Appendix 11

Essential Fish Habitat Consultation

From:	Ham, Eric
To:	"Mike R Johnson - NOAA Federal"
Cc:	Birk, Eva (FHWA); martin, cheryl; Gardner, David; Chamberlain, Kristen; zachary.jylkka@noaa.gov
Subject:	RE: Topsham/Brunswick MaineDOT WIN 22603.00 EFH Assessment
Date:	Friday, August 31, 2018 3:18:00 PM

Mike.

Thank you for the conservation recommendations.

We accept conservation recommendation 1. That recommendation will be implemented with the standard provisions in our contracts.

We accept conservation recommendation 3. It will be addressed during the permitting process with the ACOE when the final impacts numbers are developed.

We accept a portion of conservation recommendation 2. I have copied PRD on this email as well as the language the you recommended mirrors what was in the BiOp from ESA consultation. We discussed have the demolition/rock removal methods that could result in injury and are currently not predictable (blasting and hoe rams) occur during the November 8 to March 15 window. The consultation also resulted in restriction on other activities that will result in noise over 150 dB RMS but not resulting in potential injurious levels could occur between August 1 and March 15.

Conservation recommendation 2 (and AMM 8) both state "or other methods generating underwater noise above 150 dB RMS should only occur from November 8 to March 15". It is probably not going to be an issue, but I think it is important to change the wording a little. We will accept the condition below and place it into the contract for the project. I will also have the conversation with Zach about this potential change. I had reviewed this language in the draft BiOp and failed to request any alterations at that time.

All bedrock leveling and substructure removal using hydraulic breakers, hoe rams, blasting, or other methods resulting in potential injury to fish species present should occur between November 8 to March 15. All other in water work activities resulting in potential noise levels over 150 dB RMS are subject to the August 1- March 15 work window.

Thank you for the recommendations.

From: Mike R Johnson - NOAA Federal [mailto:mike.r.johnson@noaa.gov]
Sent: Friday, July 27, 2018 4:38 PM
To: Ham, Eric <Eric.Ham@maine.gov>
Cc: Birk, Eva (FHWA) <eva.birk@dot.gov>; martin, cheryl <Cheryl.Martin@dot.gov>; Gardner, David <David.Gardner@maine.gov>; Chamberlain, Kristen <Kristen.Chamberlain@maine.gov>
Subject: Re: Topsham/Brunswick MaineDOT WIN 22603.00 EFH Assessment

Eric,

Based on the information in the EFH assessment, we have the following EFH conservation recommendations to provide for the proposed bridge project.

1. Debris and rubble from the demolition of the existing bridge should be prevented from entering the river below the OHW line, to the extent possible. Any debris or rubble that inadvertently falls below the OHW line should be removed using the least damaging methods available.
2. To clarify, all bedrock leveling and substructure removal using hydraulic breakers, hoe rams, blasting, or other methods generating underwater noise above 150 dB RMS should only occur from November 8 to March 15. The information in the EFH assessment uses a date of August 1 to March 15. This measure minimizes impacts to migrating alewife, blueback herring, American shad, rainbow smelt, and striped bass.
3. Compensatory mitigation should be provided for the permanent loss of 3,000 sq. ft. from new piers and Brunswick abutment. This was calculated by subtracting the 800 sq. ft. of removal of the center pier from 3,800 sq. ft. of total impacts, providing a net impact is 3,000 sq. ft. (not 100 sq. ft. as described in the EFH assessment). The ME In-lieu fee program is an acceptable means of providing compensatory mitigation.

Thanks for your patience with our completing this consultation.

Mike

On Fri, Jul 27, 2018 at 3:41 PM, Ham, Eric <Eric.Ham@maine.gov> wrote:

> Sorry for the confusion Mike.
>
> AMM 8 is correct and AMM 9 is incorrect. Blasting (if needed) will only occur between November 15 and March 15.
>
> **From:** Mike R Johnson - NOAA Federal [mailto:mike.r.johnson@noaa.gov]
> **Sent:** Friday, July 27, 2018 3:36 PM
>
> **To:** Ham, Eric <Eric.Ham@maine.gov>
> **Cc:** Birk, Eva (FHWA) <eva.birk@dot.gov>; martin, cheryl <Cheryl.Martin@dot.gov>; Gardner, David <David.Gardner@maine.gov>; Chamberlain, Kristen <Kristen.Chamberlain@maine.gov>
> **Subject:** Re: Topsham/Brunswick MaineDOT WIN 22603.00 EFH Assessment
>
> Eric,
>
> I'm preparing the conservation recommendations for this project, but there are some remaining questions I have from your response on 7/11:
>
> AMM 8- Bedrock leveling and substructure removal using hydraulic breakers (or hoe rams), **blasting**, or other methods generating underwater noise above 150 dB RMS **will occur from November 8 to March 15**.
> AMM 9- Plans for any project-related **blasting** will be submitted with 150 days for NOAA to review, **will not occur outside of the in-water work window (August 1 to March 15**), and will be designed to remain below potential fish injury limits (206 dB Peak (2.89 PSI)).
> Aren't these two conditions in contradiction? AMM 8 requires blasting to only occur from Nov. 8 to Mar. 15, while AMM 9 allows blasting from Aug. 1 to Mar. 15.

Thanks,

Mike

On Wed, Jul 11, 2018 at 10:07 AM, Ham, Eric <Eric.Ham@maine.gov> wrote:

Mike,

Please see our responses in red below. Let me know if you have additional questions.

From: Mike R Johnson - NOAA Federal [mailto:mike.r.johnson@noaa.gov]
Sent: Monday, July 02, 2018 2:03 PM
To: Ham, Eric <Eric.Ham@maine.gov>
Cc: Birk, Eva (FHWA) <eva.birk@dot.gov>; martin, cheryl <Cheryl.Martin@dot.gov>; Gardner, David <David.Gardner@maine.gov>; Chamberlain, Kristen <Kristen.Chamberlain@maine.gov>
Subject: Re: Topsham/Brunswick MaineDOT WIN 22603.00 EFH Assessment

Eric,

Very nice job on the EFH Assessment for this project. It was thorough and provided most of the necessary information for making our determination and recommendations. However, I do have some questions that I'd like to get resolved before provided conservation recommendations.

Section 2.3.2. Demolition: It indicates the north abutment will be removed to finished grade, but the Brunswick abutment will remain in place. Why is this? Does it provide stability to the fishway or something? Likely not to the fishway. The new abutment will be between the old abutment and the fishway. The old abutment provides so stability to the existing slop and folks are still exploring potentially using it have landscape feature on top of it adjacent to the existing park.

Also, the north abutment (Topsham) isn't included in the "restoration" in Table 5.1. Is the north abutment above the highest observable water (HOW) mark?

I believe it is above the ordinary high water (OHW) mark. That is what we normally use to define the edge of the resource. Highest observable may be different? That abutment may see water on very high flows and releases from the dam, but not what I would consider normal high water.

Section 2.3.3. Mitigative Measures (Blasting). It states "The proposed in-water work window of August 1 to March 15 defines the time period during which no activities resulting in in-water noise louder than 150 dB RMS should occur." This seems to be incorrect, since as I read it it suggests elevated noise should not occur between August 1 and March 15.

You are correct. They will occur during the defined windows between AMM 8, AMM 9 below.

Section 5.2.1. In-water Structures. I have several questions and issues related to this section, including Table 5-1. The questions also apply to Section 5.4 Conclusions

Regarding Potential Project Effects on EFH.
The section on in-water structures and the conclusions section states the total permanent impact to EFH is 900 sq. ft. minus 800 sq. ft. from pier removal, or 100 sq. ft. net loss. I think the rationale you used was only "in-river" habitat is considered and "ponded and bedrock falls" habitat is excluded from impacts to EFH. I'm not sure I follow this. Is the "ponded and bedrock falls" habitat all above the HOW mark? Even if this area is flooded intermittently during spring flows, I think it still would be habitat for Atlantic salmon and prey species and should be included as impacts to EFH.

The bedrock falls where actually augmented with concrete in the past to preclude salmon from entering that portion of the river in hopes that they would move towards the fishway entrance. We did not analyze that piece as habitat because of it. It is intermittently flooded depending on damn releases as you mention above. The cofferdams required to construct the two piers in questions will effect approximately 1250 square feet each. The concrete seal used for the cofferdam becomes the base for the pier. So there is ~2500 square feet of impacts in that area.

Table 5-1 indicates 3,800 sq. ft. of permanent impacts, but the discussion in Section 5.4 refers to only the pier impacts and excludes the riprap scour protection impacts of 400 sq. ft. As I understand the project, the riprap for the Brunswick abutment is below the HOW mark and should be included. Please explain.

You are correct. Those are impacts below the OHW and should be included in the impact numbers.

Section 6.2-6.5 (Other diadromous fish). The assessment for all four species state that there may be impacts to either juvenile or multiple life stages due to sedimentation or underwater noise. However, the assessment concludes project activities are not expected to restrict the movement through the Androscoggin River. If blasting or hydraulic fracturing of rock occurs between August 1 and March 15, during either juvenile out-migration or spawning and egg development (for smelt), and this was assessed as a physiological impact (possible mortality), how is this not a potential adverse effect? I suppose strictly speaking noise impacts may not restrict movement of juveniles downstream, but it could cause mortality or injury.

We made some adjustments to this during the ESA consultation that did not get fixed in the EFH assessment.

AMM 8*- Bedrock leveling and substructure removal using hydraulic breakers (or hoe rams),*
blasting, or other methods generating underwater noise above 150 dB RMS will occur from November 8 to March 15.
AMM 9*- Plans for any project-related blasting will be submitted with 150 days for NOAA to*
review, will not occur outside of the in-water work window (August 1 to March 15), and will be designed to remain below potential fish injury limits (206 dB Peak (2.89 PSI)).

One point I would suggest could be revised for the next assessment, and that is the discussion on "Additional NOAA Trust Resource Species". It states that "Several species that use the project area and are not EFH designated species were also included due to their commercial, recreational, and ecological importance (NOAA trust resources)." The required analysis for an EFH assessment is the "adverse affects" of the action on the EFH for federally-managed species under the Magnuson-Stevens Act. The EFH regulations at § 600.810 defines an adverse effect as "any impact that reduces quality and/or quantity of EFH" and "may include direct or indirect physical, chemical, or biological alterations of the waters or substrate and loss of, or injury to, benthic organisms, prey species and their habitat, and other ecosystem components, if such modifications reduce the quality and/or quantity of EFH." So while it is correct that these other NOAA trust species have important commercial, recreational, and ecological values, the reason they should be included in an EFH assessment is because they are prey for other federally-managed species, and so the project should evaluate adverse effects to them.

Thanks,

Mike

On Mon, May 14, 2018 at 3:25 PM, Ham, Eric <Eric.Ham@maine.gov> wrote:

> Mike,
>
> The Maine Department of Transportation (MaineDOT) is proposing a bridge replacement project on the Frank J Wood Bridge carrying Route 24 over the Androscoggin River between Topsham and Brunswick, ME.
>
> The Androscoggin River is designated Essential Fish Habitat (EFH) for Atlantic salmon. The project is also located in the tidal portion of the river and is EFH for multiple coastal species. Please see the attached document for the determination of the EFH presence in the project area. The Federal Highway Administration is the action agency for this project and has delegated to MaineDOT the authority to consult with NOAA-Fisheries on projects that may have potential adverse effects on EFH. MaineDOT has reviewed the available information for the project including a field visit to survey fisheries habitat. Based on the review of the available data, assessment of site conditions, and project plans, MaineDOT has determined the project will not have a substantial adverse effect to EFH and therefore requests an abbreviated consultation under the Magnuson Steven's Conservation and Management Act per 50 CFR 600.92(h). MaineDOT respectfully requests a response to this abbreviated consultation within 30 days (June 14, 2018).
>
> Thank you and let me know if you have any questions.
>
> Eric

--
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Essential Fish Habitat Assessment Frank J. Wood Bridge Replacement Project

Prepared For:
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December 2017

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1.0 Introduction

This report presents an Essential Fish Habitat Assessment (EFHA) conducted for the Maine Department of Transportation (MaineDOT) Frank J. Wood Bridge replacement project. This assessment is required under the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) of 1976, amended in 1996 by the U.S. Congress under the Sustainable Fisheries Act (SFA), and reauthorized in 2006. The SFA recognized that many fisheries depend on marine, nearshore, and estuarine habitats for at least part of their lifecycles and introduced requirements to protect estuarine and marine ecosystems through identification and conservation of Essential Fish Habitat (EFH) for those species regulated under a federal fisheries management plan. EFH is defined as waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity (NMFS 2007a, 16 U.S.C. 1802(10)). Fish are defined as finfish, mollusks, crustaceans, and all other forms of marine animal and plant life other than marine mammals and birds (NMFS 2007a, 50 CFR 600.10). The National Marine Fisheries Service (NMFS) is mandated by the SFA to coordinate with other federal agencies to avoid, minimize, mitigate, or offset adverse effects on EFH that could result from proposed activities. The contents of this EFHA are intended to meet the requirements described by the NMFS to comply with the Magnuson-Stevens Act, including: (1) a description of the proposed action; (2) an analysis of potential adverse effects of bridge construction and removal on EFH.

2.0 Project Description

The Maine Department of Transportation proposes to construct a new bridge to replace the existing Frank J. Wood Bridge, which carries US 201/ME 24 over the Androscoggin River between the Towns of Brunswick and Topsham. After the new bridge is constructed, the existing Frank J. Wood Bridge will be removed.

2.1 Description of the Existing Bridge

The Frank J. Wood Bridge is an 85-year-old, 805-foot-long, three span steel through-truss bridge with spans of 310′-310′-175′ (Figure 2-1). Approximately 500 feet upriver of the bridge sits the Brunswick Hydroelectric Project (FERC No. 2284) which is owned and operated by Brookfield Renewable. On the southern (Brunswick side) side of the bridge sits the 250th Anniversary Park on the east and the Fort Andross Mill Complex (originally the Cabot Mill) on the west. The Topsham approach features the Bowdoin Mill Complex (originally the Pejepscot Paper Company) on the eastern side. Both the Fort Andross and the Bowdoin Mill complexes house a variety of shops, businesses, and restaurants, and the Frank J. Wood Bridge is a key pedestrian connection between the two of them and between the larger business districts and communities on each side. The bridge links the two communities across the Androscoggin River, connecting Brunswick and Topsham.

The Frank J. Wood Bridge has previously undergone rehabilitation efforts during 1985, 2006, and 2015. It is a "fracture critical" structure, indicating it is vulnerable to sudden collapse if certain components fail, in this case the truss diagonal and bottom chord members and their connections and the floor beams. Detailed inspections by MaineDOT in 2012, June 2016 and August 2016 found a number of deteriorated areas. A load rating done by MaineDOT in 2013 and updated in August 2016 noted some floor system members are no longer adequate for Maine's legal loads and as a result the bridge is now posted for 25 tons. There is corrosion and section loss in the steel floor system supporting the deck (the transverse cross beams, longitudinal stringers, and transverse floor beams). The floor system, bottom chords, and the concrete deck are currently in poor condition, and the bridge has a FHWA Sufficiency Rating (http://maine.gov/mdot/publicbridges/) of 25.4. Corrosion at the deteriorated areas is continuing and accelerating, and will do so until the bridge is rehabilitated comprehensively. The bridge is classified by FHWA as structurally deficient with superstructure and deck condition ratings of 4 out of 9 (poor condition). The 3 truss spans are fracture critical, meaning that failure of certain steel tension members could cause any of the 3 spans to collapse. Some of the steel truss bridge components are fatigue sensitive, susceptible to cracking and fracture as a result of heavy cyclic loading. The floor beams and stringers within the truss spans do not meet current design load or MaineDOT legal load standards.

