kennebec, Shawmut, and Weston and their associated impoundments impact both principle constituent elements defined in the Endangered Species Act listing of the species: migratory corridors and spawning and rearing habitat. In addition, the Anson and Abenaki project also impact historical salmon habitat but are not within the current critical habitat listing for Atlantic Salmon. These two projects also are located much further upstream and have a lesser impact on other anadromous species.

For simplicity, the calculations of habitat value (Table 14) are based on blocked habitat and do not include adjacent habitat impacts. The sum of rearing habitat impacted by the six dams is roughly 93,369 units. The quantity of rearing habitat used for this calculation is based on a modeling approach developed by Wright et al. (2008). The sum of measured spawning habitat impacted by the four dams is roughly 2,145 units. Spawning habitat has been identified by habitat surveys, but the majority of habitat in the watershed has not been surveyed and thus the quantity of spawning habitat used in this calculation represents only a portion of actual spawning habitat in the Kennebec watershed. If the fee schedule developed for the Kennebec River is applied to the total habitat impacted by the six dams, the cost to restore, enhance, create, or preserve in order to mitigate for the lost habitat would be approximately $463.8 million for projects below Williams and over $1 billion for all historic salmon habitat. While this approach is appropriate for estimating the monetary value of the impact to habitat in the Kennebec River, the quantity of habitat that is impacted is so great that it is impossible to replace in-kind.

5.0 Climate Change and Atlantic Salmon

The Atlantic Salmon is a cold-water anadromous species that has a narrow temperature tolerance range. As such, this species is susceptible to the effects of climate change during both the freshwater and marine phases of its life cycle (Brett 1956; Pörtner and Farrell 2008; Jonsson and Jonsson 2009; Hare et al. 2016). The negative effects of climate change on salmonids, however, are expected to be worse in systems with habitat that is degraded or is fragmented by dams (Rieman and Isaak, 2010; Williams et al. 2015).

In the northeastern United States, the streams and rivers where Atlantic Salmon occur are predicted to experience warmer summer water temperature combined with overall drier summers, with rainfall predominantly occurring as localized but intense events (Magnuson et al., 1997; Spierre and Wake, 2010; Todd et al. 2011). Winters are predicted to be wetter, with more rain than snow, which have the potential to alter winter baseflow, ice cover, and the timing, frequency, and severity of ice breakup events (Magnuson et al., 1997; Beltaos and Burrell 2003; Spierre and Wake, 2010). Mid-winter ice break-up events can be particularly detrimental to the over-winter survival of Atlantic Salmon and other aquatic life (Cunjak et al. 1998; Turcotte and Morse 2017). Reduced ice cover also has been linked to reduced overwinter survival of juvenile Atlantic Salmon (Hedger et al. 2012).

Salmon metabolism increases with increasing temperature, thus river temperature drives processes like timing of spawning, hatching of eggs and emergence timing, growth rates, size and age at smolt transition, migration patterns, gonad development, and fecundity (Jonsson and Jonsson 2009). At a certain temperature, termed the upper incipient lethal temperature, salmon begin to experience thermal stress; if salmon are unable to find cooler water, then they will die (Jonsson and Jonsson 2009; Elliott and Elliott 2010). For salmonids, the upper incipient lethal temperature is generally between 20 and 28 °C (Jonsson and Jonsson 2009; Elliott and Elliott 2010). Below the upper incipient lethal temperature, but outside the range of optimal temperatures, growth of juvenile salmon and energy stores of over-summering of adult salmon are reduced (Berman and Quinn 1991; Hasler et al. 2012).

Maximizing growth of juvenile salmon, energy stores available for adults, and overall survival, requires that Atlantic Salmon have access to suitable cold-water refuge habitat during summer heat events (Torgersen et al. 1999; 2012). Low flow conditions, road-stream crossings, and dams all can impede access to cooler headwater tributaries and cool refuges (Torgerson et al. 1999; Hasler et al. 2012; Brewitt et al. 2014). The warmer, drier summers expected to occur in Maine under future climate change scenarios make maintaining access to headwater tributaries and thermal refuges even more important (Magnuson et al. 1997; Spierre and Wake 2010; Todd et al. 2011; Dugdale et al. 2016; Frechette et al. 2018).

Headwater habitats have been identified as critically important for salmonid species, including Atlantic Salmon(Colvin et al. 2018). In addition to serving as cool refuges, productivity (in terms of parr density) has been positively associated with cumulative drainage area: i.e., parr density was lower in mainstem reaches (Sweka and Mackey 2010), possibly because of higher temperatures in the larger mainstem habitat. Colder headwater streams could also serve as an invasion shield, protecting native species like salmon from negative interactions with non-native species with higher temperature tolerances (Isaak et al. 2015). Erkinero et al. (2019) found greater life history diversity for Atlantic Salmon in tributaries than in river mainstems. Life history diversity can buffer effects of population fluctuations and help ensure population persistence; a concept referred to as the "portfolio effect" (Schindler et al. 2010). This evidence of the portfolio effect in Atlantic Salmon further supports the need to ensure that salmon have access to a variety of habitat types, particularly headwater tributaries, to maximize life history diversity and population persistence in the face of a changing climate.

In addition to impeding access to critical headwater habitat, dams and associated impoundments also impose other thermal challenges for salmon that can compound the effects of climate change. Impoundments created by dams alter the river temperature regime, both in the impoundment itself and in downstream habitat. Removal of the mainstem dams in the Klamath River (California) is expected to result in a decrease in mainstem river temperature by 2 to 4°C, which would help buffer the effects of climate change induced temperature increase on salmon and steelhead (Goodman et al. 2011; Perry et al. 2011; Brewitt et al. 2014). On the Snake River, most of the acute thermal stress on radio-tagged salmon and steelhead occurred at dams, with the warmest temperatures experienced in reservoirs or even in the fishways (Caudill et al. 2013; Keefer and Caudill 2016). In fact, when fishway temperatures were warmer, individuals made repeated passage attempts resulting in energetically costly passage delays (Caudill et al. 2013).

The large area of impounded water and significant numbers of dams between the only climate resilient habitat in the Kennebec river, the Sandy River, upper Kennebec, and Carrabassett River, creates an increasing urgency to remove dams in the Kennebec drainage to ensure safe, timely, and effective passage.

6.0 Summary

The Kennebec River is unique among all of Maine's river systems – it is the only one that currently supports populations of all of the State's native diadromous fish species. These fishes were once very abundant, but dams, overfishing and degraded water quality reduced their numbers or resulted in extirpation from historic habitat. Restoration efforts in the last 34 years have included fish stocking, dam removals, installation of fish passage at some dams, reduced commercial and recreational harvest, and water quality standards that have eliminated anoxic "dead zones." In some areas of the watershed, diadromous species have responded with significant increases in abundance. However, the six hydropower dams on the lower Kennebec River and the cumulative deleterious impacts they have on six species of diadromous fishes, one being endangered, represent a system out of balance. This comprehensive fisheries management plan provides a framework that balances restoration of diadromous fishes and the need for sustainable energy production. Section 10(A) of the Federal Power Act requires consideration of non-power generation uses of a waterway, such that a new or successive license shall, "…be best adapted to a *comprehensive plan* for improving or developing a waterway or waterways…" This includes the protection, mitigation, and enhancement of fish, wildlife, and habitat.

The Licensee commissioned a study, *Energy Enhancements and Lower Kennebec Fish Passage Improvements Study* (Feasibility Study), for stakeholder review and comment on May 20, 2019 FERC Accession #s 20190701-5155 and 20190701-5154). The Feasibility Study considered several fish passage options, one being dam removal, for the Shawmut, Lockwood, and Weston projects. Removal of those projects was determined to be feasible and reasonably practical. Therefore, the recommendation should be given full consideration.

6.1 Species Goals for the Kennebec River

The goal for **Atlantic Salmon** is to provide safe, timely, and effective upstream and downstream passage in order to achieve a minimum annual return of 500 naturally-reared adults to historic spawning/rearing habitat in the Kennebec River for downlisting and a minimum annual return of 2,000 naturally-reared adults to historic spawning/rearing habitat in the Kennebec River for reclassification.

The goal for **American Shad** is to provide safe, timely, and effective upstream and downstream passage in order to achieve a minimum annual return of 1,018,000[8] wild adults to the mouth of the Kennebec River; a minimum annual return of 509,000 adults above Augusta; a minimum of 303,500 adults annually passing upstream at the Lockwood and Hydro Kennebec Project dams; a minimum of 260,500 adults annually passing upstream at the Shawmut Project dam; and a minimum of 156,600 adults annually passing upstream at the Weston Project dam.

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[8] Based on 5,015 hectares of spawning/rearing habitat and a minimum return of 203 adults per hectare.

The goal for **Blueback Herring** is to provide safe, timely, and effective upstream and downstream passage in order to achieve a minimum annual return of 6,000,000[9] wild adults to the mouth of the Kennebec River; a minimum annual return of 3,000,000 adults above Augusta; a minimum of 1,788,000 adults annually passing upstream at the Lockwood and Hydro Kennebec Project dams; a minimum of 1,535,000 adults annually passing upstream at the Shawmut Project dam; and a minimum of 922,400 adults passing upstream at the Weston Project dam.

The goal for **Alewife** is to provide safe, timely, and effective upstream and downstream passage in order to achieve a minimum annual return of 5,785,000[10] adults above Augusta; a minimum of 608,200 adults annually passing at the Lockwood, Hydro Kennebec, and Shawmut project dams; and a minimum of 473,500 adults annually passing upstream at the Weston Project dam.

The goal for **Sea Lamprey** and **American Eel** is to provide safe, timely, and effective upstream and downstream passage throughout the historically accessible habitat of these two species.

6.2 Upstream Passage Performance Standards Necessary to Meet Species Goals

While the current proposal cannot meet these goals, should another proposal provide a more realistic proposal to meeting goals, the following would be recommended. DMR would recommend that the Licensee shall be responsible for providing, operating, maintaining, and evaluating volitional upstream fish passage facilities at the Lockwood, Hydro Kennebec, Shawmut, and Weston projects that shall be capable of passing the minimum populations annually in a safe, timely, and effective manner. Each project facility shall be considered to be performing in a safe, timely, and effective manner if:

1. At least 99% of the adult Atlantic Salmon that pass upstream at the next downstream dam (or approach within 200 m of the project powerhouse) pass upstream at the project within 48 hours.
2. At least 70% of the adult American Shad that pass upstream at the next downstream dam (or approach within 200 m of the project powerhouse) pass upstream at the project within 72 hours.
3. At least 90% of the adult Blueback Herring that pass upstream at the next downstream dam (or approach within 200 m of the project powerhouse) pass upstream at the project within 72 hours.
4. At least 90% of the adult Alewife that that pass upstream at the next downstream dam (or approach within 200 m of the project powerhouse) pass upstream at the project within 72 hours; and
5. At least 80% of the adult Sea Lamprey that pass upstream at the next downstream dam (or approach within 200 m of the project powerhouse) pass upstream at the project within 48 hours.

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[9] Based on 5,015 hectares of spawning/rearing habitat and a minimum return of 1,196 adults/hectare.

[10] Based on 9,946 hectares of spawning/rearing habitat and a minimum of 581.5 adults/hectare; the Maine State average is 988.4/hectare.

DMR would recommend that the Licensee shall operate the upstream passage daily from May 1 through November 10. The Licensee shall operate the upstream passage 24 hours per day from May 1 through June 30 to accommodate diurnal and nocturnal migrants.

The upstream passage facility shall adhere to the USFWS design criteria (USFWS 2019).

The Licensee shall initiate three consecutive years of upstream passage effectiveness testing using radio telemetry or an equivalent technique for each of the five species (Atlantic Salmon, American Shad, Blueback Herring, Alewife, and Sea Lamprey). The study plans shall be developed in consultation with, and require approval by, the MDMR and the other regulators and resource agencies. Based on the results of the annual reports, the regulators may require adjustments to the study methodology for the next year's evaluation.

Failure to meet effectiveness goals should result in significant modification of the project.

6.3 Downstream Passage Performance Standards Necessary to Meet Species Goals

While the current proposal cannot meet these goals, should another proposal provide a more realistic proposal to meeting goals, the following would be recommended. DMR would recommend that the Licensee shall be responsible for providing, operating, maintaining, and evaluating a volitional downstream fish passage facilities at the Lockwood, Hydro Kennebec, Shawmut, and Weston projects that shall be capable of passing adult and juvenile Atlantic Salmon(kelts and smolts), adult and juvenile American Shad, adult and juvenile Blueback Herring, adult and juvenile Alewife, adult American Eel (silver eel), and juvenile microphthalmia Sea Lamprey in a safe, timely and effective manner. MDMR recommends that each project facility shall be considered to be performing in a safe, timely, and effective manner if:

1. At least 99% of the Atlantic Salmon smolts and kelts that pass downstream at the next upstream hydropower dam (or approach within 200 m of the project spillway) pass the project within 24 hours.
2. At least 95% of the adult and juvenile American Shad that pass downstream at the next upstream hydropower dam (or within 200 m of the project spillway) pass the project within 24 hours.
3. At least 95% of the adult and juvenile Blueback Herring that pass downstream at the next upstream hydropower dam (or within 200 m of the project spillway) must pass the project within 24 hours.
4. At least 95% of the adult and juvenile Alewife that pass downstream at the next upstream hydropower dam (or within 200 m of the project spillway) pass the project within 24 hours.

The downstream passage facility shall adhere to the USFWS design criteria (USFWS 2019).

DMR would recommend the licensee shall pass 600 cfs through the forebay Taintor gate from April 1 to June 15 to provide safe passage for smolts and provide a minimum of 6% of Station Unit Flow (about 400 cfs at maximum generation) through the combined discharge of the forebay Taintor and surface sluice gates from June 16 to December 31 to provide passage for shad, blueback herring, alewife, kelts, and American eel. During the interim period between license issuance and the installation of the new fish guidance boom and turbine screening, the

Licensee shall lower four sections of hinged flashboards to pass 560 cfs via spill from April 1 to June 15 to provide a safe passage route for Atlantic salmon smolts.

The Licensee shall initiate three consecutive years of downstream passage effectiveness testing using radio telemetry or an equivalent technique for adult and juvenile Atlantic Salmon, adult and juvenile American Shad, adult and juvenile Blueback Herring, adult and juvenile Alewife, adult American Eel, and microphthalmia Sea Lamprey. The study plans shall be developed in consultation with, and require approval by, the MDMR and other regulators and resource agencies. Based on the results of the annual reports, the regulators may require adjustments to the study methodology for the next year's evaluation.

Failure to meet effectiveness goals should result in significant modification of the project.

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Table 1. Major events in diadromous fish restoration in the Kennebec River.

Year(s)	Major events
1987	First Kennebec Hydro Developers Group (KHDG) Settlement Agreement
1987-2006	MDMR stocks 1.3 million river herring into historic habitat above Edwards Dam
1987-1997	MDMR stocks American Shad adults (1,849), fry (44.6 million) and fingerlings (197,176) into historic spawning habitat above Edwards Dam
1988-2006	Interim, downstream passage operational at Benton Falls, Fort Halifax, Burnham, Lockwood, Shawmut, and Hydro Kennebec projects
1992	Interim upstream passage (fish pump) installed at Edward Dam
1993	Kennebec River Resource Management Plan
1998	Lower Kennebec River Comprehensive Hydropower Settlement (1998 Settlement)
1999	Removal of Edwards Dam
1999	MDMR completes upstream fish passage at Stetson Pond (Sebasticook River)
1999-2011	Installation of upstream eel passage at seven KHDH Dams
2002	MDMR removes Guilford Dam and completes upstream passage at Plymouth Pond (Sebasticook River)
2003	MDMR completes upstream passage at Sebasticook Lake (Sebasticook River)
2003	MDMR initiates salmon stocking (eggs, fry, returning adults) in Sandy River
2003	Relicensing of Abenaki and Anson project
2006	Fish lifts operational at Benton Falls and Burnham projects (Sebasticook River) and Lockwood Project (Kennebec River)
2006	Fish lift operational at Lockwood Project (Kennebec River)
2006	MDMR ceases stocking Alewife into 6 accessible lakes and ponds
2006	Removal of Madison Electric Works Dam (Sandy River)
2008	Removal of Fort Halifax Dam (Sebasticook River)
2009	MDMR completes upstream passage at Webber Pond Dam (Seven Mile Stream)
2009	Expanded listing of the GOM DPS of Atlantic Salmon including Kennebec River
2012-2013	Interim Species Protection Plans (ISPP) for Atlantic Salmon for Kennebec River and Androscoggin River
2012-2014	Downstream passage effectiveness studies for Atlantic Salmon smolts at Lockwood, Hydro Kennebec, Shaw, and Weston
2016	Fish lift operational at Hydro Kennebec Project
2016-2017	Upstream passage studies of adult Atlantic Salmon at the Lockwood Project
2017	Relicensing of the Williams Project
2017-2020	MDMR and partners remove Masse Dam (2017) and Lombard Dam (2018) and install fish passage at Ladd Dam (2019) and Box Mills Dam (2020) in Outlet Stream (Sebasticook River)
2018	A total of 5,580,111 river herring return to the Sebasticook River, the largest self-sustaining run on the east coast
2019	MDMR and partners complete upstream fish passage at Togus Pond
2020	MDMR develops the Kennebec River Diadromous Fisheries Management Plan

Table 2. Hydropower Projects in the Kennebec River drainage.

FERC Status	FERC number	Project name and development	Total capacity (KW)	Mean GW-hrs (2012-2017)	Expiration date
Licensed	2574	Lockwood	6,550	30.73	10/31/2036
Licensed	2611	Hydro-Kennebec	15,433	73.21	9/30/2036
Licensed	2322	Shawmut	8,650	53.18	1/31/2021
Licensed	2325	Weston	14,750	83.97	10/31/2036
Licensed	2364	Abenaki	19,917		4/30/2054
Licensed	2365	Anson	9,000		4/30/2054
Licensed	2335	Williams	14,500	92.38	12/31/2017
Licensed	5073	Benton Falls	4,468		2/28/2034
Licensed	11472	Burnham	1,000		10/31/2036
Exempt	8736	Pioneer	300		
Exempt	4293	Waverly Avenue	700		
Licensed	2556	Messalonskee	6,200		6/30/2036
Licensed		Union Gas (M5)	1,800		
Licensed		Rice Rips (M3)	1,600		
Licensed		Oakland (M2)	2,800		
Licensed	2555	Automatic (M4)	800		6/30/2036
Licensed	2809	American Tissue	1,000		4/30/2019
Exempt	7473	Gilman Stream	120		
Exempt	8791	Starks	35		
FERC approved	2329	Wyman	78,000	377.9	10/31/2036
FERC approved	2612	Flagstaff	Storage		2/28/2036
FERC approved	2142	Harris	76,600	216.19	10/31/2036
FERC approved	2671	Moosehead Lake	Storage		10/31/2036
FERC approved	2615	Brassua	4,180	30.73	3/31/2012
FERC approved	11132	Eustis	250		11/31/2026
Nonjurisdictional	UL 97-16	Moxie			

Table 3. Historic and current diadromous fish range in the focus area.

Species	Historic range	Current accessible range
Atlantic tomcod	Mainstem to head-of tide	Mainstem to head-of tide
Rainbow Smelt	Mainstem to Lockwood Dam	Mainstem to Lockwood Dam
Shortnose Sturgeon	Mainstem to Lockwood Dam	Mainstem to Lockwood Dam
Atlantic Sturgeon	Mainstem to Lockwood Dam	Mainstem to Lockwood Dam
Striped Bass	Mainstem to Lockwood Dam; Sebasticook to Benton Falls Dam	Mainstem to Lockwood Dam; Sebasticook to Benton Falls Dam
American Shad	Mainstem to Abenaki Dams; Sandy River to Rt 4	Mainstem to Lockwood Dam (truck stocking upstream)
Blueback herring	Mainstem to Lockwood Dam; Sandy River to Rt 4	Mainstem to Lockwood Dam (truck stocking upstream)
Alewife	Mainstem to Abenaki Dam; Sandy River to Rt 4	Mainstem to Lockwood Dam (truck stocking upstream)
Atlantic Salmon	Mainstem to confluence of Kennebec and Dead River; Carrabassett River; Sandy River	Mainstem to Lockwood Dam (truck stocking upstream)
Sea Lamprey	Unknown- similar to salmon	Mainstem to Lockwood Dam
American Eel	Unknown-above Williams Dam	Above Williams Dam

Table 4. Atlantic Salmon stocking and adult returns to the Kennebec River.

Year	Number of fry stocked	Number of eggs stocked	Total number of adult returns	Total naturally reared returns	Proportion naturally reared
2003	39,000				
2004	55,000	12,000			
2005	30,000	18,000			
2006	6,500	41,800	15	5	
2007	15,400	18,000	16	8	0.50
2008		245,500	21	8	0.38
2009		166,494	33	11	0.33
2010		567,920	5	3	0.60
2011		859,893	64	43	0.67
2012		920,888	5	4	0.80
2013		691,857	8	7	0.88
2014		1,159,330	18	16	0.89
2015		274,383	31	29	0.94
2016		619,364	39	39	1.00
2017		447,106	40	40	1.00
2018		1,227,353	11	10	0.91
2019		917,613	60	58	0.97
Total	145,900	8,187,501	306	223	

Table 5. Results of effectiveness testing for Atlantic Salmon smolts in the Kennebec (K) and Penobscot (P) rivers. Baseline survival is estimated from all fish. Adjusted survival (with lower and upper confidence intervals, LCI and UCI) is estimated from fish that successfully passed downstream within 24 hours. To achieve passage standards in the Penobscot, 25-50% of river flow has been spilled for the 2-week peak migration period since 2016.

			Baseline	Adjusted		
River	Project	Year	Survival	Survival	75% LCI	75% UCI
K	Weston	2013	95.70%			
K	Weston	2014	89.50%	87.50%		
K	Weston	2014	99.70%	66.00%		
K	Shawmut	2013	96.30%			
K	Shawmut	2014	93.60%	89.50%		
K	Shawmut	2014	90.60%	83.80%		
K	Hydro Kennebec	2012				
K	Hydro Kennebec	2013	94.10%			
K	Hydro Kennebec	2014	98.00%	90.00%		
K	Lockwood	2013	100.00%			
K	Lockwood	2014	97.70%	94.70%		
K	Lockwood	2014	98.00%	88.80%		
P	West Enfield	2014	95.70%			
P	West Enfield	2015	81.80%	76.70%	66.30%	83.00%
P	West Enfield	2015	82.00%	75.10%	67.20%	78.40%
P	West Enfield	2016	97.00%	96.80%	95.40%	**97.90%**
P	West Enfield	2017	99.70%	94.80%	92.70%	**96.80%**
P	West Enfield	2018	92.30%	91.80%	89.20%	94.70%
P	Milford	2014	92.70%			0.00%
P	Milford	2015	90.40%	84.80%	72.70%	92.40%
P	Milford	2015	84.90%	80.90%	73.20%	84.30%
P	Milford	2016	92.50%	92.80%	87.70%	**97.70%**
P	Milford	2016	93.40%	91.60%	88.20%	**94.70%**
P	Milford	2017	100.00%	98.10%	95.70%	**100.00%**
P	Milford	2017	99.30%	97.60%	**96.00%**	**99.10%**
P	Milford	2018	98.90%	98.80%	95.30%	**100.00%**
P	Milford	2018	98.60%	98.60%	94.70%	**100.00%**
P	Stillwater	2014	98.20%			0.00%
P	Stillwater	2015	75.20%	69.00%	52.90%	82.90%
P	Stillwater	2015	75.50%	69.20%	62.30%	76.20%
P	Stillwater	2016	95.40%	93.30%	90.50%	**96.10%**
P	Stillwater	2016	96.10%	94.30%	91.90%	**96.50%**
P	Stillwater	2017	97.80%	95.20%	93.00%	**97.40%**
P	Stillwater	2017	98.30%	95.30%	93.20%	**97.50%**
P	Stillwater	2018	98.90%	90.30%	87.00%	93.80%
P	Stillwater	2018	98.50%	91.70%	88.70%	94.50%
P	Orono	2014	92.30%			0.00%
P	Orono	2015	87.60%	82.00%	71.00%	90.30%
P	Orono	2015	86.90%	82.80%	79.30%	86.20%
P	Orono	2016	90.80%	89.70%	86.10%	92.90%
P	Orono	2016	87.00%	85.80%	81.90%	89.40%
P	Orono	2017	100.00%	98.60%	**96.80%**	**100.00%**
P	Orono	2017	100.00%	99.70%	**98.30%**	**100.00%**
P	Orono	2018	100.00%	97.80%	95.10%	**100.00%**
P	Orono	2018	100.00%	99.20%	95.80%	**100.00%**

Table 6. American Shad, Blueback Herring, and Alewife habitat and estimated production in the Kennebec River above the head-of-tide.

Habitat description	Surface area (ha)	% of total area	American Shad production	Blueback herring production	Alewife production
Kennebec-ED to LO	524	20.9	106,332	626,461	
Kennebec-LO/HK to SH	212	8.4	42,966	253,135	
Kennebec SH to WE	512	20.4	103,965	612,514	
Kennebec WE to AB	415	16.5	84,215	496,156	
Sandy to Rt 4 bridge	356	14.2	72,345	426,223	
Sebasticook to EB-WB	489	19.5	99,212	584,515	
Sebasticook lakes/ponds	9,946	78.6			7,730,400
Seven Mile lakes/ponds					
Webber Pond					1,065,200
Wesserunsett Lake	568				561,700
Sandy (4 lakes)	479				473,500
Totals			509,035	2,999,004	1,034,819

Table 7. American Shad stocked in the Kennebec River (KE) or the Sebasticook River (SE).

Adults were obtained from the Kennebec River, Narraguagus River (NA), Connecticut River (CO), Saco River, (SA), and Merrimack River (ME).

Year	Source	Adults released	Fry released (KE)	Fry released (SE)	Fingerlings released
1987	KE	16			
1987	NA	183			
1988	CO	616			
1989	NA	174			
1989	CO	444			
1989	KE	1			
1990	NA	36			
1990	CO	568			
1991	CO	639			
1992	CO	994			
1993	CO	880	186,000		16,000
1994	CO	898	51,000		15,600
1995	CO	1,518	388,000		27,841
1996	CO	462	599,990	320,000	3,070
1997	CO	420	1,484,908	474,313	60,261
1997	SA		459,241		
1998	CO		1,348,937	725,420	27,907
1999	CO		2,020,838	839,068	13,141
2000	CO		3,346,727	500,004	27,685
2001	ME		1,489,913	618,879	6,671
2002	ME		5,671,856	1,034,207	
2003	ME		5,989,358	1,857,184	
2004	ME		4,931,174	510,962	
2005	ME		1,105,343		
2006	CO		262,131		
2007	ME		7,937,841	422,518	
	Total	7,849	37,273,257	7,302,555	198,176

Table 8. River herring, American Shad, and Striped Bass at fish passage facilities. Adults returned to the Fort Halifax Project (FH), Benton Falls Project (BF) and Lockwood Project (LO); Alewife and Blueback Herring were estimated from biological sampling.

Site	Year	Total river herring	Alewife	Blueback Herring	American Shad	Striped Bass
FH	2000	137,658	137,658			
FH	2001	142,845	142,155	690		
FH	2002	151,574	150,743	831		
FH	2003	131,633	131,616	17		
FH	2004	143,697	143,663	34		
FH	2005	81,576	81,265	311		
FH	2006	46,960	43,865	3,095		
FH	2007	458,491	457,464	1,027		
FH	2008	401,059	388,692	12,367		
BF	2009	1,327,861	1,263,015	64,846	9	
BF	2010	1,628,187	1,201,559	426,628	3	4
BF	2011	2,751,473	2,537,226	214,247	54	
BF	2012	1,703,520	1,499,216	204,304	163	1
BF	2013	2,272,027	1,964,613	307,414	113	14
BF	2014	2,379,428	1,784,425	595,003	26	22
BF	2015	2,158,419	1,725,165	433,254	48	3
BF	2016	3,128,753	2,131,789	996,964	18	3
BF	2017	3,547,698	2,339,419	1,208,279	65	314
BF	2018	5,579,901	4,201,838	1,378,063	26	3
BF	2019	3,287,701	2,086,545	1,201,156	114	169
LO	2006	3,152				83
LO	2007	4,534			30	
LO	2008	90,940	89,121	1,819		
LO	2009	45,428				10
LO	2010	75,072	59,363	15,709	28	4
LO	2011	31,066				8
LO	2012	156,428				11
LO	2013	95,314				31
LO	2014	108,256	73,883	34,373	1	22
LO	2015	89,496	55,433	34,063	26	33
LO	2016	206,941	88,463	118,478	830	214
LO	2017	238,481	73,595	164,886	201	137
LO	2018	238,953	145,267	93,686	275	109
LO	2019	182,987	118,921	64,066	22	

Table 9. Results of fish passage effectiveness testing at multiple sites.
Studies to determine the effectiveness (survival) of downstream (DS) and upstream (US) passage facilites were conducted on adult fish. The time for 50% of the fish to successfully pass also is provided.

Species	Year	Type	Project	River	Survival estimate	Confidence Interval	Median time
Alewife	2019	DS	Pejepscot	Androscoggin	80.9%	75% CI = 76.3-85.7%	0.9 hr
Alewife	2015	DS	Lockwood	Kennebec	85.0%	75% CI = 69.0-100.0%	10.7 hr
Alewife	2018	DS	Milford	Penobscot	86.1%	75% CI = 82.1-89.7%	0.6 d
Alewife	2018	DS	West Enfield	Penobscot	93.7%	75% CI = 90.9-96.7%	0.7 d
Alewife	2018	DS	Stillwater	Penobscot	94.6%	75% CI = 92.4-97.8%	0.4 d
Alewife	2018	DS	Orono	Penobscot	97.8%	75% CI = 96.0-98.8%	2.1 hr
Alewife	2016	DS	Hydro Kennebec	Kennebec	100.0%	75% CI = 98.4-100.0%	3.3 d
American Shad	2019	DS	Pejepscot	Androscoggin	51.4%	75% CI = 41.6-61.1%	5.3 d
American Shad	2017	DS	Milford	Penobscot	76.6%	75% CI = 71.1-82.2%	1.6 d
American Shad	2018	DS	Milford	Penobscot	86.2%	75% CI = 82.4-89.9%	1.1 d
American Shad	2017	DS	Orono	Penobscot	87.0%	75% CI = 82.4-91.2%	1.6 d
American Shad	2018	DS	West Enfield	Penobscot	88.0%	75% CI = 84.4-91.9%	3.9 d
American Shad	2018	DS	Orono	Penobscot	94.4%		8.1 hr
American Shad	2018	DS	Stillwater	Penobscot	94.7%		0.3 d
American Shad	2017	DS	Stillwater	Penobscot	95.8%	75% CI = 91.7-97.9%	4.7 d
American Shad	2015	DS	Vernon	Connecticut			11.9 hr
American Shad	2016	DS	Vernon	Connecticut			11.6 hr
American Eel	2018	DS	Garvins Falls	Merrimack	70.1%	75% CI = 62.9-76.4%	0.2 hr
American Eel	2017	DS	West Enfield	Penobscot	84.0%		2.0 hr
American Eel	2018	DS	Amoskeag	Merrimack	84.1%	75% CI = 76.0-89.9%	0.6 hr
American Eel	2018	DS	Lowell	Merrimack	84.2%	75% CI = 74.1-90.3%	0.3 hr
American Eel	2019	DS	Garvins Falls	Merrimack	88.3%	75% CI = 82.7-92.3%	1.6 hr
American Eel	2018	DS	Lawrence	Merrimack	88.9%	75% CI = 79.8-94.2%	-
American Eel	2019	DS	Pejepscot	Androscoggin	90.0%	75% CI = 86.0-94.0%	2.1 hr
American Eel	2016	DS	Milford	Penobscot	90.0%		1.2 d
American Eel	2018	DS	Hooksett	Merrimack	90.5%	75% CI = 83.8-94.6%	0.1 hr
American Eel	2019	DS	Hooksett	Merrimack	90.6%	75% CI = 84.8-94.3%	0.2 hr
American Eel	2019	DS	Amoskeag	Merrimack	91.7%	75% CI = 85.8-95.3%	1.5 hr
American Eel	2016	DS	Stillwater	Penobscot	92.0%		1.8 hr
American Eel	2016	DS	Orono	Penobscot	98.0%		1.6 hr
American Eel	2015	DS	Wilder	Connecticut			0.2 hr
American Eel	2015	DS	Bellows Falls	Connecticut			0.2 hr
American Eel	2015	DS	Vernon	Connecticut			0.2 hr
American Shad	2010	US	Conowingo lift	Susquehanna	44.9%	±10.4%	
American Shad	2012	US	Conowingo lift	Susquehanna	25.8%	±10.6%	
American Shad	2015	US	Conowingo lift	Susquehanna	21.6%	±9.5%	
American Shad	2015	US	Lockwood	Kennebec	0.0%		
American Shad	2019	US	Pejepscot	Androscoggin	0.0%		
American Shad	2018	US	Holtwood	Susquehanna	4.2%		
American Shad	2019	US	Holtwood	Susquehanna	6.5%		
Alewife	2019	US	Pejepscot	Androscoggin	19.8%	75% CI = 14.8-24.9%	
Alewife	2019	US	Milford	Penobscot	65.1%	95% CI = 56.9-73.8%	

Table 10 Alewife habitat in the focus area and number of downstream barriers
Accessible lakes and ponds are shown in bold. The number of hydropower dams are shown first, followed by the number of non-hydropower dams in parentheses.

Subwatershed	Water body	Surface hectares	Number of dams
Sandy River	Clearwater Pond	322.0	4 (1)
Sandy River	Norcross Pond	45.6	4 (1)
Sandy River	Parker Pond	41.5	4 (1)
Sandy River	North Pond	70.0	4 (1)
Wesserunsett Stream	Wesserunsett Lake	568.3	3 (2)
Sebasticook River	**Pattee Pond**	288.1	0 (0)
Sebasticook River	China Lake	1,587.2	0 (4)
Sebasticook River	Lovejoy Pond	131.1	1 (1)
Sebasticook River	**Unity Pond**	1,023.0	1 (0)
Sebasticook River	**Pleasant Pond**	310.8	2 (2)
Sebasticook River	**Plymouth Pond**	194.2	2 (1)
Sebasticook River	**Sebasticook Lake**	1,735.3	2 (1)
Sebasticook River	Wassokeag Lake	429.8	4 (4)
Sebasticook River	Big Indian Pond	400.6	4 (3)
Sebasticook River	Douglas Pond	212.5	4 (0)
Sebasticook River	Great Moose Lake	1,450.4	4 (2)
Sebasticook River	Little Indian Pond	57.9	4 (3)
Seven-Mile Stream	**Webber Pond**	506.7	0 (1)
Seven-Mile Stream	**Three-Mile Pond**	435.8	0 (1)
Seven-Mile Stream	**Spectacle Pond**	56.3	0 (1)
Seven-Mile Stream	Three Cornered Pond	78.9	0 (1)
Total		9,946.0	

Table 11. Estimated value of Atlantic Salmon spawning/rearing habitat. Estimates of cost to mitigate for lost value of Atlantic Salmon habitat blocked by dams in the Kennebec River. For more information see Section 5.1. *Spawning habitat has been identified by habitat surveys, but the majority of habitat in the watershed has not been surveyed and thus the quantity of spawning habitat in this table represents only a portion of actual spawning habitat in the Kennebec watershed.