Due to the ongoing deterioration of the structural steel, MaineDOT has completed temporary repairs to address the worst issues so the bridge can maintain its current load rating for up to five years. Steel was added to the most impaired sections of the floor system beneath the deck and missing or deteriorated rivets were repaired or replaced. These temporary repairs were required to keep the 25 ton weight limit from being further reduced. However, a long-term solution needs to be implemented within the 5 year timeframe this maintenance buys.

Bridge improvements are needed to improve the condition ratings of the superstructure and deck. Because of the age of the bridge and considerable number of heavy loading cycles it has already experienced, steel fatigue concerns on critical tension members need to be addressed to continue to carry heavy truck traffic on the existing truss. Pedestrians on the east side of Routes 201/24 cannot cross the river without crossing the highway, which leads to pedestrians crossing mid-block. Bicycle traffic is seriously limited by the narrow, 2 ft., paved shoulder.

2.2 Description of the Proposed Replacement Bridge

The new bridge will be supported by three in-water concrete solid shaft piers supported on concrete sub footings and founded on ledge (Figure 2-2). Abutments will consist of (1) a deep cantilevered concrete abutment on the Brunswick side and (2) a stubbed cantilevered concrete abutment on the Topsham side. All piers and abutments will be founded on ledge. The bridge will have a total span of approximately 835 feet. At its greatest distance, the centerline of the new bridge will sit approximately 120 feet upstream of the existing bridge.

The existing bridge will be used to maintain traffic during construction of the new bridge and will be demolished following the opening of the new bridge to traffic. The project is expected to start in the summer of 2018 and will take approximately 2.5 years to complete.

Measures to avoid and minimize wetland and river impacts include the use of 1.75:1 (horizontal:vertical; H:V) riprapped slopes used at the abutments. The large size of the riprap combined with the steepness of the slope minimizes the footprint of riprap while providing adequate protection from scour of the new abutments. Additionally, a 2:1 H:V side slope will be used at the southwest approach corner, a retaining wall located at the back side of the sidewalk used at the northwest approach corner, and incorporation of state standards for bridge widths. The three piers will be founded on or adjacent to the bedrock outcropping that forms the downstream end of the upstream ponded area. Founding of the piers on existing ledge outcroppings avoids and minimizes impacts to the river.

To access the new bridge alignment while maintaining traffic on the existing bridge, contractors will construct a temporary work trestle upstream of the new alignment extending from the north river bank (Topsham side) to mid-channel of the lower portion of the tailrace to facilitate a dual crane span lift of the southern bridge span. All portions of the temporary trestle will be constructed upstream of the proposed alignment. MaineDOT anticipates bedrock substrate throughout the project footprint will provide suitable stability for the temporary trestle to install rock dowels to anchor the temporary structure. Once anchor points are installed, contractors will connect the temporary trestle along the bedrock. The temporary work trestle will facilitate pier construction and girder erection.

Three cofferdams will be constructed to accommodate pier construction. Plans include one cofferdam around each of the three piers, and one for the southern abutment. The northern abutment will be constructed in the dry and will not require a cofferdam. Given the potential for high flows through the project area during spring flooding and rain events, contractors will use sheetpile cofferdams cut to fit the contour of the underlying ledge.

To manage traffic issues, the existing bridge will remain in place until the replacement bridge is finished and ready for public use. MaineDOT plans to keep closures of the Frank J. Wood Bridge crossing over the Androscoggin River to the minimum extent practicable.

Figure 2-1. View of the existing Frank J. Wood Bridge as seen from the upstream side and western shoreline.

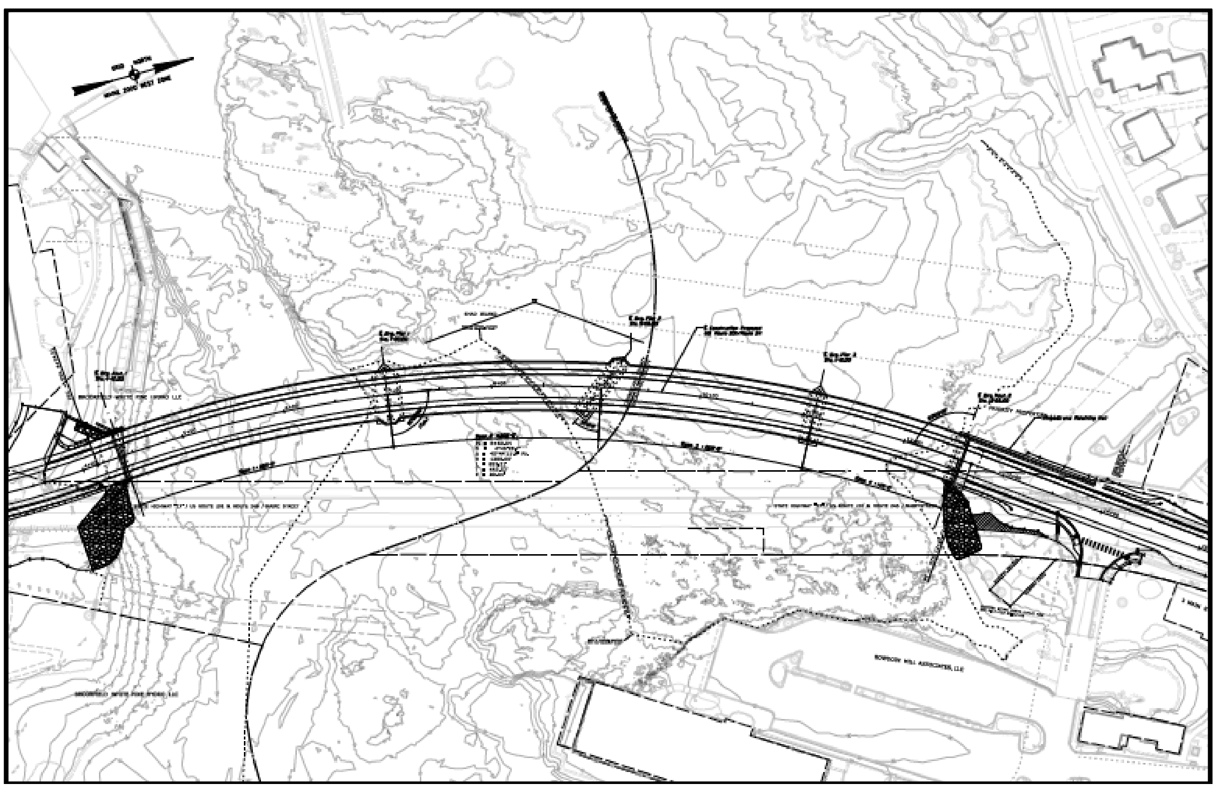

Figure 2-2. Proposed replacement Brunswick-Topsham Bridge showing locations of the three in-water concrete support piers.

2.3 Description of the Proposed Action

The project-specific construction and bridge demolition methods for the Frank J. Wood Bridge replacement project have yet not been finalized. Preparation, construction, and demolition activities are expected to use a variety of methods to complete the project. The project approach will include installation of a temporary work trestle (and associated support piles and access fill), installation of cofferdams (for construction of new piers) and rip rap scour protection. Specific construction/demolition activities may include drilling, hydraulic rock breaker, and blasting. The project will employ standard best management practices (BMP) and mitigation methods that will include a time of year (TOY) restriction for in-water work.

2.3.1 Construction Phases

Temporary Work Trestle Construction

In-water work will require the installation of a temporary work trestle to facilitate construction while avoiding disruption of traffic flow on the existing bridge during the project. The temporary work trestle will support equipment used to construct the piers, erect steel girders and construct the concrete bridge deck. The proposed temporary trestle will extend from the access point on the Topsham side to a point near the mid-channel of the lower portion of the tailrace and will sit on the upstream side of the preferred alignment. The method and design of the temporary work trestle access should minimize environmental effects to the surrounding landscape. Contractors will be required to take precautions to protect the stability of river bank that intersects with the work trestle to prevent degradation from the construction access. Proper BMPs will be utilized at the site and will include proper planning, perimeter erosions controls, and daily temporary stabilization measures.

Trestle construction will begin with the installation of a temporary access point from the Topsham bank installed during the in-water work window. The access point footprint may include up to 2,000 ft^2 (a 40 foot by 50 foot area) of temporary fill below the normal high water line upstream from the new abutment. Fill will consist of non-erodible material, appropriately sized to remain stable at high flows. Depending on the condition of the river banks adjacent to the temporary work trestle, contractors may choose to install a temporary abutment fill retention structure to increase stability of the banks.

The contractor will determine the number of piles needed to construct the temporary work trestle. Based on past experience, MaineDOT estimates the temporary work trestle may require 13 bents (support sections) spaced 50 feet apart and consisting of up to 5 piles per bent. The temporary work trestle could be up to 630 feet long to span from Topsham shoreline to mid-channel of the tailrace. Due to the presence of bedrock substrate, driving the piles associated with the temporary work trestle is not feasible. As a result, pile size restrictions to reduce hydroacoustic effects are not proposed as a part of this project. Temporary trestle piles may range from 24 to 48 inches in diameter. Installation of temporary trestle piles will result in temporary in-water impacts of approximately 408 to 816 ft^2 of riverbed to the west of the new alignment.

As driving piles for the temporary work trestle will not be an option based upon substrate in the project area, the contractor will need to seek an alternative method to attach piles to the exposed bedrock. On previous projects, MaineDOT has observed several alternative pile attachment methods for areas of bedrock substrate.

1) Pinning piles to the bedrock. The pin is set by drilling into the bedrock, setting in the pin, and applying grout to secure the pin into the drilled socket. The depth of the pin and size of the pin is determined by stability calculations. The drilling and pin setting occurs inside of a pile that has been placed onto the bedrock. After the pin has been secured, grout is placed into the pile to secure the pile to the pin.
2) Securing the piles to bedrock using a system with plates. Plates are attached to the bedrock using divers, drills, and large bolts drilled into the ledge. Once the plate has been secured, piles can be fastened to the plate and used to support the trestle.

Cofferdam Construction

Sheet pile cofferdams will be constructed around each of the three proposed in-water bridge piers creating a mostly dry workspace by blocking river flow and tidal fluctuations from the work site (Figure 2-3). Construction of the southern (Brunswick) abutment will also occur within a cofferdam. Although the southern abutment is above the normal high water line, the area may become inundated during high water events. Installation of the cofferdam will prevent the potential flooding of the worksite during high flows.

The substrate in the entire project area is exposed bedrock therefore the sheetpiles used for construction of the cofferdams cannot be driven into substrate as per typical installation. The proximity of bedrock requires that sheet pile cofferdams be cut to fit the contour of the bedrock and then placed (as opposed to driven) and braced with internal structural supports. Contractors will pour a concrete seal at the base of the cofferdam, providing a watertight workspace. Any in-river rock excavation will occur behind a cofferdam.
Once the cofferdam enclosures are installed and braced, a portion of the ledge on the inside will be cut away creating a level base on which to found the piers. Modification of the ledge may be completed with a hydraulic breaker (or hoe ram). Hoe rams are the most common way of removing bedrock. A hoe ram acts as a large jack hammer and breaks up rock by using a series of short quick, strikes until a level surface is achieved. Dismantled portions of the bedrock are bucketed from the cofferdam by excavator or crane and trucked off site.

Alternatively, contractors may choose to set a small detonation to level the pier footprint. Blasting has the advantage of being faster and possibly easier to mobilize into deep cofferdams. If a controlled explosives technique is deemed necessary to level bedrock base of the piers, a plan will be submitted to NMFS at least 150 days prior to the proposed timing of work. The blast plan will establish the expected pressure levels, the proposed timing, and minimization measures. The protected resources division of NMFS will review and approve the blast plan prior to any blasting.

Once the final bedrock elevations within each cofferdam enclosure are achieved, contractors will apply sandbags and/or pour concrete seals around the inside base of the cofferdams to create a dry workspace for pier construction. Concrete used to seal the base of the cofferdams will increase water pH but will be mostly contained inside of the cofferdam. A portion of the higher pH water from inside the cofferdam structures will leak out into the Androscoggin River during installation of the concrete seal. While it is impossible to quantify the amount of elevated pH water leaking from the cofferdam, it is presumed to be significantly less than 1% of the river flow and will be quickly neutralized in the surrounding river current with no effect on the overall pH in the Androscoggin River.

Three of the four proposed cofferdams are below the high-water line and will be “wetted”. Of the three wetted cofferdams, the area of each of the concrete cofferdam seals ranges from approximately 1,500 ft^2 to 2,000 ft^2, with an anticipated overall sealed cofferdam footprint of approximately 5,000 ft^2.

Pier Construction

Once the cofferdams are sealed and pumped dry, construction of the bridge piers will begin. Bridge piers will be constructed of solid shaft reinforced concrete supported on concrete seals founded on ledge. Forms for the piers will be built inside of each cofferdam. Steel rebar will be placed into the forms and fastened together. Concrete will then be poured around the rebar, vibrated and left to cure. This process will occur in stages until the pier reaches the design height. Because the forms will be inside the dry, isolated cofferdam, no uncured cement will be introduced into the river.

Abutment Construction

The new bridge will include a deep cantilevered concrete abutment on the Brunswick side and a stubbed cantilevered concrete abutment on the Topsham side. Both abutments will be supported on concrete sub-footings founded on ledge. The abutment designs have been optimized to reduce the overall footprint of the required foundation. Between the abutments and river will be 1.75H:1V riprapped slopes to minimize wetland impacts. The north (Topsham) abutment will be constructed above the normal high water line in the dry and will not require a cofferdam to isolate the construction area. The southern (Brunswick) abutment will also be constructed in the dry, but the slope and proximity to the waterline may require installation of a cofferdam to stabilize the downslope during construction as well as protecting the construction site during high water events. As stated above for the pier construction section, a limited amount of blasting may be required to remove bedrock material to achieve the required elevation for abutment footings.

Bridge Superstructure Construction

The bridge superstructure (girder spans, stringers, deck, railings, and wearing surface) will be built once the concrete piers and abutments are completed. The northernmost bridge spans will be lifted by a single crane stationed on the adjacent temporary work trestle. However, the construction of the 260 foot span between the Brunswick abutment and pier 1 will be challenging. The proposed bridge replacement includes a span length of 260 feet stretching from the southernmost pier to the abutment on the Brunswick side. Conversations with designers revealed that the 260 foot bridge span length will require two specialized cranes to simultaneously lift the longer beams. One crane will be deployed adjacent to the new abutment on the Brunswick side, and a second crane will be placed on the temporary trestle over the lower portion of the tailrace. Located on either end of the 260 foot span, the two cranes will perform a dual lift of the southern span.