	Y (Occupied) N (Unoccupied) I (Inaccessible)*	Critical Habitat	Blocked Rearing Habitat Units	Blocked Spawning Habitat Units*
Lockwood	Y	Y	93,369	Not surveyed
Hydro-Kennebec	Y	Y	91,284	Not surveyed
Shawmut	Y	Y	87,800	Not surveyed
Weston	Y	Y	74,617	2,145
Anson	N	N	38,954	Not surveyed
Abenaki	N	N	38,954	Not surveyed
Cost to Mitigate Lost Habitat				$ 463,816,081

Figure 1a. Map of the Kennebec River watershed showing location of hydropower dams.

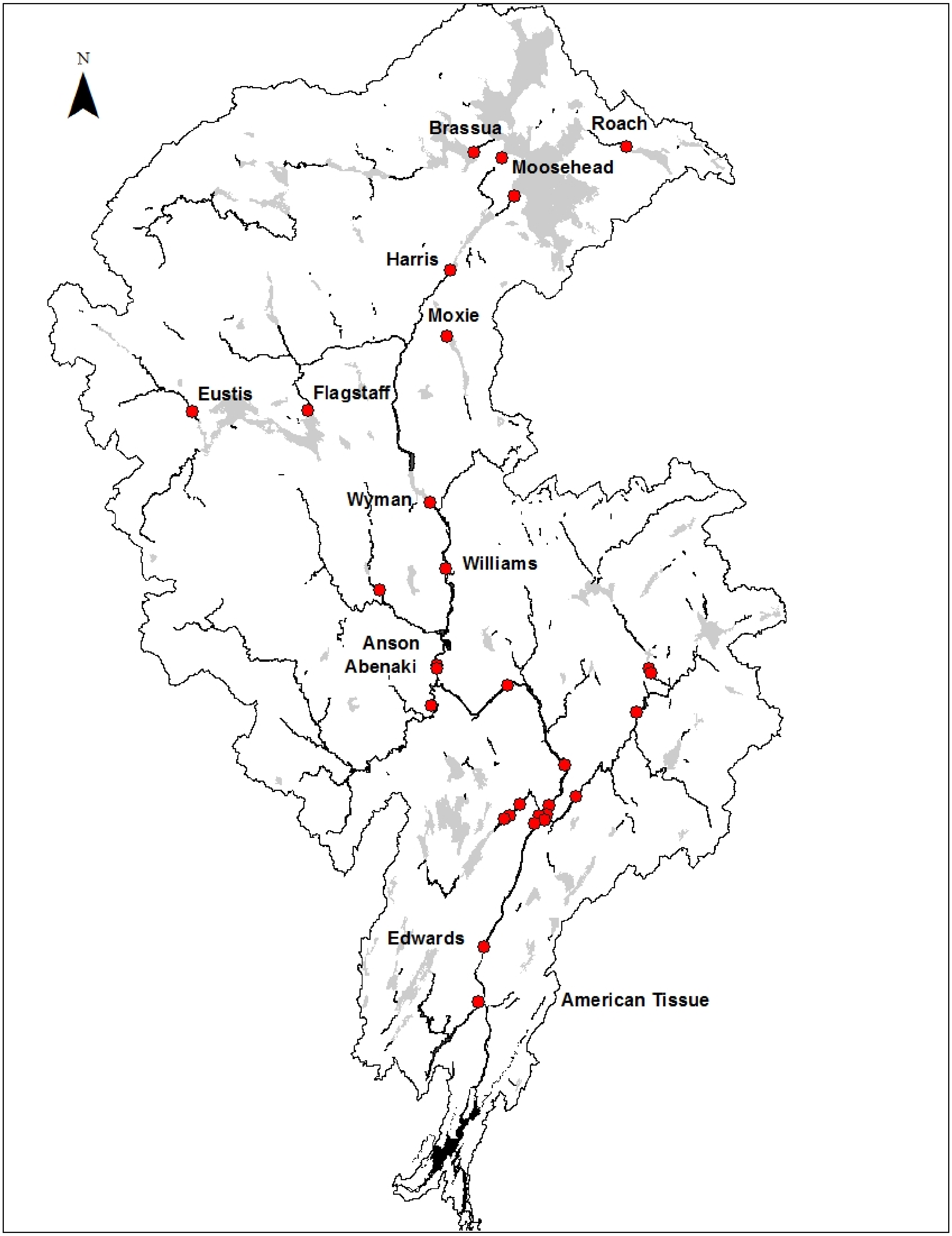


Figure 1b. Map of the upper Kennebec River showing location of hydropower dams.

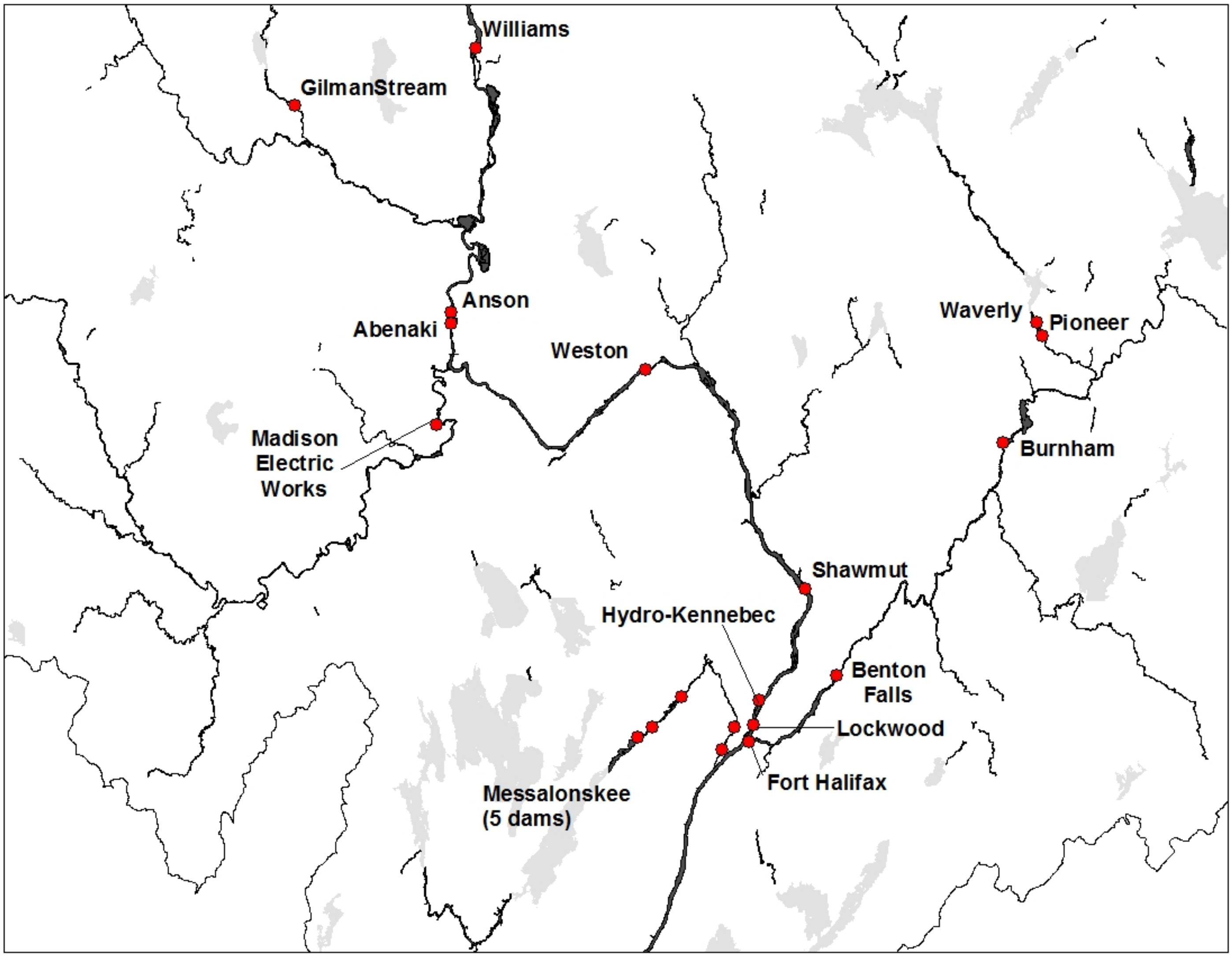


Figure 2. Estimated returns of adult Atlantic Salmon to the Kennebec River with six mainstem dams operating (Lockwood, Hydro-Kennebec, Shawmut, Weston, Abenaki, and Anson). The model was run with low marine (LM=0.00321), medium marine (MM=0.01080), and high marine (HM=0.02720) survival and low freshwater (LF=1 smolt/100m^2) and high freshwater (HF=3 smolts/100m^2) smolt production at downstream/upstream passage efficiencies of 97%/96% or 99%/99% at each dam. The former has been proposed by the Licensee, the latter is proposed by MDMR.

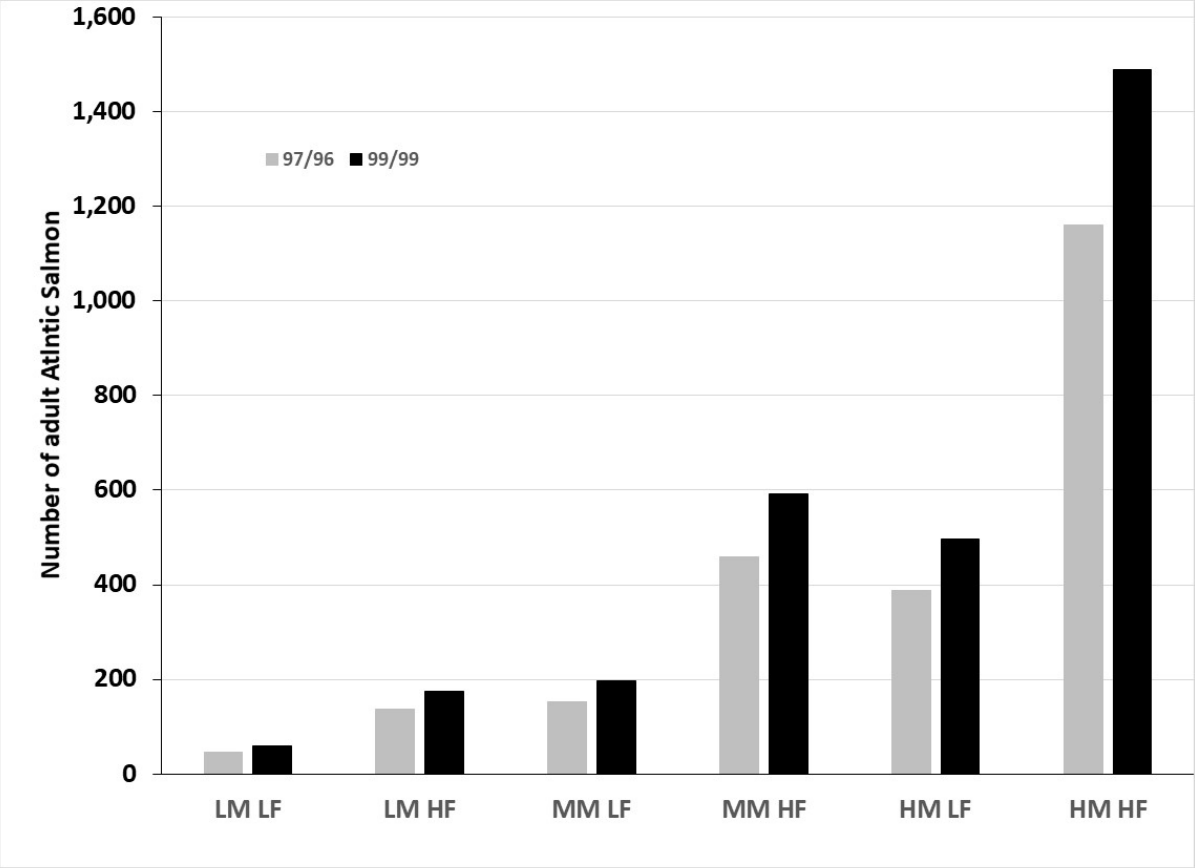
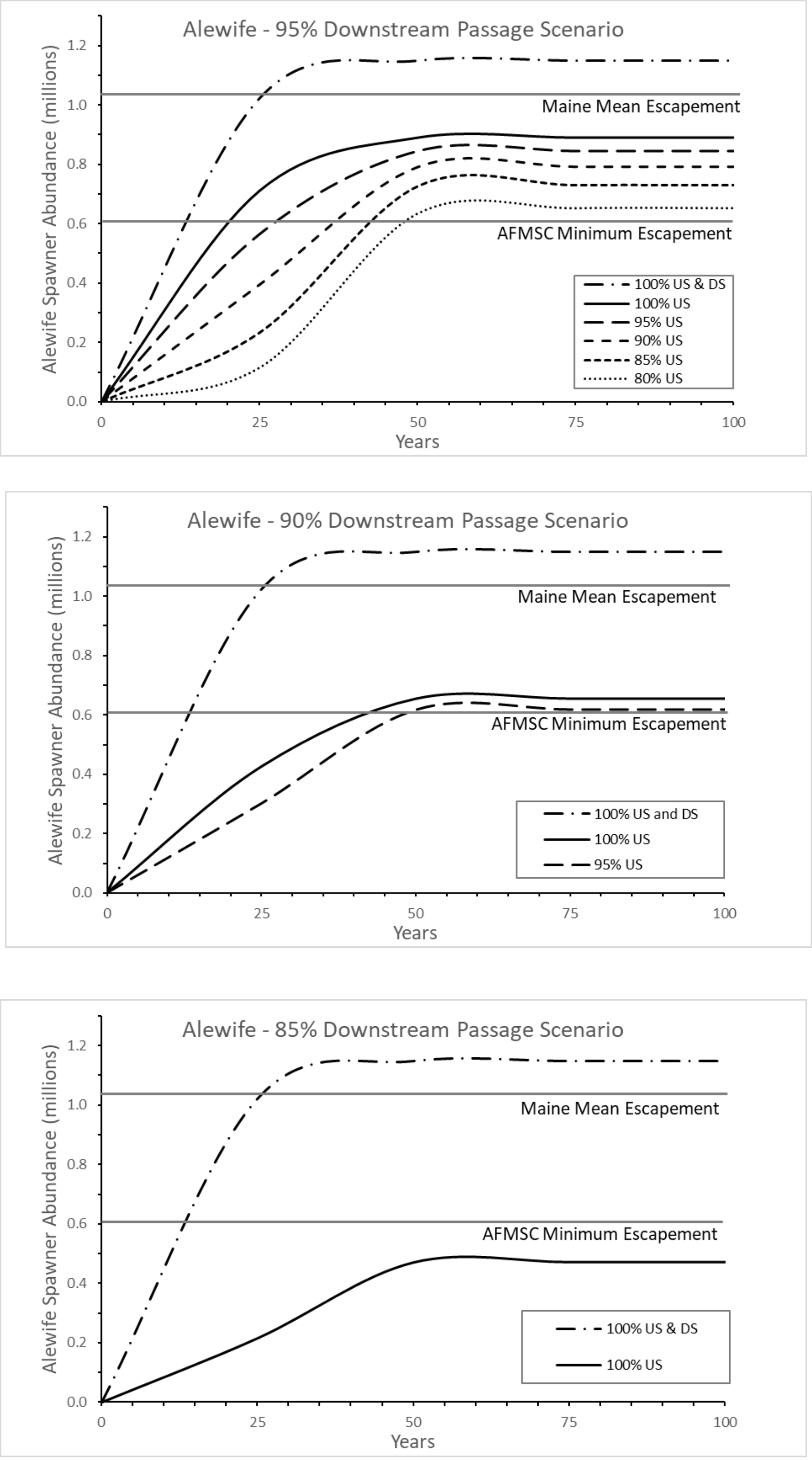


Figure 3. Modeled downstream (DS) passage efficiency (Panel A 95%; B 90%; and C 95%) and upstream passage efficiency needed to produce the minimum number of adult Alewife returns meet Atlantic States Marine Fisheries Commission's threshold (235/acre) and to be consistent with the Maine mean escapement (400/acre).



Appendix A. Recovery goals, objectives and criteria for the GOM DPS of Atlantic Salmon.
Appendix B. American Shad and Blueback Herring model results.

Appendix A.

EXECUTIVE SUMMARY

After originally listing the Gulf of Maine (GOM) distinct population segment (DPS) of Atlantic salmon as endangered in December 2000 and publishing a recovery plan in November 2005, the USFWS and NMFS conducted a second status review and listed an expanded GOM DPS on June 19, 2009. The expanded DPS encompasses all anadromous Atlantic salmon in a freshwater range covering the watersheds from the Androscoggin River northward along the Maine coast to the Dennys River and includes all associated conservation hatchery populations used to supplement these natural populations. Concurrent with the new listing, NMFS identified and designated critical habitat within the range of the expanded GOM DPS. This recovery plan pertains to the expanded DPS and accounts for new information.

RECOVERY PLANNING APPROACH: The plan adopts a planning approach recently endorsed by the USFWS and, for this plan, NMFS. The new approach, termed Recovery Planning and Implementation (RPI), focuses on the three statutory requirements in the ESA, including site-specific recovery actions; objective, measurable criteria for delisting; and time and cost estimates to achieve recovery and intermediate steps. It also provides relevant background information for understanding the proposed recovery program, including a summary of the governance structure, threats, conservation measures, and recovery strategy for the DPS. Other relevant data and analyses are available on the Atlantic Salmon Recovery Plan Companion Document. Links to specific web pages are included throughout this plan.

RECOVERY UNITS: The critical habitat rule (74 FR 29300, June 19, 2009) delineates recovery units for the expanded DPS. These units, designated as Salmon Habitat Recovery Units (SHRUs)[1], respond to life history needs and the environmental variation associated with freshwater habitats. The SHRUs encompass the full range of the DPS, including:

- Merrymeeting Bay, which covers the Androscoggin and Kennebec, and extends east to include the Sheepscot, Pemaquid, Medomak, and St. George watersheds;
- Penobscot Bay, which covers the entire Penobscot basin and extends west to and includes the Ducktrap watershed; and,
- Downeast, including all coastal watersheds from the Union River east to the Dennys River.

THREATS TO THE DPS: This plan is based in large part upon an updated threats analysis for the expanded GOM DPS. The 2009 listing rule called particular attention to three major threats to Atlantic salmon: dams, inadequacy of regulatory mechanisms related to dams, and low marine survival. The rule also identified a number of secondary stressors, including activities or actions that pertain to habitat quality and accessibility, commercial and recreational fisheries, disease and predation, inadequacy of regulatory mechanisms related to water withdrawal and water quality,

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[1] Recovery units also assist with the implementation of Section 7 consultations under the ESA. However, each Section 7 consultation must assess the effects of an action to the recovery unit and the entire listed entity.

aquaculture, artificial propagation, climate change, competition, and depleted diadromous fish communities. Collectively, these stressors constitute a fourth major threat. Since the 2009 listing, our understanding of threats to the DPS has continued to grow. New and emerging threats, all of which constitute significant impediments to recovery, include road stream crossings that impede fish passage, international intercept fisheries, and new information about the effects of climate change. It is important to note that, as recovery proceeds, information and the level of concern about various threats will continue to evolve.

RECOVERY STRATEGY: This recovery plan is based on two premises: first, that recovery actions must focus on rivers and estuaries located in the GOM DPS until we better understand threats in the marine environment, and second, that survival of Atlantic salmon in the DPS will be dependent on conservation hatcheries through much of the recovery process. In addition, the scientific foundation for this plan includes conservation biology principles regarding population viability, our understanding of freshwater habitat viability, and threats abatement needs. These principles are summarized within the viability framework of resiliency, representation, and redundancy.

The recovery strategy also incorporates adaptive management, phasing of recovery actions, a geographic framework based upon the three SHRUs, and a collaborative approach that focuses on full inclusion of partners in implementing recovery actions. This recovery plan includes a table that generally identifies the priority, timing, and involved parties for the various actions, but it is important to recognize that decisions made about recovery activities will be formulated in SHRU-level work plans.

RECOVERY GOAL: The overall goal of this recovery plan is to remove the GOM DPS of Atlantic salmon from the Federal List of Endangered and Threatened Wildlife. The interim goal is to reclassify the DPS from endangered to threatened status.

RECOVERY OBJECTIVES AND CRITERIA: The objectives and criteria in this plan address biological recovery needs and abatement of threats, as summarized below.[2]

> **Reclassification Objectives –** Maintain sustainable, naturally reared populations with access to sufficient suitable habitat in at least two of the three SHRUs, and ensure that management options for marine survival are better understood. In addition, reduce or eliminate those threats that, either individually or in combination, pose a risk of imminent extinction to the DPS.
>
> **Delisting Objectives –** Maintain self-sustaining, wild populations with access to sufficient suitable habitat in each SHRU, and ensure that necessary management options for marine survival are in place. In addition, reduce or eliminate all threats that, either individually or in combination, pose a risk of endangerment to the DPS.

Biological Criteria for Reclassification – Reclassification of the GOM DPS from endangered to threatened will be considered when all of the following biological criteria are met:

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[2] The biological recovery criteria for the GOM DPS of Atlantic salmon were established in the 2009 critical habitat final rule (NOAA 2009).

1. ***Abundance:*** The DPS has total annual returns of at least 1,500 adults originating from wild origin, or hatchery stocked eggs, fry or parr spawning in the wild, with at least 2 of the 3 SHRUs having a minimum annual escapement of 500 naturally reared adults.

2. ***Productivity:*** Among the SHRUs that have met or exceeded the abundance criterion, the population has a positive mean growth rate greater than 1.0 in the 10-year (two-generation) period preceding reclassification.

3.. ***Habitat:*** In each of the SHRUs where the abundance and productivity criterion have been met, there is a minimum of 7,500 units of accessible and suitable spawning and rearing habitats capable of supporting the offspring of 1,500 naturally reared adults.

Biological Criteria for Delisting - Delisting of the GOM DPS will be considered when all of the following criteria are met:

1. ***Abundance*:** The DPS has a self-sustaining annual escapement of at least 2,000 wild origin adults in each SHRU, for a DPS-wide total of at least 6,000 wild adults.

2. ***Productivity:*** Each SHRU has a positive mean population growth rate of greater than 1.0 in the 10-year (two-generation) period preceding delisting. *In addition,* at the time of delisting, the DPS demonstrates self-sustaining persistence, whereby the total wild population in each SHRU has less than a 50-percent probability of falling below 500 adult wild spawners in the next 15 years based on population viability analysis (PVA) projections.

3. ***Habitat:*** Sufficient suitable spawning and rearing habitat for the offspring of the 6,000 wild adults is accessible and distributed throughout the designated Atlantic salmon critical habitat, with at least 30,000 accessible and suitable Habitat Units in each SHRU, located according to the known migratory patterns of returning wild adult salmon. This will require both habitat protection and restoration at significant levels.

Threats Abatement Criteria: Threats to GOM DPS identified both in the 2009 listing rule and since then, must be diminished prior to reclassification and, to a greater extent, delisting. Therefore, this plan includes criteria specific to reducing threats to the survival and recovery of the species. In this Plan we identify a number of primary threats as well as a number of secondary stressors, that in their combination constitute a primary threat. In order to delist the GOM DPS of Atlantic salmon, each individual primary threat must be sufficiently abated according to stated criteria in section III. The Services also recognize that primary threats may change over time. The Services will develop an implementation strategy to address the secondary stressors in a manner that allows for a sufficient reduction in extinction risk as the recovery process advances. To facilitate this strategy, the adaptive management and collaborative aspects of the Recovery Strategy will come into play. Monitoring and relevant research will be critical in determining to what extent secondary stressors must be resolved in association with abatement of the threats.

Numerous criteria for abating the threats and the stressors are detailed in the body of the recovery plan.

RECOVERY ACTIONS: This recovery plan focuses on the site-specific actions necessary to recover the GOM DPS of Atlantic salmon. These actions address both survival and recovery needs and are site-specific to the extent practicable as required by section 4(f)(1)(B)(i) of the ESA. In this plan, the SHRU often represents the site in which the actions are scaled to. In some circumstances, recovery actions encompass the entire DPS or are not geographically based (e.g. genetic studies and other research). Scaling site-specific actions to the SHRU takes into account both the multi-faceted, interdisciplinary nature of recovery actions and long timeframe needed to reach reclassification and delisting objectives; thus, the SHRU constitutes the geographic scale in which the Services will measure recovery progress and carry out adaptive management. Using a finer scale than the SHRU to identify site-specific actions is not practicable because there are a number of different pathways and scenarios that could allow for salmon recovery to happen. Every dam removal or every restoration project will affect the population differently based on its position within the watershed, the level of impact that the activity is actually having on the population to begin with, and its relationship to other threats within the watershed. Therefore, being more prescriptive by using a finer scale than the SHRU-level regarding what projects need to happen would be too inflexible and mask viable options given the wide range of possible pathways and different combinations of restoration actions that could allow for recovery to occur. SHRU-level workplans provide the basis for determining activities within the SHRU that should be implemented in order to complete the plan's SHRU specific recovery actions. Although these workplans link back to this recovery plan, they are not considered part of the plan itself. The eight categories of recovery actions include:

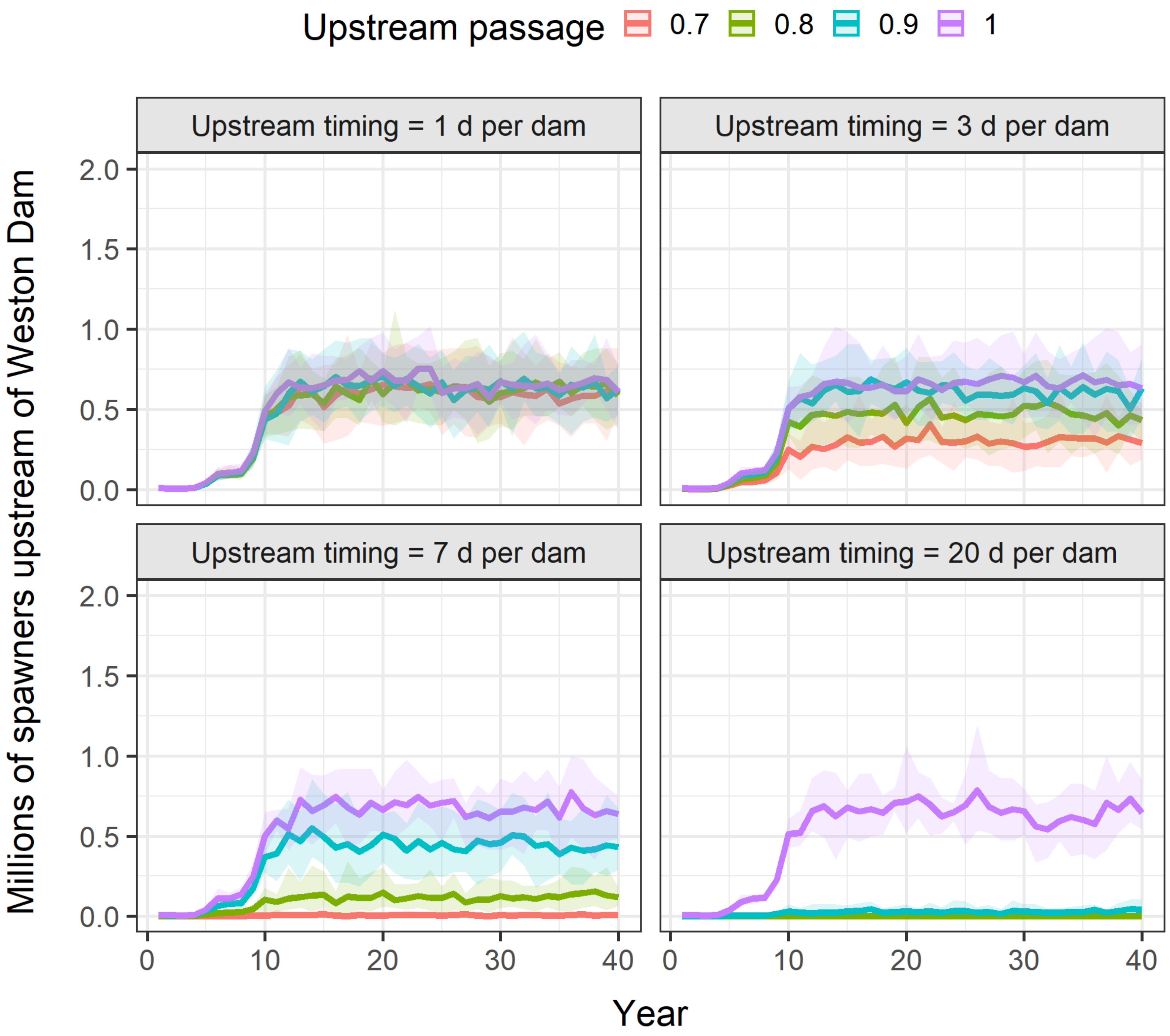
- **Habitat Connectivity**, intended to enhance connectivity between the ocean and freshwater habitats important for salmon recovery;
- **Freshwater Conservation**, intended to increase adult spawners through the freshwater production of smolts;
- **Marine and Estuary**, intended to increase survival in these habitats by increasing understanding of these salmon ecosystems and identifying the location and timing of constraints to the marine productivity of salmon in support of management actions to improve survival;
- **Outreach, Education, and Engagement**, intended to collaborate with partners and engage interested parties in recovery efforts for the GOM DPS;
- **Federal/Tribal Coordination**, intended to ensure federal agencies and associated programs continue to recognize and uphold federal Tribal Trust responsibilities;
- **Conservation Hatchery**, intended to provide demographic support and maintain genetic diversity appropriate for the purpose of recovering Atlantic salmon in the Gulf of Maine DPS;
- **Genetic Diversity**, intended to maintain the genetic diversity and promote increased fitness of Atlantic salmon populations over time;
- **Funding Program Actions,** intended to identify funding programs that support State, local and NGO conservation efforts that benefit Atlantic salmon recovery

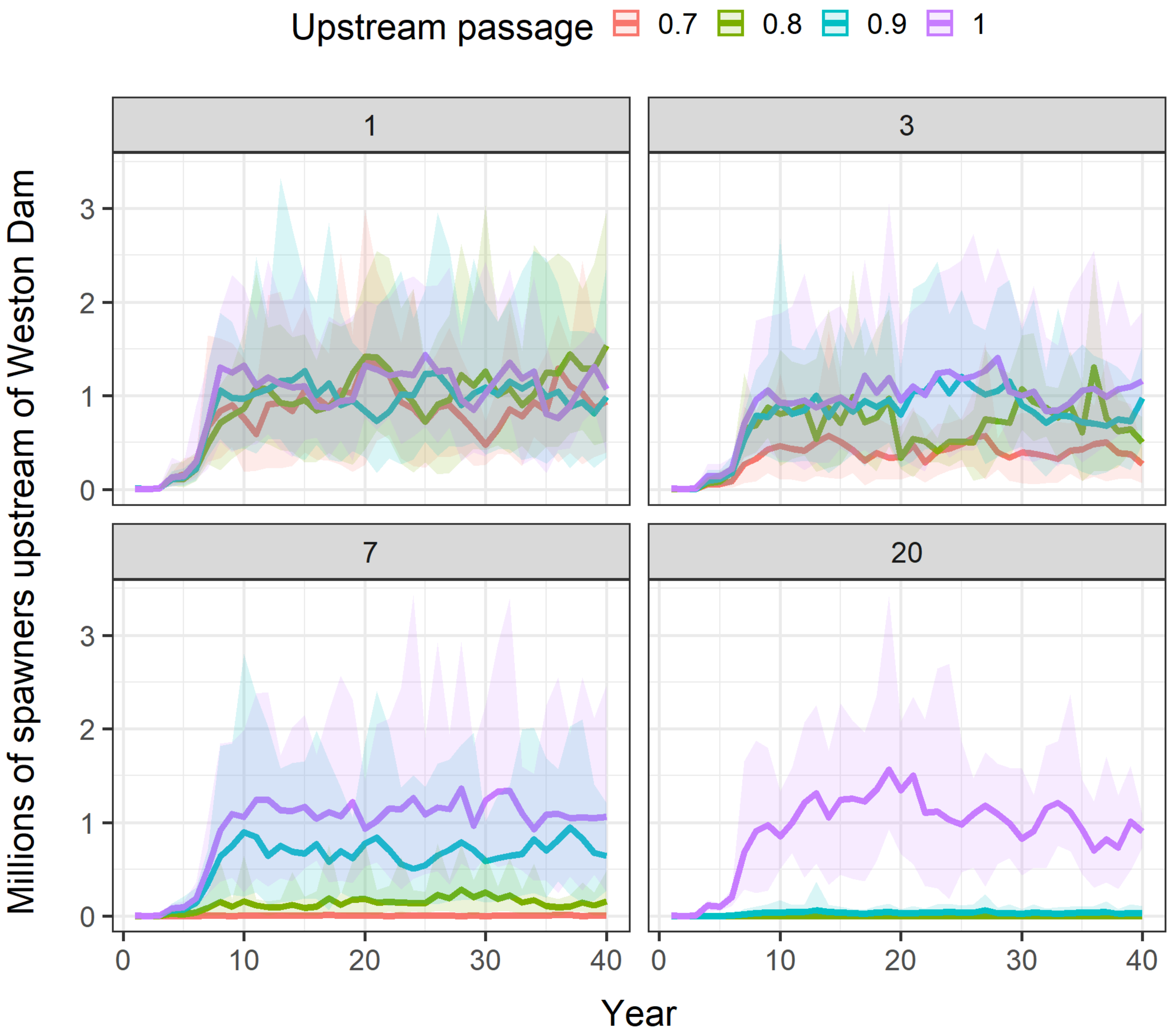
ESTIMATED TIME TO RECOVERY: The Services project a 75-year timeframe to achieve delisting of the GOM DPS of Atlantic salmon. This accounts for approximately 15 generations of salmon and assumes an estimated upper limit for resource investment into implementation of recovery actions. It is difficult to estimate a time and cost for reclassification because of uncertainties associated with the current significant threats to the species, especially marine survival, and impacts of climate change. The earliest possible time scenario would be 10 years based on the current reclassification criteria.