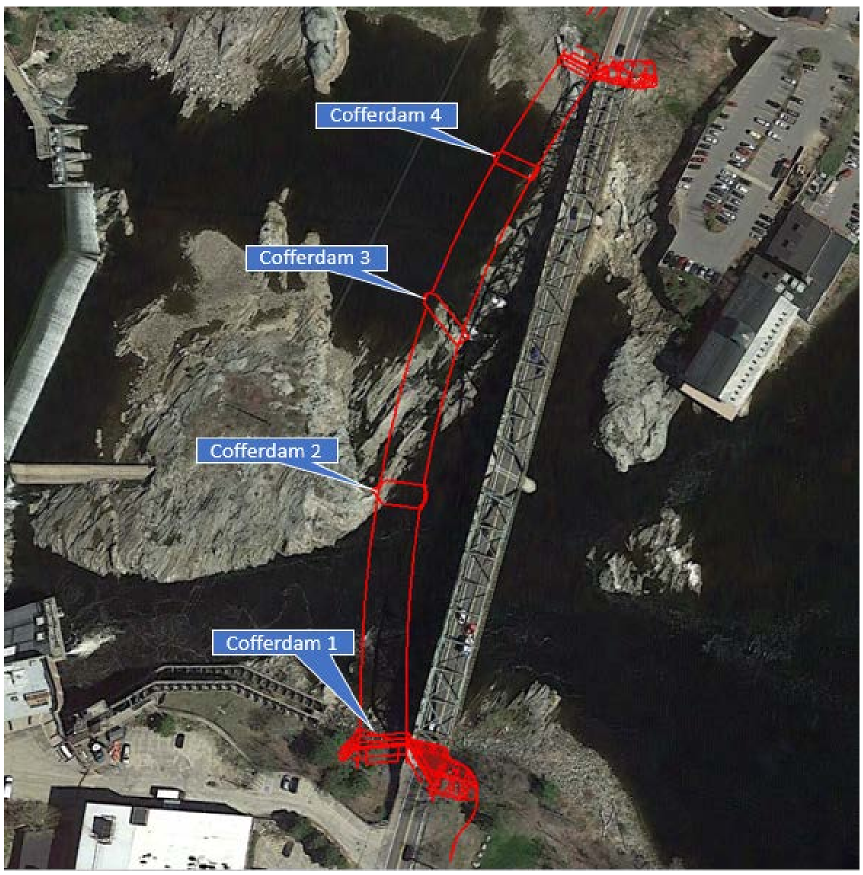

Figure 2-3. Schematic showing proposed locations of cofferdams required for installation of new Brunswick-Topsham Bridge.

2.3.2 Demolition Phases

Removal of Existing Bridge

Once construction of the new bridge is complete, traffic will be shifted to the new alignment and the Frank J. Wood Bridge demolition will begin. The superstructure of the existing bridge will be completely removed. The north abutment will be removed to finished grade and the Brunswick abutment will remain in place (MaineDOT 2015). The abutment sites will be stabilized according the Maine DOT BMPs following removal. The existing pier nearest the Topsham shore will also remain in place. Results from a hydraulic analysis indicated that removing the pier would leave downstream structures vulnerable during flood stage flows; therefore, the pier will remain in place as a hydraulic buffer for the structures during high flows. The old bridge superstructure (bridge deck and truss members) is expected to be removed by the traditional wrecking method, which utilizes a crane-mounted wrecking ball, hydraulic hammers, or jackhammers to pound, break, and tear the concrete and steel reinforcing apart (Oviatt and Archibald 2000). The pieces may also be cut with a torch or large mechanical snips into sizes that can be managed by excavators and placed into trucks to be removed from the site. The pieces of the old bridge deck would then be lifted and removed using a crane on a barge to load a vehicle for offsite disposal.

Demolition of the existing pier nearest the Brunswick shore (also known as the center pier) will likely be completed from a barge. Contractors may choose to use a hydraulic breaker or blast the structure to rubble. Inspection of the center pier revealed a deteriorated condition that will fracture easily when detonated.

Removal of Temporary Work Trestle

As explained above, the temporary work trestle may be attached to bedrock using several methods. If plates are attached to bedrock with large anchors they will be removed by unbolting or cutting the bolts flush at the attachment points. Alternatively, piles that are pinned into the ledge will be freed and pins will be cut flush with the surrounding substrate. Removal of bolted or pinned trestles may require boats and divers to unbolt, or cut trestle connections to the bedrock. Excavators will stabilize the piles while they are cut free and will lift the piles from the attachment points. Once the piles are removed the remaining pins or bolts will be cut or ground flush with the bedrock. Once the temporary trestle is dismantled, contractors will remove the temporary in-water fill used on the Topsham approach of the trestle.

Removal of Cofferdams

Once the pier concrete has cured and all necessary in-the-dry work is completed, the cofferdams will be removed. First, any sandbags used to seal the base of the cofferdam will be removed by hand or by an excavator followed by removal of the internal bracing. The concrete seal will be broken when the first sheet is removed with a vibratory extractor (hammer) and the cofferdam enclosure will be allowed to fill with water. A vibratory extractor will remove each of the remaining sheets.

Post-Project Restoration

Post-project site restoration activities at the Brunswick–Topsham Bridge will include re-grading and restoring staging areas and re-vegetating disturbed areas to prevent sedimentation and siltation in the river. All MaineDOT construction project contracts are required to be in accordance with the most recent version of the MaineDOT Standard Specifications. All construction project contracts require that contractors prepare and submit a Soil Erosion and Water Pollution Control Plan (SEWPCP) that must be approved by MaineDOT and is enforced as a contractual agreement. This SEWPCP is prepared and performed in accordance with the most recent version of the MaineDOT Best Management Practices for Erosion and Sedimentation Control[1]. Section IID: Guidance for Sensitive Water Bodies of the BMP Manual specifies under what conditions a project will be designated as a Sensitive project. Criteria include: state or federal designation of the water bodies, project scope of work, proximity of the project to the water body, etc. This project is considered sensitive due to the potential presence of endangered and threatened species and their critical habitat. A representative of the MaineDOT Surface Water Quality Unit will be assigned to the bridge replacement construction project. Prior to construction, this MaineDOT representative will provide a contract Special Provision that identifies additional project specific requirements to be addressed in the SEWPCP.

2.3.3 Mitigation Measures

Avoidance and Minimization Measures (AMMs)

All elements of the project will be conducted in compliance with MaineDOT's Standard Specifications (MaineDOT 2014[2]). The Standard Specifications is a textual compilation of provisions and requirements for the performance of any MaineDOT work and includes general Avoidance and Minimization Measures (AMMs). AMMs are measures that prevent or reduce the impact of a project on fish species or habitats. AMMs can be precautionary, avoidance, or protection procedures, such as timing restrictions or buffers around sensitive habitats and habitat features that are important to listed species.

In addition to following MaineDOT AMMs, construction actions also include implementation of best management practices (BMPs). BMPs are methods, facilities, build elements, and techniques implemented or installed during project construction to prevent or reduce project impacts on natural resources, such as water quality, soil, and animal habitats. AMMs and BMPs are measures that are considered part of the proposed activity that will be implemented. They are not recommendations, guidelines, or suggestions. A listing of the AMMs developed to date for the Frank J. Wood Bridge replacement project is provided here:

AMM 1- Contractors will submit a SEWPCP for review and approval of MaineDOT staff prior to the start of work. The plan includes the review of the implementation of any AMMs proposed.

[1] Source: http://www.maine.gov/mdot/env/documents/bmp/BMP2008full.pdf

[2] Source: http://maine.gov/mdot/contractors/publications/standardspec/

AMM 2- Prior to soil disturbance, the erosion control portion of the SEWPCP will be reviewed and in place.

AMM 3 – In-water work window. MaineDOT and FHWA commit to avoiding all activities that could result in in-water noise that could result in fish disturbance (louder than 150 dB RMS) and turbidity producing activities between March 16 and July 31.

AMM 4 - No equipment, materials, or machinery shall be stored, cleaned, fueled, or repaired within any wetland or watercourse; dumping of oil or other deleterious materials on the ground will be forbidden; the contractor shall provide a means of catching, retaining, and properly disposing of drained oil, removed oil filters, or other deleterious material; and all oil spills shall be reported immediately to the appropriate regulatory body.

AMM 5– *Contractors are required to install turbidity curtains around areas planned for in-water fill associated with construction of the temporary trestle access point.*

AMM 6 – Removal of the fourth pier (leaving three in-water piers) from preliminary design to avoid impacts to critical habitat as well as potential effects to fishway function.

AMM 7 – *All four cofferdams shall be constructed during the in-water work window, between August 1 and March 15.*

AMM 8– Bedrock leveling using hydraulic breakers (or hoe rams), blasting, or other exceedance noise generating methods will occur within the in-water work window (August 1 to March 15).

AMM 9- Plans for any project-related blasting will be submitted with 150 days for NOAA to review, will not occur outside of the in-water work window (August 1 to March 15), and will be designed to remain below potential fish injury limits (206 dB Peak (2.89 PSI)).

AMM 10- Any blasting activities to occur from August 1 to November 30 will incorporate the following minimization measures to reduce potential impacts to adult Atlantic salmon which may still be present in the area:

- *Active acoustic monitoring of the action area for any tagged fish potentially present in the Androscoggin River.*
- *Minimize charge sizes and the number of days of exposure to blasting.*
- *Deploy scare charges prior to the main blast.*
- *Conduct visual inspection of the action area post blast to document any impacts to fish.*

AMM 11- Fresh concrete will be poured inside of cofferdams and will not come into contact with flowing water.

AMM 12- MaineDOT will deploy a diver into the cofferdams to visually search for endangered fish species. Should a salmon or sturgeon be observed within a cofferdam structure, MaineDOT will coordinate with the resource agencies for removal of those individuals prior to proceeding with construction.

AMM 13- Water pumped out of the cofferdam will be within one pH unit of background (MaineDOT standard specifications). A representative of the MaineDOT Surface Water Quality Unit will periodically evaluate pH to determine whether the water is within the allowable tolerance to be pumped directly back into the river or whether it needs to be treated prior to discharge.

AMM 14 - Superstructure demolition debris will be contained using control devices and cannot enter the water.

AMM 15 – The existing pier structure will be removed down to the underlying bedrock and debris from the structure will be removed from the river to restore potential natural spawning substrate for sturgeon species.

AMM 16- Construction crews will visually monitor for sturgeons in equipment and on barges and report any sturgeon to MaineDOT environmental staff.

AMM 17 - Vessels will travel at "slow speeds, typically less than 6 knots" (6.9 miles per hour) in the construction zone.

In-Water Work Window

Time of year restrictions represent a range of dates when work should not be conducted to protect fisheries resources during times when there is a higher risk of known or anticipated impacts. MaineDOT staff collected site-specific resource information to develop appropriate time of year restrictions for in-water activities with the potential to affect federally listed species in the action area. Given the proximity of the bridge replacement to sensitive spawning and migratory habitat, MaineDOT committed to an in-water work window defined by this species occurrence data of August 1 to March 15. In-water activities that include potentially injurious activities (e.g., use of hydraulic rock breakers or blasting) an increased sedimentation and turbidity will not be conducted outside of the in-water work window.

Blasting Plans

The proposed in-water work window of August 1 to March 15 defines the time period during which no activities resulting in in-water noise louder than 150 dB RMS should occur. Should a blasting event be required between the in-water work window dates of August 1 to November 30 (which coincides with the potential presence of adult Atlantic salmon in the area during the latter part of their upstream migration period), a blasting plan will be prepared and submitted to NMFS. The blasting plan will be designed to minimize the potential for mortality and will include a description of the expected pressure levels, the proposed timing, and minimization measures to be implemented. NMFS review and approval of the plan would be required before blasting work could begin, as described above. Minimization measures would include:

- Active acoustic monitoring of the action area for any tagged fish potentially present in the Androscoggin;
- Minimize charge sizes and the number of days of exposure to blasting;

- Deploy scare charges prior to the main blast, and
- Conduct visual inspection of the action area post blast to document any impacts to fish.

3.0 Site Description

The Frank J. Wood Bridge replacement project area is located on the Androscoggin River at a point just downstream of the Brunswick Hydroelectric Project which sits at the head of tide. The Androscoggin River discharges through the Brunswick Dam at several points including, the tailrace on the Brunswick side, the flood gates on the Topsham side, and the mid-channel spillway. The various release points depend on several factors including water levels, turbine maintenance, or management agreements with regulatory agencies. At lower flows, the majority of water flows through the powerhouse into the tailrace. During times of increased flows, or scheduled maintenance, water may flow over the spillway, or through opened flood gates.

Given these various discharge points, velocities under the existing and proposed bridge vary depending on the stage of river flow and which release points are flowing. At the lowest flows, the ponded area may be nearly stagnant and the majority of flow moves through the powerhouse and tailrace. River velocities patterns change during moderate and high flows. At increased flows, water may discharge into the river over the spillway causing flow through the pond. At the highest flows, the flood gates on the Topsham side open causing increased flows and higher velocity through the left side of the river. At higher flows, fish passage may be possible into the ponded area. At normal flows, velocities in the tailrace range from approximately 6.0 to 8.0 feet per second.

The channel topography is highly variable and significantly influences the flow. Below the Brunswick Dam, the flow splits into two channels then flowing together under the Frank J. Wood Bridge. Substrate in the river below the Frank J. Wood Bridge is less scoured by high velocities and diversifies into hard bottom boulder and cobble substrate with pockets of sand. The dominant flow channel moves water through the powerhouse and downstream tailrace. Substrate within the tailrace is scoured ledge. On the Brunswick side of the channel the channel depth ranges from 15 feet to 20 feet deep. On the Topsham side, the ponded portion of the channel ranges from five feet deep along the edges to 20 feet deep directly upstream of the bedrock ridge at the lower end of the pond. The Frank J. Wood Bridge is located approximately 200 feet upstream of the narrowest point of the river downstream of the Brunswick Dam. Both shores are bounded by ledge outcroppings, and there is a small ledge island approximately 100 feet downstream from the existing bridge. At increased flows, water discharges over the spillway and flood gates causing flow through the pond on the river left side of the channel. Higher flows form a channel of increased flow through deeper sections of the pond, spilling over the bedrock ridge. At normal flows, velocities in the pond range from 2.0 feet per second along the edges of the pond to 10.0 feet per second through the center of the pond. During low flows, the pond remains somewhat stagnant.

The project area does not contain either eelgrass beds or shellfish harvest habitat (Maine Office of GIS, http://www.maine.gov/megis/catalog).

4.0 Essential Fish Habitat Designations

Essential Fish Habitat designations have been described based on 10′ x 10′ squares of latitude and longitude along coastal sections of the northeastern United States. For estuarine, riverine or other locations lying outside of that coastal grid, NOAA has provided species listings for major estuaries, bays or rivers. These listings[3] were used to determine the fish species with designated EFH at the Frank J. Wood Bridge Project Site. The NOAA listing for the Kennebec and Androscoggin Rivers includes a total of 15 fish species and 48 life stages (Table 4-1).

The Frank J. Wood project area sits immediately downstream of the Brunswick Hydroelectric Project, which serves as the head of tide for the Androscoggin River. Downstream of the project area, the Androscoggin River flows for approximately six miles prior to entering Merrymeeting Bay. The Maine Department of Conservation notes that Merrymeeting Bay is an inland, freshwater, tidal delta and over fifty freshwater fish species and ten diadromous fish species are known to inhabit the Bay[4]. Relying on depth averaged annual salinity values, the National Estuarine Inventory (NEI) has defined and mapped the extent of the tidal freshwater (salinity readings of 0.0-0.5 ppt), mixing (salinity readings of 0.5-25.0), and seawater (salinity readings >25 ppt) zones for Sheepscot Bay (NOAA 1985; Figure 4-1). These zones were used as the spatial unit to determine the expected upstream extent of the 15 EFH fish species listed in Table 4-1 relative to the Frank J. Wood project location. Based on the information presented in the NEI zone classifications in Figure 4-1 the project area sits upstream of the salinity zone boundary delineating the mixing and tidal freshwater zones.

As the section of the Androscoggin River between the available salinity zone boundary and the head of tide is relatively short, it is possible that under some conditions the mixing zone could extend upstream into the project area. Observations of Maine Department of Marine Resources (MDMR) personnel[5] note that the deep channel section known as “The Chops” keeps seawater out of the tidal freshwater habitat of the Bay under most conditions. Observations of salinity readings in the Bay greater than the freshwater classification (0.5 ppt) have been limited to August during very dry (i.e., low flow) years and never exceeded 8 ppt. In the event these precipitation and flow conditions were met, low salinity values (e.g., 1.5 ppt or less) may be present in the project area during August.