ESTIMATED COST OF RECOVERY: The implementation plan includes actions that are funded or partially funded under the Services baseline budget (based on fiscal year 2017 budget allocations), and actions that are necessary for Atlantic salmon recovery but are currently not funded under our current budget. The baseline budget of the USFWS and NMFS is approximately $8.6 million per year. This largely includes funding to support the State of Maine's management of Atlantic salmon through Maine Department of Marine Resources, population assessments, genetic analysis, and implementation of the ESA including Section 7 and Section 10, and hatchery operations. The estimated cost of implementing recovery actions not covered by the Services baseline budget is estimated at approximately $24 million per year. These costs include actions such as fishway installations, dam removals, replacing undersized culverts, among other activities. The cost of implementing recovery actions will change over time as recovery actions are completed, new actions are identified, and as new technologies and management approaches are adopted. As such estimating the final cost of recovery over 75 years is highly speculative although we present one possible scenario in Part V of the recovery plan.

ASSESSMENT OF RECOVERY PRIORITY: The USFWS and NMFS have adopted separate Recovery Priority systems to prioritize recovery planning and implementation. The recovery priority for each agency is reassessed at least biannually, as part of the agency's biennial reports to congress on recovering threatened and endangered species under the ESA. The USFWS and NMFS will revisit these priority determinations on a biannual basis and will work to ensure that these determinations are based on a consideration of the best available information and are coordinated to the maximum extent practicable, with any differences identified and explained.

Appendix B.


Upstream passage
0.7
0.8
0.9
1
Upstream timing = 1 d per dam
Upstream timing = 3 d per dam
Upstream timing = 7 d per dam
Upstream timing = 20 d per dam
Millions of spawners upstream of Weston Dam
2.0
1.5
1.0
0.5
0.0
0
10
20
30
40
Year


Upstream passage
0.7
0.8
0.9
1
1
3
7
20
Millions of spawners upstream of Weston Dam
0
1
2
3
0
10
20
30
40
Year

Attachment 5

		λ Results																			
Model Run	LTRE Scenario	Mean	Std Dev	Variance	L95	U95	Min	P2.5	P5	P10	P20	P25	Median	P75	P80	P90	P95	P97.5	Max	Iterations	Time taken
1	Existing/Low Marine Survival	0.5704	0.0761	0.0058	0.5689	0.5719	0.3457	0.4300	0.4503	0.4736	0.5055	0.5169	0.5669	0.6211	0.6343	0.6719	0.7007	0.7272	0.8690	10000	17 min
2	Existing/ High Marine Survival	0.7161	0.0977	0.0096	0.7142	0.7181	0.4131	0.5357	0.5617	0.5934	0.6318	0.6471	0.7120	0.7807	0.7986	0.8439	0.8868	0.9186	1.0876	10000	16 min
3	Unimpounded/Low Marine Survival	0.8436	0.0966	0.0093	0.8417	0.8455	0.5239	0.6661	0.6897	0.7215	0.7594	0.7752	0.8412	0.9091	0.9254	0.9706	1.0065	1.0367	1.2128	10000	16 min
4	Unimpounded/High Marine Survival	1.1022	0.1292	0.0167	1.0997	1.1048	0.6756	0.8585	0.8931	0.9362	0.9903	1.0095	1.1007	1.1920	1.2149	1.2697	1.3185	1.3583	1.5851	10000	16 min
5	FERC Performance Standard US95% DS96%/Low Marine Survival	0.6547	0.0737	0.0054	0.6533	0.6562	0.4318	0.5163	0.5359	0.5594	0.5912	0.6037	0.6538	0.7041	0.7166	0.7510	0.7785	0.8001	0.9181	10000	16 min
6	FERC Performance Standard US95% DS96%/High Marine Survival	0.8500	0.0996	0.0099	0.8481	0.8520	0.5518	0.6647	0.6898	0.7221	0.7642	0.7800	0.8464	0.9180	0.9359	0.9804	1.0181	1.0479	1.2329	10000	16 min
7	NOAA Performance Standard US96% DS97%/Low Marine Survival	0.6651	0.0750	0.0056	0.6637	0.6666	0.4271	0.5238	0.5444	0.5691	0.6007	0.6121	0.6640	0.7159	0.7286	0.7628	0.7912	0.8181	0.9375	10000	16 min
8	NOAA Performance Standard US96% DS97%/High Marine Survival	0.8625	0.0999	0.0100	0.8606	0.8645	0.5175	0.6745	0.7005	0.7352	0.7778	0.7932	0.8599	0.9307	0.9485	0.9931	1.0314	1.0618	1.2598	10000	20 min
9	Maine DMR Performance Standard US99% DS99%/Low Marine Survival	0.6737	0.0757	0.0057	0.6722	0.6752	0.4085	0.5319	0.5525	0.5777	0.6087	0.6206	0.6723	0.7246	0.7380	0.7738	0.8015	0.8247	0.9923	10000	16 min
10	Maine DMR Performance Standard US99% DS99%/High Marine Survival	0.8931	0.1028	0.0106	0.8911	0.8952	0.5467	0.6984	0.7262	0.7614	0.8054	0.8212	0.8916	0.9628	0.9808	1.0265	1.0646	1.0997	1.2623	10000	16 min
11	Shawmut Removed & Performance Standard US95% DS96%/Low Marine Survival	0.7189	0.0816	0.0067	0.7173	0.7205	0.4616	0.5681	0.5902	0.6145	0.6483	0.6614	0.7175	0.7734	0.7881	0.8264	0.8561	0.8836	1.0345	10000	16 min
12	Shawmut Removed & Performance Standard US95% DS96%/High Marine Survival	0.9373	0.1098	0.0120	0.9351	0.9394	0.5917	0.7337	0.7632	0.7971	0.8419	0.8600	0.9346	1.0110	1.0310	1.0819	1.1242	1.1567	1.3287	10000	16 min
13	Lockwood and Shawmut Removed & Performance Standard US95% DS96%/Low Marine Survival	0.7597	0.0870	0.0076	0.7580	0.7614	0.4980	0.5927	0.6191	0.6484	0.6859	0.7000	0.7566	0.8186	0.8343	0.8750	0.9071	0.9342	1.0697	10000	16 min
14	Lockwood and Shawmut Removed & Performance Standard US95% DS96%/High Marine Survival	0.9900	0.1157	0.0134	0.9877	0.9922	0.6243	0.7718	0.8041	0.8433	0.8888	0.9078	0.9875	1.0702	1.0883	1.1387	1.1832	1.2230	1.4333	10000	16 min

Model Run	LTRE Scenario	Smolt to Adult Return (S_sr)	Std. Dev.	Min.	Max	Smolt Survival (S_smolt)	Std. Dev.	Min.	Max	Adult In-river Survival (S_rm)	Std. Dev.	Min.	Max	Egg to Fry Survival (S_e)	Std. Dev.	Min.	Max	Fry to Parr Survival (S_fp)	Std. Dev.	Min.	Max.	Parr to Smolt Survival (S_ps)	Std. Dev.	Min.	Max.	Fecunity (F_2SW	Std. Dev.	Min.	Max.	Fecunity (F_3SW	Std. Dev.	Min.	Max.	Fecunity (F_MSW	Std. Dev.	Min.	Max.
1	Existing/Low Marine Survival	0.0070	0.0024	0.0021	0.0119	0.2620	0.0617	0.0088	0.4941	0.8589	0.0749	0.4758	1.0000	0.1650	0.0675	0.0800	0.3500	0.3250	0.0675	0.2100	0.4800	0.3350	0.1250	0.0500	0.5500	3780	732	2732	5659	5100	209	5009	5844	5675	1274	5285	10382
2	Existing/ High Marine Survival	0.0304	0.0104	0.0090	0.0519	0.2620	0.0617	0.0088	0.4941	0.8589	0.0749	0.4758	1.0000	0.1650	0.0675	0.0800	0.3500	0.3250	0.0675	0.2100	0.4800	0.3350	0.1250	0.0500	0.5500	3780	732	2732	5659	5100	209	5009	5844	5675	1274	5285	10382
3	Unimpounded/Low Marine Survival	0.0070	0.0024	0.0021	0.0119	0.8284	0.0387	0.6999	0.9448	1.0000	0.0000	0.9998	1.0000	0.1650	0.0675	0.0800	0.3500	0.3250	0.0675	0.2100	0.4800	0.3350	0.1250	0.0500	0.5500	3780	732	2732	5659	5100	209	5009	5844	5675	1274	5285	10382
4	Unimpounded/High Marine Survival	0.0304	0.0104	0.0090	0.0519	0.8284	0.0387	0.6999	0.9448	1.0000	0.0000	0.9998	1.0000	0.1650	0.0675	0.0800	0.3500	0.3250	0.0675	0.2100	0.4800	0.3350	0.1250	0.0500	0.5500	3780	732	2732	5659	5100	209	5009	5844	5675	1274	5285	10382
5	FERC Performance Standard US95% DS96%/Low Marine Survival	0.0070	0.0024	0.0021	0.0119	0.3744	0.0298	0.2618	0.4855	0.9430	0.0091	0.9014	0.9731	0.1650	0.0675	0.0800	0.3500	0.3250	0.0675	0.2100	0.4800	0.3350	0.1250	0.0500	0.5500	3780	732	2732	5659	5100	209	5009	5844	5675	1274	5285	10382
6	FERC Performance Standard US95% DS96%/High Marine Survival	0.0304	0.0104	0.0090	0.0519	0.3744	0.0298	0.2618	0.4855	0.9430	0.0091	0.9014	0.9731	0.1650	0.0675	0.0800	0.3500	0.3250	0.0675	0.2100	0.4800	0.3350	0.1250	0.0500	0.5500	3780	732	2732	5659	5100	209	5009	5844	5675	1274	5285	10382
7	NOAA Performance Standard US96% DS97%/Low Marine Survival	0.0070	0.0024	0.0021	0.0119	0.3846	0.0302	0.2808	0.4924	0.9542	0.0093	0.9213	0.9883	0.1650	0.0675	0.0800	0.3500	0.3250	0.0675	0.2100	0.4800	0.3350	0.1250	0.0500	0.5500	3780	732	2732	5659	5100	209	5009	5844	5675	1274	5285	10382
8	NOAA Performance Standard US96% DS97%/High Marine Survival	0.0304	0.0104	0.0090	0.0519	0.3846	0.0302	0.2808	0.4924	0.9542	0.0093	0.9213	0.9883	0.1650	0.0675	0.0800	0.3500	0.3250	0.0675	0.2100	0.4800	0.3350	0.1250	0.0500	0.5500	3780	732	2732	5659	5100	209	5009	5844	5675	1274	5285	10382
9	Maine DMR Performance Standard US99% DS99%/Low Marine Survival	0.0070	0.0024	0.0021	0.0119	0.4034	0.0316	0.2913	0.5170	0.9851	0.0076	0.9539	1.0000	0.1650	0.0675	0.0800	0.3500	0.3250	0.0675	0.2100	0.4800	0.3350	0.1250	0.0500	0.5500	3780	732	2732	5659	5100	209	5009	5844	5675	1274	5285	10382
10	Maine DMR Performance Standard US99% DS99%/High Marine Survival	0.0304	0.0104	0.0090	0.0519	0.4034	0.0316	0.2913	0.5170	0.9851	0.0076	0.9539	1.0000	0.1650	0.0675	0.0800	0.3500	0.3250	0.0675	0.2100	0.4800	0.3350	0.1250	0.0500	0.5500	3780	732	2732	5659	5100	209	5009	5844	5675	1274	5285	10382
11	Shawmut Removed & Performance Standard US95% DS96%/Low Marine Survival	0.0070	0.0024	0.0021	0.0119	0.5146	0.0377	0.3856	0.6548	0.9569	0.0081	0.9266	0.9876	0.1650	0.0675	0.0800	0.3500	0.3250	0.0675	0.2100	0.4800	0.3350	0.1250	0.0500	0.5500	3780	732	2732	5659	5100	209	5009	5844	5675	1274	5285	10382
12	Shawmut Removed & Performance Standard US95% DS96%/High Marine Survival	0.0304	0.0104	0.0090	0.0519	0.5146	0.0377	0.3856	0.6548	0.9569	0.0081	0.9266	0.9876	0.1650	0.0675	0.0800	0.3500	0.3250	0.0675	0.2100	0.4800	0.3350	0.1250	0.0500	0.5500	3780	732	2732	5659	5100	209	5009	5844	5675	1274	5285	10382
13	Lockwood and Shawmut Removed & Performance Standard US95% DS96%/Low Marine Survival	0.0070	0.0024	0.0021	0.0119	0.6002	0.0426	0.4496	0.8025	0.9710	0.0067	0.9465	0.9964	0.1650	0.0675	0.0800	0.3500	0.3250	0.0675	0.2100	0.4800	0.3350	0.1250	0.0500	0.5500	3780	732	2732	5659	5100	209	5009	5844	5675	1274	5285	10382
14	Lockwood and Shawmut Removed & Performance Standard US95% DS96%/High Marine Survival	0.0304	0.0104	0.0090	0.0519	0.6002	0.0426	0.4496	0.8025	0.9710	0.0067	0.9465	0.9964	0.1650	0.0675	0.0800	0.3500	0.3250	0.0675	0.2100	0.4800	0.3350	0.1250	0.0500	0.5500	3780	732	2732	5659	5100	209	5009	5844	5675	1274	5285	10382

August 14, 2021

UNITED STATES OF AMERICA

BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION

Brookfield White Pine Hydro LLC Project No. 2322-069

KENNEBEC COALITION'S AND THE CONSERVATION LAW FOUNDATION'S JOINT PROTESTS AND COMMENTS IN OPPOSITION TO THE "DRAFT ENVIRONMENTAL ASSESSMENT FOR HYDRPOWER LICENSE" FOR THE SHAWMUT PROJECT NUMBER 2322-069, MAINE

Pursuant to the Notice of Availability of Draft Environmental Assessment and Revised Procedural Schedule (July 1, 2021), the Kennebec Coalition and the Conservation Law Foundation jointly submit these Protests and Comments in opposition to the Draft Environmental Assessment for Hydropower License.[1]

In accordance with the Commission's Rules of Practice and Procedure, 18 C.F.R. §385..214, the Atlantic Salmon Federation U.S. ("ASF"), the Kennebec Valley Chapter of Trout Unlimited ("KVTU"), the Natural Resources Council of Maine ("NRCM"), and Maine Rivers (hereinafter collectively referred to as the "Kennebec Coalition") timely moved to intervene in the above-captioned proceeding on August 31, 2020[2] with the

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[1] Commission staff also indicated that the Draft EA would serve simultaneously as the Commission's Biological Assessment for purposes of initiation of formal section 7 consultation with NMFS under the Endangered Species Act (the "ESA"), 16 U.S.C. § 1536, for the relicensing of the Shawmut Project. FERC Accession No. 20210709-3034 (Turner to Petony correspondence requesting formal consultation on the relicensing of the Shawmut Project, July 9, 2021) ("The DEA [Draft EA] serves as our biological assessment and EFH [essential fish habitat] assessment."). Hence these Comments will also serve as the Kennebec Coalition's and Conservation Law Foundation's protests and comments on the Biological Assessment under the ESA, and on the EFH assessment.

[2] FERC Accession No. 20200831-5332; Draft Environmental Assessment (hereafter "Draft EA") section 1.4.2.

Kennebec Coalition's protest and comment on the hydroelectric application for issuance of a new license for the Shawmut Project FERC No. 2322-069. The Kennebec Coalition has therefore been granted party status by operation of 18 C.F.R. 385.214(c)(1).

The Conservation Law Foundation ("CLF") joins the Kennebec Coalition in these Protests and Comments in opposition to the Draft Environmental Assessment for Hydropower License, and has filed a motion to intervene pursuant to 18 C.F.R. 385.214(b)(1).[3]

THE NEPA FINDINGS AND ANALYSIS ARE ARBITRARY AND CAPRICIOUS

The Commission staff determination in the Draft Environmental Assessment ("Draft EA") that issuance of a new license for the Shawmut Project, with the additional staff-recommended measures, would not constitute a major federal action affecting the quality of the human environment, is clearly arbitrary and capricious. As we demonstrate in these comments, the Draft EA does not take a "hard and honest look" at the environmental consequences of relicensing the Shawmut Project. As a result, the measures proposed by Commission staff are not sufficient to reduce those consequences to a minimum. For this reason, the proposed finding of no significant impact means this Draft EA must be rejected, and an environmental impact statement ("EIS") must be prepared before the Shawmut relicensing application is considered by the Commission.[4]

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[3] FERC Accession No. 20210813-5093.

[4] The Kennebec Coalition and resource agencies object to the Commission's failure to exercise its discretion and order an EIS at the outset of this proceeding as authorized by 18 C.F.R. § 380.5(a). Exercise of this discretionary authority may still occur by this Commission now ordering resubmission to staff for reconsideration of the inadequacies in the EA. *Id.* ("Depending on the outcome of the environmental assessment, the Commission may . . . prepare an environmental impact statement."). We repeat that at the

I. Introduction

The primary function of the National Environmental Policy Act ("NEPA")[5] is to compel federal agencies "to take a hard and honest look at the environmental consequences of their decisions."[6] In *American Rivers and Alabama Rivers Alliance v. Federal Energy Regulatory Commission*, 895 F.3d 32, 49 (D.C. Cir. 2018), the Court articulated the following analytic steps required by NEPA:

- Identify accurately the relevant environmental concerns;
- Take a hard look at the problem in preparing the environmental assessment;
- Make a convincing case for any finding of no significant impact;
- Show why, if there is an impact of true significance there are sufficient safeguards to reduce the impact to a minimum; and
- If such safeguards are not in place or insufficient, then an EIS must be prepared before the action is taken.[7]

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outset of these proceedings on the final license application, USFWS, NMFS and MDMR all called for preparing an EIS rather than an EA: Letter to Vince Yearick, Director , Division of Hydropower Licensing, FERC, from Anna Harris, Project Leader, Maine Field Office, Fish and Wildlife Service, United Sates Department of the Interior, August 9, 2017 [**FERC Accession No. 20170809-5067**]; Letter to Secretary Bose, Federal Energy Regulatory Commission from Julie Crocker, ESA Fish Recovery Coordinator, (NMFS Greater Atlantic Regional Fisheries Office), August 16, 2017 [**FERC Accession No. 20170816-5134**] ("given the existing information on project effects, we recommended that FERC analyze the impacts of the project by preparing an EIS, rather than an EA."); Letter to Secretary Bose, Federal Energy Regulatory Commission from Patrick C. Keliher, Commissioner, MDMR, August 9, 2017 **[FERC Accession No. 20170817-5120**] ("However, given the existing information on project impacts, summarized below, we recommend that the Commission analyze the impacts of the project by preparing an EIS, rather than an EA.").

[5] 42 U.S.C. 4321 et seq.

[6] *American Rivers and Alabama Rivers Alliance v. Federal Energy Regulatory Commission*, 895 F.3d 32, 49 (D.C. Cir. 2018).

[7] *American Rivers*, 895 F.3d at 49.

Under this test, “the Commission’s Assessment will pass muster only if it undertook a ‘well-considered’ and ‘fully informed’ analysis of the relevant issues and opposing viewpoints.”[8]

The context in which the proposed action is to be taken is the “baseline” and must include the existing conditions and the enduring effect of past actions.[9] The analysis must then turn to a searching evaluation of the likely impact of the proposed action, including “cumulative effects” which are impacts on the environment that result from “the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions.”[10]

While “significance typically depends on the action’s effects in the immediate locale, rather than in the broader ecosystem or world as a whole,” “intensity” refers to the “ ‘severity’ or acuteness of the impact on the contextualized environment.”[11] Obviously, this is a fact driven analysis, but there is little doubt about the scope and impact of the federal action involved here: relicensing of a hydropower project that is one of four adjacent hydropower projects owned and operated by the same entity that have a cumulative and combined impact. This relicensing review is taking place at the same time that 1) the State of Maine is undertaking a significant revision of its proposed river

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[8] *Id*. (citing and quoting in part *Myersville Citizens for a Rural Cmty., Inc. v. FERC*, 783 F.3d 1301, 1324-25 (D.C. Cir. 2015)).

[9] *Id*. (“Evaluating an action’s environmental ‘significance’ requires analyzing both the context in which the action would take place and the intensity of its impact.”) (citing 40 C.F.R. § 1508.27).

[10] 40 C.F.R. § 1508.27 (quoted in *American Rivers*, 895 F.3d at 54); Draft EA at § 3.2, p.24 n.21 (referencing CEQ’s 1978 regulations).

[11] *American Rivers*, 895 F.3d at 49-50.

management plan encompassing the same four projects;[12] 2) state and federal natural resource agencies are recommending the removal of the Shawmut Project; and 3) the Shawmut Project relicensing is undergoing an almost simultaneously initiated ESA section 7 consultation process with the other three hydropower projects.[13] The environmental impacts of relicensing of the Shawmut Project in this context are clearly significant and intense.

The baseline in this proceeding is unique because the Shawmut Project is the third dam on the Kennebec River and currently has no fish passage. The first dam on the Kennebec (Lockwood, FERC Project No. P-2574) has a fish lift that is a dead-end for endangered Atlantic salmon,[14] which are trapped in the lift and then trucked past the Hydro-Kennebec Project (FERC No. 2611), Shawmut (FERC No. 2322), and the Weston Project (FERC No. 2325) up to the Sandy River – the locale of critical, ideal spawning habitat; other species captured at Lockwood, including alewives, blueback herring, and shad, are trucked to various upstream impoundments.[15] All four of these dams are located within the designated critical habitat of the Gulf of Maine Distinct Population Segment ("GOM DPS") of endangered Atlantic salmon.[16] The Draft EA cites a dismal 79% for salmon passage effectiveness at Lockwood, but even this number is too high, by

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[12] Draft EA at p. 188 (referencing and acknowledging MDMR process of plan revision).

[13] FERC Accession No. 20210709-3034 (Turner to Petony correspondence requesting formal consultation on the relicensing of the Shawmut Project, July 9, 2021); FERC Accession No. 20210726-3031 (Nguyen to Crocker correspondence requesting formal consultation on Final Plan proposing actions for the remaining license terms of the Lockwood, Hydro-Kennebec and Weston Projects).

[14] Draft EA at p. 40.

[15] Draft EA at p. 77.

[16] 74 Fed. Reg. 29,300 (Designation of Critical Habitat for Atlantic Salmon (*Salmo salar*) Gulf of Maine Distinct Population Segment) (June 19, 2009).

significantly ignoring other impacts. The fish-lift causes severe delays as well. The National Marine Fisheries Service ("NMFS") stated in a 2018 letter to Brookfield that:

> We note that consistent with the first season, the results of the second season demonstrated unequivocally that: 1) The Lockwood facility demonstrates poor upstream passage efficiency for Atlantic salmon; 2) Atlantic salmon are highly attracted to the "bypass" reach of the Lockwood facility; and 3) the Lockwood facility imposes a significant delay upon the upstream migration of Atlantic salmon. Although the study did not address the facility's upstream passage effect on other species, it is reasonable to assume that other diadromous species experience similar effects.[17]

Thus, at the present time, no fish pass upstream by the Shawmut project (except in tank trucks after being trapped at Lockwood). Under the required "cumulative analysis" of NEPA, the "reasonably likely" future actions proposed by the project licensees, including those not yet approved by the Commission,[18] must be included in the baseline and cumulative effects analysis. For example, the untested efficiency of the Hydro-Kennebec fish passage facilities (which are just above Lockwood), and the planned fish passage at the Weston Dam which has not yet been approved by any of the resource agencies, must be included in the baseline context, despite their uncertain future results. The following Comments of the Kennebec Coalition and CLF set forth the best available information establishing, beyond cavil, that the four-dam fish passage regime is reasonably certain to *fail*.[19] The Draft EA conclusion that "the development of fishways [at all four projects in the system] are reasonably certain to facilitate fish passage on an annual basis for the numbers of each species specified by NMFS and recommended by

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[17] Letter from Dan Kircheis (Acting ESA Fish Recovery Coordinator, NMFS Greater Atlantic Regional Fisheries Office) to Kelly Maloney, Brookfield re NOAA Fisheries comments on draft 2017 KHDG report (March 27, 2018) at 1 [FERC Accession No. 20180329-5166].

[18] Brookfield has just filed a Final Species Protection Plan and Biological Assessment for the four-dam watershed, FERC Accession No. 20210601-5152.

[19] The List of References to literature cited in these Comments is attached hereto.

Maine DMR" is arbitrary and capricious, especially in light of the record dispute with this conclusion by NMFS and the Maine Department of Marine Resources ("MDMR").[20] Part of taking an "honest" look at environmental consequences under NEPA is to undertake a "fully informed" and "well-considered" analysis of "opposing viewpoints."[21] As demonstrated below in these Comments, the Draft EA fails to do such an analysis.

Another glaring deficiency with the Draft EA is the complete lack of performance standards for alosine or other anadromous species in the Brookfield fishway proposals.[22] The absence of performance standards for these fish is a clear failure in the staff-recommendations and environmental impact analysis of the proposal, since the presence of such fish plays a significant role not only in the recovery of Atlantic salmon, but also in the health and quality of the riverine environment extending far beyond the project boundaries. To put it bluntly, those other species have a profound effect on the environmental analysis, yet they are not even included in the staff-recommended additional measures. That omission completely undermines a finding of no significant impact.

Indeed, the only support for the Commission staff's finding of no significant impact is anchored in staff's acceptance of the performance criteria for upstream and

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[20] **FERC Accession No. 20200828-5176** (NMFS Comments, Recommendations, etc. for the Shawmut Project) at pp. 43-44 ("Accordingly, a decision to decommission and remove the Shawmut Project and thereby remove a significant barrier to recovering an endangered species, and support the restoration of several anadromous fish, would fulfill the Commission's mandate under the FPA to ensure the best comprehensive use of a waterway."); **FERC Accession No. 20200828-5199** (Maine Department of Marine Resources ("MDMR") Comments on the Final License Application for Shawmut) at Executive Summary on Shawmut FLA) at Executive Summary p. 2 (noting MDMR's development of an amendment to the 1993 Kennebec Management Plan "as a comprehensive plan that will include dam decommissioning and removal' and supporting request to FERC to "analyze decommissioning and removal as a preferred option").

[21] *American Rivers*, 895 F.3d at 49.

[22] Draft EA at p. 38.

downstream salmonid passage at Shawmut and the other three dams in the watershed proposed by Brookfield, supplemented by a staff recommendation for effectiveness studies for salmon passage only.[23] Brookfield might as well have just written the environmental assessment itself. At a minimum, staff's conclusion that "[b]ased on our independent analysis, we find that the issuance of a new license for the Shawmut Project, with the additional staff-recommended environmental measures would not constitute a major federal action affecting the quality of the human environment" cannot survive the required level of review and must be rejected by the Commission. Specifically, the Commission must reject that conclusion because:

1. The "independent analysis" failed to take a hard look at the environmental consequences of the performance standards for upstream passage of endangered Atlantic salmon at Shawmut (95%) and for the four dams collectively (81.4 %) proposed by Commission staff, including whether those performance standards were reasonably likely to even be achieved under best available information. Draft EA at 15;

2. The "independent analysis" failed to take a hard look at the environmental consequences of proposed downstream passage performance standards of endangered Atlantic salmon at Shawmut (96%) and for the four dams collectively (84.9%), including whether those performance standards were reasonably likely to even be achieved under best available information. Draft EA at 16;

3. The failure to include performance standards for passage of alosines in the staff recommendation based on monetary costs is erroneous and fails the hard look test, and;

4. The failure to take a "hard and honest" look at dam removal and decommissioning of Shawmut, characterizing it as "speculative and premature" (Draft EA at 188), and the implication that the relicensing with the staff recommendations is a "better than nothing approach," falls far short of the NEPA and *American Rivers* analytic standards.

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[23] Draft EA at Section 5.1.2, pages 106-117, and Section 5.1.3 at 117-121 ("We conclude that any passage benefits of performance standards for alosines (including shad) are not justified by the additional cost of up to $894,470 . . . ." Draft EA at p.120.

Each of these deficiencies of the Draft EA are addressed in the following four sections of these Comments.

A. Failure to take a "Hard Look" at Upstream Fish Passage Performance Standards

While the Shawmut fish lift was not designed to meet a passage effectiveness standard for Atlantic salmon of 95%, despite Commission staff's claims that it was, this standard was used in the Draft EA analysis and findings.[24] In the Interim SPP filed by Brookfield for the Shawmut Project on May 31, 2021, Brookfield proposes a passage effectiveness of 96%, which is the same standard that was included in an NMFS prescription. In the Draft EA, Commission staff does not question the discrepancy between the standards, while observing that there is no guarantee the 96% passage effectiveness standard could be met with the proposed Shawmut fish lift, and that if Brookfield is "to achieve the higher [96%] standards, then Brookfield would likely need to construct additional fishways such as a second fish lift to attempt to meet them." But then the staff concludes that the estimated gains in passage effectiveness for a critically endangered species were insufficient to justify the annual costs of an additional fishway.[25]

From these mixed signals, it is clear that the Draft EA dodges taking a hard look at the record and in formulating an assessment of available and appropriate mitigation, protection and enhancement measures. While the difference between a 95% and a 96% passage effectiveness rate may not appear numerically significant, when it is considered

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[24] Draft EA at p. 118.

[25] Draft EA at p. 118.

that under best current information the 95% passage standard is itself as unlikely to be achieved as the 96% standard, and that the standards all address passage of an endangered species which, without game-changing recovery actions, is on the brink of extinction, the Draft EA clearly fails to take a hard look at issues underlying the reliability of actual performance of fishways at Shawmut, and the role that unreliability of effective passage plays in the system as a whole.

i. The proposed 95% upstream passage standard is unrealistic, and we are unaware of other dams that meet this standard.

Commission staff is proposing an unrealistic 95% upstream passage standard for Atlantic salmon at the Shawmut Dam. There is no justification for that proposed standard in peer-reviewed literature; in fact, extensive research shows that such standards have never been consistently reported within 48 hours of approach at <u>any</u> dam, on <u>any</u> river in the world.

While high passage success has been achieved at some hydropower dams, such as the Milford Dam on the Penobscot River in Maine, the Finsjö Dam on the Emån River in Sweden, and the Herting Dam on the Ätran River in Sweden, delays are quite common and passage is highly variable between years (Dauble and Mueller, 1993; Calles and Greenberg, 2006; Caudill et al., 2007; Holbrook, 2009; Noonan et al., 2012; Sigourney et al., 2015).[26] The reality of passage effectiveness standards is much less rosy. An extensive review of upstream salmonid passage studies revealed a mean passage efficiency of 61.7% (Noonan et al., 2012). Analyses of cumulative success passing multiple dams, as is required to reach spawning grounds above the Kennebec/Sandy

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[26] As stated previously, the Appendix to these Comments contains the list of References to literature cited in these Comments.

River confluence in this case, are even greater cause for concern, with numbers well below 50% (Holbrook et al., 2009; Gowans et al., 2003; Stevens et al., 2019). And, when passage at several dams is required for successful migration, the cumulative effect of even slightly reduced passage at these dams can be substantial (Holbrook et al., 2009).

The Draft EA's reference to passage success at the Milford Dam on the Penobscot River is misplaced. It ignores the serious, self-reported delays in salmon passage at Milford during tagging studies of adult passage. Specifically, the Draft EA neglects to recognize that at Milford in 2014, according to Brookfield's own data, 95% of tagged salmon that approached within 200 meters of the Milford Dam failed to pass the fish lift within the required timeframe of 48 hours.[27] The Draft EA also neglects to recognize that, again according to Brookfield's own data, 83% of the tagged adult salmon did not pass the fish lift within 48 hours in a 2015 study.[28] Similarly, the Draft EA neglects to acknowledge that University of Maine researchers also found in a 2015 study that 65% of adults did not pass the fish lift within 48 hours.[29]

These delays are biologically significant, as discussed below, and the Draft EA's failure to acknowledge them is unacceptable.

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[27] HDR Engineering. 2015. ATLANTIC SALMON PASSAGE STUDY REPORT ORONO, STILLWATER, MILFORD, WEST ENFIELD, AND MEDWAY HYDRO PROJECTS. P. 58. October. FERC Accession No. 20150324-5214.

[28] Kleinschmidt. 2016. 2015 ADULT ATLANTIC SALMON UPSTREAM PASSAGE STUDY MILFORD HYDROELECTRIC PROJECT. P. 21. May. FERC Accession No. 20160531-5663.

[29] Kleinschmidt. 2016. 2015 ADULT ATLANTIC SALMON UPSTREAM PASSAGE STUDY MILFORD HYDROELECTRIC PROJECT. P. 21. May. FERC Accession No. 20160531-5663.

ii. The biological significance of delays in upstream passage

Delays in upstream migration at dams can be extensive – up to 52 days reported by Gowans et al. (2003) – and these delays have the potential to devastate a population and erase any potential passage successes. Delays reduce survival and spawning success by increasing vulnerability to parasites and predation, depleting energy reserves, and creating missed spawning opportunities (Geist et al., 2000; Calles and Greenberg, 2009; Holbrook et al., 2009; Nyqvist et al., 2017(3); Izzo et al., 2016). The dangers of each of these possible outcomes is particularly alarming for the individuals that make up small populations, as in the case of the Kennebec's small endangered Atlantic salmon population.

Caudill et al. (2007) found that fish may ultimately be successful in passing one or more dams, but never make it to spawning grounds; this was attributable to the delayed passage at the dams. Geist et al. (2000) predicted that salmonids delayed more than five days passing each dam would have insufficient energy reserves to complete spawning, because migrating adults rely on energy reserves obtained in marine environments. When those energy reserves obtained from the marine environment are depleted by delays in reaching spawning habitat, spawning cannot be completed or is impaired because of insufficient energy reserves (Geist et al., 2000). Best current information and scientific literature also emphasizes the critical importance of repeat spawners – older, larger, repeat spawning fish are critical for population resilience and therefore recovery.[30]

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[30] Zydlewski, Joseph. 2021. Email to Landis Hudson, Maine Rivers Executive Director. Re: "Rubenstein Defense This Friday August 6." Received August 7. This communication is attached to these Comments. This current information is discussed further in Part B.v. herein.

Fungal infections in fish that failed upstream dam passage reported in Conon River in Scotland (Gowans, 2003) were attributed to combined stress of handling and accumulating with other fish below the dam. Similar results were found for steelhead trout and chinook salmon on the Columbia River associated with head burns and cranial legions (D.A. Neitzel et al., 2004).[31] Holbrook et al. (2009) observed frequent fallbacks into estuary among adults that failed to pass dams. They associated fallbacks with temperatures exceeding 22°C, suggesting the fallbacks to be a coping mechanism for thermal stress and migratory delays.