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[3] Source: https://www.greateratlantic.fisheries.noaa.gov/hcd/est.htm

[4] Source: https://www1.maine.gov/dacf/mnap/focusarea/kennebec_estuary_focus_area.pdf

[5] Source: Gail Wippelhauser, Maine Department of Marine Resources

Of the 15 NOAA listed fish species for the Kennebec and Androscoggin Rivers, four of them (Atlantic cod, yellowtail flounder, ocean pout and Atlantic halibut) are listed as requiring full strength seawater and as a result are not expected to occur at any time in the project area. Table 4-1 indicates that one or more lifestages of 10 of the 15 NOAA listed fish species are tolerant of mixing conditions (i.e., salinity concentrations of 25 ppt or less). Life history characteristics for each of those species and life stages are presented in (Table 4-2). A review of those characteristics indicates that the lower bound of the salinity requirements for all of the listed life stages and species (pollock, whiting, red hake, white hake, winter flounder, windowpane, American plaice, Atlantic herring, bluefish and Atlantic mackerel) exceeds salinity levels anticipated to potentially occur at the project site. Only the larval life stage for winter flounder and Atlantic herring have literature reported tolerance for salinity values less than 8 ppt. As winter flounder spawn during the winter and early spring months and Atlantic herring in inshore waters typically spawn during the spring, the larvae of neither species will be present in the project area during an extreme low flow, summer period. As a result, none of the NOAA listed fish species indicated to be tolerant of mixing conditions are expected to occur within the project area based on the tidal-freshwater nature of the project location and the range of reported salinity values required for those fish species/life stages to persist relative to conditions occurring during extreme low flow summer periods. The MDMR noted that the furthest upstream location where they capture juvenile winter flounder, windowpane and bluefish is in the vicinity of Lee Island in the Kennebec River, downstream of Merrymeeting Bay[6].

Of the fifteen NOAA listed fish species, only the Atlantic salmon is capable of persisting in the tidal freshwater conditions present in the project area. EFH requirements for salmon will be considered in the analysis of potential impacts during bridge replacement (see Section 5.4). Life history characteristics and available species information for Atlantic salmon in the project area are provided in Section 4.1.

4.1 Atlantic Salmon

Life History

Atlantic salmon is an anadromous species that is native to the North Atlantic Ocean basin from the Arctic Circle to Portugal in the eastern Atlantic, from Iceland and southern Greenland, and from northern Quebec south to the Connecticut River in the western Atlantic. In the United States, Atlantic salmon historically ranged from Maine to Long Island Sound (Collette & Klein-MacPhee 2002). The Gulf of Maine Distinct Population Segment (GOM DPS) of Atlantic salmon was officially listed as a federally endangered species on November 17, 2000 (65 FR 69459) and was expanded on June 19, 2009 (74 FR 29344). The Gulf of Maine DPS represents the last wild population of U.S. Atlantic salmon and is listed as all anadromous Atlantic salmon whose freshwater range occurs in the watersheds from the Androscoggin River northward along the Maine coast to the Dennys River, including all associated conservation hatchery populations used to supplement these

[6] Source: Gail Wippelhauser, Maine Department of Marine Resources

natural populations and wherever these fish occur in the estuarine and marine environment. The marine range of the GOM DPS extends from the Gulf of Maine, throughout the Northwest Atlantic Ocean, to the coast of Greenland (74 FR 29344). The project area is designated EFH for Atlantic salmon juvenile (smolt, post-smolt) and adult life-stages (Table 1).

Atlantic salmon have a complex life history going through several distinct phases identified by specific changes in behavior, physiology, morphology, and habitat requirements. Although spawning does not occur until late fall, the majority of Atlantic salmon in Maine enter freshwater between May and mid-July (Meister 1958; Baum 1997). Early migration is an adaptive trait that ensures adults have sufficient time to effectively reach upstream spawning areas despite the occurrence of temporarily unfavorable conditions that naturally occur within rivers (Bjornn and Reiser 1991). Salmon that return in early spring spend nearly 5 months in the river before spawning, often seeking cool water refuge during the summer months.

Spawning and juvenile rearing habitat consists of gravel or rubble in moving freshwater (Collette & Klein-MacPhee 2002). In the fall, female Atlantic salmon select sites for spawning in rivers. Embryos develop in redds (depressions created in the gravel substrate) where eggs are deposited, with fry hatching in late March or April (Danie et al. 1984). When fry reach approximately 4 cm in length, the young salmon are termed parr (Danie et al. 1984). In a parr's second or third spring smoltification occurs, preparing the parr for migration to the ocean and life in salt water. In Maine, 90 percent of naturally reared parr remain in fresh water for 2 years (USASAC 2005). Most smolts enter the sea during May to begin their first ocean migration and must contend with changes in salinity, water temperature, pH, dissolved oxygen, pollution levels, and various predator assemblages (USASAC 2004). The transition of smolts into seawater is usually gradual as they pass through a zone of fresh and saltwater mixing that typically occurs in a river's estuary. The completion of smoltification and migration through the estuary of the natal river starts the marine phase (Fay et al. 2006). The marine Atlantic salmon juvenile and adult life histories are not as well understood as the freshwater phases due to the relatively low density of salmon over an extended geographic ocean range (Fay et al. 2006). As smolts enter saltwater portions of the estuary, their movements become more directed and they move rapidly into the ocean (Lacroix and McCurdy 1996). Smolts from Gulf of Maine rivers enter the ocean during May and June (Collette & Klein-MacPhee 2002).

Available Species Information for the Project Area

Atlantic salmon adult and smolt life stages move through the action area during their spawning and outmigration periods. MDMR fishway data from 2016 recorded seven adult Atlantic salmon migrating through the fishway from May through mid-June. No kelt outmigration data exists for the Androscoggin River; however, Baum (1997) reported that 20% of kelts outmigrated to the ocean in the fall, with the remaining 80% migrating to the ocean in the spring. After hatching, salmon fry remain in their natal river for three years. Once smoltification occurs, smolts begin their downstream migration between April and June. The small number or Atlantic salmon on the Androscoggin River have precluded the study of wild outmigrating smolts. Although smolt migration timing is likely similar to that observed on the Penobscot and Narraguagus Rivers where 2% of smolt migrate in April, 77% migrate in May, and 21% migrate in June (GNP 1997).

Androscoggin River has the lowest level of Atlantic salmon stocking of any GOM DPS river actively managed for restoration of the species. In 2016, 2,000 salmon fry were stocked in the Androscoggin River, representing less than one percent of the 4,437,700 salmon stocked in Maine rivers that year (USASAC 2017). Since 2001, 20,500 fry have been released into the river and most were part of an ongoing educational program with a local school group that releases 1,000 Atlantic salmon fry into the Little River a tributary to the lower Androscoggin River (USASAC 2017). For comparison, overall restoration efforts in other portions of the GOM DPS included 5,840,900 Atlantic salmon stocked in the Kennebec River and 60,708,600 in the Penobscot River (USASAC 2017).

The action area provides habitat for out-migrating smolts between late April and June. Any Atlantic salmon smolts in the project area would likely be a result of successful fry stocking in the Little River. It is possible that some out-migrating smolts include those naturally spawned. However, there is no documentation of successful spawning in the Androscoggin River, although naturally reared fish have been documented in the river (MDMR 2012).

As part of an Interim Species Protection Plan (ISPP), Brookfield conducted a whole-station Atlantic salmon smolt passage survival study from 2013 to 2015 using radio-tagged smolt (Normandeau 2014, 2015, 2016). Normandeau noted that during the two study years with lower river flows (2013 and 2015), a greater percentage of tagged smolts moved through the powerhouse (61-67%) than traveled over the spillway (7-24%) or through the downstream fish passage structure (0-7%). During the high flow year (2014), more tagged smolts were recorded going over the spillway (57%) than either through the powerhouse (27%) or the downstream fish passage (3%). Overall smolt survival estimates for downstream passage during the three year study ranged from 83% to 95%.

Migrating adult Atlantic salmon have been observed yearly in the Androscoggin River and may be present within the project action area. Although spawning does not occur until the fall, peak upstream migration movements in the Androscoggin River occur in the month of June (Fay et al. 2006). The Brunswick Project, demarcating the upstream limit of the action area, operates a fishway from April 15 through November 15 of each year. The Atlantic salmon spawning run entering the Androscoggin River and passing the Brunswick Hydroelectric Project has been historically small. From 2000 to 2016 Atlantic salmon passage at the Brunswick fishway ranged from 0 and 44 per year with an average of 10 salmon per year (Figure 4-1; MDMR 2016). This average includes both wild and hatchery reared salmon; however, wild Atlantic salmon represent a small portion of returns. Between 2012 and 2016, the Androscoggin River had a yearly average of two wild Atlantic salmon returns (USASAC 2017). For that same time period, Atlantic salmon returns recorded at the Brunswick fishway represent approximately 0.003% of all returning migrating adult Atlantic salmon in the GOM DPS (USASAC 2017).

A limited number of adult Atlantic salmon were captured at the Brunswick fish ladder, radio-tagged and returned to the Androscoggin River just downstream of the project action area during 2013 (n=2) and 2014 (n=4) (Normandeau 2014; Normandeau 2015). Of the two individuals captured and tagged during June 2013, one was present in the Brunswick tailrace area during mid-July and the other during November. Three of the four tagged and released during 2014 were originally captured in June with the fourth captured during August. Of the three individuals tagged during June 2014, one ascended upstream of Brunswick in early July and passed back through the tailrace in early August, one remained in the project area through early July and one departed soon after release. The individual tagged and released during August 2014 was last detected in the Brunswick project area on November 1.

4.2 Additional NOAA Trust Resource Species

Several species that use the project area and are not EFH designated species were also included due to their commercial, recreational, and ecological importance (NOAA trust resources). Trust species considered in this evaluation include striped bass (*Marone saxatilis*), American eel (*Anguilla rostrata*), American shad (*Alosa sapidissima*), alewife (*Alosa pseudoharengus*) and blueback herring (*Alosa aestivalis*) collectively referred to as river herring, and rainbow smelt (*Osmerus mordax*). Potential impacts to these trust species with respect to construction activities related to the Frank J. Wood Bridge replacement are presented in Section 6.0.

Table 4-1. Fish species listed within the Essential Fish Habitat Designation for the Kennebec and Androscoggin Rivers.

Species	Eggs	Larvae	Juveniles	Adults	Spawning Adults
Atlantic salmon *(Salmo salar)*	F	F	F,M,S	F,M,S	F
Atlantic cod *(Gadus morhua)*			S	S	
Pollock *(Pollachius virens)*			M,S		
Whiting *(Merluccius bilinearis)*			M,S	M,S	
Red hake *(Urophycis chuss)*			M,S	M,S	
White hake *(Urophycis tenuis)*			M,S	M,S	
Winter flounder *(Pleuronectes americanus)*	M,S	M,S	M,S	M,S	M,S
Yellowtail flounder *(Pleuronectes ferruginea)*	S	S			
Windowpane flounder *(Scopthalmus aquosus)*	M,S	M,S	M,S	M,S	M,S
American plaice *(Hippoglossoides platessoides)*	S	S	M,S	S	S
Ocean pout *(Macrozoarces americanus)*	S	S	S	S	S
Atlantic halibut *(Hippoglossus hippoglossus)*	S	S	S	S	S
Atlantic herring *(Clupea harengus)*		M,S	M,S	M,S	
Bluefish *(Pomatomus saltatrix)*			M,S	M,S	
Atlantic mackerel *(Scomber scombrus)*			M,S	M,S	

Note: F = Freshwater; M = Mixing, S = Seawater

Table 4-2. Life history characteristics of NOAA listed fish species and life stages included in the Essential Fish Habitat Designation for the Kennebec and Androscoggin Rivers and noted to be tolerant of mixing conditions (i.e., salinity range of 0.5-25 ppt).

Species	Eggs	Larvae	Juveniles	Adults	Spawning Adults
Pollock References: Cargnelli et al. 1999a, NEFSC HCD 2014			Temperature: 0-15.6° C Salinity: 29 – 32 ppt Depth: 0 – 250 m Habitat: Inshore and offshore bank bottom habitats with sand, mud, rocks or aquatic vegetation.		
Silver Hake (Whiting) References: Morse et al. 1999, Lock and Packer 2004, NEFSC HCD 2014			Temperature: 2 - 21° C Salinity: 30 - 36 ppt Depth: 1 – 400 m Habitat: Bottom habitats of all substrate types.	Temperature: 2 - 17° C Salinity: 32 – 36 ppt Depth: 9 – 500 m Habitat: Bottom habitats all substrate types.	
Red Hake References: Steimle et al. 1999a, NEFSC HCD 2014			Temperature: 2 - 22° C Salinity: 24 – 33 ppt Depth: 1 - <120 m Habitat: Estuaries and outer shelf: < 14 cm TL hake use shells or live scallops for shelter; > 14 cm hake use various sediment types and shelter.	Temperature: 2 - 22° C Salinity: 20 – 34 ppt Depth: 5 – 300+ m Habitat: Estuaries and outer shelf bottom habitats with sand-mud in depressions and holes.	
White Hake			Temperature: 4 - 16° C Salinity: 29.5 – 34 ppt	Temperature: 5 - 14° C Salinity: 29.5 – 34 ppt	

Species	Eggs	Larvae	Juveniles	Adults	Spawning Adults
References: Chang et al. 1999a, Collette and Klein-MacPhee 2002, NEFSC HCD 2014			Depth: 5 – 225 m Habitat: Pelagic stage: pelagic waters; Demersal stage: bottom habitats with seagrass beds, mud, and fine-grained sand substrate.	Depth: 5 – 325 m Habitat: Bottom habitats with mud or fine-grained sand substrate.	
Winter Flounder References: Pereira et al. 1999, NEFSC HCD 2014	Temperature: 1 - 10° C Salinity: 10 – 32 ppt Depth: 0.3 –5 m inshore; < 90 m on Georges Bank. Habitat: Demersal eggs, bottom habitats with sand, muddy sand, mud, and gravel substrate.	Temperature: 2–20.5° C Salinity: 3.2 – 30 ppt Depth: 1 – 5 m inshore; < 90 m on Georges Bank. Habitat: Pelagic larvae, pelagic and bottom waters over fine sand and gravel.	Temperature: 2 - 25° C Salinity: 10 – 33 ppt Depth: 0.5 – 18 m inshore; < 100 m offshore. Habitat: Bottom habitats with sand with shell or leaf debris, muddy sand, and mud substrate.	Temperature: 1 - 25° C Salinity: 15 – 33 ppt Depth: 1 – 30 m inshore; < 100 m offshore. Habitat: Bottom habitats including estuaries with sand, mud, gravel, cobble, and boulder substrate.	Temperature: < 15° C Salinity: 5.5 – 33 ppt Depth: 0.3 –5 m inshore; as deep as 80 m on Georges Bank. Habitat: Bottom habitats including estuaries with sand, mud, and gravel substrate.
Windowpane Flounder References: Martin and Drewry 1978, Chang et al. 1999b, NEFSC HCD 2014	Temperature: 6 - 20° C Salinity: 18.2 – 30 ppt Depth: < 70 m Habitat: Pelagic eggs, surface waters.	Temperature: 3 - 20° C Salinity: 18.2 – 30 ppt Depth: < 70 m Habitat: Pelagic larvae, pelagic waters	Temperature: 0 - 25° C Salinity: 22-30 ppt Depth: 1 – 125 m Habitat: Bottom habitats with fine-grained sand or mud.	Temperature: 0–26.8° C Salinity: 5.5 – 36 ppt Depth: 1 – 75 m Habitat: Bottom habitats with fine-grained sand or mud.	Temperature: 6 - 21 ° C Salinity: 5.5 – 36 ppt Depth: 1 – 75 m Habitat: Bottom habitats with fine-grained sand or mud.