Even after substantial remediation efforts – replacing a technical fishway with a nature-like pool fishway – increased overall passage success to 97% from the 72% seen with the Denil fish pass, more fallbacks were reported by Nyqvist et al 2017(3). Fallbacks can cause lethal or sublethal injuries, delay or terminate migration or simply demand greater energy expenditure which has the potential to harm spawning success (Dauble and Mueller, 1993; Geist et al., 2000; Holbrook et al., 2009). Rubenstein found that Atlantic salmon experience extensive delays before passing the Lockwood Dam on the Kennebec. These delayed salmon lose more energy stores – compared to salmon that successfully reach cooler upstream habitat – due to the need to thermoregulate and/or seek-out coldwater refugia in order to survive the increased and prolonged exposure to higher water temperatures that exist below the dam. This additional expenditure of

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[31] Likewise, injuries to delayed salmon “rescued” at the Lockwood Project (FERC No. 2574) in June of this year, are fully and vividly documented. FERC Accession No. 20210701-5242 (Attachment 1, Maine Department of Marine Resources (Jennifer Noll). June 17, 2021. Field Summary of Atlantic Salmon Stranding Rescue at Lockwood Dam.)

energy causes increased pre-spawning mortality, decreased spawning success, and increased loss of iteroparity from the population.[32]

This best available information highlights the need to take a comprehensive and holistic look at the complete hydropower system on any river and not just the impacts of one individual dam on fish passage, flows, ecological changes, etc. That detail and information is part and parcel of the "hard look" required by NEPA. The Draft EA fails that test.[33]

iii. Commission staff's selection of a 95% upstream passage standard is arbitrary.

It is further unclear why Commission staff chose a 95% upstream salmon passage rate when Brookfield itself proposed a 96% rate in its draft Species Protection Plan (SPP) for the Lockwood, Hydro-Kennebec, and Weston projects.[34] In its draft SPP, Brookfield stated:

> Although the Shawmut Project is not part of this SPP, the performance standards considered and included in this SPP are based on the reasonable expectation that the Shawmut Project will be relicensed with the fish passage facilities and measures currently proposed or prescribed. These include installation of a new upstream fish lift, improvements to the downstream fish passage facilities proposed by the Licensee, and implementation of preliminary fish passage prescriptions issued by NMFS in August 2020, including a project-specific upstream performance standard of 96% and a downstream standard of 97%.[35]

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[32] Rubenstein, S.R. Energetic impacts of delays in migrating adult Atlantic salmon. August 6, 2021 Presentation (discussed in Zydlewski, Joseph. 2021. Email to Landis Hudson, Maine Rivers Executive Director. Re: "Rubenstein Defense This Friday August 6." Received August 7) (attached hereto).

[33] *American Rivers*, 895 F.3d at 49-50, 54-55.

[34] FERC Accession No. 20210601-5152.

[35] Kleinschmidt. 2021. SPECIES PROTECTION PLAN FOR ATLANTIC SALMON, ATLANTIC STURGEON, AND SHORTNOSE STURGEON AT THE LOCKWOOD, HYDRO-KENNEBEC, AND WESTON PROJECTS ON THE KENNEBEC RIVER, MAINE. May. P. 8-1, footnote 27. FERC Accession No. 20210601-5152.

Commission staff should clearly not recommend a lower passage standard than Brookfield itself has already said it would meet (albeit all without reliable basis), and doing so strains credulity.

But more significantly, Commission staff then assert that meeting the 96% standard might result in the need to build an additional fish lift:

> However, as we said in section 3.3.1.2, the fish lift was designed to meet a passage effectiveness standard for Atlantic salmon of 95% and our analysis shows that, while Brookfield should be able to meet this proposed standard, there is no guarantee that the new fish lift would be able to meet the higher standards specified by NMFS's prescription or recommended by Maine DMR. If Brookfield is unable to achieve the higher standards, then Brookfield would likely need to construct additional fishways such as a second fish lift to attempt to meet them.[36]

While these standards are themselves unrealistic, as noted above, within the parameters of the Commission staff's own analysis, the mathematics themselves do not meet the straight-face test: Commission staff is suggesting that a standard of 95% passage of their estimated 44 salmon per year is not meaningfully different from 96%. While the difference amounts to less than half an individual salmon (using the Draft EA's beginning estimate of 44), this difference is meaningful because of the alarmingly small numbers of the Kennebec's endangered Atlantic salmon population. This is a failure to take an honest and hard look at environmental consequences, as Commission staff's conceptual difference between what is assumed to meet a 95% standard instead of a prescribed 96% upstream salmonid passage standard finds no support in the record or in information of any professional integrity. In the end, Commission staff fail to comprehend the critical need to restore salmon to the Kennebec, one of only two major

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[36] Draft EA at p. 118.

river systems, and one of just a small handful of rivers altogether, in the U.S. – all in the State of Maine – that still support wild Atlantic salmon populations. Though the NGOs support removal of Shawmut entirely, the Commission should certainly not decide the appropriate passage standards for Brookfield based on the "burdens" associated with the number of required fish lifts. FERC must base passage standards for Atlantic salmon on the needs of this endangered species and the goals for Atlantic salmon recovery in the Final Recovery Plan for the Gulf of Maine Distinct Population Segment of Atlantic Salmon (*Salmo salar*).[37]

Moreover, the Draft EA misapprehends the process of fish passage *design*. Fishways are not designed to meet a certain passage or efficiency standard, nor does a fishway meeting USFWS standards reliably guarantee a particular passage standard or efficiency. Fishways are designed for capacity – pounds of fish to be lifted or passed, the size of hoppers, the rate hoppers can complete lift cycles, the size/width of fish ladders or of pools, etc. The *efficacy* of a given design – its ability to meet a certain passage percentage of efficiency – is never guaranteed. The USFWS Fish Passage Engineering Design Criteria manual (USFWS 2019) states:

> The efficacy of any fish passage structure, device, facility, operation, or measure is highly dependent on local hydrology, target species and life stage, dam orientation, turbine operation, and myriad other site-specific considerations.[38]

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[37] U.S. Fish and Wildlife Service and NMFS. 2018. Recovery Plan for the Gulf of Maine Distinct Population Segment of Atlantic Salmon (*Salmo salar*) 74 pp.

[38] USFWS (U.S. Fish and Wildlife Service). 2019. Fish Passage Engineering Design Criteria. USFWS, Northeast Region R5, Hadley, Massachusetts at Section 1.3 p. 1-1.

Simply stating that a fishway will meet a standard does not mean that it will, and this particular fishway was not designed to meet a 95% passage standard; rather, it was designed to pass fish given the configuration of the dam and powerhouses in issue sized to pass the estimated capacity needs. NEPA analysis requires the Commission to grapple with the uncontested *uncertainty* of ever meeting a 95% or 96% salmonid upstream passage effectiveness rate at Shawmut, and the significance of the environmental consequence should that passage effectiveness rate not be met. And it must grapple with that uncertainty in light of current information, set forth above, that in truth it appears no dam in the world has ever consistently met that standard.

iv. The Draft EA ignores compounding effects and compensatory and depensatory processes.

Commission staff's evaluation of the different passage effectiveness percentages ignores the profound significance of compounding effects and compensatory processes. McElhany et al., 2000 explain the density dependent compensatory and depensatory processes that strongly influence population dynamics. When populations are small, compensatory processes act to mitigate the threats of small population size through increased productivity, creating a stabilizing effect. Therefore, the contributions of each individual in a small population is higher at small population sizes. However, when populations are depleted below critical sizes, depensatory processes occur that reduce productivity and increase likelihood of extinction through inbreeding depression and increased relative predatory pressure on each individual fish (McElhany et al., 2000). For populations depleted below critical levels like the Atlantic salmon, protecting each spawning individual may be vital to recovery of the GOM DPS. While minor losses of spawner numbers may appear insignificant in a vacuum, for a critically depleted population such as Atlantic salmon, the contributions of each spawner on the number of emerging smolts must be considered (McElhany et al., 2000; Holbrook et al., 2009). In this respect, the Draft EA's dismissal of the difference between hypothetically passing (within 48 hours of approach) 35 individuals instead of 36 is an egregious error,[39] ignoring best information on the effects of compensatory and depensatory processes on a population that is indisputably on the verge of extinction.

As established by Hutchings (2001), the longer a population is burdened by such pressures, the lower its chances are of recovering. Poor returns of spawners to upstream river segments and combined inefficiencies of fishways indicate that recolonization will be slow (Bryant et al. 1999). Opening the river for passage for spawners and ensuring the greatest potential for successful repeat spawning must be prioritized to ensure the best chance of recovery.

In its rejection of 96% and 99% performance standards for Atlantic salmon, the Draft EA presents an analysis in Table 4 of adult salmon passage above the Weston Project, [40] concluding that:

> Under a[sic] 96 and 99 percent upstream survival standards, the average number of returning salmon surviving passage through all four dams would increase to about 37 to 42 adult salmon, respectively. This would represent an increase in survival of about 5.7 percent to 20 percent over existing conditions. Maine DMR's goal for Atlantic salmon is to restore a minimum population of 2,000 adults annually to historic high-quality habitats in the Kennebec River above Weston Dam (Maine DMR, 2020a). Likewise, Commerce chose 2,000 spawners as a number that can weather downturns in survival (74 CFR 29300). Thus, the average return for 2014-2020 represent about two percent of the restoration goal of 2,000 adult salmon. Based on these existing low run sizes compared to the

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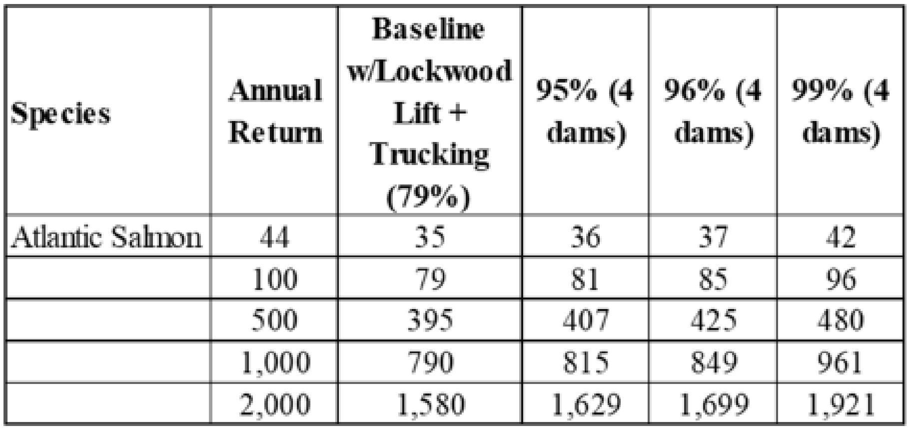
[39] Draft EA at p. 40.

[40] Draft EA at p. 41.

> restoration goals, the higher performance standards stipulated by NMFS and recommended by Maine DMR would provide minimal benefits to the Atlantic salmon population at this time.[41]

This analysis casually dismisses MDMR's recommendation for an upstream passage standard that would cut losses by more than 75% of migrating adult salmon to spawning habitat caused by passage inefficiencies at the four lower Kennebec dams. It also assumes that ongoing restoration activities, including improved fish passage, will not result in increasing numbers of spawning salmon returning to the Kennebec River during the long term of a new license. Projecting increases in salmon returns that may occur as restoration efforts ramp up, the benefits of increased passage survival are obvious. With passage success at 95% at each dam, more than 18% of returning salmon are prevented from reaching spawning habitat above the Weston Dam. Increasing passage success to 99% reduces losses to less than 5%. This is shown on the following Table A (below).

Table A. Annual returns of adult Atlantic salmon to the Lockwood project, from current estimate (44) to 2,000, calculated to pass above four dams at the current rate (trucking of 79%), 95, 96 and 99% at each project.



Species	**Annual Return**	**Baseline w/Lockwood Lift + Trucking (79%)**	**95% (4 dams)**	**96% (4 dams)**	**99% (4 dams)**
Atlantic Salmon	44	35	36	37	42
	100	79	81	85	96
	500	395	407	425	480
	1,000	790	815	849	961
	2,000	1,580	1,629	1,699	1,921

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[41] Draft EA at p. 41.

The Draft EA also errs in evaluating the benefits of fish passage solely on the current number of returning adult salmon, and assuming that it will not change over the 30+ year term of a FERC license. The current critically low number of spawners returning to the Kennebec is not surprising given that (1) restoration efforts for salmon in the Kennebec watershed are in their very early stages; and (2) restoration efforts so far have been severely hampered by the Shawmut Project and the three other dams.

v. The Draft EA's proposed operating periods for upstream passage are inadequate.

The NGO's agree with MDMR that, based on the most current information, "Atlantic salmon have been documented in the Kennebec River migrating upstream for a longer season and sea lamprey predominately migrate during the night. Fish passage should be provided from May 1 through November 10 with operations occurring 24 hours per day from May 1 through June 30 to accommodate diurnal and nocturnal migrants."[42] The Draft EA rejects MDMR's recommended operating periods for upstream passage, with no reasonable rationale provided for that rejection.

vi. The design and location of the proposed Shawmut fish lift are inadequate.

The Kennebec Coalition reasserts its comments on this issue, submitted in protest to the Shawmut license application.[43] Although an express purpose of the ISPP was to allow Brookfield to study and test methods for passing fish at Shawmut and other dams,

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[42] MDMR. 2021. Comments on Brookfield White Pine Hydro, LLC's Shawmut (FERC No. 2322) Hydroelectric Project, State Water Quality Certification. July 17. P.6 This MDMR filing is attached hereto for reference.

[43] CLF, which did not join in the protest to the Shawmut Project license application, joins in those comments now.

Brookfield has done almost nothing to study this issue since the ISPP (now expired) went into effect in 2013. Brookfield has selected the location and type of fish passage facility without evidence indicating where salmon or shad downstream of Shawmut would congregate below the dam. The single study on which Brookfield has apparently based the location of its proposed fishway was a one-time release of 150 tagged alewives in 2016.[44] Such a limited study in a single year, with small numbers of just one of the five target species of anadromous fish under a limited set of flow conditions, does not come close to providing adequate data on which to base the location of fish passage that must work for multiple species across the full range of flow conditions that may occur for decades. Brookfield cannot point to any empirical evidence that the location and type of fish passage facility are appropriate for salmon and shad at Shawmut, and there is only extremely limited evidence for river herring. A similar lack of pre-construction study has had disastrous results at the Lockwood fish lift. That project does not pass shad[45] or salmon[46] adequately. With the current upstream passage rate at Lockwood of 79%, even if all other dams passed salmon at 99%, only 77% of fish returning to Lockwood would pass the Weston Project.

Moreover, Brookfield has refused to take steps to provide effective fish passage at Lockwood since the construction of the "interim" fish lift in 2006. So not only does

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[44] Kleinschmidt. 2020 Brookfield White Pine Hydro LLC. Application for New License for Major Water Power Project – Existing Dam. Shawmut Hydroelectric Project (FERC No. 2322). January 30. Pp. E-4-48-49; FERC Accession No. 20200131-5356.

[45] MDMR. Intervention letter from Commissioner Keliher to Secretary Bose, FERC (May 2, 2014) at 2 [FERC Accession No. 20140502-5080].

[46] Letter from Dan Kircheis (Acting ESA Fish Recovery Coordinator, NMFS Greater Atlantic Regional Fisheries Office) to Secretary Bose, FERC re NOAA Fisheries comments on the draft 2017 KHDG report (March 27, 2018) at 1 [FERC Accession No. 20180329-5166].

Brookfield have essentially no empirical evidence to support the construction of the Shawmut fish passage facility, but it has demonstrated at Lockwood that it would likely do nothing to remedy future fish passage failures at Shawmut.[47]

In addition, the proposed attraction flow adjacent to the fish lift entrance could create a false attraction delaying both salmon and shad passage, particularly for fish moving across the face of the dam. The fish lift design incorporates a standard design for the crowder V-gates, which have been shown at other projects to allow shad that have passed through the V-gate to then pass downstream, contrary to the design plan to contain fish prior to lifting. Regarding the "fish ladder" portion of the proposed facility, designed to move fish attracted to units 7 and 8 to the tailrace of units 1-6, the concern is that shad would have difficulty navigating the turbulent tailrace waters. There are also questions concerning the ability for fish to find the "fish ladder" entrance. The ladder is expected to pass roughly 100 cfs. Adjacent to it, the Taintor gate will pass 600 cfs for downstream fish passage. Units 7 and 8 each can pass 1,430 cfs. With both units running, the ladder will be less than 3% of flows at the fishway entrance, well below agency standards.[48]

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[47] *See American Rivers*, 895 F.3d at 53 (recognizing that the Commission cannot ignore its own licensing record in determining whether a licensee will "regularly and predictably" comply with conditions). Brookfield has a license history of ignoring or delaying steps to improve fish passage conditions, when existing conditions have proven indisputably inadequate. Indeed, Brookfield allowed the interim Biological Opinion and associated incidental take authorization therein governing Shawmut to lapse on December 31, 2019, and has taken now nearly 3 years to even begin to take steps to confront that lapse. The Lockwood Project fish passage deficiencies have been known and acknowledged for over a decade.

[48] Kennebec Coalition. 2020. KENNEBEC COALITION'S MOTION TO INTERVENE, WITH PROTESTS AND COMMENTS OPPOSING THE ISSUANCE OF A NEW LICENSE FOR THE SHAWMUT PROJECT NUMBER 2322-069, WITH RECOMMENDATION FOR ORDER OF PLAN FOR DECOMMISSIONING AND REMOVAL. Pp. 43-45. August 29. FERC Accession No. 20200831-5332.

MDMR has issued similar comments about the poor design of the proposed Shawmut upstream fish passage facility. In comments on Brookfield's application for water quality certification, MDMR stated:

> The Licensee has proposed to construct permanent upstream fish passage (a single fish lift) at the Shawmut project. Successful fishways must create hydraulic signals strong enough to attract fish to one or multiple entrances in the presence of competing flows (i.e., false attraction). The Shawmut dam is extremely long and has multiple discharge locations that will provide significant false attraction flows during the passage season. MDMR has serious concerns about the design, operation, and location of the fishway and believes the current proposal will result in significant delays and likely poor upstream passage efficiency for multiple species. MDMR also has serious concerns about the cumulative adverse impacts of the Lockwood, Hydro-Kennebec, and Weston projects, which has similar issues.
>
> MDMR is very concerned about the effectiveness of the proposed fishway in May, June, and July when the majority of anadromous species are migrating upstream (Table 1). The maximum station hydraulic capacity of the Shawmut Project is 6,690 cfs, which is exceeded approximately 65% of the time in May, 35% of the time in June, and 20% of the time in July. Water in excess of station capacity is spilled at the sluice gate in the middle of the 1,435-foot long dam, the hinged flashboards on the west side of the dam, or the rubber crest(s) on the eastern half of the dam, providing multiple false attractions. As a result, there will be false attraction at the project during the majority of the upstream migration season to multiple areas without a fishway to the headpond. A proposed cross channel egress from an identified false attraction zone would not provide passage to the headpond or directly to the lift.
>
> The location of the fishway was based on very speculative assumptions using limited information. The CFD modeling that was conducted looked at a very limited range of flows that are not representative of the majority of the migration period. Furthermore, the siting study, conducted from May 19-June 14, 2016 with radio-tagged alewife, occurred during a low flow period, which is not representative of flows during the passage season. Alewives are not necessarily a good proxy for fish attraction of other species, as the Lockwood and Brunswick projects demonstrate. The existing American Eel fishway locations were selected based on flow conditions that will be changing based on the proposal.[49]

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[49] MDMR. 2021. Comments on Brookfield White Pine Hydro, LLC's Shawmut (FERC No. 2322) Hydroelectric Project, State Water Quality Certification.. P.5. July 17. (Note: Not submitted to FERC so we may have to attach)

The consequences of multiple discharge locations and false attraction are well illustrated at the Lockwood Dam, where false attraction to the bypass channel, combined with annual fluctuations in station discharge caused by flashboard installation, require a "fish rescue" every time flashboards are installed. According to MDMR, in 2021 this event resulted in at least three adult Atlantic salmon becoming stranded in isolated pools in the Lockwood bypass channel. One of these salmon captured and trucked upstream suffered extensive injuries, including "scraped up body dorsally, scraped up sides (both left and right), an abrasion ventrally, a bruise on its left side, a lamprey wound scar on its right side, a split dorsal fin, a split caudal fin and a bruised snout."[50] At least two other adult Atlantic salmon, one with "significant scars located dorsally on its body"[51] were also trapped during this event, but could not be captured and transported. In 2021, three endangered Atlantic salmon (compared to 15 that had been trapped and trucked from the Lockwood Dam fish lift as of August 9, 2021[52]) were subjected to this stress—two with significant injuries. That is 17% of total salmon returns to the Kennebec—at just a single dam. The future suggested by this Draft EA would include similar inefficiencies at four dams, before endangered salmon reach spawning habitat in the Sandy River. The impacts of these inefficiencies and injuries are not evaluated or even acknowledged in the Draft EA.

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[50] MDMR (Jennifer Noll). June 17, 2021. Field Summary of Atlantic Salmon Stranding Rescue at Lockwood Dam. (This report was included as Attachment 1 to a filing about the event by Trout Unlimited submitted on July 1, 2021: FERC Accession No. 20210701-5242.)

[51] Ibid.

[52] Maine Department of Marine Resources "Recent Trap Counts for Fish Returns to Maine by River," accessed at https://www.maine.gov/dmr/science-research/searun/programs/trapcounts.html on 8/11/2021.

All told, the Draft EA does nothing to confront or "grapple with" the opposing views.[53] In conducting its NEPA analysis, the Commission "cannot overlook a single environmental consequence even if it is 'arguably significant.'"[54] It must "comply with NEPA's exacting procedural requirements to 'to the fullest extent possible.'"[55] This Draft EA fails that test.

B. The Failure to take a "Hard Look" at Downstream Fish Passage Performance Standards

The Draft EA's analysis of a downstream salmon passage standard has many flaws. "Put simply, an agency's [EA] 'must give a realistic evaluation of the total impacts and cannot isolate a proposed project, viewing it in a vacuum.'"[56] Unfortunately, that is exactly the analytical flaw of the Draft EA, and as such it cannot stand.

i. Both a 96% downstream passage at Shawmut and an overall 4-dam passage survival rate of 88.5% are unrealistic and unattainable.

Brookfield's own data show that 96% downstream passage is not attainable at the Shawmut Project, and neither is an overall survival rate of 88.5% over all four of the Kennebec dams. On behalf of the Kennebec Coalition, Don Pugh, a fish passage expert with decades of experience at the S.O. Conte Anadromous Fish Research Center,[57] evaluated Brookfield's downstream smolt passage data from 2012 to 2015 and identified two key factors that inflated smolt survival percentages.

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[53] *American Rivers*, 895 F.3d at 49 & 51.

[54] *Id*. (quoting *Myersville Citizens for a Rural Cmty., Inc. v. FERC*, 783 F.3d 1301, 1322 (D.C. Cir. 2015)).

[55] *Id*. (citing *Delaware Riverkeeper Network v. FERC*, 753 F.3d 1304, 1310 (D.C. Cir. 2014)).

[56] *Id*. (quoting *Grand Canyon Trust v. FAA*, 290 F.3d 339, 342 (D.C. Cir. 2002)).

[57] Mr. Pugh's curriculum vitae is attached to these Comments.

First, Normandeau (Brookfield's consultant) inappropriately used paired release studies when analyzing the 2013 to 2015 data; paired release studies should only be used when there are at least 1000 fish. Using this methodology with the small numbers of Atlantic salmon smolts in the Kennebec, as Brookfield's consultant did, actually "creates fish" statistically, with calculated survival rates exceeding the number of fish that actually survived.[58] The Draft EA ignores this significant flaw in Normandeau's analysis.[59]

Second, Brookfield inappropriately calculated overall downstream survival rates as the product of survival rates at each individual dam, which leaves out the highly significant impacts of the impoundments between the dams.[60] Mr. Pugh analyzed the actual survival of individual smolts from 200 meters above the Weston Dam to the lowermost telemetry station below the Lockwood Dam. Only an average of 56% of smolts survived this multi-dam passage over the course of the four years of the Normandeau studies.[61] This is likely an overestimate of survival because Normandeau released smolts just above the Weston Dam, excluding the likely significant impacts on smolt survival of the long Weston impoundment, which is approximately 12 miles long. Based on Mr. Pugh's calculations, Brookfield's contention that it can meet an "end-of-

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[58] Kennebec Coalition. 2020. MOTION TO INTERVENE, WITH PROTESTS AND COMMENTS OPPOSING THE ISSUANCE OF A NEW LICENSE FOR THE SHAWMUT PROJECT NUMBER 2322-069, WITH RECOMMENDATION FOR ORDER OF PLAN FOR DECOMMISSIONING AND REMOVAL. P. 41. FERC Accession No. 20200831-5332.

[59] *Id*.

[60] See also, Part B.iv., herein, discussing best available information on the additional significant issue of delayed and estuarine mortality. This critical information is also relevant to this discussion.

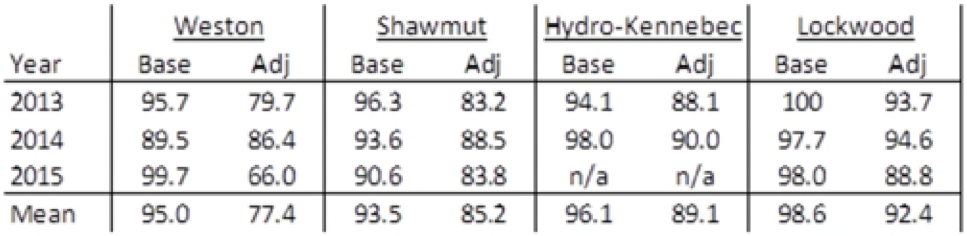
[61] Kennebec Coalition. 2020. MOTION TO INTERVENE, WITH PROTESTS AND COMMENTS OPPOSING THE ISSUANCE OF A NEW LICENSE FOR THE SHAWMUT PROJECT NUMBER 2322-069, WITH RECOMMENDATION FOR ORDER OF PLAN FOR DECOMMISSIONING AND REMOVAL. P. 38. FERC Accession No. 20200831-5332

pipe" downstream passage goal of 88.5% is both absurd and perilous for the future of the endangered Atlantic salmon.

Similarly, Mr. Pugh's analysis showed that average survival at the Shawmut dam between 2013 and 2015 was 78.3%, not the 93.9% that appears to have been accepted in the Draft EA.[62] It is extremely unlikely that any measures that Brookfield proposed in its license application could increase downstream survival to 93.9%, let alone 96%, as discussed below.

Throughout the Draft EA, downstream passage survival numbers referenced are the paired release "baseline" numbers from Brookfield's annual diadromous fish reports for 2013 to 2015. In order to understand the effect of a 24-hour downstream passage requirement, Brookfield included a paired release analysis of downstream survival that considered fish that did not pass within 24 hours as mortalities. These results are called 'adjusted'. Table B (below) compares the baseline (all fish that passed) and adjusted results for the years 2013 to 2015.

Table B. Comparison of baseline and adjusted survivals for Weston, Shawmut, Hydro-Kennebec, and Lockwood projects by year and averaged.



	Weston		Shawmut		Hydro-Kennebec		Lockwood	
Year	Base	Adj	Base	Adj	Base	Adj	Base	Adj
2013	95.7	79.7	96.3	83.2	94.1	88.1	100	93.7
2014	89.5	86.4	93.6	88.5	98.0	90.0	97.7	94.6
2015	99.7	66.0	90.6	83.8	n/a	n/a	98.0	88.8
Mean	95.0	77.4	93.5	85.2	96.1	89.1	98.6	92.4

When fish that did not pass within 24 hours are considered mortalities, **even with** a paired release analysis, survival is far below the 96% downstream bypass standard of

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[62] Draft EA at p. 52.

Brookfield's ISPP, ranging from 3.6% to 18.6% lower than the standard. As noted above, these are survivals for fish passing only one dam and do not consider the effect of passing four dams, as wild smolts must, or of the effect of passing approximately 27 miles of impounded river (which is 86% of the river from the head of the Weston impoundment to the Lockwood project).

The impact of passing multiple dams can be seen in the numbers of fish that were released above Weston, and in the Weston tailrace, that passed Lockwood in 2014 and 2015 (Normandeau 2015 & Normandeau 2016, Report Tables 7-4 and 6-4 respectively). Of the 158 fish (98 above pass four dams; and 60 below pass three dams) released at the Weston project in 2015, only 100 were detected below Lockwood (63.3%). In 2014 with similar numbers above and below Weston, 81.8% of the fish released at Weston were detected below Lockwood for a two-year average of only 72.6%. Survival to below Lockwood of fish released at Weston, Shawmut, Hydro-Kennebec, and Lockwood in 2014 of 81.8%, 86.9%, 94.1% and 99.0% clearly reveal the effect of passing multiple dams (Report Table 7-7, Normandeau 2015): Survival decreases as the number of dams passed increases (*see also* Stich et al. 2015).

Commission staff's analysis also fails to even consider delayed mortality of smolts that survive immediate passage at each dam, but suffer increased mortality as they continue their migration beyond the immediate tailrace. Research on the Penobscot River assessing survival of tagged smolts found that the number of dams passed by a salmon smolt had a "strong negative effect of fish survival in the estuary."[63] Building on these empirical results, Stevens et al. modeled salmon smolt survival through multiple

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[63] Stich et al. 2015 at pp. 68-86.

Penobscot River dams and showed a clear negative correlation between predicted smolt survival and the number of dams encountered, concluding that "up to 37% of the annual loss of hatchery smolts was attributed directly to dams."[64] They also analyzed the increase in survival from the Penobscot River Restoration Project, which removed the lowest dams on the Penobscot River, and concluded that "a 36% increase (from unrestored) in wild smolt survival to the ocean was possible with the removal of some dams in the Penobscot River."[65]

An analysis of survival that only considers the immediate impact of each dam individually is inadequate and misleading when analyzing the impact of the multiple projects on smolt survival. And it bears repeating that NEPA requires that "an agency's [EA] 'must give a realistic evaluation of the total impacts and cannot isolate a proposed project, viewing it in a vacuum.'"[66]

ii. Brookfield's proposed "improvements" to downstream fish passage at Shawmut are not sufficient to increase downstream survival to 96%.

As set forth in the comments of MDMR on Brookfield's State water quality certification application:

> The Licensee proposes to utilize three gates in the forebay area (Sluice Gate, Tainter Gate, and Deep Gate) and up to four sections of hinged flashboards to pass fish downstream. The licensee also proposes a guidance boom (discussed below) and no screening protection of fish through the Francis Turbines. Unlike the Licensee proposal in the SPP for the Lockwood, Hydro-Kennebec, and Weston projects, the Licensee does not propose any specific low flow thresholds that would require curtailment of generation to provide for additional spill for

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[64] Stevens et al. 2019 at pp. 1795–1807.

[65] Ibid.

[66] *American Rivers*, 895 F.3d at 55 (quoting *Grand Canyon Trust v. FAA*, 290 F.3d 339, 342 (D.C. Cir. 2002)).

protection of downstream passage of Atlantic salmon smolts. The proposal also fails to provide adequate protection for other species during their period of downstream passage. The proposed downstream operational facilities are inadequate to safely and effectively pass Atlantic salmon and all species downstream…

The Licensee proposed to construct a fish guidance boom system that is intended to preclude downstream migrating fish from entrainment in Units 7 and 8. MDMR does not support the Licensee's proposal to use surface guidance booms at the Shawmut Project and finds them to be inadequate to protect the GOM DPS population of Atlantic Salmon and the other diadromous species in the Kennebec River. Data provided by the Licensee in the (SPP, Table 5-1) demonstrates that the guidance booms used at the Lockwood, Hydro-Kennebec, and Weston Projects do not guide 14.3-30.6% of the migrating smolts away from the turbines. Data provided by the Licensee (FLA, Table 4-22) shows that 32.7% of the downstream migrating smolts were entrained into the turbines at the Shawmut Project. The instantaneous survival was 7% lower when fish went through the turbines compared to spill routes at Shawmut and that grossly underestimates the sublethal effects, including injury and disorientation, that would result in higher mortality in the estuary. Studies at the Ellsworth dam on the Union River assessing injury to salmon showed that 22-30% of fish that went through the turbines had injuries compared to 3.8% that went through spill routes, demonstrating that impact quantitatively. The 2015 *Evaluation of Downstream Passage for Adult and Juvenile River Herring* demonstrated that 53 percent of the study fish went through the Lockwood turbines, rather than being guided by the boom to the downstream bypass, and survival was lowest for those fish passing Lockwood via the units (i.e., 77.4% – 81.7% survival). This would indicate that performance standards would not likely be met for these species with the proposed plan…

In addition, MDMR has consulted with the USFWS regarding floating guidance booms and concurs with their comments that are provided below.

> The Service does not know of any studies that have assessed how effective floating guidance booms are at protecting eels as they attempt to migrate downstream past a hydroelectric project. However, we do know that eels are a bottom-oriented species (Brown et al. 2009) and therefore a floating guidance boom with partial depth panels would not be fully protective. As stated in our 2019 Fish Passage Engineering Design Criteria manual, "A floating guidance system for downstream fish passage is constructed as a series of partial depth panels or screens anchored across a river channel, reservoir, or power canal. These structures are designed for pelagic fish which commonly approach the guidance system near the upper levels of the water column. While full-depth guidance systems are strongly preferred, partial-depth guidance systems may be acceptable at some sites (e.g., for protection of salmonids, but not eels)." Booms have not been

> implemented as a protective measure for eels or alosines anywhere else in our region, which spans fourteen states, unless they are installed with other protective measures that are suitable to ensure the safe, timely, and effective downstream passage of our trust species (e.g., inclined bar screens, angled bar racks, etc.). Therefore, the Service recommends that any protective measure implemented at the mainstem Kennebec River hydroelectric projects, as part of the current SPP process, are protective of all migratory species and that the proposed mitigation measures comport with the Service's fish passage guidelines.[67]

Similarly, Brookfield's and Commission staff's screening proposals are also inadequate.

According to MDMR:

> The licensee did not propose any additional screening, however FERC has suggested screening may be required as this was suggested in NMFS Section 18 preliminary prescription. The preliminary screening suggestion is to equip each powerhouse with full-depth trash rack bars clear spaced at 1.5-inches and 3.5-inches for Units 1-6 and 7-8 respectively. This screening approach is inadequate for Atlantic salmon and does not take into account juvenile river herring, shad, sea-lamprey, or eels so will not result in safe downstream passage of indigenous species. In order to protect downstream migrating Atlantic Salmon smolts and kelts, adult and juvenile Alewife, adult and juvenile American Shad, adult and juvenile Blueback Herring, and adult American Eel, and adult and juvenile sea-lamprey, the Licensee would need to install full-depth inclined or angled screening with much smaller spacing and sized so that the normal velocities should not exceed 2 feet per second measured at an upstream location where velocities are not influenced by the local acceleration around the guidance structures.[68]

It is worth noting that the USFWS has prescribed 0.75-inch inclined screening for downstream eel passage at the Pejebscot Project in Maine.[69]

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[67] MDMR. 2021. Comments on Brookfield White Pine Hydro, LLC's Shawmut (FERC No. 2322) Hydroelectric Project, State Water Quality Certification. July 17. pp. 8-9. This document is attached to these Comments.

[68] MDMR. 2021. Comments on Brookfield White Pine Hydro, LLC's Shawmut (FERC No. 2322) Hydroelectric Project, State Water Quality Certification. July 17. p. 10. (attached to these Comments).

[69] USFWS. 2021. COMMENTS, RECOMMENDATIONS, PRESCRIPTIONS Application Ready for Environmental Analysis Pejepscot Hydroelectric Project, FERC No. 4748-106 Androscoggin River, Androscoggin, Cumberland, and Sagadahoc Counties, ME. P. 14. July 17. FERC Accession Number 20210617-5028.

iii. The Draft EA's proposed operating period and unit prioritization for downstream fish passage are inadequate.

MDMR's comments regarding operation of the downstream fishway as proposed by Brookfield in its application for state water quality certification are also relevant to most of Commission staff's and Brookfield's proposals. Brookfield proposes to operate the downstream fishway as follows:

> The Licensee proposed to operate the downstream fishway as follows:
>
> - Continue to operate the existing forebay surface sluice gate at maximum capacity to pass up to 35 cfs from April 1 to December 31 to provide a continuous surface bypass route for downstream migrating fish;
> - Continue to spill 600 cfs through the existing forebay Tainter gate from April 1 to June 15 to provide a passage route for Atlantic salmon smolts;
> - Continue to provide a total of 6% of Station Unit Flow (about 400 cfs at maximum generation) through the combined discharge of the forebay Tainter and surface sluice gates from November 1 to December 31 to provide a safe passage route for Atlantic salmon kelts;
> - During the interim period between license issuance and the installation of the new fish guidance boom, continue to lower four sections of hinged flashboards to pass 560 cfs via spill from April 1 to June 15 to provide a safe passage route for Atlantic salmon smolts; and.
> - Continue to pass approximately 425 cfs through the forebay deep gate and shut down Units 7 and 8 for 8 hours during the night for 6 weeks between September 15 and November 15 for downstream adult eel passage [Note: FERC recommends shut downs for units 7 and 8 from August 15 to October 31].
>
> This proposed downstream operational period is inadequate to safely and effectively pass all species downstream. Alewives and blueback herring leave the spawning grounds immediately after spawning and begin their downstream migration. American shad exhibit similar behavior. This downstream migration typically occurs between May and September each year. In addition, juvenile lifestages of these three species of alosines begin migrating downstream as early as July when they are only approximately 40mm long. Larger juveniles will migrate downstream as late as November depending on environmental variables

> [and] freshwater nursery habitats. The Licensee has proposed to cease operation of the forebay Tainter gate after June 15, which would leave only the forebay sluice gate in operation. The maximum capacity of the sluice gate is approximately 35cfs, which is 0.52% of station capacity and is 0.43-0.81% of average flow at the Shawmut dam between June and September.
>
> Brookfield also mentions prioritizing units for protection of Atlantic salmon. Based on the average daily inflow reported in Table 2 of the Draft EA, station capacity will be exceeded in all months except July, August, and September. Therefore, station capacity will be exceeded at the project for the majority of the downstream migration of Atlantic salmon smolts and adult alosines in the spring and the majority of the juvenile alosines and adult eels in the summer and fall. While unit prioritization is proposed for these times as a protective measure, the prioritization will not be in effect as all units will be "on".[70]

In addition, Table 6 of the Draft EA[71] lists the percent survival through each passage route at the Shawmut Project from telemetry studies done in 2013, 2014 and 2015. Passage through the hinged flashboards is the lowest of any route. The Commission staff alternative[72] recommends that until the new guidance boom is constructed, the hinged flash boards should continue to be used as downstream passage. As this route has the lowest survival – more than 5% lower than any other route – continuing to pass out-migrating smolts through the hinged flashboards does not make sense.

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[70] MDMR. 2021. Comments on Brookfield White Pine Hydro, LLC's Shawmut (FERC No. 2322). Hydroelectric Project, State Water Quality Certification. July 17. p. 9 (attached to these Comments).

[71] Draft EA at p. 51.

[72] Draft EA at p. 16.

iv. Best available information and scientific literature do not support attainability of these downstream passage standards.

A meta-analysis of downstream passage studies at hydropower dams in temperate regions revealed extensive fish injury as well as immediate and delayed mortality (Alegra et al., 2020). Smolt mortality is commonly reported to be substantially heightened at dams compared to free-flowing river stretches (Calles and Greenberg, 2009; Norrgård et al., 2012; Stich et al., 2015(17); Nyqvist et al., 2017(2); Alegra et al.; 2020). Direct mortality at dams is also frequently underestimated, as dead smolts are difficult to catch and can be carried downstream by drift or scavengers (Keefer et al., 2012; Havn et al., 2013).

Stich et al. (2014) reported remarkably high smolt survival of 91% at Milford Dam. However, Milford Dam has Kaplan runners rather than the Francis runners found at the Shawmut Dam, the former of which are reported in the literature to be significantly less harmful to passing fish (Calles and Greenberg, 2009; Alegra et al., 2020). Therefore, comparisons between the downstream passage rates at the Milford Dam and what is proposed for the Shawmut Dam are not meaningful and, in fact, inflate Brookfield's claims for future successes at Shawmut.

Similarly, smaller trash racks and priority operation of generators proposed by Brookfield would not effectively protect downstream migrating smolts. Current priority operation of generators has not achieved proposed passage standards for smolts, and the proposed trash racks would not exclude smolt from entrainment.

The Draft EA fails to adequately evaluate the overall impacts of hydropower operations and resulting delayed mortality on fish. Rapid pressure changes and high probabilities of striking through turbines and high concentrations of dissolved gas below spillways significantly reduce fitness and increase fish vulnerability to predation by impairing swimming and sensory functions necessary to detect and avoid predators (Johnson et al., 2005; Ferguson et al., 2006; Norgarrd et al., 2012). Indirect mortality is not accounted for in the scope of most passage studies, but most recognize it as a basic caveat to their research (Budy et al., 2002; Ferguson et al., 2006; Norgarrd et al., 2012; Stich et al. 2014; Stich et al,. 2015; Alegra et al., 2020).

Alegra et al. (2020) found 81% of data sets that evaluated fish injury at dams reported higher likelihood of injury than controls, 63% of which were significant. Stich et al. 2015 attributed a 6-7% reduction in estuarine smolt survival for each dam passed along their downstream migration. They reported greater indirect dam-related estuarine mortality than direct passage mortality reported at dams on the Penobscot River. Schaller et al. (2014) related the marine mortality of 76% of out-migrating smolts that had survived passage in the Columbia River Power System to their outmigration experience, and positively related delayed mortality to the number of powerhouse passages. Ferguson et al (2006) demonstrated delayed mortality by comparing survival of balloon-tagged and radio-tagged smolts at various distances downstream dams. They attributed 46-70% of total estimated mortality in radio-tagged fish to delayed mortality.

In addition to threats imposed by powerhouse passage, smolts are vulnerable to delays at dams. Successful migration can be critically dependent on the synchronization of numerous confounding factors (McCormick et al., 1998; National Research Council, 2004). Successful smoltification is physically, behaviorally, and environmentally constrained in time. Delays can occur approaching dams due to the transition from passive to active swimming at the impoundment, thermal stress, and difficulty finding confined passage entrances. They reduce fitness and survival through increased exposure to predation and parasites, reduced feeding opportunities, and desmoltification (Mccormick et al., 1998; Keefer et al., 2012).

Even where direct survival has been improved through technological enhancements, impacted stocks continue to decline. Several reports evaluating salmon population viability in the presence of dams recommend that breaching lower dams was the most likely management option to achieve recovery (National Research Council, 2004; Budy et al., 2002; Lawrence et al., 2016).[73]

The Draft EA's analysis of downstream smolt survival shows clearly that improved passage success at each dam in a river containing four dams has a dramatic impact on smolt survival, such that improving downstream passage success even from 96% to 99% increases smolt survival through the 50.1 km length of the Kennebec River from the mouth of the Sandy River to the base of Lockwood Dam, from 13,187 to 14,941 individuals.[74] As was the case when evaluating the benefits of improved upstream passage for salmon, set forth in Part A herein, the Draft EA's analysis and discussion of Atlantic salmon smolt losses as they pass over and through multiple dams ignores the obvious: the presence of multiple dams substantially decreases smolt survival. This is clear in the following paragraph from the Draft EA:

> Brookfield's downstream survival studies indicate that whole station survival of juvenile salmon through the Shawmut Project has never consistently exceeded 96%; its passage efforts have resulted in an average survival rate of 93.9% under existing conditions. Therefore, Brookfield's proposed, NMFS's prescribed, and Maine DMR's recommended survival standards would represent an increase in

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[73] See also Part D.ii, herein, discussing the 2019 Final Recovery Plan for Atlantic salmon, prioritizing dam removal as the key Recovery Action therein.

[74] Draft EA at p. 59.

> juvenile salmon passage survival through the project of 2.1, 3.1, and 5.1 percentage points, respectively. However, neither NMFS nor Maine DMR demonstrated how the higher survival standards would benefit the downstream migrating Atlantic salmon smolt population. To compare these survival standards, we used an initial population of 18,420 smolts migrating downstream from the mouth of the Sandy River through all four dams. Based on a natural freshwater mortality rate of 0.33% of smolts per kilometer (Stevens et al., 2019), the population potentially surviving below Lockwood Dam using a 96, 97, and 99 percent survival standard would be 13,187 smolts, 13,745 smolts, and 14,914 smolts, respectively. When accounting for estimates of estuarine mortality (1.15% per kilometer) based on Stevens et. al. (2019) and marine survival of smolts (0.4%) based on NMFS (2013), the number of adult salmon returning to Lockwood Dam under a 96, 97, and 99% downstream smolt survival standard would be 24, 25, and 27 adults, respectively. Thus, the incremental gains in survival rates of 1 and 3 percentage points that would accrue through NMFS's prescribed and Maine DMR's recommended performance standards, respectively, would be negligible.[75]

The Draft EA does not show how those estimates of smolt survival were generated, but the conclusion that the benefits of improved survival of smolts at dams are "negligible" hides the clear increases behind a tortured analysis that expresses the benefits only in terms of a modeled increase in the existing very low adult returns. Even accepting the analysis on its face, increasing downstream passage success increases adult returns from 24 to 27—a 12.5% improvement. With salmon on the brink of extinction, 12.5% is a significant gain. This benefit is much clearer if evaluated on the basis of the number of salmon smolts killed as they pass the four dams, and how this number changes with improved passage efficiency. The Draft EA does not show these numbers, but they can be calculated using the smolt survival numbers provided in the Draft EA analysis. The table below (Table C) shows estimates of the total number of smolts leaving the mouth of the Sandy River (18,420), and the number of surviving smolts at the base of the Lockwood Dam, accounting for (1) natural mortality as the smolts migrate the 50.1 km

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[75] Draft EA at p. 59.

from the Sandy River to below Lockwood Dam and (2) for smolt mortality due to passage inefficiencies at dams. Commission staff's calculation is that with 96%, 97%, and 99% passage efficiency, smolt survival will be 13,187, 13,745, and 14,914, respectively. Simple subtraction shows that with 96% passage, smolt mortality is 5,233; with 97% passage 4,695; and with 99% passage 3,506. Improving passage efficiency from 96% to 99% reduces smolt mortality by 1,727—a 33% reduction in <u>overall</u> smolt mortality.

The Draft EA does not show natural mortality and mortality at dams separately, but the relatively high rate of natural mortality it assumes obscures the benefits of improving downstream fish passage. The Draft EA used an estimate of 0.33% mortality of smolts per river-km to calculate "natural freshwater mortality." A mortality rate of 18,420 smolts over 50.1 kilometers of river generates a calculated natural mortality for this reach of 3,045, and we assume it to be the same for each passage efficiency scenario. Subtracting this estimate of natural mortality from the Draft EA's estimate of total smolt mortality, we can isolate the smolt mortalities caused by the dams: 2,188 smolts with 96% passage; 1,630 smolts with 97% passage; and 461 smolts with 99% passage. Increasing passage success from 96% to 99% reduces mortality of Kennebec River smolts at dams from 2,188 to 461, and the rate of smolt mortality at dams from 11.9% to 2.5%. The reduction in smolt mortality <u>at dams</u> from improved downstream passage is 79%.

Table C. FERC estimates of cumulative smolt survival at dams and in free flowing reaches at 96%, 97%, and 99% downstream survival at four dams, smolt losses at dams and a combined total percent mortality.

	Smolts from Sandy River	FERC Calculation of Smolts Surviving to Base of Lockwood Dam	Total Smolt Morta lity	FERC Estimate of Natural Freshwater Smolt Mortality (0.33%/km; 50.1 km)	Smolt Losses at Dams	% Smolt Mortality Due to Dams
96% DS Passage Success	18,420	13,187	5,233	3,045	2,188	11.9%
97% DS Passage Success	18420	13,745	4,675	3,045	1,630	8.8%
99% DS Passage Success	18420	14,914	3,506	3,045	461	2.5%

Incredibly, it is this reduction of 79% mortality for Atlantic salmon smolts in their downstream migration that the Draft EA characterizes as "negligible."

In addition, although the Draft EA cites Stevens et al, 2019 for estimates of freshwater and estuarine smolt mortality per river kilometer, it ignores that paper's conclusion that estuarine survival of Atlantic salmon smolts is significantly reduced by passage over hydropower dams. In their model, Stevens et al. estimate estuarine survival is 87.2% for smolts passing no hydropower dams; reduced to 67.7% for smolts passing even a single hydropower dam; and is 56.2% for smolts passing over four hydropower dams. Stevens et al. make a number of very strong statements about this:

> The latent impacts of dam passage and subsequent delayed mortality in estuaries has been investigated in Pacific salmon (Budy et al. 2002; Schaller et al. 2014; Haeseker et al. 2012; Rechisky et al. 2013), with all but Rechisky et al. (2013) concluding significant negative effects. Stich et al. (2015*b*) demonstrated the first evidence of latent estuary mortality in Atlantic salmon. The difference in estuary survival with one dam (68%) to zero dam (89%) exposure in our reference studies (Stich et al. 2015*b*; NOAA, unpublished data) strongly suggests that important delayed mortality may occur even with only one dam. However, with a rate of

> change of approximately 6% increase per dam (Stich et al. 2015*b*), the overall dam-induced latent estuary mortality is especially problematic for production areas or stocking sites above multiple dams.[76]

The Draft EA's failure to analyze or even acknowledge the issue of delayed mortality significantly undercuts the conclusion that Shawmut Project's impacts on endangered Atlantic salmon are not significant. In conducting its NEPA analysis, the Commission "cannot overlook a single environmental consequence even if it is 'arguably significant.'"[77] In doing so with respect to the issue of delayed mortality, the Draft EA commits the same category of reversible error that was present in the *American Rivers* case, where the environmental consequence that the Commission missed was the ineluctable reality that, with respect to fish passage, "[t]he Project would compound the death rate."[78] "Those fish that manage to run the gauntlet of youth and natural mortality factors will now emerge only to face hydropower turbines and *other lethal aspects* of the Project."[79] In sum, "[t]he Commission's NEPA analysis has to grapple with that," and has to do so "honestly" and under a "hard look."[80] It fails by all measures.

v. The Draft EA fails to contain or even analyze passage standards for downstream-migrating adults (kelts), and ignores the significance of repeat spawners.

The Draft EA contains no passage standards for Atlantic salmon kelts. Best available information and scientific literature emphasizes the unique importance of repeat

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[76] Stevens et al. 2019 at p. 1804.

[77] *American Rivers*, 895 F.3d at 51 (citing *Myersville Citizens for a Rural Cmty., Inc. v. FERC*, 783 F.3d 1301, 1322 (D.C. Cir. 2015)).

[78] *Id*.

[79] *Id*. (italics emphasis added).

[80] *Id*. at 51 & 49.

spawners, and the difficulty in passing kelts. This is an environmental consequence that, under NEPA, cannot be ignored.

Standards for kelts need to be considered and prioritized in order to promote recovery; without this consideration recovery plans are not adequate and will likely fail. Research indicates that downstream-migrating adult salmon follow bulk flows (Coutant and Whitney, 2000). However, even with fishways and high flow through spillways, many kelts have been observed passing through turbines, resulting in low downstream passage survival (Calles and Greenberg 2009; Nyqvist et al., 2017(8). Survival through multiple dams compared to that in free-flowing rivers is dismal (Coutant and Whitney, 2000; Wertheimer and Evans, 2005; Holbrook et al., 2009; Norrgård et al., 2012; Nyqvist et al., 2016). The positive contributions kelts were found to make towards population persistence diminished with the presence of multiple dams (Lawrence et al., 2016). Consideration of passage effectiveness rates for kelts is therefore an imperative component of a successful restoration plan.

Repeat spawners are a particularly critical factor necessary for the recovery of Atlantic salmon populations because their populations are small and recovering (Nyqvist et al., 2016; Bordeleau et al., 2020), as is especially the case for the GOM DPS. These individuals have been shown to contribute substantial numbers of offspring while providing a stabilizing effect on populations. Repeat spawners often have higher fecundity than first time spawners, given the repeat spawners' greater size and experience (Halttunen, 2011; Maynard et al., 2018; Baktoft et al., 2020). Variation in the timing of spawning among year-classes diffuses the adverse effects of environmental variability on spawning success and promotes genetic diversity within populations (Saunders and

Schom, 1985; Moore et al., 2014). A model developed by Lawrence et al. (2016) revealed that the abundance of kelts was positively related to the probability of population persistence. Thus, the loss of just a few individual repeat spawners through passage-related mortalities each season has a qualitatively greater impact on the ability of the species to avoid extinction.

Declining numbers of repeat spawners have been widely reported (Hubley et al., 2008, Nyqvist et al., 2016; Maynard et al., 2018) and associated with overharvesting and hydropower projects (Wertheimer and Evans, 2005; Keefer et al., 2008). The proportion of repeat spawners in the Penobscot River's Atlantic salmon run over the last decade has averaged 0.04%, compared to an average of 1.7% in the 1980s (Fleming and Reynolds, 2004). Average proportions of repeat spawners in the southern North American range of Atlantic salmon have decreased significantly from 4.1 to 2.7% (Bordeleau et al., 2020). Though many northern and mid-latitude populations have exhibited a relative increase in repeat spawners with reductions in fishing pressure, declines seen in the southern range have been attributed to anthropogenic threats such as hydropower projects and reliance on hatchery reared fish (Maynard et al., 2018). Hydropower projects elevate mortality of post-spawners during downstream migration through injuries and delays (Holbrook, 2009; Östergren and Rivinoja, 2008; Ferguson, 2005; Scruton et al, 2007; Kraabøl et al., 2009). Chaput and Jones (2006) highlighted the effects of hydropower projects on repeat spawners by revealing a 4.1% reduction in their prevalence between two proximate populations in the Saint John River above and below the Mactaquac Dam. Size-dependent selection against larger fish reported at passage facilities on the Penobscot and Saint John rivers may limit the persistence of repeat spawners and must be closely examined before building new passage facilities to minimize post-spawning mortality (Maynard et al., 2017; Bordeleau et al., 2020). Furthermore, delays at dams can lead to starvation, accumulated stress, increased predation and loss of marine adaptations, lowering the chances of surviving to feeding grounds (Nyqvist et al., 2016).

Recent data from researchers at the University of Maine support all of the above concerns about negative dam impacts on critically important repeat spawners and specifically show that a four-dam system would result in a loss of more than 50% of pre-spawn and post-spawn fish. In an email to the Kennebec Coalition describing work with graduate student Sarah Rubenstein, University of Maine Professor Joseph Zydlewski stated:

> 1) ATS [Atlantic salmon] face poor passage at some dams (e.g. Lockwood)
>
> 2) If passing, ATS often face long delays, usually weeks in length - sometimes months
>
> 3) Because of the high and rising downstream temperatures in lower rivers in the summer during river entry and migration, there is increased metabolic cost and this is directly related to depletion of limited and fixed energy stores.
>
> 4) Our bioenergetic model suggests that these delays significantly lower the probability of spawning success (depletion of energy stores prior to spawning likely leading to mortalities) and biologically significant declines in the probability of repeat spawning (due to energy depletion and likely mortality). For a four dam system, this loss is estimated to be greater than 50% loss for pre-spawn and post-spawn fish. These are likely conservative estimates as delays at dams are associated with increases in searching behavior, and activity means more energy demand.
>
> 5) Extensive literature suggests that older, larger, repeat spawning fish are critical for population resilience, and hence recovery (see attached).[81] In the Penobscot River (see Maynard et al., 2018) repeat

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[81] Dr. Zydlewski is referring to the following paper attached to his email cited below: Hixon, M.A., Johnson, D.W. and Sogard, S.M., 2014. BOFFFFs: on the importance of conserving old-growth age structure in fishery populations. *ICES Journal of Marine Science, 71*(8), pp.2171-2185.

> spawning is less than 1%, far less than occurs in un-dammed ATS rivers. This fact provided direct evidence that dams are associated with and likely causal to low survival (increased mortality) of post spawn salmon and underscored the demographic fragility resulting from this persistent fixed source of mortality.[82]

For all these reasons, the Draft EA's failure to even analyze the environmental consequences of downstream passage for kelts, and its failure to set passage performance standards to address the unique importance of kelt passage, fails to adhere to NEPA's "exacting procedural requirements" and to analyze the environmental consequences the Shawmut Project "to the fullest extent possible."[83]

C. The Draft EA Fails to include Alosines in Fish Passage Analysis and to take a "Hard Look" at the Environmental Consequences of Ineffective Passage of Other Species

The Federal Power Act requires the Commission to give equal consideration to fish and wildlife resources in addition to power generation.[84] NEPA requires the Commission to "integrate" its environmental impact analyses with all "related surveys and studies required by all other Federal environmental review laws."[85] This should clearly include requirements for restoration of all of the sea-run species that are so

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[82] Zydlewski, Joseph. 2021. Email to Landis Hudson, Maine Rivers Executive Director. Re: "Rubenstein Defense This Friday August 6." Received August 7. This document is attached to these Comments.

[83] *American Rivers*, 895 F.3d at 51 (citing *Delaware Riverkeeper Network v. FERC*, 753 F.3d 1304, 1310 (D.C. Cir. 2014).

[84] 16 U.S.C. 797(f).

[85] 40 C.F.R. § 1502.24(a). And of course the ESA contains the policy overlay requiring that the Commission "shall cooperate with State and local agencies to resolve water resource issues in concert with conservation of endangered species." 16 U.S.C. § 1531(c)(1).

important to Maine's environment and economy. But the Draft EA is devoid of any such analysis, as set forth below.

i. Failure to analyze the environmental consequences of not passing the full suite of sea-run species.

Another glaring omission in the Draft EA is the complete lack of any evaluation of passage standards for species other than salmon, leading to – in what can be only characterized under the *American Rivers* standard as a "breezy dismissal"[86] – its recommendation that there be no passage standards for the full suite of sea-run species. The Draft EA thus ignores Maine's multi-species restoration goals for the Kennebec, as set forth by the MDMR for Atlantic Salmon, American shad, alewives, blueback herring and American eels/sea lampreys:

> Minimum Species Goals for the Kennebec River
>
> The minimum goal for **Atlantic Salmon** is to provide safe, timely, and effective upstream and downstream passage in order to achieve a minimum annual return of 500 naturally-reared adults to historic spawning/rearing habitat in the Kennebec River for Endangered Species Act (ESA) down-listing and a minimum annual return of 2,000 naturally-reared adults to historic spawning/rearing habitat in the Kennebec River for reclassification based on the NOAA and USFWS Recovery Plan (2019). To reach spawning/rearing habitat in the Sandy River, Carrabassett River, and mainstem Kennebec River, all returning adults must annually pass upstream at the Lockwood, Hydro Kennebec, Shawmut, and Weston project dams.
>
> The minimum goal for **American Shad** is to provide safe, timely, and effective upstream and downstream passage in order to achieve a minimum annual return of 1,018,000[1] wild adults to the mouth of the Kennebec River; a minimum annual return of 509,000 adults above Augusta; a minimum of 303,500 adults annually passing upstream at the Lockwood and Hydro Kennebec Project dams; a minimum of 260,500 adults annually passing upstream at the Shawmut Project

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[86] *American Rivers*, 895 F.3d at 50.

> dam; and a minimum of 156,600 adults annually passing upstream at the Weston Project dam.
>
> The minimum goal for **Blueback Herring** is to provide safe, timely, and effective upstream and downstream passage in order to achieve a minimum annual return of 6,000,000 wild adults to the mouth of the Kennebec River; a minimum annual return of 3,000,000 adults above Augusta; a minimum of 1,788,000 adults annually passing upstream at the Lockwood and Hydro Kennebec Project dams; a minimum of 1,535,000 adults annually passing upstream at the Shawmut Project dam; and a minimum of 922,400 adults passing upstream at the Weston Project dam.
>
> The minimum goal for **Alewife** is to provide safe, timely, and effective upstream and downstream passage in order to achieve a minimum annual return of 5,785,000 adults above Augusta; a minimum of 608,200 adults annually passing at the Lockwood, Hydro Kennebec, and Shawmut project dams; and a minimum of 473,500 adults annually passing upstream at the Weston Project dam.
>
> The minimum goal for **Sea Lamprey and American Eel** is to provide safe, timely, and effective upstream and downstream passage throughout the historically accessible habitat of these two species.[87]

The Draft EA's recommendation to ignore passage standards for species other than Atlantic salmon is not just clearly inconsistent with Maine's management goals but also undercuts them. Moreover, MDMR explicitly states that the proposed fish passage measures at Shawmut would be unlikely to meet these minimum goals for any of the species.[88] These goals are important to the ecology of the Gulf of Maine and Maine's

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[87] MDMR. 2021. Comments on Brookfield White Pine Hydro, LLC's Shawmut (FERC No. 2322). Hydroelectric Project, State Water Quality Certification. July 17. p. 2. Accessible at https://www.maine.gov/dep/ftp/HYDRO/WaterQualityCertifications/Shawmut/agency-comments/DMR%20Comments%20to%20DEP%20WQC%20Shawmut_July.pdf. Also attached to these Comments.

[88] MDMR. 2021. Comments on Brookfield White Pine Hydro, LLC's Shawmut (FERC No. 2322). Hydroelectric Project, State Water Quality Certification. July 17. p.2. https://www.maine.gov/dep/ftp/HYDRO/WaterQualityCertifications/Shawmut/agency-comments/DMR%20Comments%20to%20DEP%20WQC%20Shawmut_July.pdf

iconic and economically critical marine industries. NMFS shares the MDMR's goals, stating in its comments on the Shawmut license application that:

> [t]he Kennebec River watershed once produced large runs of Atlantic salmon, American shad, blueback herring and alewife, as well as other sea-run fish including shortnose and Atlantic sturgeon (MSPO, 1993). Diadromous fish once contributed to substantial commercial, recreational, and subsistence harvests (MSPO, 1993) that were economically important to coastal communities. Anadromous fish production within the Kennebec River experienced dramatic declines throughout the past 150 years. Multiple plans since the 1980s, including the Kennebec River Resource Management Plan (1993), KHDG Settlement Accord (1998) and Atlantic salmon recovery plan (2019), highlight the importance of fish passage and habitat restoration as critical to supporting a restored anadromous fishery. Significant spawning, rearing, and migratory habitat exists above the Shawmut Project. Existing dams prevent access to those historical habitats.[89]

The Draft EA's failure to consider the positions and recommendations of the state and federal natural resource agencies is a far cry from an objective hard look at the impacts of the relicensing of the project.

ii. The Draft EA errs in concluding that other species need not be passed.

The Draft EA creates a false choice by suggesting it cannot require Brookfield to restore both salmon and the sea-run species with which they coevolved. First, there is no evidence that improvements in fish passage for other species would harm salmon, as the Draft EA so boldly declares.[90]

In the June 19, 2009 NMFS and USFWS determination of endangered status for the GOM DPS of Atlantic salmon, the agencies found:

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[89] 2020. NMFS. Comments, Recommendations, Preliminary terms and Conditions, and Preliminary Fishway Prescriptions for the Shawmut Hydroelectric Project (FERC No. 2322). Pp. 43-44. August 28. FERC Accession Number 20200828-5176.

[90] Draft EA at p.120.

> Of particular concern for Atlantic salmon recovery efforts within the range of the GOM DPS is the dramatic decline observed in the diadromous fish community. At historic abundance levels, Fay et al. (2006) and Saunders et al. (2006) hypothesized that several of the co-evolved diadromous fishes may have provided substantial benefits to Atlantic salmon through at least four mechanisms: serving as an alternative prey source for salmon predators; serving as prey for salmon directly; depositing marine-derived nutrients in freshwater; and increasing substrate diversity of rivers.[91]

As an additional example undermining the unsupported Draft EA conclusion, running the upstream fish lift 24 hours a day to allow nocturnal sea lamprey migration would not interfere with Atlantic salmon upstream migration. Sea lamprey (discussed further below, in subsection v) are also particularly important for salmon recovery because Atlantic salmon show a preference for laying their eggs in old sea lamprey redds.[92] Additionally, restoration of the suite of sea-run species with which Atlantic salmon co-evolved is necessary to restore Atlantic salmon. These species provide a prey buffer for salmon, particularly for salmon smolts migrating downstream at the same time that alewife and blueback herring are at the peak of their upstream migration. Without this buffer, avian and fish predators will focus their attention on salmon smolts. With large numbers of alewife and blueback herring migrating upstream during the smolt migration, predation on less numerous and smaller salmon smolts will be much reduced. Hence, without this prey buffer, salmon restoration is likely impossible.[93]

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[91] 74 Fed. Reg. 29,344-01 at 29,374-75 (Determination of Endangered Status for the Gulf of Maine Distinct Population Segment of Atlantic Salmon) (June 19, 2009).

[92] Saunders, R., *et a*l. 2006. Maine's Diadromous Fish Community: Past, Present, and Implications for Atlantic Salmon Recovery. Fisheries 31: 537-547. Accessible at http://www.gulfofmaine.org/kb/uploads/1717/saunders%20et%20al.pdf.; *see also* 74 Fed. Reg. 29,344-01 at 29,375 ("Sea lampreys likely provide an additional benefit to Atlantic salmon spawning activity in sympatric reaches.") (citing, *inter alia*, Kircheis, 2004).

[93] U.S. Fish and Wildlife Service and National Marine Fisheries Service. 2018. Recovery Plan for the Gulf of Maine Distinct Population Segment of Atlantic salmon (*Salmo salar*). Hadley, Massachusetts. January 2019. 74 pp. at P11 (hereafter "2019 Final Recovery Plan"). *See also* 74 Fed. Reg. 29,344-01 at 29,374-75

The Final Recovery Plan for the Gulf of Maine DPS of Atlantic salmon makes clear both that dams were a primary factor in in the decimation and near extirpation of Atlantic salmon runs and that the continued low abundance of co-evolved diadromous fish is a “secondary stressor” that contributes to reduced survival of Atlantic salmon:

> Damming rivers, thus preventing migration to spawning grounds, was a major factor in the decline of Atlantic salmon and much of the co-evolved suite of diadromous fish (e.g., alewife and blueback herring). Many co-evolved diadromous species have experienced dramatic declines throughout their ranges and current abundance indices are fractions of historical levels. The dramatic decline in diadromous species has negative impacts on Atlantic salmon populations, including through depletion of an alternative food source for predators of salmon, reductions in food available for juvenile and adult salmon, nutrient cycling, and habitat conditioning. These impacts may be contributing to decreased survival in lower river and estuarine areas.[94]

And analytically, the “exacting” requirement under NEPA is to consider the environmental consequences of the action on the whole environment, the entire ecosystem – not just one component of it. If the Shawmut Dam will block passage of other sea-run species, to any degree, that alone is a significant environmental consequence that the Commission must “grapple with.”[95] When it is considered further that that environmental consequence of blocking passage of other sea-run species likely heralds the death knell to efforts for the recovery of an endangered species, to not even consider the issue in the Draft EA clearly fails to comport with the requirements of NEPA.

(NMFS Determination of Endangered Status for the Gulf of Maine Distinct Population Segment of Atlantic Salmon) (June 19, 2009).

[94] 2019 Final Recovery Plan at p. 11.

[95] *American Rivers*, 895 F.3d at 51.

iii. The Draft EA fails to provide adequate information to assess use of the USFWS Turbine Blade Strike Analysis model.

One particular failure in conducting an Environmental Assessment instead of an Environmental Impact Statement under NEPA, is that conclusions such as use of the USFWS Turbine Blade Strike Analysis model[96] are left without the means of validation. Moreover, the information was not provided to the public by Commission staff when requested. Commission staff must provide all necessary information (all inputs for the blade strike model) for the NGOs and the public to validate conclusions based on this model. Part of taking a "hard look" under NEPA is providing the public with the information necessary to engage in that hard look. This aspect of the Draft EA analysis is deficient in this respect.

iv. The Draft EA's statement that shad may be unmotivated to pass upstream makes no sense.[97]

Shad migratory motivation can be assessed by the distance fish move upriver and by their behavior at artificial barriers, and specifically for the number of times fish attempt to enter a fish ladder and the time spent attempting to pass a dam. Repeated entries in the face of failure and extended residence in proximity to a dam represent a strong upstream drive. Telemetry studies of upstream shad movement at fishways often assess the number of entries into a ladder or fish lift and the time spent attempting to ascend a fishway. An unmotivated fish that failed to pass the fishway would be expected to fall back and not attempt entry again within a short period of time.

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[96] Draft EA at p. 53.

[97] Draft EA at p.44.

In a review of American shad for the Atlantic States Marine Fisheries Commission, historic shad runs are reported as long as 451 miles (726 km) in the Great Pee Dee and Yankin Rivers in North Carolina and over 500 miles (805 km) in the Susquehanna River (Green et al., 2009). These fish bypass significant reaches of suitable spawning habitat. Fish that migrate upstream in the Connecticut River pass multiple suitable spawning habitats areas of the river while migrating to Turners Falls (Layzer 1974; Kleinschmidt, 2016). The extent of historic shad migration in the Kennebec and Sandy Rivers is well documented in Maine's 1993 Kennebec River Resource Management Plan:

> Shad historically ascended the Kennebec River as far as Norridgewock Falls (89 miles from the sea), the Sandy River a few miles from its mouth, and the Sebasticook River in small numbers to Newport. Atkins indicated that shad ascended the Sandy River as far as Farmington.[98]

Radio telemetry studies of American shad on the Connecticut (Kleinschmidt 2016a & Kleinschmidt, 2019) and Susquehanna Rivers (Normandeau, 2011 & Normandeau, 2012) show a strong motivation for upstream passage when encountering a dam. For both rivers, Table D (below) lists the number of American shad, the number of entries, and the maximum number of entries made by a single fish. In 2018 the area around the Cabot Station tailrace and ladder entrance was ensonified with an ultrasound array in an effort to prevent shad from entering the ladder (FERC No. 1889). Even with a sound field designed to repel them, shad moved into the area searching for an upstream route of passage – a clear showing of a strong motivation to migrate upstream.

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[98] Maine State Planning Office. 1993. Kennebec River Resource Management Plan. Augusta, Maine. February 1993. P. 79.

Table D. River, fishway, year of study, number of shad entering fishway, number of entries, and the maximum number of entries by a fish.