Species	Eggs	Larvae	Juveniles	Adults	Spawning Adults
American Plaice References: Johnson et al. 1999b, Johnson 2004, NEFSC HCD 2014			Temperature: 1 - 17° C Salinity: 31 - 35 ppt Depth: 6 – 400 m Habitat: Bottom habitats with fine-grained sediments, sand, or gravel.		
Atlantic Sea Herring References: Reid et al. 1999, Stevenson and Scott 2005, NEFSC HCD 2014		Temperature: -1.8-24° C Salinity: 2.5 – 52.5 ppt Depth: 10 - 250 m Habitat: Pelagic in estuaries, coastal, and offshore waters.	Temperature: 4 - 16° C Salinity: 21 – 32 ppt Depth: 6 – 300 m Habitat: Pelagic in nearshore, coastal, and offshore waters.	Temperature: 2 - 16° C Salinity: 27 – 35 ppt Depth: 20 – 300 m Habitat: Pelagic in inshore and offshore continental waters.	
Bluefish References: Fahay et al. 1999, Shepherd and Packer 2006, NEFSC HCD 2014			Temperature: 12 - 30° C Salinity: 23 – 36 ppt Depth: 1 – 40 m Habitat: Pelagic waters	Temperature: 12 - 30° C Salinity: 29 -35 ppt Depth: 1 – 400 m Habitat: Pelagic waters	
Atlantic Mackerel References: Studholme et al. 1999, NEFSC HCD 2014			Temperature: 4 - 22° C Salinity: > 25 ppt Depth: 0 – 320 m Habitat: Pelagic waters	Temperature: 4 - 16° C Salinity: > 25 ppt Depth: 0 – 380 m Habitat: Pelagic waters	

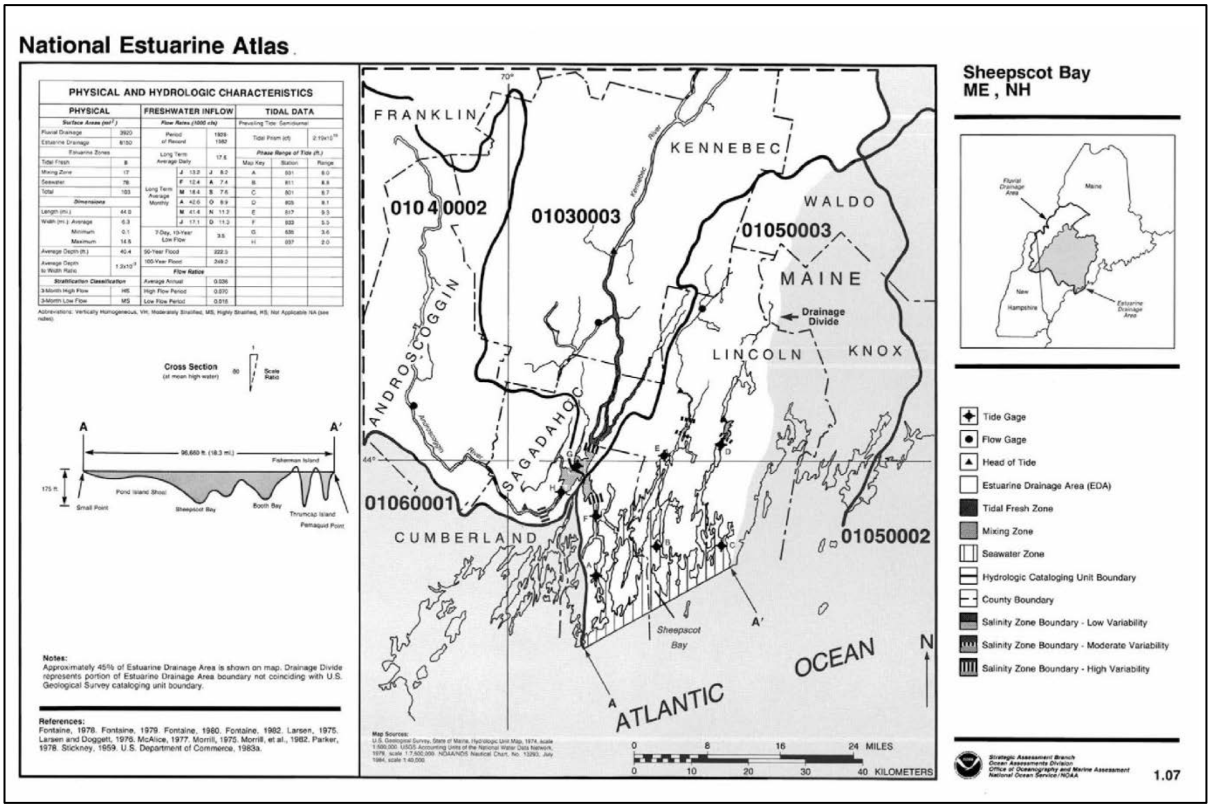

Figure 4-1. Relative locations of freshwater, mixing and seawater zones for the Kennebec and Androscoggin Rivers as defined in the National Estuarine Inventory Data Atlas (NOAA 1985).

5.0 Analysis of Potential Impacts on EFH

5.1 Adverse Impacts

An adverse effect is defined as any impact that reduces quality and/or quantity of EFH. Adverse effects may include direct or indirect physical, chemical, or biological alterations of the waters or substrate and loss of, or injury to, benthic organisms, prey species and their habitat, and other ecosystem components, if such modifications reduce the quality and/or quantity of EFH. Adverse effects are categorized as substantial or not substantial.

Bridge construction activities will primarily impact through 1) habitat alteration or loss that can result in direct or indirect morality, 2) increased suspended sediment and turbidity, and 3) underwater noise. Bridge demolition activities by mechanical techniques will primarily impact through 1) habitat alteration (i.e. falling debris) and 2) increased suspended sediment and turbidity. If a controlled explosives technique (blasting) is required, impacts would then also include pressure and shock wave impacts involving behavioral disturbances, non-lethal injury (i.e. hearing threshold shifts), and lethal injury (i.e. ruptured swim bladders and other vital organs) to fish species (Oviatt and Archibald 2000). Overall, impacts from mechanical methods are less extensive than those for explosive methods. The construction and demolition methods selected to be used during the project will determine the potential impacts to EFH in the project area.

5.2 Permanent EFH Impacts

5.2.1 In-water Structures

The replacement of the Frank J. Wood Bridge will require the placement of structures (either permanent or temporary) into aquatic habitat. These structures include the three new bridge piers and their associated temporary cofferdams, the series of piles associated with the temporary work trestle and fill associated with work trestle access on the Topsham side. Table 5-1 provides a summary of each structure, its status (permanent or temporary) and the estimated area of impact to habitat both above and below the high water elevation. As part of the current project design, three new permanent piers will be installed, covering a total area of 3,400 ft^2. Two of those piers (representing 2,100 ft^2 of area) will be placed in the ponded portion of the channel on the Topsham side. The southernmost pier will be placed on the edge of Shad Island. Of the total footprint for that pier, approximately 31% (400 ft^2) will set on ledge at elevations greater than the high water elevation with the remainder on ledge habitat in the channel leading to the Brunswick hydroelectric tailrace area. The temporary work trestle will necessitate the installation of approximately 65, 24-48" piles (covering ~800 ft^2 of riverbed to the west of the new alignment). These will be pinned or plate-mounted to bedrock substrate. Prior to commencement of trestle construction, installation of a temporary access point from the Topsham bank will be required. The footprint for this access may include up to 2,000 ft^2 (a 40 foot by 50 foot area) of temporary fill below the normal high water line upstream from the new abutment. Fill will consist of non-erodible material, appropriately sized to remain stable at high flows and will sit in the ponded portion of the channel on the Topsham side and upstream of the point where sturgeon can access.

It should be noted that the center pier for the existing Frank J. Wood Bridge will be removed down to bedrock during the demolition phase of the project. Following removal of this pier, a total of approximately 800 ft^2 of bottom substrate previously supporting the Frank J. Wood Bridge will become available for sturgeon to access. This will result in a net loss of approximately 100 ft^2 of in-river habitat and 2,500 ft^2 of ponded and bedrock falls habitat following construction of the new pier structures and removal of the existing Frank J. Wood Bridge.

Table 5-1. Approximate area and location (in-river versus in ponded and bedrock falls area) of temporary and permanent in-river structures associated with the Frank J. Wood Bridge replacement project.

Impact Type	Temporary Impacts	Permanent Impacts	Ponded and Bedrock Falls Habitat	In-River Habitat	Restored Critical Habitat
Temporary Work Trestle Piles	≤ 800 ft^2	0	740 ft^2	60 ft^2	--
Temporary Trestle Access Fill	2,000 ft^2	0	2,000 ft^2	0	--
Cofferdam/New Pier 1	0	1,300 ft^2	400 ft^2	900 ft^2	--
Cofferdam/New Pier 2	0	1,200 ft^2	1,200 ft^2	0	--
Cofferdam/New Pier 3	0	900 ft^2	900 ft^2	0	--
Rip Rap Scour Protection (Brunswick abutment)	0	400 ft^2	--	--	
Existing Pier Removal	--	--	--	--	800 ft^2
~Total Temporary Impacts	2,800 ft^2	--	2,740 ft^2	60 ft^2	--
~Total Permanent Impacts	--	3,800 ft^2	2,500 ft^2	900 ft^2	800ft^2

5.3 Temporary EFH Impacts

5.3.1 Underwater Noise

Three in-water activities may result in elevated underwater sound pressure during construction; (1) drilling, (2) hydraulic rock breaker (hoe ram) and (3) blasting. Man-made underwater noise has the potential to cause behavioral disturbances, hearing impairment or threshold shifts, physical injury, or morality to marine organisms (Southall et al. 2007, Popper and Hastings 2009, Popper et al. 2014). When a fish with a swim bladder is exposed to a sound wave, gas in their swim bladder expands and contracts more than the surrounding tissue during the periods of under pressure and overpressure, respectively. This can cause the swim bladder to oscillate resulting in tissue damage and possibly rupture. Hearing loss in a fish is likely to result in reduced fitness from decreased ability to detect and avoid predators, locate prey, communicate with peers, or sense physical environment.

Sound is described as having two components, a pressure component and a particle motion component. Sound pressure consists of two basic sound types: continuous (e.g. motorized vessel) and impulsive (e.g. explosions, pile driving or hydraulic hammering; Southall et al. 2007, Hawkins and Popper 2014). Continuous sounds may be tonal or include a wide range of frequencies. Continuous sounds that are "rougher" than others have a high crest factor (Hawkins and Popper 2014). Impulsive sounds are characterized by a sharp rise time, brief duration, and a wide range of frequencies. They generally have an increased capacity to induce physical injury compared to continuous sounds. Particle motion is the oscillatory displacement, velocity, or acceleration of fluid particles in a sound field. All fish are sensitive to particle motion; however, some fish have adaptions (e.g. gas bubbles near the ear or swim bladders that functionally affect the ear) that also make them sensitive to sound pressure. Fishes with swim bladders (or other gas bubbles) that functionally affect the ear generally have lower thresholds and wider hearing bandwidths than species without these adaptations (Normandeau 2012). Hearing range and sensitivity varies considerably among fish species (Popper et al. 2014). Atlantic salmon and sturgeons are particle motion-sensitive species, although they have physostomous (open) swim bladders these organs are not involved in their hearing (Hawkins and Johnstone 1978; Knudsen et al. 1992, 1994; Lovell et al. 2005; Meyer et al. 2010; Popper et al. 2014). Atlantic salmon have a frequency range of hearing from 30-400 Hz (Hawkins and Johnstone 1978, Popper et al. 2014). Sturgeons can detect signals from below 100 Hz to over 1,000 Hz (Tritt 2014). Atlantic salmon, shortnose sturgeon, and Atlantic sturgeon, due to their swim bladders, are susceptible to barotrauma from underwater noise (sound pressure) even though their hearing only involves particle motion (Popper et al. 2014).

The pressure fluctuations resulting from impulsive noise are expressed in units of pressure (e.g. pounds per square inch (PSI)). The Caltrans Bioacoustics manual explains the relationship as "The mathematical definition of a decibel is the 'base 10 logarithmic function of the ratio of the pressure fluctuation to a reference point.'" This results in a relation of 1 PSI = 197 dB dB re 1 μPa. The intensity of a sound wave in water is expressed in terms of decibels relative to 1 micro-Pascal (dB re μPa). Decibels are a log scale; each 10 dB increase is a 10-fold increase in sound pressure. Accordingly, a 10 dB increase is a 10× increase in sound pressure, and a 20 dB increase is a 100× increase in sound pressure.

The following are commonly used measures of sound:

- Peak sound pressure level (SPL): the maximum sound pressure level (highest level of sound) in a signal measured in dB re 1 μPa.
- Sound exposure level (SEL): the integral of the squared sound pressure over the duration of the pulse (e.g., a full pile driving strike). SEL is the integration over time of the square of the acoustic pressure in the signal and is thus an indication of the total acoustic energy received by an organism from a particular source (such as pile strikes). Measured in dB re 1μPa2-s.
- Single Strike SEL: the amount of energy in 1 strike of a pile.

- Cumulative SEL (cSEL or SELcum): the energy accumulated over multiple strikes. cSEL indicates the full energy to which an animal is exposed during any kind of signal. The rapidity with which the cSEL accumulates depends on the level of the single strike SEL. The actual level of accumulated energy (cSEL) is the logarithmic sum of the total number of single strike SELs. Thus, cSEL (dB) = Single-strike SEL + 10log10(N); where N is the number of strikes.
- Root Mean Square (RMS): the average level of a sound signal over a specific period of time.

The types of effect on and response from fishes to a sound source will, logically, depend on distance. Very close to the source, effects may range from mortality to behavioral changes. Somewhat further from the source mortality is no longer an issue, and effects range from physiological to behavioral. The potential for effects declines as distance increases between the individual and the source. The actual nature of effects depends on a number of other factors, such as fish hearing sensitivity, source level, sound propagation and resultant sound level at the fish, whether the fish stays in the vicinity of the source, and motivation level of the fish. Generally speaking, species are thought to have different tolerances to noise and may exhibit different responses to the same noise source.

Underwater sound pressure waves can injure or kill fish (several sources cited in NMFS 2012). Fish with swim bladders are particularly sensitive to underwater impulsive sounds with a sharp sound pressure peak occurring in a short interval of time (Caltrans 2001 as cited in NMFS 2012). As the pressure wave passes through a fish, the swim bladder is rapidly squeezed due to the high pressure, and then rapidly expanded as the under pressure component of the wave passes through the fish. The pneumatic pounding on tissues contacting the swim bladder may rupture capillaries in the internal organs as indicated by observed blood in the abdominal cavity, and maceration of the kidney tissues (Caltrans 2001 as cited in NMFS 2012). Potential physiological effects resulting from sound exposure are highly diverse and range from very small ruptures of capillaries in fins (which are not likely to have any effect on survival) to severe hemorrhaging of major organ systems such as the liver, kidney, or brain. Other potential effects include rupture of the swim bladder.

The Fisheries Hydroacoustic Working Group comprises biologists from NMFS, USFWS, FHWA, and the California, Washington and Oregon DOTs. In June 2008, the agencies developed interim criteria for assessing physiological effects of pile driving noise on fish. These are criteria for the onset of physiological effects and not levels at which fish are necessarily mortally damaged. The interim criteria are:

- Peak SPL: 206 decibels relative to 1 micro-Pascal (dB re 1 μPa) [for fish of any size].
- cSEL of 187 decibels relative to 1 micro-Pascal-squared second (dB re 1μPa2-s) for fishes above 2 grams (0.07 ounces).
- cSEL of 183 dB re 1μPa2-s for fishes below 2 grams (0.07 ounces).