River	Location	Year	Shad	Entries	Maximum # Entries
Connecticut	Cabot ladder	2015	102	408	8
Connecticut	Cabot ladder	2018*	53	117	7
Connecticut	Cabot ladder	2019	51	260	28
Susquehanna	East Fish Lift	2010	65	102	9
Susquehanna	East Fish Lift	2012	29	49	6

* Area around ladder entrance ensonified

In 2015, 54 radio tagged shad spent an average of 10.7 days (range 0.3 to 40.1 days) within 1.2 kilometers of the Cabot Station at the Turners Falls Project without passing. 24% of those fish spent over 15 days at the project (D. Pugh unpublished data). These fish had passed multiple known shad spawning areas in the river before reaching the Turners Falls Project, demonstrating that they were motivated to move upstream but had trouble passing the dam (Layzer, 1974; Kleinschmidt, 2016b).

Similarly, experience with dam removals in Maine indicates that American shad will colonize habitat above a removed dam as soon as the barrier is removed. On the Kennebec River, following removal of Edwards Dam in 1999, anglers caught shad in the tailrace of the Lockwood Dam, 17 river miles upstream, by mid-May of 2000. Twenty years later there is a thriving recreational fishery for shad each spring. Similarly, on the Penobscot River, following removal of the Great Works Dam in 2012 and Veazie Dam in 2013, the fish lift at the Milford Dam, 9 river miles upstream, captured 1,806 shad in 2014.[99] By 2021, shad captures at Milford Dam have increased to 11,572.[100] Given this

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[99] Maine DMR Fish Trap data, accessed here: https://www.maine.gov/dmr/science-research/searun/programs/documents/trapcounts2020.pdf.

[100] *Id.* (https://www.maine.gov/dmr/science-research/searun/programs/trapcounts.html)

hard and readily available data, Commission staff's conclusion in the Draft EA that American shad are "unmotivated" to pass upstream is unusual, at best.

v. The Draft EA errs in analysis on issues of sea lamprey passage.

The Draft EA states that the importance of upstream habitat to historical habitat for sea lamprey is not known and that sea lamprey may not be motivated to pass upstream.[101] However, sea lamprey are known to migrate several hundred kilometers upstream from the ocean. Bigelow and Schroeder note migration of 320 kilometers in the Susquehanna River and 240 kilometers in the Savannah River (Beamish, 1980). Tens of thousands of sea lamprey pass the Holyoke dam every year at river kilometer 139, a similar distance as the Weston Project which is at river kilometer 132. Prior to dam construction on the Kennebec, sea lamprey certainly migrated beyond where the lower four mainstem dams are now located. Sea lamprey recolonization of Sedgeunkedunk Stream in 2010 and 2011 above a previously impassable barrier demonstrates that they will utilize previously unavailable habitats. Sedgeunkedunk Stream experienced a fourfold increase in population in the two years after dam removal (Hogg et al., 2013).

Sea lamprey are similarly highly motivated as American shad. For example, on the Connecticut river, they move rapidly from Holyoke to the Turners Falls project (54.5 km, median time of 33.8 hours) for a median migration speed of 0.45 m s^{-1} (Castro-Santos et al., 2017). This included time for the fish to find and enter the Cabot ladder and does not consider any tortuosity of upstream movement, so this migration speed is almost certainly an underestimate. Indeed, in a controlled flume, sea lamprey were able to ascend channels with velocities as high as 3.5 m/s (T. Castro-Santos pers. Comm.).

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[101] Draft EA at pp. 43-44.

During studies in an experimental fishway at the USGS Conte Anadromous Fish Research Center, sea lamprey were highly motivated swimming against the retaining barrier at the lower end of the fishway prior to the start of tests (D. Pugh pers. Comm).

The importance of sea lamprey to Atlantic salmon recovery cannot be overemphasized. Sea lamprey provide important ecological functions including reducing sediment in pool tail and riffle spawning habitat and transport of nutrients to freshwater habitats. Sea lamprey also build large oval redds which restructure the substrate, shifting small rocks, and reducing embeddedness as flows sweep away fines and silt increasing interstitial spaces (Souse et al., 2012). Hogg et al. 2014 describe changes in stream-bed complexity including a reduction in embeddedness and an increase in macroinvertebrate abundance in mounds compared to pits and reference locations. The physical/substrate changes persisted through September. Intragravel permeability declined in the uppermost reach compared to the lowest reach, where sea lamprey had access prior to dam removal, at a statistically significant level. The authors postulate that this may reflect the lack of anadromous spawning for more than 150 years. A decrease in embeddedness between mounds, pits and reference sites between the summer of 2010 and autumn of 2011 suggest that sea lamprey spawning may condition the substrate.

Atlantic salmon – as well as brook trout – use the same habitat as sea lamprey for spawning, at times superimposing their redds over those of sea lamprey (Kircheis, 2004). In addition, by clearing fines and debris, sea lamprey provide favorable habitat for macroinvertebrates and provide a food source for macroinvertebrates after they die (Nislow and Kynard 2009, Weaver et al. 2016, Weaver et al. 2018). Macroinvertebrates are a primary food source for salmon fry and parr (Grader and Letcher, 2006).

Thus, the Draft EA errs when it cites the lack of motivation of sea lamprey and American shad as a reason not to set performance standards for passage for those species. Both species migrate long distances, passing spawning habitat while moving to upriver habitat that is preferred. Movement in open river and at fishways for sea lamprey and shad has been documented at numerous sites and the Draft EA's failure to set performance standards for their passage at Shawmut Dam is inexcusable. The impressive performance of sea lamprey moving upriver after tagging in the Connecticut River, the determination of shad to enter the Cabot ladder, and the rapid recolonization by shad of previously-inaccessible river reaches following removal of the Edwards, Veazie, and Great Works Dams, belies any concerns about their motivation. The Draft EA's reliance upon the unreliable assertions that these species would not be motivated to pass the Shawmut Dam amount to an improper "breezy dismissal" of both the environmental consequences of failure to pass, and the affirmative requirements to pass sea lamprey and shad to avoid adverse impact to the environment, particularly given their importance to a species on the verge of extinction.[102]

D. The Failure to Consider Dam Removal

i. The Draft EA ignores MDMR and NOAA recommendations for dam removal.

As summarized above, under the Federal Power Act "[n]o license may be issued unless the Commission first determines that the proposed project 'will be best adapted to a comprehensive plan for improving or developing' the relevant waterways." *American Rivers and Alabama Rivers Alliance v. Federal Energy Regulatory Commission*, 895 F.3d

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[102] *American Rivers*, 895 F.3d at 50-51.

32, 36 (D.C. Cir. 2018) (quoting 16 U.S.C. § 803(a)(1)). "In making that judgment, the Commission must give '**equal consideration to** the purposes of energy conservation, **the protection, mitigation of damage to, and enhancement of, fish and wildlife (including related spawning grounds and habitat)**, the protection of recreational opportunities, and the preservation of other aspects of environmental quality.'" *Id.* (quoting 16 U.S.C. § 797(e)) (bold emphasis added). In furtherance of the standard, compliance with the mandates of NEPA as implemented by the regulations of the Council on Environmental Quality ("CEQ"), 40 C.F.R. parts 1500 through 1508, compels federal agencies "to take a hard and *honest* look at the environmental consequences of their decisions." *American Rivers*, 895 F.3d at 49 (italics emphasis added). In light of this standard, for the Draft EA to simply brush off the state and federal wildlife agencies' recommendations for decommissioning and removal of the Shawmut Dam without "hard and honest" analysis, violates NEPA.

Brookfield's own analysis states that dam removal is the cheapest and most effective mode of fish passage at the Shawmut Dam. Brookfield received a one-year extension on its license in order to carry out a fish passage study at three of its four dams between Waterville and Skowhegan, including the Shawmut Dam.[103] For the Shawmut Dam, this study concluded that dam removal was the cheapest and most effective fish passage option.[104] Despite this, and the recommendations from NMFS and MDMR to remove the dam, Commission staff unacceptably dismissed removal as an option with almost no analysis.

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[103] Kleinschmidt. 2018. Brookfield White Pine Hydro, LLC, Energy Enhancements and Lower Kennebec Fish Passage Improvements Study. October. P. 18; FERC Accession No. 20191106-5142.

[104] *Id.*

This lack of hard analysis of the dam removal option fails to meet the Commission's obligation to "ensure the professional integrity, including scientific integrity, of the discussions and analyses and environmental documents" and to "make use of reliable existing data and resources." 40 C.F.R. § 1502.23. This failure is compounded by the Draft EA's failure to consider both the experience of and outcomes associated with several past dam removals in Maine of dams comparable to Shawmut including the Edwards, Fort Halifax, Great Works, and Veazie Dams, for example, as well as the experience and expertise of the state and federal natural resources agencies. These failures are even more reason for a finding that the Draft EA is woefully deficient.

ii. The Draft EA ignores the NMFS/USFWS 2019 Final Recovery Plan and the 2009 ESA listing for Atlantic salmon.

The Draft EA falls short of the Commission's obligations under NEPA to consider "best available scientific data" by ignoring the terms of the 2019 Final Recovery Plan for Atlantic salmon and the 2009 Endangered Species Act listing for Atlantic salmon.[105] Under NEPA, even under the less stringent requirements with respect to the preparation of an environmental assessment, the Commission is required to "integrate" environmental analyses with "related surveys and studies required by all other Federal environmental review laws . . ., including the Fish and Wildlife Coordination Act (16 U.S.C. 661 et seq.), . . . and the Endangered Species Act of 1973 (16 U.S.C. 1531 et seq.)." 40 C.F.R. §§ 1501.5(g)(3), 1502.24(a). The Commission is also required to

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[105] U.S. Fish and Wildlife Service and NMFS. 2018. Recovery Plan for the Gulf of Maine Distinct Population Segment of Atlantic Salmon (*Salmo salar*) ("2019 Final Recovery Plan"); 74 Fed. Reg. 29,344-01 (June 19, 2009) (Determination of Endangered Status for the Gulf of Maine Distinct Population Segment of Atlantic Salmon).

"ensure the professional integrity, including scientific integrity, of the discussions and analyses and environmental documents" and "shall make use of reliable existing data and resources." 40 C.F.R. § 1502.23.

The purpose of the Fish and Wildlife Coordination Act is "to provide that wildlife conservation shall receive equal consideration and be coordinated with other features of water-resource development programs through the effectual and harmonious planning, development, maintenance, and coordination of wildlife conservation and rehabilitation . . . ." 16 U.S.C. § 661. Under the Endangered Species Act, the Commission also has a coextensive responsibility "to conserve endangered species and threatened species and shall utilize [the Commission's] authorities in furtherance of the purposes of this chapter [i.e., the ESA]," and to "cooperate with State and local agencies to resolve water resource issues in concert with conservation of endangered species." 16 U.S.C. § 1531(c)(1) & (2); *Tennessee Valley Authority v. Hill,* 437 U.S. 153, 185 (1978) ("In addition, the legislative history undergirding § 7 [of the ESA] reveals an explicit congressional decision to require agencies to afford first priority to the declared national policy of saving endangered species."). "The plain intent of Congress in enacting this statute [the ESA] was to halt and reverse the trend toward species extinction, *whatever the cost*." *Id*. at 184 (italics emphasis added).

Thus, for the Draft EA to ignore the inconsistencies of its results with the recovery actions set forth in the 2019 Final Recovery Plan for endangered Atlantic salmon is unacceptable and shirks the Commission's responsibilities under NEPA. The Draft EA ignores the required "best available science" on Atlantic salmon restoration, and by doing so it yields arbitrary and capricious conclusions regarding the number of fish that must be passed at the lower four Kennebec Dams in order to meet the 2019 Final Recovery Plan for Atlantic salmon.

Doing so is particularly galling in light of the long history of the State of Maine, USFWS, and NMFS working together for the conservation and recovery of Atlantic salmon. In the early 1990s, these state and federal agencies worked together on a pre-listing recovery plan for Atlantic salmon and initiated the river-specific stocking program. The GOM DPS of Atlantic salmon was listed under the Endangered Species Act (ESA) in 2000, and this listing was expanded in 2009 to include a broader geographic range within the State of Maine, and to designate the species' critical habitat under the ESA, *see* 74 Fed. Reg. 29,344-01; 74 Fed. Reg. 29,300, an area that totally encompasses the Shawmut Project.

The Draft EA's reference to the 2019 Final Recovery Plan on page 141 in section 5.4, and Commission staff's unexplained conclusory statement that "[n]o inconsistencies were found" with it, is by definition fundamentally arbitrary and capricious. The 2019 Final Recovery Plan concludes that dams are "one of the most significant threats to Atlantic salmon" and concludes that the most significant top "Recovery Action" is to: "**Remove Dams to Ensure Access to Habitats Necessary for Atlantic Salmon Recovery**."[106]

> One of the most significant threats to Atlantic salmon are dams. Dams block or significantly impede a salmon's ability to access freshwater habitats essential for spawning and juvenile rearing. Dams, especially dams with turbines, can delay, injure or kill a significant number of downstream migrating smolts as they are heading to the ocean. Dams can kill (directly or indirectly) post-spawn adults (kelts) as they attempt to return to the ocean, preventing their ability to spawn

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[106] 2109 Final Recovery Plan at C2.0 at 33 (bold emphasis added).

> again. **Dam removal offers the highest likelihood of addressing these threats.** . . .[107]

And lest the specific point is missed on even the most casual reader, recovery action C2.4 is to, **"[w]hen feasible, remove hydro-electric dams that afford significant conservation benefit to Atlantic salmon and the ecosystems that they depend on."**[108] These Recovery Actions are higher in order of priority than "improving fish passage at dams." Compare C2.0 with C3.0.[109] So, to be clear, for the lower Kennebec dams in the Merrymeeting Bay Salmon Habitat Recovery Unit (SHRU),[110] NMFS and USFWS have prioritized *removal* of hydro-electric dams over installation of fishways, in the official final plan for recovery of Atlantic salmon – a priority further reflected in NMFS's recommendation for removal in its comment on the Shawmut final license application.[111] In direct contrast, in this Draft EA, Commission staff prioritize new fishways (ignoring best available science on their inefficacy) over dam removal, ignoring not only the best available science on their inefficacy but also the very clear position and priority of a fellow federal agency.

That is a glaring inconsistency for the Draft EA, and one that NEPA requires the Commission to "grapple with." *See American Rivers v. Federal Energy Regulatory Commission*, 895 F.3d 32, 51 (D.C. Cir. 2018) (in requiring "compounded" analysis of

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[107] *Id*. (bold emphasis added).

[108] 2019 Final Recovery Plan, C2.4 at p. 34 (bold emphasis added).

[109] 2019 Final Recovery Plan at pp. 33-34.

[110] 2019 Final Recovery Plan at ix.

[111] FERC Accession No. 20200828-5176 (NMFS Comments, Recommendations, etc. for the Shawmut Project) at pp. 43-44.

mortality factors, noting that "fish that manage to run the gauntlet of youth and natural mortality factors will now emerge only to face a high rate of death in hydropower turbines and other lethal aspects of the Project. The Commission's NEPA analysis has to grapple with that."). Brookfield's own feasibility study of record admits that removal of the Shawmut dam is not only feasible but also the most economic and efficient feasible solution, more so than installation of fish passage facilities.[112] Federal and state wildlife agencies have unequivocally conveyed a consensus position to the Commission staff that by removal there will be a significant, and uniquely pivotal, conservation benefit to the recovery of Atlantic salmon, reflected most significantly by the NMFS and MDMR recommendations for decommissioning and removal of the Shawmut Project. In reviewing the Draft EA, the Commission therefore must weigh the circumstances that fit the Final Recovery Plan's top Recovery Action, i.e., ***"[w]hen feasible*****, [we must] remove hydro-electric dams that afford significant conservation benefit to Atlantic salmon and the ecosystems that they depend on."**[113]

In the Draft EA for the Shawmut Dam, Commission staff focused exclusively on an average of the number of fish captured at the Lockwood fish lift to determine their estimated efficiency of fish passage required for the term of a new license at the Shawmut dam. In doing this Commission staff ignored the ongoing work and progress that has been made protecting and restoring access, and created hatchery capacity for Atlantic salmon restoration in the Kennebec River. These ongoing efforts include:

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[112] Kleinschmidt. 2018. Brookfield White Pine Hydro, LLC, Energy Enhancements and Lower Kennebec Fish Passage Improvements Study. October. P. 18; FERC Accession No. 20191106-5142.

[113] 2019 Final Recovery Plan at C2.4 at 34 (bold emphasis added).

- Removal of the only main stem dam in Sandy River, the 313’ long Madison Electric Works dam in the summer of 2006. This dam was removed to provide access to spawning habitat for Atlantic salmon and other sea-run fish.

- The replacement of two road-stream crossings and the pending removal of the Walton Mills Dam on Temple Stream in Farmington with approximately $3,000,000 of federal, state, and private funding. Once fully completed in 2022, these projects will fully restore access to more than 2,200 units of spawning and rearing habitat for Atlantic salmon.

- The protection of 5,774 acres of forest land with $1,300,000 of federal Forest Legacy funding plus $300,000 from the State of Maine Land for Maine’s Future program. This parcel in Madrid and Phillips, Maine, contains some of the Kennebec River’s primary spawning and rearing habitat for Atlantic salmon. Because this parcel is at high elevation, it will provide significant cold water protection for spawning Atlantic salmon, especially important as our waterbodies continue to warm because of the climate crisis.

- Significant funding and effort that has been committed by USFWS to enable hatchery production and stocking of over 100,000 Atlantic salmon smolts into the Kennebec River in 2020 and 2021.

Perhaps most significant is the Draft EA’s failure to consider the Final Recovery Plan for Atlantic salmon (“2019 Final Recovery Plan”).[114]

The 2019 Final Recovery Plan was adopted to identify and guide species recovery needs under section 4(f) of the Endangered Species Act which directs the development and implementation of recovery plans for all listed species.[115] This 2019 Final Recovery Plan addresses the recovery requirements under the ESA for the GOM DPS of Atlantic salmon. It presents a recovery strategy based on the biological and ecological needs of the species as well as current threats and conservation accomplishments that affect its long-term viability.

The 2019 Final Recovery Plan includes:

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[114] U.S. Fish and Wildlife Service and NMFS. 2018. Recovery Plan for the Gulf of Maine Distinct Population Segment of Atlantic Salmon (*Salmo salar*) 74 pp.

[115] 16 U.S.C. § 1533(f).

- A description of site-specific management actions necessary to conserve the species;
- Objective, measurable criteria that, when met, will allow the species to be removed from the endangered and threatened species list;
- Estimates of the time and funding required to achieve the plan's goals. The plan adopts a planning approach recently endorsed by the USFWS;
- Site-specific recovery actions;
- Objective, measurable criteria for delisting; and,
- Time and cost estimates to achieve recovery and intermediate steps.

The 2019 Final Recovery Plan also provides relevant background information for understanding the proposed recovery program, including a summary of the governance structure, threats, conservation measures, and recovery strategy for the GOM DPS. The simultaneously adopted critical habitat rule[116] delineates recovery units for the expanded DPS. These units, designated as Salmon Habitat Recovery Units (SHRUs), respond to the life history needs and the environmental variations associated with freshwater habitats. The SHRUs encompass the full range of the DPS, by dividing it into three segments:

- The Merrymeeting Bay SHRU, which covers the Androscoggin and Kennebec, and extends east to include the Sheepscot, Pemaquid, Medomak, and St. George watersheds;
- The Penobscot Bay SHRU, which covers the entire Penobscot basin and extends west to and includes the Ducktrap watershed; and,
- The Downeast SHRU, including all coastal watersheds from the Union River east to the "Dennys River."

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[116] 74 Fed. Reg. 29,300 (June 19, 2009).

The 2019 Final Recovery Plan goes on to say "The 2009 listing rule called particular attention to three **major threats to Atlantic salmon: dams, inadequacy of regulatory mechanisms related to dams** and low marine survival."[117] The Delisting Objectives include:

- Maintaining self-sustaining, wild populations with access to sufficient suitable habitat in each SHRU;
- Ensure that necessary management options for marine survival are in place; and,
- Reducing or eliminating all threats that, either individually or in combination, pose a risk of endangerment to the DPS…[118]

The 2019 Final Recovery Plan also creates Biological Criteria for Delisting. The Plan states that GOM DPS will be considered recovered when all of the following criteria are met:

- **Abundance**: When the DPS has a self-sustaining annual escapement of at least **<u>2,000 wild origin adults in each SHRU</u>** [emphasis added], for a DPS-wide total of at least 6,000 wild adults;
- **Productivity:** When each SHRU has a positive mean population growth rate of greater than 1.0 in the 10-year (two-generation) period preceding delisting. In addition, at the time of delisting, the DPS demonstrates self-sustaining persistence, whereby the total wild population in each SHRU has less than a 50% probability of falling below 500 adult wild spawners in the next 15 years based on population viability analysis projections; and
- **Habitat:** When sufficient suitable spawning and rearing habitat for the offspring of the 6,000 wild adults is accessible and distributed throughout the designated Atlantic salmon critical habitat, with at least 30,000 accessible and suitable Habitat Units in each SHRU, located according to the known migratory patterns of returning wild adult salmon. This will require both habitat protection and restoration at significant levels.[119]

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[117] 2019 Final Recovery Plan at p. ix (bold emphasis added).

[118] 2019 Final Recovery Plan at p. x.

[119] 2019 Final Recovery Plan at pp. x-xi.

It is vital that the Commission understand that the 43,000+ Atlantic salmon habitat units in the Sandy River watershed (including Orbeton Stream) are pivotal and critical to the recovery of Atlantic salmon in the entire GOM DPS. The recovery of Atlantic salmon in the Kennebec River and its Sandy River tributary, as called for in the 2019 Final Recovery Plan, is critical to the recovery effort of the species as a whole, and must be considered in the Commission's NEPA review. The Draft EA's failure to consider this key significance is fatal to compliance with NEPA.

By ignoring the ongoing restoration of access to spawning and rearing habitat as well as the goals and objectives of the 2019 Final Recovery Plan for Atlantic Salmon in the GOM DPS, Commission staff ignore the required escapement requirement of 2,000 wild adults in the Merrymeeting Bay SHRU. This is only possible if salmon have unfettered access to the more than 43,000 units of habitat in the Sandy River, most of which is in largely undeveloped, well-forested, and higher elevation areas, which makes the habitat highly resilient to climate change.

The Draft EA's fish passage provisions for the lower Kennebec River would limit the number of Atlantic salmon that are able to pass the Shawmut Dam and other lower Kennebec dams, and likely lead to the extinction of the Atlantic salmon population in the Gulf of Maine. The Draft EA's analysis is neither "fully informed" nor "well-considered" and as such fails to take a "hard look" at the "significant" and "intense" environmental impact of relicensing the Shawmut Project. What is required is a full evaluation under NEPA by means of an environmental impact statement *before* any action is taken.[120]

iii. The Draft EA's analysis of dam removal is inadequate and lacks detail.

The Draft EA makes the following demonstrably incorrect assertions in connection with its stunted analysis of dam removal as a viable option to relicensing:

a. Sediment Release. "Removing the dam would release stored sentiment to the Kennebec River." Draft EA pp. 188-89. But at the same time, the Draft EA states that "[t]here is no information on sediment accumulation or containment levels in the project's impoundment." *Id.* Commission staff fail to recognize, however, that experience in Maine has shown that sediment effects are transitory. There have been multiple removals of dams comparable to Shawmut (Edwards, Fort Halifax, Great Works, and Veazie, for example) with no indication of lasting consequences due to sedimentation. FERC's Environmental Assessment that assessed removal of the Great Works and Veazie Dams on the Penobscot River in a lower mainstem river of similar size and character concluded that:

> Under the Proposed Action or Action Alternative 1 (removal of all three dams) there would be minor, short-term, adverse impacts to geologic and soil resources. Dam removal activities would disturb soils and sediments and result in increased turbidity within the projects' areas. However, these impacts would persist only during dam removal activities, and the licensee's implementation of best-management-practices such as silt screens and coffer dams would help to minimize these effects. While some erosion may occur as a result of lower

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[120] *American Rivers*, 895 F.3d at 49 (quoting *Sierra Club v. Peterson*, 717 F.2d 1409, 1415 (D.C. Cir. 1983)).

> impoundment levels and increased water velocities, it is expected to be minimal as a result of natural channel substrates armoring the shoreline.[121]

b. Diversity and Wildlife Abundance. The Draft EA's "finding" that the diversity and abundance of wildlife species in the area would not be expected to significantly change if the dam was removed,[122] is simply not true. The diversity of sea-run species would increase, as would the diversity of benthic macroinvertebrates, based on experiences at other dams. This was the case on the Kennebec and Sebasticook Rivers where Yoder et al calculated both Diadromous and Riverine Indices of Biological Integrity (R-IBI, D-IBI) before and after dam removal at Edwards and Fort Halifax Dams. After Edwards Dam removal on the Kennebec River, "the DIBI showed an improvement almost immediately with the 2002 DIBI in the Lockwood to Augusta segment clearly higher than the upstream impoundments."[123] After the Fort Halifax Dam removal on the Sebasticook River both riverine and diadromous IBIs improved immediately, and "[t]he D-IBI showed a comparatively larger increase due to improved access by diadromous species and river herring."[124] In the Penobscot River, total mean abundance and generic richness of benthic macroinvertebrates increased after dam

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[121] FERC Accession No. 20100518-3016. FERC, May 2010. Final Environmental Assessment, Application for Surrender of License, Veazie, Great Works, and Howland Projects, FERC Project Nos. 2403-056, 2312-019 and 2721-020. Section 4.4.1, page 172.

[122] Draft EA at p. 190.

[123] Yoder. C.O., R.F. Thoma, L.E. Hersha, E.T. Rankin, B.H. Kulik, and B.R. Apell. 2008. Maine Rivers Fish Assemblage Assessment: Development of an Index of Biotic Integrity for Non-wadeable Rivers. (Addendum March 31, 2016). MBI Technical Report MBI/2008-11-2. Submitted to U.S. EPA, Region I, Boston, MA. 55 pp. + appendices.

[124] Ibid.

removal at both the Veazie and Great Works sites.[125] Similarly, a fish assemblage study after removal at these sites found that dam removal improves diversity and abundance:

> Dams and their impoundments disrupt river habitat connectivity to the detriment of migratory fishes. Removal of dams improves riverine connectivity and lotic habitat, which benefits not only these fishes but also resident fluvial specialist species. Restoration efforts on the Penobscot River, Maine, are among the largest recently completed in the United States and include the removal of the two lowermost dams and improvements to fish passage at several remaining barriers. We assessed fish assemblages in the main-stem river and several major tributaries before (2010–2012) and after (2014–2016) dam removal using boat electrofishing surveys and a stratified random sampling design. In total, we sampled 303 km of shoreline and captured 107,335 individual fish representing 39 species. Similarity indices and rarefaction curves indicated that significant changes in fish assemblage composition occurred in reaches that underwent both habitat and connectivity changes (i.e., directly above removed dams). The newly connected reaches became more similar in fish assemblage composition, as demonstrated by an average increase of 31% in similarity scores. The changes in similarity score in these reaches were driven by increasing access for anadromous fishes and decreasing abundances of slow-water specialist species. For example, we observed a marked reduction in lacustrine species in former impoundments. These assemblage shifts were further illustrated by nonmetric multidimensional scaling in which sites directly above former dams exhibited the largest ordinal shifts immediately following dam removal. We also found all anadromous species in greatest abundance below the lowermost dam during each respective sampling period, though we did find some anadromous species above the lowermost dam during postremoval sampling. Our results demonstrate the potential for large dam removal projects to restore both fluvial and anadromous fish assemblages.[126]

c. Industrial Infrastructure. The Draft EA concludes that removal of the dam would cause problems with industrial and municipal in-river infrastructure.[127] This is

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[125] Kusnierz, D., et al. 2021. A Comparative Analysis of Benthic Macroinvertebrate Communities and Water Quality Before and After Removal of the Great Works and Veazie Dams, Penobscot River Restoration Project. A report to The Nature Conservancy pursuant to Contract ID: PRRP Water Quality Analysis_2017_PIN_DKusnierz. National Oceanic and Atmospheric Administration Rebuilding Sea-Run Fisheries: A103519. P. 18.

[126] Watson, J.M., et. al. 2018. Dam Removal and Fish Passage Improvement Influence Fish Assemblages in the Penobscot River, Maine. *Transactions of the American Fisheries Society.* Accessed at https://usgs-cru-individual-data.s3.amazonaws.com/jzydlewski/intellcont/2018%20Watson%20et%20al%20Dam%20removal%20and%20fish%20assemblages-1.pdf.

[127] Draft EA at p. 191.

also not true based on past Maine experience. In cases of dam removals on the Penobscot and the Kennebec, municipalities and industries were able to relocate in-river infrastructure. Further, the State of Maine is well aware of these needs and still supports dam removal. As with other dam removals in Maine, industrial in-river infrastructure can be relocated or reconfigured, and there would almost certainly be financial assistance provided to do so. This was the case with the Penobscot River Restoration Project, where appropriate measures to protect infrastructure were proposed by the applicant and this Commission's Final Environmental Assessment concluded that: "With proper mitigation as proposed by the Trust and Commission staff, however, the infrastructure would be adequately protected and no impact would occur upon this environment from these actions."[128]

In addition, a free-flowing river would increase the assimilative capacity of the Shawmut reach and make it easier for dischargers such as Sappi to attain water quality standards. Currently, the Shawmut impoundment is not in attainment with Maine water quality standards due, in part, to potential failure to meet aquatic life standards for benthic macroinvertebrates.[129]

In the final analysis, the Draft EA provides no quantitative analysis of fish passage over remaining dams in the absence of the Shawmut Dam. It also does not examine the water quality benefits of dam removal or accurately portray current water quality problems in the Shawmut impoundment. This does not allow valid conclusions

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[128] FERC Accession No. 20100518-3016. FERC, May 2010. Final Environmental Assessment, Application for Surrender of License, Veazie, Great Works, and Howland Projects, FERC Project Nos. 2403-056, 2312-019 and 2721-020. Section 4.4.11, p. 178.

[129] Maine DEP. 2018. 2016 Integrated Water Quality Monitoring Report. P. 60. Accessed at https://www.maine.gov/dep/water/monitoring/305b/2016/28-Feb-2018_2016-ME-IntegratedRptLIST.pdf.

about the adequacy of engineered fish passage as a mitigation measure. The bottom line is that the failure to analyze dam removal in the context of the compounded effects of hydropower projects and dams both up- and downstream from Shawmut, in turn fails to meet NEPA's requirement that the lead agency evaluate the environmental consequences of this major federal action "to the fullest extent possible" in a "well-considered "and "fully informed" analysis.[130]

iv. The Draft EA fails to analyze run-of-river issues "to the fullest extent possible."[131]

The Kennebec Coalition's August 29, 2020 comments on the license application raised concerns about the magnitude, frequency, and duration of fluctuations in Kennebec River flows below the Shawmut Project.[132] The primary concern was on impacts of flow changes on fish passage and instream habitat—particularly if short duration flow fluctuations occur during critical periods for migration and spawning. USFWS raised similar concerns in its August 27, 2020 "Comments, Recommendations, Preliminary Terms and Conditions, and Preliminary Prescriptions," and recommended instantaneous run-of-river operation.[133] USFWS further noted that "[s]ince precise inflow is currently unavailable at the Project the headpond should be maintained at the 112 foot elevation and at most vary by 0.5 feet not one foot."[134]

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[130] *American Rivers*, 895 F.3d at 49, 51.

[131] *American Rivers*, 895 F.3d at 51(citing *Delaware Riverkeeper Network v. FERC*, 753 F.3d 1304, 1310 (D.C. Cir. 2014)).

[132] FERC Accession No. 20200831-5332 at pp. 27-34.

[133] FERC Accession No. 20200827-5121 at p. 7.

[134] FERC Accession No. 20200827-5121 at p. 7.

The Draft EA rejects this recommendation. In their analysis, Commission staff seem to have missed that USFWS was suggesting the project approximate instantaneous run-of-river by limiting headpond fluctuations to +/- 0.5 feet. Commission staff instead interpreted the request as requiring absolute run-of-river operation, and erroneously concluded that the USFWS's recommendation would "essentially eliminate any of the minor fluctuations that currently occur when adjustments are made to project facilities."[135] Finally, without any analysis, the Draft EA suggests that "there is no indication that the project is technologically capable of operating under conditions where outflow from the project instantaneously equals inflow, rather than approximates it."[136] But the Draft EA itself notes that data submitted by Brookfield indicate that the project currently operates within a deviation +/- 0.5' of elevation 96% of the time.[137] This strongly suggests that compliance with such a condition is feasible and could be accomplished with existing infrastructure at little or no additional cost.

v. The Draft EA fails to take an "honest and hard look" at the poor economics of the Shawmut Project.

The poor economics of the Shawmut Project and its minimal energy contributions do not justify its relicensing or the damage it does to Maine's environment. As MDMR stated in its comments on the Shawmut relicensing:

> The Shawmut project represents less than 0.1% of the production of electricity in the State of Maine yet, if relicensed with underperforming fishways, would hasten the extinction of an iconic Maine species, Atlantic salmon, and could result in

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[135] Draft EA at p. 79.

[136] Draft EA at p. 35.

[137] Draft EA at p. 35 n.29.

> millions of sea-run fish not reaching historic habitats over the term of the license.[138]

As Commission staff also state in the Draft EA, the Shawmut Project is uneconomic with the mandatory conditions from NMFS and USFWS, and it would be significantly more uneconomic if MDMR's recommendations are included. By proposing the relicensing of this project, Brookfield is essentially asking Maine ratepayers to subsidize one of the most destructive dams in the State to the tune of at least $1,424,770 annually.[139] This is senseless.

Moreover, Maine's growing portfolio of non-hydro renewable resources makes the energy generation from Shawmut even less relevant. For example, Maine's solar generation capacity is expected to grow by an additional 1,597 MW over the next 5 years.[140] Even assuming that the capacity factor of the Kennebec dams is 67%[141] and only 15%[142] for solar, expected new solar generation capacity dwarfs the capacity of the Shawmut Dam by about 50 to 1. Shawmut is simply not a necessary part of Maine's energy portfolio.

A recent paper examined the solar acreage necessary to replace hydroelectricity from the Shawmut Dam and other lower mainstem Kennebec dams. It concluded that

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[138] MDMR. 2020. MDMR Response to the Ready for Environmental Analysis (REA) Preliminary Terms and Conditions, and Preliminary Fishway Prescriptions for the Shawmut Project (P-2322-069). P.2. FERC Accession No. 20200828-5199.

[139] Draft EA at p. 103.

[140] Solar Energy Industries Association. Accessed at https://www.seia.org/state-solar-policy/maine-solar.

[141] 2020. Kleinschmidt Associates. Brookfield White Pine Hydro LLC. Application for New License for Major Water Power Project – Existing Dam. Shawmut Hydroelectric Project (FERC No. 2322). January 30. P. B-2. Accessible at https://1drv.ms/u/s!AkLlihAdyxqVklBuZIG6A5l9pnd8?e=sWgbBm.

[142] Energy Information Administration. Accessed at https://www.eia.gov/todayinenergy/detail.php?id=39832.

only 44.4 hectares (110 acres) of solar panels would replace Shawmut generation.[143] In comparison, the size of the Shawmut impoundment, where water quality is potentially not attaining standards and non-native warmwater species dominate, is 530 hectares (1309 acres).[144] Simply put, the Shawmut dam is an antiquated energy project that is too expensive to run, severely damaging to the environment, and unnecessary given the rapid advances in modern renewable energy systems in Maine.

II. Conclusion

In the final analysis, at the culmination of more than two decades of grappling with sea-run fish passage failures and inadequacies with the lower Kennebec hydropower dams, the best available information and scientific data have yielded a number of unassailable points of consensus: 1) no hydropower dam – anywhere on the planet – has consistently maintained 48-hour 95% upstream salmonid passage performance; 2) multi-dam fish passage facilities will not work to restore self-sustaining sea-run populations of Atlantic salmon *and* the other coevolved species – again, it has never been achieved anywhere on the planet, and the scientific data support too great an array of causal impediments – from issues of delayed mortality, to depleted energy reserves leading to unsuccessful spawning, to insufficient per-species seasonal passage percentages both up- and downstream. No current reliable information justifies multi-dam passage systems as

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[143] Sharma, S. and Waldman, J. (2021), Potential Solar Replacement of Hydroelectricity to Reopen Rivers: Maine as a Case Example. Fisheries. https://doi.org/10.1002/fsh.10619. P. 3.

[144] The Shawmut impoundment does not meet State water quality standards. The Shawmut impoundment is listed under Category 3, “Rivers and Streams with Insufficient Data or Information to Determine if Designated Uses are Attained (One or More Uses may be Impaired),” in Maine’s 303(d) list. *See* DEP. 2018. 2016 Integrated Water Quality Monitoring Report. P. 59. This is likely due to the lack of both diversity and abundance of macroinvertebrates that require high water quality in the impoundment, a common feature in large impoundments where deeper areas have low flow and dissolved oxygen.

“mitigation” of the environmental consequences posed by these dams, of which Shawmut is included. To be blunt: fish passage facilities will not work, and will not work well enough, to avoid the adverse environmental consequences posed by the dams and their impoundments. And in this case those consequences are especially dire, as the fate of an endangered species hangs in the balance.

And there is nothing in the record that tells us the Shawmut Project is any different. Indeed, the record with respect to this particular licensee, Brookfield, is a history of failure and of delay. Brookfield had the entire period from 2013 to 2019 under the interim species protection plan to try to establish that multi-dam fish passage facilities would work to restore sea-run migrations on the lower Kennebec. Brookfield failed to even get fish the ability to swim freely above the first dam in all of that time. In the face of this failed history, and the further delay and failures resulting from it, Brookfield’s assertions that we should all close our eyes to the truth and that the public should continue to accept the situation on the Kennebec is beyond the pale. All current and best scientific data tell us that the situation will not be solved by fish passage facilities installed at Shawmut and at the other three dams. Brookfield’s invitation to essentially maintain the status quo and sit back as the iconic Atlantic salmon goes extinct must be rejected by the Commission.

What the Commission should accept is what all the current and best scientific and economic data make clear – the Shawmut Project should not be relicensed. That conclusion is ineluctable if, as required under NEPA, the Commission takes a “hard and honest” look at the wager Brookfield puts to us, the gamble that risks the extinction of an iconic endangered species in the United States. It is time for this Commission to transcend the wishful thinking of its Kennebec Licensees that has prevailed for so many decades, and that has been proven wrong by all current and best available information. The Commission must abandon the idea that engineered fish passage facilities over four dams will address the significant and dire adverse environmental consequences of these four dams on the lower Kennebec, with the Shawmut Project as one of them.

At the very least, this Commission must undertake a hard and *honest* look at the state of this best, current, reliable information, as set forth herein – especially with the State of Maine, its lead wildlife resource agency on this issue (MDMR), and NMFS, all recommending decommissioning and removal of the Shawmut dam. The Commission must grapple with these hard facts, and it must do so in an Environmental Impact Statement. "NEPA requires an Environmental Impact Statement for any major federal action that might 'significantly' affect the human environment."[145] "If *any* 'significant' environmental impacts might result from the proposed agency action then an [Environmental Impact Statement] must be prepared *before* the action is taken."[146] The Federal Power Act mandates giving "'**equal consideration to** the purposes of energy conservation, **the protection, mitigation of damage to, and enhancement of, fish and wildlife (including related spawning grounds and habitat)**, the protection of recreational opportunities, and the preservation of other aspects of environmental quality.'" *American* Rivers, *supra*, 895 F.3d 32, 36 (D.C. Cir. 2018) (quoting 16 U.S.C. § 797(e)) (bold emphasis added).

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[145] *American Rivers*, 895 F. 3d at 49 (citing 42 U.S.C. § 4332(C)).

[146] *Id*. (quoting *Sierra Club v. Peterson*, 717 F.2d 1409, 1415 (D.C. Cir. 1983)) (italics emphasis in original).

We urge the Commission to reject the Draft EA, and direct the development of an Environmental Impact Statement that meets the exacting procedural requirements of NEPA, which requires development of a decommissioning plan for consideration, and that truly confronts the irreversible and significant adverse environmental consequences of the Shawmut Project.

Respectfully submitted, this 14th day of August, 2021,

The Kennebec Coalition by:

/s/ Russell B. Pierce, Jr., Esq.
Norman Hanson & DeTroy, LLC
Two Canal Plaza
P.O. Box. 4600
Portland, ME 04112
207.774.7000
rpierce@nhdlaw.com

/s/ Charles Owen Verrill, Jr., Esq.
Verrill Advocacy, LLC
Suite M-100
1055 Thomas Jefferson St. NW
Washington, D.C. 20007
202.390.8245
charlesverrill@gmail.com

The Conservation Law Foundation by:

/s/ Sean Mahoney
Executive Vice President
Conservation Law Foundation
62 Summer Street
Boston, MA 02110
smahoney@clf.org

CERTIFICATE OF SERVICE

I, Russell B. Pierce, Jr., Esq., hereby certify that a copy of these comments was transmitted by electronic means to each of the persons on the Service list maintained by the Secretary of the Commission.

/s/ Russell B. Pierce, Jr.
Russell B. Pierce, Jr., Esq.
Attorney for Kennebec Coalition

Norman, Hanson & DeTroy, LLC
Two Canal Plaza, P.O. Box 4600
Portland, ME 04112-4600
(207) 774-7000
rpierce@nhdlaw.com

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Landis Hudson
Executive Director, Maine Rivers
www.mainerivers.org
Phone: 207-847-9277
Our mission is to protect, restore and enhance the ecological health of Maine's river systems

On 8/7/21, 9:49 AM, "Joseph Zydlewski" <josephz@maine.edu> wrote:

> Landis -
>
> Thanks for the kind words. Yes - PLEASE use this information.
>
> We should have a thesis you can point to in short order - but for now you can point to Rubenstein, Sarah and Zydlewski, Joseph, unpublished data.
>
> This will be submitted for publication by the January, so really in pub form ~ June of next year if all goes well.
>
> The major points
>
> 1) ATS face poor passage at some dams (e.g. Lockwood)
>
> 2) If passing, ATS often face long delays, usually weeks in length - sometimes months
>
> 3) Because of the high and rising downstream temperatures in lower rivers in the summer during river entry and migration, there is increased metabolic cost and this is directly related to depletion of limited and fixed energy stores.
>
> 4) Our bioenergetic model suggests that these delays significantly lower the probability of spawning success (depletion of energy stores prior to spawning likely leading to mortalities) and biologically significant declines in the probability of repeat spawning (due to energy depletion and likely mortality). For a four dam system, this loss is estimated to be greater than 50% loss for pre-spawn and post-spawn fish. These are likely conservative estimates as delays at dams are associated with increases in searching behavior, and activity means more energy demand.
>
> 5) Extensive literature suggests that older, larger, repeat spawning fish are critical for population resilience , and hence recovery (see attached). In the Penobscot River (see Maynard et al., 2018) repeat spawning is less than 1%, far less than occurs in un-dammed ATS rivers. This fact provided direct evidence that dams are associated with and likely causal to low survival (increased mortality) of post spawn salmon and underscored the demographic fragility resulting from this persistent fixed source of mortality.
>
> Joe Z

Donald H. Pugh, Jr.
10 Old Stage Road
Wendell, MA 01379
Telephone 978 544 7438 Office
413 387 9439 Cell

Work History:

Self Employed

Current projects:

Maryland Power Plant Research Project – relicensing of Conowingo Project (FERC # 405) on the Susquehanna River and post-license studies at Holtwood (FERC # 1881) and York Haven (FERC # 1888) upstream of Conowingo. Principle areas of responsibility include: up- and downstream fish passage, telemetry data analysis, fish biology, habitat-flow analysis, and American eel passage.

Connecticut River Conservancy – relicensing of First light hydroelectric projects on the Connecticut River at Turners Falls (FERC # 1889) and the Northfield Mountain Pumped Storage Station (FERC #2485). Scoping began in 2012. First Light has filed its final license application. Reviewed study plans, study reports, IFIM review, shortnose sturgeon spawning flow needs analysis, and shad telemetry analysis. Participated in settlement talks with company, state and federal agencies, and NGOs.

SWCA, Inc. – Shortnose and Atlantic sturgeon habitat and protection plans for sewer line crossing construction on the Connecticut River, Springfield, Massachusetts.

Geosyntec consultants - Shortnose and Atlantic sturgeon habitat and protection plans for river bank stabilization on the Merrimack River, Haverhill, Massachusetts

Maine Rivers – relicensing of three projects on the Mousam River (FERC # 14856).

Kennebec Coalition – review and data analysis of downstream smolt radio telemetry studies (2012 – 2015) and the upstream fish passage plan at the Shawmut project on the Kennebec River (FERC # 2322).

Member of the Holyoke Cooperative Consultation Team for the Holyoke Hydroelectric Project (FERC #2004). Post-licensing downstream fish passage planning including configuration of the downstream passage protection structure, review of CFD analysis, analysis of telemetry data of American shad, shortnose sturgeon, and American eel during post licensing studies.

Santo Antônio , January 2010 to June 2011

TIRIS PIT tag installation, data analysis, and fish passage consultation for an experimental fish passage flume on the Rio Maderia, Brazil.

American Rivers, April 2010 to November 2011

Represented American Rivers for the relicensing of three projects on the Susquehanna River – Conowingo Dam, Muddy Run Pumped Storage Project and York Haven Dam. Participated in study plan development, reviewed study reports and prepared comment letters, attended meetings with the project owners, the FERC, state and federal agencies, and NGO's. Developed and independent analysis of American shad telemetry data at York Haven and Conowingo.

University of Massachusetts, Amherst MA January 1997 to January 2009

Research Assistant in the Department of Natural Resource Conservation working at the

Silvio Conte Anadromous Research Center – areas of research included the behavior and movement of adult Atlantic salmon in the Westfield River in Massachusetts using radio telemetry, upstream passage of sturgeons and riverine fishes in a spiral fishway, spawning behavior of shortnose sturgeon in an artificial ‘stream, and downstream passage of sturgeons at a bar rack and louver system with a low level bypass entrance.

Massachusetts Cooperative Fisheries and Wildlife Research Unit, University of Massachusetts, Amherst MA
March 1991 to January 1997

Project Leader for Anadromous Fish Investigations project. Duties include: hire and supervise technicians staffing the Holyoke, Turners Falls, and Westfield River fish passage facilities; conduct recreational angler creel surveys, Atlantic salmon habitat assessment, and juvenile growth and survival estimates; supervise stocking of Atlantic salmon fry for the Connecticut River basin in Massachusetts; coordinate Unit operations with utility companies and state and federal agencies; and prepare budgets and reports.

Education:

Undergraduate
Trinity College
Hartford, CT 1967-71, B.A.
Major: History
Specialty: American History

Continuing Ed.
Greenfield Community College
- Photography I, II & III, Fall 1980-81
- Engineering Drawing, Fall 1978
- Drafting for Engineers, Spring 1979
- Programming Principles and Concepts, Fall 2002
- Advanced Basic for Programmers, Spring 2002
- Database Programming and Procedures, Spring 2005
- Advanced Database Programming, Spring 2006

University of Massachusetts, Amherst
- Principles of Management, Fall 1981
- Microeconomics, Fall 1980
- Macroeconomics, Spring 1981
- Social Conflicts and Natural Resources, Spring 1991
- Biological Limnology, Fall 1991
- Anadromous Fish, Fall 1991
- Biostatistics, Fall 1991
- Intermediate Biostatistics, Spring 1992
- GIS, Spring 1992
- Population Dynamics, Fall 1992
- Animal Movement and Migration, Fall 1992
- Coastal Zone Management, Spring 1993
- Ichthyology, Fall 1993
- Principles of Fisheries Stock Assessment, Spring 1994
- Aquatic Invertebrates, Fall 1994
- Freshwater Fisheries Management, 1997
- Inland Fisheries Management, Spring 1999
- Imaging in Fisheries Science, Fall 2000
- Natural Resource Modeling, Spring 2001

American Fisheries Society Workshops
- Fish Ageing, 1995
- Stream Habitat Assessment, 1996

USFWS - National Education and Training Center
Principles and Techniques of Electrofishing, 1996

DOI-USGS – Motorboat Operator Certification Course, 2000

Certified S.O. Conte Anadromous Research Center dive team member

S.O. Conte Fish Research Projects:

Atlantic salmon behavior and movements in the Westfield River, Massachusetts 1996 to 1998 – wild adult Atlantic salmon returning to the Westfield River were internally radio tagged and released into the upper Westfield River. Fish were tracked with fixed stations and with manual tracking. Movement, habitat choice, spawning, and post-spawning behavior were evaluated. Domestic broodstock Atlantic salmon were also radio tagged and released to assess their spawning potential to contribute to the salmon restoration effort in the Connecticut River basin.

Spiral fishway 2001 to 2007 – evaluation of a spiral, side baffle fishway designed for upstream sturgeon fish passage. Sturgeon, a benthic fish, need a fishway that allows upstream movement while maintaining close proximity to the bottom of the fishway. The spiral uses side baffles to reduce velocity and provide depth allowing fish to move in a sinusoidal curve along the bottom of the channel. Sturgeon movement was evaluated with a PIT tag system detecting fish at the entrance and exit of the fishway and at four points along each of two loops. Riverine fish were also evaluated in the spiral fishway.

Shortnose sturgeon spawning behavior 2002 to 2008 – the spawning behavior of wild Connecticut River shortnose sturgeon was evaluated in an artificial stream. Mating behavior, mate choice, velocity preference, egg to larvae survival, and embryo and larval dispersal timing were evaluated.

Downstream passage and behavior studies of shortnose sturgeon 2004 and 2005 – yearling, juvenile and adult shortnose sturgeon were evaluated for swimming depth, behavior at and movement along a bar rack, entrainment and impingement, and willingness to enter an opening in the bar rack at three different approach velocities. Pressure sensitive (depth) and radio tags were used to assess swimming depth for both upstream and downstream movement in a 20’ by 120’ flume with a velocity of 1 ft/sec. PIT tags and video were used to assess individual fish movement and behavior at a bar rack oriented 90º to flow at velocities of 1, 2 and 3 ft/sec.

Downstream movement of yearling shortnose sturgeon 2004 and 2006 – yearling shortnose sturgeon (Connecticut River stock in 2004 and Savannah River stock in 2006) were evaluated in a large outdoor oval channel with a river stone substrate to determine the timing, frequency and duration of upstream and downstream movements. Fish were tested for 48 hours on a monthly basis from June through November. PIT tags and five antennas were used to determine movement.

Low level orifice use of sturgeon at an angled bar rack and louver 2006 to 2008 – green, lake, Savannah and Connecticut River shortnose sturgeon of different year classes were tested in a 10’ by 120’ flume at two bar rack angles (45º and 30º) and one louver angle (26º) with two velocities at the orifice. Approach velocity (2 ft/sec) and water depth (7.5’) remained constant for all trials. Fish were tested both day and night. Video and PIT tags were used to determine individual fish movement, behavior at the bar rack and passage through the orifice and pipe which transported fish downstream to a holding area.

Past Relicensing Projects:

Bear Swamp Hydroelectric Project – FERC # 2669
    Relicensing of project through the ILP.
Deerfield River Project – FERC # 2323, License issued 1997
    Deerfield River Compact – precursor to relicensing, all stakeholders in relicensing, including New England Power Co., met on a regular basis to discuss issues. Final report issued.
    Deerfield River Settlement – followed the conclusion of the Deerfield River Compact with similar discussions as to the issues involved in relicensing with the goal of reaching agreement on environmental mitigation prior to issuing or license. Represented Trout Unlimited in

meetings with state and federal agencies, New England Power Co. and other NGO's which reached an agreement that was incorporated into and was the basis of relicensing by the FERC.

Holyoke – FERC # 2004, Connecticut River

Relicensing of project – bypass minimum flows, downstream fish passage (salmon smolts, adult Atlantic salmon, American eels, clupeids, and riverine fish), upstream passage (adult Atlantic salmon, clupeids, American eels, and riverine fish) freshwater mussel protection, flow priorities (bypass reach, canal, up- and downstream fish passage, hydrogenation, run of river protection of federally threatened tiger beetle), and disabled angler fishing access.

Comments to both company and the FERC concerning above listed issues.

Participant in CCT meetings representing Trout Unlimited concerning above listed issues. CCT consists of Holyoke Gas & Electric (project owners), state and federal agencies, and NGO's (Trout Unlimited and Connecticut River Watershed Council).

Indian River – FERC # 12462, Westfield River

Licensing of project – bypass minimum flows, freshwater mussel protection, downstream fish passage (salmon smolts, adult Atlantic salmon, American eels, riverine fish), upstream passage for American eels.

Participation in ongoing fish passage discussions regarding both up- and downstream passage issues.

L.S. Starrett Co. – FERC # UL09-01, Millers River

Installation of new turbine initiated local Conservation Commission and Massachusetts Department of Environmental Protection actions presently on hold due to a FERC order of jurisdiction dated October 21, 2009.

Intervened in Massachusetts Department of Environmental Protection appeal by Starrett of a Superseding Order of Conditions.

Commented to the FERC concerning Starrett Motion for Stay of Order of Jurisdiction regarding downstream fish passage.

Muddy Run Pumped Storage Project – FERC # 2355, Susquehanna River. Contracted by Maryland Power Plant Project to provide biological and fish passage assistance during relicensing and post licensing. Principle issues are entrainment and the impact of the project on river flows.

New Home Dam Project – FERC # 6096, Millers River

Post licensing flow issues - run of river requirement.

Northfield Mountain Pumped Storage Project – FERC # 2485, Connecticut River

License amendment allowing more storage in upper pond. River bank erosion concerns. Amendment application withdrawn.

Woronoco – FERC # 2631, Westfield River

Relicensing of project and 401 certification – bypass minimum flows, freshwater mussel protection, downstream fish passage (salmon smolts, adult Atlantic salmon, American eels, riverine fish), upstream passage for American eels, and recreation issues.

Analyzed telemetry data from downstream smolt test to provide independent review of results.

York Haven – FERC # 1888, Susquehanna River

Contracted by Maryland Power Plant Project to provide biological and fish passage assistance during relicensing. Relicensing is currently involved in settlement discussions with project owner, Olympus Power. Principle issues are up- and downstream fish passage for American shad and American eel and bypass flows.

Publications:

Kynard, B., D. Pugh, and T. Parker. 2003. Development of a fish ladder to pass lake sturgeon. Great Lakes Foundation, Final Report, Lansing Michigan.

Kynard, B., M. Horgan, D. Pugh, E. Henyey and T. Parker. 2008. Using juvenile sturgeon as a substitute for adults: a new way to develop fish passage for large fish. American Fisheries Society Symposium 61: 1-21.

Kynard, B., M. Kieffer, E. Parker, D. Pugh and T. Parker. 2012. Lifetime movements by Connecticut River sturgeon. In Life history and behavior of Connecticut Rver shortnose sturgeon and other sturgeons. B. Kynard, P. Bronzi, and H. Rosenthal Editors. World Sturgeon Conservation Society: Special Publication #4. Norderstedt, Germany.

Kynard, B., D. Pugh, and T. Parker, M. Kieffer. 2012. Spawning of shortnose sturgeon in an artificial stream: adult behavior and early life history. In Life history and behavior of Connecticut Rver shortnose sturgeon and other sturgeons. B. Kynard, P. Bronzi, and H. Rosenthal Editors. World Sturgeon Conservation Society: Special Publication #4. Norderstedt, Germany.

Kynard, B., D. Pugh, and T. Parker. 2012. Passage and behavior of Connecticut River shortnose sturgeon in a prototype spiral fish ladder with a note on passage of other fish species. In Life history and behavior of Connecticut Rver shortnose sturgeon and other sturgeons. B. Kynard, P. Bronzi, and H. Rosenthal Editors. World Sturgeon Conservation Society: Special Publication #4. Norderstedt, Germany.

Kynard, B., E. Parker, D. Pugh, and T. Parker. 2012. Downstream and Diel Movements of Cultured Yearling Pallid, Green, Lake, and Shortnose Sturgeons: An Artificial Stream Study. In Life history and behavior of Connecticut Rver shortnose sturgeon and other sturgeons. B. Kynard, P. Bronzi, and H. Rosenthal Editors. World Sturgeon Conservation Society: Special Publication #4. Norderstedt, Germany.

Kynard, B., D. Pugh, and T. Parker. 2004. Experimental Studies to Develop Guidance and a Bypass for Shortnose Sturgeon at Holyoke Dam. Final Report to City of Holyoke, Holyoke Gas & Electric Company, Holyoke, Massachusetts.

Kynard, B., D. Pugh, and T. Parker. 2005. Experimental Studies to Develop Guidance and a Bypass for Shortnose Sturgeon at Holyoke Dam. Final Report to City of Holyoke, Holyoke Gas & Electric Company, Holyoke, Massachusetts.

Kynard, B., E. Parker, D. Pugh, and T. Parker. 2007. Use of laboratory studies to develop a dispersal model for Missouri River pallid sturgeon early life intervals. J. Appl. Ichthyol. 23: 365–374.

Kynard, B., D. Pugh, and T. Parker. 2011. Passage and behavior of cultured lake sturgeon in a prototype side-baffle ladder: I. ladder hydraulics and fish ascent. J. Appl. Ichthyol. 47 (Suppl. 1): 1-12.

Pugh, D., B. Kynard. 2001. Westfield River adult salmon report Westfield River, Massachusetts, 1966 – 1968. Final report to United States Forest Service and United States Fish and Wildlife Service.

Pugh, D. 1997. Millers and Chicopee River Basins Mussel Survey. Report to Massachusetts Natural Heritage and Endangered Species Program.

Pugh, D. 1998. French and Westfield River Basins Mussel Survey. Report to Massachusetts Natural Heritage and Endangered Species Program.

Pugh, D. 1999. Blackstone, Quinebaug, and Quabog River Basins Mussel Survey. Report to Massachusetts Natural Heritage and Endangered Species Program.

Pugh, D and A. Haro. 2000. Passage of Atlantic salmon at Turners Falls fishways: PIT tag evaluation 1999. Conte Anadromous Fish Research Center Internal Report No 00-02.

Pugh, D. 2000. Merrimack, Ipswich, Charles, and Neponsett/Weymouth/Weir Basins Mussel Survey. Report to Massachusetts Natural Heritage and Endangered Species Program.

Pugh, D. 2001. 2001 Fort River dwarf wedge mussel (*Alasmidonta heterodon*) survey. Massachusetts Division of Fisheries and Wildlife Natural Heritage and Endangered Species Program.

Pugh, D. 2002. 2002 Fort River dwarf wedge mussel (*Alasmidonta heterodon*) survey. Massachusetts Division of Fisheries and Wildlife Natural Heritage and Endangered Species Program.

Presentations:

Movement and Habitat of Atlantic Salmon in the Westfield River. D. Pugh. Connecticut River Atlantic Salmon Commission Conference, 1999.

Zebra Mussels: Can We Stop The Eastward Invasion? M. Babione and D. Pugh. Northeast Fish and Wildlife Conference, 2003.

Passage of Sturgeons and Riverine Fishes in a Prototype Spiral Fish Ladder. B. Kynard, D. Pugh, T. Parker. American Fisheries Society Meeting, 2006

Behavior of Lake, Pallid, and Shovelnose Sturgeons at Passage Structures: Toward a New Paradigm in Developing Fish Passage. B. Kynard, M. Horgan, D. Pugh, E. Henyey, and T. Parker. American Fisheries Society Meeting, 2006.

Performance of Lake Sturgeons and Riverine Fishes in a Spiral Side-Baffle Fish Ladder. B. Kynard, D. Pugh, T. Parker. Connecticut River Atlantic Salmon Commission Conference, 2009.

Review of Using a Semi-natural Stream to Produce Young Sturgeons for Conservation Stocking. B. Kynard, D. Pugh, T. Parker, M. Kieffer. International Sturgeon Society Conference, 2009.

Up- and Downstream Passage and Behavior of Lake and other Sturgeons. D. Pugh B. Kynard and T. Parker. Keeyask Fish Passage Workshop, 2011.

Eel Passage Westfield & Millers Rivers, Massachusetts. D. Pugh. ASMFC Eel Passage Workshop, 2011.

Passage and Behavior of Cultured Lake Sturgeon in a Side-Baffled Fish Ladder: II. Fish Ascent and Descent Behavior. NAC. 2011.

Behavior, impingement, and entrainment of shortnose sturgeon at a vertical bar rack: with and without a bypass orifice. B. Kynard and D. Pugh. Fish Passage Conference, Amherst, MA. 2012.

Research on Up-and Downstream Passage of Lake Sturgeons at S. O. Conte Anadromous Fish Research Center. B. Kynard, D. Pugh, E Henyey, T. Parker and M. Horgan. *Scaphirhynchus* Conference: Alabama, Pallid, and Shovelnose Sturgeon Symposium, St. Louis, Missouri, January 2005

Shortnose Sturgeon Life History Requirements and the Holyoke Dam. B. Kynard, M. Kieffer, D. Pugh. Connecticut River Atlantic Salmon Commission Conference, March 2013

STATE OF MAINE
DEPARTMENT OF MARINE RESOURCES
21 STATE HOUSE STATION
AUGUSTA, MAINE
04333-0021

JANET T. MILLS
GOVERNOR

PATRICK C. KELIHER
COMMISSIONER

July 17, 2021

Kathy Davis Howatt
Hydropower Coordinator, Bureau of Land Resources
Maine Department of Environmental Protection
17 State House Station
Augusta, ME 04333

RE: Comments on Brookfield White Pine Hydro, LLC's Shawmut (FERC No. 2322) Hydroelectric Project

Dear Ms. Howatt:

The Maine Department of Marine Resources (MDMR) has reviewed the Brookfield White Pine Hydro, LLC's (BWPH; Licensee) Application for Water Quality Certification (U.S. P.L. 92-500, Section 401) for the relicensing of the Shawmut Project by the Federal Energy Regulatory Commission (FERC). MDMR has also reviewed the Draft Environmental Assessment (DEA), Interim Species Protection Plan (ISPP) for Shawmut, the Final License Application (FLA), Species Protection Plan (SPP) for Lockwood, Hydro-Kennebec, and Weston, as well as other relevant documents in our administrative record. MDMR provides the attached comments and Kennebec River factual background paper focused primarily on the proposal's impacts to diadromous indigenous aquatic fish species and their habitat.

Please contact Gail Wippelhauser at gail.wippelhauser@maine.gov or at 207-904-7962 if you have any questions.

Sincerely,

Patrick C. Keliher, Commissioner

OFFICES AT 32 BLOSSOM LANE, MARQUARDT BUILDING, AUGUSTA, MAINE
http://www.Maine.gov/dmr
PHONE: (207) 624-6550
FAX: (207) 624-6024

Summary

Restoration of Atlantic Salmon, American Shad, Blueback Herring, Alewife, and Sea Lamprey has lagged on the mainstem Kennebec River, primarily because of the lack of upstream fish passage. This situation is particular critical for the endangered Gulf of Maine (GOM) Distinct Population Segment (DPS) of Atlantic Salmon, one of the most iconic and imperiled species in the United States. Diadromous fish species require safe, timely, and effective access to high quality habitats at different life stages in order to successfully survive and reproduce. The Shawmut Project waters currently are used as spawning and rearing habitat and/or a migratory corridor for five indigenous fish species (Atlantic Salmon, American Shad, Blueback Herring, Alewife, and American Eel). Upstream fish passage has been provided for juvenile American Eel at the lower four mainstem dams, but adult Atlantic Salmon, American Shad, Blueback Herring, and Alewife have been captured at the Lockwood Project fish lift and transported upstream for 15 years (2006-2021). A sixth indigenous species, Sea Lamprey, also will use the Shawmut Project waters as spawning/rearing habitat and as a migration corridor when new upstream passage is implemented at the Lockwood, Hydro-Kennebec, Shawmut, and Weston projects. These aquatic habitats are extremely important for diadromous fish and have been designated as Critical Habitat for Atlantic salmon under the Endangered Species Act (ESA) and Essential Fish Habitat (EFH) under the Magnuson Stevens Act (MSA) for a number of species based on the location and characteristics of habitats required to support healthy fish populations. Almost 100% of high quality Atlantic Salmon spawning and rearing habitat, over 50% of spawning and rearing habitat for American Shad and Blueback Herring, and significant areas for the other native anadromous species in the Kennebec river watershed is upstream of the Shawmut project.

The proposal as described in the Brookfield White Pine Hydro, LLC's (BWPH; Licensee) Application for Water Quality Certification (U.S. P.L. 92-500, Section 401), if implemented, will continue to have significant adverse impacts on these indigenous fish species and their habitat. These adverse impacts include, but are not limited to, anticipated low passage efficiency rates at upstream and downstream fishways, mortality and injury to upstream and downstream migrating diadromous fish, impaired in-stream habitat, significant delays in passage, and cumulative effects of multiple proposed fish passages at other projects in the watershed. Population modeling of the cumulative impacts of upstream and downstream passage of Atlantic Salmon, American Shad, Blueback Herring, and Alewife has shown that efficient downstream and upstream fish passage with minimal delays are critical to support these fish species' life history needs. Unless fish passage facilities meet MDMR's proposed performance standards based on this modeling and also provide effective passage for eels, the project waters will likely be of insufficient quality to support self-sustaining runs of these important indigenous species. Of particular concern, MDMR's analysis strongly indicates that the Licensee's proposal would preclude the ability to recover Endangered Species Act (ESA) listed Atlantic salmon in the entire Distinct Population Segment (DPS). In addition, studies have shown that similar fishways at wide, complex sites such as Shawmut could entirely preclude fish such as American Shad from passing upstream. The Department's goal is to restore diadromous fish populations in Maine to their historic habitat. To achieve this goal, MDMR has developed "minimum goals" that are achievable if suitable habitat of sufficient quality is available to support fish and other aquatic life. In other words, building fish runs to meet these minimum demographic goals is a benchmark for having resilient self-sustaining populations, which require safe, timely, and effective passage and supportive aquatic habitats. The minimum goals and concerns about how the proposed project will not likely achieve those goals and discussion of additional impacts to fish and aquatic habitat are outlined below. More detail on the modeling and background can be found in the Kennebec River factual background provided as a separate document.

Minimum Species Goals for the Kennebec River

The minimum goal for **Atlantic Salmon** is to provide safe, timely, and effective upstream and downstream passage in order to achieve a minimum annual return of 500 naturally-reared adults to historic spawning/rearing habitat in the Kennebec River for Endangered Species Act (ESA) down-listing and a minimum annual return of 2,000 naturally-reared adults to historic spawning/rearing habitat in the Kennebec River for reclassification based on the NOAA and USFWS Recovery Plan (2019). To reach spawning/rearing habitat in the Sandy River, Carrabassett River, and mainstem Kennebec River, all returning adults must annually pass upstream at the Lockwood, Hydro Kennebec, Shawmut, and Weston project dams.

The minimum goal for **American Shad** is to provide safe, timely, and effective upstream and downstream passage in order to achieve a minimum annual return of 1,018,000[1] wild adults to the mouth of the Kennebec River; a minimum annual return of 509,000 adults above Augusta; a minimum of 303,500 adults annually passing upstream at the Lockwood and Hydro Kennebec Project dams; a minimum of 260,500 adults annually passing upstream at the Shawmut Project dam; and a minimum of 156,600 adults annually passing upstream at the Weston Project dam.

The minimum goal for **Blueback Herring** is to provide safe, timely, and effective upstream and downstream passage in order to achieve a minimum annual return of 6,000,000[2] wild adults to the mouth of the Kennebec River; a minimum annual return of 3,000,000 adults above Augusta; a minimum of 1,788,000 adults annually passing upstream at the Lockwood and Hydro Kennebec Project dams; a minimum of 1,535,000 adults annually passing upstream at the Shawmut Project dam; and a minimum of 922,400 adults passing upstream at the Weston Project dam.

The minimum goal for **Alewife** is to provide safe, timely, and effective upstream and downstream passage in order to achieve a minimum annual return of 5,785,000[3] adults above Augusta; a minimum of 608,200 adults annually passing at the Lockwood, Hydro Kennebec, and Shawmut project dams; and a minimum of 473,500 adults annually passing upstream at the Weston Project dam.

The minimum goal for **Sea Lamprey and American Eel** is to provide safe, timely, and effective upstream and downstream passage throughout the historically accessible habitat of these two species.

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[1] Based on 5,015 hectares of spawning/rearing habitat and a minimum return of 203 adults per hectare.

[2] Based on 5,015 hectares of spawning/rearing habitat and a minimum return of 1,196 adults/hectare.

[3] Based on 9,946 hectares of spawning/rearing habitat and a minimum of 581.5 adults/hectare; the Maine State average is 988.4/hectare.

Performance standards necessary to meet minimum goals

Upstream fish passage

Based on the minimum goals, a project's facilities would be considered to be performing in a safe, timely, and effective manner if:

1. At least 99% of the adult Atlantic Salmon that pass upstream at the next downstream dam (or approach within 200 m of the project powerhouse) pass upstream at the project within 48 hours.
2. At least 70% of the adult American Shad that pass upstream at the next downstream dam (or approach within 200 m of the project powerhouse) pass upstream at the project within 72 hours.
3. At least 90% of the adult Blueback Herring that pass upstream at the next downstream dam (or approach within 200 m of the project powerhouse) pass upstream at the project within 72 hours.
4. At least 90% of the adult Alewife that that pass upstream at the next downstream dam (or approach within 200 m of the project powerhouse) pass upstream at the project within 72 hours; and
5. At least 80% of the adult Sea Lamprey that pass upstream at the next downstream dam (or approach within 200 m of the project powerhouse) pass upstream at the project within 48 hours.

Downstream fish passage

Based on the minimum goals, a project's facilities would be considered to be performing in a safe, timely, and effective manner if:

1. At least 99% of the Atlantic Salmon smolts and kelts that pass downstream at the next upstream hydropower dam (or approach within 200 m of the project spillway) pass the project within 24 hours.
2. At least 95% of the adult and juvenile American Shad that pass downstream at the next upstream hydropower dam (or within 200 m of the project spillway) pass the project within 24 hours.
3. At least 95% of the adult and juvenile Blueback Herring that pass downstream at the next upstream hydropower dam (or within 200 m of the project spillway) pass the project within 24 hours.
4. At least 95% of the adult and juvenile Alewife that pass downstream at the next upstream hydropower dam (or within 200 m of the project spillway) pass the project within 24 hours.