As would be expected, underwater sounds must be louder than background level to be detected by a fish. Additionally, a sound may need to be biologically relevant to an individual to elicit a particular behavioral response (Plachta and Popper 2003, Doksaeter et al. 2009). Behavioral responses may range from a temporary startle to avoidance of an ensonified area. These previous evaluations noted above support the 150 dB re 1 μPa RMS criterion as an indication for when behavioral effects could be expected in fish. For this Project, 150 dB re 1 μPa RMS is considered to be a reasonable estimate of the noise level at which exposure may result in behavioral modifications. This decision is supported by previous assessments of behavioral effects resulting from noise producing actions at several West Coast projects as well as for the State Route 197 Bridge in Richmond, Maine. In those cases, the NMFS relied on 150 dB re 1 μPa RMS as a conservative indicator of the noise level at which there is the potential for behavioral effects. Exposure to noise levels of 150 dB re 1 μPa RMS will not always result in behavioral modifications, and behavioral modifications will not always result in adverse effects (i.e., harm or harassment to listed species), but that there is the potential for behavioral response upon exposure to 150 dB re 1 μPa RMS (NMFS 2012).

Drilling

Drilling is a continuous noise source that generates vibrations as a result of friction and/or percussion between the drill bit and the bored material. Noise generated from the drill produces sound waves that transverse the sediment above the boring to the river bottom. As sound waves propagate from the inlet bottom, noise attenuates as the distance from the source increases. Noise attenuation is dependent on site-specific bottom composition, bathymetric profile, absorption of the sound by water, and scattering due to air bubbles or suspended sediment (Transit Link Consultants 2008). Spreading loss rates for large boring drills, such as a ground tunnel boring machine, range from a 3 dB to 6 dB decrease per doubling of distance and from 10 dB to 20 dB per 10-fold increase in distance (Transit Link Consultants 2008). Installation of steel piles for temporary work trestle will likely be completed with much smaller drilling equipment, so spreading loss rates are likely to be even greater as the vibrations produced from a smaller drill will be much smaller in magnitude.

The particular drill type and how the drill will be operated are dependent on the contractor, and as a result the specific information is not available to the FHWA and MaineDOT at this time. However, if we consider the known noise levels from a tunnel boring machine and the corresponding spreading loss rate as reference points for assessing the impacts of drilling on fish, the sound levels produced by drilling are likely below the range that could negatively affect fish. Reported dB RMS levels from in-water drilling activities using large boring drills are lower than 150 dB RMS (Caltrans 2015). Noise levels anticipated from the smaller drills (which will likely be used to install the temporary trestle attachments) are expected to be even less, remaining well below the behavioral effects threshold. Moreover, for several projects in the northeast and northwest, NMFS has determined that noise generated during hard-rock drilling would likely remain well below the noise levels likely to result in physiological or behavioral effects to fish (NMFS 2013).

Hydraulic Rock Breaking

Hydraulic breakers, or hoe rams, are used to fracture bedrock or concrete structures into small pieces. Typical applications include removal of underlying bedrock during bridge construction, or the demolition of concrete elements of decommissioned bridges. It is likely that the selected contractors may use hoe rams during construction of the new bridge and demolition of the existing Frank J. Wood Bridge substructure.

MaineDOT has not conducted hydroacoustic monitoring during bridge demolition activities with a hoe ram. To date, there is conflicting literature on the effects of hoe ram use on fish. Historic observations suggested that it was not likely to result in adverse effects while more recent literature indicates potential adverse effects from the activities (ATS PBA 2017). Washington State Department of Transportation (WSDOT) conducted sound monitoring during demolition of two bridge piers using a hoe ram. Underwater sound levels were recorded for two different sized hoe rams during the demolition of the above-water portion of two concrete water-based piers on the Manette Bridge in Bremerton, WA at 10 m from the source (Escude 2012). Data were not available for sound pressure levels during hoe ramming on the underwater portion of the pier, but are assumed to have been higher. Peak sound pressure levels for the two hoe rams reached 189 and 205 dBpeak respectively, average RMS reached 173 and 186 dB re 1 µPa, and cumulative sound levels were 195 and 196 dB SELcum. The recorded hoe ram waveforms were nearly identical to impact pile driving waveforms. Using the acoustic threshold criteria for pile driving above, sound pressure levels from hoe ramming may exceed criteria levels for physical injury to fish. If the peak and SEL levels in the action area are similar to those in Washington, the SEL interim criteria (183 dB re 1 µPa2·s for fish less than 2 grams in weight and 187 dB re 1 µPa2·s for fish greater than 2 grams in weight) would be exceeded by both hoe ram types. Although the peak sound pressure level did not exceed 206 dB re 1 µPa, it was within 1 dB for one size of hoe ram. Data are not available for the radial distance from the source at which sound levels will propagate to less than threshold criteria.

Hydroacoustic monitoring data from a bridge demolition conducted by Caltrans at Ten Mile Bridge (Illingworth and Rodkin 2010) reached a similar conclusion in determining that hoe ram activity at or below the water line will result in sound levels similar to impact pile driving. Monitoring at other Caltrans bridge locations indicates that demolition work on elevated structures or outside of the wetted channel does not result in potentially injurious noise levels for fish. The sample size for monitoring data for this activity is small compared to impact pile driving and results have been variable depending on multiple site-specific factors.

Blasting

The project timeline for construction of the new bridge piers will be constrained by limitations imposed by the in-water work window. As a result, contractors may petition for use of blasting to prepare footings for piers rather than the more time-consuming hoe ram chipping. Based on geotechnical evaluations of bedrock, it is possible that bedrock blasting may be more efficient to remove rock to provide suitable bearing surface for the cofferdam seals or fill concrete at the pier and abutments. In addition to preparation of the footing areas, blasting may also be used to demolish the center pier of the existing Frank J. Wood Bridge (which is currently scheduled to occur between December 16, 2020 and January 19, 2020).

Blasting may impact fish species by causing physical injury or mortality to individual fish and by displacing them from the area where blasting is occurring. Effects to species may also include modifications to habitat and reduced foraging opportunities. The use of explosives produces a pressure wave that radiates from the detonation site. The typical pressure wave from an explosion consists of an instantaneous increase to the peak pressure, followed by a slower (but still relatively fast) logarithmic decay to below ambient hydrostatic pressure (Wright and Hopky 1998; SAIC 2000 as cited in NMFS 2012). The strength of the wave depends on the type and amount of explosives, the manner and depth at which the charges are placed, and the proximity of the detonation to the rock/water interface. As detonation velocity (i.e., burn rate) differs for explosive types, so does the corresponding pressure wave. A slower burning explosive "pushes" the substrate and generates a reduced pressure wave compared to a faster burning explosive that "shatters" the substrate and produces a much stronger pressure wave. Rates of sound transmission loss and attenuation for a specific site depend on water depth, temperature, substrate composition, bathymetric profile, and scattering due to air bubbles or suspended sediment (Transit Link Consultants 2008).

As described in the Biological Assessment (BA) prepared for this project, federally listed species in the action area occurring within 500 feet of a detonation resulting in peak pressures of 120 psi (~238 dB re 1 μPa) and average pressure of 70 psi (~234 dB re 1 μPa) would be exposed to noise and pressure levels that could cause adverse effects. These effects could range from avoidance behaviors, temporary stunning, external or internal injury with full recovery, injury with delayed mortality or injury sufficient to cause immediate mortality. Alaska Department of Fish and Game recommends keeping peak pressure to no more than 7.3 PSI (~214 dB re 1 μPa) to avoid injury and mortality to salmonids and state that their "2013 blasting standard is based on 20 years of research and technological advances that provide accurate data on pressures and vibrations generated by an explosion."

5.3.2 Sedimentation and Turbidity

Specific to the Frank J. Wood Bridge replacement project, several activities associated with construction of the new structure and demolition of the existing structure have potential to disturb sediments and increase turbidity. These actions include:

- Construction and removal of the temporary work trestle;
- Construction and removal of the cofferdams; and
- Removal of existing pier structure.

It is important to note that substrate within the project area is predominately bedrock, with some rubble and cobble materials in the vicinity of the existing bridge pier. As a result, impacts from sedimentation and increased turbidity should be lower at this location than project locations with heavy loads of mud or silt sediment. Given the low anticipated levels of sedimentation from in-water activities and relatively high velocity conditions in the action area (due to release at Brunswick Dam) it is anticipated that any suspended solids will be quickly transported and dissipated downstream.

Based on available information, it is expected that construction activities may produce total suspended solid (TSS) concentrations of approximately 5.0 to 10.0 mg/L within approximately 300 feet of the activity. Potential adverse effects of these increases in turbidity on fish may include the following:

- reduction in feeding rates;
- increased mortality;
- physiological stress, including changes in cardiac output, ventilation rate, and blood sugar level;
- behavioral avoidance;
- physical injury (e.g., gill abrasion);
- reduction in macroinvertebrates as a prey source; and
- reduction in territorial behavior (Robertson et al. 2006, Newcombe 1994).

Effects on fish from short-term turbidity increases (hours or days) are generally temporary and are reversed when turbidity levels return to background levels (Robertson et al. 2006). Effects to Atlantic salmon worsen with increased levels of turbidity (Newcomb 1994). Juveniles and adults salmonids show minor physiological stress and sublethal effects at suspended sediment concentrations of 7 mg/L for a six day exposure and at 55 mg/L for a seven hour exposure (Newcomb and Jensen 1996). MaineDOT's Programmatic Biological Assessment (ATS PBA 2017) outlined biological responses for Atlantic salmon and classified them into three major categories. The three categories are behavioral responses, sub-lethal effects, and potential mortality, and they are defined below.

- Behavioral response - The range of turbidity releases expected to result in behavioral reactions ranging from a startle response to avoidance.
    - 1-20 mg/L for 1 hour
    - 1 mg/L for 24 hours
- Sub-lethal effects – The ranges of turbidity releases expected to result in sub-lethal effects including stress, reduction in feeding rates, and increased respiration rates.
    - 20-22,026 mg/L for 1 hour
    - 1 mg/L for 6 days
- Potential mortality - A higher range of releases has the potential to result in fish mortality.
    - >22,026 mg/L for 1 hour
    - 7 mg/L for 30 months

5.4 Conclusions Regarding Potential Project Effects on EFH

The potential adverse impacts on EFH associated with the in-water work activities required to complete the replacement of the Frank J. Wood Bridge are summarized above in sections 5.2 (permanent impacts) and 5.3 (temporary impacts). These temporary and permanent impacts have the potential to exert effects on EFH for the Atlantic salmon, a fish species known to occur in the project area. The anticipated range of salinity values for the project area does not support the majority of life stages and species for which EFH may be present based on the NOAA listing for the Androscoggin River (see Section 4.0). Only larval winter flounder and Atlantic herring have been documented to persist in the range of salinities expected for the project area. However, the occurrence within the project area of suitable mixing conditions required to support the larval stages of those two species occur infrequently (require low flow, summer conditions) and are separated temporally (salinities potentially present during summer, larval stages present during late-winter and spring). As a result no lifestages of winter flounder or Atlantic herring are thought to occur in the project area.

Project effects will be confined to the area immediately surrounding the bridge. The installation of three new piers is expected to permanently alter the bottom habitat in the project area. This activity will result in the loss of approximately 3,400 ft^2 of bottom area that may provide habitat for EFH species. The majority of the permanently affected habitat (2,500 ft^2) is within the ponded and bedrock ledge habitat on the Topsham side of the river. The remaining 900 ft^2 of habitat is located within the river channel and below the high water mark. Following the removal of the existing Frank J. Wood Bridge, including the current center pier, an estimated 800 ft^2 of benthic, in-river habitat will be returned and available to potentially support EFH species. This will result in a permanent net loss of benthic habitat of approximately 100 ft^2. The installation of work trestle piles and trestle access fill will temporarily disturb an additional 2,800 ft^2 of EFH habitat. The majority of that area (2,740 of the 2,800 ft^2) will be set within the ponded and bedrock falls habitat. Following removal of those structures, bottom habitat in those locations will return to its current bedrock substrate given time and exposure to flow events at the upstream hydroelectric project.

Construction activities will cause temporary increases in both underwater sound and suspended sediments. The specific construction activities generating underwater noise will include the installation of the piles forming the base of the temporary work trestle, removal of bedrock and shaping of the pier footprints prior to pier construction, and removal of the existing center pier. All of these noise producing activities will be restricted to the in-water work window of August 1 – March 15. During that period, no activities resulting in in-water noise louder than 150 dB RMS will occur. Should a blasting event be required between the in-water work window dates of August 1 to November 30 (which coincides with the potential presence of adult Atlantic salmon in the project area during the latter part of their upstream migration period), a blasting plan will be prepared and submitted to NMFS. The plan will describe minimization and monitoring measures that will be conducted pre and post blasting (see Section 2.3.3). Similarly, activities producing increased sedimentation and turbidity will be restricted to the same in-water work window as described for noise. Based on the predominance of bedrock and rock substrate and limited occurrence of soft overburden, increases in sedimentation and turbidity are not anticipated to be significant. However, the construction and removal of the coffer dam and temporary work trestle piers along with removal of the existing center pier do have the potential to increase turbidity levels and impact EFH habitat. As described in the Biological Assessment prepared for the Frank J. Wood Bridge replacement it is expected that construction activities may produce TSS concentrations of approximately 5.0 to 10.0 mg/L within approximately 300 feet of the activity. The potential impacts to EFH are described below.

5.4.1 EFH Assessment - Spawning

Project Area Habitat: Predominantly flow-scoured bedrock substrate towards upper portion of bridge area transitioning to hard bottom boulder and cobble substrate with isolated pockets of sand. Hydroelectric tailrace portion of channel ranges in depth from 15-20 feet with normal flow velocities of 6-8 ft/s. Ponded/bedrock falls portion of channel ranges in depth from 5-10 feet with a wide range of through flows from 2-10 ft/s.

EFH Species Considered: Atlantic salmon

Life Stages Considered: All

Potential impacts: According to information from the NOAA EFH website, in-water construction activities at the Frank J. Wood Bridge replacement site may impact spawning habitat for Atlantic salmon. Potential impacts may be in the form of placement of in-river structures (either permanent or temporary in nature) as well as temporary increases in sedimentation and noise levels. A total of 3,400 ft^2 of bottom habitat will be permanently impacted by the installation of new pier structures and an additional 2,800 ft^2 will be temporarily impacted by the installation of temporary work trestle piles and trestle access fill. The majority of those impacts (2,500 ft^2 of permanent and 2,740 ft^2 of temporary) will occur in bedrock and ledge habitat within the ponded/falls section located downstream of the Brunswick Dam spillway. During the removal phase of the replacement project, an estimated 800 ft^2 of bottom habitat will be returned to the project area following the removal of the center pier for the existing bridge structure. Increases in sedimentation and turbidity are not expected to exceed 5.0 to 10.0 mg/L within approximately 300 feet of the activity. Noise generation will be limited by the use of an in-water work window which extends from August 1 to March 15. In-water activities that include potentially injurious activities (e.g., use of hydraulic rock breakers or blasting) will not be conducted outside of the in-water work window.

Expected Effects to EFH for Considered Species: The proposed bridge replacement construction will not affect Atlantic salmon spawning habitat. Spawning adult Atlantic salmon require gravel/cobble bottom habitat upstream or downstream of pool habitat.

Spawning locations for Atlantic salmon adults are typically characterized by water temperatures below 10° C, water depths between 1-2 feet, water velocities around 2 ft/s, and clean, well-oxygenated fresh water. Habitat conditions required for Atlantic salmon spawning are not present in the project area.