The Licensees Proposals for fish passage performance

It is unclear what the Licensee is proposing regarding salmon effectiveness standards for the Shawmut project as the proposed Interim Species Protection Plan (ISPP) does not include updated performance standards. In the SPP for the Lockwood, Hydro-Kennebec, and Weston project, the Licensee indicates they will need to achieve a whole station survival of 88.5% for downstream passage and 84.5% for upstream passage at the four projects for Atlantic salmon. This would indicate an average of 97% for downstream passage per project, and 96% for upstream passage. A cumulative performance standard is not supported by MDMR or consistent with the precedent set by the National Marine Fisheries Service (NMFS) and the Federal Energy Regulatory Commission (FERC) for the Milford (FERC No. 2534), West Enfield (FERC No. 2600), Mattaceunk (FERC No. 2520), Orono (FERC No. 2710) and Stillwater (FERC No. 2712) projects on the Penobscot River. Cumulative performance standards can allow one or more projects to perform poorly, increasing the possibility that the cumulative effects will be even greater and reducing project by project accountability. The Licensee does not utilize DMR's recommended performance standards or provide any of their own performance standards for American Shad, Blueback Herring, Alewife, or Sea Lamprey. MDMR has completed model scenarios that represent the best available science and finds that only with a 99% upstream and downstream passage efficiency at each project (Lockwood, Hydro-Kennebec, Shawmut, and Weston) can interim minimum goals be achieved for Atlantic salmon (Factual Background, 3.1.6). Based on MDMR modeling, the 99% upstream and 99% downstream effectiveness scenario resulted in 28-29% more adult salmon returns than the 96% upstream and 97% downstream scenario suggested in the SPP. Further, based the site conditions, initial testing, and experience with similar passage approaches implemented in other river systems, we find it highly unlikely that the Licensee will meet even their own proposed standards. The Licensee had previously indicated it could achieve lower standards yet has revised those standards upward without proposing any significant commensurate measures that would likely result in those improvements. With salmon runs below replacement levels currently, MDMR concludes that the adverse impacts of the current proposal will not provide conditions where a minimum sustainable population of Atlantic salmon can be supported in the receiving water. It is also possible that species such as American Shad, which have chronic poor performance at fishways, or Sea Lamprey, which are not considered by the Licensee and migrate primarily at night, could be entirely precluded from receiving waters based on cumulative impacts from downstream projects and likely ineffective passage at the Shawmut Project. The high numbers of dams in the lower Kennebec, unknown outcomes of fish passage at those projects, and poor demonstrated performance at similar fishways (Factual Background, Table 9) significantly increases the probabilities of failure to meet basic biological requirements for some or all of the indigenous species at the Shawmut project.

Issues with Proposed upstream fish passage facilities

The Licensee has proposed to construct permanent upstream fish passage (a single fish lift) at the Shawmut project. Successful fishways must create hydraulic signals strong enough to attract fish to one or multiple entrances in the presence of competing flows (i.e., false attraction). The Shawmut dam is extremely long and has multiple discharge locations that will provide significant false attraction flows during the passage season. MDMR has serious concerns about the design, operation, and location of the fishway and believes the current proposal will result in significant delays and likely poor upstream passage efficiency for multiple species. MDMR also has serious concerns about the cumulative adverse impacts of the Lockwood, Hydro-Kennebec, and Weston projects, which has similar issues.

MDMR is very concerned about the effectiveness of the proposed fishway in May, June, and July when the majority of anadromous species are migrating upstream (Table 1). The maximum station hydraulic capacity of the Shawmut Project is 6,690 cfs, which is exceeded approximately 65% of the time in May, 35% of the time in June, and 20% of the time in July. Water in excess of station capacity is spilled at the sluice gate in the middle of the 1,435-foot long dam, the hinged flashboards on the west side of the dam, or the rubber crest(s) on the eastern half of the dam, providing multiple false attractions. As a result, there will be false attraction at the project during the majority of the upstream migration season to multiple areas without a fishway to the headpond. A proposed cross channel egress from an identified false attraction zone would not provide passage to the headpond or directly to the lift.

Table 1. Upstream Run timing by month of Atlantic Salmon, river herring (Alewife and Blueback Herring) and American Shad captured at the Lockwood Project (2006-2020) and Sea Lamprey captured at the Milford Project (2009-2020).

Month	Atlantic Salmon	River herring	American Shad	Sea Lamprey
May	9%	72%	2%	56%
June	49%	28%	78%	44%
July	32%		19%	
August	2%			
September	3%			
October	4%			

The location of the fishway was based on very speculative assumptions using limited information. The CFD modeling that was conducted looked at a very limited range of flows that are not representative of the majority of the migration period. Furthermore, the siting study, conducted from May 19-June 14, 2016 with radio-tagged alewife, occurred during a low flow period, which is not representative of flows during the passage season. Alewives are not necessarily a good proxy for fish attraction of other species, as the Lockwood and Brunswick projects demonstrate. The existing American Eel fishway locations were selected based on flow conditions that will be changing based on the proposal.

While it is hard to predict the exact passage efficiency and delays rates at each project, the results of studies conducted on Atlantic Salmon and shad migrating upstream at the Lockwood Project are illustrative. The Lockwood and Shawmut projects are similar in that they are complex, wide sites, that have multiple sources of spill that create false attraction for migrating fish.

> Two years of telemetry studies by Brookfield were conducted at the Lockwood Project. In 2016, 16 of the 18 test fish (88.9%) which returned to the Project area were recaptured in the fish lift, and the time from return to the project area to recapture was 0.7-111.2 days (mean=17 days). In 2017, 14 of the 20 test fish (70%) were recaptured in the fish lift, and the time from return to the project area to recapture was 3.3-123 days (mean=43.5). As part of a study of energy consumption, adult Atlantic salmon were captured at the Lockwood fish lift, tagged with thermal radio tags and released downstream of the Project. In 2018, 66.7% of the tagged adults (4 of 6) were recaptured at the fish lift, and the time to recapture was 16-33 days (mean=21.8). The following year, 45.0% of tagged adults (9 of 20) were

> recaptured, and the time to recapture was 9-30 days (mean=18.7). A 2015 study found that 0% of American shad captured in the fishway and returned downstream were recaptured at the fishway.

The Lockwood fishway (fish lift) was designed consistent with current standards for upstream passage of anadromous fish and yet the complicated setup at the dam has undermined the ability of the fishway to effectively pass fish. It would not be unexpected to have similar results at the Shawmut project. Results at projects such as Lockwood show significantly less than minimum goals necessary to support salmon populations and could fully preclude American shad or other species from accessing necessary habitats above the Shawmut project. MDMR believes having only one fishway at this site to the headpond that is non-volitional will likely result in large percentages of fish not finding the fishway and/or experiencing substantial delays.

Operational period

The Licensee proposed to operate the upstream fishway (fish lift) May 1 to October 31 during daylight hours. This proposed upstream operational period is inadequate to effectively pass all species upstream. Atlantic salmon have been documented in the Kennebec River migrating upstream for a longer season and sea lamprey predominately migrate during the night. Fish passage should be provided from May 1 through November 10 with operations occurring 24 hours per day from May 1 through June 30 to accommodate diurnal and nocturnal migrants. In addition, the proposed fish lift is not a volitional facility and its operation is vulnerable to regular mechanical failures and power outages. Fish lifts generally also have a minimum cycle time of about 15 minutes, during which time the fishway is closed. The Licensee considered at a conceptual level both a nature-like fishway (which is volitional) and a fish lift during a feasibility study, but only pursued the fish lift design. MDMR has further explored concepts developed in the Licensees feasibility study and has conceptual designs for a nature like fishway at this site, which can be made available to DEP upon request. There is potential with a nature like volitional and the similarly designed fish lift working together in separate locations, improved upstream fish passage efficiency and timeliness could be achieved.

Issues with Proposed downstream fish passage facilities

The Licensee proposes to utilize three gates in the forebay area (Sluice Gate, Tainter Gate, and Deep Gate) and up to four sections of hinged flashboards to pass fish downstream. The licensee also proposes a guidance boom (discussed below) and no screening protection of fish through the Francis Turbines. Unlike the Licensee proposal in the SPP for the Lockwood, Hydro-Kennebec, and Weston projects, the Licensee does not propose any specific low flow thresholds that would require curtailment of generation to provide for additional spill for protection of downstream passage of Atlantic salmon smolts. The proposal also fails to provide adequate protection for other species during their period of downstream passage. The proposed downstream operational facilities are inadequate to safely and effectively pass Atlantic salmon and all species downstream.

Radio telemetry studies conducted at the Weston, Shawmut, Hydro-Kennebec, and Lockwood projects resulted in baseline survival of downstream migrating Atlantic salmon smolts ranging from 89.5–100%, but only 66-94.5% of smolts successfully passed the projects within 24 hours. The Shawmut project averaged 93% survival. This analysis only measured survival from just above to just below the projects and fails to take into account the impact of the latent mortality and other mortality associated with the cumulative effects of passing multiple projects. For example, smolts that were released at Weston and detected at Lockwood had much lower survival, with a four-year average of 56%, and that does not include the impacts of the Weston impoundment as fish were released just upstream of the dam.

To assess the true impacts of the projects, it is important to account for survival with dam dependency. The NOAA Science Center modeled smolt survival with dam dependency (Stevens et al. 2019) using 40 years of data on the Penobscot River, with estimates of estuarine mortality for fish that passed 4 dams at 1.15% per kilometer versus 0.34% with no downstream dams (natural mortality baseline). MDMR developed a deterministic salmon model utilizing this data and other data in the watershed and modeled smolt survival with four dams under a number of scenarios. Using the passage scenario of 96% upstream and downstream passage per project, these projects would result in a 45% reduction in smolt survival to sea compared to smolt survival without the projects. Using the updated 97% survival per project proposed in the SPP (12% direct mortality across four projects) and NOAAs estimate from a dam impact model (Neiland and Sheehan 2020) of 6% mortality per dam baseline (24% indirect mortality across four projects), would result in 36% mortality of smolts from project effects alone. In NOAAs August 28, 2020 preliminary Section 18 prescription, their analysis estimated about 40% loss of smolts due to project impacts. The loss of between 36-45% of smolts from dam impacts in addition to baseline mortality on a salmon run that is currently below replacement is not supportive of recovery, even under the most favorable marine survival and freshwater production scenarios. It is unlikely that the Licensee could even achieve the 97% downstream standard based on their proposal as many fish would still be entrained in turbines without shutdowns or full screening. Thus, representations of "Whole Station Survival" vastly understate the current take of these projects as they measure only a small window of impacts that do not account for large impacts of impoundments and latent impacts to fish that pass dams (e.g. delayed mortality in estuary rather than directly after passing project). In addition, in their Augusta 28, 2020 preliminary prescription for the Shawmut project, NOAA predicted that the overall survival of kelts through the four projects cumulatively would be 42% to 51%, an incredibly low number of fish that would preclude the important life history trait of repeat spawning.

The proposed guidance structures (discussed below) at the project are unlikely to prevent or reduce entrainment of smaller alosines. In addition, smaller alosines are more likely to migrate past the Lower Kennebec Projects during the summer months (July-September) when water levels are not likely to result in spill at the project. Due to the reduced swimming ability of smaller alosines and the timing of their migrations, MDMR believes that smaller alosines are likely passing through the turbines of the projects at a high rate. Juvenile alosines migrate downstream from freshwater nursery habitat in Maine between July and November each year. While some juveniles stay in nursery habitat and reach lengths of 100-150mm before their downstream migration, a significant portion of the downstream migrants are much smaller (total length 40-100mm) and typically migrate earlier in the year. Smaller alosines do not have the same swimming ability as larger fish and are more likely to utilize routes of passage in a manner proportionate to the ratio of flow to a given a route. For this reason, smaller juvenile alosines are likely to be entrained as they migrate past the project and turbine passage has been documented as the route of highest mortality (acute and latent) when compared to other passage routes. This will result in adverse impacts to these species and not be conducive to meeting demographic or other goals to maintain self sustaining runs above these projects.

Surface Guidance Boom

The Licensee proposed to construct a fish guidance boom system that is intended to preclude downstream migrating fish from entrainment in Units 7 and 8. MDMR does not support the Licensee's proposal to use surface guidance booms at the Shawmut Project and finds them to be inadequate to protect the GOM DPS population of Atlantic Salmon and the other diadromous species in the Kennebec River. Data provided by the Licensee in the (SPP, Table 5-1) demonstrates that the guidance booms used at the Lockwood, Hydro-Kennebec, and Weston Projects do not guide 14.3-30.6% of the migrating smolts away from the turbines. Data provided by the Licensee (FLA, Table 4-22) shows that 32.7% of the downstream migrating smolts were entrained into the turbines at the Shawmut Project. The instantaneous survival was 7% lower when fish went through the turbines compared to spill routes at Shawmut and that grossly underestimates the sublethal effects, including injury and disorientation, that would result in higher mortality in the estuary. Studies at the Ellsworth dam on the Union river assessing injury to salmon showed that 22-30% of fish that went through the turbines had injuries compared to 3.8% that went through spill routes, demonstrating that impact quantitatively. The 2015 *Evaluation of Downstream Passage for Adult and Juvenile River Herring* demonstrated that 53 percent of the study fish went through the Lockwood turbines, rather than being guided by the boom to the downstream bypass, and survival was lowest for those fish passing Lockwood via the units (i.e., 77-4-81.7% survival).[4] This would indicate that performance standards would not likely be met for these species with the proposed plan.

In addition, MDMR has consulted with the USFWS regarding floating guidance booms and concurs with their comments that are provided below.

> "The Service does not know of any studies that have assessed how effective floating guidance booms are at protecting eels as they attempt to migrate downstream past a hydroelectric project. However, we do know that eels are a bottom-oriented species (Brown et al. 2009) and therefore a floating guidance boom with partial depth panels would not be fully protective. As stated in our 2019 Fish Passage Engineering Design Criteria manual, "A floating guidance system for downstream fish passage is constructed as a series of partial depth panels or screens anchored across a river channel, reservoir, or power canal. These structures are designed for pelagic fish which commonly approach the guidance system near the upper levels of the water column. While full-depth guidance systems are strongly preferred, partial-depth guidance systems may be acceptable at some sites (e.g., for protection of salmonids, but not eels)." Booms have not been implemented as a protective measure for eels or alosines anywhere else in our region, which spans fourteen states, unless they are installed with other protective measures that are suitable to ensure the safe, timely, and effective downstream passage of our trust species (e.g., inclined bar screens, angled bar racks, etc.). Therefore, the Service recommends that any protective measure implemented at the mainstem Kennebec River hydroelectric projects, as part of the current SPP process, are

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[4] Accession No. 20160331-5144

protective of all migratory species and that the proposed mitigation measures comport with the Service's fish passage guidelines."

Operational period

The Licensee proposed to operate the downstream fishway as follows:

- Continue to operate the existing forebay surface sluice gate at maximum capacity to pass up to 35 cfs from April 1 to December 31 to provide a continuous surface bypass route for downstream migrating fish.
- Continue to spill 600 cfs through the existing forebay Tainter gate from April 1 to June 15 to provide a passage route for Atlantic salmon smolts.
- Continue to provide a total of 6% of Station Unit Flow (about 400 cfs at maximum generation) through the combined discharge of the forebay Tainter and surface sluice gates from November 1 to December 31 to provide a safe passage route for Atlantic salmon kelts.
- During the interim period between license issuance and the installation of the new fish guidance boom, continue to lower four sections of hinged flashboards to pass 560 cfs via spill from April 1 to June 15 to provide a safe passage route for Atlantic salmon smolts.
- Continue to pass approximately 425 cfs through the forebay deep gate and shut down Units 7 and 8 for 8 hours during the night for 6 weeks between September 15 and November 15 for downstream adult eel passage.

This proposed downstream operational period is inadequate to safely and effectively pass all species downstream. Alewives and blueback herring leave the spawning grounds immediately after spawning and begin their downstream migration. American shad exhibit similar behavior. This downstream migration typically occurs between May and September each year. In addition, juvenile lifestages of these three species of alosines begin migrating downstream as early as July when they are only approximately 40mm long. Larger juveniles will migrate downstream as late as November depending on environmental variables freshwater nursery habitats. The Licensee has proposed to cease operation of the forebay Tainter gate after June 15th, which would leave only the forebay sluice gate in operation. The maximum capacity of the sluice gate is approximately 35cfs, which is 0.52% of station capacity and is 0.43-0.81% of average flow at the Shawmut dam between June and September.

The Licensee also mentions that they will prioritize units for protection of Atlantic salmon. Based on the average daily inflow reported in table 2 of the EA, station capacity will be exceeding in all months except July, August, and September. Therefore, station capacity will be exceeded at the project for the majority of the downstream migration of Atlantic salmon smolts and adult alosines in the spring and the majority of the juvenile alosines and adult eels in the summer and fall. While unit prioritization is proposed for these times as a protective measure, the prioritization will not be in effect as all units will be "on".

Turbine screening

The licensee did not propose any additional screening, however FERC has suggested screening may be required as this was suggested in NMFS Section 18 preliminary prescription. The preliminary screening suggestion is to equip each powerhouse with full-depth trash rack bars clear spaced at 1.5-inches and 3.5-inches for Units 1-6 and 7-8 respectively. This screening approach is inadequate for Atlantic salmon and does not take into account juvenile river herring, shad, sea-lamprey, or eels so will not result in safe downstream passage of indigenous species. In order to protect downstream migrating Atlantic Salmon smolts and kelts, adult and juvenile Alewife, adult and juvenile American Shad, adult and juvenile Blueback Herring, and adult American Eel, and adult and juvenile sea-lamprey, the Licensee would need to install full-depth inclined or angled screening with much smaller spacing and sized so that the normal velocities should not exceed 2 feet per second measured at an upstream location where velocities are not influenced by the local acceleration around the guidance structures.

Non-Attainment

MDMR notes that aquatic life monitoring in the Shawmut impoundment indicates a finding of non-attainment ME0103000306_339R_01.
https://www.maine.gov/dep/water/monitoring/305b/2016/28-Feb-2018_2016-ME-IntegratedRptLIST.pdf.

Conclusion

The proposal by the Licensee will have significant adverse impacts to fisheries habitat and aquatic life and does not provide sufficient protections for indigenous species. Many additional items, such as full depth appropriate screening, a second volitional fishway near a major area of attraction flow on river right, and reliance on other best protective practices and available science should be considered further.

Brookfield
Renewable

August 16, 2021

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

Subject: Comments on Draft Environmental Assessment
Shawmut Hydroelectric Project (FERC No. P-2322-069)

Dear Secretary Bose:

Brookfield White Pine Hydro LLC ("Brookfield") is the Licensee for the Shawmut Hydroelectric Project ("Project") and filed a new license application for the Project with the Commission on January 31, 2020. On July 1, 2021, the Commission issued its Notice of Availability of Draft Environmental Assessment and Revised Procedural Schedule (Notice) for the relicensing of the Project. The Notice provided that comments on FERC's Draft Environmental Assessment (DEA) should be filed within 45 days of the Notice. Brookfield's comments on the DEA are set forth in this filing.

Section 3.0 Environmental Analysis

3.3.1 Aquatic Resources

3.3.1.2 Environmental Effects

Operations Monitoring Plan. Section 3.3.1.2 of the DEA discusses the draft Operations Monitoring Plan, noting that it "does not currently describe the mechanisms and structures to be used to monitor compliance with impoundment elevation limits and ROR operation" (36).

Brookfield will include such detail in the final plan to be filed post-license for Commission approval.

Fish Passage Design Expectations. On page 38 of the DEA, Commission staff conclude that, based on all the consultation done on the Shawmut upstream and downstream fishway design that the proposed fishways "are reasonably certain to facilitate fish passage on an annual basis for the numbers of species specified by NMFS and recommended by MDMR."

Brookfield strongly agrees with this statement and further notes that this conclusion is not unexpected, given that the proposed fishway designs were developed through years of close consultation with the relevant fishery agencies. The proposed designs reflect extensive NMFS and MDMR comment and direction.

Shad Passage. On page 43 of the DEA, Commission staff note that “telemetry study of shad passage at the Lockwood fish lift in 2010 showed that 2 of 37 tagged shad approached the fish lift and only one entered it, in spite of a substantial number of shad congregating and spawning just downstream of the project.”

While strictly accurate, Brookfield considers the statement as written somewhat misleading, as it implies that the failure to pass resulted solely from a deficiency in the fish lift, while other contributing factors should be considered. Most importantly, as broadcast spawners, shad are only motivated to move as far upstream as necessary to reach unsaturated spawning habitat. In the Kennebec Basin, considerable shad spawning habitat is available downstream of Lockwood: over 40 percent of the shad spawning habitat (1,013 hectares) is available to shad either unimpeded or through volitional fishways. This available habitat is estimated to be able to support a spawning population of 205,544 shad.

As demonstrated by 2010 telemetry study results, the majority (71%) of the shad moved downstream and never approached the Lockwood Dam, which is obviously not indicative of poor fishway performance. Further, for the remaining shad, residence time in the area immediately downstream of the powerhouse was limited to a short duration (mean = 1.4 hours) which is not consistent with searching behavior.

Brookfield is aware of no study subsequent to Brookfield’s 2010 telemetry study demonstrating that the downstream habitat even approaches saturation. The ready availability of unsaturated spawning habitat below Lockwood could have potentially reduced the motivation of shad to move above Lockwood.

Factors Influencing Fishway Effectiveness. In Section 3.3.1.2 of the DEA, Commission staff conclude that “achievement of performance standards for American shad and sea lamprey might not be realistically achievable due to factors that are unrelated to the design of the fishways, such as: (1) lack of motivation to continue to migrate upstream after capture, tagging, and release for effectiveness studies, (2) inability or lack of motivation to pass a fishway due to the energetic demand from migrating long distances upstream and passing multiple dams during the migration, or (3) inability or lack of motivation to pass a fishway due to other factors that are poorly understood” (34).

Brookfield agrees with all three points and recommends that the Commission also consider the “availability of suitable spawning habitat below the dam” as another very important factor.

Specifically, over 40 percent of the shad spawning habitat (1,013 hectares) is currently available to shad either unimpeded or through volitional fishways downstream of the Shawmut Project and is estimated to be able to support a spawning population of 205,544 shad. Little evidence or data exists regarding the historic lamprey habitat. MDMR asserts the majority of historic lamprey habitat is above the Shawmut Project citing their own unpublished data which correlates a single radio-tagged fish observed on the Pleasant River (a tributary of the Penobscot) to expected sea lamprey’s historic or current migratory range in the Kennebec River basin.

Benefit of Effectiveness Standards. On page 59 of the DEA, Commission staff's analysis of benefits to downstream salmon smolts based on standards of 96%, 97%, and 99% finds that the higher standards would result in only 1-3 more returning adult salmon.

Brookfield strongly agrees with these findings. In previous filings Brookfield has argued that the higher performance standards recommended by NMFS and MDMR are unsupported, unrealistic, and needlessly expensive. The Commission's analysis provides important context to the potential benefit of these higher standards: 1-3 additional salmon would be extremely unlikely to affect the overall recovery of the species.

Section 5.0 Conclusions and Recommendations

5.1.3 Measures Not Recommended

On Page 121 of the DEA, Commission staff do not "recommend any upstream passage performance standards or effectiveness testing for alosines or sea lamprey."

Brookfield strongly agrees with this decision. Neither NMFS nor MDMR provide any rationale for their performance standards for alosines or sea lamprey, and Brookfield is not aware of any Kennebec-specific study that would support the agencies' recommendations. In the absence of any supporting documentation, these recommendations are arbitrary and capricious.

As detailed in Brookfield's October 14, 2020 "Response to comments on the Final License Application and Preliminary Terms and Conditions for the Shawmut Project," MDMR had recommended a total of 39 study seasons of effectiveness studies at a total estimated cost of $3.9 million, including several species for which study methodologies are not refined. As MDMR fully understands, upstream shad passage studies routinely provide inconclusive results and upstream lamprey studies are only just now being conducted in the state of Maine, whereas downstream lamprey studies have not. Brookfield objects to any study for which a sound, reproducible methodology has not been established.

Appendix F, Alternatives Considered but Eliminated from Detailed Analysis

Brookfield fundamentally agrees with the Commission's historical position that "decommissioning is not a reasonable alternative to relicensing a project . . . when appropriate protection, mitigation, and enhancement measures are available." To that point, Brookfield believes that the new fish passage measures proposed for the Shawmut Project, which were developed in close consultation with the relevant fishery agencies, and are consistent with fish passage agreements and previously issued Biological Opinions, and will support the restoration of diadromous fish to the Kennebec River Basin.

That said, Brookfield does question a statement made by Commission staff on page 189 that "[dam] removal would create a free, unobstructed path for fish." To Brookfield's knowledge, this assertion is unsupported—no assessment has been conducted of how much of an impediment to fish passage would be left if the dams were removed. Most dams on the Kennebec were built at the site of natural falls or elevation changes, and the location of the Shawmut Project may well have formed a natural impediment to upstream passage for many, if not all, of these diadromous species.

Brookfield appreciates the opportunity to comment on the Commission’s Draft Environmental Assessment for the relicensing of the Shawmut Project. Should you have any questions regarding this filing, please contact me at (207) 755-5605 or by email at randy.dorman@brookfieldrenewable.com.

Sincerely,

Randall Dorman
Licensing Manager
Brookfield Renewable

cc: Kelly Maloney, Brookfield
Wendy Bley, Kleinschmidt
Andrew Qua, Kleinschmidt

ibew

International Brotherhood Electrical Workers

Local #1837 Utility / Broadcasting

NEW HAMPSHIRE OFFICE
680 Central Avenue, Suite 201
Dover, NH 03820
(603) 743-1652
Fax (603) 743-1654
nhlocal@ibew1837.org

Tony Sapienza, Business Manager
Michelle Crocker, President
Renee Gilman, Assistant Business Manager
Matthew Beck, Business Representative

MAINE OFFICE
16 Old Winthrop Road, Suite 1
Manchester, ME 04351
(207) 623-1030
Fax (207) 621-8384
union@ibew1837.org

August 12, 2021

The International Brotherhood of Electrical Workers Local Union #1837 is proud to represent 1,000 workers in Maine, including 29 dedicated employees of Brookfield Renewables at various locations including the lower Kennebec River's Shawmut Dam. We also represented those workers when the Shawmut Dam was operated by Central Maine Power Company before deregulation and then NextEra before it was sold to Brookfield.

We support Brookfield's Final License Application and the findings of the Draft Environmental Assessment on the Shawmut Hydroelectric Project (FERC No. 2322-069) that dam removal is not a reasonable option.

As Maine lost thousands of good-paying Union jobs in manufacturing throughout the state, it became harder to find jobs that allowed people to buy a home, raise a family and have enough financial security to retire with dignity. Decommissioning Shawmut and/or other dams would have unintended consequences that will be difficult to reverse. If the dams go away, many of those good jobs will go away, too. These are people's careers and livelihoods, in some families that go back two or three generations, working on the rivers of Maine.

Of course, the ripple effects of dam decommissioning on the surrounding communities should not be overlooked. In addition to their dedication to being good stewards of the Kennebec River and helping to maintain all the recreation opportunities for the 40-year license term including the Hinckley Boat Launch and the Shawmut Boat Canoe Portage, our members at Brookfield will continue to contribute to the local economies of those communities whenever they stop to buy something at a local store or fill-up their trucks at local gas stations. Decommissioning the Shawmut Dam would hurt the economic health of these small towns that help make our state such a special place.

I recently served as a member of the Energy Working Group of the Maine Climate Council. Maine's Four-Year Plan for Climate Action calls for a 45% reduction in greenhouse gas emissions by 2030 and 80% by 2050. This month's UN Climate Change "Code Red for Humanity" Report adds an even greater sense of urgency to this. Under the terms of the license application, carbon-neutral energy generated by Shawmut Dam will make an important contribution toward reaching Maine's goals while protecting our state's environmental resources.

Furthermore, Governor Janet Mills has proposed that we double the number of Maine's clean-energy and energy-efficiency jobs by 2030. Gov. Mills said: "These 30,000 jobs will fight climate change while providing new opportunities to Maine working men and women and advancing long-term prosperity for our state."

Decommissioning the Shawmut Dam or other dams on the Kennebec will move Maine in the opposite direction and be a setback for those critical environmental and economic goals.

Sincerely,

Matt Beck

Matthew Beck
Business Representative, IBEW Local Union #1837

PIERCE ATWOOD LLP

MATTHEW D. MANAHAN

Merrill's Wharf
254 Commercial Street
Portland, ME 04101

P 207.791.1189
F 207.791.1350
C 207.807.4653
mmanahan@pierceatwood.com
pierceatwood.com

Admitted in: MA, ME, NH

July 23, 2021

The Honorable Kimberly Bose
Secretary
Federal Energy Regulatory Commission
888 First Street, NE
Room 1A, East
Washington, DC 20426

Re: Shawmut Hydroelectric Project, P-2322-069
Comments on Draft Environmental Assessment

Dear Secretary Bose:

Please accept these comments on behalf of Sappi North America, Inc. ("Sappi") on the Draft Environmental Assessment (DEA) issued on July 1, 2021 in the above-captioned docket. We previously submitted comments by letter dated March 29, 2021, which the DEA references on page 191. Specifically, the DEA states that "removing the dam could lower the water levels to a point that the mill's intake would not be functional and the diffuser for discharging its wastewater would be too close to the water surface to function properly." This is true, and it is important to add that it would cost in excess of $50 million to remediate these impacts – if such remediation is even possible – and that such remediation likely would take two or more years to design, permit, and construct, and therefore may result in significant downtime at the facility.

Thus, removal of the Shawmut Dam – or imposition of uneconomic conditions that would effectively require dam removal through license surrender – would have potentially devastating economic effects on Sappi's Somerset Mill, its employees, and its suppliers, and thus a similarly devastating impact on the surrounding communities whose economies rely to a large extent on the Somerset Mill. Sappi fully supports the DEA's conclusion that reasonable protection, mitigation, and enhancement measures can be fashioned – as outlined in the DEA – to support the recovery of diadromous fish in the basin and still provide for the generation of power, and that decommissioning therefore is not a reasonable alternative to relicensing.

Thank you for your consideration of these comments.

Sincerely,

Matthew D. Manahan

cc: FERC Service List (certificate of service attached)
Matt Cutlip, matt.cutlip@ferc.gov
Kathy Howatt, Maine DEP

CERTIFICATE OF SERVICE

I hereby certify that I have this day served the foregoing document upon each person designated on the official service list compiled by the Secretary in this proceeding.

Dated at Portland, Maine this day: July 23, 2021

Matthew D. Manahan
Pierce Atwood LLP
Merrill's Wharf
254 Commercial Street
Portland, ME 04101
207-791-1189
mmanahan@pierceatwood.com
Counsel for Sappi North America, Inc.

MAINE AFL-CIO
A Union of Unions Fighting for Maine Workers
21 Gabriel Drive, Augusta, Maine 04330
Tel. (207) 622-9675 • Fax (207) 622-9685
www.maineaflcio.org

President
Cynthia Phinney
cynthia@maineaflcio.org

Vice President
Patrick Carleton
cpcarleton@yahoo.com

Secretary-Treasurer
Douglas Born
dougia114@gmail.com

Maine AFL-CIO Comments regarding Docket P-2322-069

August 13, 2021

On behalf of the Maine AFL-CIO, we are submitting comments on Docket P-2322-069 related to the relicensing of Shawmut Dam on the Kennebec River. We support the Shawmut Draft Environmental Assessment that was released on July 1, 2021 and the relicensing application submitted by Brookfield White Pine Hydro.

The Maine AFL-CIO is a federation of unions representing approximately 40,000 working people across the state of Maine. We work to improve the lives and working conditions of our members and all working people. You have already received comments from one of our affiliate unions, IBEW Local #1837. Our comments serve to backup and reinforce the comments they expressed on behalf of the 1,000 workers they represent, including 29 dedicated employees of Brookfield Renewables at various locations.

Maine has already lost thousands of good-paying Union jobs throughout the state. Any actions that could worsen the situation for Maine's working families should be avoided whenever possible. The dams on the Kennebec River and the jobs that go with them have been a vital part of the Maine economy for generations. The workers at those dams feel tremendous pride in what they do to help provide carbon-neutral electricity for Maine and they consider themselves to be good stewards for the Kennebec.

It is more than just the jobs at the dams themselves. Companies large and small that provide services to these dams in the neighboring communities employ many more people and provide livings for many more families. Working people often enjoy the recreational opportunities on the Kennebec River afforded by Shawmut and other dams. The tax dollars that go to municipal coffers help pay for local services that benefit everyone living in those communities.

Removing just the Shawmut Dam could have profound implications. Published reports indicate that the Shawmut's removal would lower the water level by the Sappi Somerset Mill in Skowhegan by 15 – 20 feet, requiring the construction of a new water intake structure that would cost tens of millions of dollars. It's unclear if such a structure would even work, possibly putting the future of that mill at risk and all the good-paying union jobs and tax revenue that goes with it.

Removing Shawmut or any other dams from the Kennebec could have profound economic effects on hundreds of Maine workers and their communities. That is why we support the conclusion of the Shawmut Draft Environmental Assessment that dam removal is not an acceptable option.

Sincerely,

Cynthia Phinney

Cynthia Phinney
President
Maine AFL-CIO

MID-MAINE
CHAMBER OF
COMMERCE
Making the Difference

50 Elm Street • Waterville, ME 04901
Telephone (207) 873-3315 • Fax (207) 877-0087
kimberly@midmainechamber.com
www.midmainechamber.com

August 13, 2021

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

Subject: Shawmut Hydroelectric Project (FERC No. 2322-069);
Comments on Draft Environmental Assessment

Dear Secretary Bose:

Please accept and consider these comments on behalf of the Mid-Maine Chamber of Commerce which represents twenty-three communities and over 600 members in the greater Waterville area. Mid-Maine Chamber's board of directors has taken a position to unanimously oppose the removal of the Shawmut Dam or any action which would result in such -- which is currently being considered for relicensing. This would negatively impact both businesses and the municipalities in which it serves. It's non-relicensing and/or removal would result in the potential loss of jobs as well as tax revenue. Mid-Maine Chamber of Commerce is a firm supporter of clean, renewable energy in the form of hydropower.

While we do not want to see any species of fish become extinct, we do not believe that these two goals – retaining the Shawmut Dam and supporting the recovery of diadromous fish in the basin – are mutually exclusive. In fact, we believe these two goals can be jointly achieved. We urge the relicensing of the Shawmut Dam.

Thank you for your time and consideration.

Warm regards,

Kimberly N. Lindlof

Kimberly N. Lindlof
President & CEO
Mid-Maine Chamber of Commerce