5.4.2 EFH Assessment – Nursery

Project Area Habitat: Predominantly flow-scoured bedrock substrate towards upper portion of bridge area transitioning to hard bottom boulder and cobble substrate with isolated pockets of sand. Hydroelectric tailrace portion of channel ranges in depth from 15-20 feet with normal flow velocities of 6-8 ft/s. Ponded/bedrock falls portion of channel ranges in depth from 5-10 feet with a wide range of through flows from 2-10 ft/s.

EFH Species Considered: Atlantic salmon

Life Stages Considered: Larvae, alevins/fry and juveniles (parr)

Potential impacts: According to information from the NOAA EFH website, in-water construction activities at the Frank J. Wood Bridge replacement site may impact nursery habitat for Atlantic salmon. Potential impacts may be in the form of placement of in-river structures (either permanent or temporary in nature) as well as temporary increases in sedimentation and noise levels. A total of 3,400 ft^2 of bottom habitat will be permanently impacted by the installation of new pier structures and an additional 2,800 ft^2 will be temporarily impacted by the installation of temporary work trestle piles and trestle access fill. The majority of those impacts (2,500 ft^2 of permanent and 2,740 ft^2 of temporary) will occur in bedrock and ledge habitat within the ponded/falls section located downstream of the Brunswick Dam spillway. During the removal phase of the replacement project, an estimated 800 ft^2 of bottom habitat will be returned to the project area following the removal of the center pier for the existing bridge structure. Increases in sedimentation and turbidity are not expected to exceed 5.0 to 10.0 mg/L within approximately 300 feet of the activity. Noise generation will be limited by the use of an in-water work window which extends from August 1 to March 15. In-water activities that include potentially injurious activities (e.g., use of hydraulic rock breakers or blasting) will not be conducted outside of the in-water work window.

Expected Effects to EFH for Considered Species: The proposed bridge replacement construction will not affect Atlantic salmon nursery habitat. Larval Atlantic salmon require gravel/cobble bottom habitat upstream or downstream of pool habitat and clean, well-oxygenated fresh water. Atlantic salmon parr also require clean, well-oxygenated fresh water in conjunction with water depths of 0.3-2 feet and velocities of 1-3 ft/s. Habitat requirements for Atlantic salmon nursery habitat are not present in the project area.

5.4.3 EFH Assessment – Forage

Project Area Habitat: Predominantly flow-scoured bedrock substrate towards upper portion of bridge area transitioning to hard bottom boulder and cobble substrate with isolated pockets of sand. Hydroelectric tailrace portion of channel ranges in depth from 15-20 feet with normal flow velocities of 6-8 ft/s. Ponded/bedrock falls portion of channel ranges in depth from 5-10 feet with a wide range of through flows from 2-10 ft/s.

EFH Species Considered: Atlantic salmon

Life Stages Considered: Adult

Potential impacts: According to information from the NOAA EFH website, in-water construction activities at the Frank J. Wood Bridge replacement site may impact forage habitat for Atlantic salmon. Potential impacts may be in the form of placement of in-river structures (either permanent or temporary in nature) as well as temporary increases in sedimentation and noise levels. A total of 3,400 ft^2 of bottom habitat will be permanently impacted by the installation of new pier structures and an additional 2,800 ft^2 will be temporarily impacted by the installation of temporary work trestle piles and trestle access fill. The majority of those impacts (2,500 ft^2 of permanent and 2,740 ft^2 of temporary) will occur in bedrock and ledge habitat within the ponded/falls section located downstream of the Brunswick Dam spillway. During the removal phase of the replacement project, an estimated 800 ft^2 of bottom habitat will be returned to the project area following the removal of the center pier for the existing bridge structure. Increases in sedimentation and turbidity are not expected to exceed 5.0 to 10.0 mg/L within approximately 300 feet of the activity. Noise generation will be limited by the use of an in-water work window which extends from August 1 to March 15. In-water activities that include potentially injurious activities (e.g., use of hydraulic rock breakers or blasting) will not be conducted outside of the in-water work window.

Expected Effects to EFH for Considered Species: Construction activities may cause adult Atlantic salmon to temporarily seek other foraging areas in the Androscoggin River downstream to Merrymeeting Bay. The enclosure of in-river habitat by cofferdams and construction of the new piers and installation of work trestle piers may limit access to potential foraging habitat. It is expected that fish would use other foraging areas. The impacts of this project represent a small footprint of the foraging habitat available in the lower Androscoggin River and Merrymeeting Bay. The planned use of cofferdams to encase the work areas for construction of the new piers will reduce increased sedimentation and turbidity released into adjacent areas, however total avoidance of foraging habitat effects is unavoidable.

5.4.4 EFH Assessment – Shelter

Project Area Habitat: Predominantly flow-scoured bedrock substrate towards upper portion of bridge area transitioning to hard bottom boulder and cobble substrate with isolated pockets of sand. Hydroelectric tailrace portion of channel ranges in depth from 15-20 feet with normal flow velocities of 6-8 ft/s. Ponded/bedrock falls portion of channel ranges in depth from 5-10 feet with a wide range of through flows from 2-10 ft/s.

EFH Species Considered: Atlantic salmon

Life Stages Considered: Juvenile (smolt) and Adult

Potential impacts: According to information from the NOAA EFH website, in-water construction activities at the Frank J. Wood Bridge replacement site may impact shelter habitat for Atlantic salmon. Potential impacts may be in the form of placement of in-river structures (either permanent or temporary in nature) as well as temporary increases in sedimentation and noise levels. A total of 3,400 ft^2 of bottom habitat will be permanently impacted by the installation of new pier structures and an additional 2,800 ft^2 will be temporarily impacted by the installation of temporary work trestle piles and trestle access fill. The majority of those impacts (2,500 ft^2 of permanent and 2,740 ft^2 of temporary) will occur in bedrock and ledge habitat within the ponded/falls section located downstream of the Brunswick Dam spillway. During the removal phase of the replacement project, an estimated 800 ft^2 of bottom habitat will be returned to the project area following the removal of the center pier for the existing bridge structure. Increases in sedimentation and turbidity are not expected to exceed 5.0 to 10.0 mg/L within approximately 300 feet of the activity. Noise generation will be limited by the use of an in-water work window which extends from August 1 to March 15. In-water activities that include potentially injurious activities (e.g., use of hydraulic rock breakers or blasting) will not be conducted outside of the in-water work window.

Expected Effects to EFH for Considered Species: The proposed bridge replacement construction will not affect Atlantic salmon smolt shelter habitat. Outmigrating Atlantic salmon smolt habitat consists of obstruction free access to the ocean. Construction activities associated with the replacement of the Frank J. Wood Bridge will not create significant blockages within the channel with potential to impede smolt passage. Smolts outmigration habitat will not be impacted by increases in noise or sedimentation as the outmigration period (generally May) lies outside of the in-water work period.

Adult Atlantic salmon migrating to spawning grounds generally seek habitat with water temperatures below 22.8 ^{o}C and dissolved oxygen greater than 5 ppm. Construction activities may cause adult Atlantic salmon to temporarily seek other shelter areas in the Androscoggin River downstream to Merrymeeting Bay. The enclosure of in-river habitat by cofferdams and construction of the new piers and installation of work trestle piers may limit access to potential shelter habitat. Although the majority of noise generating activities and sedimentation are not expected to exceed limits for the species, it is expected that adult salmon could readily move to other shelter areas. The impacts of this project represent a small footprint of the shelter habitat available in the lower Androscoggin River and Merrymeeting Bay. The planned use of cofferdams to encase the work areas for construction of the new piers will reduce increased sedimentation and turbidity released into adjacent areas, however total avoidance of foraging habitat effects is unavoidable.

6.0 Potential Impacts to Trust Species

Consultation with NOAA fisheries may also be required if the proposed action results in adverse impacts to other NOAA-trust resources as part of the Fish and Wildlife Coordination Act. A brief summary of the life history characteristics, seasonal use of the project area and the potential impacts of construction and removal activities associated with the replacement of the Frank J. Wood Bridge for NOAA trust species considered are presented here.

6.1 American Eel

Life History

American eel is a catadromous species common in streams, rivers, lakes, tidal marshes, and estuaries throughout the North Atlantic (Collette and Klein-MacPhee 2002). In April 2010 the U.S. Fish and Wildlife Service received a petition requesting that the American eel be listed as threatened under the Endangered Species Act. In September 2011, the Service issued a 90-day finding that further review of the status of the American eel was warranted. In October 2015, it was announced that listing the American eel was not warranted at that time. American eel is a commercially important species in the state of Maine. In 2014, 9,690 pounds of elvers were harvested with a value of nearly $8.5 million (MDMR 2014).

American eel spawn in the Sargasso Sea. After spawning, leptocephalus larvae drift at sea for up to a year and are transported north by the Gulf Stream. Leptocephali larvae metamorphose into early unpigmented juveniles called glass eels as they approach the North American coast at 60-65 mm. During this metamorphosis the body changes into a cylindrical form, alteration in head and jaw aspects occur, and the digestive tract becomes functional (Collette and Klein-MacPhee 2002). Glass eels appear in southern New England in March at 50-90 mm in length. They migrate upstream primarily at night into freshwater were they feed, become pigmented (elvers), and slowly grow until sexually mature, which can take up to 20 years. However, they may reach maturity as small as 28-30 mm long for males and 45 mm for females. Glass eels and elvers use a wide range of temperatures, burrow into sand, mud, snags, plant masses and other bottom types during the day and in between upstream movements, and have been reported in salinities from 0 to 25 ppt (Greene et al. 2009). Migrations were found to occur at water temperatures between 10 and 15 °C. Information on depth, temperature, and dissolved oxygen preferences are unknown (Greene et al. 2009). Elvers consume aquatic insert larvae and are preyed upon by striped bass and larger American eels (Greene et al. 2009). Older juveniles (yellow-phase) occur in a variety of depths, temperatures, salinities, and current velocities; information on habitat parameter preferences is unavailable (Greene et al. 2009). Yellow-phase American eels are believed to be opportunistic feeders, preying on what is available in their habitat including fish, a variety of invertebrates (insect, crayfish, gastropods, crabs, and bivalves), and smaller

American eels (Greene et al. 2009). Once sexually maturity occurs in late summer to early fall, the eel begins moving downstream, the eyes and pectoral fins enlarge, and feeding stops (Collette and Klein-MacPhee 2002). Fecundity ranges from 2.5 to 20 million eggs per female. Spawning migration routes and egg life history information are unknown.

Summary of Potential Impacts

Juvenile American eels may be present in the project area year-round, while silver-phase adults may be outmigrating through the project area during September and October. American eels in the project area could be exposed to increases in suspended sediment and underwater noise from project activities. Suspended sediments are expected to be below levels shown to have an adverse effect on fish (580 mg/L for sensitive species, 1,000 mg/L for typical species). Underwater noise from drilling and use of hoe rams are expected to be below 206 dB_{peak} re 1 μPa. Hoe ram use may exceed the cumulative sound exposure level (cSEL) for juvenile and adult eels less than and greater than 2 grams (195 dB re 1 μPa reported versus limits of 183 and 187 dB re 1 μPa). In the event blasting is required during bridge replacement efforts, the peak sound pressure level will likely be exceeded within a 500 foot radius. These activities will be restricted to the in-water work window from August 1 to March 15 and will be preceded by a scare charge as required by AMM 10 (see Section 2.3.3). As juvenile and adult eels may be in the project area during that period it is possible that they are impacted from vibrations produced by in-water noise generating activities. In addition, project activities will result in the temporary loss of a small amount of benthic habitat which American eel may use for shelter and foraging. The temporary loss of this habitat would not be expected to affect movement of this species within or through the reach and eels would use undisturbed adjacent areas for foraging and shelter. Project activities could also result in the permanent loss of a small amount (approximately 900 ft^2) of in-river American eel habitat. The loss of this habitat would be partially offset by the removal of the existing center pier to the normal substrate line. Project activities will not result in substantial adverse impacts to American eel habitat.

6.2 River Herring – Alewife and Blueback Herring

Life History

Alewife and blueback herring are very similar anadromous, euryhaline, coastal, pelagic fish that are difficult to distinguish from one another and occur in similar habitat (Bigelow and Schroeder 1953, Cooper 1961, Collette and Klein-MacPhee 2002). Since it is difficult to visually distinguish between the two species, they are often considered together under the name "river herring". Alewife and blueback herring comprise the once commercially important river herring fishery, no distinction was made commercially between the two species, as both were equally useful for food and bait. Since 2014, returns of river herring at the Brunswick fish way have averaged 70,800 individuals ranging from a low of 41,050 in 2017 to a high of 114,874 in 2016.

Alewife range from the St. Lawrence River, Canada to North Carolina (Neves 1981). Adult alewife are typically 10 to 11 inches in length and 8 to 9 ounces in weight but may reach 15 inches (Bigelow and Schroeder 1953). Alewives mature at ages 3, 4, and 5 with all individuals being mature at age 6. They form large schools during their upstream, spring spawning migrations from the ocean into coastal rivers. Spawning migrations occur in a south-to-north progression as water temperatures warm in the spring and there is a high degree of fidelity to their natal stream. Alewife have been observed entering spawning streams at temperatures as low as 44° F. Adults require little or no current for spawning, utilizing ponds, lakes, or slow-flowing riverine areas at water temperatures of 55° to 68° F (Otto et al. 1976, Wyllie et al. 1976, Kellogg 1982). Spawning occurs in late April to mid-May in Maine (Bigelow and Schroeder 1953). There appears to be little preference for sediment type as spawning has been observed over hard sand, gravel, stone, detritus-covered bottoms and among sticks and vegetation (O'Dell 1934, Havey 1961). After spawning, adults return to sea while young-of-year remain in fresh water for several months before gradually descending to the ocean by their first autumn (Bigelow and Schroeder 1953, Neves 1981). Juveniles tend to immigrate in waves as early as June and as late as October. Eggs are about 1 mm in diameter, adhesive, and require 3 to 6 days to hatch over a temperature range of 16° to 22° C (61 to 72 ° F). Larvae hatch at 3 to 5 mm in total length and become juveniles at approximately 20 mm (Cianci 1969, Jones et al. 1978).

The blueback herring has a greater geographical range than the alewife ranging from Cape Breton, Nova Scotia south to St. John's River, Florida; however, they tend to be less abundant than alewives in the northern extent of their range (Collette and Klein-MacPhee 2002). Blueback herring attain about the same size as the alewife, grow and mature in saltwater, migrate in spring to spawn in freshwater, and consume the same diet as the Alewife. Their breeding habits differ from the alewife in that they run three to four weeks later in the season (early June in Maine, Collette and Klein-MacPhee 2002). Spawning may begin in waters as cool as 14° C (57° F) but optimum temperatures range from 21° to 25° C (70° to 77° F) and spawning ceases around 27° C (81° F; Bigelow and Schroeder 1953, Greene et al. 2009). Where they occur with alewife, blueback herring prefer to spawn over gravel and clean sand where the water flow is relatively swift. They actively avoid areas of slow-moving or sluggish water. Like the alewife, blueback herring mature at ages 3, 4, and 5 with all individuals being mature at age 6. Young-of-year typically remain in freshwater until autumn and can tolerate a wide range of water temperatures 11° to 32° C (Greene et al. 2009).

River herring have declined in recent years. The Atlantic States Marine Fisheries Commission reports that river herring stocks are depleted to near historic lows along the Atlantic coast (ASMFC 2012). Commercial landings have decreased dramatically and by as much as 93% since the 1970's (Harris and Rulifson 1989, Crecco and Gibson 1990, Davis and Schultz 2009, ASMFC 2012). The Gulf of Maine - Mid-Atlantic landings ranged from over 25,000 metric tons in the mid-1960's to under 1,000 metric tons (2.2 million pounds) in 1996. Eight Atlantic states reported total commercial landings of 1.98 million pounds in 2002, river herring landings then declined to 693,000 pounds in 2005 (ASMFC 2003, ASMFC 2006). River herring commercial landings were 1.6 million pounds in 2013, with the majority of these landings occurring in Maine (ASMFC 2015). River herring in Maine are harvested under municipality units in inland waters; coastal areas outside municipal boundaries are closed to all commercial river herring fishing by state law. Massachusetts, Rhode Island, and Connecticut all established moratoria on the collection of river herring due to the recent sharp declines in the number of returning adults. The National Marine Fisheries Service declared river herring a Species of Concern in 2006, indicating concern for the status of the population due to the decline in river herring stocks. The Atlantic States Marine Fisheries Commission approved an Amendment 2 to the Interstate Fishery Management Plan for Shad and River Herring in May 2009 that requires all coastal states from Maine to Florida to demonstrate sustainability through a state-based management plan or to close the fishery as of January 1, 2012 (ASMFC 2009a). Despite the closure of the river herring fishery in much of the northeast and mid-Atlantic regions, they are still subject to loss through bycatch (Cieri et al. 2008). An estimated 19 to 473 metric tons of alewives and 14 to 177 metric tons of blueback herring were part of the New England bycatch from 2005 to 2010. The National Resources Defense Council petitioned the Secretary of Commerce to list alewife and blueback Herring as threatened in August 2011. The NMFS subsequently issued a 90-day finding that such a listing may be warranted, initiating a 12-month review of the species' status. A decision was issued in August 2013 that ESA protection was not warranted at that time (78 FR 48943). At the time of that ruling, NMFS noted that they would revisit the status of both species within the next 3-5 years. Notice to the public on the initiation of that process was published in the Federal Register in August, 2017.

Summary of Potential Impacts

The adult stage of both river herring species migrate upstream through the project reach during the spring, late-April through late-May. Although it is anticipated that the majority of adults will attempt to pass upstream of Brunswick dam via the fish ladder, there is likely a portion of fish which will not ascend and may spawn directly in the freshwater tidal portion of the Androscoggin River. As a result, the egg and larval stages for both river herring species may be present during the spring period. Juvenile alosines typically outmigrate from Maine rivers during the September to early-November time period in conjunction with periods of increased river discharge.

Alewife and blueback herring in the project area could be exposed to increases in suspended sediment and underwater noise from project activities. Suspended sediments are expected to be below levels shown to have an adverse effect on fish (580 mg/L for sensitive species, 1,000 mg/L for typical species). Underwater noise from drilling and use of hoe rams are expected to be below 206 dB_{peak} re 1 μPa. Hoe ram use may exceed the cumulative sound exposure level (cSEL) for juvenile and adult eels less than and greater than 2 grams (195 dB re 1 μPa reported versus limits of 183 and 187 dB re 1 μPa). In the event blasting is required during bridge replacement efforts, the peak sound pressure level will likely be exceeded within a 500 foot radius. These activities will be restricted to the in-water work window from August 1 to March 15 and will be preceded by a scare charge as required by AMM 10 (see Section 2.3.3). Based on the life history strategies for these species and the timing of the in-water work window, it is not expected that there would be any impact to the egg, larval or adult stages of the two river herring species due to sedimentation or underwater noise. The juvenile life stage of the alewife and blueback herring has the highest likelihood of being present in the project area during the in-water work period. Project activities are not expected to restrict the movement of alewife and blueback herring through the Androscoggin River. Overall, project activities are not expected to produce permanent loss of river herring habitat as no changes to bathymetry or sediment type are expected. Project activities will not result in substantial adverse impacts to alewife and blueback herring habitat.

6.3 American Shad

Life History

American shad are an anadromous, highly migratory, coastal pelagic, schooling species that spend the majority of their life at sea (Stier and Crance 1985, Munroe 2002). American shad are found along the Atlantic coast from northern Labrador down to the St. John's River, Florida. They are the largest member of the herring family (Clupeidae) and females are larger than males at all ages. Mature male shad range from 12 to 17.5 inches (30.5 - 44.7 cm) and mature females range from 15 to 19 inches (38.3 – 48.5 cm) (Stier and Crance 1985).

American shad form large schools during their time at sea, ranging vertically from surface waters to a depth of 220 meters (Munroe 2002). Adult shad return to coastal rivers to spawn during the spring when water temperatures are 16.5 – 19.0 ^{o}C. Since 2014, returns of American shad at the Brunswick fish way have been variable ranging from a low of 0 in 2014 to a high of 1,096 in 2016 (mean = 287). In New England waters, males reach sexual maturity between ages 3 and 5 and females between ages 4 and 6. American shad are prolific spawners and large females can produce up to 600,000 eggs. Fecundity is highest in the southern portion of the species range and in older and larger females. Male American shad arrive at spawning areas ahead of females. Although shad spawn only in freshwater, there does not appear to be any required distance upstream of brackish water (Stier and Crance 1985). Shad runs typically reach far upriver and often to the headwaters. Spawning occurs in river areas characterized by broad flats with relatively shallow water (1-6 m) and moderate current (0.3-1.0 m/s). Viable eggs have been recorded over bottom types ranging from fine sand to course rock and ledge but never over silt or mud bottom (Munroe 2002). Northern populations of American shad exhibit high post-spawning survival and are considered iteroparous (repeat spawners). Fertilized shad eggs slowly sink to the bottom where they water-harden. Hatching takes place over a 6 to 15 day period (dependent on water temperature) and the majority of larvae emerge during June. Larvae may remain in freshwater or drift into brackish water and grow rapidly; transforming into juveniles approximately 4 to 5 weeks after hatch (Stier and Crance 1985). Juvenile shad form schools and gradually move downriver prior to departing for the ocean during late fall.

Summary of Potential Impacts

American shad in the project area could be exposed to increases in suspended sediment and underwater noise from project activities. Suspended sediments are expected to be below levels shown to have an adverse effect on fish (580 mg/L for sensitive species, 1,000 mg/L for typical species). Underwater noise from drilling and use of hoe rams are expected to be below 206 dB_{peak} re 1 µPa. Hoe ram use may exceed the cumulative sound exposure level (cSEL) for juvenile and adult eels less than and greater than 2 grams (195 dB re 1 µPa reported versus limits of 183 and 187 dB re 1 µPa). In the event blasting is required during bridge replacement efforts, the peak sound pressure level will likely be exceeded within a 500 foot radius. These activities will be restricted to the in-water work window from August 1 to March 15 and will be preceded by a scare charge as required by AMM 10 (see Section 2.3.3). Based on the life history strategies for American shad and the timing of the in-water work window, it is not expected that there would be any impact to the egg, larval or adult life stages due to sedimentation or underwater noise. The juvenile life stage of American shad has the highest likelihood of being present in the project area during the in-water work period as they typically outmigrate from freshwater riverine habitat to marine environments during the months of September-October. Project activities are not expected to restrict the movement of American shad through the Androscoggin River. Overall, project activities are not expected to produce permanent loss of shad habitat as no changes to bathymetry or sediment type are expected. Project activities will not result in substantial adverse impacts to American shad habitat.

6.4 Rainbow Smelt

Life History

Rainbow smelt are anadromous fish found in Atlantic coastal waters from Newfoundland to New Jersey (Collette and Klein-MacPhee, 2002). They are most abundant from the southern provinces of maritime Canada to Massachusetts. Several landlocked populations also exist, some resulting from human introduction (i.e. several rivers of the Great Lakes watershed), which constitute an important forage base for popular sport fish (Carlander 1969, Scott and Crossman 1973). Rainbow smelt are important forage fish for recreationally and commercially important fish species. This species also supports a successful commercial fishery in Canada and the United States. Rainbow smelt was identified as a Species of Concern in 2004, as populations declined due to overharvesting and degradation and loss of spawning habitat (NMFS 2007b).

Rainbow smelt are schooling, pelagic fish that occupy inshore coastal waters (Carlander 1969, Scott and Crossman 1973). In spring, typically March-May in New England, they undertake significant migrations leaving coastal waters and traveling to freshwater streams to spawn (Carlander 1969, Scott and Crossman 1973). Spawning typically occurs at night in fast-moving streams and rivers (McKenzie 1964, Lawton et al. 1990). Smelt typically arrive in the tidal portions of main tributaries when water temperatures reach about 4° C but apparently do not enter smaller streams until waters warm to 6° to 7° C (McKenzie 1964).

Spawning begins at temperatures of approximately 4° to 5° C (Clayton 1976, Lawton et al. 1990, Chase 1990), although temperatures below 2° C and near 0° C have been reported (Rupp 1959, Crestin 1973). Peak spawning activity appears to occur around 6 to 8 C and the season is reported to be essentially over by the time waters reach 15° C (McKenzie 1964, Lawton et al. 1990). Rainbow smelt spawning activities are highly variable (Rupp 1959).

Adult Rainbow smelt can grow to approximately 178-213 mm total length and reach a maximum age of 15 to 17 years (Belyanina 1969, Scott and Crossman 1973). However, the majority of fish sampled in New England were under six years old (Murawski and Cole 1978, Lawton et al 1990). Smelt consume crustaceans, aquatic insect larvae, worms, and small fish (Carlander 1969, Scott and Crossman 1973). Females mature at age 2-3 and individuals 127 to 209 mm total length can produce between 8,500-69,600 eggs per season (Baldwin 1950, Bailey 1964, McKenzie 1964).

The eggs are adhesive, attaching to the bottom substrate or other surfaces, and measure 1 to 1.2 mm in diameter (Crestin 1973). Egg incubation period is temperature dependent and highly variable. It can range from as long as 51 to 63 days at 3.9° C to as little as 8 to 10 days at 20.0° C (Leim and Scott 1966). Most spawning occurs between 5° and 8° C, producing a typical incubation period of 20 to 30 days (Crestin 1973, Hulbert 1974). Larvae are about 5.5 to 6.0 mm in length at hatching (Cooper 1978) and drift downstream to estuarine waters soon after hatching.

Summary of Potential Impacts

Rainbow smelt are known to spawn in the lower Androscoggin and have been observed depositing eggs along the outer wall of the fishway at the Brunswick Hydroelectric Project just upstream of the Frank J. Wood Bridge[7]. Smelt eggs are adhesive and typically deposited in early spring shortly after ice-out. The resulting smelt larvae will generally emerge 30 days post-spawn and will drift downstream away from the project area and towards Merrymeeting Bay. Based on information provided by MDMR, it is anticipated that rainbow smelt may be in the project area as early as October 1 and that larvae will have departed the project area by April 30.

Rainbow smelt may be exposed to increases in suspended sediment and underwater noise from project activities. Suspended sediments are expected to be below levels shown to have an adverse effect on fish (580 mg/L for sensitive species, 1,000 mg/L for typical species). Underwater noise from drilling and use of hoe rams are expected to be below 206 dB_{peak} re 1 μPa. Hoe ram use may exceed the cumulative sound exposure level (cSEL) for juvenile and adult eels less than and greater than 2 grams (195 dB re 1 μPa reported versus limits of 183 and 187 dB re 1 μPa). In the event blasting is required during bridge replacement efforts, the peak sound pressure level will likely be exceeded within a 500 foot radius. These activities will be restricted to the in-water work window from August 1 to March 15 and

[7] Source: Gail Wippelhauser, Maine Department of Marine Resources

will be preceded by a scare charge as required by AMM 10 (see Section 2.3.3). Based on the life history characteristics for rainbow smelt and the timing of the in-water work window, there may be impacts to multiple life stages of rainbow smelt due to sedimentation or underwater noise. Adult spawning and egg deposition will occur in the project area during the in-water work period. However, project activities are not expected to restrict the movement of rainbow smelt through the Androscoggin River. Overall, project activities are not expected to produce permanent loss of smelt habitat as no changes to bathymetry or sediment type are expected.

6.5 Striped Bass

Life History

Striped bass are a schooling anadromous coastal fish found along the eastern North America coast from the lower St. Lawrence River and Gulf of St. Lawrence to northern Florida and into the Gulf of Mexico. Fish older than 2 years migrate north to New England waters for the summer and return south for the winter. Striped bass is a commercially important species and one of the most sought-after sport fish.

Striped bass larvae hatch at 2 to 3.7 mm TL in estuaries including the Delaware River, Hudson River, Chesapeake Bay, and Roanoke-Albemarle Sound, where they begin feeding on zooplankton after 4 to 10 days. At about 13 mm TL, larvae form schools and move inshore (Shepherd 1998). Juvenile bass feed on small fish and invertebrates. Juveniles less than 2-3 years of age generally do not migrate but remain in or near their home rivers in large schools. These schools occasionally travel upriver as observed in the Connecticut and Merrimack Rivers.

Adult striped bass are often found in areas with high tidal and current flows and in the wash of breaking waves along the shore. They are seldom found in water more than 6 to 8 km from shore (Collette and Klein-MacPhee 2002). The spawning season is temperature dependent and usually occurs from April through June in fresh or brackish water at the heads of estuaries (Nichols 1966). Striped bass feed most actively from dusk to dawn, although some feeding occurs throughout the day. During midsummer they tend to become more nocturnal.

Striped bass males mature at approximately 2 years of age (about 10 inches), and females mature at about 4 years of age (about 19 inches; Pearson 1936). Fecundity estimates depend on the size of the female and can range from 14,000 to 5 million eggs (Nichols 1966, Bigelow and Schroeder 1953). The spawning season is temperature dependent and usually occurs from April through June in fresh or brackish water at the heads of estuaries (Nichols1966).

Atlantic coastal fisheries rely on populations spawning in the Hudson River and in tributaries of Chesapeake Bay. The majority of fish are produced in the Chesapeake. During the 1970's and 1980's, juvenile production was poor and a large decline in commercial and recreational landings occurred (Shepherd 1998). Strict management policies were adopted to improve recruitment in Chesapeake Bay in the mid 1980's. Striped bass had a successful recovery, and stock biomass has increased (Shepherd 1998). Striped bass formally became a restored stock. In 1996, approximately 14 million striped bass were caught, with over 90% released alive. The recreational harvest was over 3 times the commercial landings' level (Shepherd 1998).

Summary of Potential Impacts

Striped bass are known to frequent the Frank J. Wood Bridge replacement project area from approximately May 15 to October 31[8]. There is a recreational fishery for striped bass downstream of the fishway facility at the Brunswick hydroelectric project and shoreline anglers can be observed fishing from the rocks at the 250th Anniversary Park. Adult striped bass have been observed foraging along the outer wall of the upstream passage facility at Brunswick Dam and juvenile striped bass are counted annually by MDMR personnel following upstream passage at that facility.

Striped bass may be exposed to increases in suspended sediment and underwater noise from project activities. Suspended sediments are expected to be below levels shown to have an adverse effect on fish (580 mg/L for sensitive species, 1,000 mg/L for typical species). Underwater noise from drilling and use of hoe rams are expected to be below 206 dB_{peak} re 1 μPa. Hoe ram use may exceed the cumulative sound exposure level (cSEL) for juvenile and adult eels less than and greater than 2 grams (195 dB re 1 μPa reported versus limits of 183 and 187 dB re 1 μPa). In the event blasting is required during bridge replacement efforts, the peak sound pressure level will likely be exceeded within a 500 foot radius. These activities will be restricted to the in-water work window from August 1 to March 15 and will be preceded by a scare charge as required by AMM 10 (see Section 2.3.3). Based on available information for presence in the project area and the timing of the in-water work window, there may be impacts to juvenile or adult striped bass due to sedimentation or underwater noise. Adult and juvenile striped bass are expected to be present in the project area during the first portion of the in-water work window (from August 1 through October 31). However, project activities are not expected to restrict the movement of striped bass through the Androscoggin River and it is expected that they will shift their forage areas in response to prey species movements. Overall, project activities are not expected to result in substantial adverse impacts to striped bass habitat.

[8] Source: Gail Wippelhauser, Maine Department of Marine Resources

7.0 Literature Cited

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